Old-growth islands in an ocean of regrowth:
Canopy arthropod refugia in a temperate coastal rainforest landscape

www.treeoctopus.net/res/Canopy2009TNC.pdf

by: Y.D. Bar-Ness, L. Davis, H. Huber, C. McDonough, A. Sigler & C. Nordmeyer

5th International Canopy Conference 2009

Forest canopies : Conservation, Climate change and Sustainable use

October 25th - 31st, 2009, Bangalore, India

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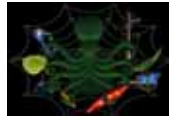

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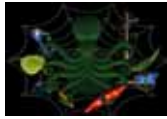
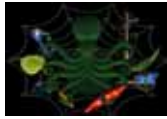
- Report posted:
  - http://conserveonline.org/workspaces/ellsworth.creek/documents/tnc-old-growth-forest-refugia-study
- Arthropod Museum Archive:
  - http://osac.science.oregonstate.edu/
- Additional resources:
  - http://www.treeoctopus.net/treetop.htm



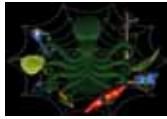
The Scenario, in Five Sentences:

- The Pacific coastal rainforests of the Willapa Hills in SW Washington State, USA have been heavily modified by a century of industrial clearcutting
- The Nature Conservancy at Ellsworth Preserve and neighboring landholders are actively seeking to restore a range of ecological functions to the landscape
- The remnant 1% of old-growth forests, following study and documentation, can offer a template for late-successional ecological attributes
- TNC coordinated the largest yet biodiversity and forest survey of the Willapa coastal rainforests
- Canopy arthropods, canopy structure, ground & deadwood arthropods, vegetation, and lichens were all studied over two years



Project Goals

- Gap in knowledge:
  - Very little biological survey work has been done in these vast forests, although inland Douglas-fir forest well-known
  - Link with Sitka spruce canopy work in Olympics and Redwood forests
- Management aims:
  - Learn about remnant old-growth forests role as a biotic refuge
  - Guide restoration efforts
- Scientific aims:
  - **Hypothesis:** These old-growth forests harbour a distinct fauna vs. regrowth forests surrounding them
  - **Exploratory**: First widescale Willapa Hills biodiversity blitz, first canopy arthropod study
  - **Documentation:** Museum archival. New species?

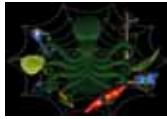


Forest Trees of Willapa Hills

Sitka spruce
Picea sitchensis
(Pinaceae)
Valley floor dominant

Western red-cedar
Thuja plicata
(Cupressaceae)
Slope side dominant

Western hemlock
Tsuga heterophylla
(Pinaceae)
Habitat generalist



Forest Dynamics

Coastal temperate rainforest

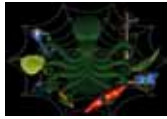
- Pacific storms in winter
- Amongst the world's tallest,largest
- Fertile, steep. Muddy
- Ferny, mossy, lichen

Regrowth:

Even-aged forests
Harvested and replanted (100yrs)
Legacy structures: stumps, logs

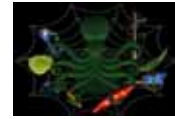
Old growth:

Wider age distribution
Nurse logs + stilting
Windstorms; mistletoes



Study Location

- Washington State:
  - The NW corner of Pacific USA
- Willapa Hills:
  - SW corner of the State
- Landholders:
  - The Nature Conservancy (Ellsworth)
  - Weyerhauser
  - US Fish & Wildlife

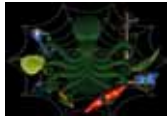


Methods: Design

Six paired study sites:

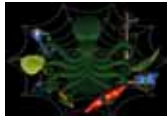
Three forest types		Two ages		Fourteen trees:
valley (spruce, hemlock) + **slope** (cedar, hemlock) + **ridgetop** (spruce, cedar, hemlock)	X	**old-growth** (undisturbed) + **regrowth** (~80 yrs old)	→	**4 spruce** + **6 hemlock** + **4 cedars**

- Tree selection: *Largest safe tree of each species present at site*
- July-Sep 2007: *Ground arthropods*
- October 2007: *Canopy arthropods following end of Marbled Murrelet seabird nesting (photo from Wikipedia)*



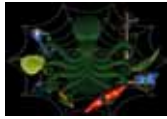
Methods: Climbing Access

Crossbow -> Ropes -> Access



Methods: Climbing Fieldwork

Bahut mushkil hai!



