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1. A possibility of sustainable pest management by introducing bio-diversity

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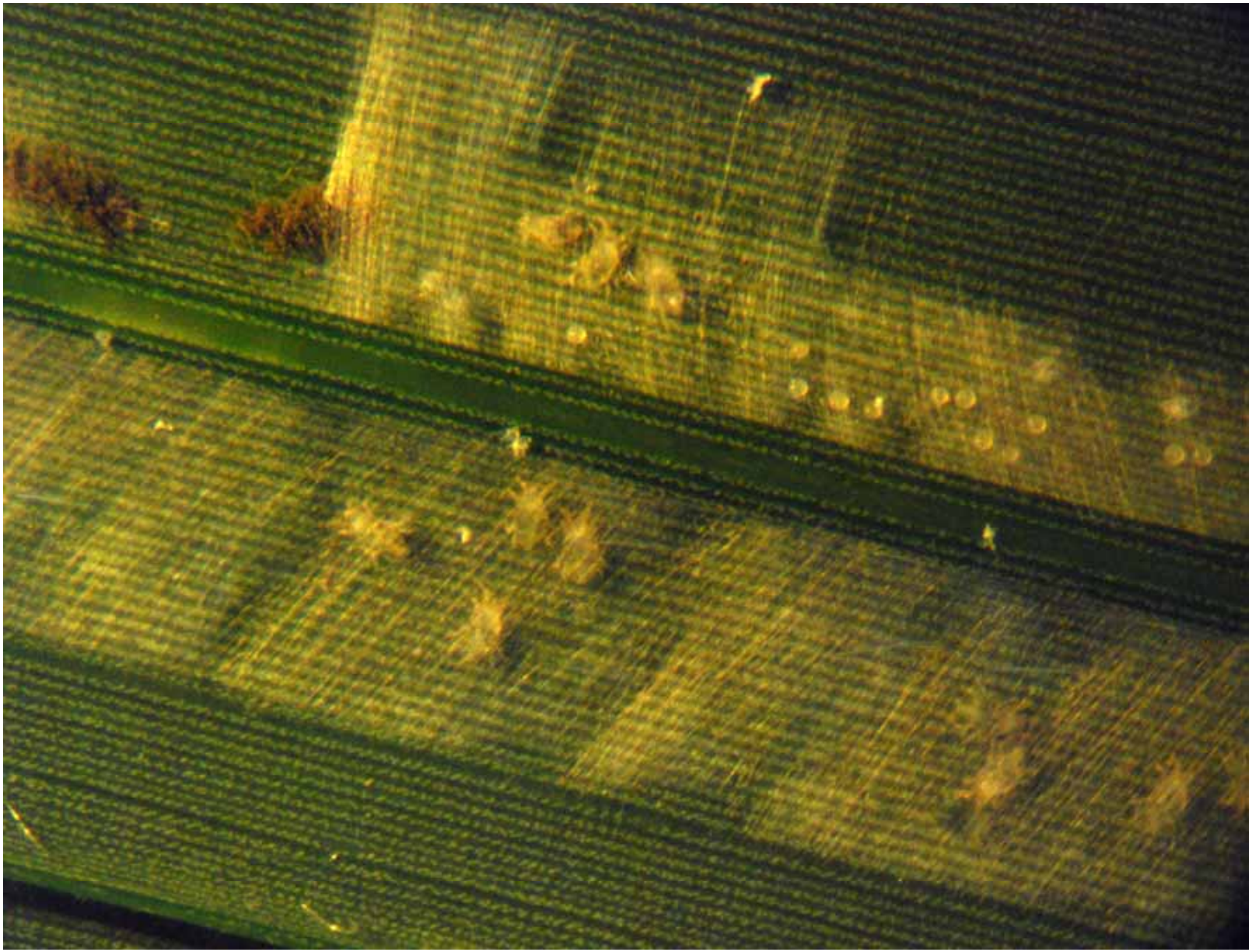
In the late ’80s & ‘90s there were spider mite outbreaks on moso bamboo plantations in China.

From the late 1980’s onwards, serious damage from spider mite pests lead to the destruction of many moso bamboo (*Phyllostachys pubescens*) forests in the Fujian province of China. Many moso forests were destroyed and the production of bamboo shoots decreased to ca. 1/2 of the highest yield.

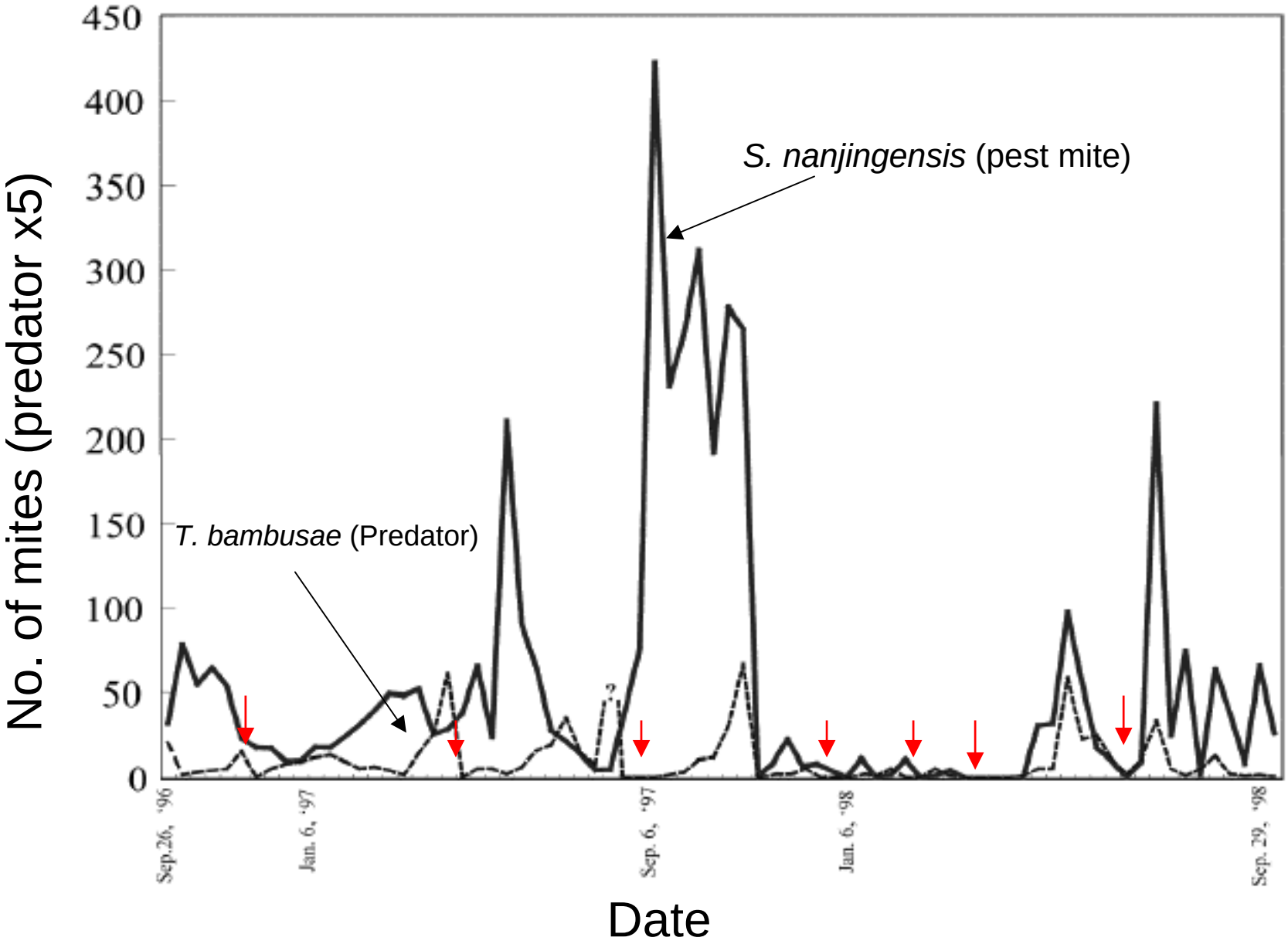
This plant is utilized in industry, housing and handicrafts, and its shoots are a prized food item in many Asian countries. Furthermore, moso bamboo forests play a vital role in preventing soil erosion in mountain areas.

