



HOKKAIDO UNIVERSITY

| | |
|------------------|--|
| Title | Loss of species diversity impacts on genetic variation in an ecological community member |
| Author(s) | Utsumi, Shunsuke |
| Relation | フィンランド-日本 共同シンポジウムシリーズ : 北方圏の環境研究に関するシンポジウム2012(Joint Finnish-Japanese Symposium Series Northern Environmental Research Symposium 2012). 2012年9月10日-14日. オウル大学、オウランカ研究所, フィンランド. |
| Issue Date | 2012-09-10 |
| Doc URL | https://hdl.handle.net/2115/51379 |
| Type | conference presentation |
| File Information | 15_ShunsukeUtsumi.pdf |



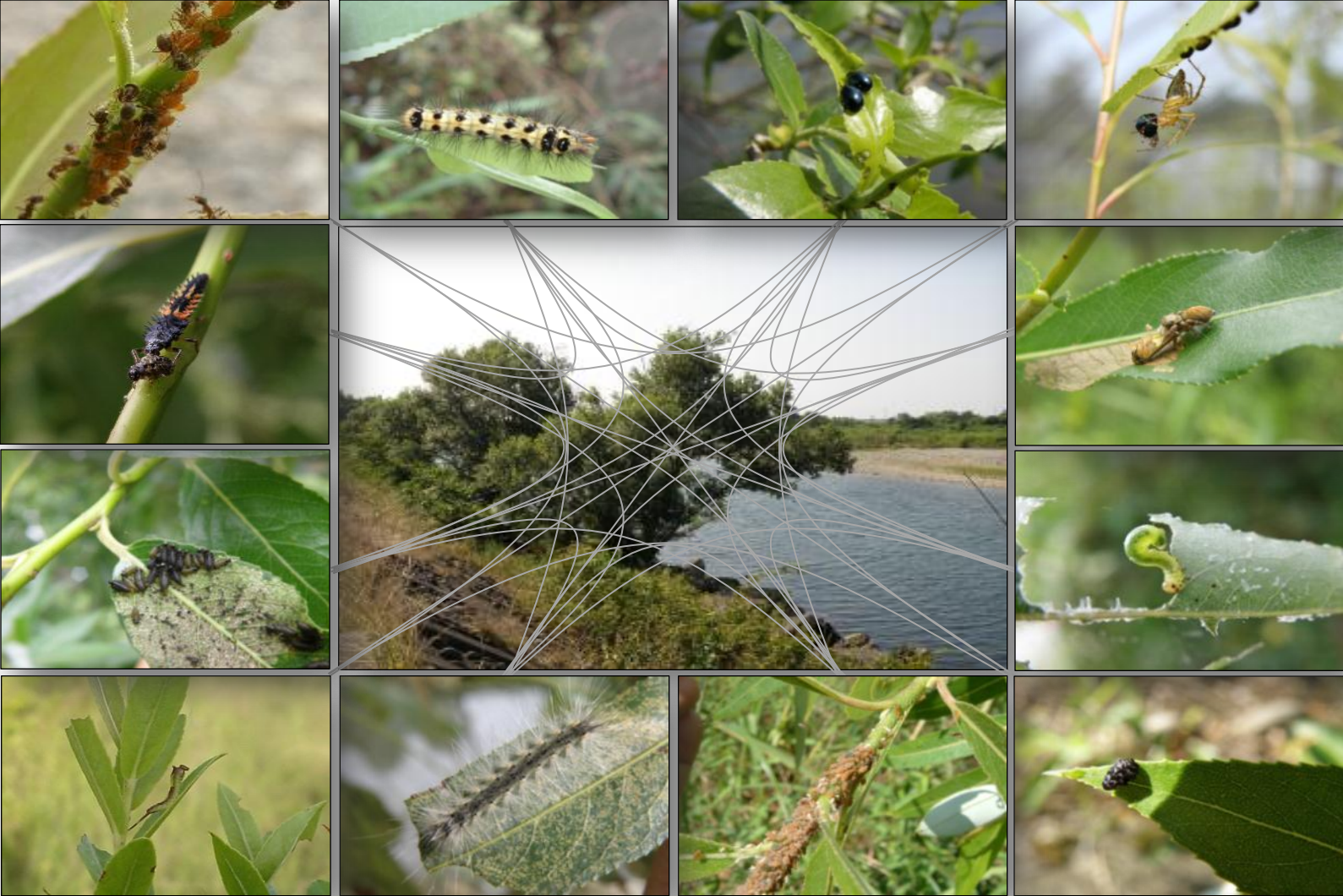
Sep 11, 2012, 5th Joint Finnish-Japanese Symposium
on Northern Environmental Research
@Oulu

Loss of species diversity impacts on genetic variation in an ecological community member

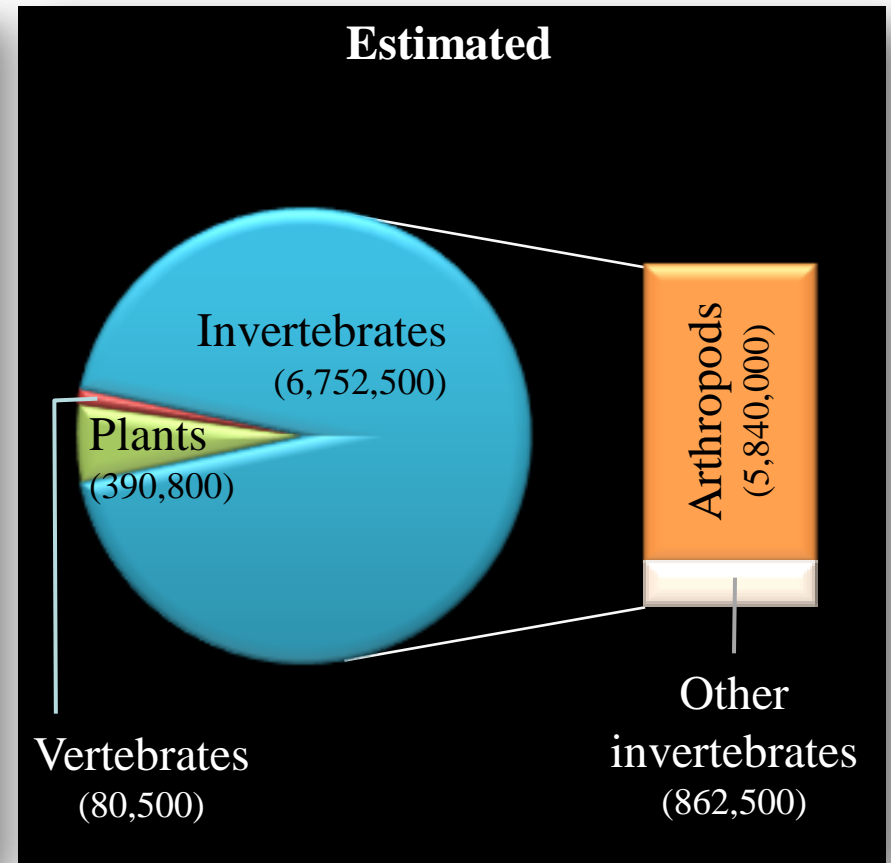
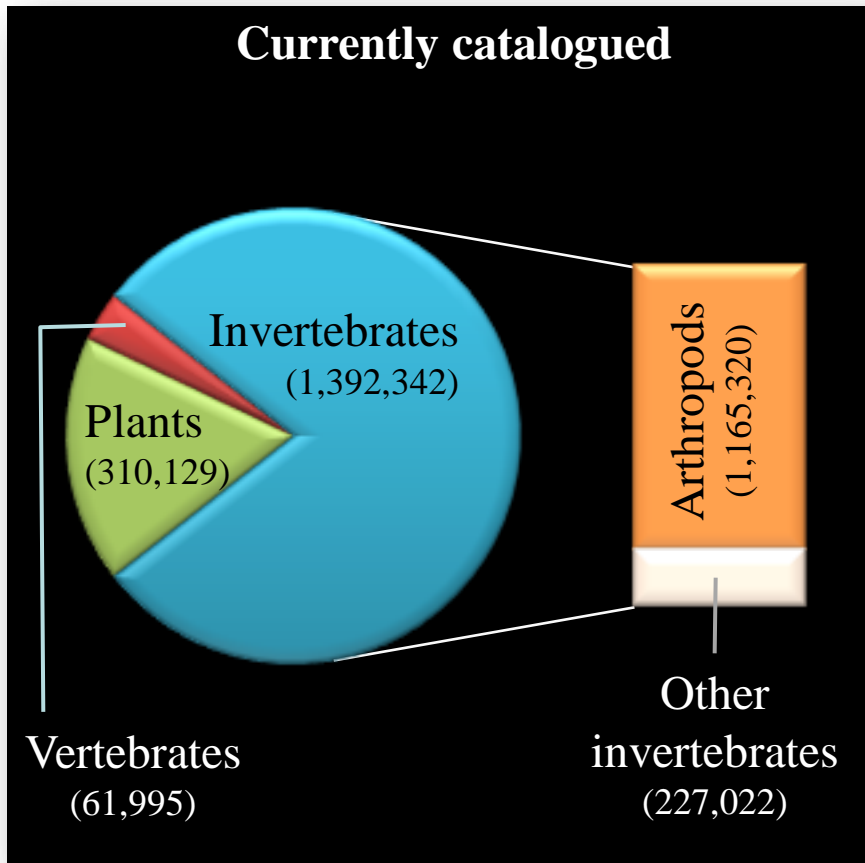
Shunsuke Utsumi



