

TRANSPORTATION RESEARCH BOARD

What Role Does Ecology Have in Sustainable Transportation?

#TRBwebinar

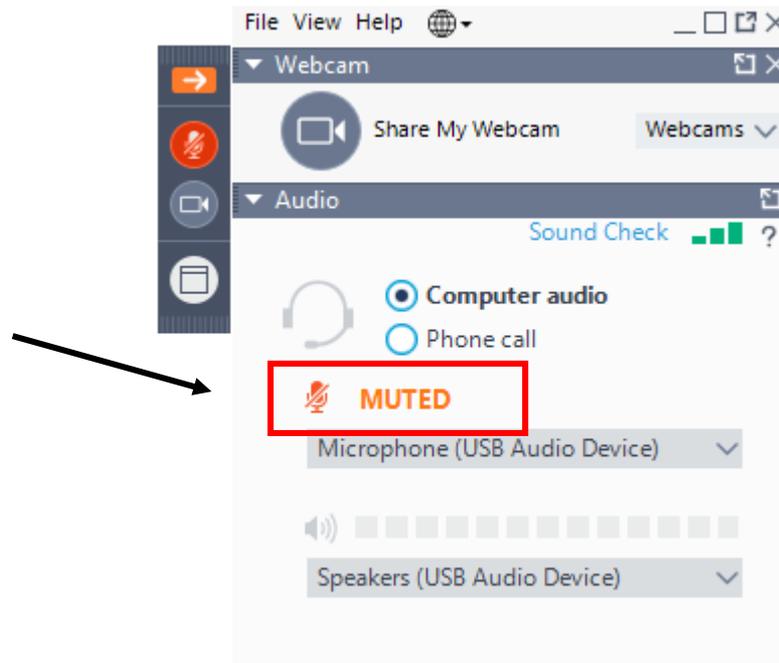
Learning Objectives

1. Define “sustainable transportation” and use that definition in action
2. Identify different ways that ecology and ecosystems are impacted and influenced by transportation systems
3. Identify potential resolutions/mitigations for ecological impacts
4. Consider ways to develop ecologically-sustainable transportation

#TRBwebinar



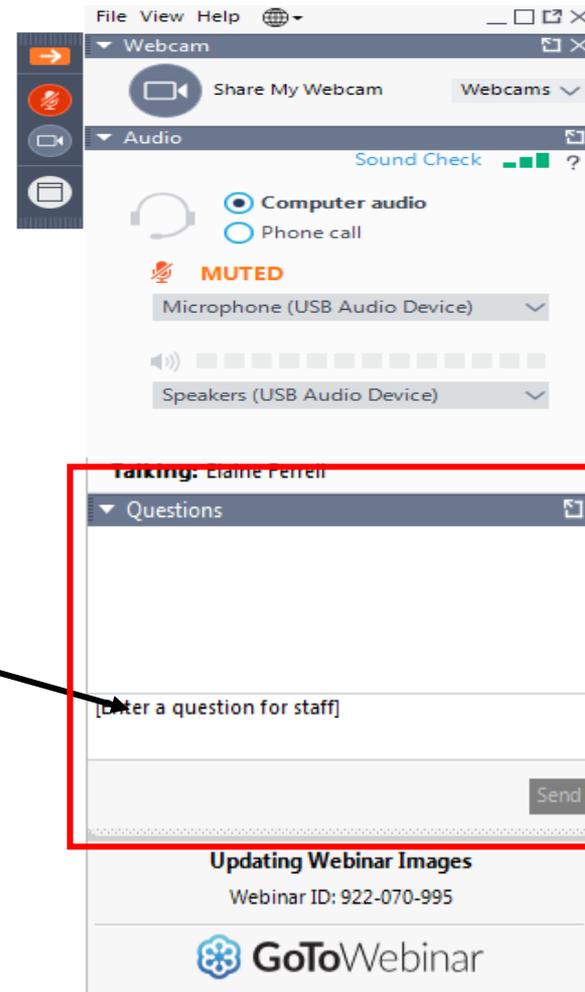
All Attendees Are Muted



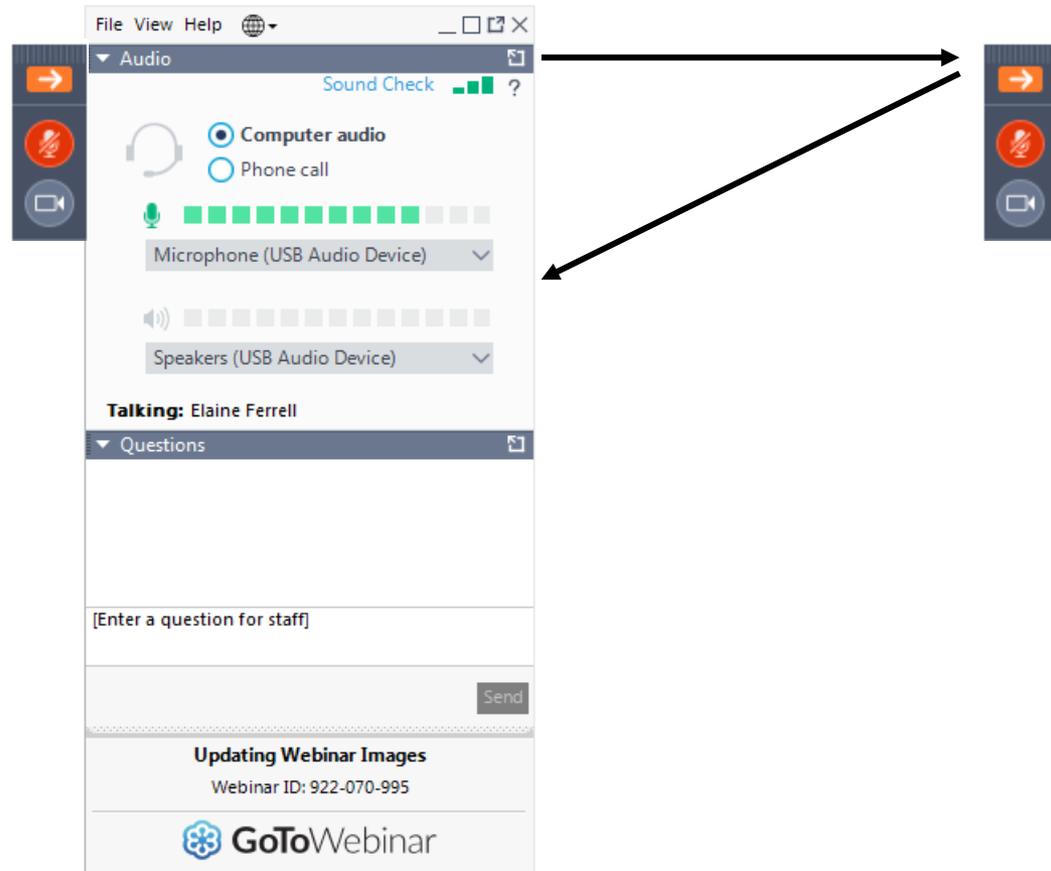
#TRBwebinar

Questions and Answers

- Please type your questions into your webinar control panel
- We will read your questions out loud, and answer as many as time allows



Can't locate the *GoToWebinar* Control Panel?



The Transportation Research Board has met the standards and requirements of the Registered Continuing Education Providers Program. Credit earned on completion of this program will be reported to RCEP. A certificate of completion will be issued to participants that have registered and attended the entire session. As such, it does not include content that may be deemed or construed to be an approval or endorsement by RCEP.



REGISTERED CONTINUING EDUCATION PROGRAM



PDH Certificate Information

- This webinar is valued at 1.5 Professional Development Hours (PDH)
 - Instructions on retrieving your certificate will be found in your webinar reminder and follow-up emails
 - You must register and attend as an individual to receive a PDH certificate
 - Certificates of Completion will be issued only to individuals who register for and attend the entire webinar session – this includes Q&A
 - TRB will report your hours within one week
 - Questions? Contact Reggie Gillum at RGillum@nas.edu
- 

Panelists Presentations

<http://onlinepubs.trb.org/onlinepubs/webinars/200430.pdf>

After the webinar, you will receive a follow-up email containing a link to the recording

#TRBwebinar



Panelists Presentations

<http://onlinepubs.trb.org/onlinepubs/webinars/200430.pdf>

After the webinar, you will receive a follow-up email containing a link to the recording

#TRBwebinar



What role does ecology have in sustainable transportation?