Undamaged and damaged moso bamboo.

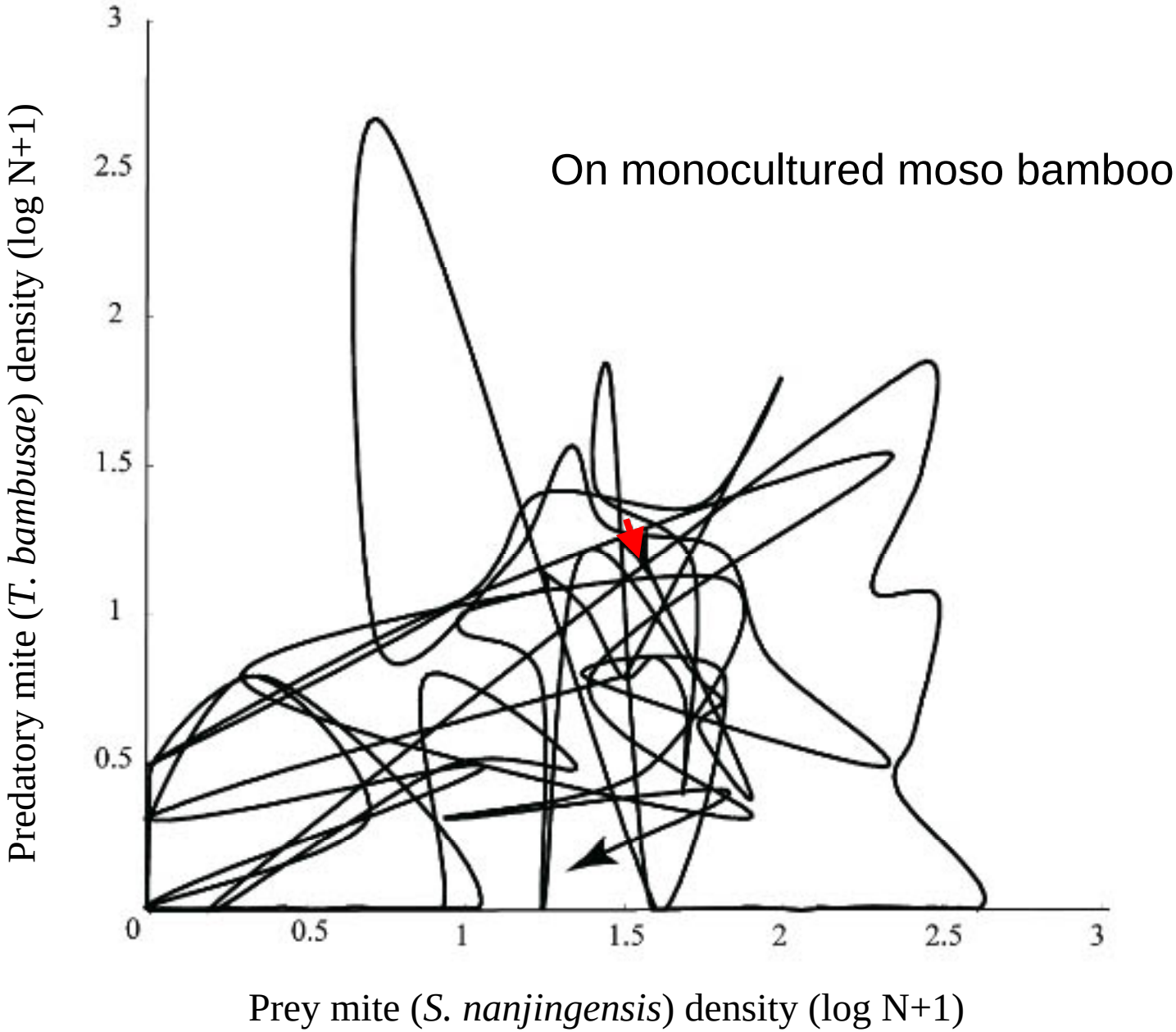
Close-up of damage from the most serious pest,
Stigmaeopsis nanjingensis



