



Bluebirds & Disturbance

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Human Disturbance & Wildlife

- Increasing development of wildlife habitat
- Correlations between different types and quantities of disturbance and wildlife need to be determined
- Quantitative, repeatable studies need to be conducted



Disturbance & Wildlife

- Different studies have shown different results
 - Ex. Habituation: Klein (1993) found waterfowl flew shorter distance with frequent disturbance
 - Ex: No habituation: Madsen (1985) found pink-footed geese flew more with more disturbance
- Non-breeding Research
 - Flush distance (Ex: Knapton et. al. 2000)
 - Distance flown (Ex: Keller 1989)
 - Found different disturbances can have different effects based on speed (Burger 1981), color (Gutzwiller and Marcum 1994), type (Taylor and Knight 2003) of disturbance factor



Breeding Birds & Disturbance

- Primarily shorebirds, waterbirds
- Often experimental (Ex: Trembley and Ellison 1979)
- Mixed results- some showed habituation, some showed no effect (Nichols et. al. 1984), most showed negative effects (reduced fledging rate, Safina and Burger 1983; higher stress levels of chicks, Fernandez and Azkona 1993)



Our Research Questions

- Primary Question: How does disturbance affect the nesting success of Eastern bluebirds, measured by both the growth and condition of the nestlings?
- Secondary Question: How does disturbance affect feeding rate and fecal sac removal rate?



Hypothesis

- High disturbance areas- higher success than areas of intermediate disturbance.
- No disturbance areas- higher success than both.
- Habituation



Methods

- Observed box while seated using binoculars, recording specific behaviors and disturbances.
- Observed nest boxes for four 1.5 hour periods.
 - Two afternoons and two mornings
 - Morning: 8:03- 11:00
 - Afternoon: 12:20-6:40



Methods

- 50 m territory size enforced by box placement 100m apart.
- Bluebirds generally forage within 40 m of their current location.
- Estimated 50 m for observer distance, later measured.
 - Misestimating
 - Obstructions
- Observer Distance
 - Average Distance: 53.2 m (std. dev. +/- 5.6)
 - Range: 43-70



Methods

- Recorded disturbances at 2 minute intervals.
 - Continuous observation impractical.
 - Two minute observations determined in a pilot study.
 - Recorded number of disturbances of each type and distance (later verified by measuring)



Disturbance Categories

Disturbance	Examples
Foot traffic	Runner, pedestrians
Non-motor	Bicycles, tricycles, big wheels
Gas-powered Vehicles	Gas golf carts, cars, semis, crashing planes
Movable Machinery	Lawn mowers, construction equipment
Predators	Dogs, cats, squirrels
Electric Golf Cart	Yeah...



Methods

- Recorded specific behaviors continuously
- Also recorded clutch size, chick age, observer, date, and day of the week.
- Decibel level readings

Behavior

Feeding Rate

Fecal Sac
Removal Rate

Competitor
Entrance

Predator

Competitor



Disturbance Statistics

- For each disturbance category
 - On track- disturbance in “normal” area. E.g. golfers on green, cars on road
 - Off track
 - Minimum distance- the closest any disturbance of that type got to the box
 - Mode distance
 - Mean distance
 - Spatial variance- variance of the distances of all disturbances of that type.
 - Temporal variance- variance of times of each disturbance.

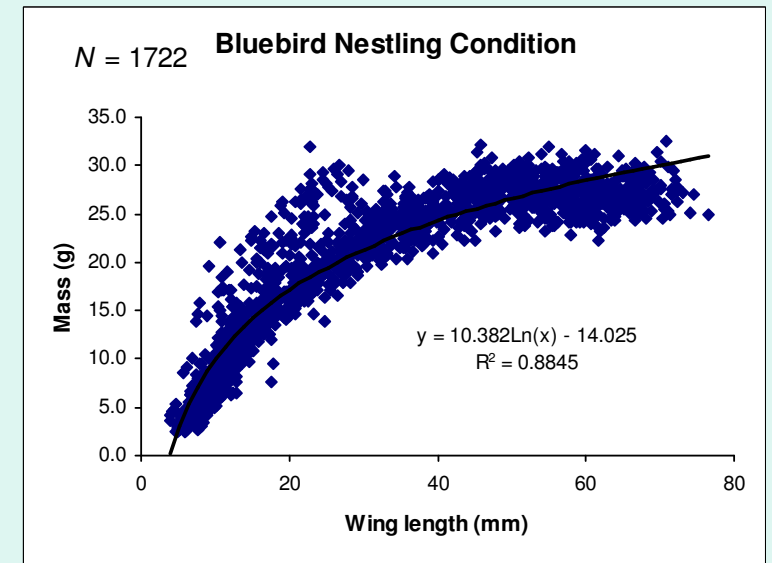
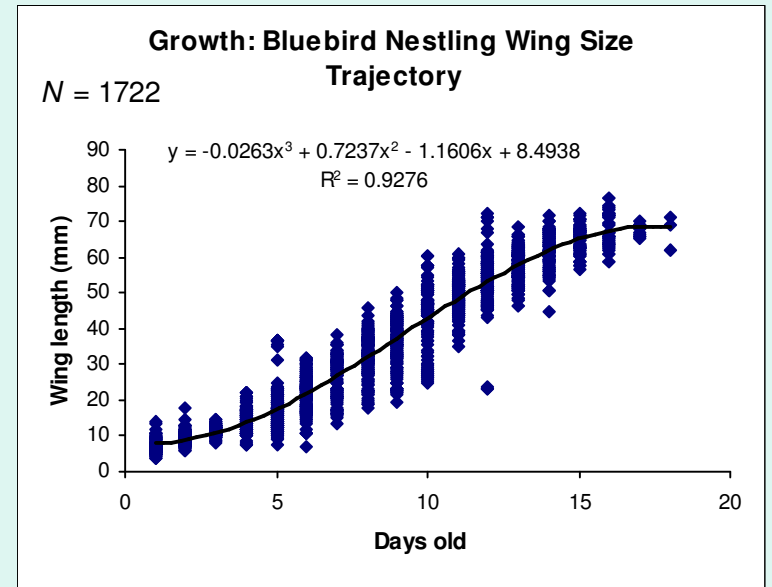


Analyses

- Used forward stepwise linear multiple regression (SPSS v11.5).
- Chooses most significant variable first and then adds a following variable only if it helps explain the variation.
- Variables are then analyzed together and their combined significance calculated.

