

Native and invasive in the same region:  
determining the above and belowground  
impacts of Monterey Pine  
invasion in California



Monterey pine (*Pinus radiata*) is native to restricted locations in coastal California











Despite its narrow native range, it is the most widely planted tree species in the world.

Cultivated to be fast-growing and non-serotinous for timber plantations in the southern hemisphere.







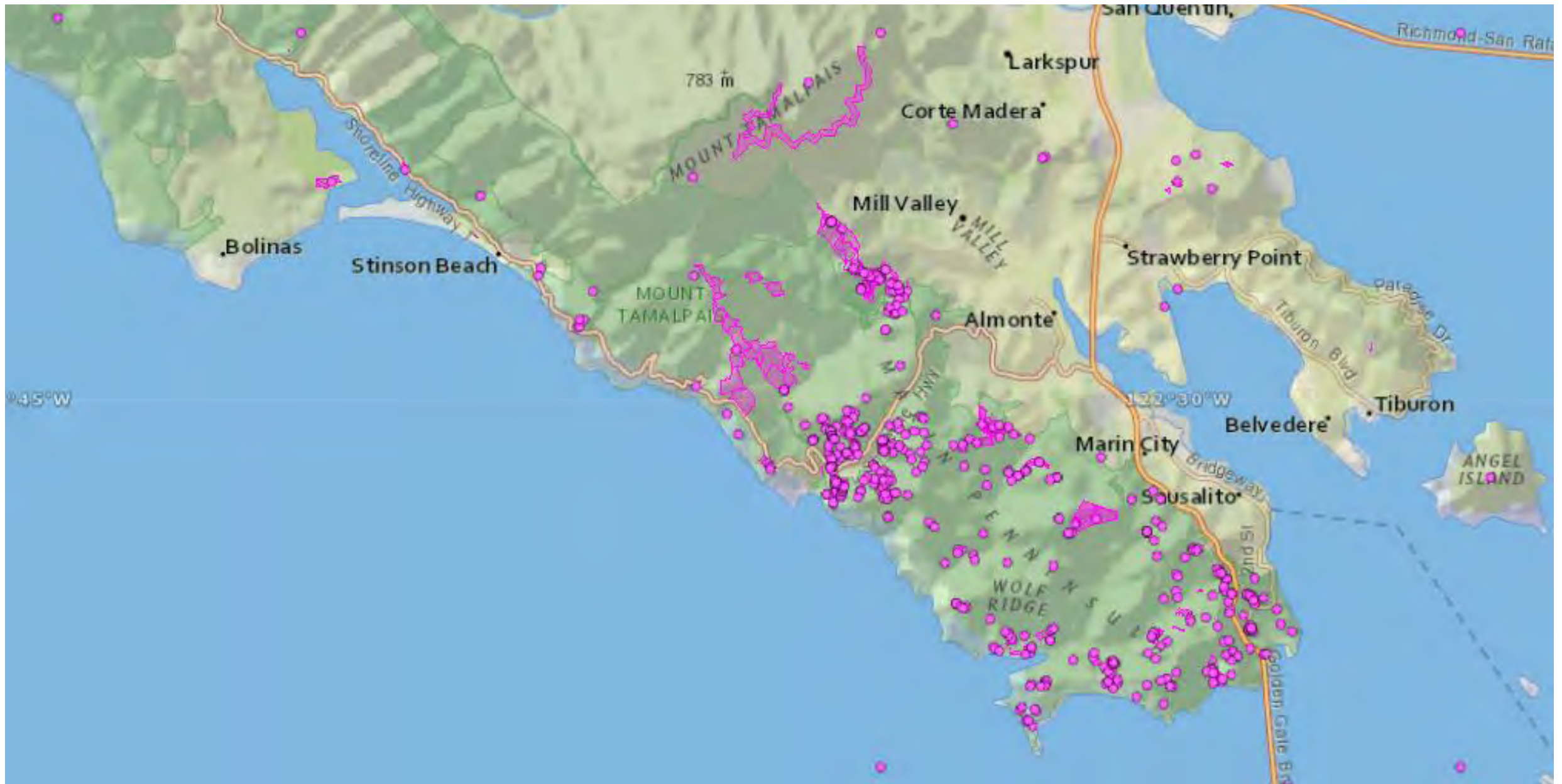
Planted cultivars are also becoming invasive in northern coastal scrub ecosystems in Marin County.



