Today's topic

interaction between masting and defoliators

For the test, I studied about forest protection

(damaged by insects, disease, climate…)

&

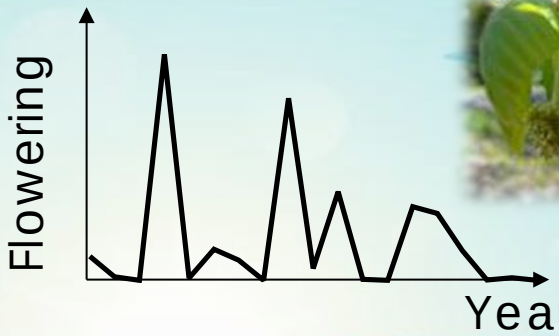
I want to present masting

Let's talk about insect damage associated with masting!!

Masting

the synchronous and periodic reproduction by plant populations

Based on resource and environmental que



Masting have two merits

- Pollination efficiency hypothesis
- Predator satiation hypothesis

It's heavy impact for seed predators (deer, rodents, seed eating ins

How about defoliators?
They are also influenced by masting, too?

There is one case

Some moth populations are rerated to oaks mast seeding in North America and North Europa

What happen here?

Thinking from photosynthesis products

References

1. Selas V. (2000) Is there a higher risk for herbivore outbreaks after cold mast years? An analysis of two plant/herbivore series from southern Norway. Ecography

2. Selas V. (1997) Cyclic population fluctuations of herbivores as an effect of cyclic seed cropping of plants: the mast depression hypothesis. Oikos

Tradeoff of photosynthetic products

growth

defense

reproducti
on

masting plants

flowering only once every few years

⇒ defense level is declined at the masting time?

⇒ herbivores eat much and increase the density?

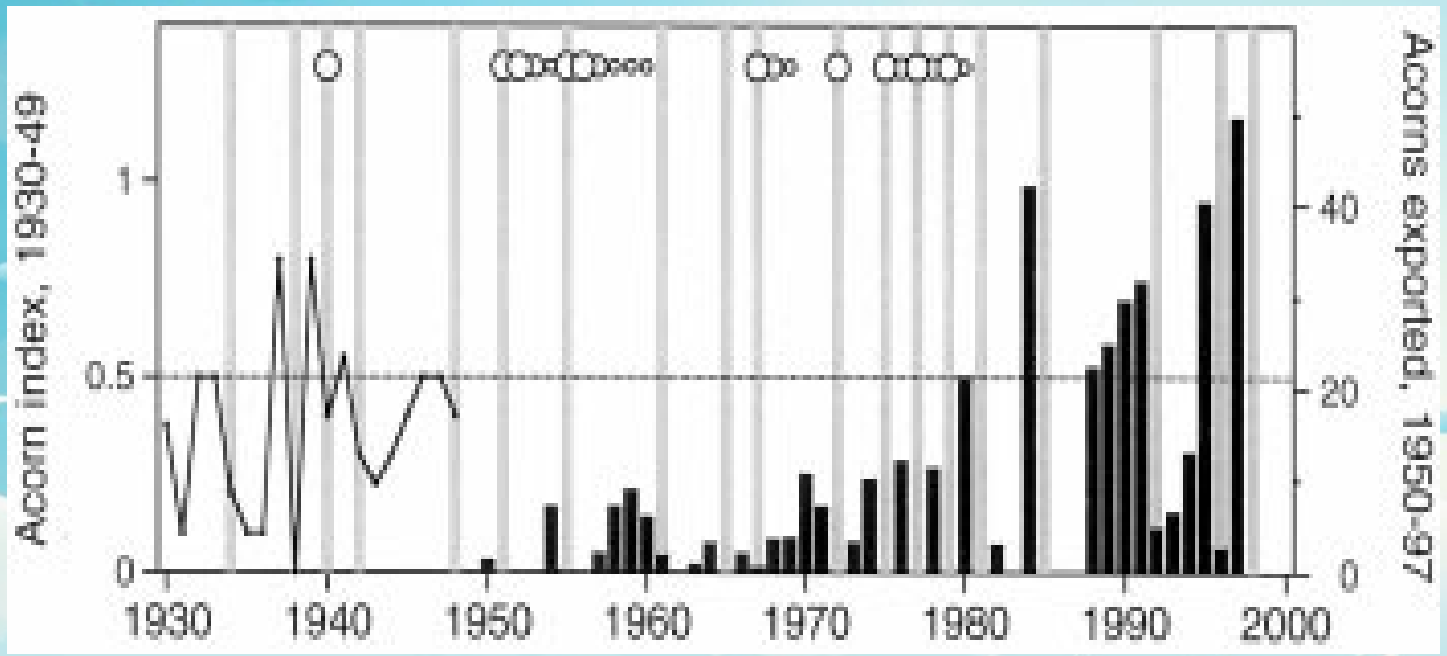
Leaves structure is decided last year (predetermination)

