

Density Dependence

Simulations

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This document provides an example of how to model density dependence in mass and M-at-age.

The life history parameters of mackerel are used to construct an **FLBRP** object that represents the equilibrium dynamics, this is then used to construct an **FLStock** object that models the time series dynamics.

The Lorenzen relationship between mass-at-age and M can model M as a function of weight-at-age. For example, $\text{lorenzen } M = a \cdot 300^{-0.288}$, so if you want $M=0.2$ at 300g then $a = 0.2 / (300^{-0.288})$

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Simulations

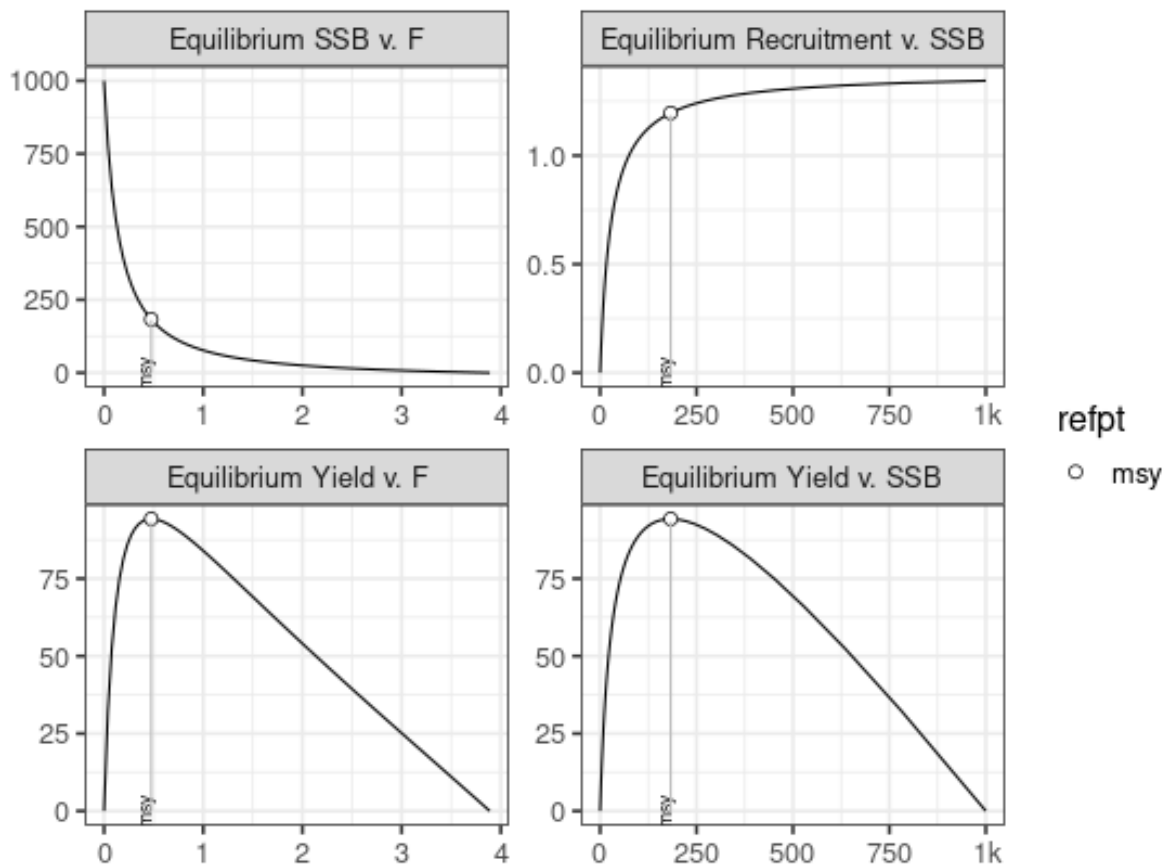


Figure 1 Equilibrium dynamics

