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Freshwater fishes of Shipstern Nature Reserve

Caspar F. A. Bijleveld
Papiliorama, caspar.bijleveld@papiliorama.ch

“Freshwater Fishes of Shipstern Nature Reserve” by Caspar F. A. Bijleveld, 1990

The attached manuscript titled: “Freshwater Fishes of Shipstern Nature Reserve” by Caspar F. A. Bijleveld is an important historical record of the fish biodiversity found in the Shipstern Peninsula, Corozal district, Belize, Central America, based on his studies in 1990.

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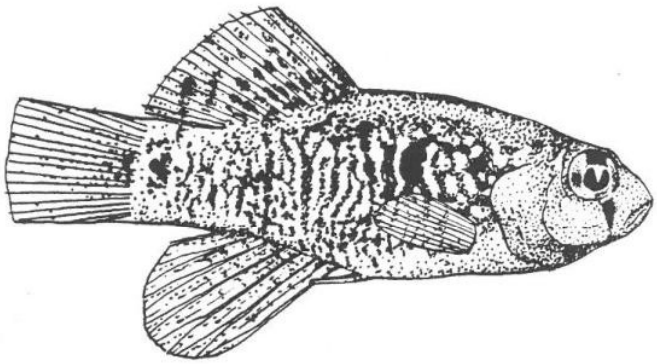
We have recently cited Bijleveld’s work in a recent update of the zoological record of the freshwater fishes of the Shipstern Peninsula in a manuscript entitled: “Diversity and parasitic load of freshwater fish of the Shipstern Peninsula, Sarteneja, Corozal District, Belize, Central America from recent collections and historical archives”.

Adrian A. Vasquez
Jeffrey L. Ram
Department of Physiology
Wayne State University
Detroit, MI 48201 USA

FRESHWATER FISHES
OF
SHIPSTERN NATURE RESERVE

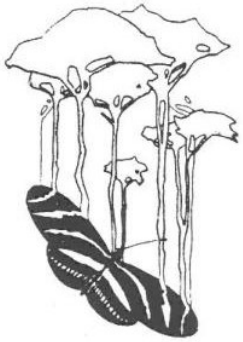
A survey of freshwater fish species
in various habitats of
Shipstern Nature Reserve,
Corozal District, Belize, Central America.



by

C.F.A. Bijleveld

illustrations by
G. Meier



International Tropical Conservation Foundation
~~P.O. Box 31~~
~~2074 Marin-Neuchâtel~~
~~Switzerland~~

c/o

Stiftung / Fondation
Papiliorama-Nocturama
P.O. Box 160
CH-3210 Kerzers / Chiètres FR
SWITZERLAND

SUMMARY

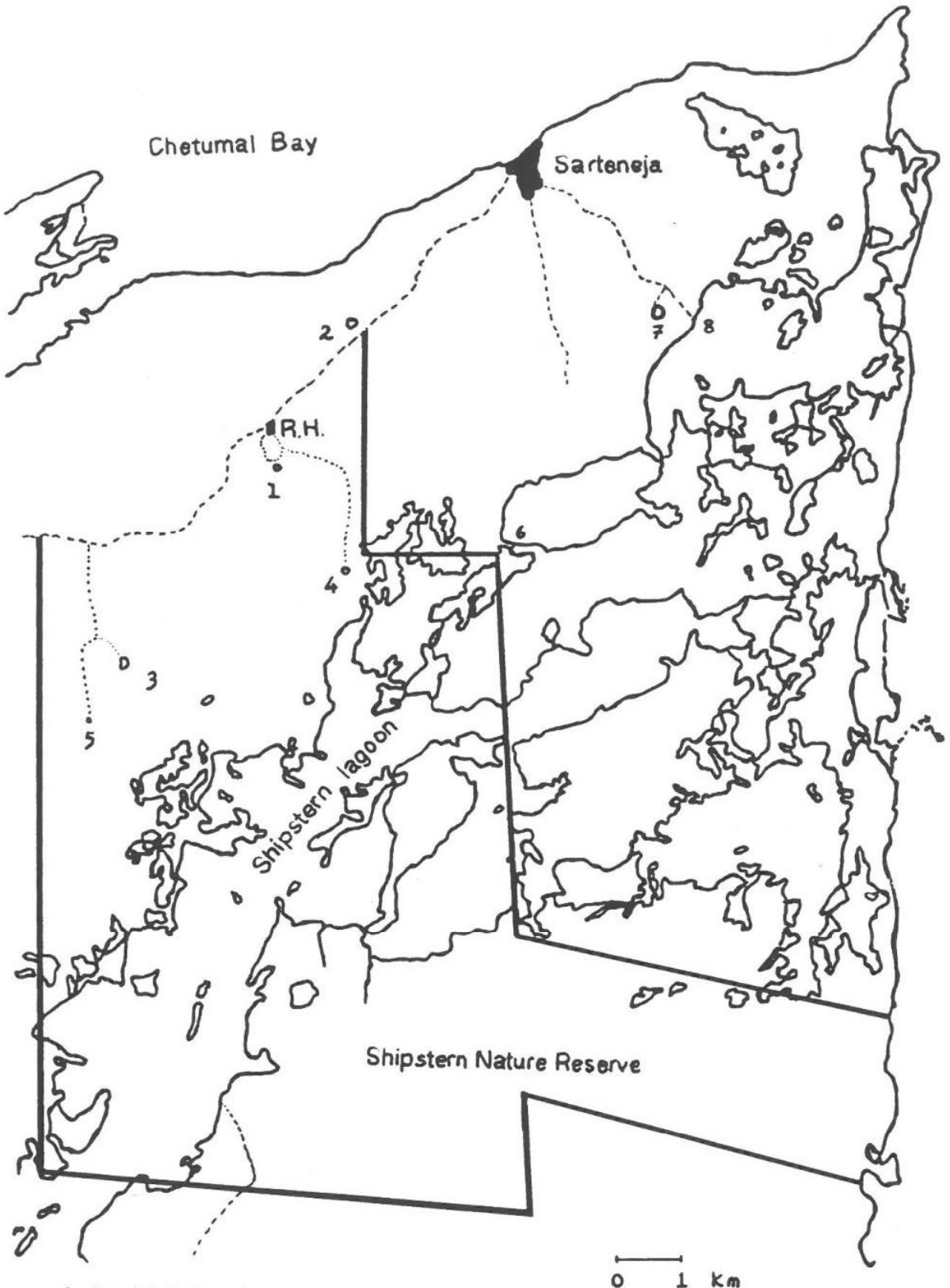
A survey of fishes in and around Shipstern Nature Reserve in Northern Belize, Central America, was carried out over a period of eight months, from February to September 1990.

Its purpose was to establish a preliminary list of the fishes of Shipstern Nature Reserve, including descriptions, distribution and collecting data and additionally to describe some of the habitats in which the fishes were found.

This study focuses on fishes considered to be freshwater species. These occured for the greater part in brackish habitats. Nevertheless, a few fish considered as marine species were caught in the waters of the reserve and these equally received attention.

Findings include 15 species of fresh or brackish water and 3 marine species. Two species are of particular interest: *Cyprinodon variegatus* (Cyprinodontidae) is a new species for the belizean fauna, while *Rivulus ocellatus* (Rivulidae), which was recorded from Twin Cays on the barrier reef (Davis et al., 1990), is now also confirmed for a mainland coastal habitat.

Outline page #



1. Orchid Pond
2. Northern Mangrove Pond
3. Main Trail Mangrove Pond
4. Lagoon Trail Savannah Tracks
5. Main Trail Savannah Tracks
6. Lagoon Canal
7. Cenote
8. Crispin's Landing

1. INTRODUCTION

Shipstern Nature Reserve is situated in the northeast of Belize, near the village of Sarteneja, Corozal District.

The reserve is owned by the International Tropical Conservation Foundation (I.T.C.F.), which has branches in Switzerland and the Netherlands. It covers approximately 8'000 ha (19'000 acres). Apart from the Reserve itself, five thousand acres of wetlands between its eastern border and the sea, and two and a half thousand acres to the West have been declared a no hunting area by the Government of Belize in April 1990.

There are three major types of habitat to be found within the boundaries of the reserve: subtropical moist forests, saline wetlands and saltwater lagoons. A short description of these habitats is given on pages 3, 7 and 8 respectively.

In the course of this investigation it was found that they include various types of aquatic habitats which supported particular groups of fishes.

2. MATERIALS AND METHODS

Fish collecting

Most fish specimens taken within the reserve have been caught by using a small net. Another useful instrument was the cast net, although it could not be used in waters deeper than one meter or for catching small fish. A trap was used to catch fish active at night and therefore not detectable during daytime. The trap consisted of a cubic frame covered with mosquito netting, with a small opening at one end leading the fish through a conical tunnel into the trap. Dead fish were used as bait. This technique proved particularly efficient with the catfishes (Pimelodidae and Ariidae).

