Final Environmental Assessment for Listing 10 Freshwater Fish and 1 Crayfish as Injurious Wildlife under the Lacey Act

Crucian carp (*Carassius carassius*), Eurasian minnow (*Phoxinus phoxinus*), Prussian carp (*Carassius gibelio*), roach (*Rutilus rutilus*), stone moroko (*Pseudorasbora parva*), Nile perch (*Lates niloticus*), Amur sleeper (*Perccottus glenii*), European perch (*Perca fluviatilis*), zander (*Sander lucioperca*), wels catfish (*Silurus glanis*), and common yabby (*Cherax destructor*)

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Table of Contents

1) Purpose for the Action

The final action is to list the crucian carp (*Carassius carassius*), Eurasian minnow (*Phoxinus phoxinus*), Prussian carp (*Carassius gibelio*), roach (*Rutilus rutilus*), stone moroko (*Pseudorasbora parva*), Nile perch (*Lates niloticus*), Amur sleeper (*Perccottus glenii*), European perch (*Perca fluviatilis*), zander (*Sander lucioperca*), wels catfish (*Silurus glanis*), and common yabby (*Cherax destructor*) as injurious species under the Lacey Act (18 U.S.C. 42, as amended; the Act), thereby prohibiting the importation and interstate transportation, with the goal of preventing the accidental or intentional introduction, establishment, and spread of these nonnative species into the United States. This action will protect native wildlife, including threatened and endangered species, and wildlife resources. Additionally, this action will protect agriculture (specifically, aquaculture) and prevent economic loss stemming from the introduction of these species. This listing, finalized as a regulation, will not prohibit the transportation of these 11 species within a State.

The listing action preserves the environmental status quo. That is, these listings help ensure that certain potential effects associated with introduction of these species that have been found to be injurious do not occur. In this way, injurious wildlife listings maintain the state of the affected environment into the future—the state of the environment prior to listing or potential introduction in the absence of a listing. Thus, prohibiting a nonindigenous injurious species from being introduced into an area in which it does not naturally occur cannot have a significant effect on the human environment. Another way of explaining it is that our action is more like the typical "no action" of a Federal agency, because it will act to prevent the species entering the United States or a new area by prohibiting importation and interstate transportation. Conversely, our "no action" alternative allows the action of the species to be imported and transported across State lines, which is more likely to have significant impacts on the human environment.

2) Need for Final Action

The need for the final action to add 10 freshwater fish species and 1 crayfish species to the list of injurious wildlife under the Act is based on the determination of the 11 nonnative species as injurious under the U.S. Fish and Wildlife Service's (Service) injurious wildlife evaluation criteria. Although these species are not present in United States ecosystems (except for one species in one lake), they are documented as highly invasive in other parts of the world (history of invasiveness), have a high climate match[1] in parts of the United States, and could become established in this country. Nine of the freshwater fish species (Amur sleeper, crucian carp, Eurasian minnow, European perch, Prussian carp, roach, stone moroko, wels catfish, and zander) have been introduced and established populations and spread within Europe and Asia. The Nile perch has been introduced to and become invasive outside of its historic waterbodies in central Africa. The freshwater crayfish, the common yabby, has been introduced to and established invasive populations in Australia (other than where it is native) and Europe. Most of these species were originally introduced for aquaculture, recreational fishing, or ornamental purposes.

[1] Meaning parts of the United States have a similar pattern of temperature and rainfall (based on 16 climate variables) with the species native and invasive ranges.

Two of these fish species (the Eurasian minnow and stone moroko) were accidently introduced when they were unintentionally transported in the water with fish intended for stocking. The Service aims to prevent the introduction and establishment of all 11 species within the United States because of the injurious nature of the 11 species consistent with the Act.

The Secretary of the Interior is authorized under the Act to add to the injurious wildlife list by regulation those wild mammals, wild birds, fish, mollusks, crustaceans, amphibians, reptiles, and the offspring, eggs, or hybrids of any of the aforementioned, which are injurious to human beings, to the interests of agriculture, horticulture, forestry, or to the wildlife or wildlife resources of the United States. The lists of injurious wildlife are at 50 CFR 16.11-15.

With the listing of each of the 11 species as injurious, both the importation into the United States and interstate transportation between States, the District of Columbia, the Commonwealth of Puerto Rico, or any territory or possession of the United States of the species would be prohibited, except by permit for zoological, educational, medical, or scientific purposes (in accordance with permit regulations at 50 CFR 16.22) or by Federal agencies solely for their own use upon filing a written declaration with the District Director of Customs and the Service Inspector at the port of entry.

In addition, no live specimens of these 11 species, gametes, viable eggs, or hybrids imported or transported under a permit could be sold, donated, traded, loaned, or transferred to any other person or institution unless such person or institution has a permit issued by the Service. The interstate transportation of any live specimens, gametes, viable eggs, or hybrids currently held in the United States for any purposes would be prohibited. An injurious wildlife listing would not prohibit intrastate (within-State) transport or possession of these 11 species, where such activities are not already prohibited by the State. Any use of these 11 species within States, other than what is covered under Federal permits for injurious wildlife, is the responsibility of each State.

3) Decisions Needed

The Service is the lead agency under the Department of the Interior for evaluating the action. The decision facing the Department is whether the live specimens of all 11 species (10 freshwater fish and 1 crayfish species), gametes, viable eggs, or hybrids are injurious and should be added to the list of injurious wildlife under the Act. The Department of the Interior's Assistant Secretary will select one of the alternatives analyzed in detail and will determine, based on the facts and recommendations contained herein, whether this Environmental Assessment (EA) is adequate to support a Finding of No Significant Impact (FONSI) or whether an Environmental Impact Statement (EIS) is required.

4) Background

A species does not have to be currently imported or present in the United States for the Service to list it as injurious. The Service produced rapid screens on approximately 2,000 foreign aquatic fish and invertebrates for a variety of purposes, one of which was to assist the Service in prioritizing which species to evaluate for listing as injurious. These rapid screens provide a prediction of the invasive potential of the species—high risk, low risk, or uncertain risk. The Service selected 11 species (10 fish and 1 crayfish species) with a rapid screen analysis of "high risk" to consider for listing as injurious. These 11 species have a high climate match in parts of the United States, a history of invasiveness outside of their native range, and are not currently found in the wild in the United States (except for one species in one lake). Although not present in United States ecosystems, all 11 species have been documented as invasive in other countries. In their invasive ranges, all 11 species have negatively affected wildlife and wildlife resources. Ten of these species may also negatively affect agriculture.

The crucian carp, Eurasian minnow, Prussian carp, roach, stone moroko, Nile perch, Amur sleeper, European perch, zander, wels catfish, and the common yabby are invasive in regions of Europe, Asia, Australia, or Africa. Two of these species, the crucian carp and Nile perch, have been previously introduced into the United States but failed to establish. Zanders are reported to be established in a single lake in North Dakota. The Prussian carp was recently discovered as established in Alberta, Canada.

The Service reviewed import data from the Service's Law Enforcement Management Information System (LEMIS) to determine if any of the 11 species have been imported alive or as eggs in the last 5 years. Little information was available because most of the species did not need to be itemized separately by importers on the import declaration form; however, importers are free to itemize without a specific request, and some imports of the 11 species may have been recorded to the species level. In October 2013, at the Branch of Aquatic Invasive Species' request and in preparation for this rulemaking, the Office of Law Enforcement issued a "Notice to the Wildlife Import/Export Community" asking importers to separate the 11 species of concern on different lines of the declaration form (Form 3-177, whether filed electronically or in paper form). Species codes had already existed (meaning this type of request had already been made) for crucian carp, Nile perch, and European perch; hence, we have some data from 2000. However, that data includes all purposes for importation, such as dead, skins, and bones. For this economic analysis, we are interested only in the live specimens and egg imports.

Table 1 shows the four species that have been declared for importation as live specimens from 2011 to 2015 (LEMIS 2016). Although we have data from 2000, here we used only the data from the last 5 years as the most relevant. The results show that the total value of all live individuals of the four species was $5,789 for approximately 6,500 individuals (exact number is not known because one shipment was by weight, not number of individuals). No eggs were reported as imports in any of the LEMIS data. None of the other seven species is known to be currently present in trade in the United States.

Table 1. Number of known live importations and values for each species that was imported from 2011 to 2015 (LEMIS 2016).

Species	**Number of Importations**	**Number of Individuals**	**Total Value $**	**Mean $ per individual**
Crucian carp	1	6,220	3,194	0.51
Nile perch	20	242	2,129	8.80
Wels catfish	3*	15 (and 27 kg (60 lb))	939*	30.20**
Yabby	1	25	13	0.52
TOTAL	**25**	**6,502****	**5,789**	**0.89****

*including one shipment by weight **excluding the one shipment declared by weight (kg=kilograms, lb=pounds)

Species Biology

Crucian carp–The crucian carp is a freshwater fish native to regions of north and central Europe (Godard and Copp 2012). This carp has been deliberately introduced to new regions for stocking for recreational fishing (Holčík 1991; Godard and Copp 2012; Kottelat and Freyhof 2007; Froese and Pauly 2014a) and accidently introduced in misidentified shipments of ornamental fish (Wheeler 2000; Hickley and Chare 2004; Innal and Erk'akan 2006). This species has been widely introduced and established in Croatia, Greece, France (Holčík 1991; Godard and Copp 2012), Italy, and England (Kottelat and Freyhof 2007), Spain, Belgium, Israel, Switzerland, Chile, India, Sri Lanka, Philippines (Holčík 1991; Froese and Pauly 2014a), and Turkey (Innal and Erk'akan 2006). The crucian carp demonstrates many of the traits for invasiveness, including a generalist diet, broad native range, and adaptability to new environments (Godard and Copp 2012). This benthic (bottom-dwelling) fish forages among bottom sediment and can increase turbidity (cloudy water) in waterbodies, thus reducing light availability to submerged plants and phytoplankton and resulting in ecosystem changes (phytoplankton blooms, nutrient availability) (Crivelli 1995; Wheeler 2000). Crucian carp can also hybridize with other carp species that are invasive in the United States, thus further exacerbating competition with native species for both diet and habitat (Wheeler 2000; Godard and Copp 2012).

Eurasian minnow–The Eurasian minnow is native to the brackish and freshwater streams, rivers, ponds, and lakes throughout Eurasia (Sandlund 2008; Froese and Pauly 2014e). This species was initially introduced as live bait but has also been inadvertently introduced with trout stocking (Sandlund 2008). The Eurasian minnow was introduced to new waterways in its native range of Europe and Asia (Sandlund 2008). This species has been introduced to new locations in Norway outside of its native range there (Sandlund 2008, Hesthagen and Sandlund 2010). The Eurasian minnow is highly adaptable to new environments and is difficult to control (Sandlund 2008). The introduction of this species can cause major changes to nonnative habitats by affecting the benthic community (reduced invertebrate diversity) and disrupting trophic level structure. These effects hinder the ability of native fish to find food and reduces reproductive success. The Eurasian minnow harbors parasites which can be transmitted to and infect native invertebrate and fish species (Sandlund 2008; Zietara *et al*. 2008). Parasites impair fish physiology and can increase susceptibility to disease.

