

Ecology and Conservation of the American Eel in the Caribbean

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NORTH CAROLINA
Cooperative Fish & Wildlife
Research Unit

USGS

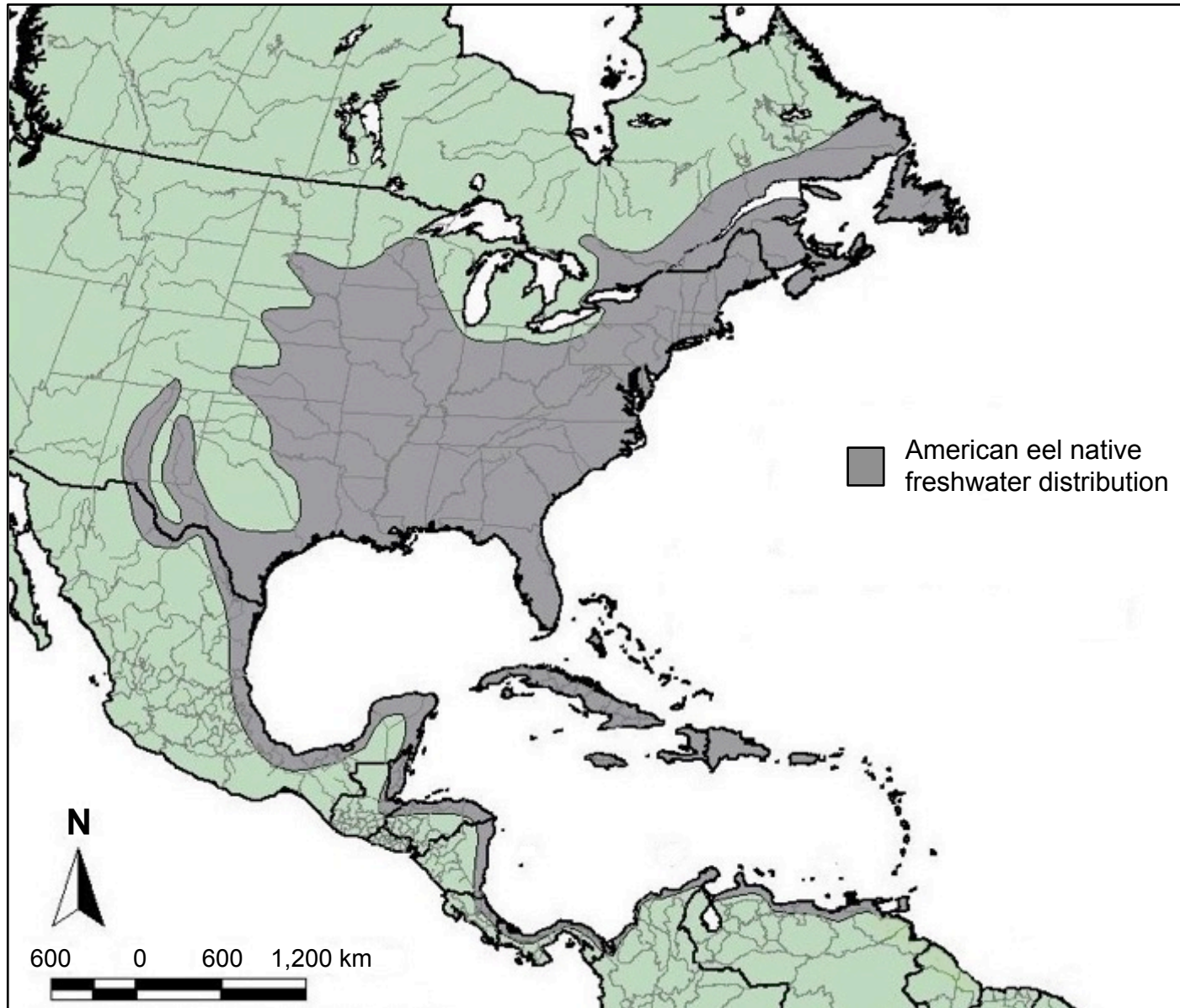


American Eel Status

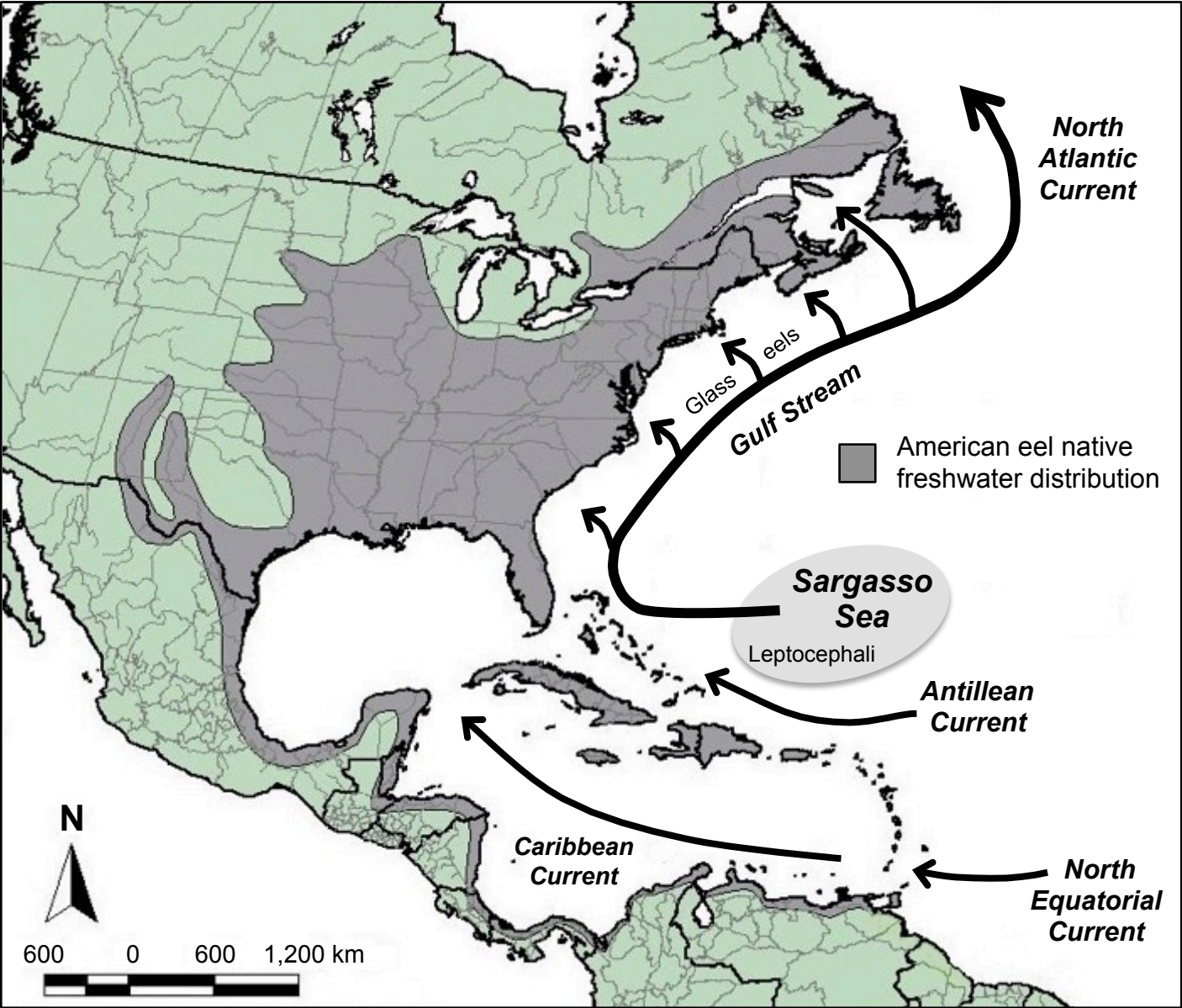
- **Widely distributed, economically valuable, culturally significant, ecologically important... but imperiled**
- **Catadromous, panmictic**
- **In decline throughout US range**
 - **Population “depleted” (ASMFC 2012)**
 - **Endangered by IUCN**
 - **Threatened in Canada**
 - **Not listed in US**
- **Little known in tropical distribution**



