

Blackchin Tilapia (*Sarotherodon melanotheron*)

Ecological Risk Screening Summary

Web Version – 10/01/2012



Photo: © U.S. Geological Survey From Nico and Neilson (2014).

1 Native Range and Nonindigenous Occurrences

Native Range

From Nico and Neilson (2014):

“Tropical Africa. Brackish estuaries and lagoons from Senegal to Zaire (Trewavas 1983).”

Nonindigenous Occurrences

From Nico and Neilson (2014):

“Established in Florida and Hawaii. Evidence indicates it is spreading rapidly in both fresh and salt water around island of Oahu, Hawaii (Devick 1991b).”

“The first documented occurrence of this species in **Florida** was a specimen gillnetted by commercial fishermen in Hillsborough Bay near Tampa, Hillsborough County, in 1959 (Springer and Finucane 1963). Additional records for the western part of the state indicate that this species is established in brackish and freshwaters in eastern Tampa Bay and in adjoining drainages in Hillsborough County, ranging from the Alafia River south to Cockroach Bay. The species has been recorded from the Alafia River from its mouth up to Lithia Springs; from the Hillsborough River, Bullfrog Creek, the Palm River, and the Little Manatee River; and from various western drainage and irrigation ditches (Springer and Finucane 1963; Finucane and Rinckey 1967; Buntz

and Manooch 1969; Lachner et al. 1970; Courtenay et al. 1974; Courtenay and Hensley 1979; Courtenay and Kohler 1986; Lee et al. 1980 et seq.; Courtenay and Stauffer 1990; DNR collections; UF museum specimens). There are two records of this species from the west side of Tampa Bay, in Pinellas County: a collection from Lake Maggiore in St. Petersburg, taken in October 1989 (UF museum specimens); and several fish taken from Mud Hole Island, in Weldon Island State Park, in December 1989 (identification based on a photograph of specimens, D. Jennings, personal communication). The species has been established in ditches and saline waters of the Banana and Indian River lagoon system along the eastern side of Florida since or shortly before about 1980 (Dial and Wainright 1983; Gilmore et al. 1983; Courtenay 1989; Snodgrass 1991; Courtenay and Stauffer 1990; Jennings and Williams 1992; Courtenay, personal communication; UF museum specimens). Jennings and Williams (1992) reported that its distribution in eastern Florida had increased significantly since initial introduction, ranging from Vero Beach, Indian River County, north to Whites Point, Brevard County. This species was reported from the Indian River lagoon south of Edgewater, Volusia County, in 1985 (C. Goodrich, personal communication), but there are no known voucher specimens and the report should be considered unconfirmed. The only record of this species in south Florida is that of five specimens taken from the upper Rio Vista Canal, at the Westview Country Club in Dade County, in November 1983 (USGS file record), but the voucher specimens have not been located and this record also should be considered unconfirmed. This species is abundant in brackish-water lagoons in **Hawaii**, including Pearl Harbor and several coastal marine environments (Randall 1987; Bishop Museum 2000). It has been established and is abundant in Wahiawa Reservoir (= Lake Wilson), a privately owned irrigation reservoir on Oahu, since the mid-1970s; it has been common in other Oahu reservoirs since the late 1970s, and also is found in many lower streams and estuaries and around local coral reefs (Maciolek 1984; Devick 1991a, 1991b)."

"At one time, the species was very popular in the aquarium fish trade (Goldstein 1973). It is very tolerant of high salinities (Dial and Wainright 1983). This species has replaced *Oreochromis macrochir* as the second most abundant tilapia (after *O. mossambicus*?) in many Hawaiian reservoirs (Devick 1991b). Distribution maps for the species have been provided for all or parts of Florida by Courtenay et al. (1974), Lee et al. (1980 et seq.), Dial and Wainright (1983), Jennings (1991), and Jennings and Williams (1992)."