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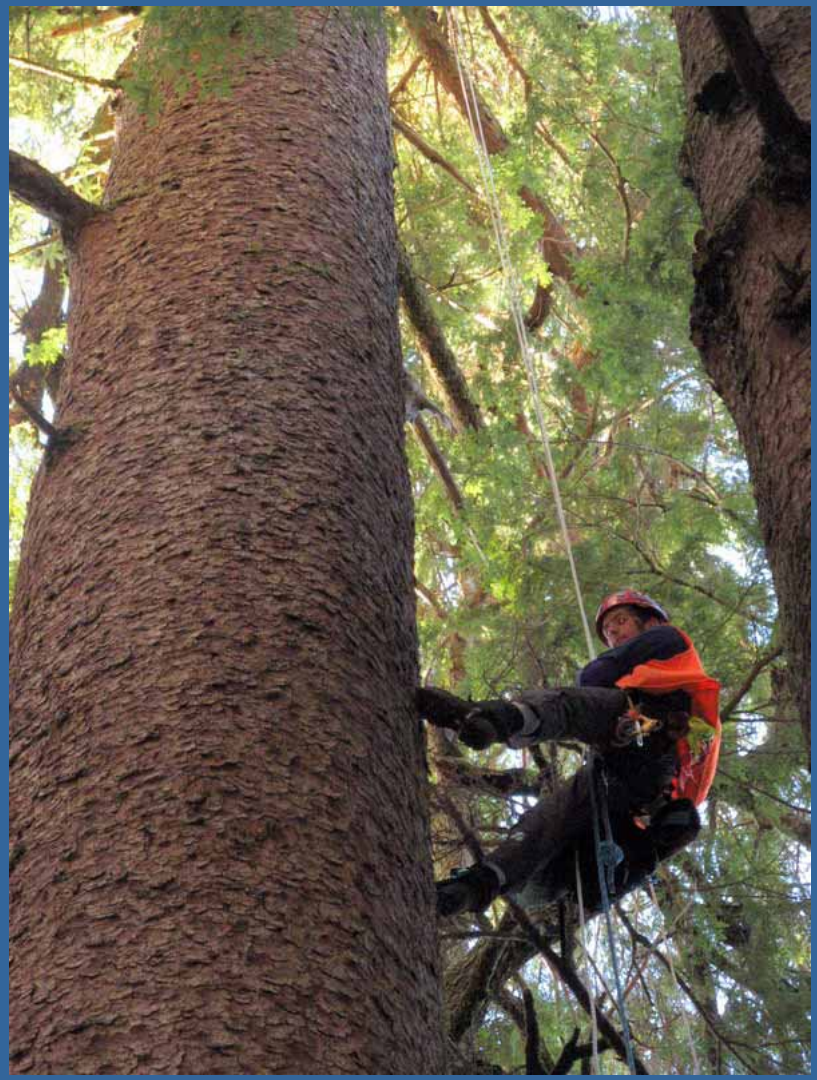
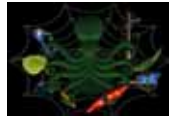
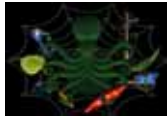




Methods: Canopy habitats

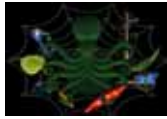


Methods: Sample collections

- **Canopy arthropods:**
  - **5 evenly spaced stations**
  - Hand-collectible material
  - ~1L capacity ziploc bag
  - As much material as possible
  - Time limitations precluded traps

Placements:

1. upper branch surface
2. trunk surface
3. foliage
4. soil (when present)
5. lower branch (when present)



Methods: Laboratory

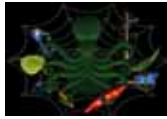
- Heat/light ->jar funnels for 24 hours:
- Samples sorted to major taxonomic unit (order)
- Mites, springtails, spiders, beetles to [morpho] species

•Special thanks to taxonomic experts Drs. Marshall, Moldenke, and Crawford

•Additional analysis being performed on:

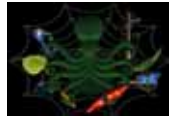
- ground arthropods
- habitat structure
- lichen communities

Zyada kire makore aur kam samay!