Analyses cont.

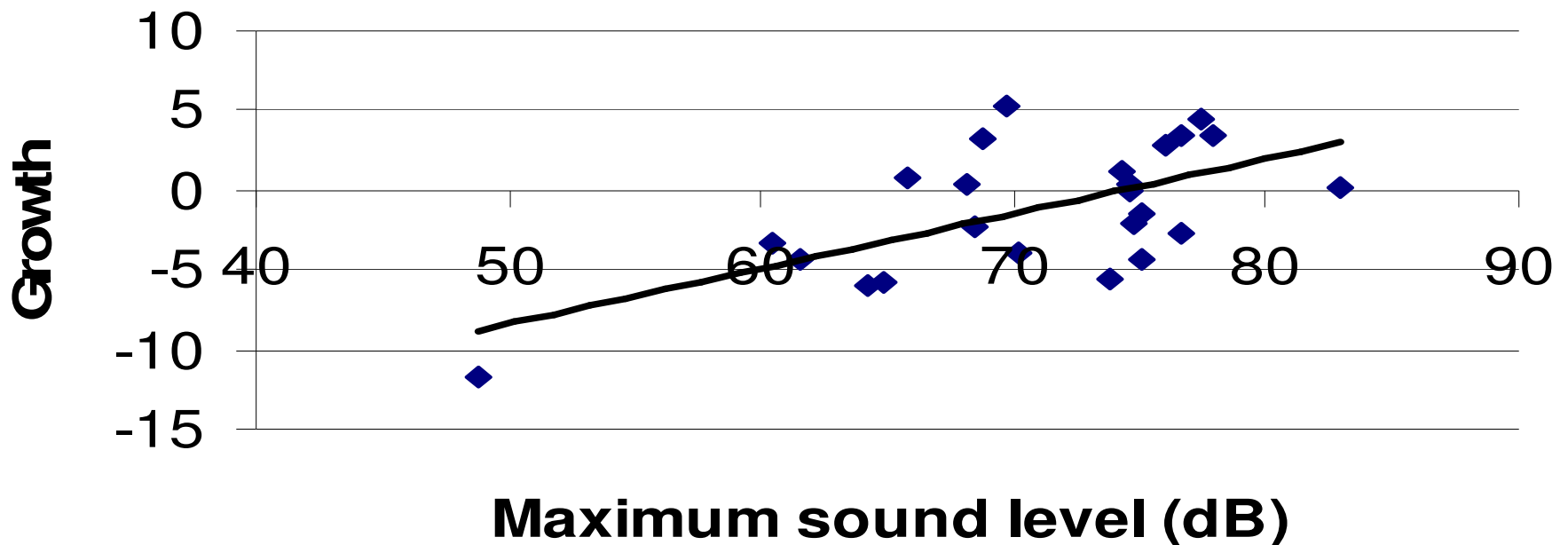
- Dependant Variables
- What is a residual?
 - Growth- residual wing length for age
 - Condition- residual of relation between wing length and mass
 - Feeding rate residual
 - Fecal sac removal rate



Growth

+ Maximum Sound Level ($R^2=0.388$, $F_{1,22}=13.951$, $p=0.001$)

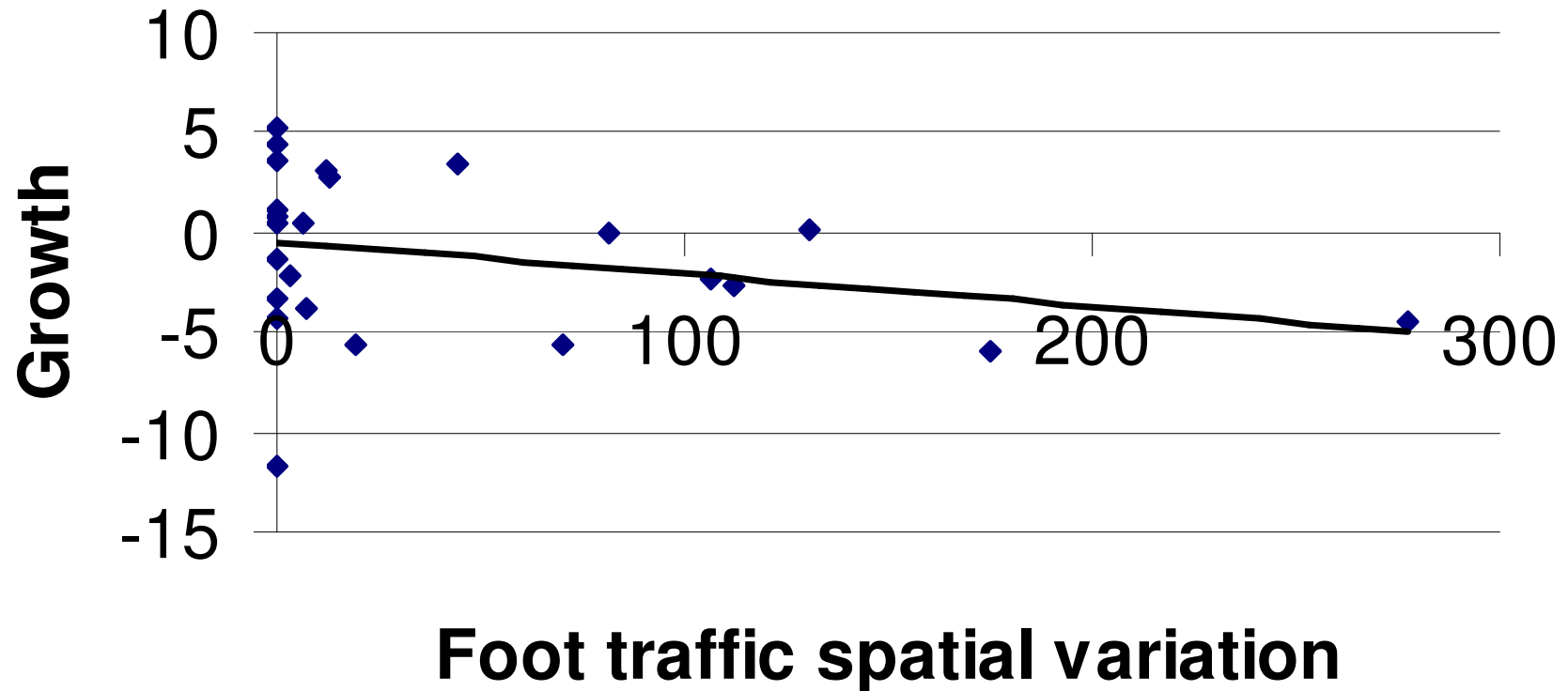
Positive relation between growth and maximum sound level



