Nile Perch (*Lates niloticus*)
Ecological Risk Screening Summary

Web Version – September 2014

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1 Native Range, and Status in the United States

Native Range

From Schofield (2011):

"Much of central, western and eastern Africa: Nile River (below Murchison Falls), as well as the Congo, Niger, Volga, Senegal rivers and lakes Chad and Turkana (Greenwood 1966 [cited by Schofield (2011) but not accessed for this report]). Also present in the brackish Lake Mariot near Alexandria, Egypt."

Status in the United States
From Schofield (2011):

"Scientists from Texas traveled to Tanzania in 1974-1975 to investigate the introduction potential of *Lates spp*. into Texas reservoirs (Thompson et al. 1977 [cited by Schofield (2011) but not accessed for this report]). Temperature tolerance and trophic dynamics were studied for three species (*L. angustifrons*, *L. microlepis* and *L. mariae*). Subsequently, several individuals of these three species were shipped to Heart of the Hills Research Station (HOHRS) in Ingram, Texas in 1975 (Rutledge and Lyons 1976 [cited by Schofield (2011) but not accessed for this report]). Also in 1975, Nile perch (*L. niloticus*) were transferred from Lake Turkana, Kenya, to HOHRS. All fishes were held in indoor, closed-circulating systems (Rutledge and Lyons 1976)."

"From 1978 to 1985, *Lates spp*. was released into various Texas reservoirs (Howells and Garrett 1992 [cited by Schofield (2011) but not accessed for this report]). Almost 70,000 *Lates spp*. larvae were stocked into Victor Braunig (Bexar Co.), Coleto Creek (Goliad Co.) and Fairfield (Freestone Co.) reservoirs between 1978 and 1984. In 1985, two *L. angustifrons*, six *L. mariae* and six *L. niloticus* were released into Smithers Reservoir (Ft. Bend Co.). It was thought that the fishes would provide good sportfishing opportunities as well as reduc[ing] populations of "rough" fishes (e.g., *Cyprinus carpio*, *Dorosoma cepedianum*, *Ictiobus bubalis*, *Carpiodes carpio*) through predation (Thompson et al. 1977). It is thought that the introductions were relatively unsuccessful and that the introduced *Lates spp*. [are no longer alive, and did not establish self-sustaining populations] (Howells and Garrett 1992; Clugston 1990 [cited by Schofield (2011) but not accessed for this report])."

"One individual (115.5 cm, 27.2 kg) was collected from Smithers Reservoir in January 1990 (Howells and Garrett 1992). It is believed that this fish died due to cold water temperatures."

Means of Introduction to the United States
From Schofield (2011):

"Intentional stocking by the Texas Parks and Wildlife Department for sport fishing."

Remarks
From Schofield (2011):

"Introduced populations in Texas [are no longer alive, and did not establish self-sustaining populations] (Howells 1992; Howells and Garrett 1992)."

2 Biology and Ecology

From ITIS (2011):

Taxonomic Hierarchy

"Kingdom Animalia
Phylum Chordata
Subphylum Vertebrata
Superclass Osteichthyes
Class Actinopterygii
Subclass Neopterygii
Infraclass Teleostei
Superorder Acanthopterygii
Order Perciformes
Suborder Percoidei
Family Centropomidae
Subfamily Latinae
Genus Lates Cuvier in Cuvier and Valenciennes, 1828
Species *Lates niloticus* (Linnaeus, 1758) -- Nile perch

Taxonomic status: valid"

Size, Weight, and Age Range

From Froese and Pauly (2010):

"Max length: 200 cm TL male/unsexed; (Stone 2007 [cited by Froese and Pauly (2010) but not accessed for this report]); common length: 100.0 cm SL male/unsexed; (van Oijen 1995 [cited by Froese and Pauly (2010) but not accessed for this report]); max[imum] published weight: 200.0 kg (Ribbink 1987 [cited by Froese and Pauly (2010) but not accessed for this report]). Length at first maturity: Lm 74.3, range 53 - 85 cm."

Environment

From Froese and Pauly (2010):

"Demersal; potamodromous (Riede 2004 [cited by Froese and Pauly (2010) but not accessed for this report]); freshwater; depth range 10 - 60 m (van Oijen 1995)."

