UNIT 12. CO-OPERATION AND HELPING IN BIRDS, MAMMALS, AND FISH

SOURCES *(for powerpoint format: http://wfsc.tamu.edu/jpackard/behavior/wfsc622/powerpoints.zip)*

required: Chapter 12 in Krebs & Davies (1993:291-317) *TIP: Read this chapter from beginning to end. It's great!*

remedial: "Rearing the Young" in Halliday 1994; "Parenting" in the Trials of Life video series

supplement: page 148, Chapter 10 in Blumstein, D.T. and Fernandez-Juricic, E. (2010) "A Primer of Conservation Behavior"

PARTS OF THIS LECTURE OUTLINE

1. Helpers at the Nest of Kin
2. Helpers at Unrelated Nests
3. Costs of Sharing a Nest

TIP1. Last unit was about co-evolution of "selfish" and "altruistic" strategies. This unit is about the evolution of a conditional strategy with two tactics "helper" and "parental". The distinction between indirect and direct fitness, established in the previous unit, is the basis of the theory in this unit.

1. HELPERS AT THE NEST OF KIN

1.1. **Princess of Burundi cichlid fish- Lake Tanganyika** ***(Taborsky 1984 cited in Krebs and Davies 1993:299)***

1. helpers are young from previous broods- stay for 2-3 breeding cycles
2. young guard nest and clean eggs or young fry=> energetic cost=> slow growth
3. females with helpers lay more eggs

1.2. **Florida scrub jay** ***(Woolfenden & Fitzpatrick 1984 cited in Krebs and Davies 1993:294 Fig. 12.1.)***

1. breeders benefit from the presence of helpers *(Krebs and Davies 1993:294 Table 12.1)*
   a. is this correlation or cause? need to do removal experiment *(Krebs and Davies 1993:302)*
2. habitat saturation: an ecological constraint *(Krebs and Davies 1993:295 Table 12.2)*
   a. small patches of oak scrub; no better place for young birds to go
   b. when openings occurred due to disease, young males dispersed
3. males inherit a breeding space *(Krebs and Davies 1993:297 Fig. 12.2)*

1.3 **Black-backed jackals - Serengeti plains** ***(Krebs and Davies 1993:299-301 Fig. 12.3, 12.4)***

1. breeding success positively correlated with number of helpers in group
   a. not clear whether helpers really helped reproductive success
      i. might be related to better territory or good years
   b. evidence of habitat constraint is circumstantial
      i. no long-term studies to see if helpers inherited breeding space

1.4. **Take-home message: helpers at the nest of kin**

1. benefits may be both direct and indirect fitness payoffs; hard to distinguish
2. e.g. Princess of Burundi cichlid fish, Florida scrub jay, black-backed jackals

Part 1	**Study Questions for Chat & Quiz 12 "Co-operation and Helping in Birds, Mammals and Fish"**
1.1	For a fish species that cares for brood of close relatives, what are the reciprocal benefits for breeders and non-breeders? (TIP: e.g. Princess of Burundi cichlids)
1.2	Why do some Florida scrub jays accept a non-breeding role within a reproductive group? (TIP: explain habitat saturation model)
1.3	Why do some black-backed jackals delay dispersal and help care for their parent's offspring? (TIP: refer to benefits for helpers and parents)
1.4	For a mammal species of your choice, how was the function of "apparently altruistic" actions tested? (TIP: e.g. ground squirrels or prairie dogs)

2. HELPERS AT UNRELATED NESTS

2.1. **Anemone fish** ***(Fricke 1979 cited in Krebs and Davies 1993:262 Fig. 10.11)***

1. satellite fish helps breeders defend the anemone (small patch of resources)
    a. unrelated because young fish disperse widely as plankton before settling
    b. "hopeful bider" waiting for a chance to acquire territory when breeder dies

2.2. **Pied kingfisher - colonial nester in East Africa** ***(Reyer 1984 cited in Krebs and Davies 1993:306 Fig. 12.5)***

1. seasonal reproduction
    a. primary helper is related (1-3 yr old male)
    b. secondary male helpers appear after eggs hatch- feed female
    c. 7 of 17 later bred with female they helped; females are scarce resource
2. Tolerance by breeding male depends on available resources *(Krebs and Davies 1993:307 Table 12.3)*
    a. Lake Naivasha- smooth water=>easy fishing=> male chases secondary helper
    b. Lake Victoria- rough water=> difficult fishing=> helper tolerated
        i. tested by removal and addition of chick: tolerance related to brood size

2.3. **Dwarf mongoose: group due to predation** ***(Creel & Waser 1991 cited in Krebs and Davies 1993:304 Plate 12.1)***

