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Chapter 8

Freshwater Crustaceans Decadpos: An Important Resource of Guatemala

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Abstract

Guatemala is a mega diversity country because it has several ecosystems and the physiography has a high diversity. However, the local population uses this biodiversity as a natural resource of food mainly. The country had three main drainage slopes for their rivers and aquatic reservoirs with several basins (the Gulf of Mexico, the Caribbean Sea, and the Pacific Sea). In these slopes, crayfish, freshwater prawns, and crabs compose the aquatic biological resources. Several fieldtrips were performed around these slopes in order to identify the species which were used as natural aquatic resources and verify if the diversity supports the food needs of the local population. Our findings were that the country has at least four crayfish species of genus *Procambarus* spp., those living in the high and middle altitude areas. Five freshwater prawn species with abbreviated larval development of genus *Macrobrachium*, that is, *Macrobrachium cemai* were also found. The bigger species of *Macrobrachium* was also identified on the three slopes as *Macrobrachium americanum*, *Macrobrachium tenellum*, *Macrobrachium occidentale*, and *Macrobrachium digueti* on the Pacific slope, while on the Gulf of Mexico and the Caribbean Sea, *Macrobrachium carcinus*, *Macrobrachium acanthurus*, *Macrobrachium heterochirus*, *Macrobrachium olfersii*, and *Macrobrachium hobbsi* were recorded, and therefore, the nonnative species *Macrobrachium rosenbergii*; with respect to other shrimps, *Palaemon pandaliformis*, *Palaemonetes octaviae*, and atyids as *Atya scabra* and *Potimirim glabra* were found. According to the freshwater crabs, the Pseudothelphusidae family is the best to represent in comparison with Trichodactylidae where only one population was recorded. Also, we register the uses of these species around the main markets in the country and we found two main ways: the first one is for the bigger species of freshwater prawns and crabs that are offered very expensive in kilogram and are almost offered in restaurants as exclusive dishes. The second one is more for the local consumption, and many families of fishery species that include crayfishes, freshwater prawns with abbreviated larval development, and smaller crabs, and so on, are sometimes found in the markets, with the prices being cheaper and can be bought only

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by the local people. Our findings show that Guatemala has an enormous potential in the crustaceans decapods for use as natural aquatic resources as protein sources at low cost, especially for the families with low economical level.

Keywords: Guatemala, crustacean decapods, biological resources

1. Introduction

Currently, Guatemala has been included as a mega diversity country, because it represents a geographical area where convergence of a lot of different ecosystems involved a change in the physiography, climates, and biomes [1]. Especially, the climate variations in small territory have been playing an important role in the speciation process and specializations and adaptations in diverse populations of plants and animals.

Originally, Guatemala was cataloged as diversity, mainly for the data from terrestrial ecosystems, which has been studied with more emphasis [2]. The marine environment has been few studied; however, the geographical position of the country indicates that there is an important marine diversity in both coasts (Atlantic and Pacific) [2]. Recently, due the interest in the sea resources exploitation, the attention on these resources has increased. In contrast, the aquatic epicontinental resources have scarcity attention as study subject and natural resources, and their potential social and economic benefits are limited. The richness and importance of these small sources of life, important to the subsistence of human populations closers has not evaluated before 2000 year, due to this, it was not possible to give their real value when it has been planning strategies to management and conserve these resources.

In Guatemala, the natural epicontinental aquatic resources begin to acquire an important role in the priorities in the country, mainly due the latent threat of climate change and desertification [3]. The freshwater springs now are considered in the planning and land preservation strategies. As an example of this, Atitlán lake (located in the Sololá Department) worry internationally, due the massive cyanobacteria bloom, due the waste water from human closer to the basin [4]; this case induces that the scientific research activity on freshwater resources increase to get data from springs and streams as bigger basins as source to know the diversity and establish management plans and uses on this natural resources (fisheries, transport, and water sources to human use).

Due to this interest, the biological resource increases in importance, and one group that has been well represented in these environments are the crustaceans, mainly freshwater shrimps, crayfishes, and crabs, together several species of fishes and mollusk are dominant in these habitats [2].

