

# Assessment of the Rio Mavillas to Support Inclusion in Puerto Rico's Heritage River Program

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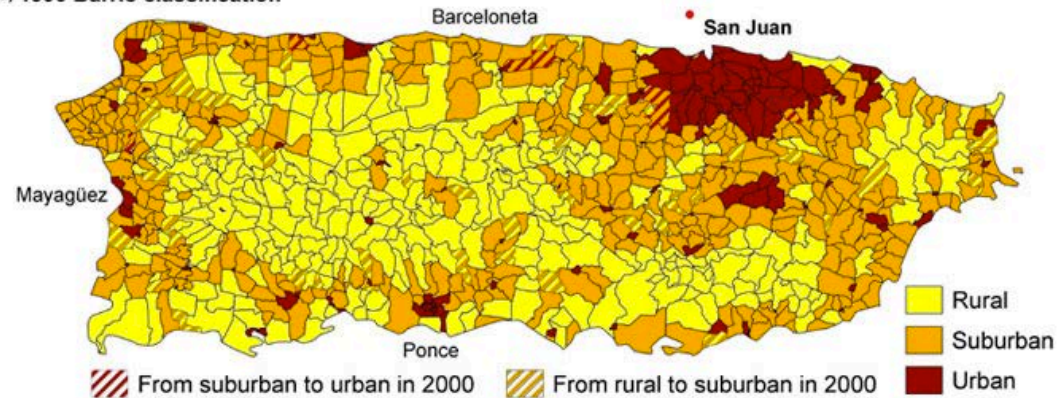
Advisors: Karen Troy &  
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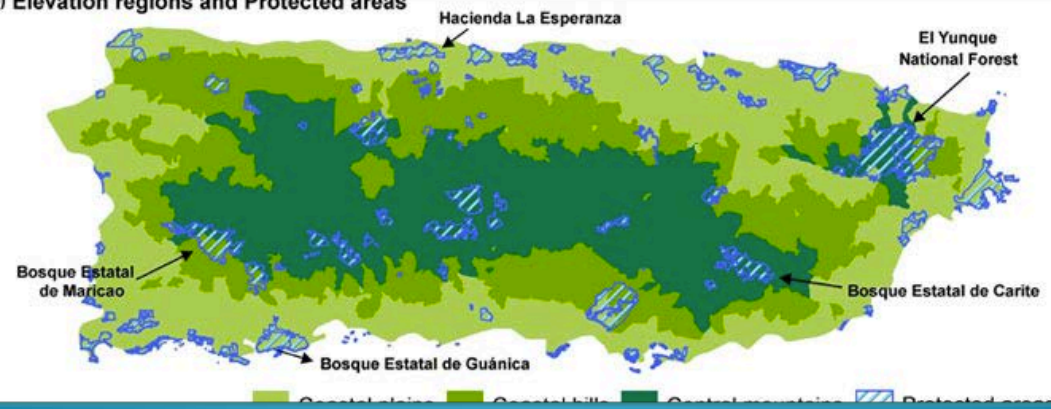
# Introduction

- Land Use Changes are dominant in Puerto Rico and can negatively impacted streams

