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1.4.5 Quiz Part 4: Creating a Phase Plane
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Mark boldly the two equilibrium points on your graph. As you complete the phase diagram, think about what makes these two points special.

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Image Description

The final step is to draw arrows along the nullclines and in the regions created by nullclines in the phase plane, to show how S and M are changing there. We can do this process in many different orders. In the previous video, Peter showed one approach; we'll use a different one here.

We start by finishing the arrows we started to draw along the nullclines. Recall that:

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

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

Question 6

1/1 point (graded)

Let's start by focusing on the nullcline $S = \frac{20}{3}$ on which $\frac{dM}{dt} = 0$. Since there is no change in M along this null-cline, the arrows on this line will point either towards or away from the M-axis indicating an increase or decrease in S.

The only place where the arrows can change direction is at the nullcline where $\frac{dS}{dt} = 0$ (think about why) so once we've found the direction on both sides of that nullcline we're done. To check values above that nullcline, suppose the marlin population is large (say 300 fish, $M = 3$) and $S = \frac{20}{3}$. Choose the answer below which best describes the value of S at that point. Use what you know about $\frac{dS}{dt}$.

- ○ increasing

- ○ constant: $\frac{dS}{dt} = 0$

- ◉ decreasing ✔

- ○ sometimes increasing, sometimes decreasing, sometimes 0.

Explanation

If $M = 3$ and $S = \frac{20}{3}$, then $\frac{dS}{dt} = 0.5S - 1.2S < 0$. At $\left(\frac{20}{3}, 3\right)$ the sardine population is decreasing. (Large numbers of hungry marlin are eating sardines faster than they reproduce.) Thus S must be decreasing on this entire section of nullcline. The arrows on the $M = 3$ side of the nullcline $S = \frac{20}{3}$ should point left, toward the M axis. Fill them in.

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ℹ Answers are displayed within the problem

Question 7

1/1 point (graded)

What direction should the arrows point on the segment of the nullcline $S = \frac{20}{3}$ which ends at $\left(\frac{20}{3}, 0\right)$? Choose the answer below which best describes the value of S along that segment.

- ⦿ increasing ✔

- ◯ constant: $\frac{dS}{dt} = 0$

- ◯ decreasing

- ◯ sometimes increasing, sometimes decreasing, sometimes 0.

Explanation

Suppose $M = 1$ and $S = \frac{20}{3}$. Then $\frac{dS}{dt} = 0.5S - 0.4S > 0$. At $\left(\frac{20}{3}, 1\right)$ the sardine population is increasing. (Sardines are reproducing faster than they're being eaten.) Thus S must be increasing on this entire section of nullcline. The arrows on the $M = 1$ side of the nullcline $S = \frac{20}{3}$ should point right, as S is increasing. Fill them in.
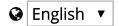
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