

KALIJ PHEASANTS (*Lophura leucomelanos*) IN HAWAII: POPULATION DYNAMICS OF A LONG-LIVED INVASIVE SPECIES



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OBJECTIVES. One hypothesis explaining why invasive species become so abundant on islands vs. their native continental range is that they are released from greater inter-specific competition and from higher mortality owing to disease and depredation. We studied an introduced population of Kalij Pheasants (*Lophura leucomelanos*) in Hawai'i Volcanoes National Park to examine (1) causes of their abundance and (2) effects of crowding on behavior, life history, and demography. In the process, we discovered that kalij are regularly cooperative breeders; this is possibly the first such case in the Galliformes.



METHODS:

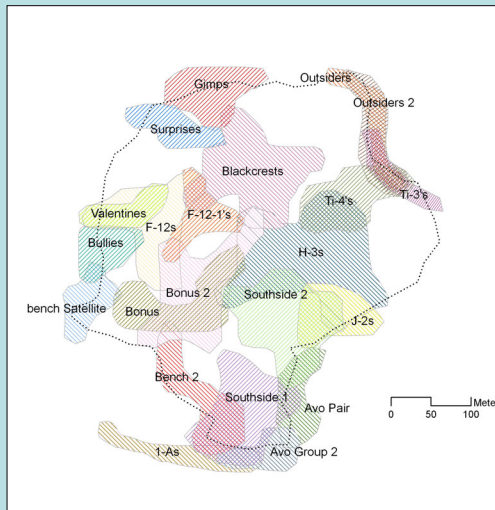
- » 25 hectare, gridded study area in montane forest
- » Color-banded 118 kalij, including most birds in all groups
- » Monitored demography and life history for 4 years

►► HIGH POPULATION DENSITY and TERRITORIALITY.

The study area supported a stable kalij population at extraordinarily high density. This map shows the distribution of territorial family groups in 2004. Only groups with four or more observations were mapped (N = 481 kalij sightings, June-November). Blank areas on the map were also occupied. In all, 29 groups totaling 88 birds divided up the entire study area in that year.

HIGH SURVIVORSHIP, LOW REPRODUCTION. Annual survivorship of resident adults was extremely high, >0.90 for both sexes, indicating that mortality from predation and disease is very low and that kalij have a long maximum lifespan. Annual reproductive success was 0.47 chicks/group/year, a very low actual rate considering that kalij fecundity is more than ten times greater. Chick mortality was high but difficult to measure.

GROUP TERRITORIES IN 2004



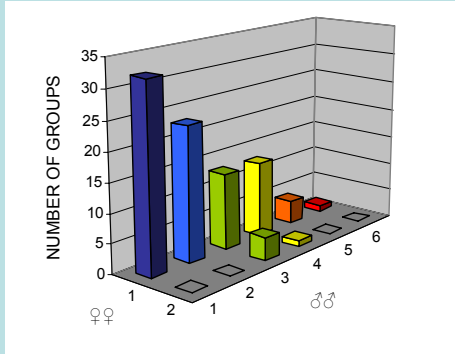
HELPERS. Care-giving by helpers includes:

- » territorial defense
- » guarding against predators
- » occasional feeding
- » play-fighting

DELAYED MALE DISPERSAL. Juvenile females at one year-of-age voluntarily left their families in search of mates and dispersed from the study area (N = 22). Juvenile males remained with their families for 1-4 years or more (N = 16). Male dispersal varied. Males departed alone or in groups of 2-3. Whereas some disappeared, others carved out a territory adjacent to their natal group. They usually paired with females arriving from outside the study area, or sometimes with an older female from a neighboring group.

GROUP COMPOSITION

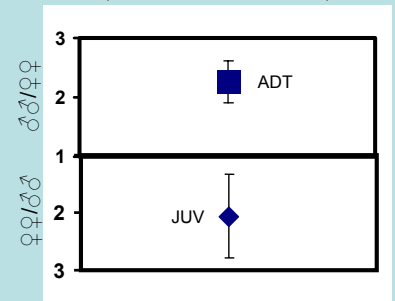
(group distribution by number of ♀♀ and ♂♂ per group)



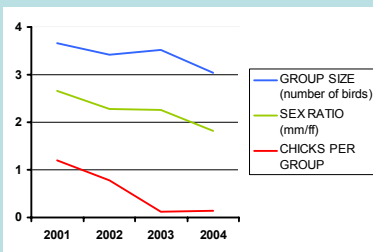
◀◀ **LONG-TERM MONOGAMY AND COOPERATIVE BREEDING.** Kalij Pheasants are thought to be polygynous. We found instead that kalij are monogamous and live in family groups. These groups contained a mated pair and their brood from the current breeding season, if they had any. Groups often included one or more adult male helpers that were older offspring or brothers of the breeding male. Pairs remained together for 1-4 years or more.

►► **SKEWED SEX RATIOS.** The adult sex ratio was highly skewed towards males. Delayed male dispersal would seem to account for this. However, recall that juvenile females always disperse early, and because paired females aggressively repel adults of their own sex, few young females ultimately settle and reproduce. Because survival of resident birds is essentially identical between sexes, differential mortality is likely higher for females during the dispersal and settlement phase. Note that the juvenile sex ratio was highly skewed in favor of females, the dispersing sex.

SEX RATIO OF JUVENILES AND ADULTS (mean annual sex ratio ± SD)



ANNUAL DECLINE IN REPRODUCTION AND GROUP COMPOSITION



CONCLUSIONS:

1. Kalij Pheasants are sedentary, intrinsically long-lived, socially monogamous, and territorial. Furthermore, young males delay dispersal until they are a few years old, and as adult group members they help defend the natal territory and provide care-giving to subsequent broods. Kalij are therefore cooperative breeders.
2. At our Hawaiian study site -- an environment relatively free of adult predation and interspecific competition -- high adult survivorship led to crowding. Potential effects of crowding may have been low reproduction and intensified territorial behavior, including further delay of male dispersal.
3. Our data suggest that when reproduction declines, so does group size because dispersing helper males are not replaced. Group size depends on the number of male helpers and may therefore be a function of reproductive rate (recruitment of males) and frequency of territorial encounters (delayed male dispersal).

▲▲ **GROUP SIZE and SEX RATIO RESPOND TO REPRODUCTION.** Group size shrinks following years of poor reproduction. Without new male recruits, groups dwindle because older helpers eventually leave to form their own groups. New groups recruit immigrating females and decrease the male-biased sex ratio.

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