Founding a base population in a fish breeding program

- A simulation study

Holtsmark,M.[1], Sonesson,A. [3], Woolliams, J. [1,4], Klemetsdal,G. [1,2]

[1]Norwegian University of Life Sciences,
Department of Animal and Aquacultural Sciences
[2]Centre for Integrative Genetics (CIGENE), Norway
[3]AKVAFORSK (Institute of Aquaculture Research), Norway
[4]Roslin Institute, Scotland, UK

Background

- No research on how to establish base populations for new breeding programs
- Genetic material - two sources:
    - Fish from domesticated strains
    - Fish from wild strains

Aims

Plaice; www.seafood.no

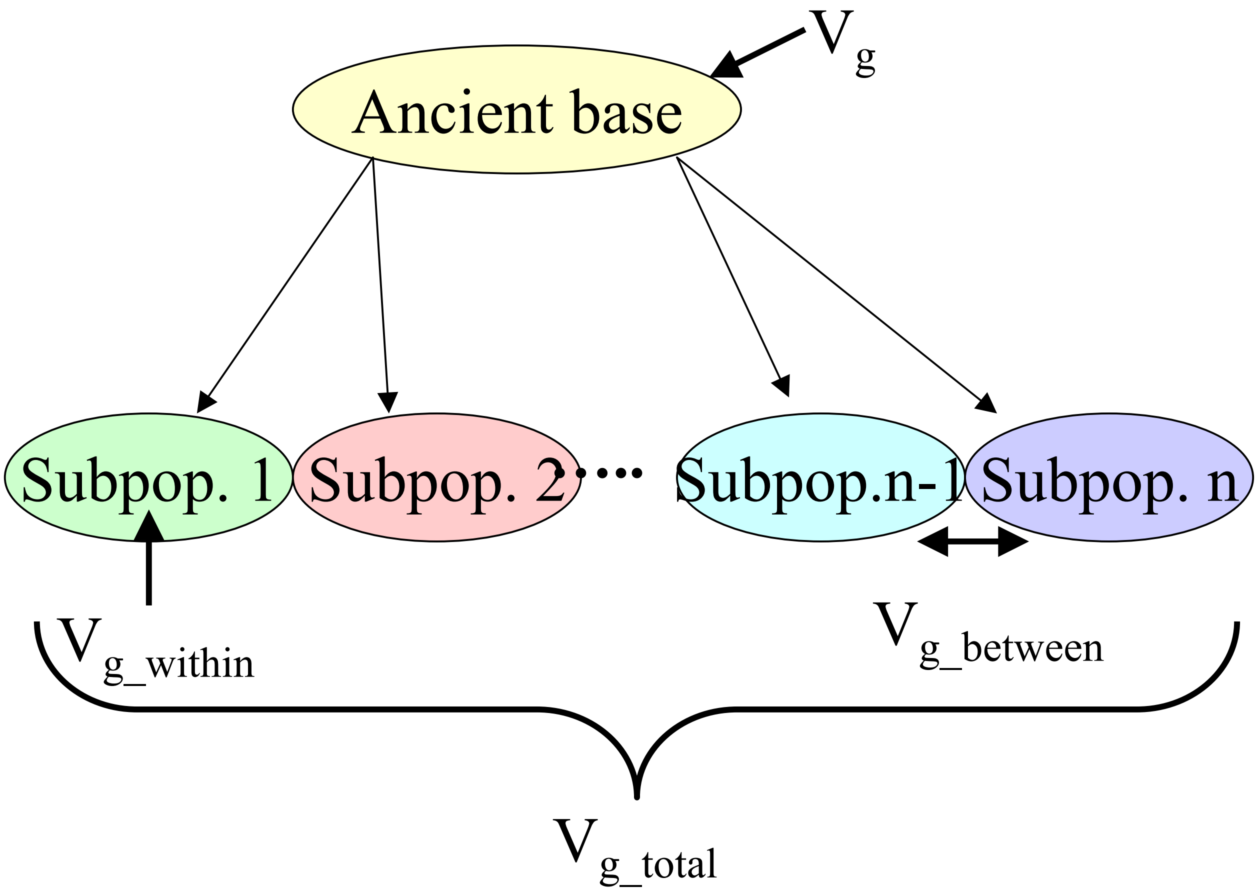
Aim 1: # subpopulations contributing to generation zero (G_0)
Aim 2: Mating design in G_0

