

# *Forests and Global Well-Being*

SEPTEMBER 22, 2023

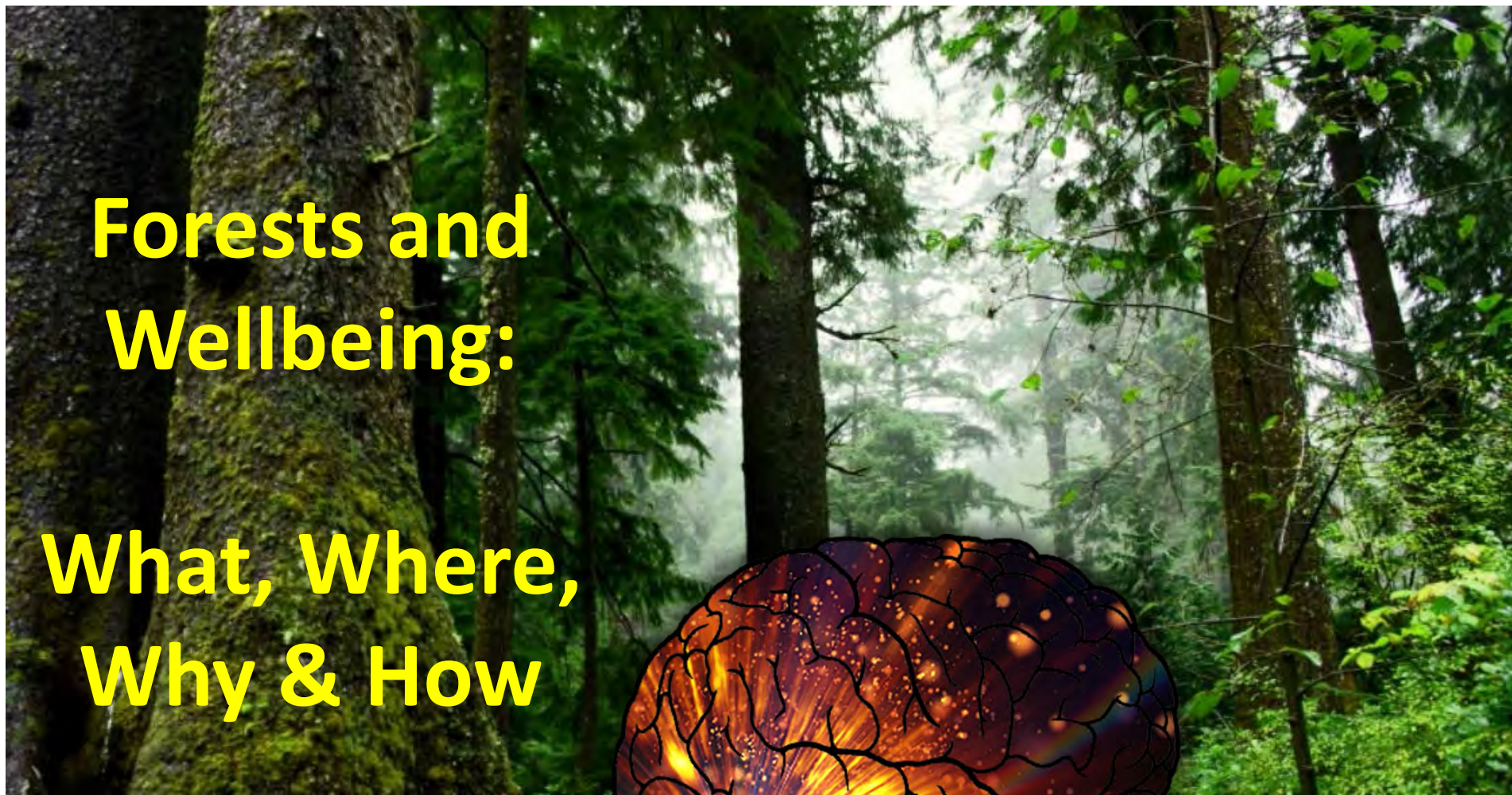
---

HEALTH & WELLNESS TRACK WORKSHOP #1

SUSAN A. MASINO, PH.D.

ANASTASSIA M. MAKARIEVA, PH.D.