Means of Introductions

From Nico and Neilson (2014):

"The probable source of Florida fish was Tampa area fish farms, although release of aquarium fish cannot be ruled out (Springer and Finucane 1963). In the eastern part of Florida, this species apparently was introduced or spread by local anglers to create a commercial fishery (Dial and Wainright 1983). Blackchin tilapia were imported into Hawaii in 1962 by the Federal Bureau of Commercial Fisheries (now the National Marine Fisheries Service); coastal and lagoon introductions were the result of escapes from a fish station on Oahu, where the species was being tested as a baitfish for tuna, in or about 1965 (Randall 1987; Devick 1991b). The fish was introduced accidentally into Wahiawa Reservoir, Hawaii, in the mid-1970s; these reservoir introductions probably resulted from bait bucket releases (Devick 1991a, 1991b)."

2 Biology and Ecology

Taxonomic Hierarchy 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 *Sarotherodon*
 Species *Sarotherodon melanotheron*

Taxonomic status: “Valid”

Size, Weight, Age

From: Froese and Pauly (2010):

“Max length : 28.0 cm SL male/unsexed; (Olaosebikan and Raji 1998); common length : 17.5 cm TL male/unsexed; (Hugg 1996.)”

Environment

From: Froese and Pauly (2010):

“Freshwater; brackish; demersal; pH range: 7.0 - 8.0; dH range: 9 - 19; depth range 3 - ? m (Page and Burr 1991)”

Climate/Range

From: Froese and Pauly (2010):

“Tropical; 23°C - 25°C (Baensch and Riehl 1985); 18°N - 0°N”

Distribution

From: Froese and Pauly (2010):

“Africa: Lagoons and estuaries from Côte d'Ivoire to Cameroon (Teugels and Thys van den Audenaerde 2003). Introduced to several countries in Asia, USA and Europe (Wohlfarth and Hulata 1983). At least one country reports adverse ecological impact after introduction.”

Short description

From Froese and Pauly (2010):

“Dorsal spines (total): 15 - 17; Dorsal soft rays (total): 10 - 12; Anal spines: 3; Anal soft rays: 8 - 10; Vertebrae: 26 - 28. Diagnosis: length of caudal peduncle 0.6-0.9 times in its depth (Teugels and Thys van den Audenaerde 2003). Melanic areas in adult usually present on lower parts of head, on cleithrum and on apices of caudal and soft dorsal fins; occasional irregular and asymmetrical spots on flanks probably representing vertical bars; median spot or transverse bar on nape rather constant (Trewavas 1983).”

From Masterson (2007):

“*Sarotherodon melanotheron*, the blackchin tilapia, is a pale (variable light blue, orange, golden yellow) cichlid whose common name refers to the dark pigmentation usually (but not always) concentrated on the underside of the head (the chin) in adult animals. Melanic pigmentation is usually also present on the posterior edge of the gill (the cleithrum) and on the tips of the soft dorsal rays. Irregular bars, spots or splotches on the body are also typical. The mouth is small and filled with up to several hundred very small teeth arranged in 3-6 rows (Trewavas 1983)”

“Sexual dimorphism is minimal in the blackchin tilapia (Trewavas 1983), although the heads of adult males are usually slightly larger than those of females and some males also have some gold coloration on their opercula.”

Biology

From: Froese and Pauly (2010):

“Primarily in estuaries and lagoons (Teugels and Thys van den Audenaerde 2003). Abundant in mangrove areas and venture in to both fresh and salt waters in native and non-native ranges (GSMFC 2003). Forms schools; is mainly nocturnal with intermittent daytime feeding. Feeds on aufwuchs [from Fishbase.org: aufwuchs is a term used to cover the small animals and plants that encrust hard substrates, such as rocks, in aquatic environments also known as periphyton] and detritus (Trewavas 1983), as well as on bivalves and zooplankton (Diouf 1996). Occurs in lower reaches of streams and can tolerate high salinity (Page and Burr 1991).”

Human uses

From: Froese and Pauly (2010):

“Fisheries: commercial; aquaculture: commercial; aquarium: commercial”

Diseases

From: Froese and Pauly (2010):

“Nosema Disease 2, Parasitic infestations (protozoa, worms, etc.)”

“Paeonodes Infestation, Parasitic infestations (protozoa, worms, etc.)”