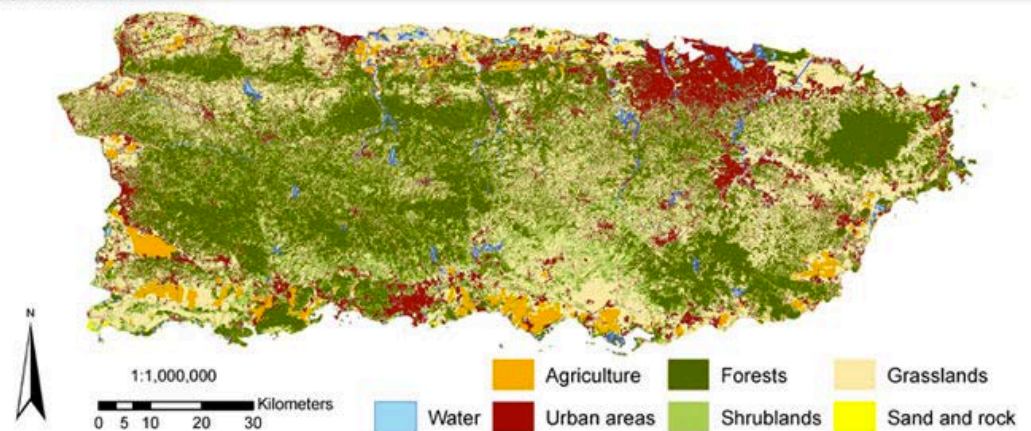
(a) 1990 Barrio classification



(b) Elevation regions and Protected areas



(c) Land cover 2000



# Introduction

Physical Condition Altered	Effect on Stream	Chemical Condition Altered	Effect on Stream	Biological Condition Altered	Effect on Stream
Erosion and Sediment Rates	Changes in Stream Course; Degrading Riparian Buffers	Addition of Heavy Metals, Pesticides, & Solutes	Lowered Water Quality	Chemical Toxicity	Elimination of macroinvertebrate species that cannot tolerate stream condition
Fluvial Dynamics	Increase Flood Peaks & Lengthens Flood Season			Habitat Instability	

- Urban Stream Syndrome: stream degradation seen through elevated concentrations of nutrients and contaminants, altered channel morphology, and reduced biotic richness

# Introduction

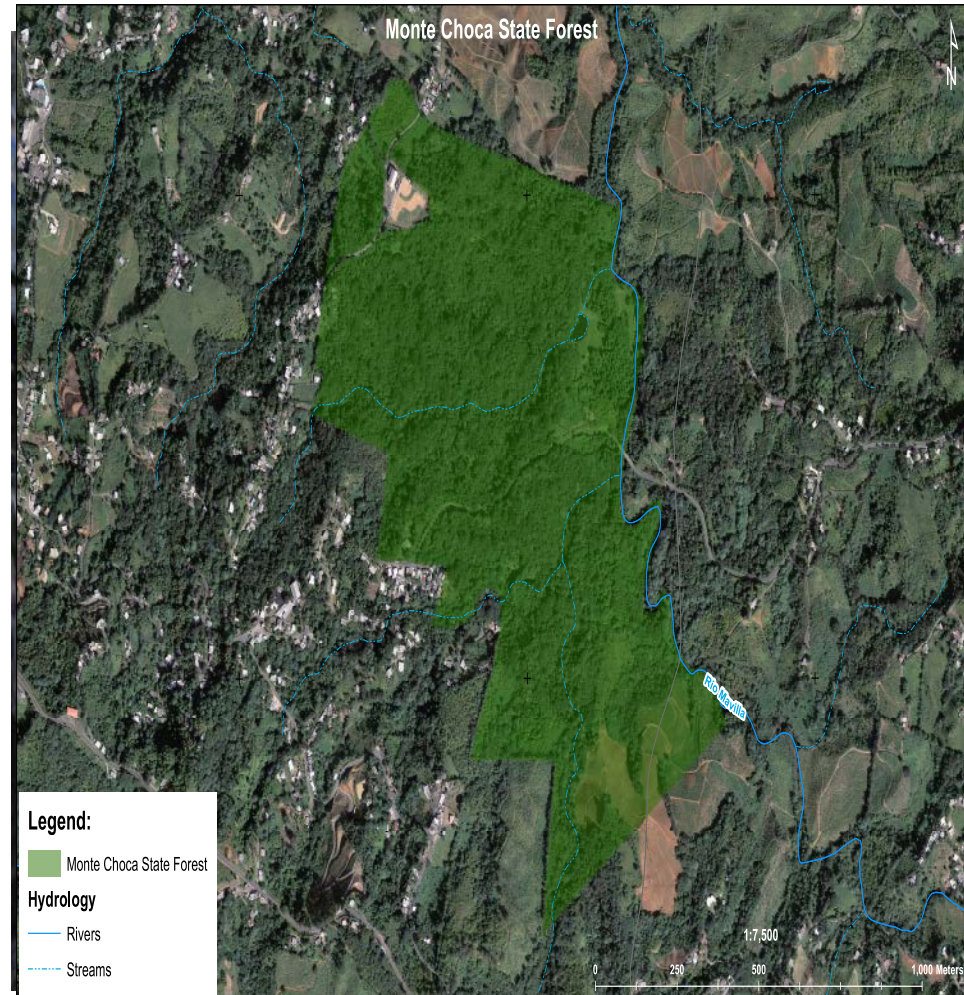
- DNER Water Monitoring Plan Division is responsible for carrying out Puerto Rico's Heritage River Program
- The Rio Mavillas, located within Monte Choca State Forest, is currently susceptible to the effects of land use changes – urging its designation as a Heritage River



