Photosynthetic light response of a native fern, *Microlepia strigosa* (Thunb.) K. Presl, to varying understory light conditions

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Microlepia strigosa (palapalai)

- Terrestrial fern found in the understory of Hawai‘i’s mesic forests
- Traditionally gathered for Hawaiian lei making and hula
- Decline and degradation of Hawai‘i’s forests has made it difficult to find and gather
- Harvesting of ferns can be an added pressure on already declining populations

Purpose of Study

- To evaluate palapalai response to varying understory light environments
- To determine optimal light conditions for outplanting palapalai
- To ascertain appropriate level of understory nonnative plant removal
- To better understand restoration potential of palapalai in nonnative dominated forests

Site Location

- Harold L. Lyon Arboretum in Mānoa Valley, O‘ahu, Hawai‘i
- Two sites at 260 to 290 m elevation

Site Description

- Lower site – closed canopy forest of reforested nonnative species.
- Upper site – intermittent overstory of both nonnative and native species.
- Six 6x6 m plots at each site, half are **cleared** of nonnative mid-story and half left **intact**
- *Ardisia elliptica* accounts for most nonnative under- and mid-story vegetation.

Relative percent of *Ardisia elliptica*

	Understory		Midstory (DBH)			Overstory (DBH)	
Site	**Seed Rain**	**Ground -cover**	**<1cm**	**1-5cm**	**5-10cm**	**10-15cm**	**15-25cm**
Upper	90	75	96	71	85	17	0
Lower	97	85	88	86	57	0	0

DBH = Diameter at Breast Height

Characterization of Light Environment

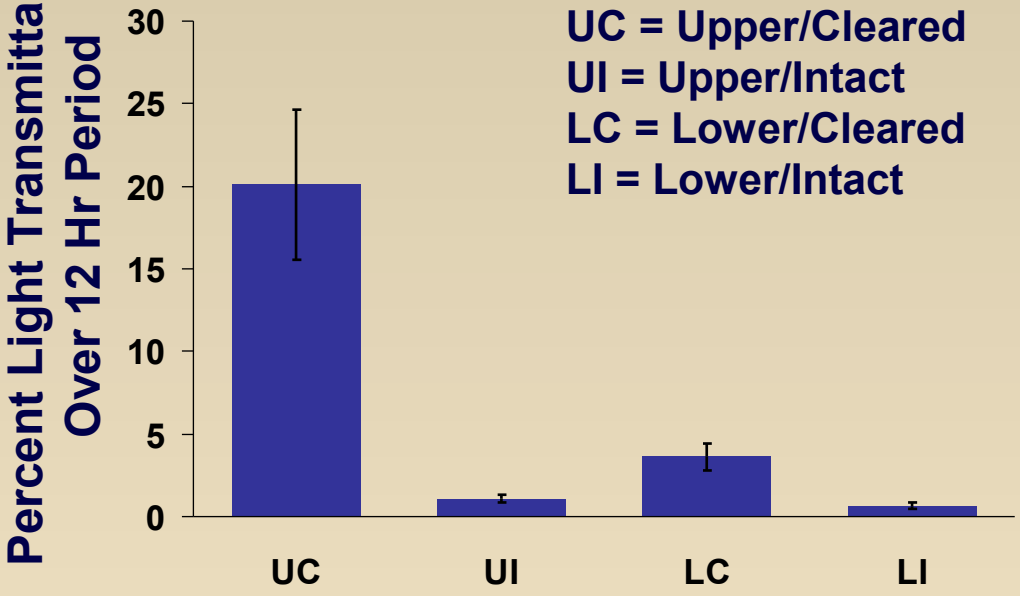
Spherical densiometer used to estimate forest canopy cover per plot

