Chapter 1

Introduction

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I have six purposes in publishing this Association for Mexican Cave Studies bulletin:

1. To present unpublished maps, cave descriptions, and photos that were forgotten for many years, but which I rediscovered with the help of the AMCS and friends. Combined with published material, some of it translated from Spanish, this is valuable material to those who explore and study the Mexican caves inhabited by *Astyanax* (Figure 1.1.) I am fulfilling my sense of duty to science and to cavers by bringing all of this material together.
2. To report cave leads that could help others find additional cavefish sites and new deep caves.
3. To recount the history of cave exploration, mapping, and discovery, and honor the many cavers and scientists who worked in the fish caves of the Sierra de El Abra Region.
4. To share my thoughts about the colonization and spread of cave *Astyanax* in two regions, based on cave maps and other evidence.
5. To list tasks that remain to be done, and where.
6. To make a case for active conservation of the *Astyanax* caves and the waters that feed them.

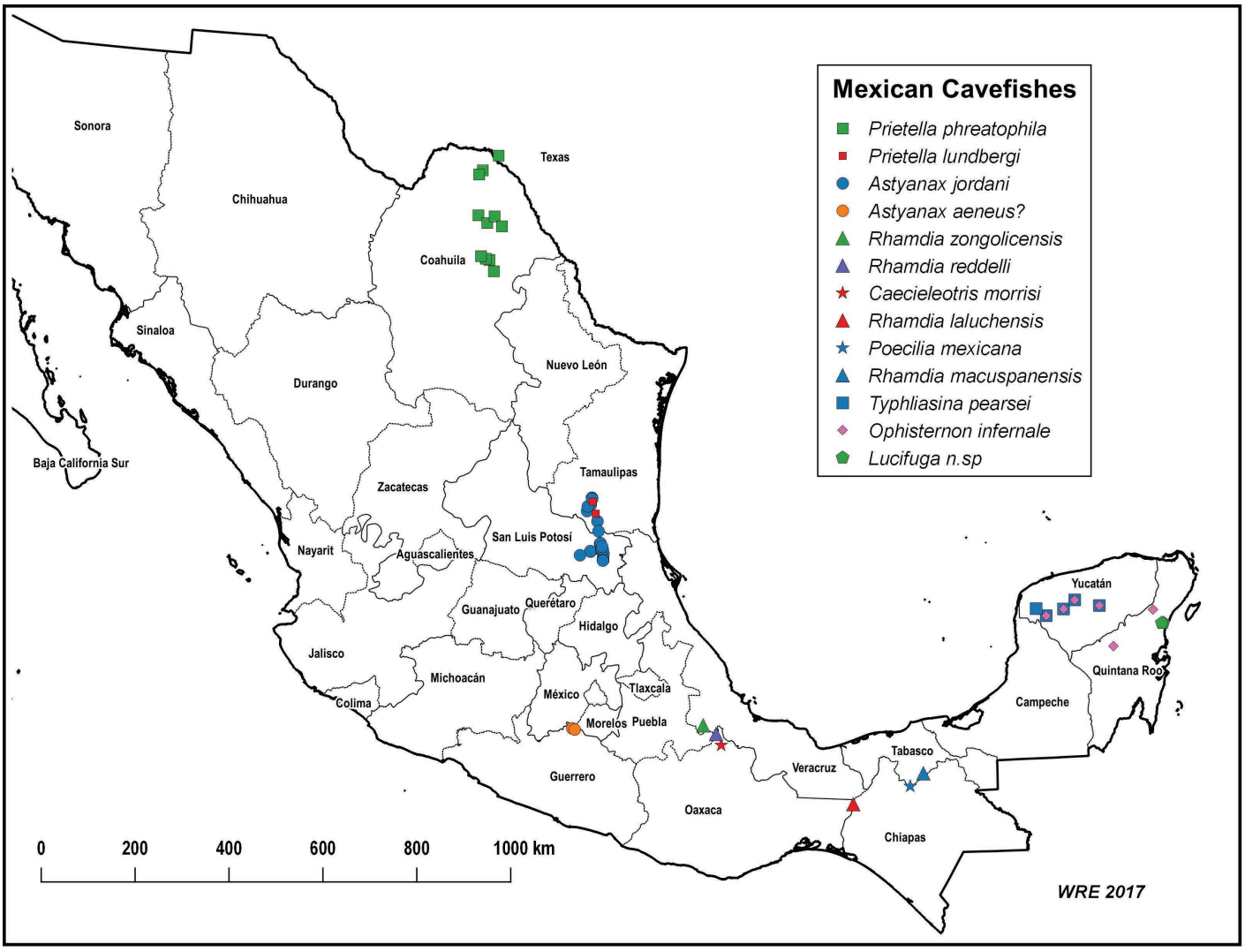
A large regional map in a map pocket, back cover, depicts the Sierra de El Abra Region, about 200 km long and 60 km wide, with lithology (rock types) overlaid on 1:250,000 INEGI topographic maps. A reduced version of the map appears in Chapter 2.