This webinar is sponsored by
The TRB Standing Committee on
Environmental Analysis and
Ecology (AEP70)

Today's Speakers

- Daniel Smith, Ph.D., A.I.C.P., University of Central Florida, Dept of Biology and Co-chair of the TRB Standing Committee on Environmental Analysis and Ecology (AEP70)
- Susan Handy, Ph.D., University of California, Davis, Dept of Environmental Science and Policy and Director of the National Center for Sustainable Transportation
- Fraser Shilling, Ph.D., University of California, Davis, Director of the Road Ecology Center
- Kimberly Andrews, Ph.D., University of Georgia, Marine Extension and Georgia Sea Grant

Sustainable Transportation

Susan Handy

National Center for Sustainable Transportation

Institute of Transportation Studies

University of California, Davis

April 30, 2020



Defining Sustainable Transportation

- Balancing the 3 pillars (Es or Ps)
 - Environment – Planet
 - Economy – Profit
 - Equity – People
- Meeting needs now without impairing our ability to meet needs in the future





Priorities

Transportation is an integral part of every American's life. At the Department of Transportation, we believe in creating the safest, most efficient and modern transportation system in the world. Secretary Elaine L. Chao's three key priorities for the Department are Safety, Infrastructure, and Innovation.



“ Our efforts are guided by three priorities. The first is: safety, which is always #1. The second priority is rebuilding and refurbishing our country's critical infrastructure. And the third priority is preparing for the future by engaging with emerging technologies to address legitimate public concerns about safety, security, and privacy, without hampering innovation ”

—Secretary Elaine L. Chao

<https://www.transportation.gov/priorities>



[Home](#) > [Mission](#) > [Sustainability](#)

Sustainability

Our Sustainability Efforts

DOT is committed to sustainability leadership. DOT defines sustainability as the integration of energy, environmental, economic and social considerations into the Department's mission, programs and day-to-day operations. This means that DOT employees at all levels must be responsible and accountable for integrating sustainability stewardship into day-to-day activities to reduce the Department's direct and indirect energy and environmental impact and to protect our natural resources.



Updated: Friday, November 21, 2014

[Read more](#)

“DOT defines sustainability as the integration of energy, environmental, economic, and social considerations into the Department's mission, programs, and day-to-day operations.”

<https://www.transportation.gov/tags/sustainability>

US DOT's University Transportation Centers



“The UTCs conduct research that directly supports the priorities of the U.S. Department of Transportation (DOT) to promote **the safe, efficient and environmentally sound movement of good and people**. UTCs work with regional, state, local and tribal transportation agencies to help find solutions to challenges that directly impact their communities and affect the efficiency of the nation’s transportation system.”

National UTCs under the FAST Act

- National University Transportation Center For Improving Mobility
- National Institute for Transportation and Communities
- Collaborative Sciences Center for Road Safety
- Safety Through Disruption (Safe-D) National UTC
- National Institute for Congestion Reduction
- National Center for Transportation Infrastructure Durability and Life-Extension
- **National Center for Sustainable Transportation**



NCST Theme

FAST-ACT Priority Research Area “Preserving the Environment”

“The challenge for the nation is to reduce [the impacts of the transportation system on our natural resources] while meeting the mobility needs of society, fostering healthy communities, and supporting economic growth.”



<https://ncst.ucdavis.edu/about>

NCST Research Areas



Environmentally
Responsible
Infrastructure and
Operations



Multimodal Travel
and Sustainable
Land Use



Zero-Emission
Vehicle and Fuel
Technologies



Institutional Change

NCST Special Focus Areas



Sustainable Freight

Investigate strategies that reduce carbon and criteria pollutants and increase freight efficiency



New Mobility

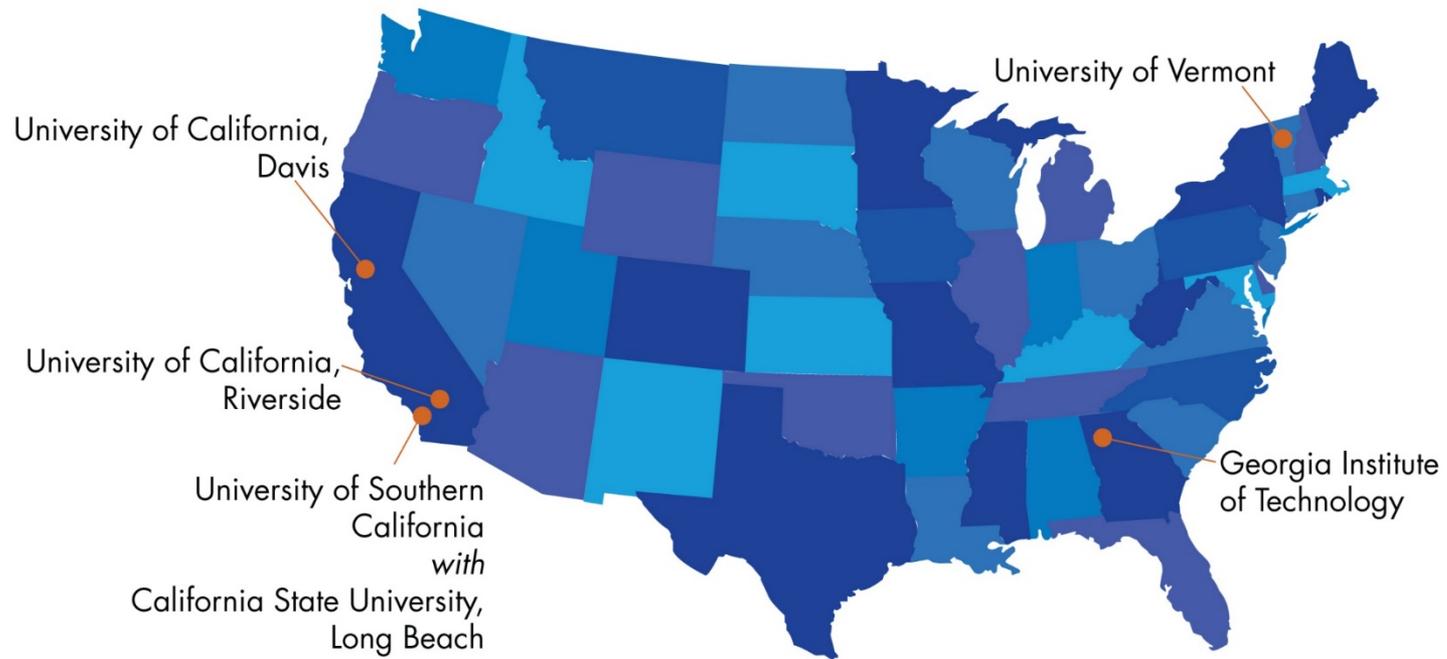
Understand the environmental impacts and benefits of new mobility services (e.g., carshare, ride-share, micro-transit)



Environmental Review

Explore improvements to NEPA that streamline environmental assessment and respond to new areas, such as environmental justice and climate change