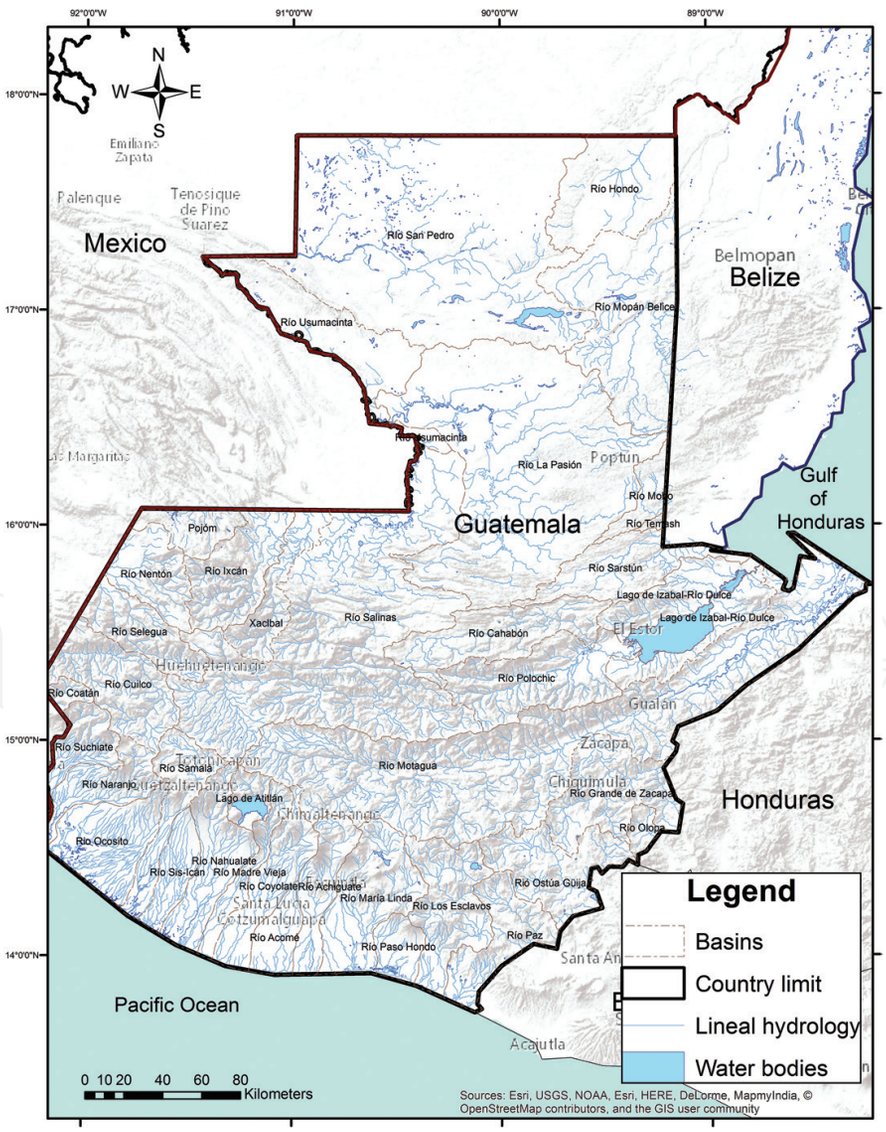
In Guatemala, these resources have been exploited economically [5]. However, their importance in production is so low that there are not records and hard data. Several human communities used directly or indirectly the river resources from springs through the coastal connection. As happened with freshwater crabs from family Pseudothelphusidae that is possibly found in the majority of rivers or springs of country on east slope, even the Maya communities from highlands have a fishery and are used for self-consumption [6]. On another slope (Ocean Pacific), *Macrobrachium tenellum* and *Atya margaritacea* have important fisheries and commercialization among the coastal towns on the Pacific especially on south of country mainly in the estuaries of rivers María Linda and Los Esclavos [7]. The aim of this chapter is the potential

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in the freshwater aquatic natural resources in Guatemala, especially on those native species, and the analysis of native human populations that use these biological resources as protein sources.

2. Study area

Guatemala as country, has a great biological diversity on the subject of aquatic continental systems. Firstly, as the country is divided into three main slopes, two with drainage on Atlantic Ocean (Gulf of Mexico and Caribbean Sea), both very well defined by bigger basins that occupied all center to north of country [8]. The main river to drainage on Gulf of Mexico is the Usumacinta conformed by important rivers as La Pasión, Chixoy, Salinas e Icbolar, all these rivers with origins on highlands flow through lower lands, which permit to have different physical and chemical water conditions, and producing several habitats that bearing an important biological diversity [9].


