Oriental Weatherfish (*Misgurnus anguillicaudatus)*
Ecological Risk Screening Summary

Web Version – 8/21/2012

Photo: W. Aguirre

1 Native Range and Nonindigenous Occurrences

Native Range
From Nico et al. (2012):

"Eastern Asia (Berg 1949; Masuda et al. 1984; Talwar and Jhingran 1992)."

Nonindigenous Occurrences
From Nico et al. (2012):

"Recently collected from Porthouse Branch, a tributary of the Coosa River in Talladega County, **Alabama** (B. Kuhajda, personal communication). Specimens were collected from a three-mile reach of the Westminster flood control channel in Orange County, **California**, in 1968 (St. Amant and Hoover 1969). Additional established populations were discovered upstream from the original collection sites in 1977 and in the adjacent Bolsa Chica Channel in 1979 (Shapovalov et al. 1981). It has also been recorded for Huntington Beach, Orange County, and in tributaries to the Salton Sea, Riverside County, California (e.g., Courtenay et al. 1986; Page and Burr 1991). In **Florida**, this species has been found in the Little Manatee River drainage since about 1988 (L. G. Nico, unpublished data); and more recently in other areas in the Peace drainage (Charlotte Harbor NEP 2004); and in the Myakka River in 2003 (Lemon, personal communication). The species was introduced into **Hawaii** prior to 1900 (Brock 1960); it now occupies primarily stream habitats in Kauai, Maui, and Oahu (Maciolek 1984; Devick 1991a, 1991b). Specimens have been found in the Harton Davis Canal, in an irrigation ditch at Eagle State Park, in the

Boise River system, Ada County, **Idaho**, since the mid 1980s (Courtenay et al. 1986; Idaho Fish and Game 1990). It has been found in the North Shore Channel, Cook County, Lake Michigan drainage, **Illinois**, since 1987, and in the Chicago Sanitary and Ship Canal in 1994 (Page and Laird 1993; Burr et al. 1996; Laird and Page 1996; Thiel, personal communication). Recently found in the Grand Calumet River and the Indiana Harbor Canal near Hammond, **Indiana** (Simon et al. 2006). Several specimens including YOY were collected near Lacombe, **Louisiana**, just downstream of a fish farm (K. Piller, pers. comm. 2005). Recently (2007-2009) collected in Gwynns Falls and the Patapsco River, **Maryland** (Ashton and Ciccotto 2010). This species was collected in headwaters of the Shiawassee River, in Oakland and Genessee counties, **Michigan**, in 1958 and 1959 where it was considered to be established (Schultz 1960). Recently established near the Celery Farm Natural Area in Allendale, **New Jersey**. Two populations of weatherfish are present in **New York**. One is located in western New York and has been present for several years; the other is located in southeastern New York and was discovered in 2009 (L. Supernant and P. McKeown, pers. comm.). Two Oriental weatherfish were collected in the Haw system, **North Carolina**, in 2009 (B. Tracy and W. Starnes, pers. comm.). The species has been reported from a diked secondary channel of the Clackamas River, **Oregon**, since the mid 1980s; it was found in the Malheur, Owyhee, and Snake River systems in 1995 (Logan et al. 1996). Several specimens were also collected in 1997 from Burlington Bottoms near the Multnomah Channel of the Columbia River (N. Bowers, personal communication), and farther downstream from Scappoose Bay on the Columbia River in 1994 (L. Pierce, personal communication; Beaston, personal communication). This species is known from **Tennessee** where it was collected in a tributary of Coffee Creek, near the Hiwassee River, Polk County, in April 1995 (D. Etnier, personal communication). Present in Lake Washington in Seattle, **Washington**, since the mid-1990s (K. Aitkin and R. Tabor, personal communication; Tabor et al. 2001). Recently collected in Tulalip Creek, near Marysville, Washington (DeLong 1999)."

