

This is an electronic appendix to the paper by Smith *et al.* 2004 Cross-Cordillera exchange mediated by the Panama Canal increased the species richness of local freshwater fish assemblages. *Proc. R. Soc. Lond. B* **271**. (DOI 10.1098/rspb.2004.2796.)

Electronic appendices are refereed with the text. However, no attempt is made to impose a uniform editorial style on the electronic appendices.

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## Electronic Appendix A.

**Table 2: The obligate freshwater and peripheral fish assemblages of the Rio Grande and Rio Chagres drainage basins, including those species that were not originally collected by Meek and Hildebrand (1916).** The species in Table 2 are organized by their salinity tolerance, and then by alphabetical order of family, genus and species names. Colonists are denoted in bold-italic text and ‘new’ refers to drainages colonized following completion of the Panama Canal. \**Cyphocharax magdalenae* was not captured by Meek and Hildebrand (1916), however, the authors captured it in the drainage basins adjacent to the Rio Grande and concluded that it was indeed part of the pre-1914 fauna of the Rio Grande. In addition, the geographic distribution of *Cyphocharax magdalenae* suggests that this species migrated through the Panama Canal. †*Brachyhypopomus occidentalis* was not captured in the Rio Grande by Meek and Hildebrand (1916), probably owing to both its rarity and the difficulties involved in collecting this fish, and consequently we have not considered this species as a cross-divide colonist. ‡Indicates species that were not recorded in Meek and Hildebrand’s (1916) survey, but whose geographic distribution (Bermingham et al. 1997) suggests that these species might represent post-Canal additions to the Rio Chagres and the Rio Grande. §Evidence suggests that although Meek and Hildebrand (1916) captured one *Hemieleotris fasciatus* in the Rio Grande, the captured individual did not represent an established population, and therefore should not be considered part of the pre-Canal community.

	Pre-1914 Rio Grande	Present-Rio Grande	Present-Rio Chagres	Pre-1914 Rio Chagres
<b>Primary and secondary freshwater fishes</b>				
<i>Astroblepus trifasciatum</i>	-	-	+	-
<b>I</b> <i>Astyanax aeneus</i>	+	+	new	-
<i>Astyanax ruberrimus</i>	+	+	+	+
<b>I</b> <i>Brycon chagrensis</i>	-	new	+	+
<i>Brycon obscurus</i> ‡	-	+	+	-
<b>I</b> <i>Brycon petrosus</i>	-	new	+	+
<i>Bryconamericus emperador</i>	+	+	+	+
<i>Compsura gorgonae</i>	+	+	+	+
<i>Gephyrocharax atricaudata</i>	+	+	+	+
<i>Hyphessobrycon panamensis</i>	-	-	+	+
<i>Pseudocheiroidon affinis</i>	-	-	+	+
<b>I</b> <i>Roebooides occidentalis</i>	+	+	new	-
<b>I</b> <i>Roebooides guatemalensis</i>	-	new	+	+
<b>I</b> <i>Cyphocharax magdalenae</i> *	+	+	new	-
<i>Hoplias microlepis</i>	+	+	+	+
<i>Piabucina panamensis</i>	+	+	+	+
<b>I</b> <i>Ancistrus chagrensis</i>	-	new	+	+
<i>Chaetostoma fischeri</i>	-	-	+	+
<i>Hypostomus panamensis</i>	+	+	+	+
<i>Leptoancistrus canensis</i>	-	-	+	-
<i>Rineloricaria uracantha</i>	-	-	+	+
<i>Imparaes panamensis</i> ‡	-	-	+	-
<i>Pimelodella chagresi</i>	+	+	+	+
<i>Rhamdia quelen</i>	+	+	+	+
<i>Brachyhyopomus occidentalis</i> †	+	+	+	+
<i>Trichomycterus striatus</i>	-	-	+	-
<i>Rivulus brunneus</i>	-	-	+	+
<i>Aequidens coeruleopunctatus</i>	+	+	+	+
<i>Archocentrus panamensis</i>	-	-	+	+
<i>Geophagus crassilabris</i>	-	-	+	+
<b>V</b> <i>ieja maculicauda</i>	-	new	+	+
<b>I</b> <i>Vieja tuyenensis</i> ‡	-	-	+	-
<i>Brachyrhaphis cascajalensis</i>	-	-	+	+
<i>Brachyrhaphis episcopi</i>	+	+	+	+
<i>Neoheterandria tridentiger</i>	+	+	+	+
<i>Poecilia gillii</i>	+	+	+	+
<i>Poeciliopsis elongata</i>	+	+	-	-
<i>Priapichthys dariensis</i>	-	+	-	-
<i>Synbranchus marmoratus</i>	-	+	+	-
<b>Peripheral fishes</b>				
<i>Dormitator latifrons</i>	+	+	-	-
<b>I</b> <i>Dormitator maculatus</i>	-	new	+	+
<i>Eleotris amblyopsis</i>	-	-	+	+
<b>I</b> <i>Eleotris picta</i>	+	+	new	-
<i>Eleotris pisonis</i>	-	-	+	+
<i>Gobiomorus dormitator</i>	-	-	+	+
<b>I</b> <i>Gobiomorus maculatus</i>	+	+	new	-
<i>Hemieleotris latifasciatus</i> §	+	-	-	-
<i>Awaous banana</i>	-	-	+	+
<i>Awaous transandeanus</i>	+	+	-	-
<b>I</b> <i>Sicydium altum</i>	-	new	+	+
<i>Sicydium salvini</i>	+	+	-	-
<i>Leptophilypnus fluviatilis</i>	-	-	+	+
<i>Agonostomus monticola</i>	-	-	+	+
<i>Joturus pichardi</i>	-	-	+	+