Although these techniques proved to be successful in smaller ponds, it is obvious that ichtyocides would have to be used to carry out proper surveys in larger areas such as lagoons and swamp complexes.

Specimens of interest were taken alive to the headquarters of the reserve to be prepared in order to build up a small reference collection. This was done in four different stages:

a) The fishes were preserved in a 10% formalin solution. This technique is the most efficient as fishes gulp in a large amount of formalin and are therefore better and immediately preserved.

b) The first thing done once the fishes were fixed was to photograph them, as colors tend to fade under the combined effects of time and preservation solutions.

c) The next step was identifying the fishes as accurately as possible, with the help of available indentification keys and literature (THOMERSON & GREENFIELD, 1972; GERY, 1977; SEEGERS, 1988 etc.).

d) Finally the fishes were put in a 10% formalin solution for three weeks after which they were put in a 70% alcohol solution. The advantage of using formalin before finally preserving them in alcohol is explained by the fact that formalin helps to protect pigments, especially those in the fins, while it also hartens the fin rays thus preventing fins from closing against the fishes' body. This helps future identifications.

Water analysis

Water analyses were carried out as follows:

pH (acidity), KH (carbonate hardness) and GH (general hardness) were measured by using a common analysis-kit found on the market and electrical conductivity was measured with a small microSiemens meter. The analysis of the concentration of some dissolved ions (Cl and SO_4) were kindly provided by the British Land Survey Team based in Orange Walk. It should be made clear that the values of pH, KH and GH given for each analysed sample can only be used in a comparative way. As a matter of fact, the kits used were designed for fresh water only, and not brackish or saline waters like those encountered in the reserve.

Identification

Although the identification of most species at Shipstern proved not to be too difficult, some doubt remains as to the correct scientific name of at least one common viviparous fish (Poeciliidae). Some genera of this family include many closely related species which are sometimes difficult to distinguish without access to reference type material or a careful revision. Dr.P.de Rham (Swiss member of the scientific advisory council of ITCF) who acquired considerable knowledge of the live-bearers and tooth-carps (Poeciliidae and Cyprinodontidae) of the area, checked the material and came to the conclusion that in some cases only a thorough examination of sufficiently large samples by a specialist could result in a reliable identification.

3. DESCRIPTION OF HABITATS

This section provides a global description of the three major habitats occurring in the reserve as well as a description of the ponds and pools where fish collecting took place. Most places cited in the text can be traced back on the map on page ii.

3.1. The Subtropical Moist Forest

The forest covers approximately 1/5 of the reserve, and can be found north as well as south of the Shipstern lagoon (see below).

This forest is generally low, with an average canopy height of 10 meters. The undergrowth is very thick and difficult to traverse when no trail is available. The forest was almost completely destroyed by the combined effect of Hurricane Janet (1955) and the fires that followed (HARTSHORN et al., 1984). It has been recovering since then, and differences in maturity today seem to correlate with soil depths (Meerman, pers.comm.)

Higher forest can be found south of the lagoon, near the abandonned village of Shipstern. Its average canopy height is 20 meters and the understory is far more open than in the lower forests.

3.1.1. The Orchid Pond

This small pond is located along the path of the Chiclero Botanical Trail, approximately 500 meters from the point of departure at the Reserve Headquarters. The pond itself is about 7 meters in diameter during the dry season. Its diameter tends to increase drastically during heavy rains. The pond lies in what locals call a "bajo" which designates a low place on which marsh vegetation occurs.

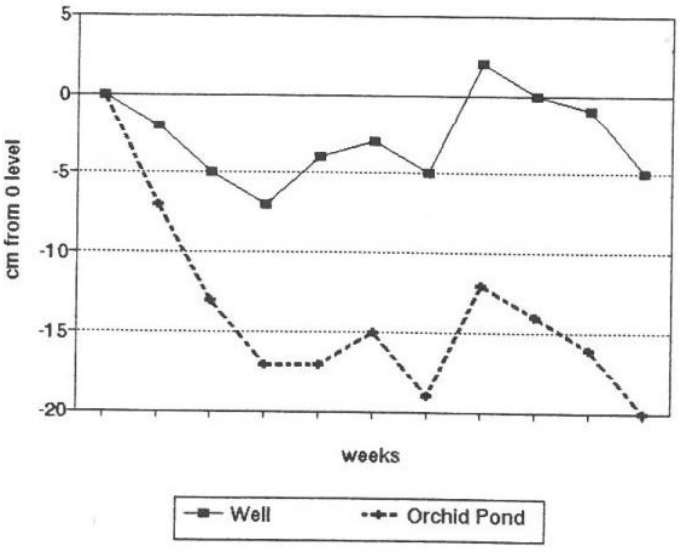


Figure 1:Water levels of the Pond and the well

Although its water level gets very low during the dry season, the pond never dries out. Minimal water depth measured was 38 cm, although generally remaining around 60 cm. The water is limpid and of a light tea-brown colour, allowing a perfect view down to the bottom.

Figure 2: The Orchid Pond

The bottom of the pond consists of a limestone bedrock covered by 5 to 10 cm of mud and decomposing leaves.

On the southern side of the pond is a group of 20 to 30 Taciste palms (*Paurotis wrightii*, Palmae). In the middle of the pond grows the well known cat-tail (*Typha angustifolia*, Typhaceae).

Because of the relative stability of the water level in this pond, a direct connection to an underground aquifer is believed to exist, possibly the same one that feeds the well at the reserve headquarters. To check this a simple test was carried out: Water levels were measured in the Orchid Pond and in the well near the headquarters. Figure no. 1 (page 3) shows the results of the data obtained which seem to point to a correlation between the water levels at the two sites. Water analyses (see Table 1 , below), on the other hand, show the opposite. At first sight these seem to indicate that both well and pond are fed by two different aquifers and that the correlation observed in the level variations of both sites are only related to rainfall. However the water could still come from the same aquifer and the higher mineral content and electrical conductance of the pond's water be due to evaporation and conse-cutive concentration of minerals in the pond. The lower pH and higher SO_4 of the pond's water can easily be explained by the presence of more organic matter falling into it.

	POND	WELL
DATE	25-4-90	25-4-90
TIME	1815	1845
WATER TEMP. (C°)	25.5	27.0
pH	6.8	7.5
GH (dH°)	58	21
KH (dH°)	14	16
COND. (μSiemens)	5900	1850
CL (mg/l)	2500	260
SO4 (mg/l)	600	220

Table I : Analyses of Orchid Pond and Well

3.1.2 The Northern Mangrove Pond

This pond is situated north of the road to Sarteneja, 500 meters from the reserve in the direction of the village. The trail to the pond branches off of the road on the left side at the back of a small clearing. This trail is 200 meters long and leads directly to the pond.

DATE	25-4-90
TIME	1400
WATER TEMP. (C°)	34
pH	8.3
GH (dH°)	50
KH (dH°)	7.5
Cond. (μSiemens)	4700

Table II: Analysis of Northern Pond

The pond is circular and approximately 40 meters in diameter. The maximum depth, determined by measuring the highest water mark on mangrove proproots emerging from the pond in the dry season, is 115 cm (+/-10 cm due to the soft mud bottom). The bottom of the pond consists of light, water-soaked mud approximately 60cm deep, offering few chances for plants to take root. The only plant that grows on this unstable soil is the red mangrove (*Rhizophora mangle,* Rhizophoraceae). On the edge of the pond, mangrove fern (*Acrostichum aureum,* Adiantaceae) was found.

The pond almost totally dries out during the dry season except for a small pool mainly filled with mud.

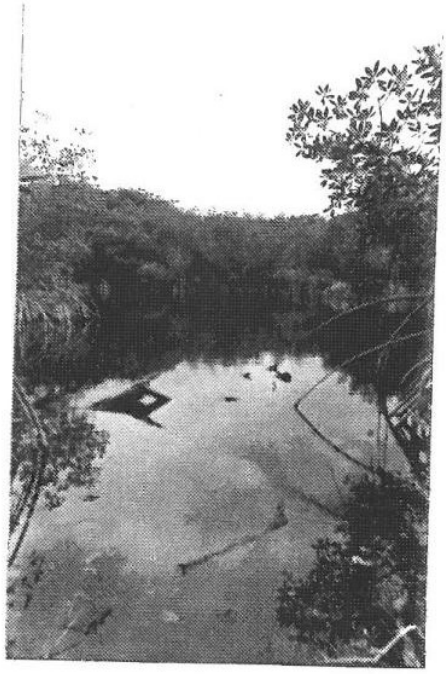


Figure 3: Northern Mangrove Pond

3.1.3 The Main Trail Mangrove Pond

This pond is located along the Main Trail, which branches off the main road close to the western border of the reserve. The easiest access to the pond is via the old milpa (slash-and-burn agriculture area) alongside the main trail. The pond lies at the end of a small trail which starts at the eastern corner of the

milpa near the bird-hide. The pond itself much resembles the Northern Mangrove Pond, except that the total area of the pond is about double the size. Three quarters of the pond is covered by red mangrove, mostly in the southern part. It completely dries out in early May, and in June, when water again fills the pond, there is no sign of living fish. The bottom is covered by at least 20 cm of mud and a substantial amount of green algae. Evidence of crocodiles (either *Crocodylus moreleti* or possibly *C. acutus*, Crocodylidae) was shown by tracks under water as observed in February 1990.