Diverse arthropods on a tree

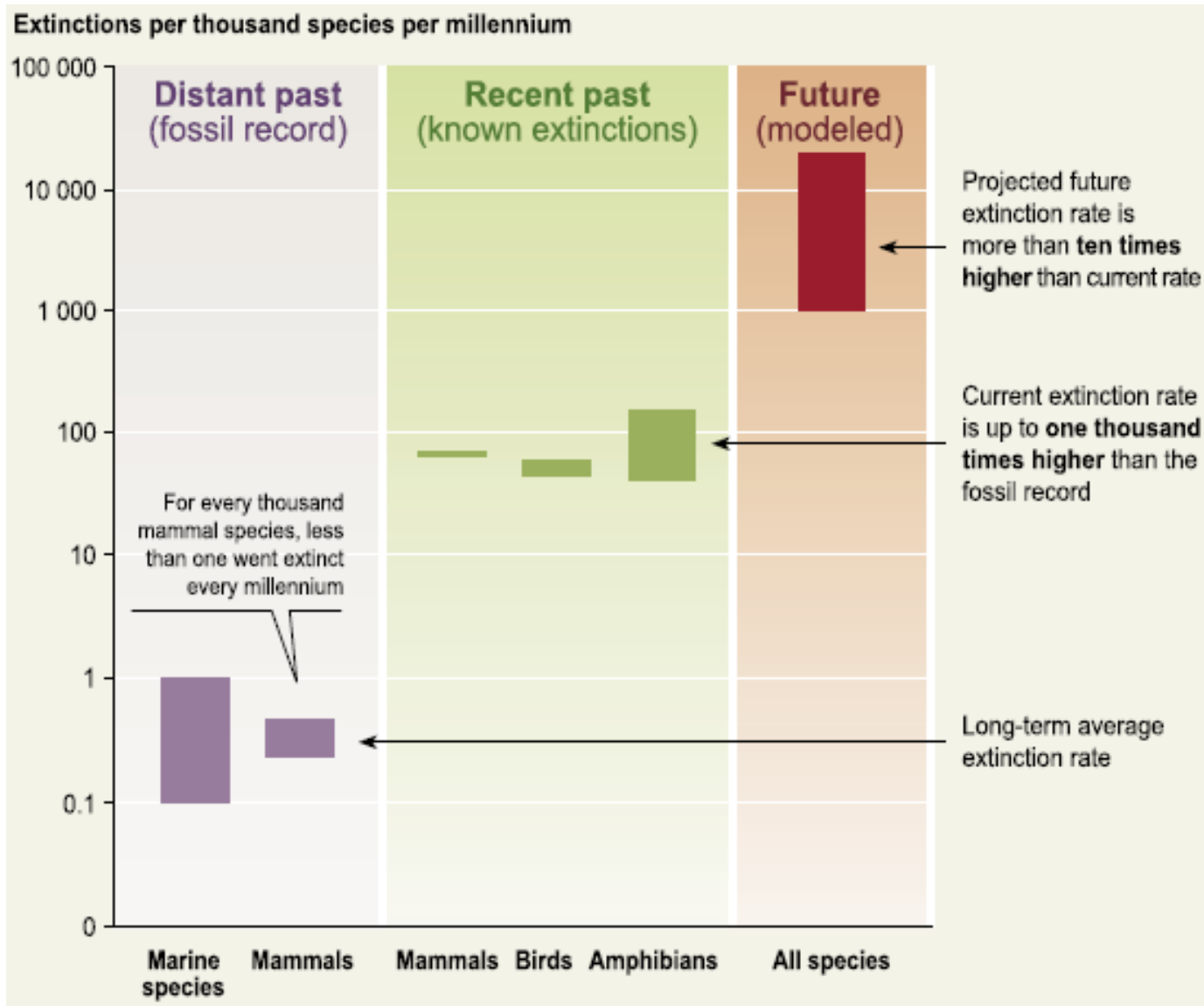


Number of species on Earth



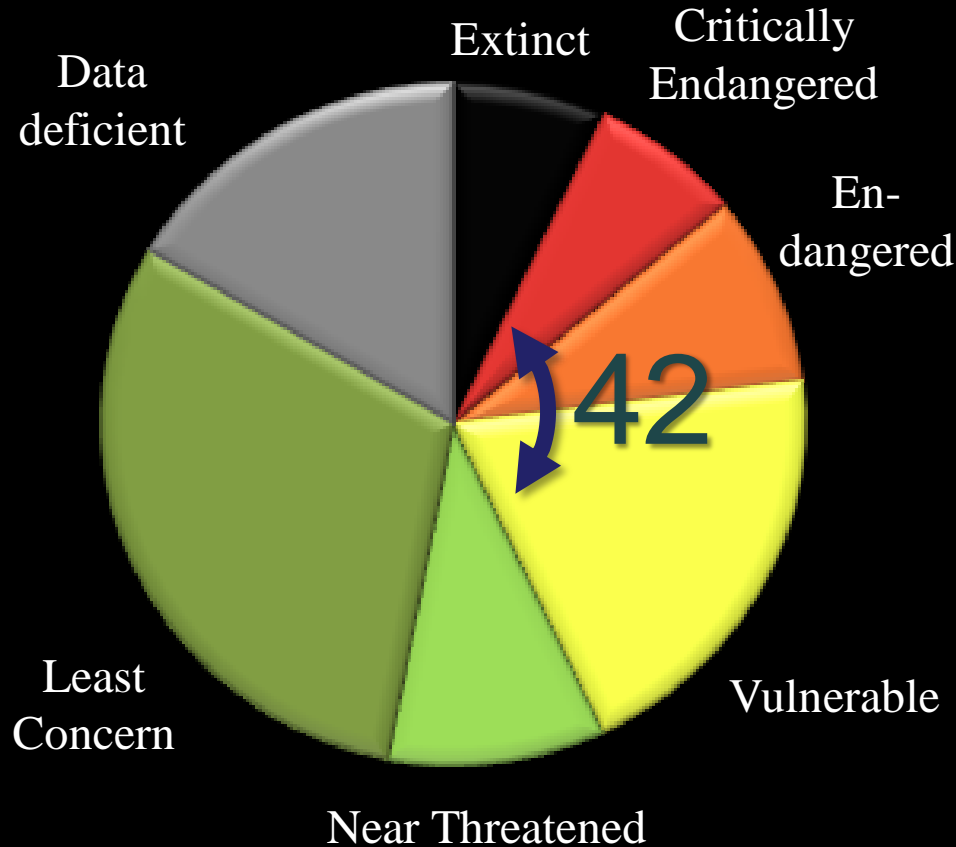
Insects > 85% of Arthropods

Loss of species diversity accelerating



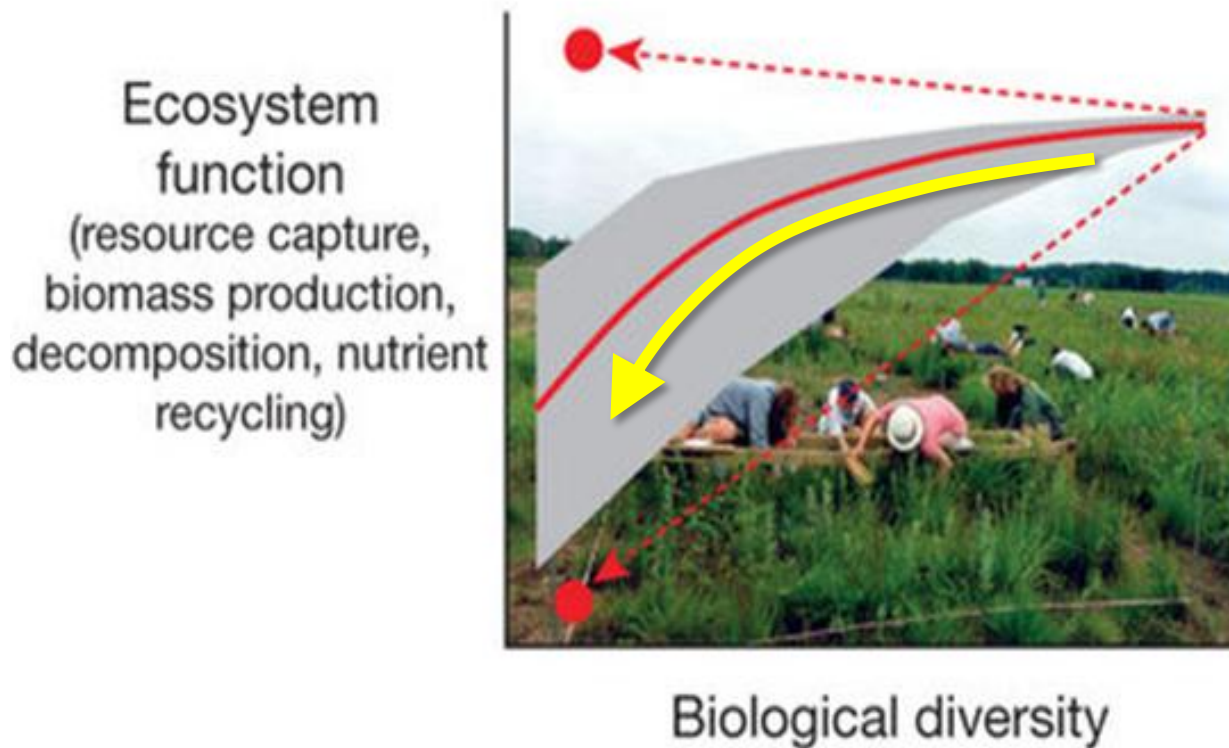
Loss of worldwide species diversity in invertebrates