Largely planted by ranchers and the US Army in the early 20<sup>th</sup> century.

### Golden Gate National Recreation Area





Data from CalFlora







# Why should we be concerned?

- different genotype from the native populations
- displacing native species in these communities
- potentially altering ecosystem functions





Monterey pines have significantly different characteristics than the native species in this region, including their:

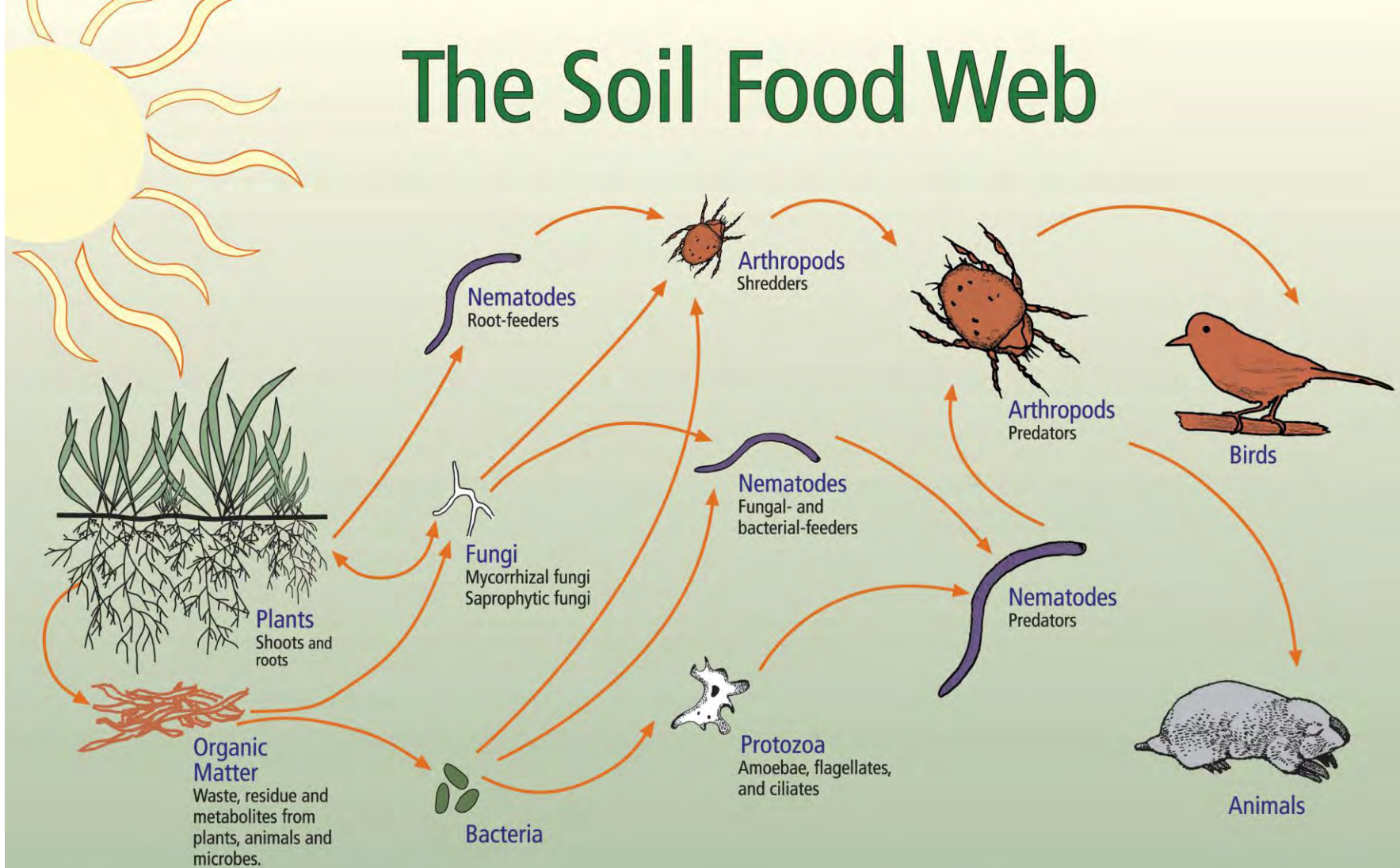
- rapid woody growth
- litter chemistry and inputs





As well as a different soil microbial community.