DATE	23-5-90
TIME	1000
WATER TEMP. (C°)	28
pH	7.8
GH (dH°)	>40
KH (dH°)	7.0
Cond (µSiemens)	>10'000

Table III: An. of Main Trail Pond

3.1.4 The Cenote

Although the Cenote is not located within the boundaries of the reserve, it is worth mentioning because of its physical features and its high diversity in cichlids (Cichlidae).

Cenote is the name given to a collapsed karst dome containing water. The pond thus created is rather deep, from 8 to 54 meters, and normally ranges from 10 - 30 meters in diameter, although it can widen up to 80 meters (WILHELMY, 1981).

This Cenote is situated north of the reserve along the road leading from Sarteneja towards Shipstern Lagoon.

Two hundred meters before the shore, there is a trail to the right and 100 meters down that trail lies the Cenote.

The Cenote is about 70 - 80 meters in diameter and almost perfectly circular. At the edge the water is already 2 meters deep and

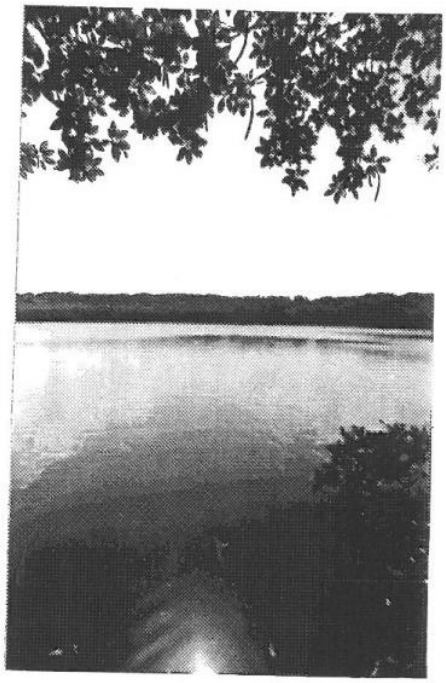


Figure 4 : The Cenote

DATE	25-4-90
TIME	1600
WATER TEMP. (C°)	28
pH	7.7
GH (dH°)	>80
KH (dH°)	13
Cond. (µSiemens)	>10'000

Table IV: Analysis of Cenote

instead of a gentle slope, a straight wall goes down to its bottom. 20 meters out from the edge the depth is about 8- 10 meters (J.-Cl. Nourissat, pers.comm.). The maximum depth of the cenote remains unknown, but, according to Nourissat, it should not exceed 40 meters. Soldiers of the British Forces have apparently tried to reach the bottom, but were unable to do so because of the general darkness below a depth of 20 meters (C.P.Farrell, pers. comm.).

The red mangrove is the only plant species to be found. The Cenote is too deep for mangroves, but roots from plants growing along the edge can be seen. As the water is exceptionally clear, it allows perfect observation of the important function of the red mangrove roots for sheltering the many cichlids in the Cenote.

3.2. The Saline Wetland

Often called "savannah" because of its appearance, the saline wetland covers about sixty percent of the total area of the reserve. It is mainly located along the Shipstern Lagoon, although there are patches of wetland found near the northern and eastern seashores. A transition zone between the proper "savannah" and the forest area shows a distinct floral pattern of grey mangrove (*Conocarpus erectus,* Combretaceae) and different grass species. This area is generally 30-50 meters wide, although in some places it is does not occur. Only a few plant species are adapted to the high salinity of the soil and the frequent flooding of the true wetland. The dominant species is red mangrove but it is found here in its dwarf form, generally not exceeding 1.5-1.8 meters. Most of the red mangroves do not develop into mature plants and remain shoots. Sometimes, the combined effect of salinity and extremely high irradiance create such harsh conditions that no plant is able to survive. This leaves large patches of bare soil throughout the wetland.

The wetland is spotted with small islands of forest growing on elevated ground (aproximately 1-2 meters high), rarely exceeding 50 meters in diameter. The Palmetto (*Thrinax radiata*, Palmae) is commonly found on these islands.

3.2.1. The Main Trail and Lagoon Trail Savannah Tracks

Both the Main Trail and the Lagoon trail were once used by vehicles for oil exploration, which left deep tracks in the soft, wet soil at the end of the trails. The tracks are about two meters in length with depth and width not exceeding 40cm. Although the whole area sur-rounding the tracks dries out in the early months of the year, the tracks retain water throughout the year.

Conditions in these small pools are extremely harsh: a temperature of 39°C (!) was measured in the tracks at the end of the Lagoon Trail, on March 4, 1990, at 1200 hours by clear weather. These pools, however, are deep enough for fish to survive, given that temperatures of 41-42°C are lethal for tropical fish (LOWE-MCCONNELL, 1987). Many other shallow pools with 5-10 cm of water in February and March were found throughout the wetland totally lacking in live fish, though a few dead *Poecilia sphenops* and *Belonesox belizanus* (Poeciliidae) were noted. These, obviously, had not survived the high temperature of 45°C measured in those pools (mid-March, 12.00h, clear weather).

DATE	23-5-90
TIME	1400
WATER TEMP. (C°)	30
pH	7.8
GH (dH°)	>40
KH (dH°)	6.0
Cond. (μSiemens)	>10'000

Table V: An. of Lagoon Trail Tracks

3.3 The Shipstern Lagoon

This shallow lagoon (0.5-1 m) divides the dry land of the reserve in two about equally large parts. It is about 20 km long and has an average width of about 1 to 1.5 km. Deeper channels linking patches of wetland are found north of the lagoon.

The lagoon itself is still in contact with the open sea, which explains the high salinity of the soil surrounding it. This situation could change, however, as the lagoon is slowly being closed off by rising mudbanks. This seems to be a natural process that could be induced by dramatic changes in landscape following hurricanes.

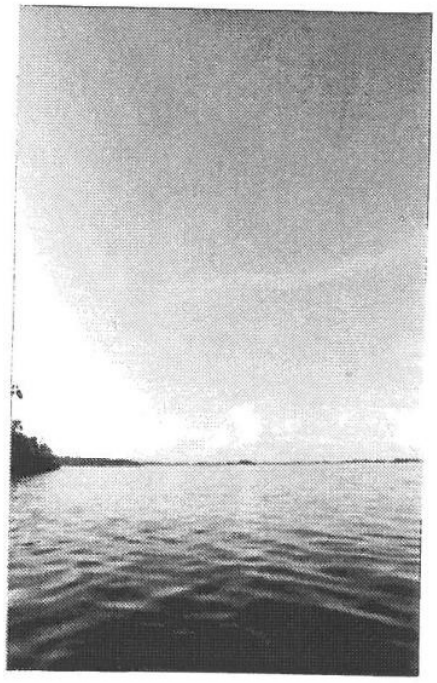


Figure 5 : Shipstern Lagoon

3.3.1 The Lagoon Canal

This canal is located on the eastern border of the reserve on the northern side of the Lagoon. It cannot be reached during the wet season, the whole wetland then being under water. In the dry season access is easy. A map and compass are needed to reach the canal as no trail exists. The canal lies approximately 1.5 kilometers Eastsoutheast of the Lagoon Trail. It has a length of about 30-40

meters and is 3-4 meters wide. The depth has not been measured, but is said to be about 2 meters (Meerman, pers.comm.).

The water is generally very murky, though visibility occasionally reaches 40-50 cm. There is a current strong enough to be visible. It is not of tidal origin, but caused by winds that actually push water in and out of the lagoon. (Meerman, pers.comm.). A similar, but rather inaccessible canal is to be found further to the South.