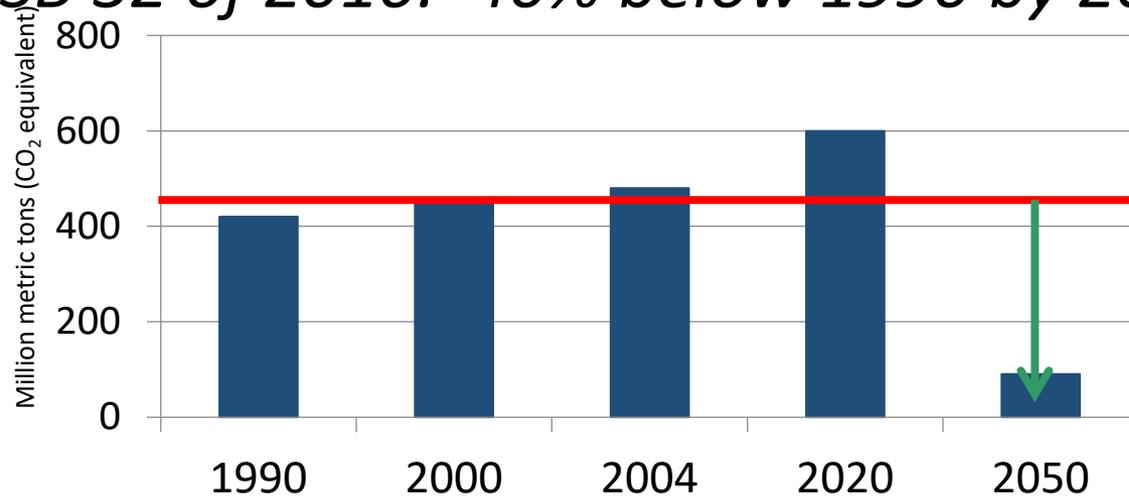
NCST Partners



AB32 The California Global Warming Solutions Act of 2006

80% reduction of GHG from 1990 levels by 2050

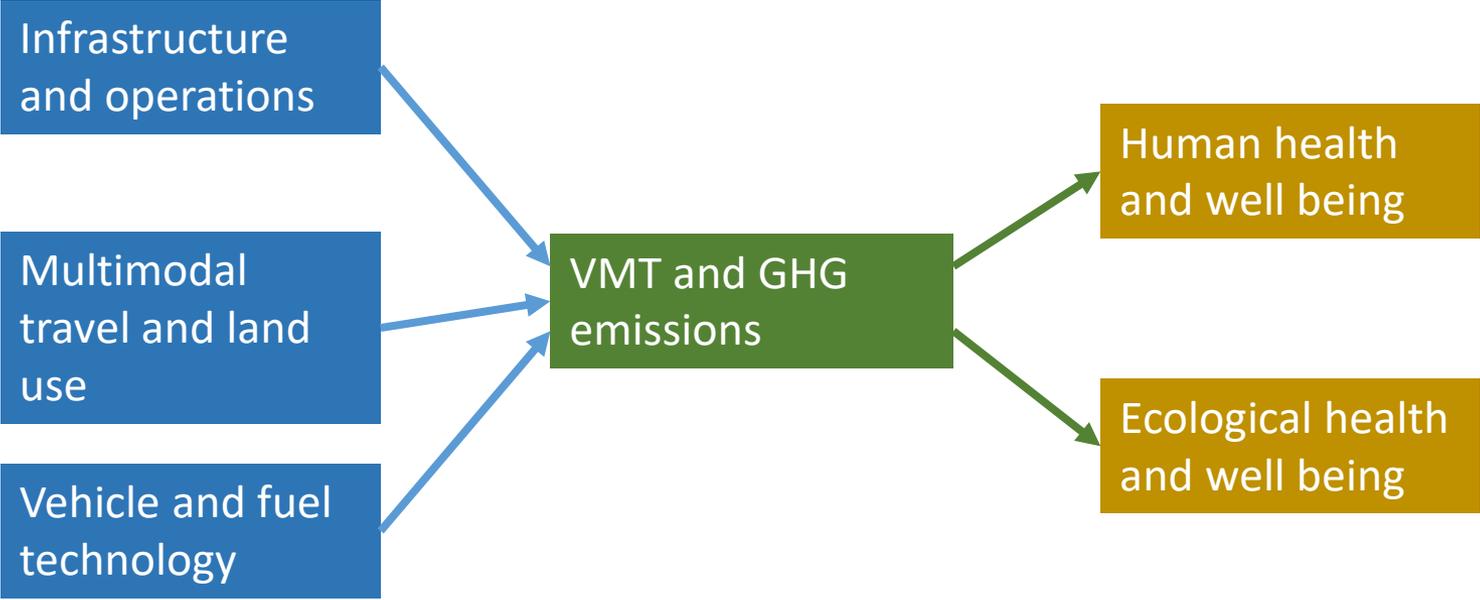
+SB 32 of 2016: 40% below 1990 by 2030



SB375 Sustainable Communities and Climate Protection Act of 2008

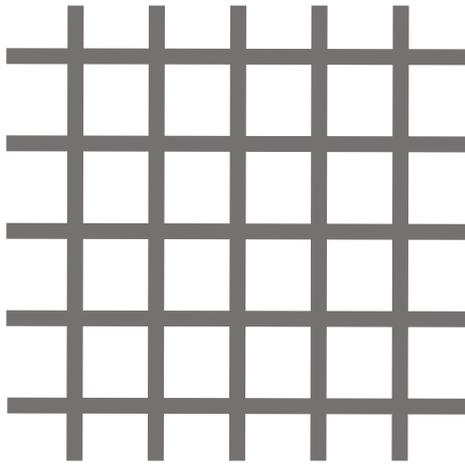
Targets for reducing per capita GHG emissions from cars and light trucks for metropolitan areas by reducing **vehicle-miles-traveled (VMT)**

| Examples | 2020 | 2035 |
|------------------------|------|------|
| Sacramento | -7% | -16% |
| San Francisco Bay Area | -7% | -15% |
| Los Angeles region | -8% | -13% |
| San Diego | -7% | -13% |



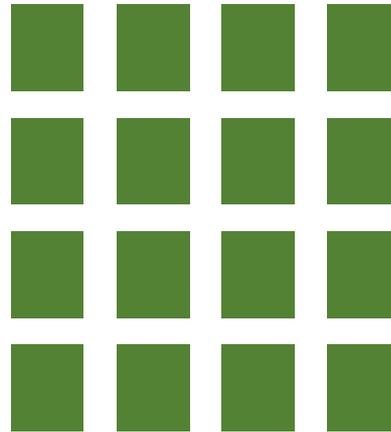
Competing perspectives example

Human perspective



Network connectivity

Ecological perspective



Patch connectivity

How can we bring the ecological perspective into the transportation process – early on, not just as mitigation?

Framework for considering and measuring ecologically-sustainable transportation

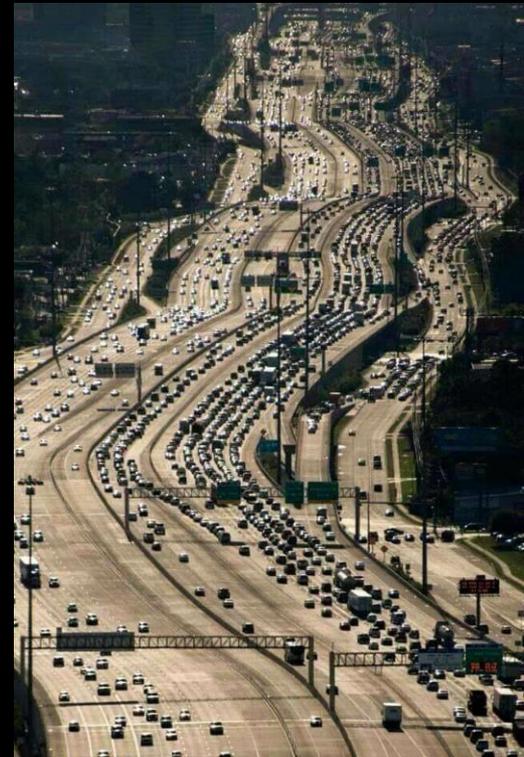
Fraser Shilling

Road Ecology Center

University of California, Davis

fmshilling@ucdavis.edu

<https://roadecology.ucdavis.edu>



Acknowledgements

- TRB staff: Elaine Ferrell and Beth Ewoldsen
- Funding: Center for Transportation Environment and Community Health; National Center for Sustainable Transportation; Federal Highway Administration; Caltrans; California Department of Water Resources

What is “Ecologically-Sustainable Transportation”?

Transportation: *“Land-based transportation systems are combinations of the infrastructure, vehicles, and social/economic exchanges taking place along them”*

Sustainability: *“A system that is sustainable, should meet today’s needs without compromising the ability of future generations to meet their own needs.”* (Brundtland Commission, 1987)

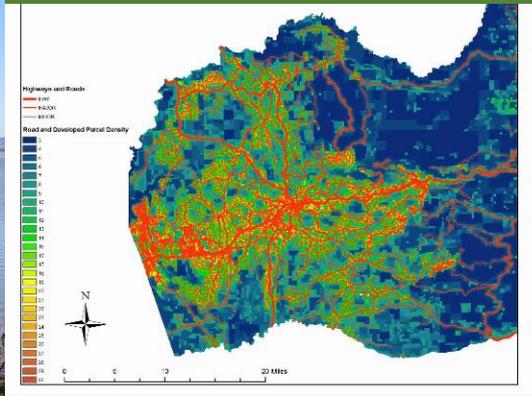
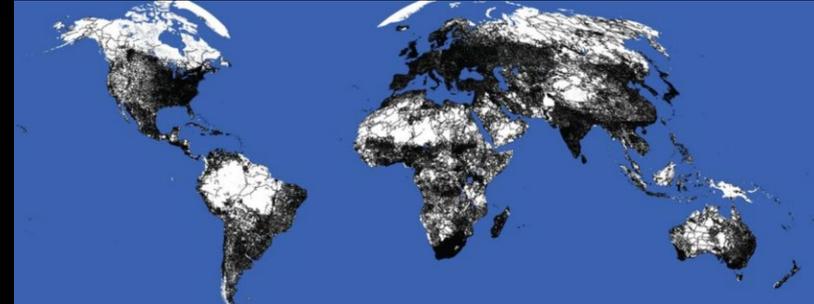
Sustainable Transportation: *“Where total social, economic, and environmental benefits of the system are greater than the combined impacts AND total impacts are below acceptable thresholds.”*

Eco-Sustainable Transportation: *“Transportation systems where the ecological impacts have been minimized so as to pose no threat to ecological systems.”*

The theory and practice of ecology and transportation

Interactions between ecology and transportation
Transportation networks as novel ecosystems

Legal and social thresholds for mitigation
Most action related to listed species/habitats and wildlife
& most action is compensatory mitigation, not avoidance or minimization



State Transportation Plans and Ecology

- Current policies and practices
- Can be used as an indication of state DOT intent and resource allocation

State Transportation Plans

Searched current plans for occurrences of words common to RE field: “wildlife”, “ecology”, “ecosystem”, “habitat”, “connectivity”, and “environment”

CA 2040, NYS 2030, TX 2040, FL 2060, WA 2040, MI 2040

Findings

| Term | CA | FL | NY | TX | WA | MI |
|------------------------------------|-----|----|----|----|----|----|
| Wildlife | 1 | 7 | 2 | 0 | 4 | 0 |
| Ecology | 0 | 0 | 0 | 0 | 0 | 0 |
| Ecosystem | 1 | 1 | 0 | 0 | 1 | 0 |
| Habitat | 9 | 8 | 2 | 0 | 1 | 0 |
| Connectivity/ Fragmentation | 1 | 1 | 0 | 0 | 0 | 0 |
| Environment* | 170 | 49 | 70 | 95 | 37 | 6 |
| Annual Spending (\$ billion, 2017) | 14 | 6 | 15 | 13 | 5 | 4 |

* Includes names of environmental agencies and regulations

Specific Funding Example: CA SB 1

California passed SB1 (“fuel-tax”) in 2017, dedicating additional ~\$53 billion over 10 years to transportation.

