

Effects of rearing conditions on low-temperature tolerance of Nile tilapia, *Oreochromis niloticus*, juveniles

By

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Background information

- Global expansion of tilapia farming constrained by sensitivity to low temperature
- Optimal growth temperature: 25-28°C
- Over-wintering mortalities common
- Cold tolerance in fish dependent on
 - Environment
 - Health and nutrition
 - Genetic effects
- Selection for growth in low input environments at Abbasa, Egypt
- Improvement of trait important for extension of grow-out period

Objectives

- Investigate the effect of age, genotype and body size on cold tolerance (Experiment-1)
- Investigate effect of diet on cold tolerance (Experiment 2)
- Determine low lethal temperature for *O. niloticus* reared under low-input environments (Experiment 1 and 2)
- Determine the effect of acclimatization on cold tolerance (Experiment 1 and 2)

Experiment 1

- Fry families produced and grown in separate 2x3 m hapas in pond until tagging
- Pond received 50kg/ha chicken manure per day
- Carried out in summer
- 10 fry/ family from 80 families tagged
- Age range from 41-90 days
- Weight: 1-20g



Cold tolerance test

- Experiment in cold room and 5 aquaria
- Water temperature lowered from 16 °C at the rate of 1°C/day
- Fry not fed
- Hourly measurements of temperature and mortality
- Trait description:
Temperature at Death (TAD)
or Cooling Degree hours (CDH)



Experiment 2



- Carried out in Fall
- 20 full-sib families produced using brooders in first experiment
- Each family divided in two groups of 30 swim-up fry
- Assigned to two treatments: pellet and natural-fed
- Reared for 42 days
- 10 fish per treatment per family tagged for cold tolerance
- Cold tolerance measured as in experiment 1

Data analysis



- Genotype, aquarium, age, size analyzed in experiment 1
- Model 1:
 - $Y_{ijkl} = \mu + a_i + \beta 1 * AGE_{ijkl} + \beta 2 * \ln(w)_{ijkl} + s_j + d_k(s_j) + e_{ijkl}$
- Effect of diet, genotype, aquarium, specific growth rate, condition factor and genotype X diet effects analyzed in second experiment
- Correlation of size and cold tolerance