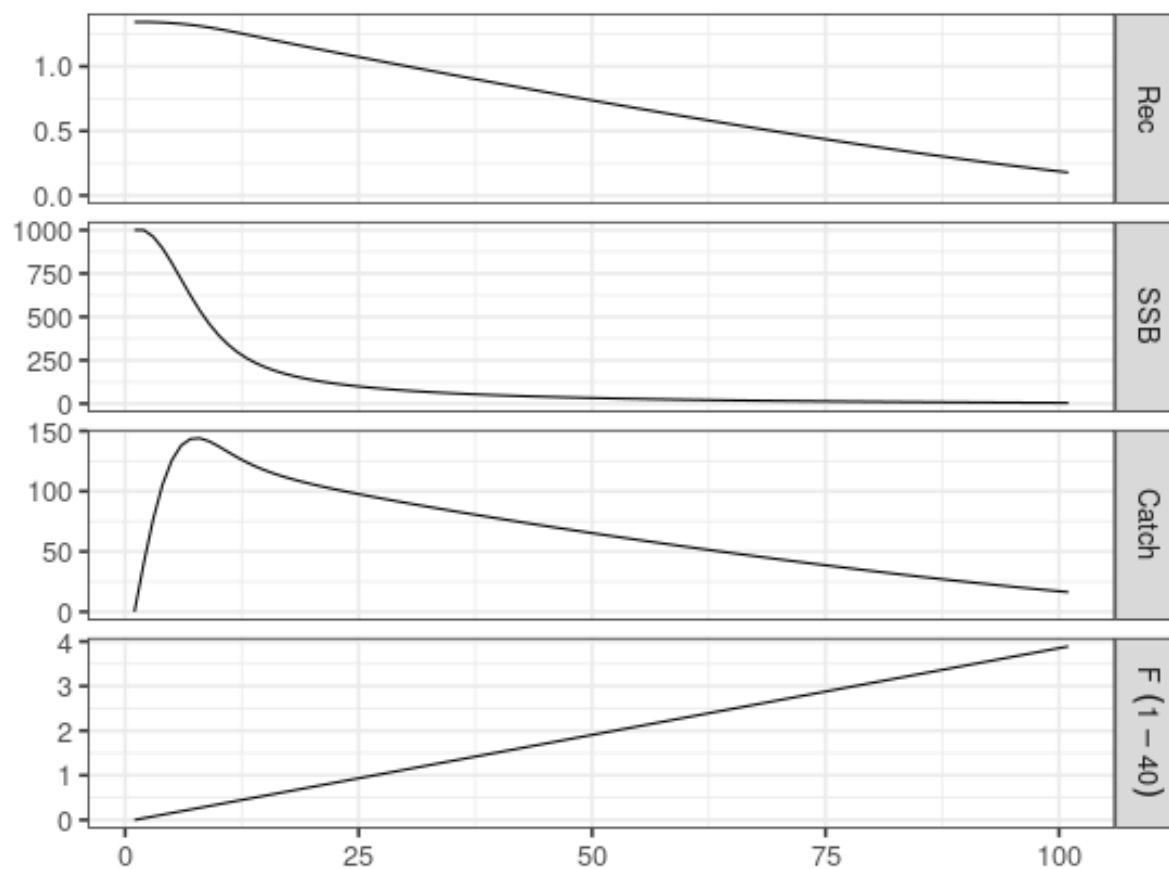


Figure 2 Time series dynamics

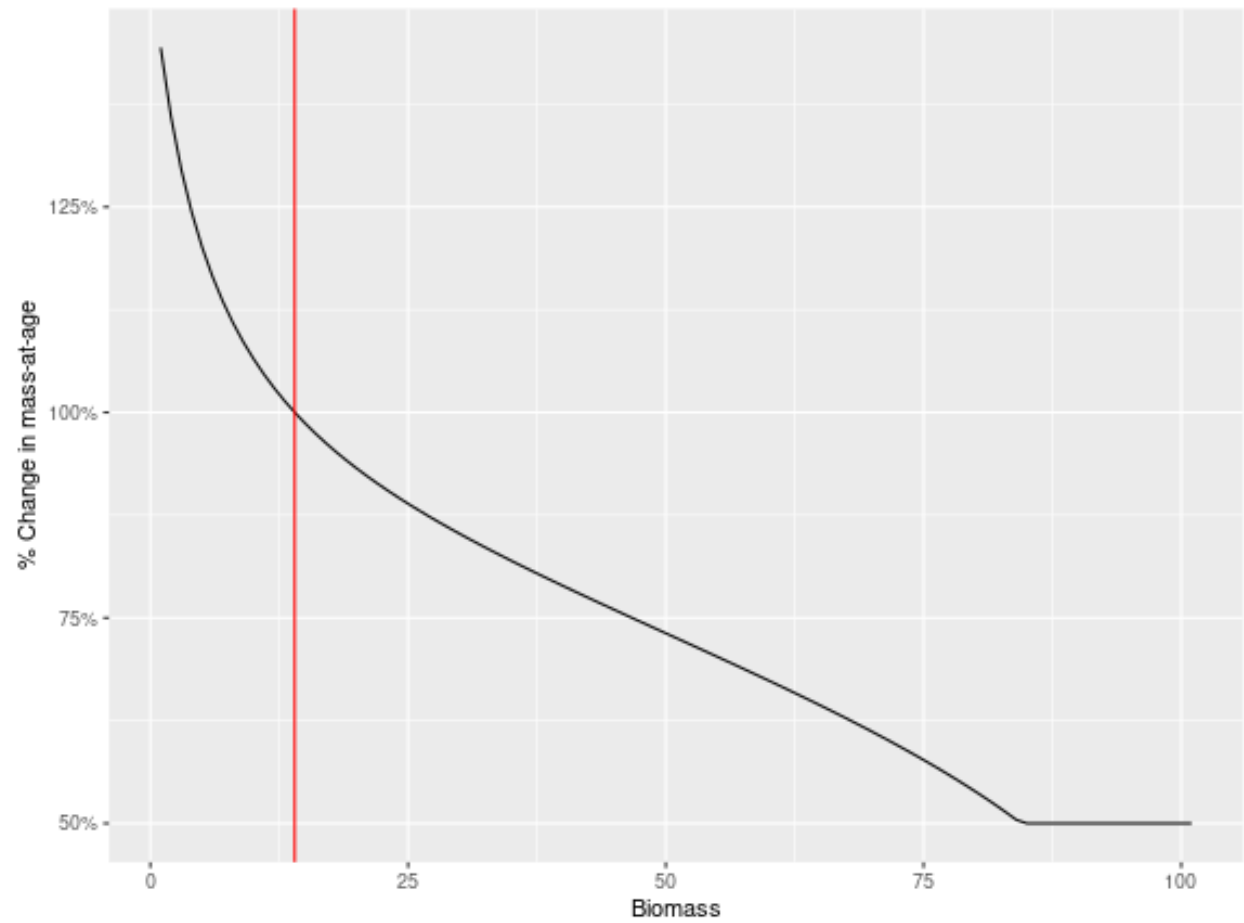


Figure 3 Density dependence multiplier, red is B_{MSY}

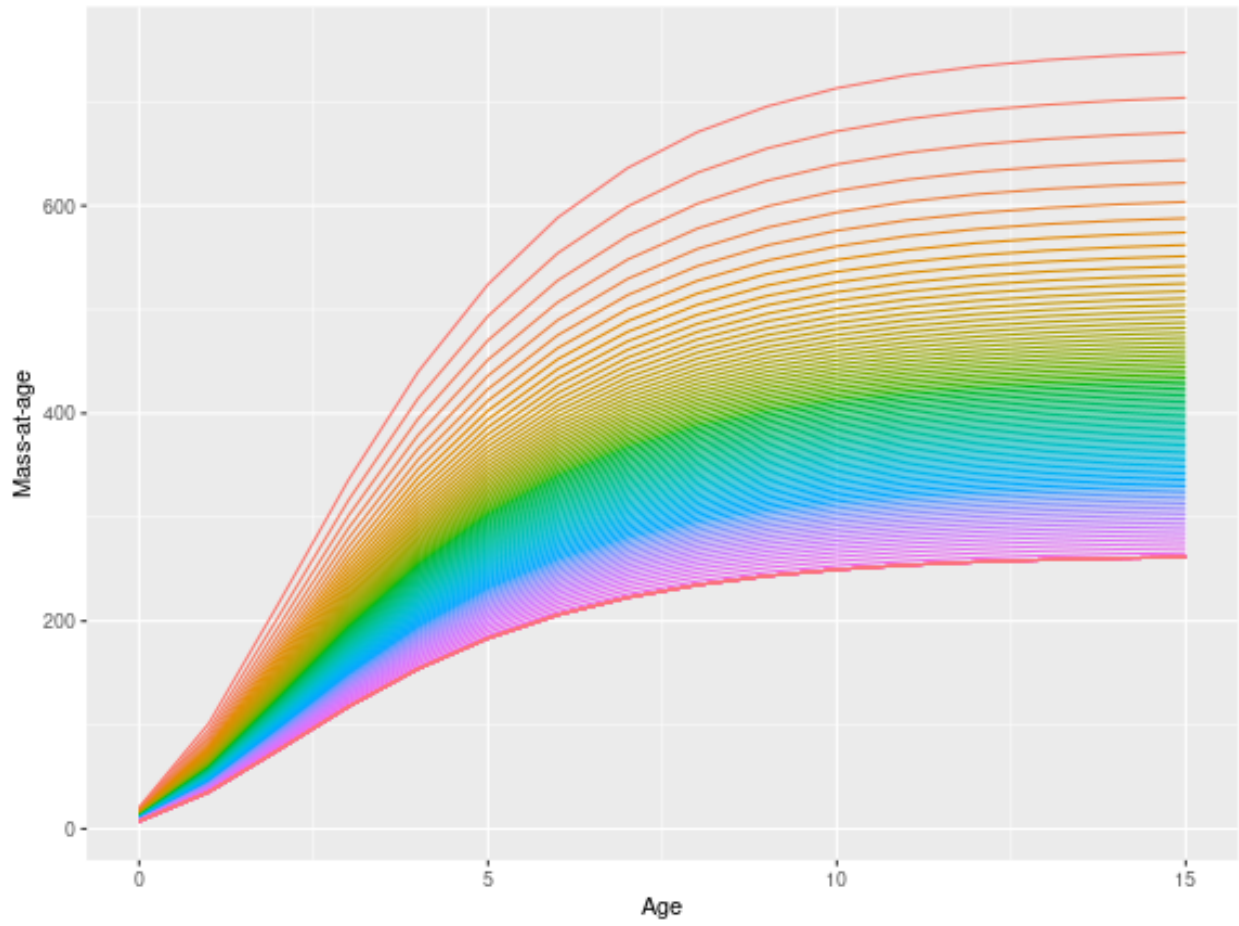


Figure 4 Simulation of density dependence in mass-at-age

