
Cool-water & Warm-water Produce Options & Fish Selection In Aquaponics

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Selection Criteria

- Compatibility – fish, plants, bacteria
 - Simultaneous selection
- Availability – source of fish
 - Know your national, state, and local Import regulations
 - Health certificate & quarantine
 - Year round or cyclical
- Quantity – how many do you need?
- Marketing – will you sell them? To whom?



Requirements

Bacteria

Parameter	Optimum Range
Temperature: <i>Nitrosomonas</i> <i>Nitrobacter</i>	68 – 86°F / 20 – 30°C 82 – 100°F / 28 – 38°C
pH: <i>Nitrosomonas</i> <i>Nitrobacter</i>	7.8 – 8.0 7.3 – 7.5

Compromise:

Temperature: 70-80°F / 21 - 26°C

pH = 7.0

Plants (typical)

Parameter	Range
Temperature	60-80°F / 15-26°C
pH	Preferred: 5.8 - 6.2 Maximum: 7.0 - 7.5

Fish

Parameter	Range
Temperature	60-80°F / 15-26°C
pH	7.0 – 8.0



Generalized Fish Categories



Group	Temperature	DO requirement	Ammonia tolerance	Protein requirement
Coldwater	<60°F / <15°C	>5 mg/L	Low	High
Coolwater	60 – 75°F / 15 – 24°C	>5 mg/L	Low	Moderate
Warmwater	>75°F / >24°C	>2 mg/L	Moderate	Moderate



Tolerance Ranges for Growth of Tilapia

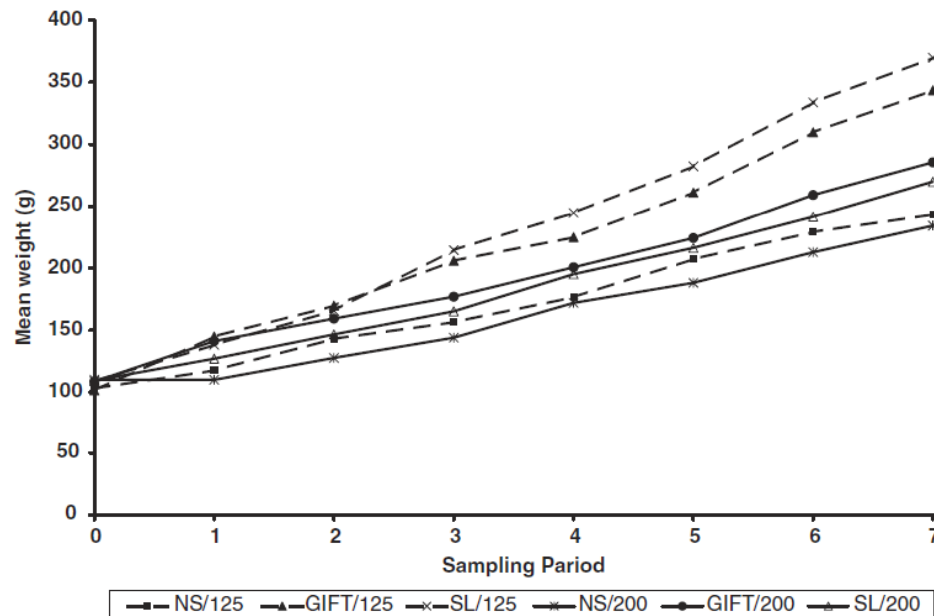
Culture factor	Range
Temperature	64 - 90°F (17 - 32°C)
Dissolved oxygen	3 – 10 mg/L
pH	7 – 8
Ammonia-N	0 – 0.04 mg/L
Nitrite-N	0 – 0.8 mg/L
Hardness	50 - 350 mg/L
CO ₂	0 – 30 mg/L

- Widely cultured in tropical and sub-tropical regions.
- A favorite for aquaponics.