Global Distribution



Global Distribution



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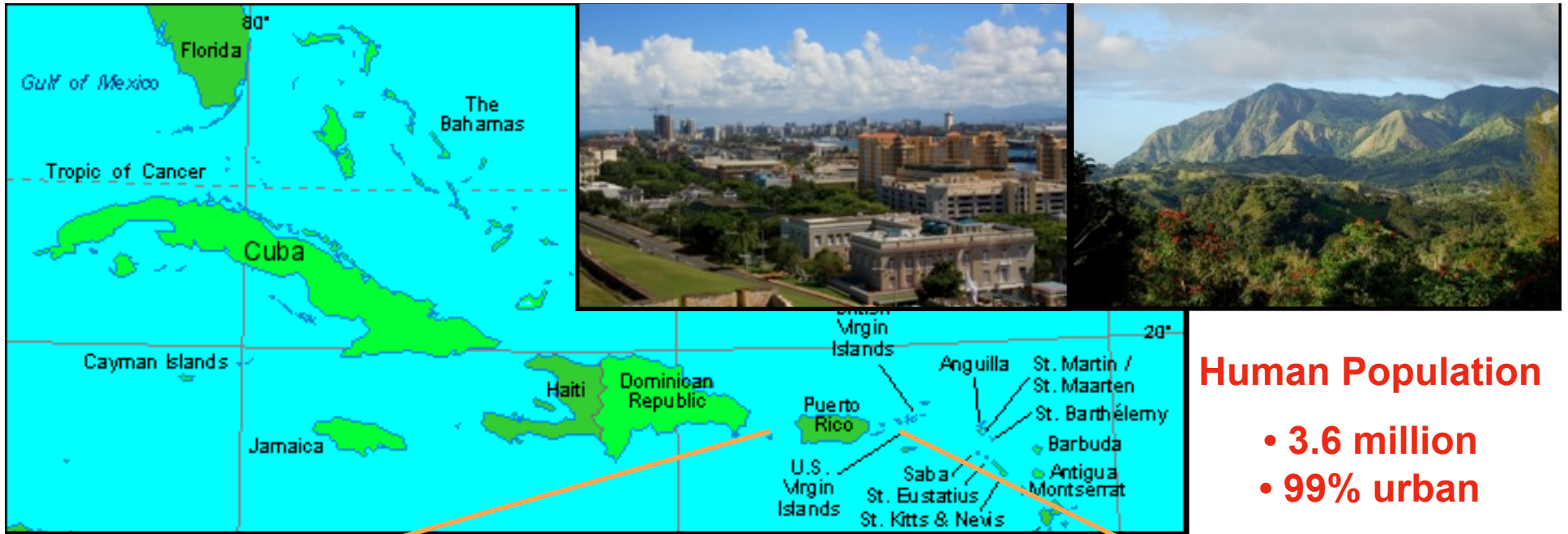
PRGAP

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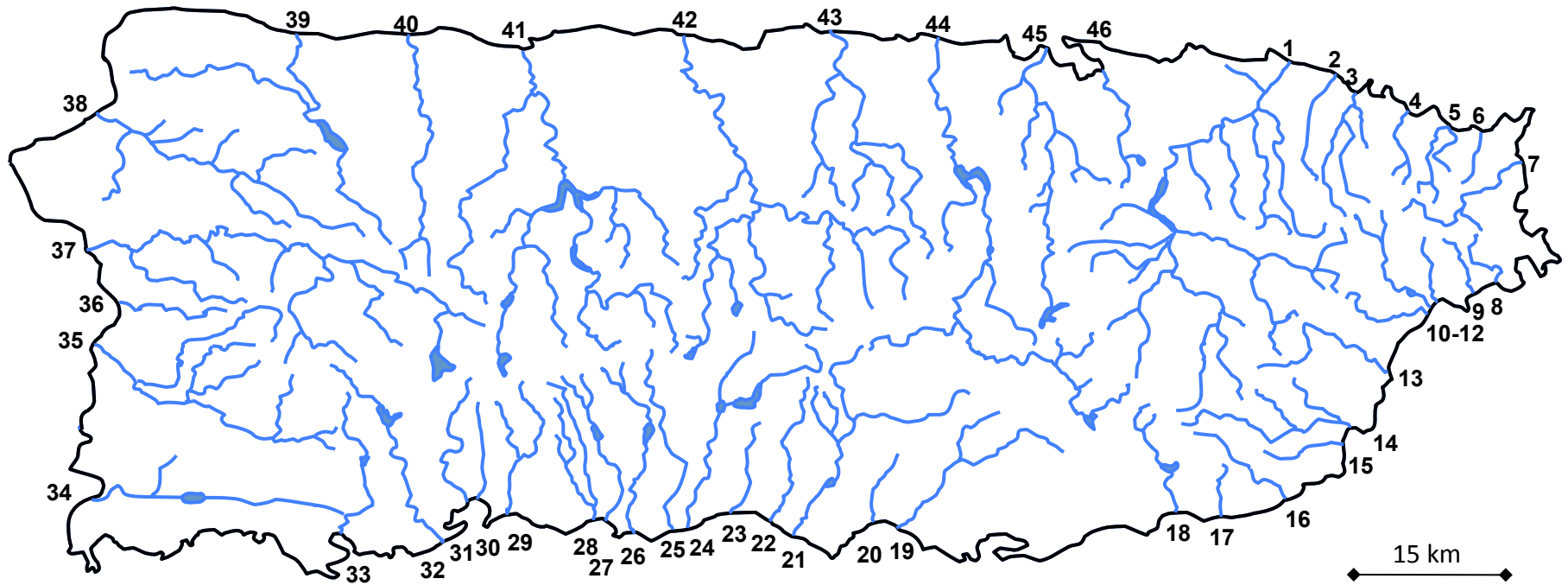




Human Population

- 3.6 million
- 99% urban





Puerto Rico Rivers

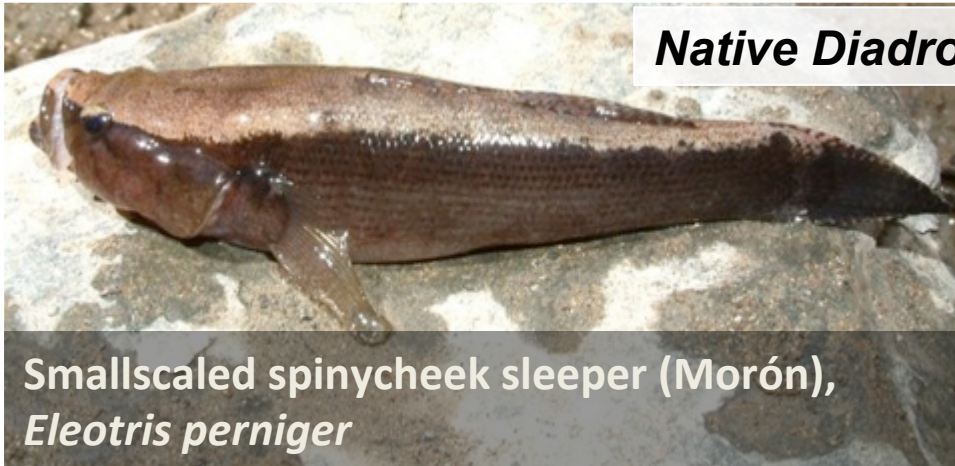
- **46** major drainages
 - **0** natural lakes
 - **29** large reservoirs
- drinking water
 - hydroelectric power
 - irrigation
 - cultural value
 - recreation
 - habitat







Native Diadromous Fishes



Smallscaled spinycheek sleeper (Morón),
Eleotris perniger



Bigmouth sleeper (Guavina),
Gobiomorus dormitor



Sirajo goby (Olivo), *Sicydium* spp.