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W
E
S
Emiliano Zapata
Palenque
Tenosique de Pino Suarez
Mexico
Río Hondo
Río San Pedro
Belmopan
Belize
Río Mopán Belice
Río Usumacinta
Río La Pasión
Poptun
Río Motagua
Río Polochic
Río Sarstún
Río Cahabón
Río Salinas
Río Ixcán
Río Nentón
Río Selegua
Río Cuilco
Río Coatán
Río Suchiate
Río Samalá
Río Naranjo
Río Ocosito
Río Nahualate
Río Sis-Icán
Río Madre Vieja
Río Coyolate
Río Achiguate
Río María Linda
Río Los Esclavos
Río Acomé
Río Paso Hondo
Río Ostúa Güija
Río Paz
Río Grande de Zacapa
Río Olopa
Río Motagua
Río Mopán
Río Macal
Río Belice
Río Sibun
Río Hondo
Río Sarstún
Río Dulce
Río Polochic
Río Cahabón
Río La Pasión
Río Salinas
Río Usumacinta
Río Chixoy
Río Icbolar
Río Ixcán
Río Xalbal

On the Caribbean slope, Guatemala has other rivers with conditions completely different as Dulce, Motagua, and Sarstún Rivers, that with another they end on this slope. River Dulce is the main effluent of important aquifers on Sierra de las Minas and Cerro San Gil, as well as highlands from Alta Verapaz, all these rivers produce the Río Polochic that end on Izabal Lake with connection with the sea in the Amatique Bay [8].

The Motagua River is the longest of the country. However, due to their origin (closed to Guatemala City) and magnitude, induces an excessive carry of solid wastes mainly plastics and nondegradable material that reach the Caribbean Sea and produce marine pollution [10].

Finally on the Pacific Slope, some main rivers are María Linda, Los Esclavos, La Paz, Achiguate, Coyolate, and Naranjo are located and drainage on the Departments of Escuintla, Rethauleu, Santa Rosa, Jutiapa, Sichitepéquez, San Marcos Quetzaltenango y Sololá [7] (**Figure 1**).

3. Materials and methods

Two structured sampling trips were made on the Atlantic Slopes (Gulf of Mexico and Caribbean), and in Pacific Slope, different trips were made (**Figure 2**). In these trips, the crustaceans were collected using nets and hand. At that time, the GPS and physical and chemical water data were recorded using a GPS Garmin and YSI Oxygen Dissolved recording. In each place, the animals were preserved in ethanol to posterior lab identification. Also, in each

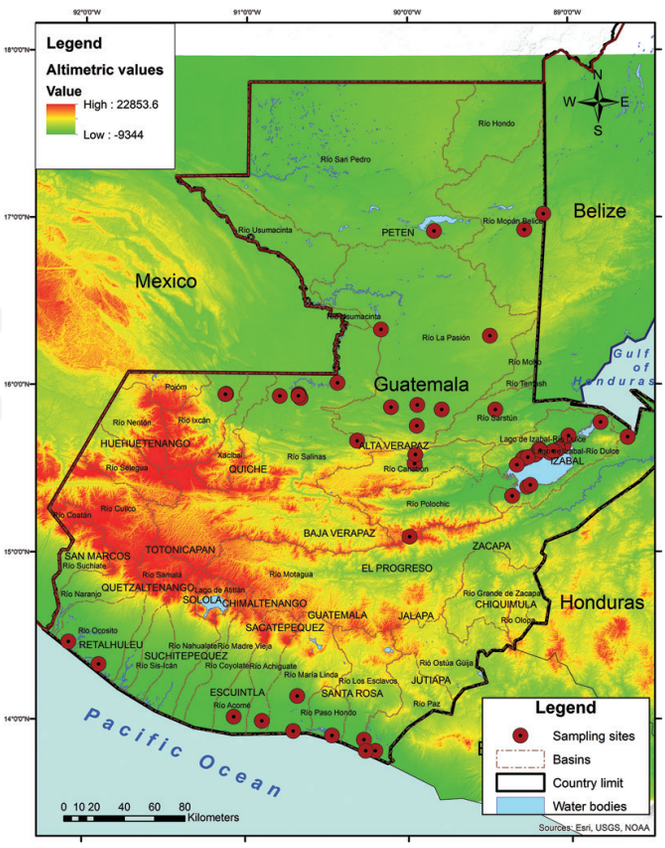


Figure 2. Location of sampling sites around the three main slopes Gulf of Mexico, Caribbean Sea and Pacific Ocean.

