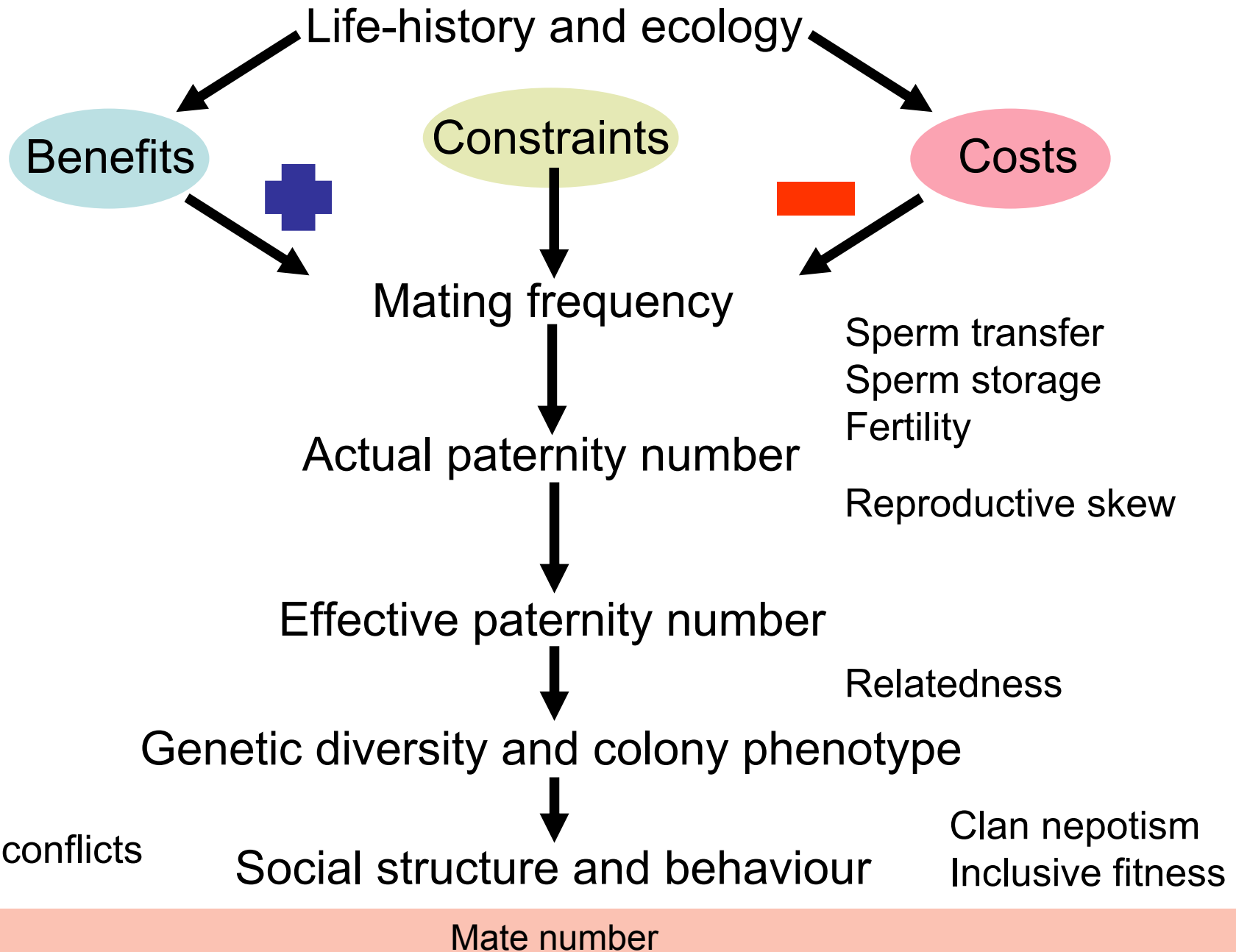


# Reconstructing colony pedigree structure using