4. A PRELIMINARY LIST OF THE FISHES OF SHIPSTERN NATURE RESERVE

Freshwater species:

Family SYNBRANCHIDAE	:	*Synbranchus marmoratus*
Family CHARACIDAE	:	*Astyanax fasciatus mexicanus*
Family PIMELODIDAE	:	*Rhamdia laticauda laticauda*
Family CYPRINODONTIDAE	:	*Jordanella pulchra*
		Cyprinodon variegatus
Family RIVULIDAE		*Rivulus ocellatus*
Family POECILIIDAE	:	*Belonesox belizanus*
		Gambusia puncticulata yucatana
		Poecilia cf. sphenops
Family CICHLIDAE	:	*Thorichthys meeki* *
		Parapetenia salvini *
		Cichlasoma synspilum
		Parapetenia urophthalmus *
		Petenia splendida
Family ELEOTRIDIDAE		*Gobiomorus dormitator*

* According to Kullander's (1983) revision of the genus *Cichlasoma* (SWAINSON, 1839), only about 12 South American species remain within the genus *Cichlasoma*. All other, mostly Central American species will eventually be included in existing or new genera. Correct generic names are given here when known with some certainty.

Marine species:

Family TETRAODONTIDAE	:	*Sphoeroides sp.* (prob. *S. greeleyi*)
Family ARIIDAE	:	*Arius sp.* (prob. *A. felis*)
Family GERREIDAE	:	*Eucinostomus sp.* (prob. *E. argenteus*)

5. DESCRIPTION, COLLECTING DATA AND DISTRIBUTION WITHIN THE RESERVE

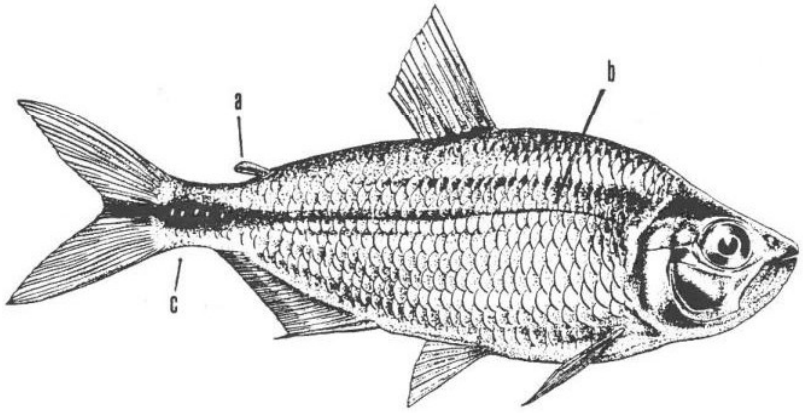
A) Fresh- and brackishwater species

Synbranchus marmoratus (BLOCH, 1795)

Family	:	SYNBRANCHIDAE (mud eels)
Synonym	:	none
Vernacular	:	Mud eel
Identification	:	A slender eel-like fish, brown to olive green with a white-yellowish belly. Note the absence of scales and pectoral fins, and a single gill opening on the throat (a).

Collecting data :			
	location	:	Main Trail Mangrove Pond
	date	:	25.4.90
	time	:	10.00
	sex	:	unknown
	S.length	:	12 cm
	caught by	:	handnet
	remarks	:	preserved
Distribution	:	Main Trail Mangrove Pond	

Astyanax fasciatus mexicanus (CUVIER, 1819)



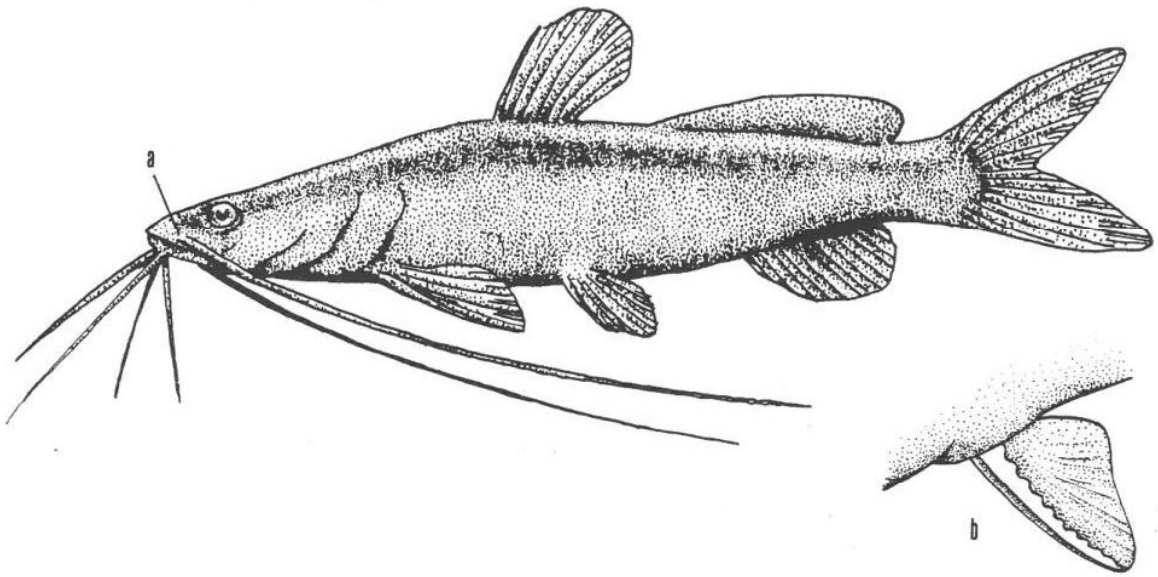
Family	:	CHARACIDAE (tetras)
Synonym	:	*Astyanax mexicanus*
Vernacular	:	billum, mexican tetra
Identification	:	a slender tetra with silver sides and yellow or reddish fins. Note adipose fin (a), complete lateral line (b) and distinct dark blotch at base of caudal fin and caudal peduncle (c).

Collecting data :

location	: Orchid Pond		
date	: 6.2.90		
time	: 13.30		
sex	: unknown	|	unknown
S.length	: 4 cm	|	5.3 cm
caught by	: hook	|	hook
remarks	: preserved	|	preserved

Distribution : Orchid Pond

Rhamdia laticauda laticauda (HECKEL, 1858)



Family	:	PIMELODIDAE (freshwater catfishes)
Synonym	:	*Rhamdia motaguensis*
Vernacular	:	catfish
Identification	:	a brown to olive-green catfish, with white to light brown belly. 6 barbels, 1 pair originating just above mouth (a). Note absence of scales on body and of bony plates between head and dorsal fin. Note also pectoral fin with weak posterior teeth (b) and adipose fin.

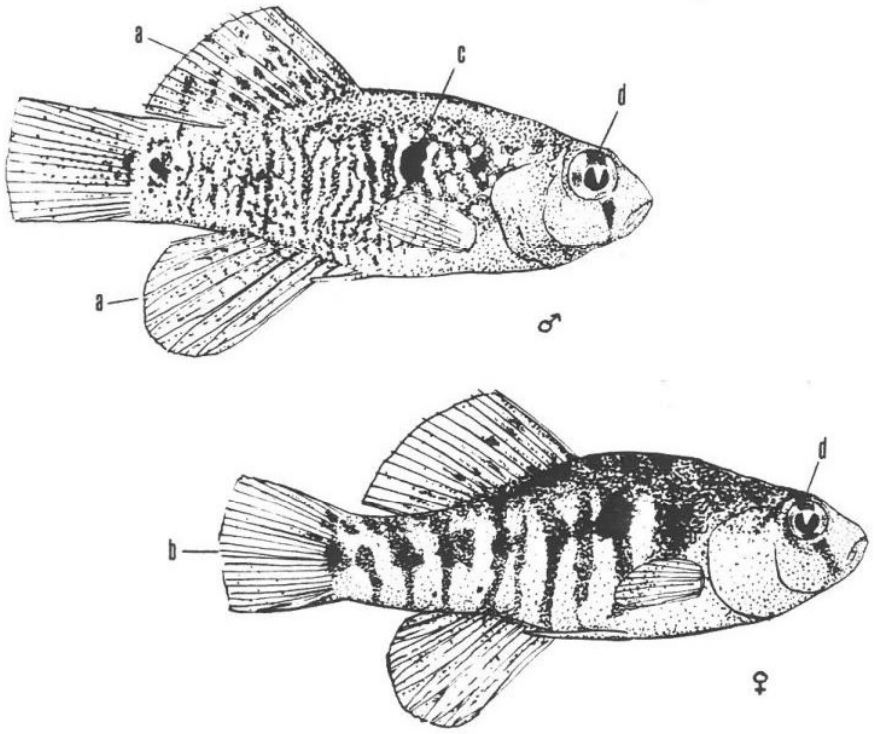
Collecting data :

location	:	Orchid Pond
date	:	7.2.90
time	:	night
sex	:	unknown
S.length	:	15.3 cm
caught by	:	trap
remarks	:	released in order not to affect a, possibly, very small population.

Distribution : Orchid Pond

Cenote : The *Rhamdia sp.* observed by Nourissat on 25.4.90. belongs probably to the same species.

