DEPARTMENT OF THE INTERIOR

Fish and Wildlife Service

50 CFR Part 16

RIN 1018–AI36

Injurious Wildlife Species; Snakeheads (family Channidae)

AGENCY: Fish and Wildlife Service, Interior.

ACTION: Final rule.

SUMMARY: The U.S. Fish and Wildlife Service adds all species of snakehead fishes in the Channidae family to the list of injurious fish, mollusks, and crustaceans. By this action, the Service prohibits the importation into or transportation between the continental United States, the District of Columbia, Hawaii, the Commonwealth of Puerto Rico, or any territory or possession of the United States. The best available information indicates that this action is necessary to protect wildlife and wildlife resources from the purposeful or accidental introduction and subsequent establishment of snakehead populations in ecosystems of the United States. Live snakehead fishes or viable eggs can be imported only by permit for scientific, medical, educational, or zoological purposes, or without a permit by Federal agencies solely for their own use; permits will also be required for the interstate transportation of live snakeheads or viable eggs currently held in the United States, for scientific, medical, educational, or zoological purposes. This final rule becomes effective immediately upon publication.

DATES: This rule is effective October 4, 2002.

FOR FURTHER INFORMATION CONTACT: Kari Duncan, Division of Environmental Quality, Branch of Invasive Species at (703) 358–2464 or *kari_duncan@fws.gov*.

SUPPLEMENTARY INFORMATION:

Background

Summary of Actions Taken and Comments

The Fish and Wildlife Service published a proposed rule in the July 26, 2002 (67 FR 48855), **Federal Register** based upon information we obtained indicating that snakehead fishes are injurious to the wildlife and wildlife resources of the United States. The proposed rule invited comments for 30 days ending August 26, 2002. We received 453 written comments during this period. Of those 453 comments, 386 were nonrelevant or nonsignificant, one offered editorial suggestions on the proposed rule, 32 were opposed to adding snakeheads to the list of injurious fishes, and 34 stated their support for the proposed rule. Of the 386 nonrelevant or nonsignificant comments, 353 were electronic messages that were generated erroneously, 13 were electronic messages pertaining to investment scams, 8 were electronic messages pertaining to advertising, one comment offered a resume for employment opportunities, 2 were unknown, 2 offered suggestions/opinions on treating the ponds in Crofton, Maryland, and 7 provided information on sightings of snakeheads. Of the 67 comments that were considered relevant and significant, one came from a Federal agency, 12 from private organizations, 8 from State agencies, and 46 from private individuals.

We reviewed all comments received for substantive issues and new information regarding the injurious nature of snakehead fishes. Similar comments were grouped into issues; these issues and our responses to each are presented below:

Issue 1: One respondent stated that some readers may not understand that snakeheads are fishes until it's stated later in the proposed rule. The respondent suggested clarifying the rule by using the terms ''snakehead fish'' or ''snakehead fishes'' either early in the rule or throughout the rule.

Response: The Service agrees with the respondent's comments on this issue. The suggested changes to improve clarification are used in the final rule.

Issue 2: Twenty-one respondents requested that we not list the entire family of snakehead fishes (Channidae) as injurious, but that we list those species (up to five species) that are large and cold tolerant. The respondents stated that the small, temperature-sensitive species used in the aquarium hobby would not pose a threat in most of the United States because, if released, they would not survive the cold climates.

Response: We acknowledge that five of the 28 species recognized in the Channidae family at this time are considered large, approximately 6 are considered dwarf species, and the remaining species are considered medium-size snakehead fishes. As we presented in the proposed rule, the family Channidae contains 9 species that are strictly tropical, 4 can be considered tropical to subtropical, one is subtropical, 12 can tolerate tropical or subtropical to warm temperate conditions, one is warm temperate, and one is warm temperate to cold temperate.

The tropical species would survive in the warmest waters such as extreme southern Florida, perhaps parts of southern California, Hawaii, and certain thermal spring systems and their outflows in the American west. The tropical to subtropical species would have a similar potential range of distribution as for tropical species but with a greater likelihood of survival during cold winters and more northward limits. The tropical or subtropical to warm temperate species could survive in most southern States. The warm temperate, and warm temperate to cold temperate, species could survive in most areas of the United States.

Although the tropical to subtropical species of snakehead fishes are not likely to become established in the northern waters of the United States, all of the Channidae species, including the dwarf species, are aggressive and highly predatory. Should a species of snakehead fishes be accidentally or intentionally released into U.S. waters, the 131 taxa of threatened and endangered amphibians, fishes, and crustaceans could face additional threats. Additionally, because snakehead fishes are morphologically very similar, it would be very difficult for biologists, wildlife inspectors at entry ports, and law enforcement agents to differentiate among species of snakeheads.

Based upon the aggressive, predatory nature of all species of snakehead fishes, the fact that one or more species could become established in most waters of the United States, and the fact that it is very difficult to differentiate among the species of snakeheads, the Fish and Wildlife Service has determined that all 28 of the currently recognized species of snakehead fishes in the Channidae family should be listed as injurious fishes under the Lacey Act.

Issue 3: Six respondents indicated that most hobbyists and fish keepers are responsible and know that releasing exotic species into the environment is dangerous to the environment. The respondents indicated that the responsible hobbyists should not be punished and all species of snakehead fishes should not be listed as injurious. Additionally, most of these respondents stated that an educational campaign should be initiated to explain the hazards of releasing exotic species into the environment and encourage the proper disposition of unwanted pets.

Response: The Service appreciates that most hobbyists and fish keepers are responsible and properly dispose of unwanted pets. It is to the tremendous credit of hobbyists that snakehead fishes

have been imported into the United States and only a small number have been found in the wild. This rule is not intended to punish hobbyists; it is based upon the scientific evidence that indicates that snakehead fishes are aggressive and highly predatory and therefore threaten the wildlife and wildlife resources of the United States. It is important to note that individuals or organizations who possessed snakeheads prior to the injurious wildlife listing in States where possession of snakeheads is legal will be able to continue to possess them; however, they will be prohibited from transporting them across State lines.

The Fish and Wildlife Service has initiated a national public awareness campaign known as Stop Aquatic Hitchhikers! This campaign targets aquatic recreation users to raise their awareness about the growing aquatic invasive species problem and to encourage them to become part of the solution in preventing the spread of harmful, nonnative species. While aquatic recreation users may not be responsible for bringing these species into the country, they may inadvertently transport them overland. The Service is working with State fish and wildlife agencies, conservation organizations, and the fishing and boating industries to address this issue. The campaign has a supporting web site with the address: *http://www.protectyourwaters.net.*

The Service is considering the development of a new campaign similar to Stop Aquatic Hitchhikers! that would target aquarium hobbyists. This campaign would be conducted in conjunction with the Pet Industry Joint Advisory Council, the largest trade association in the United States representing the pet industry in Washington, DC, and it would focus on raising awareness about aquatic invasive species, and encouraging aquarium hobbyists to adopt preventive actions to avoid having unwanted aquarium fish and plant species become part of our environment. The campaign would be a multi-layered, voluntary effort, and would encourage aquarium species importers, wholesalers, retailers and consumers to focus on how the aquarium industry is a responsible economic sector that collectively values the environment and seeks to protect it while simultaneously enjoying the benefits of the aquarium hobby.

Issue 4: Two respondents stated that they are opposed to the injurious wildlife listing because snakehead fishes are valuable food fish.

Response: The Service recognizes the value of snakehead fishes as a food source, just as we recognize their value to hobbyists. However, as stated above, the decision to list the Channidae family of snakehead fishes is based upon scientific data on the hazards that these fishes would present to the wildlife and wildlife resources of the United States. Dead or frozen snakehead fishes can continue to be imported and transported as an alternative to importing live snakeheads.

Issue 5: Two respondents stated that they consider the injurious wildlife listing of snakehead fishes to be racist against the Asian American community because it would prohibit the use of a valuable food source and protect the sport activity of European Americans. Additionally, the respondents indicated that the Service should consult with the Asian American community and that we should consider snakeheads as an economic resource and not a threat.

Response: The decision to list snakehead fishes as injurious under the Lacey Act is based solely on the biological characteristics of the fishes and the need to protect our native wildlife and wildlife resources, and is in no way based upon race or ethnicity, or preserving recreational opportunities for certain sectors of the population. We have substantial scientific data that describe the harm that snakehead fishes cause when introduced outside of their native range and are likely to cause if released into U.S. waters.

According to our Law Enforcement data, 372 individuals and 892 kilograms of snakehead fishes were imported into the United States in 1997; 1,488 individuals and 1,883 kilograms were imported in 1998; 6,044 individuals and 8,512 kilograms were imported in 1999; 8,650 individuals and 9,240 kilograms were imported in 2000; and 20,547 individuals were imported in 2001. We do not have information on how many of those imports contained young fishes destined for the aquarium trade and how many were larger individuals destined to be sold as live food fish. While the importations did increase between 1997 and 2001, the importation of snakehead fishes into the contiguous United States does not appear to represent a significant portion of live fish imports. We suggest that all persons who previously used live snakeheads as a food fish consider the use of dead or frozen fish as an alternative.