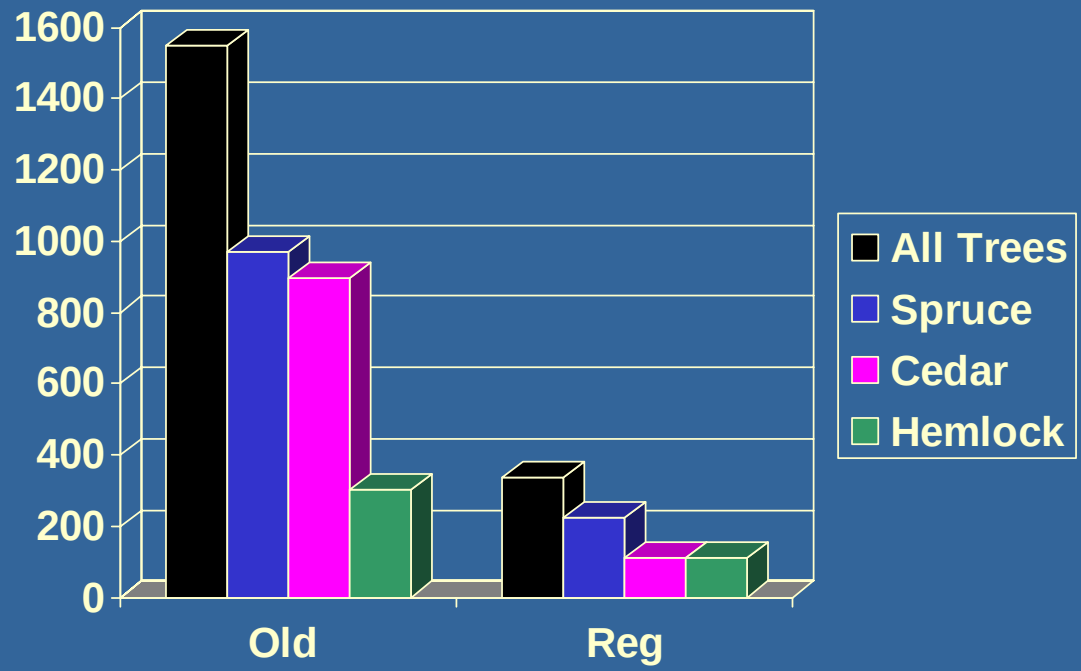
Results Overview

- Statistical values are available online
  - http://conserveonline.org/workspaces/ellsworth.creek/documents/tnc-old-growth-forest-refugia-study
- 9,732 canopy arthropods processed from the fourteen trees
- Analysis focused on age classes

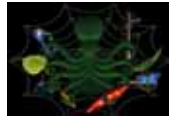


Results: Basic Collection

Significantly more material was taken from the crowns of old forest trees than from regrowth forest trees. (3.02 kg vs. 1.02 kg)



Mean # of Arthropods collected per tree



Results Totals

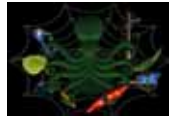
Total Individuals Collected:

	Acari	Araneae	Collem-bola	Hymen-optera	Diptera	Hemi-ptera	Coleo-ptera
Old	**2205**	**69**	**2813**	**33**	31	**55**	**4**
Regrowth	191	29	860	9	**59**	15	3

Number of Taxa distinguished:

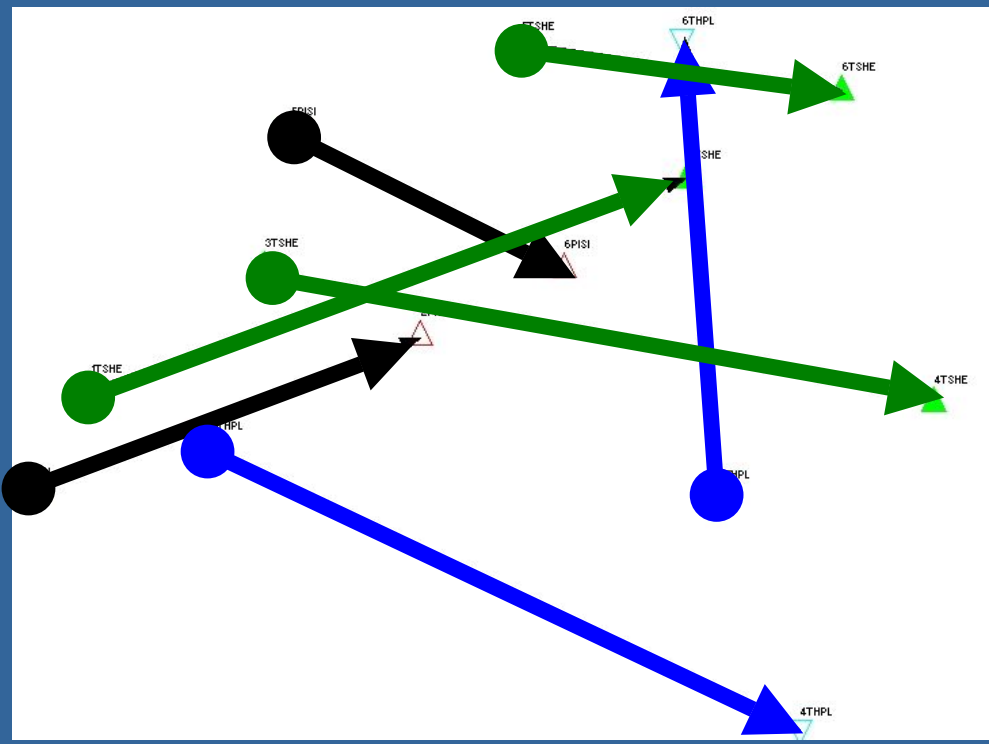
	Acari	Araneae	Collem-bola	Hymen-optera	Diptera	Hemi-ptera	Coleo-ptera
Old	**83**	**19**	14	**8**	7	7	**4**
Regrowth	41	13	10	7	**16**	7	3