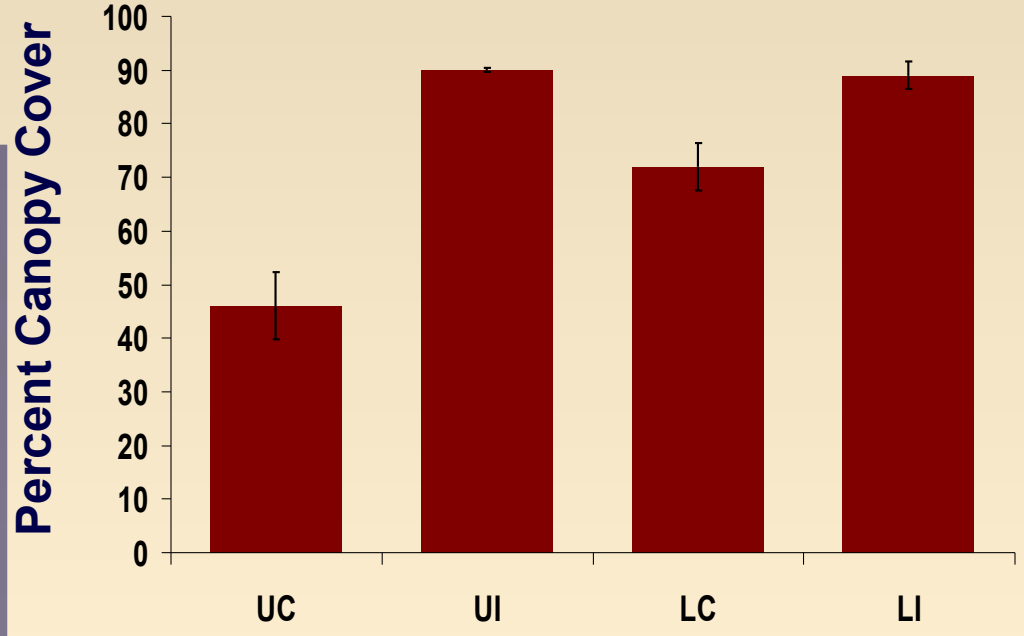
Percent light transmittance in each plot calculated using data from quantum light sensors in open and understory conditions

Light Environment

Site Treatment	% Light Transmittance	% Canopy Cover
Upper		
Cleared	20±4.6a	46±6.0
Intact	1.1±0.25	90±0.0
Lower		
Cleared	3.6±0.82a	72±4.0
Intact	0.07±0.18	89±3.0

a and b indicate statistical significance ($p \leq 0.05$, $p \leq 0.10$, respectively) in difference between cleared and intact within each site.