Means of Introductions

From Nico et al. (2012):

"California populations were apparently descended from individuals that had escaped from a local goldfish farm, possibly as early as the 1930s (St. Amant and Hoover 1969). Similarly, populations in the upper Shiawassee River system, Michigan, were believed to have descended from individuals imported from Kobe, Japan, that had escaped from a nearby aquarium supply company in Oakland County before 1951 and possibly as early as about 1939 (Schultz 1960; Courtenay et al. 1984). In Hawaii, the species was presumably introduced by Asian immigrants during the 1800s, probably to serve as a source of food (Maciolek 1984; Devick 1991b). Brock (1960) stated that its use as bait for fish was apparently instrumental in its spread in Hawaii. Collections in Louisiana were the result of escapes from a fish farm. Introductions into other states were presumably the result of aquarium releases."

Remarks

From Nico et al. (2012):

"Established in Shiawassee River and L. Michigan (U.S.EPA 2008). Established in California, Florida, Hawaii, Idaho, Illinois, Michigan, New York, Oregon, and Washington, and possibly in Louisiana. Reported from Tennessee and North Carolina."

"In addition to appearing in the aquarium trade, *M. anguillicaudatus* has been introduced into several parts of the world for aquaculture purposes and as a bait fish (Welcomme 1988). It is considered a cool-water species (Welcomme 1988); individuals burrow into soft substrates and tolerate low oxygen conditions by breathing atmospheric air (Sterba 1973). As its name suggests, this fish becomes more active in response to changes in barometric pressure; thus it frequently has been cited as a harbinger of storms (Sterba 1973; Axelrod et al. 1985). There is concern that if *M. anguillicaudatus* becomes more abundant and spreads, it will reduce populations of aquatic insects important as food to native fishes (Page and Laird 1993). Maciolek (1984) categorized *Misgurnus* along with several other introduced fishes as species having an intermediate impact on Hawaiian streams, this conclusion based on their preferred habitat and diet and on their numbers. The Bolsa Chica Channel, California, cited by Shapovalov et al. (1981), likely represents the Huntington Beach, Orange County site reported by other authors (e.g., Courtenay et al. 1986; Page and Burr 1991)."

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From ITIS (2012):

Kingdom Animalia
Phylum Chordata
Subphylum Vertebrata
Superclass Osteichthyes
Class Actinopterygii
Subclass Neopterygii
Infraclass Teleostei
Superorder Ostariophysi
Order Cypriniformes
Superfamily Cobitoidea
Family Cobitidae
Subfamily Cobitinae
Genus Misgurnus Lacepède, 1803 – weatherfishes
Species Misgurnus anguillicaudatus – oriental weatherfish

Size, Weight, Age

From Froese and Pauly (2010):

"Max length: 28.0 cm SL male/unsexed; (Kottelat and Freyhof 2007); common length: 15.0 cm TL male/unsexed; (Hugg 1996)."

Environment

From Froese and Pauly (2010):

"Demersal; freshwater; depth range 5 - ? m (Kottelat 1998)."

Climate/Range

"From Froese and Pauly (2010):

Subtropical; 5°C - 25°C (Baensch and Riehl 1985); 53°N - 27°S."

Distribution

From Froese and Pauly (2010):

"Asia: Native to Siberia (Tugur and Amur drainages), Sakhalin, Korea, Japan, China south to northern Vietnam. Europe: Introduced in several localities in Rhine (Germany) and Ticino (Italy, north of Milano) drainages, Aral Sea basin, North America, Australia and Hawaii. This species proved successful in the aquarium fish trade and has also been introduced to other countries (Yamamoto and Tagawa 2000). At least one country reports adverse ecological impact after introduction."

Short description

From Froese and Pauly (2010):

"Dorsal view shows the male with larger pectoral fins and the female with fuller abdomen (Yamamoto and Tagawa 2000). Body is mottled with darker greenish-gray to dark brown markings, against a yellow-brown to brown color; conspicuous adipose crests along the ventral and dorsal mid-lines of the caudal peduncle; 10 barbels; suborbital spine hidden in the skin (Kottelat 1998)."