Climate/Range

From Froese and Pauly (2010):

"Tropical; 27°N - 7°S"

Distribution

From Froese and Pauly (2010):

"Africa: Widespread throughout the Ethiopian Region of Africa, occurring commonly in all major river basins including the Nile, Chad, Senegal, Volta and Congo. Present in the brackish waters of Lake Mariout, near Alexandria. Exists in Lakes Albert, Rudolph and Tana. Several countries report adverse ecological impact after introduction."

From Schofield (2011):

"Harrison (1991 [cited by Schofield (2011) but not accessed for this report]) found difficulties in separating the different *Lates* species introduced into African lakes. He recommended a reappraisal of Nile perch taxonomy. As such, the positive identification of one or more of the *Lates* species introduced to Texas may eventually also be called into question."

"The Nile perch is of great commercial importance in East Africa (especially the Lake Victoria Basin), where the fishery has brought modernization (e.g., electricity) and profitability to fishing villages that were traditionally based on subsistence fishing (Abila 1998 [cited by Schofield (2011) but not accessed for this report]). Fishing pressure has been so strong in the Lake Victoria basin that measures aimed at protecting the [Nile perch] fish stocks (e.g., mesh size restrictions for gill nets) have been implemented (Ogutu-Ohwayo 2004 [cited by Schofield (2011) but not accessed for this report])."

Short description

From Froese and Pauly (2010):

"Dorsal spines (total): 78; Dorsal soft rays (total): 10 14. Caudal fin rounded (Eccles 1992 [cited by Froese and Pauly (2010) but not accessed for this report]). Pre-orbital and pre-opercular bones armed with spines; a large spine on the free edge of the operculum. Dark greyish-blue dorsally, greyish-silver on flank and ventrally (van Oijen 1995)."

Biology

From Froese and Pauly (2010):

"Inhabits channels, lakes and irrigation canals. Adults inhabit deep water, while juveniles are found in shallow water. Feeds on fish especially clupeids and *Alestes* (Reed et al. 1967 [cited by Froese and Pauly (2010) but not accessed for this report]); smaller fish also feed on larger crustaceans and insects. Juveniles are planktivorous (Bailey 1994 [cited by Froese and Pauly (2010) but not accessed for this report]). Threatened due to over harvesting (Stone 2007). No length type given but assumed to be in TL."

Human uses
From Froese and Pauly (2010):

"Fisheries: highly commercial; aquaculture: commercial; gamefish: yes"

Diseases
From Froese and Pauly (2010):

"Sporozoa Infection (*Hennegya* sp.), Parasitic infestations (protozoa, worms, etc.)
Dolops Infestation, Parasitic infestations (protozoa, worms, etc.)
Ergasilus Disease, Parasitic infestations (protozoa, worms, etc.)
Gonad Nematodosis Disease, Parasitic infestations (protozoa, worms, etc.)
Diplectanum Infestation, Parasitic infestations (protozoa, worms, etc.)"

Threat to humans
From Froese and Pauly (2010):

"Potential pest."

3 Impacts of Introductions

From Global Invasive Species Database (2011):

"*Competition*: [Nile perch] directly compet[es] for food with local fauna and alter[s] competition within local faunal groups."

"*Economic/Livelihoods*: [Nile perch] completely changed the socio-economics of the existing fisheries and secondary activities."

"*Habitat alteration*: The upsurge of the Nile perch is one of the reasons for the change of Lake Victoria from a highly complex ecosystem into a stressed ecosystem with a simplified foodweb."

"*Modification of nutrient regime*: Decimating or eliminating [native] haplochromines with special trophic niches."

"*Predation*: Generalist top predator; at least partly responsible for the decimation and elimination of several hundred [native] species of haplochromine fishes."

From Schofield (2011):

"The introduction of the Nile perch into the Lake Victoria basin has caused the extinction of at least 200 species of endemic fishes and significant changes in the trophic function and diversity of the lake (Ogutu-Ohwayo 1990b, Kaufman 1992; Witte et al. 1992a [cited by Schofield (2011) but not accessed for this report]). Cascading effects of these losses of native fish diversity and abundance have also occurred, such as algal blooms and insect outbreaks. Similar to Lake Victoria, declines in native fish diversity and distribution have occurred in other lakes with the introduction of Nile perch (e.g., Lake Kyoga basin) (Mbabazi et al. 2004 [cited by Schofield (2011) but not accessed for this report])."

