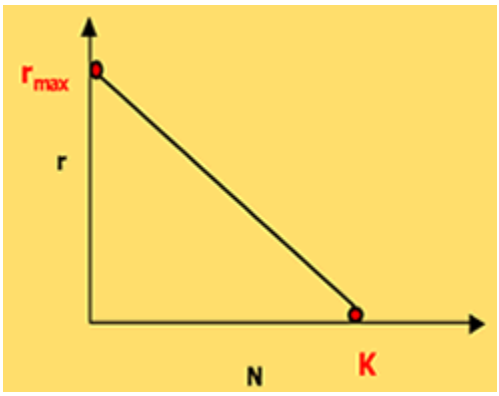
Population Dynamics: Zebra Mussel Study

The capacity for growth is a measure of the success of a population of a species. Because there are so many interactions between individuals and the environment, measuring how well populations grow is often complex. Population biologists frequently use mathematical growth models to help them study real populations.

Population models might seem like all theory and math, but they help us understand real ecological systems in simpler terms. They are used for testing theories, making predictions, and for making decisions about managing or conserving populations of many species.

In this lesson, you'll learn more about two widely used population growth models: exponential and logistic.



Next to habitat destruction, invasive species are an important agent leading to loss of biodiversity. Models are useful for predicting what is happening and what could happen in a population of invasive species or species affected by them.

ENVIRONMENTAL WEEKLY!

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Zebra mussels found at unbelievable densities in Lake Ontario!

In some areas scientists found 700,000 mussels per square meter. They clogged water intake pipes, nearly depriving a southern Ontario town its water supply!

Zebra mussels are invasive freshwater mollusks that threaten many bodies of water they inhabit. In high numbers, they become a nuisance to other aquatic species and an indirect threat to humans. They can clog-up industrial water supplies, eliminate native species and alter aquatic food chains.

Questions to be answered in Journal:

- Which growth model best describes a zebra mussel population?
- How to measure zebra mussel population size?
- How to construct a population growth curve?
- How to use a growth model to calculate r and predict N in the future?

Your task Examine the population growth of zebra mussels in a lake.

You are a DNR aquatic biologist assigned to study the ecology of Lake Madonna, a small lake in south central Wisconsin. Recently, a single adult zebra mussel was found in Lake Madonna. Citizens, government officials, and scientists are concerned about a large scale invasion of the lake by this pest.

It’s up to you to answer the question: What will the zebra mussel population look like in 5 years?

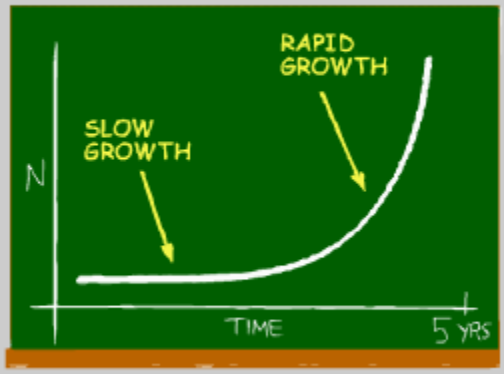
Here’s what you’ll do to answer this question:

1. Find out what experts predict about this zebra mussel population.
2. Collect data on zebra mussels in the lake for 5 years.
3. Plot your data and compare it with experts' models.
4. Present your findings.

Expert Opinion's

Prof. Barrios

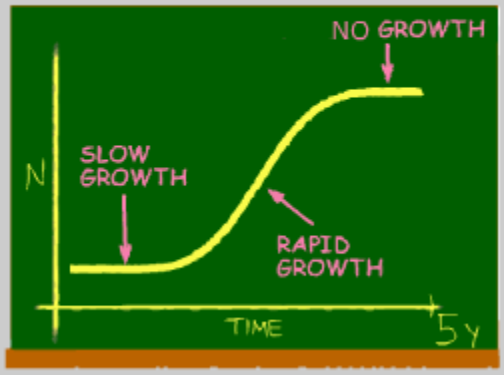
"Hello! I'm glad to meet the person who's carrying out this important study! Here's my model for zebra mussel population growth at Lake Madonna. As you can see, it predicts that the rate at which the population size (N) increases is proportional to the number of individuals present, so the fastest growth will occur when the population size is largest.



An assumption of this model is that growth is not limited by external factors but only by the reproductive capacity of zebra mussels. I think this assumption is reasonable given conditions at Lake Madonna. In fact, I predict that the population will still be increasing by year 5 in your study."

Prof. Nielsen

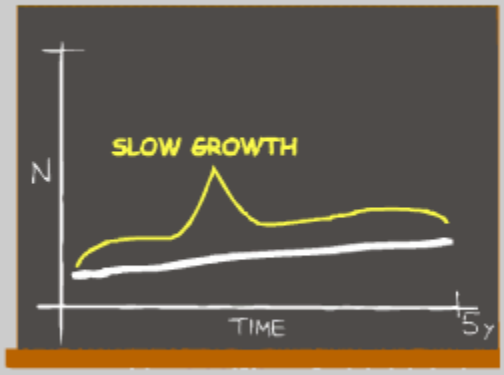
"Hey there! I agree with professor Barrios--to a point. my model also predicts that increase in population size (N) is proportional to the number of individuals currently in the population. But my model shows that external factors will slow down the growth rate as the population gets bigger.



I don't think Barrios' assumption of unlimited resources at Lake Madonna is valid. I think you'll see the population level off during the 5 years of your study."

Prof. Cho

"Hi! Barrios' and Nielsen's models are good for describing how populations grow, however, I don't think you'll be able to tell which of their models fits your population. Right now, the number of zebra mussels in Lake Madonna is so low that the population will still be in a lag phase of growth during the five years of your study. It will look as if a small, constant number of new individuals is added to the population every year.

