Spotted Tilapia (*Tilapia mariae*)
Ecological Risk Screening Summary

Web Version – October 1, 2012

Photo: Noel Burkhead

1 Native Range and Nonindigenous Occurrences

Native Range
From Nico (2012):

"Tropical Africa. West Africa from middle Ivory Coast to southwestern Ghana and from southeastern Benin to southwestern Cameroon (Thys van den Audenaerde 1966; Philippart and Ruwet 1982)."

Nonindigenous Occurrences

From Nico (2012):

Tilapia mariae was possibly introduced for experimental purposes into waters of southern **Arizona** (Courtenay and Hensley 1979b; Lee et al. 1980 et seq.; Courtenay et al. 1984, 1986) and it was considered to be established in the state by Courtenay and Hensley (1979b). Spotted tilapia are present in the Salton Sea, Colorado River, and Los Angeles area in California. The first records in **Florida** were from Snapper Creek Canal in South Miami, Dade County, in April 1974 (Hogg 1974). By the latter half of the 1970s, it had become established in canals throughout most of eastern Dade County (Hogg 1976a, 1976b), in southeastern Broward County, and possibly in southern Collier County (Courtenay and Hensley 1979b; Courtenay et al. 1984, 1986). Previously absent in Everglades National Park (Loftus and Kushlan 1987), it became established in the park and in Big Cypress National Preserve by the late 1980s (Courtenay 1989; Lorenz et al. 1997; museum specimens; Tilmant 1999). This species is now considered established or has been reported from water bodies, mainly canals, lakes, and ponds, in at least eight counties, all in the southern portion of the state; these include Brevard, Broward, Collier, Dade, Indian River, Martin, Monroe, and Palm Beach counties (Hogg 1976b; Courtenay and Hensley 1979a, 1979b; Courtenay et al. 1984, 1986; Clark 1981; Gilmore et al. 1983; Taylor et al. 1986; Loftus and Kushlan 1987; museum specimens; USGS file records). It has been established and reportedly has been abundant in **Nevada** in Rogers Spring, a thermal spring in Lake Mead National Recreation Area above the Overton Arm of Lake Mead, in Clark County, since about 1980 (Courtenay and Deacon 1982, 1983; Deacon and Williams 1984; Courtenay and Stauffer 1990). A single specimen was taken from the Blue Point Spring outlet in Lake Mead National Recreation Area, Clark County, in December 1980, but there was no evidence of reproduction (Courtenay et al. 1986; UF museum specimen)."

Means of Introductions

From Nico (2012):

"Spotted tilapia was introduced into Florida as a result of escapes or intentional releases from one or several aquarium fish farms in Dade County, probably between 1972 and 1974 (Hogg 1974, 1976a, 1976b; Courtenay and Hensley 1979b; Courtenay and Stauffer 1990). The Nevada introduction was reportedly due to an aquarium release (Courtenay and Deacon 1982, 1983; Courtenay and Stauffer 1990)."

Remarks

From Nico (2012):

"Established in Florida; locally established in Nevada; reported from Arizona."

"Since the early 1970s, *Tilapia mariae* has rapidly dispersed in south Florida, where it has gradually replaced black acara *Cichlasoma bimaculatum* as the most abundant cichlid in area canal systems, possibly through competition for space (Courtenay and Hensley 1979a, 1979b; Kushlan 1986; Loftus and Kushlan 1987). Possession of this species in Florida has been banned since 1974 (Clark 1981). A portion of a population found in a borrow pit in Perrine, Dade County, Florida, included hybrids with redbelly tilapia *Tilapia zillii* (Taylor et al. 1986). Distribution maps for Florida records were given by Hogg (1976b), Courtenay and Hensley (1979b), Lee et al. (1980 et seq.), Clark (1981), Kushlan (1986), and Loftus and Kushlan (1987). The conclusion by some authors that this species was introduced into and is possibly established in Arizona apparently is based entirely on the fact that Minckley (1973) presented a photograph of *Tilapia mariae* (incorrectly identified as "*Tilapia nilotica*") in his book on Arizona fishes. Minckley also described young tilapia that more closely matched *T. mariae* as opposed to *Tilapia nilotica* (= *Oreochromis niloticus*) (see Courtenay and Hensley 1979b; Courtenay et al. 1984, 1986). However, the conclusion that *T. mariae* was ever present in Arizona assumes that the specimens photographed and examined by Minckley actually were collected in Arizona."

