Risk Assessments for Nile Tilapia in Namibia

By

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1. Background

Namibia is the only country in Southern Africa that doesn't farm with Nile tilapia and poses the least threat to the natural ecosystem. The major perennial Transboundary Rivers that exist in Namibia all do not originate from Namibia and the countries they originate from are all farming the commercial specie of Nile tilapia.

Namibia comprises of non-perennial rivers, manmade reservoirs, boreholes, springs, water canals and isolated water bodies throughout the country. These areas are ideal to farm commercial species which can make aquaculture viable and a wealth creating industry.

Nile tilapia originates from Africa and has been one of the largest contributors for food production in Asia, Europe, North and South America from which it does not originate from. Africa generally has been omitted during the blue revolution with exception of Egypt which in Nile tilapia was one of the leading contributors.

However, in recent years it has been notable that Nile tilapia continues to create great success stories throughout Southern Africa notably the company Lake Harvest which produces approximately 10 000 tons of Nile tilapia annually in the Kariba lake which is part of the Zambezi river. Their success has allowed them to export their fish as far as the United Kingdom where it fetches prime prices.

Namibia stands to benefit immensely by farming Nile tilapia in areas which pose no threat to the natural environment but needs to follow restriction that will prevent the species escaping into the natural environment such as the Cunene River, Okavango River, Zambezi River and the Upstream Orange River. Nile tilapia is considered the most widely distributed fish in the world and generates economic revenue of over a USD100 000 000.00

2. Origin of Nile tilapia

The Nile tilapia is indigenous naturally in the Nile basin, Jebel Marra, Lake Kivu, Lake Tanganyika, Awash River, various Ethiopian lakes, Omo River system, Lake Turkana, Suguta

River and Lake Baringo (FishBase 2014). In West Africa, natural distribution covers the basins of the Senegal, Gambia, Volta, Niger, Benue and Chad.

3. Global Distribution of Nile tilapia

Nile tilapia is the main farmed tilapia species mainly due to its superior growth rates and their global production exceeds 2 million tons (FAO 2014). As a result of the success of Nile tilapia in stock enhancements and aquaculture, they are one of the ten most introduced species in the world (Garciá - Berthou et al. 2005). Introductions are summarised in www.fishbase.org (Fishbase 2014) which lists the occurrence of Nile tilapia in 102 countries. Introductions outside of its native range include: Albania, Bangladesh, Belgium, Bolivia, Botswana, Brazil, Cambodia, Central African Republic, China, Colombia, Comoros, Democratic Republic of Congo, Costa Rica, Cuba, Cyprus, Czech Republic, Dominican Republic, Ecuador, El Salvador, Eritrea, Fiji, Gabon, Galapagos Islands, Greece, Grenada, Guatemala, Guyana, Haiti, Honduras, Hong Kong, India, Indonesia, Iran, Italy, Jamaica, Japan, Kiribati, Korea, Laos, Liberia, Madagascar, Malaysia, Mauritius, Mexico, Mozambique, Nepal, Netherlands, Nicaragua, Pakistan, Panama, peru, Philippines, Puerto Rico, Reunion, Saint Lucia, Sao Tome, Saudi Arabia, Sierra Leone, Singapore, Slovakia, South Africa, Sri Lanka, St Vincent, Syria, Taiwan, Tanzania, Thailand, Trinidad and Tobago, Tunisia, Turkey, United Kingdom, USA, Vietnam and Zimbabwe. In southern Africa, established populations are documented from Zambia, Botswana, Zimbabwe, Mozambique, Angola, the Democratic Republic of Congo and Tanzania (Picker & Griffiths 2011). In South Africa, Nile tilapia was introduced into South Africa for aquaculture in 1955 and is thought to be confined to the Limpopo River system and small coastal river systems in the Kwa-Zulu Natal Province, although their current status in the latter is uncertain (de Moor & Bruton 1988; van Rensburg et al. 2011; Zengeya et al. 2013b).

