Relationship between body condition and growth rate in green turtles in The Bahamas

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Background

- Somatic growth rates are variable within and among aggregations of sea turtles.
- 59% of variation in somatic growth rates among green turtles in the southern Bahamas can be explained by mean straight carapace length (SCL), sex, location, and year (Bjorndal et al. 2000).
- Body condition index (BCI), a measure of nutritional status, is a potential covariate of growth rate that has not been assessed in sea turtles (Fig. 1).
- We expect individuals with a greater BCI to exhibit faster growth rates.

Questions

1. How much variation in growth rate can be explained by BCI?
2. Can BCI be used to estimate relative growth rate?

Methods

- We used data from a long-term (> 30 years) capture-mark-recapture study in Union Creek Reserve, Great Inagua, Bahamas.
- We expanded upon the results of Bjorndal et al. (2000) using additional data and investigating an additional covariate of growth rate.
- We defined BCI as (Ricker 1975):

$$BCI = mass/(SCL)^3$$

- We used individuals with SCL <70 cm which had mass and SCL at both ends of the growth interval (n=373).
- Generalized Additive Model (GAM) analysis was used to investigate covariates of length growth.
- Our GAM equation was:

Growth rate ~ s(mean SCL) + s(mean BCI) + s(year) + s(recapture interval)

- We replaced mean BCI with initial and final BCI of each growth interval in separate models.

Figures

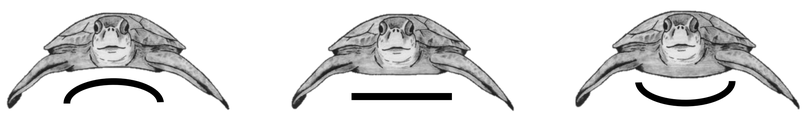

Figure 1: Illustration of different body conditions as shown by plastron shape (black bar): poor (left), fair (middle), and good (right). Modified from Thomson et al. (2009).

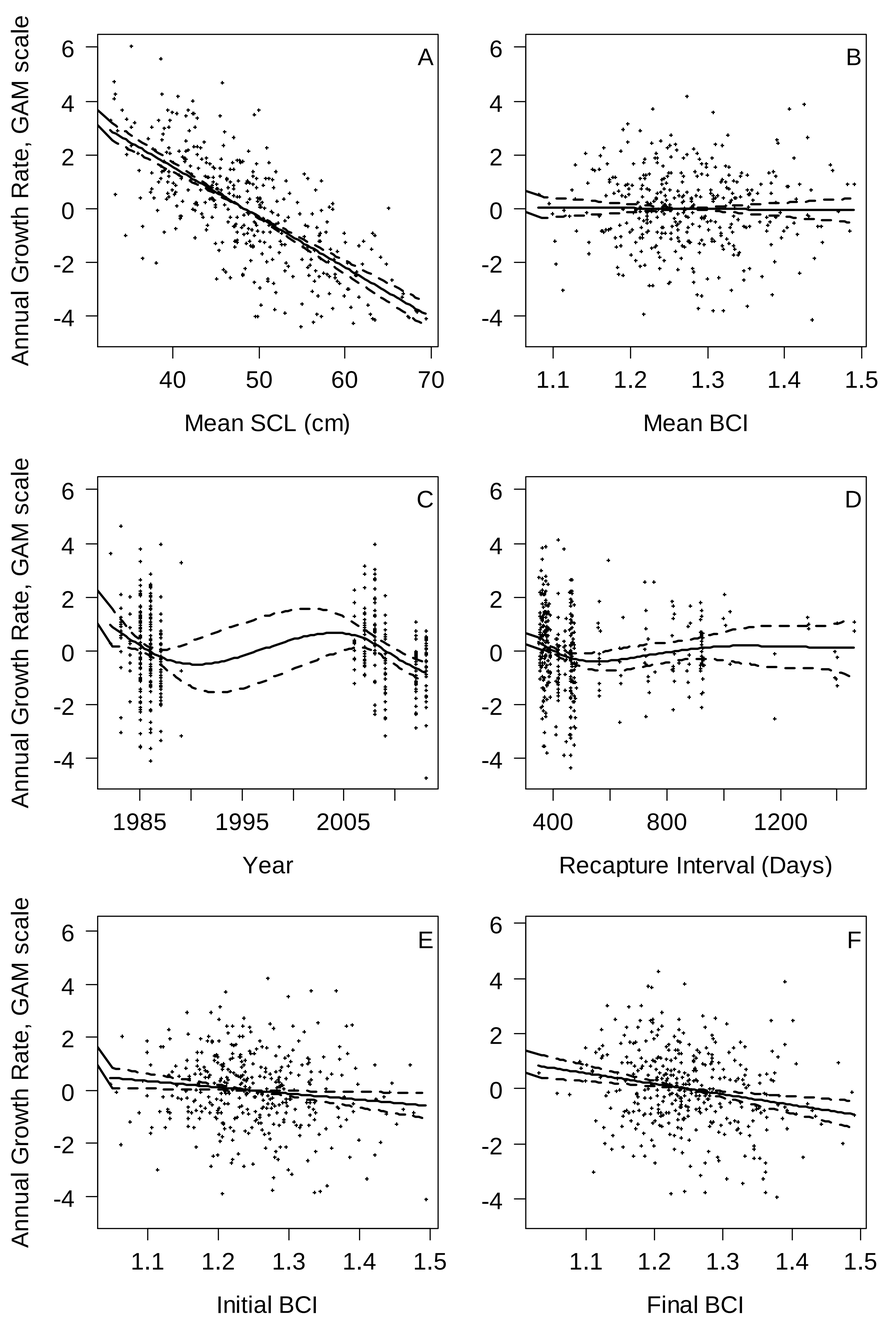

Figure 2: Graphical summary of GAM analyses for growth covariates (A) mean SCL (B) mean BCI (C) year of recapture and (D) recapture interval. The response variable (annual length growth rate) is shown on a centered smoothed function scale to ensure valid pointwise 95% confidence bands. Solid lines are smoothing splines from the GAM. Dashed lines are 95% confidence lines. Points are residuals. (E) initial BCI and (F) final BCI show how different measurements of BCI have different relationships with growth rate.

Results

- 51.2% of variation in growth rate can be explained by:
  - Mean SCL
  - Mean BCI
  - Year
  - Recapture Interval
- Mean SCL and Year are significant ($p<0.01$; Fig. 2A,C).
- Mean BCI is not significant and does not help explain variation in growth rate (Fig. 2B).
- The BCI with which a turtle begins a growth interval (initial BCI; Fig. 2E) is a significant covariate ($p<0.01$).
- The BCI with which a turtle ends a growth interval (final BCI; Fig. 2F) is a significant covariate ($p<0.01$).
- An additional 0.9% and 2.0% of variation in growth rate is explained by initial BCI and final BCI, respectively.

Conclusions and Future Directions

- Mean BCI does not explain additional variation in green turtle growth rate.
- While significant, initial and final BCI explain only a small amount of variation in growth rate.
- BCI is not a good predictor of relative growth rate.
- Individuals with a higher BCI did not exhibit a faster growth rate as we had predicted.
- Next step will be to compare covariates of growth rate among different populations/regions.

Literature Cited

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