"The Nile perch hosts a number of parasites, including helminths, cestodes, acanthocephalans and myxozoans (Emere 2000; Kostoingue et al. 2003 [cited by Schofield (2011) but not accessed for this report])."

From Witte (2009):

"<u>Impact Summary</u>

- Category [and] Impact
    - Environment (generally) Negative
    - Human health Positive and negative
    - Cultural/amenity Positive and negative
    - Economic/livelihood Positive and negative"

"<u>Impact: Economic</u>
In the 1990s filleting factories arose which exported Nile perch fillets to Europe and Asia (Ntiba et al. 2001 [cited by Witte (2009) but not accessed for this report]). The total capacity of these factories was several hundred tons per day and they became the main buyers of Nile perch. Many of these fish processing plants operated below their installed capacity. Balirwa (2007 [cited by Witte (2009) but not accessed for this report]) reports for Uganda alone, 15 factories with a total installed capacity of 420 t per day, but actually processing 185 t per day."

"At the beginning of the century, about 1.2 million people were directly or indirectly dependent for livelihoods on the fishery in Lake Victoria (Matsuishi et al. 2006 [cited by Witte (2009) but not accessed for this report]). In 2003 the estimated annual catch was worth at least US $540 million at the fish landings, whereas a further US $240 million was earned in fish exports (Balirwa 2007)."

"<u>Impact: Environmental</u>
Impacts on Habitat--It has been suggested that the algal blooms that occurred concomitantly with the Nile perch boom in different areas of Lake Victoria, were (partly) caused by a top down effect, i.e. disappearance of the phytoplanktivorous and detritivorous haplochromine cichlids by Nile perch predation (Kilham and Kilham 1990; Kaufman 1992; Hecky and Bugenyi 1992; Goldschmidt et al. 1993; Ochumba 1995; Ogutu-Ohwayo 1999 [cited by

Witte (2009) but not accessed for this report]). Conversely, it has been suggested that the increase of the eutrophication that started already in the 1920s had a negative impact on haplochromines and provided an opportunity for the Nile perch boom (Hecky 1993; Verschuren et al. 2002; Kolding et al. 2008 [cited by Witte (2009) but not accessed for this report])."

"Other environmental issues associated with this species include the demand for firewood for processing the fish. At Wichlum Beach (Kenya) the number of smoking kilns increased between 1984 and 1991 from about ten to over 50 (Riedmiller 1994 [cited by Witte (2009) but not accessed for this report]). Although the majority of the Nile perch catches are currently sold to the fish filleting factories, unsuitable individuals (e.g. fish that are too small) and waste from the factories are still smoked and/or fried. These activities contribute to deforestation, and consequently to land erosion and eutrophication of the lake."

"*Impacts on Biodiversity*--It has so far been impossible to establish the causal relationship between the Nile perch boom and eutrophication, and the relative impact on haplochromine cichlids of each of these phenomena separately. There are a number of reasons for this. First, both the Nile perch upsurge in Lake Victoria and the increase of eutrophication occurred between the late 1960s and early 1980s. Furthermore, systematic data on haplochromine abundance and diversity were not collected until 1969/70 and 1978, respectively (Kudhongania and Cordone 1974a,b; Witte 1981 [cited by Witte (2009) but not accessed for this report])."

"Eutrophication resulted in decreases in dissolved oxygen levels and increased water turbidity. The latter especially has a negative impact on haplochromines and among others resulted in hybridization of several species (Seehausen et al. 1997a, 2008 [cited by Witte (2009) but not accessed for this report]). Nevertheless, there is ample evidence that Nile perch predation did have a strong impact on haplochromine biodiversity (e.g. Witte et al. 2007a,b; Chapman et al. 2008 [cited by Witte (2009) but not accessed for this report])."

"In 1983 Nile perch started to boom in the Mwanza Gulf, mainly due to immigration of sub-adult fishes (Goudswaard et al. 2008 [cited by Witte (2009) but not accessed for this report]). Concomitantly, the decline of some groups of haplochromines accelerated strongly in the sub-littoral and open waters, and shortly after the Nile perch peak in 1986-1987 haplochromines had virtually disappeared from the catches in these areas. Until the haplochromines had disappeared, they were the main food items of Nile perch (Ligtvoet and Mkumbo 1990; Mkumbo and Ligtvoet 1992 [cited by Witte (2009) but not accessed for this report]). Scanty data from other parts of the lake indicate similar accelerations of the decline of haplochromines after Nile perch began to boom in those areas (Witte et al. 1995 [cited by Witte (2009) but not accessed for this report]). In shallow areas, with relatively low Nile perch densities and areas with structured bottoms, such as rocky shores, haplochromines were less affected (Witte et al. 1992b; Seehausen et al. 1997b [cited by Witte (2009) but not accessed for this report])."