42% of terrestrial invertebrates assessed by IUCN *RL* are threatened with extinction

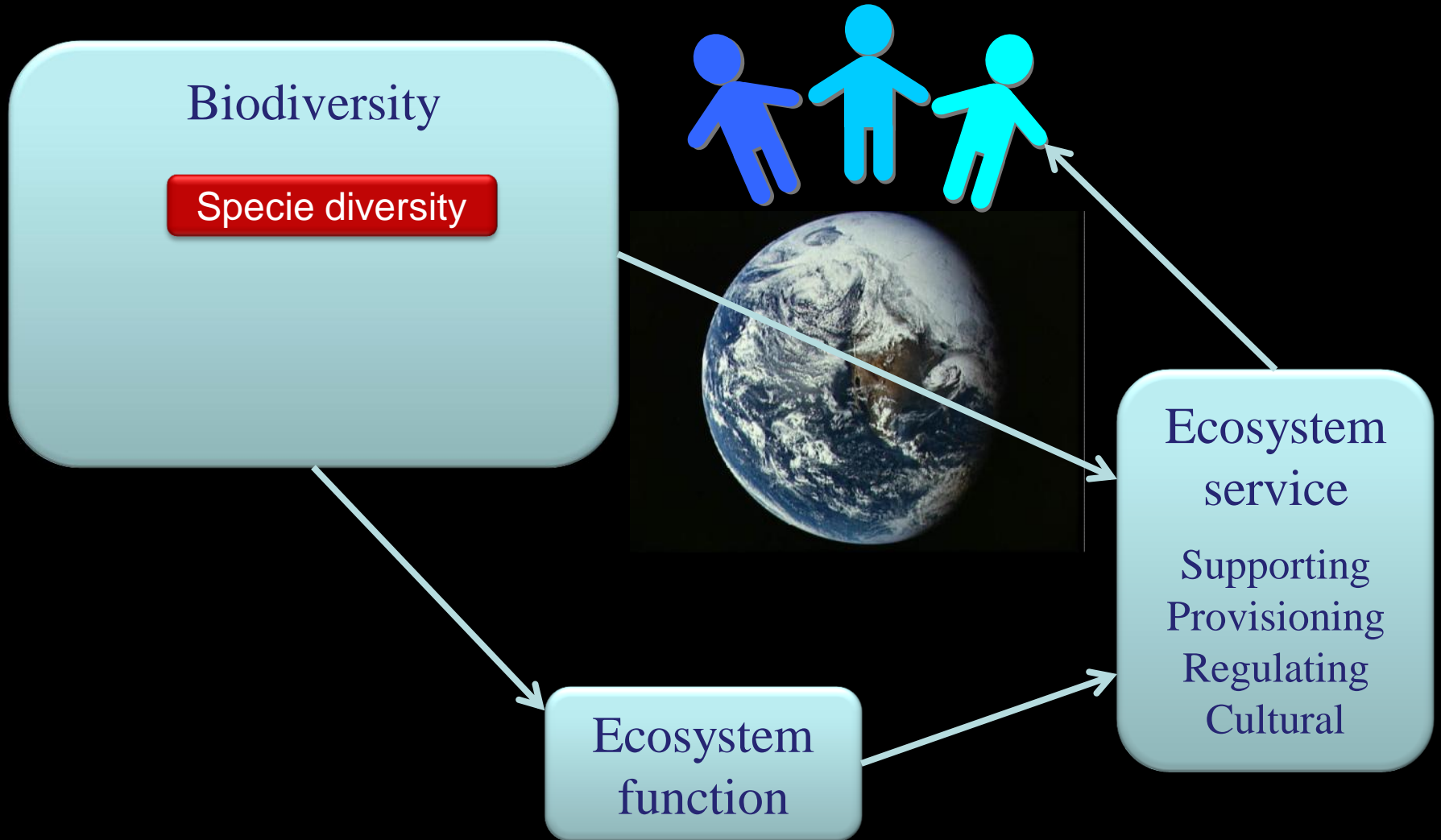


Why biodiversity is important?

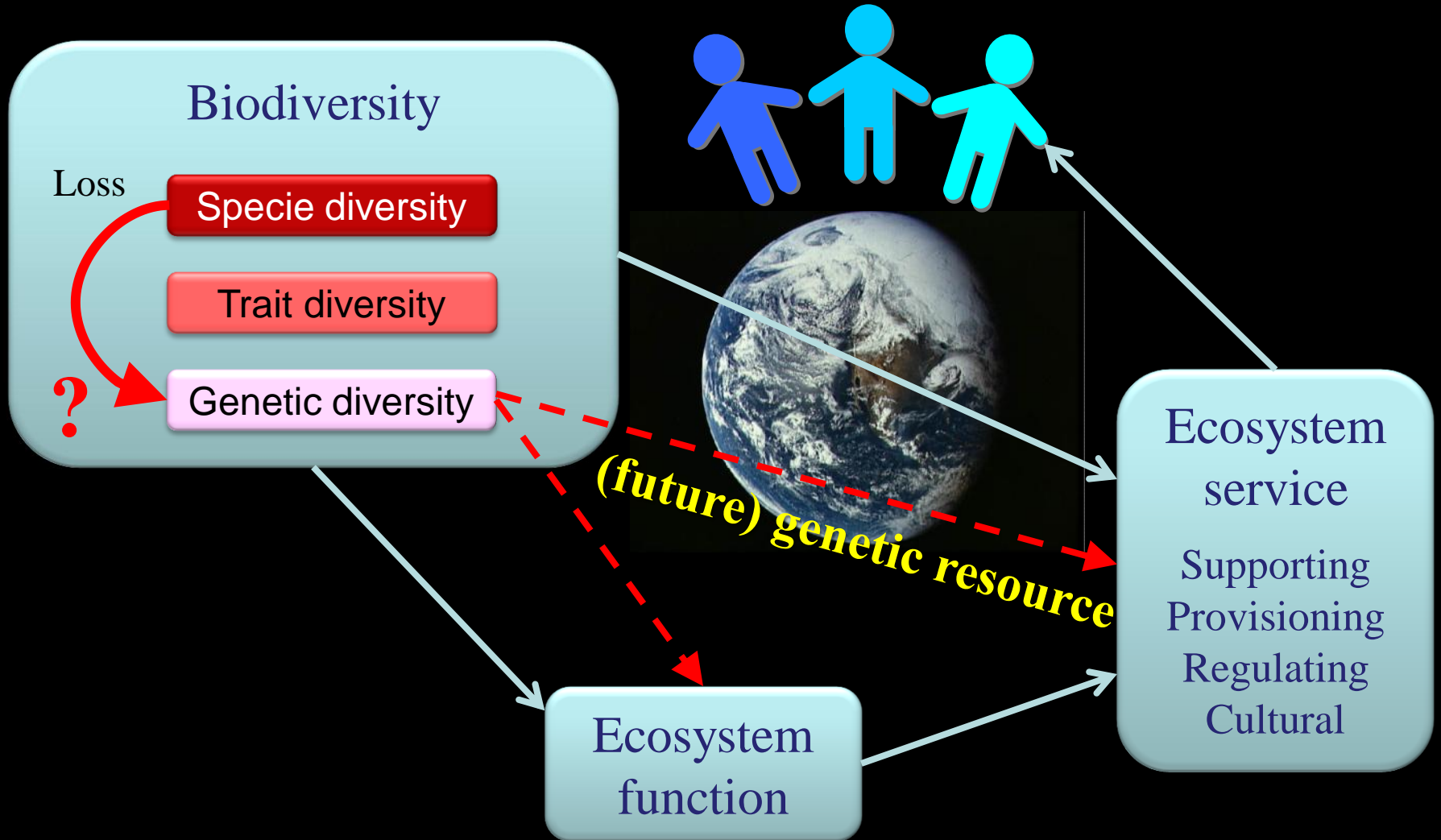
Relationship of Biodiversity-Ecosystem Function (BEF) Consensus of 20-year BEF studies



