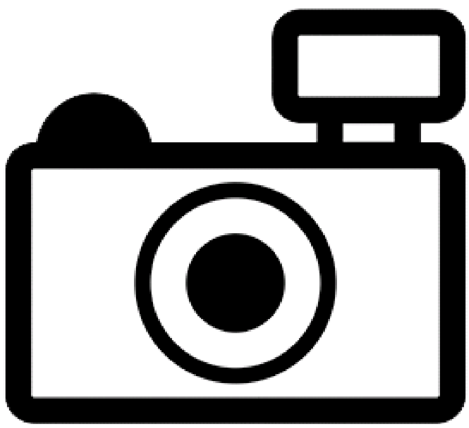
Lake Magadi Tilapia (*Alcolapia grahami*)
Ecological Risk Screening Summary

U.S. Fish & Wildlife Service, March 2015
Revised, August 2017, October 2017
Web Version, 8/21/2018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1 Native Range and Status in the United States

Native Range
From Bayona and Akinyi (2006):

"The natural range of this species is restricted to a single location: Lake Magadi [Kenya]."

Status in the United States
No records of *Alcolapia grahami* in the wild or in trade in the United States were found.

The Florida Fish and Wildlife Conservation Commission has listed the tilapia *Alcolapia grahami* as a prohibited species. Prohibited nonnative species (FFWCC 2018), "are considered to be dangerous to the ecology and/or the health and welfare of the people of Florida. These species are not allowed to be personally possessed or used for commercial activities."

Means of Introductions in the United States
No records of *Alcolapia grahami* in the United States were found.

Remarks

From Bayona and Akinyi (2006):

"Vulnerable D2 ver 3.1"

Various sources use *Alcolapia grahami* (Eschmeyer et al. 2017) or *Oreochromis grahami* (ITIS 2017) as the accepted name for this species. Information searches were conducted under both names to ensure completeness of the data gathered.

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

According to Eschmeyer et al. (2017), *Alcolapia grahami* (Boulenger 1912) is the current valid name for this species. It was originally described as *Tilapia grahami*; it has also been known as *Oreoghromis grahami*, and as a synonym, but valid subspecies, of *Oreochromis alcalicus*.

From ITIS (2017):

"Kingdom Animalia
Subkingdom Bilateria
Infrakingdom Deuterostomia
Phylum Chordata
Subphylum Vertebrata
Infraphylum Gnathostomata
Superclass Actinopterygii
Class Teleostei
Superorder Acanthopterygii
Order Perciformes
Suborder Labroidei
Family Cichlidae
Genus *Oreochromis*
Species *Oreochromis grahami* (Boulenger, 1912)"

Size, Weight, and Age Range

From Froese and Pauly (2017):

"Max length: 20.0 cm SL male/unsexed; [Trewavas 1983]"

Environment

From Froese and Pauly (2017):

"Freshwater; benthopelagic; pH range: 7.5 - 8.5; dH range: 10 - 20. […]; 24°C - 32°C [assumed to be recommended aquarium temperature range] [Baensch and Riehl 1985]; […]"

"Occur at [water] temperatures ranging from 16.0-40.0 °C [Trewavas 1983]."

From Bayona and Akinyi (2006):

"Occurs in generally unfavourable environmental conditions for fishes (water temperature, chemical composition) (Seegers and Tichy 1999)."

From Wood et al. (2016):

"The Magadi tilapia, *Alcolapia grahami*, thrives in one of the most extreme environments on earth, characterized by high pH (up to 10.0), extreme alkalinity (>300 mmol L−1), high temperature (>40 °C), high levels of reactive O2 species (>8 μmol L−1), unusual water chemistry with salinity close to 60% seawater, and large daily fluctuations in O2 levels (severe hypoxia to hyperoxia)[Coe 1966; Johansen et al. 1975; Pörtner et al. 2010; Johannsson et al. 2014]"

"Field C_{tmax} [critical maximum temperature], measured at lakeside using a standardized protocol [Becker and Genoway 1979] in SWHS [South West Hot Springs population] fish freshly caught from water at 40–41 °C, was 45.6 [114 °F, body temperature] ± 0.1 °C (N= 8), the highest ever recorded for a fish […]. FSL [Fish Springs Lagoon population] fish were also very temperature tolerant: the comparable field C_{tmax} for FSL fish caught from 33 °C water was 43.6 ± 0.1 °C (N = 8). In both cases, field C_{tmin} values were approximately 30 °C lower than C_{tmax}. A"

Climate/Range

From Froese and Pauly (2017):

"Tropical; […]; 1°S - 2°S"

Distribution Outside the United States

Native

From Bayona and Akinyi (2006):

"The natural range of this species is restricted to a single location: Lake Magadi [Kenya]."