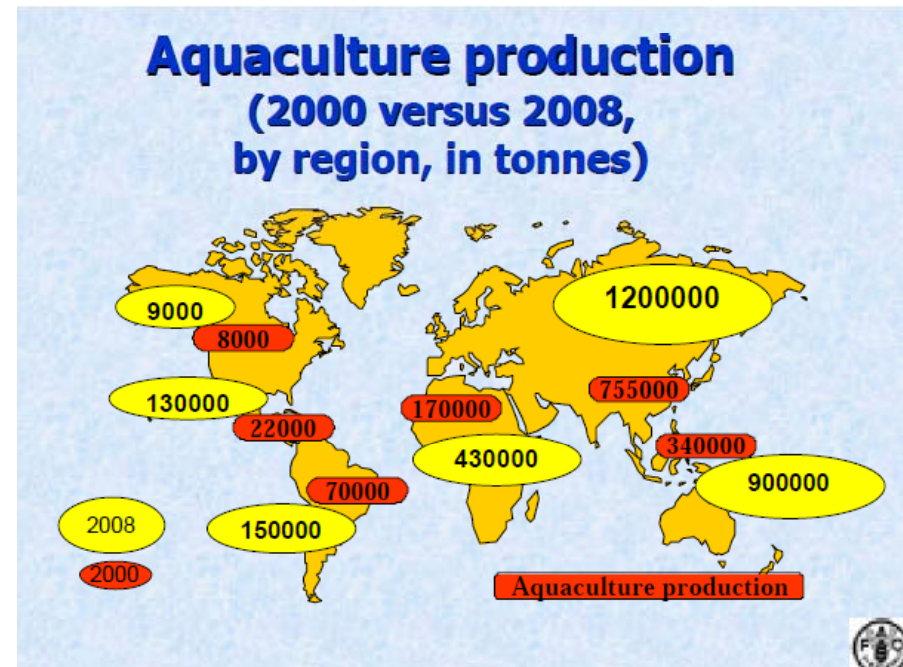
Growth Rate of Nile Tilapia

- More than tripled in weight during 104 day (3 ½ months) study.
- Inverse relationship between density and growth.



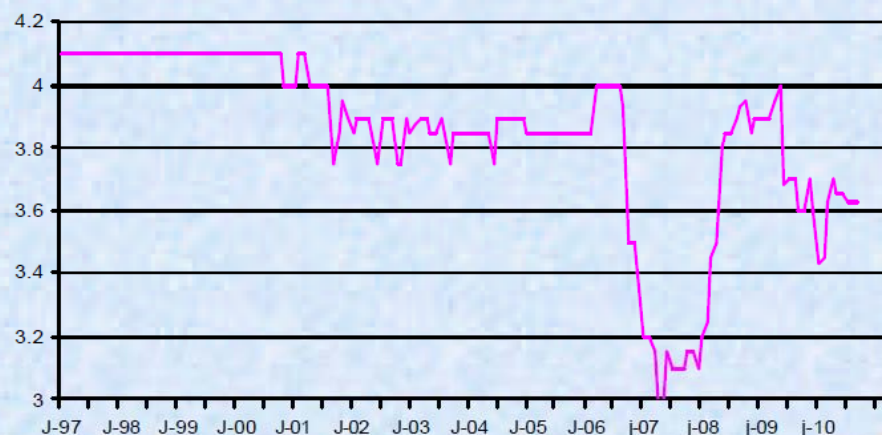
Tilapia Production

- Worldwide:
 - 830,000 tons in 1990
 - 1.6 million tons in 1999
 - 3.5 million tons in 2008
- China: 1.1 million tons in 2008
 - Frozen tilapia fillets from China (90% of market)
- Fresh tilapia fillets are a niche market.



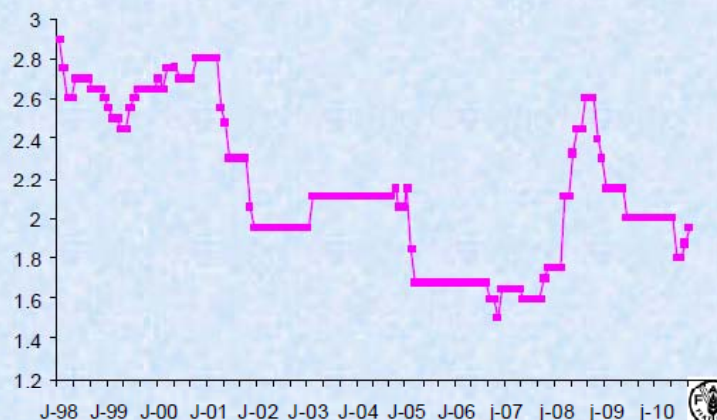
Estimated Cost of Production

Fresh tilapia fillets in the US wholesale market (US\$/lb)



