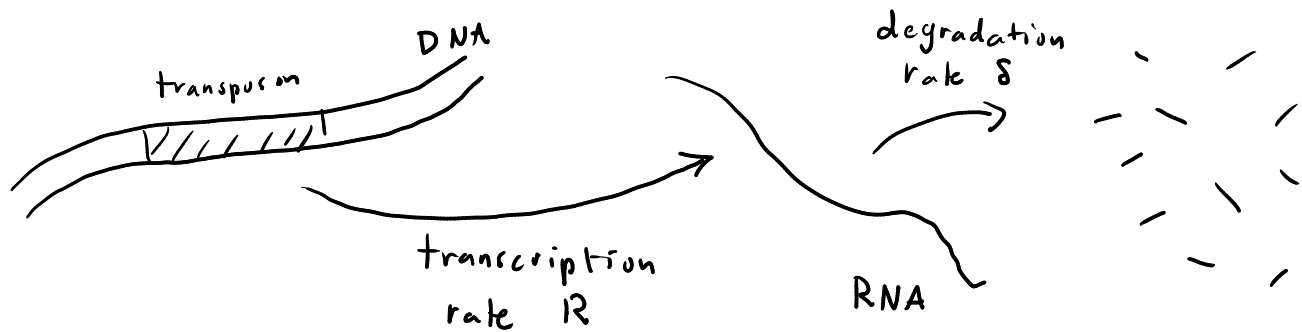


Lynch + Marinov PNAS (2015):

transposon (6000 bp) makes a new copy of itself, increasing genome by 6000 bp



$n(t)$ = avg. #
of RNA
from
transposon

$$\frac{dn}{dt} = R - \delta n$$

at steady-state

$$0 = R - \delta n$$

$$R = \delta n$$

typically $n \sim 1$ copy
(1-100 copies)

$$R \approx \delta$$

Costs:

- costs of synthesizing new RNA : 46 ATP per nucleotide
- assembling RNA chain :
2 ATP per nucleotide
at rate $\approx R$

extra cost over entire cell "lifetime" t_g

$\Rightarrow t_g = \overset{\text{avg.}}{\text{time to cell division}}$

$$\Delta M = \underset{\substack{\downarrow \\ 1}}{n} \underset{\substack{\downarrow \\ 6000}}{L} (46 + 2 \underset{\substack{\downarrow \\ \approx \delta}}{R} t_g)$$

prokaryote (bacteria): $t_g = 0.7 \text{ hr}$

$$\delta = 10 \text{ hr}^{-1}$$

$$\Delta M = 3.6 \times 10^5 \text{ ATP}$$

eukaryote (yeast): $t_g = 10 \text{ hr}$

$$\delta = 3 \text{ hr}^{-1}$$

$$\Delta M = 6.4 \times 10^5 \text{ ATP}$$

Lynch / Marinov claimed:

$$\frac{f_{w/\text{mut.}}}{f_{w/o \text{ mut.}}} = 1 - \frac{\Delta M}{M_{\text{tot}}} \Rightarrow \delta = \frac{f_{w/\text{mut.}}}{f_{w/o \text{ mut.}}} - 1 = -\frac{\Delta M}{M_{\text{tot}}}$$

$\uparrow$ total ATP consumption
for cell over time t_g

Rough justification: $\left\{ \begin{array}{l} \rightarrow \text{conv. factor from nutrient} \rightarrow \text{ATP} \\ \downarrow \text{replication time} \end{array} \right.$