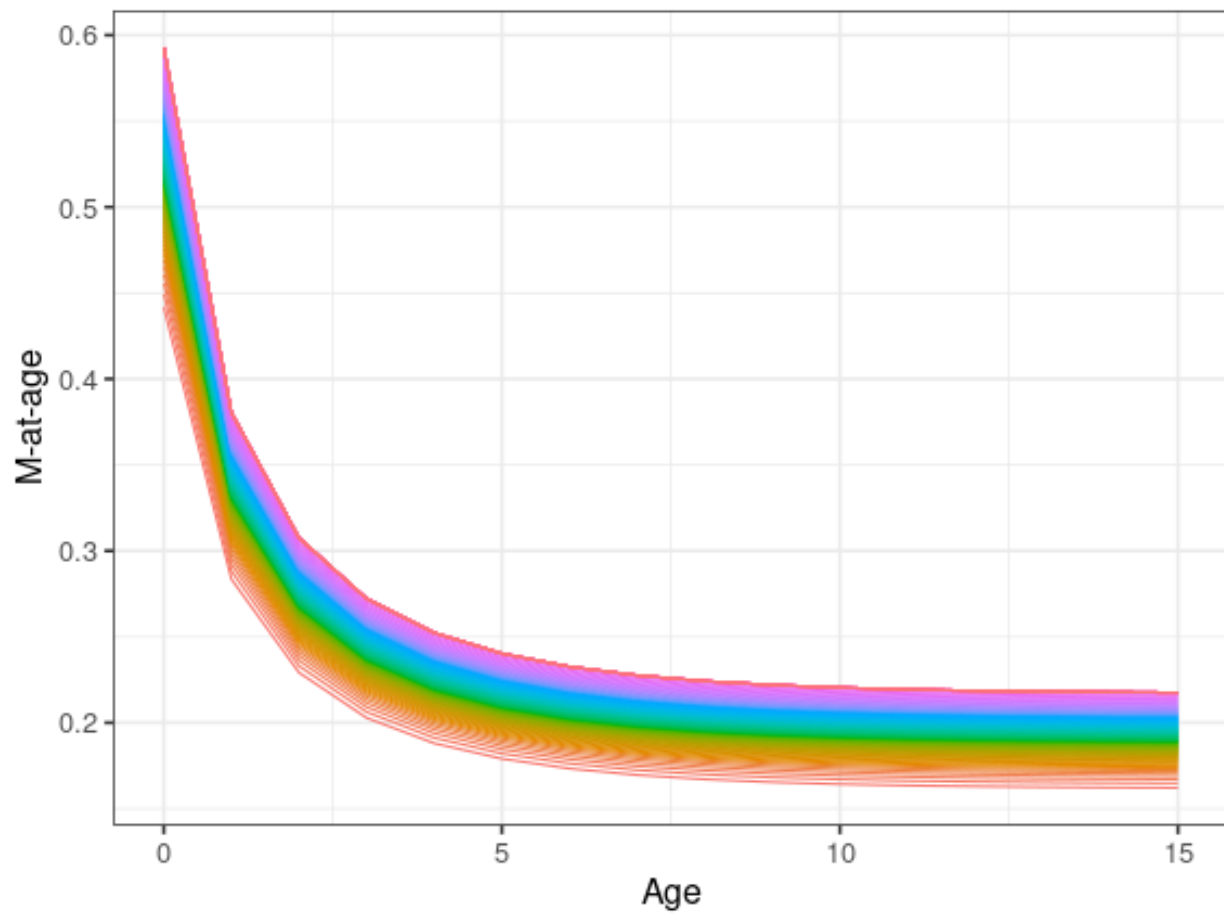


Figure 5 Simulation of density dependence in M-at-age

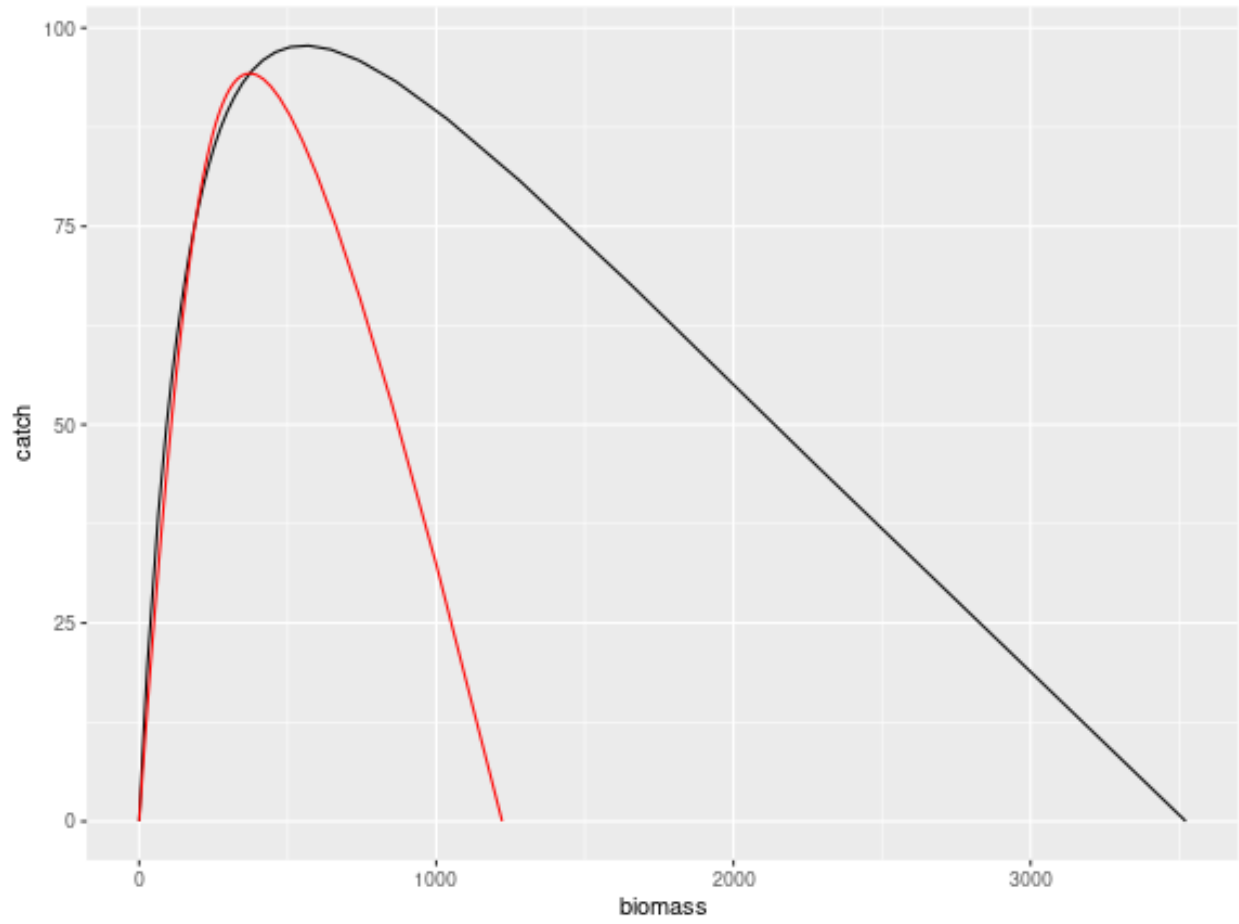


Figure 6 Comparison of equilibrium curves with (black) and without (red) density dependence.

