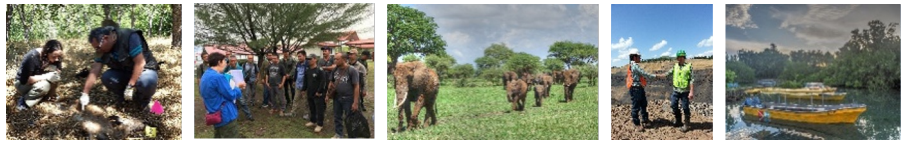
REGIONAL FLYWAY INITIATIVE TRAINING SERIES:
From Wetland Ecosystem Services to Nature-based Solutions

ADB HQ on 27–30 June 2023

Supplementary Slides & Further Reading from **Dr. Ariana Sutton-Grier**

Wetlands & Ecosystem Services: Opportunities & Applications



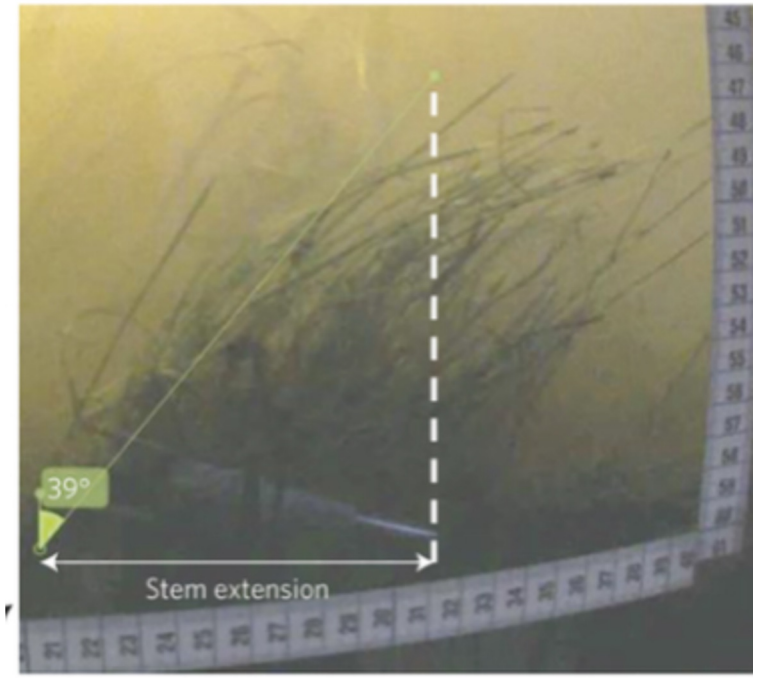
Wetlands & Ecosystem Services: Opportunities & Applications

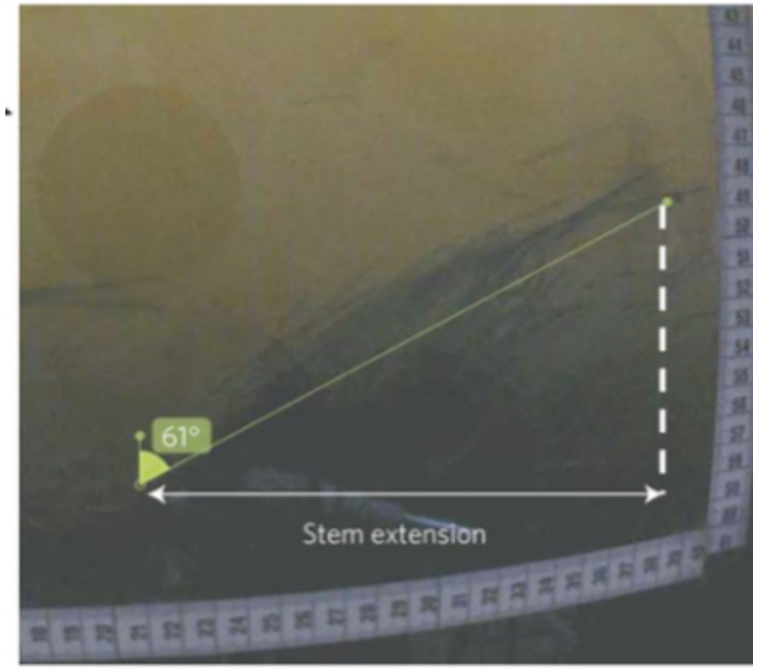
Dr. Ariana Sutton-Grier
DOI International Technical Assistance Program &
US Geological Survey
Land Change Science/Climate R&D Program Coordinator

Salt Marsh Wave Reduction and Erosion Protection

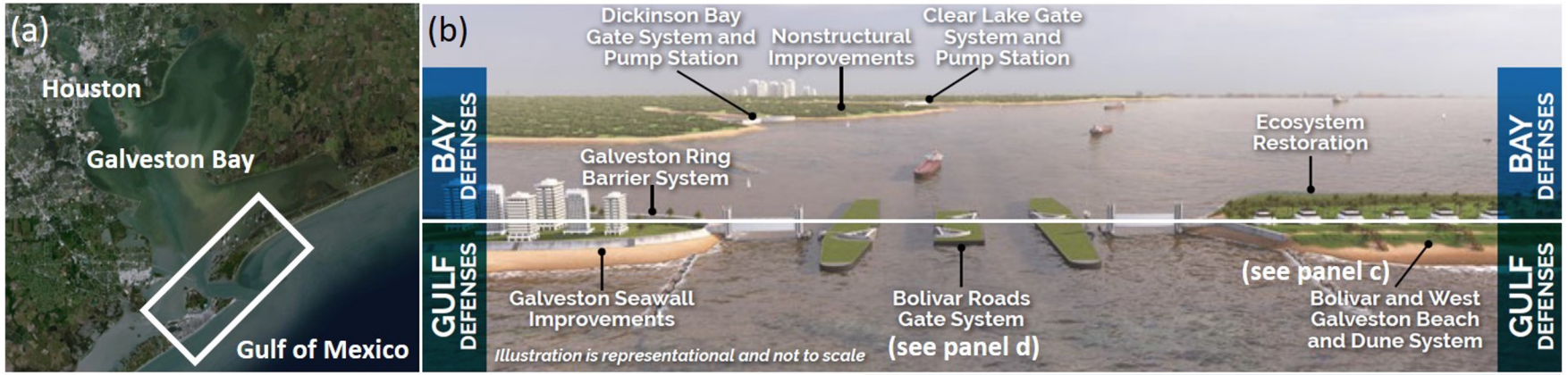
- Up to 60% of wave reduction attributed to vegetation
- Marsh substrate remained stable under all conditions, even once waves had broken the stems
- **“…salt marsh ecosystems can be a valuable component of coastal protection schemes.”**

