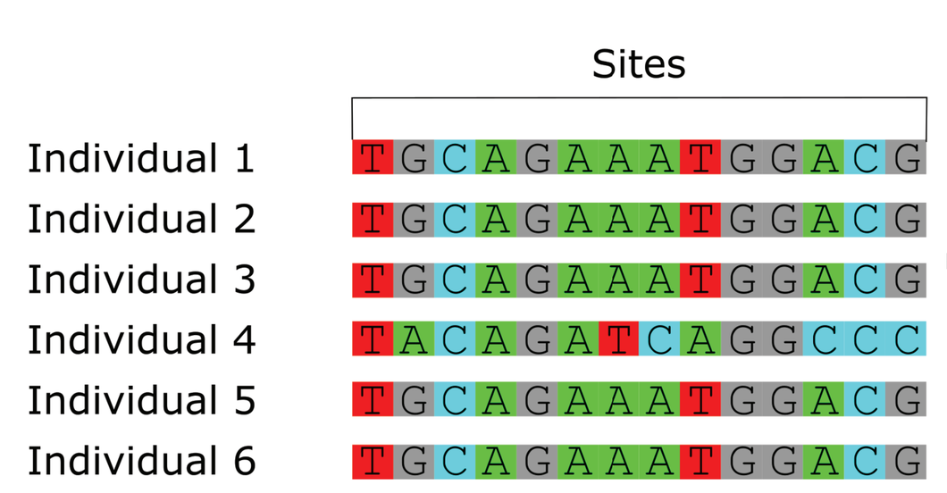
Spatial Close-Kin Mark Recapture:
A method to estimate population density across the landscape from genetic data through close-kin relationships

Gilia Patterson, Institute of Ecology and Evolution, University of Oregon

Knowing the population size and density of animals across the landscape is critical for conservation and public health

Genetic data contains information about population size

Sample and sequence DNA



→ Amount of genetic variation → Effective population size

Capture-recapture: Identify recaptures of the same individual → Census population size

Close-kin mark recapture: Identify close-kin relationships → Census population size

Close-kin mark recapture doesn't require recapturing the same individual

- Can be used on lethally sampled individuals

- More close-kin pairs, e.g. siblings or parent-offspring, in a sample means a smaller population size

(Intuition: Two people chosen at random from Portland are much less likely to be siblings than two people chosen at random from a very small town.)

- The relationship between population size and close-kin in the sample depends on the biology of the population, such as the average number of offspring per parent

Close-kin mark recapture has worked very well for aquatic species

A major barrier to using it on terrestrial species is that current methods don't account for spatial information

- Estimates can be biased when offspring don't disperse very far from parents

- Population density often varies across the landscape

Spatial Close-Kin Mark Recapture

Goals:

