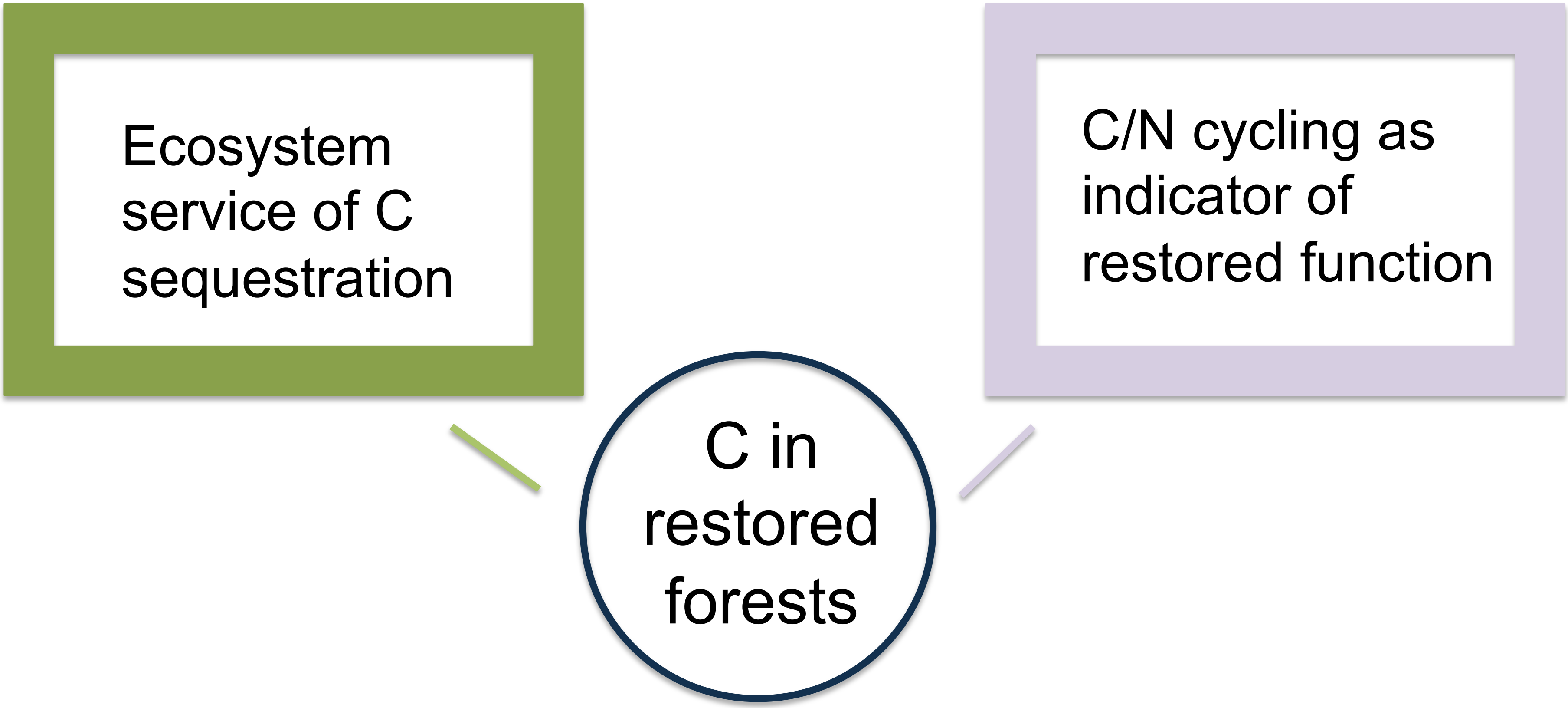
Carbon pools and carbon credits along a restoration chronosequence

