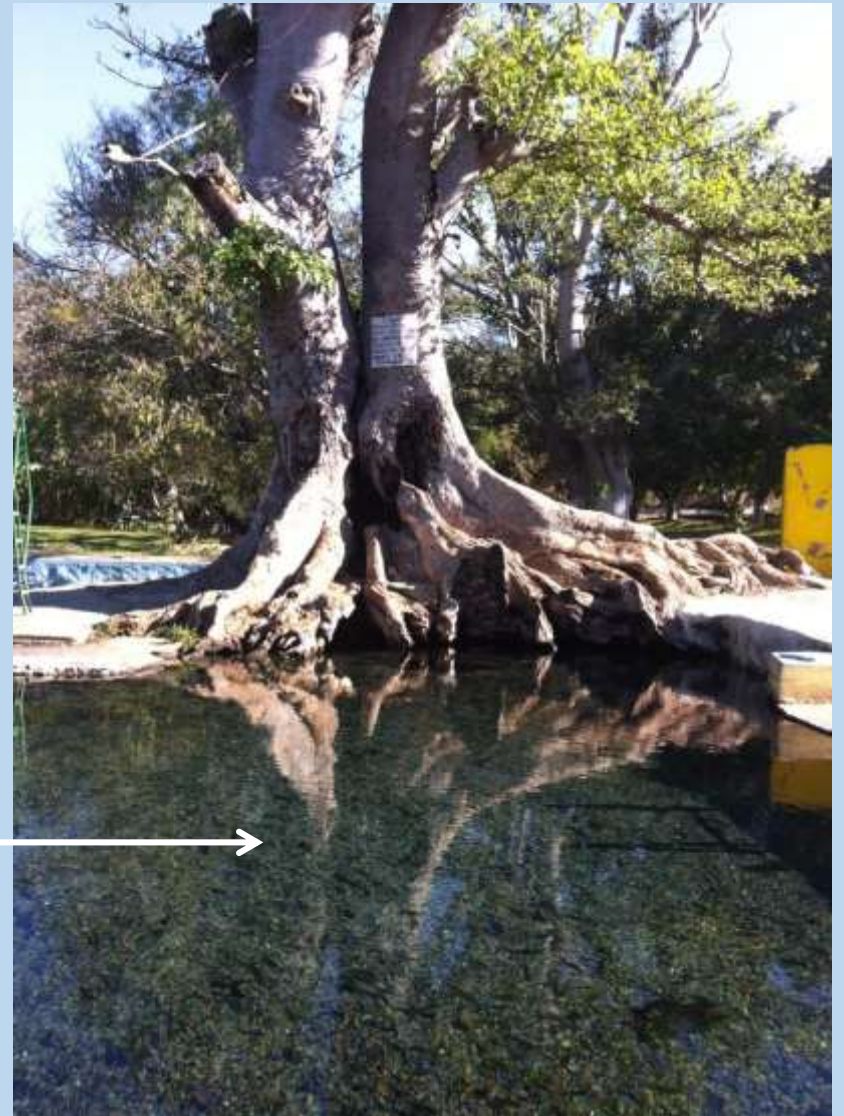




Zoogoneticus tequila reintroduction project: an international cooperative project



Reintroduce *Zoogoneticus tequila* to Teuchitlan wetland area



Phase 1 (year one and two).

Securing the reintroduction by the biological, ecological and limnologic characterization of the springs of Teuchitlán