Evaluation criteria:

- Accumulated genetic gain
- Genetic variance

At a fixed rate of inbreeding

Population structure



$V_{g\_total} = (1+F)V_g$

$V_{g\_within} = (1-F)V_g$

$V_{g\_between} = 2FV_g$

Falconer & Mackay 1996

A-matrix

1+F	2F	0	0
2F	1+F	0	0
0	0	1+F	2F
0	0	2F	1+F

Model assumptions

- Stochastic simulation
- Infinitesimal model
- One trait measured in both sexes
  - G_0 : g_{ij} = subpop. mean + animal effect
  - Later: $g_i = \frac{1}{2}(g_{sire,i} + g_{dam,i}) + \sqrt{(0.5*CF)}*\sigma_{g\_within} * w_i$

    $P_i = g_i + \sigma_e * v_i$
- Optimal contribution selection based on phenotypic information on the selection candidates

Model assumptions

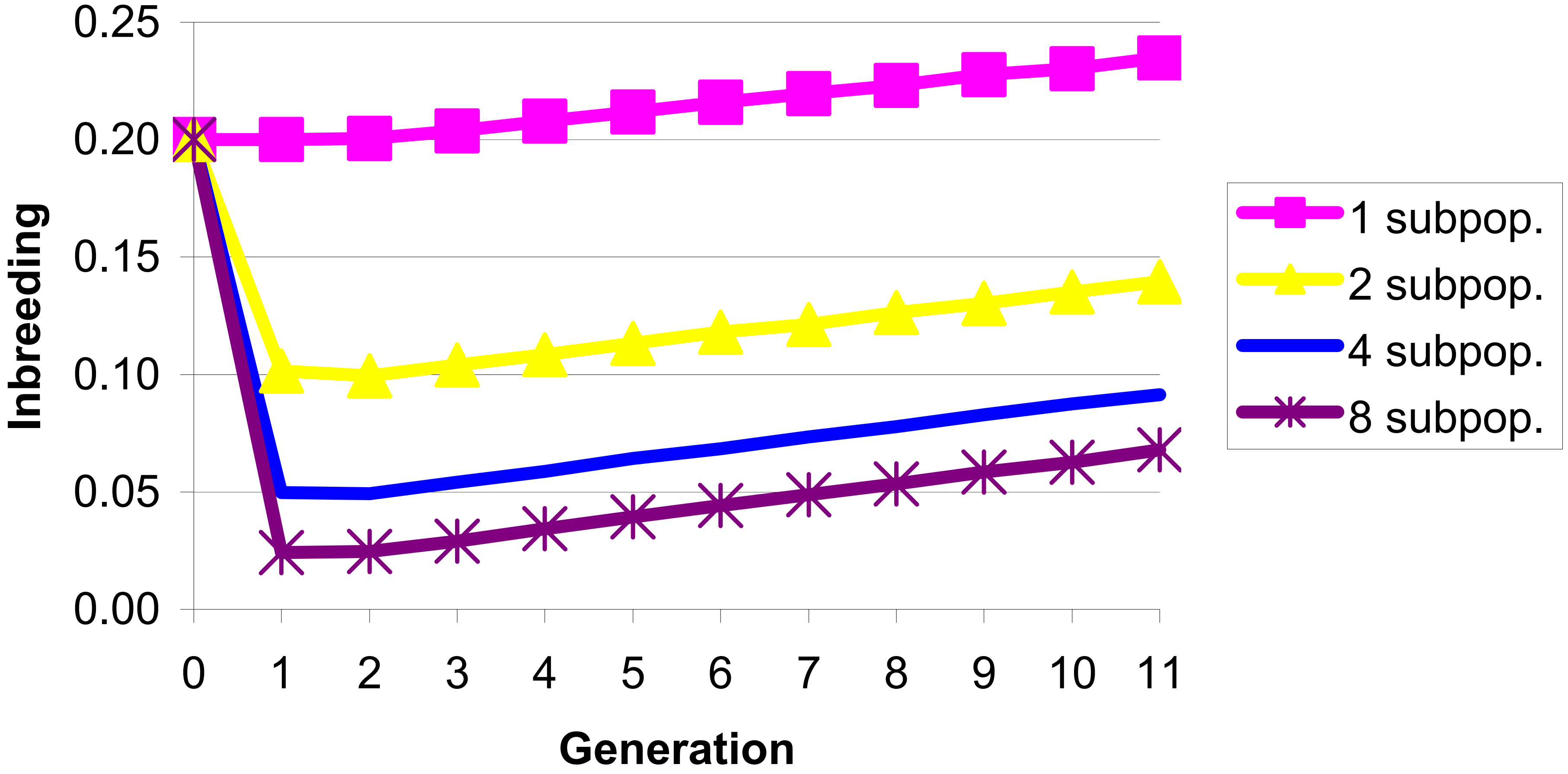
- Sampling the wild fish from 1, 2, 4 or 8 subpopulations
- Mating in G_0
  - Random mating within and across subpopulations
  - Mating within subpopulations
- Parameters:
  - $V_{g\_total} = 0.2$
  - $F = 0.2$
  - $V_E = 0.8$

