

Fishes recorded in surveys of streams in Guanacaste Conservation Area (ACG)

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In March 2015, we visited ACG with the primary objective to characterize fish communities around Rincon de la Vieja National Park and other habitats. We were particularly interested in identifying sites that are characterized by high concentrations of hydrogen sulfide. We found two sulfide springs, but only one (Middle Earth; MT15-09) was inhabited by fish.

Fish at each site were sampled with seines or a backpack electro-shocker, depending on the habitat. All species were identified on site based on keys provided by Bussing (1998). After photographing select specimens, fish were released unharmed at the original collection site. The exception included select specimens of the family Poeciliidae, which were fixed for morphological analyses as permitted by our permit.

In the coming months, we will analyze morphological variation of *Poecilia gillii* collected at the Middle Earth site and compare it to specimens from adjacent, non-sulfidic habitats. Considering the similarity of the Middle Earth site to sulfide springs in Mexico, future research should include genetic analyses that test for genetic differentiation between sulfidic and non-sulfidic populations, which has been documented for sulfide spring species of the genus *Poecilia* in Mexico (Tobler & Hastings 2011; Tobler *et al.* 2011).

Below we provide our data from sampling efforts during last month's visit. For each site, we provide latitude and longitude, as well as a list of species detected. We also include photographs of habitats and select specimens that were seen at each site.

Rio Colorado, just outside of entrance to Sector Las Pailas (MT15-04)

Latitude/longitude: 10.75562/ -85.35339

Fish species recorded: *Priapichthys annectens*

Habitat picture



Priapichthys annectens male



Priapichthys annectens
female



Rio Los Ahogadas (MT15-05)

Latitude/longitude: 10.75438/ -85.51608

Fish species recorded:
Brachyrhaphis olomina
Poecilia gillii
Amatitlania siquia
Parachromis dovii
Gymnotus maculosus
Rhamdia guatemalensis

Habitat picture



Gymnotus maculosus



Rhamdia guatemalensis



Tributary of Rio Azul, near Buenos Aires (MT15-06)

Latitude/longitude: 10.88441/ -85.32259

Fish species recorded: *Priapichthys annectens*

Rivulus isthmensis

Astatheros alfari (note: this species may have been an escapee from an adjacent, artificial pond)

Note:

This was a very interesting stream because of the high levels of calcium carbonate, which created rocks covered in light color.

Interestingly, *P. annectens* at this site were almost white, in contrast with other populations in this area. This phenomenon needs further investigation.

Habitat picture



Priapichthys annectens male



Priapichthys annectens
female



Rivulus isthmensis



Quebrada Garcia, east of Quebrada Grande (MT15-07)

Latitude/longitude: 10.86298/ -85.42132

Fish species recorded: *Brachyrhaphis olomina*
Astyanax aeneus
Rhamdia guatemalensis
Amatitlania siquia
Astatheros alfari
Parachromis dovii

Brachyrhaphis olomina,
male



Brachyrhaphis olomina,
female



Astatheros alfari



Sulfide springs at Middle Earth, west of Quebrada Grande (MT15-08)

Latitude/longitude: 10.83823/ -85.51614

Fish species recorded: *Poecilia gillii*

Note: This habitat was characterized by high levels of hydrogen sulfide. Similar to springs in Mexico, the only inhabitant was a species of *Poecilia*. This will provide an opportunity to study adaptation to the toxic environments in a comparative fashion.

Habitat picture



Poecilia gillii male



Quebrada Cerro Grande at Middle Earth, west of Quebrada Grande (MT15-09)

Latitude/longitude: 10.83913/ -85.51730

Fish species recorded:
Brachyrhaphis olomina
Poecilia gillii
Astyanax aeneus
Synbranchus marmoratus
Amatitlania siquia

Poecilia gillii male



Rio Tempesquito (MT15-10)

Latitude/longitude: 10.78935/ -85.55112

Fish species recorded:
Brachyrhaphis olomina
Poecilia gillii
Poeciliopsis turrubarensis
Astyanax aeneus
Rhoeboides bonchellei
Rhamdia guatemalensis
Amatitlania siquia
Astatheros alfari
Parachromis dovii

Poeciliopsis turrubarensis



Quebrada Carmen (MT15-11)

Latitude/longitude: 11.121074/ -85.593573

Fish species recorded:
Alfaro cultratus
Phallichthys amates
Poecilia gillii
Astyanax aeneus
Rivulus isthmensis
Rhamdia guatemalensis
Amatitlania siquia
Astatheros alfari
Parachromis dovii

Alfaro cultratus



Phallichthys amates, female



Phallichthys amates, male



Rivulus isthmensis



Rio Sapoa (MT15-12)

Latitude/longitude:

11.121905/ -85.595165

Fish species recorded:

Alfaro cultratus

Poecilia gillii

Astyanax aeneus

Rhamdia guatemalensis

Loricariidae sp. (introduced)

Amatitlania siquia

Amphilophus citrinellus

Astatheros alfari

Astatheros longimanus

Astatheros rostratus

Hypsophrys nematopus

Parachromis dovii

Parachromis loisellei

Tomocichla tuba

Habitat picture



Poecilia gillii



Amatitlania siquia



Amphilophus citrinellus



Astatheros longimanus



Astatheros rostratus



Hypsophrys nematopus



Parachromis loisellei



Tomocichla tuba



Tributary to Rio Tempisquito (MT15-13)