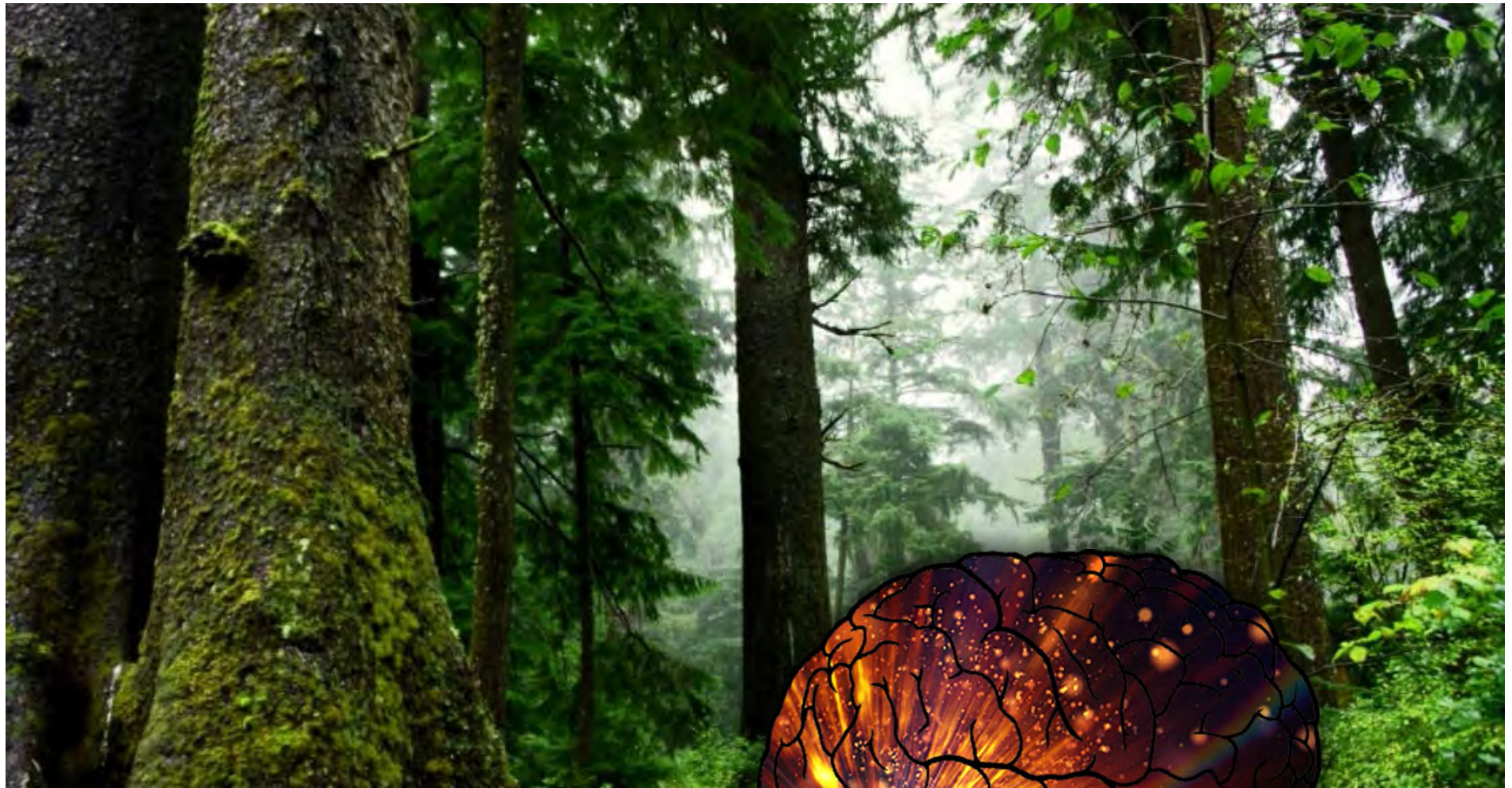


# Forests and Wellbeing: What, Where, Why & How

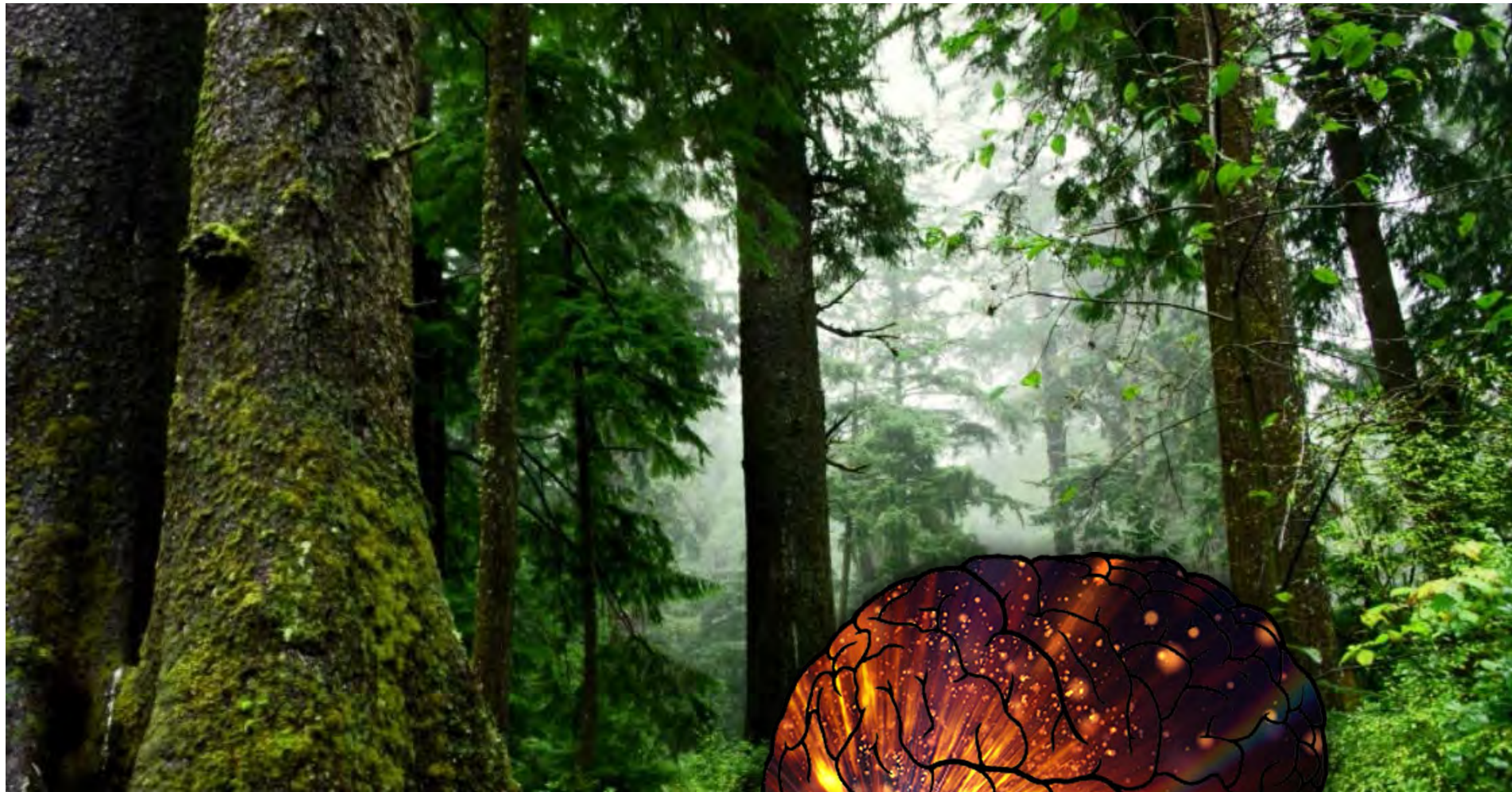
**Susan A. Masino, Ph.D.**  
*Professor of Applied Science, Trinity College*  
*Charles Bullard Fellowship in Forest Research*  
*Board Member, Pinchot Institute for Conservation*

*County Coordinator,  
Old Growth Forest Network*

*Science and Technology Working Group  
Governor's Council on Climate Change (GC3)*



***We need nature.***



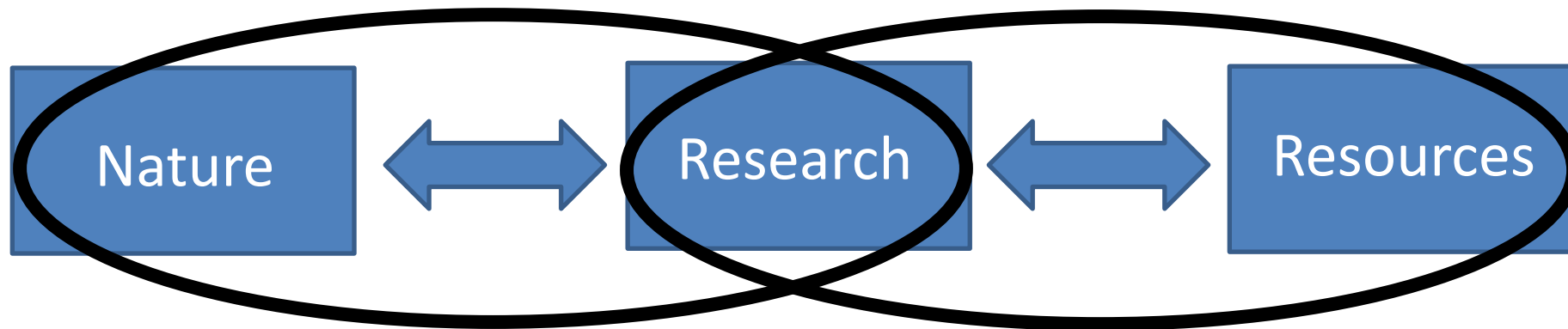
***We need nature.***

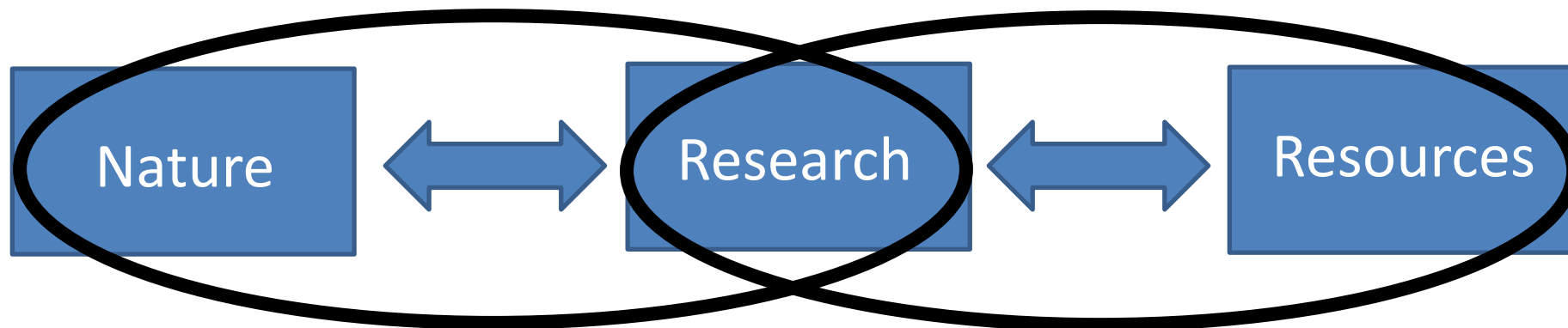
***We need healthy brains.***

# Local and Global Wellbeing Requires Strategic Decisions:



# Local and Global Wellbeing Requires Strategic Decisions:





- essential lifeline  
*land and water*

**First Do No Harm**

- data collection  
*baselines, protocols*

**knowledge, “wise use”**

- local, circular, opportunistic  
*integrated support system*

**“waste not, want not”**



**Chief Randy Moore, USFS**

**Pinchot Institute, USFS**  
***Memorandum of Understanding,***  
***April 2023***

**Gifford Pinchot:**  
***“the forest comes first”***



# *What - Why - Where - How*



**Wildlands in New England**  
*Past, Present, and Future*

# *What - **Why** - Where - How*



*Climate stability*  
*Prevent extinction*

# *What - **Why** - Where - How*



*Climate stability*

*Prevent extinction*

*Individual and community health*

*Repository of evolution, adaptation and resilience*

# *What - **Why** - Where - How*



*Climate stability*

*Prevent extinction*

*Individual and community health*

*Repository of evolution, adaptation and resilience*

***Connect across generations to the mystery and beauty of life on earth***



# *Essentials . . .*



NATIONAL  
ASSOCIATION for  
OLMSTED  
PARKS

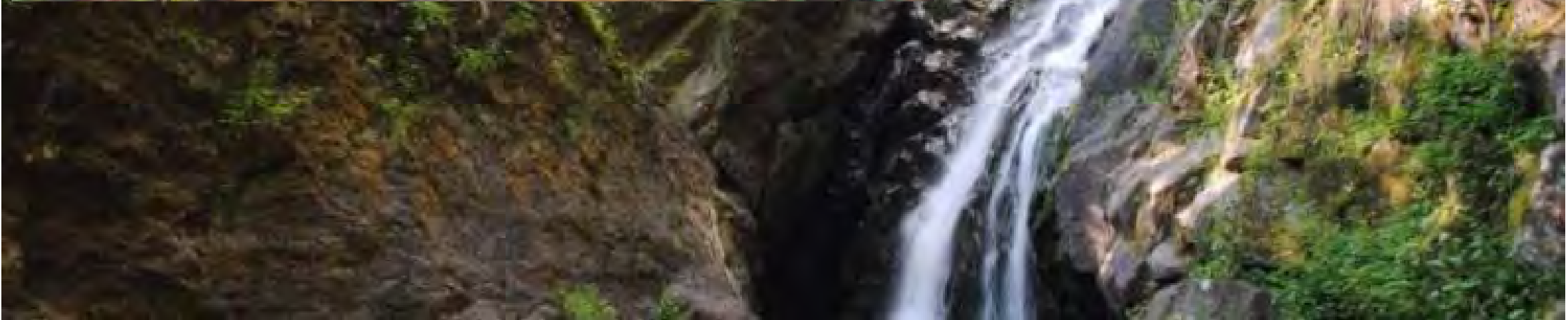




# Essentials . . .



NATIONAL  
ASSOCIATION for  
OLMSTED  
PARKS





The Ten Mile Woods, c. 1900<sup>102</sup>

*Each town should have a park, or rather a primitive forest, of five hundred or a thousand acres, either in one body or several—where a stick should never be cut for fuel—nor for the navy, nor to make wagons, but stand and decay for higher uses—a common possession forever, for instruction and recreation.*