place, the use and the value that local community has on these animals were recorded. In several markets around the country, make a survey to identify the different crustaceans species that are to sale and know if the local or exotic species have special preferences or major value.

4. Results

Guatemala has three main basins and several economical decapod species associated to these. The first basin analyzed was Caribbean where it was possible to find the following species *Macrobrachium carcinus* (**Figure 3A**), *Macrobrachium acanthurus* (**Figure 3B**), *Macrobrachium olfersii*, *Macrobrachium hobbsi*, *Macrobrachium heterochirus*, and one introduced species *Macrobrachium rosenbergii*; In general, all these species have a good acceptation in the market and in some cases their acceptation had reached high levels, for example *Macrobrachium carcinus* ("La pigua" in Spanish) in the Departments of Quiche, Alta Verapaz, Izabal, and Petén, the populations recently shown an important decrease in the fisheries, due to the over exploitation, pollution of rivers and reservoirs, and therefore, the barriers as dams in rivers that limited their migrations. In contrast, the exotic species *M. rosenbergii* is more frequently in the market and fisheries at least in the harbor fishery of Río Dulce, just now is evaluated if this last species have an impact on native species in several rivers of region. Also, in this region, there are several populations that have an abbreviated larval development and recently was described *Macrobrachium cemai* (**Figure 3C**), that is, used as food by the autochthonous community of Qek'chi in Cerro San Gil, Puerto Barrios, and Izabal. Therefore, there are another small decapods that lack economical value as *Palaemon pandaliformis*, *Palaemonetes octaviae*, and some atyids as *Atya scabra* and *Potimirim glabra* (**Figure 3D**).

In this basin, the crayfish species of *Procambarus* spp. (**Figure 3E**) was recorder and in some rivers there are freshwater crabs of family Trichodactylidae (**Figure 3F**) and Pseudothelphusidae (**Figure 3G**) and the local populations especially the indigenous communities as Qek' chi used by self-consumption and these species are hard to be found in the markets and fisheries, but the families use the children to search these species and by this way, they contribute with food to family.

The second basin is the Gulf of Mexico, the rivers and aquatic reservoirs drainage on the Usumacinta River and the main species are *Macrobrachium carcinus*, *Macrobrachium acanthurus,* and *Macrobrachium heterochirus,* but in this case due to few important markets to sale these products in general are to self-consumption. On this basin, we have recorded two populations with abbreviated larval development but in general few people know their existence and only indigenous populations used this biological resources together crayfish (*Procambarus* spp.) and freshwater crabs of family of Pseudothelphusidae.

In contrast on the Pacific slope in Guatemala, the biological aquatic resources are more diverse in small areas because the mountain chain is a barrier to limit their distribution. But in this area, the species of freshwater prawns are *Macrobrachium tenellum*, *Macrobrachium americanum*, *Macrobrachium occidentale*, and *Macrobrachium digueti,* all these with high commercial value and are easy found in the markets or the people just sale in their houses. The water pollution on rivers or dams are sometimes especially those sites close to cities where few control of waste water exists, the data of oxygen registered was lower in these sites, and the animals were absent, in contrast with those sites so far from human effects. The *Macrobrachium* species are a good indicator of the water quality because there are species as *M. heterochirus* where the oxygen requirements are higher in comparison with another species.



Figure 3. Freshwater decapods species in Guatemala. (A) *Macrobrachium carcinus*; (B) *Macrobrachium acanthurus*; (C) *Macrobrachium cemai*; (D) *Potimirim glabra*; (E) *Procambarus* spp.; (F) *Trichodactylidae*; (G) *Pseudothelphusidae*; (H) *Macrobrachium rosenbergii*.