# The Soil Food Web



- First trophic level:** Photosynthesizers
- Second trophic level:** Decomposers, Mutualists, Pathogens, Parasites, Root-feeders
- Third trophic level:** Shredders, Predators, Grazers
- Fourth trophic level:** Higher level predators
- Fifth and higher trophic levels:** Higher level predators

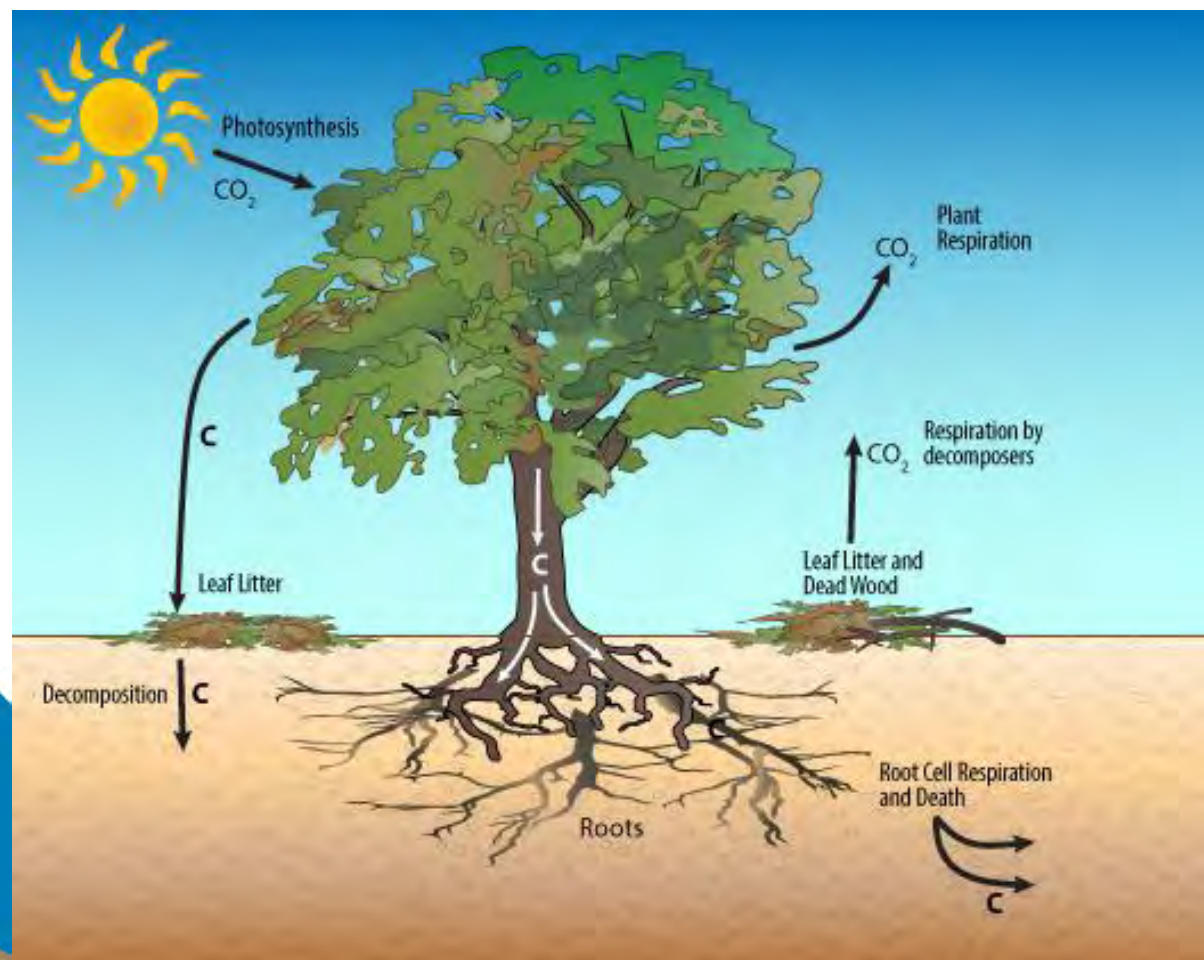
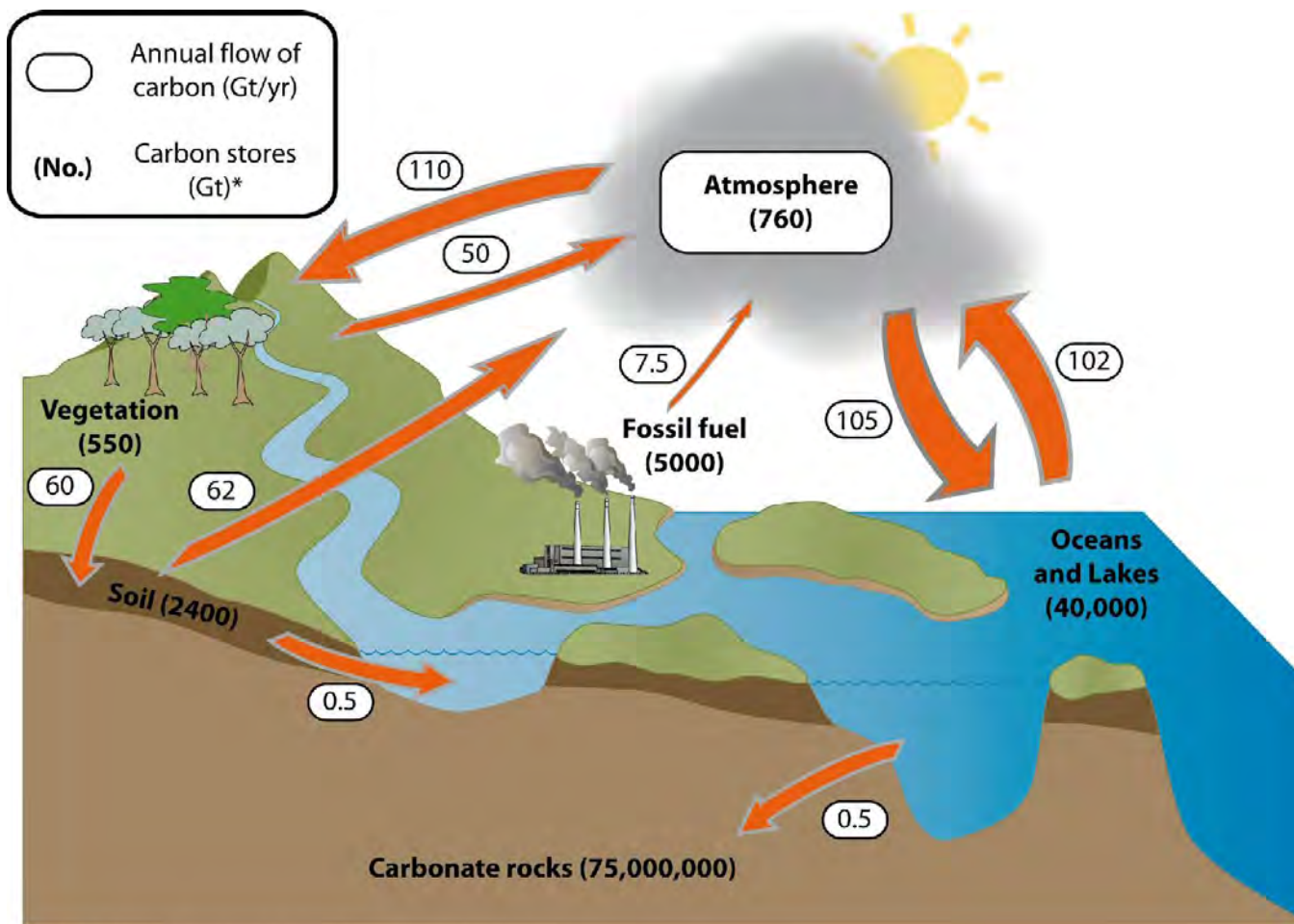




