

Communities

The set of graphs on page 3 shows the results of a 35-year study of a seemingly simple food chain on Isle Royale in Michigan. These results were published in the journal *Science* (vol. 266 pp. 1555-1558) – you don't need to read this, although it is an interesting paper. On Isle Royale, moose (*Alces alces*) eat fir tree (*Abies balsamea*) leaves and wolves (*Canis lupus*) eat the moose.

a) In the graph, "Fir (west) (mm)" gives the average size of the tree rings produced in each year by the fir trees on the west end of the island in millimeters; "Fir (east) (mm)" gives the same for the trees on the east end. The more a tree grew in a particular year, the wider the ring. The width of a tree ring is defined as the distance from the ring in question to the ring formed just prior to it.

i) The scientists use the width of the tree rings as a measure moose consumption. That is, they assume that more moose results in more grazing, and more grazing decreases tree growth that year. Explain the theory behind this assumption.

ii) What is another possible relationship between moose and fir trees?

b) Most of the paper deals with a predator-prey oscillation in this system. For example, the moose and wolves appear to be in a classic predator-prey oscillation. That is, the populations of both organisms rise and fall regularly.

i) Explain what causes the oscillation in the moose/wolf system and why the two population graphs show opposite oscillations.

ii) What specific times or time-periods from the graph show the behavior you described in part i)?

c) There are several possibilities for how the **three** species interact to cause their oscillatory behavior. Here are two possible models.

(1) “Top-down”: The wolves and moose are in predator-prey oscillation and the fluctuations in the moose population cause the fluctuations in the tree ring size.

(2) “Bottom-up”: yearly fluctuations in the primary productivity of the trees, caused by climate changes, cause oscillations in the moose population which, in turn, cause oscillations in the wolf population. Strictly, speaking, this is not a predator-prey oscillation.

Describe an experiment that you could perform to test these different models. Discuss the possible results and the conclusions you could draw from this data.

d) The bottom graph shows “AET” in mm. Their figure legend says “The AET is the amount of water available to the plants during the growing season as a function of both rainfall and temperature and has a close relation to primary productivity.” What do each of the models predict about the relationship between AET and the other graphs? Based on the AET graph, which model is correct?

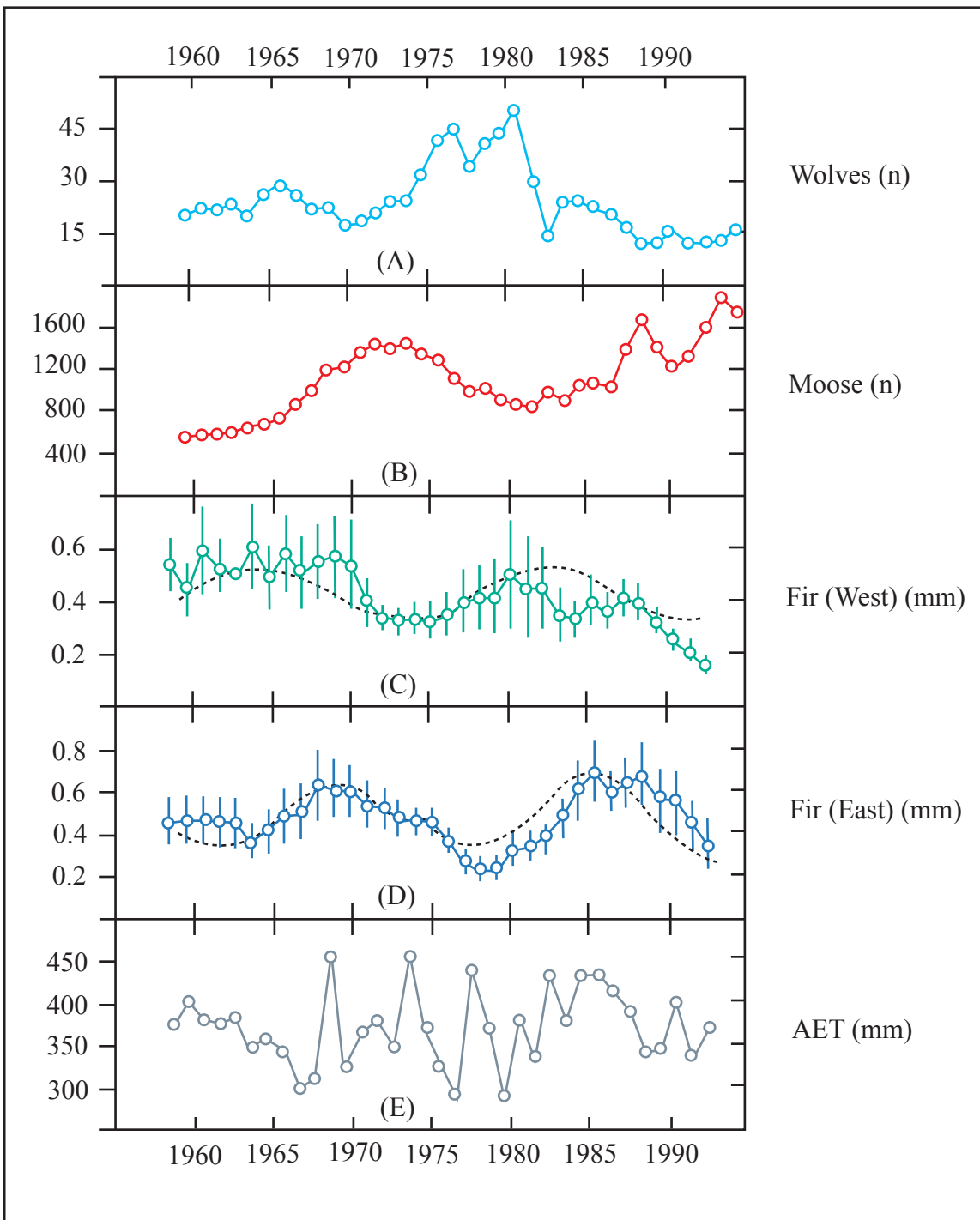


Figure by MIT OCW.