BIO 120: SPECIATION 2016/10/12

HAWAIIAN HONEYCREEPERS DESCENDED FROM ONE ANCESTOR.
HOW?

WHY ARE THERE SO MANY FLIGHTLESS BIRDS ON OCEANIC ISLANDS?

HYP1. ABSCENSE OF PREDATORS

→ WINGS AS A MEANS TO GET AWAY | NEUTRAL MUTATIONS

HYP2.

ADAPTATION TO LIFE ON THE ISLANDS FAR FROM THE MAINLAND

EG.

FLIGHTLESS BIRDS SWIM BETTER.

TWO MAIN SPECIES CONCEPTS:

- TAXONOMIC
  MORPHOLOGIC DIFFERENCES
- BIOLOGICAL

BASED ON INTER-FERTILITY (CROSSABILITY) AMONG INDIVIDUALS

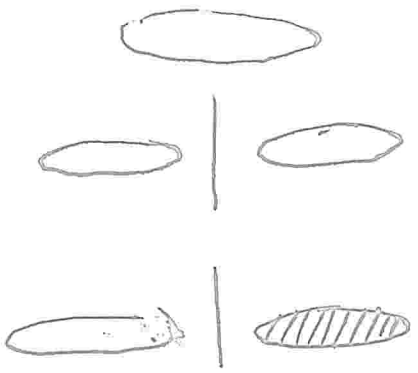
⇒ CONCEPTS VARY AMONG DIFFERENT GROUPS OF ORGANISMS
⇒ NO UNIVERSAL SPECIES CONCEPT

THE BIOLOGICAL SPECIES CONCEPT.

ERNST MEYER

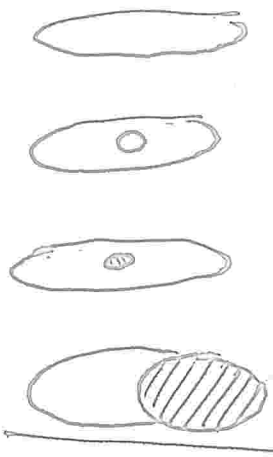
TWO MODES OF SPECIATION

ALLOPATRIC



ALSO KNOWN AS GEOGRAPHIC SPECIATION

SYMPATRIC



METHODOLOGICAL ISSUES WITH DETERMINING ITS OCCURENCE

HOWEVER,

→ POLYPLOIDISM IN PLAN

"JUST A PLANT THING"

- J. COYNE

WHAT CAUSES REPRODUCTIVE ISOLATION?

FINDING A COMPATIBLE MATE

↓

MATING & FERTILIZATION

↓

DEV. OF ZYGOTE

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ADULT GROWTH AND SURVIVAL

↓

REPRODUCTION

POST-MATING BARRIERS:

