

INTERNATIONAL TROPICAL CONSERVATION FOUNDATION

Summary report on the

FRESHWATER FISHES and AQUATIC ECOSYSTEMS

observed in Belize

with special reference to

SHIPSTERN NATURE RESERVE

and

WHITEWATER LAGOON

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by

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## INTRODUCTION

For the last 4 years I have been spending one month each year traveling in Middle America with my friend Jean-Claude NOURISSAT and his wife Nicole (Mexico 1987, Guatemala 1988, 89, 90, Belize 1990). The main purpose of these trips was to observe and collect freshwater fishes of the region, especially Cichlids, called "Tuba" in Belize and "Mojarra(s)" by most Spanish speaking people of Middle America. This in order to increase our knowledge on the geographical distribution of the various species, on their ecology and behavior and to bring back breeding stock for further propagation and study in Europe. J.-CL. Nourissat, a dentist by profession living in Southern France near Toulon, has become a leading and internationally known expert in the care and breeding of neotropical Cichlids (family Cichlidae), which because of their colors, shapes and interesting breeding behavior, count amongst the most popular aquarium fishes. Previously to 1987 J.-Cl. Nourissat had already traveled extensively in South America and Mexico and he maintains large breeding facilities in France. As a result of his efforts, which are pursued on a totally non commercial and no profit basis, a number of species new to science have been discovered and many more have been introduced for the first time to Europe, reproduced in aquaria and made available to the aquarium hobby and science.

As for myself I am a biologist by training and an environmentalist by profession and secondarily have developed over the years a growing interest for the ecology and distribution of freshwater tropical fishes I have been fortunate enough to study and collect in various parts of Africa, tropical America and Southeast Asia.

In Middle America, Cichlids are our main priority, however I try to give also some attention to the other species of fishes, especially to the Live-bearers, family Poeciliidae, since these fishes and the Cichlidae are by far the most diversified families of freshwater fishes in this part of the world.

Although after having surveyed neighboring Southern Mexico and Guatemala it was very unlikely that we would find new species of Cichlids in Belize, we were keen to visit this country to close a gap in our knowledge on the geographical distribution of some species. We also hoped to encounter colorful populations and morphs of known species, we had some reasons to believe existed in this small and somewhat hydrologically isolated region of Middle America.

Some time before leaving for Guatemala and Belize, upon knowing my interest for the natural history of the region, I had been appointed member of the Scientific Advisory Council of the International Tropical Conservation Foundation (ITCF), which manages the Shipstern Nature Reserve in Corozal District, North Belize. This gave me an additional reason to visit Belize and

the subsequent success of our trip was in great part due to the logistic support provided by ITCF and to the collaboration of Caspar Bijleveld a Dutch-Swiss biology student who guided us during our whole stay in the country. Caspar Bijleveld is the son of Dr. Marteen Bijleveld, Director of ITCF and he is presently undertaking ecological and ichthyological studies in Shipstern Nature Reserve.

### SHIPSTERN NATURE RESERVE AND SURROUNDINGS

Upon arriving at Belize Airport (24.4.90) we were driven directly north to the Shipstern Reserve Headquarters where we spent our first night in the country.

The following morning after having briefly visited the facilities in which colorful local butterflies are bred on a self sustaining basis, we started our tour of the wet places which abound in and around the Reserve.

The Shipstern area around Sarteneja is extremely low lying, the altitude nowhere exceeding a few feet above sea level. It is bordered on the North by the Bay of Chetumal, an extension of the Caribbean Sea and includes a large part of Shipstern Lagoon which is also linked to the sea. The underlying rock is limestone and the soil is in most place very shallow. As a result most of the forest is of moderate height or scrubby with a lot of palmettos and often gives way close to the sea and lagoon to a salty type of periodically flooded savanna. The landscape is reminiscent of some parts of Southern Florida. There are no streams as such but many depressed areas are occupied by swamps and shallow ponds with extensive stands of mangrove, the water being very salty at most places.

Under these circumstances I did not expect to find many "freshwater " species of fishes, but rather brackish or even marine species. However it turned out that the most abundant fishes to be found at Shipstern were Live-bearers and Cichlids, two families which are usually considered to be freshwater fishes, even though we know that many of their species can adapt well to saltwater. In the unique small natural freshwater pond found in the area, with a surface area of only a few square meters (dry season) and situated close to the Reserve's headquarters (Orchid Trail pond) , live even two "primary" freshwater fishes, the Characid *Astyannax fasciatus mexicanus*, which is abundant, and the unobtrusive Pimelodid Catfish *Rhamdia cf. motaguensis* (two specimens collected previously by C Bijleveld). How these species could have reached this completely isolated pond, which to our knowledge is separated by many tens of miles of dry land and saline lagoon from the closest freshwater, remains a mystery. The pond is apparently fed by underground water and the fishes might have travelled through the aquifer or more likely are relics of a past wetter climate, when surface freshwater was much more prevalent in the area.

One of the most ubiquitous fishes in Shipstern is the Cichlid Parapetenia (*Cichlasoma*) urophthalmus which is found in every swamp

and pond with some free water, water which as already said is usually highly saline, at least during the dry season.

Belonging to the same family we also found *Parapetenia salvini*, *Thorichthys meeki*, "*Cichlasoma*" *synspilum* and *Petenia splendida* (all these Cichlids but *Petenia splendida* used to be classified in the catch all genus *Cichlasoma* but are in the process of being attributed to new genera which are given here when known with some certainty). We could observe these cichlids underwater by snorkeling in the clear water of the "Cenote" a small circular sinkhole lake, fringed by large mangrove trees (*Rhizophora mangle*).

Here a long standing mystery, at least for us, was finally solved when through or diving masks we saw some some beautifully colored "*Cichlasoma*". *synspilum*. These fishes were similar to the spectacular aquarium strain maintained in Europe since many years, but which precise origin had remained unknown up to now. "C". *synspilum* abounds in all the waters of the Atlantic slope lowlands of Southern Mexico and Guatemala where we had the opportunity to observe this species many hundred of times, but nowhere had we seen before this color form in a natural habitat. Close to the bank of the cenote at a depth of about 6 feet, large breeding pairs had dug deep cavities in the soft bottom between the mangrove roots and were caring for their fry and chasing away the intruders.