5. Discussion

The aquatic biological resources in Guatemala are best represented with freshwater decapods species, but the economical values of these resources are lower in comparison with freshwater fishes and only few species have an important acceptance in their consumption of local population. The species of *Macrobrachium* that are the largest freshwater decapod have a big distribution on the three basins because the majority of sampling sites in this study were recorded (**Table 1**).

Site	Locality	Department	GPS X	GPS Y	Altitude	Taxa	Population richenss
Caribbean and Gulf of Mexico Slope							
Escobas Cerro San Gil	Las Escobas	Puerto Barrios	−88.6456667	15.6851667	116	*Macrobrachium cemai*	High >200
						Potimrim sp.	Medium >50
						Raddus sp	Low >10 org
El Boqueron	El Estor	Izabal	−89.2844722	15.5660278	9	*Trichodactylidae*	Low >10
						Pseudothelphusidae	Low >10
Río Zarco	El Estor	Izabal	−89.2951111	15.5571944	20	*Macrobrachium sp.*	High >200
Puente Pedernales	El Estor	Izabal	−89.0426944	15.6364722	9		
Puente la Máquina	El Estor	Izabal	−89.0753333	15.6157222	26		
Sumache	El Estor	Izabal	−89.0941667	15.6056389	19		
Puente Manaco	El Estor	Izabal	−89.1230278	15.5952778	16		
Balneario caliente	El Estor	Izabal	−89.2085556	15.5908611	35		
Afluente remanso	Sumache	Izabal	−89.1074444	15.6054444	65	*Procambarus sp.*	High >100
Aldea Manantiales, Esmeralda del Paraiso	Agua caliente	Izabal	−89.2206111	15.5833056	55		
Rio Zarquito	Río Oscuro	Izabal	−89.3595278	15.3377222	5	*Palaemon pandaliformis*	High >200
Rio Chapin	Chapin abajo	Izabal	−89.2665278	15.3924444	9		
Río Balandra	Quinel/Estor	Izabal	−89.2481944	15.4031111	14		
Puente Prieto	Sa Rosita/El Estor	Izabal	−89.2623889	15.5692222	13	*Pseudothelhusidae*	Low <50
El lago	El Estor	Izabal	−89.3294722	15.5239722	12	*Palemonetes octaviae*	High >200
Arroyo colorado	El Bongo/El Estor	Izabal	−89.1920833	15.6183333	212	*Procambarus sp.*	Medium >50
Río Bouro	El Bongo/el Estor	Izabal	−89.1861667	15.6092222	159	*Procambarus sp.*	Medium >50
Río Branche	Esmeralda	Livingston	−89.0110278	15.6929722	17	*Palaemon pandaliformis*	High
La Palmera	Esmeralda	Livignston	−89.0103056	15.6942500	29	*Procambarus sp.*	High >200

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Site	Locality	Department	GPS X	GPS Y	Altitude	Taxa	Population richenss
Cenote de Sarstum	Sarstum	Livingston	−89.9428056	15.8822500	15		
Siete Altares	Livingston	Livingston	−89.7918889	15.8542778	83	*Macrobrachium heterochirus*	Low <10
						Macrobrachium carcinus	Medium >50
						Macrobrachium ofersii	Medium >50
						Potimirim sp.	High >200
Cueva del tigre	Barra Lampara	Livingston	−88.8125278	15.7747500	74	*Pseudothephusidae*	Low <10
Las Conchas	Chasac	Alta Verapaz	−89.4616944	15.8533056	144	*Macrobrachium sp.*	High <100
Río Lachua	Santa Lucia, Reserva Lachua	Alta Verapaz	−90.6639722	15.9245833	171	*Pseudothelphusidae*	High>100
Puente la machaca	Santa Lucia, Reserva Lachua	Alta Verapaz	−90.6750833	15.9486389	195		
Arroyo El Caoba	Santa Lucia, Reserva Lachua	Alta Verapaz	−90.6758333	15.9406944	175	*Macrobrachium sp.*	Low <20
Arroyo las ranas	Santa Lucia, Reserva Lachua	Alta Verapaz	−90.6761944	15.9376389	180	*Procambarus sp.*	High >100
Hunal-Ye	Chisec	Coban	−90.3143333	15.6699722	403	*Macrobrachium sp.*	High>200
						Pseudothelphusidae	Medium>30
Semuc- Champey	Larkin	Alta Verapaz	−89.9595833	15.5336667	353	*Macrobrachium sp.*	High >200
Cueva las Marias	Semuc-Champey	Alta Verapaz	−89.9555556	15.5875000	357	*Macrobrachium sp.*	Medium>50
Las Mesas	Rio Hondo Zacapa		−89.5932000	15.0545000		*Macrobrachium heterochirus*	Low <10
Pacific Slope							
Las Pozas	Buena Vista	Santa Rosa	−90.16264″	13.52519	14	*Macrobrachium americanum*	Medium >50
Manchon Guamuchal	Manchon Guamuchal	Rethauleu	−92.05112	14.27499	17	*Macrobrachium occidentale*	Medium >50

