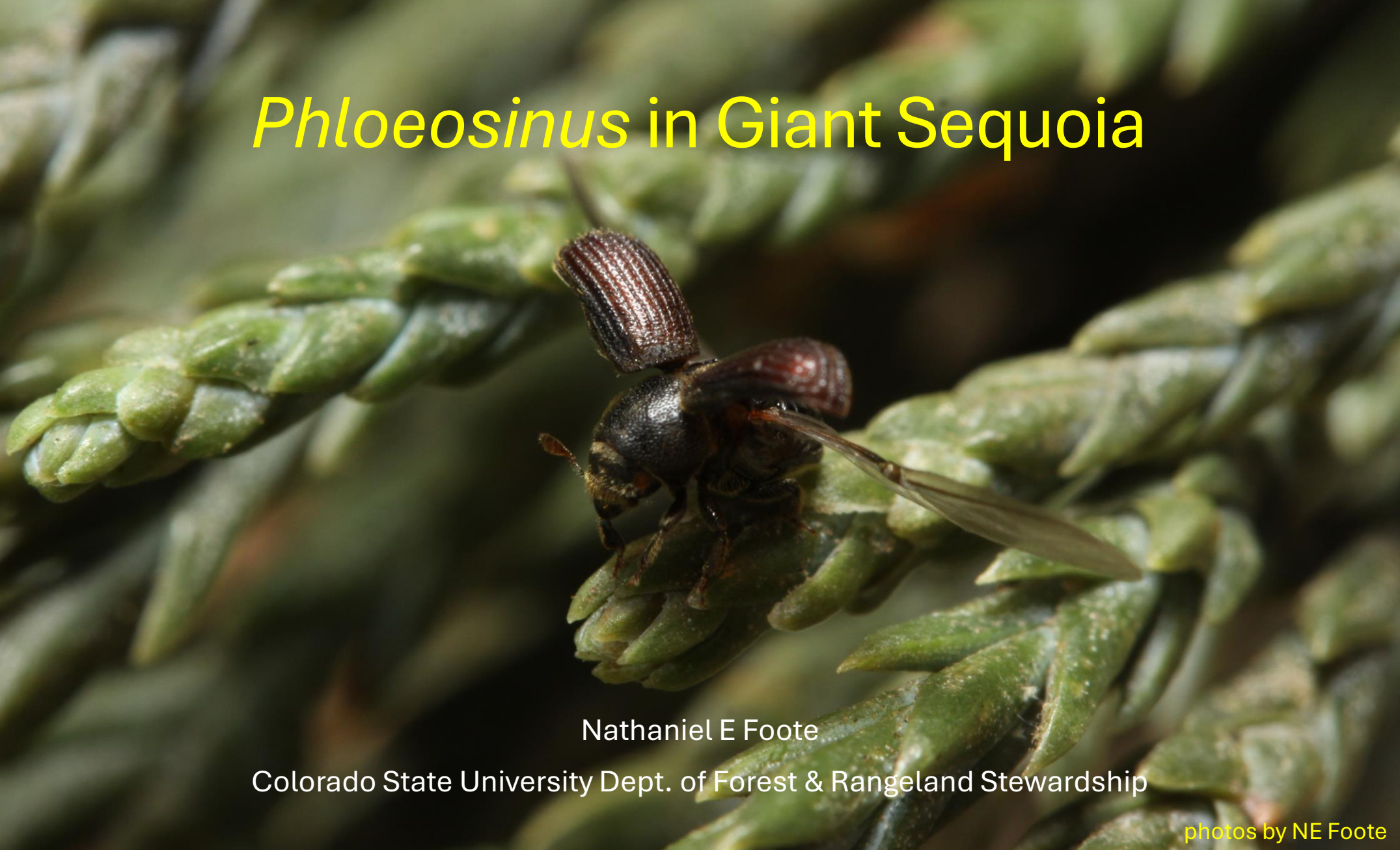
Phloeosinus in Giant Sequoia



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