In this deep lake, albeit probably not as deep as locally believed, non Cichlid fishes appear to be few, whereas in the the many shallow ponds and mangrove swamps the smaller Poecilids dominate. These belong mainly, if not all, to three genera, *Gambusia*, *Poecilia* and *Belonesox*.

Most Shipstern *Gambusias* are probably *G. puncticulata yucatanana* (*G. yucatanana*). This species is somewhat stockier than the other species of the genus such as *G. sexradiata* which is common inland and seems to avoid brackish waters. Both species have nicely spotted dorsal and caudal fins.

It is always difficult to give a correct scientific name to the various species of *Poecilia*, belonging to the subgenus *Mollienesia*, commonly called Mollies and found everywhere in Middle America. The systematics of this subgenus seem to be in great need of a revision, a matter which is further complicated by the large variability in color that can be observed between different populations or even within one population. The latter case occurs in the already mentioned small freshwater pond (Orchid Trail pond) which besides a Characid, Catfish and Cichlid and *Gambusia*, hosts also a population of a small Molly. Most males were brightly colored in vivid hues of yellow, green and blue, but a few individuals which did not appear to be overly dominant sported bright orange-red fins. Basing myself on available photographs, I have tentatively attributed this population and the other Mollies found in Shipstern to the species *Poecilia sphenops*, but this will need to be confirmed and perhaps more than one species of *Poecilia* live in the area.

*Belonesox belizanus*, the Pike live-bearer lives in the same habitats as the Gambusias and Mollies which are quite likely its main fare. This species appears to be common in Shipstern and among the various specimens we caught, a few large females reached a length of nearly 20 cm.

I was happy to collect and see, for the first time in my life, *Garmanella pulchra*. This short bodied Tooth-carp or Killifish (Cyprinodontidae) looks somewhat like its cousin, the Florida Flagfish, *Jordanella florida*, with which it has sometimes been confused. The large dorsal fin is kept erect and in the breeding season, which had not yet begun, the dominant males become suffused with orange, hence the popular name Orange Flagfish. In Shipstern *G. pulchra* is usually found living together with the Gambusias and Mollies, but appears to be more dependant on saltwater than the latter species. It is very common in some places.

Recently the related *Cyprinodon* cf. *variegatus* has been collected by Caspar Bijleveld in Shipstern, but was not seen during our short stay. This is a new record for this species in Belize.

At the end of a trail which terminated in a periodically flooded "savanna", some heavy vehicle had left deep tracks in the soft ground, which remained full of water. A lucky strike of my hand net brought forth a rather robust *Rivulus* species which at first glance seemed different from *R. tenuis*, the only species of this killifish genus I had found up to now in the region. A few more smaller specimens of the same fish were found in a small indentation of the beach of the Shipstern lagoon where they were hiding in very shallow water under a stranded canoe end among dead leaves. Upon closer examination these *Rivulus* were identified as *R. marmoratus*. This fish is famous for being at most time a full hermaphrodite, that is one single individual can produce self fertilized eggs, functional female and male sexual organs being present at the same time in the same fish. These hermaphrodite individuals are typically female in outlook (phenotype) and bear a very distinct and round "female *Rivulus* spot" in the upper part of the caudal base. Primary males are known to develop from time to time under certain circumstances (cool water) and will then breed normally with the female type individuals. No males were found in Shipstern.

Hermaphroditism in *R. marmoratus* is usually presented as an eco-physiological adaptation allowing the species to live and perpetuate itself in small temporary pools which are too small to host more than one adult fish at a time. Like with many other species of Killy-fish the hard-shelled eggs are able to survive in the sediment for a long period if the habitat subsequently dries out. However as seen in Shipstern Lagoon, *R. marmoratus* can also live in small aggregations in open habitats and I believe that hermaphroditism may be also linked to another aspect of the reproduction strategy of this species and explains its ability to extend and maintain its distribution along the Caribbean and tropical West Atlantic shore, where it inhabits often unstable and changing habitats. *R. marmoratus* is able to live in full strength

seawater and probably even in hypersaline water (that is more saline than seawater). Although obviously not an open water fish, a few individuals can probably be dispersed across the sea on special occasions, for instance during a hurricane, and if it happens that one individual reaches a favorable and vacant habitat, such as a mangrove swamp, shallow lagoon or even a mere puddle, it can alone as an hermaphrodite establish a new population. Therefore hermaphroditism gives to *R. marmoratus* much better chances to spread from one island to another and along the coast, whereas another species would need the very improbable simultaneous arrival of at least a couple to be able to colonize a new habitat. *R. marmoratus marmoratus*, the nominal subspecies is known from coastal localities in Southern Florida, Cuba, Haiti, Yucatan and now in Belize. The subspecies *R.m. bonairensis* lives of the coast of Venezuela in the Dutch West-Indies, Aruba, Curacao and Bonaire and very closely related species with the same biology, possibly only subspecies, are known to occur along the coast of South America. *R. marmoratus* is most probably restricted to coastal and brackish waters. In Belize and neighboring countries the inland waters are occupied by another species: *R. tenuis*.

One specimen of Mud eel, *Synbranchus marmoratus*, another champion of ecological adaptability, was caught in a mangrove swamp in strongly brackish water. This finding shows that this species is capable of living in most types of aquatic habitats and in any kind of water, all over tropical Middle and South America.