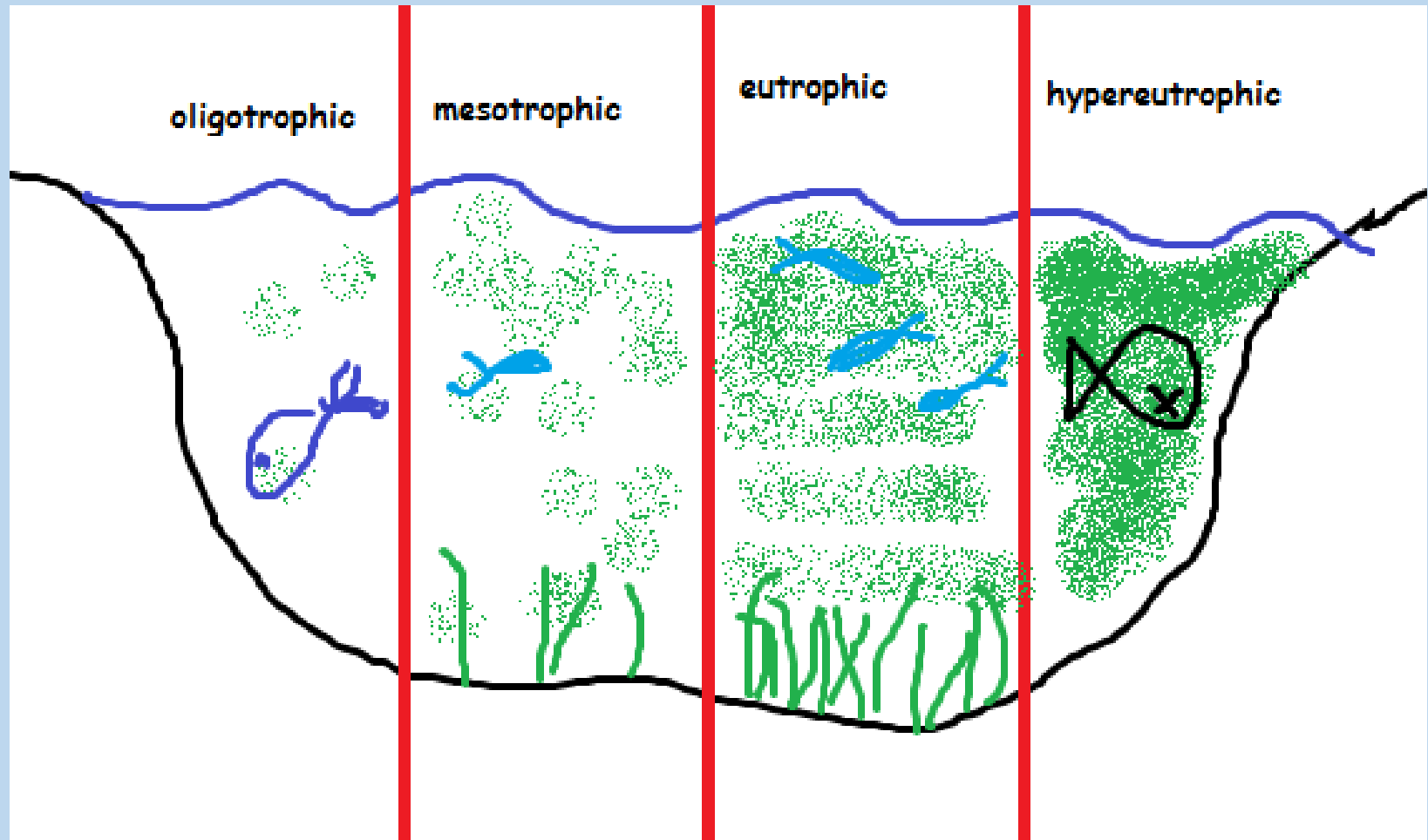
- Electrochemical characteristics of the water
- Water and habitat Quality Indexes
- Geomorphologic variables
- Aquatic vegetation
- Plankton community
- Fish community structure
- Food chain of the fish community
- Growth and reproduction of the fish species
- Parasitological studies