2 Biology and Ecology

Taxonomic Heirarchy and Status

From ITIS (2012):

Kingdom Animalia
  Phylum Chordata
    Subphylum Vertebrata
      Superclass Osteichthyes
        Class Actinopterygii
          Subclass Neopterygii
            Infraclass Teleostei
              Superorder Acanthopterygii
                Order Perciformes
                  Suborder Labroidei
                    Family Cichlidae
                      Genus Tilapia
                        Species Tilapia mariae

Taxonomic Status: "valid"

Size, Weight, Age

From Froese and Pauly (2010):

"Max length : 39.4 cm TL male/unsexed; (IGFA 2001); common length : 17.5 cm TL male/unsexed; (Hugg 1996); max. published weight: 1,360 g (IGFA 2001)."

Environment

From Froese and Pauly (2010):

"Freshwater; brackish; demersal; pH range: 6.0 - 8.0; dH range: 5 – 19"

Climate/Range
From Froese and Pauly (2010):

"Tropical; 20°C - 25°C (Ref. 1672); 9°N - 2°N, 9°W - 11°E (Florida Museum of Natural History 2005)."

Distribution
From Froese and Pauly (2010):

"Africa: Coastal lagoons and lower river courses from the Tabou River (Côte d'Ivoire) to the Kribi River (Cameroon), but absent from the area between the Pra River (Ghana) and Benin (Teugels and Thys van den Audenaerde 2003)."

Also recorded from the lower Ntem, Cameroon (Stiassny et al. 2008).

Short description
From Froese and Pauly (2010):

"Dorsal spines (total): 15 - 17; Dorsal soft rays (total): 13-15; Anal spines: 3; Anal soft rays: 10 - 11. Diagnosis: body rather elevated (body depth 46.9-51.6% SL); outer teeth on jaws bicuspid and spatulated; micro-gillrakers present; adults (> 150 mm) with a series of dark blotches in the middle of the flanks (sometimes body entirely blackish), juveniles with seven to nine large vertical bands (Teugels and Thys van den Audenaerde 2003)."

Biology
From Froese and Pauly (2010):

"Live in still or flowing waters in rocky or mud-bottom areas (Allen et al.2002). Occur in warm springs and mud-bottomed to sand-bottomed canals (Page and Burr 1991). Consume plant matter. Reach sexual maturity at 10-15 centimeters length. Parents prepare nest site on logs, leaves and other debris. The eggs (600-3300 per female) are guarded by the parents and hatch in 1-3 days. Parental care of the brood continues until the fish are about 2.5-3.0 centimeters (Allen et al. 2002)."

Human uses
From Froese and Pauly (2010): "Aquarium: commercial"

Diseases
None reported

Threat to humans
None reported

3 Impacts of Introductions

From Nico (2012):

"This apparently aggressive species is the dominant fish in many canal systems of southeastern Florida and has the potential to affect other introduced and native fishes (Courtenay and Hensley 1979b). In Nevada, *T. mariae* was reportedly the dominant fish in Rogers Spring and there was concern that this omnivorous cichlid competed with endemic spring fishes for food and also preyed on smaller fishes (Courtenay and Deacon 1982, 1983)."

From GISD (2006):

"*Tilapia mariae*, or spotted tilapia, is a cichlid native to coastal lagoons in western equatorial Africa that has established populations in Australia and United States. Due to its high fecundity, aggressive behaviour, and ecological plasticity it has the potential for rapid, explosive invasion and has become a significant pest in introduced ranges."

