Size Dependent Cannibalism in Juvenile Nile Tilapia (*O. niloticus*)

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Introduction

Cannibalism in fish

- Cannibalism is wide spread & common in fish
- Various sizes or ages, between cohorts or age classes
- size variation, food availability, high population density, limited refuge areas & light conditions
- Is more intense in early life stages

Introduction

- Early stages → maximum variability of growth → size heterogeneity →social dominance → aggressive behavior & ***cannibalism***

Cannibalism in O. niloticus

- Major problem in tilapia hatcheries
- It has received little attention
- Factors underlying it have not been investigated in detail

Objectives

- To test the hypothesis that prey size in *O. niloticus* is a function of predators' oral gape and prey body depth
- To predict cannibalism based on body measurements of both prey and predator

Materials and Methods

Predator-prey linear regression model

Assumptions:

- Oral gape of a predator largely determines maximum prey size
- A predator could swallow a fish with a body depth smaller or equal to its maximum oral gape

Materials and Methods

- A predictive model for maximum prey size was developed based on morphometric dimensions of 140 fingerlings

- All individuals were measured for total weight (W), total length (L) oral gape (G) & body depth (D)

- Linear regressions were developed between body measurements

Materials and Methods

Linear regressions

- Body weight/Gape:

$Log_{10}G_{predator} = a_1 + ß_1 Log_{10}W_{predator}$................(1)

- Body weight/body depth:

$Log_{10}D_{prey} = a_2 + ß_2 Log_{10}W_{prey}$ ....(2)

Where: $ß_1$, $ß_2$ = regression coefficients &
a_1, a_2 = intercepts

Materials and Methods

- A predator can consume a prey with body depth (D) smaller or equal to predator's Gape (G)
- $G_{predator} \leq D_{prey}$ → Equation 1= Equation 2
- Maximum prey size for a given predator size:

$$Log_{10}W_{prey} = (a_1-a_2)/ß_2 + (ß_1/ß_2)Log_{10}W_{predator}....(3)$$

Materials and Methods

Model Verification

- 76 trials conducted to:
  - → Verify the regression model
  - → estimate the actual max prey size
- Trials were carried out in a 20L aquaria (26-28°C and 12L:12D)
- One prey & one predator of known length were paired in an aquarium fish & were checked daily

Materials and Methods

- If a prey had been eaten →prey size within the predation range & the predator was given a slightly bigger prey
- If the prey had not been consumed with in two days it is considered too large for that predator (upper limit for the predator)

Results

Predator-prey model

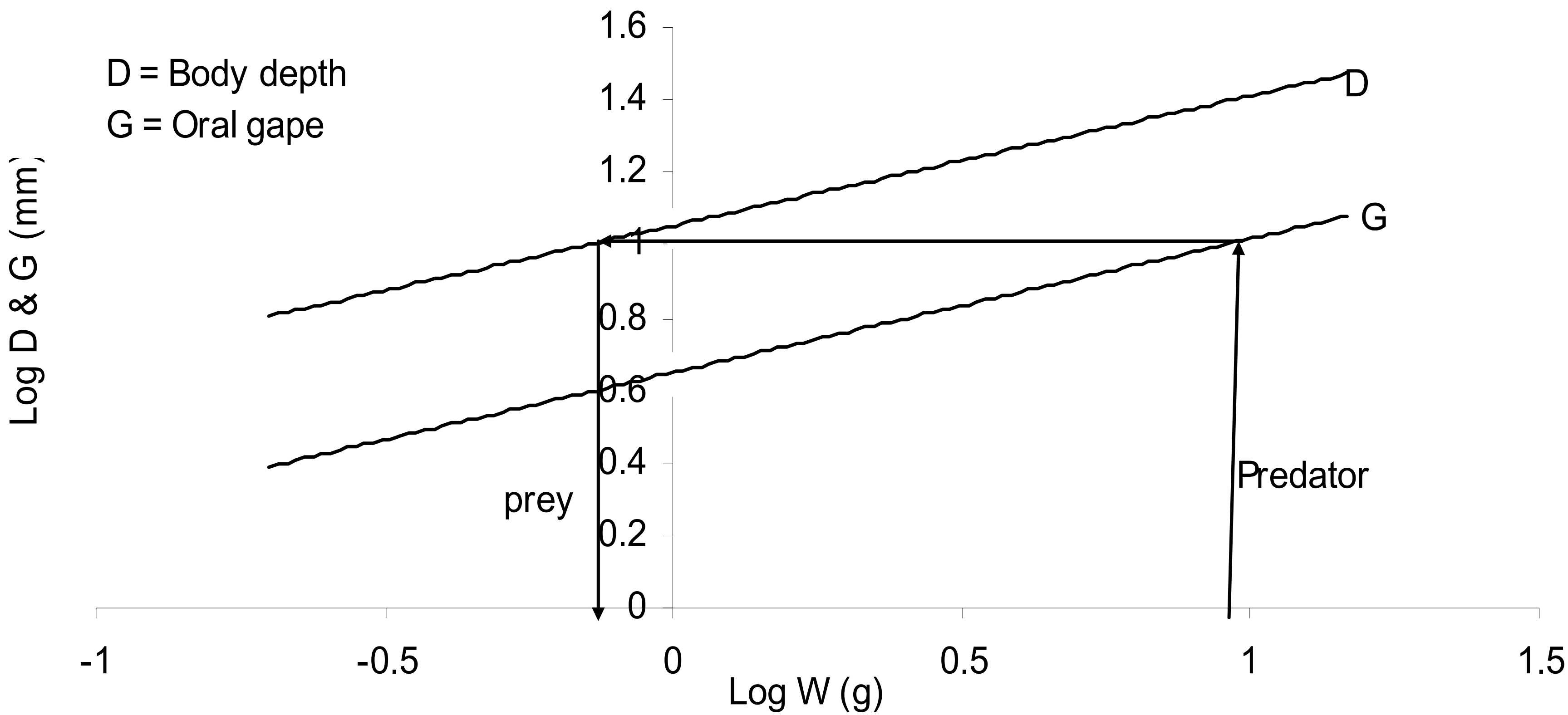

Fig 1 Regression of D & G on W

Results

Linear regressions:

- Body weight/Gape:

  $Log_{10}G_{predator} = 0.65 + 0.37Log_{10}W_{predator}$ ($R^2 = 0.963$, n = 140)

- Body weight/body depth:

$Log_{10}D_{prey} = 1.06 + 0.36Log_{10}W_{prey}$ ($R^2 = 0.981$, n = 140)

- Regression model for maximum prey size is given by:

  $Log_{10}W_{prey} = 1.03Log_{10}W_{predator} – 1 .13$ …………..(4)

Results

- Verification showed that the model slightly over estimates prey size

- The model should be revised as:

$Log_{10}W_{prey} = Log_{10}W_{predator} – 1.18$ …………(5)

Results

Model verification

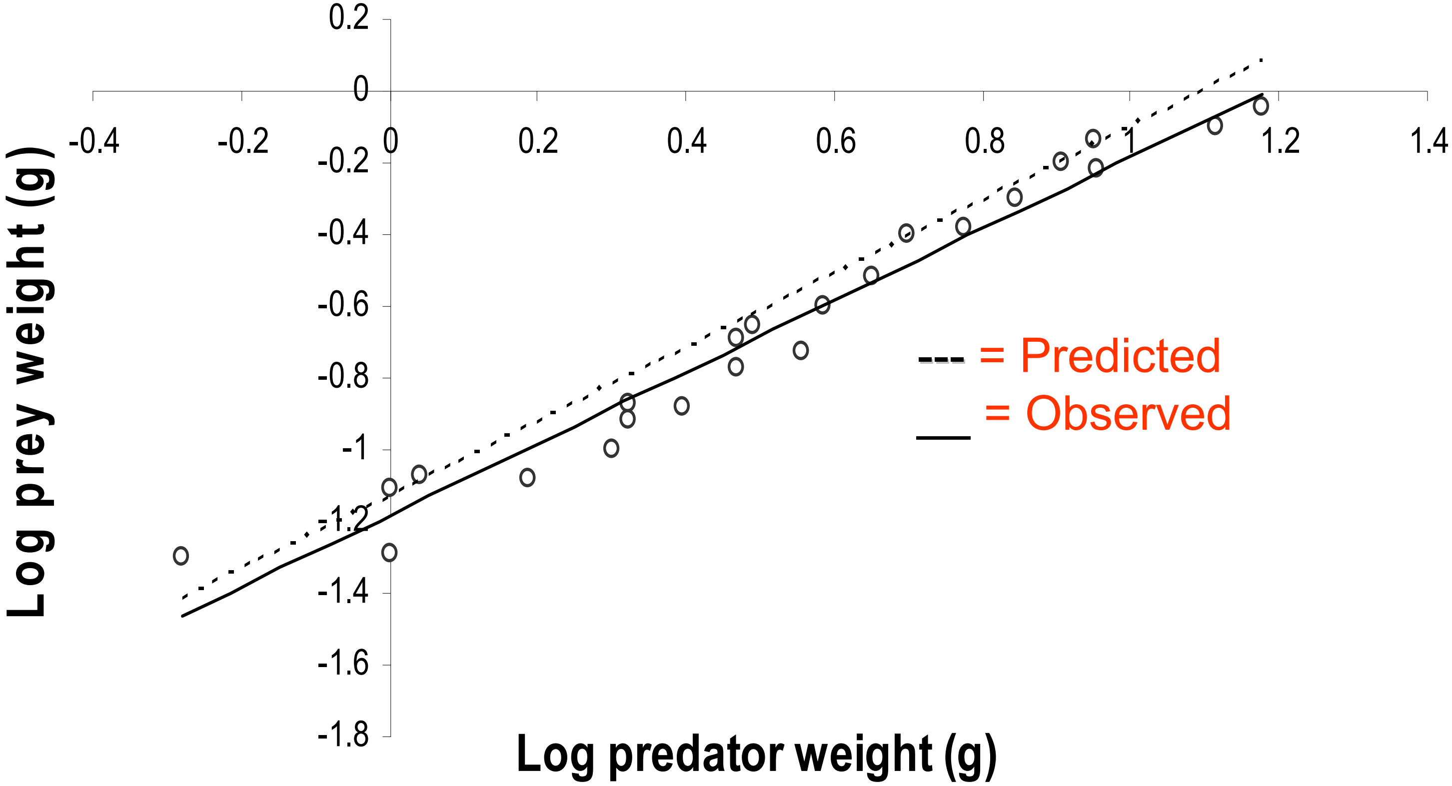

Fig. 2 observed & predicted maximum prey weight for a given weight of predator

Discussions

- The model approach can prove useful for predicting cannibalism between larvae of known size distribution

- The model verification yielded observed values slightly higher than expected

  → Other features might play a role in limiting maximum prey size e.g. pharyngeal gape

  → Actual mouth elasticity might be smaller than our measurements indicated

Conclusions

Practical implications

- The model can be of practical use in size grading which is a key step in controlling cannibalism
- Over estimation of prey size → higher safety margin → reduces cannibalism further
- Cannibalism could be kept minimal if predator to prey weight ratio is less than 13 times

Thank You