1. unrelated helpers- immigrants from other groups
    a. benefits: oldest subordinates become breeders when breeder dies
    b. ecological constraints: shortage of breeding opportunities outside group
2. subordinate breeders- as they get older, probably less related to breeders
3. pseudopregnancy- young related females breed but do not give birth
    a. probably indirect fitness benefits outweigh direct fitness costs

2.4. **Take-home message: helping at unrelated nests**

1. direct benefits of acquiring breeding role; constraints: predation, food & mate scarcity
2. e.g. anemone fish, pied kingfisher, dwarf mongoose

Part 2	**Study Questions for Chat & Quiz 12 "Co-operation and Helping in Birds, Mammals and Fish"**
2.1	Why would a fish care for a brood to which it was not related? (TIP: e.g. anemone-fish)
2.2	In a bird species of your choice, how is care of unrelated young related to environmental variation? (TIP: pied kingfisher)
2.3	In a mammal species of your choice, why would individuals care for unrelated young? (e.g. dwarf mongoose)
2.4	Where individuals care for unrelated young, what are the potential benefits that might offset the cost of missed opportunities for direct reproduction? (TIP: take-home message)

3. COSTS OF SHARING A NEST

3.1. **Groove- billed anis: plural breeding** ***(Vehrencamp 1977 cited in Krebs and Davies 1993:312 Table 12.4)***

1. group territory with communal nest; high predation pressure
    a. females toss out previously laid eggs
2. dominant lays last- most of her eggs hatch subordinates do better in communal than solitary nest
    a. lay more eggs than dominant; wait 2-3 days between eggs
    b. although they primarily raise the dominant's offspring, they also feed their own

3.2. **Acorn woodpeckers: communal larder** ***(Koenig et al. 1984 cited in Krebs and Davies 1993:313 Fig.12.7)***

1. groups formed by band of brothers and unrelated band of sisters
    a. helpers are offspring; defend granary tree and feed young
2. cost: first female's eggs may be eaten by second female ecological constraint: varies between California & Arizona
    a. CA: females can't make it through winter without granary tree
    b. AZ: lower acorn production=> no granary trees=> abandon territory

3.3. **Naked mole rats in arid regions of East Africa** ***(Sherman et al. 1992 cited in Krebs and Davies 1993:315 Fig. 12.8)***

1. burrow system: 1 breeding pair in a colony of up to 80 individuals
   a. limited dispersal related to high predation outside burrow, little food
2. small young non-breeders dig the burrow and search for food
   a. large tubers feed many; not accessible to solitary individuals
3. large older non-breeders tend young & breeder; may breed if breeder is removed
   a. females have undeveloped ovaries; pheromonal inhibition?
   b. males produce sperm; apparently don't copulate

3.4. **Take-home message: costs of sharing a nest**

1. short-term costs appear to be outweighed by long-term benefits
2. e.g. groove-billed anis, acorn woodpeckers, naked mole rats

Part 3	**Study Questions for Chat & Quiz 12 "Co-operation and Helping in Birds, Mammals and Fish"**
3.1	In groove-billed anis, why would several females share a nest? (TIP: refer to costs and benefits for dominants and subordinates)
3.2	For acorn woodpeckers, what are the costs and benefits of communal nesting? (TIP: refer to the ecological constraints for this species in diverse habitats)
3.3	Why would subordinate naked mole-rats remain in a non-breeding role within a colony? (TIP: refer to costs and benefits for breeders and non-breeders)
3.4	What are the costs of sharing a nest, for breeders and non-breeders?(TIP: take-home message)

4. SUMMARY

4.1 Helpers at the nest of kin related to ecological constraints

1. benefits may be both direct and indirect fitness payoffs; hard to distinguish
2. e.g. Florida scrub jay, black-backed jackals, cichlid fish

4.2 Helping at unrelated nests: usually secondary helpers

1. direct benefits of acquiring breeding role;
2. constraints: predation, food & mate scarcity
3. e.g. anemone fish, pied kingfisher, dwarf mongoose

4.3 Costs of sharing a nest

1. short-term costs appear to be outweighed by long-term benefits
2. e.g. groove-billed anis, acorn woodpeckers, naked mole rats

Summary	**Study Questions for Chat & Quiz 12 "Co-operation and Helping in Birds, Mammals and Fish"**
4.1	What are three take-home messages from this unit on cooperative behavior? (TIP: summary)
4.2	Has cooperative behavior evolved for similar reasons in taxa as diverse as fish, birds and mammals? (TIP: define cooperation and address differences as well as similarities)