The most frequent question I get from cavers and biologists is, "Are all those blind fish caves connected?" I try to explain that in the Sierra de El Abra Region, considering the 29 known fish caves in about 10 clusters, caves within clusters may have aquatic connections to each other, but perhaps more during high water episodes after storms. They are semi-isolated today. Then I usually wave my hands and talk about the three-dimensional El Abra karst, that water moves up and down and laterally in dynamic flow paths. Yes, water can flow uphill when it is under pressure in a confined conduit, a cave. In karst the water can spill from one underground basin into another during storms, many of the caves have a distributary flow pattern, and it is all four-dimensional because timing is part of it all.

But wait! In the last year I have learned about two more fish caves, one found in 1991 and another in 2016. So now there are 31 known fish caves in the Huasteca Region of San Luis Potosí and Tamaulipas (the large region around the Sierra de El Abra), inhabited by various populations of *Astyanax.*

Details of the cavefish's biology will be revealed in Chapter 3, Biology of *Astyanax* Cavefishes, and Chapter 4, Ecology and Fauna. *Astyanax* is well-suited for surviving

Figure 1.1. *Astyanax jordani*, Cueva de El Pachón, Tamaulipas. Jean Louis Lacaille Múzquiz



and adapting to dark caves with poor food supplies compared to the surface environment. Taxonomists are revising and describing many species of *Astyanax* lately. The cave form was described in 1936 from Cueva Chica as *Anoptichthys jordani*, but the genus *Anoptichthys* was abandoned long ago, and researchers agree that the cavefish is in the genus *Astyanax*. In this volume I follow the taxonomic convention of calling all cavefishes in the Sierra de El Abra Region the species *Astyanax jordani* (see chapters 3 and 4).

Worldwide there are currently 230 species of cave and groundwater fishes in 10 orders and 19 families (Proudlove 2006 2018). Mexico is home to at least 13 known species of cavefishes in five Orders and seven Families, shown in the map of Mexico. These cavefishes have reduced or nearly absent eyes and pigment, and they have evolved from very different fishes in widely separated areas: Characidae (*Astyanax)*, Heptapteridae (*Rhamdia*), Ictaluridae (*Prietella*), Bythitidae (*Lucifuga, Typhliasina*), Eleotridae (*Caecieleotris*), Synbranchidae (*Ophisternon*), and Poeciliidae (*Poecilia*). In 2016 *Prietella phreatophila*, a small catfish, was found in a cave in SW Texas in the Amistad National Recreation Area on the Rio Grande, extending its range from many sites in the Central Plateau of northern Mexico (Hendrickson *et al.* 2018).

In the 2015 book, *Biology and Evolution of the Mexican Cavefish*, cavefishes of the El Abra region were referred to as "the Mexican cavefish" or *Astyanax mexicanus*. Those terms are commonly used by some biologists who study these fishes, but because there are so many Mexican cavefishes I refer to those in the El Abra Region as "*Astyanax* cavefishes" or *Astyanax jordani* instead of "the Mexican cavefish" or *Astyanax mexicanus.* See Chapter 3 for a discussion of taxonomy, and Appendix 1, Glossary, for scientific and Spanish terms.

Whatever the Latin name may be, the *Astyanax* cavefishes appear to be a distinct species or complex of species that have basically separated from their epigean (surface) forms. Also known as the "blind cave tetra," they can be purchased in aquarium shops, and they are easy to keep and breed. The aquarium breed came from Cueva Chica, described below, but some may have come from Cueva de El Pachón. The commercial cavefish is a hybrid between the river and cave forms, but altered by decades of human selection for the troglomorphic (caved-adapted) look and inbreeding. Al-

though they hybridize with the surface form in a few caves, in most cases the surface form does not survive well when swept into caves, and they probably do not interbreed with the cave form significantly. It appears that in most sites the cave form has speciated (has become a distinct species).

The following chapters will discuss in detail many aspects of *Astyanax* cavefishes in the Sierra de El Abra Region and Guerrero: hydrogeology, biology, ecology and fauna list, exploration and mapping, cave areas and clusters, cave descriptions, maps, tables, photos, colorful caver stories, conclusions and future work, followed by six appendices.