Material & Method

- Sight:
  Southern Norway
- Dominant species:
  Scots pine, Norway spruce,
  Sessile oak, Aspen, Birch…
- Data set:
  the amount of acorn product of sessile oak
  (Quercus petraea)
  Report of forest damage about green oak leaf roller moth
  (Tortrix viridana)
- Climate data:
  Summer temperature in mast year, Summer precipitation in mast year, Spring temperature in post-mast year

Result ①

- Relationship between acorn products and moth population size



Gray bars are post-mast year

There are eight moth attacks, and all of them is post-masting year

Solid lines: Acorn index, **black bars**: acorn exported(1000kg)
White circles: serious moth attacks
circle size means population size compared with previous year.

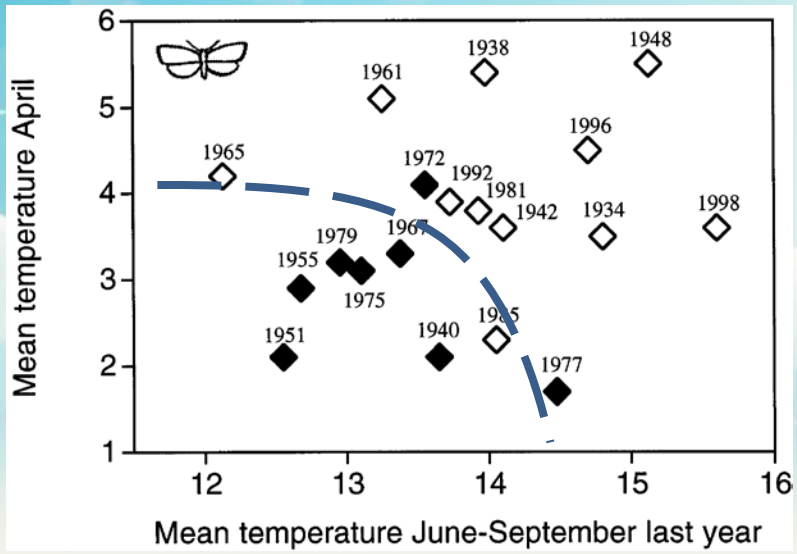
The year over the horizontal line is mast year



Result ②

- Moth attack

Response	Explanatory variable	χ^2	p
Moths (n = 19)	Summer temperature in the mast year (year t − 1)	4.17	0.035*
	Summer precipitation in the mast year (year t − 1)	0.44	0.503
	April temperature in the post-mast year (year t)	5.47	0.019*
	May–June temperature in the mast year (year t − 1)	0.03	0.861
	May–June temperature in the post-mast year (year t)	0.03	0.867
	Whole model ($R^2 = 0.52$)	13.49	0.019
	Selected model ($R^2 = 0.50$)	12.92	0.002