The enabling bill language does not talk about conflicts with wildlife or nature; it does not mention environmental impacts (except with greenhouse gases); it does not include additional funding for legacy impacts to wildlife movement, reduced noise/water/air impacts, reduced spread of invasive weeds, structural changes to reduce impacts (e.g., elevation over wetlands/waterways), or reduced impacts to aquatic ecosystems.



Specific Funding Example: CA SB 1

Provides 0.2% for “advance mitigation planning” which covers mitigation already required, but is supposed to streamline requirements for individual projects and move their mitigation funding to an independent pot of funds.

“(d) The department may use advance mitigation credits to fulfill mitigation requirements of any environmental law for a transportation project eligible for the State Transportation Improvement Program or the State Highway Operation and Protection Program.” (SB 1, as amended)

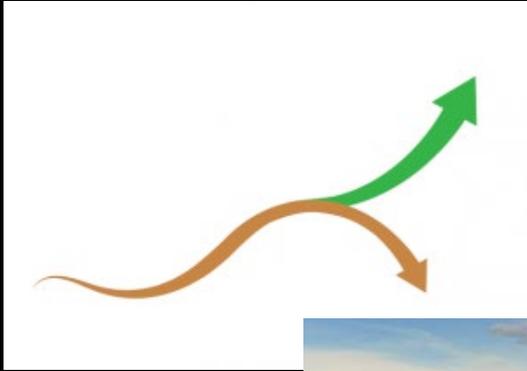
State TPs – Gaps

- Adequate consideration of natural environment
- Understanding of ecology, ecosystems, ecological processes
- Dedication of planning role for ecology
- Authority for transportation officials to protect environment
- Dedication of funding to repair legacy impacts of transportation
- Ways to measure impacts and effectiveness of mitigation for new projects

Framing and Measuring Sustainability

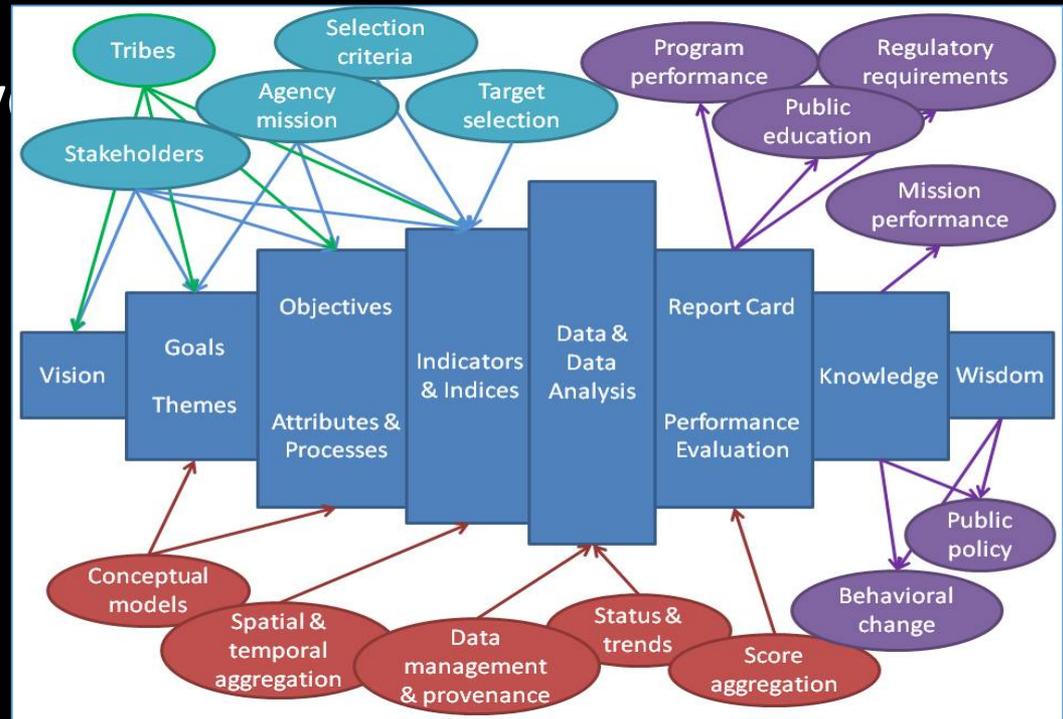
- Beyond fuel-related concerns (EV, climate change)
- Beyond pollutant impacts on people
- Beyond minimum interpretation of legal requirements
- Includes protecting and repairing harm to nature
- Includes making decisions with adequate information
- Includes taking responsibility

Sustainability: Direction, Goal, or Success?



Sustainability Framework

- Goals
- Measurable Objectives
- Indicators/Metrics



The California Water Sustainability Indicators Framework, California Water Plan, 2013 Update

An Eco-Sustainable Transportation Framework

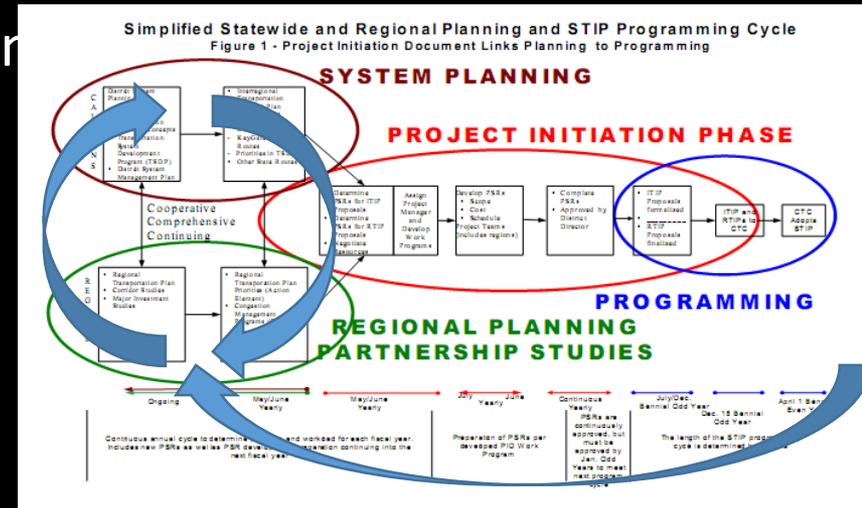
ONE EXAMPLE: Eco-Logical Goals

- *Conservation*: Protection of larger scale, multi-resource ecosystems;
- *Connectivity*: Reduce habitat fragmentation;
- *Predictability*: Knowledge that commitments made by all agencies will be honored, i.e., that the results and outcomes of planning and conservation agreements will occur as negotiated; and
- *Transparency*: Better public and stakeholder involvement at all key stages in order to establish credibility, build trust, and streamline infrastructure planning and development.