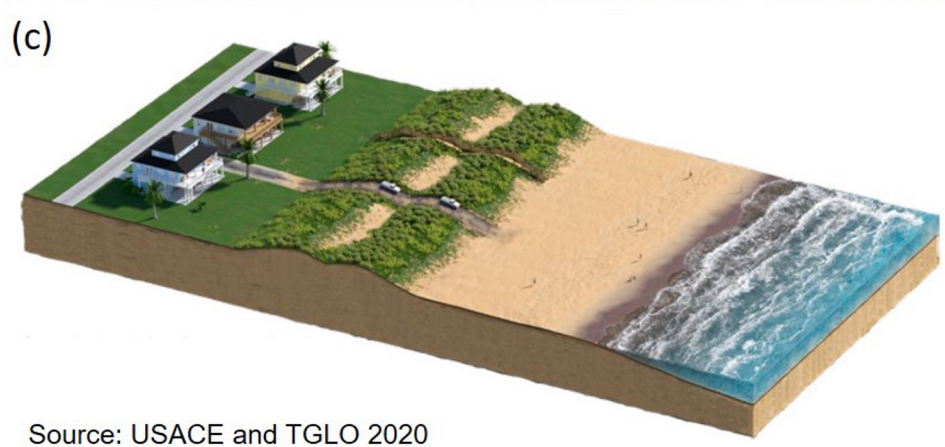
Möller et al. Nature Geosciences. 2014



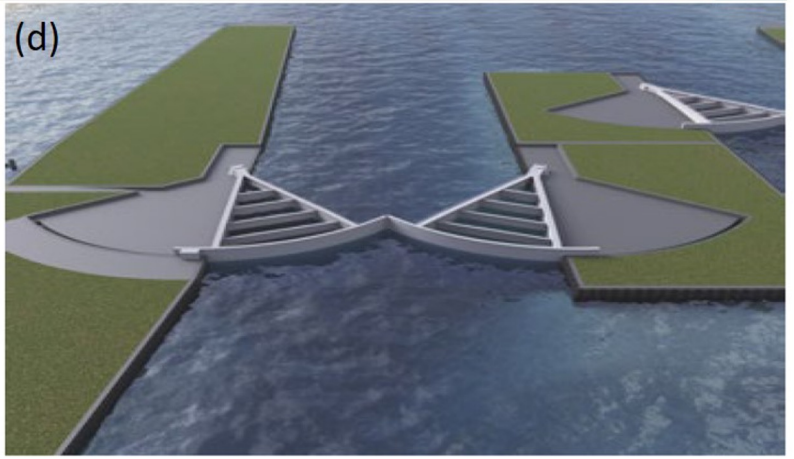


New Coastal Resilience Case Studies: Coastal Texas Protection and Restoration Project, Galveston





Source: USACE and TGLO 2020



- Multiple lines of defense; outer barrier island and inner bay
- Restored beach and dune system
- Gate system at primary connection to Gulf of Mexico
- USACE still awaiting Congressional approval and funding for project

Palinkas et al. (2022)

Rebuild By Design: Big “U” Project

- Hard and soft infrastructure with recreational benefits
- Integrate flood protection into community, improve water access
- Berms and flood walls or barriers

Big “U” Project: Eastside Resilience Project

Climate Adaptation and Recreational Benefits

AKRF-KSE, JV | BJARKE INGELS GROUP | MATHEWS NIELSEN LANDSCAPE ARCHITECTS, P.C. | NEW YORK CITY DEPT. OF DESIGN AND CONSTRUCTION | NEW YORK CITY DEPT. OF PARKS AND RECREATION | NEW YORK CITY DEPT. OF TRANSPORTATION | NEW YORK CITY DEPT. OF ENVIRONMENTAL PROTECTION | NEW YORK CITY MAYOR'S OFFICE OF RECOVERY AND RESILIENCY

COMMUNITY BOARD PROJECT UPDATE
EAST SIDE COASTAL RESILIENCY PROJECT
MARCH 26, 2018

20th Street Park Entry
Preliminary Review - Closed B-21

Natural and Hybrid Research Needs?

- Natural and hybrid storm protection benefits?
- Value of storm protection benefits and co-benefits?
- Best practices for design?
  - Need Multidisciplinary efforts
- How to implement?

Main Findings:

- US coastal wetlands are a sink for greenhouse gases
- Loss of wetlands is a growing source; loss mostly in the Gulf
- A lot less restoration is occurring than loss
- Accomplished this with globally available Landsat data and the Wetlands Supplement other countries can do this, too

nature climate change

ARTICLES

https://doi.org/10.1038/s41558-018-0345-0

Coastal wetland management as a contribution to the US National Greenhouse Gas Inventory

Stephen Crooks[1*], Ariana E. Sutton-Grier[2,3,8], Tiffany G. Troxler[4], Nathaniel Herold[5], Blanca Bernal[6,9], Lisa Schile-Beers[1] and Tom Wirth[7]