# Overview of Project

## OBJECTIVES

1. Rosgen Stream Classification System
2. Visual Assessment Protocol for Puerto Rico Streams
3. Macroinvertebrate Assessment
4. River Usage Survey
5. Interpretive Map

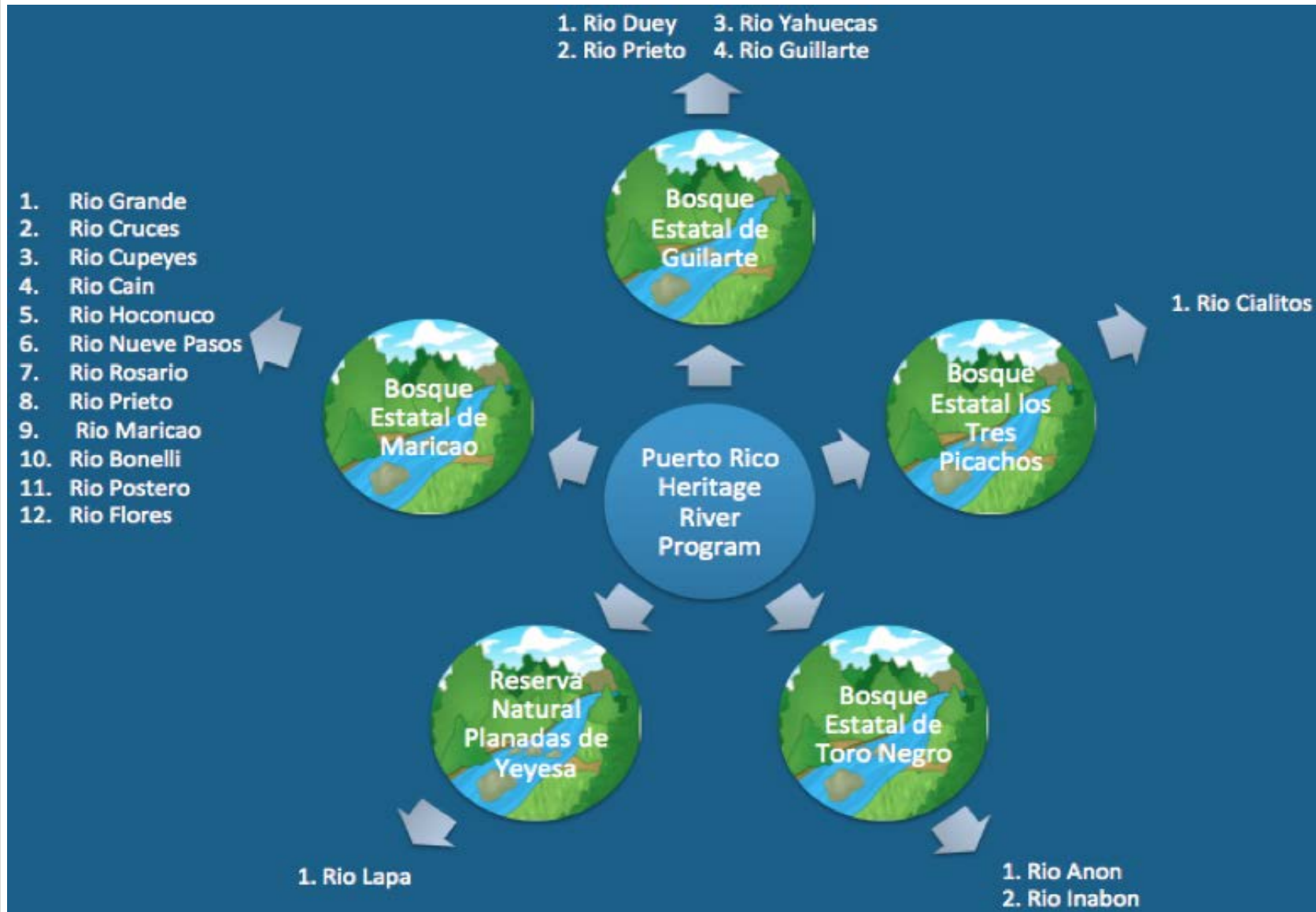


# Puerto Rico Heritage River Program

- Law 180 “Aims to recognize the value of rivers as nature closely linked to the heritage of people, set limits to stop the deterioration of their functions and their intrinsic values, and provide the DNER another mechanism to protect bodies of water for the use and enjoyment of this and future generations of our island.”