Virginia Matzek, Santa Clara University

C in restored forests

C/N cycling as indicator of restored function

C in restored forests


Ecosystem service of C sequestration
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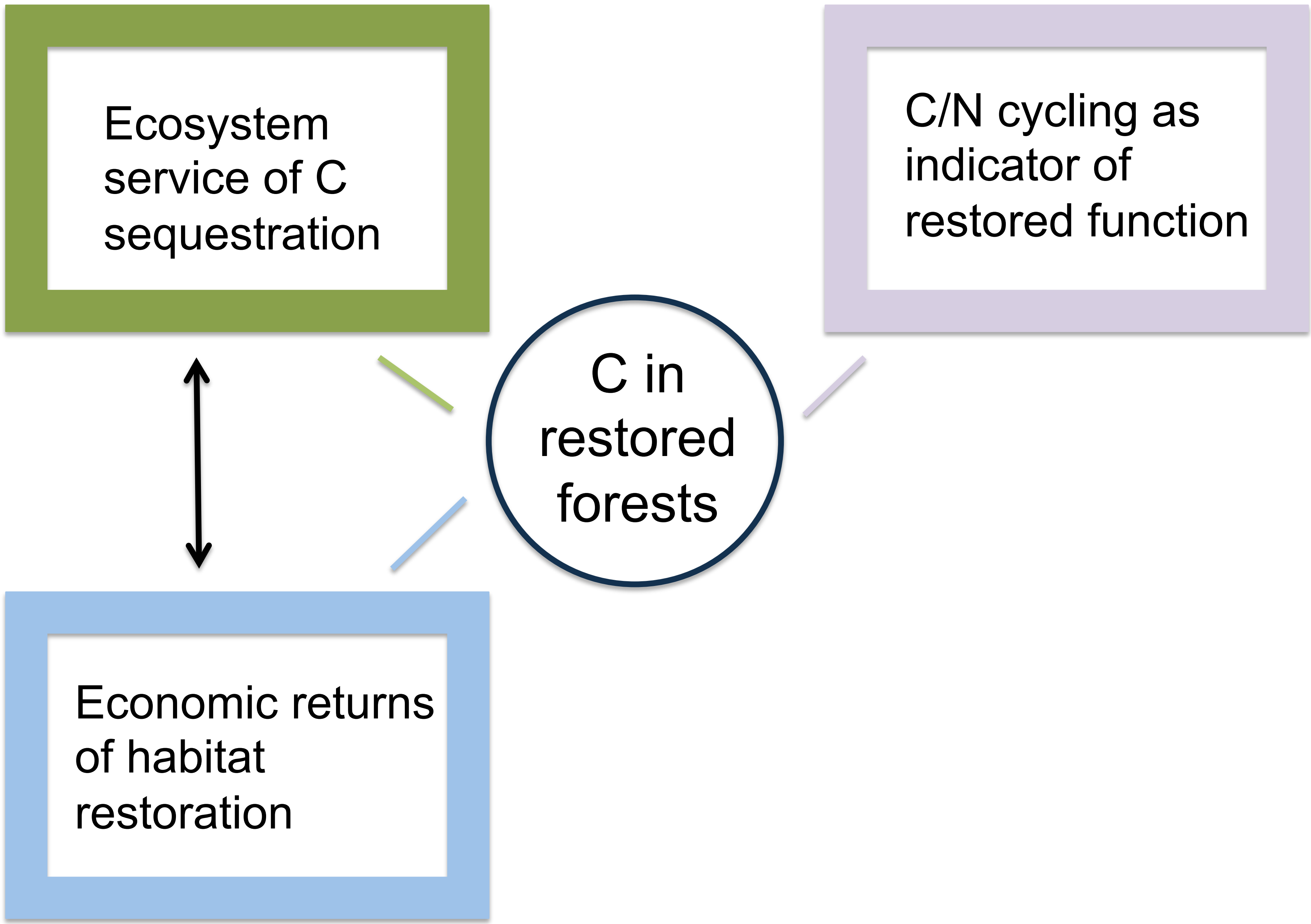
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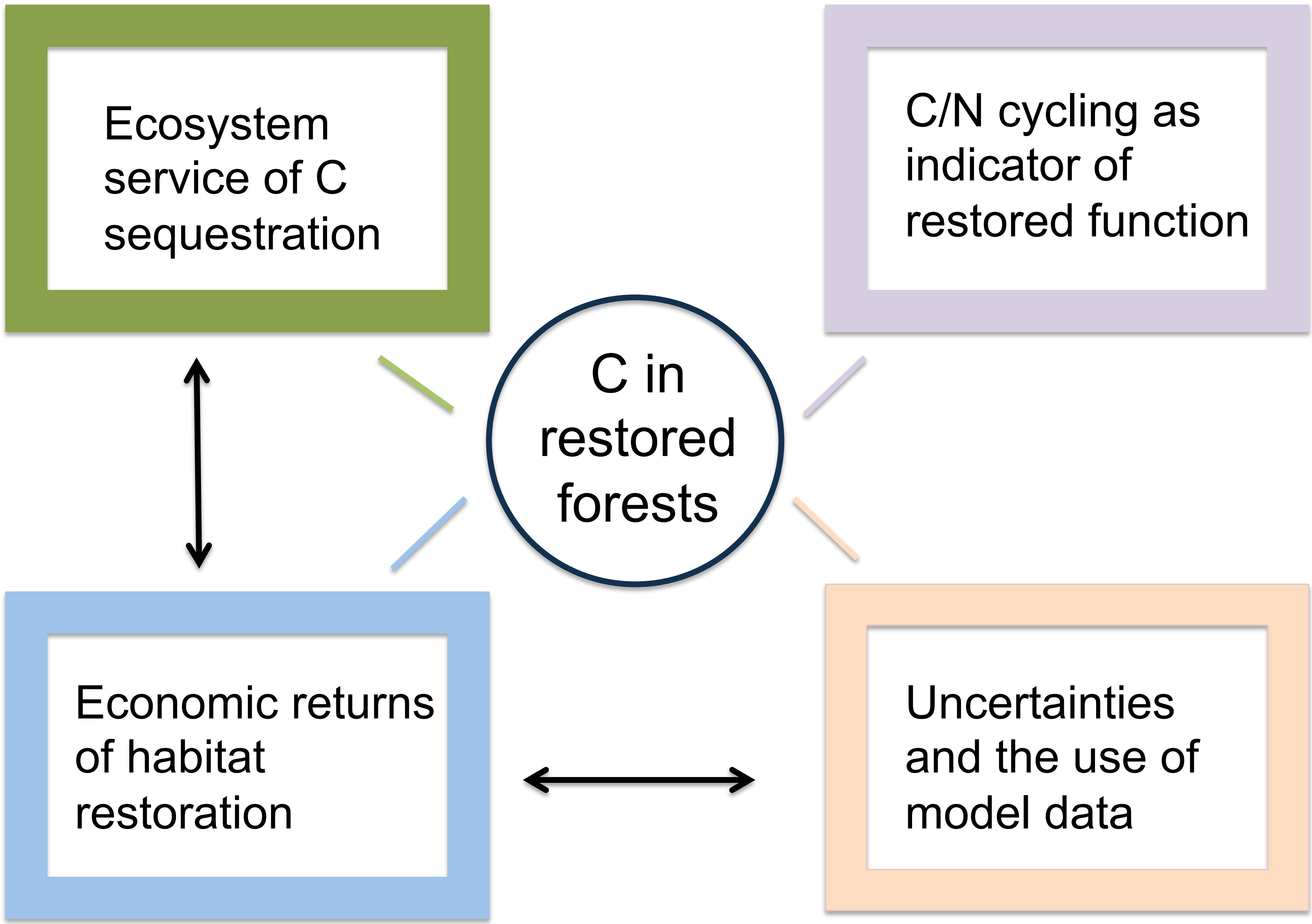
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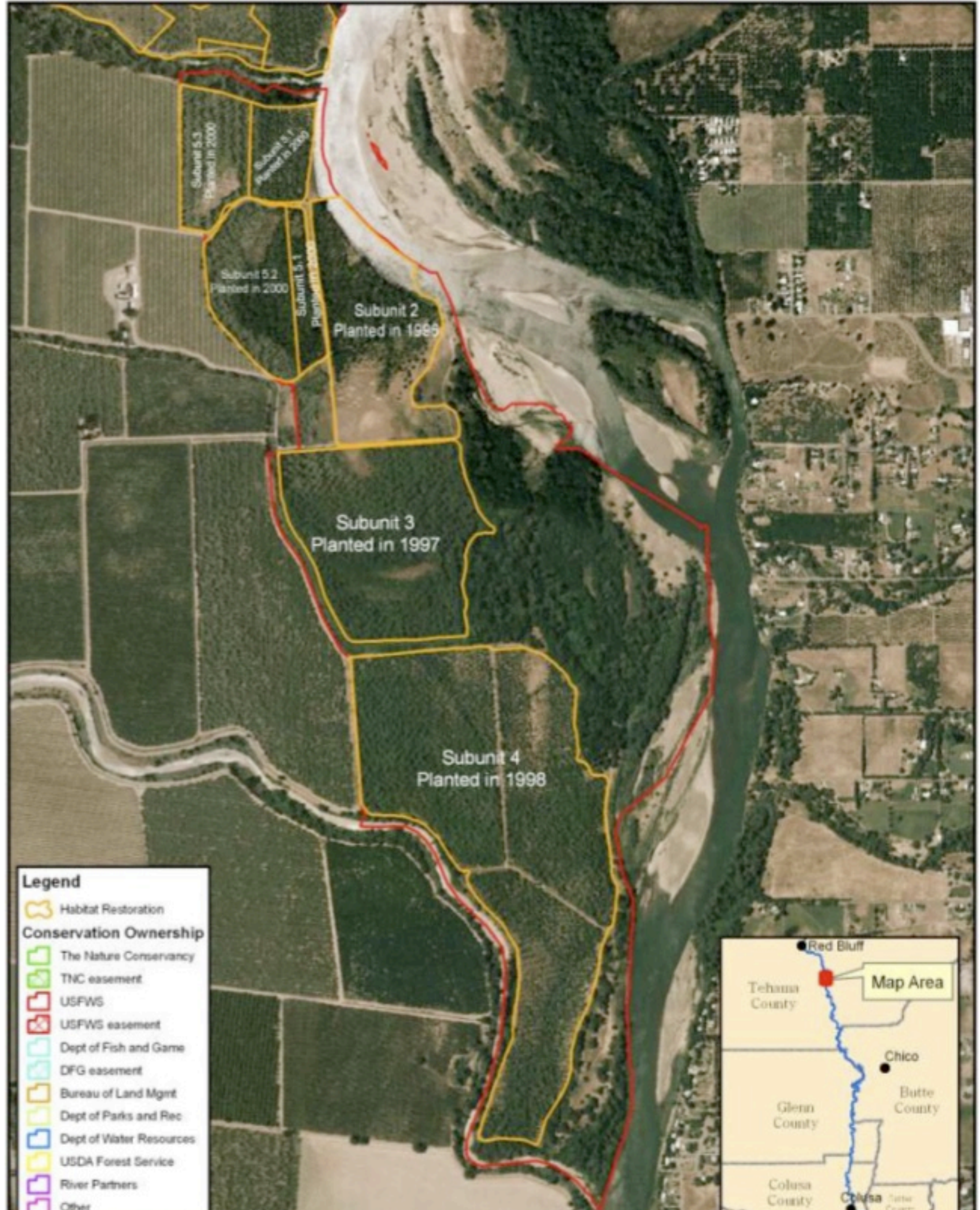
Uncertainties and the use of model data