For human well-being

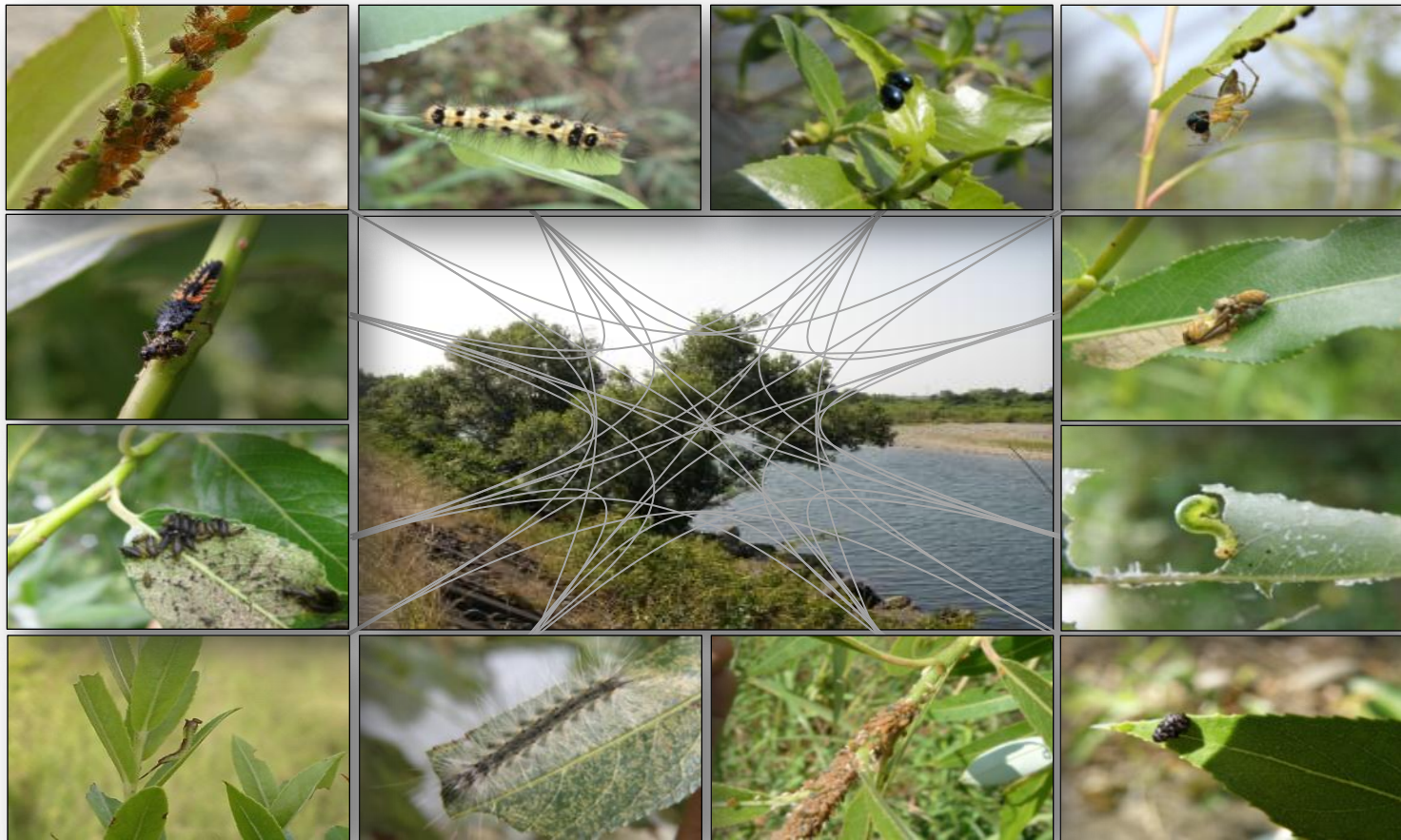


Hierarchy of Biodiversity



The main question of our study

How does insect species diversity affect genetic variation in one insect species through **evolutionary** interactions?



Genus *Salix* (willow) as a model system

Nature

- One of the most dominant and diverse plant group of northern hemisphere (e.g., > 450 species in the whole Holarctic region), growing all northern habitats from tundra to old-growth forests. Common in Finland and Japan.
- Utilized by many, many different insect species (Lepidoptera, Hemiptera, Coleoptera, Hymenoptera, Diptera,...). → **We focused on species diversity and genetic diversity of insects on a willow**



Genus *Salix* (willow) as a model system

Applied use

- Short Rotation Coppice (SRC) as an energy crop
- Phytoremediation to clean up soil

→ for **Sustainable Development**

- In Hokkaido, SRC trial has been initiated by the government
- **Insect attack** is a critical topic for productivity and success of plantation