"In Lake Kyoga and Lake Nabugabo, where Nile perch had also been introduced as well, the haplochromines also declined strongly with increasing Nile perch densities (Ogutu-Ohwayo 1990a,b, 1993, 1995 [cited by Witte (2009) but not accessed for this report]). In contrast, in several small satellite lakes of Lake Victoria and Lake Kyoga, where Nile perch was absent, haplochromines remained abundant (Ogutu-Ohwayo 1993; Namulemo and Mbabazi 2000; Aloo 2003; Mbabazi et al. 2004 [cited by Witte (2009) but not accessed for this report]). However, it has to be mentioned as a confounding factor, that in some of these lakes the water was also clear (Kaufman et al. 1997; G. Namulemo, Fisheries Resource Research Institute, Uganda, personal communication 2009 [cited by Witte (2009) but not accessed for this report]). There are a few satellite lakes where Nile perch and haplochomines seem to coexist. Aloo (2003 [cited by Witte (2009) but not accessed for this report]) found both haplochromines and Nile perch in the murky Lake Sare (transparency 0.25 m), but did not record when Nile perch entered this lake and how many cichlid species used to live there before Nile perch introduction. Nile perch and haplochromines also seem to coexist in Lake Saka in Uganda (Witte et al. 2007b [cited by Witte (2009) but not accessed for this report]). In Lake Nabugabo haplochromines apparently found refugia in the hypoxic and highly structured shoreline wetlands (Chapman et al. 1996, 2002, 2003 [cited by Witte (2009) but not accessed for this report]). The same may hold for a few wetland species of Lake Victoria, but not for the sub-littoral and deepwater species, or for those of sandy shores of Lake Victoria, because many of them were strongly restricted to these habitats (e.g. Witte (1984 [cited by Witte (2009) but not accessed for this report])) that are often at great distances from wetlands."

"Nile perch predation and competition also caused declines in native species other than haplochromines, e.g. the lung fish (*Protopterus aethiopicus*), catfishes (e.g. *Bagrus docmak*, *Xenoclarias eupogon*, *Synodontis victoria*) (Ogutu-Ohwayo 1990a,b; Goudswaard and Witte 1997; Goudswaard et al. 2002 a,b [cited by Witte (2009) but not accessed for this report]). By the end of the 1980s only three fish species were common in sub-littoral and offshore waters of Lake Victoria; these were the small indigenous cyprinid *Rastrineobola argentea*, and the introduced Nile perch and Nile tilapia (Ogutu-Ohwayo 1990b; Wanink 1999; Goudswaard et al. 2002b [cited by Witte (2009) but not accessed for this report]). Together, they dominated the fish landings by more than 80% (Reynolds et al. 1995; Witte et al. 2009 [cited by Witte (2009) but not accessed for this report])."

"In the course of the 1990s, after a decline in Nile perch in Lake Victoria due to intensive fishing, a slow resurgence of some haplochromine species was observed, mainly zooplanktivores and detritivores (Witte et al. 2000, 2007a,b; Seehausen et al. 1997b; Balirwa et al. 2003 [cited by Witte (2009) but not accessed for this report]). Of each group only about 30% of the species recovered and the ratio between detritivores and zooplanktivores reversed (Witte et al. 2007a,b [cited by Witte (2009) but not accessed for this report]). Before the 1980s detritivores made up about 50% of the haplochromine biomass in the sublittoral waters and zooplanktivores about 25% (Goldschmidt et al. 1993 [cited by Witte (2009) but not accessed for this report]), whereas by 2001 detritivores constituted only 15% and zooplanktivores more than 80%. However, the majority of the species did not recover. Many of the highly specialized trophic types like scale eaters, parasite eaters and prawn eaters have not been caught since the 1980s, whereas piscivores and paedophages are extremely rare now, both with respect to numbers of individuals and species."

