Oreochromis niloticus
Question & Answer Sheet
Updated September 13, 2017
Developed May 30, 2014

1. Is tilapia established in Hawaii?

Tilapia are found in every freshwater and salt water body of water in Hawaii. Several species were introduced in the 1950's with *Sarotherodon melanotheron (S. melanotheron)* and *Oreochromis niloticus (O. niloticus)* in the 1980's. Regardless of the initial reason of import, the spread of tilapia has been fueled by the lucrative live whole fish ethnic market. As farmers trade fish and try to improve their stocks to increase production, the wild populations have benefitted through inadvertent introduction of better bloodlines.

Source:
"A Status Report on Tilapia Cultivation in Hawaii: Regulatory and Related Considerations". 1983. Department of Land and Natural Resources.

2. Do domestic stocks thrive if released into existing wild populations that include similar or same species? What would a domesticated pure O. niloticus look like?

Domesticated animals are not bred for native habitat survival. In nature, reproductive success is the "goal" of natural selection. On the other hand, domestic stocks of *O. niloticus* have been bred for an optimized growth rate in a high density environment on a controlled diet. Territorial instincts have been breed out of the fish to accommodate crowding and docile behavior. These domesticated traits are not well suited to the wild environment where fish must compete for food while avoiding predators. *O. niloticus* hybrids found in feral Hawaii populations originated from hybrid stocks and, therefore, were able to adjust to wild conditions more easily.

The image below shows a pure *O. niloticus* from Florida. It is an example of breeding for food production traits such as high yield and faster growth. At two years, it was 6.5 pounds and approximately 20 inches long and 5 inches wide. The fish's siblings averaged 4 to 5 pounds. The Florida fish reach 2 pounds in 10 to 12 months v. 2 years for Hawaii's stock (a larger photo is attached).

Source: Dr. Benny Ron / Pentair Aquatic Ecosystems

3. Will the natural carrying capacity of the existing bodies of water and the existing tilapia populations limit the impact of any release of niloticus?

Food supply is the primary limiting factor to population growth. Adding fish to established populations has little chance of significantly increasing fish numbers. As tilapia are already widely established in Hawaii, any immediate increase in population size by an introduction of niloticus into a habitat will be negated as the population is restored to the previous level.

Source: Dr. Benny Ron
Blankenship, H.L. and K. Leber. 1995. "A responsible approach to marine stock enhancement." American Fisheries Society Symposium 15:167-175.

4. Is S. melanotheron (blackchin tilapia) the dominant species in wild tilapia populations in Hawaii? As such, do you think escaped O. niloticus will impact their populations?

Melanotheron is an aggressive species which has taken over the wild populations in Hawaii. It is abundant in to fresh and saltwater and will continue to out-compete any introduced or existing tilapia, including *O. niloticus*.

Source: Dr. Gordon Grau
Fabrice Duponchelle & Marc Legendre. 2000. "Oreochromis niloticus (Cichlidae) in Lake Ayame, Cote D'Ivoire: Life History Traits of a Strongly Diminished Population". Cybium 2000, 24(2): 161-172.

5. Is O. niloticus established in Hawaii's farms and in the wild?

A 2012 Center for Tropical and Subtropical Aquaculture study shows that captive and wild *O. niloticus* stocks exist in Hawaii using DNA sequencing. Hybrid niloticus stocks have been maintained and cultivated since introduction in the 1980's.

Source:
Liang Wu and Jinzeng Yang. 2012. "Identification of Captive and Wild Tilapia Species Existing in Hawaii by Mitochondrial DNA Control Region Sequence". PLoS ONE 7(12): e51731

6. Can O. niloticus inter-breed with S. melanotheron to create hybrids?

Research shows the difficultly in creating hybrids of *O. niloticus* and *S. melanotheron* in a commercial setting. In a natural setting, *S. melanotheron* and *O. niloticus* will not inter-breed.

Source: Dr. Benny Ron
Li Si-Fa, Zhao Yan, Fan Wu-Jiang, Cai Wan-Qi, Xu Ying-Fang. 2011. Possible genetic reproductive isolation between two tilapiine genera and species: Oreochromis niloticus and Sarotherodon melanotheron. Zoological Research. Oct. 32(5): 521-527.