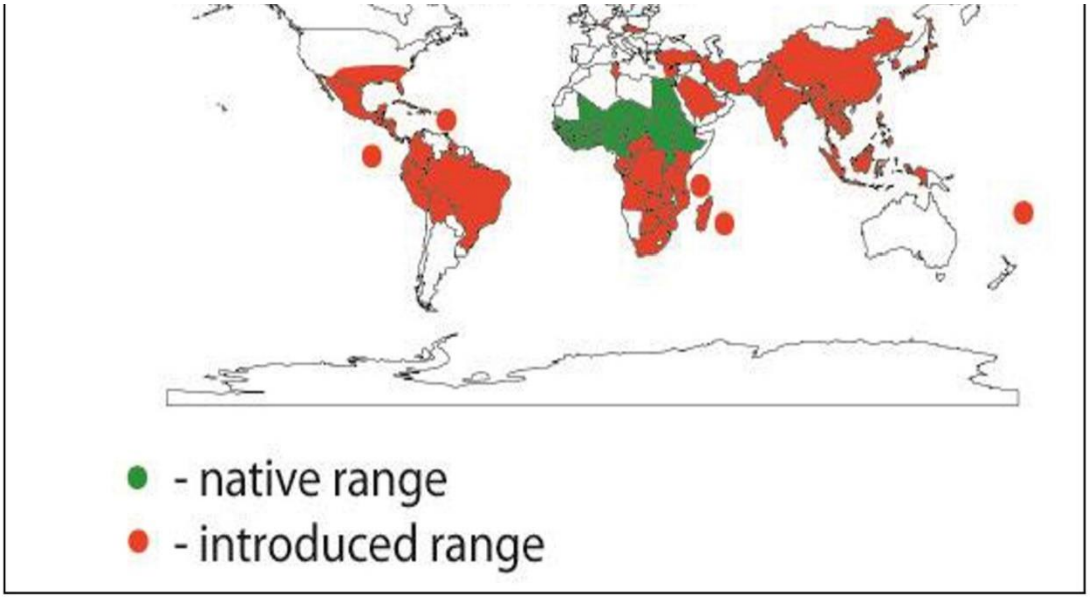

Fig 1. Global Nile tilapia distribution

4. Taxonomy of Nile tilapia

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 niloticus* (Linnaeus, 1758)”

5. Habitat Range

Occurs in a wide variety of freshwater habitats like rivers, lakes, sewage canals and irrigation channels, Oshanas, and ponds. Does not do well in pure salt water, but is able to survive in brackish water (Ref. 52307). Mainly diurnal. Nile tilapia is a tropical species that prefers to live in shallow water. The lower and upper lethal temperatures for Nile tilapia are 11-12 °C and 42 °C, respectively, while the preferred temperature ranges from 31 to 36 °C. It is an omnivorous grazer that feeds on phytoplankton, periphyton, aquatic plants, small invertebrates, benthic fauna, detritus and bacterial films associated with detritus. Nile tilapia can filter feed by entrapping suspended particles, including phytoplankton and bacteria, on mucous in the buccal cavity, although its main source of nutrition is obtained by surface grazing on periphyton mats.

6. Life Cycle of Nile tilapia

Although variable, sexual maturity can be attained as early as 5-6 months (FAO 2014). They are summer spawners and reproduction is limited to temperatures exceeding 20ºC. Males excavate nests and defend territories that are visited by females. Nile tilapia are maternal mouthbrooders and females brood eggs and fry for a period of 1-2 weeks (Trewavas 1983; de Moor & Bruton 1988; FishBase 2014; FAO 2014). In culture conditions, the egg number is consistent with the body weight of the female. A 100 g female will produce about 100 eggs per spawn, while a female weighing 600-1000 g can produce 1000 to 1500 eggs (FAO 2014). After spawning, the male remains in his territory, guarding the nest, and is able to fertilize eggs from a succession of females. Nile tilapia can live longer than 10 years and reach a weight exceeding 5 kg (Picker & Griffiths 2011).