Growth

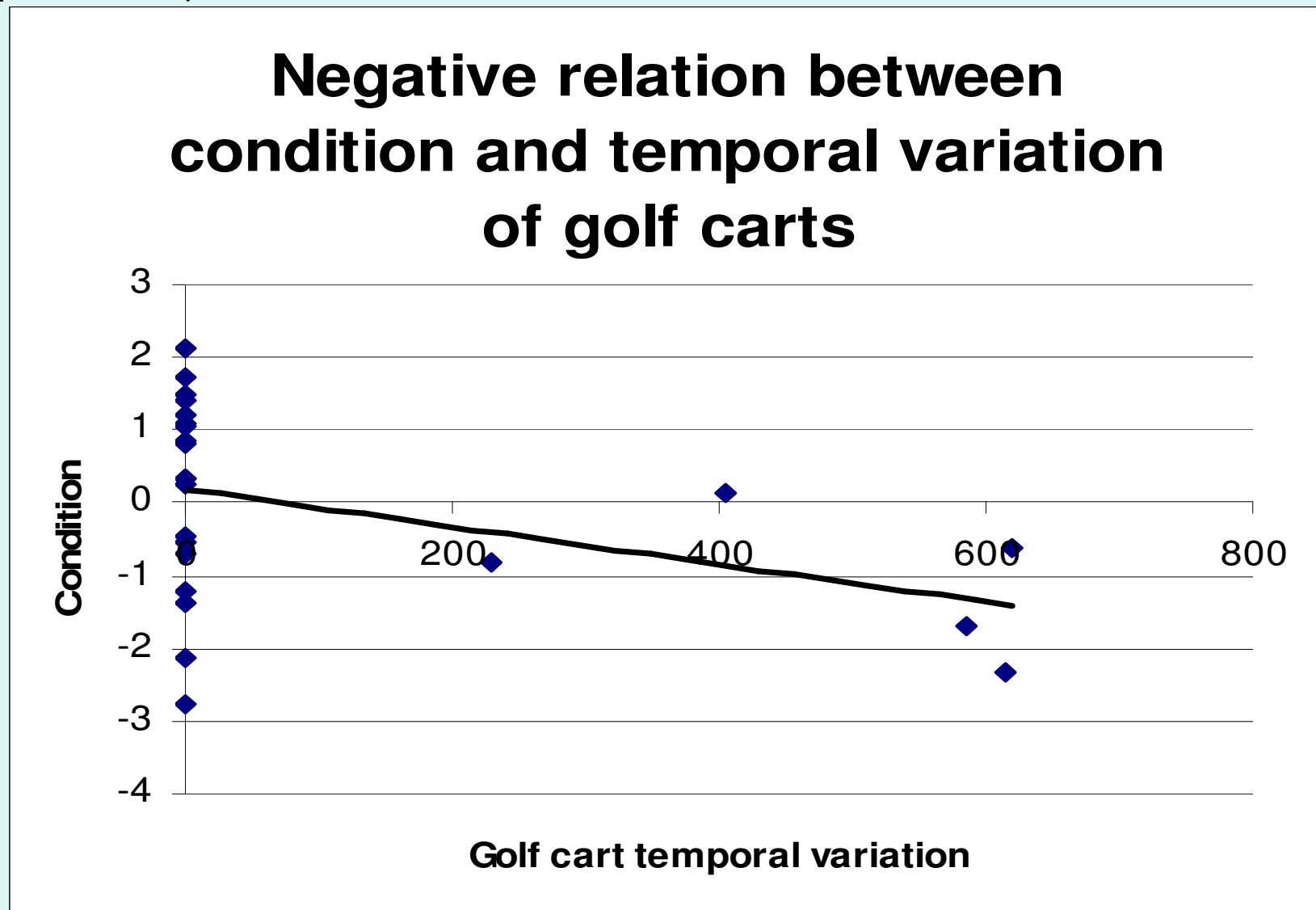
- Foot Traffic Spatial Variation ($R^2=0.554$, $F_{2,21}=13.054$, $p<0.001$)