Prussian carp–The Prussian carp is native to regions of central Europe and eastward to Siberia (Britton 2011). The Prussian carp's nonnative range includes the Asian countries of Armenia, Turkey, and Uzbekistan and the European countries of Belarus, Belgium, Czech Republic, Denmark, Estonia, France, Germany, Poland, Switzerland (Britton 2011), Iberian Peninsula (Ribeiro *et al.* 2015) and, most recently, Canada (Elgin *et al.* 2014). This carp has been introduced in many localities for recreational fishing and aquaculture. This species grows rapidly and can reproduce from unfertilized eggs (natural gynogenesis) (Vetemaa *et al.* 2005; Britton 2011). Prussian carp have been implicated in the decline in both the biodiversity and population of native fish, invertebrates, and plants (Anseeuw *et al.* 2007; Lusk *et al*. 2010). As with its close relative, the crucian carp, the Prussian carp is a benthic fish and has been linked to increased turbidity (Crivelli 1995; Lusk *et al*. 2010) and the consequential adverse changes to nutrient availability and disruption of trophic level structure.

Roach–The roach is native to regions of Europe and Asia (Kottelat and Freyhof 2007). The roach has been introduced and become established in Ireland, Italy, Madagascar, Morocco, Cyprus, Portugal, the Azores, Spain, and Australia (Rocabayera and Veiga 2012). This species has been introduced to several countries for recreational fishing. Once introduced, the roach has moved into new water bodies within the same region (Rocabayera and Veiga 2012). Invasive roach populations compete for resources and hybridize with native fish species, and alter habitats and nutrient cycling (Rocabayera and Veiga 2012). The roach is a highly adaptable species that adapts to a different habitat and diet to avoid predation and competition (Winfield and Winfield 1994). This species has a high reproductive rate (up to 77,000 eggs per female) and spawns early in the season, which provides the roach larvae a competitive edge over native fish larvae (Volta and Jepsen 2008; Rocabayera and Veiga 2012).

Stone moroko–The stone moroko is native to Asia, including southern and central Japan, Taiwan, Korea, China, and the Amur River basin (Copp 2007). This species was first introduced in Europe (Romania) in the early 1960s. By 2000, this species had invaded nearly every European country and additional countries in Asia (Copp 2007). This species was primarily introduced unintentionally with shipments of other fish intended for stocking. Secondary natural dispersal also occurred in most countries (Copp 2007). The stone moroko has proven to be a highly invasive fish, establishing invasive populations in nearly every European country over a 40-year span. This species has proven to be adaptive and tolerant of a variety of habitats, including those of poor quality (low dissolved oxygen concentrations) (Beyer *et al*. 2007). The invasion of the stone moroko has been linked to the decline of native freshwater fish populations (Copp 2007). The stone moroko competes with native fish for zooplankton diet and also consumes the larvae of these same fish (Britton *et al.* 2010b). This species is also an unaffected vector of *Sphaerothecum destruens*, which infects a fish's internal organs, causing spawning failure, organ failure, and death (Gozlan *et al*. 2005). We do not know the extent of State regulations regarding the stone moroko, but at least one State (Illinois) lists this species as injurious in its State regulations, with strict prohibitions that include possessing, propagating, transporting, selling, and buying (IDNR 2015).

Nile perch –The Nile perch is a freshwater fish native to central, western, and eastern Africa (Witte 2011). The species is found throughout the Nile River basin as far north as Alexandria, Egypt, on the Mediterranean Sea (Azeroual *et al.* 2010), which is at 31° North; this latitude also includes the U.S. Gulf Coast States. This species was introduced into Lake Victoria and Lake Kyoga in Africa in 1954 to improve the local fishery. This species has also been introduced to Morocco and Cuba for aquaculture and recreational fishing (Witte 2011). Since this species' introduction in Lake Victoria, the Nile perch has become the top predator in the system, contributing over 90 percent of demersal (bottom-dwelling) fish body mass within this lake (Witte 2011). Additionally, this species has an extremely high reproductive rate of 3 to 15 million eggs per breeding cycle (Asila and Ogari 1988). Nile perch is considered responsible for the decreased populations of native fish species (lungfish and catfish species) and the local extinction of at least 200 haplochromine cichlid fish species. The Lake Victoria ecosystem was unique, including at least 400 endemic species of haplochromine fishes (Gophen 2015). Historically, the food web structure was naturally balanced, with short periods of anoxia in deep waters and dominance of diatomides algal species. During the 1980s, the Nile perch became the dominant fish. The haplochromine species disappeared and the whole ecosystem was modified. The disappearance of many native fish species has drastically altered Lake Victoria's trophic level structure and reduced biodiversity. These changes have resulted in increased lake eutrophication (excess nutrient load) and frequency of algal blooms (Witte 2011). The introduction and establishment of the Nile perch has been so devastating to the Lake Victoria ecosystem that this species was named as one of the 100 worst alien invaders in the world (Lowe *et al.* 2000). In the United States, Texas Parks and Wildlife Department stocked a mixture of approximately 68,000 larvae of *Lates angustifrons*, *L. mariae*, and *L. niloticus* from 1978 to 1984 in three reservoirs (Howells and Garret 1992). Although the fish did not establish, biologists in Texas and Florida recommended against stocking Nile perch because of its ability to tolerate cold winter temperatures in some local waters, tolerance of salt water, and ability to range widely in riverine habitats, as well as large size and predatory nature (Howells and Garret 1992).

Amur sleeper–The Amur sleeper is native to the freshwater regions of northeastern China, northern North Korea, and eastern Russia (Reshetnikov and Schliewen 2013). The species is invasive in western Russia and 16 other countries: Mongolia, Belarus, Ukraine, Lithuania, Latvia, Estonia, Poland, Hungary, Romania, Slovakia, Serbia, Bulgaria, Moldova, Kazakhstan, Croatia, and Germany, where it is dispersing up the Danube River (Reshetnikov and Schliewen 2013). This species has been introduced as ornamental fish, unintentionally shipped to fish farms in herbivorous fish stocks, released as bait fish, and naturally expanded its own range (Grabowska 2011, Reshetnikov and Schliewen 2013). Amur sleeper is one of the most invasive fish species in eastern and central Europe (Reshetnikov and Schliewen 2013). Within the Vistula River (Poland), the Amur sleeper has expanded its range by an average of 88 kilometers (54.5 miles) per year (Grabowska 2011). This species' invasiveness is aided by its highly varied generalist diet, fast growth rate, high reproductive potential, adaptability to different environments, and their expansive native range and proven history of increasing its nonnative range by itself and through human-mediated activities (Grabowska 2011). The Amur sleeper competes with native species for similar habitat and diet resources and transmits harmful parasites to these species (Košuthova *et al.* 2008; Košuthova *et al.* 2009).

European perch –The European perch is native to Europe (ISSG 2005) and regions of Asia, including Afghanistan, Armenia, Azerbaijan, Georgia, Iran, Kazakhstan, Mongolia, Turkey, and Uzbekistan (Froese and Pauly 2014k). This species has been introduced for both aquaculture and recreational fishing and has become established in Ireland, Italy, Spain, Australia, New Zealand, China, Turkey, Cyprus, Morocco, Algeria, and South Africa (FAO 2014). In New South Wales, Australia, this perch species is a serious pest and is classified as a Class 1 noxious species (NSW DPI 2013). These predatory fish have been blamed for the local extinction and severe depletion of native fish and invertebrates (Moore 2008). The European perch reportedly consumed 20,000 rainbow trout fry from an Australian reservoir in less than 72 hours (NSW DPI 2013). This perch species also forms dense populations, forcing fish to compete among their own for a reduced food supply, even to the extent that they stunt their own growth (NSW DPI 2013).

Zander–The zander is native to the freshwater basins of the Caspian Sea, Baltic Sea, Black Sea, Aral Sea, North Sea, and Aegean Sea (Godard and Copp 2011). The zander is native to much of eastern Europe, the Scandinavian Peninsula, and regions of Asia. The zander has been repeatedly introduced for recreational fishing and aquaculture purposes and also as a biocontrol agent of cyprinids (Godard and Copp 2011). This species has been introduced and become established in parts of Asia (China, Kyrgyzstan, and Turkey), Africa (Algeria, Morocco, Tunisia), and much of Europe (Belgium, Bulgaria, Croatia, Cyprus, Denmark, France, Italy, the Netherlands, Portugal, the Azores, Slovenia, Spain, Switzerland, and the United Kingdom) (Godard and Copp 2011). The zander was introduced to the United States and is reportedly established in Spiritwood Lake in North Dakota (Fuller 2009). This species is a predatory fish that is well-adapted to turbid water and low-light habitats (Sandström and Karås 2002). The zander competes with native fish, preys on native fish, hybridizes with some Old World species (Godard and Copp 2011), and is a vector of parasites linked to decreased cyprinid populations (Kvach and Mierzejewska 2011). We do not know the extent of State regulations regarding the zander, but at least one State (Illinois) lists this species as injurious in its State regulations (IDNR 2015), with strict prohibitions that include possessing, propagating, transporting, selling, and buying .

Wels catfish–The wels catfish is a giant fish, commonly growing to 3 meters (9.8 feet) in body length with a maximum length of 5 meters (16.4 feet) and is Europe's largest freshwater fish (Rees 2012). The maximum published weight is 306 kilograms (675 pounds) (Rees 2012). Although the maximum reported age is 80 years (Kottelat and Freyhof 2007), the average lifespan of a wels catfish is 15 to 30 years. The wels catfish is native to eastern Europe and western Asia including the North Sea, Baltic Sea, Black Sea, Caspian Sea, and Aral Sea basins (Rees 2012). This catfish has been introduced for both aquaculture and recreational fishing and has become established in China; the North African countries of Algeria, Syria, Tunisia; and the European countries of Belgium, Bosnia-Hercegovina, Croatia, Cyprus, Denmark, Finland, France, Italy, Portugal, Spain, and the United Kingdom (Rees 2012). The wels catfish is a habitat-generalist that tolerates a variety of warm-water habitats including those with low dissolved oxygen levels. The invasive success of this species will likely be further enhanced with the predicted increase in water temperature with climate change (Rahel and Olden 2008; Britton et al. 2010 a). The major risks associated with this invasive catfish species to the native fish population include disease transmission (spring viraemia (or viremia) of carp (SVC)), competition, and predation (Rees 2012). SVC is an OIE-reportable disease (OIE 2014). Additionally, this fish species also excretes large amounts of both phosphorus and nitrogen (Schaus *et al*. 1997; McIntyre *et al*. 2008) into the environment and consequently greatly affects nutrient cycling and transport (Boulêtreau *et al*. 2011). We do not know the extent of State regulations regarding the wels catfish, but at least one State (Illinois) lists this species as injurious in its State regulations, with strict prohibitions that include possessing, propagating transporting, selling, and buying (IDNR 2015).

Common yabby–The common yabby is a large freshwater crayfish native to regions of south and eastern Australia. It is as large (total body length up to 15 cm (6 in)) as the largest species of crayfish native to the United States and at least twice as large as most species. This crayfish has a high commercial value as food for humans and is frequently stocked for aquaculture, aquariums, and research. This species has been introduced and become established in western Australia, Tasmania, China, South Africa, Zambia, Italy, Spain, and Switzerland (Gherardi 2012). The species can survive in temperatures from 1°C (34 °F) to 35°C (95 °F) as well as long periods of drought (Withnall 2000). The yabby can hide for years in burrows up to 5 meters (16.4 feet) deep during droughts, thus essentially being invisible to anyone looking to survey or control them (NSW DPI 2015). The yabby has a quick growth and maturity rate, high reproductive potential, and generalist diet. The yabby may reduce native wildlife biodiversity through competition and predation with native species. In its nonnative range, this crayfish outcompetes native crayfish species for food and habitat (Beatty 2006; Gherardi 2012). The yabby may transmit harmful parasites to native crayfish species causing disease and death. Forty-eight percent of U.S. native crayfish are considered imperiled (Taylor *et al.* 2007; Johnson *et al.* 2013). We do not know the extent of State regulations regarding the yabby, but at least one State (Illinois) lists this species as injurious in its State regulations, with strict prohibitions on possessing, transporting, selling, and so on (IDNR 2015).