Hot summer in mast year or warm April in post-mast year →moth attacking is low

Summer temperature:
to influence photosynthetic activity
⇒they can use more products for defer

April temperature:
Hot ⇒ moth eggs hatch too early relative to oak budbreak and die

black symbols: moth attacking year
white symbols: non-attacking year

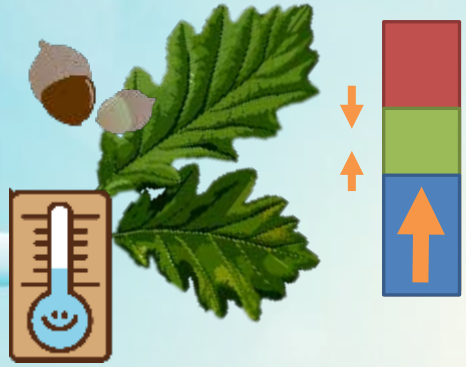


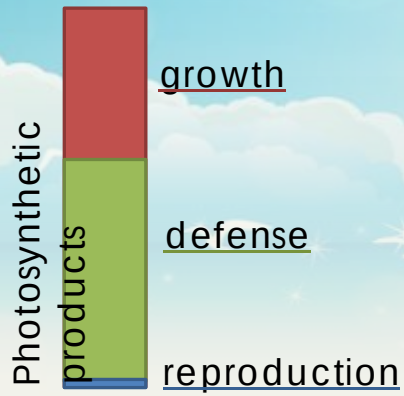
Conclusion

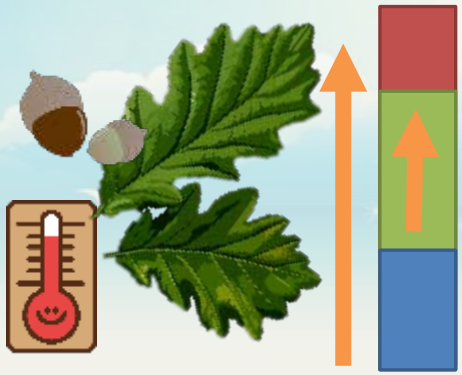
non-flowering year

flowering year

post-flowering year







THERE IS ALWAYS ONLY ONE TRUTH?

In North America, another researcher hypothesizes different mechanism

Thinking from predators of moth

References

1. Liebhold A. et al. (2000) What cause outbreaks of the gypsy moth in North America?. Population Ecology

2. Elkinton S. J. et al. (1996) interactions among gypsy moths, white-footed mice, and acorns. Ecology

Predators of gypsy moth

In Northern America, gypsy moth is related to masting of oak

The most important predator is different from densities

- **high densities**: nuclear polyhedrosis virus
- **low densities**: small mammals, mainly white-footed mouse