Site	Locality	Department	GPS X	GPS Y	Altitude	Taxa	Population richenss
La verde	Champerico	Rethauleu	−91.5408	14.195107	13	*Macrobrachium tenellum*	High >200
Málaga	Málaga	Escuintla	−91.0416.5	14.01048	19		
Otacingo	Otacingo	Escuintla	−90.53562	13.59368	24	*Macrobrachium digueti*	Low >10
Brito	Brito	Escuintla	−90.40555	14.08333	44		
El Paraíso	Santa Rosa	Santa Rosa	−90.12144	13.485168	5	*Macrobrachium tenellum*	High >200
Las Lisas	Las Lisas	Santa Rosa	−90.15489	13.48516	6	*Macrobrachium tenellum*	High >200
Iztapa	Iztapa	Escuintla	−90.42251	13.55576	7	*Macrobrachium tenellum*	High >200
						Macrobrachium americanum	Medum >50
La Avellana	Monterrico	Santa Rosa	−90.28119	13.54231	6		
Peten Zone							
La campana	La campana	Peten	−91.07213	15.56554	231		
Trinitaria	Trinitaria	Peten	−90.47287	15.56126	168	*Macrobrachium sp.*	Medium>50
Tres Rios	Tres Rios	Peten	−90.26084	16.00559	138		
Las Pozas	Las Pozas	Peten	−90.09585	16.20044	168	*Pseudothephusidae*	Low >10
Flores	Flores	Peten	−89.50106	16.55238	131	*Macobrachium sp.*	Medium >50
Melchor de Mencos	Melchor de Mencos	Peten	−89.09262	17.012404	106	*Macrobrachium sp.*	Medium >50
Salpet	Salpet	Peten	−89.16325	16.55458	146		
Poptun	Poptun	Peten	−89.293103	16.17421	420	*Procambarus sp.*	High >100
Chabilchoch	Chabilchoch	Peten	−89.56472	15.45272	190		
San Antonio Las Cuevas	San Antonio Las Cuevas	Peten	−90.061916	15.52079	244	*Macrobrachium sp.*	Medium >50
La Campana	La Campana	Peten	−91.07391	15.564503	244	*Procambarus sp.*	High >100

Table 1. Relation of sites explored, GPS, species, and population richness data.

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But only two or three species are possibly found in the market in different places around the country. In the Pacific slope, the acceptance of these resources are major, but it is due to the cultural aspects on the indigenous people. In the Gulf of Mexico and Caribbean Sea slopes, the Qek' chi people use these resources for self-consumption and only in the local markets, sometimes by seasons, this aquatic resource is possibly found. Also, there are another species smaller or with less economical value as crayfishes and freshwater prawns, that in general the people that fishing their animals are children as part of their contribution to food in the family. These problems on the acceptance and sale of resource is only in some areas because for special species (largest), the over exploitation of *Macrobrachium carcinus* in the recent years has produced an important decrease in the fishery on this species as was reported in another countries [11].

Therefore, less important problem is the increase in the pollution on rivers due the chemical products used in the sugar and palm farmers and their respective industries reported not only in Guatemala because it is a normal practice in Central America and Mexico.

In general, the commercial species have migrating behaviors, the constructions of dams, and the water use to agricultural activities also decreased the native populations producing that exotic species occupied the niches empty [12].

However, just now Guatemala has an important opportunity to make plans to development according the basin and their resources. To protect those species over exploited and increase their potential of those species that only are using by indigenous people could be establish farmers because there are the technologies to producing by tons, and could be one mechanism to conserve the biological diversity and have management plans on aquatic biological resources.

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