- Henry Thoreau 1862. *Huckleberries*





NATIONAL  
ASSOCIATION for  
OLMSTED  
PARKS





NATIONAL  
ASSOCIATION for  
OLMSTED  
PARKS

*“First Do No Harm”*

**Decrease** Anxiety, Depression

**Promote** Creativity and Awe

**Existence Value**



# Research on East and West Coasts

Berkeley News

---

**Rush of wild nature lowers PTSD in veterans, at-risk teens**

## **The Healing Power of Awe**

By [Tom Valtin](#) August 9, 2018



**We Are Aware and Unhappy Conversations about mental health are everywhere. So why do we still feel so bad?**

**Perspectives on Mental Health . . .**

**B TEENAGERS ARE TELLING US THAT SOMETHING IS WRONG WITH AMERICA**  
BY JAMIESON WEBSTER

## **AAP-AACAP-CHA Declaration of a National Emergency in Child and Adolescent Mental Health**

[Home](#) / [Advocacy](#) / [Child and Adolescent Healthy Mental Development](#) / AAP-AACAP-CHA Declaration of a National Emergency in Child and Adolescent Mental Health



A declaration from the American Academy of Pediatrics, American Academy of Child and Adolescent Psychiatry and Children's Hospital Association:

**We Are Aware and Unhappy Conversations about mental health are everywhere. So why do we still feel so bad?**

***Prevention is Essential***

**B TEENAGERS ARE TELLING US THAT SOMETHING IS WRONG WITH AMERICA**  
BY JAMIESON WEBSTER

## **AAP-AACAP-CHA Declaration of a National Emergency in Child and Adolescent Mental Health**

[Home](#) / [Advocacy](#) / [Child and Adolescent Healthy Mental Development](#) / AAP-AACAP-CHA Declaration of a National Emergency in Child and Adolescent Mental Health



A declaration from the American Academy of Pediatrics, American Academy of Child and Adolescent Psychiatry and Children's Hospital Association:

- **Coordinated action on climate, biodiversity and health.**
- **Nature has not received sufficient attention. (*It's our lifeline.*)**

## Call for emergency action to limit global temperature increases, restore biodiversity, and protect health

Wealthy nations must do much more, much faster

Lukoye Atwoli,<sup>1</sup> Abdullah H Baqui,<sup>2</sup> Thomas Benfield,<sup>3</sup> Raffaella Bosurgi,<sup>4</sup> Fiona Godlee,<sup>5</sup> Stephen Hancocks,<sup>6</sup> Richard Horton,<sup>7</sup> Laurie Laybourn-Langton,<sup>8</sup> Carlos Augusto Monteiro,<sup>9</sup> Ian Norman,<sup>10</sup> Kirsten Patrick,<sup>11</sup> Nigel Praities,<sup>12</sup> Marcel G M Olde Rikkert,<sup>13</sup> Eric J Rubin,<sup>14</sup> Peush Sahni,<sup>15</sup> Richard Smith,<sup>8</sup> Nicholas J Talley,<sup>16</sup> Sue Turale,<sup>17</sup> Damián Vázquez<sup>18</sup>



[www.ParkWatershed.org](http://www.ParkWatershed.org)

[https://www.parkwatershed.org/wp-content/uploads/2020/01/Park\\_EnvEd-report.pdf](https://www.parkwatershed.org/wp-content/uploads/2020/01/Park_EnvEd-report.pdf)

OPEN

10 April 2017

22 August 2017

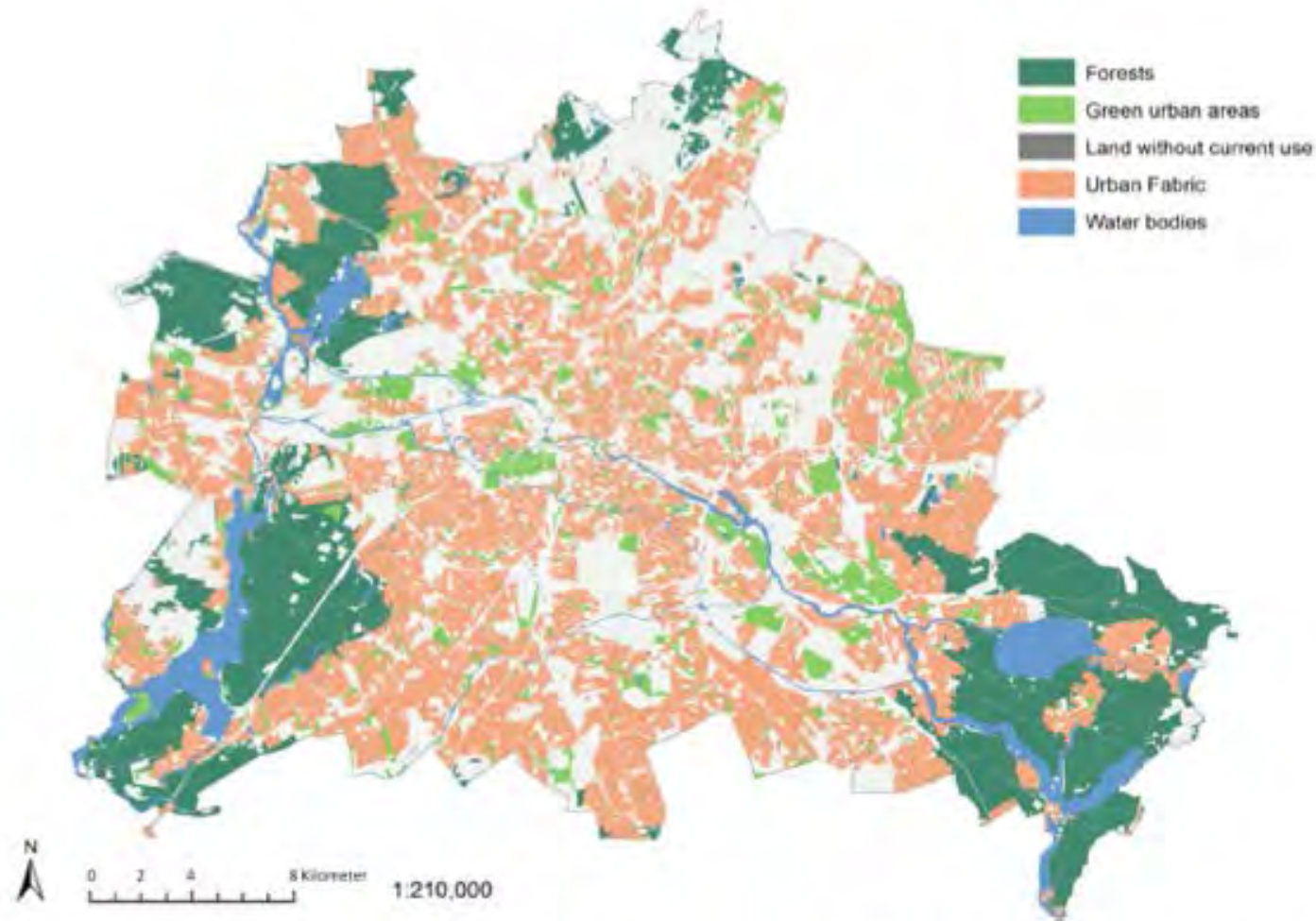
online: 20 September 2017

## In search of features that constitute an “enriched environment” in humans: Associations between geographical properties and brain structure

Simone Kühn<sup>1,2</sup>, Sandra Düzel<sup>1</sup>, Peter Eibich<sup>3,4</sup>, Christian Krekel<sup>3,7,8</sup>, Henry Wüstemann<sup>6</sup>, Jens Kolbe<sup>5</sup>, Johan Martensson<sup>1</sup>, Jan Goebel<sup>3</sup>, Jürgen Gallinat<sup>2</sup>, Gert G. Wagner<sup>1,4,5</sup> & Ulman Lindenberger<sup>1,9</sup>



# Positive relationship between living within 1 km of *forest* and amygdala integrity (Berlin, Germany)



**Figure 1.** Spatial distribution of land use categories in the city of Berlin, Germany. Data taken from the Urban Atlas Land Use Data 2012 (European Environment Agency) created by means of the GIS software package Esri ArcGIS Desktop 10.3 (<https://www.esri.de/support-de/produkte>).

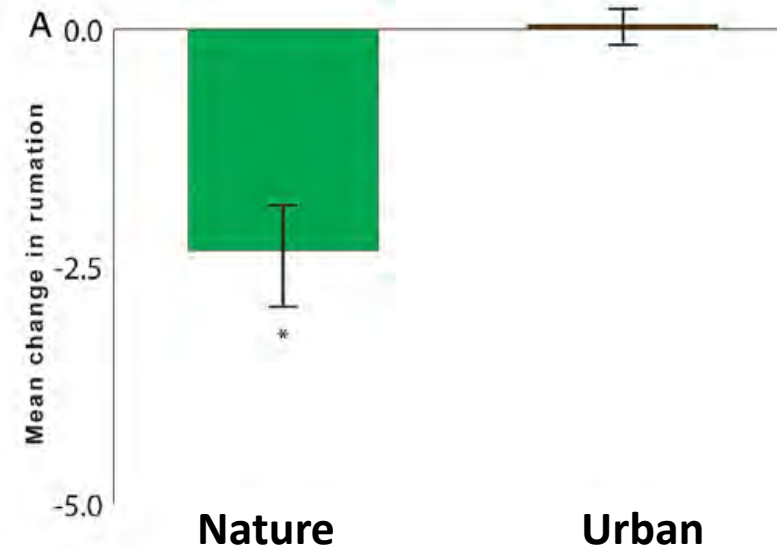
# Nature experience reduces rumination and subgenual prefrontal cortex activation

Gregory N. Bratman<sup>a,1</sup>, J. Paul Hamilton<sup>b</sup>, Kevin S. Hahn<sup>c</sup>, Gretchen C. Daily<sup>d,e,1</sup>, and James J. Gross<sup>c</sup>