River goby (Saga), *Awaous banana*



Mountain mullet (Dajao),
Agonostomus monticola



American eel (Anguila), *Anguilla rostrata*

Exotic Fishes

Poeciliids



Cichlids



Centrarchids



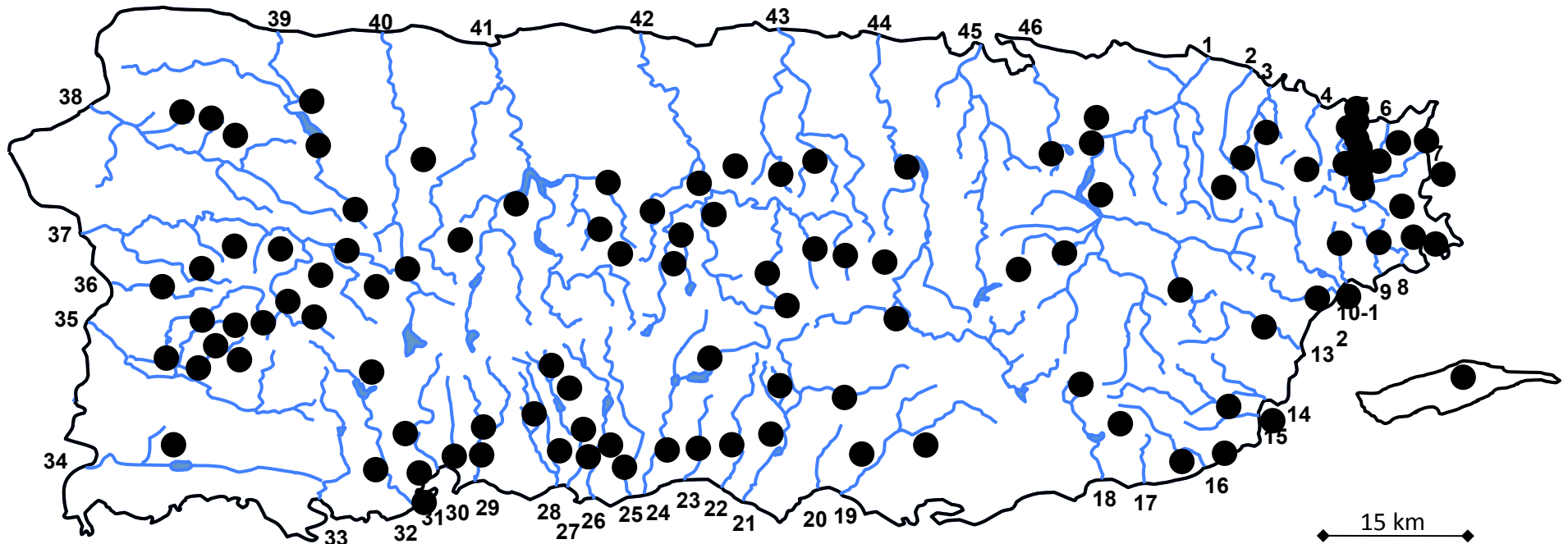
Newly discovered



Loricariids



Fish and Habitat Sampling



- Fish distribution and abundance
- **116** sample reaches
- **49** river drainages

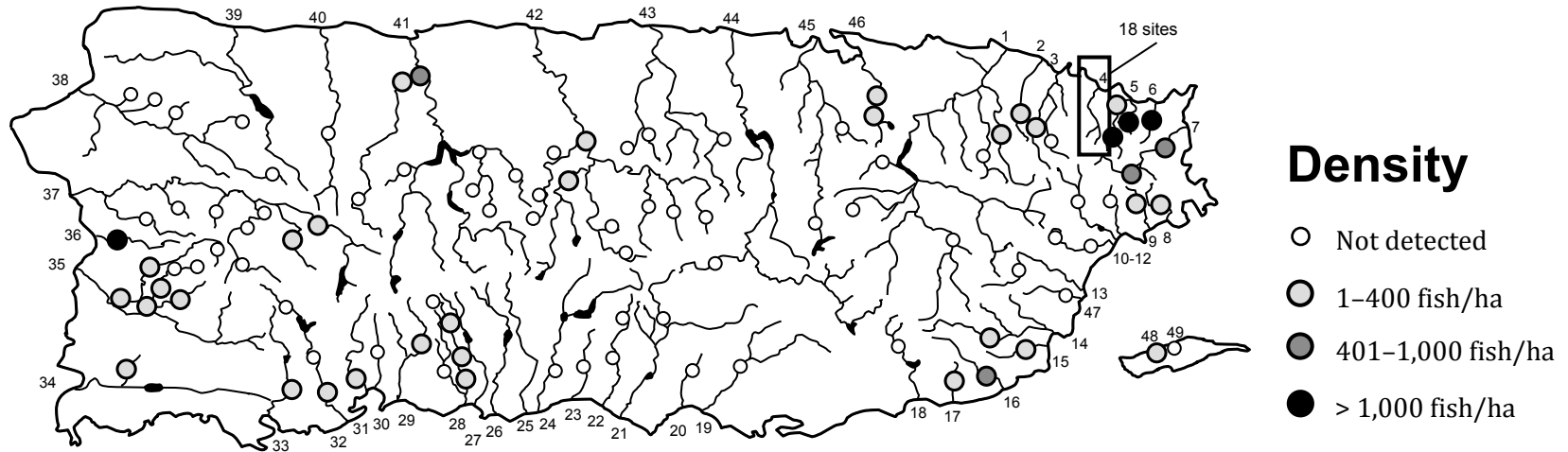


American Eel Sampling

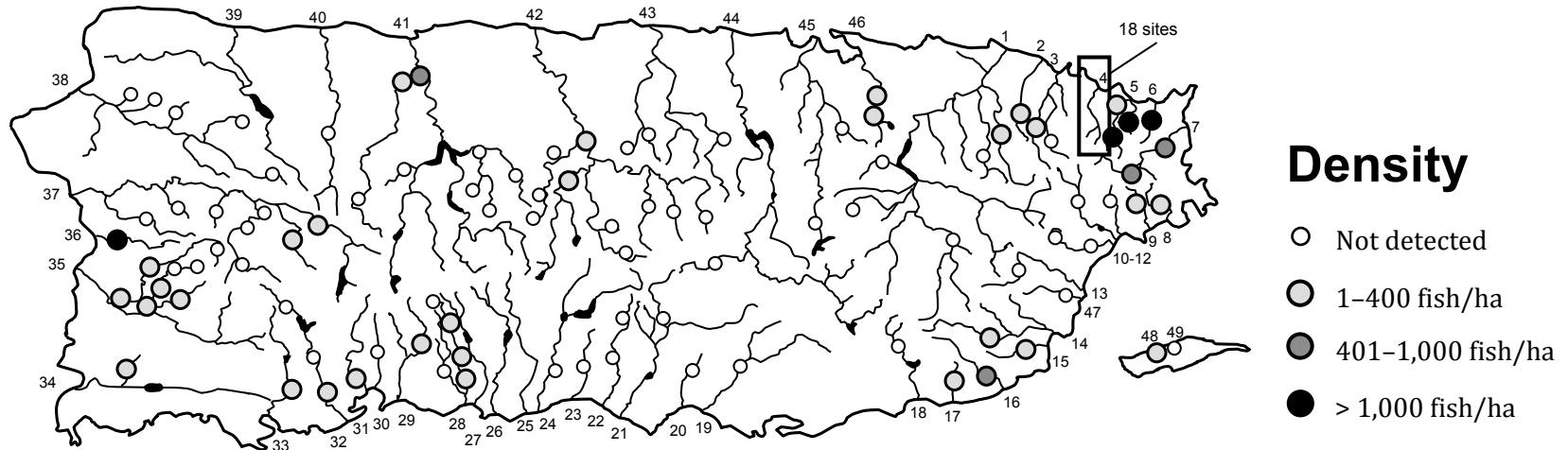
- **Captured at 48 (41%) stream and river sites**
- **3-pass removal population estimates**
 - mean 439 fish/ha
 - mean 23 kg/ha
 - mean individual weight 118 g
- **Occurrences include urbanized watersheds (up to 39% urban land cover)**