→

$V_{g\_within} = 0.17$

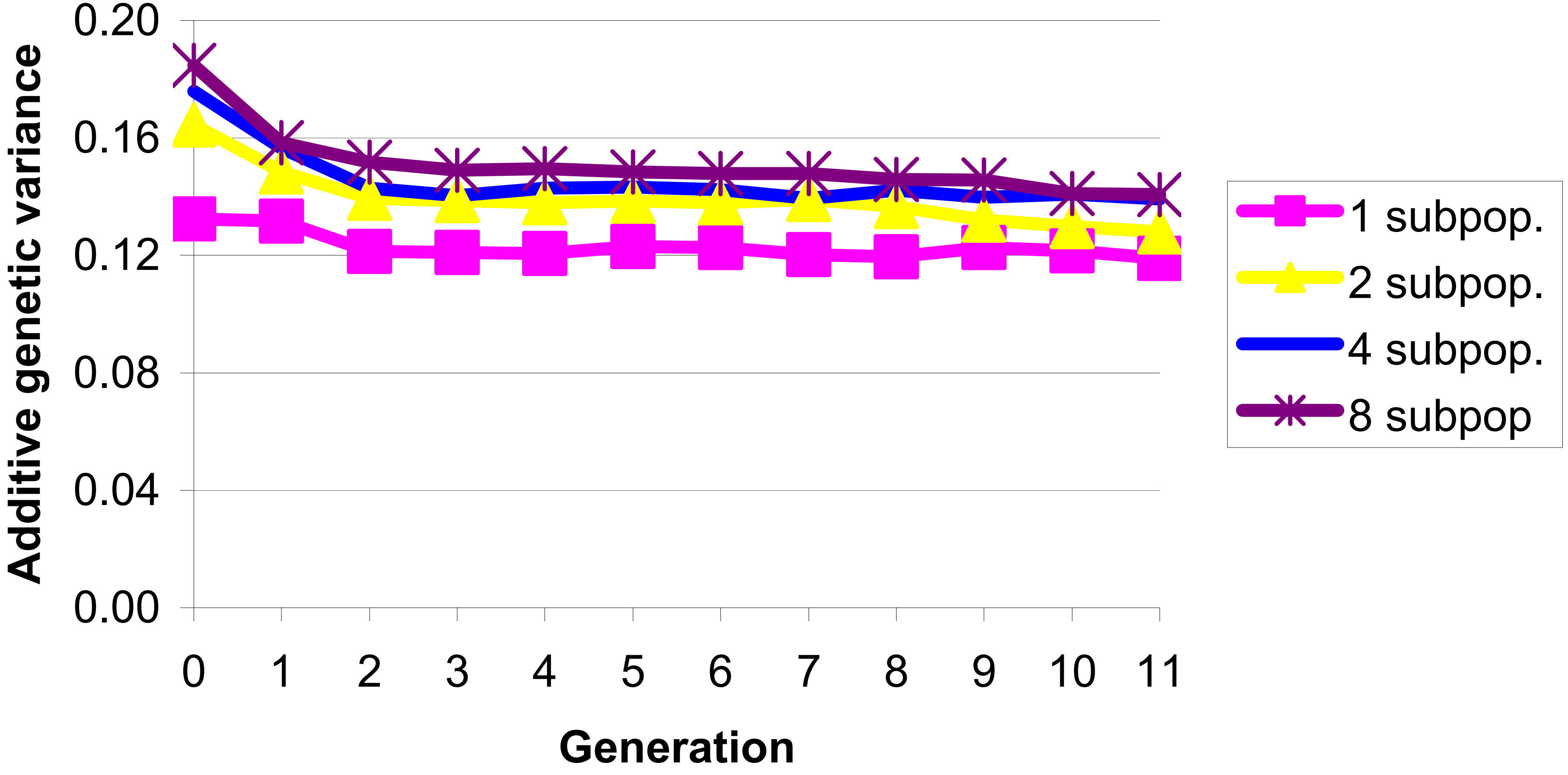
$V_{g\_between} = 0.07$

Effect # subpopulations on inbreeding
- random mating in G_0

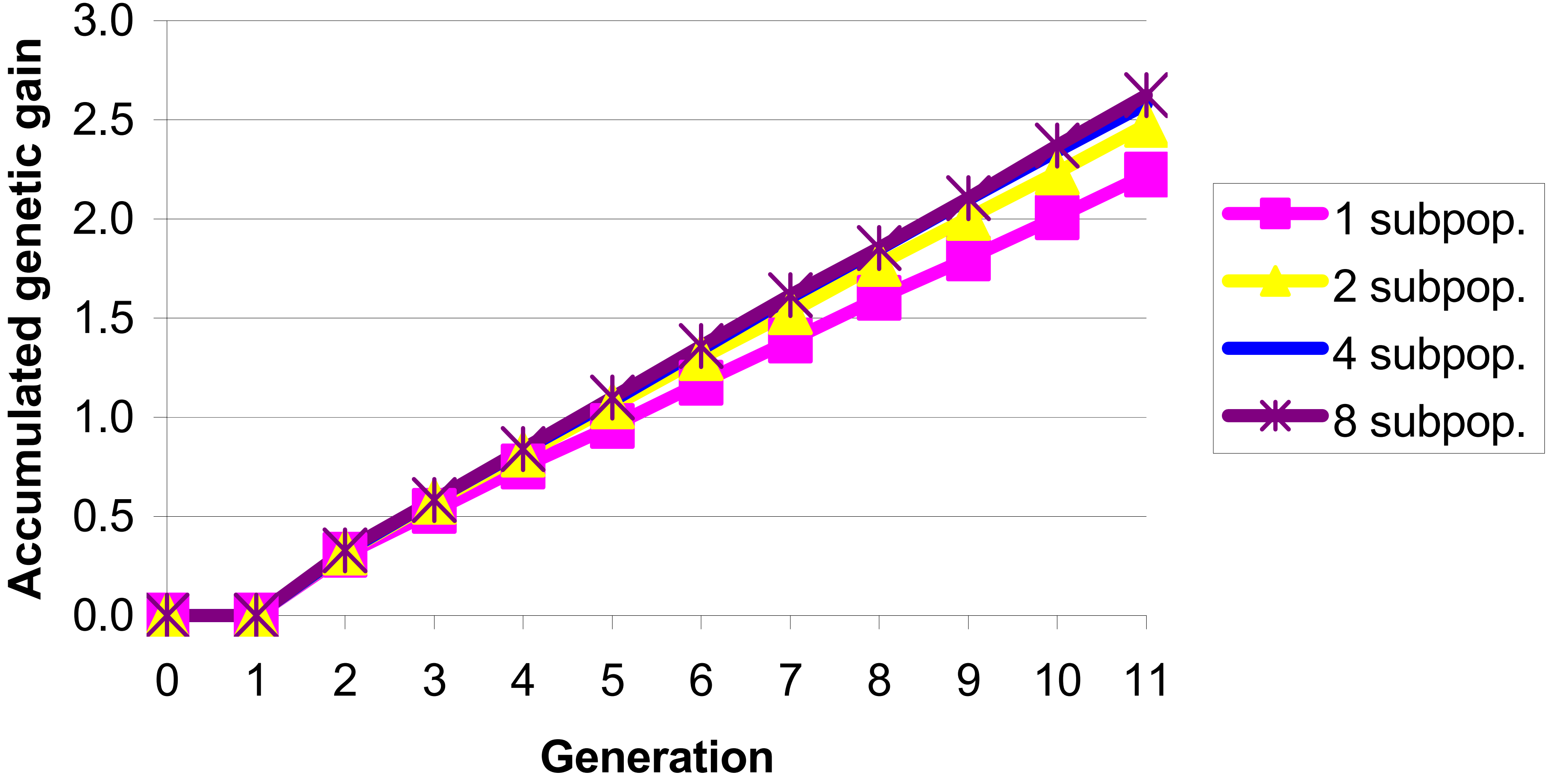


Effect of # subpopulations on genetic variance

- random mating in G_0

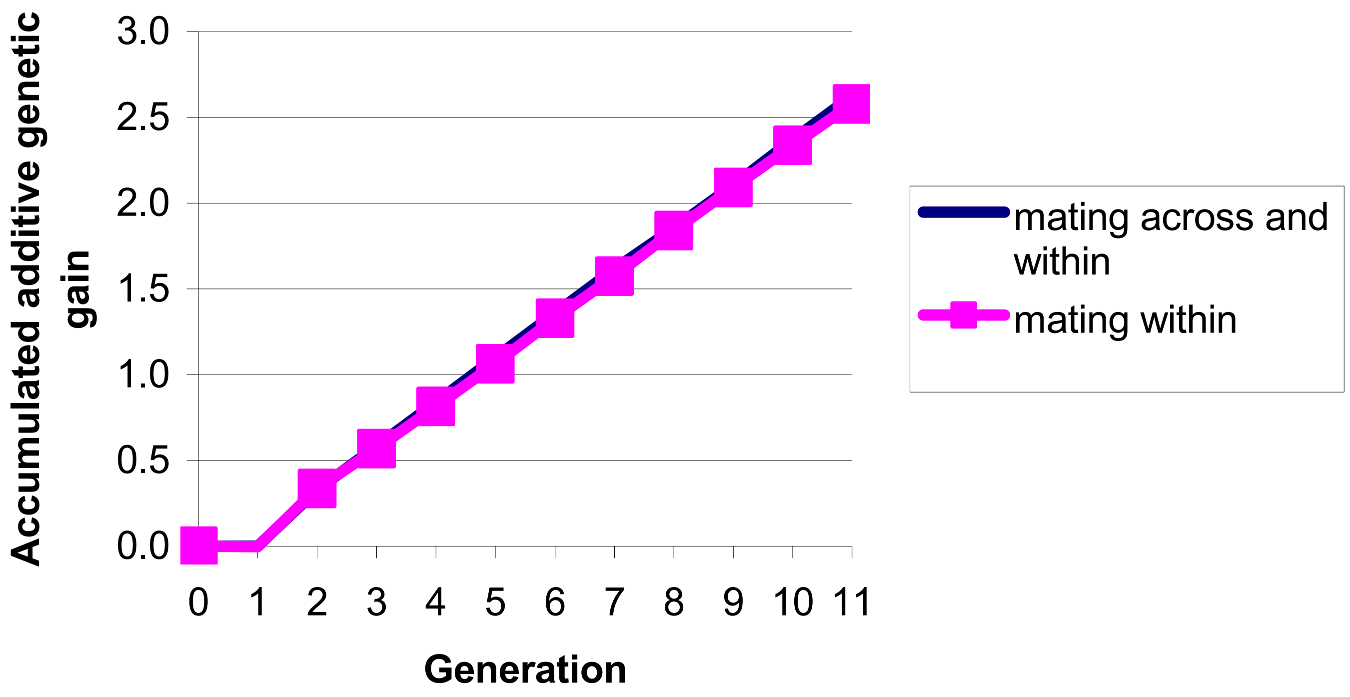


Effect # subpopulations on accumulated genetic gain - random mating in G_0



Mating strategies in G_0

- Random, within and across subpopulations
- Within subpopulations



•Resulted in equal accumulated genetic gain

Discussion

- Results depend on inbreeding (F) in wild fish
  - F = 0 => no difference between subpopulations
- Selection for more than one trait
  - sample from ≥ 4 subpopulations

Conclusion

Haddoc; www.seafood.no

- Inbreeding through genetic variance is driving the system (genetic variance and gain)
- Sample from $\geq$ 4 subpopulations; maximizes genetic gain
- Mating within, and random mating within and across subpopulations, in G_0, gave equal gain