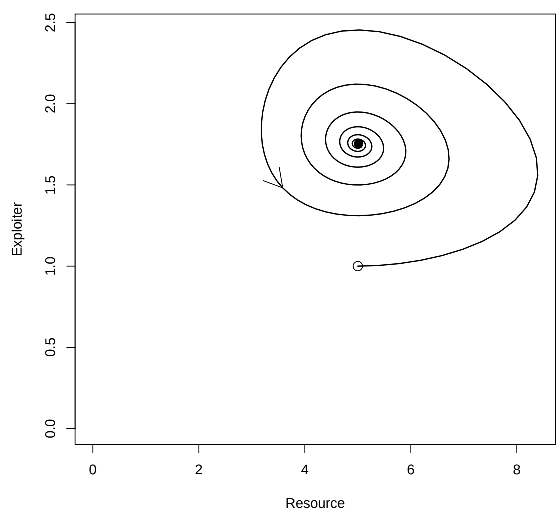
Population ecology assignment: Exploitation

Study the R function `explPlots` documented at `https://bio3ss.github.io/explCode/`, and associated explanations.

1. (3 points) Make a "default" plot (call `explPlots` without any parameters). What behaviour does this system show? In addition to the exploiter eating the resource species (and the resource species getting eaten), what other mechanism is incorporated in this simulation? Use `args(explPlot)` and the documentation to help figure out the last part.



The system shows damped oscillations to equilibrium. The additional mechanism is resource density dependence (predator satiation and predator density dependence are set to NULL).

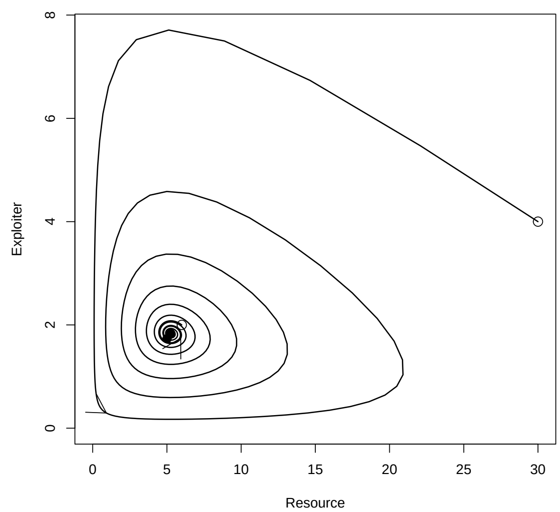
2. (2 points) The default plot does not incorporate predator satiation (the idea that there's only so much that the exploiter species can eat). `satF` is the parameter we use to measure satiation – when resource density is high compared to `satF` predator satiation is important. What parameters in the model have the same units as `satF`?

`satF`, `Kf` and `Cf` all have units of resource density.

3. (3 points) Experiment with different values of `satF` in this model. What

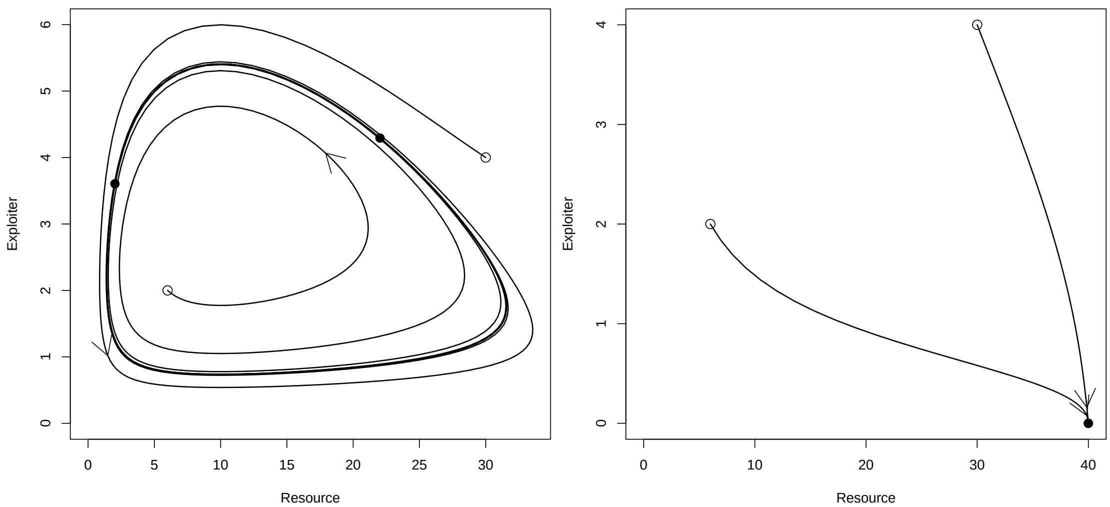
sort of behaviour do you get if `satF` is small; intermediate; large, compared to the other parameters with the same units? Use `explPlots` to make plots demonstrating three different types of behaviour (one plot per behaviour).

We see from the explanation page that the default value of `Kf` = 40, and `Cf` = 5. We choose `satF` = 100 as a large value (below). We take two starting points, one close and one far from equilibrium. Since `satF` is much larger than the amount of prey required to feed the predator, this picture looks very similar to the one with no saturation.



We choose `satF` = 10 as an intermediate value (left panel below). The effect of predator satiation is to destabilize the equilibrium, so we get persistent cycles. If we are too close to equilibrium, we spiral out because of satiation. If we are too far from equilibrium, we spiral in because of density dependence.

When we use `satF` = 1 (right panel below), the predator is slow at processing prey even at levels below those it requires to survive. At these parameters, the predator goes extinct.

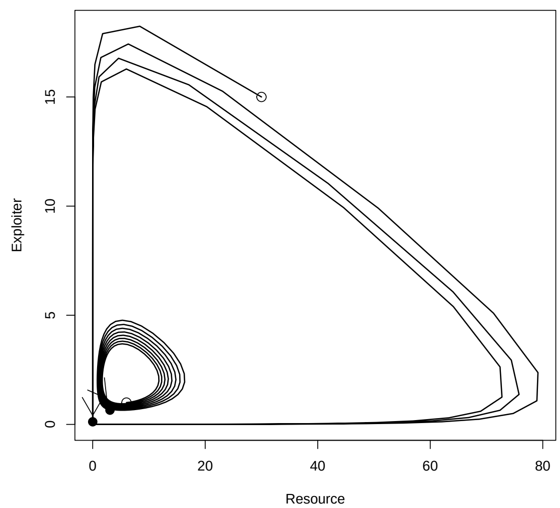


4. (1 point) Does increasing `satF` increase or decrease the strength of predator satiation?

We get satiation when resource density is large compared to `satF`, so decreasing `satF` increases the effect. We can also see this from the plots; our large `satF` plot is most similar to the one with no satiation.

5. (3 points) What is the effect of increasing `Kf` on the strength of density dependence? How do you expect it to affect cycling? Pick one of the plots you've already shown, and change `Kf` in a way that changes the behaviour of the system.

Increasing `Kf` *increases* the amount of prey required for density dependence to have a given impact, so it *decreases* the effect of density dependence. This makes it more likely to get stable cycles instead of damped cycles. Starting from stable cycles (the first figure in Q3), we increase `Kf` to 150.



Note the extreme (and unrealistically sharp) crashes in the populations for these parameter values. This is a concern for this kind of simple, homogeneous population model.