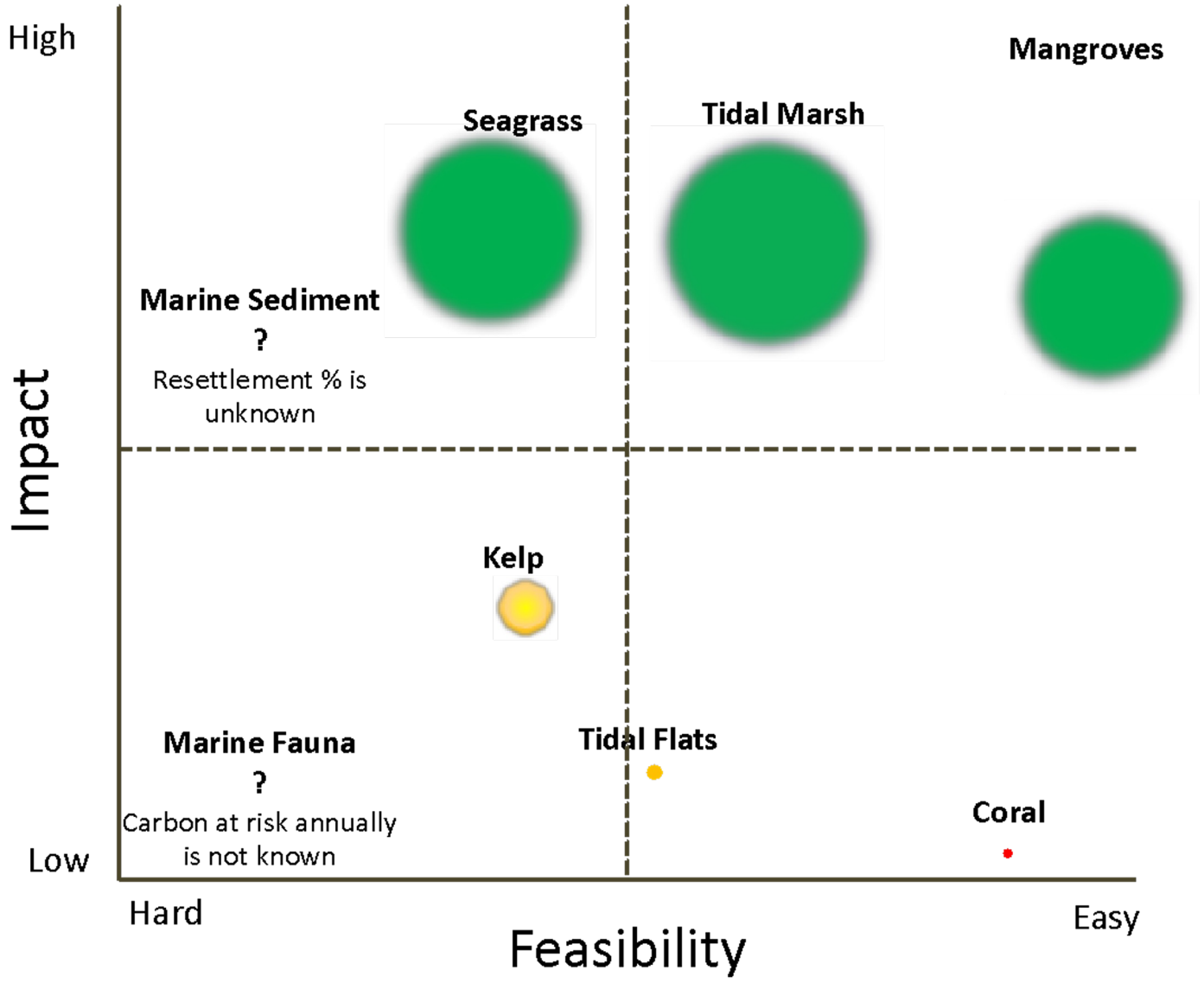
The IPCC 2013 Wetlands Supplement provided new guidance for countries on inclusion of wetlands in their National GHG Inventories. The United States has responded by including managed coastal wetlands for the first time in its 2017 GHG Inventory report along with an updated time series in the most recent 2018 submission and plans to update the time series on an annual basis as part of its yearly submission to the United Nations Framework Convention on Climate Change (UNFCCC). The United States followed IPCC Good Practice Guidance when reporting sources and sinks associated with managed coastal wetlands. Here we show that intact vegetated coastal wetlands are a net sink for GHGs. Despite robust regulation that has protected substantial stocks of carbon, the United States continues to lose coastal wetlands to development and the largest loss of wetlands to open water occurs around the Mississippi Delta due mostly to upstream changes in hydrology and sediment delivery, and oil and gas extraction. These processes create GHG emissions. By applying comprehensive Inventory reporting, scientists in the United States have identified opportunities for reducing GHG emissions through restoration of coastal wetlands that also provide many important societal co-benefits.

The IPCC's 2013 Wetlands Supplement provided additional guidance for countries to include wetlands in their national GHG inventories. The United States has responded to this opportunity by including managed coastal wetlands in its 2017 GHG Inventory report and subsequently including wetland data in the 2018 Inventory. The plan is to update the time series on an annual basis as part of the yearly submission of the United States to the UNFCCC. Here we show that it is possible to use publicly available data to incorporate coastal wetlands into national in which countries can report GHG emissions and sinks; all other Inventory sectors only report sources of GHGs.

When the 2006 IPCC Guidelines were developed, many wetlands were not included because the science was considered to be insufficient to produce globally applicable default values on GHG emissions and removals due to human activities. The 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands[4] (Wetlands Supplement) helped to fill this gap. Countries currently have an opportunity (not a require-

Comparing Coastal and Ocean Carbon Opportunities

- Others have claimed that there are other blue carbon sinks that should be considered
- Green is actionable now
- Science is still lacking for many systems
  - (Yellow emerging, ? Not enough data)
- And the feasibility of incorporating these into human policies is still undetermined
- Howard et al. In Review