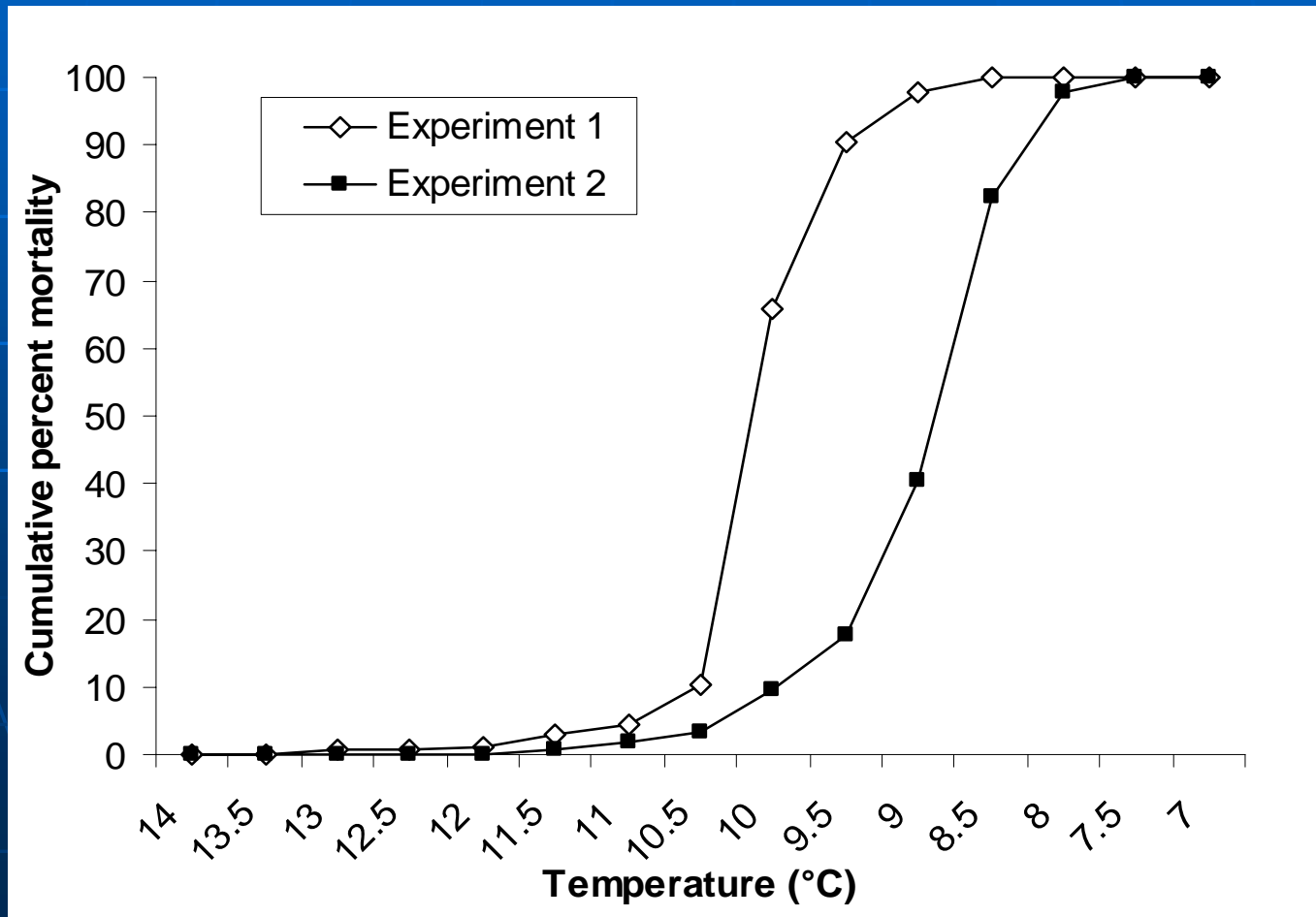
Results

Fish that lost balance
(arrows) considered
dead



Results

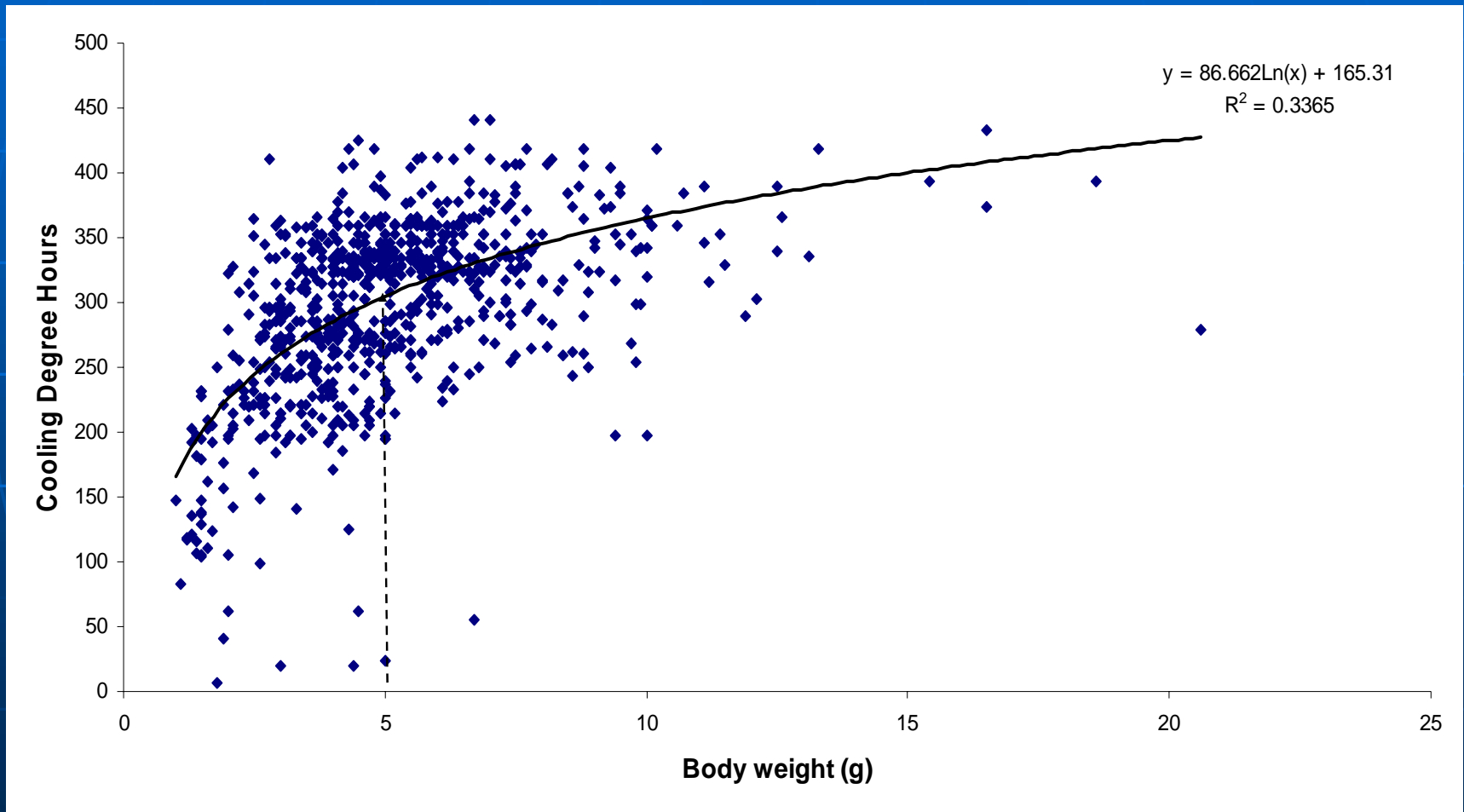
- Mortality in experiment 1 from 13.6°C to 8.6 °C
- Experiment 2: from 11.7 °C to 7.5 °C