Issue 6: Two respondents indicated that the proposed listing of snakehead fishes was based more on hype than fact, and is an overreaction to media attention.

Response: As a result of the discovery of the bullseye snakeheads in south Florida, the U.S. Geological Survey and the Service began evaluating the risks associated with snakehead fishes in 2001. Consequently, the injurious wildlife listing was being developed within the Service before the recent media attention.

Outside of what is published in our official press releases, the Service has no control over what is published in the media. We agree that some of the facts have been exaggerated, and we have taken measures to correct misinformation that has appeared in the media.

Issue 7: Thirteen respondents stated that snakehead fishes threaten ecological harmony, present major risks to ecosystems and aquatic communities, and could eliminate some of our threatened and endangered species that are restricted in distribution. The respondents also stated that the United States has a well-documented history of adverse consequences to native species due to the introduction of other nonnative species.

Response: The Service agrees with the respondents' comments on these issues. The biological characteristics of snakehead fishes and their potential to be injurious to the wildlife and wildlife resources of the United States is the basis for our decision to add snakeheads to the list of injurious fishes under the Lacey Act.

Issue 8: Two respondents stated that the fines are too lenient compared to the potential ecological devastation caused by the potential establishment of snakeheads.

Response: The Secretary of the Interior has the authority under the Lacey Act to add species to the injurious wildlife list, but the Secretary does not have the authority to change the penalties. The penalties are established by statute and can be changed by an act of Congress.

Issue 9: Three respondents stated that the prohibition on importation and interstate transportation of snakehead fishes would not significantly impact the aquarium industry. They also stated that the humane disposition of snakeheads will be encouraged.

Response: The Service is pleased that this action will not result in significant financial losses to aquarium fish producers, wholesalers, and retailers. We are also encouraged that the respondents are willing to proactively promote the humane disposal of the fishes, thereby reducing the risk that they would be introduced into the environment.

Issue 10: Three respondents stated that they are opposed to listing the family Channidae by simply referring to ''Channidae'' because the taxonomy is not clear and not all people are

conversant with scientific names. The respondents suggested we revise 50 CFR 16.13 to resemble a list instead of a paragraph, and that we include the genus, species, and common names of all currently recognized snakehead species, as well as the family name.

Response: We have accepted this suggestion and made the changes in this rule. We have also included synonyms for the *Channa* and *Parachanna* genera.

Issue 11: One respondent expressed concern that permits for importation and interstate transportation can be issued for medical purposes under the Lacey Act. The respondent indicated that permits should be granted only to accredited medical institutions.

Response: As described in 50 CFR 16.22, the Director of the Fish and Wildlife Service may issue permits for the importation and interstate transportation of injurious species only for scientific, medical, educational, or zoological purposes. Persons or institutions wishing to apply for a permit must meet the application requirements, additional permit conditions, and issuance criteria as set forth in 50 CFR 16.22. Permits are issued only to legitimate individuals and/or institutions for medical research, scientific, zoological, or educational purposes.

Description of the Final Rule

The regulations contained in 50 CFR part 16 implement the Lacey Act (18 U.S.C. 42) as amended. Under the terms of that law, the Secretary of the Interior is authorized to prohibit by regulation certain activities involving wild mammals, wild birds, fish (including mollusks and crustaceans), amphibians, reptiles, and the offspring or eggs of any of the foregoing that are injurious to human beings, to the interests of agriculture, horticulture, or forestry, or to the wildlife or wildlife resources of the United States. The lists of injurious wildlife species are at 50 CFR 16.11 to 16.15. By adding snakehead fishes to the list of injurious wildlife, their importation into, and transportation between, States, the District of Columbia, the Commonwealth of Puerto Rico, or any territory or possession of the United States by any means whatsoever is 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 without a permit solely for their own use, upon filing a written declaration with the District Director of Customs and the U.S. Fish and Wildlife Service Inspector at the port of entry. No live snakehead fish, progeny thereof, or viable eggs imported or transported under a permit may be sold, donated, traded, loaned, or transferred to any other person or institution unless such person or institution has a permit issued by the Director of the U.S. Fish and Wildlife Service. The interstate transportation of any live snakehead fish or viable eggs currently held in the United States for any purpose is prohibited without a permit.

Biology

Two genera of snakehead fishes are currently recognized in the family Channidae. They are *Channa* (snakehead fishes of Asia, Malaysia, and Indonesia) and *Parachanna* (African snakeheads). Synonyms include *Bostrychoides*, *Ophicephalus* and its misspelled form *Ophiocephalus*, and *Parophiocephalus*. Although 86 species and 4 subspecies have been described (Eschmeyer, 1998), current taxonomy is in flux with approximately 28 species recognized as valid (Musikasinthorn, 2001; Table 1). Because their morphology is very similar, it is very difficult to differentiate among species of snakeheads. Juvenile and adult color patterns are often quite different (Day, 1875; Lee and Ng, 1991, 1994), and some are quite variable in size and color, and may represent species complexes. A taxonomic revision of the family, expected to be published within the next two years, will likely result in additional species being recognized as valid and perhaps new species described.

TABLE 1.—CURRENTLY RECOGNIZED SPECIES OF THE FAMILY CHANNIDAE (AFTER MUSIKASINTHORN, 2000, 2001).

Channa amphibeus (McClelland, 1845)—no common name known.
Channa argus (Cantor, 1842)—northern snakehead.
Channa asiatica (Linnaeus, 1758)—Chinese snakehead.
Channa aurantimaculata Musikasinthorn, 2000—no English common name; naga-cheng (Assam, India).
Channa bankanensis (Bleeker, 1852)—Bangka snakehead.
Channa baramensis (Steindachner, 1901)—Baram snakehead.
Channa barca (Hamilton, 1822)—barca snakehead.
Channa bleheri Vierke, 1991—rainbow snakehead.
Channa cyanospilos (Bleeker, 1853)—bluespotted snakehead.
Channa gachua (Hamilton, 1822)—dwarf snakehead.
Channa harcourtbutleri (Annandale, 1918)—Inle snakehead.
Channa lucius (Cuvier, 1831)—splendid snakehead.

TABLE 1.—CURRENTLY RECOGNIZED SPECIES OF THE FAMILY CHANNIDAE (AFTER MUSIKASINTHORN, 2000, 2001).—Continued

Channa maculata (Lacepéde, 1802)—blotched snakehead.
Channa marulius (Hamilton, 1822)—bullseye snakehead.
Channa maruloides (Bleeker, 1851)—emperor snakehead.
Channa melanoptera (Bleeker, 1855)—no common name known.
Channa melasoma (Bleeker, 1851)—black snakehead.
Channa micropeltes (Cuvier, 1831)—giant snakehead.
Channa nox (Zhang, Musikasinthorn, and Watanabe, 2002)—no English common name.
Channa orientalis Schneider, 1801—Ceylon snakehead.
Channa panaw Musikasinthorn, 1998—no English common name; ng panaw (Myanmar).
Channa pleurophthalmus (Bleeker, 1851)—ocellated snakehead.
Channa punctata (Bloch, 1793)—spotted snakehead.
Channa stewartii (Playfair, 1867)—golden snakehead.
Channa striata (Bloch, 1797)—chevron snakehead.
Parachanna africana (Steindachner, 1879)—Niger snakehead.
Parachanna insignis (Sauvage, 1884)—Congo snakehead.
Parachanna obscura (Günther, 1861)—African snakehead.

Snakehead fishes have distinctive morphological features as follows: Long, almost cylindrical body; long dorsal and anal fins, and all fins supported only by rays; most with large scales on head, somewhat similar to the large epidermal scales on the heads of snakes (hence the common name, snakeheads); eyes dorsolateral (back and side) and located on the anterior portion of the head; tubular, anterior nostrils; pectoral and caudal fin margins rounded; large mouth with protruding lower jaw; lower jaw always toothed, and prevomer and palatines often toothed; some lower jaw teeth canine-like, and canines present or absent on prevomer and palatines; most species with pelvic fins present; and ventral aorta typically divided into two portions, one serving the gills and the other the suprabranchial (above the gills) chambers. Suprabranchial chambers of *Channa* are non-labyrinthic (complex system of paths/tunnels), and made up of two plates, one formed by the first epibranchial (above the gills), the second from the hyomandibular; those of *Parachanna* consist of a single cavity with elements from the epibranchial of the first gill arch and hyomandibular absent.

Two larger snakehead species, *Channa marulius* and *C. maruloides,* superficially resemble the native bowfin, *Amia calva,* in that all three are elongated fishes, have long dorsal fins, tubular nostrils, and an ocellus (eyespot) at the base of the upper portion of the caudal fin. The bowfin, however, has its pelvic fins in a more abdominal rather than thoracic or anterior-abdominal position, and the anal fin is not elongated. Moreover, the bowfin does not have a rosette (circular arrangement) of enlarged scales on top of the head.