Oak acorn predator
⇒population size is regulated by masting

eat

eat

re-
produ
ce

mastin
g

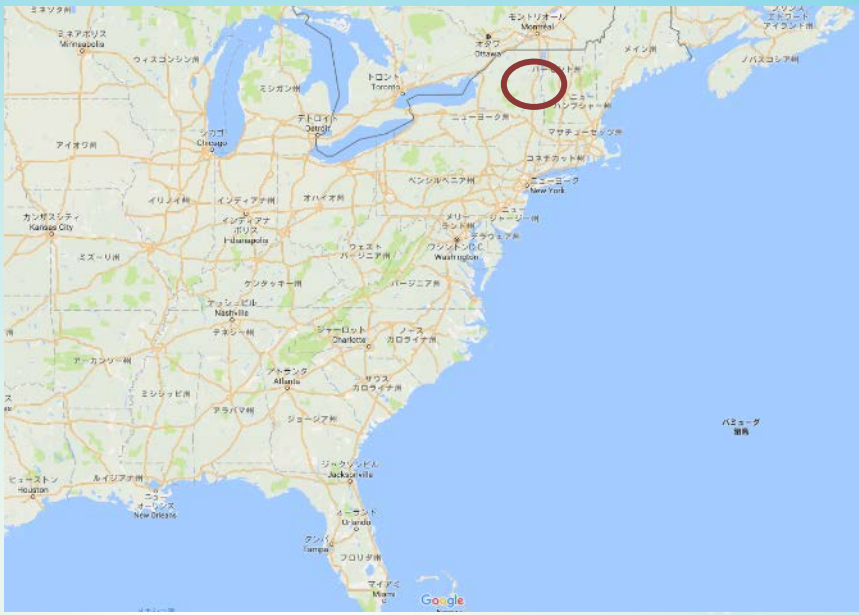
eat

Material and method

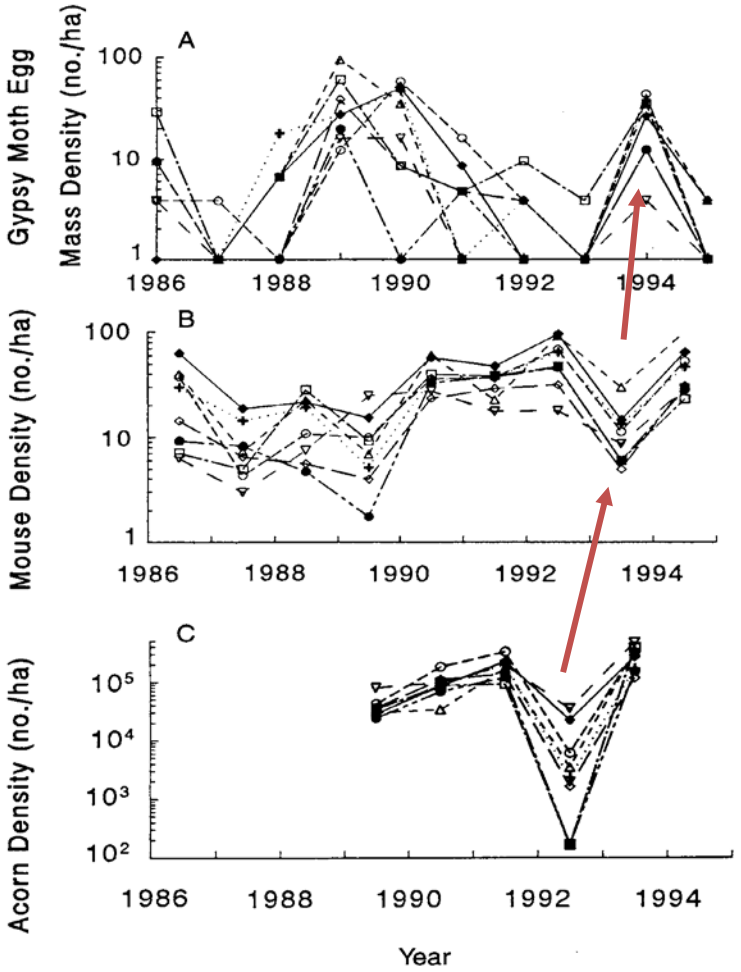
- Sight:
  North America

- Species:
  northern red oak *(Quercus rubra)*

- Data set:
  Gypsy moth eggs in winter 1986-1994
  White-footed mouse in Augst 1986-1994
  Acorn products of oak in orterm 1989-1993