"Tilapia mariae dominates introduced habitats, representing a competitive threat to native species and can lower biodiversity. They are extremely aggressive and territorial while breeding. They are capable of rapid invasion and have high fecundity. *T. mariae* can compete with native fish for resources such as prey or breeding sites which can cause the displacement of native fish species. In much of its introduced range, *T. mariae* is the dominant species both by number and biomass (ACTFR, 2007; Cribb, 2006; GSMFC, 2005). Brooks and Jordan (2009) tested whether *T. mariae* and native Lepomis sunfishes compete for territory in South Florida. They found that *T. mariae* are significantly more aggressive and have an advantage in the acquisition and retention of territories; this may impact spawning sites of Lepomis sunfish. As a significant predator Lepomis sunfishes are important in structuring small fish and invertebrate assemblages (Loftus & Kushland 1987 in Brooks & Jordan 2009). Thus competitive displacement of sunfishes by *T. mariae* may further disrupt the ecosystems which they invade. Furthermore, the butterfly peacock *Cichla ocellaris* which was introduced as a biocontrol agent for *T. mariae* is physiologically restricted to the canal systems in Florida and cannot survive in the natural wetlands, meaning there is further potential for *T. mariae* densities to increase in these natural systems."

From Brooks and Jordan (2009):

"South Florida's freshwaters are amongst the most invaded in the world with 34 naturalized fish species. How these non-natives affect the local native fish populations, however, is largely unknown. Native sunfish of the genus Lepomis are important as predators in structuring fish and invertebrate assemblages in the swamps and seasonal wet prairies of the Big Cypress Swamp and Florida Everglades. The spotted tilapia, *Tilapia mariae*, is a successful West African invader that exhibits territorial and spawning behavior that closely matches that of native Lepomis sunfishes. We tested the hypothesis that Lepomis sunfishes and *T. mariae* would compete when space was limiting. Additionally, we predicted that *T. mariae*, because of their aggressiveness, would be more successful in acquiring space. We collected juveniles of both groups from Big Cypress National Preserve, Everglades National Park, and the South Florida Water Management District canal system for laboratory trials in which likely competitive interactions were staged and observed. *T. mariae* were bolder and more aggressive than Lepomis sunfishes. *T. mariae* residents resisted all intruders whereas 30% of Lepomis sunfish residents were ejected. We surmise that these enhanced behaviors of *T. mariae* are an important component of their success in South Florida. The continued spread of *T. mariae* populations throughout South Florida into natural habitats suggests an increasing potential to affect the quality of spawning habitat available for Lepomis sunfishes and warrants a renewed focus on *T. mariae* as a non-native species of special concern."

General information on the impacts of Tilapia
Although sources on the effects of *T. mariae* introductions are limited, the following information illustrates that other species in the Tilapia genus have also proven to be highly invasive.

From Canonico et al. (2005):

"The common name 'tilapia' refers to a group of tropical freshwater fish in the family Cichlidae (*Oreochromis*, *Tilapia*, and *Sarotherodon* spp.) that are indigenous to Africa and the southwestern Middle East. Since the 1930s, tilapias have been intentionally dispersed worldwide for the biological control of aquatic weeds and insects, as baitfish for certain capture fisheries, for aquaria, and as a food fish. They have most recently been promoted as an important source of protein that could provide food security for developing countries without the environmental problems associated with terrestrial agriculture. In addition, market demand for tilapia in developed countries such as the United States is growing rapidly."

"Tilapias are well-suited to aquaculture because they are highly prolific and tolerant to a range of environmental conditions. They have come to be known as the 'aquatic chicken' because of their potential as an affordable, high-yield source of protein that can be easily raised in a range of environments } from subsistence or 'backyard' units to intensive fish hatcheries. In some countries, particularly in Asia, nearly all of the introduced tilapias produced are consumed domestically; tilapias have contributed to basic food security for such societies."

"This review indicates that tilapia species are highly invasive and exist under feral conditions in every nation in which they have been cultured or introduced. Thus, the authors have concluded that, despite potential or observed benefits to human society, tilapia aquaculture and open-water introductions cannot continue unchecked without further exacerbating damage to native fish species and biodiversity. Recommendations include restricting tilapia culture to carefully managed, contained ponds, although exclusion is preferred when it is feasible. Research into culture of indigenous species is also recommended."