ENVIRONMENTAL STUDIES

Natural climate solutions for the United States

Joseph E. Fargione[1]*, Steven Bassett[2], Timothy Boucher[3], Scott D. Bridgham[4], Richard T. Conant[5], Susan C. Cook-Patton[3,6], Peter W. Ellis[3], Alessandra Falcucci[7], James W. Fourqurean[8], Trisha Gopalakrishna[3], Huan Gu[9], Benjamin Henderson[10], Matthew D. Hurteau[11], Kevin D. Kroeger[12], Timm Kroeger[3], Tyler J. Lark[13], Sara M. Leavitt[3], Guy Lomax[14], Robert I. McDonald[3], J. Patrick Megonigal[6], Daniela A. Miteva[15], Curtis J. Richardson[16], Jonathan Sanderman[17], David Shoch[18], Seth A. Spawn[13], Joseph W. Veldman[19], Christopher A. Williams[9], Peter B. Woodbury[20], Chris Zganjar[3], Marci Baranski[21], Patricia Elias[3], Richard A. Houghton[17], Emily Landis[3], Emily McGlynn[22], William H. Schlesinger[23], Juha V. Siikamaki[24], Ariana E. Sutton-Grier[25,26], Bronson W. Griscom[3]

Limiting climate warming to <2°C requires increased mitigation efforts, including land stewardship, whose potential in the United States is poorly understood. We quantified the potential of natural climate solutions (NCS)—21 conservation, restoration, and improved land management interventions on natural and agricultural lands—to increase carbon storage and avoid greenhouse gas emissions in the United States. We found a maximum potential of 1.2 (0.9 to 1.6) Pg CO_2e $year^{-1}$, the equivalent of 21% of current net annual emissions of the United States. At current carbon market prices (USD 10 per Mg CO_2e), 299 Tg CO_2e $year^{-1}$ could be achieved. NCS would also provide air and water filtration, flood control, soil health, wildlife habitat, and climate resilience benefits.

INTRODUCTION

Limiting global warming below the 2°C threshold set by the Paris Climate Agreement is contingent upon both reducing emissions and removing greenhouse gases (GHGs) from the atmosphere (*1*, *2*). Natural climate solutions (NCS), a portfolio of discrete land stewardship options (*3*), are the most mature approaches available for carbon conservation and uptake compared to nascent carbon capture technologies (*4*) and could complement increases in zero-carbon energy production and energy efficiency to achieve needed climate change mitigation. Within the United States, the maximum and economically viable mitigation potentials from NCS are unclear.

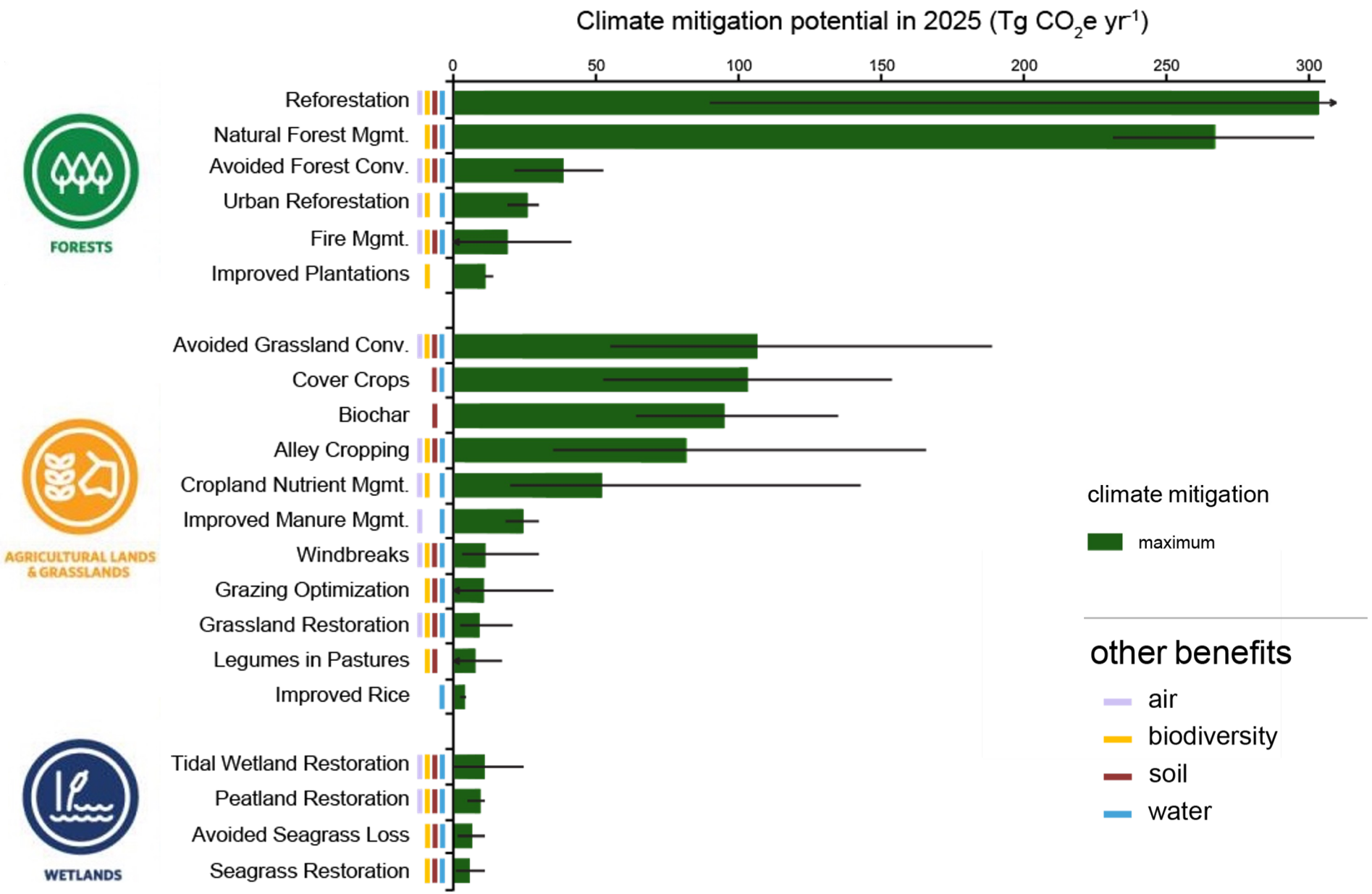
Here, we quantify the maximum potential for NCS in the United

several price points. We consider 21 distinct NCS to provide a consistent and comprehensive exploration of the mitigation potential of conservation, restoration, and improved management in forests, grasslands, agricultural lands, and wetlands (Fig. 1), carefully defined to avoid double counting (details in the Supplementary Materials). We estimate the potential for NCS in the year 2025, which is the target year for the United States' Nationally Determined Contribution (NDC) under the Paris Agreement to reduce GHG emissions by 26 to 28% from 2005 levels. Our work refines a coarser-resolution global analysis (*3*) and updates and expands the range of options considered in previous analyses for the United States (*5*–*8*).