Species and species complexes of the genus *Channa* are native from southeastern Iran and eastern Afghanistan eastward through Pakistan, India, southern Nepal, Bangladesh, Myanmar (Burma), Thailand, Laos, Malaysia, Sumatra, Indonesia, and China northward into Siberia. Of the currently recognized 25 species of *Channa,* 9 species and representatives of 4 species complexes occur in peninsular Malaysia, Sumatra, and/or Indonesia. Of the same 25 species, 16 species and members of 5 species complexes are tropical to subtropical; members of three species complexes are temperate; and one species is temperate to boreal and can live beneath ice in the northern portion of its range. The three species of *Parachanna* are native to Africa and are tropical.

Snakeheads are considered as non-ostariophysan primary freshwater fishes (Mirza, 1975, 1995), meaning they have little or no tolerance for seawater. Habitat preferences vary by species or species complex, with a majority occurring in streams and rivers. Others occur in swamps, rice paddies, ponds, and ditches. All can tolerate hypoxic (low oxygen) conditions because they are airbreathers from late juvenile stages. Where known, pH range varies by species with one (*Channa bankanensis*) preferring highly acidic (pH 2.8–3.8) waters. At least three species are tolerant of a wide pH range; *C. gachua, C. punctata,* and *C. striata* survived for 72 hours at pH levels ranging from 4.25 to 9.4 (Varma, 1979).

Spawning seasons vary by species. While information on reproductive biology of many species is lacking, several conclusions can be drawn from those for which this information is available. Breeding in several species occurs primarily in summer months (June through August), and in at least two (the *Channa striata* species complex and *C. punctata*), breeding pairs can be found throughout the year. Some species spawn twice each year. Okada (1960) reported that female northern snakeheads, *C. argus,* are capable of spawning five times per year. There are several reports that when snakeheads pair, the pair remains monogamous for a spawning season, perhaps longer, but a pair may not mate for life.

Snakehead fishes build nests by clearing a generally circular area in aquatic vegetation, often weaving the removed vegetation around the centrally cleared area. This results in a vertical column of water surrounded by vegetation. One species (*C. punctata*) prepares elaborate tunnels through vegetation leading into the nest column. At time of spawning, the male and female move upward into the central region of the nest column. The male entwines his body around that of the female, with some species appearing to ''dance'' in the water column as eggs are released and fertilized (Breder and Rosen, 1966; Ng and Lim, 1990). Eggs are buoyant, rising to the surface of the nest column, where they are vigorously guarded by one or both parents. Snakeheads in two species complexes (*C. gachua* and *C. orientalis*) are mouthbrooders, with the male being the mouthbrooder of fertilized eggs and, later, fry. Most snakehead fishes, however, are not mouthbrooders, but one or both parents guard their young vigorously; one species (*C. micropeltes*) reportedly attacked and in some instances killed humans who approached the mass of young (Kottelat, 1993). Thus, parental care, whether by mouthbrooding or guarding, is a behavioral characteristic of snakehead fishes. Successful spawning in the absence of vegetation has also been reported for three species of snakeheads (Parameswaran and Murgesan, 1976b).

Fecundity and early development: There is limited information on fecundity (capacity to produce offspring) except for those snakehead fishes of commercial importance. Nevertheless, that information shows a pattern that likely applies to the entire family Channidae. Smaller species, such as *Channa gachua* and *C. orientalis,* produce few oöcytes or unfertilized ''eggs'' (about 20 when sexual maturity is first reached and later up to 200; Lee and Ng, 1991, 1994). Both are considered to be ''species complexes'' and one or both ''species'' contain mouthbrooding adults; low fecundity is a general rule among mouthbrooding fishes (Breder and Rosen, 1966). Fecundity increases greatly in larger snakehead species and appears to follow increasing body length. For example, Quayyum and Quasim (1962) recorded fecundity ranging from 2,300 to 26,000 oöcytes for *C. striata,* increasing in number with increasing body length. The bullseye snakehead, *C. marulius,* the largest species of snakehead, has been reported to produce approximately 40,000 oöcytes (Jhingran, 1984). Frank (1970) reported that the northern snakehead, *C. argus,* produced approximately 50,000 oöcytes. Frank's data came from Nikol'skiy (1956) who recorded fecundity of 22,000 to 51,000 in northern snakehead from the Amur basin. Dukravets and Machulin (1978) gave fecundity rates of 28,600 to a high of 115,000 for northern snakehead (probably from Yangtze River stock) introduced to the Syr Dar'ya basin of Turkmenistan/Uzbekistan. They also noted that, although the growth of northern snakehead is slower than that reported for this species from the Amur basin, growth rates from both stocks become equal once sexual maturity is reached.

Oöcytes, when released from the female parent, are small, ranging from approximately 1 mm to slightly over 2 mm in diameter, depending on species. Fertilization takes place by the male releasing milt (sperm) on the oöcytes (or eggs) as they emerge from the female. Eggs contain an oil droplet within the yolk mass, which causes them to rise to the surface. Development time to hatching varies with water temperature and, to a lesser extent, with the species involved. For example, hatching occurred in 54 hours at 16–26°C and 30 hours at 28–33°C in *Channa punctata* (Khan, 1924). In the northern snakehead, *C. argus,* eggs hatch in 28 hours at 31°C, 45 hours at 25°C, and 120 hours at 18°C.

Early life history: In general, newly hatched fry, depending on species, are about 3.0—3.5 mm in length. Following yolk absorption, snakehead fry begin feeding on zooplankton. Fry typically remain together until they reach early juvenile stage, guarded by one or both adults, or until they can fend for themselves (Lee and Ng, 1994). Late juveniles of the giant snakehead, *Channa micropeltes,* school and feed in packs (Lee and Ng, 1991). Although there are few reports of early life history except for species of commercial importance, it appears that, as larval snakeheads mature to early juvenile stages, the diet changes to small crustaceans and insects, particularly insect larvae. Presence of phytoplankton, plant material, and detritus in the digestive system of young snakeheads, as well as adults, appears to occur from incidental ingestion.

Respiration and overland migrations: Snakeheads are highly evolved airbreathing teleostean (bony) fishes, and many are capable of overland migration by wriggling motions (Lee and

Ng, 1991; Berra, 2001). They possess suprabranchial (above the gills) chambers for aerial respiration, and the ventral aorta is divided into two portions to permit bimodal (aquatic and aerial) respiration (Das and Saxena, 1956; Graham, 1997). The suprabranchial chambers become functional during the juvenile stage of growth (Graham, 1997), following which some species of snakehead fishes are obligate (limited, bound to a restricted environment) and others are facultative (optional, ability to live under varied conditions) airbreathers. In *Channa,* the chambers open into the pharynx through inhalent openings. The chamber lining contains respiratory ''islets'' with vascular papillae. The chambers can be filled with air or water. In addition, in *C. striata,* there are also vascular structures in the mouth and pharynx that can be utilized for respiration; these, however, can be retracted into depressions to prevent damage when feeding (Munshi and Hughes, 1992).

Some channids, perhaps all, have a circadian rhythm in oxygen uptake. *Channa marulius,* for example, showed a peak in oxygen uptake at night. *C. striata* and *C. gachua* peaked in early night hours, and *C. punctata* at dusk (Munshi and Hughes, 1992). Munshi and Hughes (1992) attributed these rhythms to evolution in swamp ecosystems (*i.e.*, the rhythm is a property of the ecosystem).

It is unknown how many species of snakehead fishes are capable of overland migrations, but several are known to do so. These migrations from drying habitats in search of those with water are probably driven by instinctive behavior. Overland migrations likely apply to those species whose native range is subject to seasonal dry/wet (or monsoonal) conditions (encompassing much of western to southeastern Asia, where a majority of snakehead species exist).

Hypoxic survival: Snakehead fishes are either obligate or facultative airbreathers. Therefore, survival in hypoxic waters is not problematic to these fishes. When prevented from access to the surface, some adult snakeheads will drown due to lack of oxygen (Day, 1868, Lee and Ng, 1991). Moreover, snakeheads can remain out of water for considerable periods of time as long as they remain moist. Some snakeheads, especially *Channa striata,* can bury themselves in mud during times of drought (Smith, 1965). They are known to secrete mucus that helps to reduce desiccation and facilitates cutaneous breathing (Mittal and Banerji, 1975; Lee and Ng, 1991).

Fishers in Thailand are aware of this habit and, during drought periods, will slice into the mud until they locate the fish (Smith, 1965).

For larger species of snakeheads such as *Channa marulius,* young are facultative airbreathers and adults are obligate breathers (Wee, 1982), but all species are airbreathers.