Introduced

From Froese and Pauly (2017):

"Nakuru (introduced) in Kenya (IUCN 1990)"

From Bayona and Akinyi (2006):

"Introduced in Lake Nakuru in 1953, 1959 and 1962 (Vareschi 1979). Possibly also introduced in Lake Elmenteita. Lake Natron in Tanzania (Lever 1996)."

Means of Introduction Outside the United States

From Vareschi (1979):

"In 1953, 1959 and 1962 (Cunningham-van Someren, 1973) *Tilapia grahami* was introduced from Lake Magadi into Lake Nakuru to combat mosquito breeding."

Short Description

From Froese and Pauly (2017):

"Dorsal spines (total): 11 - 13; Dorsal soft rays (total): 12-13; Anal spines: 3; Anal soft rays: 9 - 11; Vertebrae: 28. Mature females with an overall golden hue; males with the flanks a pale blue. Swollen and brilliant white lateral parts of the lower lip of the mature male. Blue spots on scales becoming iridescent. Genital papilla conical, prominent and yellow in the mature male; swollen in the mature female. An oblique eye-bar intensely black in the breeding male, duller in the female."

Biology

From Froese and Pauly (2017):

"Feed actively in the evening. Young *O[reochromis] alcalicus grahami* eat eggs as they are shed by the female, and much of the time and energy of the territorial male is occupied in driving them off. Feed on invertebrates, at the surface [Trewavas 1983]."

"Male prepares a breeding pit, the structure of which may vary with the nature of the substratum. Breeding activities are more actively pursued by both sexes in the morning than in the afternoon. Female lays about 3-10 eggs at a time, picks them up instantly and the male swims with his genital papilla near the mouth, probably emitting sperm. Brooding period reportedly 12-16 days."

"At smaller sizes, these fish are significantly carnivorous [Trewavas 1983]."

From Bayona and Akinyi (2006):

"Primary food sources are blue-green algae (90%), Crustacea (Copepods) and dipteran larvae. Has no marked breeding season. The male has a breeding territory and constructs a pit of about 15 cm in diameter where he tries to attract females to spawn. No firm pair bond relationship. Female is a mouthbrooder, brooding period two weeks (Seegers and Tichy 1999)."

From Vareschi (1979):

"Coe found that at sunset *Tilapia grahami* began to move from the shallow waters to the deeper parts of the springs, which kept a temperature of 32-36° C all night. Coe suggests a preferance [*sic*] for higher temperatures, based on his observations that the fish did not breed in his aquaria if temperatures were <32°C, and below 23° C they lost color, became sluggish and stayed near the bottom. At Lake Nakuru, the fish do reproduce at temperatures of 20° C (mean temperature of the top 50 cm = 20-22° C), but they still prefer higher temperatures […]"

Human Uses

From Froese and Pauly (2017):

"Aquarium: commercial"

The Florida Fish and Wildlife Conservation Commission has listed the tilapia *Alcolapia grahami* as a prohibited species. Prohibited nonnative species (FFWCC 2018), "are considered to be dangerous to the ecology and/or the health and welfare of the people of Florida. These species are not allowed to be personally possessed or used for commercial activities."

Diseases

No records of OIE reportable diseases were found.

From Froese and Pauly (2017):

"Contracaecum Disease (larvae), Parasitic infestations (protozoa, worms, etc.)"

