Redbelly Tilapia (*Tilapia zillii*)
Ecological Risk Screening Summary

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Photo: J. Hoover, USACE.

1 Native Range, and Status in the United States

Native Range

From Teugels and Thys van den Audenaerde (1991):

"Africa and Eurasia: South Morocco, Sahara, Niger-Benue system, rivers Senegal, Sassandra, Bandama, Boubo, Mé, Comoé, Bia, Ogun and Oshun, Volta system, Chad-Shari system, middle Congo River basin in the Ubangi, Uele, Ituri and Itimbiri (Democratic Republic of the Congo), Lakes Albert (Thys van den Audenaerde 1964) and Turkana, Nile system and the Jordan system."

Status in the United States

Nico et al. (2014):

"Established or locally established in southern Arizona and California, Hawaii, North and South Carolina, and Texas; reported from several other states. Considered eradicated from all sites in Florida (Smith-Vaniz, personal communication) and Nevada (Courtenay et al. 1984, 1986). In California, *Oreochromis mossambicus* has largely replaced *T. zillii* in the Salton Sea (and possibly in coastal southern California) (Swift et al. 1993)."

"This species was annually stocked in state lakes and farm ponds in Alabama in past years (Smith-Vaniz 1968 [as *T. melanopleura*]; Lee et al. 1980 et seq.), but it is not known to be established (Courtenay et al. 1986). It has been collected in Arkansas but is not considered established (Carter, personal communication). This species was stocked in Arizona by the state government between 1961 and 1980. Sites stocked included Cholla Lake, Navajo County, in 1968; Pecks Lake near Cottonwood, Yavapai County, in 1979; Phoenix Zoo, Maricopa County, in 1979; and Sally Ann nos. 1 and 2, Yuma County, in 1980 (Grabowski et al. 1984). This species was introduced into a canal in Mesa, Maricopa County, in early 1973, and the population apparently overwintered (Minckley 1973). It also is established in Papago Park, Scottsdale, and in waters near Phoenix, Maricopa County (Courtenay et al. 1984, 1986). It is established in Bill Williams National Wildlife Refuge (USFWS 2005). The redbelly tilapia is established in the southern part of California (Lee et al. 1980 et seq.). It was first introduced into drainage ditches near Calexico, Imperial County, in May 1972 (Hauser 1975), and into tributaries of the San Gabriel and Santa Ana rivers in 1973 (Knaggs 1977). The species was recorded from irrigation canals in Bard and Imperial valleys, Imperial County, and in the Coachella Valley, Riverside County; it is also recorded from Palo Verde Valley, including the Salton Sea and vicinity, backwaters of the lower Colorado River, and Lake Cahuilla, Riverside County (Moyle 1976, Courtenay and Hensley 1979a, Schoenherr 1979, Shapovalov et al. 1981, Courtenay and Robins 1989). The species was introduced into 20 ponds, lakes, and creeks in Kern, Santa Clara, Los Angeles, Orange, and Riverside counties, but the populations either did not become established or their status is unknown (Moyle 1976, Courtenay et al. 1986). Legner and Pelsue (1977) indicated it was no longer extant in Los Angeles County, and Pelzman (1973) reported that fish introduced into Napa County perished during the third winter after introduction. The redbelly tilapia was reported in High Rock Spring, Lassen County, as of January 1983 (Courtenay et al. 1984, 1986). There are recent indications that *T. zillii* has been replaced by *Oreochromis mossambicus* in the Salton Sea and has been partially or completely replaced in many other areas of California (Swift et al. 1993). In Florida, this species was stocked in the Bok Tower wildlife pond in Lake Wales, Polk County; it was introduced experimentally at Eustis, Lake County, but that population was exterminated in 1970; this species reportedly was established in a closed ditch on a fish farm near Micco, Brevard County (Courtenay et al. 1974) but has not been collected since. A population in a 0.2-ha isolated borrow pit (quarry pond) at Wayside Park in Perrine, Dade County, first reported in 1974, was eradicated by the state in December 1975 (Hogg 1976b, Courtenay et al. 1984, 1986, Taylor et al. 1986). In Guam, specimens were recently caught in a freshwater island reservoir (S. Walsh and L. Nico, pers. comm., UF museum specimens). In Hawaii, this species (identified as both *Tilapia zillii* and *Tilapia melanopleura*) is established in reservoirs on the islands of Hawaii, Maui, Oahu, and Kauai; it first was released in 1957 (Maciolek 1984) or possibly as early as 1955 (Morita 1981). It reportedly is confined to