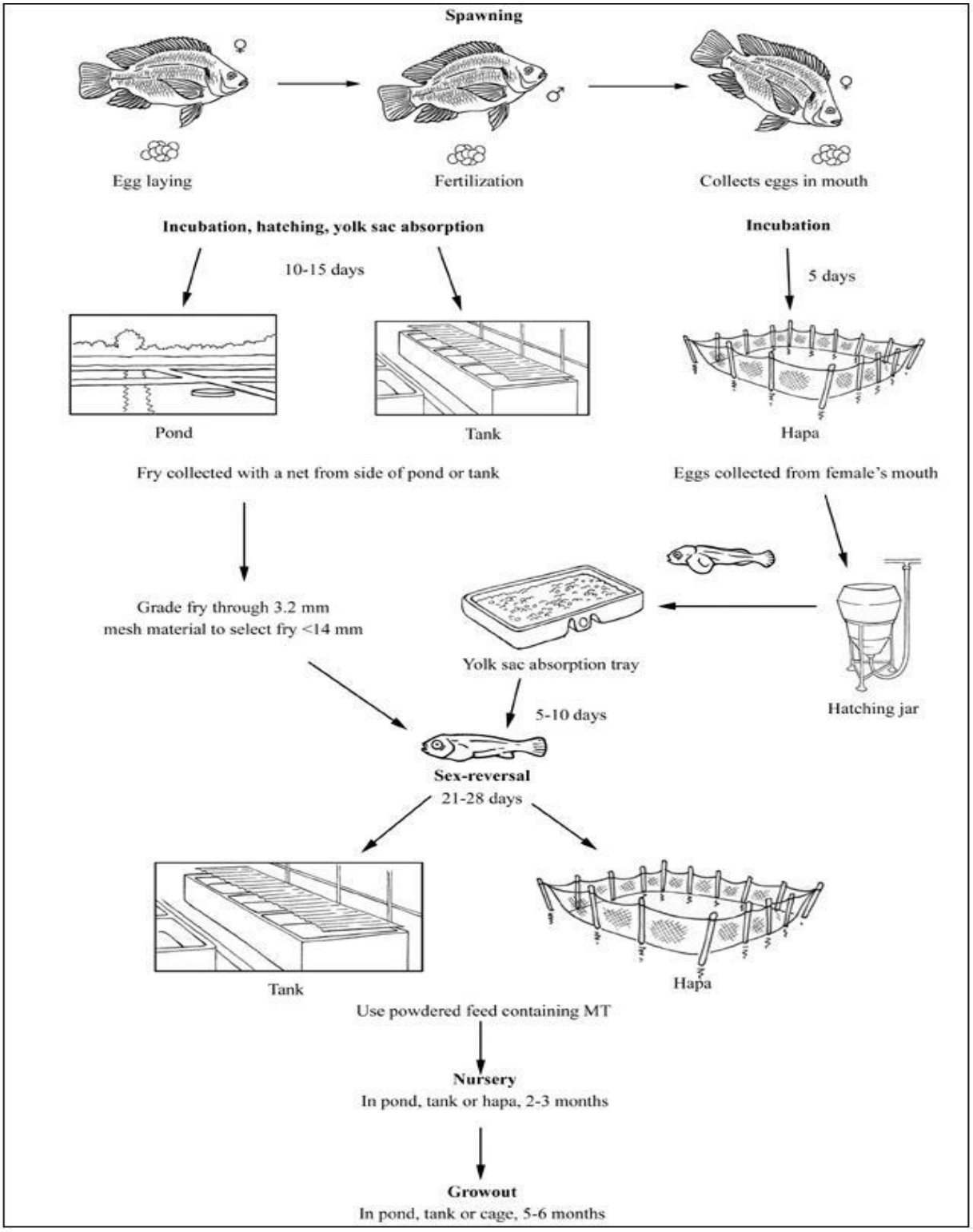

Fig. 2. Nile tilapia life cycle

7. Experimental Location

The experiment will be conducted at the Hardap Eco fish farm. This farm is located in close proximity to the Hardap Dam which is a man-made dam consisting of tilapia mainly

Oreochromis mossambicus, yellow fish, carp, African catfish and bass. The aforementioned species were introduced to the dam for recreational fishing purposes and are not endemic to Namibia with the exception of the African catfish and the Yellow fish.

Fig 3. Arial View of Hardap Aquaculture Farm

8. Culture Methods

The experiment will be conducted in the hatchery which consists of a recirculation system which is a closed system which significantly reduces water usage. The Nile tilapia will be stocked in the tanks for a period of 6 months and they will be fed experimental diets. Their growth, survival and feeding rate will be monitored throughout the duration of the experiment. The will minimal water discharge with a renewal of 10% per week depending on the conditions.

