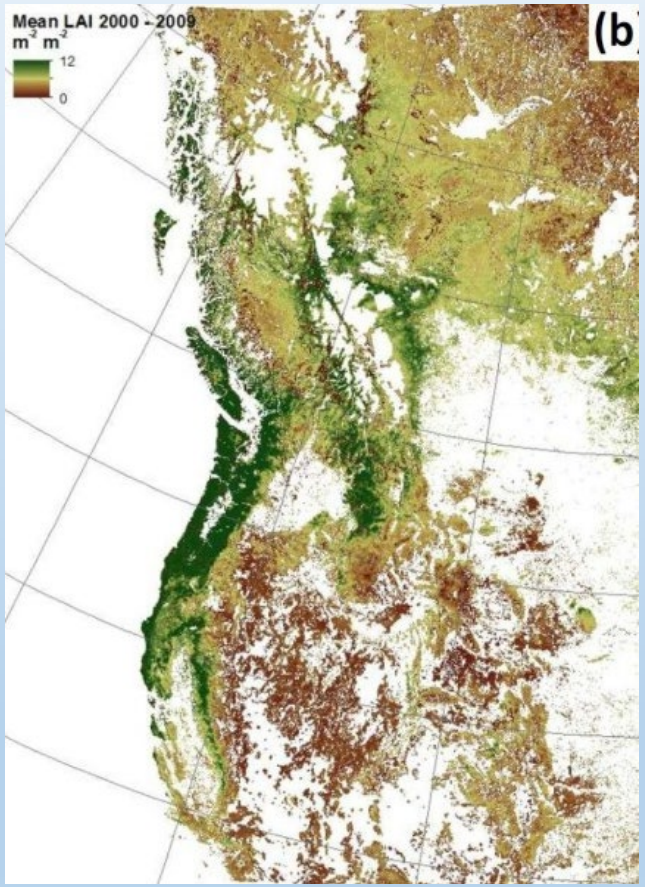

NASA
NASA Earth Exchange Seminar
From Tree Physiology to Rocket Science:
Insights from a Long, Lucky Career
Richard Waring
Monday, Feb 25, 11 am
See Centerwide for attendance details
Ames Research Center

From tree physiology to rocket science: Insights from a long, lucky career

Richard Waring
Oregon State University
1963-2018



I. Why a lucky career?

I. Background: Lucky from the start

a lucky life and career

- 1935 depression kids, among the few born
- married Doris Carlson in 1957
- grew up between the Korean and Viet Nam Wars, not drafted
- started career with 12-month-tenured position at Oregon State Univ.
- did research in the golden age of federal grant funding
- opportunities to leave OSU for 8 years
- Doris and I stayed healthy
- extended career 18 years after retirement with NASA funding on predicting responses of forests to climate change

Lucky educational background: practical at Minnesota, theoretical at Berkeley, + overseas

BS Forestry, U of MN , 1957
MS. Forestry/Botany, U. of MN, 1959

Ph.D. Botany/Soils,
U. of CA, Berkeley
1963

Waring, R.H. 1970. Die Messung des Wasserpotentials mit der Scholander-Methode und ihre Bedeutung für die Forstwissenschaft. *Forstwissen-schaftliches Centralblatt* 89:195-200. **U. of Innsbruck & U. of Munich**

Lucky in selecting graduate students, many of whom were funded by NASA (*)

Steve Running *

Henry Gholz *

Pam Matson *

Bev Law *

Barbara Bond *

Hank Margolis*

Jennifer Swenson*

Wendy Peterman*

Celio Sousa *

Jeanne Panek *

Mike Ryan*

Ram Oren

John Marshall

If you can't recruit them, recognize their talent when they are young!

Indy Burke

Dean, Yale School of Forestry & Environmental Sciences

David Whitehead

Leader, Ecosystem & Global Change, Landcare, Lincoln, New Zealand

Jiquan Chen

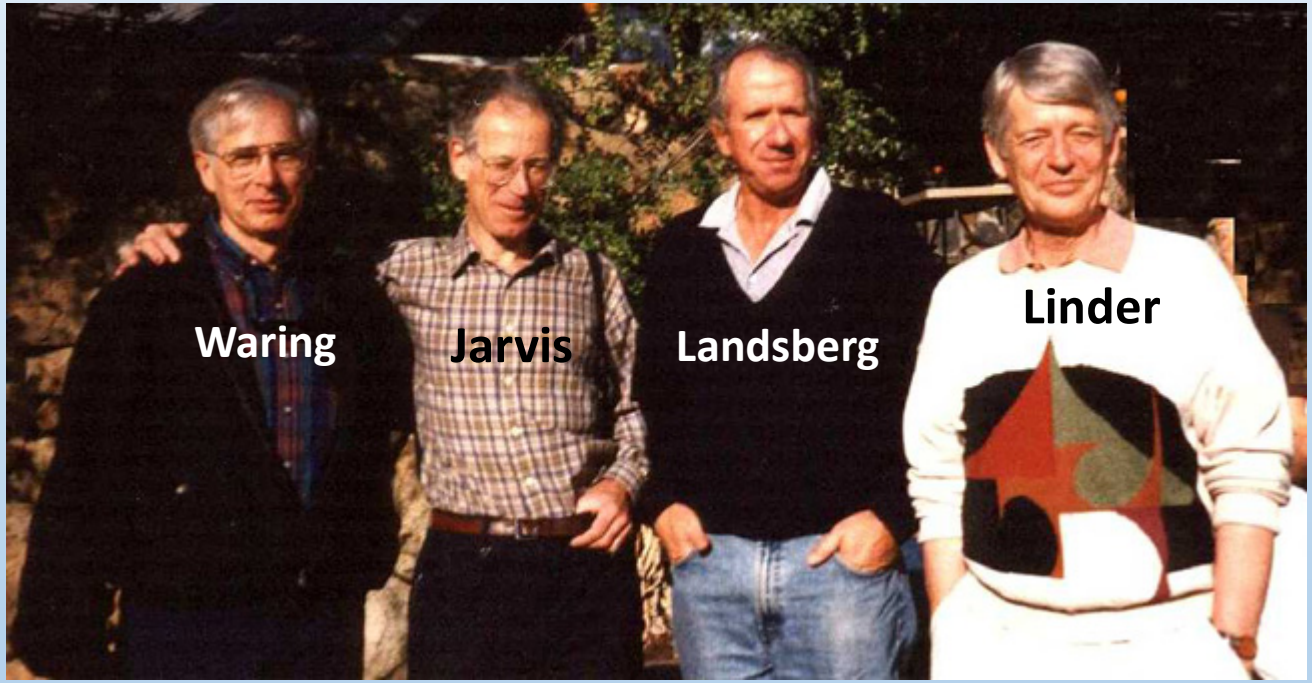
Professor, Landscape Ecology & Ecosystem Science, Mich. State Univ.