Negative Relation between growth and foot traffic spatial variation



Condition

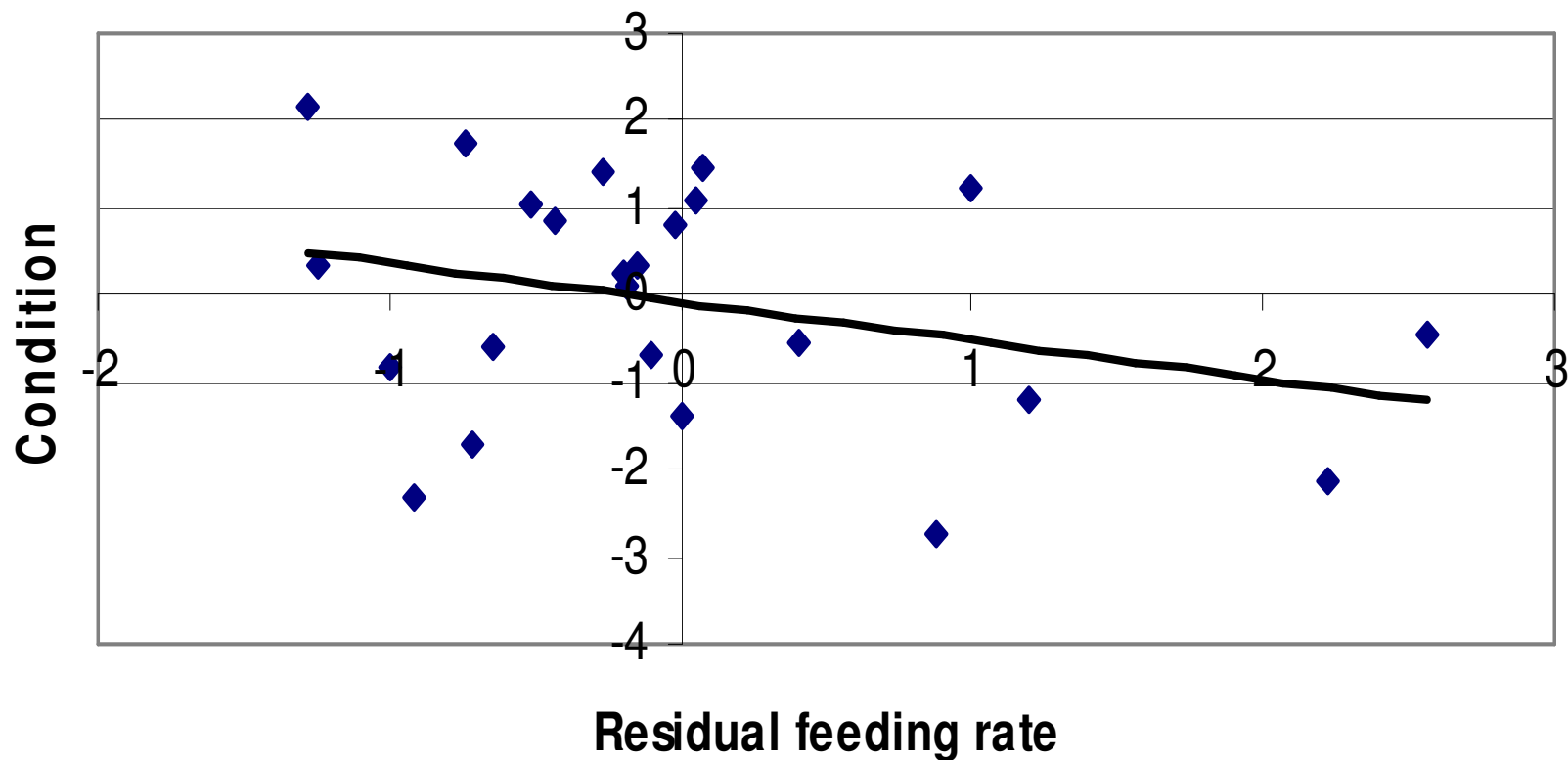
- Golf Cart Temporal Variation ($R^2=0.166$, $F_{1,22}=4.377$, $p=0.048$)



Condition

- Residual Feeding Rate ($R^2=0.405$, $F_{2,21}=7.159$, $p=0.004$)

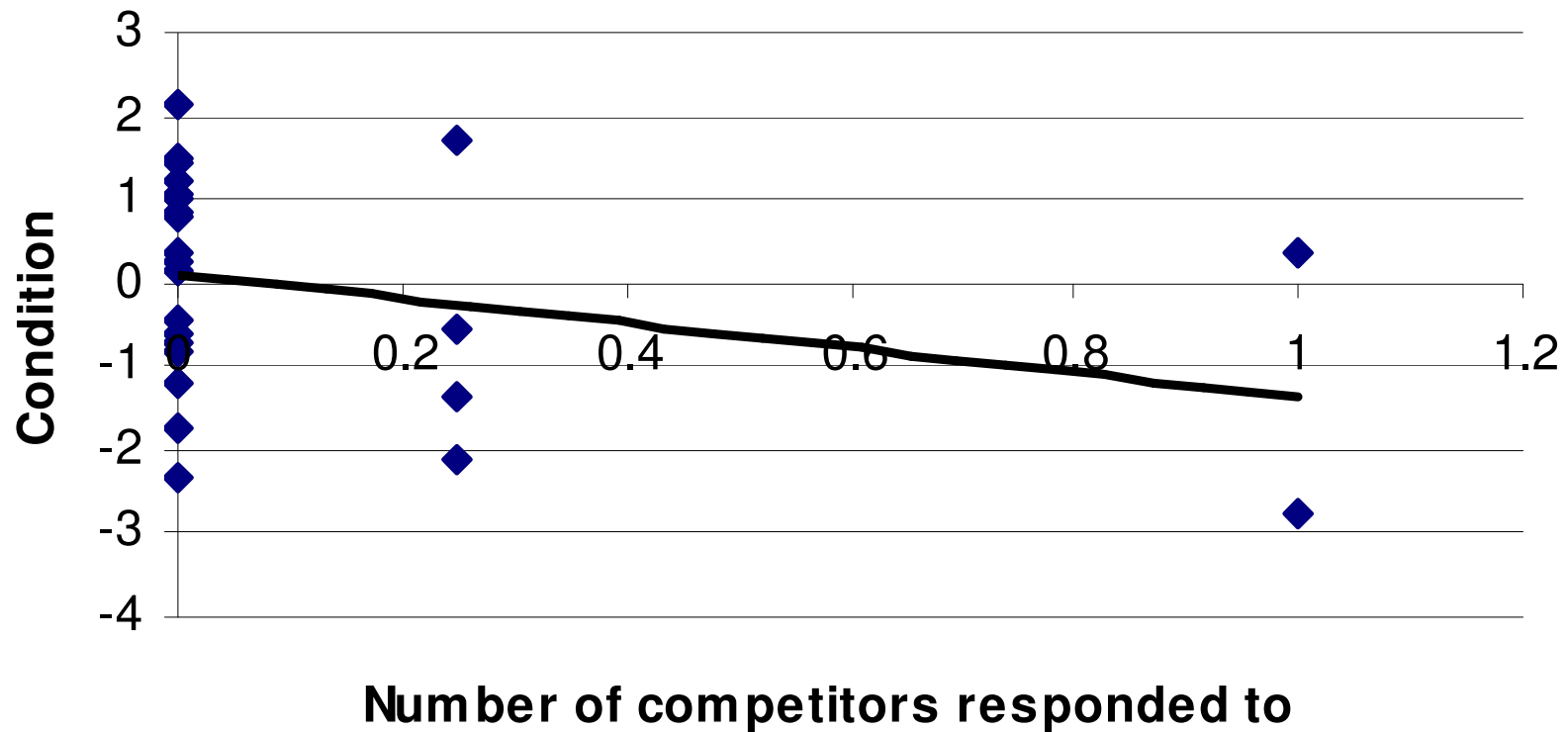
**Negative relation between condition
and residual feeding rate**