#### **SOUTHERN RIVERS**

One of our main purposes in visiting Belize was to get to know the southern rivers flowing down the Maya Mountains to the Gulf of Honduras. Apart from the faint chances of finding something new in those little explored rivers, we wished to see where the species of- Cichlids characteristic of the Rio Polochic - Lake of Izabal - Amatique Bay region of Guatemala to the South met or were replaced by the more northerly species which ranges often extend from Belize to at least the Rio Usumacinta watershed in Northern Guatemala and neighboring Mexico. We also hoped to find a few rare species such as *Herichthys bocourti* we had already collected in Guatemala, but always in very limited numbers

The time we could spend exploring the southern rivers was really much too short to fulfill the above objectives. When we reached San Antonio, near Punta Gorda, our vehicle gave signs of breaking down and we judged more prudent to retreat. We were also keen to have some time left in the country to visit a difficult to reach lagoon in Central Belize, which, we had been told on our way down from Shipstern, should be highly interesting. However we did give a quick look to the main rivers crossed by the southern highway and also to a few minor creeks.

Going south the appearance of new southern cichlid species seems to be progressive as is the disappearance of some northern forms. The Sibun River is still a northern river, with all the

main northern species, such as "*Cichlasoma*" *synspilum*, *Thorichthys meeki* and *Chuco* (*Cichlasoma*) *intermedium*, being still present. The first southern species are to be seen in the fish poor Stan Creek and further south in the Rio Grande (surveyed at Great Falls), southern species, such as *Vieja* (*Cichlasoma*) *maculicauda*, *Thorichthys aureus* and *Chuco godmani*, have taken over and replaced their northern counterparts. It therefore seems that the range of the Maya Mountains that reaches the coast north of Dangringa forms the limit between the two cichlid faunas. However it should be pointed out that some species such as *Amphilophus* (*Cichlasoma*) *robertsoni* and *Parapetenia salvini* have extensive ranges on both sides of this divide and that *Archocentrus* (*Cichlasoma*) *spilurus*, the Blue-eye cichlid, which according to its main geographical range is to be considered as a southern element, has penetrated North up to at least the New River drainage (but curiously has not found its way further North and West to the Peten region of Guatemala). One also wonders what can stop such seemingly successful species as *V. maculicauda* and "*C.*" *synspilum* from moving respectively North and South along the coast, especially since we have observed that these species can live and even breed in seawater. We unfortunately had no time to explore the very lower reaches of the rivers and the coastal lagoons, this accounts probably for not having been able to find such species as the Cichlid *Herichthys bocourti* and the Poeciliid *Carlhubbsia stuarti*, two species which are present south in the Bay of Amatique region of Guatemala. The previous year we had observed *H. bocourti* in the Rio Sarstun (Sarstoon River) near Modesto Mendez, Guatemala, very close to the border with Belize. Since a little further down river the watercourse actually marks the border between the two countries, the presence of this species on the left Belize bank can be considered as certain. Recently it appears to have been also recorded from the Moho River in Southern Belize.

We did not observe either any of the rheophilic Cichlids of the genus *Theraps* (*T. irregularis*, *T. belone*), found in fast flowing streams on the other side of the border. This is surprising since some habitats such as the Big Fall Rapids on the Rio Grande would have seemed adequate and that we also saw a few of these fishes in the Rio Sarstun near Modesto Mendez where they lived in a small fast flowing habitat created by the submerged remains of an old wooden bridge.

Generally speaking we found the southern rivers to be comparatively poor in fishes, both in species diversity and in quantity. This is probably related to the shortness of the river courses and to the low biological productivity of the water resulting from the limited amounts of mineral nutrients leached from the crystalline rock formations of the central Maya Mountains where these rivers are born.

### **SMALL STREAMS, RIVERS AND LAGOONS OF THE PLAINS North of Dangringa**

A large part of Belize consists of a sedimentary coastal plain and our party coming from rugged and rocky Guatemala was surprised by the flat landscape and stands of Caribbean pines (*Pinus caribbea*) often growing on a poor white sand soil. In the northern half of the country these lowlands are studded by depressions often aligned in a broadly south - north direction, which obviously must reflect faults of the underlying bedrock. These depressions are occupied by many rivers, creeks, shallow lagoons or swamps, among which only a very few were sampled by our party.

Coming back from Shipstern Reserve on our way to Orange Walk, the first creek we crossed was Freshwater Creek. The water was indeed fresh but also clear and tea colored, which indicates that it flows from swampy areas. The cichlids belonged to the same species seen in Shipstern, plus "*Cichlasoma*" *octofasciatum*, a fish we were going to find many times again, especially in the smaller creeks. The Characid *Astyanax fasciatus* was as usual, when it occurs, the most abundant species.

After Orange Walk we had a short look at the New River, the rather cloudy water and dirty bottom of which were not very appealing. However it was interesting to find in this river our first *Archocentrus spilurus* in Belize. As said previously the main range of this species, Caribbean Nicaragua and Honduras, Rio Motagua and Rio Polochic drainages, Guatemala, points to a southeastern origin. It is the only "southern" species of Cichlid to penetrate as far north in Belize.

Then we proceeded to Crooked Tree Lagoon and Nature Reserve. The extremely muddy bottom rendered the use of the nets practically impossible and the cloudy water did not allow any visual inspection. The few fishes we could catch had dull colors as is common in such silty water. However the aquatic flora was interesting and we could observe, unfortunately at a great distance, a good colony of pink spoonbills.

On our way to the Belize River, along the Western Highway, we stopped at a small creek in which about two weeks before Caspar Bijleveld had observed some Swordtails, *Xiphophorus helleri*. Since then the creek had nearly dried out and conveniently close to the road, water remained only in two small pools. However the *Xiphophorus helleri* were still there and with them came their swordless cousin *X. maculatus*, the spotted Platy or Moonfish. The sympatry of these two species belonging to the same genus in this small habitat shows that they are genetically completely separated. The male Platies are quite pretty with a patch of iridescent blue scales under the dorsal fin, the latter being partially red in some individuals. Otherwise I can remember finding three more Poeciliids, *Heterandria* cf. *bimaculata*, *Poecilia* sp. (Molly) and *Belonesox belizanus*, plus the Tooth-carp *Rivulus tenuis* and the Cichlid "*Cichlasoma*" *octofasciatum*. This fish assemblage was to be found in many other small creeks of the region, sometimes minus or plus



one or two species. Aside from fishes this particular creek hosted an abundant population of a small crayfish (Astacidae) with furry claws of which we had already collected a few specimens the previous year in neighboring Guatemala.