one or a few geothermal waters in south-central Idaho in the Snake River region below Shoshone Falls (Idaho Fish and Game 1990, voucher specimens). There are also unconfirmed reports that this species is cultured as a food fish in some unspecified localities in Idaho (Courtenay et al. 1984, 1986). A reproducing population survived several winters in Nevada in a spring-fed golf course pond at Cottonwood Park, Pahrump Valley, Nye County, ca. 1980 (Courtenay and Deacon 1982), but that population is no longer extant (Courtenay et al. 1984, 1986, Deacon and Williams 1984). The species was introduced into various sites in North Carolina including Lake Hyco in Person and Caswell counties, in 1984 (McGowan 1988, Crutchfield 1995, voucher specimens), and other reservoirs or ponds, also associated with electric power (e.g., Sutton Lake adjacent to the Lumber River), as well as drainage ponds around phosphate mines (e.g., sites near Aurorean addition to Person and Caswell counties, other North Carolina counties involved are Beaufort, Brunswick, New Hanover, and Robeson (Courtenay et al. 1986, Menhinick 1991, J. Crutchfield, personal communication). This species has been cultured for aquatic plant control and for use as a possible food fish in a heated section of the Santee-Cooper Reservoir, South Carolina (= Lake Marion?) (Courtenay et al. 1986, 1991). The first report of this species in Texas was from spring waters (headwaters of the San Antonio River) within the San Antonio Zoo, Bexar County, in 1978 (Hubbs 1982, Courtenay et al. 1984, 1986, Hubbs et al. 1991). That population is limited to a short stretch of the San Antonio River, does not seem to be expanding its range, and this species is not found elsewhere in the state (Howells 1991, 1992a, b, voucher specimens)."

Means of Introductions in the United States

Nico et al. (2014):

"Introduced in most locations by state agencies, universities, or private companies for control of aquatic plants, to control mosquitoes and chironomid midges, as forage or food fish, and for aquaculture evaluation (Minckley 1973, Legner and Pelsue 1977, Lee et al. 1980 et seq., Shapovalov et al. 1981, Grabowski et al. 1984, McGowan 1988, Courtenay and Robins 1989, Page and Burr 1991). For example, the species has been stocked into various North Carolina waters for aquatic plant control by Texas Gulf, Inc., and also by Carolina Power and Light Company (Courtenay et al. 1986, J. Crutchfield, personal communication). There have been both authorized as well as illegal releases. Introductions into Dade County, Florida, probably resulted from escapes from nearby fish farms or aquarium releases (Hogg 1976a, b). Redbelly tilapia and blue tilapia were inadvertently introduced into Hyco Reservoir in North Carolina in 1984 after a small number of fish escaped from a holding cage located in the heated discharge area during an on-site agricultural study (Crutchfield 1995). Agents and reasons for introductions were reviewed by Courtenay et al. (1986)."

Remarks

Nico et al. (2014):

"Populations introduced into Alabama normally did not survive the winter and required annual restocking (Smith-Vaniz 1968). However, their tolerance to cold temperatures in central California prompted officials to place the species on the prohibited list for portions of the state (Shapovalov et al. 1981). A portion of the population found in a borrow pit in Perrine, Dade County, Florida, included hybrids with *Tilapia mariae* (Taylor et al. 1986, UF 39875). For detailed information on introduction history see Courtenay and Hensley (1979b), Shapovalov et al. (1981), Grabowski et al. (1984), and Courtenay et al. (1986). In addition to the U.S., redbelly tilapia has been introduced to a variety of places worldwide (Welcomme 1988)."

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From ITIS (2011):

"Kingdom Animalia
Subkingdom Bilateria
Infrakingdom Deuterostomia
Phylum Chordata
Subphylum Vertebrata
Infraphylum Gnathostomata
Superclass Osteichthyes
Class Actinopterygii
Subclass Neopterygii
Infraclass Teleostei
Superorder Acanthopterygii
Order Perciformes
Suborder Labroidei
Family Cichlidae
Genus Tilapia
Species Tilapia zillii (Gervais, 1848)

Taxonomic Status: Valid."