- Brazil, Ecuador, Cuba: \$1.10 / kg
- Costa Rica, Jamaica: \$1.20 / kg
- Colombia, Mexico: \$1.25 / kg
- USA: \$2.00 / kg
- Canada: \$2.10 / kg

Frozen tilapia fillets in the US wholesale market (US\$/lb)



Current Market Trends

- U.S. and European growers will concentrate on live sales.
- Latin America and Southeast Asia will be primary U.S. suppliers of fillets and processed forms.
- Latin America, Caribbean and Africa will supply European markets.
- U.S. imports are growing, demand is very good and almost all supplies are coming from imports.
- Second most popular fish in U.S. retail stores, behind salmon, and the 5th most popular fishery product overall.
- Tilapia supply will continue to expand from increased Chinese production mainly directed at U.S. markets.



Tolerance Ranges for Growth of Percidae

(Example: Yellow perch)

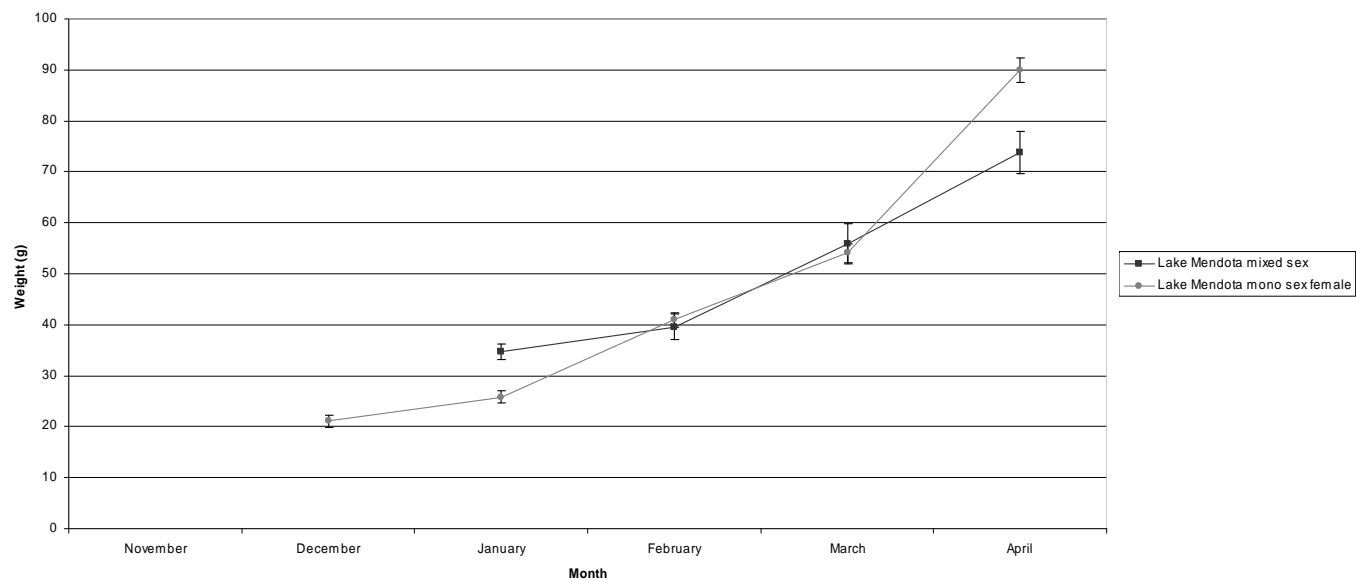
Culture factor	Range
Temperature	70 – 75°F (21-24°C)
Dissolved oxygen	3.5 – 10 mg/L
pH	6.5-9
Ammonia-N	0 – 0.0125 mg/L
Nitrite-N	0 – 1.0 mg/L
Hardness	50 – 400 mg/L
CO ₂	0 – 6 mg/L

- Widely cultured in Midwest U.S.
- A favorite fish for the Friday-night fish fry.