Condition

- Number of competitors Responded to
($R^2=0.527$, $F_{3,20}=7.439$, $p=0.002$)

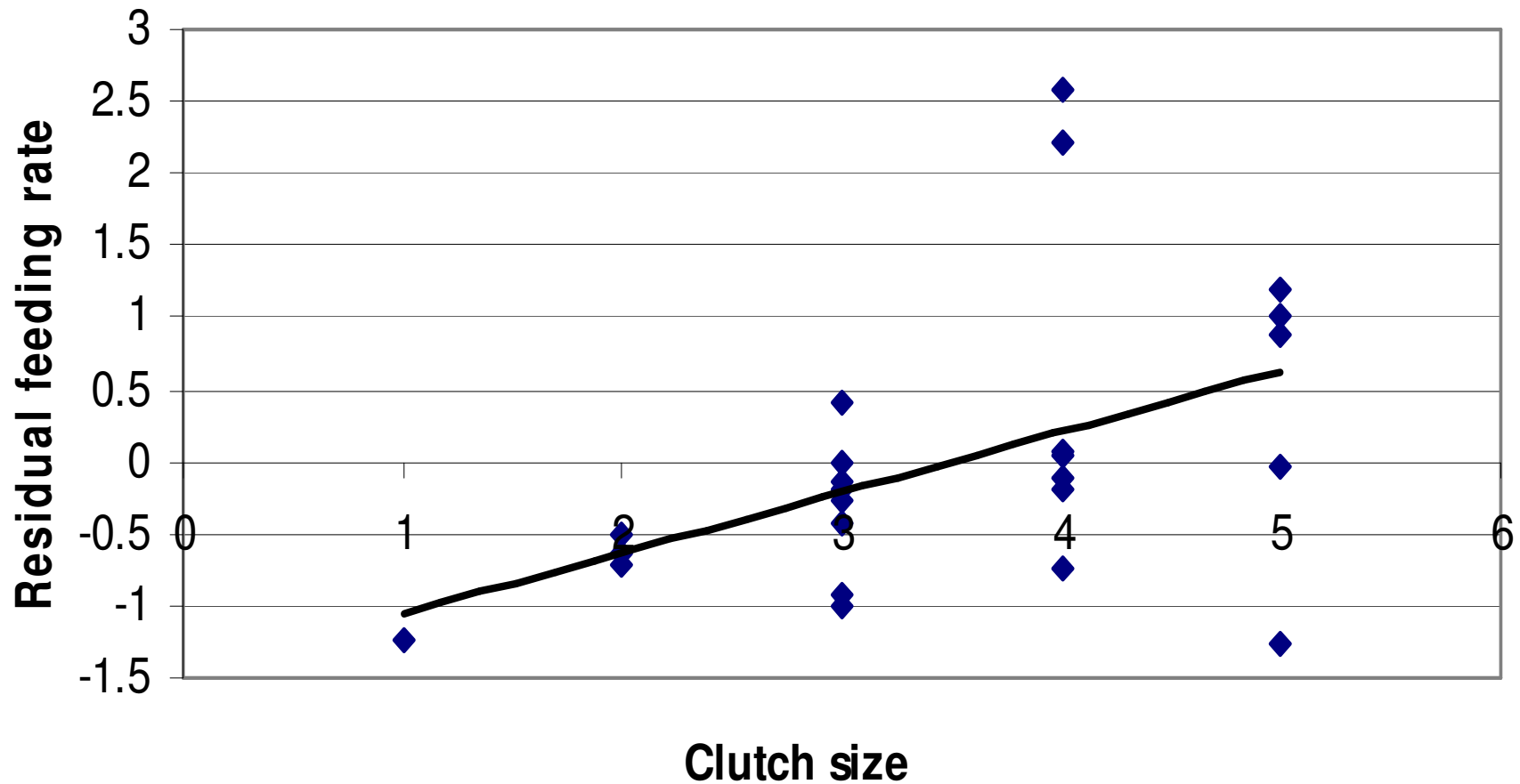
**Negative relation between
condition and number of
competitors responded to**