Size, Weight, and Age Range

From Teugels and Thys van den Audenaerde (1991):

"Maturity: Lm 7.0, range 20 - ? cm; Max length: 40.0 cm SL male/unsexed; (van Oijen 1995); common length : 30.0 cm SL male/unsexed; (van Oijen 1995); max. published weight: 300.00 g (Ita 1984); max. reported age: 7 years (Noakes and Balon 1982)."

Environment

From Teugels and Thys van den Audenaerde (1991):

"Freshwater; brackish; benthopelagic; pH range: 6.0 - 9.0; dH range: 5 - 20; potamodromous (Riede 2004); depth range 1 - 7 m (Eccles 1992)."

Climate/Range

From Teugels and Thys van den Audenaerde (1991):

"Tropical; 11°C - 36°C (Philippart and Ruwet 1982); 35°N - 10°S"

Distribution Outside the United States

Native

From Teugels and Thys van den Audenaerde (1991):

"Africa and Eurasia: South Morocco, Sahara, Niger-Benue system, rivers Senegal, Sassandra, Bandama, Boubo, Mé, Comoé, Bia, Ogun and Oshun, Volta system, Chad-Shari system, middle Congo River basin in the Ubangi, Uele, Ituri and Itimbiri (Democratic Republic of the Congo), Lakes Albert (Thys van den Audenaerde 1964) and Turkana, Nile system and the Jordan system."

Introduced

From Teugels and Thys van den Audenaerde (1991):

This species is reported as introduced in the USSR, western Australia, Iran, Iraq, Israel, Jordan, Malaysia, Northern Marianas, Russia, Saudi Arabia, Singapore, Syria, Uganda, Turkey, Libyan Arab Jamahiriya, Antigua, Mexico, Thailand, Kenya, New Caledonia, Madagascar, Guam, Mauritius, Côte d'Ivoire, Fiji, South Africa, Japan, Taiwan, UK, Tanzania, Sri Lanka, Philippines, Ethiopia, China and Eritrea (FAO 2014).

Means of Introduction Outside the United States

From Teugels and Thys van den Audenaerde (1991):

Reasons listed for the introduction of this species include aquaculture, weed control, fisheries, research, mosquito control, fill ecological niche and unknown. The species is listed as established in most locations where introduced and having negative impacts on native species in some locations (FAO 2014).

Short description

From Teugels and Thys van den Audenaerde (1991):

"Dorsal spines (total): 13 - 16; Dorsal soft rays (total): 10-14; Anal spines: 3; Anal soft rays: 8 - 10. Diagnosis: upper profile of head not convex; lower pharyngeal bone about as long as broad, and with anterior lamella shorter than toothed area; median pharyngeal teeth not broadened;

dorsal fin with 14-16 spines and 10-14 soft rays (mean 15, 12); 8-11 lower gillrakers; dark longitudinal band appears on flanks when agitated; no bifurcated dark vertical bars on flanks; dorsal and caudal fins not or feebly blotched (Teugels and Thys van den Audenaerde 2003). Body brownish-olivaceous with an iridescent blue sheen; lips bright green (van Oijen 1995, Teugels and Thys van den Audenaerde 2003). Chest pinkish (van Oijen 1995). Dorsal, caudal and anal fins brownish-olivaceous with yellow spots, dorsal and anal fins outlined by narrow orange band; "tilapian" spot large, extending from last spine to 4th soft ray and always bordered by yellow band (van Oijen 1995, Teugels and Thys van den Audenaerde 2003). Specimens 2-14 cm SL with completely yellowish or greyish caudal fin without dots, but tend to develop a greyish caudal fin with dots of increasing size during development; above 14 cm SL, this species has greyish caudal fins with dots on entire caudal fin (Nobah et al. 2006)."

Biology

From Teugels and Thys van den Audenaerde (1991):

"Occasionally form schools; mainly diurnal. Prefer shallow, vegetated areas (Eccles 1992). Fry are common in marginal vegetation and juveniles are found in the seasonal floodplain. Herbivorous, feed on water plants and epiphyton, and some invertebrates. Substrate spawner (Bailey 1994). Larvae develop in close association with substrate. Extended temperature range 6.5 - 42.5 °C, natural temperature range 10.5 - 36°C (Philippart and Ruwet 1982)."