1. Account for spatial patterns of sampling when estimating population size and density

2. Estimate a map of population density across the landscape

Genetic data

Microsatellites

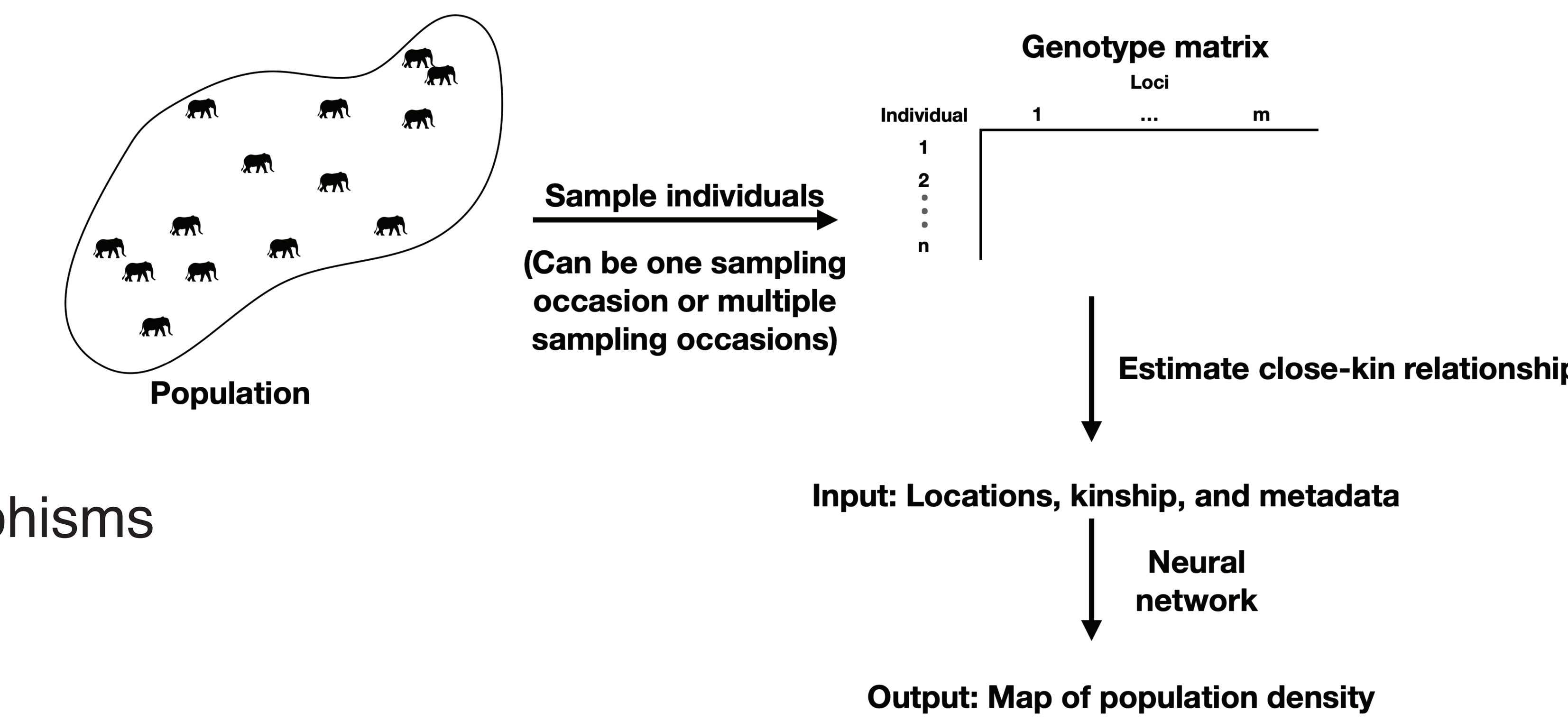
CATCATCAT

CATCATCATCATCATCAT

Single nucleotide polymorphisms

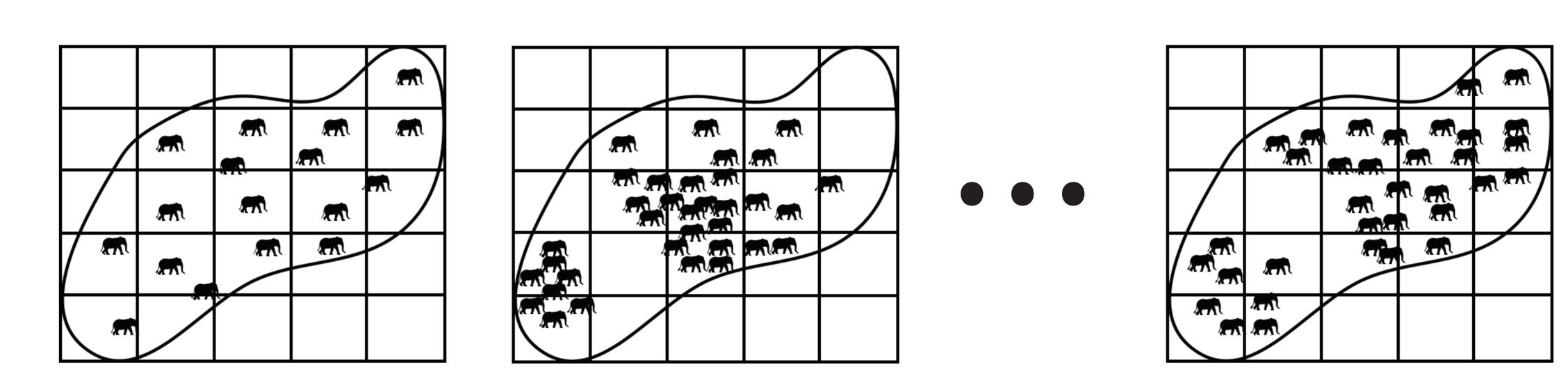
CATAGCA

CTTAGCA

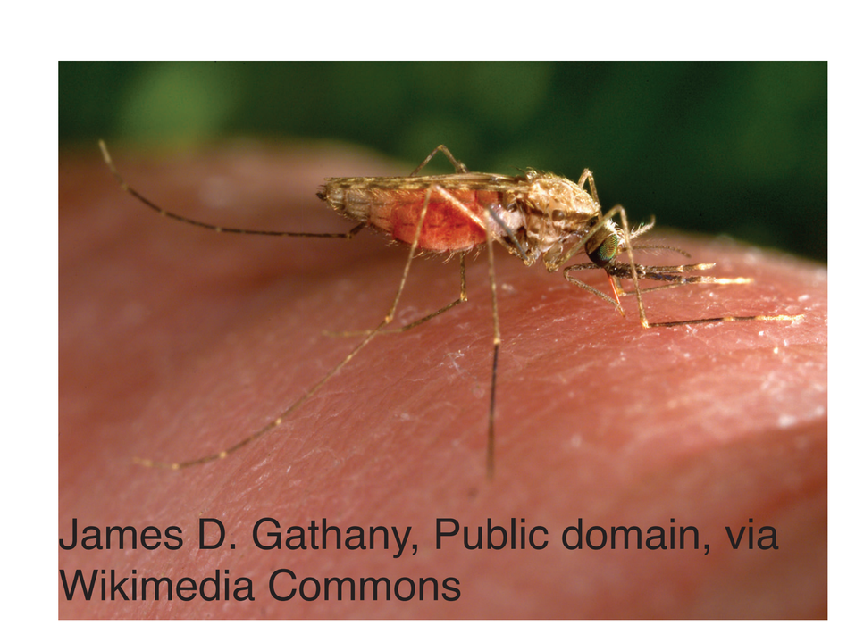


Use simulated populations and a neural network to learn the relationship between close-kin in the sample and population density across the landscape