<sup>a</sup>Emmett Interdisciplinary Program in Environment and Resources, Stanford University, Stanford, CA 94305; <sup>b</sup>Laureate Institute for Brain Research, School of Community Medicine, Tulsa, OK 74136; <sup>c</sup>Department of Psychology, Stanford University, Stanford, CA 94305; <sup>d</sup>Center for Conservation Biology, Department of Biology, and Woods Institute, Stanford University, Stanford, CA 94305; and <sup>e</sup>Global Economic Dynamics and the Biosphere, Royal Swedish Academy of Sciences, and Stockholm Resilience Centre, Stockholm 114 18, Sweden

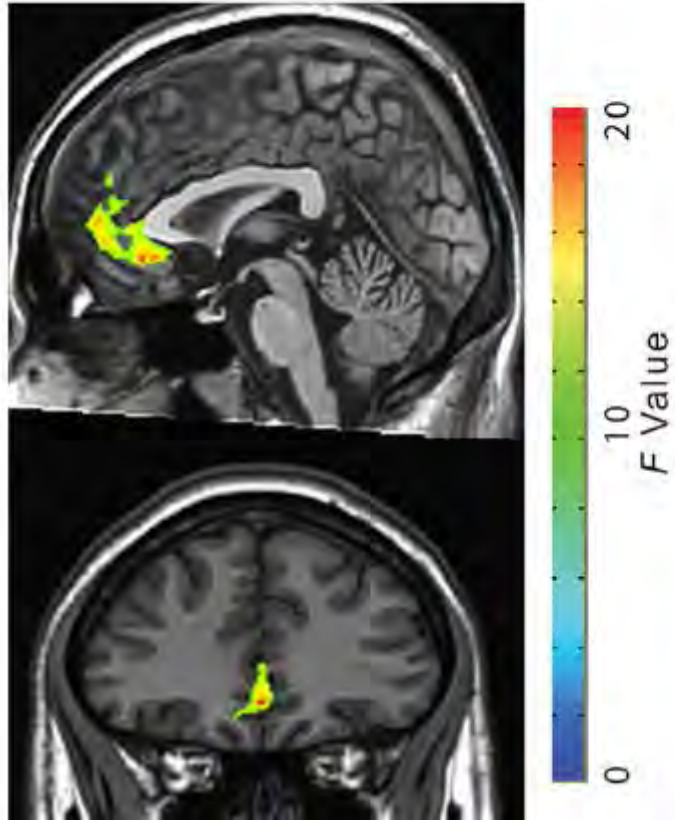
Contributed by Gretchen C. Daily, May 28, 2015 (sent for review March 9, 2015; reviewed by Leslie Baxter, Elliot T. Berkman, and Andreas Meyer-Lindenberg)

- Self-reported rumination decreased significantly after a 90 minute walk in Nature vs. Urban setting

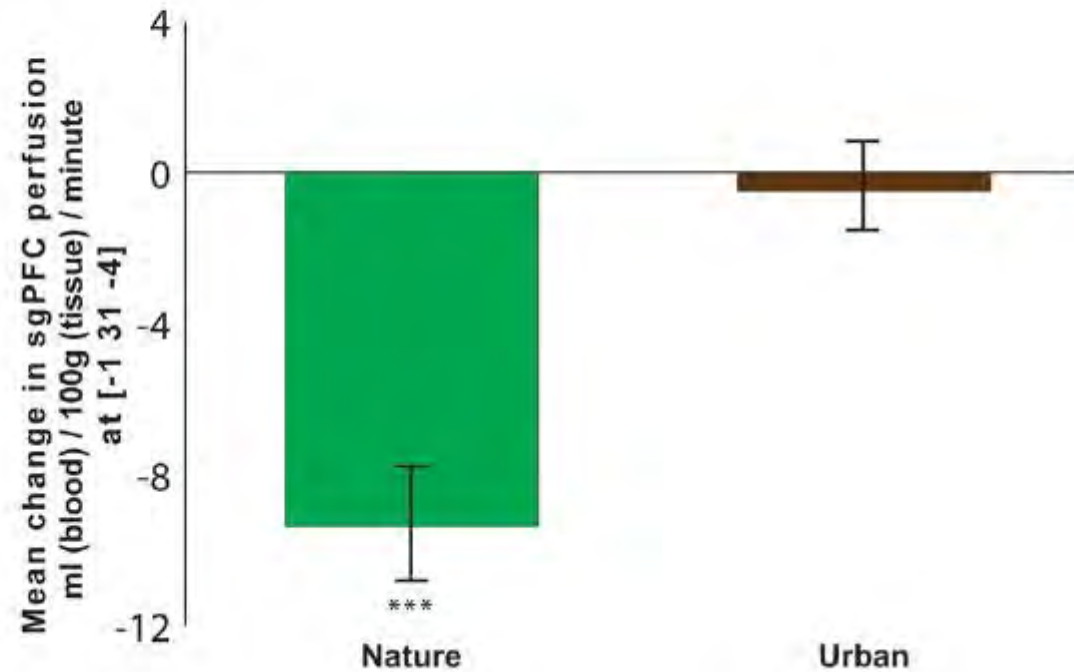


# Decreased self-reported rumination MATCHED change in blood flow in Nature vs. Urban

B



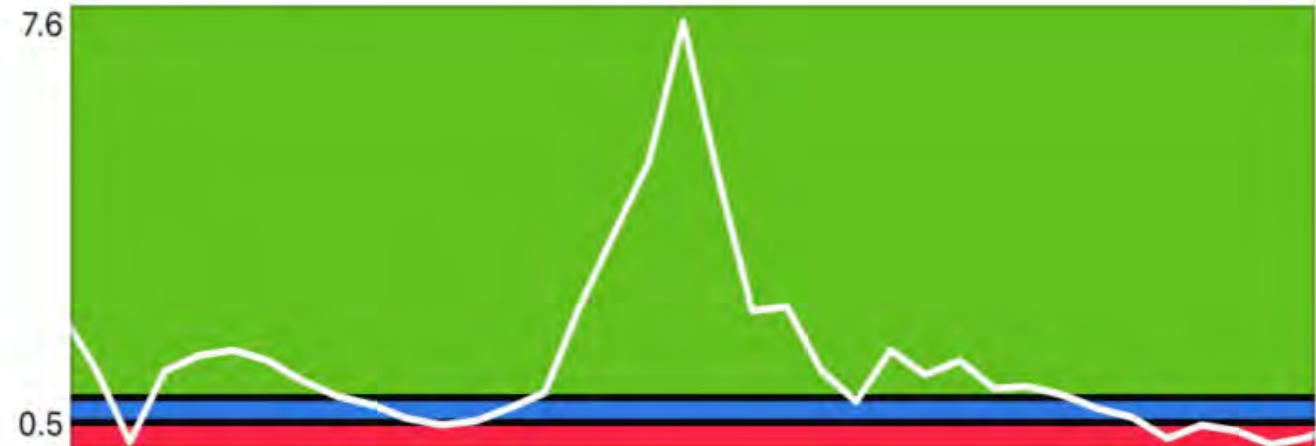
C



# Heart Rate Variability

- Data from walk through forest field trip.
- Peak coherence occurred when we transitioned to walking through the forest.
- Coherence increased in time spent in forest and decreased after exiting forest and entering a more urban environment.