Threat to humans

From: Froese and Pauly (2010): “Potential pest”

3 Impacts of Introductions

Information specific to *S. melanotheron*:

From Nico and Neilson (2014):

“In Lithia Springs, Florida, *S. melanotheron* made up about 90 percent of the total fish biomass (Courtenay et al. 1974). An estimated 20,000 tilapia, most of them *S. melanotheron*, were killed in Wahiawa Reservoir, Hawaii, by fungal infections in early 1991; populations of this tilapia appear to be serving as a reservoir for fungal disease and may be responsible for spreading infection to other fish species (Devick 1991a). Devick estimated that the 20,000 dead tilapia represented only about 0.05 percent or less of the total tilapia population in the reservoir.”

From Molnar (2008):

“Ecological impact - Depletion of aquatic vegetation in areas where blackchin tilapia were commonly caused by overgrazing. These authors also noted that in Lithia Springs, Florida, where blackchin tilapia constituted 90% of the total fish biomass, co-occurring largemouth bass and bluegill appeared diseased and malnourished. Given their adaptability to broad salinity ranges and their trophic plasticity, they can become locally dominant and contribute to lowering biodiversity. As is the case with other cichlids, blackchin tilapia also compete with native fishes for breeding grounds (Molnar 2008).”

From Masterson (2007):

“Invasion History:

The blackchin tilapia was the first of at least six species of tilapia that have been released into Florida environments (Shafland 1996). The species was originally imported into the United States to be raised and sold for the aquarium trade (Axelrod and Schultz 1955). Initial release to the natural environment was most likely an accidental escape from a west coast fish farm in the mid-1950s. “

“Introduction of blackchin tilapia to Florida waters initially occurred near Tampa Bay in the 1950s, through release associated with the aquarium trade (Springer and Finucane 1963, Courtenay and Robins 1973, Hensley and Courtenay 1980, Jennings and Williams 1992). The first records confirming collection of this species from the wild on the west coast of Florida date to 1959 (Springer and Finucane 1963).”

“The east coast IRL [Indian River Lagoon] watershed blackchin tilapia population became established substantially later; the first reported collection from the wild dates to 1980 from Satellite Beach in Brevard County (Dial and Wainright 1983).”

“The east coast population may also derive from aquarium releases or aquaculture escapes, although there is some speculation that it resulted from an intentional introduction by fishermen (Dial and Wainright 1983, Jennings and Williams 1992). One additional IRL introduction pathway has been proposed that points to escape of this species from an ornamental pond located at the Satellite Beach Civic Center where it was used to control the growth of algae (Dial and Wainright 1983). Regardless of the actual mechanism, authors have suggested Satellite Beach as the likely epicenter for the east coast *S. melanotheron* introduction (Dial and Wainright 1983, Jennings and Williams 1992).”

“Thermal tolerance limits may restrict northward expansion of the Florida range of blackchin tilapia, but there appears to be no similar mechanism limiting southward range expansion (Snodgrass 1989, Jennings and Williams 1992).”

“Potential to Compete With Natives:

Large populations of *S. melanotheron* likely compete with native fish populations for resources. Courtenay et al. (1974) provide circumstantial evidence, noting a malnourished and diseased appearance in largemouth bass and bluegills co-occurring with non-native blackchin tilapia in a Florida freshwater spring. In addition to dietary items, blackchin tilapia may compete with other species for breeding and nesting space, as is typical for cichlids.”

“Direct predation of *S. melanotheron* on co-occurring native species may be less important than competitive interactions. Given their adaptability and euryhaline habit, however, the species nevertheless has the ability to dominate systems it invades potentially resulting in biodiversity reduction (Dial and Wainright 1983). FishBase rates the resilience of *S. melanotheron* as "medium" based on an estimated minimum population doubling time of 1.4 - 4.4 years.

Established populations of blackchin tilapia have been associated with a reduction of aquatic vegetation due to overgrazing (Courtenay et al. 1974).”