# Puerto Rico Heritage River Program





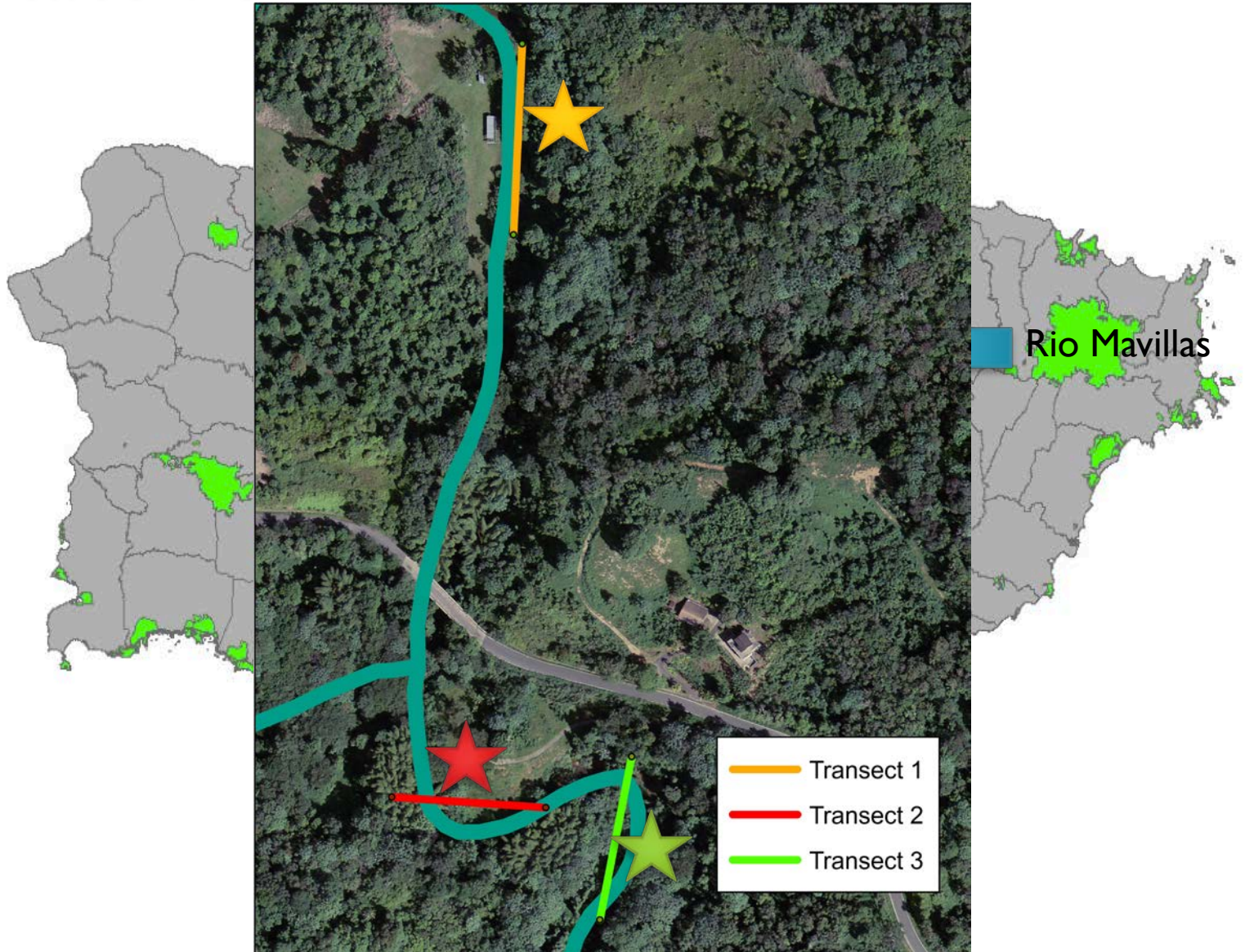
# Puerto Rico Heritage River Program

- The Rio Mavillas of the Monte Choca State Forest will be the first river designated a Heritage River under classification type 3!