American Eel Sampling

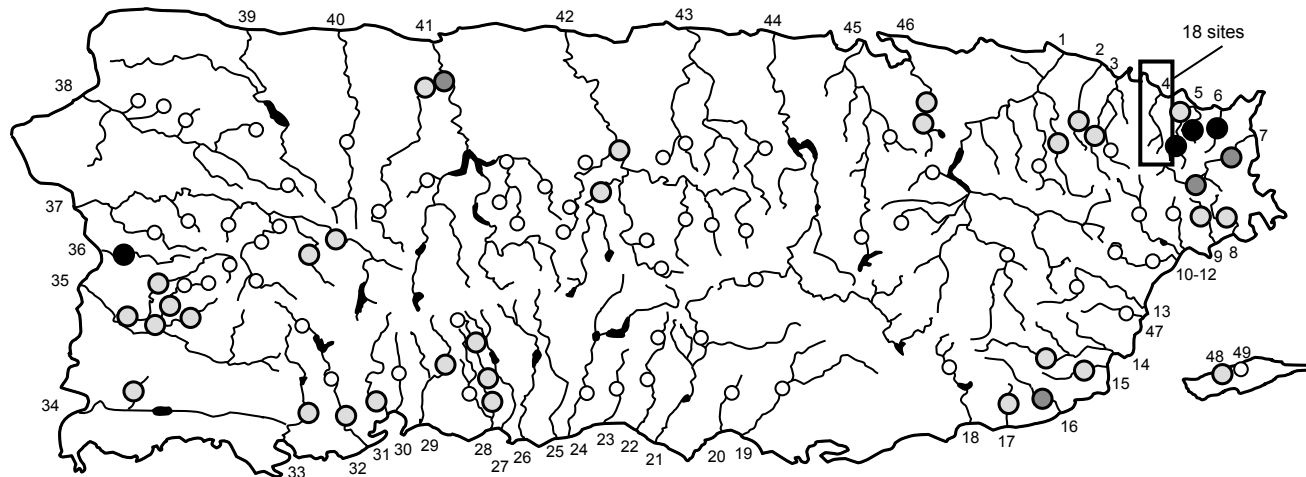


American Eel Sampling



• *Highest densities at lower elevations*

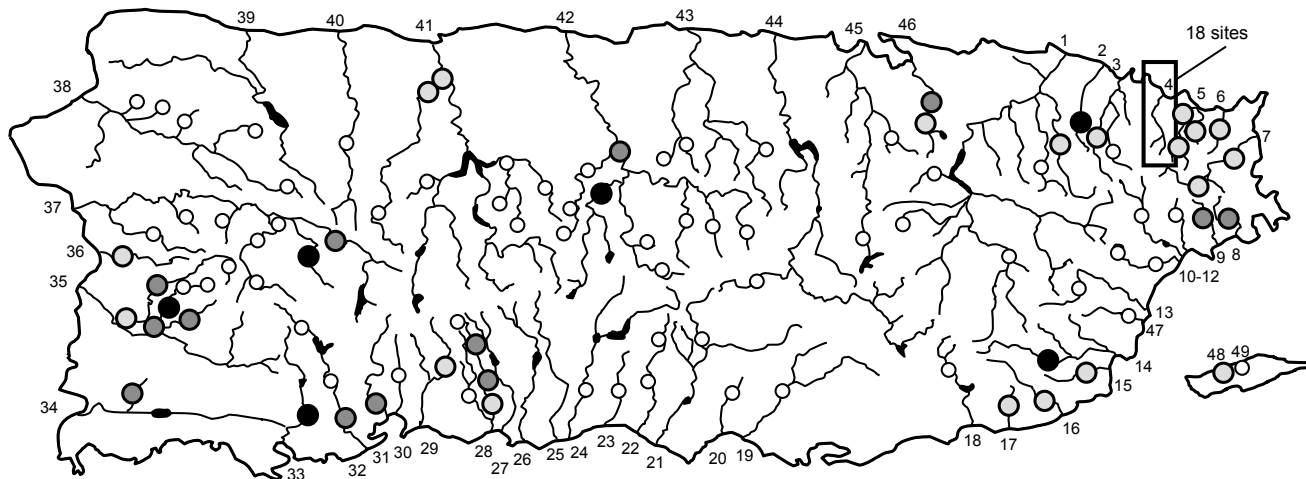
American Eel Sampling



Density

- Not detected
- 1-400 fish/ha
- 401-1,000 fish/ha
- > 1,000 fish/ha

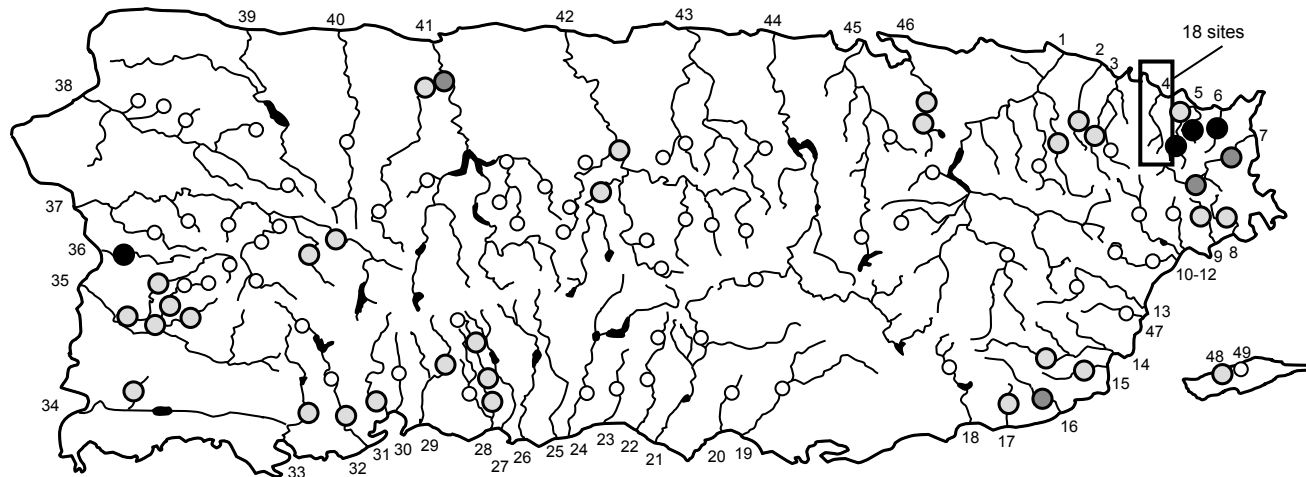
• *Highest densities at lower elevations*



Mean Weight

- Not detected
- 1.0-100.0 g
- 100.1-200.0 g
- > 200.0 g

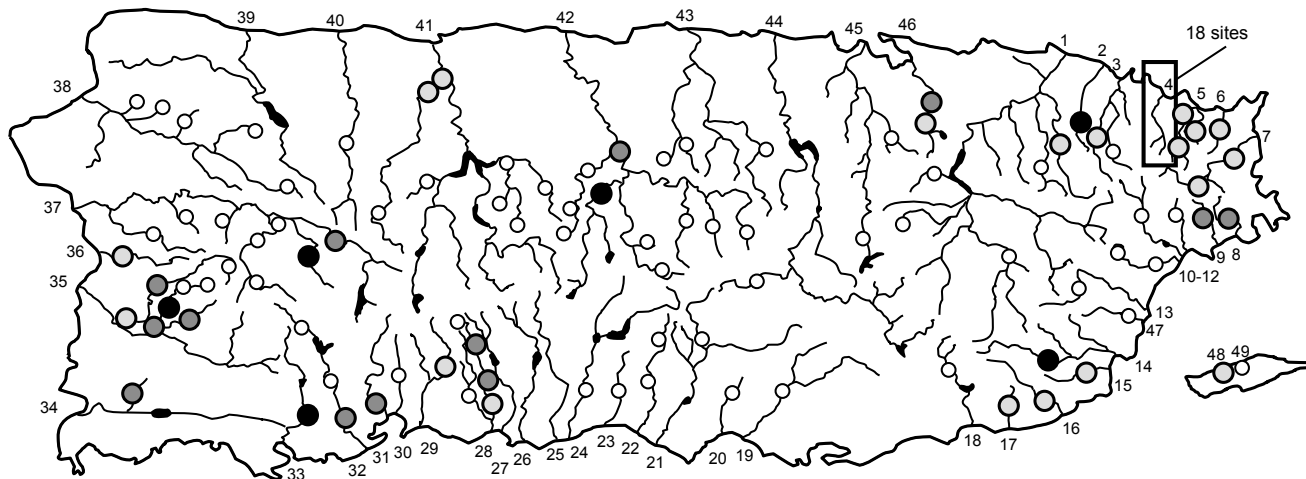
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Mean Weight

- Not detected
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- 100.1-200.0 g
- > 200.0 g

