Redbreast Tilapia (*Coptodon rendalli*)
Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, 2012
Revised, May and July 2019
Web Version, 9/18/2019


1 Native Range and Status in the United States

Native Range
From Nico et al. (2019):

“Tropical and subtropical Africa. Kasai drainage, upper Congo River, Cunene, Okavango, Limpopo and Zambezi system, Lakes Tanganyika and Malawi, east coastal rivers south to Phongolo, and coastal lakes to Lake Sibaya; also occurs in estuaries in Mozambique and Natal (Thys van den Audenaerde 1964; de Moor and Bruton 1988; Teugels et al. 1991; Skelton 1993).”
From Konings et al. (2018):

“In central Africa, *Coptodon rendalli* is naturally known from the Upper Congo basin (Katanga region and Lualaba River) down to Kisangani (Stanleyville) and even to Isangi (Central Congo basin) [Democratic Republic of the Congo].”

“In eastern Africa, this species is native to the Lake Tanganyika and Malawi Basins [Burundi, Tanzania, Democratic Republic of the Congo, Zambia, Malawi, Mozambique] and Lakes Chilwa and Chiuta [Malawi, Mozambique] (Twedde 1979, 1983) and the Shire River (Malawi) (Twedde and Willoughby 1979).”

“In southern Africa, this species is native to the Cunene, Okavango, Zambezi systems including Lake Malawi [Tanzania, Malawi, Mozambique, Zambia, Zimbabwe, Botswana, Angola, Namibia], and east coastal rivers south to the Phongolo and coastal lakes to Lake Sibaya (Skelton 2001) [Mozambique, Eswatini, South Africa], as well as estuaries in Mozambique and KwaZulu-Natal [South Africa]. It is found in all Zimbabwean rivers although it was probably absent originally from the upper Save-Runde and scarce on the highveld (Junor 1969).”

“Native: Angola; Botswana; Burundi; Congo, The Democratic Republic of the; Eswatini; Malawi; Mozambique; Namibia (Caprivi Strip); South Africa (Gauteng, KwaZulu-Natal, Limpopo Province, Mpumalanga, North-West Province); Tanzania, United Republic of; Zambia; Zimbabwe”

**Status in the United States**

From Nico et al. (2019):

“Although this species was formerly considered established and spreading in Hawaii (Maciolek 1984), or at least established (Courtenay et al. 1991), its recent status in the state is considered uncertain (Devick 1991a). Established in Puerto Rico.”

Wu and Yang (2012) confirmed establishment of *T. rendalli* in a reservoir on the Hawaiian island of Oahu through genetic analysis.

From Wu and Yang (2012):

"The results of phylogenetic tree analysis demonstrated that the populations collected from the wild reservoirs included two different species, *S. melanotheron* and *T. rendalli* [...]"

There is no indication that this species is in trade in the United States.

**Means of Introductions in the United States**

From Nico et al. (2019):

“This species was brought to Hawaii as a shipment of 52 fish from Africa in 1957; these fish were bred in tanks by the state, and resulting offspring were stocked in Wahiawa Reservoir in 1958 and 1959 and on Maui in 1959. According to Devick (1991b), these intentional
introductions were undertaken for aquaculture (aku bait) and weed control. The [sic] were intentionally introduced into Puerto Rico for week [sic] control and angling.”

Remarks
A previous version of this ERSS was published in 2012 under the formerly accepted scientific name *Tilapia rendalli*. Because the acceptance of *C. rendalli* as the valid scientific name occurred within the past decade and the name *T. rendalli* is still commonly used in literature, both scientific names were used as search terms to find information for this report.

From Nico et al. (2019):

“Identification of this species in the United States has been problematic and some reports in the literature on nonindigenous species may be misidentifications (Lee et al. 1980 et seq.) or hybrids (Courtenay et al. 1984; Taylor et al. 1986; Howells 1991b). Redbreast tilapia is nearly identical to redbelly tilapia *Tilapia zillii*, and the two species frequently hybridize; many reports or specimens of *T. rendalli* may potentially be *T. zillii* or their hybrids. Both redbreast and redbelly tilapia are superficially similar to another North American introduced cichlid, spotted tilapia *Tilapia mariae*: spotted tilapia lacks the red ventral coloration present in *T. rendalli*, has lateral vertical stripes that extend onto the dorsal fin, and 5-6 square black blotches along the side (lacking in *T. rendalli*).”