“Possible Economic Consequences of Invasion:

Blackchin tilapia have been exploited as a food resource in their native range, and have been utilized as an aquaculture and non-native fishery species elsewhere as well. Early records of commercial utilization in Florida date from 1959, when the species was marketed under the name "African sunfish" (Springer and Finucane 1963). *S. melanotheron* taken from Florida waters are included as commercial fishery landings, but no estimate on the value of this fishery component has been assessed.”

“No studies have been reported that fully evaluate the economic impacts this exotic fish has had on freshwater, marine, and estuarine systems in Florida.”

From Hoover (2006):

“Tilapias are a group of hardy, fast-growing fresh and brackish water fishes native to Africa and the Near East which have been widely spread throughout the tropics for food and aquaculture. Many are, or were at one time, classified in the genus *Tilapia*, thus the common name. All tilapias are members of the enormous freshwater fish family Cichlidae--the second-largest fish family in the world and one of the most diverse. Some cichlids are quite colorful. Because they are easy to breed, many have entered the freshwater aquarium trade. Over the years, aquarists have released a surprising number of cichlid species into Hawaii's streams and reservoirs, where some have become established. Most of the tilapias, however, were deliberately introduced beginning with four species in the early 1950s brought in control vegetation in irrigation canals, for possible use as baitfish, and also for human food and recreation. Of these introduced species, the Mozambique Tilapia (*Oreochromis mossambicus*) was at first the most successful, becoming almost ubiquitous in the fresh and brackish waters of the Islands. Salt-tolerant, it even entered the marine environment to some degree. However, it has since been largely displaced by the even more hardy and adaptable Blackchin Tilapia (*Sarotherodon melanotheron*), which was introduced accidentally in 1965.”

“Sometimes called the "saltwater tilapia", the Blackchin has the ability to survive, maybe even to breed, in pure seawater and can be seen off sheltered beaches and in lagoons around O`ahu and possibly the other islands. We do not yet know yet what effect this fish will have on our marine ecosystems but in places like Pearl Harbor or Kane`ohe Bay it is sometimes caught in nets intended for the the Hawaiian Anchovy, or nehu, a valuable baitfish, and may be preying upon them. (At other Pacific Islands, such as Fanning and Nauru, the picture is more clear: introduction of tilapias into saltwater ponds has damaged or destroyed traditional culture of mullets and milkfish and eradication has proved impossible.) In Hawai`i these fish are now considered pests in canals and reservoirs because they reproduce quickly, out-compete other species, and then often suffer massive die-offs. In 1991, for example, an estimated 20,000 tilapia--most of them Blackchins--died of a fungal infection in Lake Wilson, O`ahu. These were estimated to represent half a percent or less of the total tilapia population in the reservoir. At

present about 10 species of tilapias are believed to be established in Hawai`i, although rampant hybridization can make identification difficult and uncertain.”

General information on the impacts of Tilapia

Although sources on the effects of *S. melanotheron* introductions are limited, the following information illustrates that other species among the group of fish known as “tilapias” 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.”

4 Global Distribution



Figure 1 (above). Global distribution of *S. melanotheron*. Map from GBIF (2010).

5 Distribution within the United States



Figure 2 (above). Distribution of *S. melanotheron* in the United States. Map from Nico and Neilson (2014).

6 CLIMATCH

Summary of Climate Matching Analysis

The climate match (Australian Bureau of Rural Sciences 2010; 16 climate variables; Euclidean Distance) was high in Florida and southern California. Medium matches ran along the West Coast, southern border, and the southern East Coast. Low and low-medium matches covered the rest of the country. 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 *S. melanotheron* is 0.116.



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 *S. melanotheron* climate matching. Source locations from GBIF (2010) and Nico and Neilson (2014). Only established locations were used for climate matching.