1. PREVENTION OF THE PROPER FUNCTIONING OF ZYGOTES

→

X

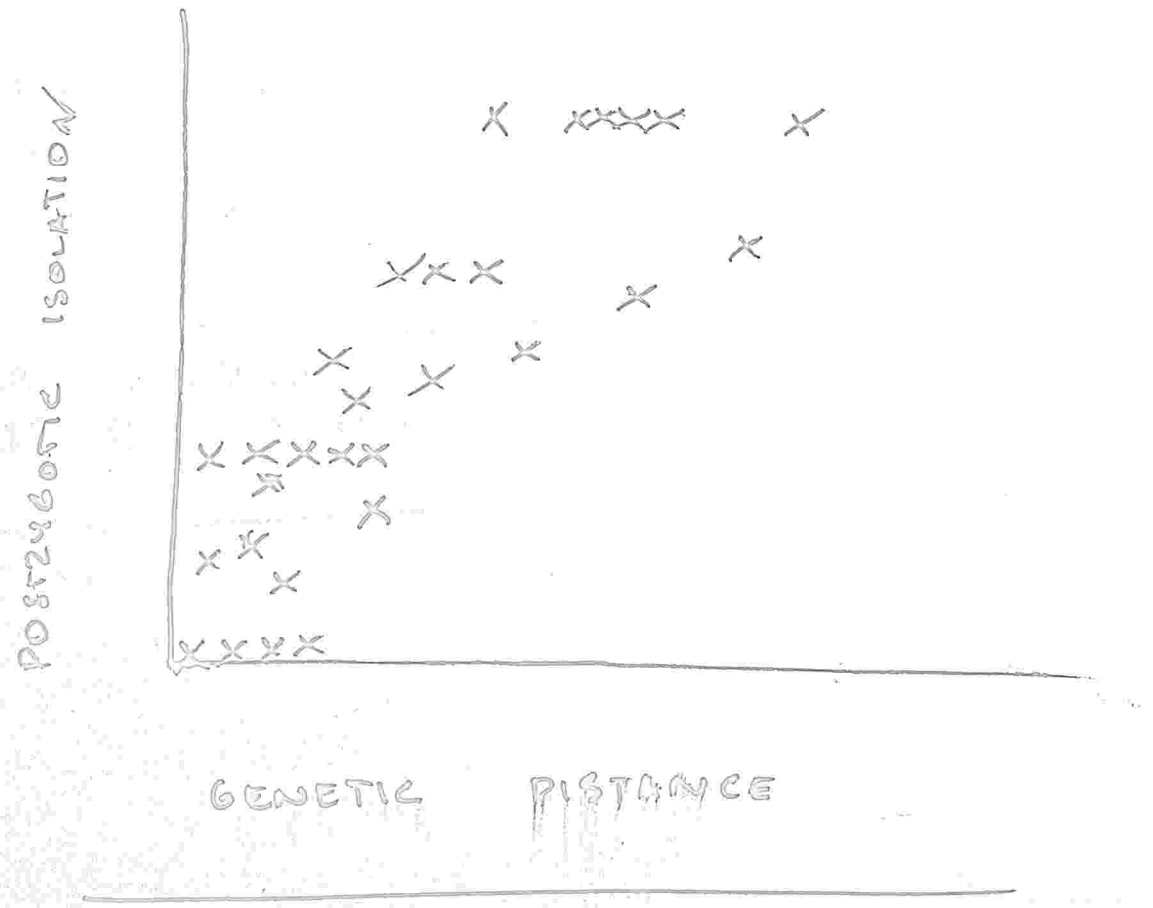
↓

$F_1 \times F_1$ } STERILITY OR LETHALITY

↓

F_2

FRUIT FLIES



THE MORE GENETICALLY DIFFERENTIATED FLIES ARE, THE MORE LIKELY THE REPRODUCTIVE BARRIER WOULD INCREASE.

PREMATING ISOLATION FACTORS

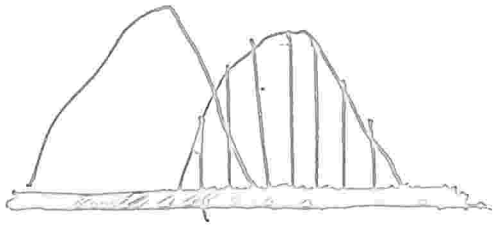
- GEOGRAPHICAL, ECOLOGICAL
  EG GENETIC DIFFERENCE
- TEMPORAL, BEHAVIOURAL
- MECHANICAL, PREVENTION OF GAMETE FUSION

"RIGHT TIME, RIGHT PLACE, BUT ..."
NO OPPORTUNITY TO COPULATE

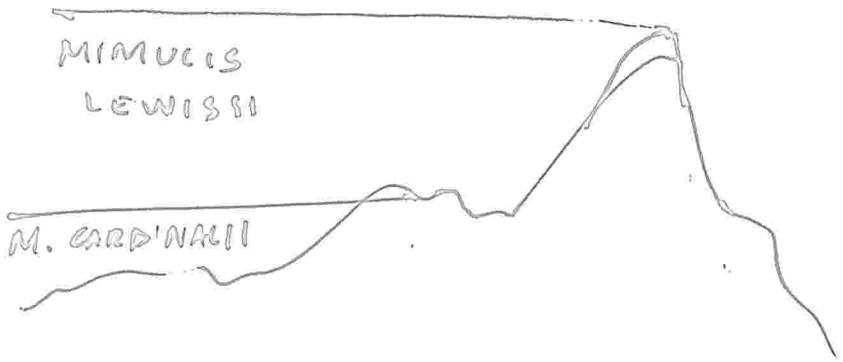
EXAMPLE

(1) RHAGOLETIS POMONELLA

- TEMPORALLY ISOLATED
- HOST DIFFERENCES
  SOME MOVED TO APPLES IN XIX c.