Lifespan: No specific information on lifespan can be found in the literature. Nevertheless, one species (*C. marulius*) is reported to reach a total length of 1.8 meters in Maharashtra State, India (Talwar and Jhingran, 1992), indicating a relatively long lifespan. Smaller snakeheads, such as members of the *C. gachua* and *C. orientalis* species complexes, may not live for more than a few years. Most larger snakeheads are reported to reach sexual maturity in two years, after which growth slows but fecundity increases with increasing size.

Feeding habits: There are few studies of feeding habits of snakeheads. For those species studied, following yolk-sac absorption, snakehead fry feed mostly on zooplankton. As juveniles, they feed on insect larvae, small crustaceans, and fry of other fishes (Munshi and Hughes, 1992). What is universal in reports of adult feeding habits is that snakeheads are predators with many species showing a preference for other fishes, although they may also consume crustaceans, frogs, smaller reptiles, and larger species may sometimes consume birds and small mammals. Under conditions of food deprivation, snakeheads can become cannibalistic on their own young. The piscivorous (fish-eating) nature of snakeheads has led to the use of some species (*C. striata* and *C. micropeltes* in particular) to control tilapia populations in aquaculture.

Associated diseases and parasites: Investigations of diseases and parasites of snakeheads concentrate on those species of importance in aquaculture. Bykhovskaya-Pavlovskaya *et al.* (1964) cited *Channa argus* as hosting 18 parasite species (Table 2). Two of the same parasites listed by Bykhovskaya-Pavlovskaya *et al.* (1964) were reported from the digestive tracts of northern snakehead from Kyungpook Province, Korea, from 115 specimens collected between 1995 and 1997. The trematode *Azygia hwangtsinyi* was found in 47% of the samples and the nematode *Pingis sinensis* in 73%.

TABLE 2.—PARASITES OF NORTHERN SNAKEHEAD, *Channa argus* (ADAPTED FROM BYKHOVSKAYA-PAVOLOVSKAYA ET AL. (1964)

Parasite	Group	Host issues	Other fishes affected
Myxidium ophiocephali	Myxosporidia	Gall bladder, liver ducts.	
Zschokkella ophiocephalli	Myxosporidia	Kidney tubules.	
Neomyxobolus ophiocephalus	Myxosporidia	Gill filaments.	
Mysosoma acuta	Myxosporidia	Gill filaments	crucian carp.
Myxobolus cheisini	Myxosporidia	Gill filaments.	
Henneguya zschokkei?	Myxosporidia	Gills, subcutaneous, musculature.	salmonids (tubercle disease of salmonids).
Henneguya ophiocephali	Myxosporidia	Gill arches, suprabranchial chambers.	
Henneguya vovki	Myxosporidia	Body cavity.	
Thelohanellus catlae	Myxosporidia	Kidneys.	
Gyrodactylus ophiocephali	Monogenoidea	Fins.	
Polyonchobothrium ophiocephalina	Cestoidea	Intestine.	
Cysticercus Gryporhynchus cheilancristrotus	Cestoidea	Gallbladder, intestine	cyprinids, perches.
Azygia hwangtsiüi	Trematoda	Intestine.	
Clinostomum complanatum	Trematoda	Body cavity	perches.
Pingis sinensis	Nematoda	Intestine.	
Paracanthocephalus curtus	Acanthocephala	Intestine	cyprinids, esocids, sleepers, bagrid catfishes.

TABLE 2.—PARASITES OF NORTHERN SNAKEHEAD, *Channa argus* (ADAPTED FROM BYKHOVSKAYA-PAVOLOVSKAYA ET AL. (1964)—Continued

Parasite	Group	Host issues	Other fishes affected
Paracanthocephalus tenuirostris	Acanthocephala	Intestine.	
Lamproglena chinensis	Copepoda	Gills.	

Literature on parasites of snakeheads includes numerous descriptions of new species, not detailed herein, but indicates that most studies concentrate on cultured fishes such as Channa argus, C. punctata, and C. striata. The potential threat of these parasites to native North American fishes has yet to be examined.

A disease that received broad attention is epizootic ulcerative syndrome (EUS) that causes high mortality in snakeheads, particularly *Channa striata* and *C. punctata* under intensive culture. EUS involves several pathogens, including motile aeromonad bacteria (*e.g., Aeromonas hydrophila, A. caviae, Pseudomonas fluorescens;* Prasad *et al.*, 1998; Qureshi *et al.*, 1999), a fungus *Aphanomyces invadans* (considered a primary pathogen; Mohan *et al.*, 1999; Miles *et al.*, 2001), and perhaps a rhabdovirus (Kanchanakhan *et al.*, 1999; Lio-Po *et al.*, 2000). Another bacterium, *Aquaspirillum* sp., has also been implicated in the disease (Lio-Po *et al.*, 1998). EUS may have originated in India in the 1980s, but has since been found in Pakistan, Thailand, and the Philippines with outbreaks reported from all these areas during the 1990s. Snakeheads are not the only fishes affected by this disease. It is also known to occur in airbreathing catfish (*Clarias*), the bagrid catfish genus *Mystus,* two cyprinid genera (*Cyprinus* and *Puntius*), mastacembalid eels (*Mastacembalus*), and the nandid genus *Nandus* in India (Mukherjee, 1998). In Thailand, it has been found in giant gourami (*Osphronemus gouramy*) and climbing perch (*Anabas testudineus*) during an outbreak in 1996–1997 (Kanchanakhan *et al.*, 1999).

History of introduction in the United States: Four species of snakeheads (*Channa argus, C. marulius, C. micropeltes,* and *C. striata*) have been recorded from open waters of the United States (California, Florida, Hawaii, Maine, Maryland, Massachusetts, and Rhode Island), and two have become established as reproducing populations. At least 16 States prohibit possession of live snakeheads (Alabama, Arkansas, California, Colorado, Florida, Georgia, Idaho, Kentucky, Mississippi, Nevada, North Carolina, Oregon, Pennsylvania, Texas, Utah, and Washington), and illegal activity, confiscations, citations, or investigations have occurred in six of those States within the past two years (Alabama, California, Florida, Kentucky, Texas, and Washington).

Florida: An established population of the bullseye snakehead, *Channa marulius,* was discovered in residential lakes and adjoining canals in Tamarac, Broward County, Florida, in 2001 (Florida Fish and Wildlife Conservation Commission, 2001). It is unknown how long this species has occupied these waters, perhaps several years, but both juveniles and adults have been collected, which indicates reproductive success. This species is the largest of snakeheads, with adults commonly reaching lengths of 120–122 cm (Talwar and Jhingran, 1992). Researchers have reported that in Maharashtra State, India, this species can reach a length of 1.8 m and a weight of 30 kg (Talwar and Jhingran, 1992). A length of 30 cm can be reached in one year (Talwar and Jhingran, 1992). The pathway of the introduction to Florida is unknown. The species may have escaped from a fish farm (although there are none known in Tamarac), been purposefully introduced to establish a food or aquarium fish resource, or they may have been introduced by aquarists. Tamarac is located just east of Water Conservation Area II, north of Everglades National Park, and interconnected canal systems lead into this area. Nevertheless, there are water control structures on canals leading into Water Conservation Area II that would have to be open to allow this snakehead access to that area. It is likely that *C. marulius* will expand its range in peninsular Florida as its native range includes tropical to temperate climates. The bullseye snakehead is considered predacious (Jhingran, 1984; Talwar and Jhingran, 1992), especially on other fishes (Schmidt, 2001).

The northern snakehead, *Channa argus,* is also reported from Florida waters. Two individuals were caught in the St. Johns River below Lake Harney, Seminole and Volusia counties, in 2000. Unconfirmed reports indicate three additional individuals having been caught nearby. An attempt to collect additional specimens by U.S. Geological Survey (USGS) personnel by electroshocking was unsuccessful, but will be repeated in 2002. Until reproduction has been confirmed, the species is considered present but not established. This species is not involved in the aquarium fish trade, but is sold in live food fish markets as a food fish. The most likely pathway is introduction of live food fish, perhaps to establish a local source. The northern snakehead is sold in live food fish markets and some restaurants in Boston and New York, where snakeheads are legal. Live *C. argus* were confiscated in Washington (100 individuals, alive on ice, destined for the international district of Seattle), a market in Houston, Texas (Howells *et al.*, 2002), markets in Miami and Plantation, southeastern Florida, in 2001, and in Orlando, Florida, in March 2002, all indications of the availability of this species in States where possession is illegal. Moreover, a few U.S. aquarium fish retailers sell snakeheads via the Internet. USGS scientists purchased three species from a reputable dealer in Rhode Island, who first requested a copy of the State permit that allowed USGS to possess the fish in Florida. Private purchases can also be made through several Internet ''chat rooms'' where possession of permits is not discussed.