Matt Williams, Chair
Global Change Ecology
University of Edinburgh

Nicholas Coops

Canada Research Chair in Remote Sensing
University of British Columb

Lucky in finding life-long colleagues



Started collaborating in 1973

II. Lessons learned

with Walter Moser in Austria on glacier, 1969

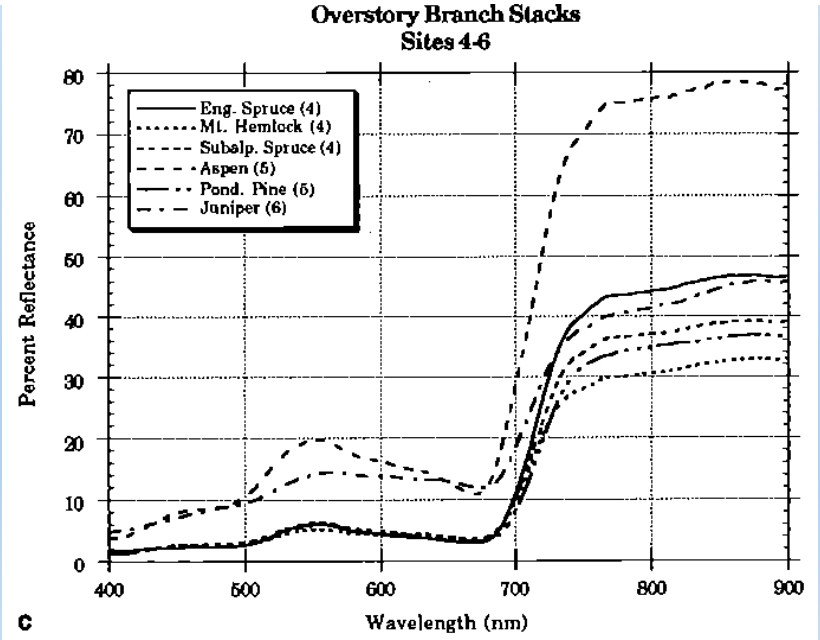
REMOTE SENS. ENVIRON. 47:190–203 (1994)

(MY EARLY MENTORS IN REMOTE SENSING)

Visible-Near Infrared Spectral Reflectance of Landscape Components in Western Oregon

Samuel N. Goward, Karl F. Huemmrich,* and Richard H. Waring†*

Alex Goetz



Sam Goward

Differences in approaches

Physiologist (applied theory)

Look for general principles that drive life processes & fluxes from systems

Diagnose what should happen before measuring

Predict biotic responses to specific changes in environment over time

Remote Sensor (empirical approach)

Measure signals from targets

Look for changes over time

Correlate observed changes with an array of variables

REMOTE SENS. ENVIRON. 49:81–91 (1994)

(Looking for underlying principles in remote sensing)

The Normalized Difference Vegetation Index of Small Douglas-Fir Canopies with Varying Chlorophyll Concentrations

*Barbara J. Yoder** *and Richard H. Waring**

Canadian Journal of Remote Sensing/Journal canadien de télédétection

(Baby steps toward satellites)