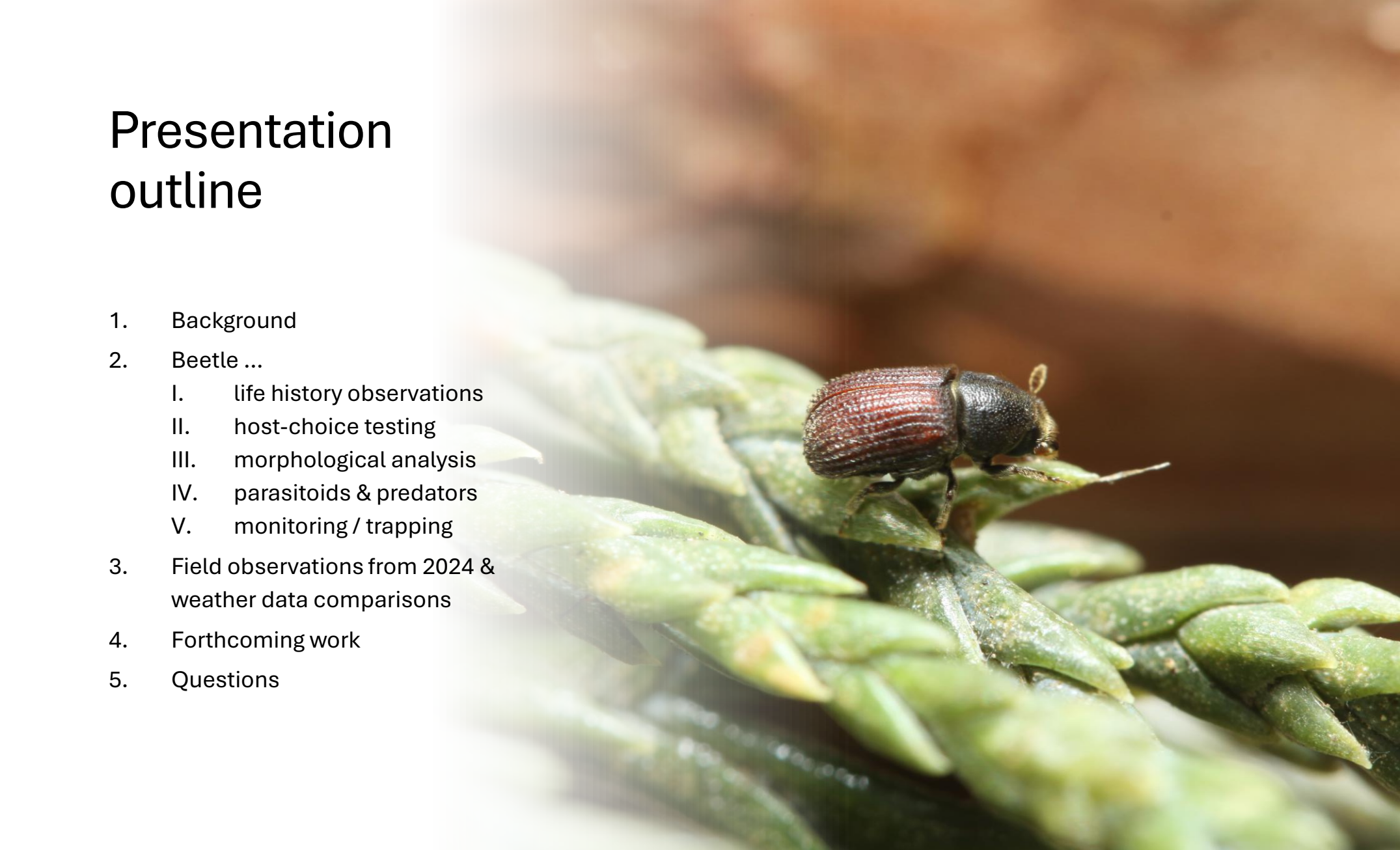
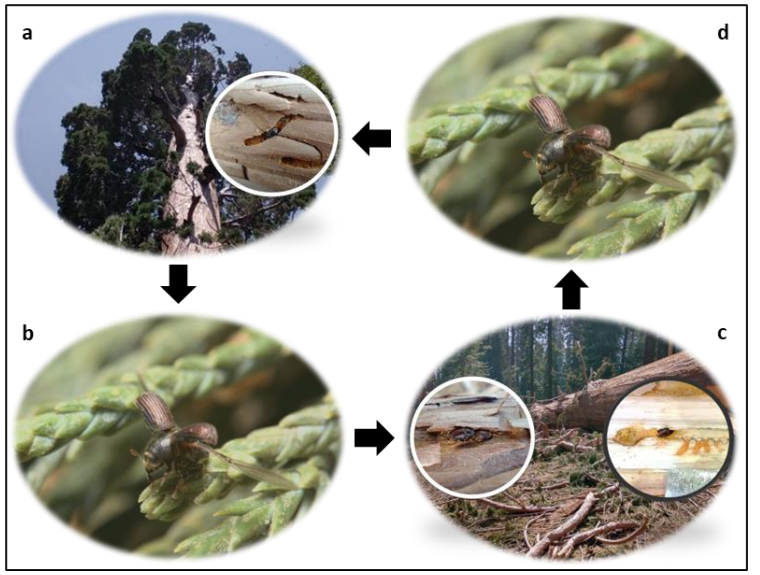
photos by NE Foote