“This species is referenced as *T. melanopleura* in previous reports concerning introduced species (e.g., Maciolek 1984; Devick 1991a, 1991b). A report of *T. melanopleura* in Alabama by Smith-Vaniz (1968) was based on incorrect identifications of fish later shown to be *T. zillii* (Smith-Vaniz, personal communication). Barrett (1983) tentatively re-identified some California specimens, previously reported to be *T. zillii*, as *T. rendalli*; he based his determination on various morphological characters and color patterns. These fish were taken from near Blythe, Riverside County.”

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing
From Froese and Pauly (2019b):

“Biota > Animalia (Kingdom) > Chordata (Phylum) > Vertebrata (Subphylum) > Gnathostomata (Superclass) > Pisces (Superclass) > Actinopterygii (Class) > Perciformes (Order) > Labroidei (Suborder) > Cichlidae (Family) > Pseudocrenilabrinae (Subfamily) > Coptodon (Genus) > *Coptodon rendalli* (Species)”

“Status accepted”
From Fricke et al. (2019):

“Current status: Valid as *Coptodon rendalli* (Boulenger 1897). Cichlidae: Pseudocrenilabrinae.”

**Size, Weight, and Age Range**

From Froese and Pauly (2019a):

“Maturity: $L_m$ 17.7 range ? - ? cm
Max length : 45.0 cm TL male/unsexed; [Anonymous 1994]; max. published weight: 2.5 kg [Anonymous 1994]; max. reported age: 7 years [Baensch and Riehl 1991]”

**Environment**

From Froese and Pauly (2019a):

“Freshwater; brackish; benthopelagic; depth range 3 - 8 m [Mundy 2005]. [...] 24°C - 28°C [Baensch and Riehl 1991; assumed to be recommended aquarium water temperature range]”

“They are tolerant of a wide range of temperatures (8-41°C) and salinities [Philippart and Ruwet 1982; Skelton 1993; Genner et al. 2018].”

From Konings et al. (2018):

“This species is tolerant of a wide range of temperatures (11–37°C) and salinity to 19 parts per thousand.”

**Climate/Range**

From Froese and Pauly (2019a):

“Tropical; [...] 20°N - 20°S”

**Distribution Outside the United States**

Native

From Nico et al. (2019):

“Tropical and subtropical Africa. Kasai drainage, upper Congo River, Cunene, Okavango, Limpopo and Zambezi system, Lakes Tanganyika and Malawi, east coastal rivers south to Phongolo, and coastal lakes to Lake Sibaya; also occurs in estuaries in Mozambique and Natal (Thys van den Audenaerde 1964; de Moor and Bruton 1988; Teugels et al. 1991; Skelton 1993).”

From Konings et al. (2018):

“In central Africa, *Coptodon rendalli* is naturally known from the Upper Congo basin (Katanga region and Lualaba River) down to Kisangani (Stanleyville) and even to Isangi (Central Congo basin) [Democratic Republic of the Congo].”
“In eastern Africa, this species is native to the Lake Tanganyika and Malawi Basins [Burundi, Tanzania, Democratic Republic of the Congo, Zambia, Malawi, Mozambique] and Lakes Chilwa and Chiuta [Malawi, Mozambique] (Tweddele 1979, 1983) and the Shire River (Malawi) (Tweddele and Willoughby 1979).”

“In southern Africa, this species is native to the Cunene, Okavango, Zambezi systems including Lake Malawi [Tanzania, Malawi, Mozambique, Zambia, Zimbabwe, Botswana, Angola, Namibia], and east coastal rivers south to the Phongolo and coastal lakes to Lake Sibaya (Skelton 2001) [Mozambique, Eswatini, South Africa], as well as estuaries in Mozambique and KwaZulu-Natal [South Africa]. It is found in all Zimbabwesian rivers although it was probably absent originally from the upper Save-Runde and scarce on the highveld (Junor 1969).”