(Bacher-Greock and Schwarzer, 2009)

What if we used a Framework

- Learning
 - Collect data about past actions
 - Explicitly connect learning to r
- Language
 - Use existing terms
 - Connect and translate
- Decision-making
 - Decision points
 - Scales
 - Authority

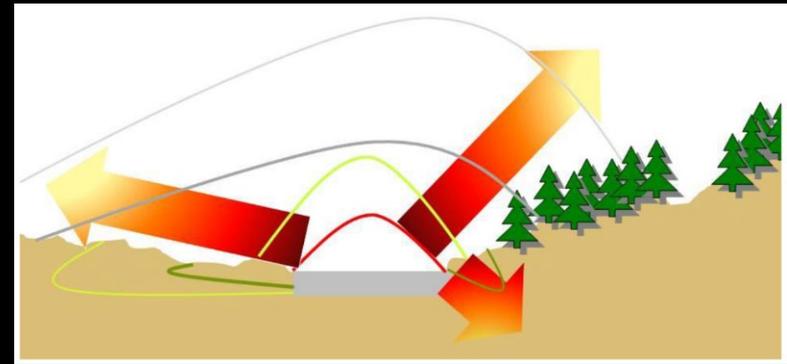


Using Road Ecology to Measure Sustainability

- Roadmap
 - Use broad range of skills/knowledge (i.e., not just wildlife biology)
 - Rely on the public university systems for R & E
 - Clear responsibility and authority for qualified scientists in agencies

Using Road Ecology to Measure Sustainability

- Principles
 - Measure, understand, act, measure....
 - Ecosystem components and processes
 - Scientific process, not just mitigation planning
 - Develop ecological thresholds to measure sustainability



Using Road Ecology to Measure Sustainability

- Metric Menu

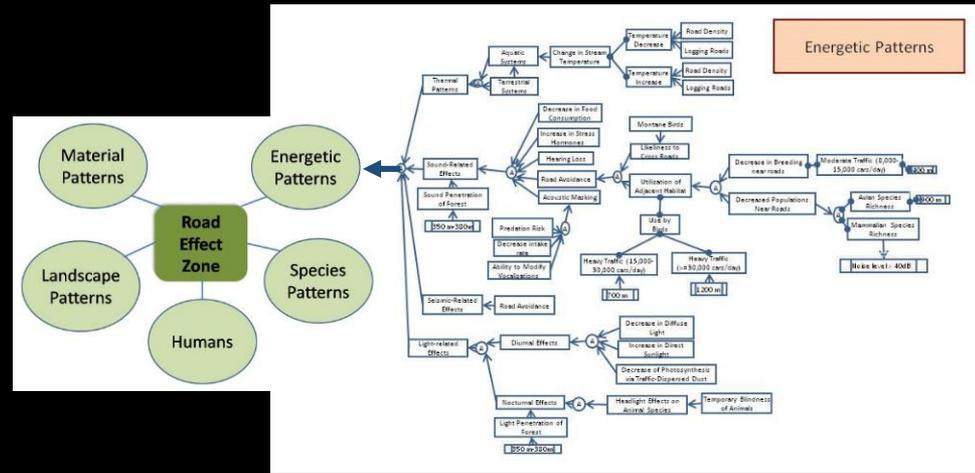
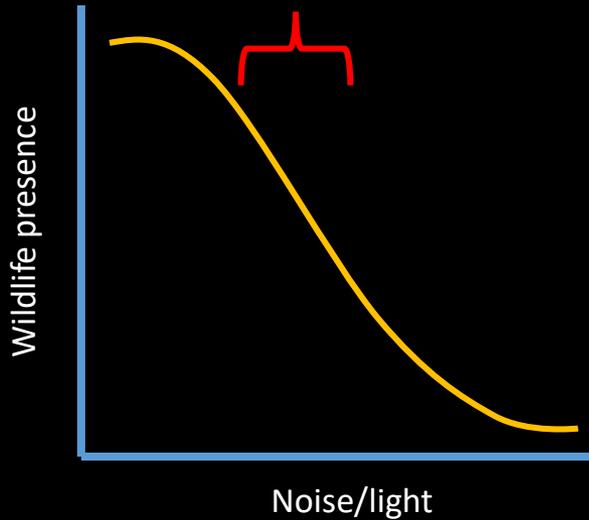
Ecosystem Fragmentation

- Roadway as a Division of Habitat (Clair 2003)
- Passage Efficacy (Clevenger et al. 2001)
- Maintain Intact/Roadless Habitat (Crist et al. 2005)
- Endangered KIT Fox (Cypher et al. 2005) (CC)
- Gap Crossing by Understory Birds (Develey and Stouffer 2001) (SN)
- Large Patch Fragmentation (Forman 2005)
- Genetic and Demographic (Forman and Alexander 1998)
- (Forman and Deblinger 2000)
- (Jeager et al. 2005)
- Inbreeding and local extinction of Agile Frog (Lesbarreres et al. 2003)
- Road density and Biogeography and Fragmentation (Lin 2006)
- Fragmentation observed at Landscape scale; Logging and Roads (McGarigal et al. 2001)
- Carnivores of southern California and Mitigation (Ng et al. 2003)
- Avifaunal habitat fragmentation (Palomino and Carrascal 2007)
- Avifaunal & mammalian habitat fragmentation (Pocock and Lawrence 2005)
- Butterfly mortalities at roadsides (Ries et al. 2001)
- Salamander and Road effect zones (Semlitsch et al. 2007)
- Acacia fragmentation by roadworks (Spooner 2005)
- Vulnerability of plant communities due to frag
- Traffic and use of space by Raptors (Bautista e
- Barriers to movement and genetic exchange in
- Road density and Elk distribution (Rowland et
- Road Avoidance and Roosevelt Elk (Storlie 200

“Insufficient data make it nearly impossible for agencies to properly establish and prioritize environmental opportunities. Across the United States, there are large data gaps for current ecosystem information.” (Bacher-Gesock and Schwarzer, 2009)

Using Road Ecology to Measure Sustainability

- Metric Menu
- Appropriate thresholds

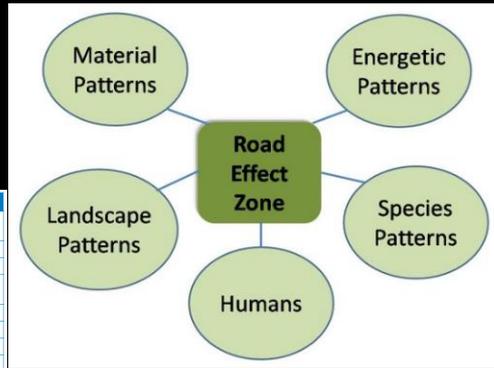


“Insufficient data make it nearly impossible for agencies to properly establish and prioritize environmental opportunities. Across the United States, there are large data gaps for current ecosystem information.” (Bacher-Gesock and Schwarzer, 2009)

Using Road Ecology to Measure Sustainability

- Metric Menu
- Appropriate thresholds
- Reporting system

| Icon | Objectives |
|---|--|
|  | <ol style="list-style-type: none"> 1) Protect receiving waters from pollution to comply with current and future water quality regulations 2) Maintain water quality for healthy aquatic systems* 3) Protect the quality of drinking water supplies 4) Maintain and restore natural stream flows for aquatic and riparian communities* 5) Maintain water supplies to meet human needs within the watershed |
|  | <ol style="list-style-type: none"> 1) Protect and enhance native fish populations, including anadromous fish* 2) Protect and enhance bird populations 3) Protect and enhance amphibian populations 4) Protect and enhance mammal populations* 5) Protect and enhance native invertebrate communities* 6) Discourage and reduce invasive, non-native species |
|  | <ol style="list-style-type: none"> 1) Protect and enhance riparian habitat quality 2) Protect and enhance wetland habitat quality 3) Protect and enhance aquatic habitat connectivity* 4) Protect and enhance terrestrial habitat connectivity* 5) Maintain and restore stream geomorphic processes 6) Optimize primary production and nutrient cycling to support aquatic and terrestrial communities* (for N) 7) Manage land-uses to reduce impacts |
|  | <ol style="list-style-type: none"> 1) Reduce high severity fire frequency 2) Reduce flood risk to human communities that support native species 3) Reduce greenhouse gas emissions to support climate change |
|  | <ol style="list-style-type: none"> 1) Protect and enhance wildlife 2) Improve grazing management 3) Encourage sustainable land uses 4) Improve community economic condition* 5) Improve community relationships 6) The Watershed supports sustainable human uses 7) Support and improve human uses 8) To have widespread community awareness and deep civic engagement in the protection and improvement of watersheds* |



“Insufficient data make it nearly impossible for agencies to properly establish and prioritize environmental opportunities. Across the United States, there are large data gaps for current ecosystem information.” (Bacher-Gesock and Schwarzer, 2009)

Contact

fmshilling@ucdavis.edu

<https://roadecology.ucdavis.edu>

Impact of COVID-19 Mitigation on California Traffic Crashes



Impact of COVID-19 on California Traffic Crashes (UPDATED REPORT, 4/15)

The Governor's order for "shelter-in-place" in response to the COVID-19 pandemic went into effect on 3/20/2020. You can read the rapid response report by clicking the report link below. These maps show the hotspots for injury and fatal crashes on state highways and

certain major roads patrolled by the California Highway Patrol for 3/21-3/30/2019 and the same period in 2020. You can read the report by clicking the attachment link below.