# Rio Mavillas & the Monte Choca State Forest





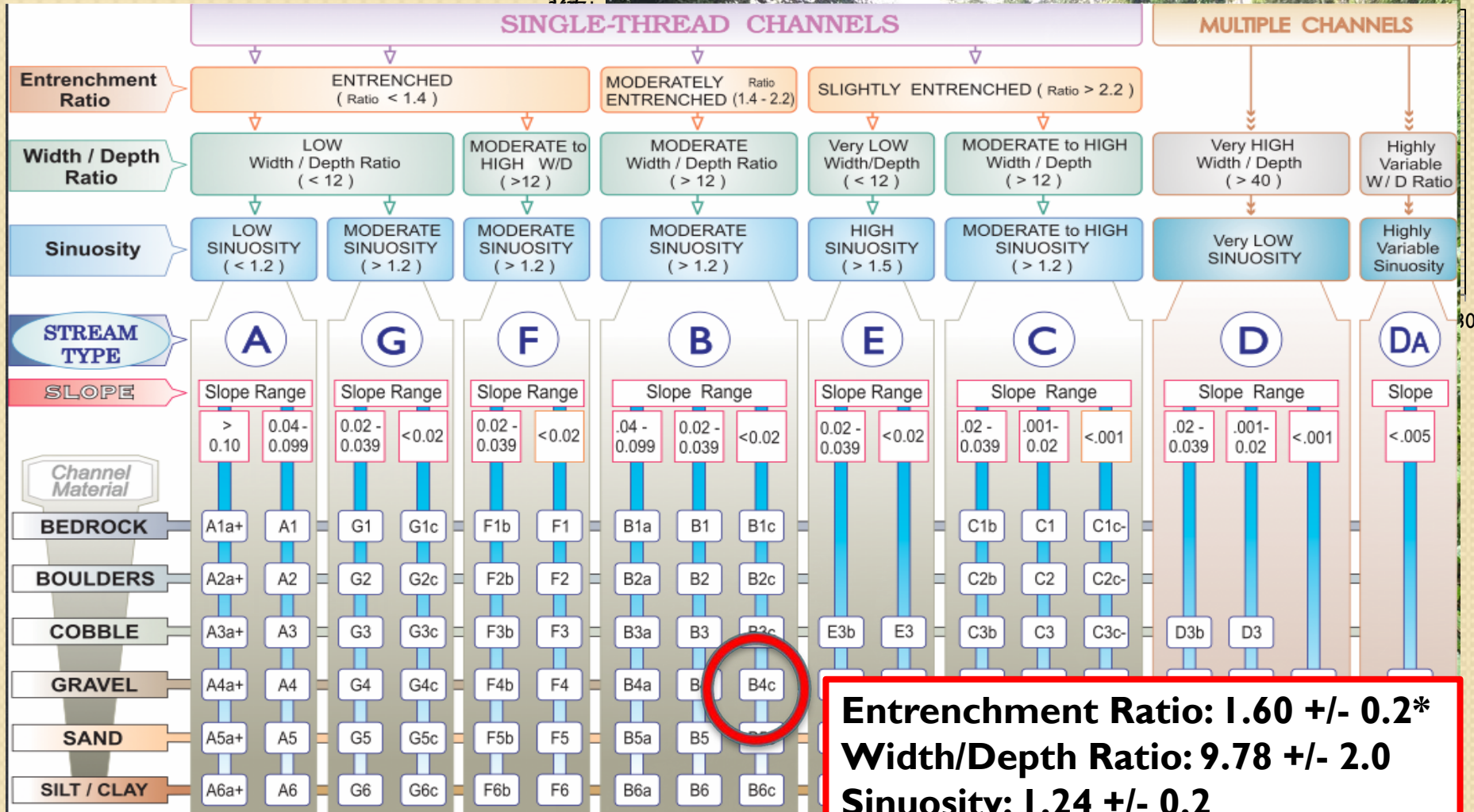


# METHODOLOGY & RESULTS



# OBJECTIVE I

## Rosgen Stream Classification



KEY to the **ROSGEN** CLASSIFICATION of NATURAL RIVERS. As a function of stream reaches, values of **Entrenchment** and **Sinuosity** ratios can vary by +/- 0.2 units; while

**Entrenchment Ratio: 1.60 +/- 0.2\***  
**Width/Depth Ratio: 9.78 +/- 2.0**  
**Sinuosity: 1.24 +/- 0.2**  
**Slope: 0.0065**  
**Channel Material: Gravel**



# OBJECTIVE 2

## Visual Assessment Protocol for Puerto Rico Streams

Transect	Stream Index	Classification
1	1.82	Very High
2	1.95	Very High
3	1.82	Very High



Element
Turbidity
Plant Growth
Channel Condition
Channel Flow
Percent Embeddedness
Bank Stability
Canopy
Riparian Condition
Habitat Available
Litter/Trash
Total Score