Biology

From Froese and Pauly (2010):

"Found in rivers, lakes and ponds. Also in swamps and rice fields (Kottelat 1998, Allen et al. 2002). Adults prefer still or gently flowing water (Allen et al. 2002), also the muddy bottoms, where they hide in the muck and leaf litter with only their heads sticking out; also found in muddy bottoms of streams and ponds; in Hawaii, can also be found under mats of honohono

(*Commelina diffusa* and California grass (*Brachiara nuatica*). Feed on worms, small crustaceans, insects, insect larvae, and other small aquatic organisms (Yamamoto and Tagawa 2000). Benthic (Mundy 2005). Can tolerate temperatures between 2 and 30°C, and can breathe air to supplement respiratory requirements in oxygen-depleted waters. Commonly used by anglers as live bait, so escapes may also have contributed to their spread (Allen et al. 2002)."

Human uses

From Froese and Pauly (2010):

"Fisheries: commercial; aquaculture: commercial; aquarium: commercial; bait: occasionally."

Diseases

From Froese and Pauly (2010):

"Yellow Grub, Parasitic infestations (protozoa, worms, etc.)
Turbidity of the Skin (Freshwater fish), Parasitic infestations (protozoa, worms, etc.)
Bacterial Infections (general), Bacterial diseases
Hidden Viral Infection, Viral diseases
Viral Diseases (general), Viral diseases"

Threat to humans

From Froese and Pauly (2010):

"Potential pest."

3 Impacts of Introductions

From: Nico et al. (2012):

"It may reduce populations of aquatic insects important as food to native fishes (U.S.EPA 2008)."

From: Global Invasive Species Database (2005):

"*Misgurnus anguillicaudatus* was found to cause significant reductions in macroinvertebrate numbers and biomass in experimental conditions. It is also associated with elevated ammonia, nitrate/nitrite (NOx), and turbidity levels, having a similar effect on water quality as carp (*Cyprinus carpio*). There is concern that *M. anguillicaudatus* may impact native fishes by reducing populations of macroinvertebrate prey, competing for shelter and spawning sites, and preying on eggs and juveniles. Such impacts combined with its environmental adaptability, high competitive ability, high reproductive capacity, high survivorship, and high dispersal ability make it a potentially problematic invasive. In Hawaii it is reported as having an intermediate

ecological effect in Hawaii based on its habitat, diet, and populations (Keller & Lake 2007; Koster et al, 2002; Freyhoff & Korte, 2005; Nico et al. 2012)."

From: Burchmore et al. (1989)

"Accidentally released by aquarists into Lake Burley Griffin, and in Yarra and Owens rivers. Established in the local streams around Canberra, Sydney, New South Wales and in Victoria. The species was banned from import to Australia as an aquarium fish due to its documented feral habits."

From: Oregon Department of Fish and Wildlife (2012):

"Potentially, weatherfish could impact native species by predation and competition for food and habitat."

From: Tabor et al. (2001)

"The impact of oriental weatherfish introductions on aquatic ecosystems has received little attention. In Hawaii, they were categorized as having intermediate impacts to native stream fauna because of their preferred habitat, food habits, and abundance (Maciolek 1984). In some areas oriental weatherfish introductions have been considered beneficial (Welcomme 1984) because they can be used as a food fish or used for mosquito control (Kim et al. 1994). Due to possible impacts to native fishes and other organisms in Australia, the government made the importation of oriental weatherfish illegal in 1986 (Lintermans and Rutzou 1990; Dove and Ernst 1998). Presently, fishery managers have speculated on possible impacts but little data is available. Possible interactions include introduction of fish parasites (Dove and Ernst 1998), competition for food or space, predation of fish eggs, or some type of indirect effect by restructuring the aquatic ecosystem."

From Invasive Species Compendium (2011):

"Impact: Environmental

Impact on Biodiversity
This species can impact native species through direct predation and through transmission of diseases (Logan et al., 1996). *M. anguillicaudatus* are of special concern because they possess many of the characteristics of previous successful invaders. They have broad tolerance for physiological parameters, low vulnerability to predation, a flexible diet, and a high reproductive potential (Logan et al., 1996).

Risk and Impact Factors

Invasiveness
Has a broad native range
Has high reproductive potential

Highly adaptable to different environments

Impact outcomes
Threat to/ loss of native species

Impact mechanisms
Pest and disease transmission
Predation

Likelihood of entry/control
Highly likely to be transported internationally deliberately."