**Table 3: The dietary habits of the primary and secondary freshwater fish communities of the Panama Canal watershed.**

Species	Diet	Source
<i>Astroblepus trifasciatum</i>	N/A	N/A
<i>Astyanax aeneus</i> <55mm	General insectivore-both Aquatic and terrestrial	Angermeier and Karr (1983)
<i>Astyanax aeneus</i> >55mm	Omnivore	Angermeier and Karr (1983)
<i>Astyanax ruberrimus</i> <55mm	General insectivore-both Aquatic and terrestrial	Angermeier and Karr (1983)
<i>Astyanax ruberrimus</i> >55mm	Omnivore	Angermeier and Karr (1983)
<i>Brycon chagrensis</i> <80mm	General insectivore	Angermeier and Karr (1983)
<i>Brycon chagrensis</i> 80-130mm	Omnivore	Angermeier and Karr (1983)
<i>Brycon chagrensis</i> >130mm	Terrestrial herbivore	Angermeier and Karr (1983)
<i>Brycon obscurus</i> <80mm	General insectivore	Angermeier and Karr (1983)
<i>Brycon obscurus</i> 80-130mm	Omnivore	Angermeier and Karr (1983)
<i>Brycon obscurus</i> >130mm	Terrestrial herbivore	Angermeier and Karr (1983)
<i>Brycon petrosus</i> <80mm	General insectivore	Angermeier and Karr (1983)
<i>Brycon petrosus</i> 80-130mm	Omnivore	Angermeier and Karr (1983)
<i>Brycon petrosus</i> >130mm	Terrestrial herbivore	Angermeier and Karr (1983)
<i>Bryconamericus emperador</i>	Omnivore	Kramer and Bryant (1995)
<i>Compsura gorgonae</i>	Herbivore	Bussing (1998)
<i>Gephyrocharax atricaudata</i>	General insectivore-both Aquatic and terrestrial	Angermeier and Karr (1983)
<i>Hyphessobrycon panamensis</i>	General insectivore-both Aquatic and terrestrial	Angermeier and Karr (1983)
<i>Pseudocheirodon affinis</i>	Aquatic insectivore	Angermeier and Karr (1983)
<i>Roeboides occidentalis</i>	Scale eater-also Omnivorous diet	Angermeier and Karr (1983)
<i>Roeboides guatemalensis</i>	Scale eater-also Omnivorous diet	Angermeier and Karr (1983)
<i>Cyphocharax magdalenae</i>	Herbivore	Bussing (1998)
<i>Hoplias microlepis</i>	Piscivore	Angermeier and Karr (1983)
<i>Piabucina panamensis</i>	Omnivore	Angermeier and Karr (1983)
<i>Ancistrus chagrensis</i>	Algivore	Angermeier and Karr (1983)
<i>Chaetostoma fischeri</i>	Algivore	Angermeier and Karr (1983)
<i>Hyostomus panamensis</i>	Algivore	Angermeier and Karr (1983)
<i>Leptoancistrus canensis</i>	N/A	N/A
<i>Rineloricaria uracantha</i>	Algivore	Angermeier and Karr (1983)
<i>Imparaes panamensis</i>	Aquatic insectivore	Angermeier and Karr (1983)
<i>Pimelodella chagresi</i> <80mm	Aquatic insectivore	Angermeier and Karr (1983)
<i>Pimelodella chagresi</i> >80mm	Omnivore	Angermeier and Karr (1983)
<i>Rhamdia quelen</i>	Aquatic insectivore	Angermeier and Karr (1983)
<i>Brachyhypopomus occidentalis</i>	Aquatic insectivore	Angermeier and Karr (1983)
<i>Trichomycterus striatus</i>	Aquatic insectivore	Angermeier and Karr (1983)
<i>Rivulus brunneus</i>	Aquatic insectivore	Angermeier and Karr (1983)
<i>Aequidens coeruleopunctatus</i> <70mm	Aquatic insectivore	Angermeier and Karr (1983)
<i>Aequidens coeruleopunctatus</i> >70mm	Aquatic and terrestrial insectivore, terrestrial plant material, fish	Angermeier and Karr (1983)
<i>Archocentrus panamensis</i>	N/A	N/A
<i>Geophagus crassilabris</i>	Aquatic insectivore	Angermeier and Karr (1983)
<i>Vieja maculicauda</i>	Aquatic insectivore	Angermeier and Karr (1983)
<i>Vieja tuyenensis</i>	N/A	N/A
<i>Brachyrhaphis cascajalensis</i>	General insectivore-both Aquatic and terrestrial	Angermeier and Karr (1983)
<i>Brachyrhaphis episcopi</i>	General insectivore-both Aquatic and terrestrial	Angermeier and Karr (1983)
<i>Neoheterandria tridentiger</i>	Aquatic insectivore	Angermeier and Karr (1983)
<i>Poecilia gillii</i>	Algivore	Angermeier and Karr (1983)
<i>Poeciliopsis elongata</i>	Detritivore	Bussing (1998)
<i>Priapichthys dariensis</i>	General Insectivore	Bussing (1998)
<i>Synbranchus marmoratus</i>	Piscivore, frogs	Zaret and Rand (1971)

### **Cited References for Electronic Appendix A**

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