Focal insect species to consider genetic variation

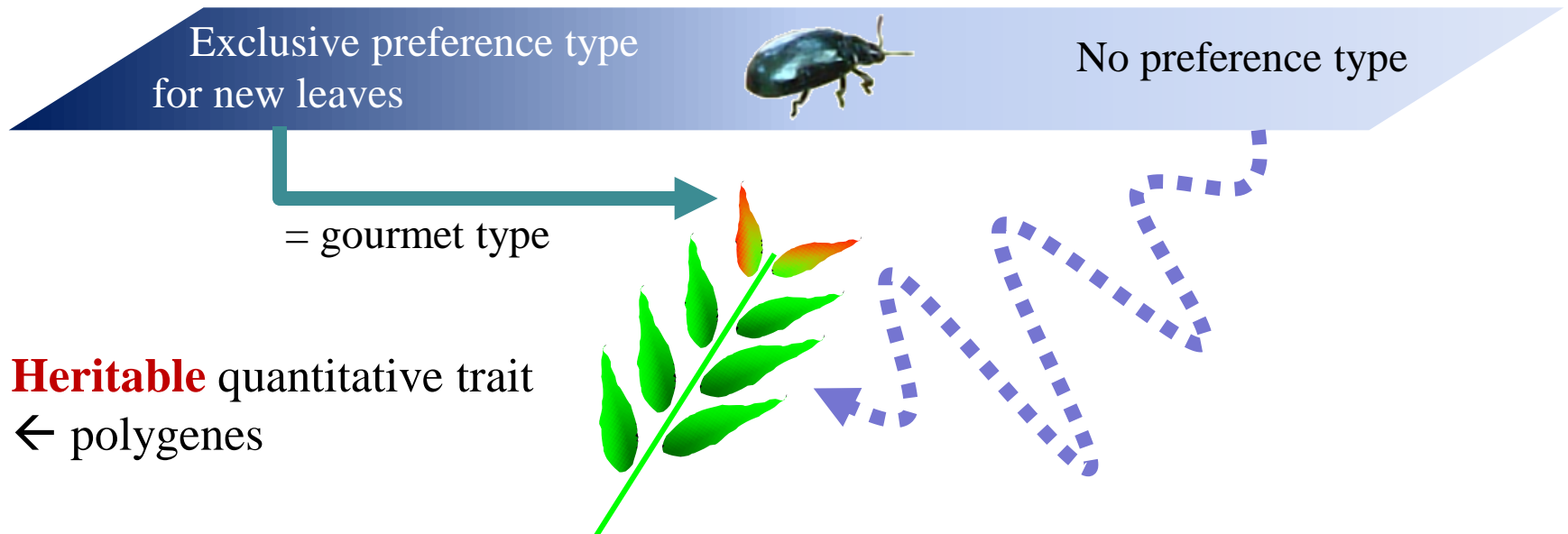


Leaf beetle

Plagiodera versicolora

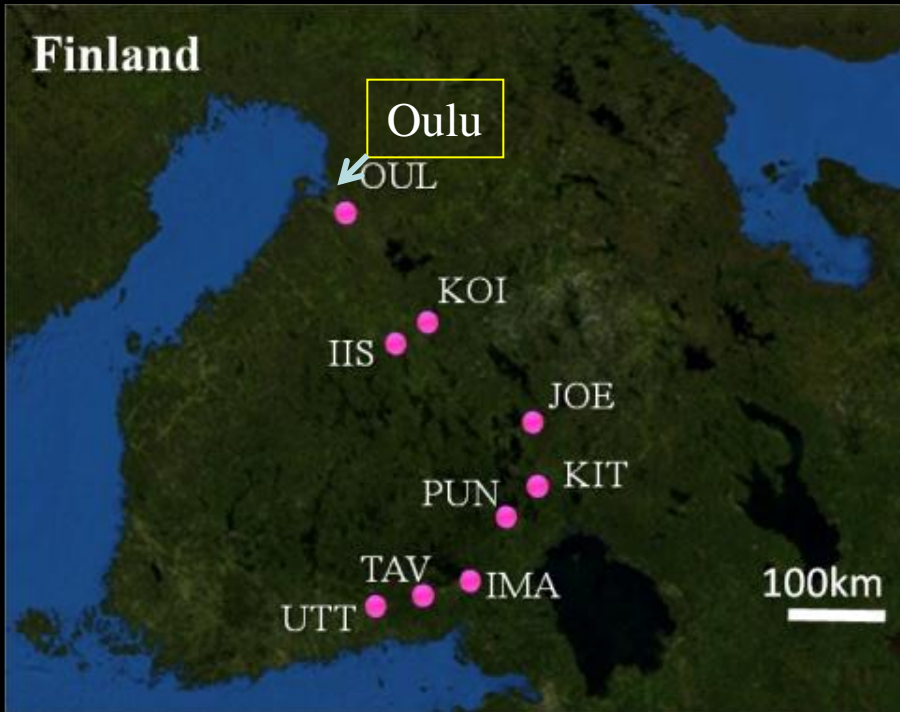
- only feeding on salicaceous trees
- wide distribution in northern hemisphere

Continuative variation among individuals in “preference”



Research in Finland and Japan

Finland



- Field Census-
- 1. Herbivorous insect species diversity

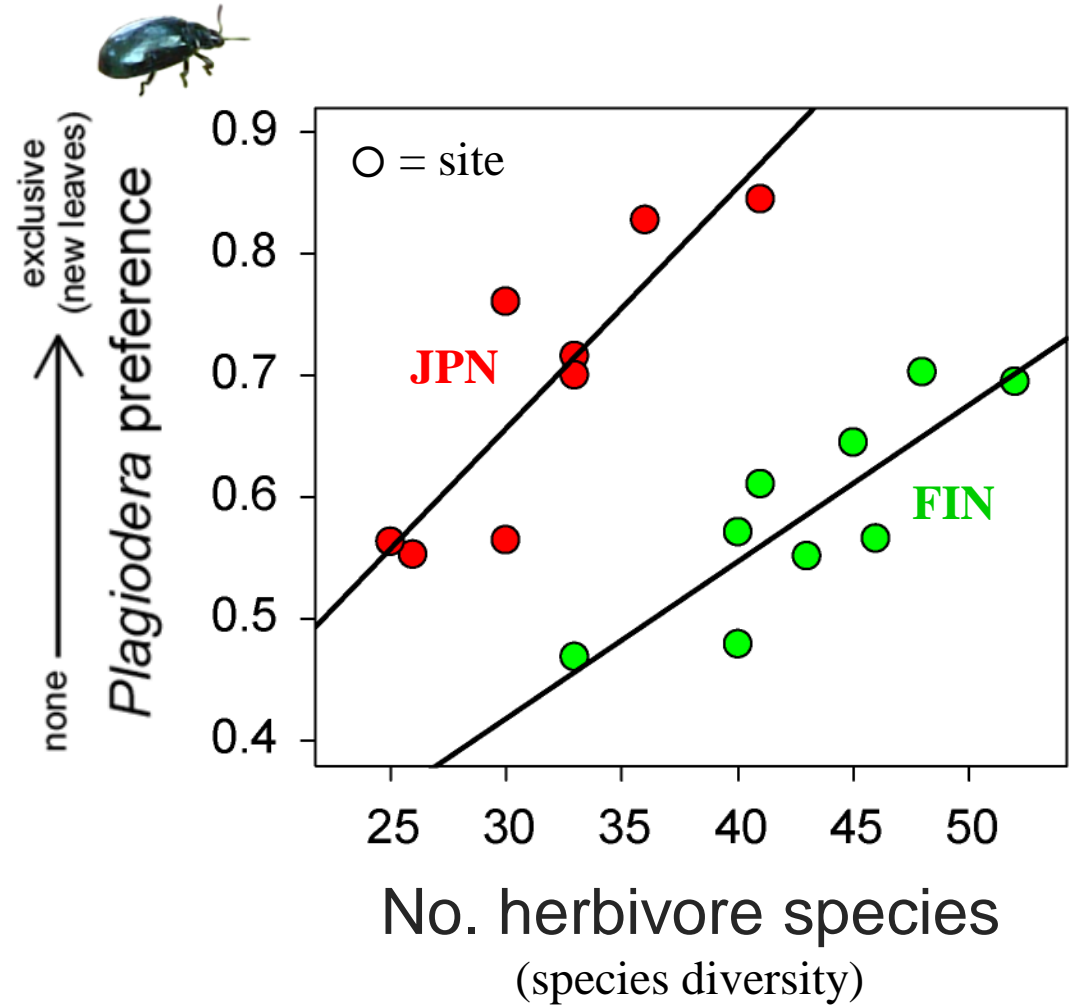
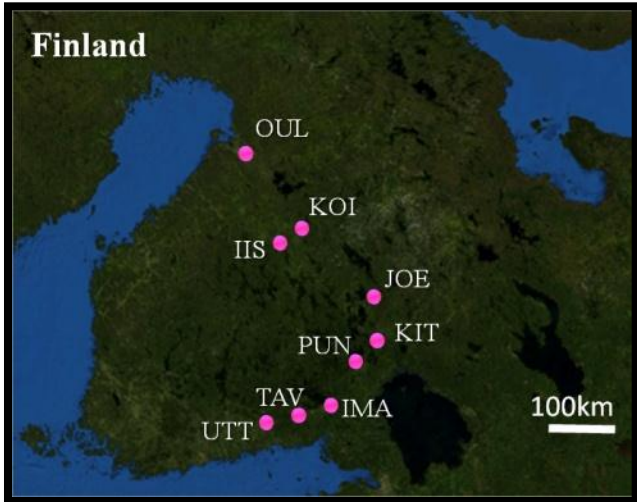


Japan



- Collecting leaf beetle populations-
- 2. Preference test under laboratory condition
- 3. Genetic structure

Biodiversity-Trait relationship





Sequence analyses of mitochondrial gene (COI region)

- Significant among-population **genetic differentiation** (within each country)

[AMOVA: $P < 0.05$]

- Non-significant correlation between genetic differentiation (F_{ST}) and trait difference (within each country).

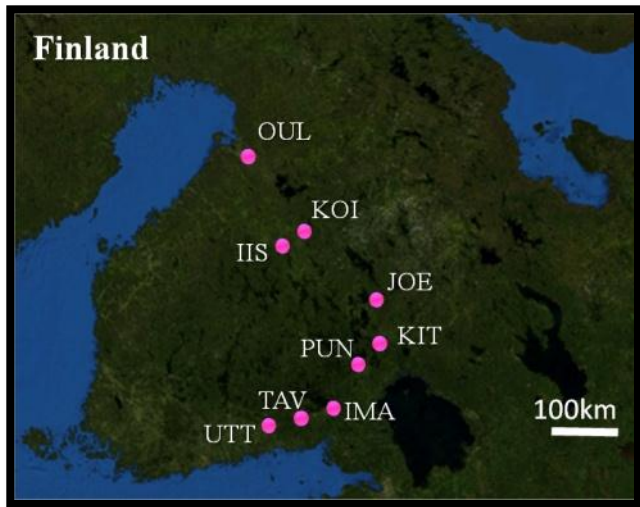
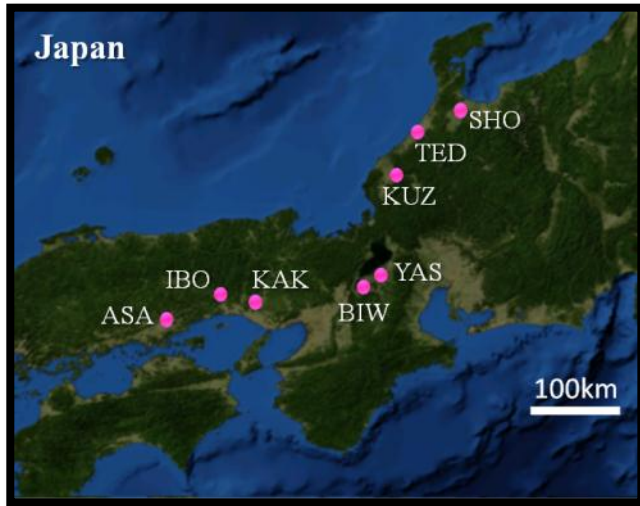
[Mantel test: NS]