genetic data

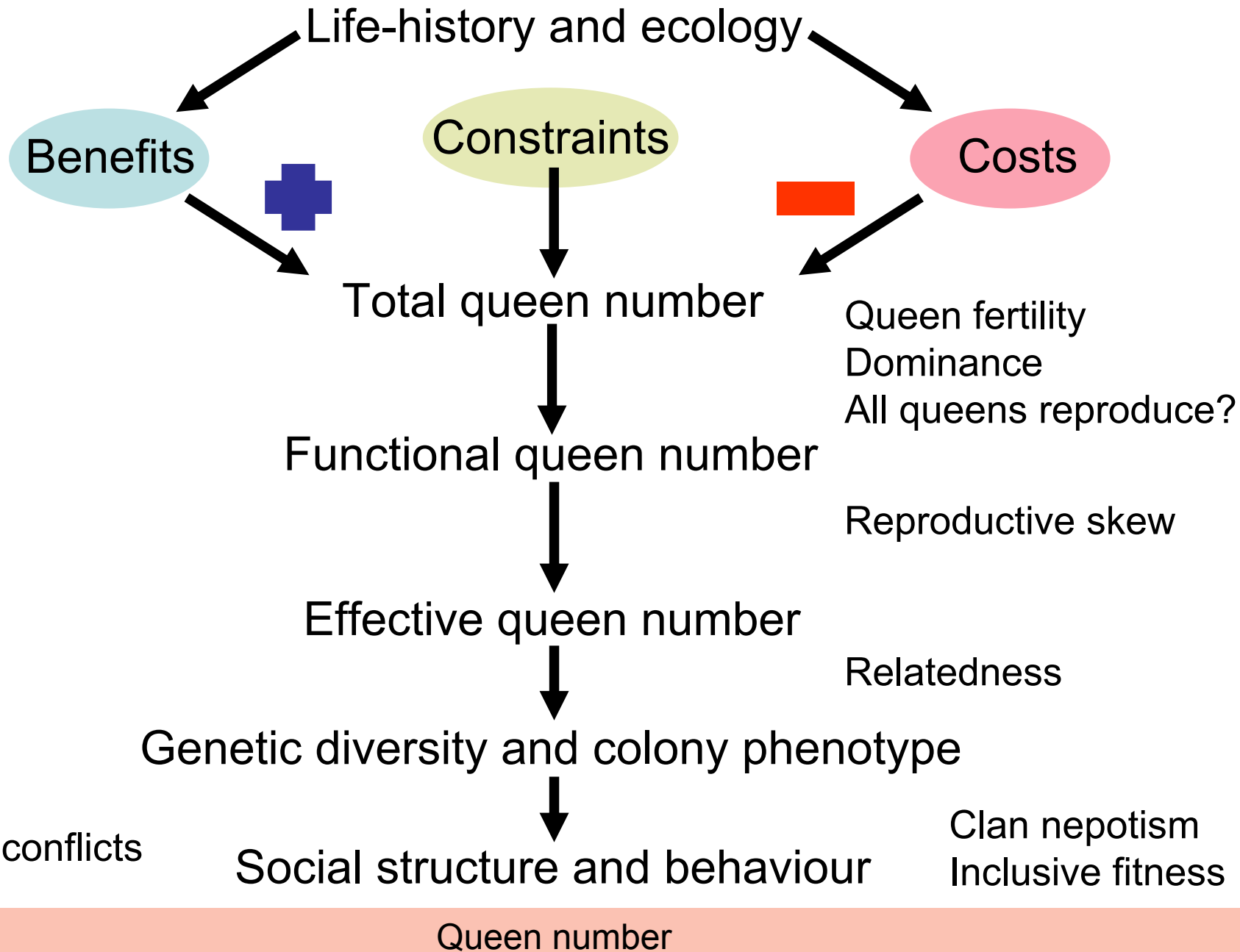
DANIEL KRONAUER



