# UNIT 7: Exploitation

#### Outline

#### Introduction

Balance and equilibrium Tendency to oscillate

#### A simple model

More detailed models Reciprocal control

#### Adding details

Dynamics

Equilibri

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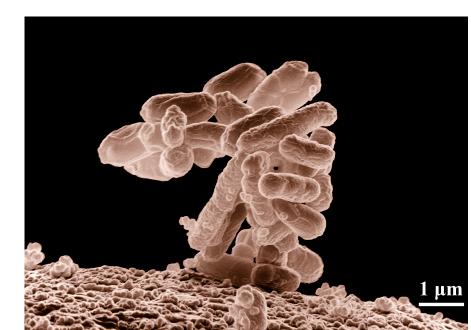
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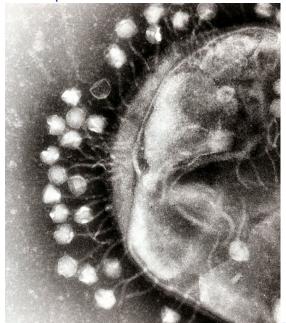












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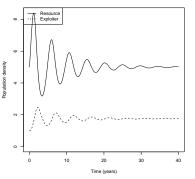
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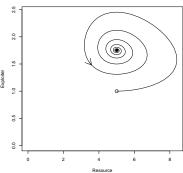
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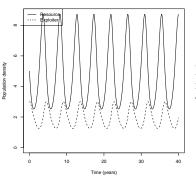
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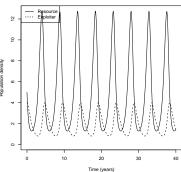
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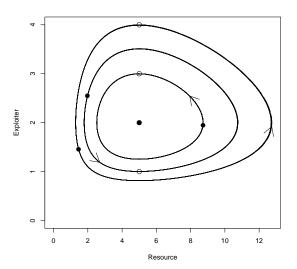


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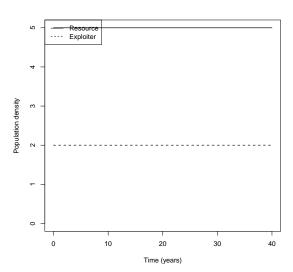


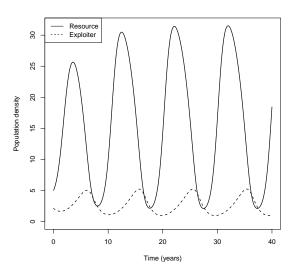


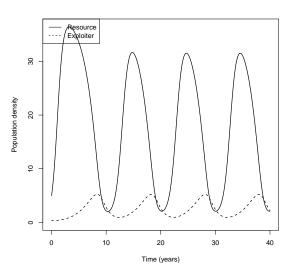
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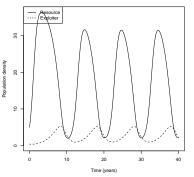
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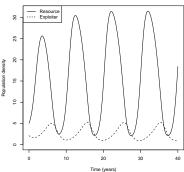




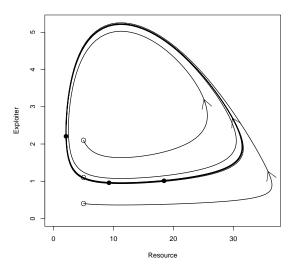


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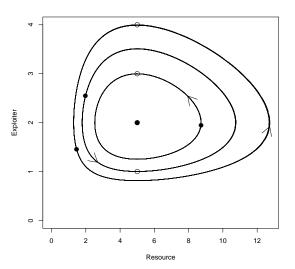
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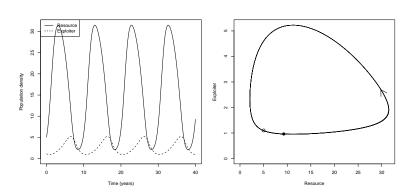
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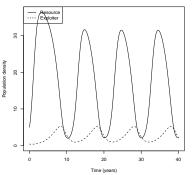
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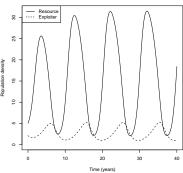
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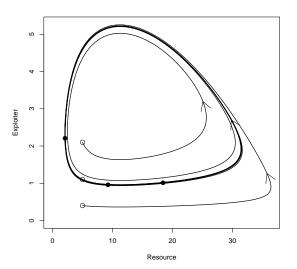
# Neutral cycles (repeat)