Preference variation among sites is due to evolutionary change in each site rather than individual migration

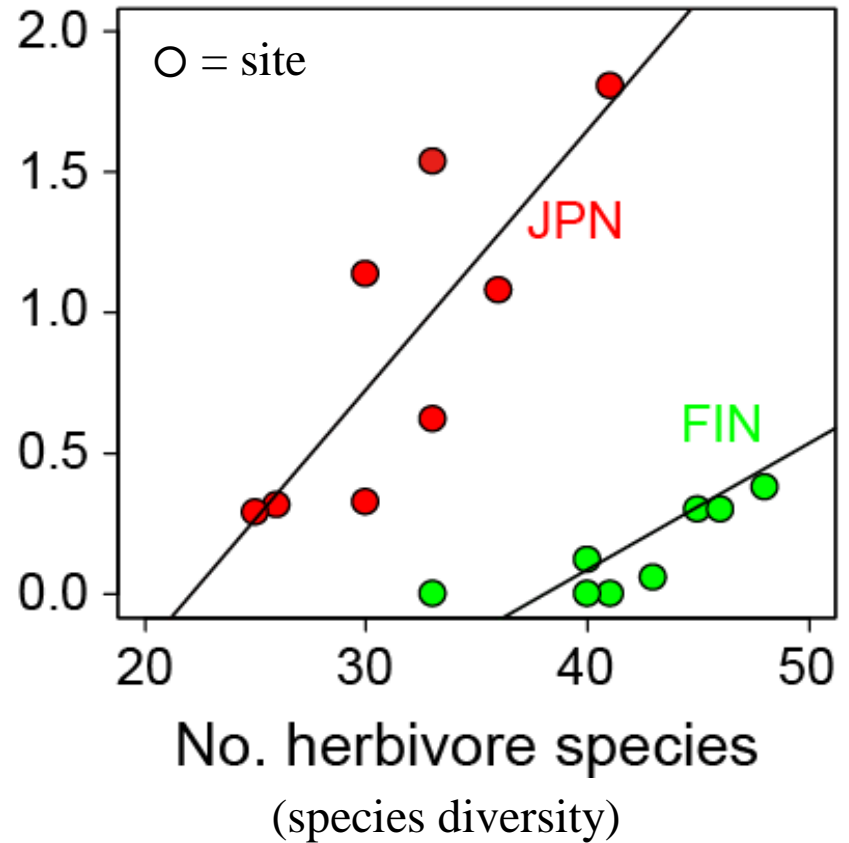


How does different preference type evolve?

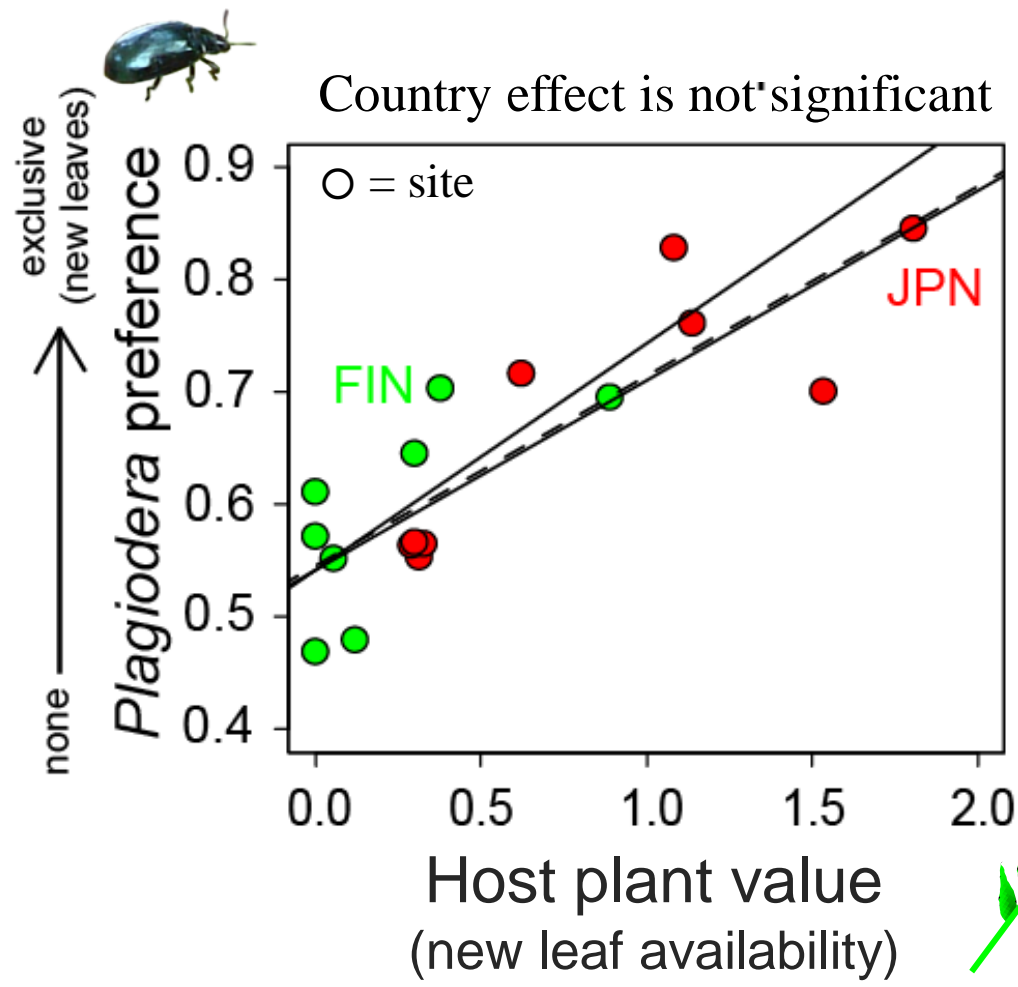
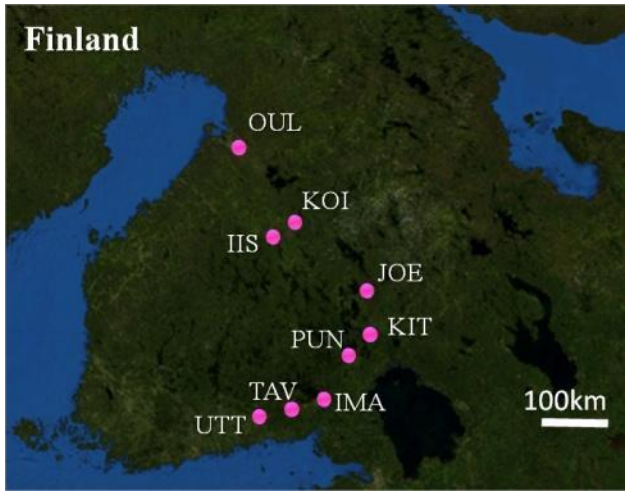
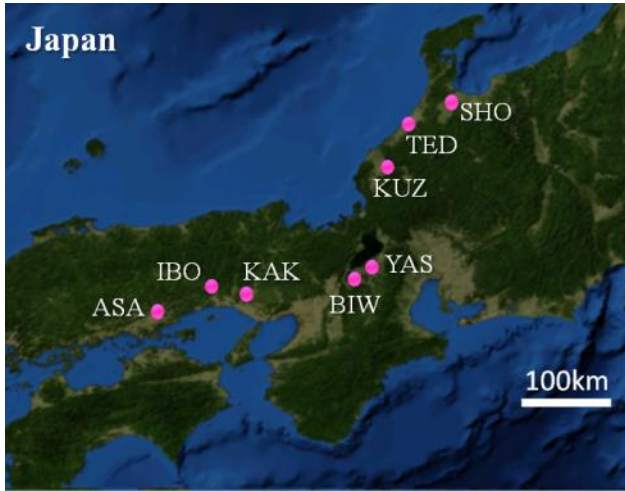
Herbivore diversity → host plant value