Coherence Over Time



# The Green Road Project

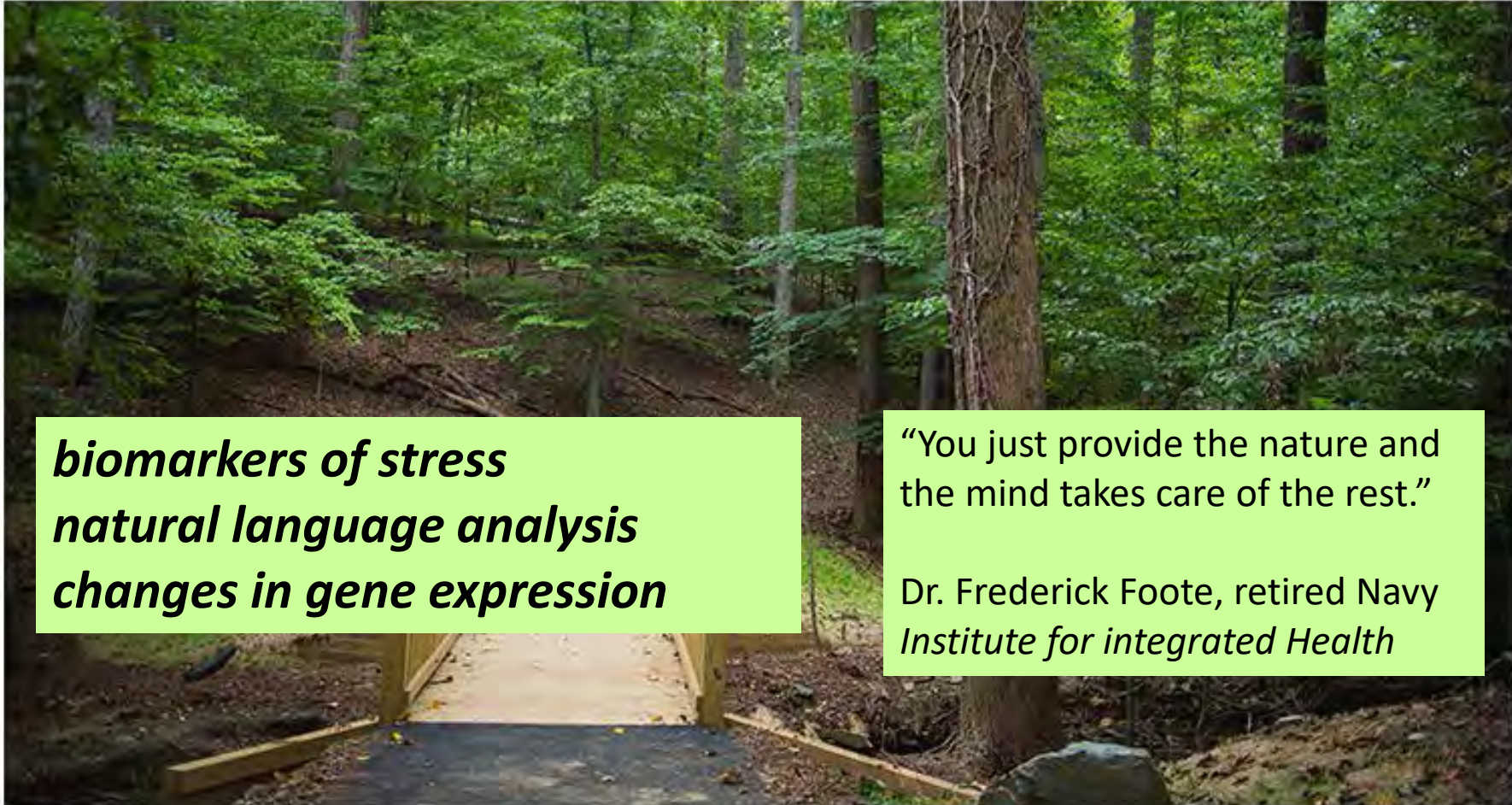
Bethesda, MD



A natural healing environment for injured service members & their families

# The Green Road Project

---






***biomarkers of stress  
natural language analysis  
changes in gene expression***

***“You just provide the nature and  
the mind takes care of the rest.”***

***Dr. Frederick Foote, retired Navy  
Institute for integrated Health***

**A natural healing environment for injured service members & their families**

# Benefit of woodland and other natural environments for adolescents' cognition and mental health

[Mikaël J. A. Maes](#) , [Monica Pirani](#), [Elizabeth R. Booth](#), [Chen Shen](#), [Ben Milligan](#), [Kate E. Jones](#)  & [Mireille B. Toledano](#) 

[Nature Sustainability](#) **4**, 851–858 (2021) | [Cite this article](#)

- 3,568 adolescents aged 9 to 15 years at 31 schools across London, UK
- **green space** was distinguished as *woodland* and *grassland*

Higher daily exposure to woodland (*not grassland*) associated with:

- ***higher scores for cognitive development***
- ***lower risk of emotional and behavioral problems***

# Molecules and Medicines

Clinical trial [NCT05518578](#)

Supernus Pharmaceuticals, Inc: **SPN-817**

RENAISSANCE STUDY: Phase II, Open label

Adult Refractory Epilepsy – Huperzine (club moss)

- Protection from organophosphate poisoning
- Reduce traumatic brain injury, stroke, spinal cord injury
- Speed healing from injury to central nervous system
- Reduce systemic and CNS inflammation
- Block the development or progression of Alzheimer's disease
- Improve the symptoms of Parkinson's disease
- Anti-pain (most potent compound ever tested)
- Anti-seizure (most potent compound ever tested)





# Molecules and Medicines

Original Paper | Published: 01 September 2021

**Less COVID-19 deaths in southern and insular Italy explained by forest bathing, Mediterranean environment, and antiviral plant volatile organic compounds**

[Valentina Roviello](#) & [Giovanni N. Roviello](#) 

[Environmental Chemistry Letters](#) (2021) | [Cite this article](#)



# GOULD FARM

---

Harvesting Hope ♦ Promoting Recovery



Be it known that these  
Lands and Woods  
are sacred to Gould Farm.

They have kindled the healing in many, and  
by God's will, may they continue to do so in  
many more to come.

Be open to their blessings and please  
treat them with respect.

*Out in the sugarbush by Rawson Brook, this sign hangs on the door to the nature center. In the center are many educational posters and pamphlets where community members can come to learn about the natural world.*

- Synthesis by Joan Maloof, PhD.

# *Forests & Human Health*



OLD-GROWTH FOREST NETWORK

***Vitamin F: Forests are critical for human and planetary health***

# How Can We Achieve More Wildlands?

*Upgrade “weak” protection*

*Add to and connect existing areas*

*Identify key areas, such as:*

*a protected network of WATER*

*old forests*

*special habitats*

*wildlife corridors*

*places without invasive plants!*

# Wildlands Intent: Terminology and Stewardship

- Wildland
- Reserve
- Wilderness
- Research Natural Area
- Natural Area Preserve
- National Park / National Preserve
- Sanctuary

# Wildlands Intent: Terminology and Stewardship

- Wildland
- Reserve
- Wilderness
- Research Natural Area
- Natural Area Preserve
- National Park / National Preserve
- Sanctuary
- Natural Stewardship
- Natural Area Stewardship
- Natural Succession
- Proforestation

*In Essentials,  
Unity*





Theoretical physicist Dr. Anastassia Makarieva  
*(forests regulate themselves and the water system of the entire planet):*

*“The biosphere is divided between*  
**natural ecosystems that work for stability and**  
**disturbed ecosystems that cannot do that work.”**



# Forests and Global Wellbeing

**Susan A. Masino,**

**Anastassia M. Makarieva**

Institute for Advanced Study, Technical University of Munich  
Theoretical Physics Division, Petersburg Nuclear Physics Institute

*The Eastern Old-Growth Forest Conference  
Geneva Point Center, NH, 21 September 2023*

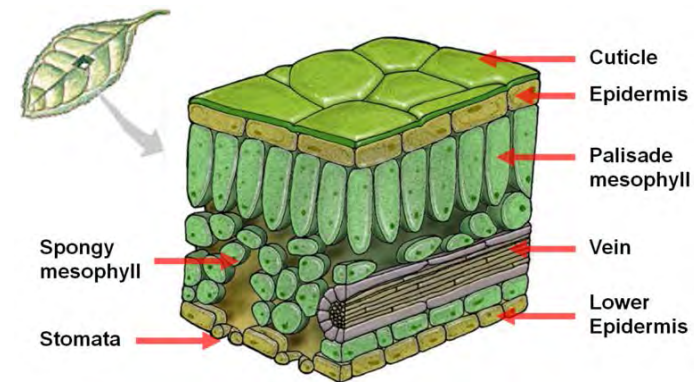


# The Forest Path: From Individual to Planetary Health

**Human health is about maintaining homeostasis of the body's internal milieu**

- Human body contains about  $4 \times 10^{13}$  cells and about  $2 \times 10^{11}$  epidermal skin cells coming in about 50 cell layers.
- Only **one cell in about ten thousand in our body** borders with the external environment!
- Large animals like humans are predisposed to predominantly regulating their **internal environment**.

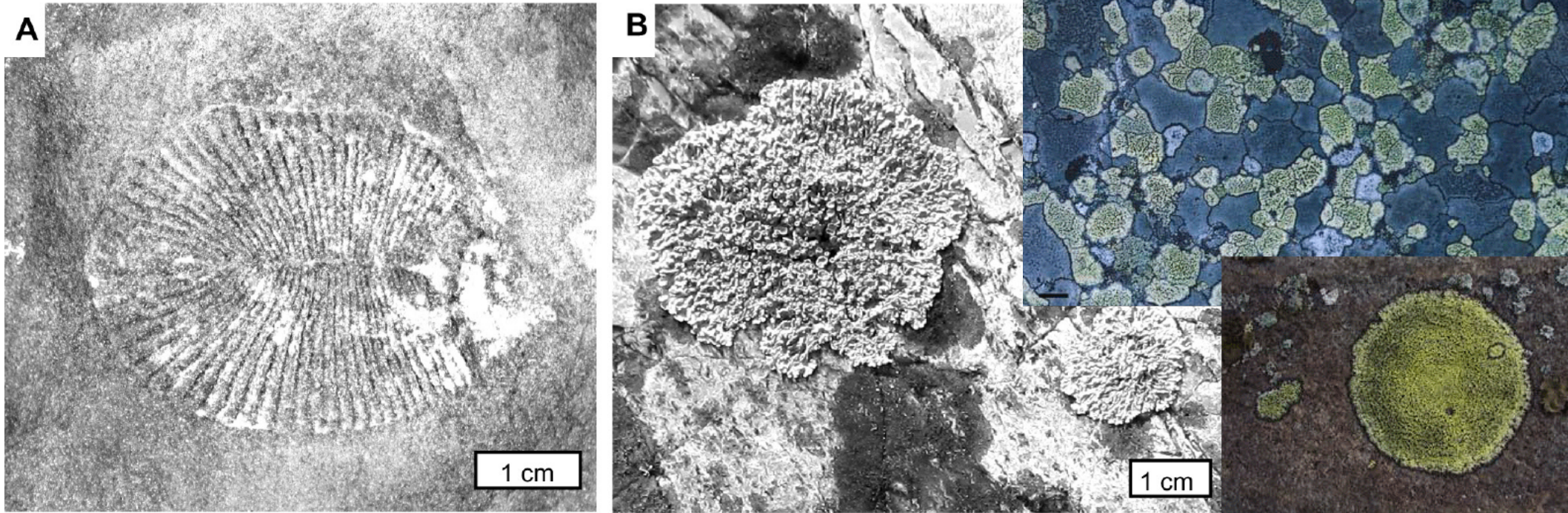
**Planetary health is about maintaining homeostasis of life's environment**



- Green leaves, bacteria and fungi have a **major share of their cells exposed to the “external” environment**, which becomes for them as **important as the internal one**.