Threat to Humans

From Froese and Pauly (2017):

"Harmless"

3 Impacts of Introductions

From Vareschi (1979):

"At the Magadi springs *Tilapia grahami* [the only fish species present in Lake Magadi] feed benthic filamentous cyanophytes, insect larvae and copepods (Coe, 1966), in Lake Nakuru they have switched to filter feeding of *Spirulina*. *Tilapia grahami* is the only fish species in the lake. Unfortunately, very few biological data are available from Lake Nakuru before *Tilapia grahami* was introduced (Jenkin, 1936 and Beadle, 1932) and it is difficult to judge the influence of the fish introduction on the ecosystem. Now they are among the main primary consumers of the lake, supporting a wide variety of fish eating birds."

"All primary consumers of the lake [Lake Nakuru] (Lesser Flamingos, fish, copepods, rotifers, chironomid larvae and corixids) together consume about 1% of the algal biomass per day (Vareschi, 1978). Therefore it is very unlikely that the grazing of *Tilapia* means a nutritional competition for other grazers or significantly reduces the algal biomass, especially since increased harvesting should expand the euphotic zone and thus increase primary production. The turnover rate of the algae could even be accelerated by the presence of an additional grazer."

"The fish introduction into Lake Nakuru is one of the few examples which seemingly had only positive effects: the fish and especially the fish eating birds increased the diversity of the ecosystem. Before the fish introduction in 1959/62 the bird life of the lake itself was poor if compared with the present situation. Besides the impressive flamingo numbers (up to 1.5 million; Vareschi, 1978) there were few other water birds and only occasionally some stray fish eating birds, which have now increased to > 50 species and are a major contribution to the bird life of Lake Nakuru National Park."

From Kiprutto et al. (2012):

"The diminishing flamingo food could also be the result of the 1959 and 1982 introduction of tilapia (*Tilapia grahami*) […] that led to competition for the planktonic blue-green alga, (*Spirulina platensis*) fed on by the flamingos. This could be a possible cause for migration of flamingos to other lakes including Lake Simbi Nyaima in Western Kenya."

4 Global Distribution

Figure 1. Known global distribution of *Alcolapia grahami*. Location is in Kenya. Map from GBIF Secretariat (2015).

5 Distribution Within the United States

No records of *Alcolapia grahami* in the United States were found.

6 Climate Matching

Summary of Climate Matching Analysis

The climate match for *Alcolapia grahami* was medium for the coastal areas of California, the Mexican border with Arizona, and the southernmost tip of Texas. The Climate 6 score (Sanders et al. 2014; 16 climate variables; Euclidean distance) for the contiguous United States was 0.000, low, and no States had individually medium or high climate matches.

Alcolapia grahami also exists in the hot springs around Lake Magadi. It is unknown how well the climate match results reflect the conditions in the hot springs.