From Mackenzie and Rachel (2003):

"There are 16 species of exotic fish that have formed significant self-maintaining populations in Queensland waters (Arthington et al. 1999). From this group, carp (*Cyprinus carpio)*, gambusia (*Gambusia holbrooki)* and two species of tilapia (*Oreochromis mossambicus* and *Tilapia mariae)* are listed as noxious in Queensland (Queensland Freshwater Management Plan 1999). These fishes are considered to pose the greatest threat to Queensland waters at the moment. It is acknowledged, however, that any species of fish that has formed a self-maintaining population has the potential to become a pest (Arthington et al.1999)."

4 Global Distribution

Summary

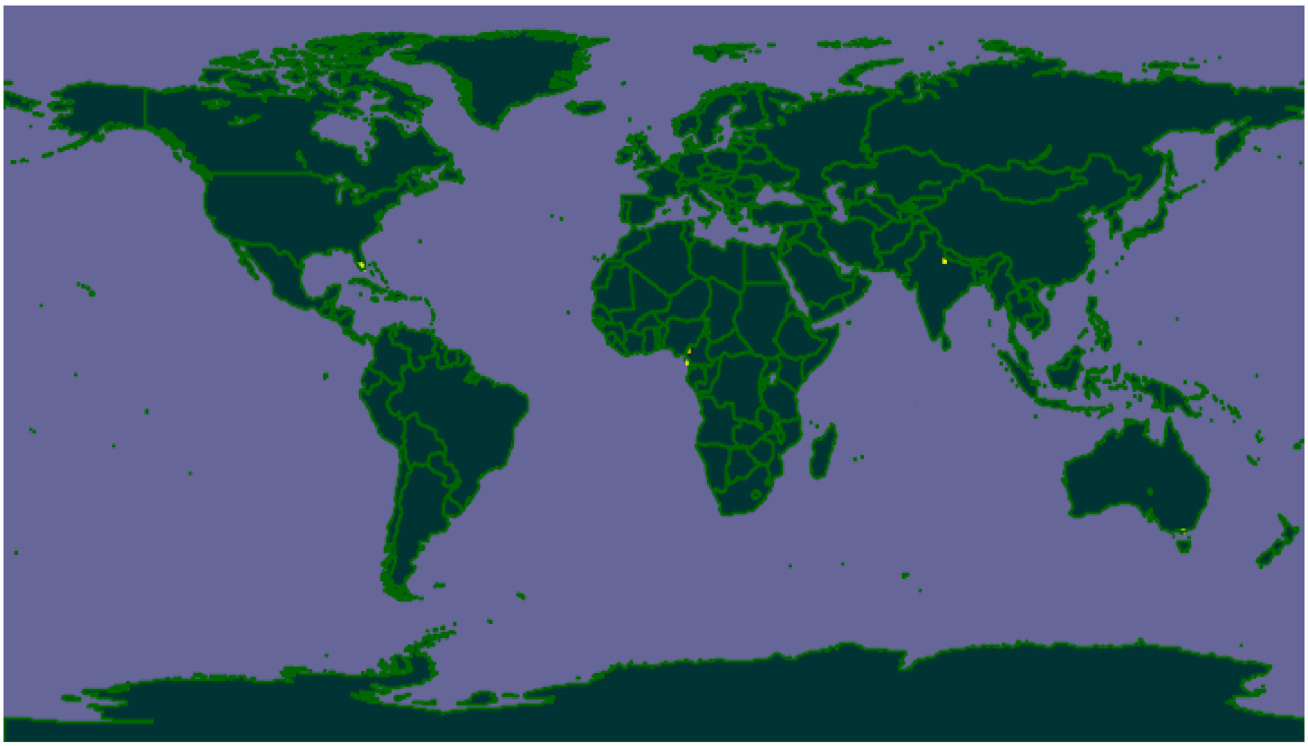

Figure 1 (above). Global distribution of *T. mariae*. Map from GBIF (2010). One location in India was located incorrectly and should have been placed in the United States. This point was not included in the data.

5 Distribution within the United States

Figure 2 (above). Distribution of *T. mariae* in the United States. Map from Nico (2012).

6 CLIMATCH

Summary of Climate Matching Analysis

The climate match (Australian Bureau of Rural Sciences 2010;16 climate variables; Euclidean Distance) was high in Nevada and southern Arizona and California, as well as Florida. Medium matches mostly traced the coasts and Southern border. Low matches covered the North and interior of the United States. Climate 6 match indicated that the United States has a high climate match. The range for a high climate match is 0.103 and greater; the climate match of *T. mariae* is 0.119.