Jordanella pulchra (HUBBS, 1936)



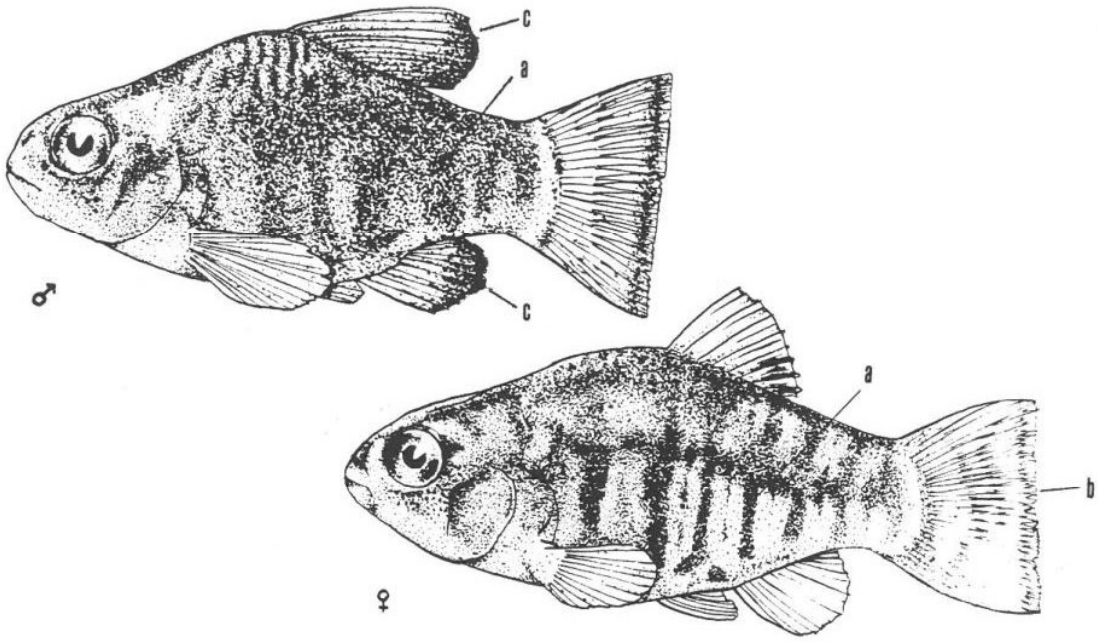
Family	:	CYPRINODONTIDAE (toothcarps)
Synonym	:	*Garmanella pulchra*
Vernacular	:	orange flagfish
Identification	:	a small cyprinodont with a relatively deep body. Males orange when alive, females grey to pale blue. Note dorsal fin about as large as anal fin (a), caudal fin non-forked (b), conspicuous dark spot on middle of side (c), and dark bar through eye (d).

Collecting data :

location	:	Lagoon Trail Savannah Tracks	
date	:	9.3.90	
time	:	13.00	
sex	:	male	female
S.length	:	2.2 cm	2.4 cm
caught	:	handnet	handnet
remarks	:	preserved	preserved

Distribution : Lagoon Trail Savannah Tracks, Lagoon, Main Trail savannah Tracks, Main Trail Mangrove Pond

Cyprinodon variegatus (LACEPEDE, 1803)



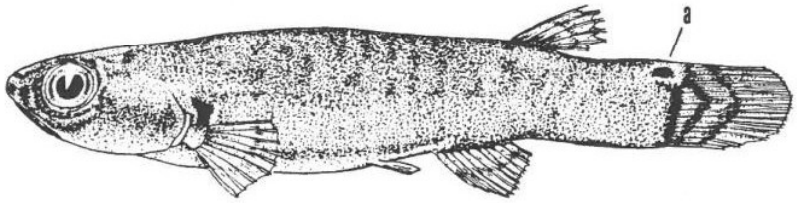
Family	:	CYPRINODONTIDAE (toothcarps)
Synonym	:	none
Vernacular	:	Broad killifish
Identification	:	a small cyprinodont,much resembling *Jordanella pulchra*, but body somewhat deeper. Both sexes have vertical dark lines on side (a). Caudal fin unforked (b). Note the absence of dark spot behind pectoral fins. Males have orange fins bordered by a black fringe (c). Females lack coloration in fins except in the anal one which is slightly orange. Males have a metallic blue hue on upper half of body.

Collecting data :

location	:	Lagoon Trail Savannah Tracks	
date	:	27.7.90	
time	:	10.00	
sex	:	male	female
S.length	:	3.8 cm	3.2 cm
caught	:	handnet	handnet
remarks	:	preserved	preserved

Distribution : Lagoon Trail Savannah Tracks, probably also Shipstern Lagoon

Rivulus ocellatus (POEY, 1884)



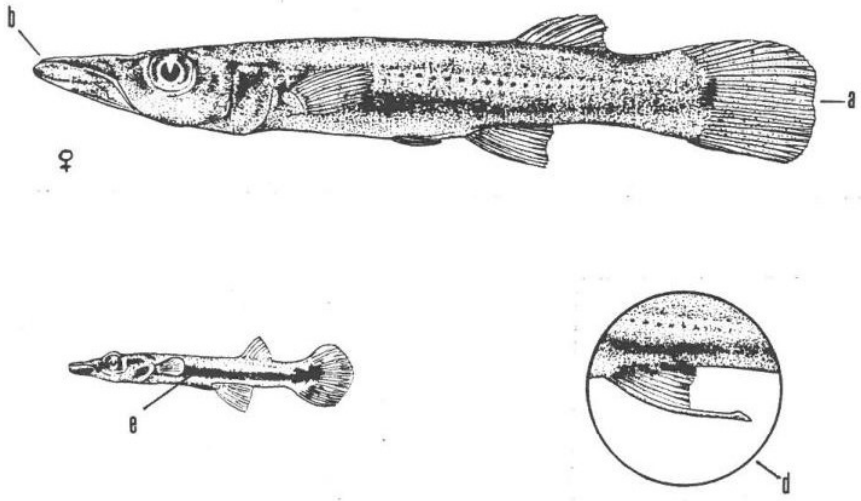
Family	:	RIVULIDAE (killifish)
Synonym	:	*Rivulus marmoratus marmoratus*
Vernacular	:	marmored killifish
Identification	:	a typical killifish, with a dark olive-green to brown body and a dark mark behind and slightly above the base of the pectoral fin. Males with a slight orange throat and dots on side of body. Females with an ocellus on upper half of caudal peduncle (a).

Collecting data :

location	:	Main Trail Savannah Tracks
date	:	31.5.90
time	:	11.00
sex	:	female
S.length	:	1.9 cm
caught	:	handnet
remarks	:	preserved

Distribution : Main Trail Savannah Tracks, Shipstern Lagoon

Belonesox belizanus (KNER, 1860)



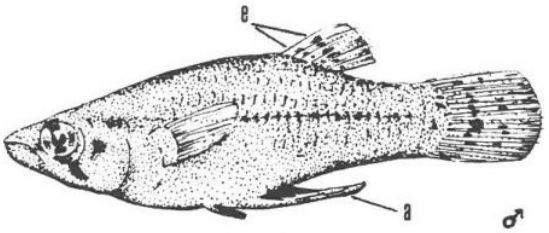
Family	:	POECILIIDAE (live-bearers)
Synonym	:	*Belonesox belizanus maxillosus* (HUBBS, 1936)
Vernacular	:	alligator fish, pike live-bearer
Identification	:	an elongated fish with the appearence of a small pike. Note absence of adipose fin and spines in dorsal. Caudal fin not forked (a). Note also elongated jaws (b) and long sharp teeth . Anal fin of males modified into a gonopodium (d). Young (under 3 cm) with dark bar running from snout to caudal peduncle (e).