The very succinct analysis of the water of a few creeks gave some rather surprising results as some of the smallest creeks draining white sand soils had a very soft and slightly acidic water, a condition rarely found in Middle America where most waters are usually alkaline and often highly mineralized (hard).

With the cast-net we sampled briefly the cloudy Belize River at Isabella Banks, but caught only some common and not too colorful Cichlids. We were therefore surprised to find in nearby Mussel Creek a beautifully colored population of Firemouth Cichlids, *Thorichthys meeki*. The mouth area and anterior underpart of most specimens was vividly red and the upper part of the body brilliantly blue. These fishes were probably the most colorful Firemouths we had seen up to now. This widespread and variable species occurs from the Usumacinta Basin, Mexico, across Northern Guatemala to Belize. In Mussel Creek I also collected a few more *Phallichthys fairweatheri*, a small and pretty live-bearer, already found two days before in Whitewater Lagoon.

#### WHITEWATER LAGOON

Although Whitewater Lagoon should be logically included in the preceding chapter, I am giving it a place of its own because of its outstanding character and biological interest.

About two years ago I had seen by chance on the Swiss TV a few sequences of the BBC production "On the steps of the Rain God" which shows different aspects of Belize's outstanding nature and wildlife. Some very good shots, obviously taken in a very clear water natural habitat, showed breeding pairs of cichlids caring for their fry. Among them was a pair of *Petenia splendida*, the male of which belonged to the red or rather orange morph we had previously been looking for unsuccessfully in Mexico and Guatemala. We were therefore very anxious to be able to localize this habitat. Upon discussing the matter with John Polisar, an American biologist studying the Hickety river turtle (*Dermatemys mawii*), the personnel of the Belize Zoo, Belmopan, and local folks, we precisely localized our habitat as a lagoon flowing into Laboring Creek, a left bank tributary of the Belize River. We first thought that this water-body was called Freshwater Creek, but it eventually turned out that its correct name was Whitewater Lagoon while Freshwater Creek is a minor right bank tributary of Laboring Creek which slightly tea colored water is appreciated as drinking water by passing by locals.

Miraculously, after a frantic search, when we had only less than 5 more days to stay in Belize, we were lucky enough to find two local gentlemen who knew well the place, one of whom owned a canoe, locally called a dory, powered by a small outboard engine and just

large enough to accommodate 6 persons plus our gear. After having hastily bought some food and fuel for the motor, we started out a few miles downstream from Isabella Banks at approximately 11 o'clock in the morning. The two first hours up the Belize River were easy going and only the passage of the rapids at Big Falls provided some excitement. But when we began to ascend Laboring Creek we immediately found out that its name was more than well deserved. The course of this small river winds through the forest and was continuously obstructed by fallen trees or branches. Only seldom could we motor more than a hundred feet before having to stop. In two especially bad instances we had to push out of the water and balance the many hundred pounds wooden boat over large trunks, a long and exhausting exercise. Long before we reached the lagoon the night fell on us and only the extraordinary knowledge our crew had of the river and its dexterity in maneuvering the canoe permitted us to reach our destination at 9 30 PM, the trip having lasted more than 10 hours. Then we had another shock as the small field camp we had expected to find had recently burnt down. My friends managed to accommodate themselves under what remained of the palm covered roof of the camp's kitchen, whereas I had to hang my much larger hammock between two widely separated palm trees which were defended by hordes of bitterly stinging army ants, not to mention the many mosquitoes which continuously harassed us until we could slip under our protective netting. Fortunately, apart from a few alarming drops, it did not rain that night and in the next morning sun, when we could finally have our first clear view of the lagoon", we immediately saw that our efforts to reach this place had been well spent: we were looking at a most unusually beautiful and interesting freshwater habitat.

Whitewater Lagoon is a rather peculiar water-body, which however according to the map should not be totally unique in Belize. More than a lake it is rather a type of wide (150 to 300 ft. and mostly very shallow) river. The total length of the lagoon could not be estimated as we had not enough time to reach its upper end, but it certainly extends for many miles. More or less in the middle of the lagoon one finds a deeper (6 to 12 ft.) and narrow (15 to 45 ft.) channel in which a quite significant downstream current is felt. The lateral parts on both sides of the channel are much shallower with a depth which is often less than 3 ft., in such places the water is totally still. Both sides of the lagoon are bordered by a type of savanna which is burnt from time to time by the local hunters to attract deer, the resulting ashes and new grass being much favored by these animals. The predominant grass species (*Echinocloa* sp.) indicates that this savanna is periodically inundated and that the area covered by water must be much wider during the rainy season. Further inland the savanna gives way to tropical forest which unfortunately, we were told, has been heavily logged in the recent past.

One of the most remarkable aspects of Whitewater Lagoon is its luxuriant aquatic vegetation. Only very small parts of the bottom (the deepest parts of the channel and a few tree shaded areas on the banks) are free from a dense cover of aquatic macrophytes which in most places grow right to the surface. The different dominant

species are distributed according to the water depth and to the strength of the current. The channel is mainly occupied by a dense stand of a *Potamogeton* species swaying in the current. The less deep and quieter areas are favored by *Vallisneria*, while the extensive shallows are dominated by thick growths of a reddish *Cabomba*. A white flowering water-lily, probably *Nymphaea flavovirens*, grows a bit everywhere, but its stands tend to be more important along the shores and on the edges of the channel. In the latter place this plant produces many submerged leaves and may even flower underwater. In the shallower areas the big floating leaves of the water-lilies may prevent by their shade other plants from growing and provide small areas of bare mud bottom which are much favored as fry raising grounds by some species of cichlids. Less dominant but nevertheless striking, a large and delicate species of *Utricularia* is found from place to place. The shores are usually clogged by floating plants: *Pistia*, *Salvinia* and floating grasses.