California: California Department of Fish and Game personnel collected a snakehead while electrofishing in a reservoir, Silverwood Lake, in 1997. Silverwood Lake is in the Mohave River drainage, east-northeast of Los Angeles and north of San Bernardino in the San Bernardino Mountains. The specimen was subsequently frozen and later discarded (Camm Swift, pers. comm.). It was identified as *Channa argus* (John Sunada, pers. comm. to W.R. Courtenay, Jr.). It is believed that the fish got in the lake from the California Aqueduct that runs from the San Joaquin River south of Stockton into Lake Silverwood, one of several reservoirs that serves Los Angeles.

Hawaii: The chevron snakehead, (*Channa striata*) has been established on Oahu, Hawaii, since the late 1800s and was introduced from southern China (Herre, 1924). For whatever reasons, it does not appear to have been introduced to other waters of Hawaii and is confined to reservoirs on Oahu (Maciolek, 1984). In addition, the

species is now being cultured as a food fish on Oahu. This species is regarded as carnivorous with a preference for other fishes (Moshin and Ambak, 1983; Conlu, 1986). Lee and Ng (1991) described it as a territorial ambush feeder. It is also used to control tilapia populations in the Philippines (Conlu, 1986).

Maryland: Two adults and eight juveniles of *Channa argus* were found in a pond in Crofton, Anne Arundel County, Maryland in late June and early July 2002. Maryland Department of Natural Resources personnel captured over 100 juveniles from the pond in July 2002. The adults are known to have over-wintered in the pond. The fish were purchased from a live food fish market in New York City, transported to Maryland, and kept in an aquarium, and two fish were released into the pond in 2000. This species appears to be the most common snakehead available in food markets and restaurants as a live food fish.

New England States: A specimen of the northern snakehead, *Channa argus,* was collected in October 2001 from Newton Pond, Sudbury, Worcester County, Massachusetts, by Massachusetts Department of Fish and Wildlife personnel. The likely source is from live food fish markets. It is capable of establishment in most fresh waters of the United States. Okada (1960) reported adults as voracious feeders, particularly on other fishes.

Specimens of the giant snakehead, *Channa micropeltes,* have been collected from open waters in Maine, Massachusetts, and Rhode Island (Courtenay et al, 1984; Fuller *et al.*, 1999). This tropical/subtropical species could not become established in those temperate waters. Juveniles of the species are cardinal red with two dark stripes on either side of the body, and sold by aquarium fish retailers as red or redline snakeheads. Aquarist-oriented web sites note that this species requires much animal food and that growth is rapid. These sites often advise that, once these fish reach approximately 15–20 cm in length, no more than one individual should be kept in a single aquarium because they are aggressive predators. The pathway into these New England States was likely aquarists who released their ''pets'' when they grew too large for their aquaria and/or because it was too costly to feed them. Releases of this species into subtropical waters in southern Florida or Hawaii could lead to establishment of this snakehead, regarded as the most predaceous channid and known to have attacked humans (Ng and Lim, 1990; Lee and Ng, 1991; Kottelat *et al.*, 1993).

Uses: According to U.S. Fish and Wildlife Service Law Enforcement data, 16,554 individuals or 20,527 kilograms of all species of snakeheads were imported into the United States between 1997 and 2000 at a declared value of $85,425 (records of imports report numbers of individual fish OR weight in kilograms). Importations of snakeheads into the United States do not appear to represent a significant portion of live fish imports at present. However, from the raw data, it is clear that the trend has been upward in recent years.

Snakeheads have been imported into the United States for two purposes: as aquarium fish and for use as food. In Southeast Asia, particularly in Thailand and Malaysia, and to a lesser extent in Japan, there are developing recreational fisheries for the larger snakehead species (see *http://www.fishingasia.com* as an example).

Several species of snakeheads are listed on aquarium fish websites. Some of these entries are for information purposes and a few others list fish for sale. The most popular species are, in order of importance and availability: *Channa micropeltes,* juveniles sold as red or redline snakehead; *C. marulius,* juveniles sold as cobra snakehead; *C. bleheri,* sold as rainbow snakehead; *C. barca* sold as barca or tiger snakehead; *C. gachua* sold under a variety of names; and *Parachanna africana,* juveniles sold as African snakehead. Some are cultured and others are captured from the wild. Rarely does one see listings for *C. asiatica, C. orientalis, C. pleuropthalma, C. punctata,* or *C. stewartii.* This is somewhat surprising because several are attractive aquarium fishes, and they can be purchased from dealers in southeast Asia via the Internet. *Channa bleheri, C. gachua,* and *C. orientalis* are small snakeheads, unlike *C. micropeltes* and *C. marulius* that grow quickly to large sizes. All but the smallest snakeheads are unsuitable for community tanks, and even they may kill other fishes in aquaria. Larger snakeheads require very large aquaria and must be kept alone. The number of aquarium hobbyists interested in keeping snakeheads appears to be small, and snakeheads represent a minor component in the aquarium fish industry (Marshall Myers, pers. comm. to J.D. Williams).

Conversely, use of snakeheads as food fishes is growing in the United States (Table 3). Live snakeheads of the larger species can be purchased in live food fish markets and in some restaurants in States where these fishes are not prohibited, but they are also appearing in markets in States where possession is prohibited (Howells *et al.*, 2002). Some restaurants display live snakeheads in aquaria, a common practice where these fishes are native, allowing customers to choose a fish to be prepared for a meal. This is reminiscent of many U.S. seafood restaurants where one can select a lobster to be cooked from an aquarium.

During FY 1999, the USDA Small Business Innovation Research Program funded a Phase II project to the Hawaii Fish Company of Waialua, Hawaii, to develop commercial culture of the chevron snakehead, *Channa striata.* It is now being cultured in Hawaii as a food fish.

TABLE 3.—SPECIES OF THE FAMILY CHANNIDAE CURRENTLY KNOWN TO BE CULTURED FOR FOOD AND/OR AQUARIUM FISH TRADE

*Channa argus***
Channa marulius
Channa punctata
Parachanna africana
Channa maculatus
*Channa micropeltes****
*Channa striata**
Parachanna obscura

* Species most widely cultured for food. Also being cultured in Hawaii.

** Second most important species cultured for food.

*** Appears to be the most important species cultured for the aquarium fish trade.

Although several snakehead species may be found for sale alive in live food fish markets, the most available species is the northern snakehead, *Channa argus.* It is being sold in Boston and New York City, where snakeheads are legal. Through confiscation by State fish and game personnel in 2001, it has also been found in the live food fish trade of three States (Florida, Texas, and Washington) where possession of snakeheads is prohibited. The northern snakehead is able to tolerate a considerable temperature range, from warm temperate to boreal climates, where this species can live under ice. Additionally, its airbreathing capabilities enhance its transport and marketing. Marketing and customer preferences, however, are not synonymous. For example, persons of southeastern Asian descent prefer chevron snakehead, *C. striata,* above any other species. It is currently being cultured in much of southeastern Asia, the Philippines, and Hawaii.

Potential Range: Temperature is the most important environmental factor that would determine potential range of snakeheads in the United States. Because there are few data providing thermal tolerance ranges for snakeheads, potential range must be inferred from

distribution within native ranges. The family Channidae contains nine species that are strictly tropical, and if introduced, would survive in the warmest waters such as extreme southern Florida, perhaps parts of southern California, Hawaii, and certain thermal spring systems and their outflows in the American west. Another four can be considered tropical to subtropical, indicating a similar potential range of distribution as for tropical species but with a greater likelihood of survival during cold winters and more northward limits. One is subtropical. Another 12 (4 of which appear to be species complexes) snakeheads can tolerate tropical or subtropical to warm temperate conditions, indicative of species that could survive in most southern States. One is warm temperate, and another warm temperate to cold temperate (*Channa argus* with a temperature range of 0–>30 °C).

In summary, there are few waters in the United States or territories of the United States that, based on temperature, would preclude some member(s) of the family Channidae from becoming established.

Factors That Contribute to Injuriousness

The likelihood of release or escape of snakeheads is high. One species, *Channa striata*, was released and became established in waters of Oahu, Hawaii, before 1900. It was likely introduced as a food fish. A second species, *Channa marulius,* is a recent introduction to southeastern Florida (Broward County) and has also become established. The pathway for this introduction was release of either food or aquarium fish. Two specimens of *Channa argus* were caught in the St. Johns River near Sanford, Florida, and three more are believed to have been caught at or near the same location. This species is available only through live food fish markets. The same species was captured from a pond in central Massachusetts in October 2001. The snakehead captured in Lake Silverwood, California, was also *C. argus.* Two adults and eight juveniles of *C. argus* were collected from a pond in Crofton, Maryland, in June and July 2002. Individual specimens of *Channa micropeltes* were caught in Maine, Massachusetts, and Rhode Island in past years, the source of which were most likely aquarium fish releases. The availability of 8 species of snakehead fishes in live food fish markets and the aquarium trade raises the probability that one or more species will be released into open water. As demonstrated by the documented discoveries of both aquarium and food fish species of snakeheads in the wild, there is a high likelihood that snakeheads would escape or be released.