5) Public Involvement

The Service published the proposed rule in the *Federal Register* for a 60-day comment period on October 30, 2015 (80 FR 67026) on the rule, the draft environmental assessment, and the draft economic analysis. We received 20 public comments. Comments specifically addressed the rule, but no comments specifically addressed the environmental assessment or the economic analysis. We reviewed all comments at the conclusion of the comment period. The final rule contains a summary of comments received on the proposed rule and our responses, states the final decision, and provides justification for that decision.

6) Peer Review

Service policy requires solicitation of independent peer reviews for influential science. In conducting our peer review, we followed Service policy as outlined in the Office of Management and Budget's 2004 memorandum (OMB 2004). In 2015, we posted our peer review plan on the Service's Headquarters Science Applications website (*http://www.fws.gov/science/peer_review_agenda.html*), explaining the peer review process and providing the public with an opportunity to comment on the peer review plan. We received no comments regarding the peer review plan. The Service solicited independent scientific reviewers who submitted individual comments in written form. We avoided using individuals who might have strong support for or opposition to the proposed rule and individuals who were likely to experience personal gain or loss (such as financial or prestige) because of the Service's decision. Department of the Interior employees were not used as peer reviewers.

We received responses from the three peer reviewers we solicited. Please also see the final rule to list 11 species as injurious that is associated with this environmental assessment for more information on the peer review responses. We provided a summary of comments and responses specifically regarding the Environmental Assessment at the end of this final environmental assessment. We revised the final rule, economic analysis, and environmental assessment to reflect peer reviewer comments and new scientific information where appropriate.

7) Alternatives Considered

Three alternatives are considered in this assessment: 1) <u>no action</u>; 2) <u>list all 11 species (10 freshwater fish and 1 crayfish species) as injurious</u> [crucian carp (*Carassius carassius*), Eurasian minnow (*Phoxinus phoxinus*), Prussian carp (*Carassius gibelio*), roach (*Rutilus rutilus*), stone moroko (*Pseudorasbora parva*), Nile perch (*Lates niloticus*), Amur sleeper (*Perccottus glenii*), European perch (*Perca fluviatilis*), zander (*Sander lucioperca*), wels catfish (*Silurus glanis*), and common yabby (*Cherax destructor*)]; and 3) encourage a <u>voluntary refrain from importing following a Memorandum of Understanding</u> between the Service, Pet Industry Joint Advisory Council, and the Association of Fish and Wildlife Agencies (USFWS 2013a) but not limited to the parties of the MOU.

7.1.1) Alternative 1: No action

The effects of the alternatives are compared to a baseline scenario. This alternative refers to no action being taken to list any of the 11 species as injurious species under the Act, and thus allow importation and interstate transportation of the 11 species, gametes, eggs, and their hybrids. The species are not currently established in the United States (except for one species in one lake) and this alternative would allow for introduction, establishment, and spread. Importers will be able to bring the species into the United States for any purpose. Several of the species (Nile perch, zander, wels catfish, and yabby) are or have been raised for food in commercial aquaculture operations outside of their native ranges. Others have been released into natural water bodies outside of the United States to provide recreational fishing opportunities. Several species also serve as aquarium fish or pond ornamentals. Not only do these species have histories of invasiveness elsewhere in the world, but all have had well-documented adverse effects stemming from introduction, establishment, and spread. These experiences abroad indicate that the threats from these species are not merely speculative. If these species are introduced, become established, and spread in the United States, they could harm native wildlife, including threatened and endangered species, damage wildlife resources, and reduce agricultural (aquaculture) productivity.

7.1.2) Alternative 2: List as injurious the crucian carp (*Carassius carassius*), Eurasian minnow (*Phoxinus phoxinus*), Prussian carp (*Carassius gibelio*), roach (*Rutilus rutilus*), stone moroko (*Pseudorasbora parva*), Nile perch (*Lates niloticus*), Amur sleeper (*Perccottus glenii*), European perch (*Perca fluviatilis*), zander (*Sander lucioperca*), wels catfish (*Silurus glanis*), and common yabby (*Cherax destructor)* [Preferred Action]

Under Alternative 2, the Service would list all 11 species (10 freshwater fish and 1 crayfish species) as injurious wildlife under the Act, and thus prohibit both the importation and interstate transportation of all 11 species, gametes, viable eggs, or hybrids, except by permit for zoological, educational, medical, or scientific purposes. An injurious wildlife listing would not prohibit the intrastate transport or possession of the 11 species where such activities are not already prohibited by the State.

Although the 11 species are not currently in U.S. ecosystems (except for one species in one lake), rapid screening analyses found that these species were “high risk” for invasiveness considering their high climate match in parts of the United States and history of invasiveness outside of their native ranges elsewhere in the world. The 11 species were evaluated as injurious using the Service’s Injurious Wildlife Evaluation Criteria. The introduction, establishment, and spread of these 11 species would be injurious to the interests of agriculture, wildlife, or the wildlife resources of the United States.

This listing action preserves the environmental status quo. That is, these listings help ensure that any potential effects associated with the introduction of these species (that have been found to be injurious) do not occur. In this way, injurious wildlife listings maintain the state of the affected environment into the future—the state of the environment prior to listing or potential introduction in the absence of a listing. Thus, prohibiting a nonindigenous injurious species from being introduced into an area in which it does not naturally occur cannot have a significant effect on the human environment.

7.1.3) Alternative 3: Voluntary refrain from importing

Under this alternative, the Service would not amend the list of injurious wildlife but would encourage the public to voluntarily refrain from importation or interstate transportation of these 11 species. This follows a Memorandum of Understanding (MOU) signed by the Service, Pet Industry Joint Advisory Council, and the Association of Fish and Wildlife Agencies in June 2013 (USFWS 2013a) but is not limited to those parties. Under the MOU, the Service provides the technical information on the risk of invasiveness of many nonnative species, and the live animal businesses can voluntarily choose not to import those species determined by the Service to be high or uncertain risk. The 11 species were all high risk (for invasiveness) as determined by the Service, would be contenders for voluntary refrain from trade. Under the MOU, however, the Service does not relinquish the ability to list the species.

Voluntary cooperation will not have any enforcement provisions or legal restraint on the public, businesses, or members of the organizations. Any person could still import and transport these 11 species. The success or failure of this alternative depends on individuals, organizations, and businesses that may have, or in the future develop, a commercial interest in any of these species. This alternative would not prevent the importation and interstate transportation of any of these 11 species and would allow for their potential introduction, establishment, and spread. If these species are introduced into the United States, they could harm native wildlife, including threatened and endangered species, damage wildlife resources, and reduce agriculture productivity.

8) Affected Environment

Under Alternative 2, no environment in the United States would be affected. Under both Alternative 1 and 3, these 11 species, gametes, eggs, and hybrids could be imported into and transported within the United States and would likely have an adverse effect on the environment. A climate match analysis was completed for all 11 species to estimate those regions of the United States potentially affected if the species were introduced and established. The climate match used data from the species' native range and nonnative range. The climate match analysis (Australian Bureau of Rural Sciences 2010) incorporates 16 climate variables (eight for rainfall and eight for temperature) to calculate climate scores that can be used to calculate a Climate 6 ratio (USFWS 2014). Using the Climate 6 ratio, species can be categorized as having a low (0.000 to 0.005), medium (greater than 0.005 to less than 0.103), or high (equal to or greater than 0.103) climate match (Bomford 2008; USFWS 2014). For the 11 species under consideration, the overall climate match ranged from medium for the Nile perch to high for the remaining nine fish and one crayfish species.

The crucian carp has an overall high climate match with a Climate 6 ratio of 0.355. This species has a high climate match throughout much of the Great Lakes region, southeastern United States, and southern Alaska and Hawaii. Low matches occur in the desert Southwest.

The Eurasian minnow has an overall high climate match with a Climate 6 ratio of 0.397. The highest climate matches are in the northern States, including Alaska. The lowest climate matches are in the Southeast and Southwest.

The Prussian carp has an overall high climate match with a Climate 6 ratio of 0.414. This fish species has a high climate match to the Great Lakes region, northern Plains, some western mountain States, and some of California. The Prussian carp has a medium climate match to much of the United States, including southern Alaska and regions of Hawaii. This species has a low climate match to the southeastern United States, especially Florida and along the Gulf Coast. This species is not found within the United States but has been recently discovered as established in Alberta, Canada (Elgin *et al.* 2014); the climate match was run prior to this new information, so the results do not include any North American actual locations.

The roach has an overall high climate match to the United States with a Climate 6 ratio of 0.387, with high matches in southern and central Alaska, the Great Lakes region, and western mountain States. The Southeast and Southwest have low climate matches.

The stone moroko has an overall high climate match with a Climate 6 ratio of 0.557. This species has a high or medium climate match to most of the United States. The highest matches are in the Southeast, Great Lakes, central plains, and West Coast.

The Nile perch has an overall medium climate match to the United States with a Climate 6 ratio of 0.038. However, this fish species has a high climate match to the Southeast (Florida and Gulf Coast), Southwest (California), Hawaii, Puerto Rico, and the U.S. Virgin Islands.

The Amur sleeper has an overall high climate match with a Climate 6 ratio of 0.376. The climate match is highest in the Great Lakes region (Ohio, Indiana, Illinois, Michigan, Wisconsin, and Minnesota), central and high Plains (Iowa, Nebraska, and Missouri), western mountain States (South Dakota, North Dakota, Montana, Wyoming, and Colorado), and central to eastern Alaska.

The European perch has an overall high climate match with a Climate 6 ratio of 0.438, with locally high matches to the Great Lakes region, central Texas, western mountain States, and southern and central Alaska. Hawaii ranges from low to high matches. Much of the rest of the country has a medium climate match

The zander has an overall high climate match with a Climate 6 ratio of 0.374. The zander has high climate matches in the Great Lakes region, northern Plains, western mountain States, and Pacific Northwest. Medium climate matches include southern Alaska, western mountain States, central Plains, and mid-Atlantic and New England regions. Low climate matches occur in Florida, along the Gulf Coast, and desert Southwest regions.

The wels catfish has a high climate match to much of the United States with a Climate 6 ratio of 0.302 with high climate matches occurring in the Great Lakes, western mountain States, West Coast, and southern Alaska). All other regions had a medium or low climate match.

The common yabby has an overall high climate match with a Climate 6 ratio of 0.209. There is a high climate match in the Southeast (Florida, Georgia, Alabama, South Carolina, North Carolina, Tennessee, Virginia, and West Virginia), Texas, regions of Washington, and regions of southern Alaska (Aleutian Islands).

9) Environmental Consequences

Alterative 1: No Action

Direct Effects

Ecological Impacts

If the 11 species are not listed as injurious, these 11 species would be allowed to be imported into the United States and transported between States, the District of Columbia, the Commonwealth of Puerto Rico, or any territory or possession of the United States(unless regulated by a smaller jurisdiction). This would increase the risk of introduction, establishment, and spread. The establishment of any of these species would likely significantly impact agriculture, wildlife, and wildlife resources.