• *Largest eels at higher elevations*

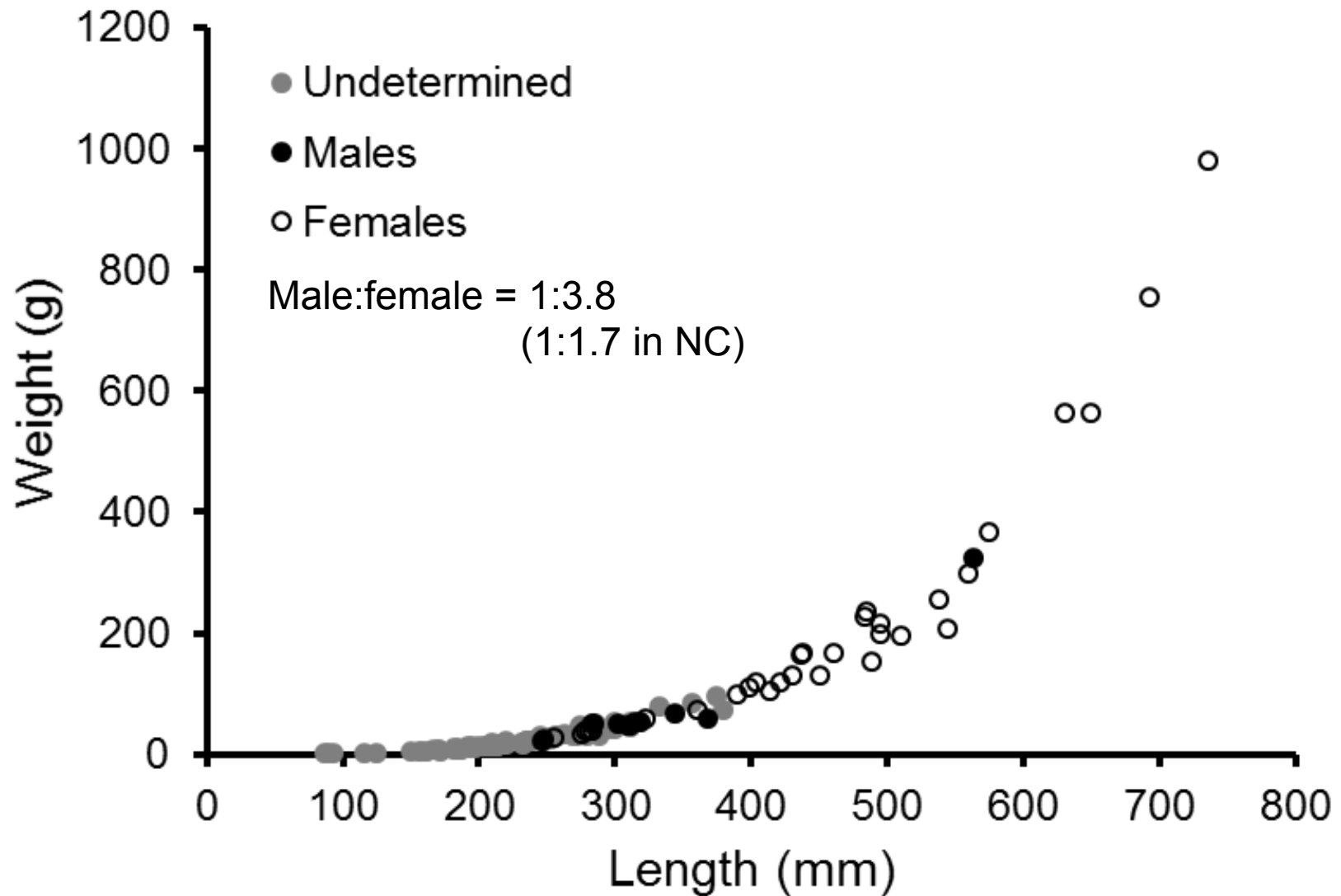
Population characteristics

120 eels sampled 2015–2016

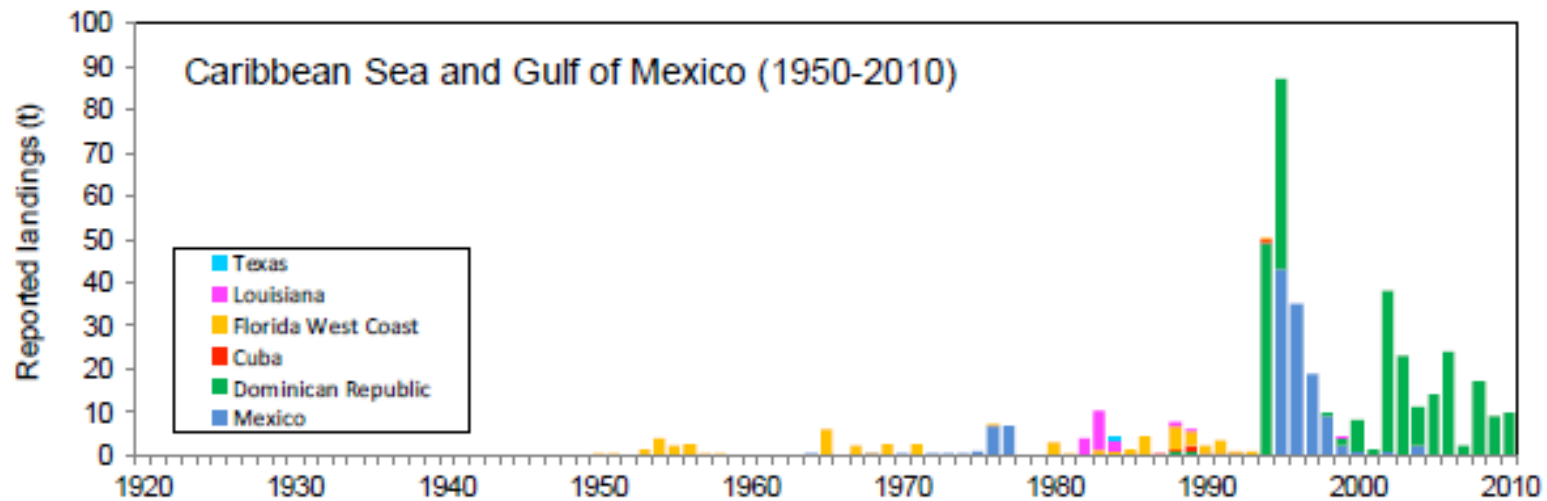
- 4 rivers
 - Mameyes (92)
 - Arecibo (25)
 - Rio Piedras (2)
 - Vieques (1)
- **No presence** of invasive swim bladder nematode *Anguillicoloides crassus*
 - **Roanoke River in North Carolina**
 - 37% have nematodes present
 - » Up to 14 nematodes present (mean = 1.9)
 - » Can exceed 7% of individual eel mass



Population characteristics



Caribbean American Eel Harvest



Cairns et al. 2014

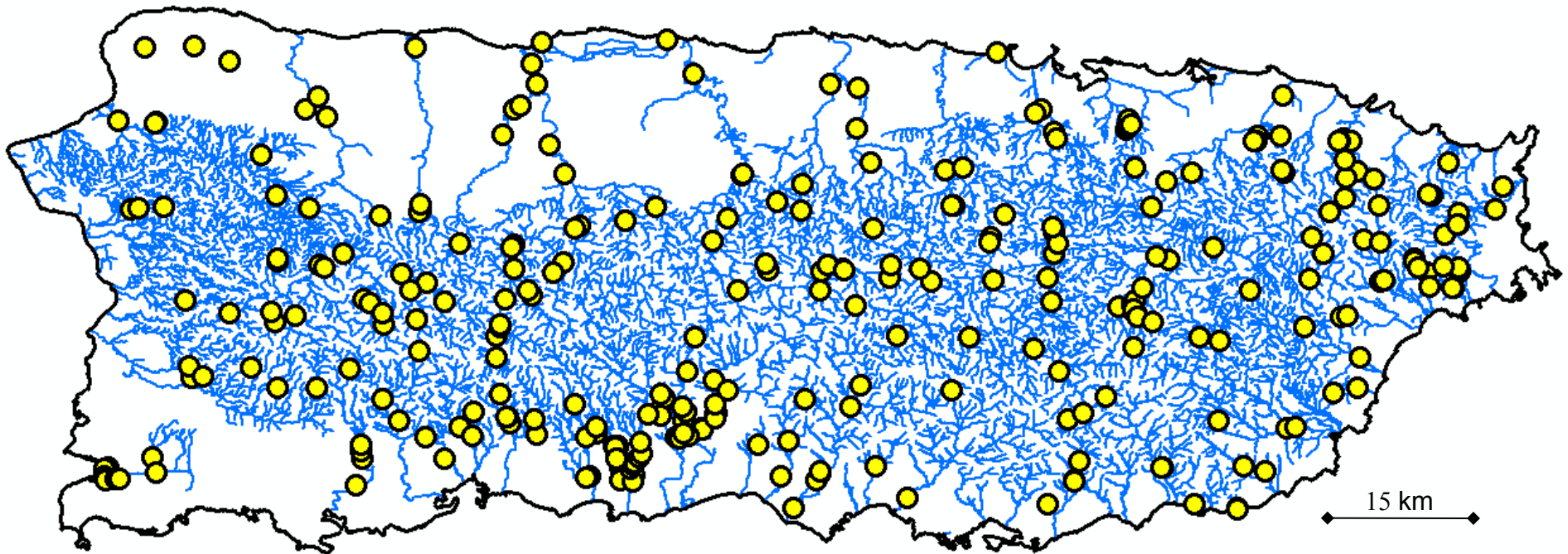
- **Relatively low commercial harvest**
- **Primarily yellow eels**
- **Pressure to allow glass eel harvest**
 - High demand for Asian aquaculture
 - Up to \$4,800/kg
 - Illegal harvest unknown







