OBJECTIVE:

Introduce the various methods that Amphibians have adapted to provide parental care and the costs/benefits associated with these adaptations.

LECTURE OVERVIEW:

A. What is parental care?
B. Parental care in Anurans
C. Parental Care in Urodeles
D. Parental Care in Caecilians
E. Costs associated with parental care
F. Benefits associated with parental care
G. Future direction for research or conservation
PARENTAL CARE: SUMMARY

- Refers to any type of parental investment in offspring after eggs are laid or the young are born.
- Does not include the initial energy investment of producing gametes.
- Increases the survivorship of the young.

SUMMARY CONT.

- Some costs to the care-giving parent.
- Has been reported in most of the major amphibian families.
- It is thought to have evolved as a response to the dangers of physical or biological threats to the survival of the species.

ANURANS

- Occurs in an estimated 10-15%.
- Crump (as seen in Wells, 2010) reported it to occur in 6%.
- Figures are believed to be underestimated.
ATTENDANCE OF EGGS

• Most common form among Anurans
• Occurs in 13-15 families
• Both males and females can be the care giver
  • over 60% of species have male attendance

Some species exhibit amphisexual attendance- Either the male or female, but not both, are the primary caregiver (Lehtinen, 2003).

TRANSPORT OF EGGS

• Transport of eggs have evolved in four distantly related families:
  1. Discoglossidae
  2. Pipidae
  3. Myobatrachidae
  4. Hemiphractinae

All four species within the above families exhibit males as the egg transporter, all others the female transport the eggs.

ATTENDANCE OF TADPOLES

• Most adult frogs are terrestrial, therefore very few species attend aquatic tadpoles.
• The ones who do, however, display a wide range of behavior.

Aggression:
  • Aggressive display

Assurance of tadpole safety:
  • Prey removal / protection

TRANSPORT OF TADPOLES

- Usually in association with attendance to tadpoles
- Has been observed in both male and female of various species
- Some tadpoles are transported to water while others show complete development on parents back
- Species carry a range of tadpoles at any given time (range 1-40)

FEEDING OF TADPOLES

- Always associated with oviposition site with limited resources
- Observed in several species of Dendrobatids
  - Males only
  - Females only
  - Biparental
- Male transportation appears to be the ancestral trait with biparental care evolving independently in several groups

ONE UNIQUE FROG!

- Rhinoderma darwinii seems to show characteristics of several forms of parental care.
TRANSPORT OF FROGLETs

- Fairly recent discovery
- Associated with frogs that undergo direct development
- The main function appears to be dispersal of juveniles into suitable habitats.
- Have been known to carry up to 500.

ATTENDANCE OF FROGLETs

- Frogs have been reported to remain with a parent for 2-40 days in Cophixalus species.

PARENTAL CARE OF URODELES

- Considered less complex when compared to Anurans
- Consists entirely of egg attendance and larvae
  - Or does it?

<table>
<thead>
<tr>
<th>Study</th>
<th>Eggs</th>
<th>Larvae</th>
<th>Total</th>
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</thead>
<tbody>
<tr>
<td>Oneto, Ottonello, Pastorino, and Salvidio (2010)</td>
<td>2.46% ± 0.08</td>
<td>2.67% ± 0.08</td>
<td>2.77% ± 0.08</td>
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</tbody>
</table>

PARENTAL CARE OF CAECILIANS

- Poorly understood
- More than half are viviparous
- Many oviparous believed to show attendance to eggs, etc.
COSTS

- Physical risk to the parent
  - Injury
  - Death

- Genetic costs:
  - Reduction of fitness
  - Kupfer et al. (2006) showed a 14% reduction
  - Reduction of stored energy reserves

- Reproductive costs

BENEFITS

- Protection against conspecifics
- Protection against heterospecific predators
- Protection against desiccation
- Protection against fungus and pathogens
- Aeration and agitation of eggs

Marble Salamander

Clearly enhances the survival of offspring! (Wells, 2010)

Croshaw & Scott, 2005

<table>
<thead>
<tr>
<th>Treatment group</th>
<th>N</th>
<th>Mean</th>
<th>S.D.</th>
<th>Mean</th>
<th>S.D.</th>
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<tr>
<td>Single shelled</td>
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<td>52.8</td>
<td>10.9</td>
<td>54.5</td>
<td>11.3</td>
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<tr>
<td>Female shelled</td>
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<td>53.3</td>
<td>10.3</td>
<td>53.3</td>
<td>11.3</td>
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<tr>
<td>Female unshelled</td>
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<td>50.0</td>
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<tr>
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<td>50.0</td>
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</tr>
</tbody>
</table>

Croshaw & Scott, 2005
ECOLOGY AND EVOLUTION

- Believed to have emerged in response to the tendency toward terrestrial modes of reproduction
- Aquatic environment dangers favored eggs being laid away from water
- New set of problems led to evolution of parental care
- Discussion

WHERE DO WE GO FROM HERE?

- Sex roles
  - Internal fertilization tends toward female care
  - External fertilization tends toward male care
- Caecilians are poorly understood
- Costs/benefits coupled with reproductive care would give a more detailed insight into relationships between reproductive modes, parental behavior, and mating systems

REFERENCE CITED