# Ecological communities have evolved to maintain environmental homeostasis

- Water is key for life on land. Early terrestrial life could not regulate the terrestrial water cycle.  
Retallack (2013): Precambrian life on land (A) could be similar to modern lichens (B).



Lichens tolerate prolonged desiccation (metabolism drastically declines). They do not control the water cycle.

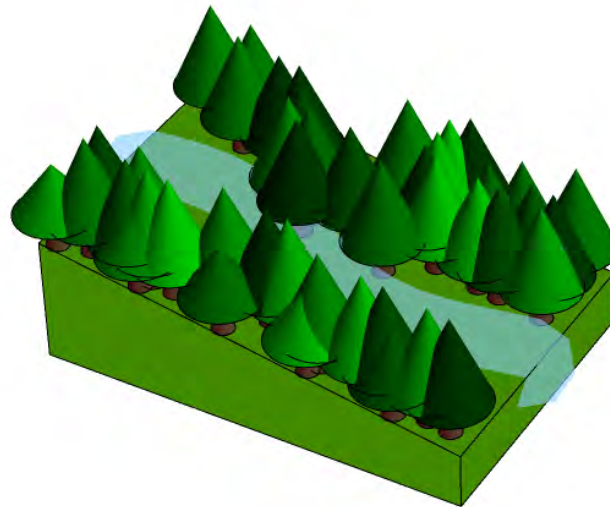
# Regulation of the water cycle by forests: Biotic pump of atmospheric moisture

- If natural ecosystems regulate all major environmental parameters that matter for life, then terrestrial ecosystems must be able to regulate the water cycle – where the physical laws permit such a regulation.
- How does forest maintain its water cycle?
- Why does forest disturbance disrupt the water cycle?

## Water cycle on land

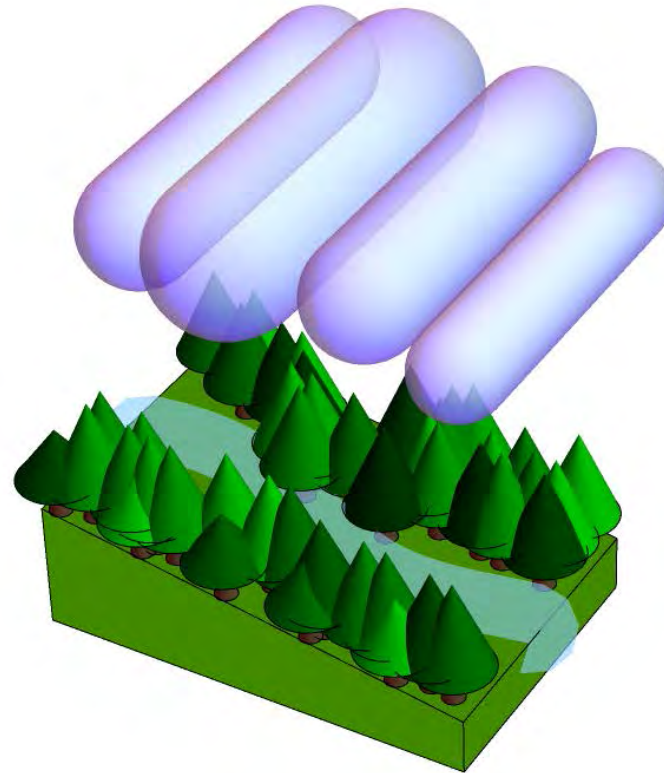
- Forest transpiration adds water vapor to the atmosphere

~200 molecules of H<sub>2</sub>O emitted per each CO<sub>2</sub> molecule fixed



## Water cycle on land

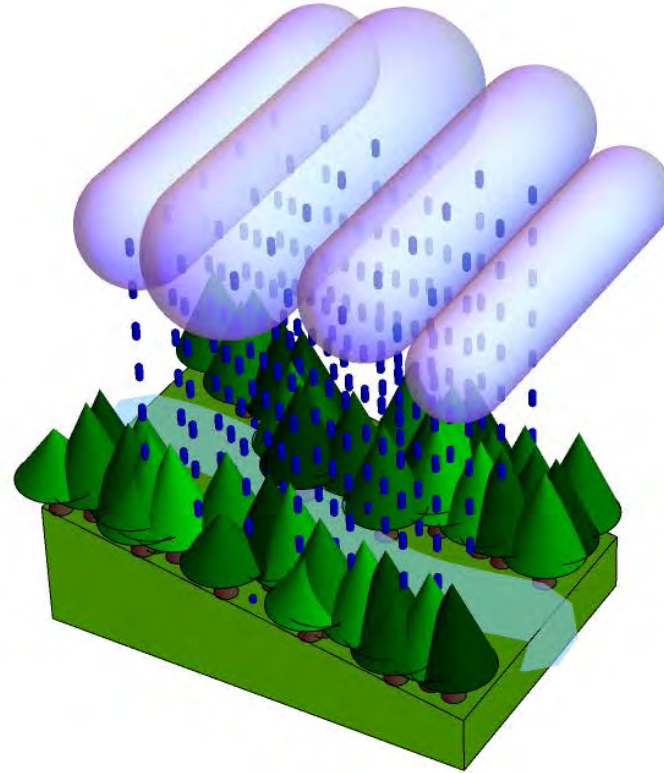
- Forest transpiration adds water vapor to the atmosphere
- ~200 molecules of H<sub>2</sub>O emitted per each CO<sub>2</sub> molecule fixed
- Water vapor condenses in the upper colder atmosphere forming clouds





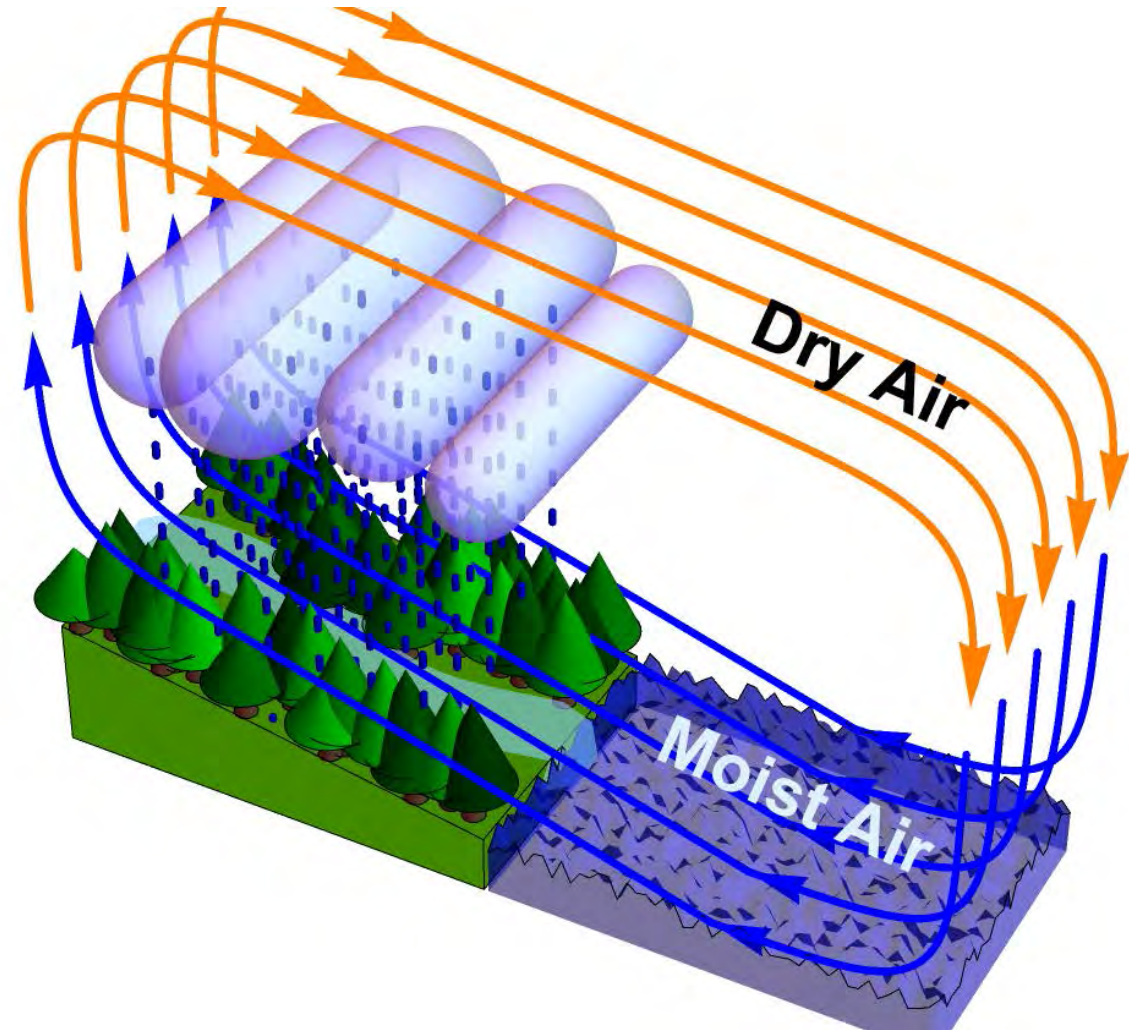
## Water cycle on land

- Forest transpiration adds water vapor to the atmosphere
- ~200 molecules of H<sub>2</sub>O emitted per each CO<sub>2</sub> molecule fixed
- Water vapor condenses in the upper colder atmosphere forming clouds
  - Then it rains