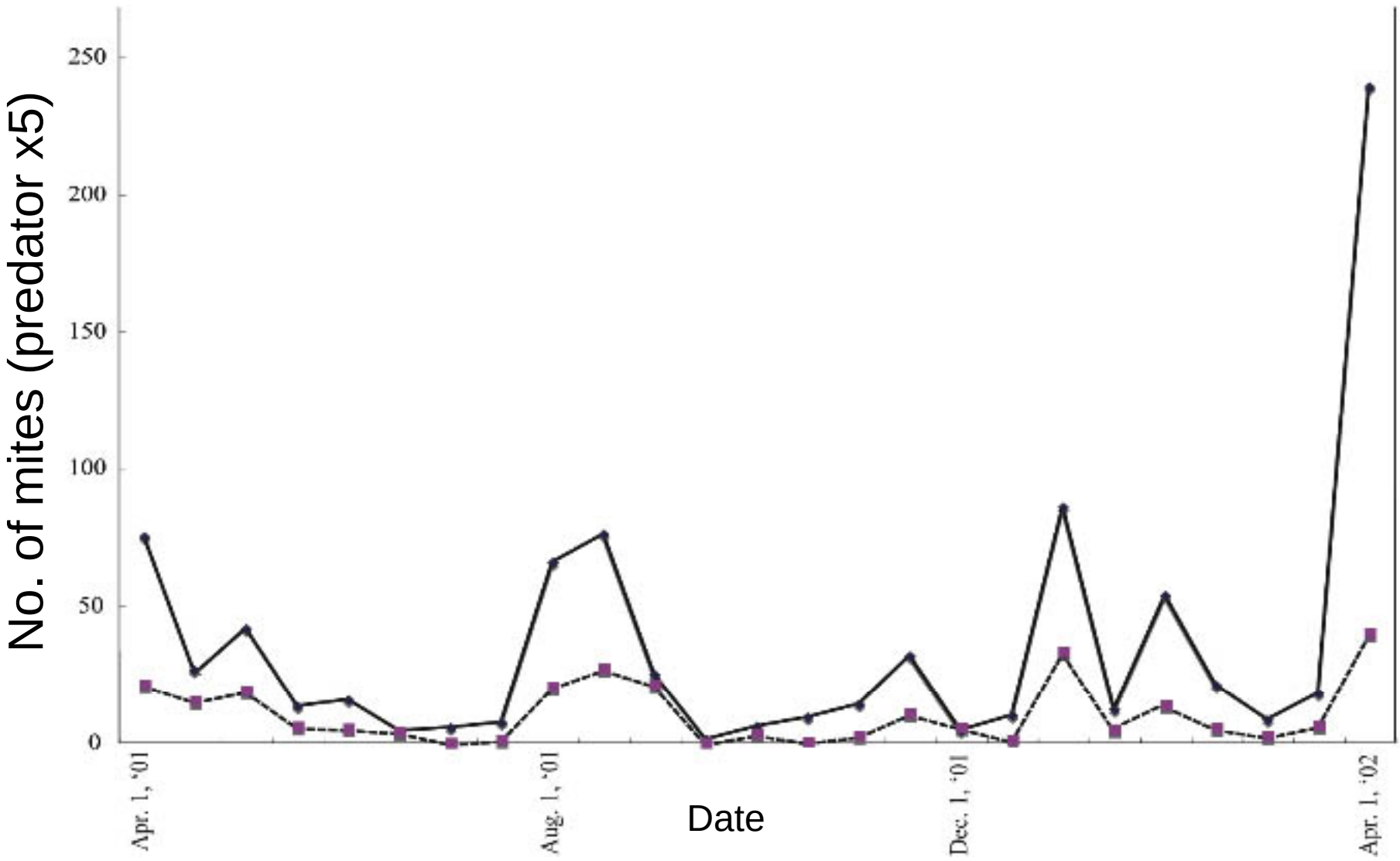
Stigmaeopsis miscanthi on Chinese silvergrass. This mite has the same life type (nest weaving) as *S. nanjingensis*.



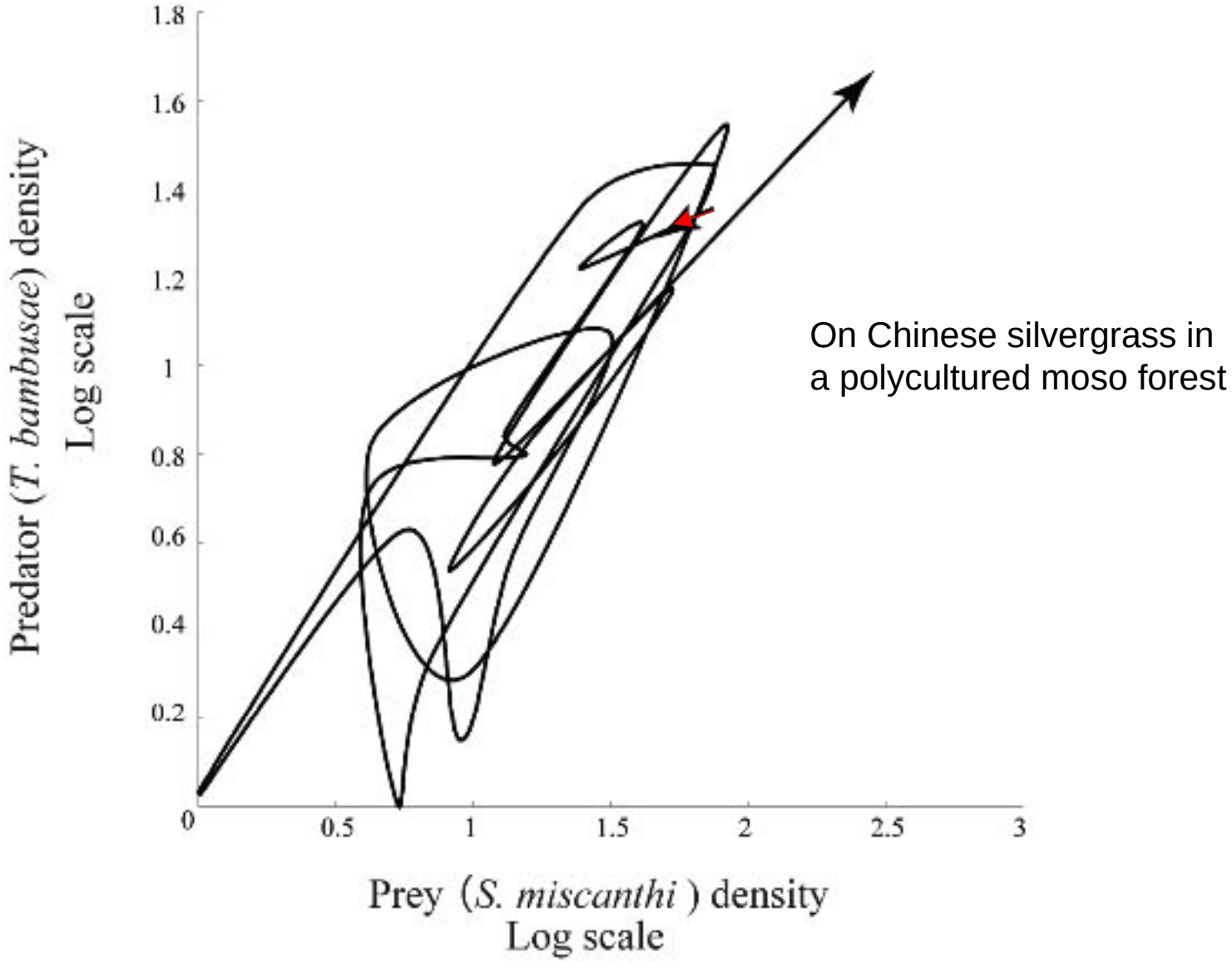
Outbreak in monocultured moso bamboo in Fuzhou, China (from Zhang 2000) . Mites per 10-leaves