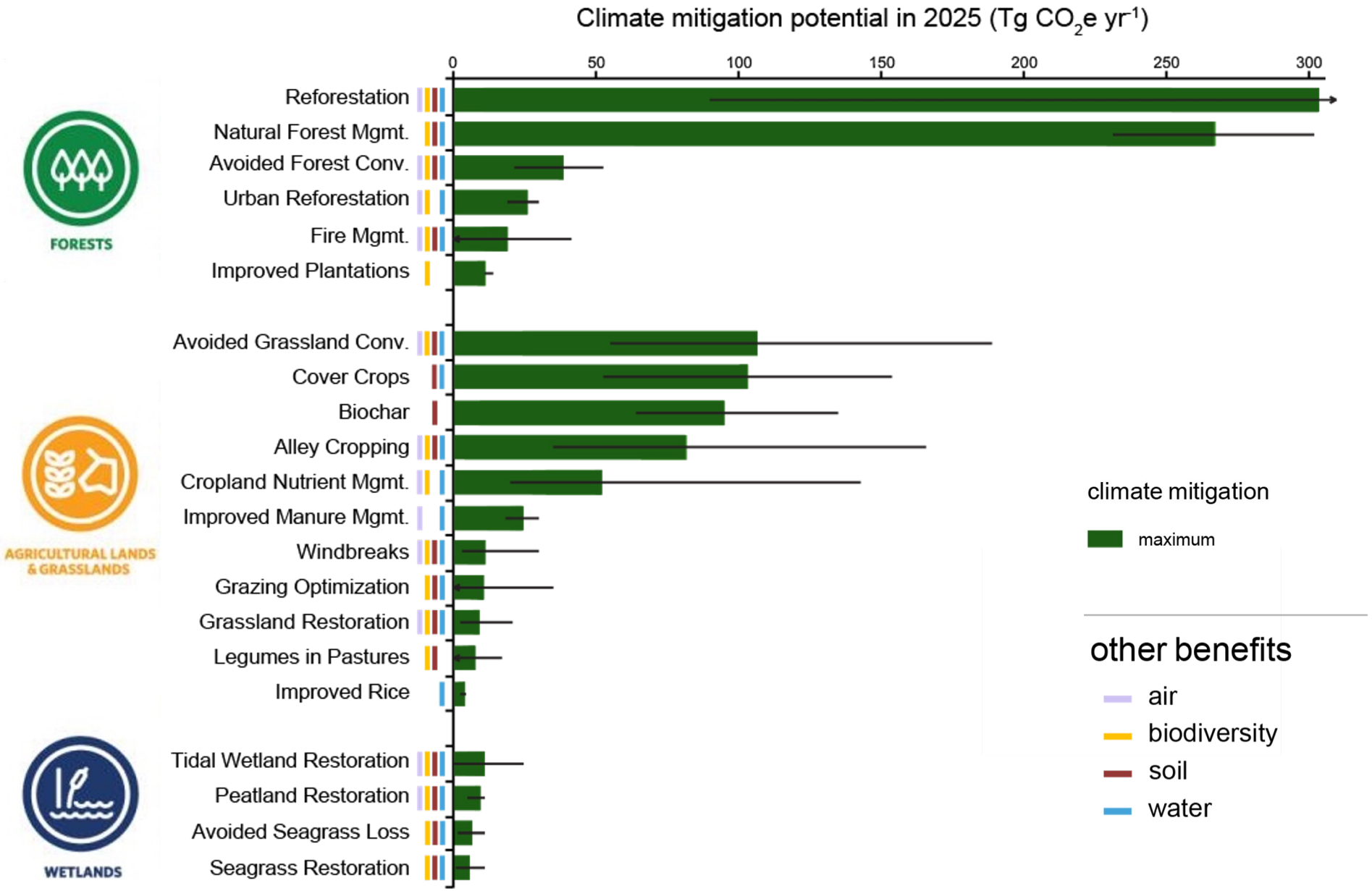
For each NCS opportunity (Fig. 1 and the Supplementary Materials),

How much carbon can ecosystems in the U.S. store if we implemented ALL natural climate solutions?