Result ①



Relation between moth & mouse

1990-1992: mouse density is high ⇒moth density is low bease of predation

1993: mouse density is low ⇒moth has many eggs

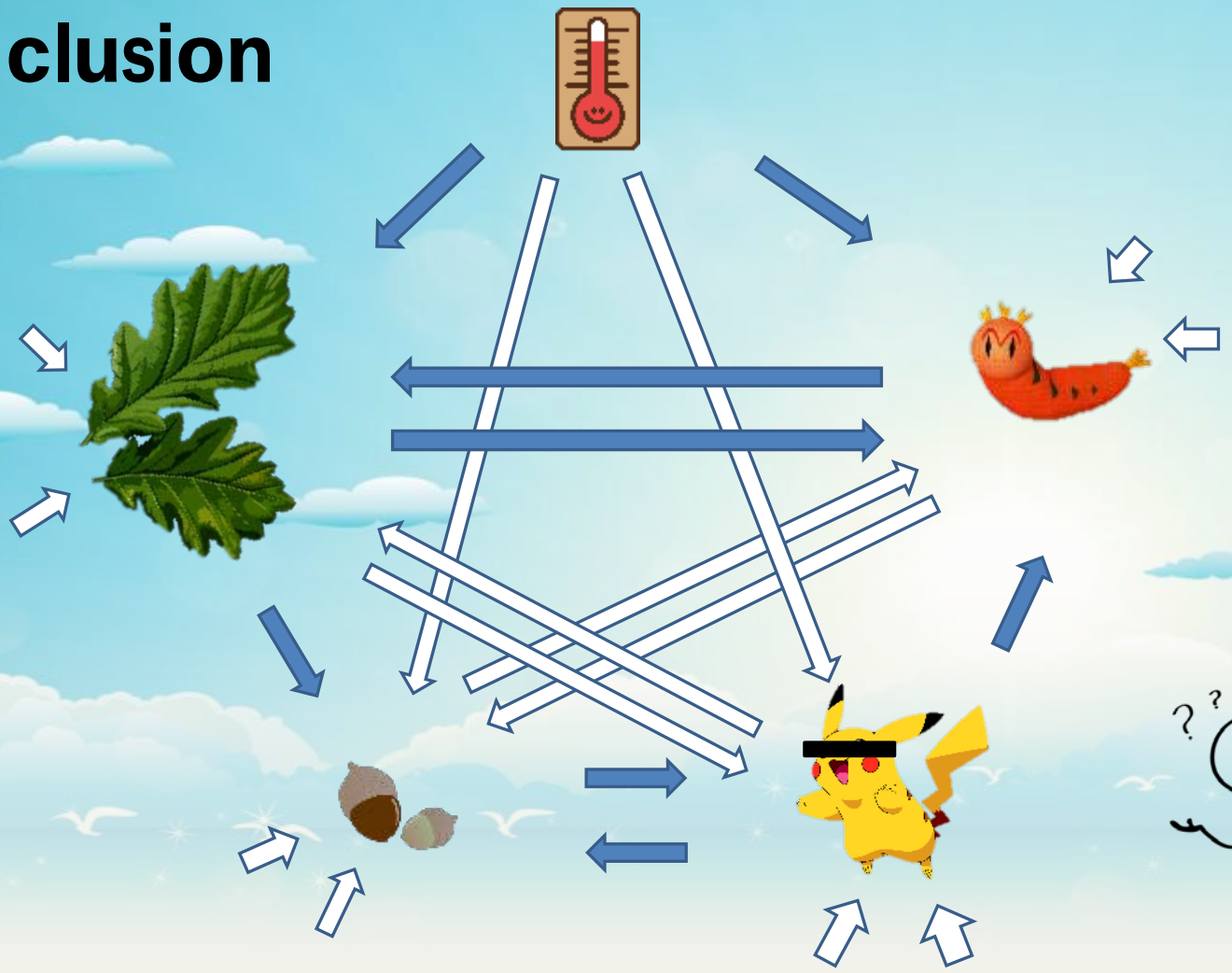
Relation between oak & mouse

1999-1991: acorn density is high ⇒mouse density of post-generation is also high

1992: oaks produce few acorns ⇒mouse become low population in 1993

Probably, masting of oaks is responsible for gypsy moth population through the mouse

Conclusion



It’s too difficult to discuss insect disease!

At the end...

Beech insect damage by aphids at this campus flowering (shade area)

This

Last

Two years

How do you think about this picture?