Hypotheses and alternative management actions for Zealandia Hihi

Hypotheses

* Hypothesis 1: Predation by native species (ruru or falcon) is reducing adult survival.
* Hypothesis 2: Birds are moving outside of the fence into surrounding neighborhoods to feed and are being depredated, reducing adult and fledgling survival.
* Hypothesis 3: Birds are dispersing away from Zealandia and thus are lost to the population, functioning from the standpoint of the population as a reduction in survival.
* Hypothesis 4: Inbreeding depression is reducing survival and/or breeding success and thereby dampening population growth.
* Hypothesis 5: A male-skewed sex ratio is resulting in harassment of females by males, which reduces female survival or breeding success.
* Hypothesis 6: Weather events, specifically cold temperatures in the early breeding season, reduce breeding success and survival of females.
* Hypothesis 7: Disease, either aspergillosis or others (e.g., Toxoplasmosis, trematodes, Plasmodium sp., avian malaria, internal or external parasites), is reducing adult survival, fledgling survival, or breeding success.
* Hypothesis 8: Current habitat conditions result in poor nutrition (quality or quantity of food) and reduced survival.
* Some interacting combination of factors:
  + Hypothesis 9a: Weather events (Hypothesis 6) are causing females to approach feeders at a higher rate, where they are harassed by males (Hypothesis 5), which is reducing female survival and breeding success.
  + Hypothesis 9b: Inbreeding depression (Hypothesis 4) is increasing the disease susceptibility of Hihi (Hypothesis 7), thereby reducing survival and breeding success.
  + Hypothesis 9c: Weather events (Hypothesis 6) are causing stress to females, making them susceptible to disease (Hypothesis 7), reducing female survival.
  + Hypothesis 9d: A male-skewed sex ratio (Hypothesis 5) is increasing the rate of female dispersal out of Zealandia (Hypotheses 2 and 3), thereby reducing female survival.
  + Hypothesis 9e: The current habitat conditions (Hypothesis 8) are such that birds are dispersing out of Zealandia to find food (Hypotheses 2), reducing adult and fledgling survival.
  + Hypothesis 9f: Current habitat conditions and poor nutrition (Hypothesis 8) are increasing Hihi’s susceptibility to disease (Hypothesis 7), reducing survival.
* Hypothesis 10: Hihi get killed from hitting fences, reducing survival.
* Hypothesis 11: Hihi chicks are being fed wasps, causing internal trauma from stingers and leading to death, reducing overall chick and fledgling survival.
* Hypothesis 12: Hihi are consuming poisoned baits, either through primary or secondary poisoning, causing reduced adult survival.
* Hypothesis 13: Hihi are being caught in mammalian traps and other control tools, reducing adult survival.
* Hypothesis 14: Wasps are limiting nectar and insects, reducing survival.
* Hypothesis 15: Competition with mice for insects and seeds is reducing survival.
* Hypothesis 16: Inter and intraspecific competition for supplemental feeding resources is reducing female survival.
* Hypothesis 17: Hihi rearing is phenologically asynchronous with invertebrate prey availability, leading to poor survival.

Alternative Management Actions

* Manipulate the nest box design (e.g., mesh cages around boxes)
* Manipulate nest box placement (e.g., move boxes to areas with thick vegetation)
* Reduce bird feeders outside of the fence
* Reduce cat predation outside of the fence
* Reduce predation by non-native species outside of the fence
* Transfer birds from Hauturu
* Transfer birds from other population
* Remove excess males
* Exclude males from feeders to reduce dominance interactions between males and females
* Redesign nest boxes to make them warmer
* Pathogen specific management, i.e., hygiene at feeders
* Plant different food sources
* Change feeding regime
* Wait for forest to mature
* Actions from specific combinations
* Change kill trap management, e.g., change trap management, reducing entrance sizes, manage hoods, change location, change trigger pressure
* Implement wasp control tools, e.g., active nest search and destroy
* Change management of sugar water to reduce availability to wasps
* Change rodent control, e.g., minimize amount of time baits are available, placement of baits
* Change mammalian trap regime