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## A simple model

More detailed models

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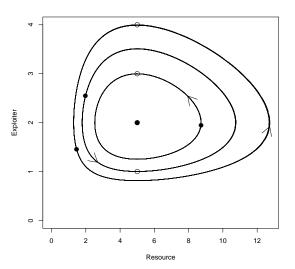
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# Neutral cycles (repeat)



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# People and the ocean (repeat)



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#### Outline

#### Introduction

Balance and equilibrium Tendency to oscillate

#### A simple model

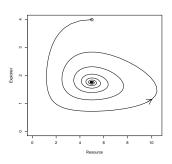
More detailed models Reciprocal control

# Adding details Dynamics

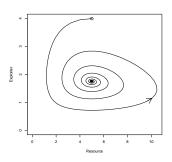
Equilibria

Who controls whom?

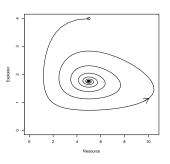
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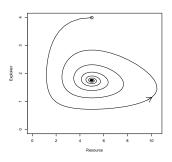
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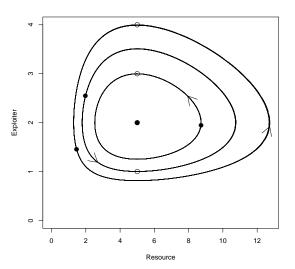
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- ► Makes cycles get smaller, leading to **damped** cycles



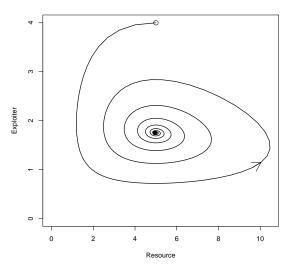
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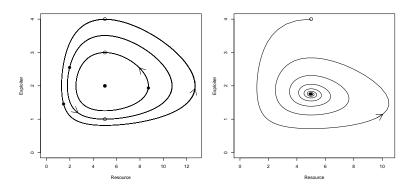


# Neutral cycles (repeat)



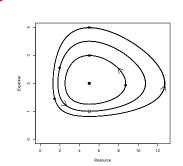
# Prey density dependence (repeat)



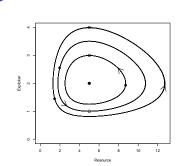


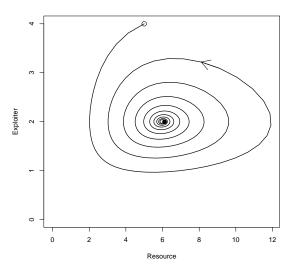
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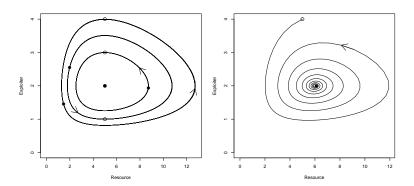


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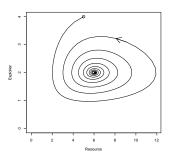




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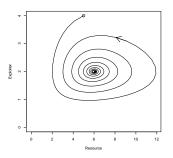


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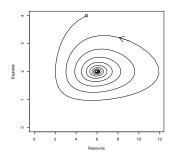


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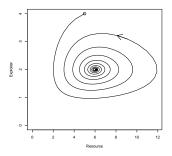


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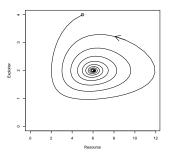