AERIAL AND SATELLITE SENSOR DETECTION AND CLASSIFICATION OF WESTERN SPRUCE BUDWORM DEFOLIATION IN A SUBALPINE FOREST

by S.E. FRANKLIN • R.H. WARING • R.W. McCREIGHT • W.B. COHEN • M. FIORELLA

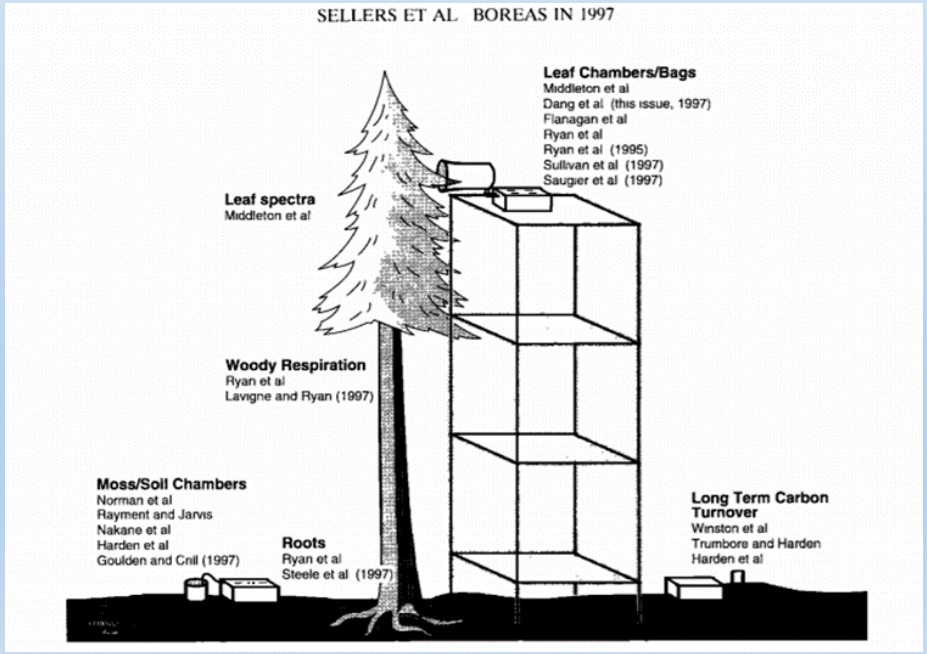
Physiological background: Waring, R.H., T. Savage, K. Cromack, Jr., and C. Rose. 1992. Thinning and nitrogen fertilization in a grand fir stand infested with western spruce budworm. Part IV. An ecosystem management perspective. *For. Sci.* 38:275-286.

Plant, Cell and Environment (1995) **18,** 1201–1213

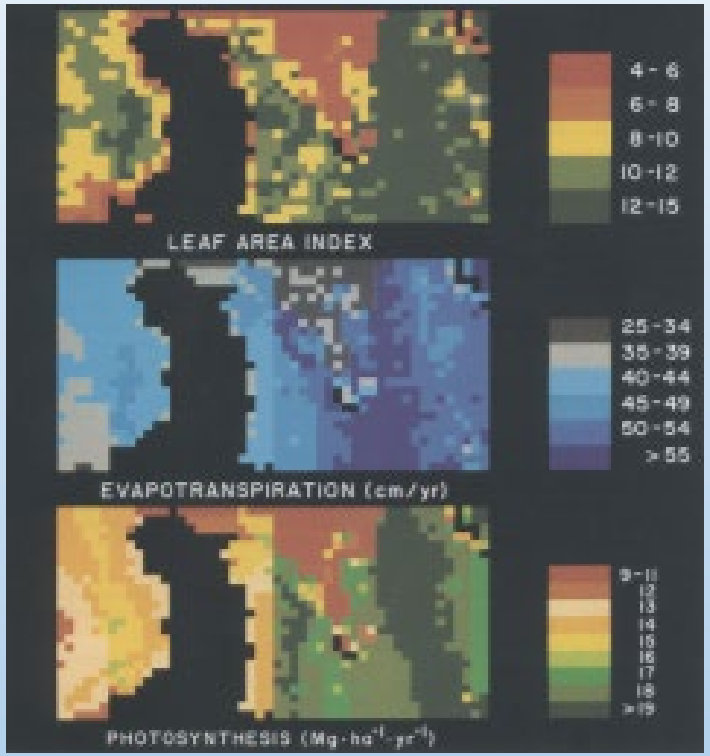
(Modeling seasonal changes in canopy photosynthesis)

Scaling gross ecosystem production at Harvard Forest with remote sensing: a comparison of estimates from a constrained quantum-use efficiency model and eddy correlation

R.H. WARING,[1] B.E. LAW,[1] M.L. GOULDEN,[2] S.L. BASSOW,[3] R.W. McCREIGHT,[1] S.C. WOFSY[2] & F.A. BAZZAZ[3]



1989: 1st satellite-derived scaling of ET and photosynthesis



Running, SW., R.R. Nemani, et al. 1989. Mapping regional forest evapotranspiration and photosynthesis by coupling satellite data with ecosystem simulation. *Ecology* 70:1090-1101.

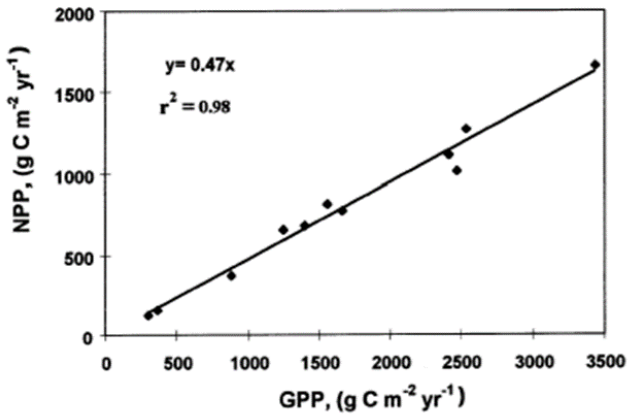
Linking Photosynthesis to Growth via Respiration

Tree Physiology 18, 129–134

Gross Photosynthesis (GPP) = ∑(Plant Respiration +All Growth Products)

Net primary production of forests: a constant fraction of gross primary production?

R. H. WARING,[1] J. J. LANDSBERG[2] and M. WILLIAMS[3]



Soil Respiration

Above-ground growth + Tree Respiratiion

Leaf Litterfall

State-wide analysis, four seasons from 9 platforms with 24 sensors

Environmental Limits on Net Primary Production and Light-Use Efficiency Across the Oregon Transect

J. Runyon; R. H. Waring; S. N. Goward; J. M. Welles

Ecological Applications, Vol. 4, No. 2 (May, 1994), 226-237.