Introduced and established populations would be difficult and costly to control. Control may be possible for some species using habitat modification, bio-manipulation (introduced predators), or the piscicide rotenone. However, there are no published accounts of definitive, long-term success using any method. Additionally, these control measures incur their own wildlife or habitat damages, and therefore, are not recommended or considered a viable mitigation plan under the Injurious Wildlife Evaluation Criteria.

Crucian carp

Potential Impacts to Native Species

The crucian carp reduces native wildlife diversity through competition with native fish species, hybridization with carp species (Godard and Copp 2012), as a vector of the fish disease SVC (Ahne *et al.* 2002), and by altering the health of freshwater habitats. The introduction of crucian carp to the United States could result in increased competition with native fish species for food resources (Welcomme 1988). Additionally, the ability of crucian carp to hybridize with other species of Cyprinidae (including common carp (*Cyprinus carpio*) and goldfish (*Carassius auratus*)) species already invasive in U.S. ecosystems may exacerbate competition over limited food resources and ecosystem changes through hybrid vigor.

Crucian carp harbor the fish disease SVC and parasites. Although SVC infects other carp species, this disease can also be transmitted through the water column to native fish species (including pike and perch species). SVC can cause up to a 70-percent mortality rate among juvenile fish and 30-percent rate in adult fish (Ahne *et al.* 2002).

Potential Impacts to Threatened and Endangered Species

The crucian carp has the potential to negatively affect threatened and endangered species. The crucian carp's diet includes plankton, benthic invertebrates, plant materials, and detritus. We estimate that introduced crucian carp may prey on the 83 species of clams, 19 species of crustaceans, and 30 species of snails currently listed as threatened or endangered species and inhabiting climate-suitable (to the crucian carp) States and territories.

Crucian carp have been linked to increased turbidity in lake habitats (Crivelli 1995). Increased turbidity limits light availability to the water column and can result in changes in nutrient cycling and reduction of overall water quality (Pretty 2003). Changes in nutrient cycling and water quality affect the success and survival of all aquatic organisms (invertebrates and vertebrates) inhabiting that ecosystem. Thus, we estimate that introduced crucian carp populations could potentially affect 17 species of amphibians, 83 species of clams, 19 species of crustaceans, 30 species of snails, and 92 species of fish that are currently listed as threatened or endangered species and living in States and territories with climates ideal for crucian carp (USFWS 2013b).

Potential Impacts to Agriculture

The introduction of crucian carp may affect agriculture by reducing aquaculture productivity. This fish species can harbor SVC, which can infect numerous fish species including carp, pike, and perch (Ahne *et al.* 2002) and cause disease and death. This disease can cause high fish mortality, and thus can detrimentally affect the productivity of commercial aquaculture facilities (Ahne *et al.* 2002; Goodwin 2002).

Eurasian minnow

Potential Impacts to Native Species

The Eurasian minnow can affect native species through several mechanisms, including competition over resources, predation, and parasite transmission. Introduced Eurasian minnows have a more harmful effect in waters with fewer species than those waters with a more developed, complex fish community (Museth *et al.* 2007). In Norway, dense populations of the Eurasian minnow have resulted in an average 35-percent reduction in recruitment and growth rates in native brown trout (*Salmo trutta*) (Museth *et al.* 2007).

Eurasian minnow introductions have also disturbed freshwater benthic invertebrate communities (Næstad and Brittain 2010). Increased predation by minnows has led to shifts in invertebrate populations and declines in benthic diversity (Hesthagen and Sandlund 2010). Many of the invertebrates consumed by the Eurasian minnow are also components of the diet of the brown trout; thus, exacerbating competition between the introduced Eurasian minnow and brown trout (Hesthagen and Sandlund 2010). Additionally, the Eurasian minnow may prey on brown trout larvae (Huusko and Sutela 1997).

The Eurasian minnow serve as a host to parasites, such as *Gyrodactylus aphyae*, that it can transmit to fish species including salmon and brown trout (Zietara *et al*. 2008). Once introduced, these parasites would likely spread to native salmon and trout species. Depending on pathogenicity, parasites of the *Gyrodactylus* species may cause high fish mortality (Bakke *et al.* 1992).

Potential Impacts to Threatened and Endangered Species

Introduced Eurasian minnow populations could challenge the resilience of populations of federally threatened and endangered species. Through competition for food resources and predation on larvae, this minnow species has reduced the recruitment and growth rates of European trout species (Museth *et al*. 2007). If introduced, we estimate that the European minnow could have similar effects on the six salmon and trout species listed as federally threatened or endangered species and also inhabiting climates suitable for the Eurasian minnow.

The Eurasian minnow's diet consists of benthic invertebrates. Increased predation from introduced minnow population has decreased benthic invertebrate diversity (Hesthagen and Sandlund 2010). If introduced, we estimate that increased predation pressure could negatively impact 3 clam, 5 crustacean, and 19 snail species that are currently listed as threatened or endangered species and inhabiting regions suitable for Eurasian minnow establishment (USFWS 2013b).

Potential Impacts to Agriculture

The Eurasian minnow may affect agriculture by reducing aquaculture productivity. This fish species harbors a parasite that may infect other species and can cause high fish mortality (Bakke *et al.* 1992). Eurasian minnow populations can adversely impact both recruitment and growth of brown trout. Reduced recruitment and growth rates can reduce the economic value associated with brown trout aquaculture and recreational fishing.

Prussian carp

Potential Impacts to Native Species

The Prussian carp is closely related and behaviorally similar to the crucian carp. As with crucian carp, introduced Prussian carp may compete with native fish species, alter freshwater ecosystems, and serve as a vector for parasitic infections. Introduced Prussian carp have been responsible for the decreased biodiversity and overall populations of native fish (including native Cyprinidae), invertebrates, and plants (Anseeuw *et al.* 2007; Lusk *et al.* 2010).

This species can alter freshwater habitats, as the invasive Prussian carp did by greatly increasing turbidity in Lake Mikri Prespa (Greece) (Crivelli 1995). Although increased lake turbidity frequently results from increased eutrophication (excess nutrient loading), scientists discovered that increased turbidity was linked to the increased population of Prussian carp. This carp species increased turbidity levels by disturbing sediment during feeding. These carp also intensively fed on zooplankton, thus, resulting in increased phytoplankton abundance and phytoplankton blooms (Crivelli 1995). Increased turbidity results in imbalances in nutrient cycling and ecosystem energetics.

Prussian carp may exacerbate competition over limited food resources and habitat resources, and thus, further threaten native species including those already listed under the Endangered Species Act.

Several different types of parasitic infections (*Thelohanellus* and Posthodiplostomatosis) causing disease are associated with the Prussian carp (Wang et al. 2001; Ondračková *et al.* 2002; Marković *et al.* 2012). Posthodiplostomatosis, or black spot disease, particularly affects young fish and can cause physical deformations, decreased growth, and decrease in body condition (Ondračková *et al.* 2002). These parasites and the respective diseases may infect and decrease native fish stocks.

Potential Impacts to Threatened and Endangered Species

Like their close relative the crucian carp, the Prussian carp may also negatively affect threatened and endangered species. Introduced Prussian carp populations may increase predation pressure on invertebrate species and increase competition pressure on those fish species that eat invertebrates. Within the Prussian carp's climate match, we estimate that 12 clam, 11 crustacean, 19 snail, and 43 fish species are federally threatened or endangered and could be adversely affected by this introduced carp species (USFWS 2013b).

Prussian carp populations have caused habitat disturbances including increased turbidity, sedimentation, and phytoplankton bloom frequency. These disturbances can result in changes in nutrient cycling and ecosystem energetics and can detract from the success and survival of threatened and endangered species. Thus, we estimate that Prussian carp may adversely alter the habitat of 6 amphibian, 12 clam, 11 crustacean, 19 snail, and 43 fish species that are federally threatened or endangered and native to regions with suitable climates for this carp species (USFWS 2013b).

Potential Impact to Agriculture

Prussian carp may affect agriculture by reducing aquaculture productivity. Prussian carp harbor several types of parasitic infections that may cause physical deformations, decreased growth, and decrease in body condition (Ondračková *et al.* 2002). Decreased fish physiology and health detract from the productivity and value of commercial aquaculture.

Roach

Potential Impacts to Native Species

The introduction of the roach may reduce native wildlife diversity through competition over food and habitat resources, hybridization, alterations to ecosystem nutrient cycling, and transmission of parasites and pathogenic bacteria. The roach is a highly adaptive species and will switch between habitats and food sources to best avoid predation and competition from other species (Rocabayera and Veiga 2012). The roach consumes an omnivorous generalist diet, including benthic invertebrates (especially mollusks), zooplankton, plants, and detritus (Rocabayera and Veiga 2012). With such a varied diet, this fish species would likely compete with numerous native fish and mollusk species ranging among trophic levels. Both increased competition with and predation on native species may alter trophic cycling and diversity of native aquatic species.

The roach will likely be able to hybridize with some U.S. native species in the same subfamily (Leuciscinae), which includes minnows.

Large populations of the roach may affect nutrient cycling in lake ecosystems. Increased populations of roach may prey heavily on zooplankton, thus resulting in increased phytoplankton communities and algal blooms (Rocabayera and Veiga 2012). These changes alter nutrient cycling and can consequently affect native aquatic species that depend on certain nutrient balances.

Several parasitic infections, including worm cataracts, black spot disease, and tapeworms, have been associated with the roach (Rocabayera and Veiga 2012). The pathogenic bacterium *Aeromonas salmonicida* also infects the roach causing furunculosis (Wiklund and Dalsgaard 1998). This disease causes skin ulcers and hemorrhaging. The pathogen can be spread through a fish's open sore. This disease affects both farmed and wild fish. The causative bacteria *A. salmonicida* has been isolated from fish in United States freshwaters (USFWS 2011). The roach may spread these parasites and bacteria to new environments and native fish species.

Potential Impacts to Threatened and Endangered Species

Introduced roach populations may challenge the resilience of federally threatened and endangered species. Roach may increase predation pressure on invertebrate species (especially mussels and snails) and increase competition pressure on those fish species that eat those invertebrates. Within the roach's climate match, we estimate that 7 clam, 2 crustacean, 14 snail, and 25 fish species are federally threatened or endangered and could be affected by introduced roach.

Dense roach populations may predate heavily on zooplankton, resulting in increased phytoplankton communities and algal blooms. These changes alter nutrient cycling and trophic level cycling, and consequently, can detract from the success and survival of threatened and endangered species (Rocabayera and Veiga 2012). Thus, we estimate that the roach may adversely affect the habitat of 1 amphibian, 7 clam, 2 crustacean, 14 snail, and 25 fish species that are federally threatened or endangered and native to regions with suitable climates for this fish species (USFWS 2013b).

Potential Impacts to Agriculture

The roach harbors several parasitic infections (Rocabayera and Veiga 2012) that can impair fish physiology and health. The pathogenic bacterium *Aeromonas salmonicida* infects the roach causing furunculosis (Wiklund and Dalsgaard 1998) and can be spread through a fish's open sore and infect farmed fish. Introduction and spread of parasites and pathogenic bacterium to an aquaculture facility can result in increased incidence of fish disease and mortality and decreased productivity and value.

Stone moroko

Potential Impacts to Native Species

The introduction of the stone moroko has been linked to the decline of native freshwater fish species (Copp 2007). The stone moroko could threaten native species through predation, competition, disease transmission, and altering freshwater ecosystems (Witkowski 2011).