“Native: Angola; Botswana; Burundi; Congo, The Democratic Republic of the; Eswatini; Malawi; Mozambique; Namibia (Caprivi Strip); South Africa (Gauteng, KwaZulu-Natal, Limpopo Province, Mpumalanga, North-West Province); Tanzania, United Republic of; Zambia; Zimbabwe”

Introduced
According to Froese and Pauly (2019a), *C. rendalli* is established in Brazil, Chad, Colombia, Cuba, El Salvador, Ethiopia, Gabon, Kenya, Madagascar, Mauritius, Papua New Guinea, Peru, Rwanda, Sri Lanka, Thailand, Turkey, and Uganda.

According to Froese and Pauly (2019a), *C. rendalli* is probably established in Antigua, Republic of the Congo, and Wallis and Futuna.

According to Froese and Pauly (2019a), *C. rendalli* is not established or probably not established in Cameroon, Central African Republic, Cote d’Ivoire, Dominican Republic, Panama, Sudan, and Taiwan.

Capture of over 50 adult *T. rendalli* from a reservoir in northwest Cameroon, reported by Tombi et al. (2017), supports establishment in Cameroon.

From Konings et al. (2018):

“It has been introduced and translocated in many parts of Africa. In northern Africa, it is recorded from Mauritania (introduced). It has also been introduced in many tropical and subtropical areas around the world.”

“Introduced: Cameroon; Congo; Gabon; Kenya; Mauritania; Rwanda”

From Cassemiro et al. (2018):

“In Brazil, *O[reochromis] niloticus* and *C. rendalli* have been recognized as established in the reservoirs of Paraná, São Paulo, and Minas Gerais (Petesse et al., 2007; Novaes & Carvalho, 2012; Ortega et al., 2015; Daga et al., 2016) […]”
“[…] this species has been recorded primarily in reservoirs of hydroelectric power plants along the Paraná-Paraguay River Basin in Brazil (Luiz et al., 2003; Baumgartner et al., 2006; Rocha et al., 2011; Ortega et al., 2015) and weirs in northeast Brazil (Silva & Araújo, 1996).”

Sherley (2000) reports *C. rendalli* (as *T. rendalli*) is established in the Pacific island nations of Wallis, Papua New Guinea, and Guam, and introduced but not established in Fiji and New Caledonia.

Pérez-Ponce de León et al. (2000) report *C. rendalli* (as *T. rendalli*) is established in Mexico.

**Means of Introduction Outside the United States**

From Konings et al. (2018):

“It has been introduced (as *Tilapia melanopleura*) for aquacultural purposes, in 1949, from Yangambi, Democratic Republic of Congo, to Yaoundé, Cameroon. According to Thys van den Audenaerde (1966), who observed a few specimens of this species at the fisheries station of Melen near Yaoundé, the specimens from Yangambi originated from Katanga. Its use for aquaculture in Cameroon has been abandoned. It has also been introduced, for aquacultural purposes, in 1953, from the Democratic Republic of Congo to the fisheries station of Djoumouna, Republic of the Congo (Congo basin). According to Moreau *et al.* (1988) its use in aquaculture was abandoned, but this species probably established in the country [Republic of the Congo]. The introduction of *C. rendalli* into the Lower Guinean part of the Republic of the Congo is confirmed by a museum record originating from a pond at the station of Dimonika. *Coptodon rendalli* has also been introduced (as *T. melanopleura*) around 1950, from Katanga but originating from the fisheries station of Kinshasa (Leopoldville), Democratic Republic of Congo, to Libreville, Makokou, Lebamba, Franceville and maybe other places in Gabon. Its presence in Gabon is confirmed by museum records from the Ogowe River basin.”

“It has been introduced in Lake Victoria and many dams and water systems all over the region [Kenya, Tanzania, Uganda], for example the Pangani drainage (including Lake Jipe), Lake Chala and Athi/Sabaki drainage. It has also been introduced in the Tana River system (Mann 1966, 1968, Seegers *et al.* 2003). According to Welcomme (1988) and Lever (1996) it was introduced from an unrecorded source into Kenya in 1955 for stocking (Seegers *et al.* 2003). It has also been introduced and is now well settled in the upper and middle Akagera system [Burundi, Rwanda].”