We use a chronosequence approach, a substitution of space for time

Mixed riparian forest sites in 5 age classes + remnants

2-4 sites per age;
3 subplots per site



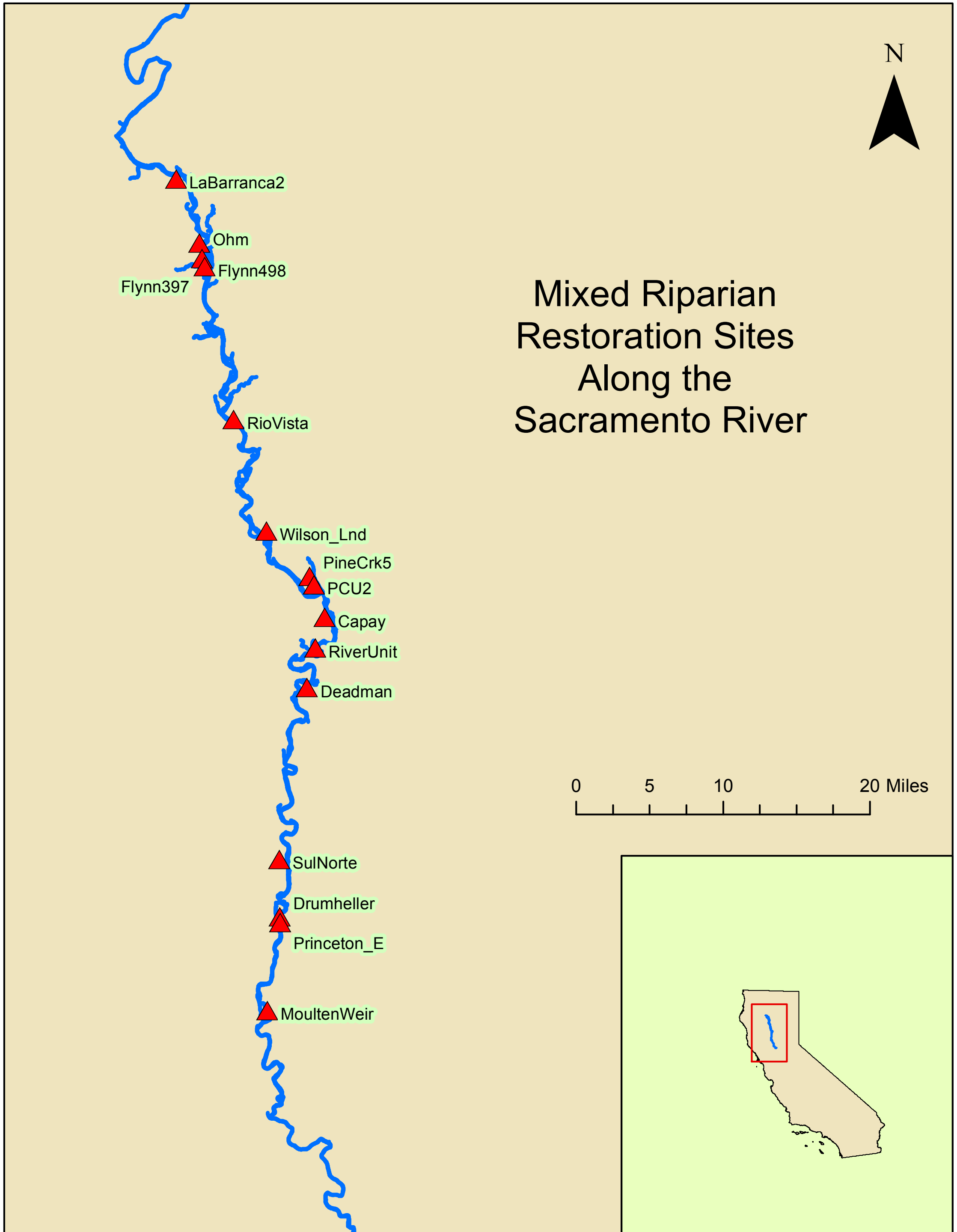
Under 5
Wilson Landing

5-6 years
Capay
Deadman's Reach
Drumheller
Pine Creek

9-10 years
LaBarranca
Moulton Weir
Ohm
Sul Norte

14-15 years
Flynn (2)
Pine Creek
Rio Vista

19-21 years
Princeton East
River Unit



C/N cycling as indicator of restored function

C in restored forests

C/N cycling as indicator of restored function

How many years until restored forests function like remnant forests? Is there a trajectory?

- Litterfall
- Fine root production
- Soil C mineralization
- Soil N mineralization
- Soil and leaf C, N, ^{15}N
- C:N:P in biomass