Average max incident light is ≈ 2000 µmol m^{-2} s^{-1} so…

2000 x 20% = 400

1.1% = 22

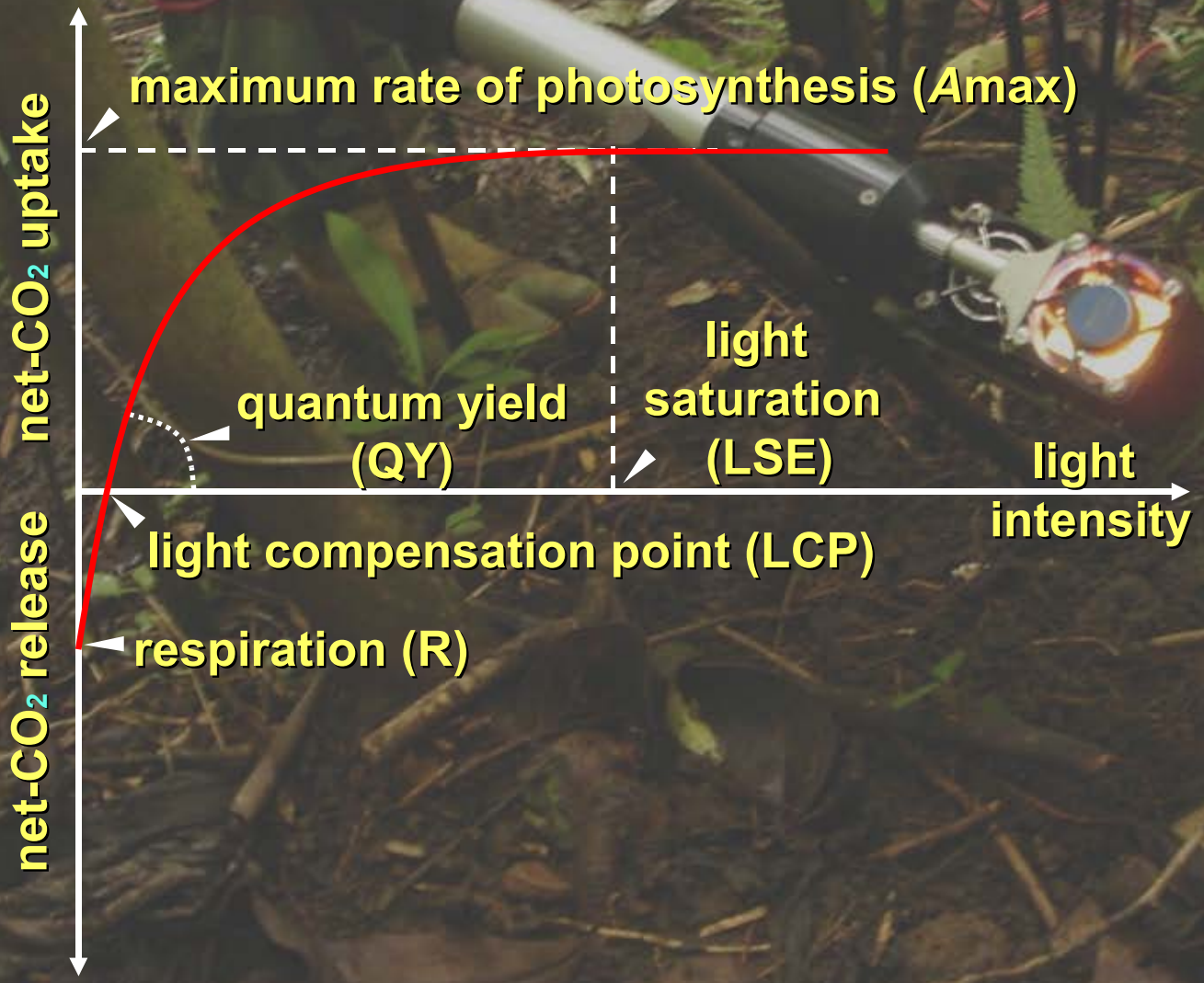
3.6% = 72

0.07% = 14

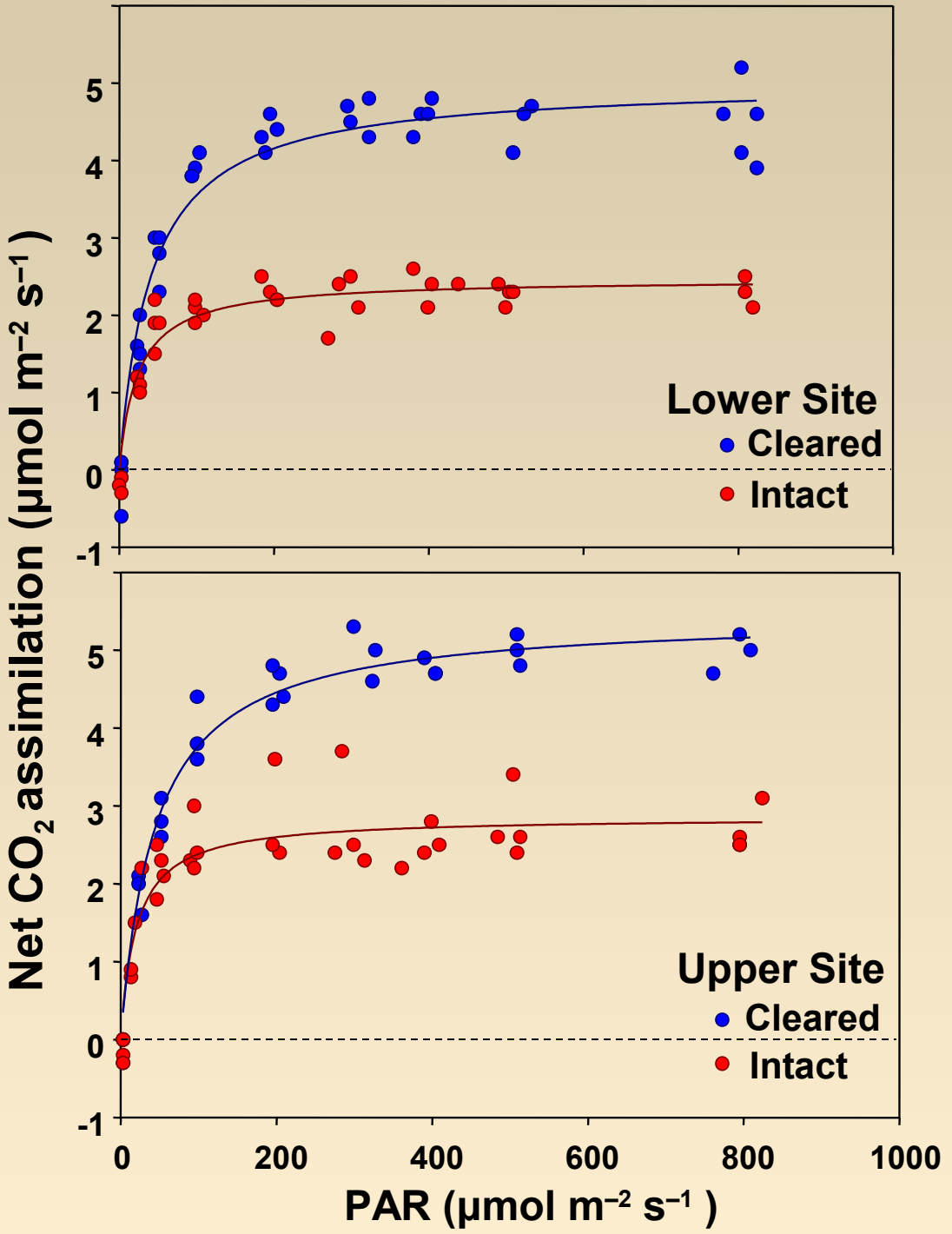
Photosynthesis Measurements

- Measured in field using portable photosynthesis system.
- Gas exchange measured one plant per plot at nine light levels ranging from 0 to 800 µmol m^{-2} s^{-1}.
- Used to generate light response curve of net CO_2 assimilation (*A*) to photosynthetically active radiation (PAR).

Light Response Curve



Net CO2 assimilation of palapalai as a function of photosynthetically active radiation (PAR) at two sites for ferns growing in cleared and intact understory



Photosynthetic Light Response

Values for *A*max, QY and R are means±SE (*n*=3). LCP and LSE are estimated values from a fitted curve.

Site Treatment	*A*max µmol m–2 s–1	QY mol C fixed mole photon-1	R µmol m–2 s–1	LCP µmol m–2 s–1	LSE µmol m–2 s–1
Upper					
Cleared	5.63±0.31 [a]				488
Intact	3.25±0.34				269
Lower					
Cleared	4.94±0.22 [a]				478
Intact	3.63±0.44				238

Average max incident light is ≈ 2000 µmol m^{-2} s^{-1} so...

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a b Indicate statistical signi… y) in the difference between cleared and intact within each site.

Conclusion

- Palapalai takes advantage of increased light transmittance under a reduced canopy cover by increasing photosynthetic capacity.
- Photosynthetic activity is significantly reduced under midstory canopy cover of *A. elliptica* where percent light transmittance is very low.
- Optimal light levels for palapalai are still unclear since no differences in photosynthetic capacity were observed between sites in the cleared treatment even though percent light transmittance was much greater at the upper cleared plots.

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