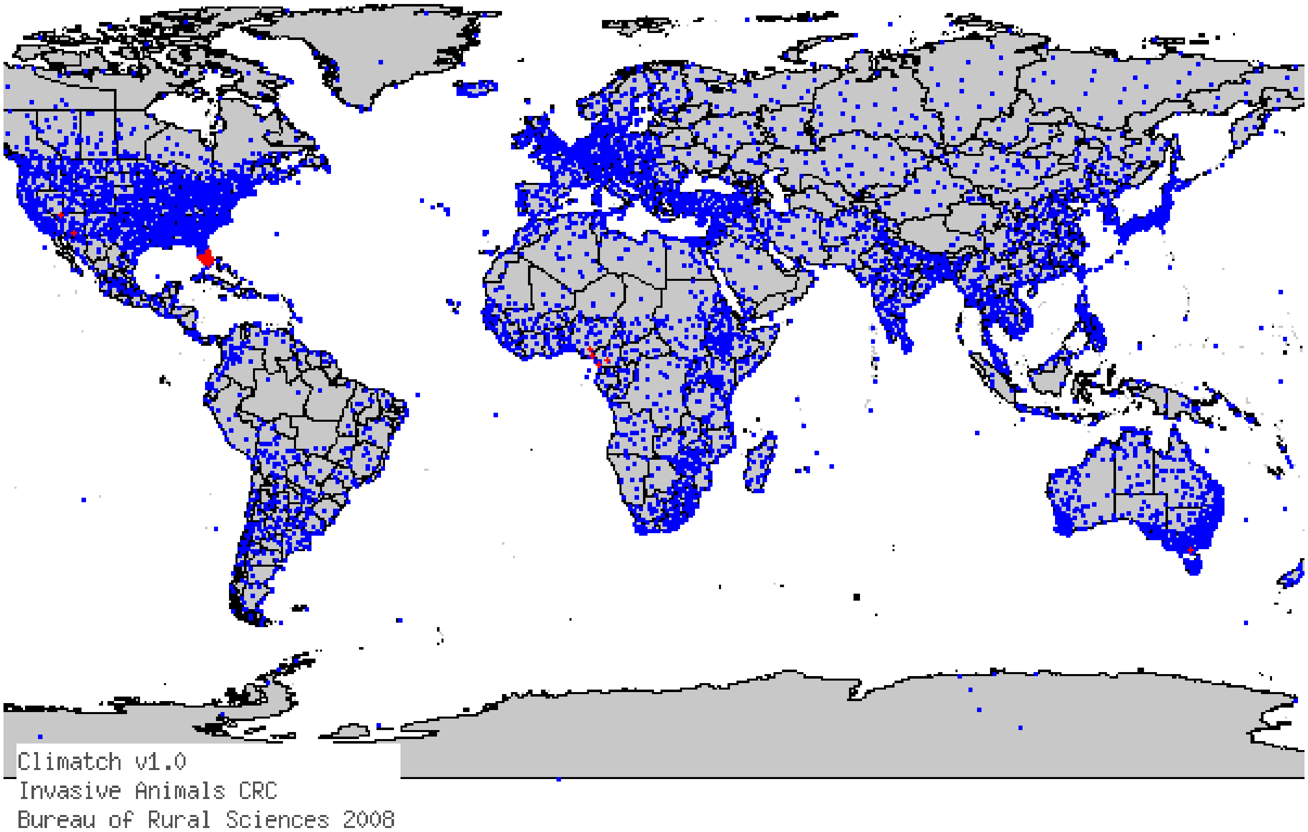

Figure 3 (above). CLIMATCH (Australian Bureau of Rural Sciences 2010) source map showing weather stations selected as source locations (red) and non-source locations (blue) for *T. mariae* climate matching. Source locations from GBIF (2010) and Nico (2012).