Stone moroko introductions have mostly originated when unintentionally included in water with other fish for stocking. In many stocked ponds, the stone moroko actually outcompetes the farmed fish species for food resources, which results in decreased production of the farmed fish (Witkowski 2011). The stone moroko's omnivorous diet includes insects, fish, fish eggs, molluscs, planktonic crustaceans, algae (Froese and Pauly 2014g), and plants (Kottelat and Freyhof 2007). With this diet, the stone moroko may compete with many native United States freshwater fish. In the United Kingdom, Italy, China, and Russia, the introduction of the stone moroko correlates with dramatic declines in native fish populations and species diversity (Copp 2007; Witkowski 2011). The stone moroko first competes with native fish for food resources and then preys on the eggs, larvae, and juveniles of these same native fish species (Pinder 2005, Britton *et al*. 2007).

The stone moroko is a vector of the pathogenic rosette-like agent *Sphaerothecum destruens* (Gozlan *et al.* 2005; Pinder *et al*. 2005), which is a documented pathogen of farmed and wild European fish (Gozlan *et al.* 2009). Although this agent does not harm the stone moroko, it is transmitted through the water and infects native fish species. This pathogen infects a fish's internal organs causing spawning failure, organ failure, and death (Gozlan *et al.* 2005). This pathogen has been documented as infecting the sunbleak and the native Chinook salmon, Atlantic salmon, and the fathead minnow (Gozlan *et al.* 2005).

The stone moroko consumes large quantities of zooplankton. The reduced zooplankton populations result in increased phytoplankton populations, which in turn causes algal blooms and unnaturally high nutrient loads (eutrophication). These changes can cause imbalanced nutrient cycling, decrease dissolved oxygen concentrations, and adversely impact the health of native aquatic species.

Potential Impacts to Threatened and Endangered Species

Introduced stone moroko populations may negatively affect threatened and endangered species. The stone moroko's diet of fish larvae and small fish may not only increase predation pressure on those prey species, but also potentially increase competition with fish that consume similar prey items (Pinder 2005; Britton *et al*. 2007). We estimate that increased predation and competition could harm 56 fish species listed as federally threatened or endangered and inhabiting regions with climates suitable to the stone moroko.

In many areas of introduction and establishment (such as United Kingdom, Italy, China, and Russia), the stone moroko has been linked to the decline of native freshwater fish populations (Copp 2007). In England, where stone morokos were introduced, they dominated the fish community quickly, and the other fish species exhibited decreased growth rates and reproduction, as well as shifts in their trophic levels (Britton *et al*. 2010b). The trophic level is the position an organism occupies in a food chain.

Additionally, the stone moroko consumes large quantities of zooplankton and consequently causes increased phytoplankton populations (Yalçın-Özdilek *et al.* 2013). This includes larger species of planktonic crustaceans, resulting in increased quantities of phytoplankton, leading to eutrophication of the water bodies (Witkowski 2011). Stone morokos feed on juvenile stages of many fish species (*ibid*.). We estimate that these changes could adversely affect 5 amphibian, 9 clam, 6 crustacean, 45 snail, and 56 fish species listed as federally threatened or endangered and native to areas with a high climate match for the stone moroko (USFWS 2013b).

Potential Impacts to Agriculture

The stone moroko affects agriculture by decreasing aquaculture productivity. This fish species often contaminates farmed fish stocks and competes with the farmed species for food resources resulting in decreased aquaculture productivity (Witkowski 2011). The stone moroko is an unaffected carrier of the pathogenic rosette-like agent, *Sphaerothecum destruens* (Gozlan *et al*. 2005; Pinder *et al*. 2005). This pathogen is transmitted through water and causes reproductive failure, disease, and death to farmed fish. This pathogen is not species-specific and has been known to infect cyprinid and salmonid fish species. *S. destruens* is responsible for disease outbreaks in North American salmonids and causes mortality in both juvenile and adult fish (Gozlan *et al.* 2009). If this pathogen was introduced to an aquaculture facility, it may spread and infect numerous fish, resulting in high mortality.

Nile perch

Potential Impacts to Native Species

Potential impacts of introduction of the Nile perch include outcompeting and preying on native species, altering habitats and trophic systems, and disrupting ecosystem nutrient cycling. The Nile perch produces up to 15 million eggs per breeding cycle (Asila and Ogari 1988), thus elucidating this species' efficiency and effectiveness in establishing an introduced population. Nile perch were introduced to Lake Victoria in Africa in the 1950s (Gophen 2015). Historical evidence from the Lake Victoria basin indicates that the Nile perch outcompeted and preyed on at least 200 endemic fish species leading to their local extinction (Kaufman 1992, Snoeks 2005, Witte 2011, Gophen 2015). Many of the affected species were haplochromine cichlid fish species, and the populations of native lung fish (*Protopterus aethiopicus*) and catfish species (*Bagrus docmak*, *Xenoclarias eupogon*, *Synodontis victoria*) also witnessed serious declines (Witte 2011). The haplochromine cichlid species comprised 15 subtrophic groups with varied food (detritus, phytoplankton, algae, plants, mollusks, zooplankton, insects, prawns, crabs, fish, and parasites) and habitat preferences (Witte and Van Oijen 1990, Van Oijen 1996). The depletion of so many fish species has drastically altered the Lake Victoria ecosystem's trophic level structure and biodiversity. These changes resulted in abnormally high lake eutrophication and frequency of algal blooms (Witte 2011). A recent study of Lake Victoria (Gophen 2015) confirms the effect of Nile Perch predation on native fish and the ecological implications of eliminating the haplochromines' planktivory. The Lake Victoria ecosystem contained at least 400 endemic species of haplochromine fishes. Historically, the food web structure was naturally balanced, with short periods of anoxia in deep waters and dominance of diatomides algal species. During the 1980s, Nile perch became the dominant fish. The haplochromine species (plankton eaters) were depleted and the whole ecosystem was modified. Algal assemblages were changed to Cyanobacteria, anoxia became more frequent and in shallower waters.

The depletion of the native fish species in Lake Victoria by Nile perch led to the loss of income and food for local villagers. Nile perch are not a suitable replacement for traditional fishing. Fishing for this larger species requires equipment that is prohibitively more expensive, requires processing that cannot be done by the wife and children, requires the men to be away for extended periods, and decreases the availability of fish for household consumption (Witte 2013).

If introduced to the United States, the Nile perch would prey on small native fish species. These native fish species are not only economically important to both commercial and recreational fishing but are integral components of freshwater ecosystems.

Potential Impacts to Threatened and Endangered Species

The introduction of the Nile perch could further stress the populations of threatened and endangered species. Nile perch will prey on small fish species, and then compete with those fish that normally consume smaller species. We estimate that this increased predation and competition could impact 19 fish species listed as federally threatened or endangered species and inhabiting regions where the Nile perch has a high climate match (USFWS 2013b).

Amur sleeper

Potential Impacts to Native Species

The Amur sleeper is a voracious generalist predator that eats invertebrates, tadpoles, and small fish. Declines in lower trophic level populations (invertebrates) would result in increased competition among native predatory fish. In some areas, the Amur sleeper's eating habits have been responsible for the dramatic decline in juvenile fish and amphibian species (Reshetnikov 2003, Kottelat and Freyhof 2007). Amur sleepers prey on larval and juvenile stages and can result in decreased reproductive success and reduced populations of the native fish and amphibians (Reshetnikov 2003).

Additionally, the Amur sleeper harbors such parasites as *Nippotaenia mogurndae* and *Gyrodactylus perccotti*. The introduction of the Amur sleeper has resulted in the simultaneous introduction of parasites to the Amur sleeper's nonnative range. These parasites have in essence expanded their own nonnative range and successfully infected new hosts of native fish species (Košuthová *et al.* 2008).

Potential Impacts to Threatened and Endangered Species

The introduction of the Amur sleeper could harm threatened and endangered species. This fish species is a voracious predator with a diet of invertebrate, tadpoles, and small fish. We estimate that increased predation may reduce the populations of 2 amphibian, 8 clam, 3 crustacean, 20 snail, and 26 fish species that are listed as federally threatened or endangered and occur in regions with a high climate match for the Amur sleeper (USFWS 2013b). The Amur sleeper could also increase competition among predatory fish that are threatened or endangered species.

Potential Impacts to Agriculture

The parasites carried by the Amur sleeper may affect agriculture by decreasing aquaculture productivity. These parasites may switch hosts (Košuthová *et al.* 2008) and infect farmed species involved in aquaculture. Increased parasite load reduces a fish's physiology and general health, and consequently, may decrease aquaculture productivity.

European perch

Potential Impacts to Native Species

The European perch may affect native species through outcompeting and preying on them and by infecting them with pathogens or parasites. This introduced fish competes with native species for food and habitat resources (Closs *et al.* 2003) and has been implicated in the local extinction (in Western Australia) of the mud minnow (*Galaxiella munda*) (Moore 2008; ISSG 2010). Additionally, the European perch can form dense populations competing with each other to the extent that they stunt their own growth (NSW DPI 2013).

European perch prey on zooplankton, macroinvertebrates, and fish; thus, the introduction of this species can significantly alter trophic level cycling and affect native freshwater communities (Closs *et al.* 2003). These fish are reportedly voracious predators that consume the eggs, fry, and small native fish species (NSW DPI 2013). In one instance, European perch consumed 20,000 newly released rainbow trout (*Oncorhynchus mykiss*) fry from a reservoir in southwestern Australia in less than 72 hours (NSW DPI 2013).

The European perch can also harbor the virus that spreads Epizootic Haematopoietic Necrosis (EHN) (NSW DPI 2013). This virus can cause mass fish mortalities and is known to affect the Australian species of silver perch (*Bidyanus bidyanus*), Murray cod (*Maccullochella peelii*), *Galaxias* fish, and Macquarie perch (*Macquaria australasica*). The spread of this virus (with the introduction of the European perch) has been partly responsible for declining population of native Australian fish species (NSW DPI 2013). This virus is currently restricted to Australia, but could expand its international range with the introduction of European perch to new waterways where native species would have no natural resistance.

Potential Impacts to Threatened and Endangered Species

The introduction of the European perch could negatively affect threatened and endangered species. This perch species may increase predation and competition pressure on threatened and endangered species and could further hinder the health, reproductive success, and resilience of these already at-risk species. We estimate that introduced European perch populations could threaten 6 clam, 3 crustacean, 46 snail, and 30 fish species listed as federally threatened or endangered and located in a region with climate match to the European perch (USFWS 2013b).

Potential Impacts to Agriculture

The European perch could affect agriculture by decreasing aquaculture productivity through disease introduction. The European perch may potentially spread the viral disease EHN (NSW DPI 2013) to farmed fish in aquaculture facilities. Although this virus is currently restricted to Australia, this disease can cause mass fish mortalities and is known to affect other fish species (NSW DPI 2013).

Zander

Potential Impacts to Native Species

The zander may affect native fish species through outcompeting and preying on native species, transferring pathogens to them, and hybridizing with them. The zander is a top-level predator and competes with other native piscivorous (fish-eating) fish. The zander's diet is composed of small-bodied and juvenile fish. Heavy predation on juvenile fish disrupts the life cycle and reproductive success of native fish species. Decreased reproductive success results in decreased populations (and sometimes extinction) (Crivelli 1995) of native fish species. The zander can hybridize with both the European perch and Volga perch (*Sander volgensis*) (Godard and Copp 2011). Our native walleye (*Sander vitreus*) and sauger (*Sander canadensis*) also hybridize (Hearn 1986, Van Zee *et al.* 1996, Fiss *et al*. 1997), providing further evidence that species of this genus can readily hybridize. Hence, there is concern that zander may hybridize with walleye (Fuller 2009) and sauger (P. Fuller, pers. comm. 2015). Zander hybridizing with native species could result in irreversible changes to the genetic structure of native species (Schwenk *et al*. 2008). Hybridization can reduce the fitness of a native species and, in some cases, has resulted in drastic population declines leading to endangered classification and, in rare cases, even extinction (Mooney and Cleland 2001).