Dam Inventory

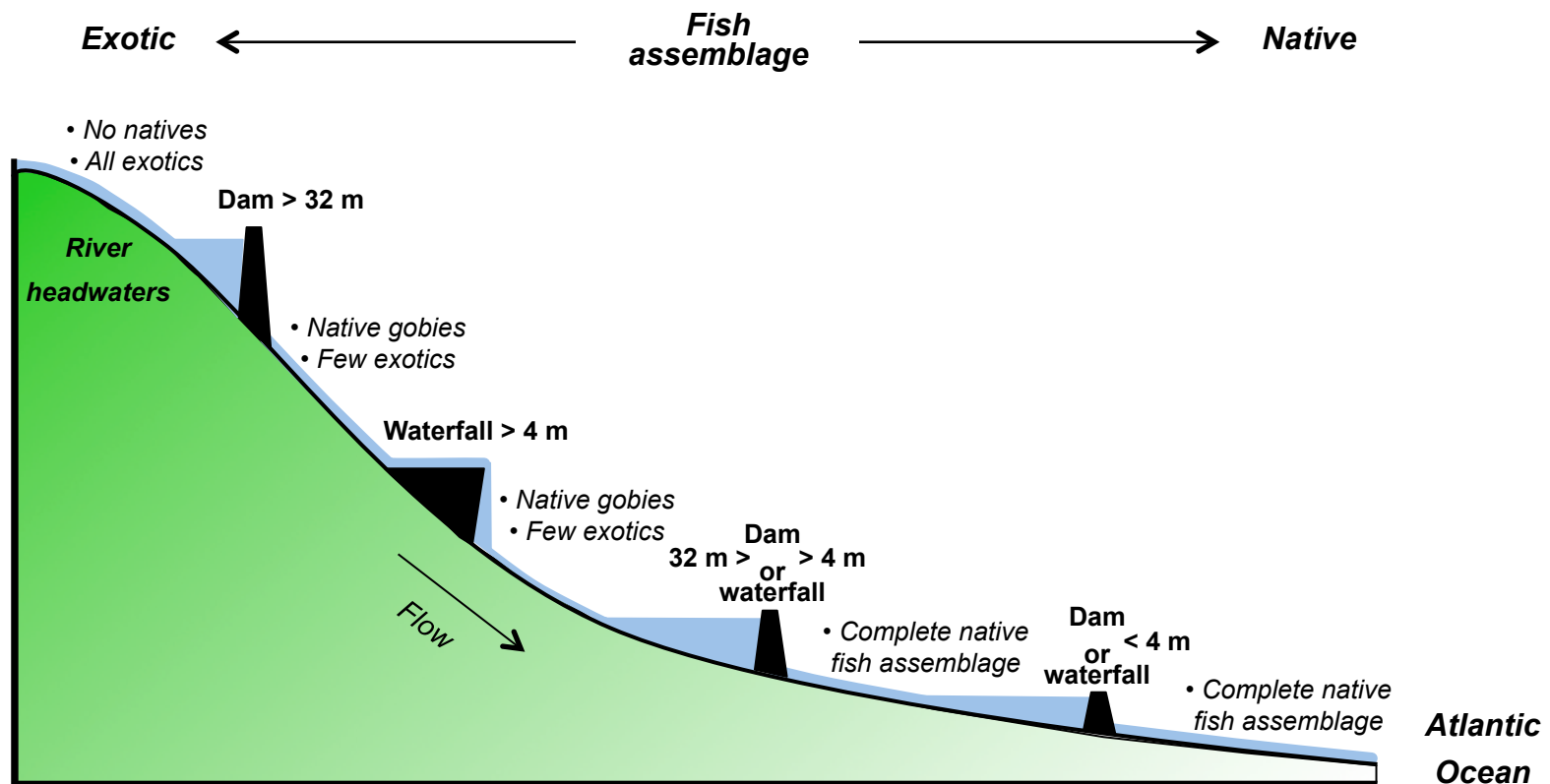


335 Fish Barriers

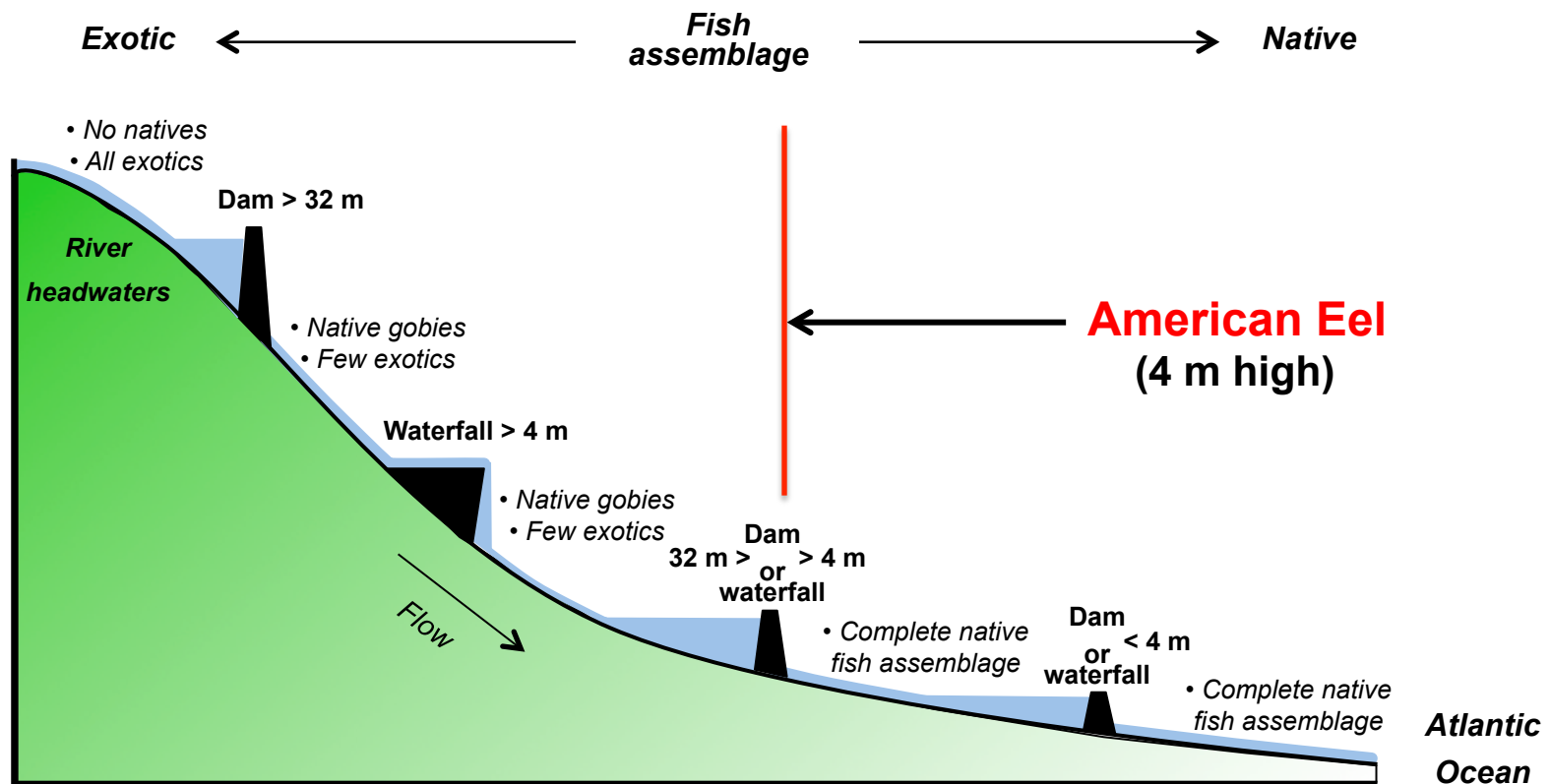
- 29 high dams
- 208 low dams
- 98 road crossings