1.2 Pg CO_2e yr^{-1} ($100tC)



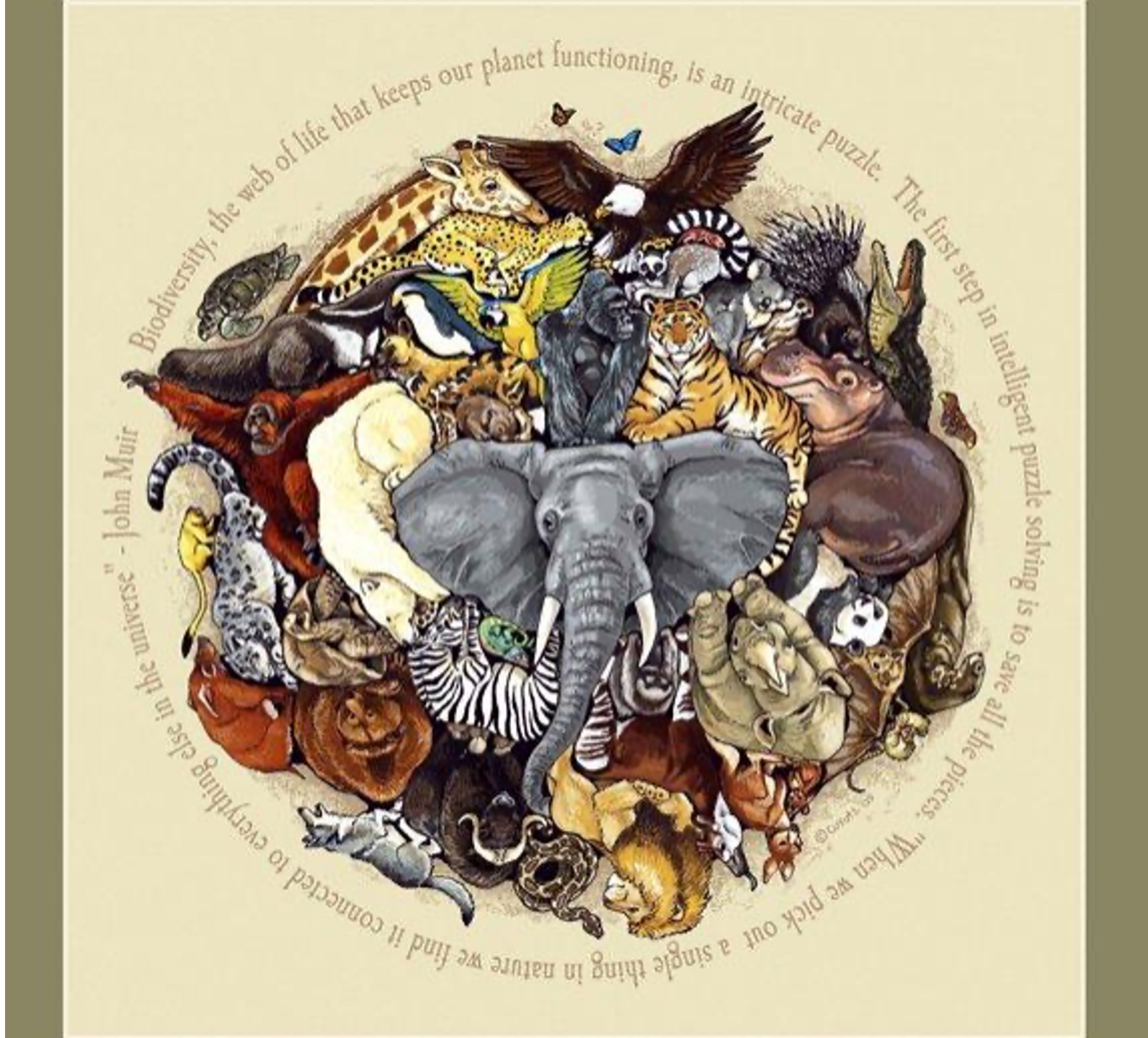
20% of US net emissions



3. Nature/Biodiversity and Human Health

Biodiversity Conservation

- Prior reasons to conserve biodiversity
  - Intrinsic value
  - Provisioning of food, medicines
  - Climate regulation



Nature/Biodiversity and Human Health

- New evidence suggests important connections between biodiversity and human health and well-being

Biodiversity
WE ARE ALL IN THIS TOGETHER

Human Health and Well-Being

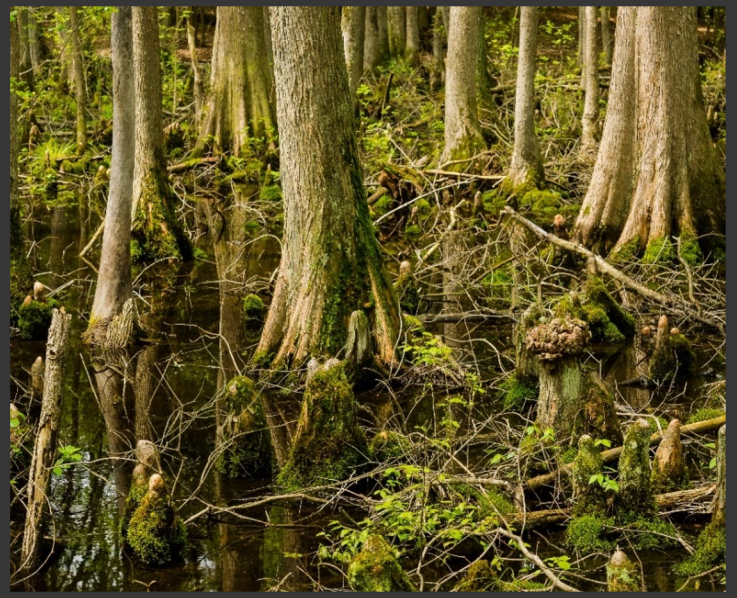
- “…a state of physical, mental and social well-being and not merely the absence of disease or infirmity.”
  -World Health Organization (1946)

Synthesis Study Questions

1. Is there convincing evidence that experiencing more natural settings can improve psychological and physical health? YES!
2. Does exposure to biodiverse nature result in measurable health responses?

   YES.