*Illustration of 1 cm<sup>3</sup> of soil (Elliott and Coleman, 1988)*

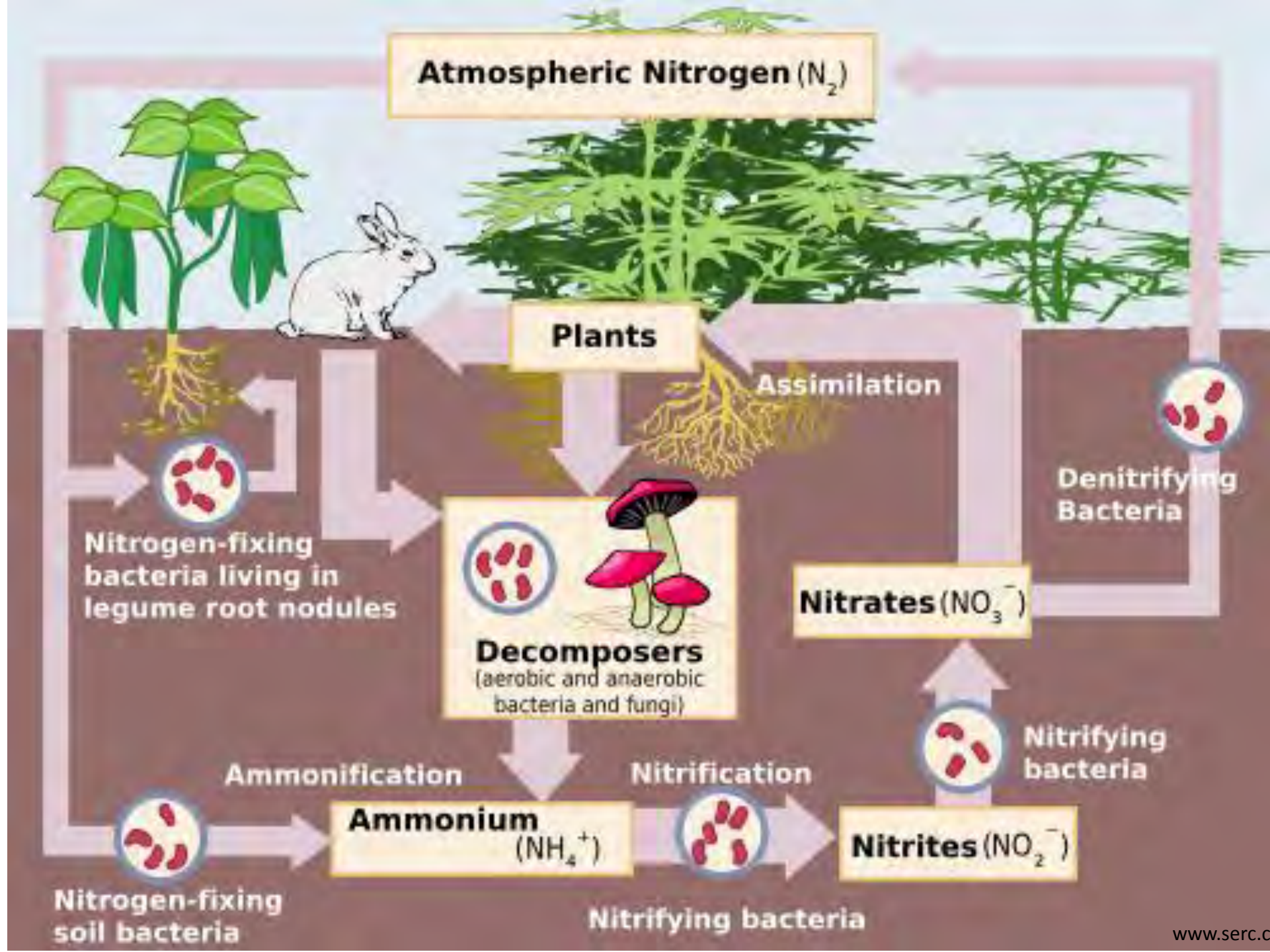


# Carbon Cycle



\* 1 Gt = 1 Gigatonne = 1 billion metric tonnes







# Mycorrhizal fungi



-Symbiotic fungi which exchange Nitrogen and Phosphorous for photosynthetic carbohydrates