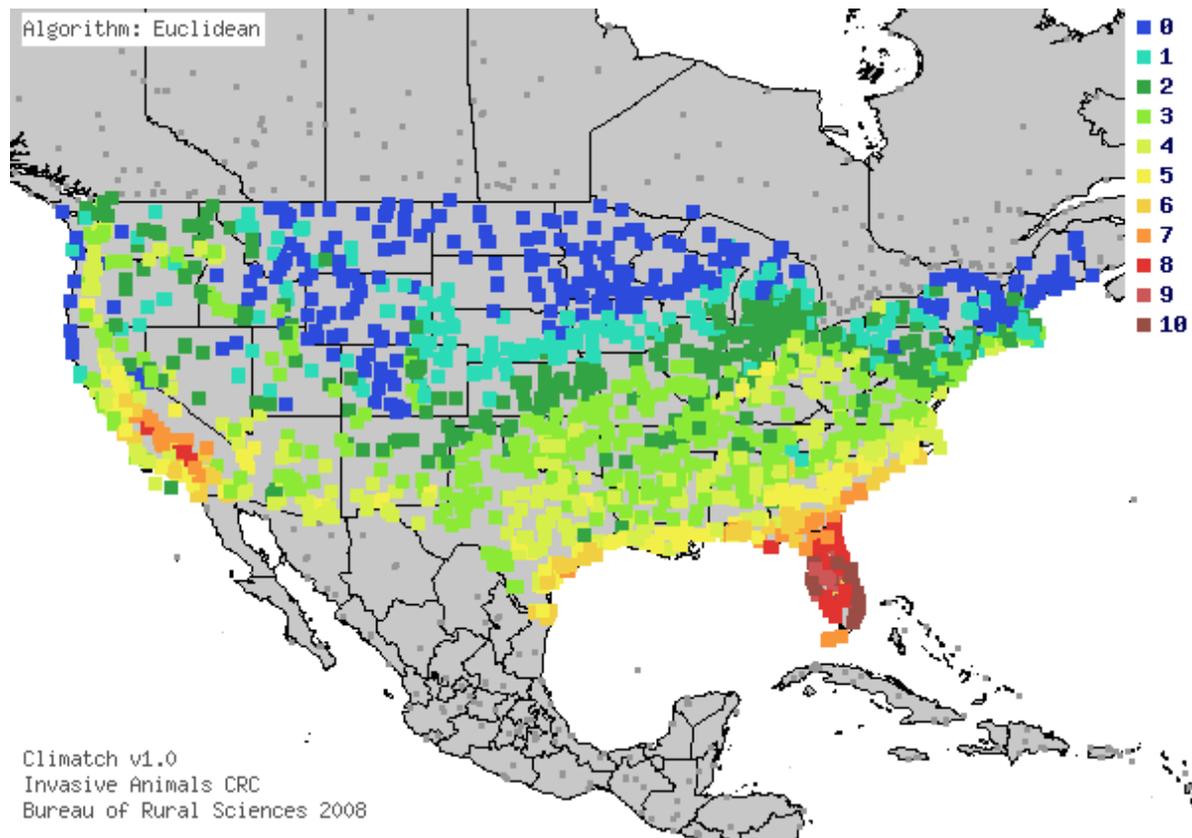


Figure 4 (above). Map of CLIMATCH (Australian Bureau of Rural Sciences 2010) climate matches for *S. melanotheron* in the continental United States based on source locations reported by GBIF (2010) and Nico and Neilson (2014). 0= Lowest match, 10=Highest match.

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	297	222	363	424	315	129	91	53	36	11	38
Climate 6 Proportion = 0.116 (High)											

7 Certainty

Information on *S. melanotheron* is fairly abundant, both on its biology and on the impacts caused by introduction of this species. The three fish genera known as “tilapias” (*Oreochromis*, *Tilapia*, and *Sarotherodon* spp.) are known to be highly invasive genera; however, more research specifically on the invasive nature of *S. melanotheron* would strengthen the certainty of this assessment. Certainty of this assessment is medium.

8 Risk Assessment

Summary of Risk to the Continental United States

USGS.gov describes *S. melanotheron* as spreading rapidly and transferring diseases to other fishes. FishBase.org lists *S. melanotheron* as a Potential Pest, and the United Nations (2010) lists it as having adverse ecological impacts. Additional sources specific to the invasiveness of *S. melanotheron* could not be found, but many other tilapia species have been described as highly invasive (see “Description of Impacts”).

Assessment Elements

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