1. Can biodiversity provide humans and animals protection from allergic and inflammatory diseases?



Sandifer, Sutton-Grier and Ward, 2015

Biodiverse Nature can help prevent…

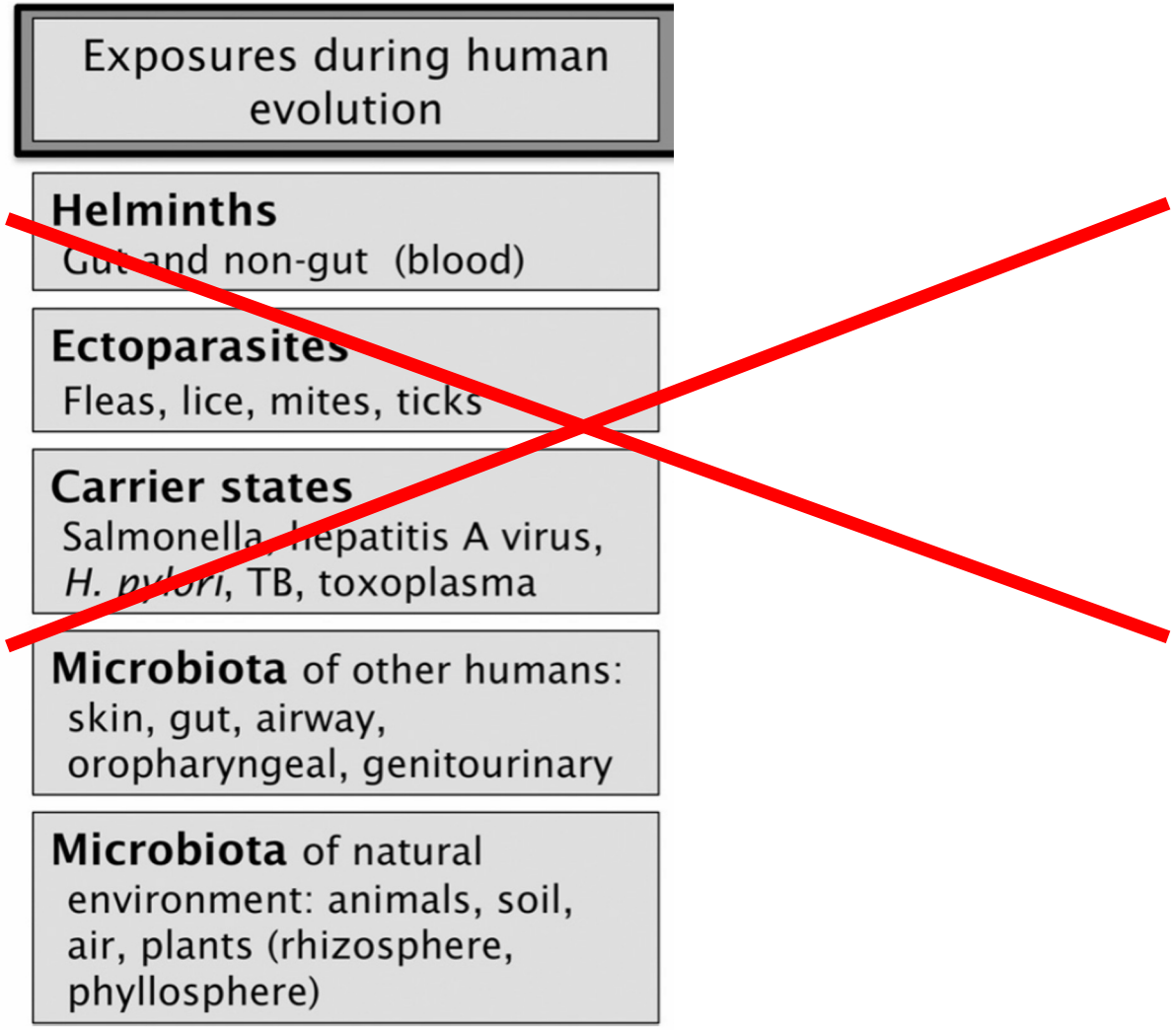
- Allergies
- Asthma
- Some heart disease
- Type 2 diabetes
- Some types of obesity
- Some cancers

Sandifer, Sutton-Grier and Ward, 2015

Allergies and Biodiversity

Allergies: Protective Role of Microbial Diversity

“Biodiversity” or “Hygiene” Hypothesis



- Our bodies must learn not to attack:
  - Self
  - Harmless molecules in air (pollen)
  - Gut contents

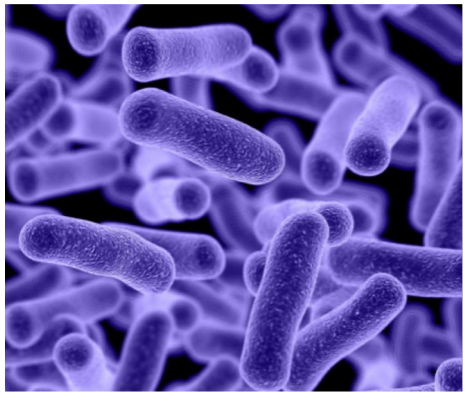
Rook 2013

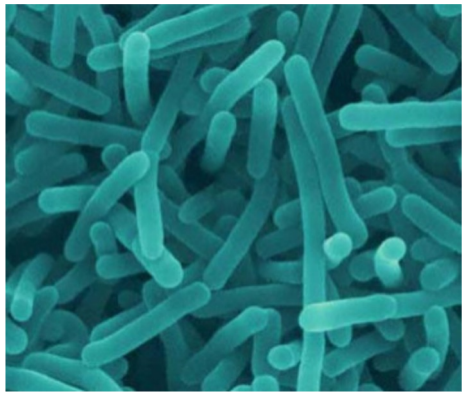
Finland Adolescent Study

- Analyzed land-use types within 3km radius of homes
- Kids with allergies
  - Lower diversity of habitats
  - Fewer kinds of Gram-negative gammaproteo-bacteria on their skin which have an allergy protective effect (Hanski et al. 2012)
- **Loss of contact with diverse natural world is making us sick**

https://www.anthropocenemagazine.org/conservation/2012/09/biodiversity-under-our-skin-2/