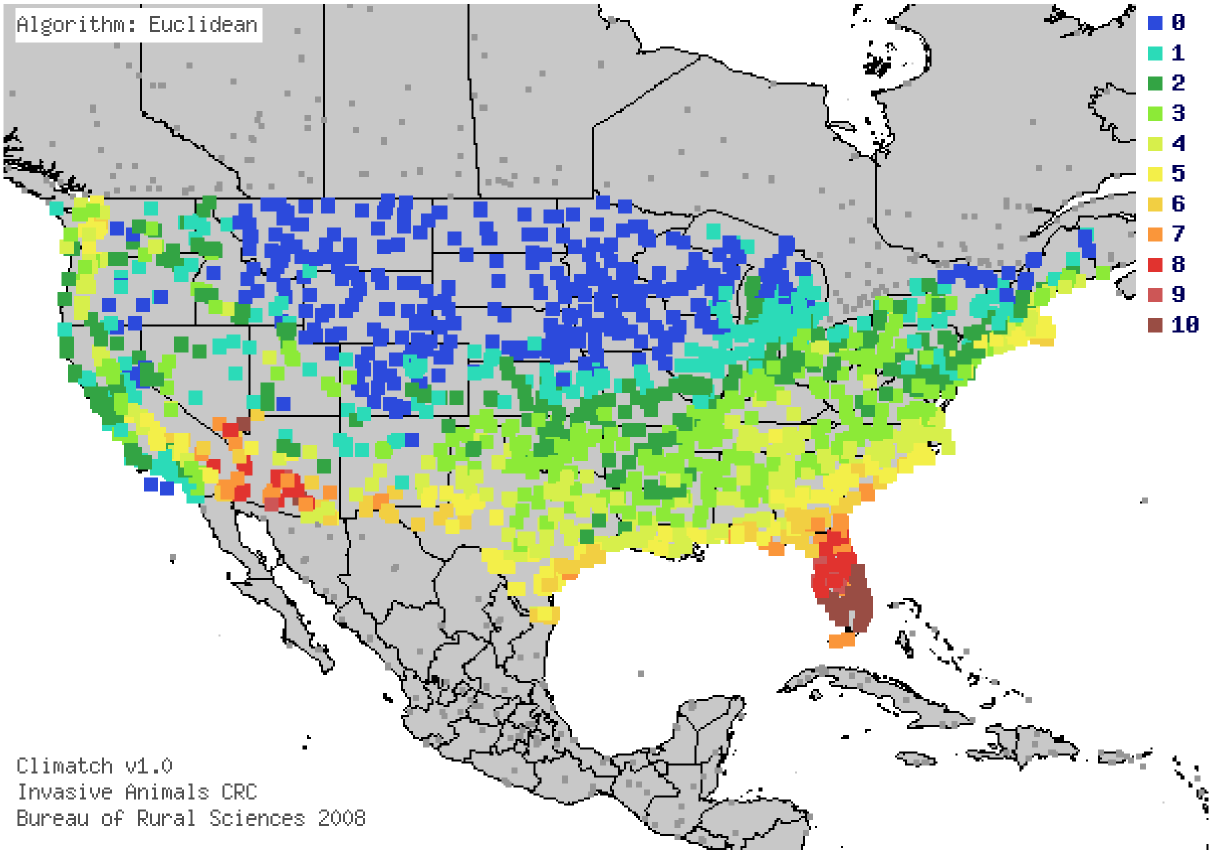

Figure 4 (above). Map of CLIMATCH (Australian Bureau of Rural Sciences 2010) climate matches for *T. mariae* in the continental United States based on source locations reported by GBIF (2010) and Nico (2012). 0= Lowest match, 10=Highest match.

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

CLIMATCH Score	0	1	2	3	4	5	6	7	8	9	10
Count	394	270	325	337	272	141	88	45	54	12	36
Climate 6 Proportion =			0.119	(High)							

7 Certainty of Assessment

Information on *T. mariae* is abundant, both on its biology and on the impacts caused by introduction of this species. The Tilapia genus is known to be a highly invasive genera. Certainty of this assessment is high.

8 Risk Assessment

Summary of Risk to the Continental United States

T. mariae is established in several U.S. states. A multitude of sources report negative impacts of its introduction in multiple locations. (See "Description of Impacts.) This fish species is currently expanding its range where it can. Areas of high to medium climate match have a significant risk of invasion.

Assessment Elements

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