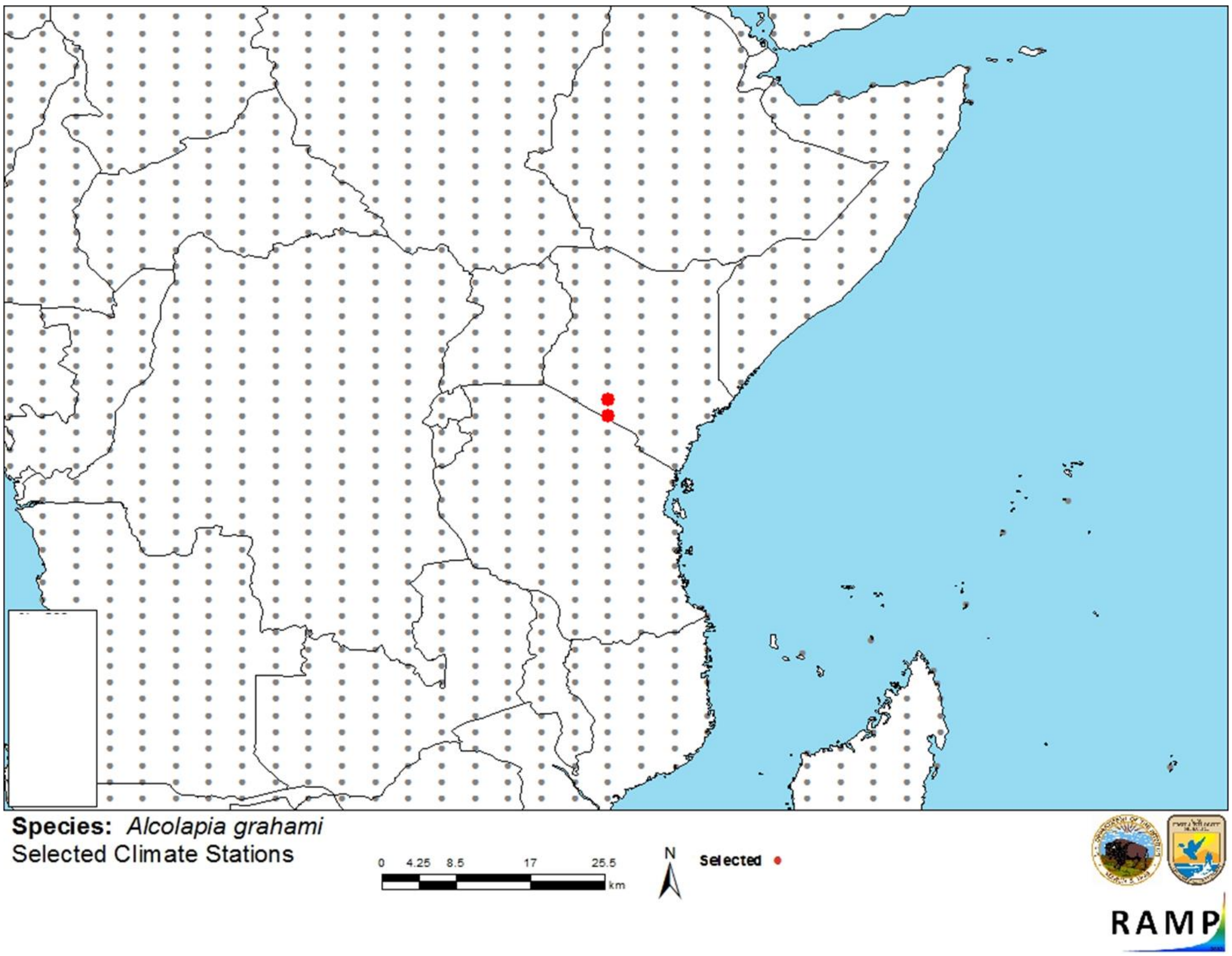

Figure 2. RAMP (Sanders et al. 2014) source map showing weather stations selected as source locations (red; Kenya) and non-source locations (grey) for *Alcolapia grahami* climate matching. Source locations from GBIF Secretariat (2015).