The aquatic plants which reach the surface are often partly encrusted by predominantly white mineral deposits. From a distance this gives to whole parts of the lagoon a whitish hue, which may explain the name Whitewater Lagoon, since the water itself is clear. Only the electrical conductivity of the water was measured. The reading, approximately 1500 microsiemens, indicates an extremely high mineral content. The abundant mineral nutrients in conjugation with the clearness of the water favoring an optimal photosynthetic activity, must be the main reason of the extraordinarily high biological primary productivity of the ecosystem. The temperature of the water was between 28 and 30°C.

The quantity and diversity of fishes matched this beautiful setting. Among the cichlids the most common species was probably the herbivorous "C". *synspilum*. Like in Shipstern, this population was very colorful and "some individuals were really magnificent, with a lot of red in the anterior part of the body. Hundreds of pairs were looking after their eggs or young and were especially common in the slightly deeper parts, such as on the sides of the central channel. In a soft bottom environment such as this, breeding pairs will dig large and deep cavities to hide their eggs and larvae. It is possible that the holes are dug in order to reach an underlying hard object, such as a piece of wood, on which the eggs are laid, but this could not be ascertained.

The smaller *T. meeki* (Firemouth) were very common in the shallow areas and were also breeding massively as were the slightly less numerous *A. spilurus* (Blue-eye). *Amphilophus* (*Cichlasoma*) *robertsoni* were seen quite frequently but breeding pairs were few. *Parapetenia urophthalmus* were also very colorful and some very large breeding males were observed. Still larger and more massive, the predatory *Parapetenia friedrichsthalii* were scarcer and I only saw one breeding pair. The fishes belonging to this group of large *Parapetenia* are called "Guapotes" by most Spanish speaking people of Middle America. Also presently included in the genus *Parapetenia*, the much smaller and rather different *P. salvini* was also common. This fish has a large geographical distribution and its different populations are quite variable in morphology and

color. For once the *P. salvini* we saw in Belize, including those of Whitewater Lagoon, did not seem extremely colorful, when compared with some Mexican and Petenian populations.

By far the most impressive cichlids of the lagoon were the specialized predators, *Petenia splendida*, called Bay Snook in Belize. Already going up Laboring Creek we could observe some large breeding pairs along the banks and just before arriving at the camp we spotted with the flashlight our first red specimen. The next day we could observe many hundred breeding pairs in the lagoon, but we saw only two couples with a red fish. The first breeding red *Petenia* I could observe and fortunately photograph underwater, was a small to medium size female guarding its eggs on a dead branch close to the shore in approximately 3 ft. of water. The much larger normally colored male fled immediately when I approached and was not to be seen again. The breeding place was shaded by an overhanging tree. The second time we saw such a couple, the male was red and the female normal and they were guarding thousands of free swimming fry. We were lucky to spot this pair just before we left the lagoon in the morning of the third day.

These two observations show that either sex can be red. Like with most Middle American Cichlids, the eggs and fry are guarded more closely by the female. The normally larger male assumes the peripheral defence and chases away the other fishes when they get too close. But it is always the male which flies the first when a diver approaches. There is therefore no difficulty in identifying the respective sexes of a couple of *Petenias* caring for there eggs or young. If breeding red *Petenias* were very scarce, quite a few non-breeding red individuals were seen, either while snorkeling or from the dory, as by standing up in the boat, the brilliant red-orange fishes could easily be spotted at a distance of 20 to 30 meters through the clear water. The smallest red *Petenia* I saw had a length of approximately 10 cm and was actually of a pale pink color, the young therefore seem to be all normally colored up to a certain age, a few individuals beginning to change when they reach 8 to 10 cm.

The red color must be linked to a recessive genetic character which appears unusually frequent (probably not more than one in a thousand, however) in the Whitewater Lagoon population. In many other parts of the species' range, red *Petenias* seem to be very rare or even not to occur at all. For instance, according to local fishermen, no red *Petenia* has ever been observed in Lake Peten Itza, Guatemala, where the species is very abundant. Previously, J.-Cl. Nourissat had seen only once some red *Petenias* in the Rio Candelaria, Campeche, Mexico.

On our way back, we swam down the first stretch of the swiftly running Laboring Creek and could observe through our masks many Chuco intermedium, this rheophilic cichlid was not seen in the lagoon.

The other fish species observed in Whitewater Lagoon were:

Silversides (Atherinidae)

Melaniris sp.? , at least one small atherinid was fairly common.

Live-bearers (Poeciliidae):

Belonesox belizanus (Pike live-bearer)

Gambusia sp., most probably G. sexradiata, but possibly more than one species.

Phallichthys fairweatheri, according to the information available to us, this was the first time that this pretty and small species was recorded in Belize. We had previously collected it in the Peten, Rio de la Pasion and Rio Salinas drainages, Usumacinta Basin, Guatemala.

Poecilia sp. (Molly).

Xiphophorus maculatus (spotted Platy).

All the live-bearers were mainly found close to the shore and among the aquatic vegetation.

Characins (Characidae)

Astyanax fasciatus mexicanus, very common everywhere.

Hyphessobrycon cf. milleri (or obesus?), this small and apparently defenseless fish must have its own way to avoid predation from larger fishes as it was extremely common among the aquatic vegetation, practically everywhere.

Catfish (Ictaluridae)

Ictalurus cf. furcatus, a large catfish, possibly belonging to this species, was harpooned. Its estimated length was about 100 cm. and its weight 10 pounds or more.

Tarpon

Megalops atlanticus, one or two tarpons were sighted close to the outlet of the lagoon.

These are the fishes I can remember seeing in the lagoon, but I believe that a more thorough search would produce at least 10 more species. This would make about 30 species of fish, out of which 8 to 9 are cichlids. I don't remember seeing "C" octofasciatum in the lagoon, but it is most likely present. This is a good diversity of fishes and especially of Cichlids, however none of these species are restricted to Whitewater Lagoon and there are probably quite a few other water-bodies with the same number of species in Belize, but possibly no other site offers such good conditions to observe them.