If snakeheads escaped, or were released into the wild, the likelihood that they would survive and/or become established with or without reproduction is dependent upon the species of snakehead involved and the location of the release. The family Channidae contains 9 species that are strictly tropical, 4 can be considered tropical to subtropical, one is subtropical, 12 can tolerate tropical or subtropical to warm temperate conditions, one is warm temperate, and one is warm temperate to cold temperate. The tropical species would survive in the warmest waters such as extreme southern Florida, perhaps parts of southern California, Hawaii, and certain thermal spring systems and their outflows in the American west. The tropical to subtropical species would have a similar potential range of distribution as for tropical species but with a greater likelihood of survival during cold winters and more northward limits. The tropical or subtropical to warm temperate species could survive in most southern States. The warm temperate, and warm temperate to cold temperate, species could survive in most areas of the United States.

That *Channa striata,* a tropical to warm temperate species cultured for the live food trade, has been established for over a century in Hawaii and, more recently, *C. marulius,* a tropical to warm temperate species cultured for the aquarium trade, has become established as a reproducing population in southeastern Florida is indicative of the likelihood of survival and potential for establishment of snakehead fishes. Although *C. striata* is largely confined to reservoirs on Oahu, *C. marulius* has ample opportunity to expand its range in southeastern Florida through the large network of interconnected canals and Water Conservation Areas to the west of the metropolitan areas. The release of live food or aquarium fishes is a viable pathway for introduction of snakehead fishes and, depending on temperature, many species could become established from Florida to or above the U.S.-Canadian border and in many territories of the United States.

The likelihood and magnitude of spread would be high for all species within their thermal limits. Both the northern snakehead, *Channa argus,* and, to a somewhat lesser extent, the blotched snakehead, *C. maculata,* expanded their ranges of distribution from sites of initial introduction in Japan. Since introduction of the northern snakehead into the Aral Sea basin in the 1960s, there has been a dramatic range expansion in waters of Kazakhstan, Turkmenistan, and Uzbekistan. Range expansion also occurred in the Philippines following introduction of the chevron snakehead, *C. striata.*

Although there is limited information on the fecundity of snakeheads, scientific data indicate that fecundity increases greatly in larger snakeheads and follows increasing body length. According to Quayyum and Quasim (1962), fecundity for *C. striata,* a medium-sized snakehead species, ranges from 2,300 to 26,000 öcytes. Larger species, such as *C. marulius* and *C. argus* can produce 40,000 to 50,000 öcytes. Given that two individual northern snakeheads, *C. argus,* were reportedly released into the pond in Crofton, Maryland, and successfully reproduced two times in the summer of 2002, and that several species of snakeheads are known to have a high fecundity, there is a high likelihood that snakeheads would be capable of spreading within their thermal limits.

Several species of snakeheads, whose native ranges are subject to seasonal dry/wet conditions, are known to be capable of overland migrations. According to Peter Ng (pers. comm. to W.R. Courtenay, Jr.) some species can crawl sinuously on land, even dry land, from point to point. There are 2 main groups of snakeheads that are slow, but effective and directed, at overland migrations. One group, including *C. striata, C. micropeltes, C. asiatica* and *C. gachua,* has a more dorso-ventrally flattened body with a somewhat flatter belly and can crawl on land. The second group, including *C. argus, C. maculata* and *C. lucius,* has a more laterally compressed or rounded body and is not as successful at overland migrations. For those species that are not capable of overland migration, there is a high likelihood that they can be transferred to other water bodies through flooding if they are released into flood-prone areas. In summary, there are few waters in the United States or territories of the United States that, based on temperature, would preclude some member(s) of the family Channidae from becoming established and expanding their ranges through reproduction and/or overland migration.

At all life stages, snakeheads will compete for food with native species. As discussed above in the Biology section, snakehead fry feed on zooplankton; juveniles feed on insect larvae, small crustaceans, and fry of other fishes; and

adults are predators, feeding on other fishes, crustaceans, frogs, smaller reptiles (snakes, lizards), and sometimes birds (particularly young waterfowl) and mammals. Native fish and wildlife populations that prey upon fishes, crustaceans, frogs, snakes, lizards, and young waterfowl would face reductions resulting from the loss of food sources.

Although the literature on snakeheads does not include specific information on feeding habits of every species, what is universal for those species that have been studied in this respect is that fishes are an important component of snakehead diets. This can range, for example, from approximately 20–30% (*e.g., Channa gachua*) of the diet to well over 90% (*e.g., C. argus, C. micropeltes, C. striata*). Next in line to fishes, crustaceans (particularly shrimp, etc.) form a substantial dietary component for snakeheads. Native fish populations in particular would likely be reduced through predation if snakeheads were introduced and became established in bodies of water. Through predation, ecosystem balance and predator-prey relationships could be modified drastically should snakeheads become established in waters with low diversity of native fishes and low abundance or absence of native predatory species. Therefore, the likelihood and magnitude of adverse impacts on native wildlife through competition for food and predation on native wildlife is high.

While the potential for snakeheads to transfer pathogens to native wildlife is largely unknown, all snakehead species examined are host to at least several species of parasites. At least two snakehead species, *Channa punctata* and *C. striata,* are susceptible to epizootic ulcerative syndrome (EUS), a disease believed to be caused by several species of bacteria, a fungus, and perhaps a retrovirus, under intensive culture conditions. EUS is not specific to snakeheads and has affected other fishes, such as clariid catfishes, bagrid catfishes, two cyprinid genera, mastacembalid eels, and a nandid fish in India; in Thailand, it has been found in giant gourami and climbing perch. Although there have been no studies undertaken to examine transfer of parasites or diseases from snakeheads to native North American fishes, there are numerous cases documented in the scientific literature where nonnative species have transferred diseases and pathogens to native species. Several of the parasites of northern snakeheads listed in Table 2 are known to affect salmonids, cyprinids, and percids. Therefore, there is a credible evidence on the potential for snakeheads to transfer pathogens to native fishes.

Due to the highly predatory nature of snakeheads, the likelihood and magnitude of effect on threatened and endangered species is high. Of all the taxa listed as endangered or threatened in U.S. aquatic habitats, 16 amphibians, 115 fishes, and 5 of the 21 crustaceans (the surface-dwelling crayfish and shrimp) would be the most likely to be affected. Based on habitat requirements and life history, fishes are more likely to be affected by introduced snakeheads than amphibians and the surface-dwelling crustaceans. Nonetheless, the possibility of an additional nonindigenous predator in the aquatic community with any listed amphibian or crustacean would constitute a threat.

In the western United States, habitat requirements of listed fishes range from steep-gradient, coldwater mountain streams, lower-gradient large desert rivers, to thermal (warm) springs in desert areas. Eastern fishes likewise occupy a variety of habitats, including springs, creeks, large rivers, and the Great Lakes. One or more species of snakeheads would be capable of living in any of the above habitats. Since all snakehead species prey on fish, to a greater or lesser extent, all of the fishes listed as endangered or threatened would be vulnerable to predation at some stage in their life history. The degree of threat would vary from extremely high for any species of snakeheads introduced in relatively small, isolated habitats, such as desert thermal springs and their outflows in the American southwest, to somewhat less in steep-gradient coldwater mountain streams. Based on the food habits and habitat preferences of snakeheads, it is likely to invade the habitat, feed on, and further threaten Federally listed freshwater fishes. Snakeheads are likely to also further threaten candidates for Federal protection.

The likelihood that one or more species may be placed in danger of extinction or become endangered within the foreseeable future as a result of introduction/establishment is high. The introduction of a small number of individuals (<5) into isolated spring habitats could result in the extinction of endemic spring-adapted fishes or crustaceans. The snakeheads would not have to establish a reproducing population to reduce or eliminate a fish or crustacean species confined to a small section of a stream or isolated spring habitat. Any snakehead that becomes established in a water body would represent a significant threat and could potentially push any listed amphibian, fish, or crustacean to extinction.

The likelihood and magnitude of ancillary wildlife resource damage due to control measures is high. Chemical control using rotenone or other similar toxins that work by preventing fish from removing oxygen from the water would likely be damaging to nontarget native organisms.

Only one species of snakehead, *Channa micropeltes,* a tropical/subtropical species, is reported to have attacked human beings. There have been reports of human deaths as a result. All such incidents apparently happened when humans approached a nest or group of young, and attacks were perpetrated by guarding adults. However, the likelihood and magnitude of direct impacts on human beings is low.

Factors That Reduce or Remove Injuriousness

The ability to eradicate or control snakehead populations depends on where they are found. However, there is no known method of removing all snakeheads following introduction. If established in large lakes or river systems, eradication and/or control are expected to be nearly impossible, and snakeheads would likely become permanent members of the fish community. Control in smaller water bodies depends upon the amount of vegetation, the accessibility to the water body, and the effectiveness of the control methods. Piscicides work by preventing fish from removing oxygen from the water. Chemical control using rotenone and similar toxins would likely be ineffective to airbreathing snakeheads and damaging to nontarget organisms except in closed situations. Electrofishing and netting may provide some level of control of snakehead populations; however, eradication using these methods would be too selective on size classes to remove a population of snakeheads. When a population is discovered, it is typically too late for removal unless the population is isolated.