Human uses

From Teugels and Thys van den Audenaerde (1991):

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

Diseases

From Teugels and Thys van den Audenaerde (1991):

Trichodinosis, Parasitic infestations; Trichodinella Infection 1, Parasitic infestations; Trichodina Infection 1, Parasitic infestations; Tripartiella Infestation, Parasitic infestations; Trichodina Infection 5, Parasitic infestations; Ergasilus Disease 3, Parasitic infestations; Centrocestus Disease, Parasitic infestations; Enterogyrus Infestation, Parasitic infestations; Neascus Disease, Parasitic infestations; Nosema Disease 2, Parasitic infestations; Bolbophorus Infection, Parasitic infestations; Clinostomum Infestation 3, Parasitic infestations; Amplicaecum Infection (Larvae), Parasitic infestations; Pentastoma Infection (Larvae), Parasitic infestations; Yellow Grub, Parasitic infestations; Goezia Disease 2, Parasitic infestations; Cichlidogyrus Disease, Parasitic infestations; Cichlidogyrus Infestation 3, Parasitic infestations; Cichlidogyrus Infestation 4, Parasitic infestations; Cichlidogyrus Infestation 9, Parasitic infestations and Dilepid Cestode larvae Infestation (general sp.), Parasitic infestations.

There are no known OIE-reportable diseases listed for this species.

Threat to humans

Potential pest.

3 Impacts of Introductions

From Nico et al. (2014):

"The redbelly tilapia is considered a potential competitor with native fish for food and spawning areas, and is potentially detrimental to California rice crops (Pelzman 1973). Juvenile *T. zillii* were implicated in population declines of desert pupfish *Cyprinodon macularius* inhabiting shallow irrigation canals near the Salton Sea, California (Lee et al. 1980 et seq., Schoenherr 1985). In Florida, this species was found to be highly aggressive; it is considered a serious threat to native aquatic plants and to fish that rely on plants for cover, foraging, or spawning sites (Courtenay et al. 1974). In Hyco Reservoir, North Carolina, feeding by introduced redbelly tilapia eliminated all aquatic macrophytes from the reservoir within a 2-year period that coincided with declines in populations of several native fishes; tilapia populations continued expanding in the absence of macrophytes because of its ability to switch to alternate food sources (Crutchfield et al. 1992, Crutchfield 1995)."

From GISD (2014):

"Adult *Tilapia zillii* are considered to be voracious herbivores, often decreasing plant density and changing the composition of native plants which can threaten many native aquatic organisms that depend on such plants for forage, protection, or spawning (GSMFC 2005, Spataru 1978)."

"Guam
Economic/Livelihoods: *Tilapia zillii* has had a beneficial socio-economic impact on this location and has created a small recreational fishery (FishBase 2008)."

"United States (USA)
Modification of natural benthic communities: *Tilapia zillii* often reduce the amount of vegetative cover in a body of water which is used for spawning or protection from predation of golden shiner, eastern mosquitofish and green sunfish (FishBase 2008)."

"California (United States (USA))
Modification of natural benthic communities: *Tilapia zillii* have been linked to the decline in desert pupfish in the Salton sea (Costa-Pierce 2003)."

"Florida (USA) (United States (USA))
Other: There was no recorded impact for this location, only a risk of modification of natural benthic communities (Taylor 1986)."

"Nevada (United States (USA))
Other."

"North Carolina (United States (USA))
Modification of natural benthic communities: The introduction of *Tilapia zillii* into Hyco Reservoir, North Carolina resulted in the elimination of all aquatic macrophytes within 2 years after introduction, coinciding with declines in population of the golden shiner (*Notemigonus*

crysoleucas), the eastern mosquitofish (*Gambusia holbrooki*), and the green sunfish (*Lepomis cyanellus*) (Crutchfield 1995)."