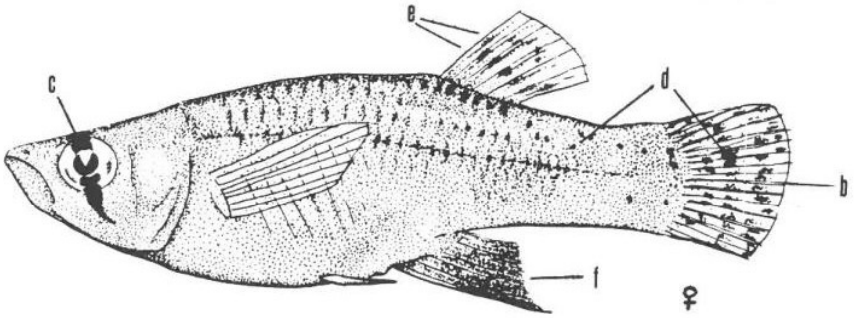
Collecting data :

location	: North.Mangr.P.	Main Tr.S.Tracks
date	: 25.4 90	25.4.90
time	: 13.00	10.00
sex	: female	immature
S.length	: 5.6 cm	2 cm
caught	: handnet	handnet
remarks	: preserved	preserved

Distribution : Main Trail Mangrove Pond, Northern Mangrove Pond, Main & Lagoon Trail Savannah Tracks, Shipstern Lagoon

Gambusia puncticulata yucatana (REGAN, 1914)





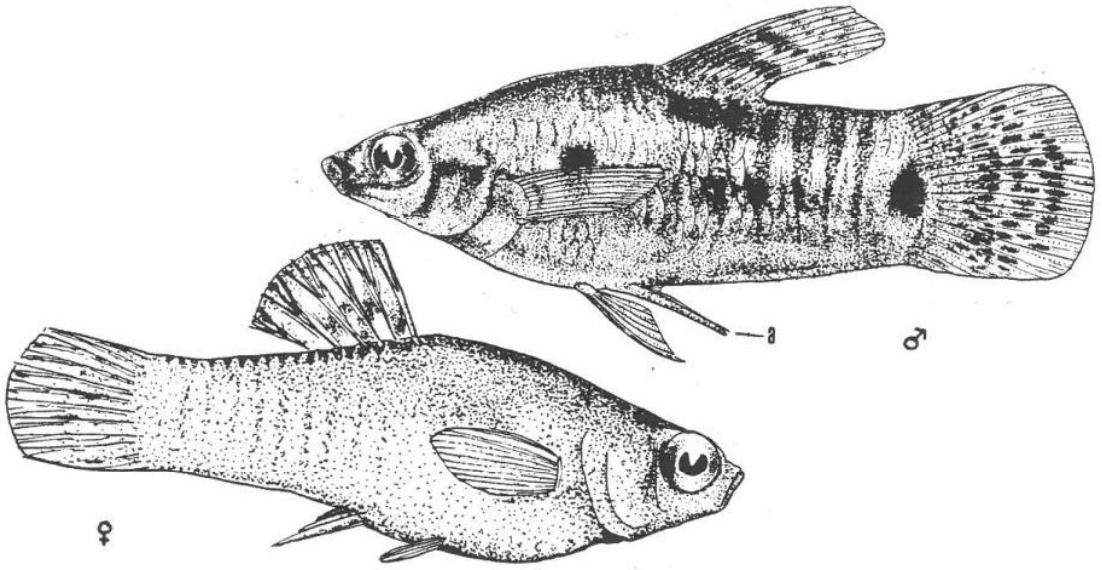
Family	:	POECILIIDAE (live-bearers)
Synonym	:	*Gambusia yucatana* (REGAN, 1914)
Vernacular	:	mosquito-fish
Identification	:	No spines in dorsal fin, no adipose fin. Anal fin of males modified into a gonopodium (a). Caudal fin not forked (b). Note black bar through eye (c), a few dots on side of body and in caudal fin (d), two rows of black dots in dorsal fin (e) and black anal fin (f).

Collecting data :

location	:	North.Mangr.P.	| Cenote
date	:	17.2.90	| 25.4.90
time	:	14.00	| 16.00
sex	:	male	| female
S.length	:	2.4 cm	| 2.8 cm
caught	:	handnet	| handnet
remarks	:	preserved	| preser.

Distribution : Main Trail Mangrove Pond, Northern Mangrove Pond, Lagoon & Main Trail Savannah Tracks, Cenote, Shipstern Lagoon

Poecilia cf. sphenops (VALENCIENNES, 1846)



Family	:	POECILIIDAE (live-bearers)
Synonym	:	*Mollienesia sphenops* (the *Poecilia* of the sub-genus *Mollienesia* comprise some closely related species, at times difficult to distinguish in the field).
Vernacular	:	molly
Identification	:	no spines in dorsal fin, no adipose fin. Anal fin of males modified into a gonopodium (a). Males with orange or yellow in dorsal and/or caudal fin. Silver to grey-blue on side of both sexes. Females with rows of dark spots on body, giving sometimes impression of dark vertical bars. A great variability in color pattern between different populations or even between individuals of the same population is often observed.

Collecting data :

location	: Orchid Pond	
date	: 11.2.90	
time	: 14.00	
sex	: female	| male
S.length	: 3.2 cm	| 4.7 cm
Caught by	: handnet	| handnet
remarks	: preserved	| preserved

Distribution : Orchid Pond, Northern Mangrove Pond, Main Trail Mangrove Pond, Shipstern Lagoon, Lagoon Trail Savannah Tracks

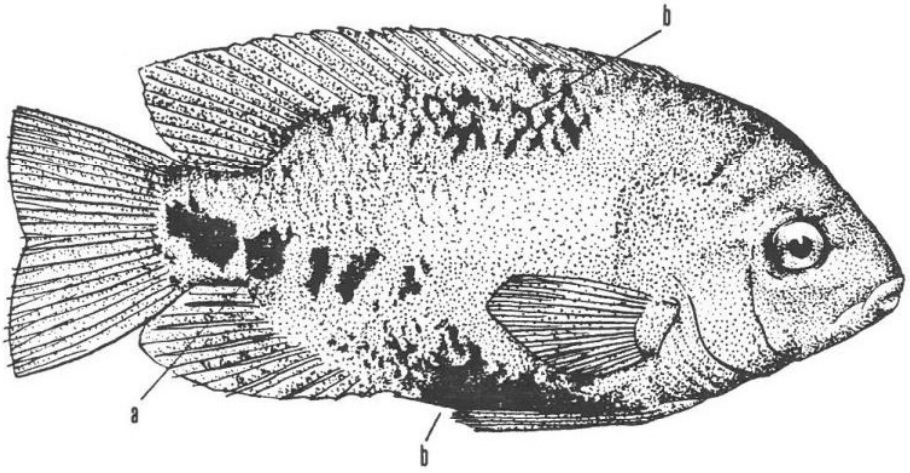
Thorichthys meeki (BRIND, 1918)

Family	:	CICHLIDAE (cichlids)
Synonym	:	*Cichlasoma meeki*
Vernacular	:	tuba, fire-mouth
Identification	:	family: no adipose fin, lateral line interrupted below soft part of dorsal fin, a single nostril on either side of snout, dorsal and anal fin with hard sharp spines. *T.meeki*: basic coloration of body yellow to pale red. 5-6 dark vertical bars, sometimes weak and difficult to see. Conspicuous dark blotch on inferior half of gill. Metallic blue head. Bright red throat during breeding period. 15-17 dorsal, 8-10 anal spines.
Observed	:	Cenote: 25.4.90, 16.00h. Many adults (standart length approx. 10 cm) as well as a few breeding pairs.
Distribution	:	Cenote

Parapetenia salvini (GUENTHER, 1862)

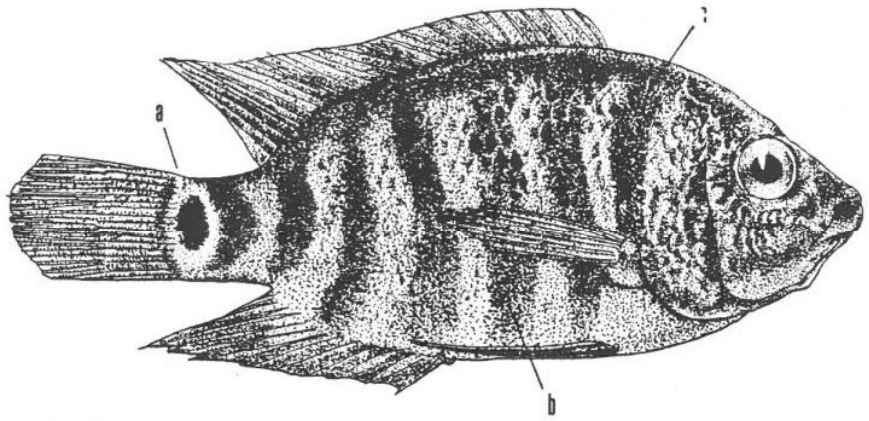
Family	:	CICHLIDAE (cichlids)
Synonym	:	*Cichlasoma salvini*, *C. triagramma* (STEINDACHNER, 1864)
Vernacular	:	tuba
Identification	:	(family ident. see *T.meeki*). Body relatively long compared to its depth. Two distinct dark lines running across top of head from eye to eye. Line of connected blotches on bright yellow body sides. Distinct dark line from eye to corner of mouth. Triangular head. Lower part of body red in breeding adults. 17 dorsal, 8 anal spines.
Observed	:	Cenote: 25.4.90, 16.00 . Two breeding pairs.
Standart length	:	approx. 30-35 cm.
Distribution	:	Cenote

Cichlasoma synspilum (HUBBS, 1935)



Family	:	CICHLIDAE (cichlids)
Synonym	:	*C. hicklingi* (FOWLER, 1956)
Vernacular	:	tuba
Identification	:	(family iden. see *T.meeki*). Horizontal series of blotches on anterior of body, originating at caudal peduncle(a). Sometimes also black blotch under dorsal fin and on belly (b). Adults with red head. Adult male with proeminent forehead . 17 dorsal, 6-7 anal spines.
Observed	:	Shipstern Lagoon Canal, January 1990 : one specimen (stnd. length approx. 15 cm). Cenote, 25.4.90, 16.00 : several breeding pairs (S.length approx 25-30 cm).
Distribution	:	Cenote, Shipstern Lagoon, Sea (see " Remarks on select species ")

Parapetenia urophthalmus (GUENTHER, 1862)



Family	:	CICHLIDAE (cichlids)
Synonym	:	*Cichlasoma urophthalmus*
Vernacular	:	tuba
Identification	:	(family ident. see *T. meeki*). Color of body cloudy-white to yellowish, with sometimes a reddish throat. Purple red during breeding period. A very distinct and conspicuous ovoid dark spot at very base of caudal fin (a), generally surrounded by bright white to blue line. Six dark vertical bars on the sides of the body (b), especially visible during breeding season. A seventh half-bar running from pectoral fin base to top of head (c). Young usually no bars, but 3-4 black blotches on anterior part of body. 15-17 dorsal, 6-7 anal spines.