Presentation outline

1. Background
2. Beetle …
   I. life history observations
   II. host-choice testing
   III. morphological analysis
   IV. parasitoids & predators
   V. monitoring / trapping
3. Field observations from 2024 & weather data comparisons
4. Forthcoming work
5. Questions



Beetle life history observations, Mariposa Grove

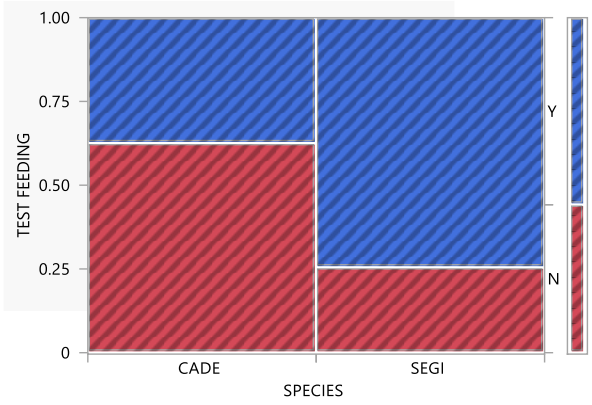


Month	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Crown												
Forest Floor												
Overwintering												
Flight												
Reproducing												

Left: Photographic flow-chart of beetle location and activity, one generation per year; a) adults overwintering and sheltering in giant sequoia crowns, b) spring flight to downed branches on forest floor, c) mating, egg gallery construction and reproduction, d) summer thru early fall flight returning to giant sequoia crowns. **Right:** 2020-2023 field observations of adult beetle location and biological activity; blue denotes single generation per year, red denotes partial or complete second generation in same year.

Host choice testing

- Beetles collected using aerial net during spring swarming flight in Mariposa Grove
- 70 containers provided one giant sequoia and one incense-cedar branch cutting (from Mariposa Grove), and two beetle mating pairs each
- Per every branch cutting, observations made of:
  - ‘Test’ feeding
  - ‘Selection’ feeding
  - Gallery entrance formation

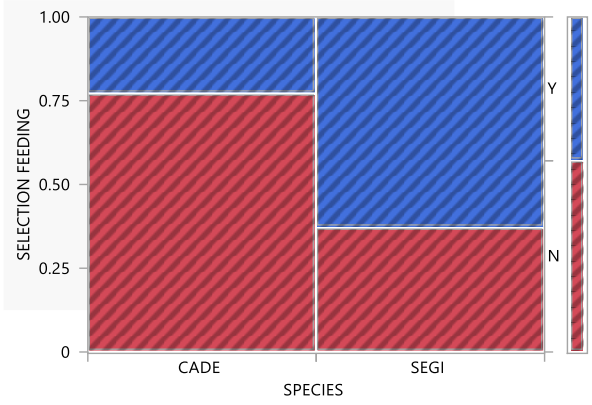


Count Total %	N	Y	Total
CADE	22 31.43	13 18.57	35 50.00
SEGI	9 12.86	26 37.14	35 50.00
Total	31 44.29	39 55.71	70

N	DF	-LogLike	RSquare (U)
70	1	5.0206019	0.1045

Test	ChiSquare	Prob>ChiSq
Likelihood Ratio	10.041	0.0015*
Pearson	9.785	0.0018*

Fisher's Exact Test	Prob	Alternative Hypothesis
Left	0.9997	Prob(TEST FEEDING=Y) is greater for SPECIES=CADE than SEGI
Right	0.0018*	Prob(TEST FEEDING=Y) is greater for SPECIES=SEGI than CADE
2-Tail	0.0036*	Prob(TEST FEEDING=Y) is different across SPECIES