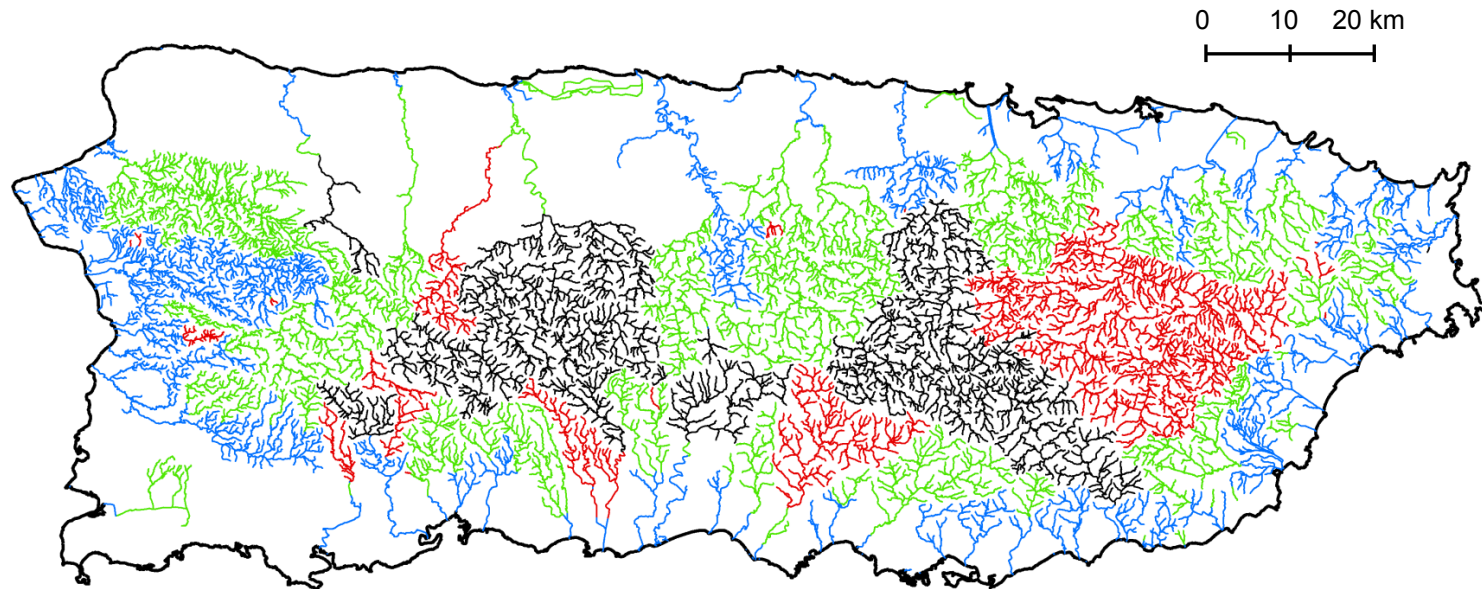
Upstream Loss of Native Species



Upstream Loss of Native Species



Island-Wide Habitat Loss

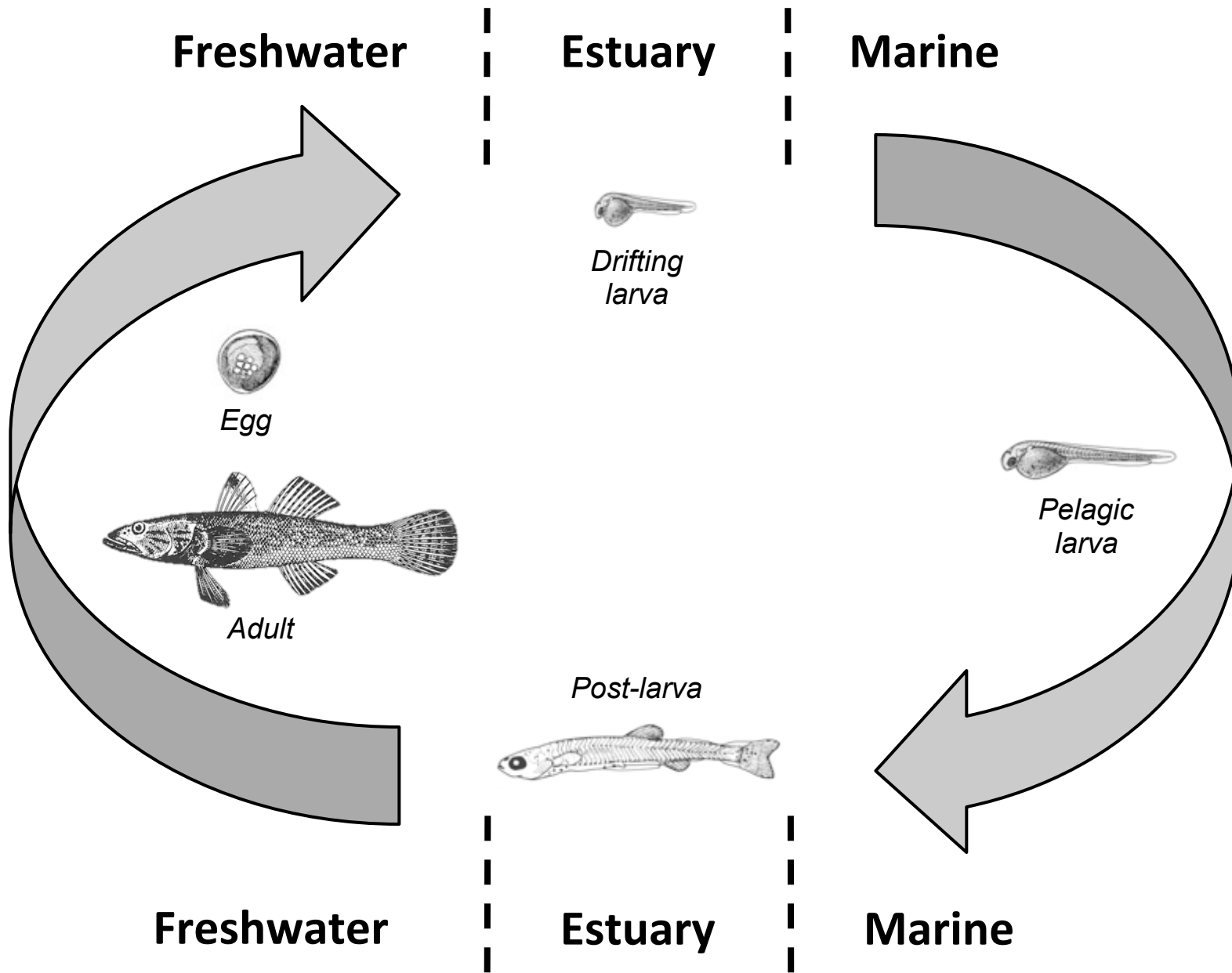


- Native assemblage accessible (no artificial barrier)
- Native assemblage accessible (dam affected)
- Non-goby extirpated, Goby restricted
- Native assemblage extirpated