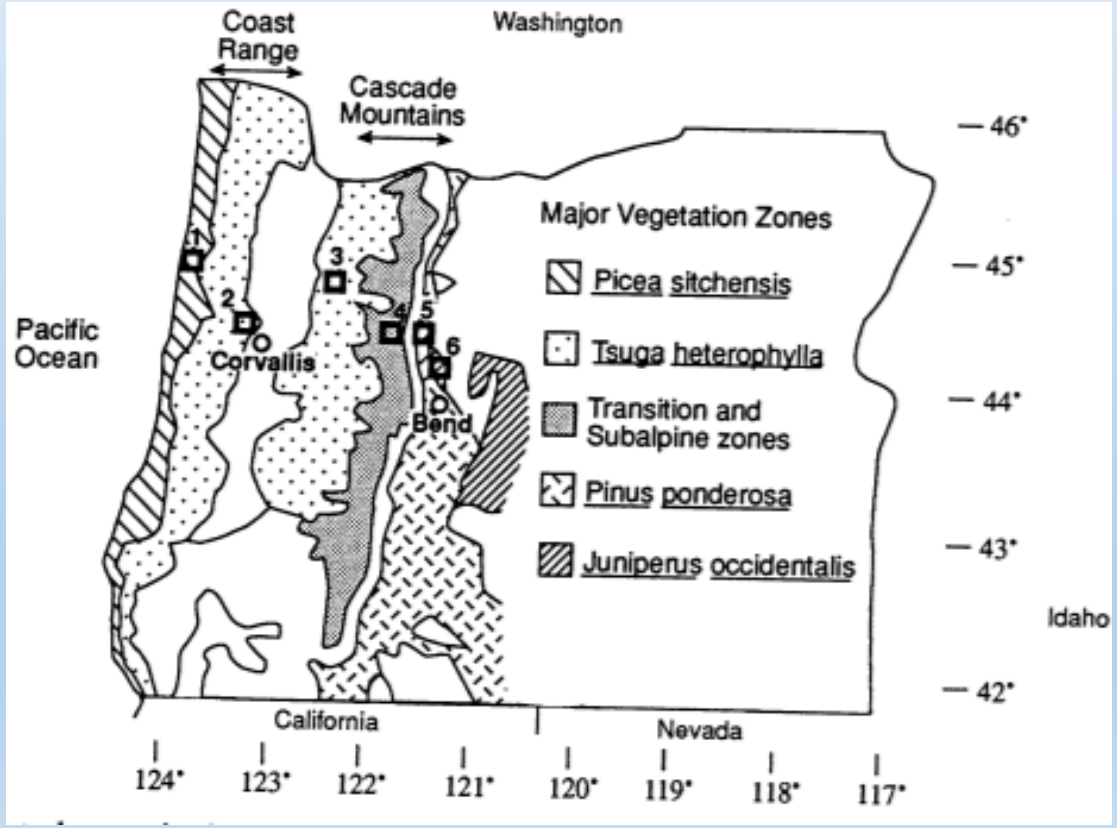
OTTER PROJECT

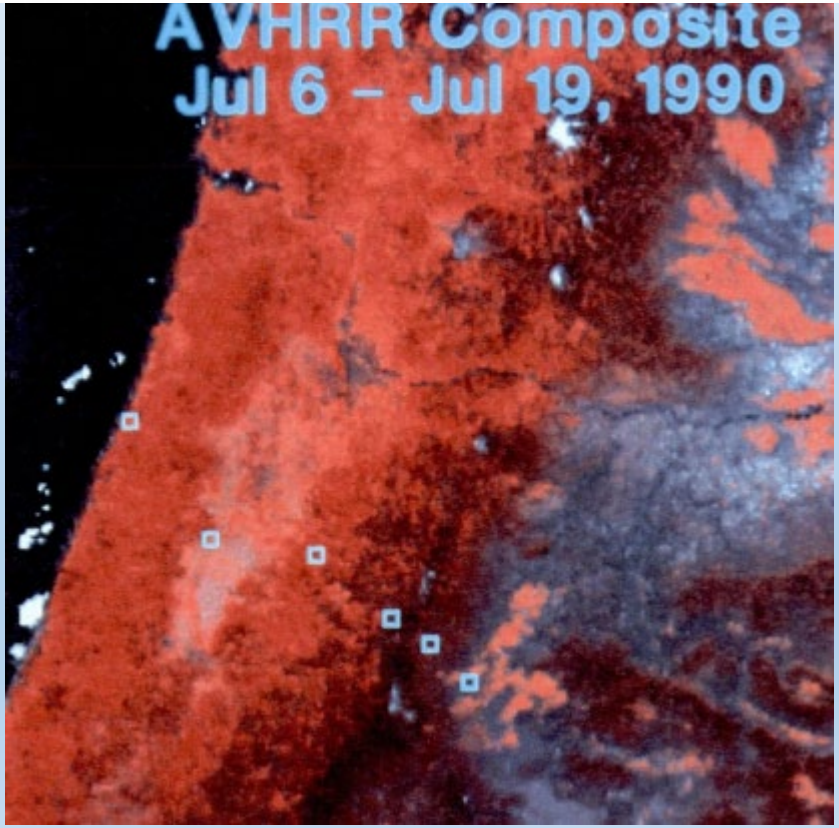
Ecological Applications, 4(2), 1994, pp. 211–225

OVERVIEW OF THE OREGON TRANSECT ECOSYSTEM RESEARCH PROJECT[1]