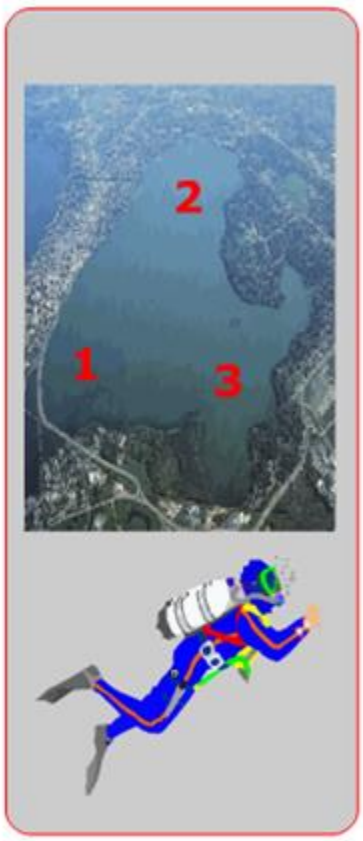


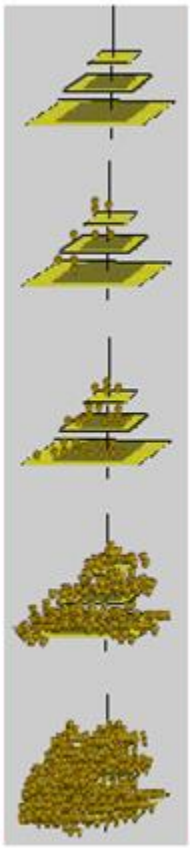
The reason I predict this slow rate of growth is that zebra mussels reproduce by releasing gametes into the water. At low population densities, gametes won't find each other."

Hypothesis: Based on the experts, predict which will most closely resemble the growth of the mussels.

Collect Data:

Measure the growth of zebra mussels in Lake Madonna over the next five years. Once a year, you'll send a diver into the lake to observe growth and pull up sampling structures from 3 sites.



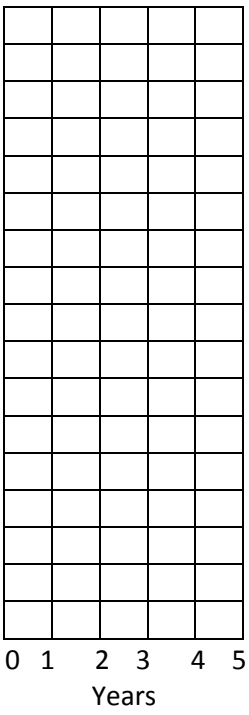


ANNUAL AVERAGE OF SAMPLES

Year	#ZM/m²
1	0.33
2	6.7
3	133
4	2,674
5	53,709

Now you need to graph your data and see which model it fits.

Average



Graph the Results:

1. LABEL AXES

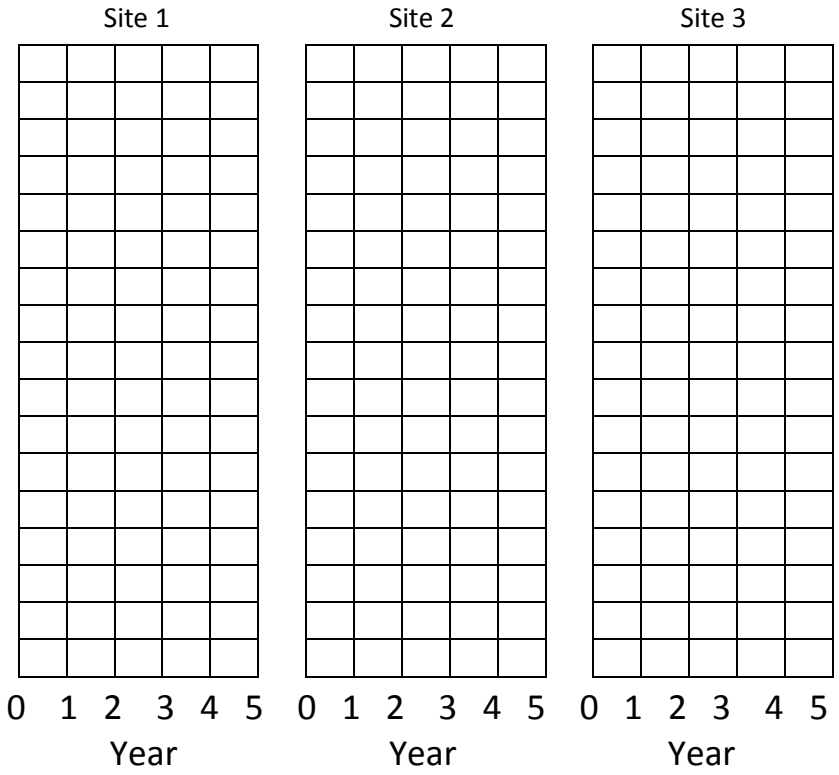
Scientific graphs depict the relationship between an independent variable (the one controlled by the experimenter) and a dependent variable (the one measured by the experimenter).

Traditionally, the independent variable is plotted on the x-axis, and the dependent variable is plotted on the y-axis.

YOUR DATA:
Zebra Mussels in Lake Madonna (zebra mussels/m^2)

Year	Site 1	Site 2	Site 3
1	0	0	1
2	9	8	3
3	183	126	90
4	3,380	2,765	1,869
5	68,274	58,329	34,524

Graph the results for each site and then determine which expert prediction best fits the data.



Conclusion: State whether or not the data collected matched your prediction.