From Teugels and Thys van den Audenaerde (1991):

"Reintroduced in 1972. Elimination of aquatic macrophytes by the redbelly tilapia led to the observed declines in populations of the golden shiner, eastern mosquitofish and green sunfish since this resulted to the loss/decrease of vegetative cover for either spawning or protection against predation of these species. Due to its high degree of adaptability the species has spread rapidly in fresh and even marine waters. It is particularly common in irrigation ditches in California, Arizona and Texas (Crutchfield 1995)."

From Andreu-Soler and Ruiz-Campos (2013):

"We assessed the effects of the abundance and biomass of four exotic fishes (common carp, *Cyprinus carpio*; guppy, *Poecilia reticulata*; green swordtail, *Xiphophorus hellerii*; and redbelly tilapia,*Tilapia* cf. *zillii*) on the residual somatic condition (Kr) of endangered Baja California killifish (*Fundulus lima*) in two oasis systems of Baja California Sur, Mexico. We used multiple regressions to analyze relationships between Kr of the killifish and 21 ecological variables. Biomass of redbelly tilapia and common carp were variables that better explained variation in Kr among populations of killifish. In both drainages, redbelly tilapia was the dominant fish, which relegated smaller habitat units to the other coexisting species of fishes, increasing competition among them and decreasing Kr and abundance of the endemic killifish."

4 Global Distribution

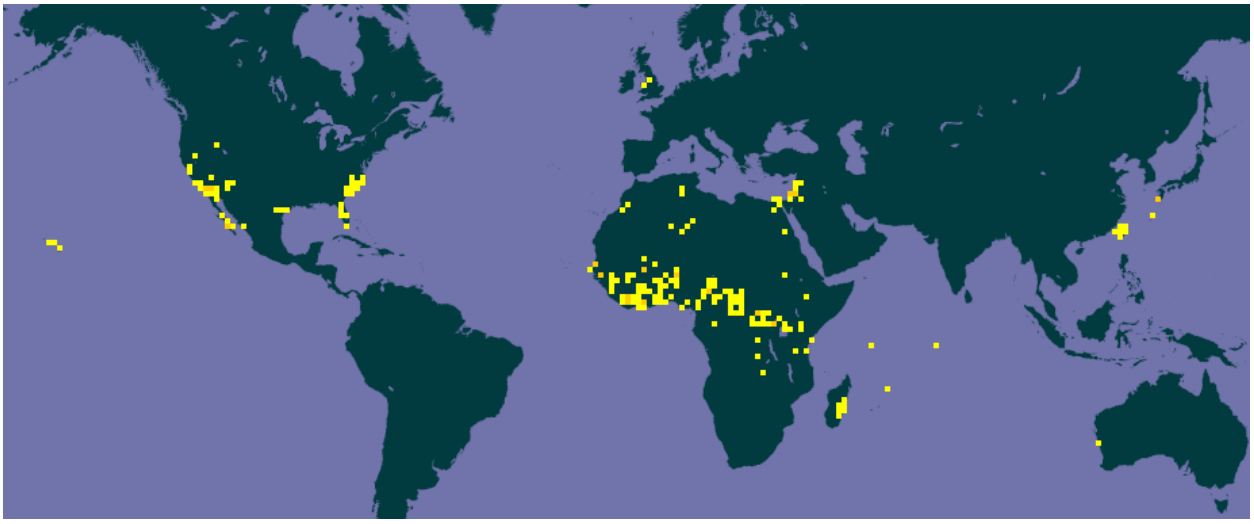

Figure 1. Map of known global distribution of *Tilapia zillii*. Map from GBIF (2014).

5 Distribution within the United States

Figure 2. U.S. distribution of *Tilapia zillii*. Map from Nico et al. (2014).

6 CLIMATCH

Summary of Climate Matching Analysis

The climate match (Australian Bureau of Rural Sciences 2008; 16 climate variables; Euclidean Distance) was high in southern California, southern Arizona, Southern Texas, and the Mid-Atlantic with the lowest match areas being in the upper Great Plains, the Northeast, and the Rocky Mountains. Climate 6 proportion indicated that the contiguous U.S. has a high climate match. The range for a high climate match is 0.103 and greater; climate match of *Tilapia zillii* is 0.416.