# OBJECTIVE 3

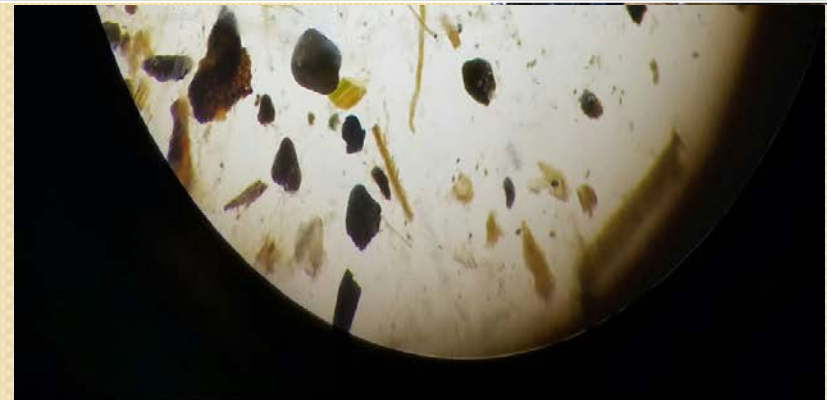
## Macroinvertebrate Assessment

All Sections of Rio Mavillas			
Order	Family	Total Number	Family Score
Acariformes	Hydrachinidia	2	2
Annelida	Oligochaeta	2	1
Coleoptera	Elmidae	358	5
Coleoptera	Hydraenidae	56	7
Coleoptera	Staphilinidae	81	7
Decapoda	Pseudothelphusidae	1	5
Diptera	Ceratopogonidae	16	5
Diptera	Chironomidae	20	2
Diptera	Stratiomyidae	1	3
Diptera	Psychodidae	118	3
Ephemeroptera	Baetidae	6	5
Ephemeroptera	Leptophlebiidae	13	5
Mollusca	Hydrobiidae	69	3
Mollusca	Thiaridae	106	2
Odonata	Libellulidae	2	5
Trichoptera	Calamoceratidae	2	7
Trichoptera	Helicopsichyidae	6	7
Trichoptera	Hydropsychidae	2	4
Trichoptera	Hydroptillidae	29	6

		890	
		Total Score	84

- Classified families present
- Biodiversity Index

BMWP-PR	Water Quality
$\geq 97$	Waters of excellent quality.
77-96	Waters of good quality, not contaminated or not altered in a sensitive manner.
57-76	Water of regular quality, eutrophic, moderate contamination.
37-56	Waters of poor quality, contamination.
18-36	Waters of poor quality, high contamination.
$\leq 17$	Waters of very poor quality, extreme contamination



# OBJECTIVE 4

## River Usage Survey

Ecosystem Service Category	Definition & Examples
Provisioning	Products obtained from ecosystems, including food, fresh water, fiber, genetic resources, etc.
Regulating	Benefits obtained from regulation of ecosystem processes, such as air quality maintenance, climate and water regulation, erosion control, pollination and disease regulation, etc.
Cultural	Nonmaterial benefits obtained from ecosystems, including spiritual enrichment, recreation, aesthetic experiences, etc.
Supporting	Services necessary for the production of all other ecosystem services, including soil formation, nutrient cycling, and biodiversity conservation.

## Modifications

- Added questions to assess ecosystem service knowledge
- Modified ranking questions for ease of analysis
- Generalized questions for the use of the survey at any river in Puerto Rico
- Providing more detailed instructions and responses, as well as “other” options, to clarify questions to survey takers
- Removed biased responses to avoid skewed results
- Corrections made by Prof. Santiago