The zander is a vector for the trematode parasite *Bucephalus polymorphus* (Poulet *et al.* 2009), which has been linked to decreased native cyprinid populations in France (Lambert 1997, Kvach and Mierzejewska 2011). This parasite may infect native cyprinid species and could result in their population declines.

Potential Impacts to Threatened and Endangered Species

The introduction of the zander could negatively affect threatened and endangered species. The zander would predate on juvenile and small fish, and then potentially compete with adult piscivorous fish species. Increased predation and competition could result in decreased reproductive success and population size. We estimate that introduced zander populations could harm 13 fish species listed as federally threatened or endangered species inhabiting regions with high climate matches for the zander (USFWS 2013b).

Potential Impacts to Agriculture

The zander could affect agriculture by decreasing aquaculture productivity through parasite introduction. This species is a vector for the trematode parasite *Bucephalus polymorphus* (Poulet *et al.* 2009), which has been linked to decreased native cyprinid populations in France (Lambert 1997, Kvach and Mierzejewska 2011). This parasite may infect U.S.-native cyprinid species involved in the aquaculture industry.

Wels catfish

Potential Impacts to Native Species

The wels catfish may affect native species through outcompeting and preying on native species, transferring diseases to them, and altering their habitats. This species is a large predatory fish that would compete with other top trophic-level native predatory fish for both food and habitat resources. Additionally, the wels catfish can be territorial and unwilling to share habitat with other fish (Copp *et al.* 2009).

The wels catfish is a generalist predator, and thus, consumes invertebrates, fish, crayfish, eels, small mammals, birds (Copp *et al.* 2009) and amphibians (Rees 2012). Increased predation on native cyprinids, mollusks, crustaceans, and amphibians can result in decreased species diversity and food web disruption.

The wels catfish is a carrier of the virus causing SVC and may transmit this virus to native fish (Hickley and Chare 2004). The disease depletes native fish stocks and disrupts the ecosystem food web. SVC transmission could further compound the adverse impacts of competition and predation.

Additionally, this catfish species excretes large amounts of phosphorus and nitrogen to the freshwater environment (Schaus *et al.* 1997, McIntyre *et al.* 2008). In France, where wels catfish are invasive, this large species aggregates in groups averaging 25 individuals, thus creating the highest biogeochemical hotspots ever reported for freshwater systems for phosphorus and nitrogen (Boulêtreau *et al.* 2011). Excessive nutrient input can disrupt nutrient cycling and transport (*ibid.*) that can result in unnatural eutrophication, increased frequency of algal blooms, and decreased dissolved oxygen levels. These decreases in water quality will affect both native fish and mollusks.

Potential Impacts to Threatened and Endangered Species

The introduction of the wels catfish could harm populations of threatened and endangered species. This species is a generalist predator with a diet that includes amphibians (Rees 2012), invertebrates, fish, and crayfish species (Copp *et al*. 2009). We estimate that increased predation pressure could decrease reproductive success and survival for 5 amphibian, 9 clam, 4 crayfish, 19 snail, and 35 fish species listed as federally threatened or endangered and native to regions with high climate matches for the wels catfish (USFWS 2013b).

The wels catfish also contributes to eutrophication of the freshwater habitat. Excess nutrient inputs may alter nutrient cycling, and thus, further stress the at-risk populations of threatened and endangered species.

Potential Impacts to Humans

The Wels catfish can achieve a giant size, have large mouths, and are able to beach themselves to hunt and return to the water. There are anecdotal reports of exceptionally large wels catfish biting or dragging people into the water. There is also a report of a human body in a wels catfish's stomach, although it is not known if the person was attacked or scavenged after drowning (Der Standard 2009; Stephens 2013; National Geographic 2014). However, we can find no scientific documentation of attacks on humans.

Potential Impacts to Agriculture

The wels catfish could affect agriculture by decreasing aquaculture productivity through pathogen introduction. The wels catfish may transmit the virus causing SVC to cyprinids (Hickley and Chare 2004). An SVC outbreak could result in mass mortalities among farmed fish stocks at an aquaculture facility.

Common Yabby

Potential Impacts to Native Species

Potential affects to native species from the common yabby include outcompeting native species for habitat and food resources, preying on native species, transmitting pathogens and parasites, and altering habitats. The common yabby has large chelae (claws) (Austin and Knott 1996) and a quick growth rate (Beatty 2005) allowing this species to outcompete smaller, native crayfish species. The yabby will exhibit aggressive behavior toward other crayfish species (Gherardi 2012). Introduced common yabbies will compete with native fish species for burrowing space and once established, aggressively defend their territory.

The common yabby consumes a similar diet to other crayfish species, causing competition over food resources. However, unlike most other crayfish species, the common yabby switches to an herbivorous, detritus diet when preferred prey is unavailable (Beatty 2006). This prey-switching allows the common yabby to outcompete native species. If introduced, the common yabby will likely compete with native crayfish species. Furthermore, increased predation pressure on macroinvertebrates and fish may reduce populations to levels that are unable to sustain a reproducing population. Reduced populations or the disappearance of certain native species further alters trophic level cycling.

The common yabby is a carrier of the microsporidian parasite *Thelohania parastaci* that causes "chalky tail", muscle deterioration, and host death (Moodie *et al.* 2003). If introduced, the common yabby could spread disease among native crayfish species, resulting in decreased populations and changes in ecosystem cycling.

The common yabby digs deep burrows (Withnall 2000). This burrowing behavior has eroded and collapsed banks at some waterbodies (Gherardi 2012). Increased erosion or bank collapse results in increased sedimentation, which increases turbidity and decreases water quality.

Potential Impacts to Threatened and Endangered Species

The introduction of the common yabby would further stress populations of threatened and endangered species. This is of particular concern for the United States, where 48 percent of the native crayfish species are considered imperiled (Taylor *et al.* 2007, Johnson *et al.* 2013); including the endangered Nashville crayfish (*Orconectes shoupi*), which is only found in Tennessee and in an area with a high climate match with the yabby. The common yabby would also increase predation pressure on federally threatened and endangered macroinvertebrate and fish populations. We estimate that this may result in declining populations of 5 crustacean, 71 snail, and 49 fish species listed as federally threatened or endangered species and inhabiting a locale with a high climate match for the common yabby (USFWS 2013b).

Potential Impacts to Humans

The common yabby may directly harm human health by transferring metal contaminants through consumption (Gherardi 2011). Several crayfish species, including the common yabby, can live in contaminated waters and accumulate high heavy metal contaminants within their tissues (King *et al.* 1999, Khan and Nugegoda 2003, Gherardi 2011). The contaminants are then passed on to humans when they eat the crayfish. Heavy metals vary in toxicity to humans ranging from no or little effect to causing skin irritations, reproductive failure, organ failure, cancer, and death (Hu 2002, Martin and Griswold 2009). While the common yabby may directly impact human health by transferring metal contaminants through consumption (Gherardi 2011, 2012) and may require consumption advisories, these advisories are not expected to be any more stringent than those for crayfish species that are not considered injurious.

Potential Impacts to Agriculture

The common yabby would affect agriculture by decreasing aquaculture productivity. The common yabby can be host to a variety of pathogens and parasites causing such diseases as crayfish plague, burn spot disease, *Psorospermium* sp., and thelohaniasis (Jones and Lawrence 2001, Souty-Grosset *et al.* 2006). The yabby is a carrier of the microsporidian parasite *Thelohania parastaci*, which causes "chalky tail", muscle deterioration, and host death (Moodie *et al.* 2003). These pathogens and parasites can infect other crayfish species, resulting in decreased physiology and death. Crayfish are commonly raised in U.S. commercial aquaculture, and increased incidence of death and disease would reduce this industry's productivity and value. The State of Illinois' strict regulation was instrumental in prohibiting the proposed introduction of the Australian crayfish *Cherax* spp. (IDNR 2015). Lodge et al. (2000) recommends that, because crayfishes invariably escape from outdoor aquaculture facilities, the most stringent possible criteria should govern use of nonnative crayfish for aquaculture.

Economic Impacts

Species introduced into U.S. ecosystems cause more than $100 billion of damage to the U.S. economy every year (Pimentel 2011). Industries must spend millions of dollars to defend against damage from injurious species such as zebra mussels (*Dreissena polymorpha*), silver carp (*Hypophthalmichthys molitrix*), and brown treesnakes (*Boiga irregularis*). Based on the negative effects of more than 40 nonnative fish species that have become invasive in the United States, Pimentel (2011) estimates conservatively that $5.4 billion is lost to the sportfishing industry annually. No market forces exist that can shift these costs to the individuals responsible for them.

Under Alternative 1, no action will be taken to regulate trade in these 11 species. As a result, importers would be able to bring these species into the United States for any purpose. We did not have information to allow us to quantify the future potential impacts that could result from introduction of these species into the United States. To our knowledge, the total number of importation events of the crucian carp, Nile perch, wels catfish, and yabby is 25 for the only four species that we know were imported from 2011 to 2015 (see Table 1), with a declared total value of $5,789. The total number of fish imported was 6,502 (excluding one shipment quantified by weight, not number of individuals). Because these species are either not currently in trade or have been imported in only small numbers since 2011, the economic effect of the final rule would be negligible, if not nil. On the other hand, the Service's draft economic analysis (USFWS 2015b) identified potential impacts to aquaculture, recreational resources, and freshwater ecosystems, each of which could have significant associated negative economic impacts under Alternative 1.

<u>Indirect Effects</u>

Under the No Action Alternative, there is risk of accidental or intentional introduction of some or all of these 11 species. If any one of these species enters the United States and is released into the wild under the appropriate conditions, it could survive and establish thriving populations in many types of water bodies. Through the direct effects of predation or outcompeting native species, other nonprey species would be affected, causing indirect effects to the natural environment, such as a subsequent imbalance in the food chain or decrease in water quality.

<u>Cumulative Effects</u>

Under the No Action Alternative, there is risk of accidental or intentional introduction of some or all of these 11 species. If any one of these species enters the United States and is released into the wild under the appropriate conditions, it could survive and establish populations in many types of water bodies. If introduced and established, these species would prey on native fish, including threatened and endangered species, compete with native fish species for food and habitat resources, serve as a vector for pathogens and parasites causing disease, and impact commercial fishery and aquaculture resources. Our analysis also found that these species are also likely to spread, causing similar effects to aquatic ecosystems where suitable climate and habitats exist. These species will also have direct effects on human activities (such as reduced profit from aquaculture or reduced pleasure in fishing) or indirect effects on humans (reduced wildlife biodiversity). If more than one of the 11 species is introduced into the United States, the detrimental effects would be greater than if only one was introduced. With each introduction of another injurious species, the harmful effects increase. In some cases, the harmful effects could be compounded by hybridization with native or other invasive species (creating offspring that are even more harmful than the parent species) or by the introduction of pathogens and parasites that cause diseases and can spread to native or aquaculture species. While a native species may be able to withstand the competition or habitat disturbance from a single injurious species, the cumulative effects of competition or habitat disturbance of multiple injurious species would likely seriously adversely affect the natural environment.