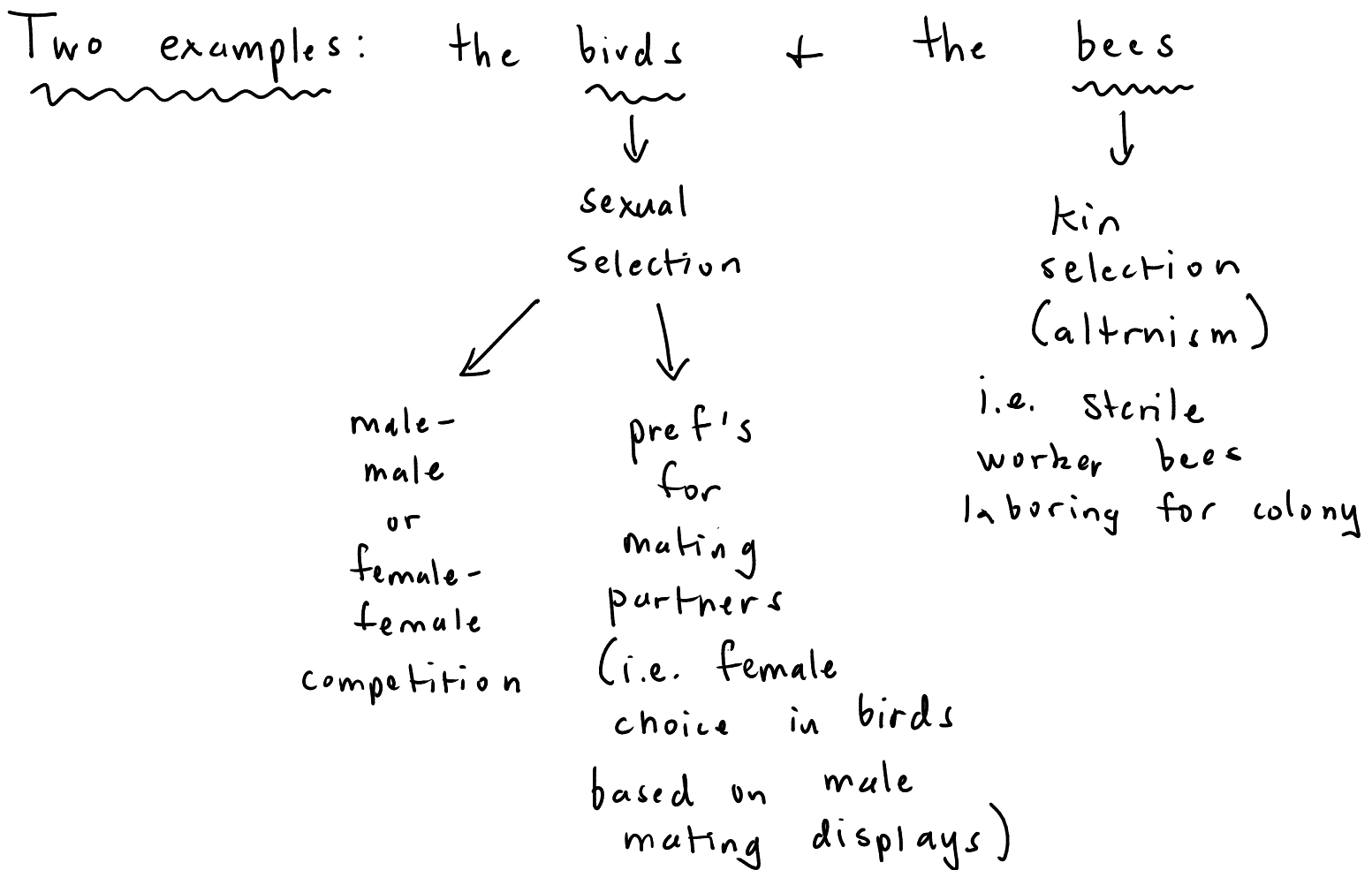
w/o mut: $M_{\text{tot}} = \underset{\text{ATP}}{\alpha} \underset{\substack{\rightarrow \text{nutrient uptake / second}}}{\gamma} t_g$

w/ mut: $M'_{\text{tot}} = M_{\text{tot}} + \Delta M = \alpha \gamma t'_g$
 $\uparrow$ longer repl. time

$$\frac{f'}{f} = \frac{\frac{1}{t'_g}}{\frac{1}{t_g}} = \frac{t_g}{t'_g} = \frac{M_{tot}}{M_{tot} + \Delta M} \approx 1 - \frac{\Delta M}{M_{tot}}$$

for $\Delta M \ll M_{tot}$

How is evolution affected by interactions among organisms? (i.e. ecology)



Rationale: bird mating behavior

one explanation: "indicator" model



"good genes"
display correlates
w/ genetic fitness

↓
correlation
w/ parental
investment
"direct benefits"

alternative:

"runaway" sexual selection
⇒ male ornament / behavior
becomes prevalent b/c
female pref. even if it
comes at a fitness cost
to the male