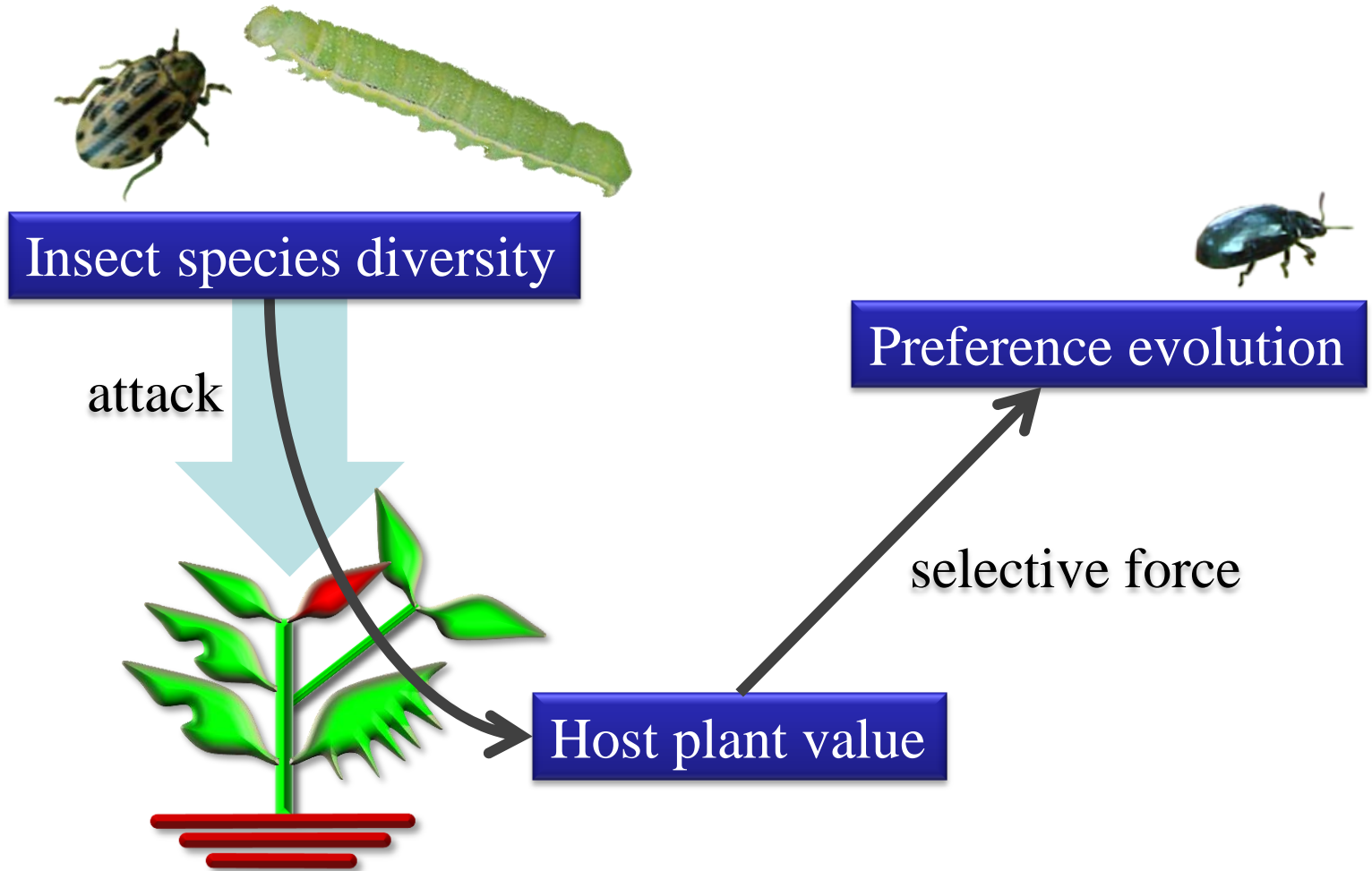
Host plant value
(new leaf availability)



Host plant value → leaf beetle preference



Scenario



Community-manipulation experiment

Experimentally demonstrated
trait evolution scenario of the leaf beetle



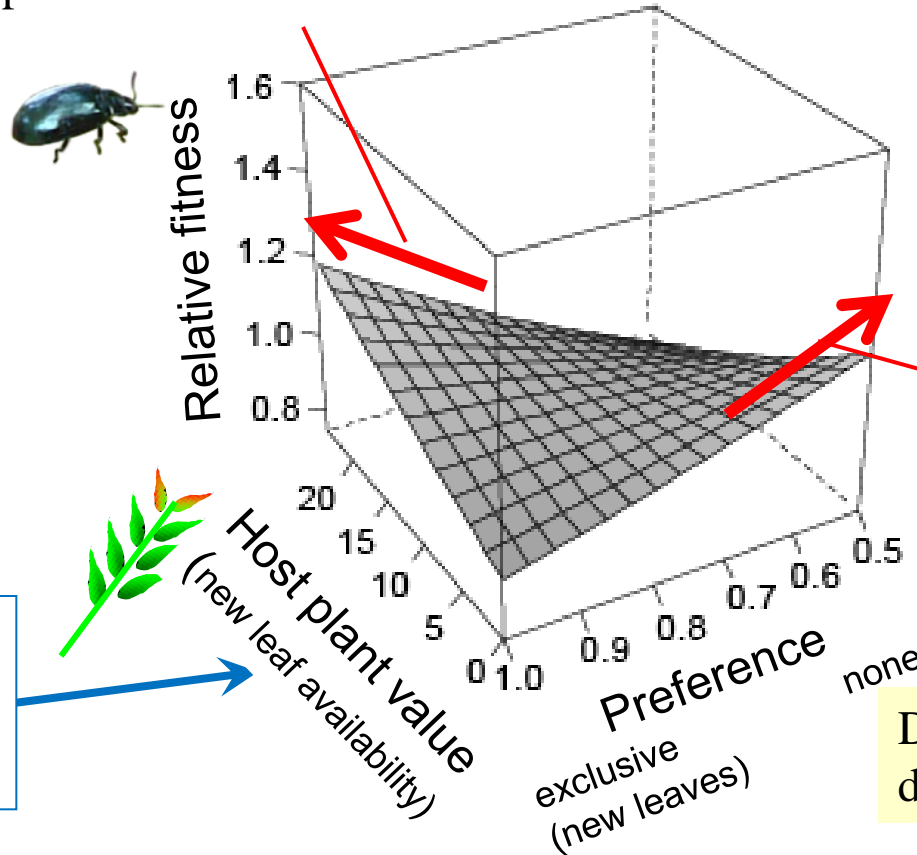
mesocosm

3 species community

+

the leaf beetle

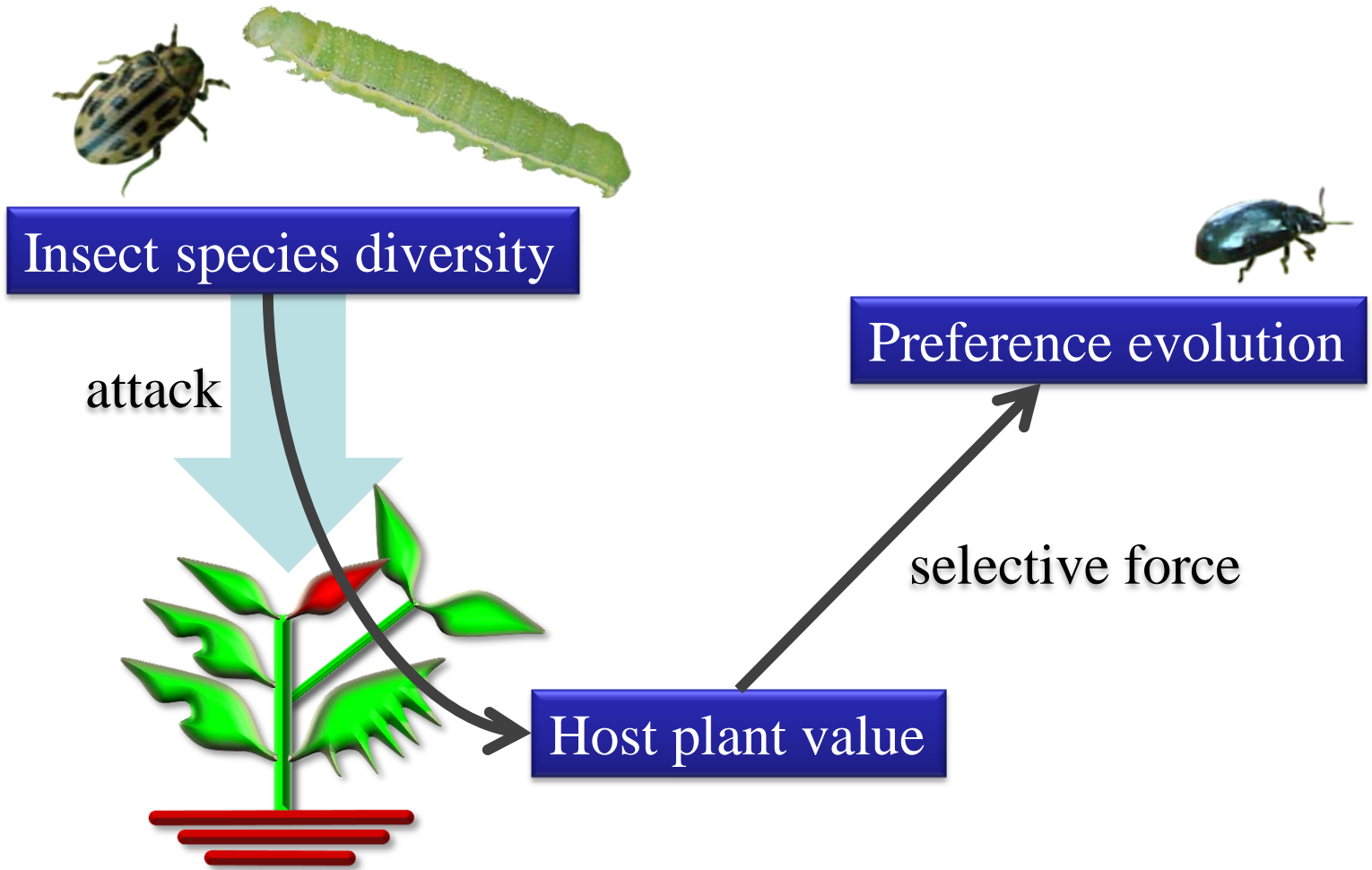
Natural Selection toward
exclusive preference for new leaves