Besides fishes, water turtles were common, especially a species of Painted turtle, Pseudemys cf. scripta. One Hickety (Dermatemys mawii) was caught by our crew.

Aquatic birds. Herons, Egrets, Jacanas, Cormorants and Ducks, were fairly common. Much to my dislike one "Muscovy" Duck (*Cairina moschata*) was shot. The same happened to a Collared Peccari on our way down the Laboring Creek.

### **CONSERVATION OF FISH SPECIES AND INLAND AQUATIC ECOSYSTEMS IN BELIZE**

Much too short for a serious survey, our journey to Belize has at least shown us, that in spite of its small size, this country already renowned for its marine life, was also endowed with a diverse and interesting inland ichthyofauna living in a good variety of aquatic habitats.

Among the latter, Whitewater Lagoon was really outstanding by the diversity and abundance of its aquatic flora and fauna. Its obviously very high primary productivity qualifies this water-body as an eutrophic system, whereas it is very seldom that eutrophic rivers or lakes have clear water. As a result of this rather unique combination of high productivity, species diversity and clear water, Whitewater Lagoon would appear to be an ideal site for a large range of ecological studies (e.g.: primary and secondary productivity, nutrient cycling, fish population and behavior studies, etc.). Properly presented and explained the lagoon could be very attractive to the Nature minded tourist, who would have the unique opportunity of comparing at a short distance and in the same country two beautiful and diverse aquatic, one marine (coral reef) and one freshwater, ecosystems.

Because of all these assets, I would hope that Whitewater Lagoon be considered as a priority area to be included in a network of Reserves set up to conserve the natural areas of high species diversity and biological interest in Belize.

A reserve status for Whitewater should not necessarily entail that everything should be strictly protected. The high productivity of the ecosystem means that it is well able to support some subsistence and even sport fishing, as long as such activities and their side effects are controlled, especially to avoid that the water quality and the aquatic vegetation deteriorate. According to the high mineral content and clarity of the water, the lagoon is most probably fed by underground water originating in a karst limestone, region. This water source should also be fully protected against contamination and erosion. Ideally the whole watershed should be placed within a reserve, including a corridor along the course of Laboring Creek which is very representative of a still largely untouched tropical forest stream. The terrestrial fauna should be strictly protected in such a reserve.

There is presently some work going on in order to restore an old logging trail and make the lagoon accessible by car. While I fully understand the desire to develop some touristic activities in the area, I believe that it would be much better to improve the

navigability of Laboring Creek than to build a road. Especially for the foreign tourist, the attraction of going to a place that can be reached only by boat and the excitement and interest of going up and down a tropical river, should be much more enticing than a car trip. A few days work with a chain saw would be sufficient to improve considerably the waterway, while the construction of a road and its maintenance would be much more costly and are bound to have a detrimental effect on the environment and wildlife.

Finally I would like to say that our party was extremely pleased not to encounter any introduced (exotic) species of fish in Belize. This was a great change from Mexico and Guatemala where the native fishes and aquatic ecosystems are more and more disturbed by the irresponsible introduction of North American, African and more recently, Asiatic fish species. As we have been able to observe directly, in many areas the indigenous species are declining due to the predation, competition and/or environmental deterioration resulting from the introduction of alien species. In some cases, which unfortunately are bound to become more numerous, species endemic to limited areas have already become extinct.

In Lake Atitlan, Guatemala, the introduction of the North American Black Bass to promote sport fishing has led to the extermination of the local fish species (previously an important food resource for the local Indian population) which in turn has brought the demise of the unique Atitlan Grebe. In the same countries, most lowland rivers and lakes are invaded by African Tilapias (*Oreochromis* sp., Cichlidae), which in many places are already today among the commonest fishes and are displacing the native cichlids. Recently we have witnessed in the Rio de la Passion and Rio Salinas drainages the arrival and proliferation of the Asiatic Grass Carp, *Ctenopharyngodon idellus*. The sudden increase in its numbers from one year to another, shows that this Cyprinid is reproducing locally and the impact of this voracious herbivore on the plant rich aquatic ecosystems of the area will certainly have very detrimental consequences for the native river life. These fishes most likely escaped from some Chinese supported fish culture project.

One should remember that once a foreign species has successfully established itself in a large water-body, it is likely to remain there for ever and can not be eradicated if eventually found to be a nuisance. It is also in most cases a great illusion to believe that the introduction of a new species will considerably improve the long-term fish production. This may be the case in some very isolated areas with few fish species, leaving vacant ecological niches, or in man-made lakes which can not be efficiently used by the local stream fishes, but this is not applicable to Belize where exists a sufficiently diverse and rich ichthyofauna adapted to a great variety of aquatic habitats and food sources and where the fish production is most likely limited only by the productivity of the ecosystems. In Belize the introduction of new species of fish, after a possible temporary increase, would most likely lead to a deterioration of the ecosystems and to a long term decrease in fish production. As has happened and is still happening elsewhere, it

could bring about the extinction of native species, which apart from any economic consideration, is we believe an unredeemable loss to a country's natural heritage.

As it was my first time in Belize, it is difficult for me to evaluate how much the ichthyofauna and aquatic ecosystems are already suffering from pollution and loss of water quality. For example pesticide runoff from the large citrus plantations might already be affecting negatively the water life in Stan Creek and explain partly the low fish density we observed in this river. But overall my general impression was that the inland aquatic ecosystems of Belize were still in fairly good shape and this is why for the time being I consider the introduction of exotic species as possibly the greatest potential threat to the country's native inland fishes and other aquatic life. It should be noted that in the previously mentioned countries as well as in many others, introductions have usually been done by official authorities, such as Fisheries Departments or Government approved development projects, which heads should have known better or asked the advice of knowledgeable scientists.