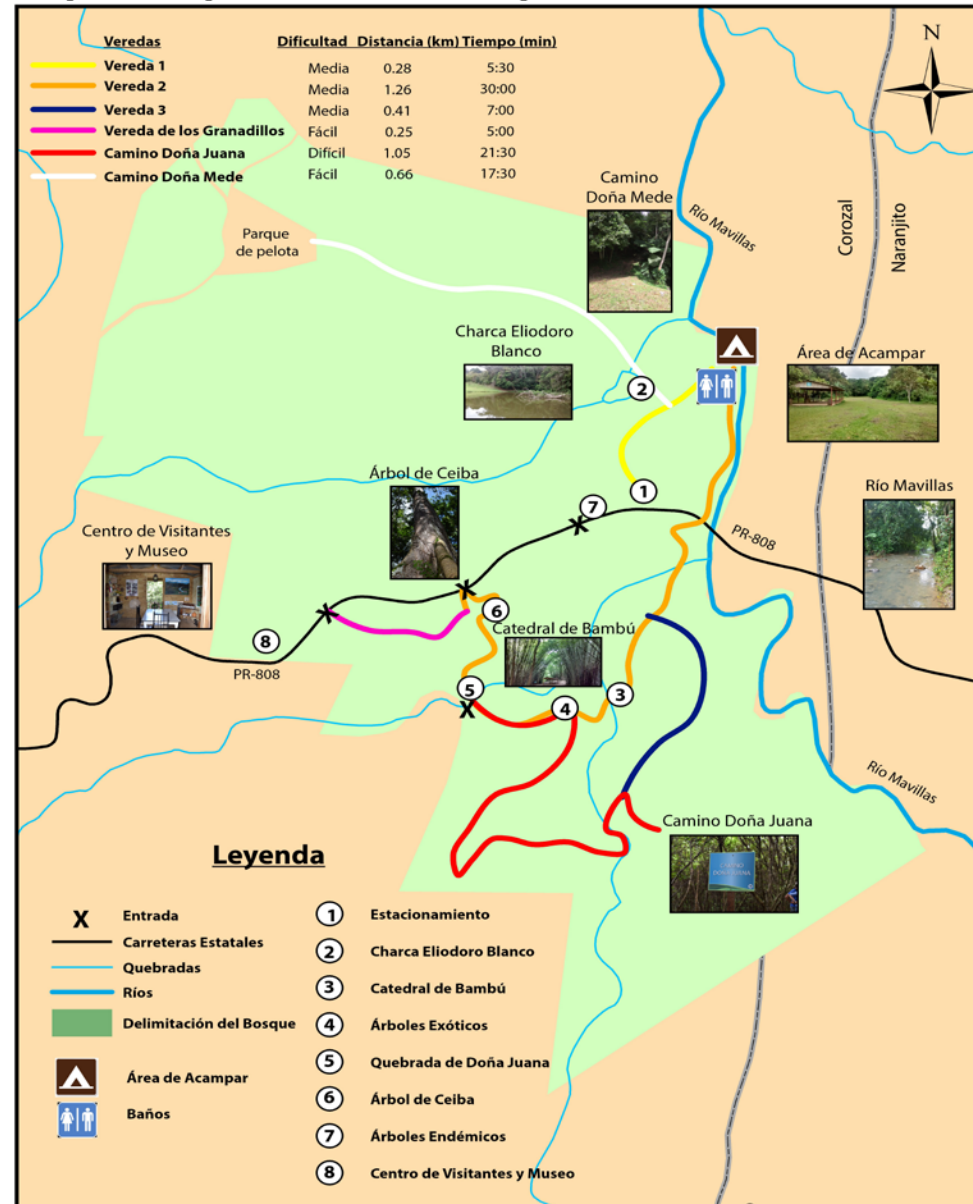


# OBJECTIVE 5

## Interpretive Map

- Through ArcGIS software, an interpretive map of the Monte Choca State Forest was created
- Trails marked by level of difficulty and time, as well as historic and aesthetic points of interest are included
- Map put on brochure that points out Monte Choca history and attractions

## Mapa Interpretativo del Bosque Estatal de Monte Choca



Fuente: División de Monitoreo del Plan de Aguas  
Departamento de Recursos Naturales y Ambientales  
Colaboradores: James Vorosmarti, Kevin Walsh  