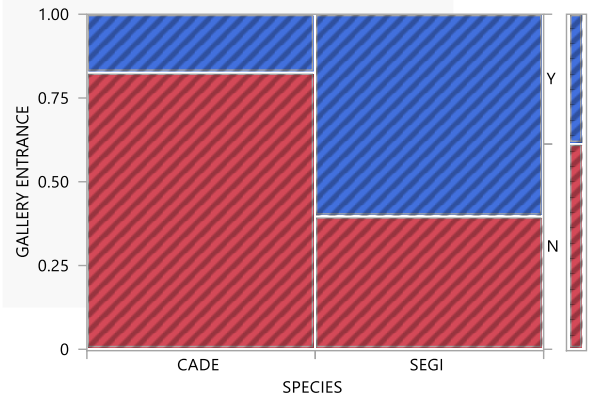


Count Total %	N	Y	Total
CADE	27 38.57	8 11.43	35 50.00
SEGI	13 18.57	22 31.43	35 50.00
Total	40 57.14	30 42.86	70

N	DF	-LogLike	RSquare (U)
70	1	5.8996064	0.1234

Test	ChiSquare	Prob>ChiSq
Likelihood Ratio	11.799	0.0006*
Pearson	11.433	0.0007*

Fisher's Exact Test	Prob	Alternative Hypothesis
Left	0.9999	Prob(SELECTION FEEDING=Y) is greater for SPECIES=CADE than SEGI
Right	0.0007*	Prob(SELECTION FEEDING=Y) is greater for SPECIES=SEGI than CADE
2-Tail	0.0015*	Prob(SELECTION FEEDING=Y) is different across SPECIES



Count Total %	N	Y	Total
CADE	29 41.43	6 8.57	35 50.00
SEGI	14 20.00	21 30.00	35 50.00
Total	43 61.43	27 38.57	70

N	DF	-LogLike	RSquare (U)
70	1	7.0850120	0.1518

Test	ChiSquare	Prob>ChiSq
Likelihood Ratio	14.170	0.0002*
Pearson	13.566	0.0002*

Fisher's Exact Test	Prob	Alternative Hypothesis
Left	1.0000	Prob(GALLERY ENTRANCE=Y) is greater for SPECIES=CADE than SEGI
Right	0.0002*	Prob(GALLERY ENTRANCE=Y) is greater for SPECIES=SEGI than CADE
2-Tail	0.0005*	Prob(GALLERY ENTRANCE=Y) is different across SPECIES

Morphological measurements of adult *Phloeosinus* associating with giant sequoia and incense-cedar

Table 3. A comparison of mean (± SE) morphological trait values for *Phloeosinus punctatus* emerging from giant sequoia and incense-cedar and accompanying univariate (2-sample Student's *t*-test) test statistics

	Tree species			
Morphological trait	Giant sequoia	Incense-cedar	Student's *t* test	*P*-value
Antennal length	0.436 ± 0.003	0.390 ± 0.004	7.626	<0.001
Abdominal length	1.087 ± 0.011	0.959 ± 0.011	7.847	<0.001
Body length	3.130 ± 0.022	2.695 ± 0.034	10.548	<0.001
Elytron length	2.161 ± 0.015	1.848 ± 0.024	10.763	<0.001
Pronotum width	1.303 ± 0.008	1.165 ± 0.014	8.089	<0.001
Head width	0.860 ± 0.009	0.766 ± 0.010	6.809	<0.001
Interstriae width	0.625 ± 0.006	0.565 ± 0.06	6.694	<0.001
Interstriae: pronotum ratio	2.087 ± 0.016	2.062 ± 0.017	1.038	0.303

Bold type denotes significant effects.