Since effective measures to eradicate, manage, or control the spread of snakeheads once they are established are not currently available, the ability to rehabilitate or recover ecosystems disturbed by the species is low. Re-establishment of extirpated populations of native amphibians, fishes, and crustaceans, if biologically possible, would be labor and cost intensive and would depend on eradication of snakeheads within those habitats.

Conclusion

Because several species of snakehead fishes are available through the

aquarium, restaurant, and the live food fish trades, the likelihood that they would escape or be intentionally released into the wild is high. If they escape or are intentionally released, they are likely to survive or become established within their respective thermal limits. Because there are no known limiting factors, because some species have the ability to move across land, and because snakeheads have a fairly high reproductive potential, they are likely to spread once they are in the wild. Snakeheads fishes are likely to compete with native species for food, may transmit parasites to native species, and are likely to feed on native species, which will negatively affect native fishes, amphibians, crustaceans, birds, small reptiles, and small mammals. The air-breathing and mobile characteristics of snakeheads increase the difficulty in preventing, eradicating, managing, or controlling their spread. Because the successful removal of all individual snakeheads from a water body would be very difficult to accomplish, it will be very difficult rehabilitate or recover ecosystems disturbed by snakeheads. In conclusion, for the reasons stated above, the Service finds snakeheads to be injurious to the wildlife and wildlife resources of the United States.

Effective Date

We are making this rule effective upon publication. In accordance with the Administrative Procedure Act, we find good cause as required by 5 U.S.C. 553 (d)(3) to make this rule effective less than 30 days after publication in the **Federal Register**. Approximately 2.94 times more snakeheads were imported in July 2002 than in July 2001. Inspectors at ports of entry have noticed an increase in interest in importing snakeheads before the final rule becomes effective; some importers have told inspectors that they are trying to ''beat the ban'' and import as many snakeheads as possible before the prohibition on importation and interstate transportation is imposed. Because we have already documented a nearly three-fold increase in the importation of snakeheads from one year ago, and because of the increased interest in importing snakeheads before the final rule becomes effective, the Service believes that there will be a substantial and significant increase in the numbers of snakehead fishes imported and transported across State lines if this rule is effective 30 days after publication in the **Federal Register**. The increases in importations and interstate transportations during that 30-day period could result in a significant potential for damage to the wildlife and wildlife resources of the United States. As discussed previously in the preamble to this rule, snakehead fishes are highly predatory, are difficult to control, and are difficult to differentiate among species. Therefore, we believe that we have sufficient evidence and cause to take immediate action to prohibit further importation and interstate movement of the entire Channidae family of snakehead fishes.

Required Determinations

Paperwork Reduction Act

This rule contains information collection activity for special use permits. The Fish and Wildlife Service has approval from OMB to collect information under OMB control number 1018–0093. This approval expires March 31, 2004. The Service may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number.

Regulatory Planning and Review

In accordance with the criteria in Executive Order 12866, the Office of Management and Budget has determined that this rule is not a significant regulatory action.

(a) This rule will not have an annual economic effect of $100 million or adversely affect an economic sector, productivity, jobs, the environment, or other units of the government. A cost-benefit and economic analysis is not required.

The net economic effect of prohibiting the importation and interstate transportation of snakeheads is difficult to determine because of the minimal amount of data available for a relatively new species to the aquarium, live fish markets, and restaurant trades. There is a trade-off between damage avoided by not letting snakeheads get into U.S. water bodies and the economic benefits received by fish markets and aquarium owners who want to own the species. Since only $85,000 worth of snakeheads were imported during the four-year period between 1997 and 2000, and the potential damage by snakeheads if they get into U.S. waters would be in the millions of dollars from the loss of native species, including threatened and endangered species, this rule will have a net positive benefit. The dollar amount of imported and traded value is not the net economic value of this fish, but the relatively small value compared to environmental damage avoided by prohibiting these species is convincing that this rule will not have a major negative economic effect.

(b) This rule will not create inconsistencies with other agencies. This rule pertains only to regulations promulgated by the Fish and Wildlife Service under the Lacey Act. No other agencies are involved in these regulations.

(c) This rule will not materially affect entitlements, grants, user fees, loan programs, or the rights or obligations of their recipients. This rule does not affect entitlement programs. This rule is aimed at regulating the importation and movement of nonindigenous species that have the potential to cause significant economic and other impacts on natural resources.

(d) This rule does not raise novel legal or policy issues. No previous listings of wildlife as injurious have raised legal or policy concerns.

Regulatory Flexibility Act and SBREFA

This rule will not have a significant economic effect on a substantial number of small entities as defined under the Regulatory Flexibility Act (5 U.S.C. 601 *et seq.*). A Regulatory Flexibility Analysis is not required. Accordingly, a Small Entity Compliance Guide is not required. The rule is not a major rule under 5 U.S.C. 804(2), the Small Business Regulatory Enforcement Fairness Act. This rule will not have an annual effect on the economy of $100 million or more, and does not have significant adverse effects on competition, employment, investment productivity, innovation, or the ability of U.S.-based enterprises to compete with foreign-based enterprises.

No individual small industry within the United States will be significantly affected if snakehead importation and interstate transport are prohibited. Live food fish markets, restaurants, and aquarium hobbyists are the entities most likely to be affected by this rule. The number of aquarium hobbyists interested in keeping snakeheads appears to be small, and snakeheads represent a minor component in the aquarium fish industry (Marshall Myers, pers. comm.. to J.D. Williams). With only 16,554 individual snakeheads imported over four years and most of these going to markets and restaurants for human consumption, the number of entities engaging in selling and buying these fish is very small. There is no recreational fishery for these species. The number of entities involved in the trade of these species is not known, but it is assumed to be very small because of the small number of these fish imported. This rulemaking will have the indirect effect of protecting native fishes, amphibians, and crustaceans from the intentional or accidental

introduction of snakeheads into U.S. water bodies. The snakeheads would likely devastate many native wildlife populations if introduced into a waterway. It is very unlikely that this rulemaking will affect a substantial number of small entities and those entities affected will not be significantly affected because of the very small numbers of these fish imported. This rulemaking, by protecting the environment from the spread of a nonnative species that would devastate native fishes, amphibians, and crustaceans, will indirectly work to sustain the economic benefits enjoyed by numerous small establishments engaged in the recreational fishing industry, among others.

This rule will not cause a major increase in costs or prices for consumers, individual industries, Federal, State, or local government agencies, or geographic regions. This rulemaking will not affect costs or prices for any fish species other than snakeheads. Once this rule is published, and importation and interstate movement are prohibited, the maximum loss would be approximately $22,000 per year to the few entities that deal in these species.

Unfunded Mandates Reform Act

In accordance with the Unfunded Mandates Reform Act (2 U.S.C. 1501 *et seq.*), the rule will not ''significantly or uniquely'' affect small governments. A Small Government Agency Plan is not required. The Service has determined and certifies pursuant to the Unfunded Mandates Reform Act that this rulemaking will not impose a cost of $100 million or more in any given year on local or State governments or private entities; will not produce a Federal mandate of $100 million or greater in any year and therefore, is not a ''significant regulatory action''.

Takings

In accordance with Executive Order 12630, the rule does not have significant takings implications. A takings implication assessment is not required. This rule will not impose significant requirements or limitations on private property use.

Federalism

In accordance with Executive Order 13132, the rule does not have significant Federalism effects. A Federalism assessment is not required. This rule will not have substantial direct effects on States, in the relationship between the Federal Government and the States, or on the distribution of power and responsibilities among the various levels of government. Therefore, in accordance with Executive Order 13132, we determine that this rule does not have sufficient Federalism implications to warrant the preparation of a Federalism Assessment.

Civil Justice Reform

In accordance with Executive Order 12988, the Office of the Solicitor has determined that the rule does not unduly burden the judicial system and meets the requirements of sections 3(a) and 3(b)(2) of the Executive Order. The rule has been reviewed to eliminate drafting errors and ambiguity, was written to minimize litigation, provides a clear legal standard for affected conduct rather than a general standard, and promotes simplification and burden reduction.

NEPA

We have reviewed this rule in accordance with the criteria of the National Environmental Policy Act and our Departmental Manual in 516 DM. This rule does not constitute a major Federal action significantly affecting the quality of the human environment. Since only 16,554 snakehead fishes were imported between 1997 and 2000 for a declared value of $85,000, the maximum annual loss to the few entities that deal in these species is estimated to be $22,000. Therefore, an environmental impact statement/assessment is not required. The action is categorically excluded under the Department's NEPA procedures (516 DM 2, Appendix 1.10), which apply to policies, directives, regulations, and guidelines of an administrative, legal, technical, or procedural nature; or the environmental effects of which are too broad, speculative, or conjectural to lend themselves to meaningful analysis and will be subject later to the NEPA process, either collectively or on a case-by-case basis.