There is no trend for predator response to prey density

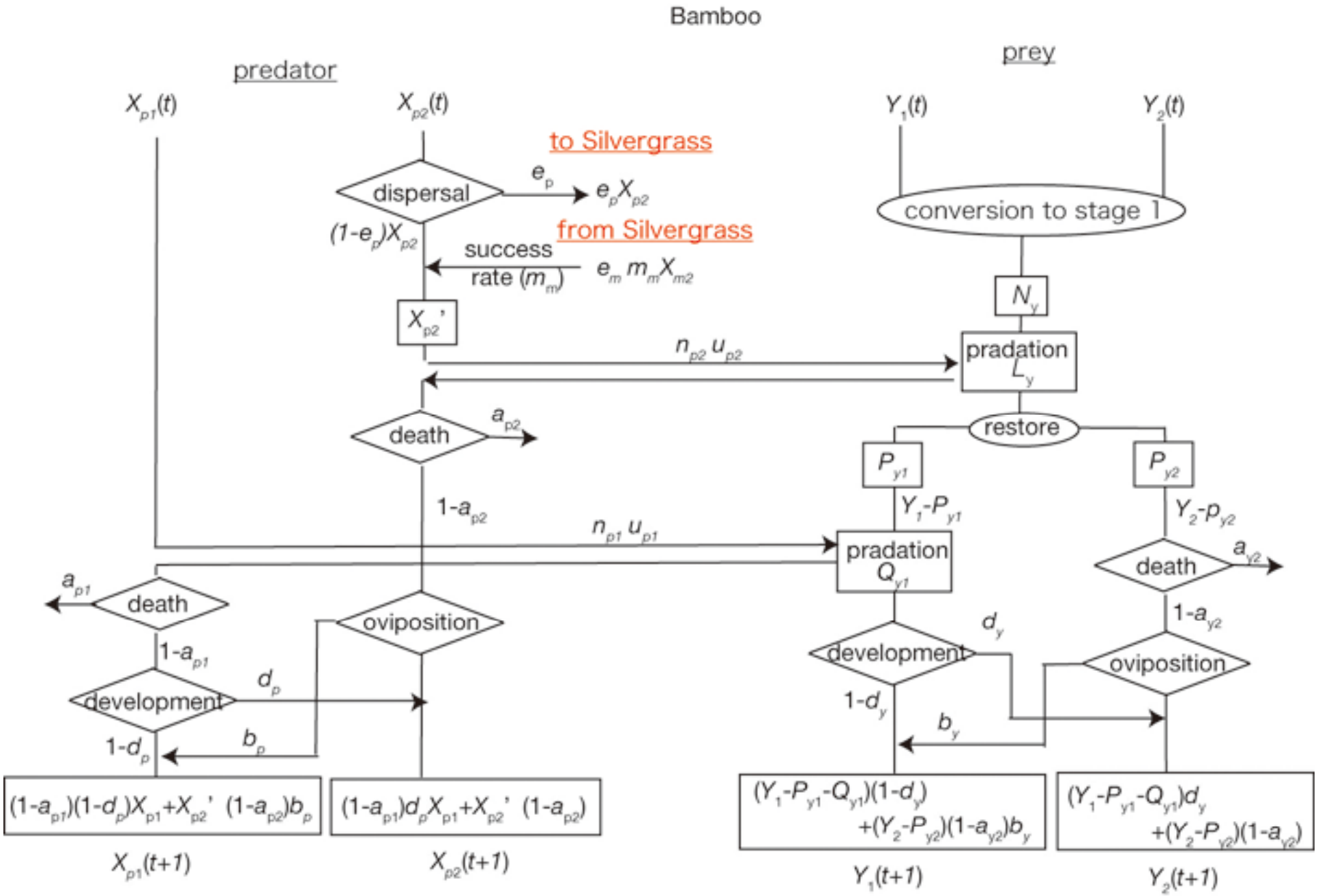


Predator (*T. bambusae*) and prey (*S. miscanthi*) populations on Chinese silvergrass (*Miscanthus sinensis*) growing in a mixed forest (polycultured moso bamboo). Mites per 50-leaves.