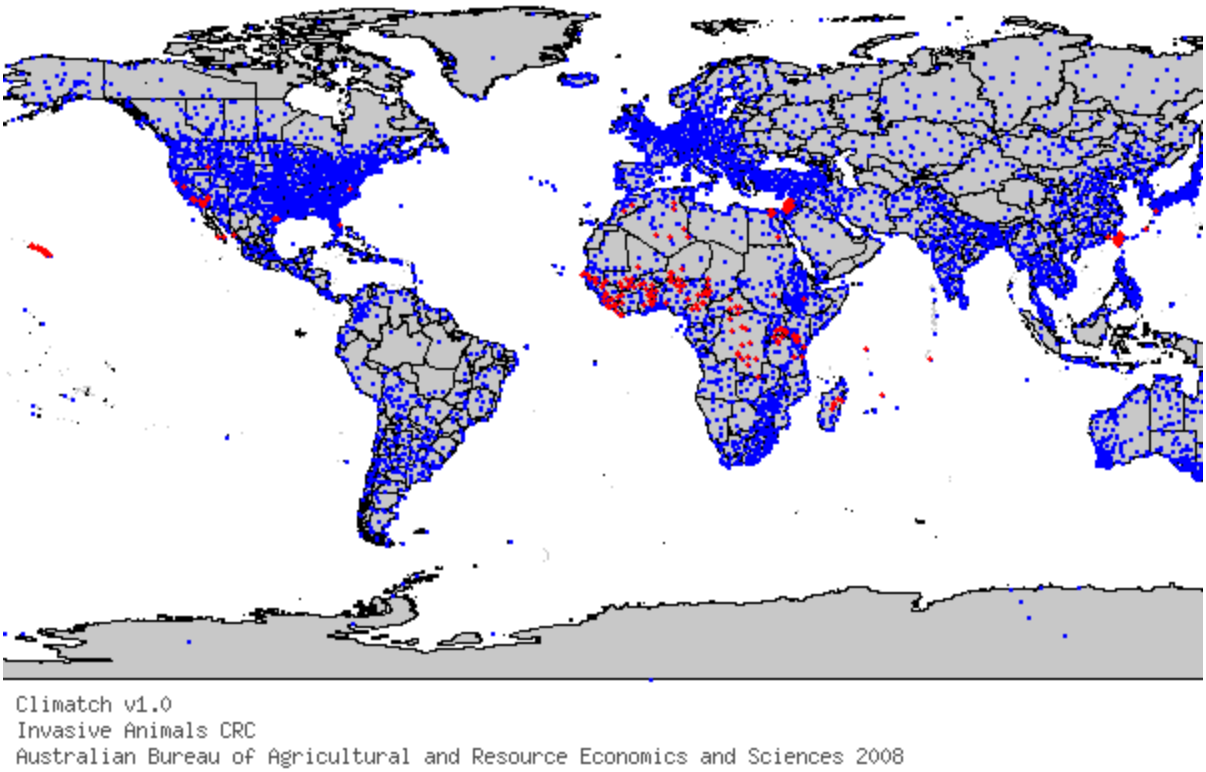

Figure 3. CLIMATCH (Australian Bureau of Rural Sciences 2008) source map showing weather stations selected as source locations (red) and non-source locations (blue) for *Tilapia zillii* climate matching. Source locations from GBIF (2014) and Nico et al. (2014).