Sun leaves of canopy species sampled with slingshot

Root ingrowth core method to measure fine root production and C:N:P

Plastic mesh tubes packed with sieved, root-free native soil


Flynn 397
sub3
Ingrowth Core#1

Moistened soils are incubated for 60 days at 30°C

Sampled periodically for CO_2 emission and NO_3/NH_4 content

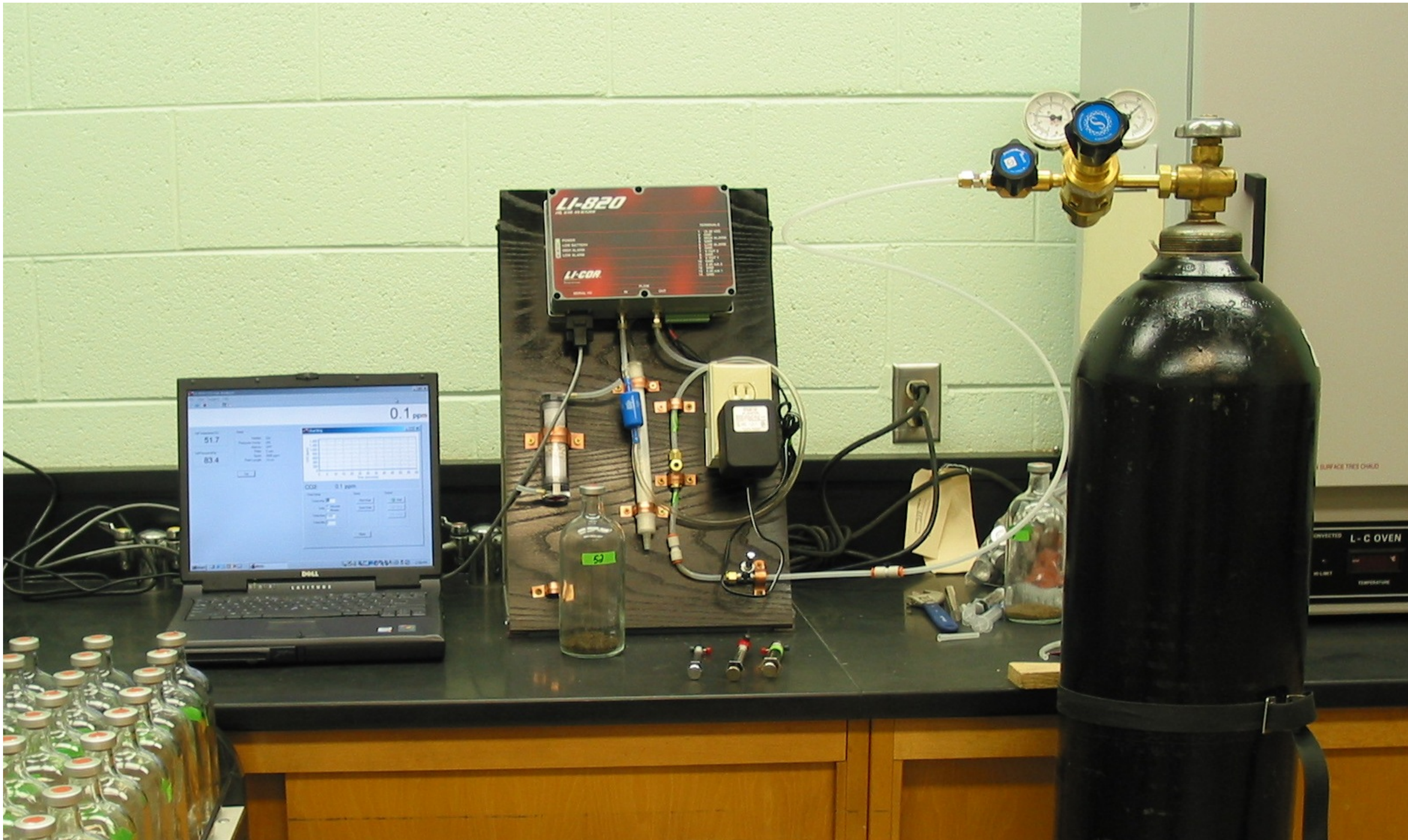
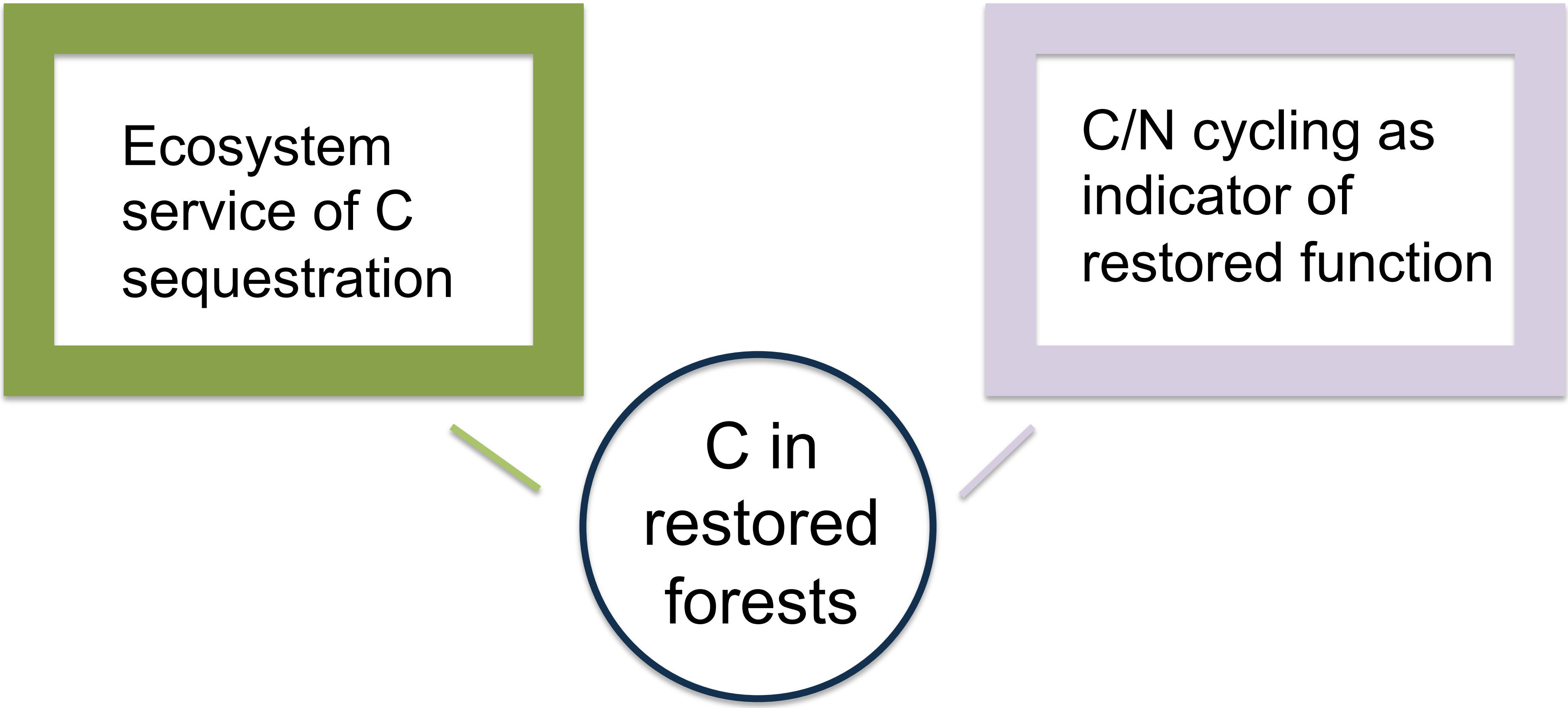


Photo courtesy Lucretia Sherrod, USDA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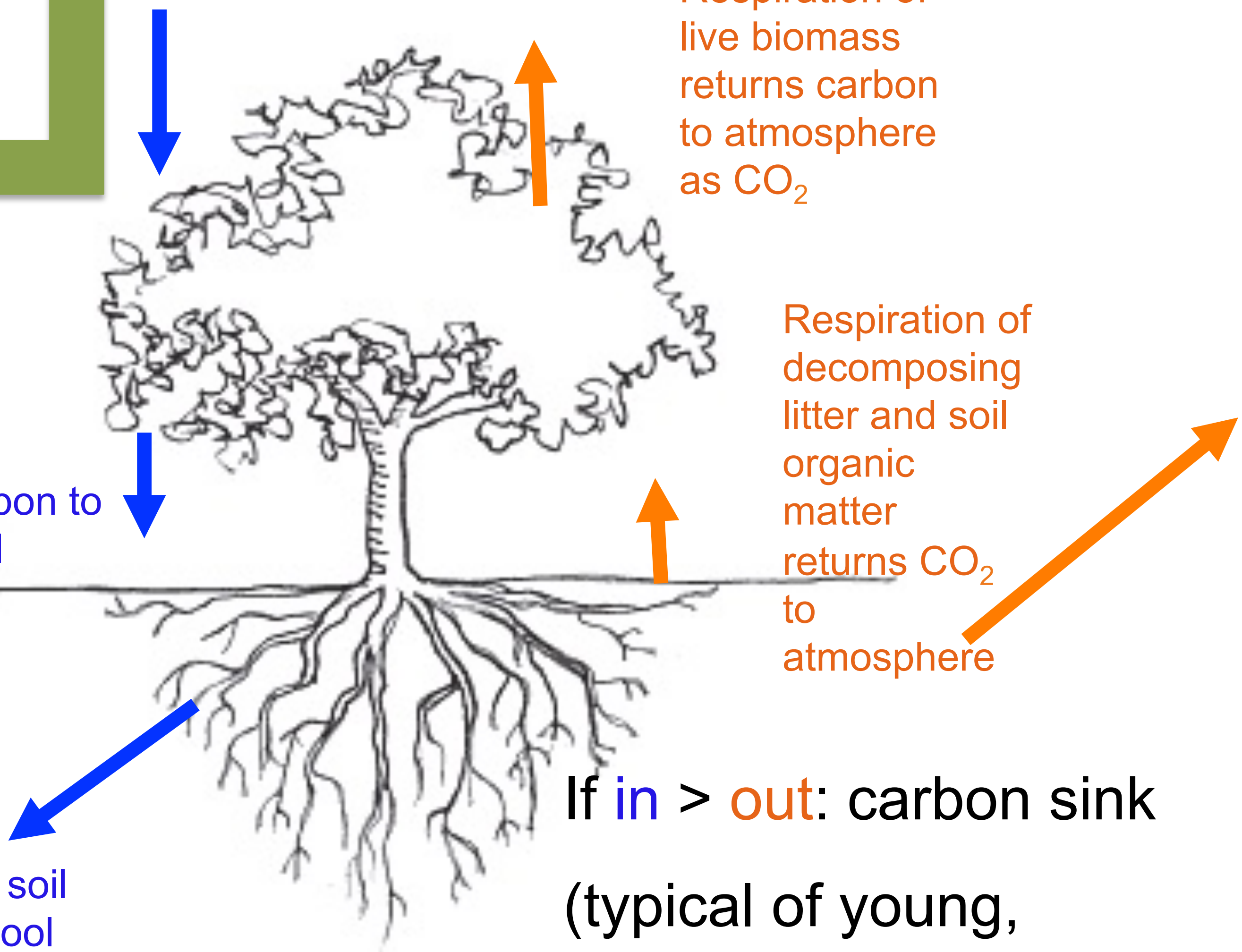
Ecosystem service of C sequestration



