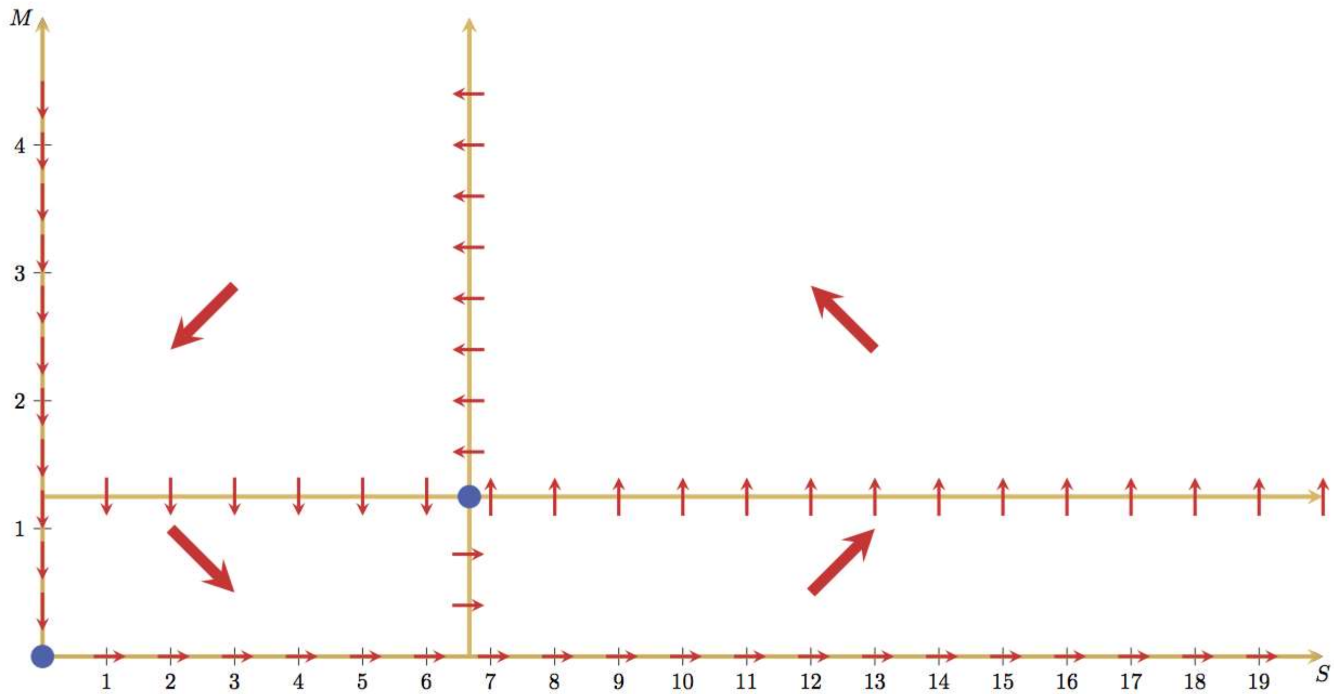
Course > Section... > 1.5 Ho... > 1.5.1 Vi...

1.5.1 Video: How Populations Change

Bookmark this page

As you have discovered, the predator prey phase plane looks like this:



View Larger Image
Image Description

We can see from the direction of the arrows that the trajectories will be moving counterclockwise. Are they spiraling in, spiraling out, or closed loops?

In the video that follows, we'll answer this and see what it implies about the populations.

Video

0:00 / 2:06 2.0x

Start of transcript. Skip to the end.

[MUSIC PLAYING]

ETHAN ADDICOTT: We've just examined an example of a predator-prey system

and identified the equilibrium.

You probably noticed, from the direction of the arrows,

that the trajectories could spiral towards the equilibrium,

away from the equilibrium,

Video

Download video file

Transcripts

Download SubRip (.srt) file

Download Text (.txt) file

As Ethan stated, the trajectories of a predator-prey system are closed cycles. (This is a non-obvious fact, but can be proved using calculus. See for example, p. 443-444 of Braun.*Differential Equations and Their Applications, An Introduction to Applied Mathematics*)

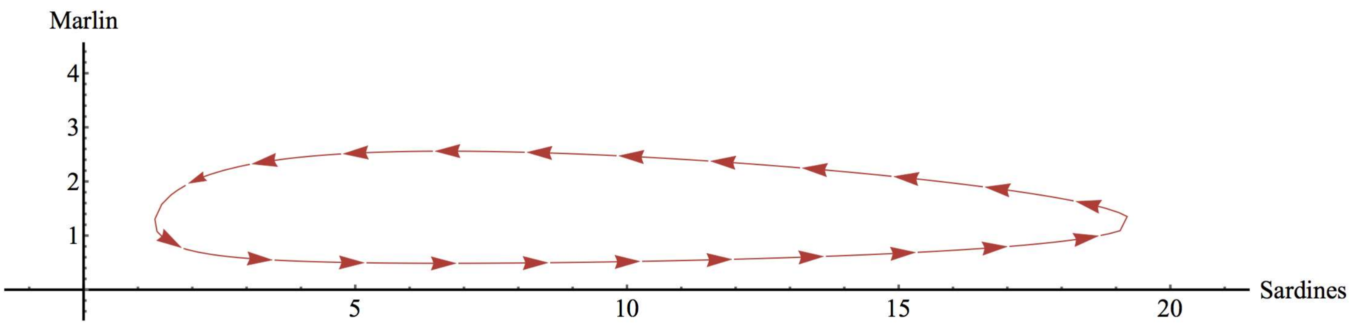
The diagram below shows one cycle of the system

$$\frac{dS}{dt} = 0.5S - 0.4SM$$

$$\frac{dM}{dt} = -0.2M + 0.03SM$$

with initial condition $S(0) = M(0) = 2$. (Assume S and M are measured as before, so the system starts with 200 marlin and 200,000 sardines.)