Feeding Rate

+ Clutch Size ($R^2=0.267$, $F_{1,22}=8.003$, $p=0.010$)

**Positive relationship between residual feeding rate
and clutch size**

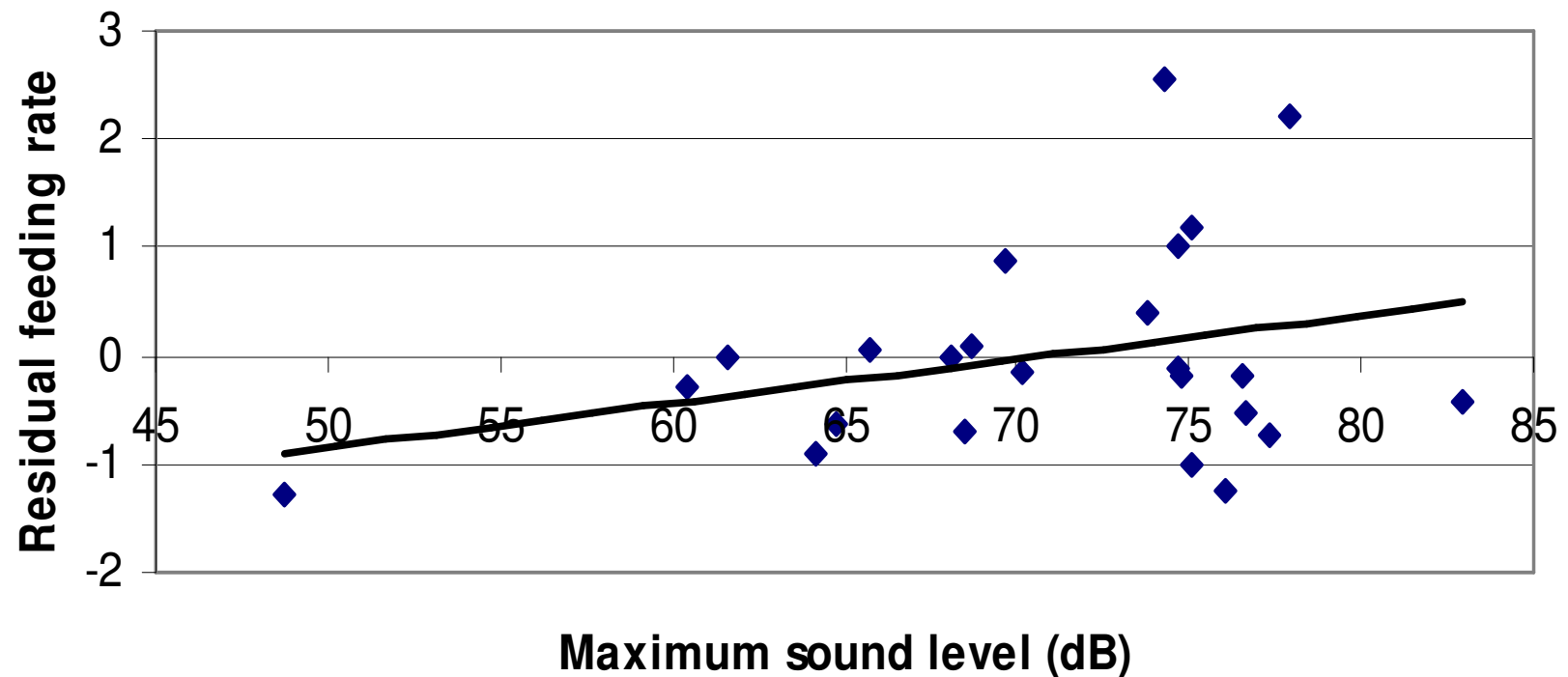


Feeding Rate

+ Maximum Sound Level

($R^2=0.401$, $F_{2,21}=7.039$, $p=0.005$)

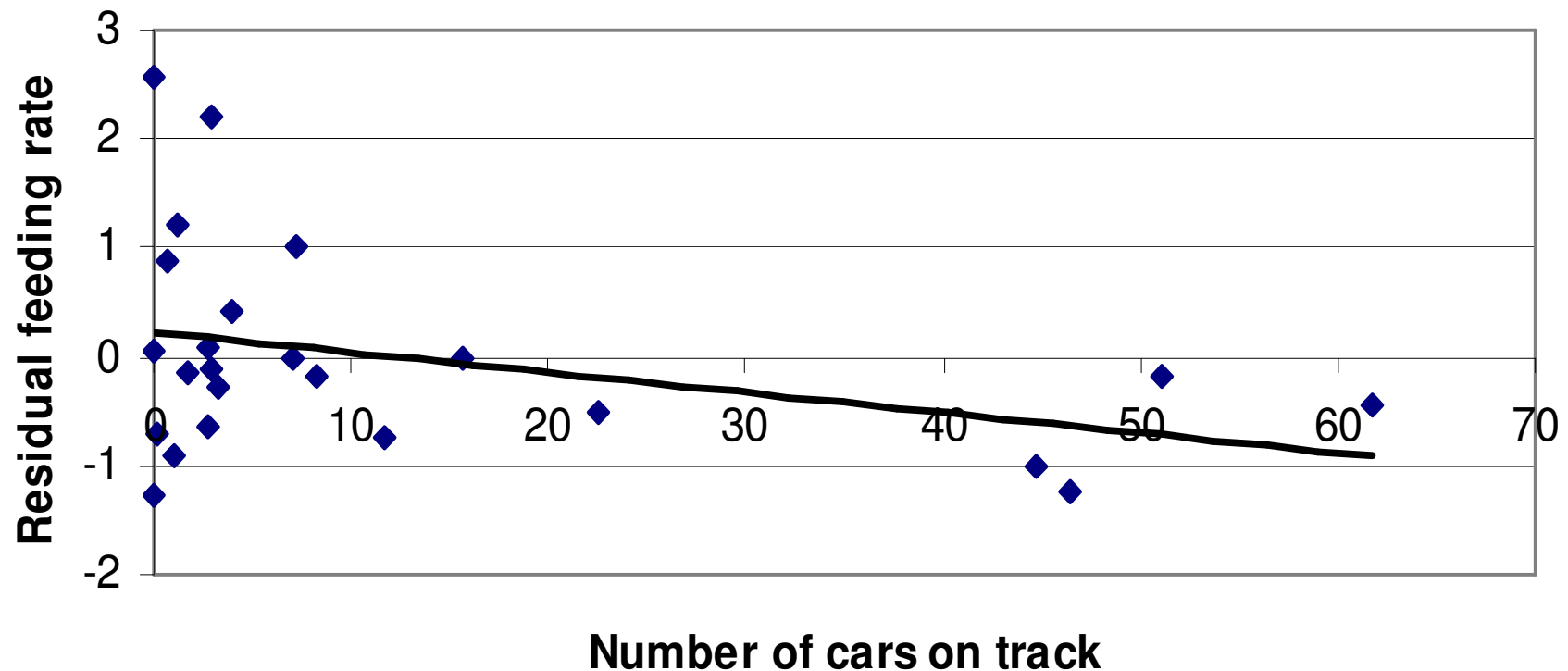
Positive relationship between residual feeding rate and maximum sound level