Colection sites



Limnobiological characterization

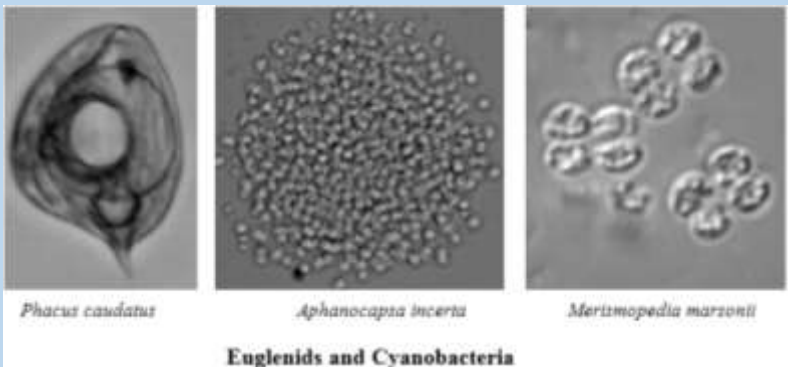
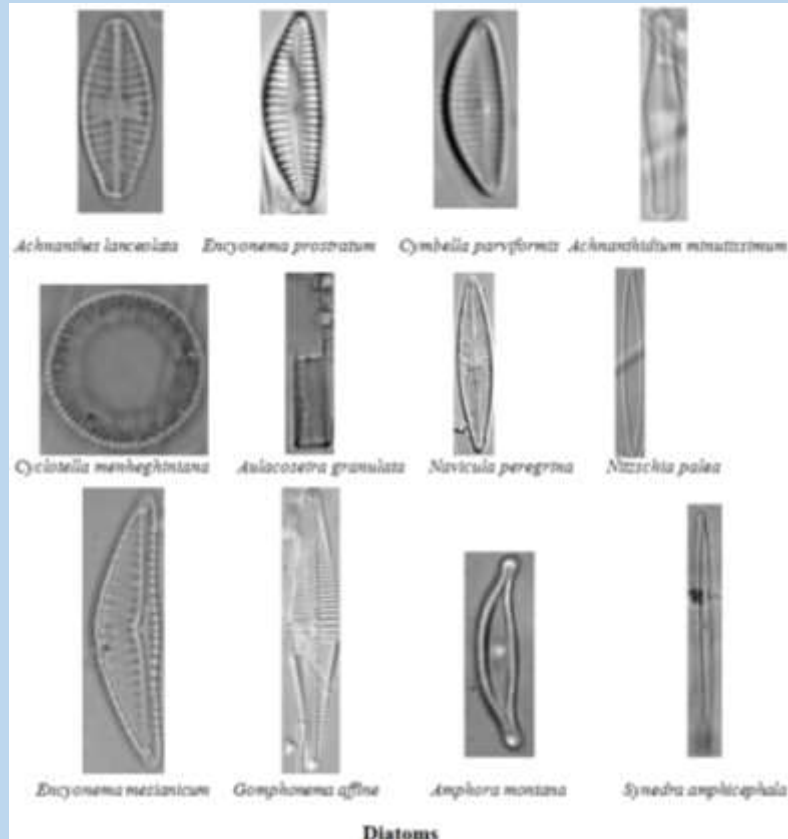


Water quality along the river using 35 Parameters

PARAMETER	% TEST PROBLEM	% VARIATION COEFFICIENT
pH	0.0	11.2
Suspended solids	8.3	22.6
Dissolved solids	0.0	0.0
Electrical conductivity	16.7	10.7
Dissolved oxygen	19.4	29.9
DBO ₅	0.0	8.2
Total hardness	0.0	3.2
Chlorides	5.6	13.4
Total alkalinity	100.0	4.8
Nitrate	2.8	16.8
Total phosphorus	97.2	22.4
Turbidity	27.8	22.5
Total coliforms	69.4	28.1
Fecal coliforms	38.9	31.0



Phytoplankton community



SITE	Phytoplankton	Dominant algal group
S1	< 200 org/mL	Diatoms
S2	< 200 org/mL	Diatoms
S3	< 1000 org /mL	Diatoms Green algae
S4	< 500 org/mL	Green algae Diatoms Blue green algae
S5	< 500 org/mL	Diatoms Green algae
S6	< 200 org/mL	Green algae Diatoms
S7	< 200 org/mL	Green algae
S8	< 500 org/mL	Diatoms
S9	> 1000 org/mL	Green algae, Diatoms, Blue Green algae, Euglenoids