## Water cycle on land

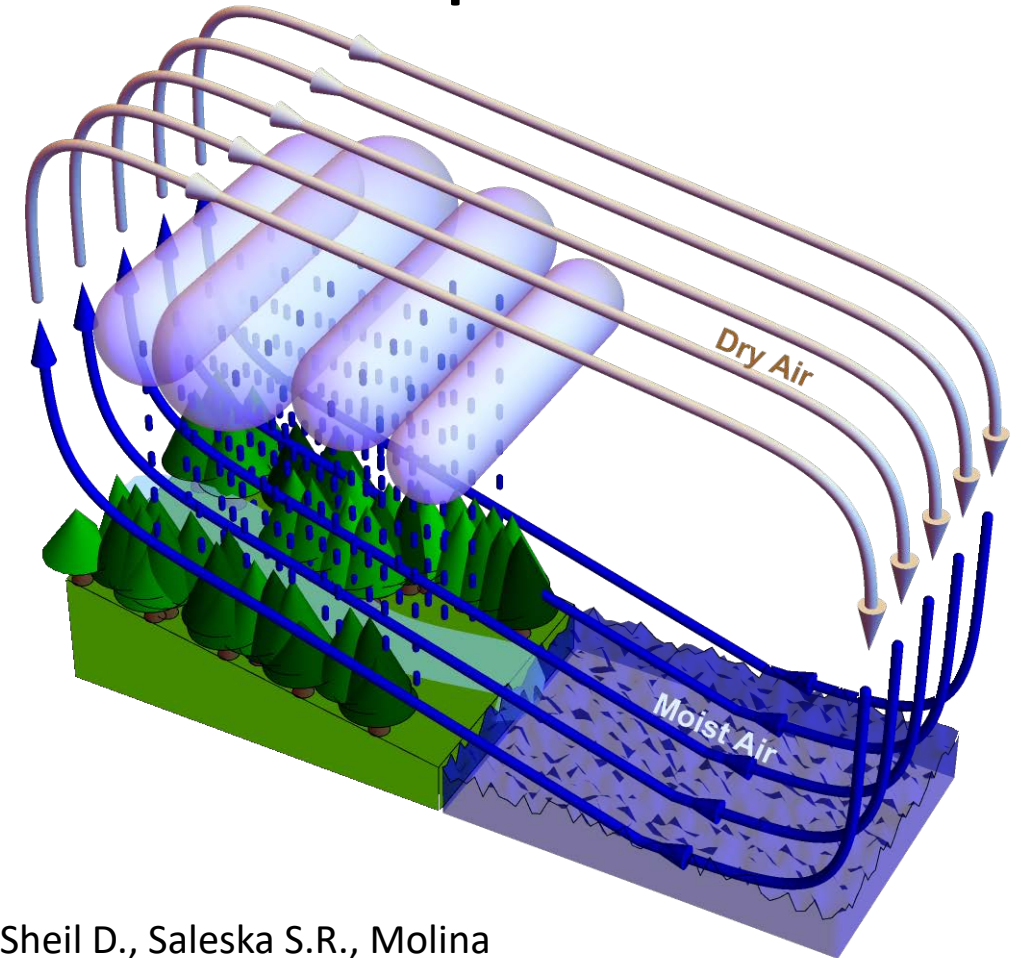
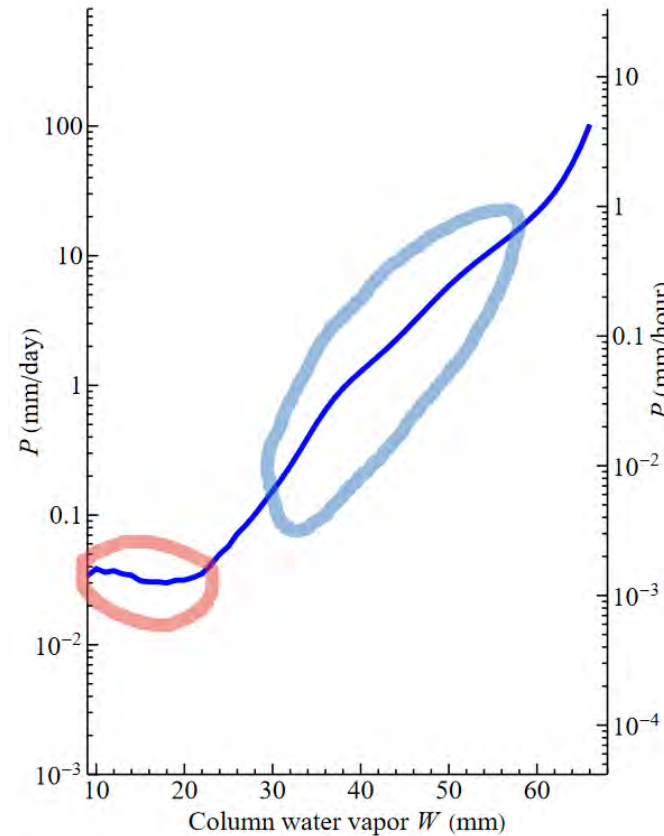
- All soil water can run off to the ocean in just a few years
- There must be a compensatory import
- It goes via the atmosphere
- Winds bring water vapor from over the ocean to land
- **Moist air must ascend over land and cool, then it rains**
- Dry air flows back to the ocean



# Natural forest moistens the atmosphere by **transpiration** and initiates moisture import



Pine needle stomata



Makarieva A.M., Nefiodov A.V., Nobre A.D., Baudena M., Bardi U., Sheil D., Saleska S.R., Molina R.D., Rammig A. (2023) Global Change Biology <https://doi.org/10.1111/gcb.16644>

# Two regimes, dry and wet



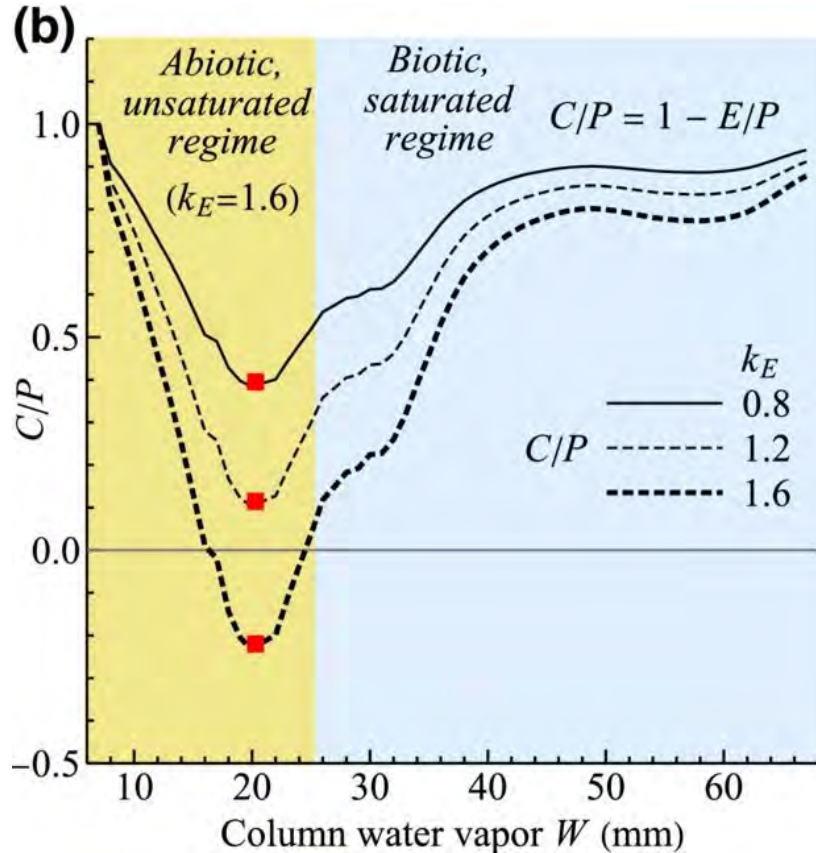
In the dry regime, enhanced transpiration reduces moisture convergence. Water vapor behaves as a passive tracer.