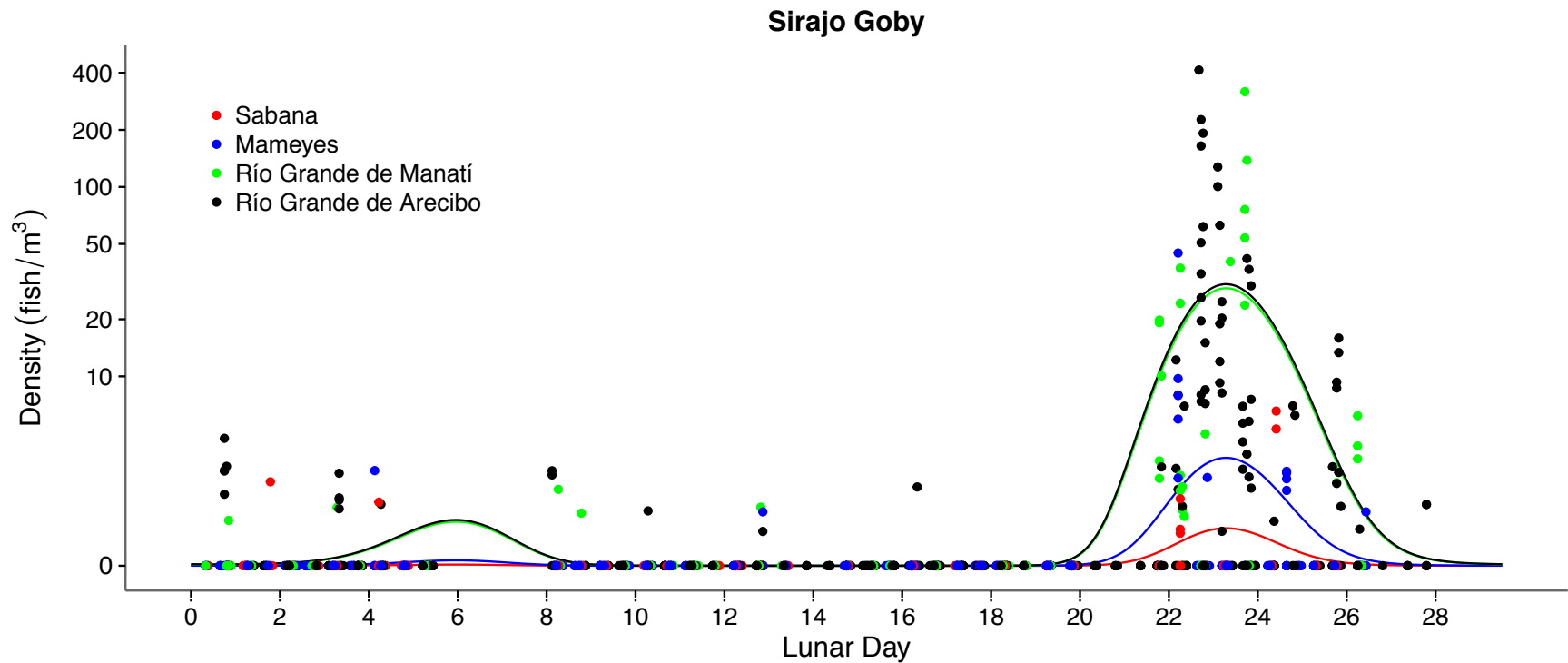
- **75% of river length affected by dams**
- **22% of river length extirpated of native fishes**
- **American Eel extirpated from 39% of river length**

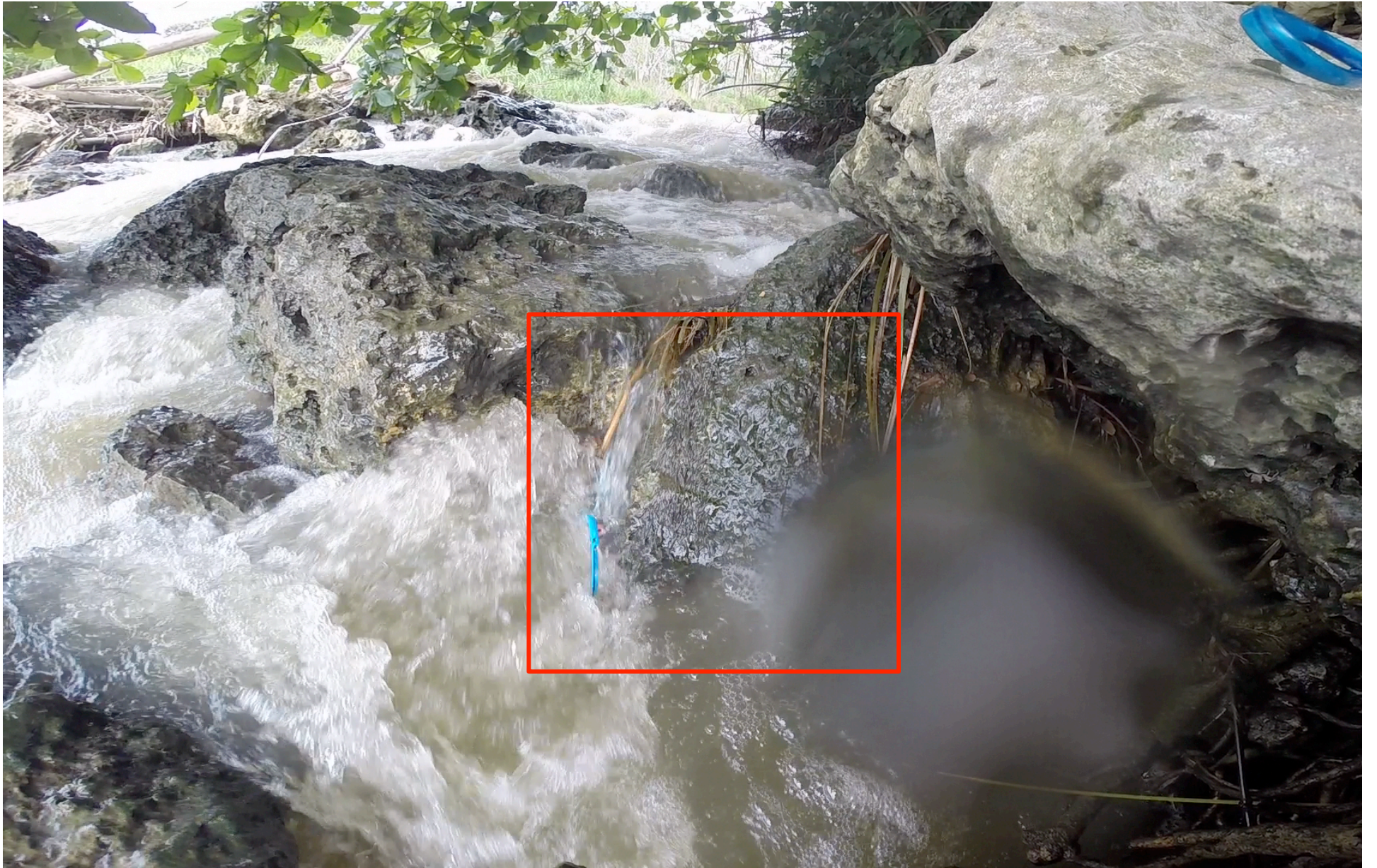


Amphidromous Life Cycle



Lunar Periodicity in Postlarval Recruitment





Boat Electrofishing Lower Rivers



Boat Electrofishing Lower Rivers

Common Snook, *Centropomus undecimalis*



A Super-Abundant Temporary Food Resource



Amphidromous Fish Postlarvae: A Marine Subsidy

Predator	Fullness (% body weight)		P-value
	Before	During	
American Eel	<0.01	0.65	0.01
Tarpon Snook	0.31	1.53	<0.01
Bigmouth Sleeper	0.19	0.87	0.03

Predator	Frequency of occurrence (%)	Composition by weight (%)
American Eel	71	41
Tarpon Snook	75	50
Bigmouth Sleeper	50	38

Threats to the American Eel in the Caribbean

Threats

1. Instream migration barriers
2. Habitat loss and alteration
3. Pollution
4. Exotic species
5. Legal and illegal harvest
– lax enforcement
6. Climate change

Actions

1. Removal, passage, flow regulation
2. Protection, flow regulation
3. Monitoring, mitigation
4. Regulations, monitoring, habitat management, education
5. Regulations, resources and training, education
6. Planning for adaptation and resilience, global cooperation