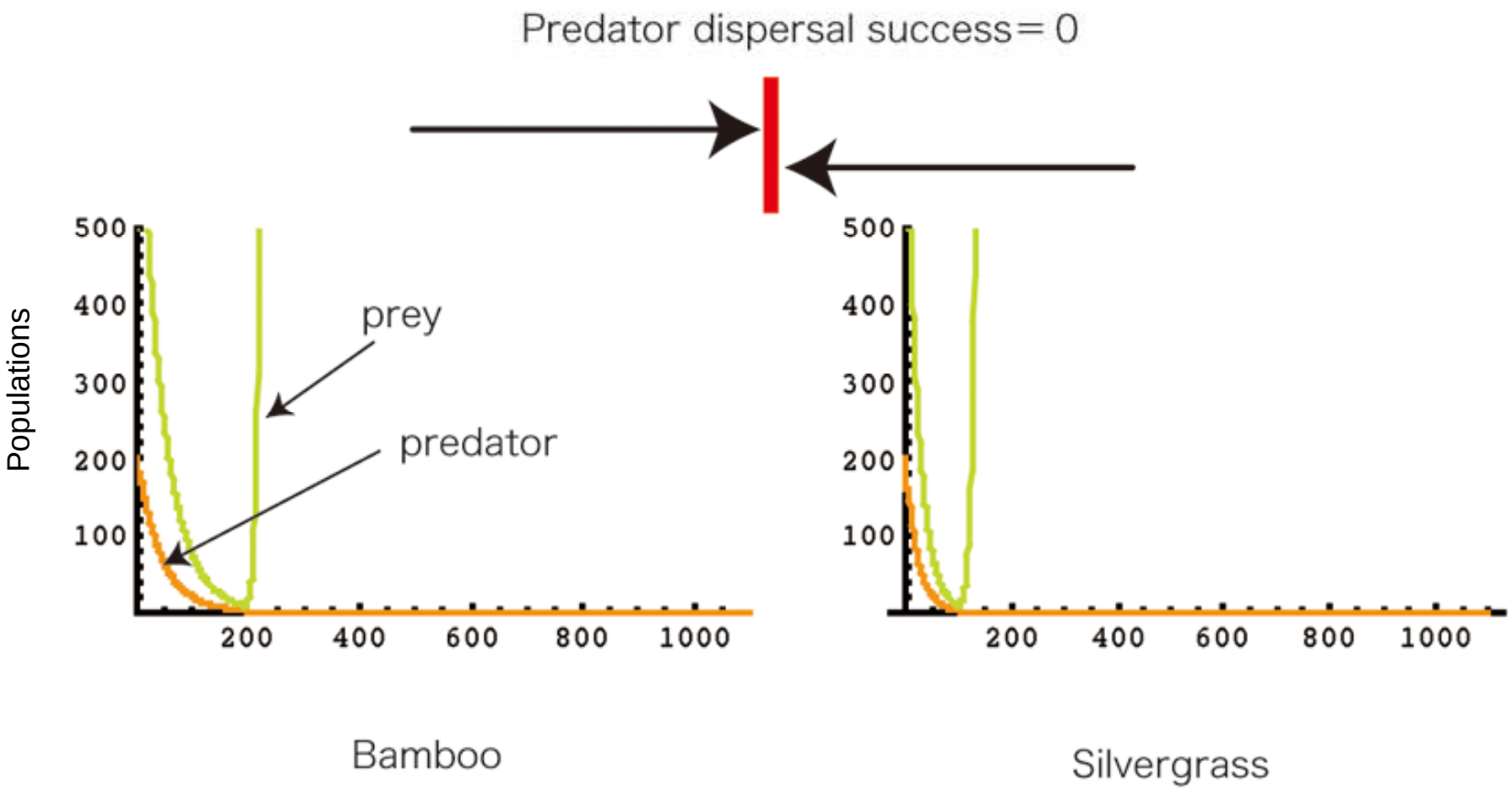


There is a trend like “limit cycle”, showing prey density regulation by predator

In order to understand what happening in the bomboo forests, we develoed a systems simulation model by using the parameters obtained in the experiments.