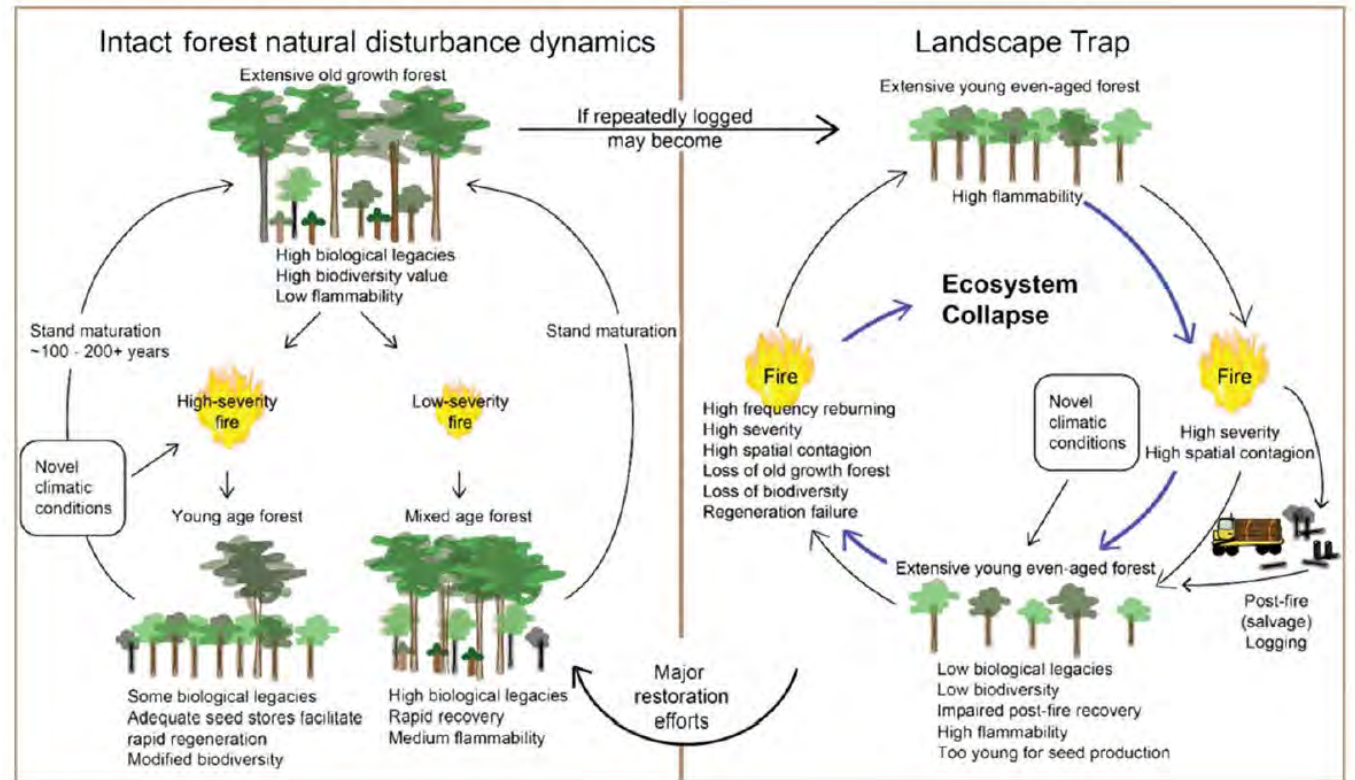
In the wet regime, enhanced transpiration increases moisture convergence by changing atmospheric dynamics.

# Two regimes, dry and wet

Makarieva et al. 2023 GCB



Lindenmayer et al. 2022 doi:10.1007/s11258-021-01217-2

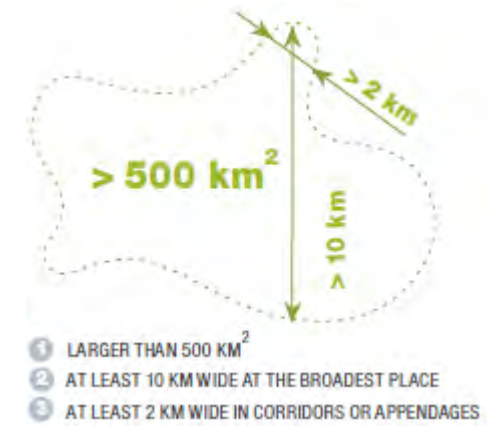


The ecosystem can be forced to enter the dry regime (e.g., by logging). Whether it restores back to the wet regime, is not guaranteed (“landscape trap”).



# Intact Forest Landscapes in the North

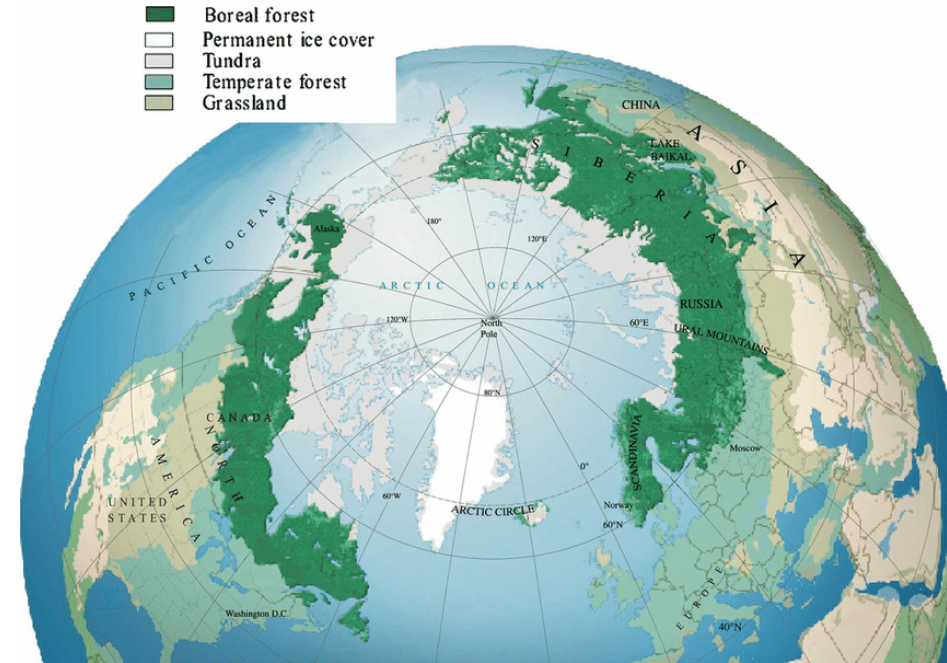
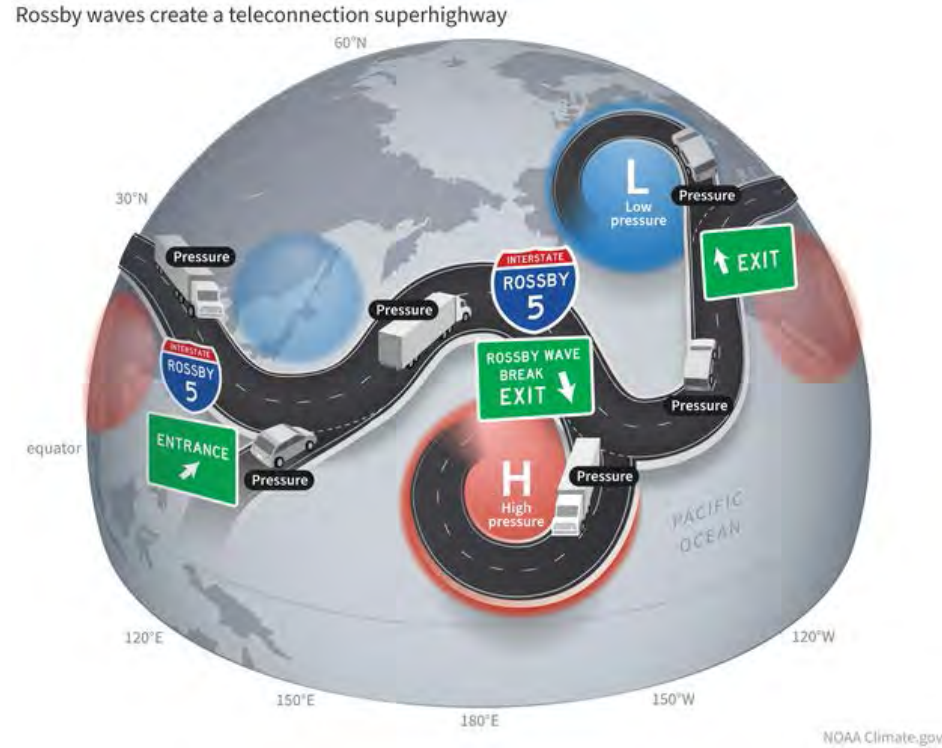
An **Intact Forest Landscape (IFL)** is defined as a territory within today's global extent of forest cover which contains forest and non-forest ecosystems minimally influenced by human economic activity, **with an area of at least 500 km<sup>2</sup> (50,000 ha) and a minimal width of 10 km** (measured as the diameter of a circle that is entirely inscribed within the boundaries of the territory). <https://intactforests.org/concept.html>



Intact forest landscapes (2020, green) and their disappearance in 2000-2020 (red, yellow)

<https://glad.earthengine.app/view/intact-forests>

# Preserve natural forests to stop the aggravating water cycle disruptions in our teleconnected world!



Climate.gov, 22 December 2022: **What are teleconnections? Connecting Earth's climate patterns via global information superhighways**

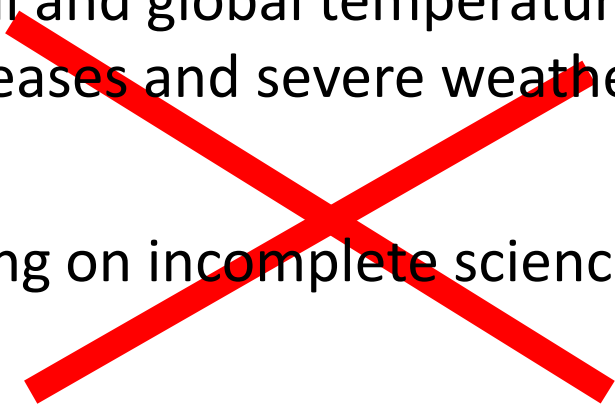
Boreal and temperate forests (from Yoon & Chen 2005 J Climate 19:1437)

**We are all connected.**



# Where should we go? The risks and benefits of natural forests in climate

## Risks to avoid:

- Local and global temperature increases and severe weather
  - Acting on incomplete science
  - Ignoring simple solutions
- 

## Benefits to support:

- Natural forests as a powerful mechanism for global wellbeing
- Avoid climate destabilization and water cycle calamities
- Optimize a vital strategy to mitigate global change

***“Science and everyday life cannot and should not be separated.”***

Rosalind Franklin, PhD (1920-1958)





THANK YOU FOR JOINING US!! QUESTIONS?