Worcester Polytechnic Institute

0 0.2 0.4 Km



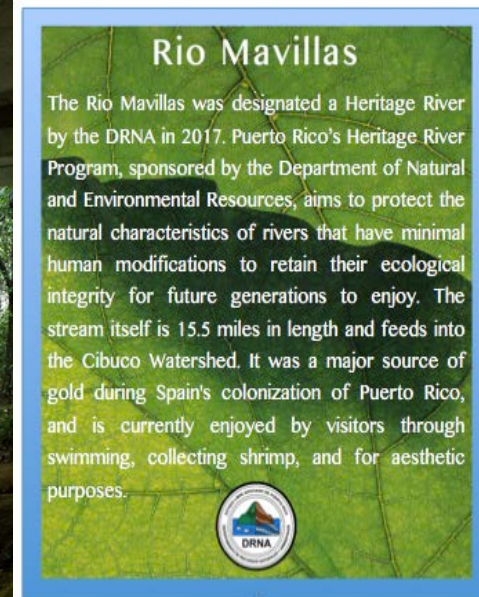
# Conclusions





# Recommendations

- Aerator for manmade pond
- Widen riparian buffer along campsite & bridge
- Visit forest more (Alberto's request)
- Survey community and forest visitors
- Post map in 5 designated locations of Monte Choca State Forest
- Conduct more stream assessments
- Repeat assessments 5-10 years after designation
- Signs/Brochure





# Acknowledgements



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# Questions?