Collecting data :

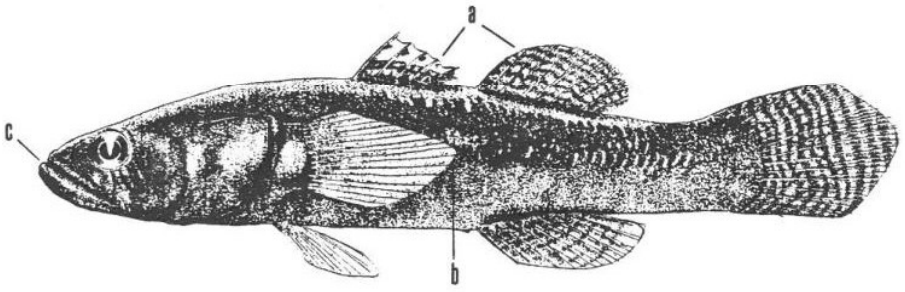
location	:	Orchid Pond	
date	:	6.2.90	
time	:	13.00	
sex	:	unknown	unknown
S.length	:	7.6 cm	2.3 cm
caught	:	hook	h.net
remarks	:	preser.	preser.

Distribution : Orchid Pond, Main Trail Mangrove Pond, Northern Mangrove Pond, Lagoon Trail Savannah Tracks, Cenote, Shipstern Lagoon, Sea

Petenia splendida (GUENTHER, 1862)

Family	:	CICHLIDAE (cichlids)
Synonym	:	none
Vernacular	:	bay snook
Identification	:	(family iden. see *T. meeki*). An elongated cichlid, body length about 3.2 times that of depth. Mouth large and highly protractile. Color of body gray-white to yellow, with a series of black blotches running from eye to caudal peduncle. In adult specimens, a dark spot appears on upper base of caudal fin. Body covered with tiny black dots.15 dorsal,4-6 anal spines.
Observed	:	Cenote, 25.4.90, 16.00 . Several specimens.
Distribution	:	Cenote, Shipstern Lagoon

Gobiomorus dormitator



Family	:	ELEOTRIDIDAE (sleepers)		
Synonym	:	*G. dormitor*		
Vernacular	:	bigmouth sleeper		
Identification	:	a brown fish with clear and spotted fins. A first dorsal fin with hard spines, a second dorsal with rays (a). Pectoral fins pointed towards back (b). No adipose fin. Pointed snout (c), head about as broad as deep.		
Collecting data	:	location	:	Shipstern Lagoon
		date	:	12.9.90
		time	:	1600
		sex	:	unknown
		S.length	:	6.3 cm
		caught	:	net
		remarks	:	preserved
Distribution	:	Shipstern Lagoon		

B) Marine species

Arius sp. (prob. *A. felis*)

Family	:	ARIIDAE		
Vernacular	:	sea-catfish		
Identification	:	a dark brown to black catfish. 2 maxillary barbels originating at upper jaw. Bony plates between head and dorsal fin. Very strong pectoral spine.		
Collecting data	:	location	:	Lagoon Canal
		date	:	8.3.90
		time	:	night
		sex	:	unknown
		S.length	:	19.5 cm
		caught	:	trap
		remarks	:	released. Collected pectoral spine on dead specimen.
Distribution	:	Shipstern Lagoon		

Sphoeroides sp. (prob. *S.greeleyi*)

Family	:	TETRAODONTIDAE (pufferfish)		
Vernacular	:	caribbean puffer		
Identification	:	A grey to olive-green or brown pufferfish, with orange iris in eye. White belly.		
Collecting data	:	location	:	Lagoon Canal
		date	:	9.3.90
		time	:	11.00
		sex	:	unknown
		S.length	:	10.2 cm
		caught	:	hook
		remarks	:	released
Distribution	:	Shipstern Lagoon		

Eucinostomus sp. (prob. *E. argenteus*)

Family	:	GERREIDAE
Vernacular	:	spotfin mojarra
Identification	:	no adipose fin, no sharp spines in dorsal fin. Body relatively deep in comparison to its length, giving the fish an almost triangular aspect. Very slender, bright silvery in colour. Fins yellowish except for dorsal fin that is dusky.

Collecting datas :

location	:	Shipstern Lagoon (Crispin's Landing)
date	:	25.4.90
time	:	17.00
sex	:	unknown
S.length	:	8.3 cm
caught	:	casting net
remarks	:	preserved

Distribution : Shipstern Lagoon

6. DISCUSSION ON SELECT SPECIES

Synbranchus marmoratus

The presence of this eel-like fish in a highly saline mangrove swamp is of interest as it demonstrates the adaptability of this hardy species to practically any type of aquatic habitat. The range of *Synbranchus marmoratus* extends over most of the neotropical realm. P. de Rham observed this species in fast flowing, rocky bottomed and highly oxygenated mountain streams (southern Mexico), nearly or totally deoxygenated waters like drying up muddy bogs or under dense floating vegetation (Mexico, Guatemala and Peruvian Amazon), highly acidic and very soft water as occuring in the Buriti palm swamps of the Amazon as well as in many less extreme habitats in the above mentionned countries, including Belize. In Peru one individual was caught completely out of the water slithering on the damp forest floor many meters away from the closest stream. Dr. K.H. Lüling of Germany who studied the biology of this species in some detail in the Peruvian Amazon (LULING, 1958, 1972), was able to observe that *S. marmoratus* did not die when its habitat dried up during the dry season, but dug burrows down to the water-table in the mud and estivated until the water returned. This fish can absorbe atmospheric oxygen through an enlarged and vascularised pharyngial cavity. Its snake like body enables it to move with agility through all types of obstacles and a thick coat of mucus reduces friction and protects the skin. Because of this sliminess it is practically impossible to hold a *S. marmoratus* in the hand.

This species has been caught only in the Main Trail Mangrove Pond but probably occurs elsewhere in the reserve, in view of its ability to survive in any habitat and move easily from one to another.

Astyanax fasciatus mexicanus

Astyanax fasciatus mexicanus has been caught only in the Orchid Pond, but recently it was also found in a very similar pond not far to the South. Freshwater Creek on the road from Sarteneja to Orange Walk near Progresso Lagoon, is the next nearest known place for the species. The fact remains, however, that it is found in the middle of a coastal brackish water system in a stagnant water body, which in itself is rather astonishing. Collecting done by the author in various water systems of Belize showed that it occurs in all examined rivers along the highways but never in stagnant swampy waters. However, RIEDEL (1972) describes *A. fasciatus* as relatively resistant to brackish waters, which could explain its presence in the Orchid Pond. In Guatemala it is found in many

lakes and populations are known to exist in isolated cenotes of the dry Yucatan limestone plateau where it usually lives in company of the cichlid *Parapetenia urophthalmus* (de Rham, pers. comm.). The most acceptable explanation for the presence of the species in the Yucatan cenotes is that they reached them via aquifers.

In the Orchid Pond at the very end of the wet season (January, 1990), *A. fasciatus* seemed to be a dominant species considering its numbers. In the second half of the dry season (April through May) these numbers decreased dramatically, as weaker specimens succumbed either to increasing salinity or predation. Wherever found, *A. fasciatus* always occurs in great numbers. Its capability of rapid population increase is counterbalanced by its poor resistance to deoxygenation.

Rhamdia laticauda laticauda

This rather large catfish seems to play the role of top predator in the Orchid Pond fish community, probably together with big specimens of *Parapetenia urophthalmus*. This was shown when the trap was set in place with a dead fish as bait: not only did the dead fish attract the catfish but also a few *Astyanax fasciatus*, which, in turn, became a meal for the catfish. This was deducted from the numerous remains of *Astyanax* that were found in the trap.