If in > out: carbon sink

(typical of young, aggrading forests)

Ecosystem service of C sequestration

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Economic returns of habitat restoration

AB32 authorizes reduction of GHG emissions in CA via cap-and-trade

Carbon stocks to be verified in reforestation projects

- Aboveground tree biomass
- Shrub and understory biomass
- Litter/duff
- Standing dead trees
- Coarse woody debris (lying dead)
- Soil*

–

- Emissions associated with planting and site preparation

CLIMATE ACTION RESERVE

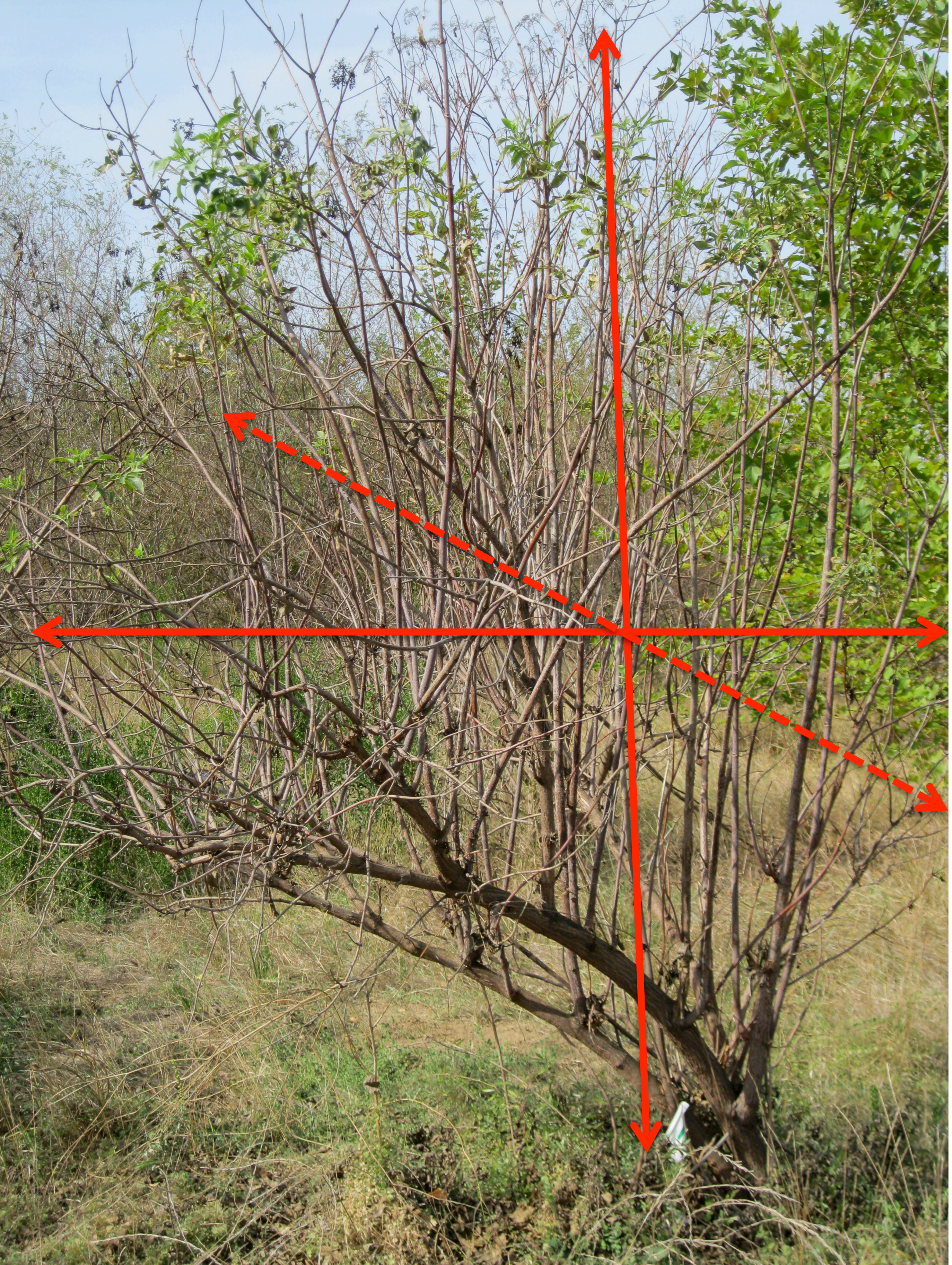
Tree diameter at breast height (dbh)

Species-specific allometric equations relate dbh to total tree biomass

Populus fremontii
Wood biomass (g) =
$-38248.29 + 359.69(\text{dbh})^2$

AAAAACK!

For shrubs, an allometric equation relates their ellipsoid volume to total biomass.



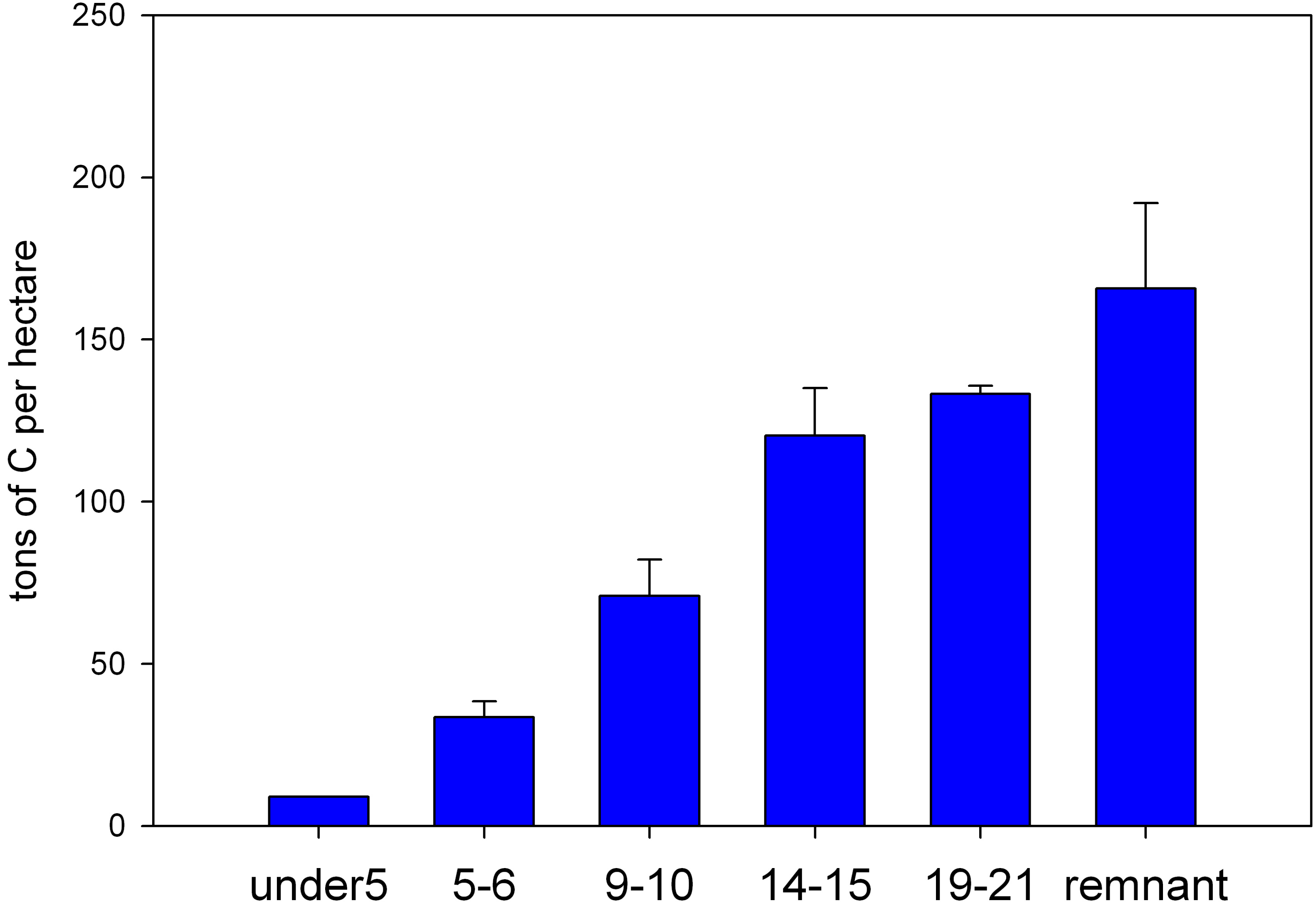
For shrubs, an allometric equation relates their ellipsoid volume to total biomass.