Flow diagram of predator-prey systems on moso bamboo

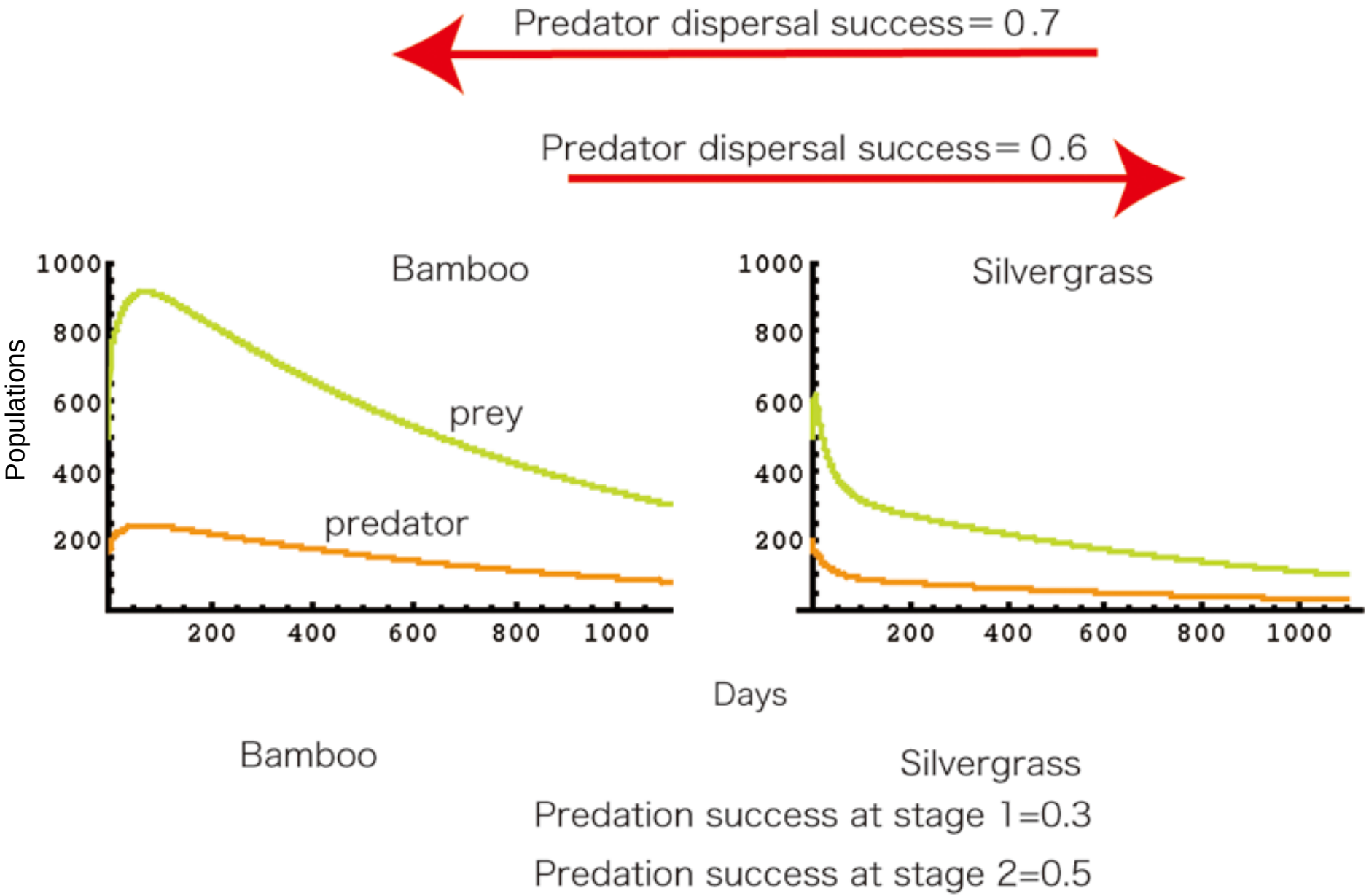


Predation success at stage 1=0.3

Predation success at stage 2=0.5

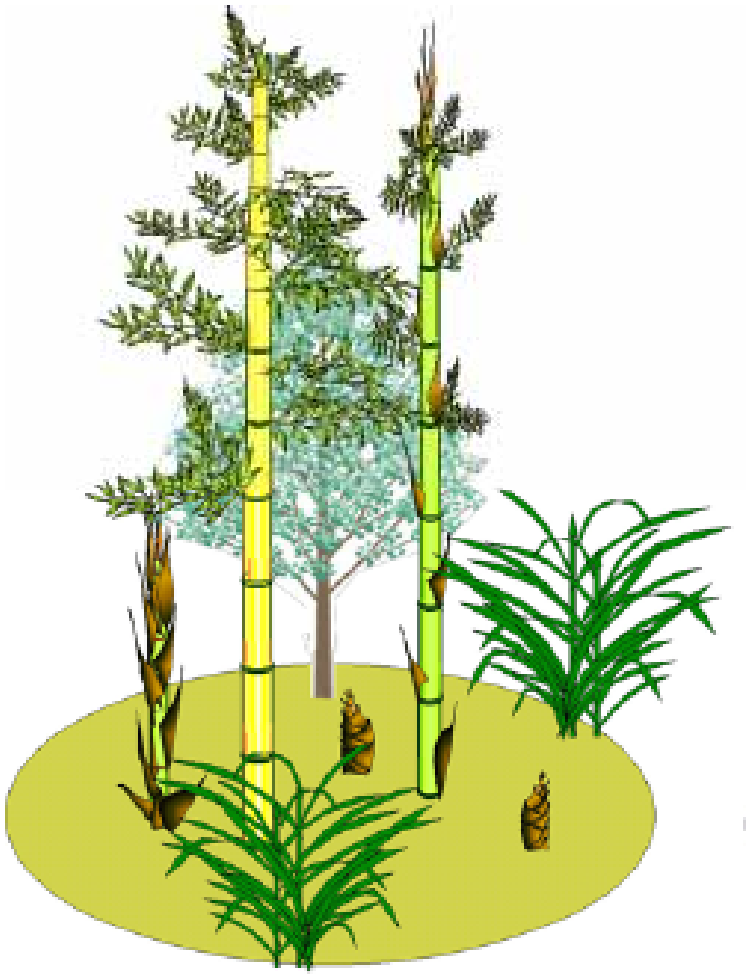
Predator became extinct, then the prey overshot in both systems.

If two plant systems are isolated, such systems are unstable.

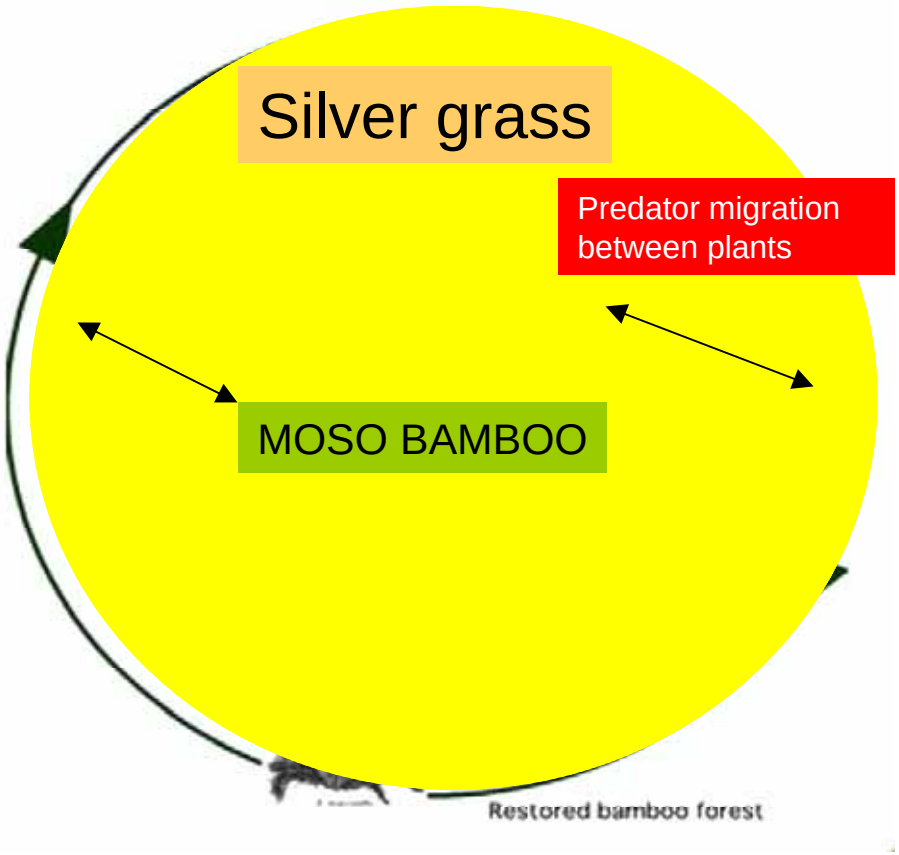


When plant systems are connected by predatory migration, systems are easy to become stable.

Supposed relationships between mites and plants in polycultured bamboo forests



Predator *T. bambusae* is common to these two pests on two plants



Simulations showed that a “two plants / two host specific pest species / single natural enemy” system can attain stability, suggesting that the recovery of bio-diversity must control the mite pest outbreak.

As such, we learned that the re-introduction of Chinese silvergrass (*M. sinensis*) must be necessary to restore moso bamboo plantations in China.