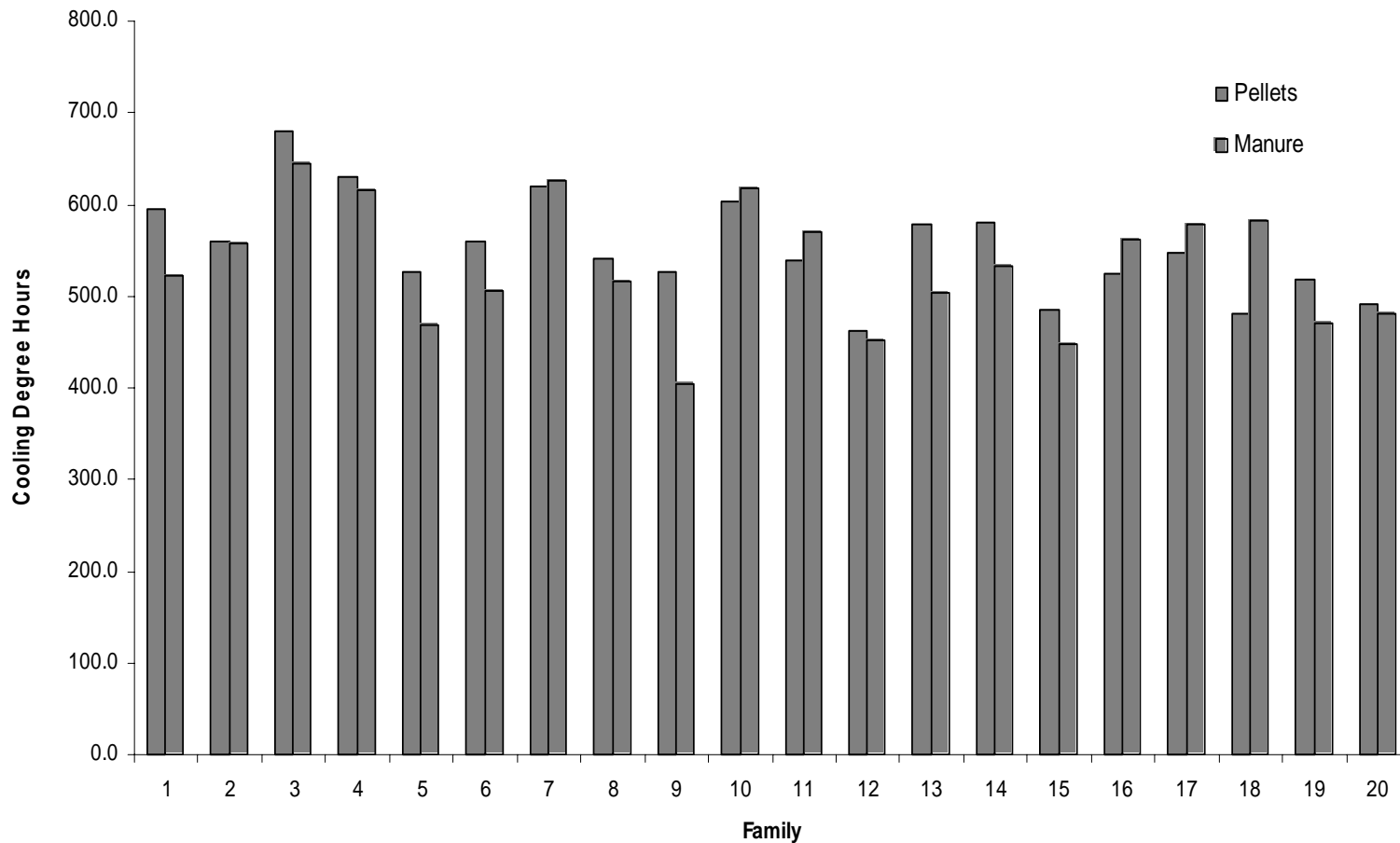
Size and cold tolerance parameters of pellet and natural-fed tilapia fry