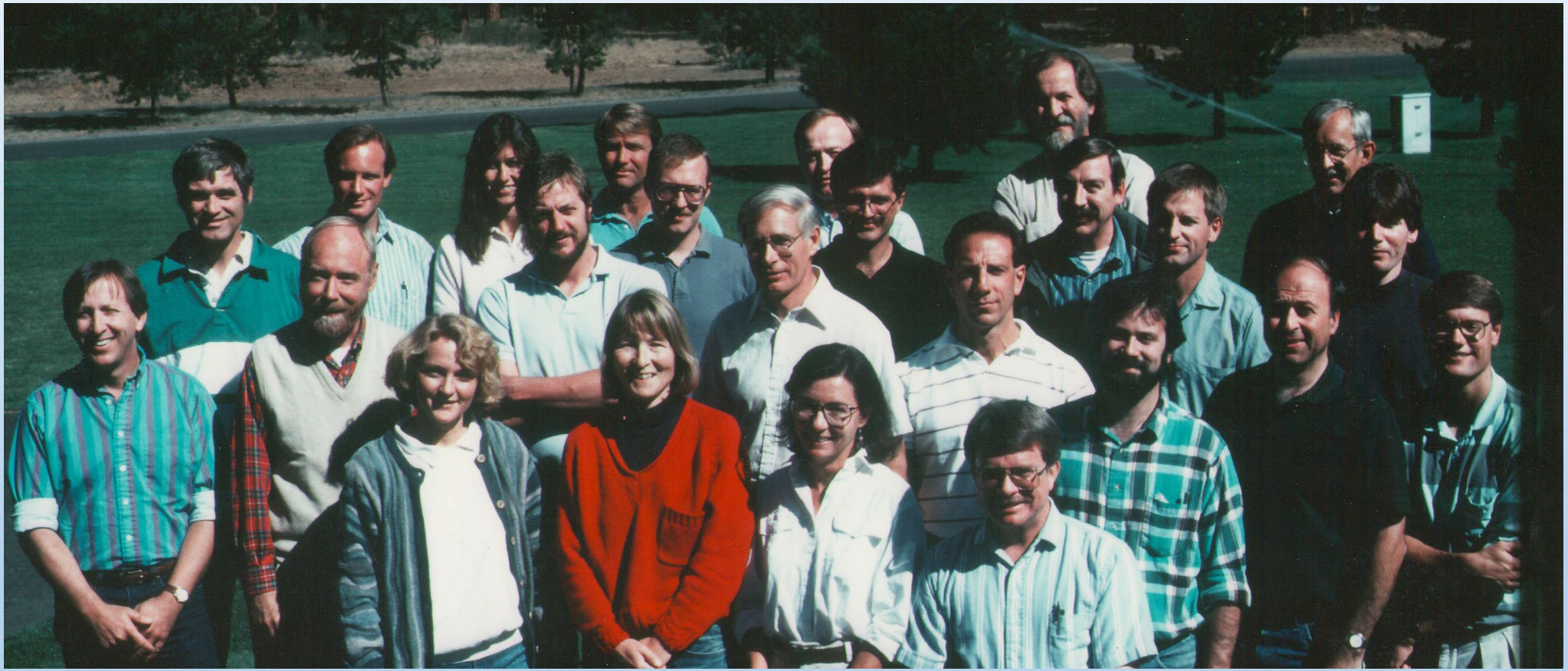
DAVID L. PETERSON
Ecosystem Science and Technology Branch, NASA Ames Research Center, Moffett Field, California 94035 USA

RICHARD H. WARING
Department of Forest Science, Oregon State University, Corvallis, Oregon 97331 USA