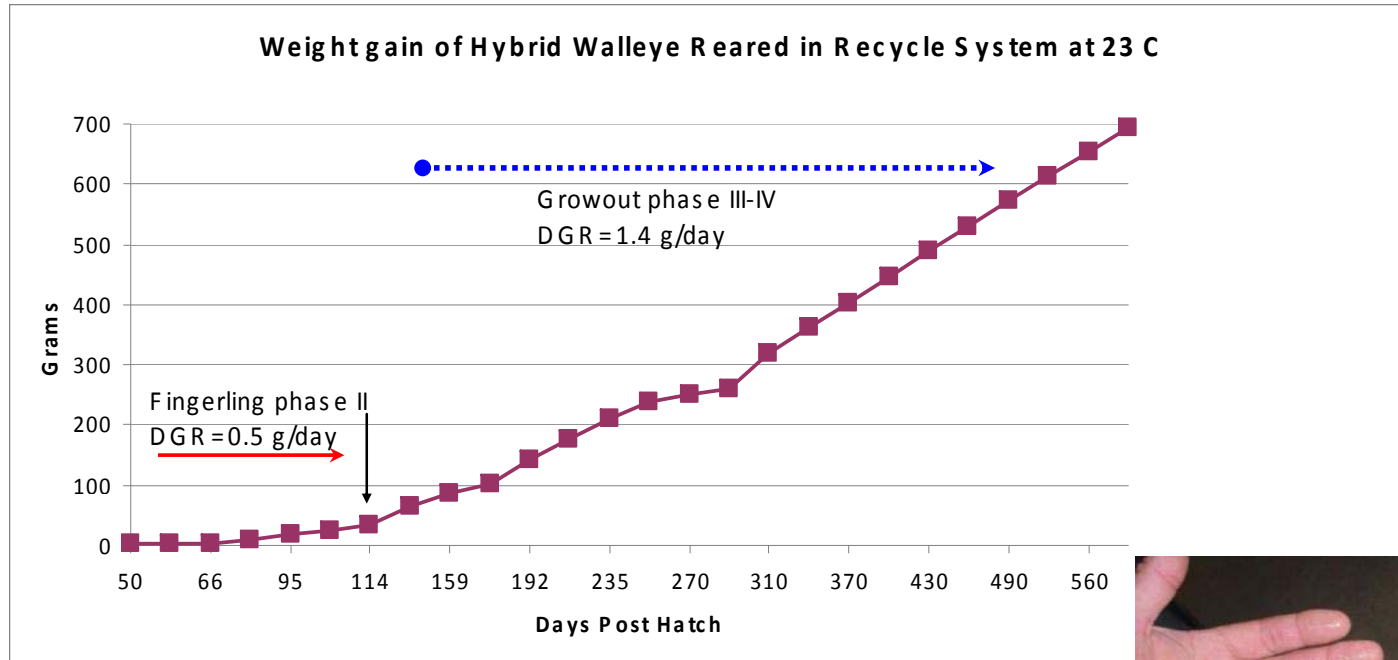


Growth Rates of Yellow Perch & Pikeperch

- Yellow perch: 19°C RAS, raised for 4 months
- Mixed vs monosex (female)



Growth Rates of Walleye & Hybrids



Tolerance Ranges for Growth of Centrarchids (Example: Bluegill)