(Note: these images were created by a computer program that can numerically solve the system of differential equations to give solution trajectories and solution curves.)

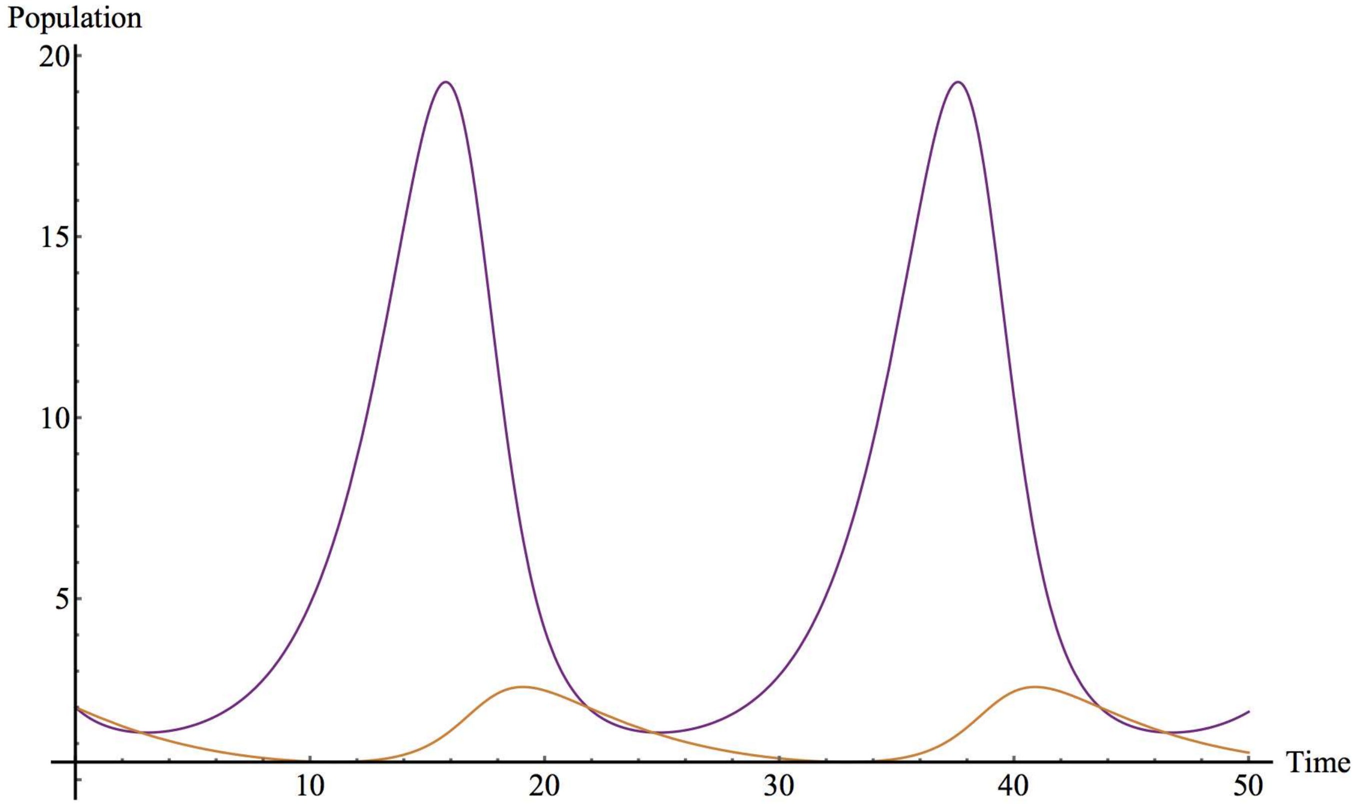


View Larger Image
Image Description

The size of the sardine population is indicated on the horizontal axis (in hundreds of thousands) and the vertical axis shows the number of marlin (in hundreds).

We can also visualize the population sizes by recording the sizes of the sardine and marlin populations on the vertical axis and time on the horizontal axis. (Here we assume that time is measured in quarter years – this time scale was chosen for the purposes of this problem and may not reflect exactly the biological reality.)

Here are those graphs for the length of one cycle. Notice how the graph is periodic, reflecting the fact that the solution trajectories are closed loops (the sardine and marlin return to their starting population over and over again.)



View Larger Image
Image Description

In the next quiz, you'll get to interpret these graphs together. Then you'll do a summary quiz on population models from this section.

Then in the next section, Population Dynamics Part II, we'll learn how to find the average value of populations, as Ethan suggested, and solve D'Ancona's biological puzzle.

Learn About Verified Certificates

English ▼