Wetlands and Human Health



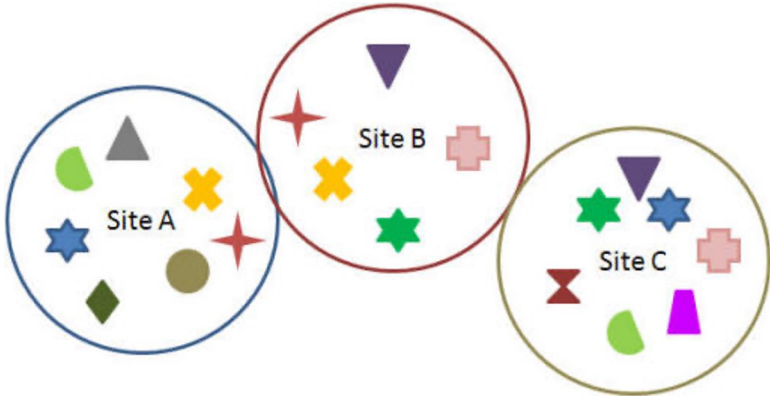


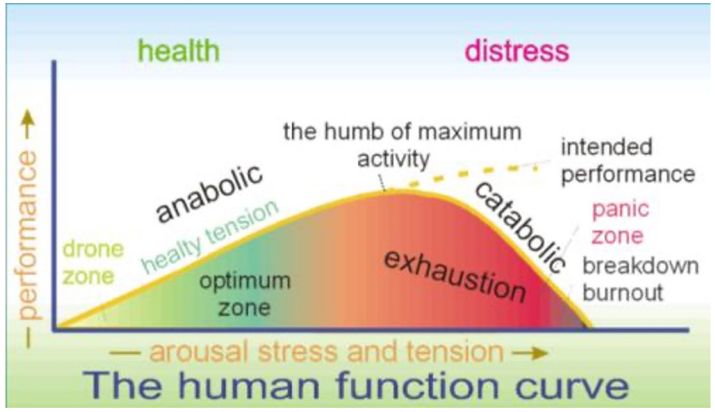
- Bacterial communities in anaerobic marsh soils of Sapelo Island, GA
  - Diversity similar to terrestrial soils but unique composition
  - Bacteria included representatives of Firmicutes and Bacteriodetes, two of the bacterial groups to which exposure was negatively associated with allergic reactions (Lasher et al. 2009)
- **Need to develop and test hypotheses about wetland biodiversity, particularly microbial diversity, and health protective benefits to people**

Sutton-Grier and Sandifer. 2018. Wetlands

Ongoing Research Needs

- Specific mechanisms for biodiversity affects human health
- Best ways to measure biodiversity to determine human exposure?
- Which metrics of health would be the best indicators of biodiversity-human health impacts?
- Better monitor biodiversity and integrate info into public health and natural resource management and policy
- Need for large, community-wide health datasets and over longer periods of time





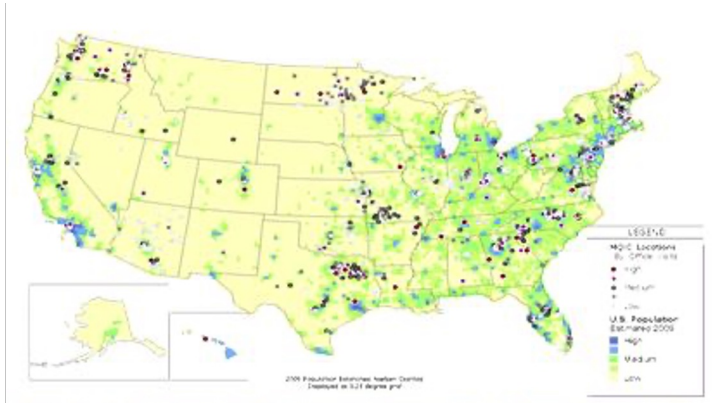


Figure 2. The Medical Quality Improvement Consortium (MQIC) comprises 35 million de-identified patient records from participating CPS and Centricity EMR practices.

And more research is coming out all the time…

Neuroimaging study provides new details on the link between stress reduction and green urban landscapes

by Eric W. Dolan — November 29, 2020 in Cognitive Science, Mental Health

Chang et al. 2021

People's attachment to the wilderness is linked to the fulfillment of basic psychological needs, study finds

by Beth Ellwood — October 12, 2020 in Mental Health

Landon et al. 2020

10 JAN 2023 | MADDIE MASSY-WESTROPP

Urban green space reduces cardiovascular disease risk, and more trees are key.

Trees can make public areas more inviting to exercise, socialise and spend time in. Photo: iStock.

A walk in the park a day, keeps the doctor away… A new study from UNSW Sydney, published in *Heart, Lung and Circulation*, shows how different types of urban green space impact cardiovascular health.

Previous studies demonstrate that nearby green space reduces risk of cardiovascular disease by promoting physical activity, reducing stress, and mitigating excess heat and air pollution. High quality green spaces can also reduce loneliness, which then also benefits

7 September 2022

Going with the flow: study shows canals help boost your mood

The study, carried out by King's College London, Nomad Projects and J & L Gibbons in partnership with the Canal & River Trust, shows that spending time by canals and rivers is linked to feeling happy and healthy.

New evidence shows planting around school playgrounds protects children from air pollution

26 August 2022 12:31

© Barbara Maher

Western red cedar leaves; installation of western red cedar at a school for the study

> *Our findings show that we can protect school playgrounds, with carefully chosen and managed tredges, which capture air pollution particulates on their leaves. This helps to prevent at least some of the health hazards imposed on young children at schools next to busy roads where the localised air quality is damagingly poor, and it can be*

Opportunity: Nature/Biodiversity

- Exposure to nature has direct, positive heath effects and exposure to biodiversity may have direct, positive impacts human health
- Potential to implement these findings to enhance human well-being ***and*** develop increased public support for green & blue space protection and restoration

Analysis | Open Access | Published: 11 October 2021

Nature inequity and higher COVID-19 case rates in less-green neighbourhoods in the United States

Erica N. Spotswood, Matthew Benjamin, Lauren Stoneburner, Megan M. Wheeler, Erin E. Beller, Deborah Balk, Timon McPhearson, Ming Kuo & Robert I. McDonald

Nature Sustainability **4**, 1092–1098 (2021) | Cite this article

Abstract

Urban nature—such as greenness and parks—can alleviate distress and provide space for safe recreation during the COVID-19 pandemic. However, nature is often less available in low-income populations and communities of colour—the same communities hardest hit by COVID-19. In analyses of two datasets, we quantified inequity in greenness and park proximity across all urbanized areas in the United States and linked greenness and park access to COVID-19 case rates for ZIP codes in 17 states. Areas with majority persons of colour had both higher case rates and less greenness. Furthermore, when controlling for sociodemographic variables, an increase of 0.1 in the Normalized Difference Vegetation Index was associated with a 4.1% decrease in COVID-19 incidence rates (95% confidence interval: 0.9–6.8%). Across the United States, block groups with lower income and majority persons of colour are less

U.S. DEPARTMENT OF THE INTERIOR
INTERNATIONAL TECHNICAL ASSISTANCE PROGRAM

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