"The hypothesis that Nile perch had a large impact on haplochromine biomass is supported by the observations of a partial recovery of haplochromines in Lake Victoria, Lake Nabugabo and Lake Kyoga, following declines in Nile perch due to heavy fishing pressure (Ogutu-Ohwayo 1995; Witte et al. 2000; Chapman et al. 2003; 2008; Getabu et al. 2003; Mbabazi et al. 2004 [cited by Witte (2009) but not accessed for this report]). On the other hand, the incomplete recovery in Lake Victoria suggests that Nile perch may not be the only factor (Witte et al. 2007b [cited by Witte (2009) but not accessed for this report])."

"Threatened Species
Threatened Species Conservation Significance Where Threatened Mechanism References

- Haplochromis IUCN red list: Not evaluated
- *Synodontis afrofischeri* IUCN red list: Least concern
- *Synodontis victoriae* IUCN red list: Near threatened
- *Xenoclarias eupogon* IUCN red list: Critically endangered"

"Impact: Social
The changes in the fishery had impacts at the in-dividu-al, the house-hold and the community level. The following changes were mentio-ned by Harris et al. (1995 [cited by Witte (2009) but not accessed for this report]): (1) Fishing was traditionally mixed with agricultural and pastoral activities and it used to be a house-hold enterprise in which the whole family was involved. The husband was the boat owner and fisherman, his son crew and his wife or daughters fish processors or dealers. Because currently more capital is needed for the fishe-ry, fisher-men are often not the boat- or net-owners, but employees. (2) Fishermen are now away from home for extended periods, and their wives and other members of the family are no longer involved with their activities. (3) The availa-bi-lity of fish for household consumption decreased. Due to the relatively high price, the mana-gers do not like fish to be taken home by crew members. (4) The increased value of the nets and the fish led to an increased incidence of net and fish thefts. This led to distrust among local fis-hers and between boat owners and operators."

"Risk and Impact Factors

- Invasiveness
  - Abundant in its native range
  - Capable of securing and ingesting a wide range of food
  - Fast growing
  - Has a broad native range
  - Has high reproductive potential
  - Highly mobile locally
  - Is a habitat generalist
  - Long lived
  - Proved invasive outside its native range"

"Impact outcomes
- Altered trophic level
- Changed gene pool/ selective loss of genotypes
- Damaged ecosystem services
- Ecosystem change/ habitat alteration
- Modification of natural benthic communities
- Modification of nutrient regime
- Negatively impacts cultural/traditional practices
- Reduced native biodiversity
- Threat to/ loss of endangered species
- Threat to/ loss of native species"

"Impact mechanisms
- Competition - monopolizing resources
- Predation
- Rapid growth"

"Likelihood of entry/control
Difficult/costly to control"

"Uses
Originally, the fishermen did not like Nile perch, because they had problems with handling, processing and marketing the fish; the larger and relatively fat perches could not easily be dried or transported. However, in the years after the upsurge, people rapidly adjusted the processing and transport techniques. The larger fishes were chopped into pieces and fried (Ligtvoet et al. 1995 [cited by Witte (2009) but not accessed for this report]). The smaller ones were dried in the sun or smoked. In the 1990s filleting factories arose which export Nile perch fillets to Europe and Asia (Ntiba et al. 2001; Balirwa 2007 [cited by Witte (2009) but not accessed for this report])."

"Apart from fillets, the Nile perch yields swim-bladders, suitable for the production of beer finings and traditional medicines in the Far East, and its skin may be used for leather (Geheb 1995 [cited by Witte (2009) but not accessed for this report])."

"Though biodiversity decreased strongly and water quality deteriorated, fish production in Lake Victoria flourished after the Nile perch boom. In the 1960s the total landings for the lake were approximately 100,000 t y-1. In the late 1980s and early 1990s, just after the Nile perch boom, the fisheries produced over 500,000 t of fish annually, an increase by a factor of five (Reynolds et al. 1995; Balirwa 2007; Witte et al. 2009 [cited by Witte (2009) but not accessed for this report])."

