

BI0120: MODEL SYSTEMS IN ECOLOGICAL GENETICS

20160927

→ LOTS OF GENES WHICH ARE NOT VARIABLE (NONMORPHIC)
HOW DO WE KNOW?

→ RON FISHER, ——— EMPHATIC

• *CECA MEMORALIS*



• *LIANTHUS PAREVAE*



→ WHAT PROCESSES INFLUENCE THE
MAINTENANCE OF GENETIC VARIATION
IN POPULATIONS?

FOUNDATIONS OF POPULATION GENETICS

• R. A. FISHER



• J. B. S. HALDANE



• S. WRIGHT



Neo-DARWINISM

NEW SYNTHESIS

→ CONTINUOUS VARIATION AND DARWIN'S THEORY
ARE CONSISTENT WITH MENDELIAN LAWS

IMPORTANT PARAMETERS:

• P :: POLYMORPHISM

PROPORTION OF GENE LOCI THAT ARE POLYMORPHIC

• H :: HETEROZYGOSITY

AVERAGE FREQUENCY OF HETEROZYGOTUS
INDIVIDUALS PER GENE LOCUS[†].

[†] - A SITE ON A CHROMOSOME THAT
IS USUALLY A GENE

INFLUENTIAL PATTERNS

- MUTATION: RANDOM ERRORS DURING REPLICATION
- RANDOM GENETIC DRIFT
- OR NATURAL SELECTION:

a) PURIFYING

b) POSITIVE SELECTION (ADAPTATION)

MUTATIONS THAT INCREASE FITNESS BECOME FIXED

c) BALANCING

NATURAL SELECTION MAINTAINS DIVERSITY

DIFFERENT PROCESSES \uparrow & \downarrow GENETIC DIVERSITY
WITHIN POPULATIONS

EARLY EVIDENCE FOR GENETIC VARIATION

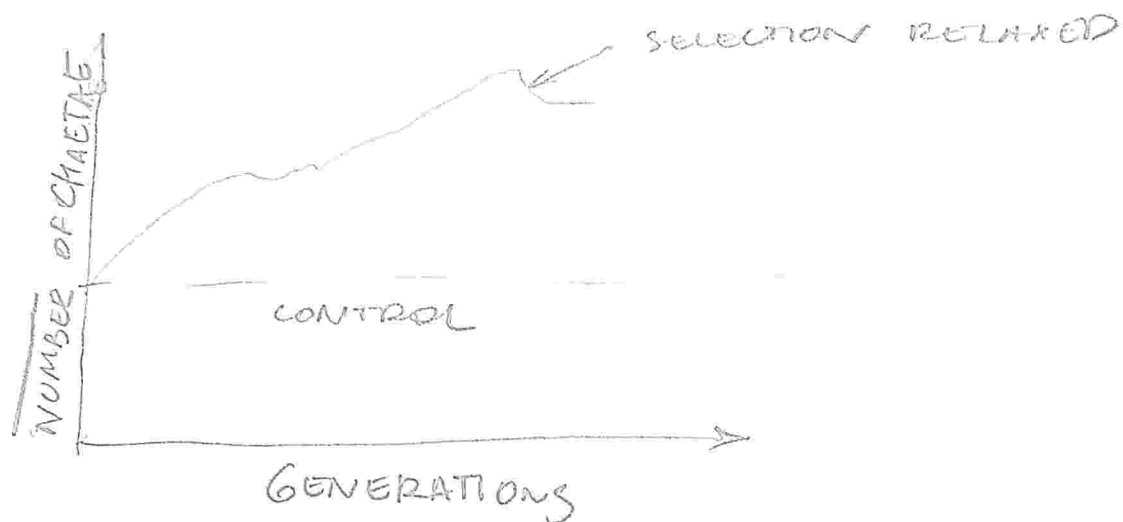
- SELECTION EXPERIMENTS

CONTROLLED BREEDING AND SELECTION
FOR MANY GENERATIONS

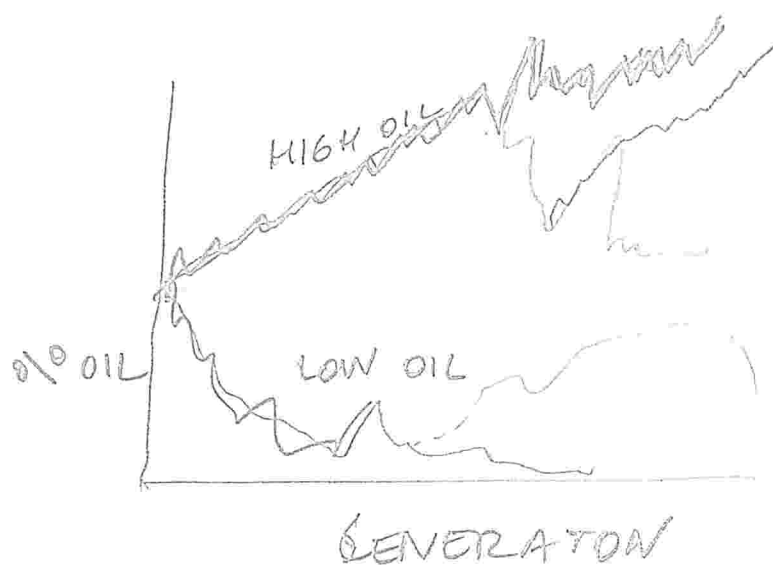
→ ARTIFICIAL SELECTION

└→ AGRICULTURE

SELECTION RESPONSE FOR BRISTLE NUMBER IN
DROSOPHILA MELANOGASTER



SELECTION RESPONSE IN MAIZE



- DEMONSTRATE THAT ABUNDANT GENETIC VARIATION EXISTS
- NO INFO ON KEY POPULATION PARAMETERS.
- OFTEN TRAITS ARE GROUP SPECIFIC