-Associate with ~90% of all land plant species

-Two main kinds of mycorrhizal fungi:

1. Ectomycorrhizal
2. Arbuscular mycorrhizal



# 1. Ectomycorrhizal fungi (EMF)

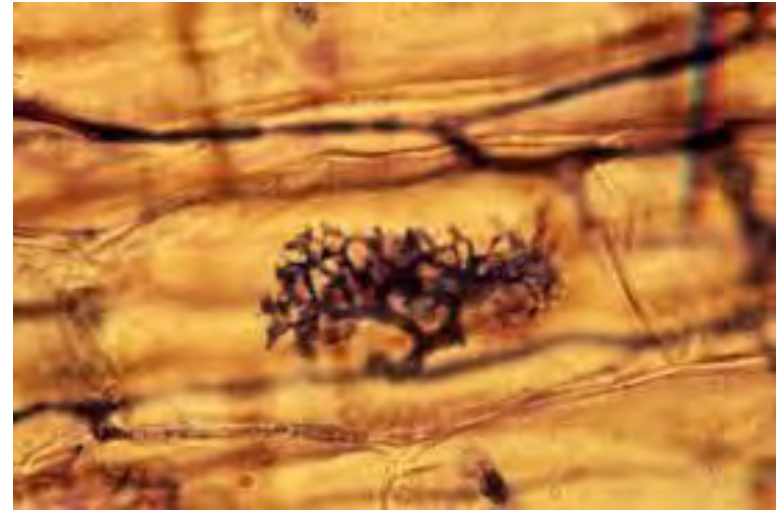
- Possess extracellular degradative enzymes capable of soil organic matter decomposition
- Mineralize organic N and P with their nutrient scavenging hyphae
- Pines are obligately ectomycorrhizal





## 2. Arbuscular Mycorrhizal Fungi (AMF)

- Common and generally less host-specific; limited if any saprotrophic abilities.
- Play an important role in plant biodiversity, as well as in C and inorganic P cycles
- California northern coastal scrub plants associate primarily with AMF