Tribal Consultation

In accordance with the President's memorandum of April 29, 1994, ''Government-to-Government Relations with Native American Tribal Governments'' (59 FR 22951), Executive Order 13175, and 512 DM 2, we have evaluated potential effects on Federally recognized Indian tribes and have determined that there are no potential effects. This rule involves the importation and interstate movement of live snakeheads. We are unaware of trade in these species by Tribes.

Effects on Energy

On May 18, 2001, the President issued Executive Order 13211 on regulations that significantly affect energy supply, distribution, and use. Executive Order 13211 requires agencies to prepare Statements of Energy Effects when undertaking certain actions. Because this rule is intended to prevent the accidental or intentional introduction of snakeheads and the possible subsequent establishment of populations of these fish in the wild, it is not a significant regulatory action under Executive Order 12866 and is not expected to affect energy supplies, distribution, and use. Therefore, this action is a not a significant energy action and no Statement of Energy Effects is required.

References Cited

A complete list of all references cited in this rule is available upon request from the Division of Environmental Quality (see **FOR FURTHER INFORMATION CONTACT** section).

Authority

The Fish and Wildlife Service is issuing this final rule under the authority of the Lacey Act (18 U.S.C. 42).

List of Subjects in 50 CFR Part 16

Fish, Imports, Reporting and recordkeeping requirements, Transportation, Wildlife.

For the reasons discussed in the preamble, we amend part 16, subchapter B of chapter I, title 50 of the Code of Federal Regulations as set forth below.

PART 16—[AMENDED]

1. The authority citation for part 16 continues to read as follows:

Authority: 18 U.S.C. 42.

2. Amend § 16.13 by revising paragraph (a)(2) to read as follows:

§ 16.13 Importation of live or dead fish, mollusks, and crustaceans, or their eggs.

(a) * * *

(2) The importation, transportation, or acquisition of any of the species listed in this paragraph is prohibited except as provided under the terms and conditions set forth in § 16.22:

(i) Live fish or viable eggs of walking catfish, family Clariidae;

(ii) Live mitten crabs, genus *Eriocheir*, or their viable eggs;

(iii) Live mollusks, veligers, or viable eggs of zebra mussels, genus *Dreissena*; and

(iv) Any live fish or viable eggs of snakehead fishes of the genera *Channa* and *Parachanna* (or their generic synonyms of *Bostrychoides*, *Ophicephalus*, *Ophiocephalus*, and *Parophiocephalus*) of the Family Channidae, including but not limited to:

(A) *Channa amphibeus* (Chel or Borna snakehead).

(B) *Channa argus* (Northern or Amur snakehead).

(C) *Channa asiatica* (Chinese or Northern Green snakehead).

(D) *Channa aurantimaculata*.

(E) *Channa bankanensis* (Bangka snakehead).

(F) *Channa baramensis* (Baram snakehead).

(G) *Channa barca* (barca or tiger snakehead).

(H) *Channa bleheri* (rainbow or jewel snakehead).

(I) *Channa cyanospilos* (bluespotted snakehead).

(J) *Channa gachua* (dwarf, gaucha, or frog snakehead).

(K) *Channa harcourtbutleri* (Inle snakehead).

(L) *Channa lucius* (shiny or splendid snakehead).

(M) *Channa maculata* (blotched snakehead).

(N) *Channa marulius* (bullseye, murrel, Indian, great, or cobra snakehead).

(O) *Channa maruloides* (emperor snakehead).

(P) *Channa melanoptera*.

(Q) *Channa melasoma* (black snakehead).

(R) *Channa micropeltes* (giant, red, or redline snakehead).

(S) *Channa nox*.

(T) *Channa orientalis* (Ceylon or Ceylonese Green snakehead).

(U) *Channa panaw*.

(V) *Channa pleurophthalmus* (ocellated, spotted, or eyespot snakehead).

(W) *Channa punctata* (dotted or spotted snakehead).

(X) *Channa stewartii* (golden snakehead).

(Y) *Channa striata* (chevron or striped snakehead).

(Z) *Parachanna africana* (Niger or African snakehead).

(AA) *Parachanna insignis* (Congo, square-spotted African or light African snakehead).

(BB) *Parachanna obscura* (dark African, dusky, or square-spotted snakehead).

* * * * *

Dated: September 26, 2002.

Paul Hoffman,

Acting Assistant Secretary for Fish and Wildlife and Parks.

[FR Doc. 02–25337 Filed 10–3–02; 8:45 am]

BILLING CODE 4310–55–P

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

50 CFR Parts 600 and 660

[Docket No. 011231309–2090–03; I.D.092602B]

Fisheries off West Coast States and in the Western Pacific; Pacific Coast Groundfish Fishery; Annual Specifications and Management Measures; Trip Limit Adjustments; Correction

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

ACTION: Inseason trip limit adjustments and correction; request for comments.

SUMMARY: NMFS announces changes in the following trip limits for the Pacific Coast groundfish fisheries: limited entry groundfish trawl gear fisheries for minor slope rockfish, splitnose rockfish, DTS complex (Dover sole, thornyheads and sablefish), flatfish fisheries, widow rockfish, yellowtail rockfish, and the 'other fish' category; limited entry fixed gear fisheries for minor slope rockfish, splitnose rockfish, sablefish, minor nearshore rockfish, lingcod and the 'other fish' category; and open access fisheries for sablefish, minor nearshore rockfish, lingcod, and the 'other fish' category. Additionally, pink shrimp exempted trawl gear incidental groundfish landings limits are now listed in the open access trip limit table rather than just in the text at IV.C.(3) to ensure clarity. These actions, which are authorized by the Pacific Coast Groundfish Fishery Management Plan (FMP), will allow fisheries access to healthy groundfish stocks, prevent fisheries that are approaching their OY from exceeding their OY, and protect overfished and depleted stocks. With this inseason trip limit adjustment, NMFS also announces that the States of Washington and Oregon are implementing a declaration requirement for limited entry trawl vessels intending to fish with midwater trawl gear in the Darkblotched Rockfish Conservation Area (DBCA) north of 40°10′ N. lat. This document also contains a correction to the limited entry trawl gear trip limit for canary rockfish south of 40°10′ N. lat. to reflect the closure in the south that was effective July 1, 2002.

DATES: Effective 0001 hours local time October 1, 2002, until the 2003 annual specifications and management measures are effective, unless modified, superseded, or rescinded through a publication in the **Federal Register**.

ADDRESSES: Submit comments to D. Robert Lohn, Administrator, Northwest Region, NMFS, 7600 Sand Point Way NE, Seattle, WA 98115–0070; or Rod McInnis, Acting Administrator, Southwest Region, NMFS, 501 West Ocean Blvd, Suite 4200, Long Beach, CA 90802–4213.

FOR FURTHER INFORMATION CONTACT: Jamie Goen (Northwest Region, NMFS), phone: 206–526–6140; fax: 206–526–6736; and e-mail: jamie.goen@noaa.gov.

SUPPLEMENTARY INFORMATION:

Electronic Access

This **Federal Register** document is available on the Government Printing Office's website at: *http://www.access.gpo.gov/su_docs/ca/docs/aces/aces140.html.* Background information and documents are available at the NMFS Northwest Region website at: *http://www.nwr.noaa.gov/1sustfsh/gdfsh01.htm* and at the Pacific Fishery Management Council's website at: *http://www.pcouncil.org.*

Background

The Pacific Coast Groundfish FMP and its implementing regulations at 50 CFR part 660, subpart G, regulate fishing for over 80 species of groundfish off the coasts of Washington, Oregon, and California. Annual groundfish specifications and management measures are initially developed by the Pacific Fishery Management Council (Pacific Council), and are implemented by NMFS. The specifications and management measures for the current fishing year (January 1–December 31, 2002) were initially published in the **Federal Register** as an emergency rule for January 1–February 28, 2002 (67 FR 1540, January 11, 2002), as a proposed rule for all of 2002 (67 FR 1555, January 11, 2002), and as a final rule effective March 1, 2002 (67 FR 10490, March 7, 2002). The final rule was subsequently amended at 67 FR 15338, April 1, 2002, at 67 FR 18117, April 15, 2002, at 67 FR 30604, May 7, 2002, at 67 FR 40870, June 14, 2002, at 67 FR 44778, July 5, 2002, at 67 FR 48571, July 25, 2002, at 67 FR 50835, August 6, 2002, at 67 FR 55166, August 28, 2002, at 67 FR 56497, September 4, 2002, and at 67 FR 57973, September 13, 2002.

The following changes to current groundfish management measures were recommended by the Pacific Council, in consultation with Pacific Coast Treaty Tribes and the States of Washington, Oregon, and California, at its September 9–13, 2002, meeting in Portland, OR. Pacific Coast groundfish landings will