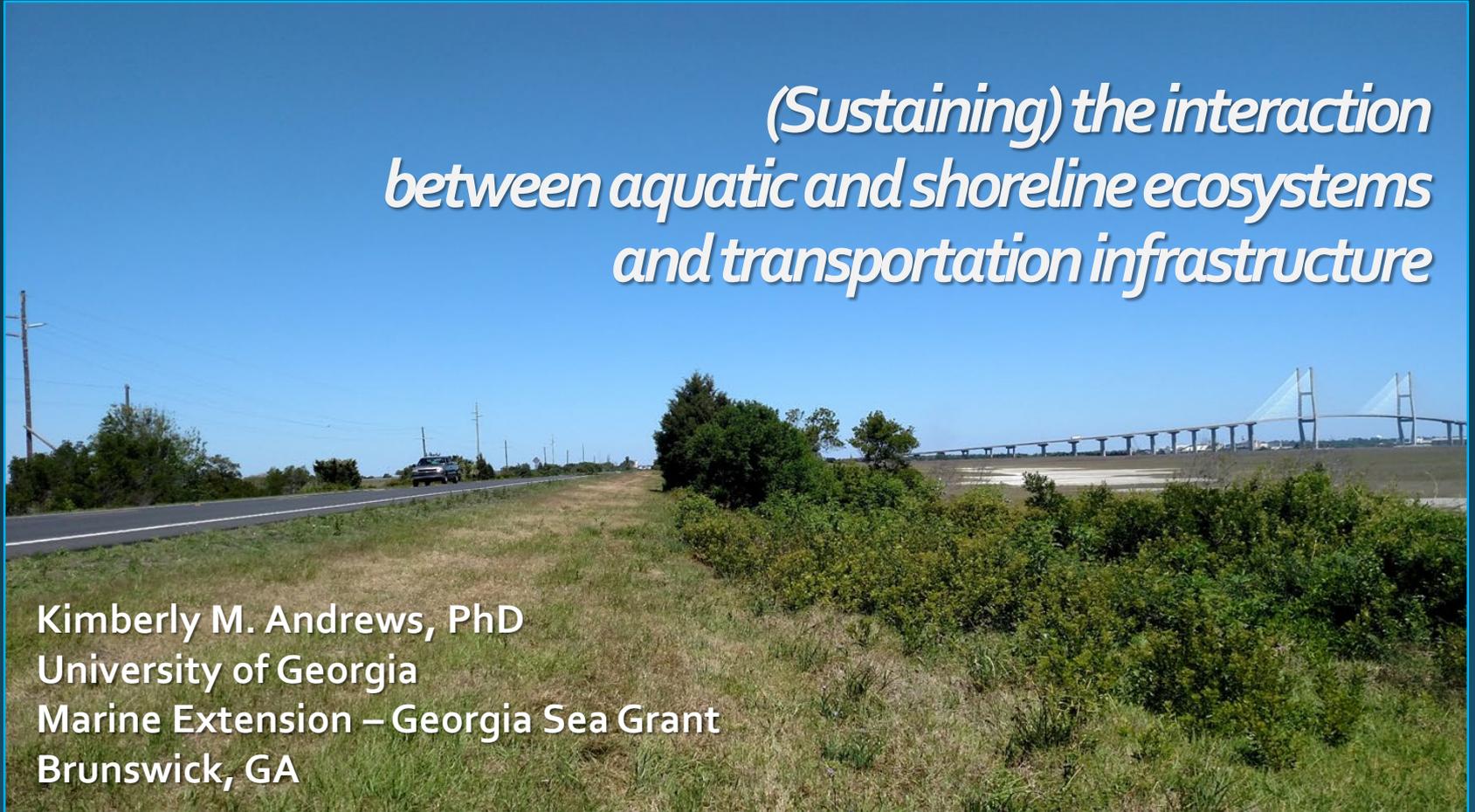
[Click for more detail](#)

| Attachment | Size |
|---|-----------|
|  COVID_CHIPs_Impacts_updated_415.pdf | 914.93 KB |

TRB Webinar: What role does ecology have in sustainable transportation?

*(Sustaining) the interaction
between aquatic and shoreline ecosystems
and transportation infrastructure*

Kimberly M. Andrews, PhD
University of Georgia
Marine Extension – Georgia Sea Grant
Brunswick, GA



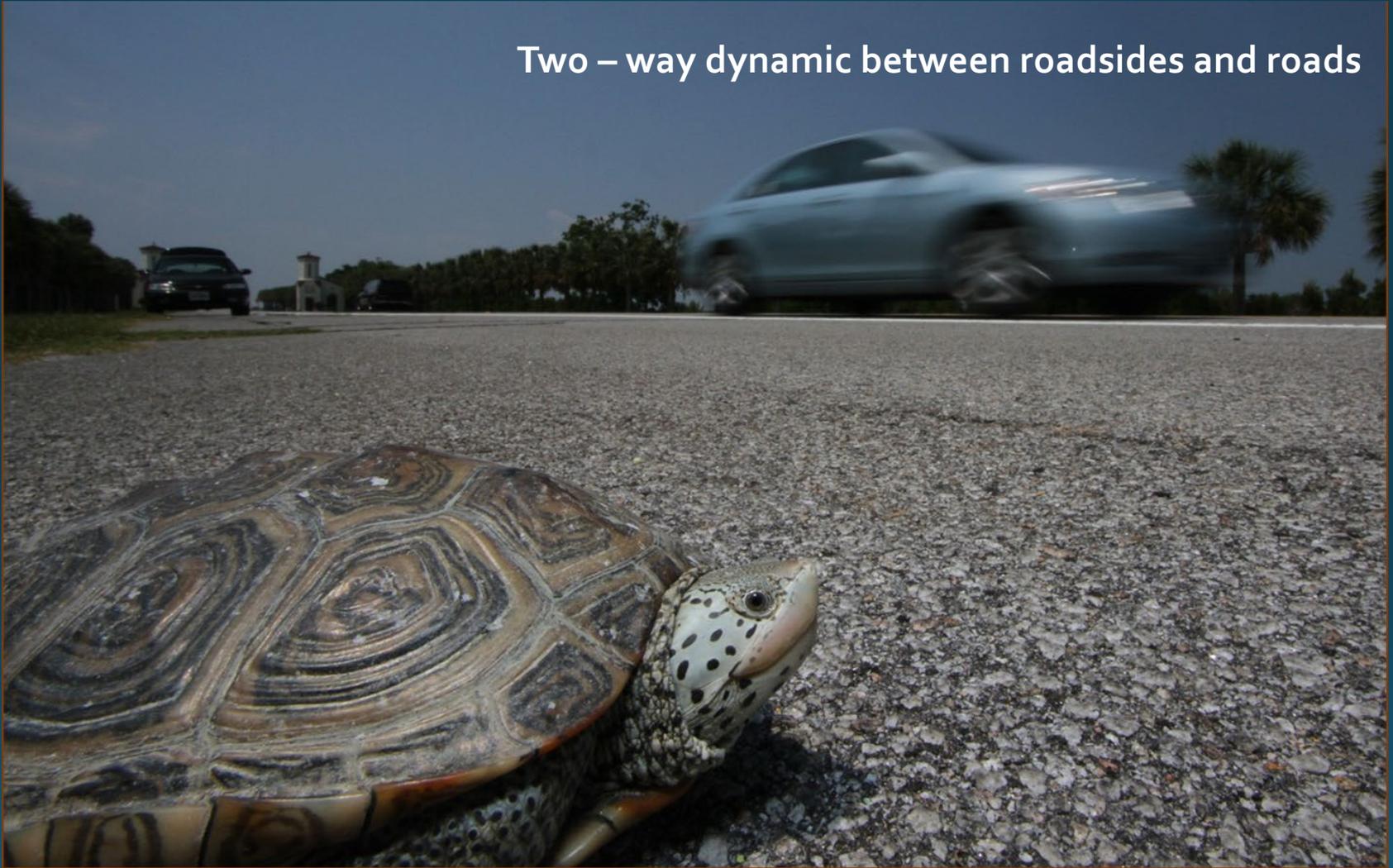
Shorelines = interface of land and water (coastal, rivers/streams, lakes)