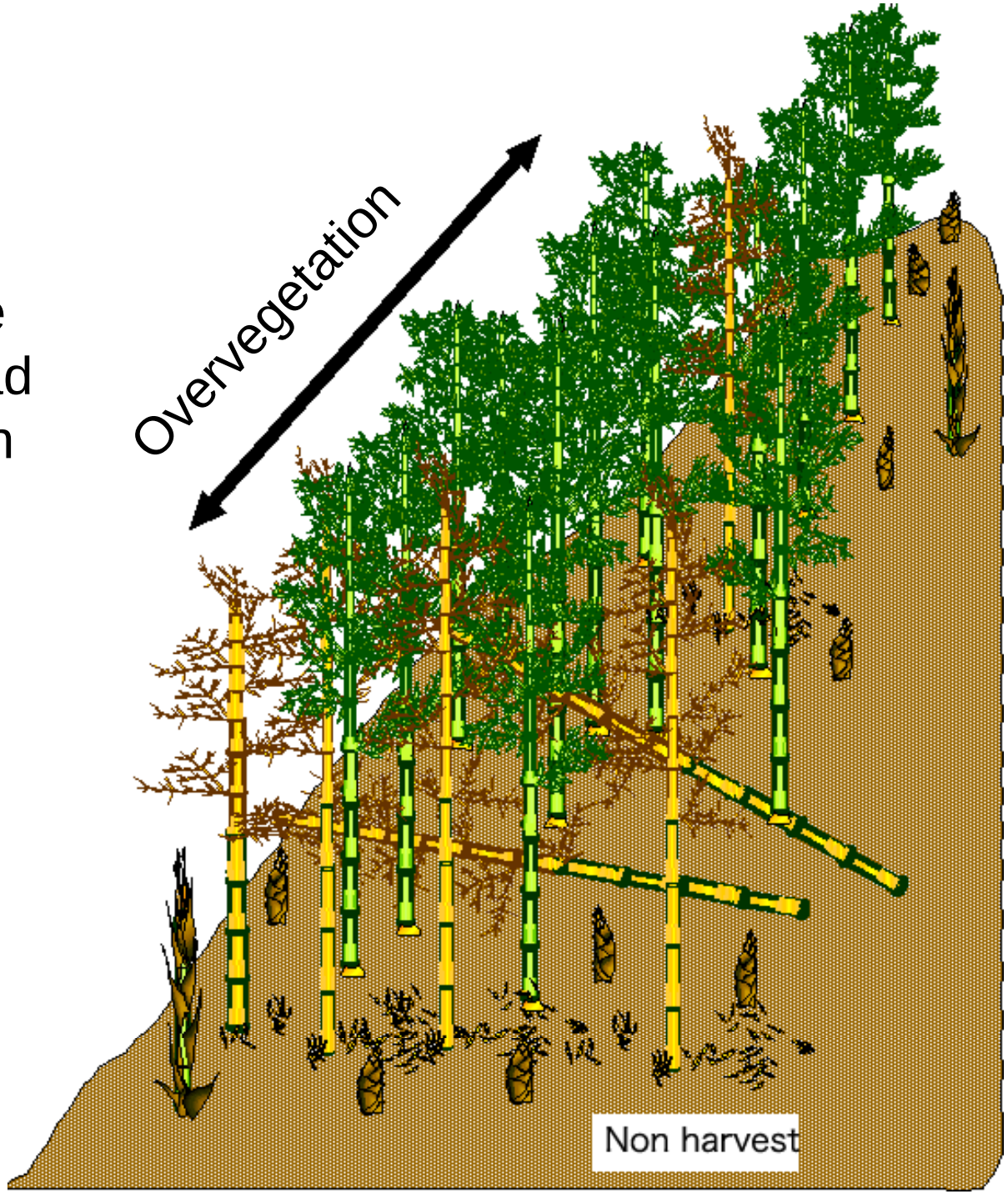
Although traditional polycultured moso plantations involved much more diversity in plants as well as arthropods, it is important that the recovery of only a single plant species can greatly improve the system stability, i.e. sustainability in agricultural fields.

If so, why have Japanese Sato-yama been destroyed by overvegetation of moso bamboo introduced from China?

There may be several reasons:

1. Japanese bamboo farmers have given up maintaining their moso bamboo forests due to cheaper bamboo shoots being imported from China.
   ----->periodic harvesting of bamboo shoots is necessary to prevent overvegetation and to maintain the bamboo forests integrity !
2. There are no strong pests to suppress the overvegetation of moso bamboo (because it is an exotic plant in Japan).
   ------->*S. nanjingensis*, bamboo rats, giant panda!

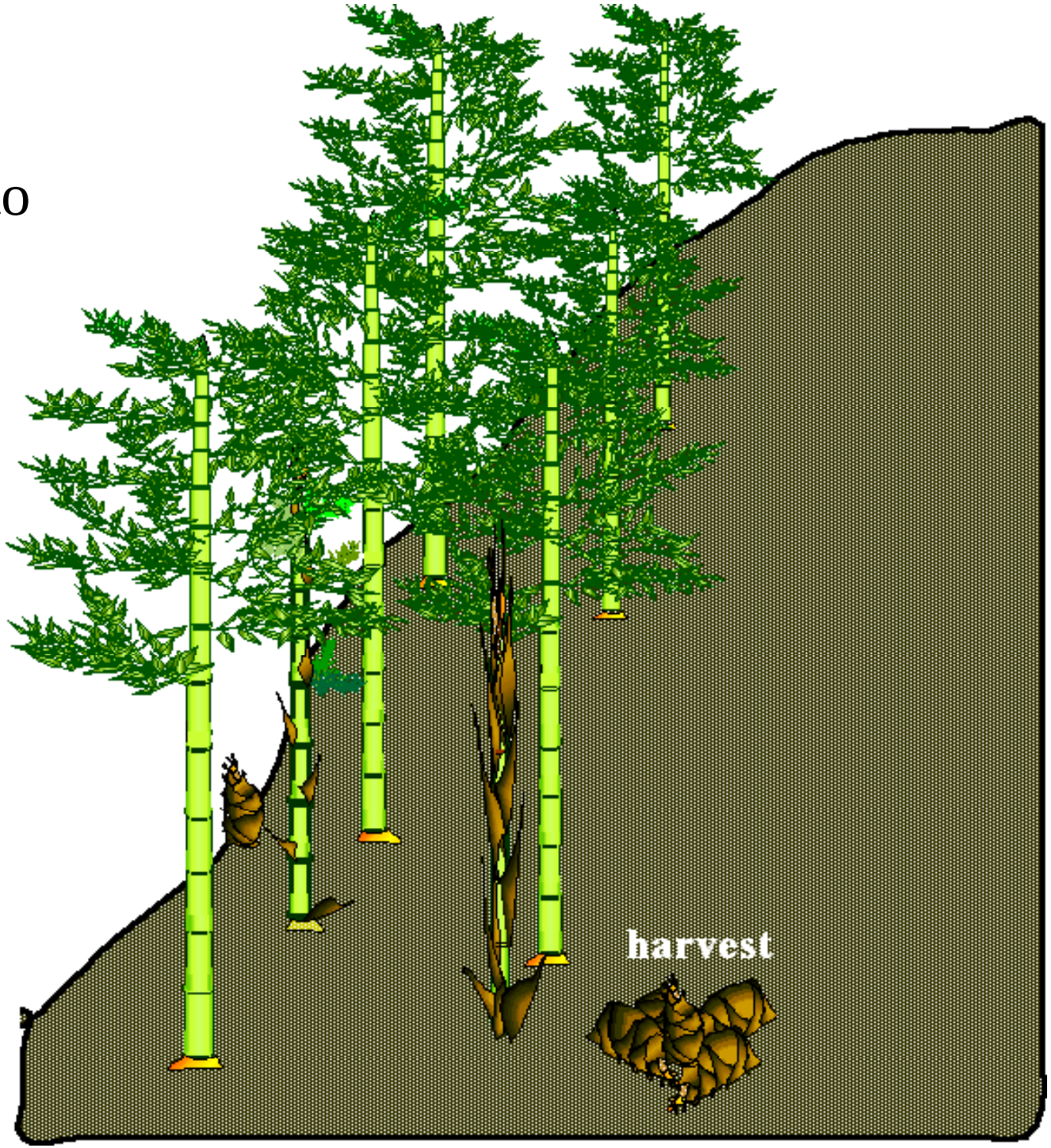
Without thinning-out moso bamboo forests dwarf and manipulation becomes impossible due to overcrowding and dead shoots as in Satoyama in Japan.