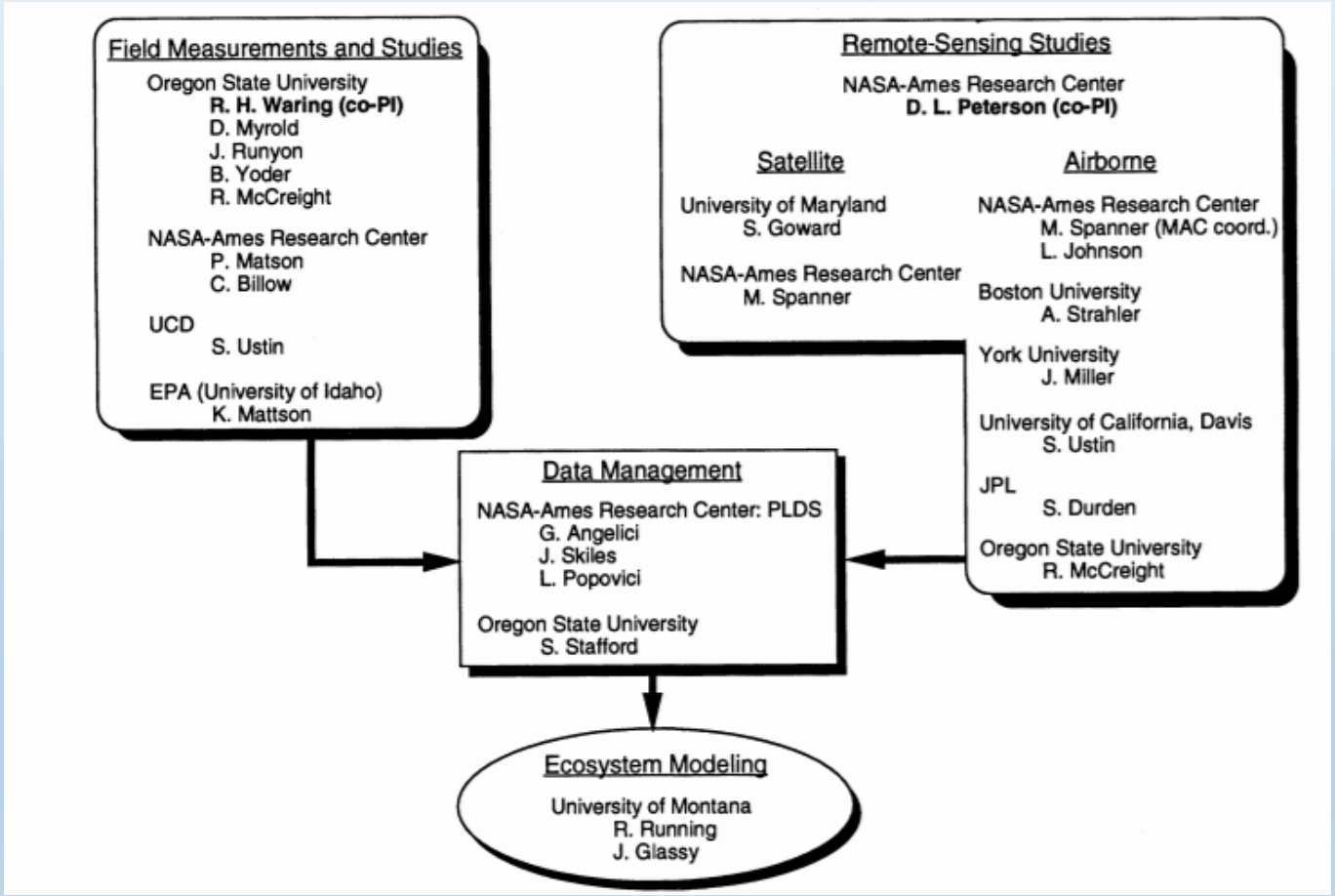


NASA-sponsored OTTER Project across Oregon circa 1990



Peterson, D.L., and R.H. Waring. 1994. Overview of the Oregon Transect Ecosystem Research Project. *Ecol. Appl.* 4:211-225

OTTER: integrated research with full seasonal coverage from nine platforms + ground truth



Forests **2014**, *5*, 518-534; doi:10.3390/f5030518

OPEN ACCESS

forests

ISSN 1999-4907

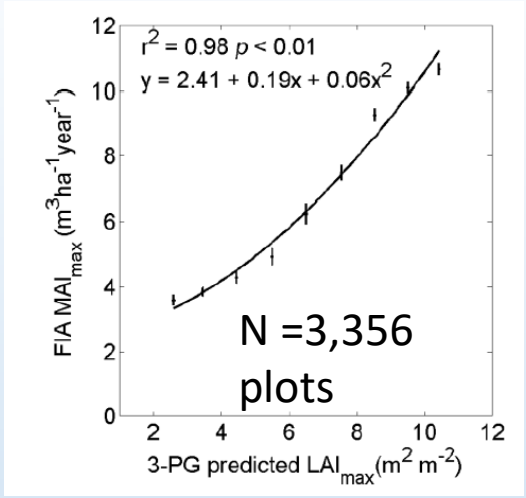
www.mdpi.com/journal/forests

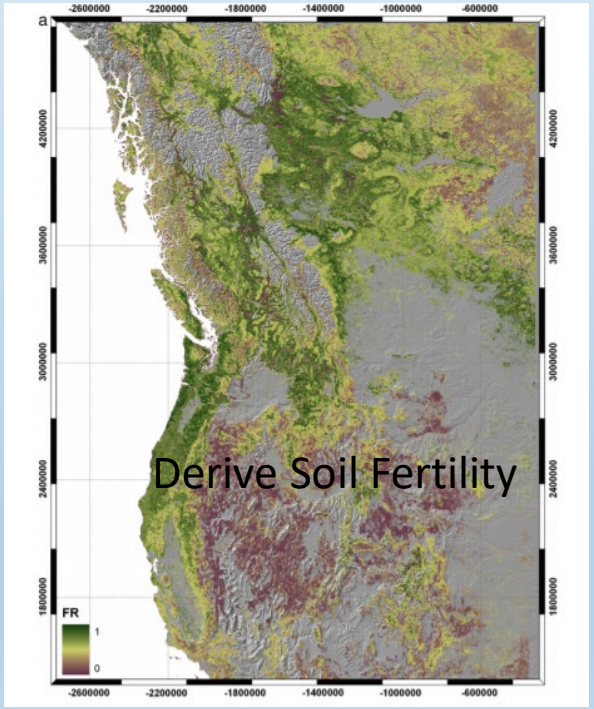
Predicting above-ground growth with knowledge of soil properties to partition production above- & below ground

