• Feedbacks between ecology and evolution: interactions between $\Delta N$ and $\Delta p$ in a life-history model

• or

• Eco-evolutionary feedbacks and the fundamental theorem of natural selection
• What is carrying capacity (K)?

• What is $s$, the selection coefficient? Is it a constant?

• Does the additive genetic variance for fitness depend on $s$?

\[
V_A = 2pq[q - h(q - p)]^2 (W_{11} - W_{22})^2
\]

\[
V_A = 2pq[q - h(q - p)]^2 s^2 W_{11}^2
\]
• “It is a patent oversimplification to assert that the environment determines the numbers of each of organism which it will support.” (Fisher 1958, p. 45)

• “The numbers must indeed be determined by the elastic quality of the resistance offered ...” (Fisher 1958, p. 45)
• “The rate of increase in fitness of any organism at any time is equal to its genetic variance for fitness at that time.” (Fisher 1958, p. 37)

\[ \Delta \bar{W}_{ns} = \frac{V_A}{\bar{W}} , \]

• “... the theorem is exact only in idealized populations, in which fortuitous fluctuations in genetic composition have been excluded, ...” (Fisher 1958, p. 38)
“Any net advantage gained by an organism will be conserved in the form of an increase in the population, rather than in increase in the average Malthusian parameter, which is kept by this adjustment always near zero.” (Fisher 1958, p. 51)
• Derive the total change in mean fitness due to Natural Selection and due to environmental deterioration.
• Derive $V(A)$ for fitness.
• Consider a life-history model.
Fig. 1

\[ K_{22} = \frac{(b_{22} - d_{22})}{a_{22}} \]

\[ K_{11} = \frac{(b_{11} - d_{11})}{a_{11}} \]
\[ \Delta \bar{W}_{ns} = \bar{W}'E - \bar{W}E \]

\[ \Delta \bar{W}_{ec} = \bar{W}'E' - \bar{W}'E. \]
Fig. 2
Fig. 3

(A) $N$ increases

(B) $N$ increases

$p$

$V_A$

Generation