4 Global Distribution

Figure 1. Global distribution of *M. anguillicaudatus*. Map from GBIF (2010).

5 Distribution within the United States

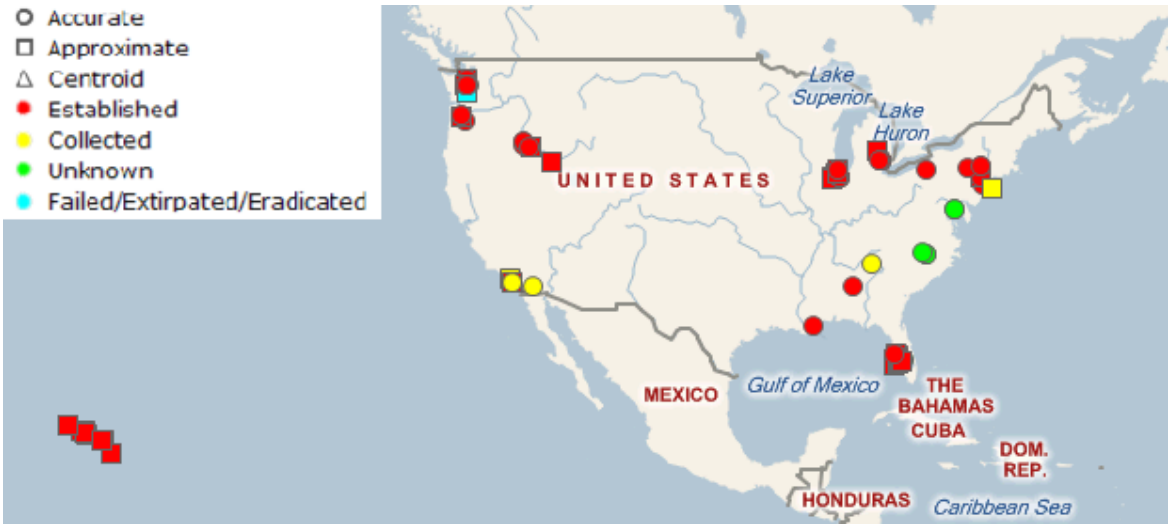

Figure 2. US distribution of *M. anguillicaudatus*. Map from Nico et al. (2012).

6 CLIMATCH

Summary of Climate Matching Analysis

The climate match (Australian Bureau of Rural Sciences 2010, 16 climate variables; Euclidean Distance) was high throughout the US except for Southern California and extreme high elevations. Climate 6 match indicated that the US has a high climate match. The range for a high climate match is 0.103 and greater, climate match of *M. anguillicaudatus* is 0.833.

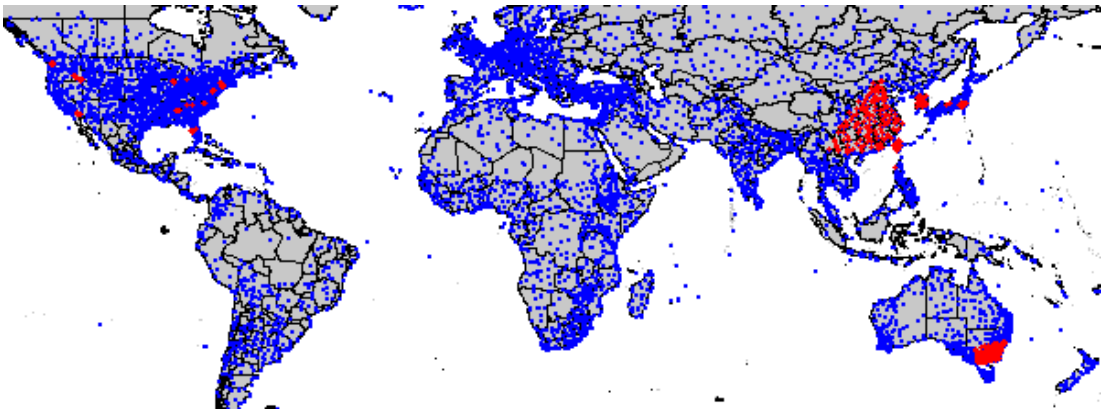

Figure 3. CLIMATCH (Australian Bureau of Rural Sciences 2010) source map showing weather stations selected as source locations (red) and non-source locations (blue) for *M. anguillicaudatus* climate matching. Source locations from GBIF (2010) and Nico et al. (2012). Only established locations were used.