I am saying all this with the hope that should this account be read by some person influential on land and water use policies and natural resources management in Belize, it may help in taking a few measures which could significantly ensure the preservation of a large segment of the country's wildlife. Such measures could and should include: the strengthening of the protection given to already existing nature reserves covering water habitats, such as Shipstern N.R., the establishment of new reserves in areas of high, both terrestrial and aquatic, species diversity and outstanding biological interest, such as Whitewater Lagoon, and finally, to prohibit the introduction of non-indigenous fishes and other aquatic organisms. Otherwise all the fish species we have observed in Belize seem to have large, widespread and healthy populations which should be well able to sustain a reasonable fishing pressure as well as the occasional and inconsequential removal of a few specimens by a visiting scientist or aquarist!



## ANNEX

List of inland species of fishes observed in  
 BELIZE  
 by Patrick de Rham

24 April - 4 May 1990

## AREAS

Shipstern Reserve = SR  
 Southern rivers = SO  
 Northern Plain = NP  
 Whitewater Lag. = WL

## FAMILIES

## CICHLIDAE

	SR	SO	NP	WL
<u>Amphilophus</u> (Cichlasoma) <u>robertsoni</u>		X	X	X
Archocentrus (C.) spilurus		X	X	X
"Cichlasoma" synspilum	X		X	X
"Cichlasoma" octofasciatum			X	
Chuco (C.) godmani		X		
Chuco (C.) intermedium			HS	LC
Parapetenia (C.) friedrichstahli				X
Parapetenia (C.) salvini	X	X	X	X
Parapetenia (C.) urophthalmus	X		X	X
Petenia splendida	X		X	X
Thorichthys (C.) aureus		X		
Thorichthya (C.) meeki	X		X	X
<u>Vieja</u> (C.) <u>maculicauda</u>		X		

## GERREIDAE

<u>Eugerres</u> sp.	X			
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## GOBIIDAE

<u>Gobionellus</u> sp.? small goby, low Belize R.			X	
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## ELEOTRIDAE

<u>Eleotris amblyopsis</u> ?		X	X	
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## ATHERINIDAE

<u>Melaniris</u> sp.				X
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## POECILIDAE

<u>Belonesox belizanus</u>	X	X	X	X
Gambusia p. yucatanana	X			
Gambusia sexradiata			X	X
Heterandria. cf. bimaculata		X	X	X
Phallichthys fairweatheri			X	X
Poecilia sp. (many species?)	X	X	X	X
Xiphophorus helleri		X	X	
<u>Xiphophorus maculatus</u>			X	X

## CYPRINODONTIDAE

<u>Ictalurus furcatus</u>	X			
<u>Garmanella pulchra</u>	X			
<u>Rivulus marmoratus</u>	X			
<u>Rivulus tenuis</u>		X	X	

## SILURIFORMES

<u>Cyprinodon variegatus</u>				X
<u>Rhamdia</u> cf. guatemalensis/cf.		X	X	

## CHARACIDAE

<u>Astyanax fasciatus mexicanus</u>	FP	X	X	X
Brycon sp.? (Characid of unrecorded sp. )		X		
<u>Hyphessobrycon. milleri/obesus</u>		X	X	X

## CLUPEIDAE

<u>Dorosoma</u> sp.			X	
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## MEGALOPIDAE

<u>Megalops atlanticus</u>				X
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## SYNBRANCHIDAE

<u>Synbranchus marmoratus</u>	X		X	
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## DISCUSSION

A comparison with the list of species given by J. E. Thomerson and D. W. Greenfield, 1972, in their "Preliminary key to the Freshwater Fishes of Belize" (unpublished, available at: Belize Center for Environmental Studies, 55 Eve Street, Belize City, Belize C.A.) shows that in our 10 day trip we have been able to observe a fair proportion of the species known to occur in this country's inland waters and that among, the species we did not record figure many estuarine fishes a more intensive search of the coastal habitats might have produced.

With 13 observed species the Family Cichlidae ranks first. This is partly explained by the fact that Cichlids were our main targets and are easy to observe underwater with a diving mask, our favorite method of assessing the fish species present in an aquatic habitat every time the water is sufficiently clear. But since Cichlids make up also the most numerous family in the above mentioned list, there is little doubt that they are among if not the most diversified group of inland fishes in Belize. As to the Cichlids listed by Thomerson and Greenfield we did not record, I feel unlikely that "*Cichlasoma*" insignis and "C." melanurum occur at all in Belize, since these two species are now considered to be endemics of Lake Peten Itza, Guatemala. As to *C. hyorhynchum* it is understood here to be a synonym of *Thorichthys meeki*, the Firemouth, a very common fish in Belize north of the Dangringa - Maya Mountains Line.

We would expect that further investigations in the South would produce two more species: *Herichthys bocourti* recorded by us in the Rio Sarstun (Sarstoon River) at Modesto Mendez, Guatemala, a few thousand feet from the border and which appears to have been also found slightly north in the Moho River, Belize, and a rheophilic *Theraps*, *T. irregularis* or *T. belone* (possibly the same species) also found by us at Modesto Mendez, but more common in the faster flowing hill streams (occurs also in the Usumacinta Drainage System). It is interesting to note that 3 species, *C. godmani*, *T. aureus* and *V. maculicauda* seem not to occur north of the Maya Mountains range that nearly reaches the sea north of Daring (Maya Mountains - Dangringa Line). The two first species can be considered as endemics of the Amatique Bay Region (Rio Motagua and Rio Polochic, plus a few smaller rivers north in Guatemala and Belize), whereas *V. maculicauda* has a much larger distribution along the Caribbean coast, right down to Panama.