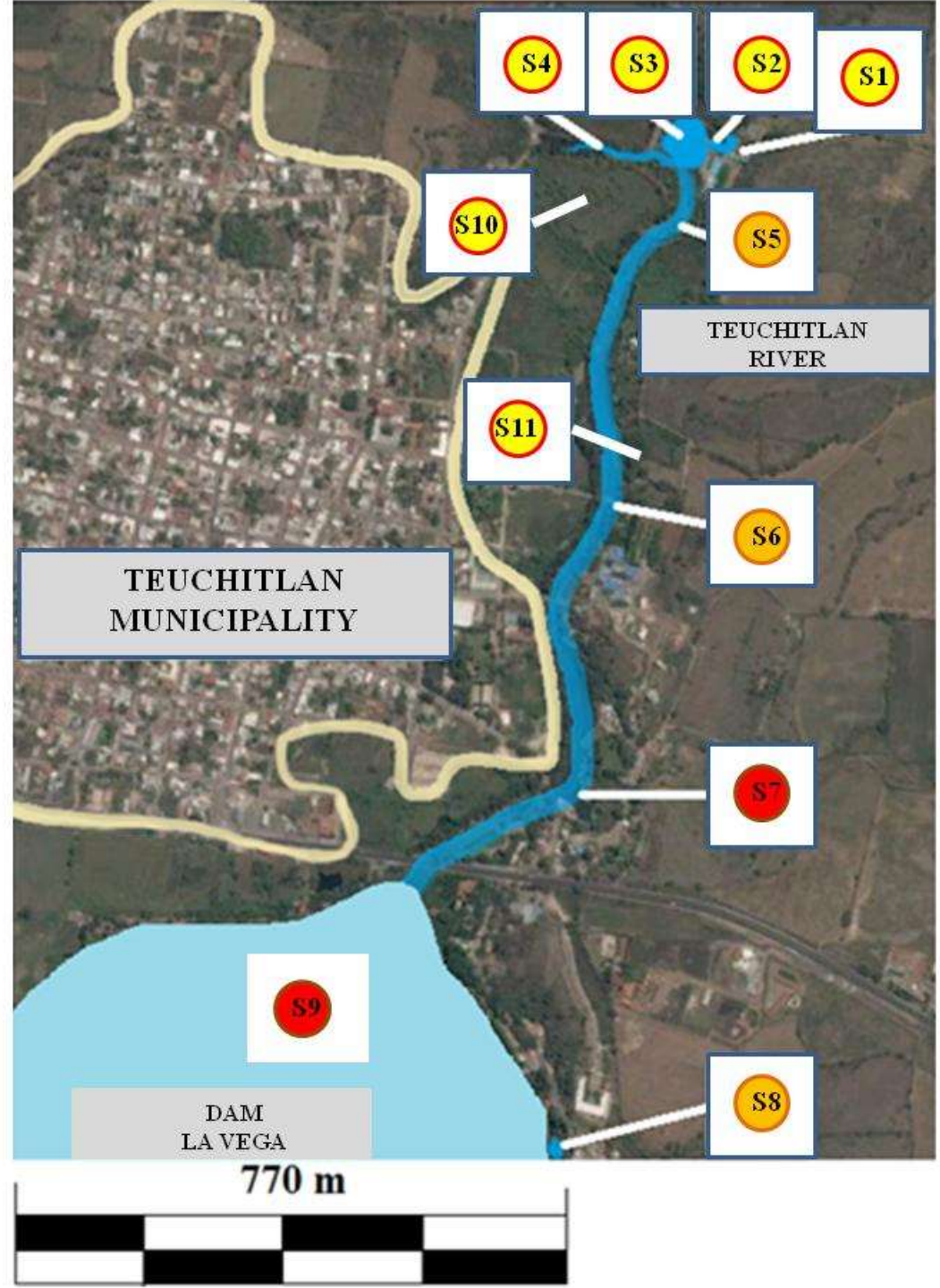
NYGAARD INDEX

 MESOTROPHIC

 MESOTROPHIC
TO EUTROPHIC

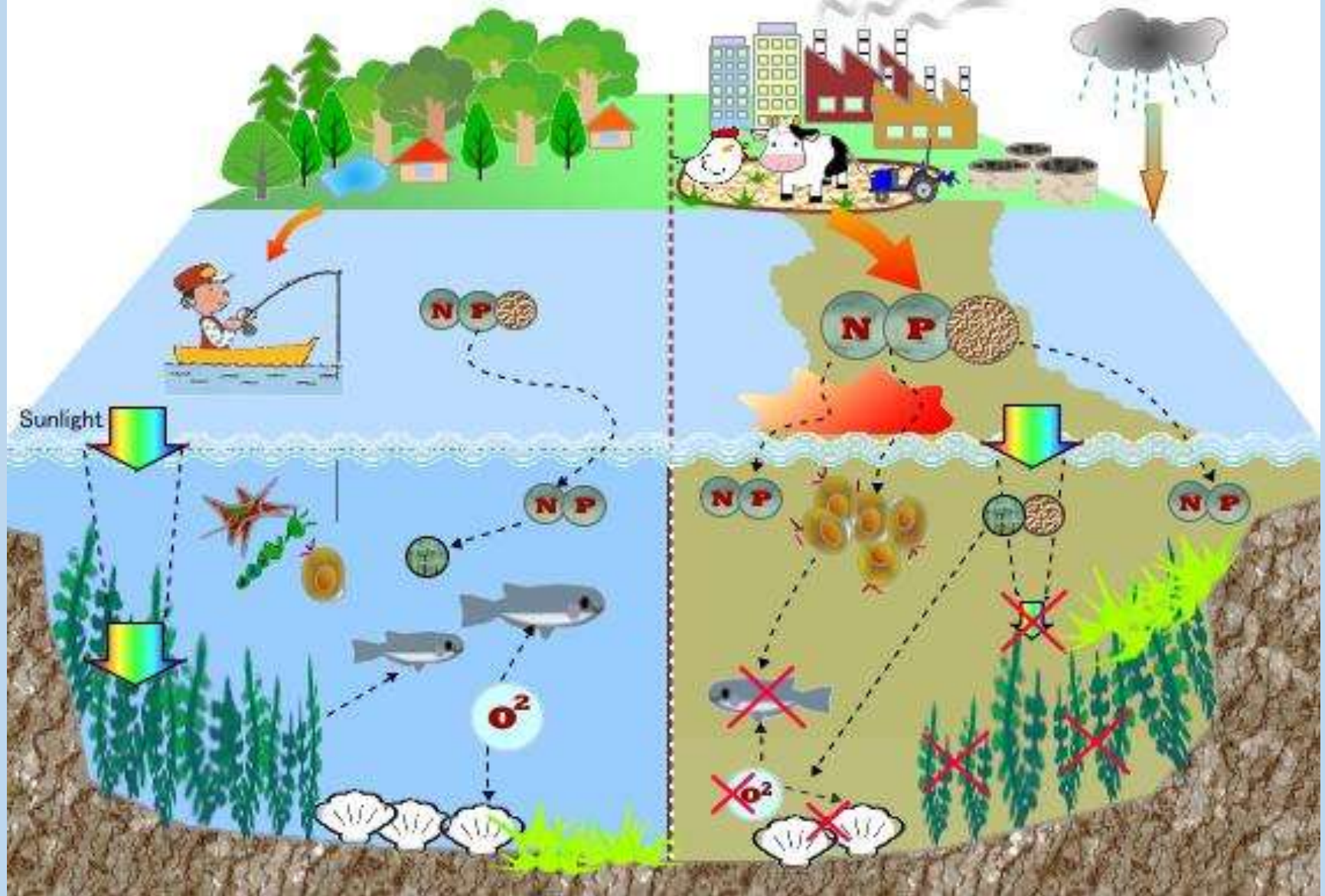
 EUTROPHIC

- Algal species and water quality
- Agriculture and domestic water discharge



Healthy ecosystem

Eutrophic ecosystem



28 Taxa

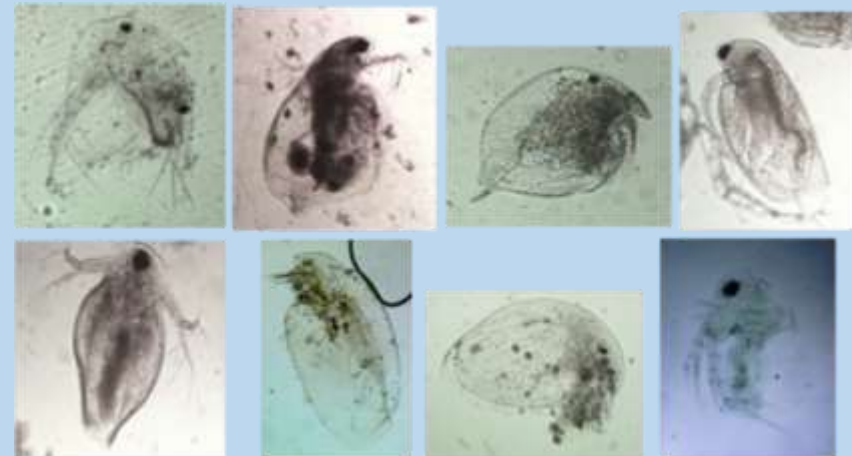