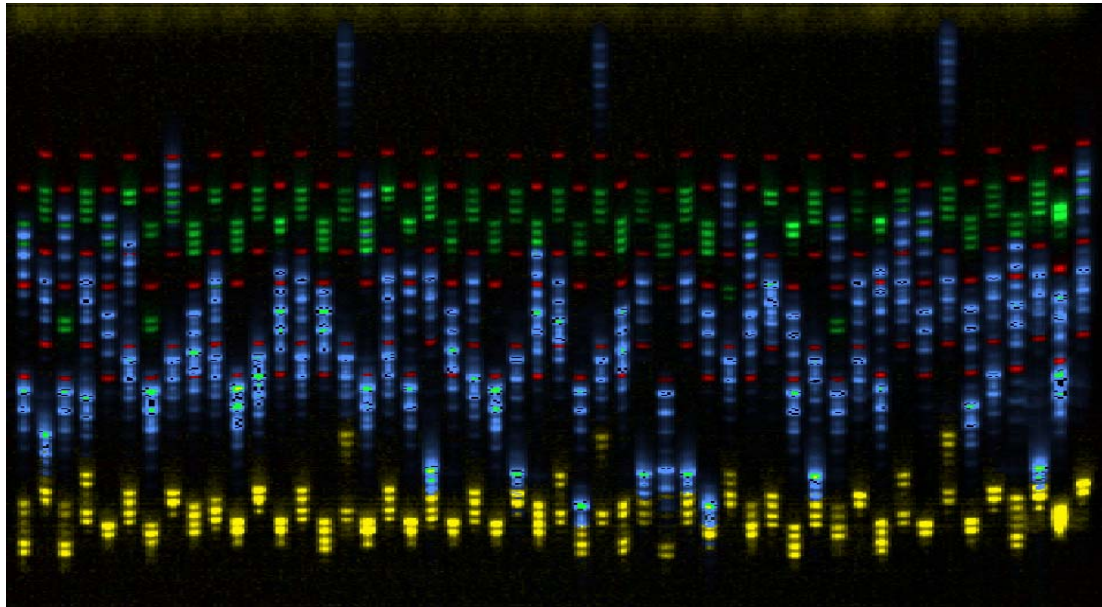
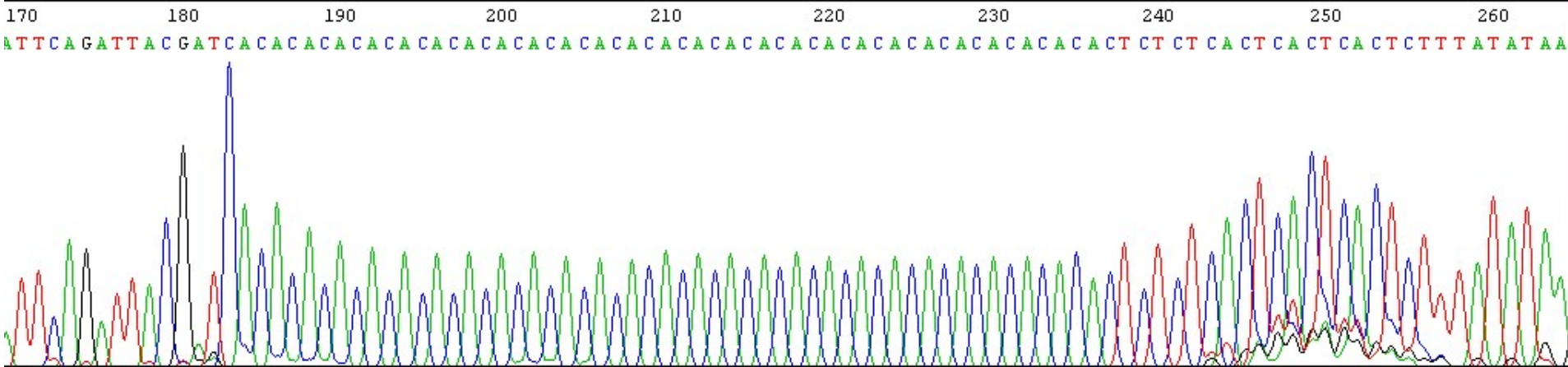
# COLONY PEDIGREE STRUCTURE