All of the focused taxa were more abundant and rich in the old forest collections



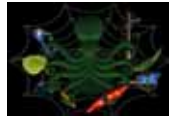
Results Compositional

- NMS Ordinations:
  - Major taxa- parallel shift (spruce, hemlock) for canopy major-taxa (shown)
  - Canopy Acari: same observation, high abundances driving force
- This indicated an age effect masked by inter-tree species variability
- MRPP:
  - Canopy Collembola and canopy Acari were significantly different between the age classes
- Inter vs Intra Taxonomic Distance:
  - Acari: consistent within age classes -> age effect?
  - Collembola: consistent within study pairs -> geographic effect?



NMS Ordination of Fourteen Trees, by composition of major taxa

Spruce
Cedar
Hemlock
Reg →Old



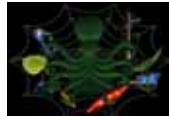
Results: Archival

Processed, museum archived, and accessible:

Oregon State Arthropod Collection

Corvallis, Oregon, USA

http://osac.science.oregonstate.edu/

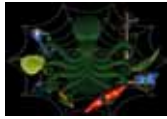


Discussion

Some evidence that there is a higher arthropod biodiversity and a distinct canopy arthropod community in the old-growth forests.

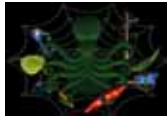
Results strongly driven by Acari and Collembola.

Higher collection of both material, and therefore animals in oldgrowth forests



Future Work

- Variety in collection scheme
- Additional processing at OSAC
- Analysis between tree species, between study sites
- Correlations with lichen communities, structural measurements
- Study canopy habitat dynamics



Many Thanks!

The Nature Conservancy
Dave Rolph (TNC)
Tom Kollasch (TNC)

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Andy Moldenke
Glenn Kohler

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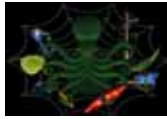
Estella Leopold, Jerry Franklin



Abstract

Old-growth islands in an ocean of regrowth: canopy arthropod refugia in a temperate coastal rainforest landscape

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Additional resources: http://www.treeoctopus.net/treetop.htm

In a temperate coastal rainforest landscape historically managed for timber harvest on private land holdings, there are now management imperatives for conservation of biodiversity and ecosystem function. In the Willapa Hills of the Northwest coast of the United States of America, remnant patches of old-growth spruce and cedar rainforest can be found surrounded by regrowth plantations. In 2007, The Nature Conservancy initiated a study in cooperation with Weyerhauser and US Fish & Wildlife Service to both document the biodiversity within and assess the biogeographical role of these remnant patches. To document the species in these forests, arthropods were collected, resolved, and archived for future taxonomists with the Oregon State Arthropod Collection. To test the hypothesis that there was a distinct community in these forests, canopy and ground arthropods living in quantifiable habitat materials were compared and contrasted from pairs of old-growth and regrowth forests representing the range of forest conditions on the landscape. Despite severe constraints from weather and permit issues, the study found elements of evidence supporting the role of these forests as biogeographical refugia for a distinct and diverse community of arthropods (especially mites), and highlights pathways for future work in both the field and laboratory. 21, 220 arthropods were prepared and archived, and offer the first exploration of arthropod zoology in the canopy of these temperate coastal rainforests.