"In the course of the 1990s the total annual landings did not change much, but the contribution of Nile perch declined, whereas landings of *R. argentea* and *O*[*Oreochromis*]. *niloticus* increased (Matsuishi et al. 2006 [cited by Witte (2009) but not accessed for this report]). Just after the boom, Nile perch contributed more than 70% of the landings (Van der Knaap et al. 2002 [cited by Witte (2009) but not accessed for this report]), but between 1990 and 2000 the catch per unit effort for Nile perch dropped from about 80 to 45 kg per boat day (Matsuishi et al. 2006 [cited by Witte (2009) but not accessed for this report]). By 2000 the total landings amounted to 657,000 t, 40% of which was made up by Nile perch, 41% by *R. argentea* and 8% by *O. niloticus* (calculated from table 1 in Matsuishi et al. 2006 [cited by Witte (2009) but not accessed for this report]). In 2005-2006, the annual landings were even estimated at 1 million t and the contribution of Nile perch was about 26%, while that of *R. argentea* had increased to about 53% (LVF 2006; Witte et al. 2009 [cited by Witte (2009) but not accessed for this report]). Apparently, the species composition in the fish landings have changed towards lower trophic level species (viz. *R. argentea* and Nile tilapia [*O. niloticus*]; Matsuishi et al. 2006 [cited by Witte (2009) but not accessed for this report]), but hydroacoustic surveys between 1999 and 2007 revealed that over the studied period the overall fish biomass in Lake Victoria remained more or less constant (Getabu et al. 2003; Lake Victoria Fisheries Organization 2007 [cited by Witte (2009) but not accessed for this report]). The foregoing seems to represent a second fishing down episode in Lake Victoria (Balirwa et al. 2003 [cited by Witte (2009) but not accessed for this report])."

"Balirwa et al. (2003 [cited by Witte (2009) but not accessed for this report]) suggested that conservation of biodiversity and fishery sustainability may not have to be antitheses in the management of Lake Victoria. A modelling study suggested that Nile perch prefer and grow fastest on a haplochromine prey base (Kaufman and Schwarz 2002 [cited by Witte (2009) but not accessed for this report]). If the model is realistic, it would suggest that it is worth thinking of management strategies that allow enough fishing on Nile perch to ensure an abundance of their haplochromine prey, but not so much pressure as to threaten the Nile perch stock itself (Balirwa et al. 2003 [cited by Witte (2009) but not accessed for this report]). However, to allow maintenance and restoration of haplochromine diversity, the urgent measures must include serious attempts to reverse the eutrophication of Lake Victoria (Seehausen et al. 1997a; Balirwa et al. 2003; Witte et al. 2005 [cited by Witte (2009) but not accessed for this report])."

"Uses List
General--Sport (hunting, shooting, fishing, racing)
Materials--Skins/leather/fur
Human food and beverage--Meat/fat/offal/blood/bone (whole, cut, fresh, frozen, canned, cured, processed or smoked)"

4 Global Distribution

Figure 1. Global distribution of *L. niloticus* from Froese and Pauly (2010). Map from Google Earth (2011).

5 Distribution in the United States

Figure 2. US distribution of *L. niloticus*. Map from Schofield (2011).

6 CLIMATCH

Summary of Climate Matching Analysis

The climate match (Australian Bureau of Rural Sciences 2010; 16 climate variables; Euclidean Distance) was low in most of the country. Much higher matches were found in southern

California, Florida, along the rest of the Gulf Coast, and especially in Hawaii, Puerto Rico and the U.S. Virgin Islands. Climate 6 match indicated that the continental United States has a medium climate match. The range for medium climate match is 0.005 to 0.103; climate match of the Nile perch is 0.068.