(2)



→ THE TWO PARENTAL FORMS ARE INTER-FERTILE AND PRODUCE FERTILE F_2

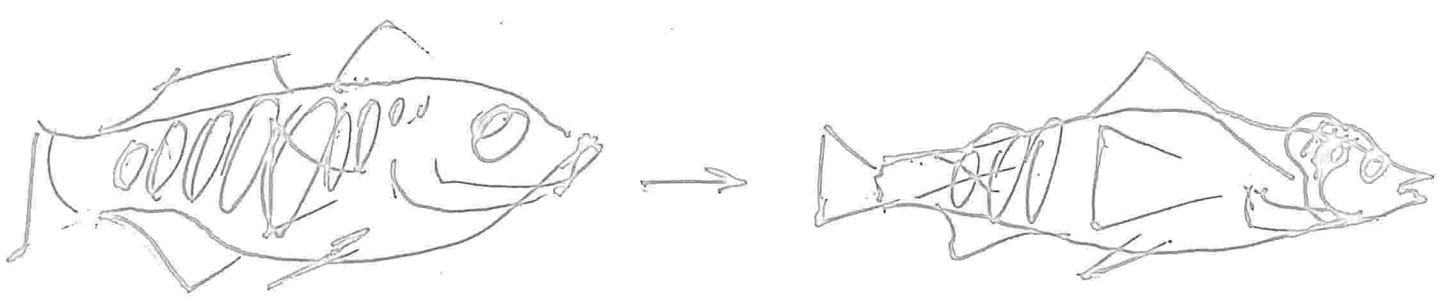
→ RARELY SEEN DUE TO ALTITUDINAL PREFERENCES AND DIFF. IN POLLINATORS

CROW SPECIATION IN EUROPE — AN EXAMPLE OF EXTRINSIC POSTZYGOTIC ISOLATION DUE TO POORLY ADAPTED HYBRIDS

HYBRIDS ARE STRONGLY SELECTED AGAINST

ECOLOGICAL SPECIATION ⟹ SEARCH FOR SPECIATION GENES

3- SPINED STICKLEBACK LOSES A BONY DEFENSIVE ARMOR AS AN ADAPTATION TO FRESHWATER.



EDA — A KEY GENE FOR THE FORMATION OF BONY ARMOR

LOSS OF PLATES INCREASES GROWTH RATE → INCREASED WINTER SURVIVAL

ADAPTIVE RADIATION : FEATURES

1. RECENT COMMON ANCESTRY
2. PHENOTYPE - ENV. CORRELATION
3. TRAIT UTILITY
4. RAPID SPECIATION

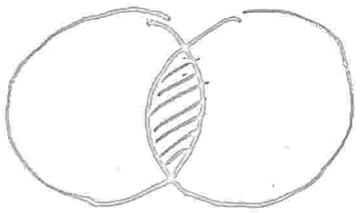
WHY ADAPTIVE RADIATION?