“*Its distribution [in Zimbabwe] has been extended by translocations, especially into small farm dams, in an attempt to control plant growth.”*

From Cassemiro *et al.* (2018):

“In parts of these regions [north Argentina to northeast Brazil], the introduction of *C. rendalli* occurred with the principal purpose of increasing the fisheries in dammed systems (Agostinho *et al.*, 2007). Thus, this species has been recorded primarily in reservoirs of hydroelectric power plants […]”
From Espinosa-Pérez and Ramírez (2015):

“Oreochromis aureus” (Steindachner, 1864), O. mossambicus (Peters, 1852), O. niloticus (Linnaeus, 1758), Tilapia rendalli (Boulenger, 1897), T. zillii (Gervais, 1848) and Hemichromis guttatus Günther, 1862 are African species introduced for aquaculture in Mexico. These species have been progressively introduced in many freshwater bodies of the country, both natural and artificial for aquaculture and commercial catch.”

**Short Description**
From Froese and Pauly (2019a):

“Dorsal spines (total): 15 - 17; Dorsal soft rays (total): 10-13; Anal spines: 3; Anal soft rays: 9 - 10; Vertebrae: 29. Diagnosis: A large, deep-bodied species with a steep head profile, narrow head and small mouth; often appearing brownish with a white belly, some individuals have bright red bellies [Genner et al. 2018]. The sexes look very similar, although males are usually larger [Genner et al. 2018]. Very difficult to distinguish from Coptodon zillii, but C. rendalli usually have a steeper head profile and less prominent vertical bars; in East Africa, the tailfin of C. rendalli is often divided into a brownish upper part ad [sic] yellowish lower part, whereas that of C. zillii is uniform and spotted [Genner et al. 2018].”

**Biology**
From Froese and Pauly (2019a):

“It prefers quiet, well-vegetated water along river littorals or backwaters, floodplains and swamps. […] Forms schools; is mainly diurnal. Juveniles feed on plankton [Lamboj 2004]; adults feed on leaves and stems of underwater plants as well as algae, and vegetative detritus [Lamboj 2004], insects and crustaceans. A substrate spawner; male and female form pairs to rear the young: eggs and larvae are usually guarded in a steep-side circular pit dug in the mud [Genner et al. 2018]. Occasionally it spawns in large cave-like structures [Lamboj 2004], e.g. in Lake Malawi they are reported to dig a network of tunnels at some sites [Genner et al. 2018].”

**Human Uses**
From Froese and Pauly (2019a):

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

From Konings et al. (2018):

“The species is not targeted by the ornamental fish trade, but is an important food fish.”

From Nico et al. (2019):

“Tilapia rendalli is a popular angling species in Africa, is important in aquaculture and fisheries, and also is used for weed control in reservoirs (Skelton 1993). This species is widely targeted by
anglers in the Humacao Natural Reserve lagoon system in Puerto Rico (Ferrer Montaño and Dribble 2008).”

**Diseases**

No OIE-reportable diseases (OIE 2019) have been documented for this species.

From Froese and Pauly (2019a):

“Anchor worm Disease, Parasitic infestations (protozoa, worms, etc.)
*Cichlidogyrus* Disease, Parasitic infestations (protozoa, worms, etc.)
*Clinostomum* Infestation (metacercaria), Parasitic infestations (protozoa, worms, etc.)
*Acanthogyrus* Infestation, Parasitic infestations (protozoa, worms, etc.)
*Paradilepis* Infestation, Parasitic infestations (protozoa, worms, etc.) […]
Eye Infection (*Diplostomum* sp.), Parasitic infestations (protozoa, worms, etc.)”