PREDICTIONS ON HOW MUCH GENETIC VARIATION
OCCURS IN NATURAL POPULATIONS:

CLASSICAL
SCHOOL

BALANCE
SCHOOL

• MORGAN T.H

• MULLER H.J

• E.B. FORD

• T. DOBZHANSKY

-
- LAB MUTANTS
 - HIGH HOMOZYGOSITY
 - LOW POLYMORPHISM
 - PURIFYING SELECTION
REDUCES DIVERSITY;
WILD TYPE IS
THE BEST GENOTYPE

-
- NATURAL POPULATIONS
 - HIGH POLYMORPHISM
 - LOW HOMOZYGOSITY
 - NO BEST OR IDEAL
GENOTYPE; BALANCING
SELECTION FAVOURS
DIVERSITY.

RICHARD LEWONTIN AND THE ELECTROPHORETIC
REVOLUTION

AUTOZYME GEL ELECTROPHORESIS PROVIDED A
WAY TO ASK "WHAT PROPORTION OF
GENES ARE VARIABLE?"

→ INITIATED LARGE SCALE SURVEYS OF
PROTEINS AND ENZYMES, MEASURING
DIVERSITY AT GENES WHICH CONTROL THEM.

ADVANTAGES OF STUDIES OF ENZYME POLYMORPHISM:

- MANY LOCI CAN BE EXAMINED
- CAN BE USED IN NEARLY ANY ORGANISM
- CO-DOMINANT LOCI AND HETEROZYGOTES CAN BE DETERMINED
- VARIATION EXAMINED CLOSE TO DNA
- PROVIDES GENETIC MARKER LOCI FOR OTHER STUDIES

BUT STUDIES OF QUANTITATIVE INHERITANCE ARE NECESSARY TO FIND OUT HOW MUCH VARIATION OCCURS FOR ECOLOGICALLY RELEVANT TRAITS SUCH AS BODY SIZE, FERTILITY AND OTHER LIFE-HISTORY

CONTRASTING PATTERNS OF GD IN
GENERALIST VS SPECIALIST BARNYARD GRASSES

GENERALIST

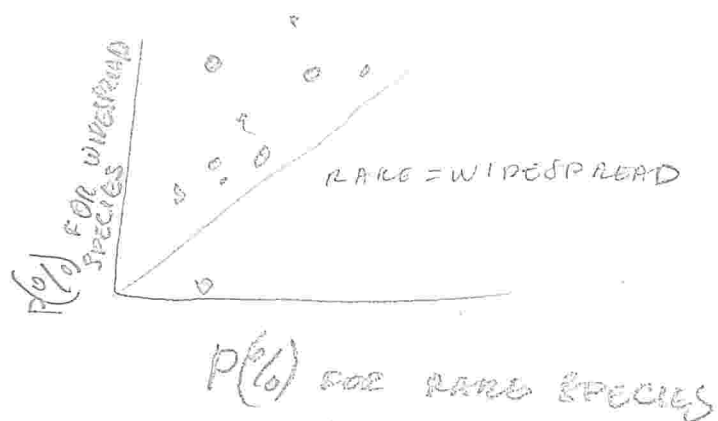


SPECIALIST



HIGH DIVERSITY
LOW DIVERSITY

CONTRASTING LEVELS OF POLYMORPHISM IN RARE VS. WIDESPREAD PLANT SPECIES



- HIGHER P IN THE GENERA BUT ONE
- INDICATES RARE SPECIES HAVE LOWER VALUES OF P

STUDYING GENETIC VARIATION AT THE DNA LEVEL

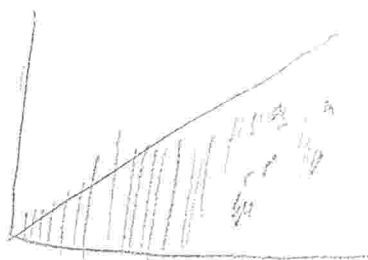
- DNA SEQUENCER

S. Barrett

2 \longrightarrow 30 \longrightarrow 26 000
1977 2016

- DNA SEQUENCING ALLOWS DIFFERENCES BETWEEN INDIVIDUALS IN SINGLE NUCLEOTIDES TO BE IDENTIFIED

DNA VARIATION IN MAIZE VS. TEOSINTE



STEPHEN WRIGHT AND COLLEAGUES FOUND THAT DOMESTICATION OF MAIZE FROM ITS PROGENITOR TEOSINTE CAUSED A 57% REDUCTION IN VARIATION AT SNP'S: ~ 1200 GENES HAVE BEEN AFFECTED FOR ARTIFICIAL SELECTION

HUMAN GENOME PROJECT

• INDIVIDUALS DIFFER BY THOUSANDS OF SNPs