Since there are no known effective measures to control or eradicate any of the 11 species, the ability to rehabilitate or recover disturbed ecosystems would be difficult, if not impossible. If no action is taken to prohibit the importation and interstate transportation of these 11 species, the introduction and establishment of these species in the United States will likely add to the destructive effects of already established invasive species (such as Asian carp and snakehead species).

Alternative 2: List as Injurious the crucian carp (*Carassius carassius*), Eurasian minnow (*Phoxinus phoxinus*), Prussian carp (*Carassius gibelio*), roach (*Rutilus rutilus*), stone moroko (*Pseudorasbora parva*), Nile perch (*Lates niloticus*), Amur sleeper (*Perccottus glenii*), European perch (*Perca fluviatilis*), zander (*Sander lucioperca*), wels catfish (*Silurus glanis*), and common yabby (*Cherax destructor)* [Preferred Action]

Ecological Impacts

Listing all 11 species as injurious will protect native wildlife and wildlife resources of the United States freshwater ecosystems. No impacts to the environment will result from listing these 11 species.

Potential Impacts on Native Species

Prohibiting the importation and interstate transport of the 11 species will protect native aquatic species. No impacts to native species will result from listing these 11 species.

Potential Impacts on Threatened and Endangered Species

Prohibiting the importation and interstate transport of the 11 species will protect threatened and endangered species. No impacts to federally endangered or threatened species will result from listing these 11 species.

Potential Impacts to Humans

No impacts to humans will result from listing these 11 species.

Potential Impacts to Agriculture

No impacts to agriculture will result from listing these 11 species. Listing the species, thereby prohibiting the importation and interstate transport of these species, will prevent effects to agriculture, since 10 of 11 species (not the Nile perch) were found to be injurious to the interests of agriculture by transferring pathogens and parasites that cause disease and by predation on farmed species.

Economic Impacts

Of the 11 species, only one population of one species (zander) is found in the wild in one lake in the United States. Of the 11 species, four species (crucian carp, Nile perch, wels catfish, and yabby) have been imported in only small numbers since 2011 (see Table 1); and 7 species are not in U.S. trade. Therefore, businesses derive little or no revenue from their sale, and the economic effect in the United States of this final rule would be negligible, if not nil. The draft and final economic analyses that the Service prepared support this conclusion (USFWS 2015b, USFWS 2016b).

Indirect Effects

Because none of the 11 species is in significant trade, and most are not in trade yet, there should be no indirect effects to the natural or human environments of the United States,

Cumulative Effects

Listing the 11 species as injurious will protect wildlife and wildlife resources, including threatened and endangered species, of the United States. This alternative would prohibit the importation and interstate transport, thereby decreasing the likelihood of introduction, establishment, and spread of these 11 species in the United States, thus maintaining the status quo of the environment. Therefore, there would be no cumulative effects.

Alternative 3: Voluntary cooperation by the public

Ecological Impacts

Since this alternative does not list the 11 species as injurious, there is risk of importation and interstate transportation of these species. If businesses or individuals voluntarily do not import or transport these 11 species, there would be no damage to native wildlife and wildlife resources. There would be no negative effects to the environment stemming from the decision to not import or transport these 11 species.

However, if some entities choose to import some or all of these 11 species, there is potential for the introduction, establishment, and spread of these species into the natural environment. In this case, the ecological impacts would be the same as for Alternative 1. Unlike Alternative 2, this alternative would not protect the interests of agriculture, wildlife, and wildlife resources from the purposeful or accidental introduction and subsequent establishment of these 11 species into ecosystems of the United States through listing the 11 species as injurious.

Potential Impacts on Native Species

If the voluntary cooperation is followed for all species and there is no importation and interstate transport of the 11 species, native species will be protected. There will be no negative effects to native species.

If the voluntary cooperation is not followed, there will be similar effects as outlined in Alternative 1. The introduced 11 species would compete with native species, prey on native species, and transmit pathogens and parasites causing diseases to native species. Some of these 11 species may also hybridize with native species, or other invasive species (creating offspring that are even more harmful than the parent species), further exacerbating competition. Several of these 11 species alter freshwater habitats to the extent that nutrient availability and trophic level cycling are detrimentally affected.

Potential Impacts on Threatened and Endangered Species

If the voluntary cooperation is followed and there is no importation and interstate transport of any of the 11 species, there would be no risk to threatened and endangered species. There would be no negative effects on threatened and endangered species.

If the voluntary cooperation is not followed and some or all of these 11 species are introduced and established, there would be similar effects as those outlined under Alternative 1. The introduced 11 species would compete with threatened and endangered species, prey on threatened and endangered species, and transmit pathogens and parasites that cause diseases to threatened and endangered species. Several of these 11 species alter freshwater habitats to the extent that nutrient availability and trophic level cycling are detrimentally affected.

Potential Impacts to Humans

Voluntary cooperation, if adhered to, would have little effect on humans. However, if the voluntary cooperation is not followed, the effects would be similar to those listed under Alternative 1.

Potential Impacts to Agriculture

If the voluntary cooperation is followed, there will be no negative impacts on agriculture. If the voluntary cooperation is not followed, the effects would be similar to those listed under Alternative 1.

Economic Impacts

Voluntary cooperation to not import these species will not have any enforcement provisions or legal restraint on the public, businesses, or members of the organizations. Voluntary cooperation creates a situation in which the first importer will have no competition as all of the other importers continue to comply. Therefore, the species may be more rare and desirable and the profits to be made by importing the species may increase. If there is a large enough profit to be made, the market would be expected to exploit this opportunity and import one or more of these species. Eventually other dealers will see the opportunity, the agreement may break down, and the species may be introduced into ecosystems of the United States. The costs of Alternative 3 are likely to be smaller than those of Alternative 1 to the extent that the voluntary cooperation forestalls imports but have the potential to be similar to Alternative 1.

Indirect Effects

If the voluntary cooperation is followed for all species and there is no importation and interstate transport of the 11 species, the indirect effects will be the same as for Alternative 2. However, if the voluntary cooperation is not followed, there will be similar effects as outlined in Alternative 1.

Cumulative Impacts

If the voluntary cooperation was followed, importation and interstate transportation of the 11 species would not occur, and that would protect the interests of agriculture, wildlife, and wildlife resources from the purposeful or accidental introduction and subsequent establishment of these 11 species into ecosystems of the United States.

However, voluntary cooperation is *voluntary* and may not include all organizations involved in import and trade. Not all potential importers may know about the voluntary effort or be willing to abide. The cooperation does not include any enforcement of legal mandate on those organizations that do agree to voluntary not trade in these species. At any time, these organizations can choose to no longer agree to the voluntary agreement and begin importing and transporting these species. The voluntary cooperation does not eliminate the risk that some or all of these 11 species may be imported, introduced, established and spread in the United States. If introduced and established, cumulative impacts would be similar to those discussed in Alternative 1.

Selected Alternative

All of these 11 species have a well-documented history of invasiveness outside of their native range, although not yet in the United States. These species have escaped or been released into the wild environment, survived and established, expanded their nonnative range, preyed on native wildlife species, and competed with native species for food and habitat. Since it will be difficult to prevent, eradicate, manage or control the spread of these 11 species; it will be difficult to rehabilitate or recover habitats disturbed by these species; and because introduction of all 11 species will negatively affect agriculture, and native wildlife and wildlife resources, the Service prefers Alternative 2 to list all 11 species as injurious under the Act.

10) Coordination with Federal Agencies

The Service sent a summary of the proposed rule (for which this environmental assessment was prepared) to the following Federal agencies: Council for Environmental Quality, Department of Homeland Security, National Invasive Species Council, National Oceanic and Atmospheric Administration, Small Business Administration, U.S. Coast Guard, U.S. Department of Agriculture, U.S. Environmental Protection Agency, U.S. Forest Service, and Department of the Interior (including Bureau of Indian Affairs, Bureau of Land Management, Bureau of Ocean and Energy Management, Bureau of Reclamation, National Park Service, Office of Surface Mining Reclamation and Enforcement, and U.S. Geological Survey). There were no substantive comments. Those that responded supported the proposal.

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13) Appendix: Peer Review and Public Comments and Responses on the Draft Environmental Assessment

The following comments were submitted by the peer reviewers specifically on the Draft Environmental Assessment (USFWS 2015a), although some may apply to the rule and the economic analysis. Please see the "Injurious Wildlife Species; Listing 10 Freshwater Fish and 1 Crayfish" published in the Federal Register (see *www.regulations.gov*, Docket No. FWS–HQ–FAC–2013–0095) for details about the peer review process. No comments were submitted by the public specifically on the draft environmental assessment.

(PR1) Comment: Voluntary refraining importation through a Memorandum of Understanding (MOU) between the USFWS, the pet industry, and the Association of Fish and Wildlife Agencies (Alternative 3) is a very interesting consideration. In my experience, industry does not desire harm to the environment but they are extremely fearful of regulation. Involving the affected industry directly into the rule making process could greatly benefit future rulemaking considerations. The 11 species proposed for listing as injurious in this rule are not currently of commercial importance in the United States and seemingly not being considered currently by industry for future commercial purposes. However, arguably the worst invasive species in the United States can be connected to an industry for some commercial purpose. Involving industry in discussions that involve animals that have economic benefits should be considered for the rule process in the future.

Our Response: This is the first rule we are promulgating based on the concepts of our MOU, which was signed in 2013. We agree with the commenter that working with industry is important, and we are working to provide low risk species alternatives if industry wants to import a new species. By public comment (December 22, 2015), Michigan Department of Natural Resources referred to this MOU and stated that this MOU provides a forum to discuss species in trade and potential voluntary or regulatory actions, and they encourage the Service to leverage this MOU when considering future species for listing as injurious. The Service intends to do that.

(PR2) Comment: Hybridization is a significant criteria when evaluating a species potential to negatively impact an environment. The Environmental Assessments for European Perch (*Perca fluviatilis*) and Zander (*Sander lucioperca*) do not mention the potential for hybridization with native species to the United States, yellow perch and walleye, respectfully. Hybridization is mentioned in the ERSSs for each species but only minimally.

Our Response: The commenter is correct. We have revised Section 9, Alternative 1 for the zander to be consistent with the information we provided in the proposed and final rules. That information does suggest that hybridization with the native walleye and sauger are a concern

(PR3) Comment: A few parts of the EA suffered from lack of clarity, such as some sentences are convoluted and a few are potentially misleading. Clarity could be improved by simply writing more concisely and breaking up larger sentences.

Our Response: We have made revisions for clarity.

(PR4) Comment: Section 1, Purpose for the Action, Paragraph 2 of the EA is overly confusing, especially the attempt to explain that the Service's "action" is like the typical "no action" of a Federal agency. This paragraph should be replaced with one or a few straight-forward declarative sentences. Consider something as follows: "Listing these 11 non-native species under the Lacey Act will reduce the risk that these organisms will be introduced into waters of the USA and thus eliminate or greatly reduce the possibility of them causing harm to US ecosystems."

Our Response: We have edited part of the paragraph for clarity, but we maintained most of it the way it was because of how we determine if the action has a significant impact on the human environment, which is what we base a Finding of No Significant Impact on. We need to clearly state that the action preserves the environmental status quo and how it does that, so that, if we conclude that the action will not have a significant impact on the human environment, it will be clear to the public why.