# Aboveground impacts



*Invasive Plant Science and Management* 2013 6:231–242

## Invasive Pine Tree Effects on Northern Coastal Scrub Structure and Composition

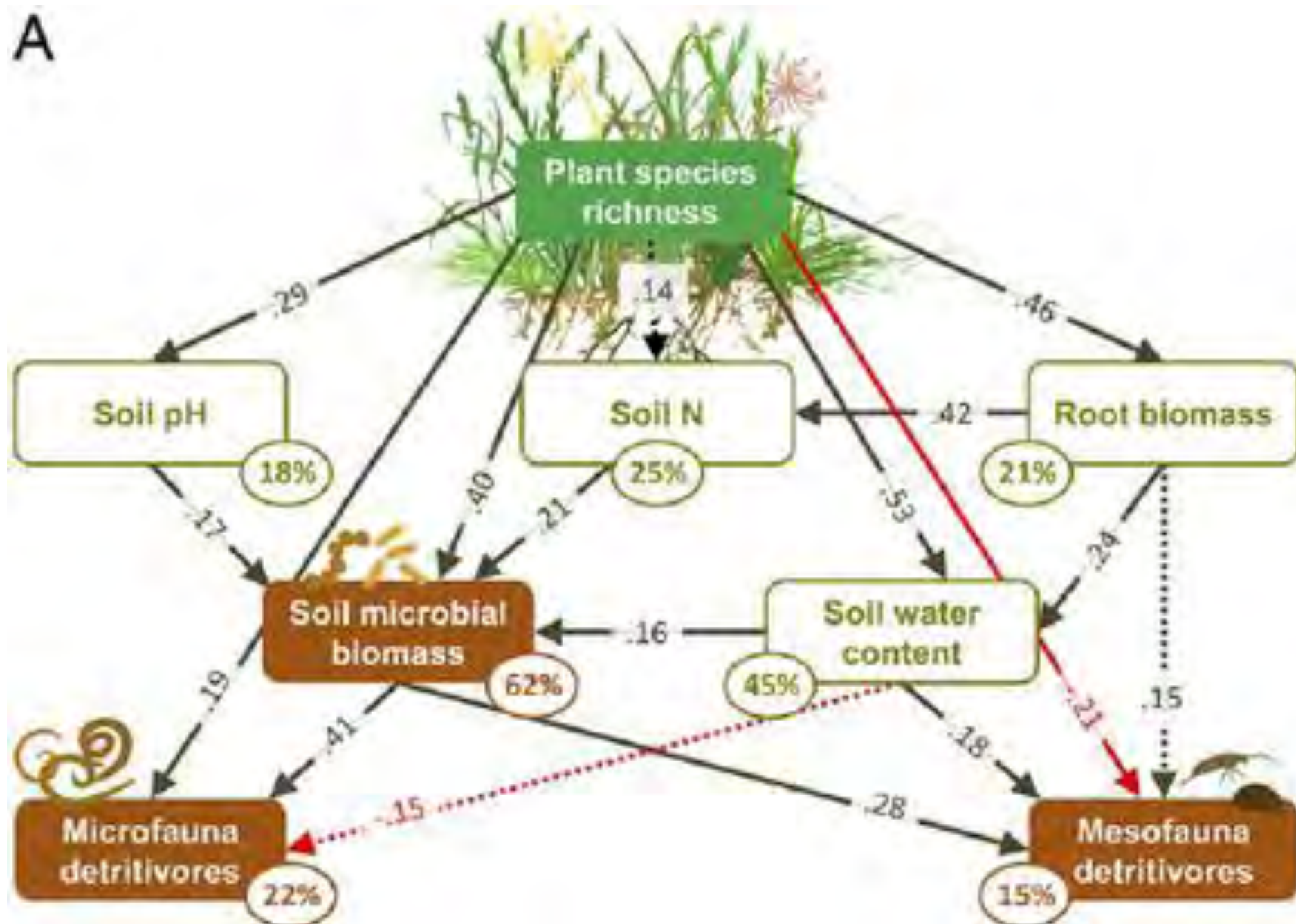
Robert J. Steers, Susan L. Fritzke, Jen J. Rogers, James Cartan, and Kaitlyn Hacker\*

-Invasive Monterey pine cover was negatively correlated with native cover and species richness





A







Collect soil samples for fungal DNA extraction and characterizing the soil environment



Extract fungal DNA from pine root tips and sequence the ITS region to identify fungal taxa.



Compare EMF communities in the native vs. invasive range for Monterey pines in California.

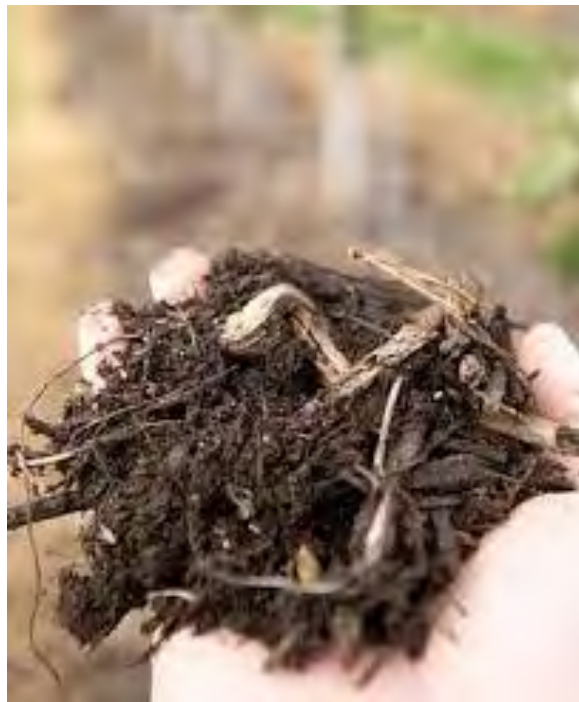


Measure important soil variables in the invaded range





C mineralization: measure heterotrophic respiration by rate of CO<sup>2</sup> efflux



Soil organic matter content



*In situ* N mineralization cores



Soil pH



# Litter

- Litter traps to measure litterfall mass
- Measure decomposition rates with litter bags



[forestprime.wordpress.com/litter-trap](http://forestprime.wordpress.com/litter-trap)





Effects of  
management?

Consequences  
for  
restoration?







Questions?

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