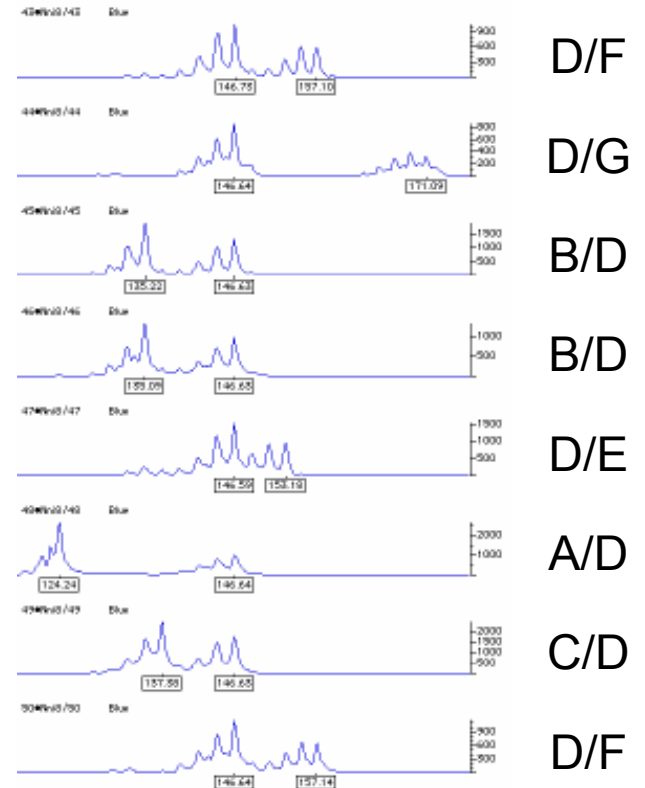
# COLONY PEDIGREE STRUCTURE



# COLONY PEDIGREE STRUCTURE



alternatively: SNPs, AFLPs



Microsatellite analysis



# COLONY PEDIGREE STRUCTURE

## **Genotyping errors:**

Incorrect inference of additional patriline and overestimation of paternity number in most cases

## **Sampling errors:**

Subfamilies are not represented in their true proportions; especially at high paternity numbers and small sample sizes paternity number is often overestimated

## **Nondetection errors:**

Different patriline do not differ at the marker loci used, which leads to an underestimation of paternity number

The probability that two random males will carry identical alleles is:

$$(\sum q_i^2) (\sum r_i^2) (\sum s_i^2) \dots \quad \text{Boomsma \& Ratnieks 1996}$$

**Mutations, drifted workers, functional polygyny, differential fertilization, colony age**

# COLONY PEDIGREE STRUCTURE

- **MATESOFT** (Moilanen et al. 2004)

To deduce parental genotypes in monogynous colonies; to assign workers to patriline; to estimate mating system statistics; paternity skew for single-double mating; haplo-diploid data

- **COLONY** (Wang 2004)

To deduce parental genotypes in monogynous or polygynous colonies; to assign workers to matriline and patriline; to estimate allele frequencies taking pedigree into account; to detect genotyping errors; haplo-diploid and diploid data

- **RELATEDNESS** (Goodnight & Queller 2001)

E.g. to estimate worker-worker relatedness to calculate  $k_e$ ; to estimate queen-male and male-male relatedness

# COLONY PEDIGREE STRUCTURE

- Open all three datasets in a text editor and try to figure out the pedigree structure manually
- Analyze datasets 1 and 2 using MATESOFT
- Analyze dataset 3 using COLONY2
- Estimate male parentage for datasets 1 and 2





# COLONY PEDIGREE STRUCTURE

- 1. How many matriline (queens) can be found in the colony from dataset 3 and with how many males has each queen mated?  
Ten queens (25 workers each) and each queen has mated with a single male
- 2. How many patriline (mates) can be found per queen in datasets 1 and 2, i.e. what is the observed mating frequency?  
Dataset 1: 27 patriline; Dataset 2: 20 patriline
- What is the estimated actual mating frequency of the queens from datasets 1 and 2?  
Dataset 1: 36; Dataset 2: 33
- What is the effective mating frequency of the queens from datasets 1 and 2? Use both the estimators by Pamilo (1993) and Nielsen et al. (2003).  
Dataset 1:  $ke_2 = 31.6$ ;  $ke_3 = 30.8$ ; Dataset 2:  $ke_2 = 33.5$ ;  $ke_3 = 31.1$

# COLONY PEDIGREE STRUCTURE

- 1. How many males from each colony are clearly not sons of the queen, i.e. are worker sons?

Dataset 1: all 20 males could be queen sons ;Dataset 2: 17 of the 31 males cannot be queen sons (55%)

- 2. What is the mean probability to detect a worker-derived male in each of the colonies and how does this compare to the proportion of detected worker-derived males?

Dataset 1:  $P_j = 0.79$ ; Dataset 2:  $P_j = 0.69$

- 3. What is the probability of not detecting any worker-derived males for each colony assuming that workers produce 2.5% or 25% of the males?

Dataset 1:  $p(2.5\%) = 0.67$ ;  $p(25\%) = 0.01$ ; Dataset 2:  $p(2.5\%) = 0.58$ ;  $p(25\%) = 0.002$