Natural shorelines are a fluid line

We build a hard line when we build critical infrastructure

Two – way dynamic between roadsides and roads





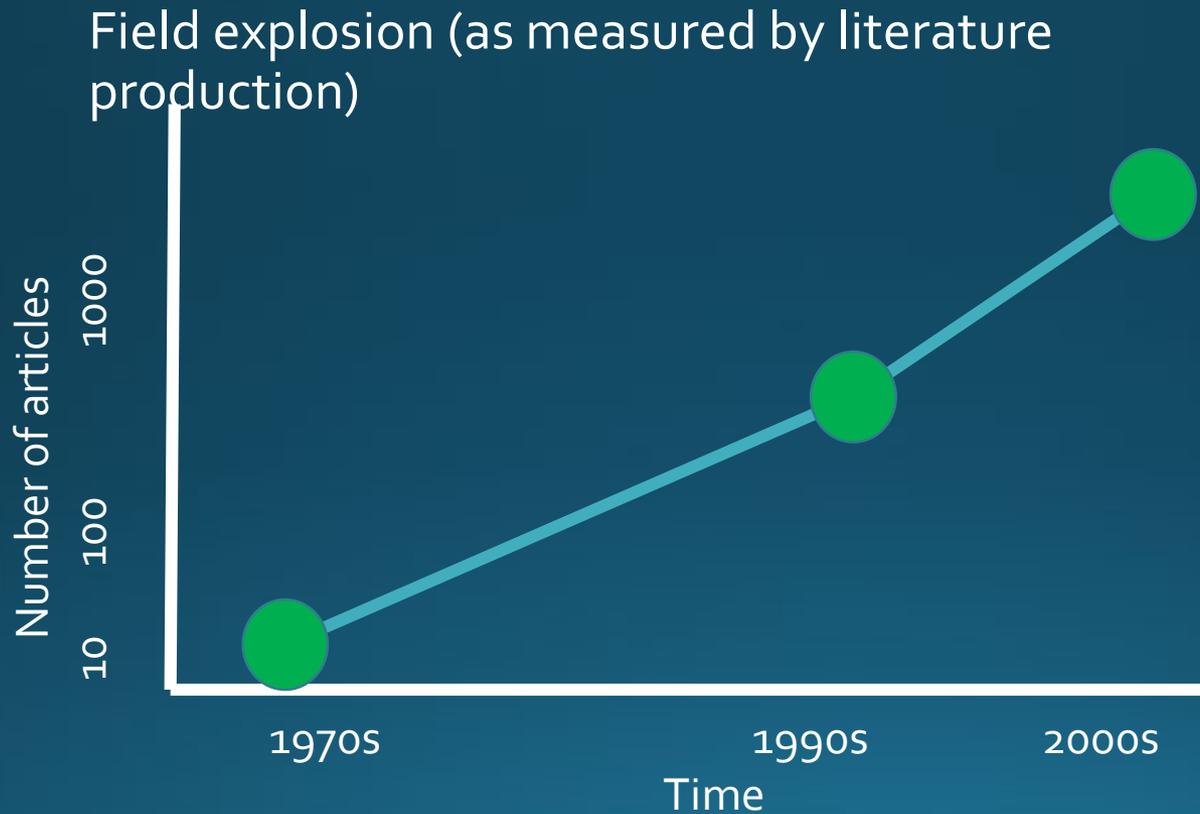
What is *sustainability* in the interface between land and water?

- Different needs of the different systems:
 - Aquatic habitats – dynamic and ever-changing
 - Transportation infrastructure – constant, stable in space and time
- Different needs of different on-road/ROW users:
 - Drivers
 - Emergency access, road maintenance
 - Recreationists (e.g., bike/jogging paths)
 - Wildlife, plants, physical ecosystem processes



From: Fraser and Andrews. 2017. ICOET

Roads and Ecology



The Terrestrial-Aquatic Ecotone

- Nowhere to “move” the **WATER** to when you are at water level
- Sensitive **ECOSYSTEMS** – plant and wildlife
- Diverse **WILDLIFE** communities (life histories)
 - Different physiologies and morphologies
 - Activity patterns
 - Microhabitat needs
 - Vagility (movement capability and willingness)
 - Site fidelity
 - Sensitivity to alterations



Dwarf Waterdog



Softshell Turtle

Mitigation Options

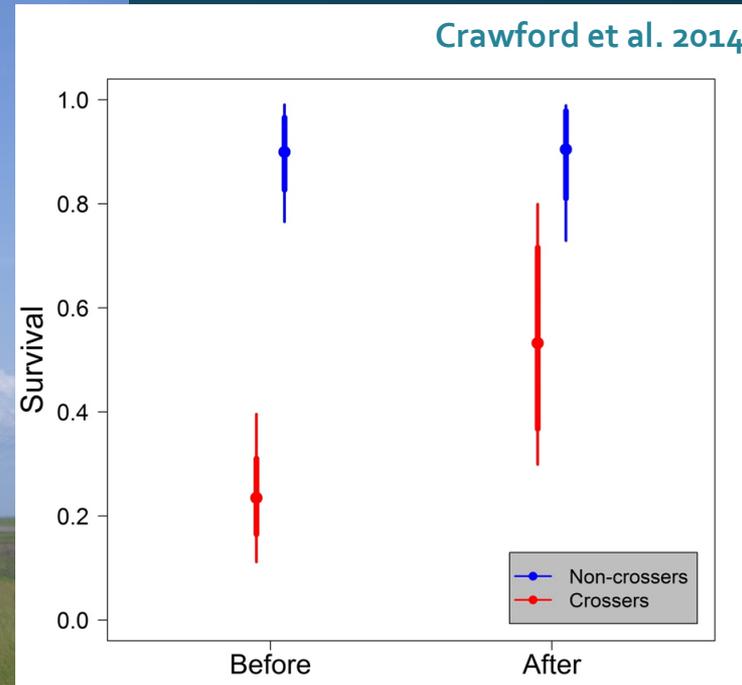
- Overpasses and underpasses
- Retrofit existing culverts for continuous microhabitat (undisrupted connectivity that will reduce behavioral deterrence)
- Vegetation management to encourage or discourage use of particular locations
- Exclusion fencing (not all are matters of connectivity)
- Relocation or other interventions
- Increased monitoring of our alternatives
- What about other effects?



Diamondback Terrapin nest box

Examples in Andrews et al. (2015). Johns Hopkins Uni Press

Signage placed seasonally (hot spots)
"School crossing" flashes at high tide (hot moments)



Posterior means and credibility intervals:
95% (thin bars); 75% (thick bars)

Public Awareness

Drive slow... Fertile turtles are on the go!

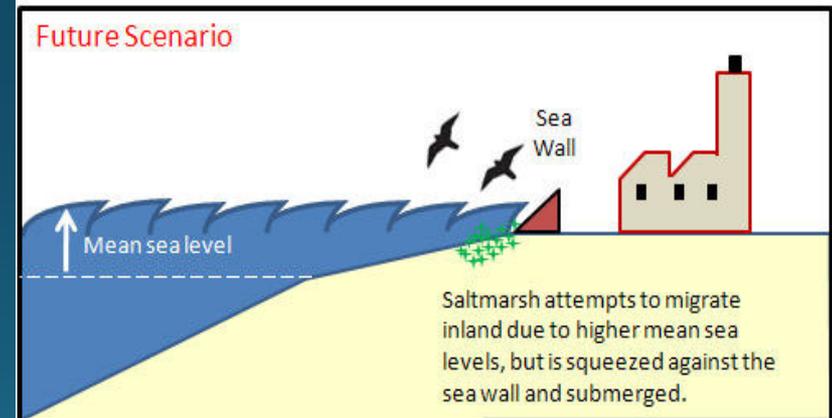
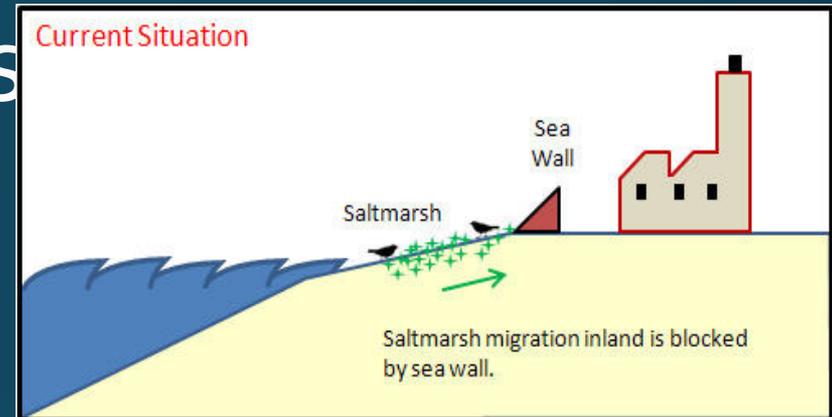
**Diamondback
Terrapin
Monitoring Project**
www.georgiaseaturtlecenter.org





Infrastructure Risks

- Rising waters, runoff, unstable edges (erosion and accretion)
- Coastal squeeze



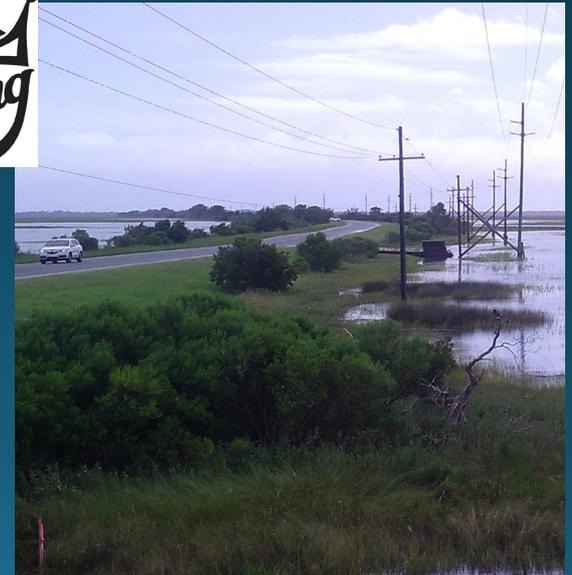
Caloosahatchee River News

People Risks

- Tides and extreme weather events
- Sunny-day flooding



Miami Herald



An aerial photograph of a coastal town. A river flows through the center, surrounded by green trees and residential buildings. The ocean is visible on the right side, with a sandy beach and waves. The sky is clear and blue.