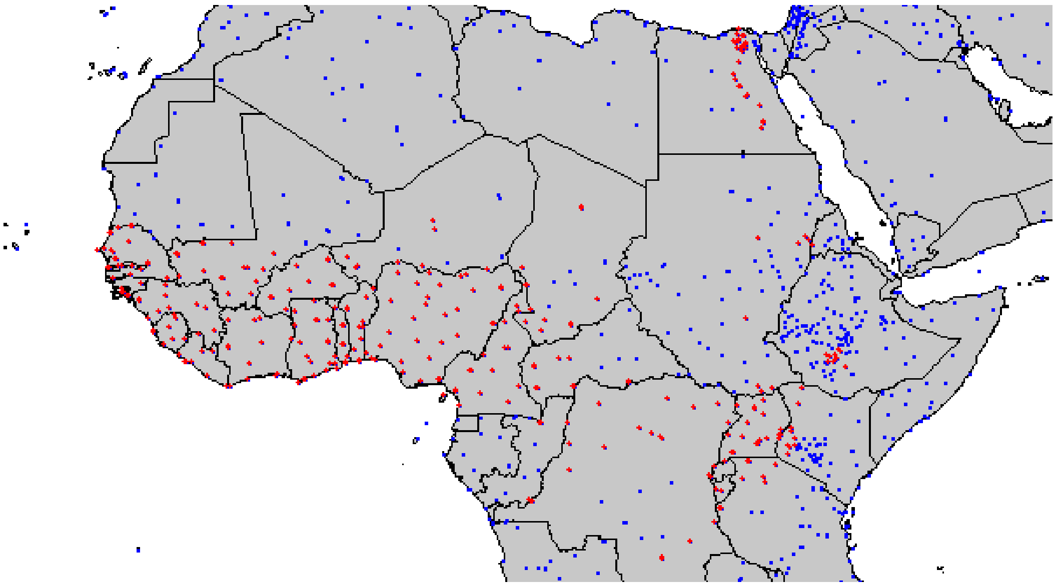

Figure 3. CLIMATCH (Australian Bureau of Rural Sciences 2010) source map showing weather stations selected as source locations (red) and non-source locations (blue) for *L. niloticus* climate matching. Source locations are from Froese and Pauly (2010). Only established populations were used.

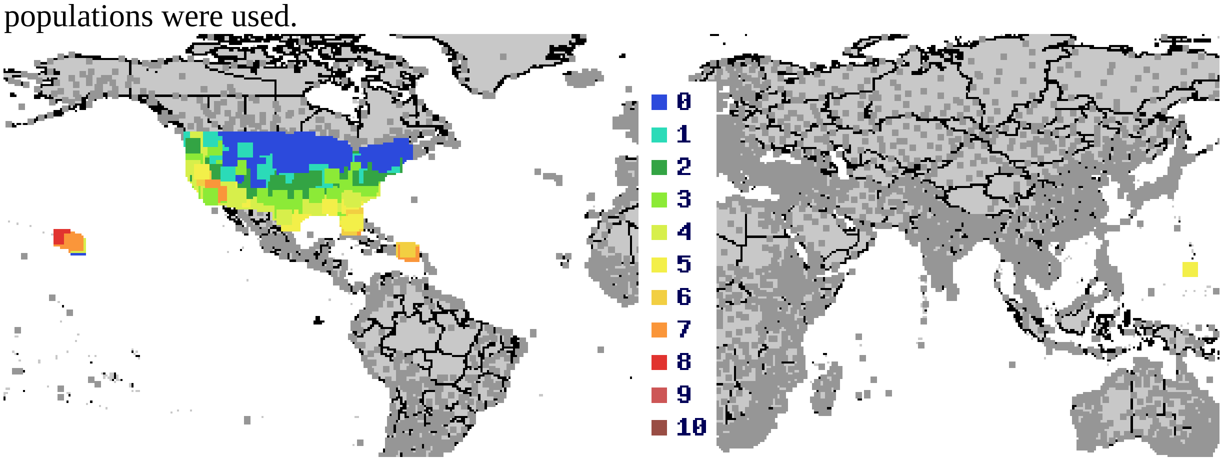

Figure 4. Map of CLIMATCH (Australian Bureau of Rural Sciences 2010) climate matches for *L. niloticus* in the continental United States and US territories based on source locations reported by Froese and Pauly (2010). 0= Lowest match, 10=Highest match.

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

CLIMATCH Score	0	1	2	3	4	5	6	7	8	9	10
Count	506	297	332	307	289	152	72	57	8	0	0
Climate 6 Proportion =			0.068	(Medium)							

7 Certainty of Assessment

Information on the biology, invasion history, and impacts of this species is sufficient to give an accurate description of the risk posed by this species. Certainty of this assessment is high.

8 Risk Assessment

Summary of Current U.S. Status

Establishment and impacts in Lake Victoria and other interior African waters occurring, possibly leading to the extinction of nearly 200 endemic fish species. There is a moderate risk of additional introductions, establishment, and impacts in areas where demand for the economic benefits of the Nile perch exists. Climate match for the U.S. and territories is medium. Highest climate matches were calculated for southeastern, southwestern, and western continental states, and Hawaii, Guam, and Puerto Rico. Thus, risk of *L. niloticus* population establishment is highest there.