(PR5) Comment: Regarding Section 2, paragraph 1, the current second sentence reads: "All 11 species have a high climate match in parts of the United States and a history of invasiveness outside their native ranges (but not in the United States)." Why not simply state that "Of these 11 species, only xxxx (species?) has been adequately documented as has having been introduced into open waters of the USA. All species could eventually become established in this country. "Each of these species is known to be highly invasive in other parts of the world and ..."

Our Response: We prefer to be consistent with the terms "climate match" and "history of invasiveness," but we did revise for clarity.

(PR6) Comment: Regarding Section 2, I recommend substituting "intrastate" with "within-state".

Our Response: "Intrastate" is the commonly accepted term to distinguish from interstate, but we added "(within-State)" after "intrastate" to explain the term.

(PR7) Comment: The authors state that, "If the 11 species are not listed as injurious, these 11 species would be allowed to be imported and transported throughout the United States." However, the statement is not entirely correct since some States may already prohibit or restrict any of the 11 species.

Our Response: The commenter is correct, and we have revised the sentence accordingly in this final EA.

(PR8) Comment: It is the responsibility of the authors to provide clear documentation regarding the biology and known or potential impacts of these species. I went to one link that took me to a home page (*www.cabi.org/isc*) and I had to search for the paper. At a minimum, a link should go directly to the web site that provides the supporting information. I prefer citations of peer-reviewed scientific journal articles or books. The only reason to cite a web source is if the information is not provided in any published source.

Our Response: The Service has been searching for several years for a more efficient method to locate information on species that are not native to the United States and that may not have been published by American or English-speaking authors and, thus, not easy for the Service to locate. Papers may be published in journals and reports around the world and in many languages. One organization, CAB International (CABI), has helped solve this problem for us and others by soliciting an expert to prepare a full datasheet (report) on a particular invasive species. This expert gathers the available papers internationally; CABI will professionally translate relevant papers. The resulting datasheet is reviewed by three other experts. Then CABI makes the datasheet accessible worldwide at no cost at *http://www.cabi.org/isc*. We used the full datasheets on all 11 species for basic information and for leads to find primary sources. We did verify with the primary sources that we were able to locate and that were in English. We provided the direct links to all 11 of the CABI datasheets to the peer reviewers. In the Draft Environmental Assessment, we provided the link to the CABI website, but we will link directly to the species for the final rule. Although we are not required to provide links to all of the sources we use, we provided a list of the references on *www.regulations.gov* for this docket (FWS–HQ–FAC–2013–0095). We also must maintain a copy of each source for our records.

(PR9) Comment: It should be mentioned that the Prussian carp is similar to the crucian carp and they are also known to hybridize. Such a situation creates added problems, so listing both under the Lacey Act reduces confusion with regulations or prohibitions.

Our Response: Prussian carp are closely related to crucian carp and goldfish, and it is likely that they also would hybridize with closely related species if given the opportunity. However, we have no documentation of that occurring. One paper that documents *Carassius* hybridization discovered that the species identified as gibel (or Prussian) carp were really crucian carp (Hanfling and Harley 2003). We are listing the Prussian carp for other threats, and while the listing does reduce confusion with regulations, that is not a criteria for listing.

(PR10) Comment: A more recent paper on the Amur sleeper that includes mention of its introduction in more countries than listed in the draft environmental assessment is Reshetnikov and Schliewen (2013).

Our Response: We have incorporated into the rule and the Final Environmental Assessment the information of the additional countries and spread identified in Reshetnikov and Schliewen (2013).

(PR11) Comment: Regarding Section 9 for the Amur Sleeper, is there any information about potential negative interactions with our native *Dormitator maculatus* the Fat Sleeper, especially since that species has value in aquaculture as a food fish? It would be worthwhile to mention for any of the 11 species which native species are most closely related or similar and thus may be impacted or even replaced.

Our Response: The fat sleeper is in a different family from the Amur sleeper, and the reviewer does not explain how the two species are closely related. The two species are somewhat similar in appearance, but that is true of many species, especially at the juvenile stage. We have no specific information about potential negative interactions of the two species or of the fat sleeper in aquaculture. Regarding the reviewer's request for us to mention species that are most closely related or similar and thus may be impacted, we note that a species does not need to be closely related or similar to affect or even replace another. However, we have added some information in the rule and in the EA wherever we had information available.

(PR12) Comment: Regarding Section 9 for the roach, the reason for inclusion of the following statement is unclear, especially since it is within subsection on potential impacts to native species (which in this case should be U.S. natives): "Although this particular bream species is not found in the United States, the rudd is already considered invasive in the Great Lakes (Fuller *et al*. 1999; Kapuscincki *et al.* 2012)."

Our Response: We agree that the sentence is marginally useful and have deleted that sentence.

(PR13) Comment: (Section 9 – Stone Moroko): The authors state that this species could harm 56 ET fish species. It would be useful to have a couple of examples and indicate if predation or competition is the main threat.

Our Response: The stone moroko maintains an omnivorous diet, which includes fish eggs, and resides in freshwater lakes, ponds, rivers, streams, and irrigation canals. Because of this generalist diet and habitat, the stone moroko may adversely affect the Ozark hellbender (*Cryptobranchus alleganiensis bishopi*), Neosho madtom (*Noturus placidus*), and Topeka shiner (Notropis topeka (=tristis)) by eating the eggs.

(PR14) Comment: Is there really any evidence that introduced populations of Stone Moroko have caused altered nutrient cycling, decreased dissolved oxygen concentration, and adversely impacted the health of all aquatic species inhabiting that ecosystem? If so, give a reference.

Our Response: The sentence in question was preceded in the EA by this sentence: "Additionally, the stone moroko consumes large quantities of zooplankton and consequently causes increased phytoplankton populations (Yalçın-Özdilek et al. 2013)." The next sentence did not state that the altering of nutrient cycling has already occurred, but it implied that that is what normally occurs: "Increased phytoplankton populations result in more algal blooms and increased nutrient loads. These changes alter nutrient cycling, decreased * * *." However, on further checking, we did find a source that supported that statement and have revised the paragraph accordingly, as well as in the final rule.

(PR15) Comment: Regarding Section 9 for the wels catfish, this is a large catfish. Its adult and maximum size should be emphasized, since it is a predator with a very large mouth. The subsection relating to potential harm to humans borders on sensationalism. Neither of the supporting citations are scientific publications.

Our Response: We have added information from the final rule regarding the giant size that wels catfish can attain. However, due to the species' potentially giant size, large mouth, predatory nature, and ability to beach itself and then return to the water, we mention the anecdotal reports. However, we do reiterate that we were unable to find scientific documentation of attacks on humans.

(PR16) Comment: A detailed timeline of introductions and or invasions for each of the 11 species proposed in countries outside of the United States is generally lacking. This information would be extremely important to assist evaluating the No Action scenarios for each species proposed.

Our Response: We agree that a detailed timeline would be useful. However, we believe that we have substantial evidence without such details to determine that these 11 species are injurious. The history of introduction and spread can be found at the CABI Invasive Species Compendium website (http://www.cabi.org/isc) for each species. We utilized these reports (full datasheets) for information for our proposed rule.

(PR17) Comment: In Section 4, more information should be provided on the rapid screen analysis method. Has this method been described and defended in a scientific or technical

publication or reviewed report? If so, that source should be cited. Otherwise it is difficult to judge why these 11 species were selected over other non-native fishes or other nonnative aquatic animals that could be considered equally bad or more likely to cause high impact.

Our Response: Our ERSS process has not been published, but it has undergone peer review per OMB's policies for influential science (OMB 2004). In addition, components of the ERSS process have undergone publication (for example, see climate matching in Howeth *et al.* 2016) in peer reviewed journal articles. The agency will continue to pursue opportunities to publish findings specific to results derived from the ERSS or its principle components: climate matching and history of invasiveness. The rapid screen analysis method (ERSS) does not prioritize within the categories of high, low, and uncertain risk. We have ERSSs for more than 50 fish, crustaceans, and mollusks that are high risk that we did not evaluate in this rule. We do not have a way of ranking those species at this time. Because of the amount of work required to evaluate each species and prepare the documentation, we are not able to evaluate all the species at one time. We chose many species in this rule because of their risk to the Great Lakes region and Mississippi River Basin, which face ecosystem crisis if native aquatic populations collapse due to invasions of nonnative aquatic fish, mollusks, or crustaceans, as well as a corresponding widespread economic hardships if the commercial fishing industry collapses due to the same. We plan to evaluate more of the high-risk species for injuriousness.

(PR18) Comment: A reviewer expressed difficulty in finding more information in the rule and supplemental documents regarding the rapid screening (ERSS) method. The reviewer located the standard operating procedures for the rapid screening as cited in the draft environmental assessment but found it not sufficiently informative. For example, the 16 climate variables were not explained. The authors should explain what a Climate 6 ratio is.

Our Response: The climate match score is a calculation that ranges from 0 to 10. It compares the 16 climate variables as one point (source climate station) to another point (target station). The equation calculates a figurative "distance" between every source and target station, then selects the highest score (best match and closest "distance"). This distance is then normalized on a score from 0 to 10 to make it easier to understand and do math on the scores. The Climate 6 score (or ratio) equals the (Sum of the Counts for Climate Match Scores 6-10)/(Sum of all Climate Match Scores). The 16 climate parameters used to estimate the extent of climatically matched habitat in the CLIMATE program are in this table (Bomford *et al.* 2010).

Temperature parameters (°C)	**Rainfall parameters (mm)**
Mean annual	Mean annual
Minimum of coolest month	Mean of wettest month
Maximum of warmest month	Mean of driest month
Average range	Mean monthly coefficient of variation
Mean of coolest quarter	Mean of coolest quarter
Mean of warmest quarter	Mean of warmest quarter
Mean of wettest quarter	Mean of wettest quarter
Mean of driest quarter	Mean of driest quarter

We use Climate 6 scores because that system was peer reviewed (Bomford 2008). In Bomford's seminal risk assessment manual, she stated "The generic model is based on Climate 6 (as opposed to Climate 5, 7 or 8), since Climate 6 was shown to be the best predictor of success of introduction," referring to exotic freshwater fish. We believe that the categorical system provided by generating and using the Climate 6 Ratio is the most effective for our current needs. For more information on how the climate match scores are derived, please see the revised Standard Operating Procedures (USFWS 2016a).

(PR19) Comment: (Section 8): The authors cite Bomford (2008) with regard to climate match. Did they use the adjustments Bomford mentions for evaluating fish or aquatic organisms?

Our Response: We assume that the reviewer is talking about Bomford's algorithm for Australia (Bomford 2008). We did not use that algorithim, which includes the raw Climate 6 score, along with other factors. Instead, we use only the Climate 6 score, which Bomford said was shown to be the best predictor of success of introduction. Howeth *et al.* (2016) also supports these findings.

(PR20) Comment: At a minimum, for any unpublished documents cited, the authors should provide a functional link to where one can access the full report, such as Bomford's report.

Our Response: The Bomford report (2008) is available on the internet (http://www.pestsmart.org.au/wp-content/uploads/2010/03/Risk_Assess_Models_2008_FINAL.pdf). Please also reference PR8 for additional details.

(PR20) Comment: Although not a major problem, it should be noted that more and more ichthyologists and fish biologists capitalize the common names of fishes.

Our Response: The Service chooses to capitalize only the proper names used to name species in rulemaking documents, as we do for all other classes of animals. The most recent American Fisheries Society list of crustaceans (McLaughlin *et al.* 2005) did not capitalize crustaceans, so we will remain consistent throughout.