Complicating Factors

- Aging infrastructure
- Building codes are insufficient for many shoreline pressures
- Uncertainty about the changes and risks to our infrastructure

Increase our Understanding

- What needs to be assessed, documented, and prioritized?
- To what degree do we need to assess the degree of change over time and the variation among locations?
- To what degree do we rely on models?



Shoreline Monitoring in CA and GA



1. Time-lapse photography



Examples of camera views

2. RTK-GPS



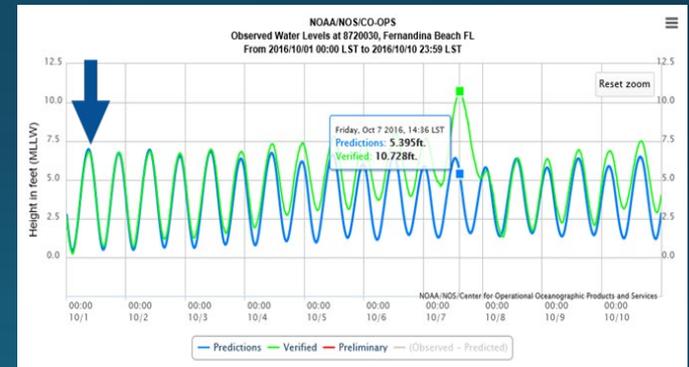
3. UAV-Drones



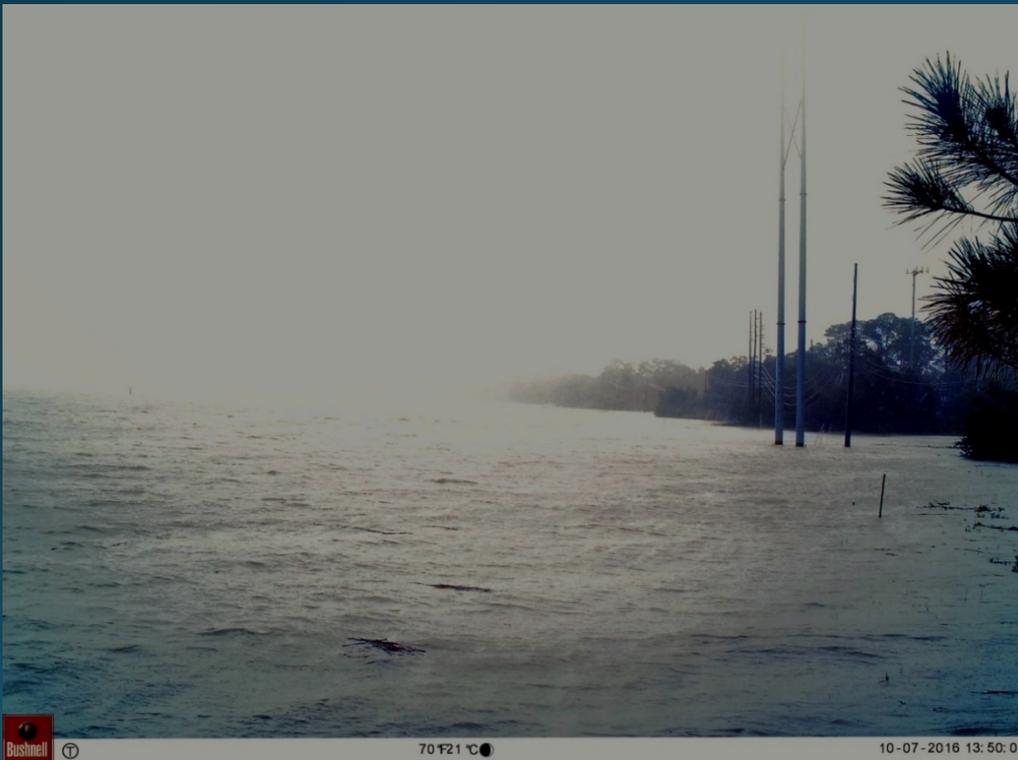
Typical: Causeway Bridge, Wastewater treatment plant



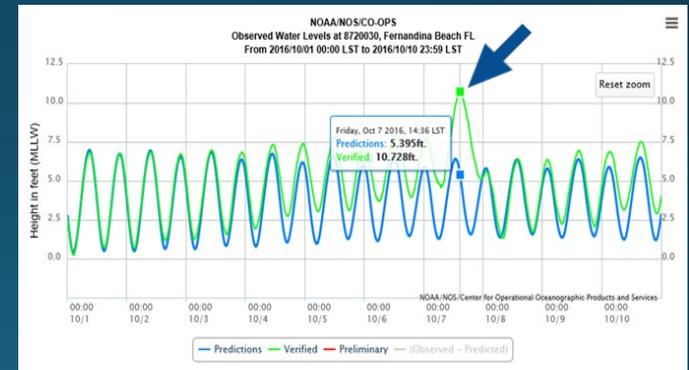
- October 1, 2016
- High Tide
9:51 A.M.



Hurricane Matthew: Causeway Bridge, Wastewater treatment plant



- October 7, 2016
- High Tide
1:47 P.M.



The Time is



N:OW

- Increasing shoreline instability (erosion, flooding)
 - decreases effectiveness of some traditionally used structures
- Increasing wildlife regulations of federally and listed species
 - increases legal and permitting expenses and visibility
- There are diverse issues, too many to figure out and address as they arise
- It's become too much to address on case-by-case basis
- Have an obligation (not only regulatory) to reduce impact to natural resources that also benefit our audience (public) – water quality, flood protection, fishing, recreation/tourism

“DOT defines **sustainability** as the **integration** of **energy**, **environmental**, **economic**, and **social** considerations into the Department’s mission, programs, and day-to-day operations.”

Getting Started with Sustainability

- Sustainability can feel like a lot
- Sustainability can feel abstract
 - Lack of clear and consistent definition
 - Limited scientific data to establish measurability
- Sustainability can be intimidating to talk about
 - Not the social norm
 - Not the operational norm
 - Political resistance
 - Logistical constraints



The Trail is Ours to Blaze



- **We** have the opportunity to figure this out
- Find common goals and adopt multi-agency cooperative approaches
- Need measurability of process and success for feedback
- Develop case studies and models which can be replicated and customized in different locations

Filling the Gaps



- We can build off existing opportunities to introduce ecology into the transportation discussion
- Leverage existing resources and strategically appropriate additional resources (monetary, expertise)
- Where can ecological systems help us do our work in addition to us doing our service to protect ecological systems?
 - Marsh and wetlands serve as protective habitat against flooding and erosion if we build and manage to accommodate their functionality

Does paying forward
with proactive and coordinated planning
increase the integrity of our product
and save us money ?



"If you don't know where you're going,
you might end up someplace else"

- Yogi Berra

Kimberly Andrews
kma77@uga.edu





Fraser Shilling
fmshilling@ucdavis.edu
Road Ecology Center



Kimberly Andrews
kma77@uga.edu



Marine Extension and
Georgia Sea Grant
UNIVERSITY OF GEORGIA



Susan Handy
slhandy@ucdavis.edu



Daniel Smith
Daniel.Smith@ucf.edu



Get Involved with TRB

- Getting involved is free!
- Join a Standing Committee (<http://bit.ly/TRBstandingcommittee>)
- Become a Friend of a Committee (<http://bit.ly/TRBcommittees>)
 - Networking opportunities
 - May provide a path to become a Standing Committee member
- For more information: www.mytrb.org
 - Create your account
 - Update your profile



@NASEMTRB



@NASEMTRB



Transportation
Research
Board

TRB turns 100 on November 11, 2020

100  YEARS
2020

TRB

Help TRB:

- Promote the value of transportation research;
- Recognize, honor, and celebrate the TRB community; and
- Highlight 100 years of accomplishments.

Learn more at

www.TRB.org/Centennial

#TRB100

MOVING IDEAS: ADVANCING SOCIETY—100 YEARS OF TRANSPORTATION RESEARCH