Latitude/longitude: 10.85064/ -85.48477

Fish species recorded:
Poecilia gillii
Astyanax aeneus
Rhamdia guatemalensis
Amatitlania siquia

Habitat picture

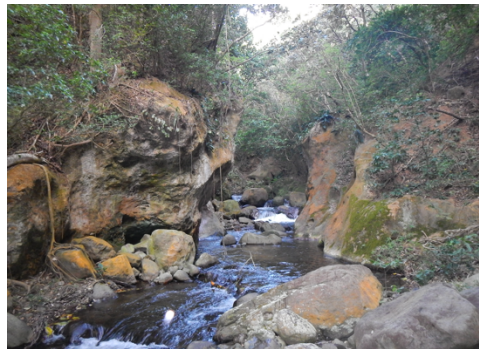


Stream north of Quebrada Grande (MT15-14)

Latitude/longitude: 10.88541/ -85.47228

Fish species recorded:
Priapichthys annectens
Rhamdia guatemalensis

Habitat picture



Stream at Aguas Termales Santa Maria (MT15-15)

Latitude/longitude: 10.75903/ -85.32280

Fish species recorded: *Rivulus isthmensis*

Note: Portions of this habitat exhibited high levels of hydrogen sulfide, but no fish were caught in the sulfidic portion of the stream.

Habitat picture



Rio Zopilote, by waterfall (MT15-16)

Latitude/longitude: 10.76439/ -85.31147

Fish species recorded: *Priapichthys annectens*

Habitat picture



Stream near headquarters at Sta. Maria (MT15-17)

Latitude/longitude: 10.76430/ -85.30643

Fish species recorded: *Priapichthys annectens*
Rivulus istmensis

Habitat picture



Priapichthys annectens male



Tributary of Quebrada Pailas (MT15-18)

Latitude/longitude: 10.77476/ -85.34472

Fish species recorded: *Priapichthys annectens*
Rhamdia guatemalensis

Habitat picture

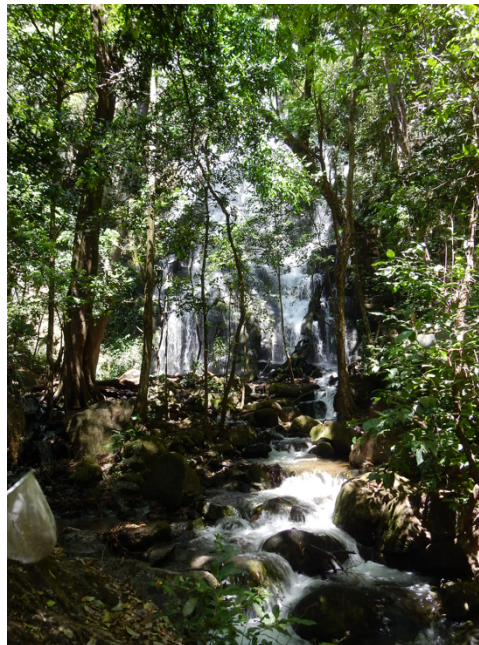


Quebrada Pailas (MT15-19)

Latitude/longitude: 10.77416/ -85.34187

Fish species recorded: *No fish*

Habitat picture



Creek just outside of Rincon de la Vieja NP (MT15-20)

Latitude/longitude: 10.75481/ -85.36729

Fish species recorded: *Brachyrhaphis olomina*
Parachromis dovii

Habitat picture



Parachromis dovii



Creek past Rio Blanco (MT15-21)

Latitude/longitude: 10.78104/ -85.36063

Fish species recorded: *No fish*

Habitat picture



Arroyo Agria (MT15-22)

Latitude/longitude: 10.78119/ -85.35670

Fish species recorded: *No fish*

Habitat picture



Stream in Sector Sta Maria (MT15-23)

Latitude/longitude: 10.75226/ -85.30841

Fish species recorded: *Priapichthys annectens*
Rivulus isthmensis

Habitat picture



Priapichthys annectens



Rivulus isthmensis



Rio Panilla (MT15-24)

Latitude/longitude: 10.25711/ -85.81276

Fish species recorded:
Brachyrhaphis olomina
Poecilia gillii
Rhamdia guatemalensis
Dormitator latifrons
Eleotris picta

Habitat picture



Dormitator latifrons



References

Bussing WA (1998) *Peces de las Aguas Continentales de Costa Rica - Freshwater Fishes of Costa Rica*, 2nd edn. Editorial de la Universidad de Costa Rica, San José.

Tobler M, Hastings L (2011) Convergent patterns of body shape differentiation in four different clades of poeciliid fishes inhabiting sulfide springs. *Evolutionary Biology* **38**, 412-421.

Tobler M, Palacios M, Chapman LJ, Mitrofanov I, Bierbach D, Plath M, ... Mateos M (2011) Evolution in extreme environments: replicated phenotypic differentiation in livebearing fish inhabiting sulfidic springs. *Evolution* **65**, 2213-2228.