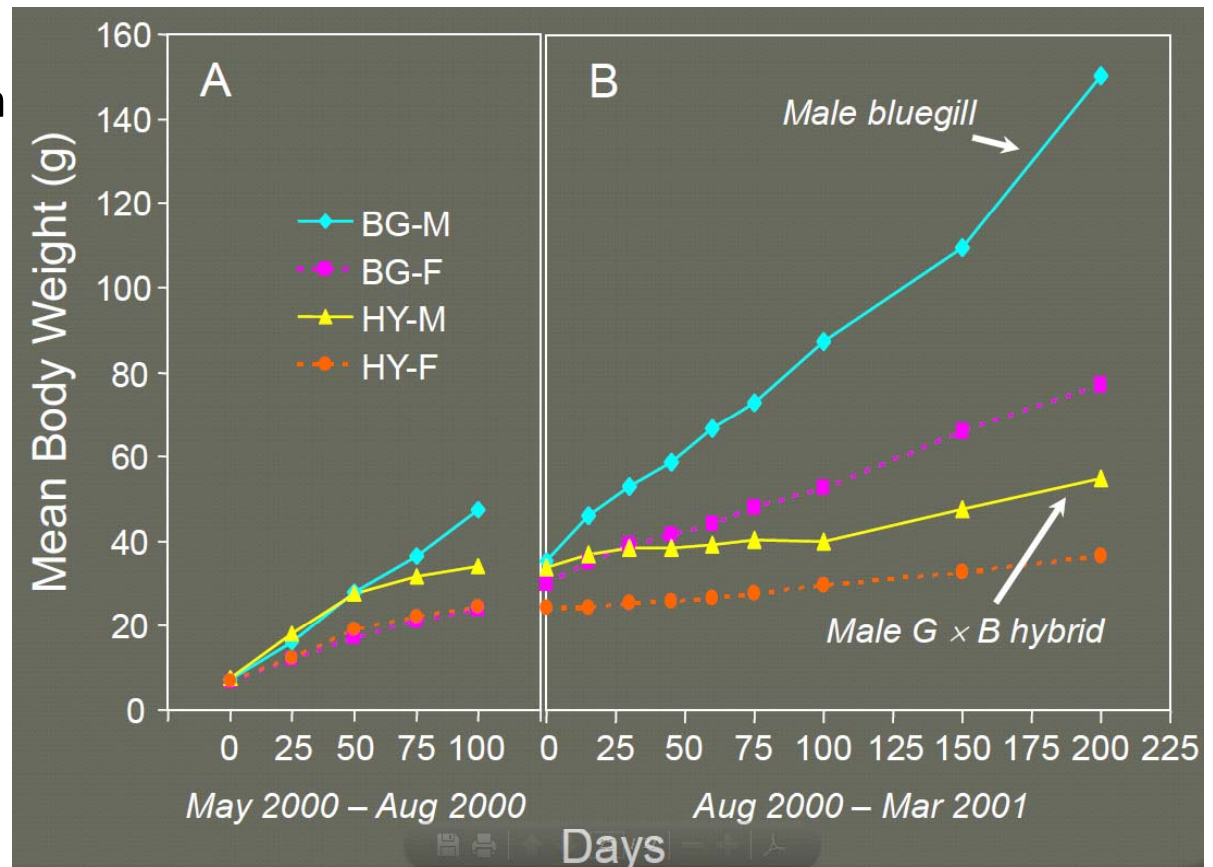
Culture factor	Ranges
Temperature	68 – 85°F (20-29°C)
Dissolved oxygen	4 – 10 mg/L
pH	7 – 8.5
Ammonia-N	0 – 0.01 mg/L
Nitrite-N	0 – 0.8 mg/L
Hardness	50 – 200 mg/L
CO ₂	0 – 25 mg/L

- Potential as temperate region tilapia.
- Widely cultured in Midwest U.S.
- Broad geographic distribution.



Growth Rates of Bluegill & Hybrids

- Bluegill and female green- male bluegill hybrids.
- 0.5 lbs (227 g) market-size needed in 10-12 months.
- Feed ranges:
32-40% crude protein



Tolerance Ranges for Growth of Carp

(Example: Koi & Goldfish)

Culture factor	Ranges
Temperature	65 – 75°F (18-24°C)
Dissolved oxygen	4 – 10 mg/L
pH	6 – 8
Ammonia-N	0 – 0.08 mg/L
Nitrite-N	0 – 0.6 mg/L
Hardness	50 – 350 mg/L
CO ₂	0 – 25 mg/L

- Ornamental trade and sales.
- Hardy & tolerant.
- Marketing.



Freshwater Species

- Most any fish can be cultured in RAS as long as it does well under medium to high density culture.
- Optimization data needed.
 - Largemouth bass
 - Markets mostly large cities
 - Barramundi (sea bass)
 - Australia to Southeast Asia
 - 1.5 – 2.0 lbs in a year
 - Murray cod
 - Australia, carnivorous but readily accepts feed
 - Adaptable to crowding
 - Jade perch
 - Australia, require water temperature $>16^{\circ}\text{C}$
 - Can grow to 500 g in under 12 months
 - Pacu
 - Others