Feeding Rate

- Number of cars on track ($R^2=0.561$, $F_{3,20}=8.530$, $p<0.001$)

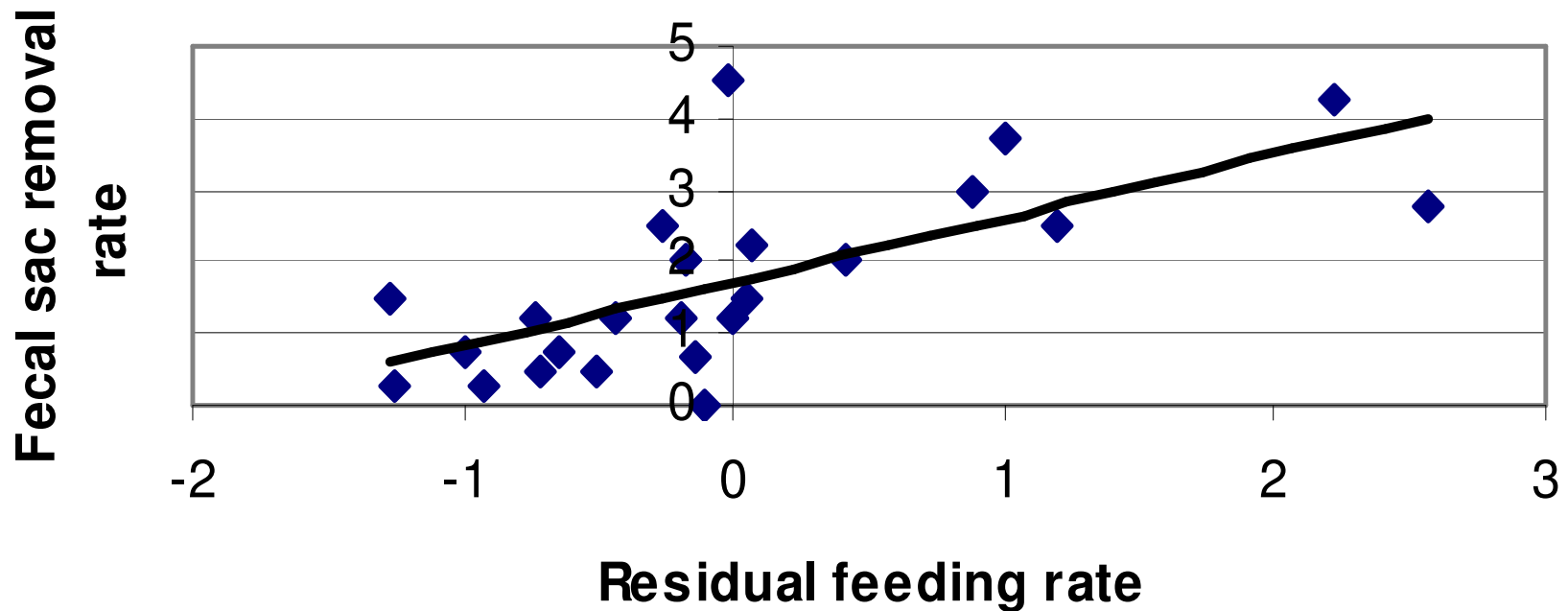
**Negative relationship between residual feeding rate
and number of cars on track**



Fecal Sac Removal Rate

+ Feeding Rate ($R^2=0.549$, $F_{1,22}=26.728$, $p<0.001$)