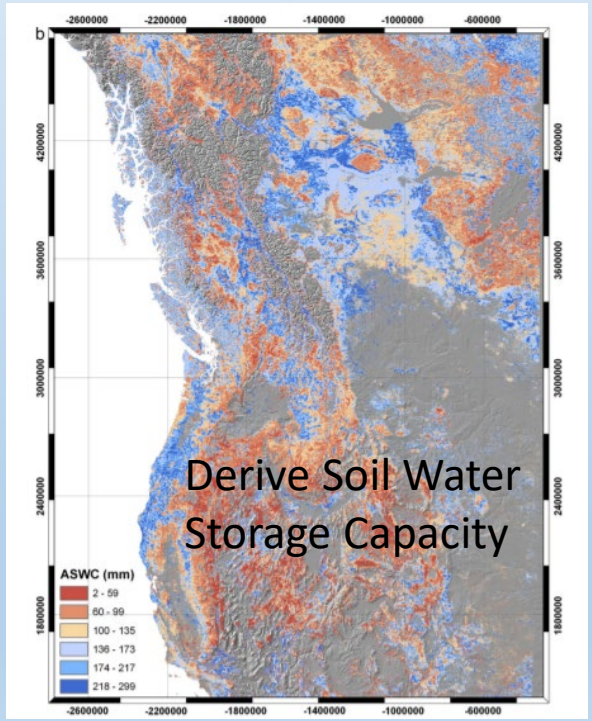
Article

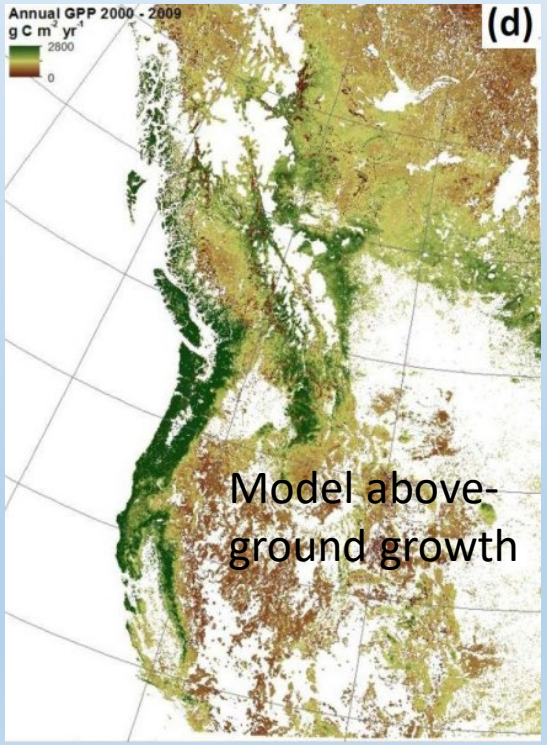
Process-Based Modeling to Assess the Effects of Recent Climatic Variation on Site Productivity and Forest Function across Western North America

Richard H Waring [1], Nicholas C Coops [2,*], Amanda Mathys [2], Thomas Hilker[1] and Greg Latta [1]









Nicholas Coops

Thomas Hilker

Coops, N.C., R.H. Waring, and T. Hilker. 2012. Prediction of soil properties using a process-based forest growth model **to match satellite-derived estimates of leaf area index**. *Remote Sensing of Environment* 126:160-173.

The great bark beetle experiment https://islandpress.org/blog/great-bark-beetle-experiment

Waring, R.H. and G.B. Pitman. 1985. Modifying lodgepole pine stands to change susceptibility to mountain pine beetle attack. *Ecology* 66:889-897.

Remote Sensing of Environment 113 (2009) 1058–1066

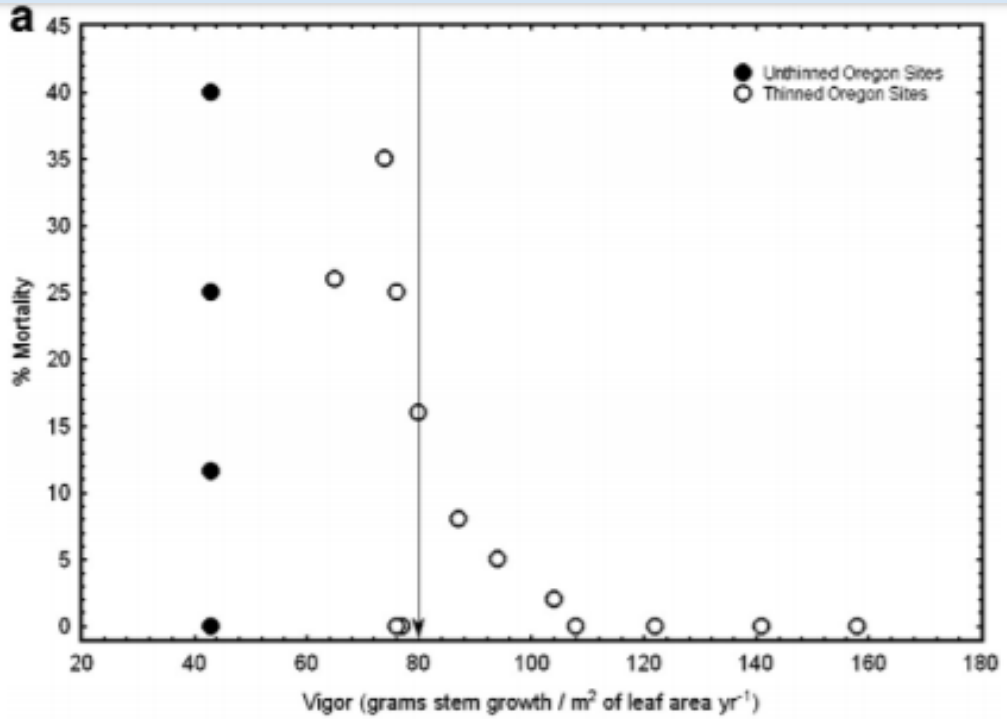
Contents lists available at ScienceDirect