Herbaceous biomass was clipped down to ground level, and all litter/duff collected

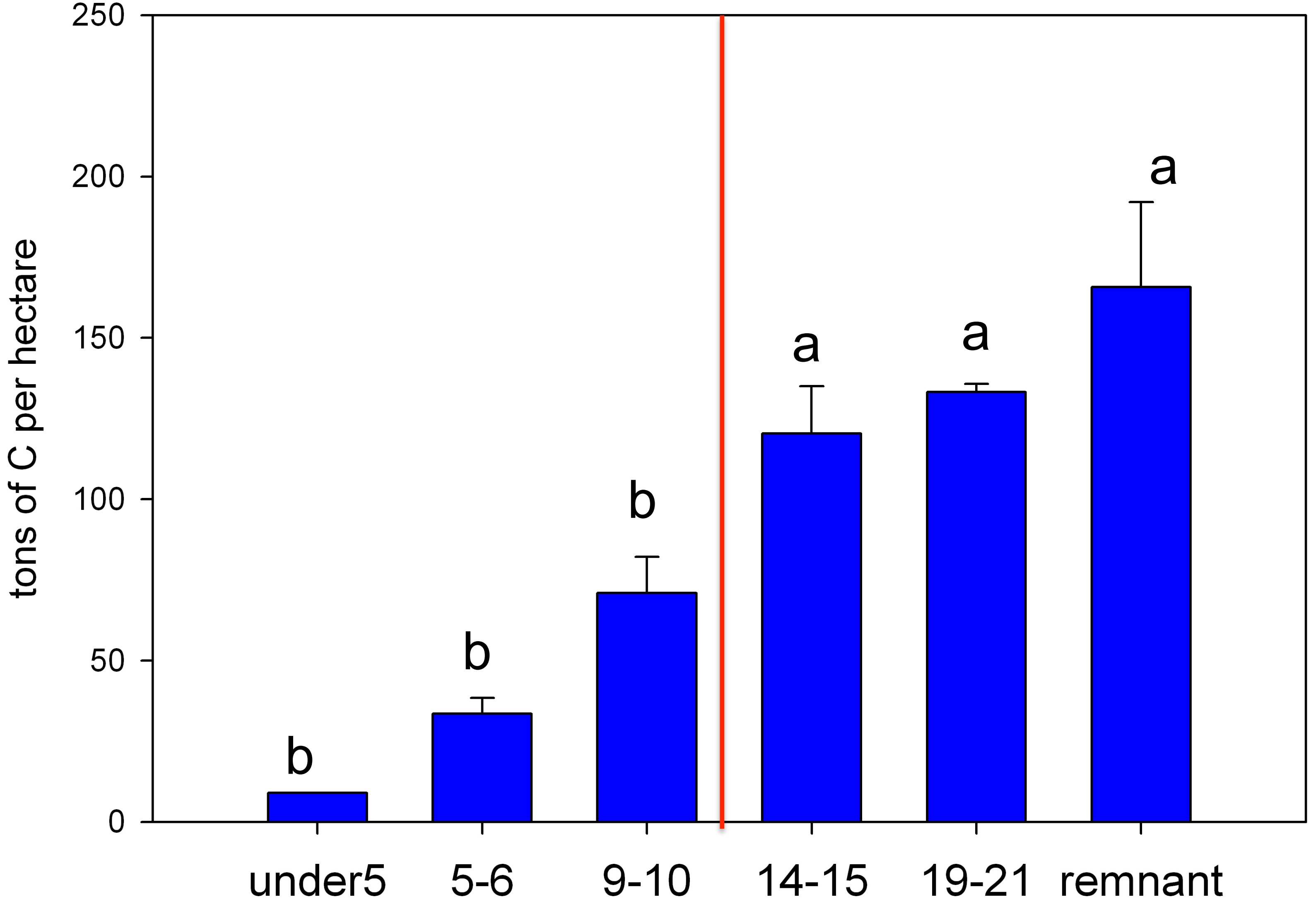
Coarse woody debris (lying dead wood) measured and classified by soundness