7 species, "*Cichlasoma*" *synspilum*, "*C.*" *octofasciatum*, *Chuco intermedium* (found only in flowing water, hill streams, HS, and Laboring Creek, LC), *Parapetenia friederichsthalii*, *P. urophthalmus*, *Petenia splendida*, *Thorichthys meeki*, seem not to occur much or at all south of the Maya Mountains - Dangringa Line. These "northern" species are all found in the large Rio Usumacinta Basin (Guatemala and Mexico) which is most likely their center of origin. *A. robertsoni* and *P. salvini* which are also part of the Usumacinta Basin Cichlid fauna, occur however extensively south of the Maya Mountains - Dangringa Line. Finally the case of *A. spilurus* is especially intriguing, since this southern species which area of distribution includes part of Northern Nicaragua, Caribbean Honduras and the Motagua- Polochic drainage in Guatemala, has been able to penetrate in Belize up to the New River, well north of the Maya Mountains, but has not

reached the Rio Usumacinta Drainage. One can conclude that for the Cichlids, Belize is a moderately isolated and transition area which can be divided into a northern and a southern zone. As previously said, the North Belize Cichlid fauna is closely related to the Rio Usumacinta Basin fauna and can be considered as part of a larger Usumacinta Region Cichlid fauna (Usumacinta Basin, Northern Belize plus a few independent river systems in Guatemala and Mexico, draining mainly into the Gulf of Mexico). However there is the unique but remarkable exception of *A. spirulus* and isolation is shown by the fact that a number of common Usumacinta species are not found in Belize. Moreover some Cichlid populations found in Belize differ markedly from the Usumacinta populations of the same species. This is the case of the "C." synspilum observed in Shipstern, Sibun River and Whitewater Lagoon which are much more colorful and have a different color pattern than the Usumacinta fishes of the same species. Strangely enough, J.-Cl. Nourissat tells me that the "C.," synspilum he observed some years ago in the Rio Hondo belong to the Usumacinta type.

As for the South Belize Cichlid fauna it is part of the Amatique Bay Region fauna which is less diverse than the Usumacinta fauna and counts a small but significant number of endemic species limited in distribution to a few rivers and lakes all draining into or close to the Amatique Bay at the bottom of the Gulf of Honduras. From what we have seen the Maya Mountains - Dangringa Line is not a sharp divide between the northern and southern species, a few northern species still reaching a few more rivers south, only in the Rio Grande the southern species seemed to have completely replaced their northern counterparts. But underwater visibility was not always perfect, fishes were often few and we lacked time to look in all the rivers and make completely reliable observations to be able to tell exactly in which river one species appeared and another disappeared and if there were any overlap between northern and southern species.

For various reasons the other fishes could not be observed as closely as the Cichlids. Among the Poeciliidae, the second most important family in Thomerson and Greenfield's list, we more or less recognized 8 species, but it is very likely that some of our species cover two or more species. In Belize, at least, all Cichlid species are relatively easy to differentiate in the field, whereas it is not at all the same with some genera of Poeciliids in which it is often difficult to distinguish between the different species, even in the lab. The most difficult group corresponds probably to the fishes popularly known as Mollies and presently classified in the genus *Poecilia* (subgenus *Mollienesia*). The Mollies which are common in all types of water and habitats show a great degree of color and morphological variability, sometimes even within the same population. We were told by the personnel of the Belize Zoo who had collaborated in the making of the TV production "On the steps of the Rain God" that they had seen big Sailfin Mollies in some coastal lagoons north of Belize City. These were probably *P. velifera*, a species not recorded by us or in the List of freshwater fishes of Belize, but which is known to occur in nearby Yucatan.

*Gambusia* and *Xiphophorus* could also count more species in Belize than believed up to now. All the Swordtails we saw looked

superficially like the common green Swordtail, *Xiphophorus helleri*, but we were told that some hill streams we had no time to visit contained a population of very large Swordtails that could eventually prove to be a new sub or even full species. According to what is known from Guatemala, Heterandria could also count more than one species in Belize

This means that comprehensive collecting, followed by a serious study of the Live-bearers found in Belize would most likely increase the number of known species for the country and the family Poeciliidae could eventually prove to be as rich in species as the presently better known Cichlidae. The discovery by us of a new species for Belize, *Phallichthys fairweatheri*, serves to strengthen this point.

We were also pleased to have the luck to be able to confirm the presence of *Rivulus marmoratus* which figured with a question mark in the above mentioned list. The finding in the same area (Shipstern Nature Reserve, Sarteneja, Corozal District) of *Cyprinodon* cf. *variegatus* by Caspar Bijleveld has doubled the number of Cyprinodontidae (2 Rivulins and 2 Cyprinodontins) known to exist with certainty in the country. In my previous trips to Mexico and Guatemala I had been able to find only one species, *Rivulus tenuis*, but the other 3 species, *R. marmoratus*, *Garmanella pulchra* and *Cyprinodon variegatus* are known to exist in Yucatan. For climatic reasons, increasingly wetter climate, I do not expect these 3 species to extend much southwards along the Belize coast (two of these species, *R. marmoratus* and *C. variegatus*, seem however to reappear further south, outside Belize, in drier areas), whereas *R. tenuis* is found on the Atlantic slope all the way from Veracruz, Mexico, to Honduras.

The remaining fishes were only collected or observed incidentally. It seems that one small to medium size Characid collected along the Main Highway does not fit within any of the species given in the Thomerson and Greenfield list. *Astyanax fasciatus mexicanus* was present in all but the smallest streams and was often the most numerous species. In Shipstern N.R., Sarteneja, it occurs only in a small isolated freshwater pond (FP). The Clupeid, *Dorosoma* sp., appeared to me slightly different from the *D. petenense* collected previously in Peten, Guatemala. This is why I have given no specific name, but it could have been *D. anale*. Finally the finding of the Mud-eel, *Synbranchus marmoratus*, in a saline Mangrove swamp in Shipstern N.R., shows that this species is at home in most of tropical Middle and South America in the most various types of habitats and waters. For instance I remember collecting this species in: strongly acidic and mineral poor waters in the Amazon basin, fast flowing - clear water - rocky bottom - mountain streams in Southern Mexico, oxygen poor waters and muddy bogs - often covered by aquatic plants - everywhere, and now, strongly saline coastal swamp in Belize.