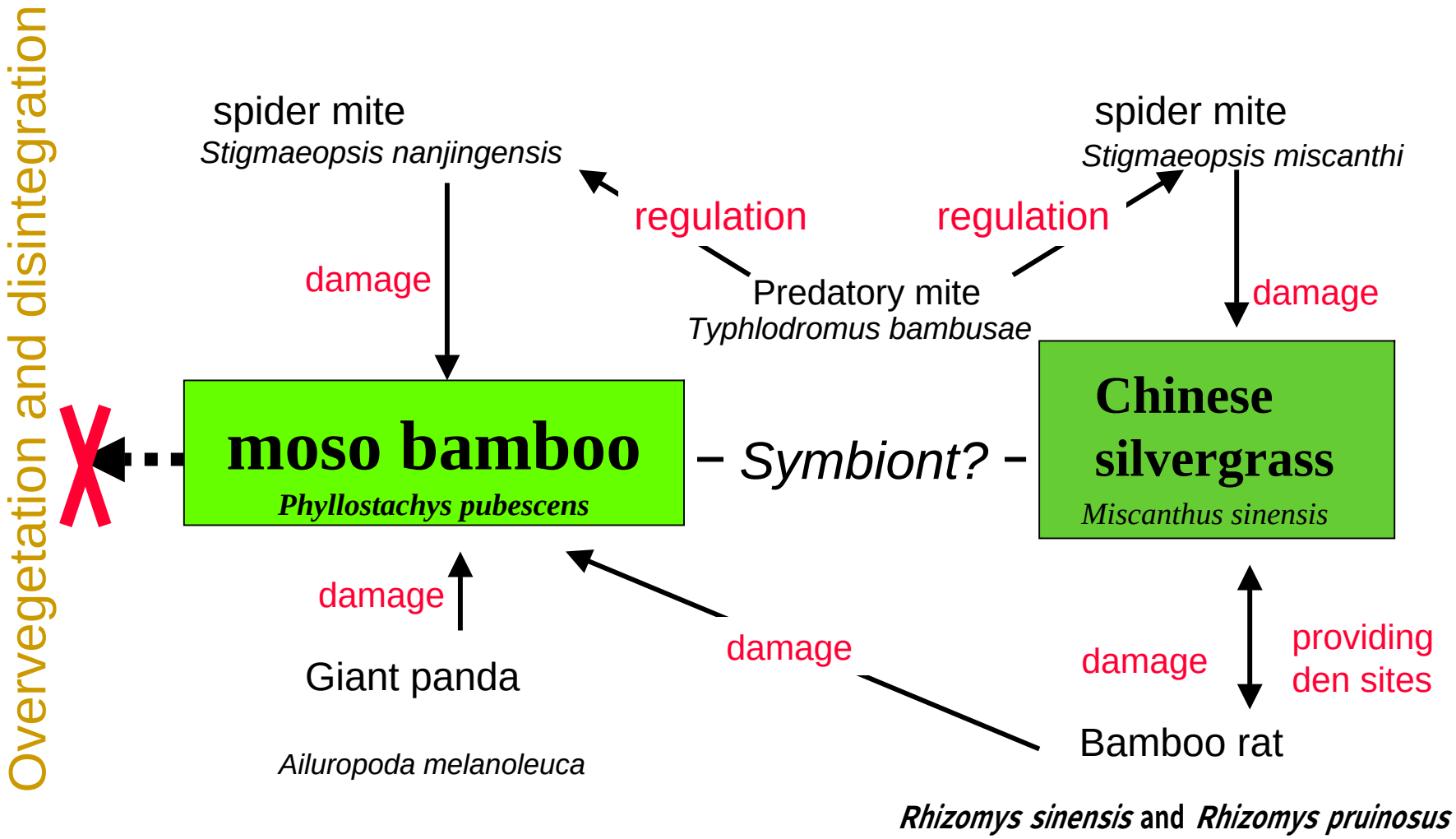
Bamboo climbing Sato-yama

Karatsu City in Kyushu, 2008

Periodic harvesting must be necessary to keep moso bamboo plantations sustainable



Supposed relationships in native moso bamboo forests before historic times



How to conserve Japanese Sato-yama from overvegetation of moso bamboo is quite a difficult problem.

Because the introduction of exotic pest species (mites, bamboo rats) is historically dangerous, we cannot recommend such a course of action.

Instead, we strongly recommend that moso bamboo is heavily utilized both as material for industry and as a source of bio-energy.

Thank you very much!