Assessment Elements

- **History of Invasiveness (See Section 3):** High
- **Climate Match (See Section 6):** Medium, for U.S. and Territories (but High in southeastern, southwestern, and western continental states, and Hawaii, Guam, and Puerto Rico)
- **Certainty of Assessment (See Section 7):** High
- **Overall Risk Assessment Category: High**

Table 1. Generalized, projected impacts of *L. niloticus* on natural resources of the continental United States. Details of impacts are too numerous to list in this screening report. Specific details of impacts will depend on local ecological structure (i.e., fish species composition, population abundance, and community structure; food resource biomass and community structure; and habitat variables).

Threat	Projected Level of Impact to Wildlife Resources of the U.S.	Description of Impact	Projections of Impacts to Wildlife Resources of the U.S.
Habitat Degradation	Medium	*L. niloticus* caused a decline of endemic haplochromine and tilapiine fishes. Those declines resulted a reduction of their commercial catches, and in a	Habitat degradation at greatest in large, shallow, sub-tropical to tropical lakes.

		disruption of trophic dynamics in the Lake Victoria ecosystem. These fishes were consumers of the dominant and bloom-forming algae and detritus, so their high feeding capacity prevented water quality deterioration. Their absence was partly responsible for recent algal blooms (Ochumba and Kibaara 1989) and detritus accumulation in the deep layers of Lake Victoria, followed by an increase in anoxia there (Ochumba et al. 1994).	Water quality, in lakes dependent on detritivores and algae consumers, is projected to be degraded.
Species Extirpation/ Extinction	High	The introduction of the Nile perch into the Lake Victoria basin has caused the extinction of at least 200 species of endemic fishes, and significant changes in the trophic function and diversity of the lake (Ogutu-Ohwayo 1990b; Kaufman 1992; Witte et al. 1992).	Few lakes in the world are projected to be as affected as Lake Victoria (due to the lake's former high diversity and species assemblages [haplochromine and tilapiine fishes]). However, other waters in tropical and subtropical climates containing endemic, threatened, or endangered fishes are at risk of loss of biodiversity, extirpation, and/or extinction. Cyprinid species are projected at greatest risk of diversity decline, but competitors (e.g., largemouth bass [*Micropterus salmoides*]) are also at risk of extinction in waters where *L. niloticus* becomes established and abundant.
Food Web Disruption	High	The introduction of the Nile perch into the Lake Victoria basin has caused the	In any lake where *L. niloticus* becomes

		extinction of at least 200 species of endemic fishes, and associated significant changes in the trophic functions and diversity within the lake (Ogutu-Ohwayo 1990b; Kaufman 1992; Witte et al. 1992).	established, the species is projected to become the top predator. Species at every trophic level serve as prey items for *L. niloticus* at some point, and some trophic levels are at risk of elimation. Therefore, food web disruption is projected where L. niloticus becomes established and abundant.
Degradation of Fish Stocks	High	See Species Extirpation/Extinction and Food Web Disruption, Competition, and Predation, and Reproductive Interference.	Establishment of *L. niloticus* is projected to decimate fish stocks that support sport and commercial fisheries, and that are ecologically important. See Species Extirpation/Extinction , Food Web Disruption, Competition, and Predation, and Reproductive Interference sections.
Competition	Medium	Global Invasive Species Database (2011) lists this species as being a direct competitor with local fauna, and a top generalist predator. Impact on prey is well documented, but their impact on other top predators is less detailed.	Competition, between *L. niloticus* and other top predators (particularly largemouth bass), is a risk after prey fishes decline
Predation	High	*L. niloticus* began to appear in the commercial catches in Kenya in 1977. As their proportion increased from 1% of the total landings in 1977 to 68% in 1983, that of the haplochromine cichlids, which initially formed its main food, declined from	Where *L. niloticus* becomes established, prey fishes are projected to be the most impacted species at first.

		32% in 1977 to less than 1% by 1983. Haplochromine cichlids are no longer recorded from commercial catches (Ogutu-Ohwayo 1990b).	
Reproductive Interference	High	Predation will reduce breeding populations of prey species. This certainly led to extinction of species in Lake Victoria.	Prey fishes and competitive predators are at risk to decline, Reductions in stock sizes of those species are projected to result in reduced recruitment. Reduced recruitment will result in populations that will not be sustained at historic levels.

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