9. Biosecurity Measures

For the purpose of biosecurity, safety filters nets of 1mm will be placed on the outlets of the culture tanks which is a preventative measure that will prevent any of the fingerling from escaping.

The water discharged from the closed system is discharged through a channel that leads to a water way. The water way flows into an open area where the water simply drains into the soil or evaporates. Therefore in any case there was an escape of fingerlings of the Nile tilapia they will not be able to survive simply there is no water body which leads to a perennial water system.

It is noteworthy that the fish river is an ephemeral river which is induced to flow once the dam gates are open to release water. The water from the dam in most cases especially. This water only flow periodically during rainy season of which never reaches the Orange River.

The Nile tilapia used in the experiment and research will not be allowed to leave the farm alive at any point.

The biggest threat Nile tilapia can pose to the natural ecosystem is if live fish are translocated to a natural river system which is over 500 km from the Hardap. Thus no fish will be allowed to be removed from the farm alive.

Fig. 4 Orange river basin in Namibia

10. Quarantining

The aquaculture farm in Hardap will quarantine the fry once they arrived for a period no lesser than 7 days. They will be contained in a closed system and the culture water will disposed of once the 7 days have lapsed.

11. Diseases management

All mortalities caused by any diseases will be incinerated and buried. In cases of any disease outbreak the fish will be isolated in separate tanks throughout the duration of treatment. The below show the various methods used to treat the potential diseases that may arise.

DISEASE	AGENT	TYPE	SYNDROME		MEASURES
Motile Aeromonas Septicaemia (MAS)	*Aeromonas hydrophila* & related species	Bacteria	Loss of equilibrium; lethargic swimming; gasping at surface; haemorrhaged or inflamed fins & skin; bulging eyes; opaque corneas; swollen abdomen containing cloudy or bloody fluid; chronic with low daily mortality		$KMnO_4$ at 2-4 mg/litre indefinite immersion or 4-10 mg/litre for 1 hour; antibiotics (need 'extra-label use permit' in the USA), e.g. Terramycin® in feed at 50 mg/kg fish/d for 12-14 d, 21 d withdrawal
Vibriosis	*Vibrio anguillarum* & other species	Bacteria	Same as MAS; caused by stress & poor water quality		Antibiotic in feed
Columnaris	*Flavobacterium columnare*	Bacterium	Frayed fins &/or irregular whitish to grey patches on skin &/or fins; pale, necrotic lesions on gills		$KMnO_4$ as with MAS; indefinite immersion with $CuSO_4$ at 0.5-3 mg/litre, depending on alkalinity
Edwardsiellosis	*Edwardsiella tarda*	Bacterium	Few external symptoms; bloody fluid in body cavity; pale, mottled liver; swollen, dark red spleen; swollen, soft kidney		Antibiotic in feed
Streptococcosis	*Streptococcus iniae* & *Enterococcus* sp.	Bacteria	Lethargic, erratic swimming; dark skin pigmentation; exophthalmia with opacity & haemorrhage in eye; abdominal distension; diffused haemorrhaging in operculum, around mouth, anus & base of fins; enlarged, nearly black spleen; high mortality.		Antibiotic in feed, e.g. Erythromycin at 50 mg/kg fish/d for 12 d (requires 'extra-label use' permit in the USA)

Saprolegniosis	*Saprolegnia parasitica*	Fungus	Lethargic swimming; white, grey or brown colonies that resemble tufts of cotton; open lesions in muscle		$KMnO_4$ or $CuSO_4$ treatments; use 1 mg/litre of $CuSO_4$ for every 100 mg/litre alkalinity up to 3.0 mg/litre $CuSO_4$; formalin at 25 mg/litre indefinite immersion or 150 mg/litre for 1 h
Ciliates	*Ichthyophthirius multifiliis*; *Trichodina* & others	Protozoan parasite	Occurs on gills or skin		$KMnO_4$, $CuSO_4$ or formalin treatments
Monogenetic trematodes	*Dactylogyrus* spp.; *Gyrodactylus* spp.	Protozoan parasite	Occurs on body surface, fins or gills		Same as for ciliates

Table 1: FAO Cultured Aquatic Species Information Programme

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