There was no evidence of any young animals and only two adults were observed during a nightly visit to the pond (18.7.90), when they were searching for food on the bottom. It is unlikely that the total number exceeded 4-5 individuals as the available food supply would not seem to allow for a much larger population.

Jordanella pulchra

This fish can be found in every permanent pool on the savannah and throughout the lagoon system. Further studies may reveal that this species constitutes a basic food supply for the many fish-eating birds living on the savannah and near Shipstern lagoon.

The author investigated other aquatic habitats throughout the country between the 26th of April and the 4th of June, but was unable to discover other populations of *J.pulchra*, even in similar coastal swamp areas near Ladyville, Belize district.

This species seems to be strictly related to mangrove habitats and, perhaps, only occurs in the northern coastal ecosystems of the country.

Rivulus ocellatus

Unlike *Jordanella pulchra* , this killifish was found in mud pools that dry out totally at the end of the dry season. DAVIS et al. (1990) have discovered this species on Twin Cays on the barrier reef. It was found living in crab burrows and proved to be strongly associated to mangral ecosystems. However, about 10 specimens of this species were caught in a small indentation in the shore of Shipstern Lagoon (locally known as "Crispin's landing"). Here they were living under a stranded canoe and among dead leaves in very shallow water. This indicates that *Rivulus ocellatus* can also colonize shallow shores of permanent water bodies. According to BOER, HOOGERWERF & KRISTENSEN (1973), females are hermaphroditic and produce only litters of females. Males are very rare, but in places where they occur, cross-fertilization happens more readily than self-fertilization. DAVIS et al. (1990) have observed that the Twin Cays population contained about 10-25% of males, whereas another population in Florida consisted nearly exclusively of hermaphrodites (>99%).

Inland waters are occupied by another species, *R.tenuis* which range extends on the Atlantic slope from Veracruz, Mexico, down to Honduras.

As to *Rivulus ocellatus*, it is known from isolated coastal stations in Southern Florida, Cuba, Haiti, Yucatan, and now Belize , but also in the Dutch Antilles, Aruba, Curacao and Bonaire . A closely related species with the same biology, possibly a subspecies, is known from the Brazilian coast near Rio de Janeiro. This extended and irregular distribution of the superspecies *Rivulus ocellatus* along the Atlantic littoral is possibly explained by the ability of its members to disperse occasionally across the sea and for one hermaphroditic individual to colonize a suitable habitat (WILDEKAMP, 1981).

Cyprinodon variegatus

This species has apparently not been recorded previously in Belize, probably because coastal habitats have not yet been studied in detail. *C. variegatus* is a typical inhabitant of coastal waters and has a large distribution: it ranges from the coasts of Massachusetts down to the coasts of Venezuela (WILDEKAMP,1981). Many subspecies have been described, but these are difficult to distinguish. Therefore its name will be kept to that of the species.

C. variegatus was only caught in the Lagoon Trail Savannah Tracks, but was sighted in Shipstern Lagoon schooling in great numbers together with *Jordanella pulchra*. The population in the Savannah Tracks was very dense and males had extremely small territories: a measured area of 0.35 sq.meter contained 4 territories, actively defended against any intruders.

Gambusia puncticulata yucatana

A very common and widely distributed fish throughout the reserve. The first specimens caught were identified as *G. sexradiata*. Further specimens were caught in order to check this identification: it appeared that all specimens were of the species *G. puncticulata yucatana*. *G.sexradiata* being very similar, has 3 rows of black dots in the dorsal fin and a much darker caudal fin. Collecting done by the author in the main river systems of Belize showed that *G. sexradiata* inhabits fresh and running waters.

Poecilia cf. sphenops

Poecilia cf. sphenops is a common fish in the reserve, occuring in most permanent waters. Its range from fresh to saline water (up to 9%, de BOER,1973) makes it one of the most adaptable fish to be found in the reserve.

According to de Rham, the specimens caught in the Orchid Pond belong to one of the most beautiful forms of *P.sphenops* in Central America. Two very different coloration patterns in males occur in this small pool: one male form has an orange dorsal and caudal fin, the caudal fin bordered on its extremity by a black fringe. The other form has yellow patches in the dorsal and sometimes also in the caudal fin. However, it remains possible that we are dealing with two different species, and further study of these fishes would be necessary to clarify this point.

Cichlasoma synspilum

Although *Cichlasoma synspilum* is reported to be very adaptable (STAECK & LINKE, 1985), it is surprising to find it swimming in saline habitats like Shipstern Lagoon and Chetumal Bay (see map), which are almost if not as saline as the open sea.

Breeding pairs were observed in the Cenote (25.4.90) and at the peninsula in Chetumal bay (early May, 1990).

At the time of observation, the pair in the Cenote had established a "nest" under mangrove roots which consisted of a cleared hollow area about 30x30 cm in which the female had deposited her eggs. Both parents were guarding the site.

According to J.-C. Nourissat, the *C.synspilum* observed in the Cenote ranked among the most beautiful forms encountered up to now in the wild.

Parapetenia urophthalmus

Parapetenia urophthalmus is the only cichlid found in shallow waters. It bred in the Orchid Pond, the Main Trail Mangrove Pond and the Cenote at the end of April. The common breeding pattern for cichlids is characterized by a breeding period starting at the end of the dry season in order to provide the young with a fresh food supply when the first rains come (LOWE- MCCONNELL,1987). An unusual exception to this pattern was discovered in the reserve: 30 breeding pairs were counted in the Northern Mangrove pond on the 24th of February, 1990 . These 30 pairs were counted along a stretch of water less than 30 meters long, with a distance between each breeding pair not exceeding 1.5 meters.

In the second half of April being the usual breeding period of the species, water had dropped to only 15 cm in the deepest part of the pond, whereas the average was approximately 5 cm. Measured temperature of water indicated 36°C. No living adults were sighted, but schools of 100-200 young were observed taking shelter between mangrove roots. Apparently this is a very local adaptation of *P. urophthalmus* to extreme seasonality: as most of the adults perish under the combined effect of harsh conditions and predators, the species survives in the pond because of very young specimens. This implies that the young have to reach sexual maturity before the next dry season, which is very likely what happens in this case. Ecological attributes of fish living under extremely seasonal conditions are short life-cycles, early maturation, fast growth rates and high biomass production (LOWE-MCCONNELL,1987). It seems plausable that *P. urophthalmus* uses all of these attributes to adapt itself to this seasonal habitat.

To find normal breeding behaviour in the coastal area, with, at a short distance, a remarkable case of local adaptation confined to a single pond, was a surprising find.

7. CONCLUSION

This study focuses on fresh and brackish water species. It should be made clear that the species list on page 10 is certainly not complete: although the freshwater species seem to be fairly well covered, there are certainly many saltwater species spending part of their life in the lagoon system, which have not been described in this report.

What other species are likely to occur in the range of habitats within Shipstern Nature Reserve? Mangrove swamps generally provide very unstable habitats in which temperature and salinity vary greatly (from 20-39°C and 0- 4.6% salinity) with dissolved oxygen also fluctuating considerably. Some very euryhaline species can survive in mangrove swamps. These include cyprinodonts, poecilids, some eel species, some cichlid species, gobbies and blennies. Open-lagoon fishes to be expected include ariid catfishes, sphoeroids (puffers) and syngnathids (LOWE-MCCONNELL, 1987). Numerous seafish (reputedly 400 out of all marine species) use open mangrove swamps and lagoons as nursery grounds (GUNDERMANN & POPPER, 1984 in LOWE- MCCONNELL, 1987). The waters of Shipstern Nature Reserve thus match this scheme almost exactly: cyprinodonts, poecilids, eels and cichlids form the euryhaline species found here. Two families , those of the blennies and the gobies, appeared to be absent, although a future survey of Shipstern Lagoon might reveal their presence. 4 out of 5 of the open lagoon families are represented in the Shipstern Lagoon. Centropomids (snooks) were not caught by the author, but according to local fishermen they are present in the lagoon. Further investigation of marine species is definitely needed, because the number of species that use Shipstern Lagoon as a breeding ground is unknown.

Pollution is a potential threat to fish populations , although it is not yet a major problem. Some small species, such as cyprinodonts, though resistent to natural changes in water conditions, are known to be very sensitive to pollution. A sharp decrease in fish populations could have devastating effects on local bird populations dependant on these lagoon dwelling fishes. However, the main threat to bigger fish species remains overfishing by local people, a fact difficult to change under present conditions.

Finally, Shipstern Lagoon is one of the major open lagoon systems in Central America and well deserves the protection it is acquiring today. Even with this protection, continuous destruction of surrounding areas threaten the integrity of the ecosystems within Shipstern Nature Reserve. Further efforts should therefore be undertaken to protect this beautiful wild area.

8. ACKNOWLEDGEMENTS

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