**Threat to Humans**

From Froese and Pauly (2019a):

“Potential pest”

### 3 Impacts of Introductions

From Redding (1989):

“The main negative effects on the environment caused by *T. rendalli* has been due to its voracious feeding habits. In Mauritius (George 1976), Brazil (Nomura 1976, 1977), and Madagascar (Lamarque et al. 1975) *T. rendalli* is reported to have upset the ecology of the waters through either overpopulation, destruction of vegetation or through disturbing the ecology. It is reported that in Madagascar *T. rendalli* was accidentally introduced and proceeded to wipe out 3000 hectares of *Ceratophyllum* and *Nymphaea* in three years and, as a result, one valuable species of indigenous fish *Paretropus petiti* was almost wiped out (Lamarque et al. 1975).”

From Starling et al. (2002):

“We examined whether a large stock of tilapia (>750 kg ha⁻¹, in littoral areas >1300 kg ha⁻¹), mostly *Oreochromis niloticus* (L.) and *Tilapia rendalli* (Boulenger), could contribute to the eutrophication of a tropical reservoir (Lago Paranoá, Brasília, Brazil) by enhancing P(osphorus)-loading.”

“We took advantage of an extensive fish kill [mostly *Oreochromis niloticus* (L.) and *Tilapia rendalli* (Boulenger)] (>150 tons removed) during May–August 1997 in a hypereutrophic branch of the reservoir to compare water quality characteristics 1 year before and after this event by means of BACI statistics. We also measured P-excretion rates in laboratory trials to assess the P-loading of the reservoir by the tilapia relative to tributary inputs and loading from a sewage treatment plant.”
“Concentrations of chlorophyll $a$ (decline from 84 to 56 μg L$^{-1}$, $P = 0.018$) and total P (decline from 100 to 66 μg L$^{-1}$, $P < 0.001$) decreased significantly in the branch of the reservoir affected by the fish kill, compared with a similar but unaffected branch that served as a control. Because P-loading by both a sewage treatment plant and tributaries remained high after the incidence, the fish kill was likely to contribute to the observed water quality improvement.”

From Wager and Rowe-Rowe (1972):

“Wager (1968) lists many floating and submerged aquatic, shallow water and verge plants that are entirely consumed by $T. rendalli$. Junor (1969) gives a similar list, including many different species. $T. rendalli$ avidly feeds on fry of other fish, notably of largemouth bass, Micropterus salmoides.”

“Most harm is done to a fresh water habitat by $T. rendalli$.”

From Canonico et al. (2005):

“In Lake Alaotra, the progressive introductions of different species – carp first, followed by several species of tilapias in 1954 ($T. rendalli$), 1958 ($O. macrochir$), and 1961 ($O. niloticus$ and $O. mossambicus$) – have also induced a drastic decline of native fish (Lévêque, 1997). Lévêque noted the quick proliferation of each of the tilapias since the first introduction in 1954, attributed to their high fecundity and ability to occupy empty niches.”

From Ramanantsalama et al. (2018):

“$Paretroplus$ dambabe is a local endemic fish species only found in Kinkony Lake (in northwestern wetland and protected area) and two surrounding small lakes, Andranobe and La Digue [Madagascar]. […] Environmental variables and the presence of the Tilapiinae cichlids do not yet affect the presence of $P. dambabe$ in the Kinkony Lake. But, the abundance of this endemic fish is negatively and significantly influenced by the abundance of the common carp Cyprinus carpio, Ambassis sp., sleepy goby Glossogobius biocelatus, tank goby $G. giuris$, longfin tilapia Oreochromis macrochir, Nile tilapia $O. niloticus$, Mozambic tilapia $O. mossambicus$, redbreast tilapia Tilapia rendalli and redbelly tilapia $T. zillii$. ”
4 Global Distribution

Figure 1. Known global distribution of *Coptodon rendalli*, reported from Africa and the Americas. Map from GBIF Secretariat (2019). Occurrences in Alabama (United States), central Brazil, the Dominican Republic, and the Ivory Coast were excluded from the climate matching analysis because they do not represent established populations of *C. rendalli*.
5 Distribution Within the United States

Figure 2. Known distribution of *Coptodon rendalli* in the United States. Map from Nico et al. (2019). Yellow diamonds represent established populations; the orange diamond represents a specimen with a status of “collected”.