Parameter	Diet		
	Pellet-fed	Natural-fed	P-value
Initial weight (g)	0.045(0.03)	0.045 (0.03)	-
Final weight (g)	1.97 (0.65)	1.92 (0.61)	0.4771
Standard length (mm)	38.05 (3.99)	37.58 (3.81)	0.2239
Specific growth rate (%/day)	9.37 (1.21)	9.34 (1.29)	0.8659
Condition factor	3.86 (0.40)	3.71 (0.37)	0.0002
Temperature at death (°C)	8.9 (0.67)	9.0 (0.64)	0.0348
Cooling degree hours	551.66 (104.53)	530.56 (99.80)	0.0414

Tendency for smaller fish to have lower cold tolerance



Presence of genotype environment interaction

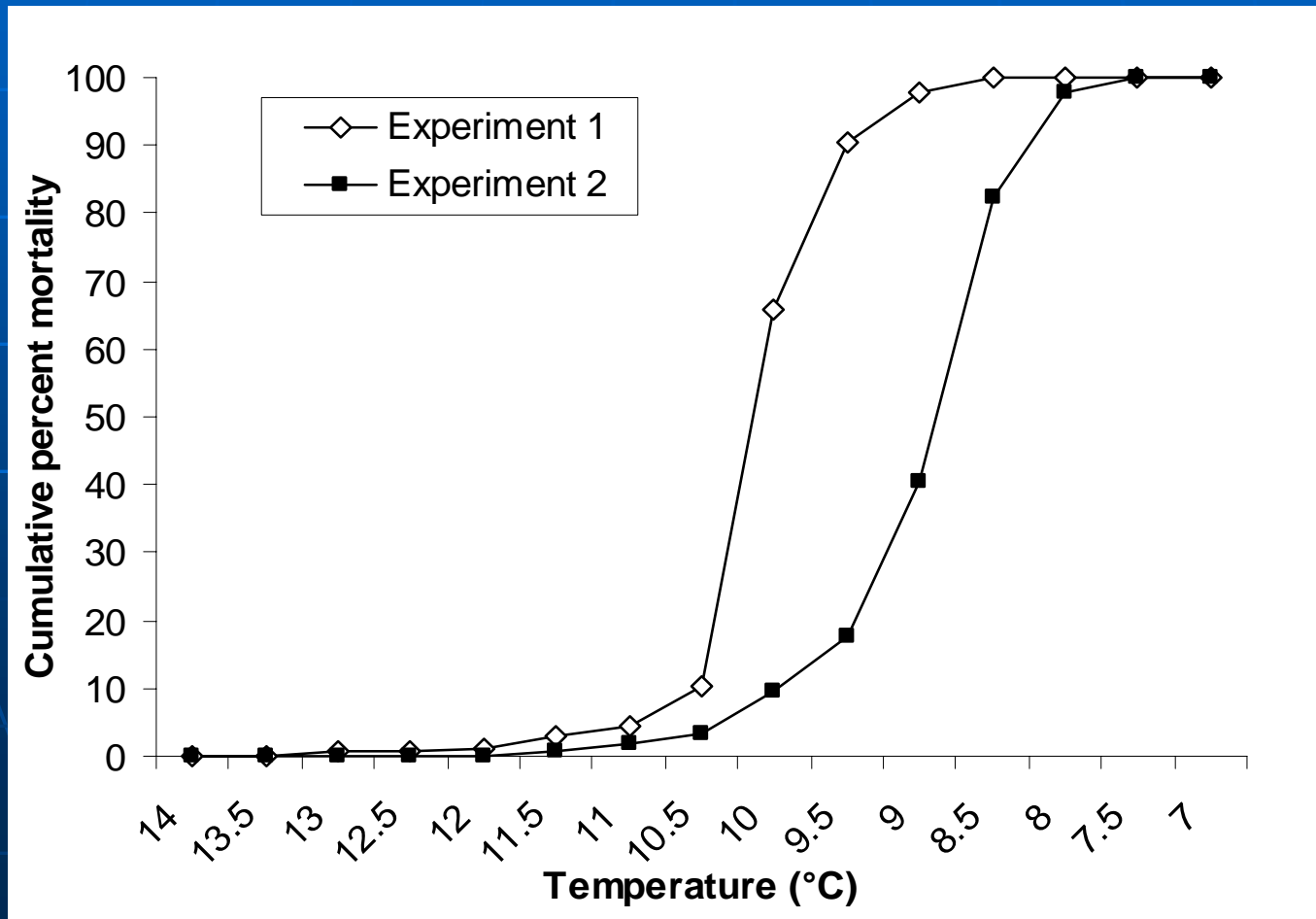


Results and Discussion

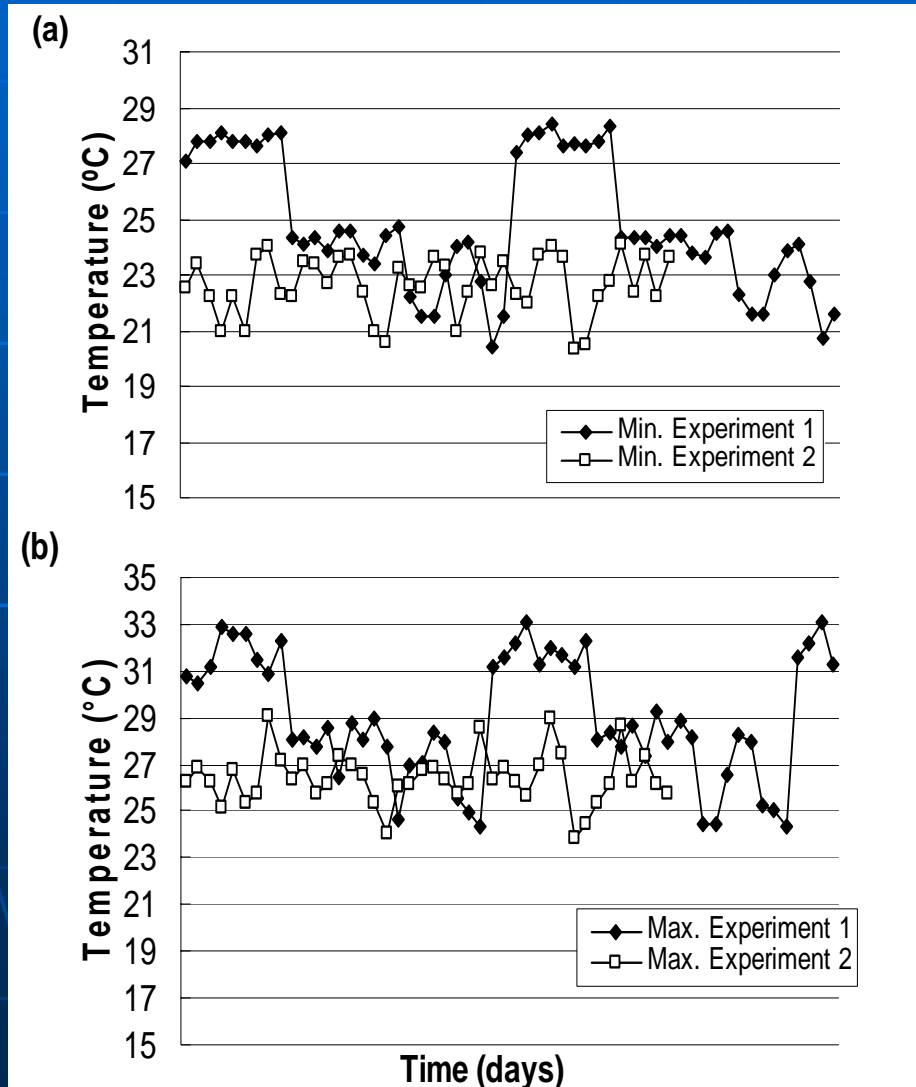
- Significant effect of aquarium, genotype, fish size in both experiments
- Age does not affect tolerance
- Pellet-fed fish significantly more cold tolerant than natural (phytoplankton) fed fish
- Fish reared in autumn more cold tolerant
 - Acclimatization effect ?

Acclimatization

- Mortality in experiment 1 from 13.6°C to 8.6 °C
- Experiment 2: from 11.7 °C to 7.5 °C



Temperature regimes during fry rearing in the two experiments



Conclusions

- Smaller (<5g) fish are less tolerant to lower temperatures
- Potential for manipulation of environment and diet for improved cold tolerance
- Genotype x diet interactions should be further studied

Acknowledgements

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Thank You All!