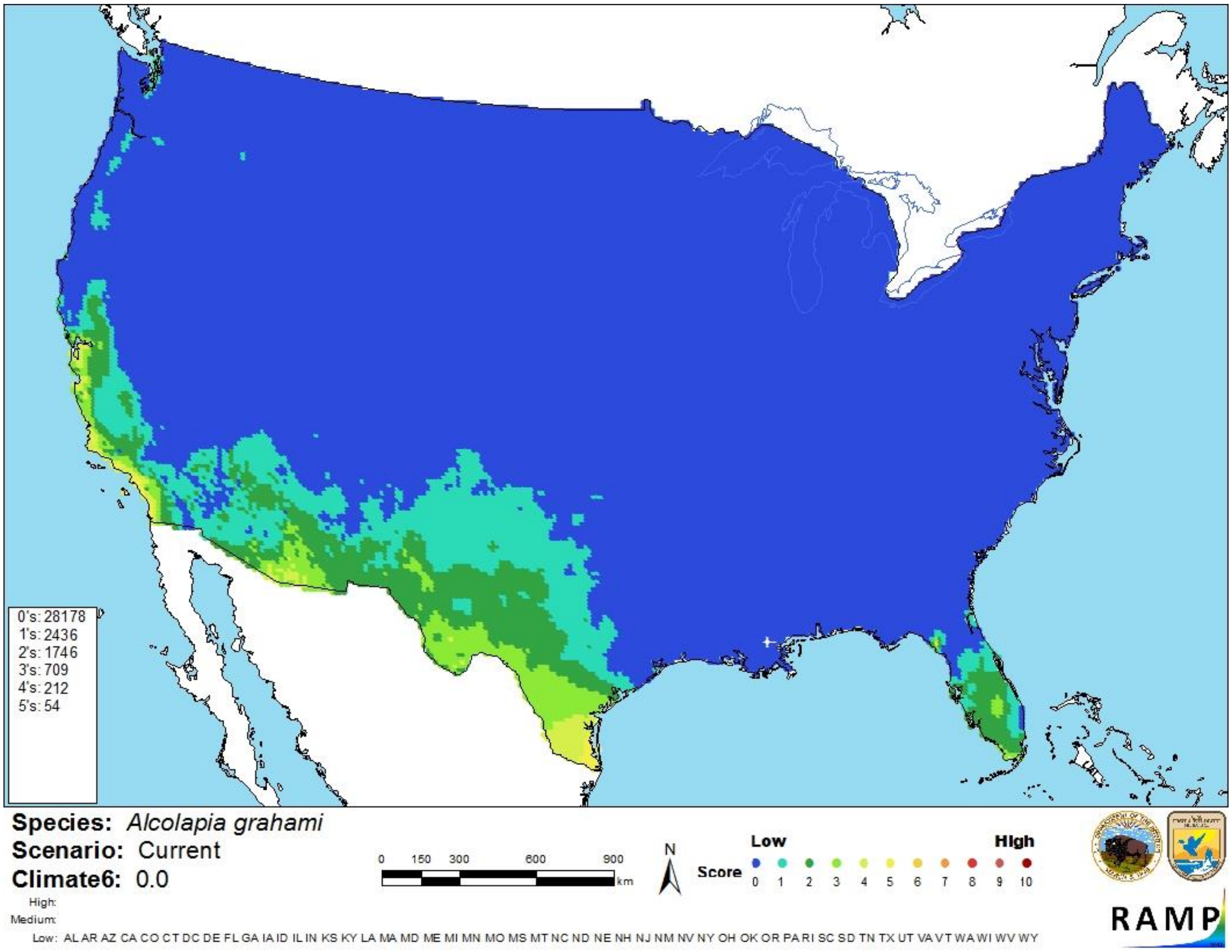

Figure 3. Map from RAMP (Sanders et al. 2014) of a current climate match for *Alcolapia grahami* in the contiguous United States based on source locations reported by GBIF Secretariat (2015). 0 = Lowest match, 10 = Highest match. Counts of climate match scores are tabulated on the left.

The High, Medium, and Low Climate match Categories are based on the following table:

Climate 6: Proportion of (Sum of Climate Scores 6-10) / (Sum of total Climate Scores)	Climate Match Category
$0.000 \leq X \leq 0.005$	Low
$0.005 < X < 0.103$	Medium
≥ 0.103	High

7 Certainty of Assessment

The certainty of assessment is low. There is some information on the biology of the species. Records of introductions and an establishment were found. Some information on impacts of that establishment were found but defensible conclusions regarding the impacts could not be drawn.

8 Risk Assessment

Summary of Risk to the Contiguous United States

Lake Magadi Tilapia (*Alcolapia grahami*) is a cichlid species that was endemic to Lake Magadi. It is the only fish species in Lake Magadi and can exist in the lake's hot springs, which can reach 40°C (104°F). The history of invasiveness is not documented. *Alcolapia grahami* was introduced in two locations, Lake Nakuru, Kenya, and Lake Natron, Tanzania. The population in Lake Nakuru became established. Previously this lake did not contain any fish species. Changes in the biological community, including a recent decline in the flamingo population, were seen at this lake after introduction but could not be directly linked or separated from the presence of this fish. Climate match was low, 0.000. All States had low individual climate scores. The climate match results may not accurately reflect the climate requirements of this species due to its use of the hot springs around the edge of Lake Magadi. RAMP does not have the ability to address microclimates such as the hot springs. Certainty of assessment was low. The overall risk assessment category is uncertain.

Assessment Elements

- **History of Invasiveness (Sec. 3): None Documented**
- **Climate Match (Sec. 6): Low**
- **Certainty of Assessment (Sec. 7): Medium**
- **Remarks/Important additional information** No additional information.
- **Overall Risk Assessment Category: Uncertain**

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

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.

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