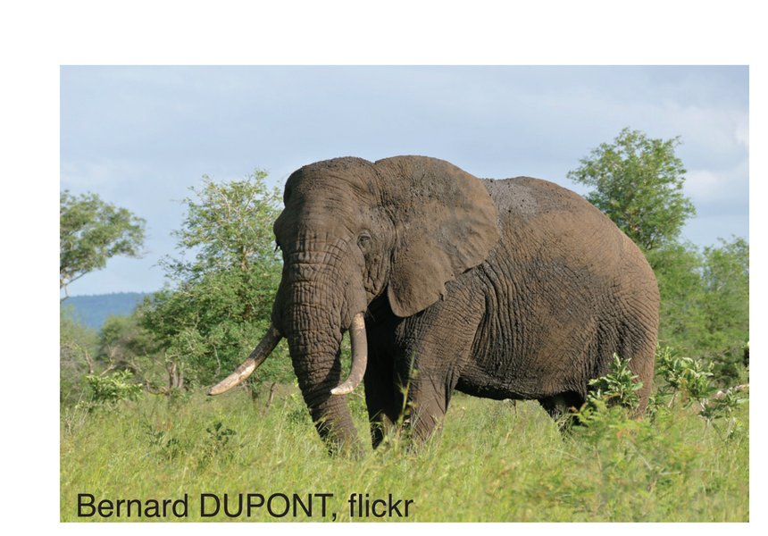
Simulate individual animals moving, interacting, and reproducing on the landscape

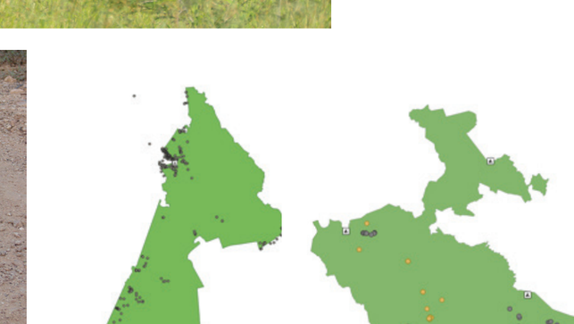


Applications



Estimate the density of malaria-transmitting mosquitoes across an island in Lake Victoria and test ways to decrease the population size





Maps from Claire Goodfellow

Estimate the population size of savanna and forest elephants in Bwindi and Kibale National Parks in Uganda from dung samples