- ECOLOGICAL OPPORTUNITY
- HIGH RATES OF SPECIATION CHARACTERIZE THE CLADE
- ORIGIN OF A KEY INNOVATION

→ TOEPAD IN ANOLES, FLORAL NECTAR SPUR IN COLUMBINES

ACQUISITION OF A TRAIT DURING THE HISTORICAL DEVELOPMENT OF THE ANCESTRY

HYBRIDIZATION



- RESULTS IN COMPLEX PATTERNS OF VARIATION
- VARIATION CAN BE OF EVOLUTIONARY SIGNIFICANCE, ESP. BY POLYPLOIDY

→ COMMON IN PLANTS AND FISH, RARE IN MAMMALS

POLYPLOIDY

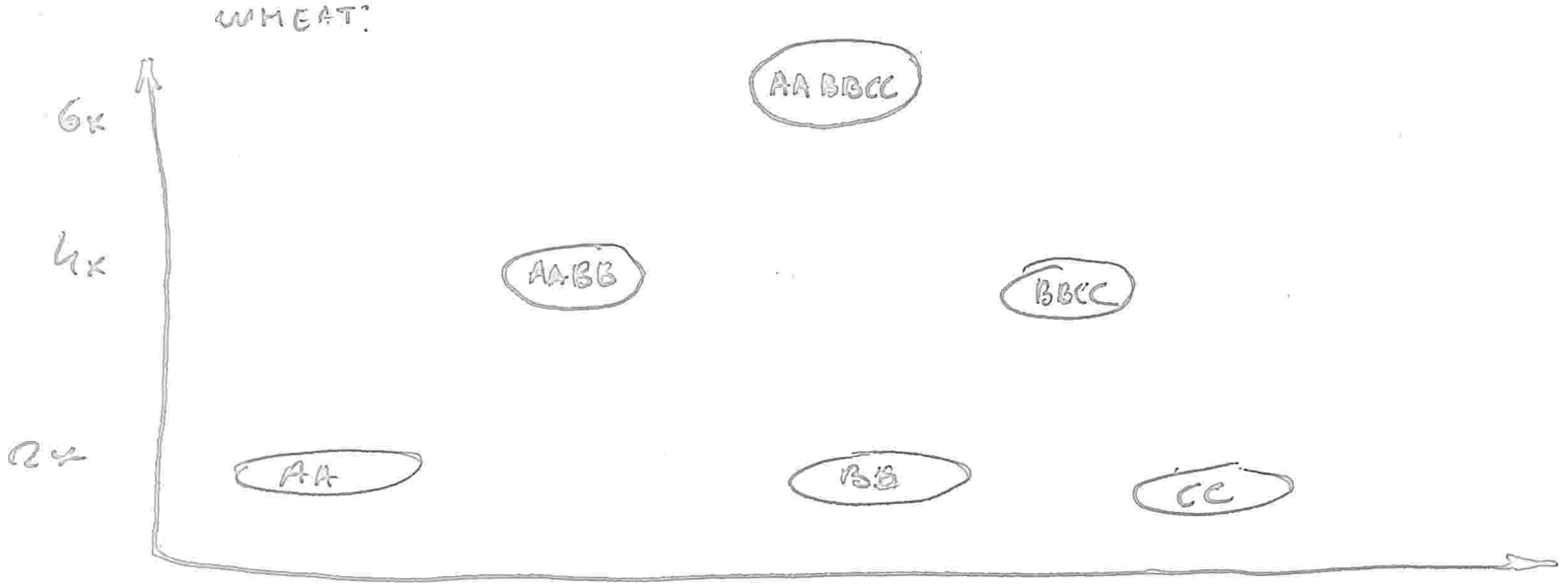
MORE THAN TWO COMPLETE SETS OF HOMOLOGOUS CHROSOMES

=> RECORD: IP(FERN) > 1000

POLYPLOID CONDITIONS RANGE FROM AUTOPOLYPLOIDY (AAAA) TO ALLOPOLYPLOIDY (E.G. AABB)

ALLOPOLYPLOIDY ARISES FROM OCCASIONAL HYBRIDIZATION BETWEEN SPECIES AND IS THE COMMONEST TYPE OF POLYPLOIDY.

WHEAT:



- POLYPLOIDS REPRODUCTIVELY ISOLATED
  → AN EXAMPLE OF SYMPATRIC SPECIATION
- POLYPLOIDS EXHIBIT NOVEL PHENOTYPES ALLOWING EXPLOITATION OF NEW HABITATS
- HYBRID VIGOUR EVIDENT DUE TO HETEROZYGOSITY

ONE HALF OF ALL FLOWERING PLANTS ARE POLYPLOID