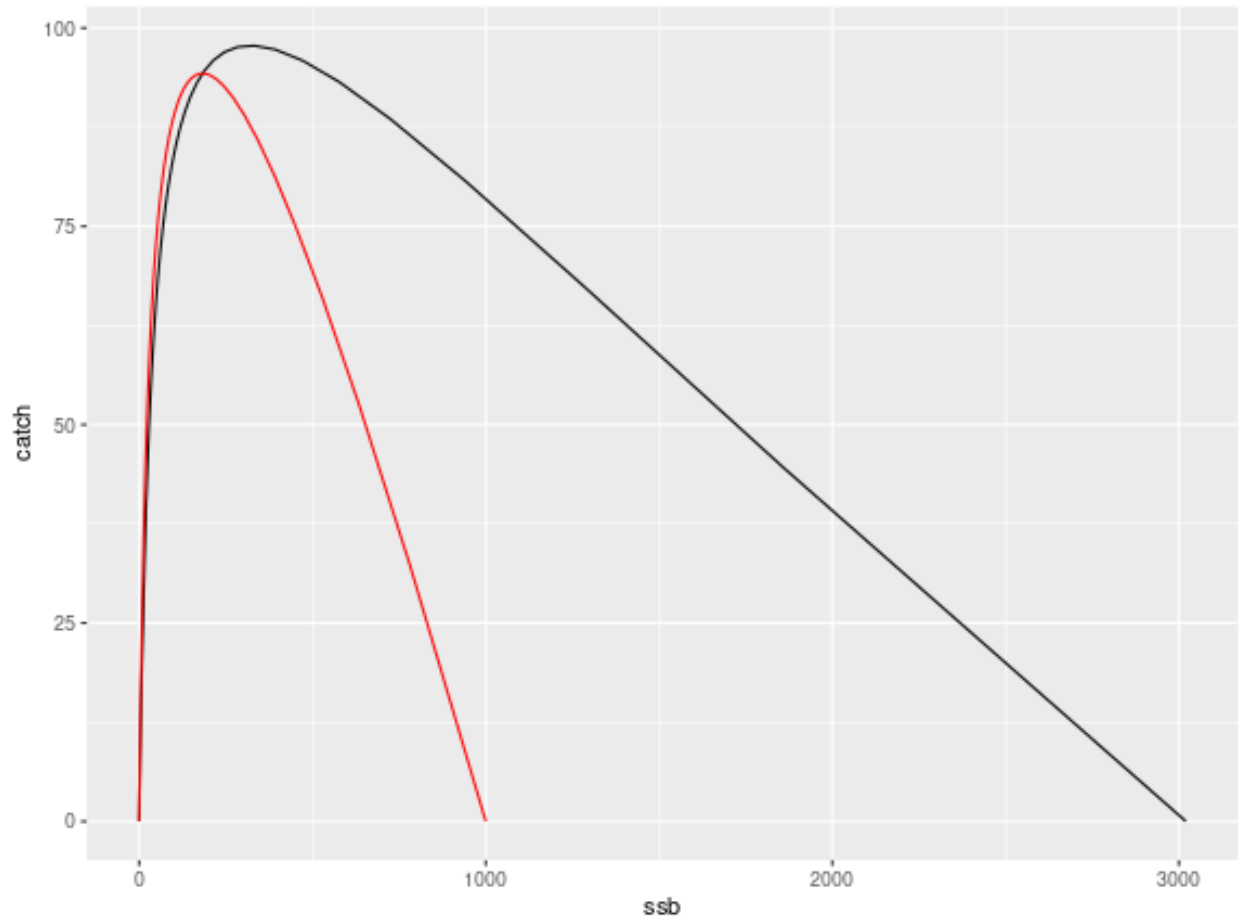


Figure 7 Comparison of equilibrium curves with (black) and without (red) density dependence.

Funding

References