$C \equiv$ Clutch Size $r \equiv \%$ ♂ wild type $\hat{r} \equiv \%$ ♂ mutant

$1-r = \%$ ♀ wild type $1-\hat{r} \equiv \%$ ♀ mutant

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mutant

$$♀ \xrightarrow{\frac{c}{2}(1-\hat{r})} ♀ \qquad ♀ \xrightarrow{\frac{c}{2}(\hat{r})} ♂$$

$$♀ \xrightarrow{c} \frac{c^2}{2}(1-\hat{r})$$

WT

$$n♀ \xrightarrow{n\cdot C(1-r)} ♀ \qquad n♀ \xrightarrow{n\cdot Cr} ♂$$

$$\frac{\frac{c}{2}\hat{r}}{\cancel{\frac{c}{2}}\hat{r} + \cancel{ncr}} \cdot \left[\cancel{\frac{c}{2}(1-\hat{r})} + \cancel{n}C(1-r)\right] \cdot C$$

$$\approx$$

$$\frac{C^2}{2} \frac{\hat{r}}{r}(1-r)$$

So

$$\hat{R}_0 \approx \frac{C^2}{2}(1-\hat{r}) + \frac{C^2}{2}\frac{\hat{r}}{r}(1-r)$$

and

$$R_0 = C^2(1-r)$$

So

$$\hat{R}_0 \simeq \frac{c^2}{2}(1-\hat{r}) + \frac{c^2}{2}\frac{\hat{r}}{r}(1-r)$$

and

$$R_0 = c^2(1-r)$$

$$\lambda(\hat{r}, r) = \frac{\hat{R}_0}{R_0} = \frac{1}{2}\left[\frac{(1-\hat{r})}{1-r} + \frac{\hat{r}}{r}\right]$$

$$\frac{d\lambda(\hat{r}, r)}{d\hat{r}} = \frac{1}{2}\left[\frac{-1}{1-r} + \frac{1}{r}\right]$$

so $\frac{d\lambda(\hat{r}, r)}{d\hat{r}} > 0$ if $1-r > r$

if $r < \frac{1}{2}$, $\hat{r} > r$ invades.

if $r > \frac{1}{2}$, $\hat{r} < r$ invades