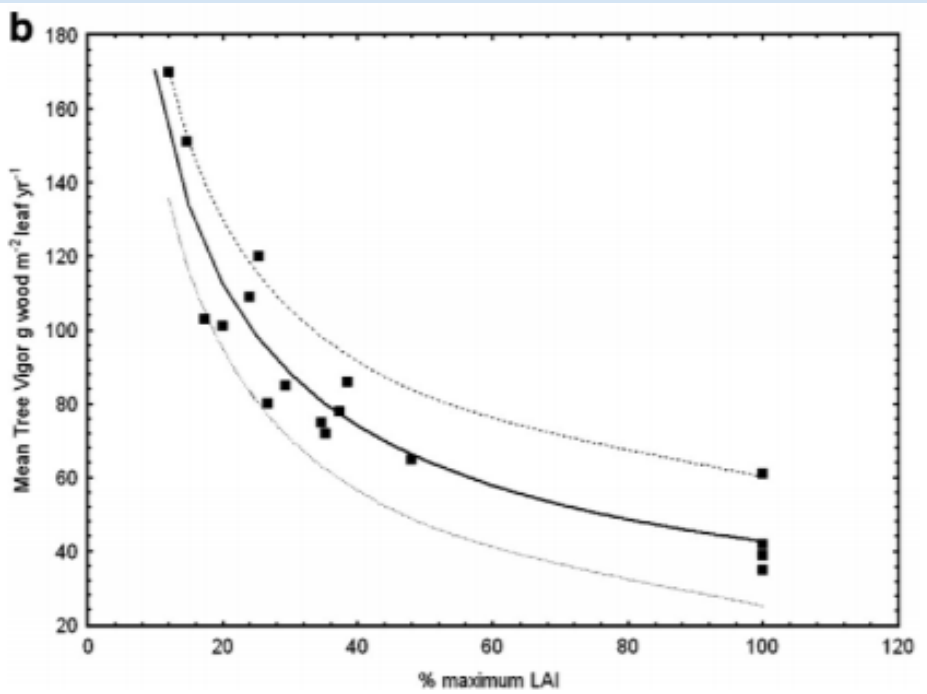
Remote Sensing of Environment

journal homepage: www.elsevier.com/locate/rse

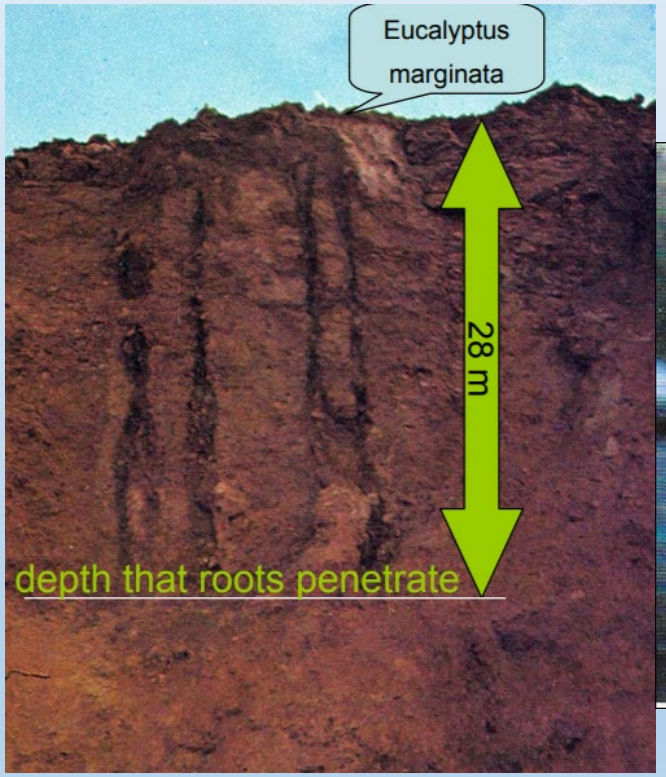
Prediction and assessment of bark beetle-induced mortality of lodgepole pine using estimates of stand vigor derived from remotely sensed data

Nicholas C. Coops [a,*], Richard H. Waring [b], Michael A. Wulder [c], Joanne C. White [c]





Background in plant water relations useful to predict drought



Jeanne Panek

me, with pressure chamber in 1965

Waring, R.H. and B.D. Cleary. 1967. Plant moisture stress: Evaluation by pressure bomb. *Science* 155: 1248-1254.

Climatic Change (2016) 135:325–339
DOI 10.1007/s10584-015-1569-x

Predicting large wildfires across western North America by modeling seasonal variation in soil water balance

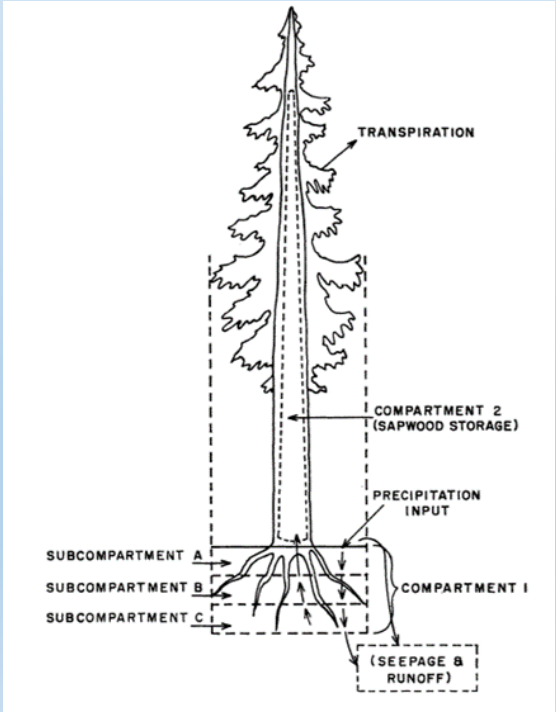
Richard H. Waring[1] · Nicholas C. Coops[2]

Physiological Background

Running, S.W., R.H. Waring, and R.A. Rydell. 1975. Physiological control of water flux in conifers: A computer simulation model. Oecologia 18:1-16.

Landsberg, J.J. and R.H. Waring. 1997. A generalized model of forest productivity using simplified concepts of radiation-use efficiency, carbon balance and partitioning. *Forest Ecol. and Manage.*95: 209-228.

Coops, N.C., and R.H. Waring. 2001. Estimating maximum potential site productivity and site water stress of the eastern Siskiyous using 3-PGS. *Canadian Journal of Forest Research* 31:143-154



Last Lesson: Leave science with options

2018

Summary of Lessons Learned

- Take advantages of opportunities
- Recognize talent in others
- Tell science as a story
- Keep your word
- Make the process fun