7. A member of the Sub-Committee stated – "O. niloticus should only be cultured in closed systems that are not within close proximity to a natural body of water to prevent escapes". Can O. niliotcus survive in saltwater? What about introduction into freshwater populations?

Research has shown that *niloticus* has a restricted salinity tolerance vis-à-vis the permitted tilapias – limiting its ability to survive in brackish or saltwater. Research shows that *O. niloticus* prefers will perish in 9-10 ppt

saltwater (note: average seawater is 34.7 ppt saltwater). If an escape or release occurs, the species will be limited to freshwater environments which are already populated with *S. melanotheron* or *Oreochromis* hybrids. Discussion regarding the ability of niloticus to integrate and impact freshwater existing wild populations can be found in Questions 2, 3 and 4.

Source: Dr. Gordon Grau
Breves, J.P., S. Hasegawa, M. Yoshioka, b, B.K. Fox, L.K. Davis, D.T. Lerner, Y. Takei, T. Hirano and E.G. Grau. 2010. "Acute salinity challenges in Mozambique and Nile tilapia: Differential responses of plasma prolactin, growth hormone and branchial expression of ion transporters." General and Comparative Endocrinology, Volume 167, Issue 1, May.

E.O. Lawson & M.A. Anetekhai. 2011. "Salinity tolerance and Preference of Hatchery Reared Nile Tilapia, *Oreochromis niloticus* (Linneaus 1758). Asian Journal of Agricultural Sciences 3(2): 104-110.

Yanaguchi, Y., Breves, J., Haws, M., Lerner, D., Grau, G., & Seale, A. 2017 "Acute salinity tolerance and the control of two prolactins and their receptors in the Nile tilapia (*Oreochromis niloticus*) and Mozambique tilapia (*O. mossambicus*): A comparative study." General and Comparative Endocrinology.

8. A member of the Sub-Committee stated the following concern – "While this species does not have a high salinity tolerance, Kaneohe Bay often experiences large freshwater inputs with heavy rains. During a large rain event, with the tanks/ponds at Kualoa being exposed to the outside environment, this poses the potential for escape and survival in the now temporarily lower salinity waters of Kaneohe Bay". Is this a valid concern?

O. niloticus cannot survive in Kaneohe Bay and will perish in less than 6 hours if exposed to seawater. Freshwater or rather the lower salinity film that appears during a heavy rain only on calm (no wind) days is highly ephemeral and cannot support *O. niloticus*. Refer to question 7 for salinity preferences and tolerances of *O. niloticus*.

Source: Dr. Gordon Grau

9. A member of the Sub-Committee stated – "All imported tilapia should be quarantined for a minimum of 30 days to prevent the introduction of disease to the operation and surrounding area. Closed systems are required for this procedure. If water exchanged is needed, the effluent should flow into a catchment system where it can be disinfected before going to the ocean". Is this a valid concern?

Disease concerns are valid for any imported species. Specifically for tilapia, as far back as 1996, farms on Oahu have been challenged by a Rickettsia-Like Organism (RLO), which can cause widespread deaths in certain conditions. This disease is now known to be caused by *Francisella noatunensis*. Current research is focusing on testing local stocks and identifying inexpensive testing options for the farmers. The introduction and maintenance of a clean stock source would stabilize the industry and provide assurance that infected stock could be harvested and replaced with a healthy population. The timing of this permit would allow many of the farmers to switch to clean *O. niloticus* lines and create their own hybrids based on Hawaii specific growing conditions for optimal production. Importing clean stock of the currently approved species (*O. mossambicus*, *O. aureus* and *O. spilurus*) would also help mitigate the RLO impact but, as stated above, their growth and yield performance is sub-standard compared with *O. niloticus*.

Quarantine systems are an industry standard based on best aquaculture practices to protect the farm's existing stocks. Pre-shipment disease testing will also mitigate disease concerns. Both topics can be addressed in the permit conditions.

Source:
Tilapia. 1996. Center for Tropical and Subtropical Aquaculture (CTSA) 123, May.