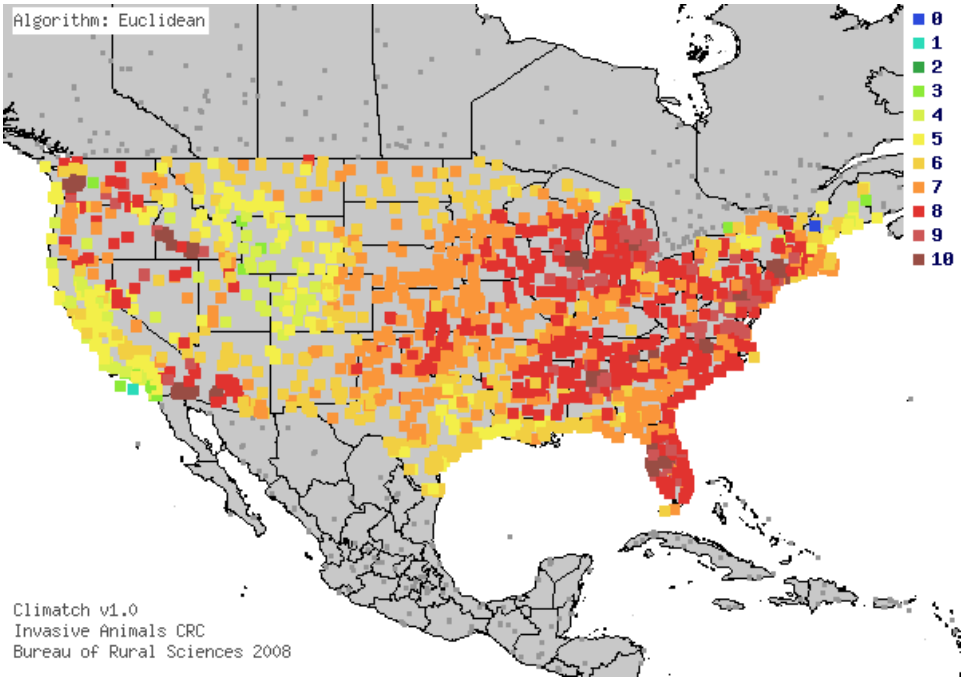

Figure 4. Map of CLIMATCH (Australian Bureau of Rural Sciences 2010) climate matches for *M. anguillicaudatus* in the continental United States based on source locations reported by GBIF (2010) and Nico et al. (2012). 0= Lowest match, 10=Highest match.

Table 1. CLIMATCH (Australian Bureau of Rural Sciences 2010) climate match scores

CLIMATCH Score	0	1	2	3	4	5	6	7	8	9	10
Count	1	1	0	18	84	225	390	511	532	120	92
Climate 6 Proportion =			0.833	(High)							

7 Certainty of Assessment

Information on the biology of this species is fairly abundant. However, while information on the impacts caused by introduction of this species is available, in order for higher certainty more research is needed. Certainty of this assessment is medium.

8 Risk Assessment

Summary of Risk to the Continental United States

M. anguillicaudatus has been established in the US and many other countries worldwide and is continually expanding. There is a high risk of additional introductions, establishment, and impacts in other areas because this species is highly adaptable, quick to reproduce, and is extremely popular in the aquaculture and aquarium industry. Multiple authors have found that this species has caused reductions in macroinvertebrate populations, altered aquatic habitats, and

are vectors for certain fish parasites. Due to the impacts from introduction of this species into Australia, importation of this species was banned in 1986. Climate match with the US is high, with very high readings surrounding the Great Lakes.

Assessment Elements

- **History of Invasiveness (Sec. 3):** High
- **Climate Match (Sec. 6):** High
- **Certainty of Assessment(Sec. 7):** Medium
- **Overall Risk Assessment Category:** High

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