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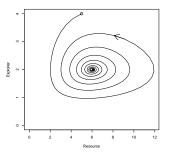
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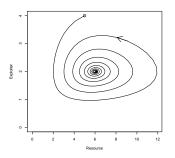
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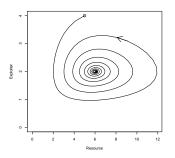
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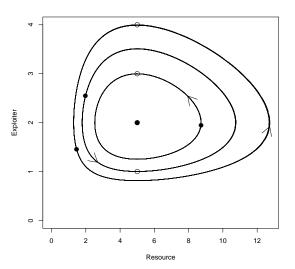
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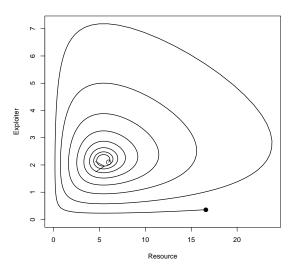
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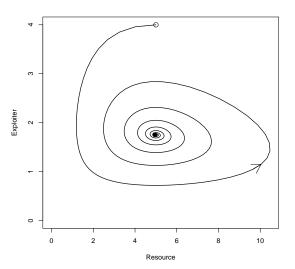
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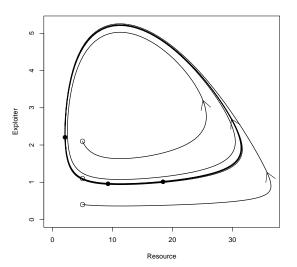
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#### A simple model

More detailed models Reciprocal control

#### Adding details

Dynamics

Equilibria

Who controls whom?

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- ▶ What if we start catching sharks?
  - $\blacktriangleright$  \*  $r_e$  goes down, so  $N_f$  must go up
  - ► \* Satiation: More fish means higher *r<sub>f</sub>* means more sharks at equilibrium!
  - ▶ \* This is the opposite of what we see for density dependence, so we would have to ask which is the stronger effect in particular circumstances.

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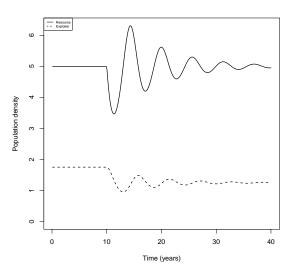
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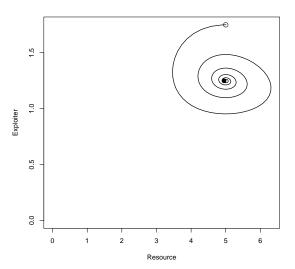
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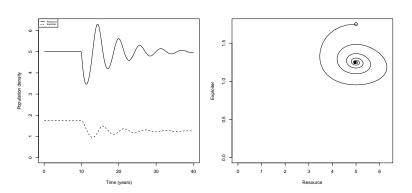
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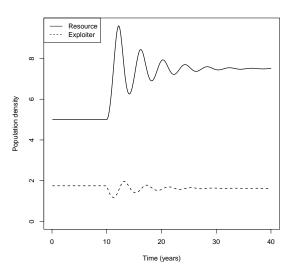
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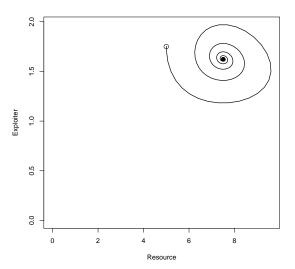


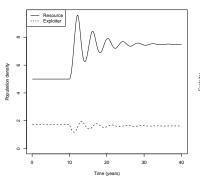
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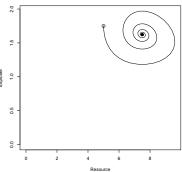




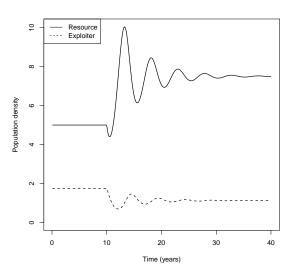




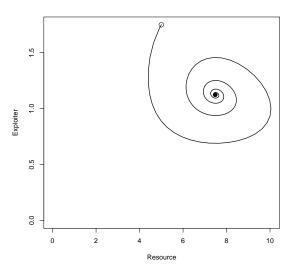




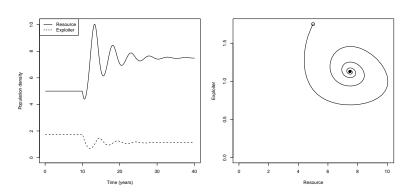
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### Outline

#### Introduction

Balance and equilibrium Tendency to oscillate

### A simple model

More detailed models Reciprocal control

### Adding details

Dynamics Equilibria

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## What controls ecosystem-level balance? (repeat)





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