from Foote et al. (2024), *Environ. Entomol.*

Passive flight-intercept trapping

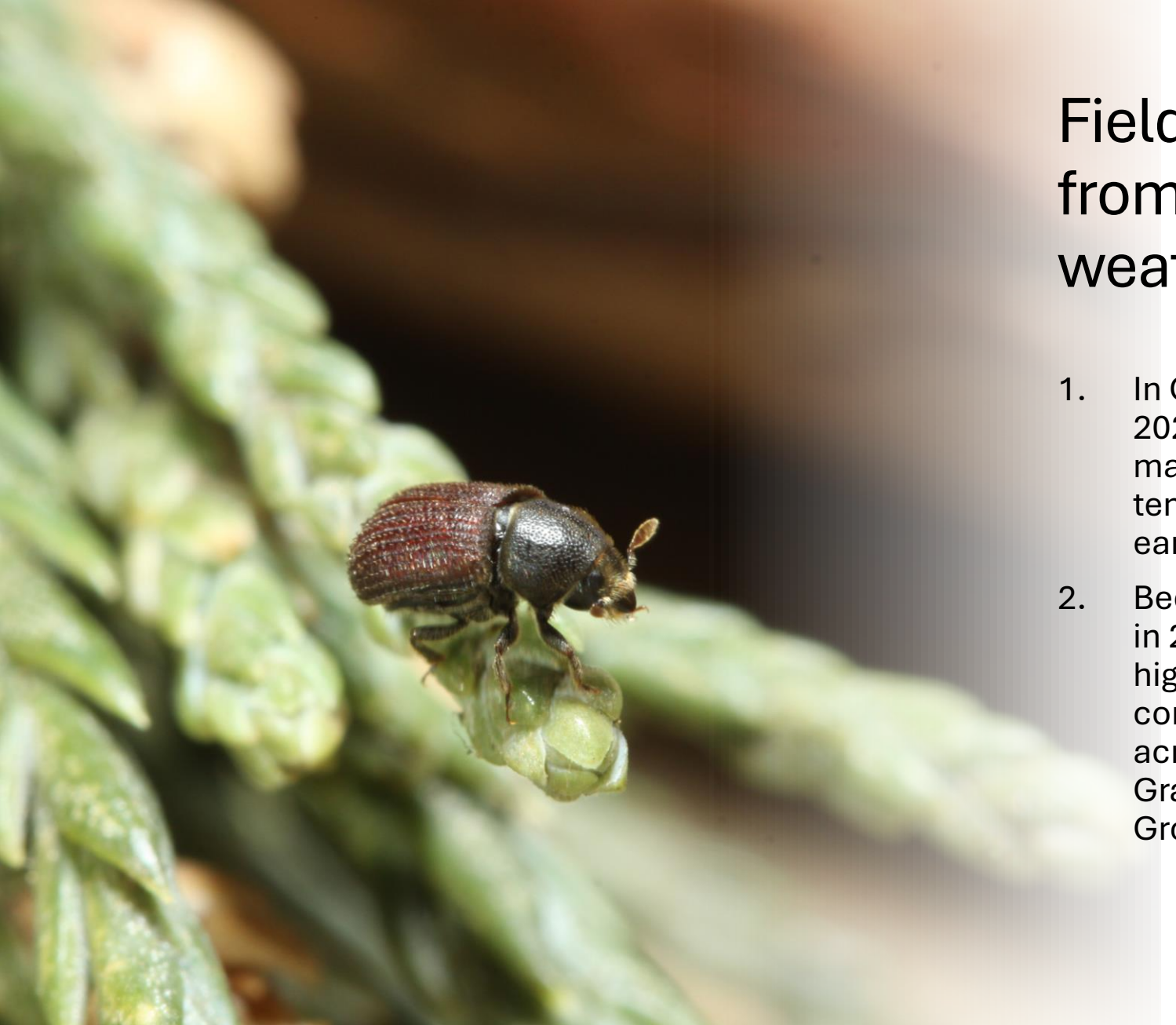
- Deployed July - October 2024 in Giant Forest above beetle-colonized downed giant sequoia material

- First successful capture of *Phloeosinus* during summer emergence flight towards the canopy