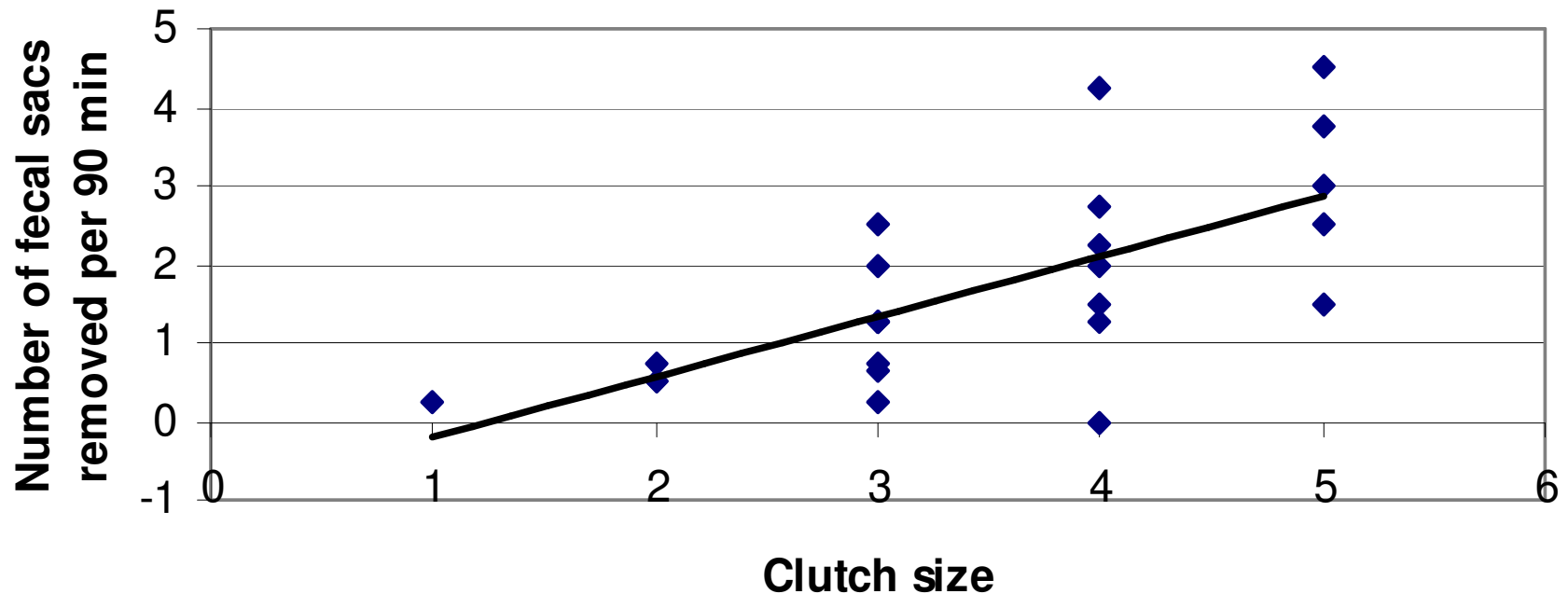
Positive relationship between fecal sac removal rate and residual feeding rate



Fecal Sac Removal Rate

+ Clutch Size ($R^2=0.633$, $F_{2,21}=20.837$, $p<0.001$)

Positive relationship between fecal sac removal rate and clutch size





Discussion

- Our hypothesis not supported
- All results were linear: no evidence of habituation



Discussion: Explaining Disturbance

- Three results negatively relate human disturbance to nesting success
- Growth:
 - Foot traffic spatial variation
 - Especially convincing
- Condition:
 - Temporal golf cart variation
 - Not as convincing
- Feeding Rate:
 - Number of cars on track
 - Especially convincing



Competitors

- Negative relationship between number of competitors recognized and condition
 - Expected: Parents preoccupied



Sound Level

- Our findings that positively relate maximum sound level to growth and feeding rate conflict with the literature.
- Possible Explanations
 - Sound meters used register wind noise as sound.
 - More wind=more open habitat
 - Some past noise level methods suspect and inapplicable (eg Burger and Gochfield, 1998 use 'scale of 0 to 5').

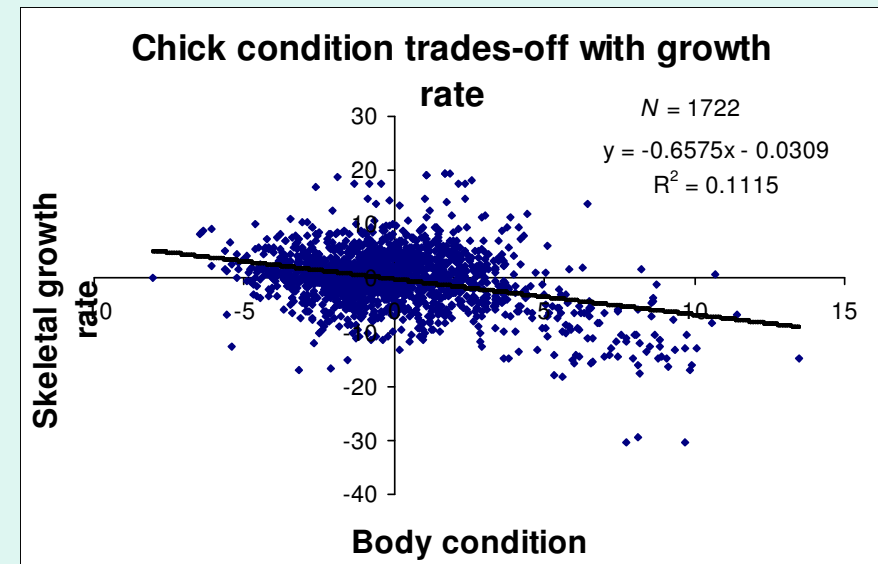


Clutch Size and Feeding Rate

- Clutch size positively relates to fecal sac removal rate and feeding rate residual: Intuitive.
- Similarly, feeding rate relates positively to fecal sac removal rate

Feeding Rate contd.

- Feeding rate is negatively related to nestling condition: unexpected finding.
- Feeding rate does not necessarily relate directly to food intake.
 - Size matters
 - Exponential energetic tradeoff of adults



- Tradeoff between body condition and growth rate



Bluebirds as representatives?

■ Possibly:

- Easy to study
- Widespread

■ Maybe not:

- Not a typical cavity nester
- Different species can react differently



Future Investigations

- How does food quality relate to feeding rate, growth, or condition?
- How does parent age/experience relate to disturbance, parental care, behavior?
- Is open space more ideal habitat?
- Is wind speed a good indicator of open space?
- Is the distance from box to nearest “track” important?
- Are pesticides harmful to nestlings?



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