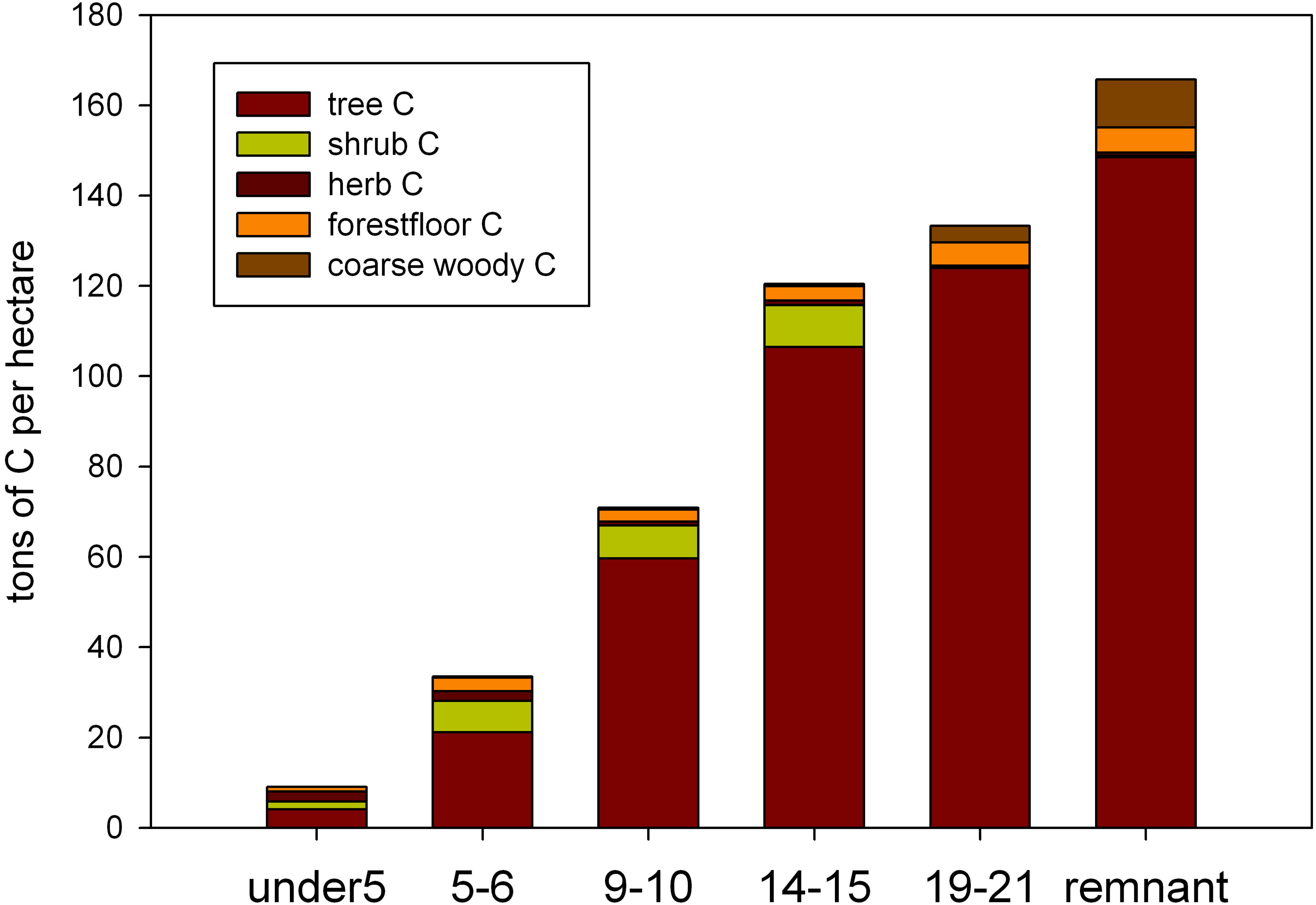
4 30-cm-deep soil samples per subplot
3 subplots per site, 2-4 sites per age class

Total biomass stocks (not including soil carbon)



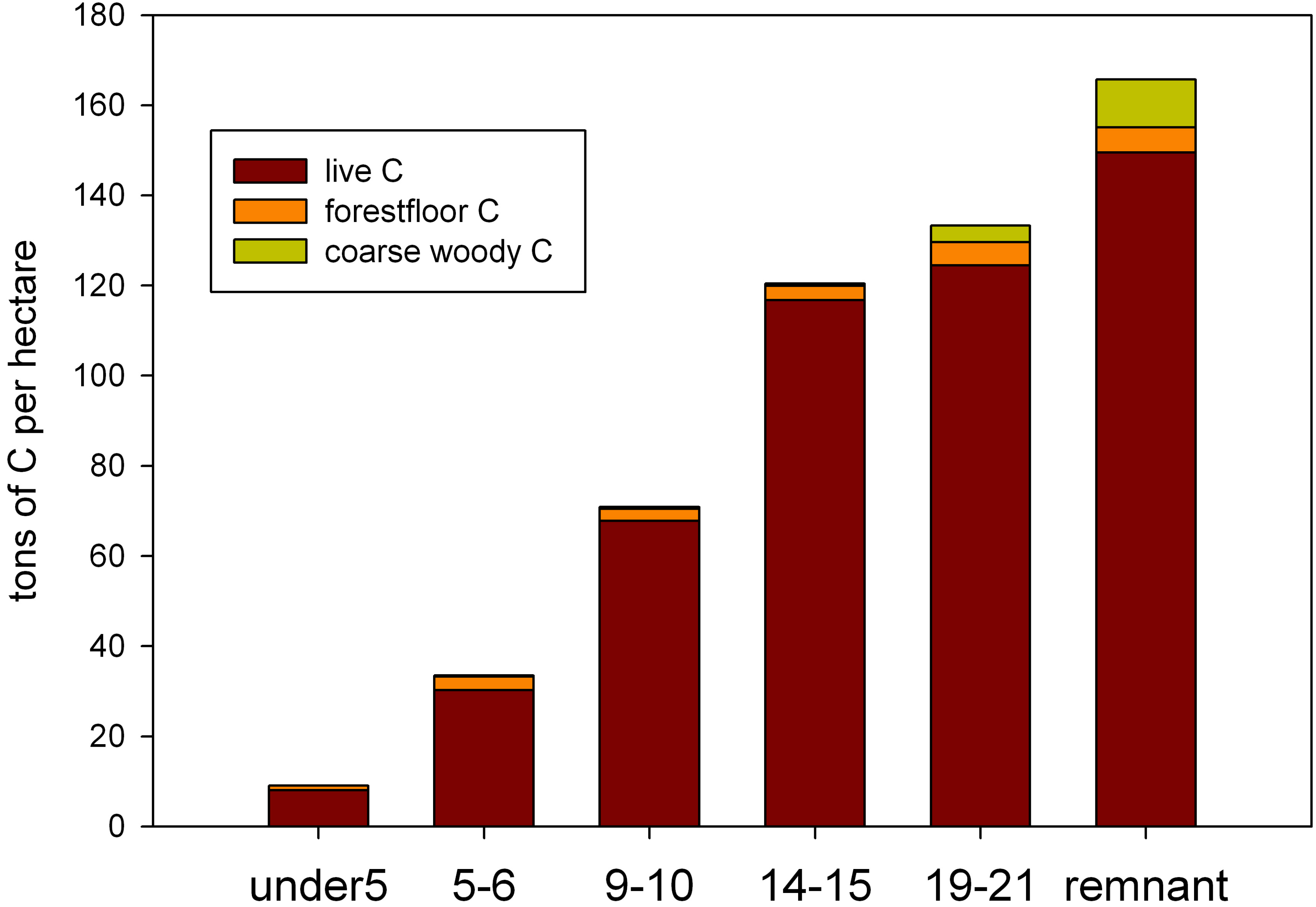
Threshold occurs after ~1 decade where stocks are similar to remnant forests