Parasitoids & predators associated with *Phloeosinus* in giant sequoia

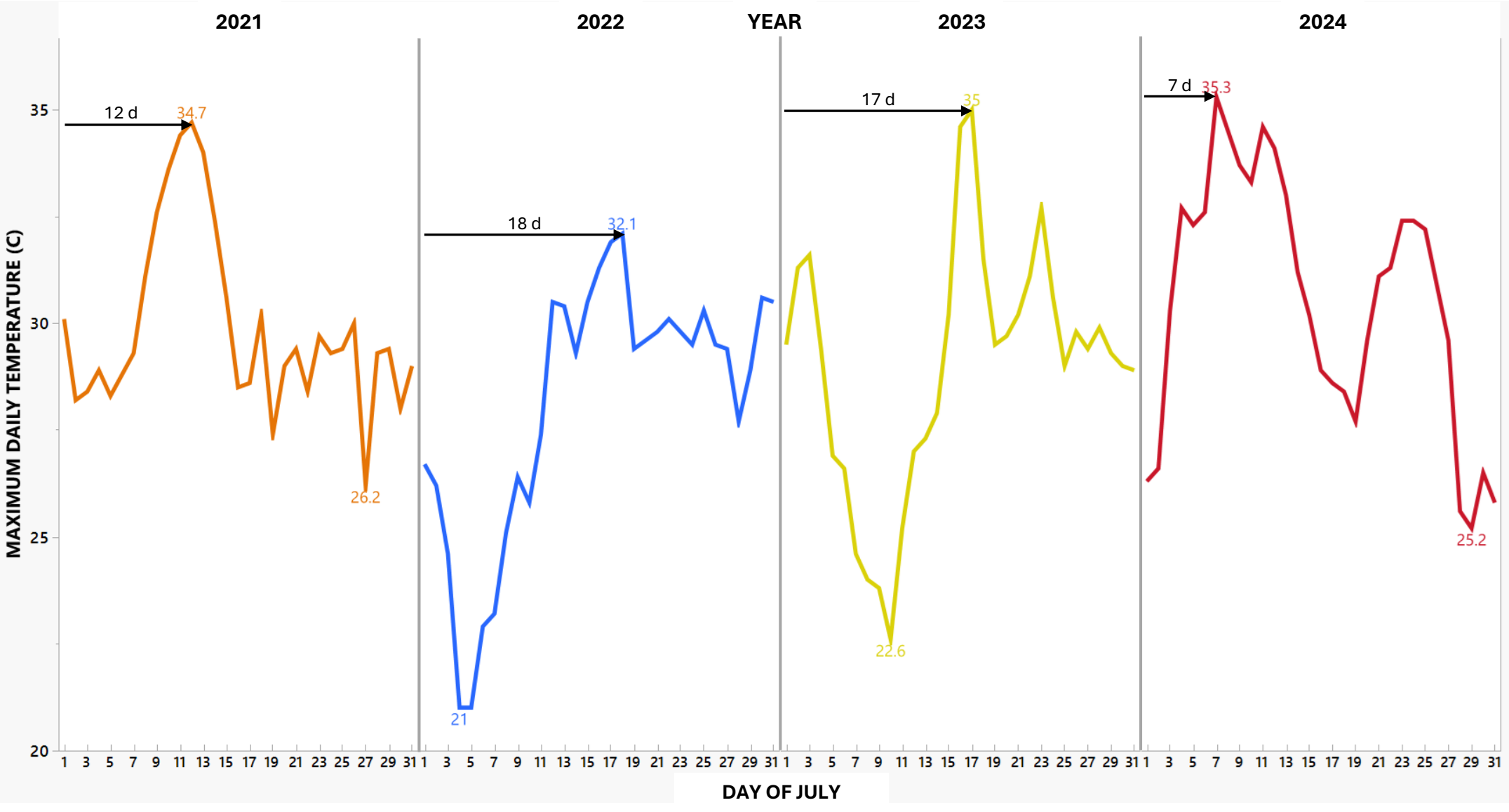
Beetle-associated parasitoids & predators

1. An apparent poly-familial hymenopteran parasitoid complex associates with *Phloeosinus* in giant sequoia; emergence typically occurs mid-summer through fall.
2. Adult *Temnoscheila chlorodia* (Trogossitidae) *and Lasconotus vergrandis* (Zopheridae) beetles are highly abundant in the spring; *L. vegrandis* typically emergences from *Phloeosinus*-colonized material late-summer through fall.



Field observations from 2024 & weather data

1. In Giant Forest during July 2024, an estimated maximum daily air temperature occurred 10 d earlier than in 2023.
2. Beetle summer emergence in 2024 was earlier and highly asynchronous compared to 2021-2023 across sites in Giant Forest, Grant Grove, and Mariposa Grove.



modeled weather data generated by PRISM Climate Group, Oregon State University

Forthcoming work

1. Expanding passive flight-intercept trapping to include multiple sites and beetle generations (i.e., early-spring through late-summer).
2. Deploying beetle emergence cages along elevational and latitudinal gradients for generating improved phenological models.
3. Experimentally determining beetle attrition from associated predators and/or parasitoids

Questions?