Natural Selection toward
no preference

Herbivore
Species
diversity

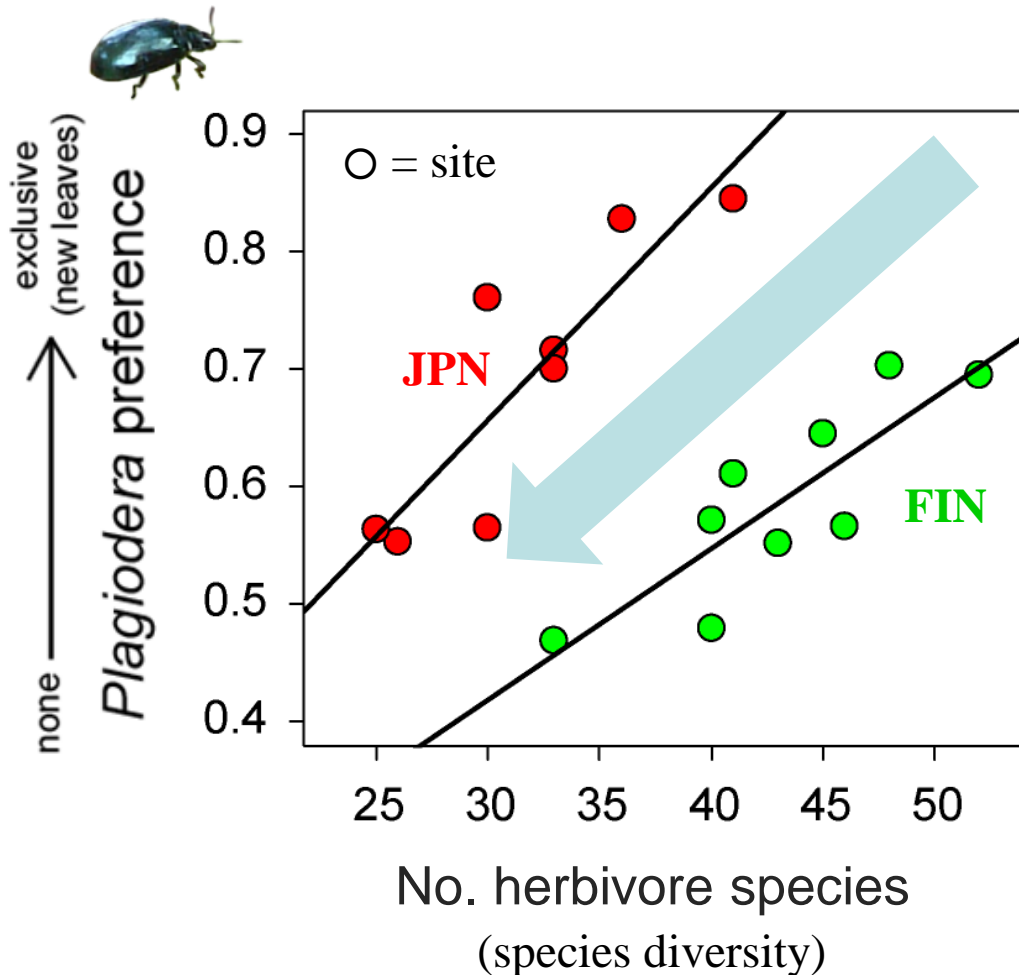
Different trait can evolve,
depending on species diversity



“ubiquitous” evolutionary process

Loss of species diversity leading to...

- Evolution toward no preference type
- Extinction of gourmet type populations



All populations are no preference type

All populations are homogenous

Low genetic diversity

Genes contributing to gourmet type may be lost

Take-home message

Loss of species diversity can result in

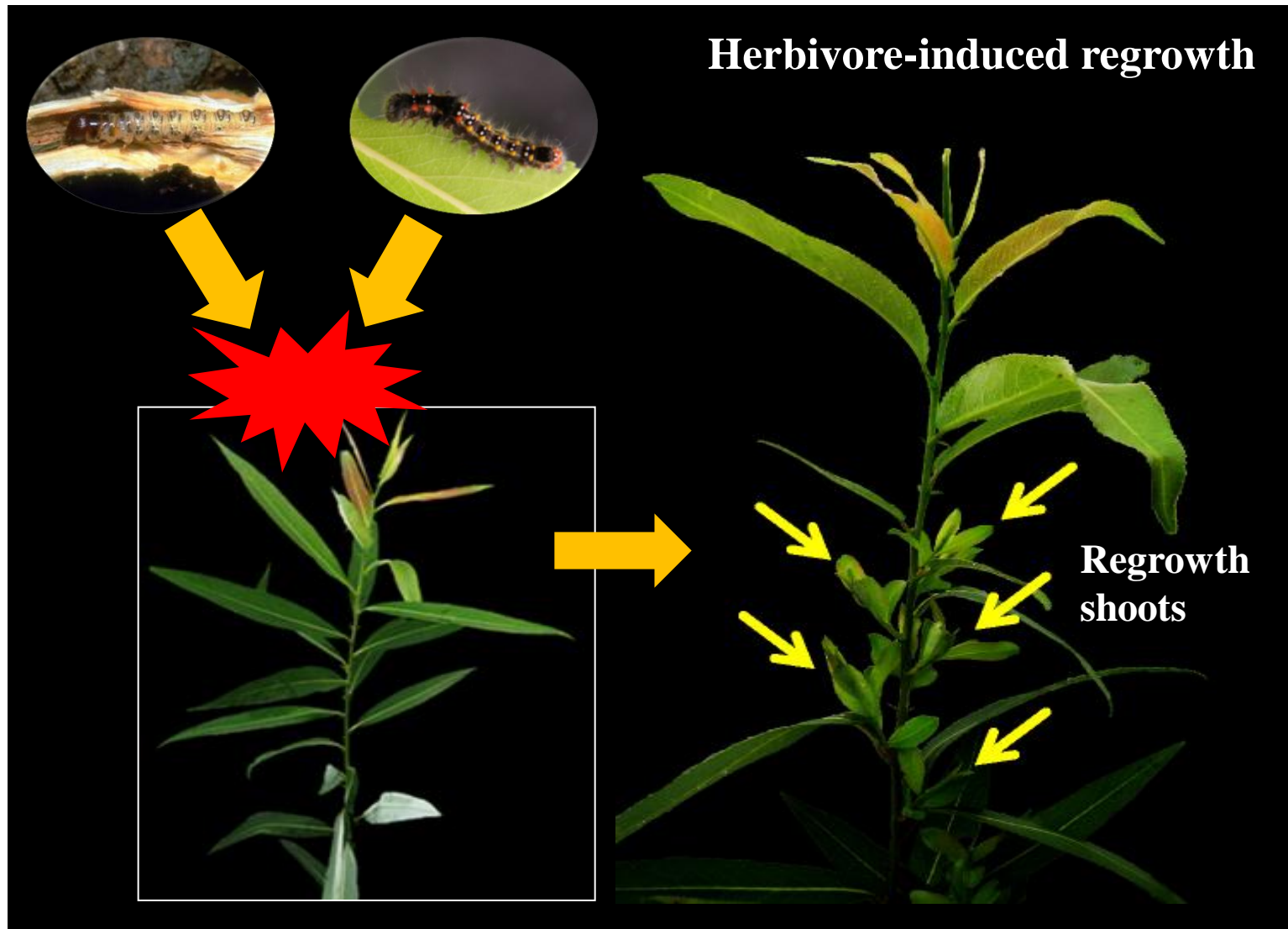
- **Homegeneity of selective force** for a community member among localities
- Reduction in trait and genetic diversity among populations
- **Cascade of biodiversity degradation across hierarchies** (i.e., species \rightarrow trait \rightarrow genes \rightarrow ? feedback ?)
- Loss of potential genetic resource loss on Earth

We need a new “Evolutionary Community Ecology” study in various ecosystems

Kiitos paljon



Willow – Herbivore System



Strong regrowth drastically increase availability of new leaves