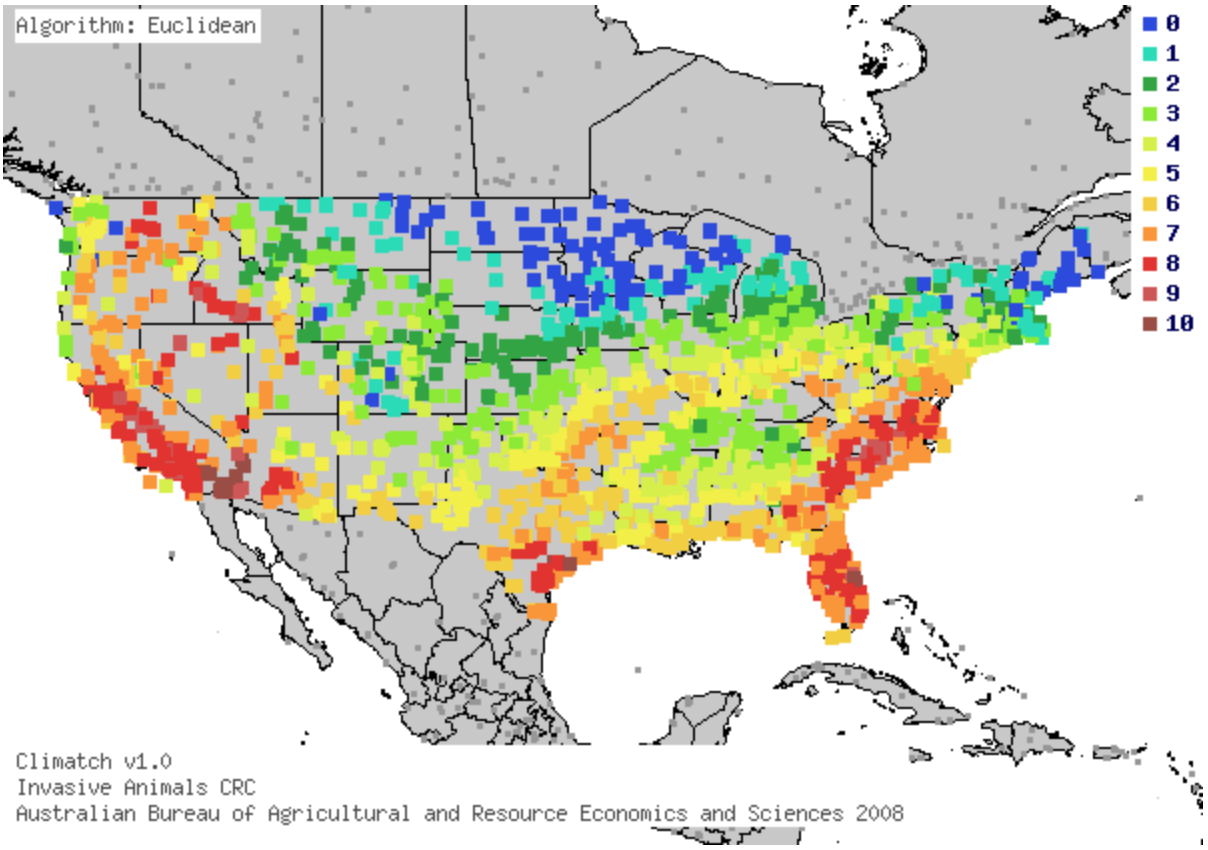

Figure 4. Map of CLIMATCH (Australian Bureau of Rural Sciences 2008) climate matches for *Tilapia zillii* in the contiguous United States based on source locations reported by GBIF (2014) and Nico et al. (2014). 0= Lowest match, 10=Highest match.

Table 1. CLIMATCH (Australian Bureau of Rural Sciences 2008) climate match scores.

CLIIMATCH Score	0	1	2	3	4	5	6	7	8	9	10
Count	132	119	174	279	229	219	277	282	196	40	27
Climate 6 Proportion =		0.416									

7 Certainty of Assessment

Information on the biology, distribution, and impacts of this species is readily available. Certainty of assessment for this species is high.

8 Risk Assessment

Summary of Risk to the Contiguous United States

Error! Reference source not found. is a freshwater and brackish water species native to Africa and Eurasia. This species is used for aquaculture, mosquito control, and weed control; introductions sometimes result from pond escapes. This species has established in over 30 countries outside of its native range, including the United States. *Tilapia zillii* feeds heavily on macrophytes, sometimes completely eliminating them from the system. This can lead to reductions in the abundance of native fishes due to lack of food, cover, and spawning habitat. The condition of the endangered Killifish is likely impacted by the introduction of *Tilapia zillii*. Climate match for the contiguous U.S. is high, especially in the southern half of the country. Overall risk for this species is high.

Assessment Elements

- **History of Invasiveness (Sec. 3):** High
- **Climate Match (Sec.6):** High
- **Certainty of Assessment (Sec. 7):** High
- **Remarks/Important additional information** Host of 21 diseases/parasites and listed as a potential pest
- **Overall Risk Assessment Category: High**

9 References

Note: The following references were accessed for this ERSS. References cited within quoted text but not accessed are included below in Section 10.

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10 References Quoted But Not Accessed

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