6 Climate Matching

Summary of Climate Matching Analysis

The Climate 6 score (Sanders et al. 2018; 16 climate variables; Euclidean distance) for the contiguous United States was 0.101, indicating a medium overall climate match. A Climate 6 score between 0.005 and 0.103 indicates a medium climate match. The southern United States had the highest climate match: individual State Climate 6 scores were high in Alabama, Arizona, Florida, Georgia, Louisiana, Mississippi, North Carolina, New Mexico, and Texas; and medium in California and South Carolina. Locally, high matches occurred in peninsular Florida, along the Gulf Coast, in western Texas, and in southern New Mexico. The northern United States had a generally low climate match, except around Puget Sound, where the climate match was medium.
Figure 3. RAMP (Sanders et al. 2018) source map showing weather stations selected as source locations (red; southern and central Africa [including Madagascar], Brazil, Colombia, the United States [Puerto Rico and Hawaii], and Mexico) and non-source locations (gray) for *Coptodon rendalli* climate matching. Source locations from GBIF Secretariat (2019).
The “High”, “Medium”, and “Low” climate match categories are based on the following table:

<table>
<thead>
<tr>
<th>Climate 6: Proportion of (Sum of Climate Scores 6-10) / (Sum of total Climate Scores)</th>
<th>Climate Match Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.000≤X&lt;0.005</td>
<td>Low</td>
</tr>
<tr>
<td>0.005&lt;X&lt;0.103</td>
<td>Medium</td>
</tr>
<tr>
<td>≥0.103</td>
<td>High</td>
</tr>
</tbody>
</table>

7 Certainty of Assessment

Information is available on the biology, ecology, and distribution of *Coptodon rendalli*. Multiple introductions of this species outside of its native range have been documented, although identification to the species level can be difficult at times. Negative impacts of introduction of this species have been documented, but only one study attributed impacts solely to *C. rendalli* and not to a group of introduced species. Further information is needed to be confident in the assessed risk, so the certainty of this assessment is medium.
8 Risk Assessment

Summary of Risk to the Contiguous United States

*Coptodon rendalli*, the Redbreast Tilapia, is a fish species native to a wide range of fresh and brackish waters in tropical and subtropical Africa. It has been introduced widely outside its range in Africa for aquaculture and weed control, and it is also a commercial and recreational fishing target. *C. rendalli* has been introduced to parts of Africa outside the native range, Central and South America, Thailand, Turkey, and some Pacific islands. In the United States, *C. rendalli* is established in Hawaii and Puerto Rico. In Madagascar, extreme population decline of an endemic fish is attributed to the impacts of *C. rendalli* herbivory on its habitat. Because most introductions of *C. rendalli* have occurred in locations where other nonnative species introductions have also occurred, the impacts of *C. rendalli* often cannot be separated from impacts of other nonnative species. For these reasons, the history of invasiveness is high for *C. rendalli*, but the certainty of the assessment is medium. *C. rendalli* has a medium climate match with the contiguous United States, with the highest match occurring in the southern United States. The overall risk assessment category is high.

Assessment Elements

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


10 References Quoted But Not Accessed

Note: The following references are cited within quoted text within this ERSS, but were not accessed for its preparation. They are included here to provide the reader with more information.


Courtenay et al. 1984 [Source material did not provide full citation for this reference.]


Howells 1991b [Source material did not provide full citation for this reference.]


Lamboj, A. 2004. The cichlid fishes of Western Africa. Birgit Schmettkamp Verlag, Bornheim, Germany.

Lee et al. 1980 et seq. [Source material did not provide full citation for this reference.]


Moreau et al. 1988 [Source material did not provide full citation for this reference].


Ortega, J. C. G., H. F. Julio Jr., L. C. Gomes, and A. A. Agostinho. 2015. Fish farming as the main driver of fish introductions in Neotropical reservoirs. Hydrobiologia 746:147-158.


Taylor et al. 1986 [Source material did not provide full citation for this reference.]


Thys van den Audenaerde 1966 [Source material did not provide full citation for this reference].