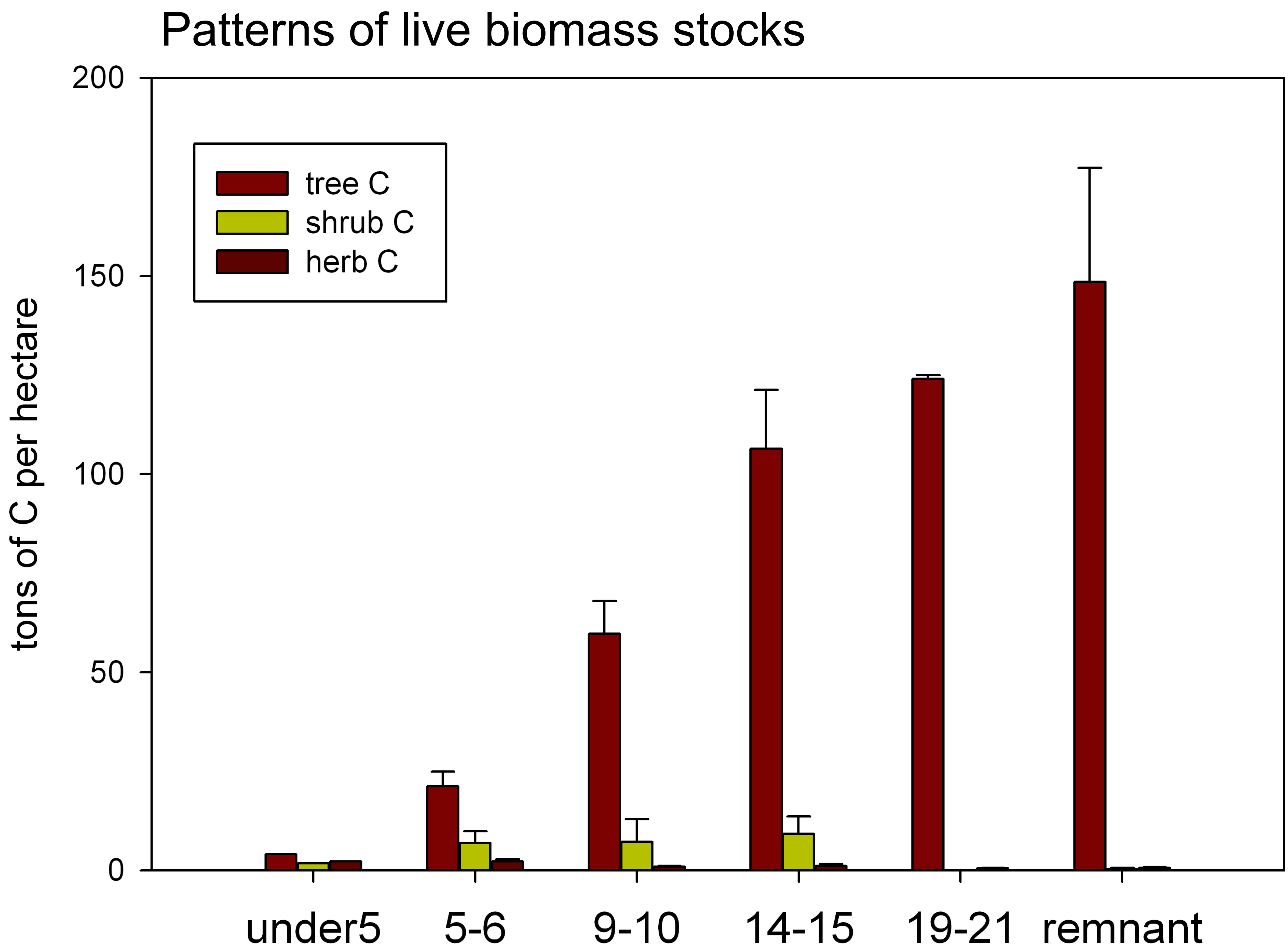




tons of C per hectare
180
160
140
120
100
80
60
40
20
0
tree C
shrub C
herb C
forestfloor C
coarse woody C
under5
5-6
9-10
14-15
19-21
remnant

Live = tree+shrub+herb




Patterns of live biomass stocks
tons of C per hectare
0
50
100
150
200
tree C
shrub C
herb C
under5
5-6
9-10
14-15
19-21
remnant

At today's auction price for a ton of carbon:

<5 years old

5-6 years old

9-10 years old

14-15 years old

19+ years old

At today’s auction price for a ton of carbon:

<5 years old

Wait…a few caveats…

5-6 years old

9-10 years old

14-15 years old

19+ years old

At today's auction price of $14/ton of carbon:

<5 years old	$126/ha
5-6 years old	$469/ha
9-10 years old	$992/ha
14-15 years old	$1686/ha
19+ years old	$1865/ha

Total value of currently restored acreage after 20 years of growth:

$4,528,220

Cost of planting and verification

Emissions associated with planting

Uncertainties abound

$4,528,220

Variance in biomass estimate (±10-15%)

Confidence deductions

Insurance against risk

Carbon price can range from $10 to $50 a ton (-28% to +250%)

Erik Nelson, Bowdoin University

Will use InVEST model to analyze land-use patterns, crop income, and conservation credits

Economic returns of habitat restoration

↔

Uncertainties and the use of model data

What do almond growers make?

Income maxes out at ~ $3600/ha…annually
vs. $1865/ha for carbon credits after 20 years

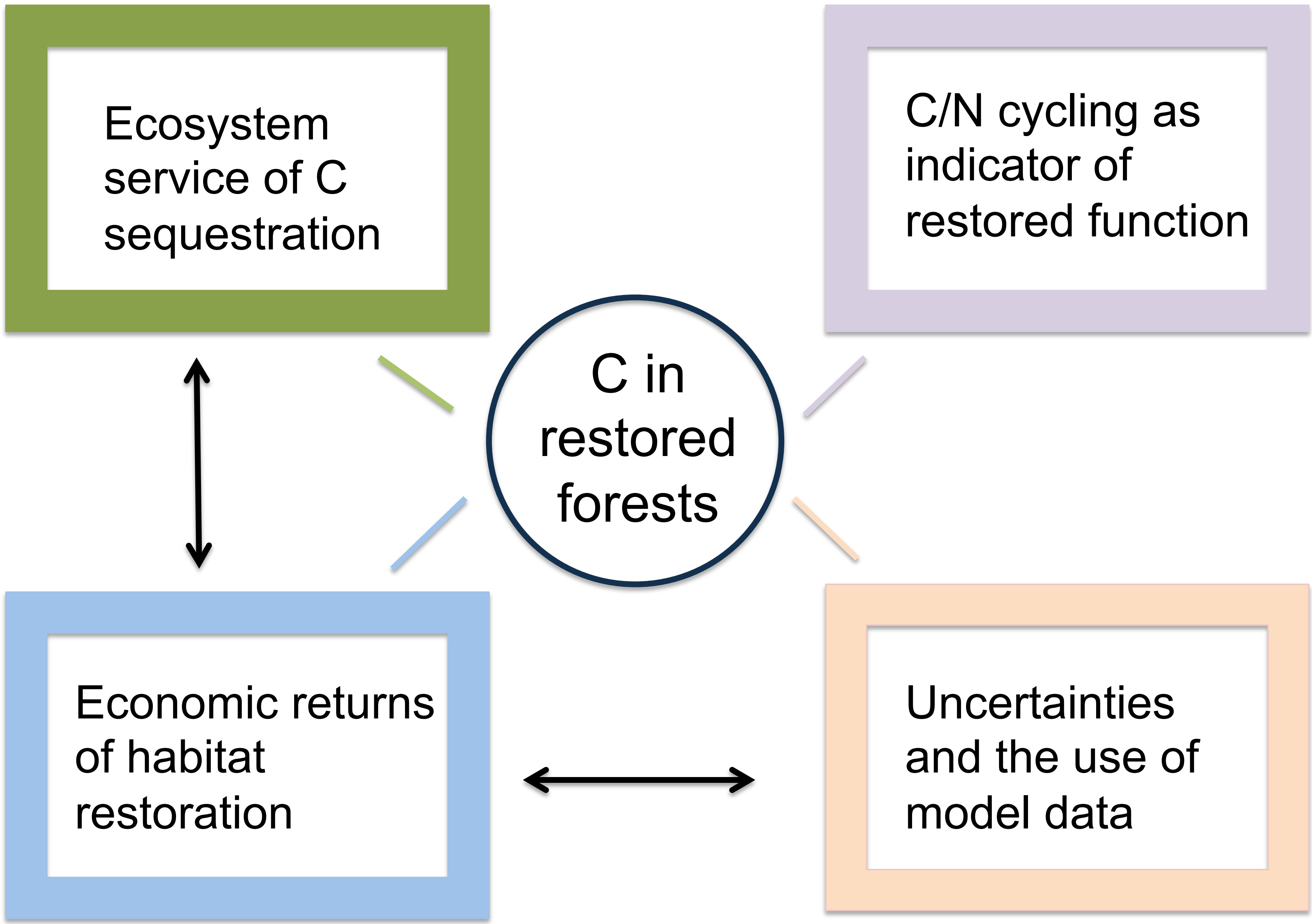
Will compare forest growth and soil nutrient cycling models to actual data, to see if models predict riparian forest C sequestration well

Cedric Puleston, UC Davis

Economic returns of habitat restoration

↔

Uncertainties and the use of model data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