COPEPODA



ROTIFERA



CLADOCERA



OSTRACODA



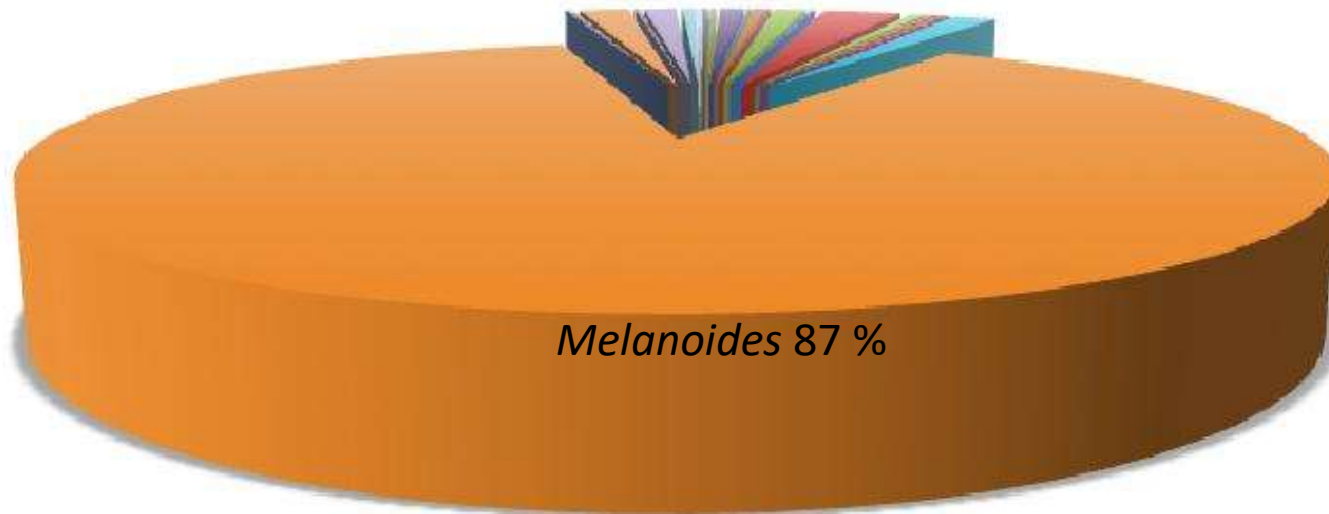
MACROINVERTEBRATES



Taxonomic list

❖ 37 taxa

❖ *Melanoides* as the most abundant 87%.



Acroloxidae	Aphylla	Baetidae	Cambarellus	Chironomidae	Chironominae	Coenagrionidae	Coleoptera
Corbicula	Curculionidae	Decapoda	Delphacidae	Diplostraca	Fossaria	Glossiphoniidae	Goeldichironomus
Gomphidae	Helicopsyche	Hemiptera	Hyaella	Hydrophilidae	Libellula	Lumbriculida	Melanoides
Odontomyia	Oecetis	Pelocoris	Physidae	Planorbidae	Pomacea	Scirtes	Simuliidae
Sphaeriinae	Sphaeriidae	Tanypodinae	Tipulidae	Tropisternus			

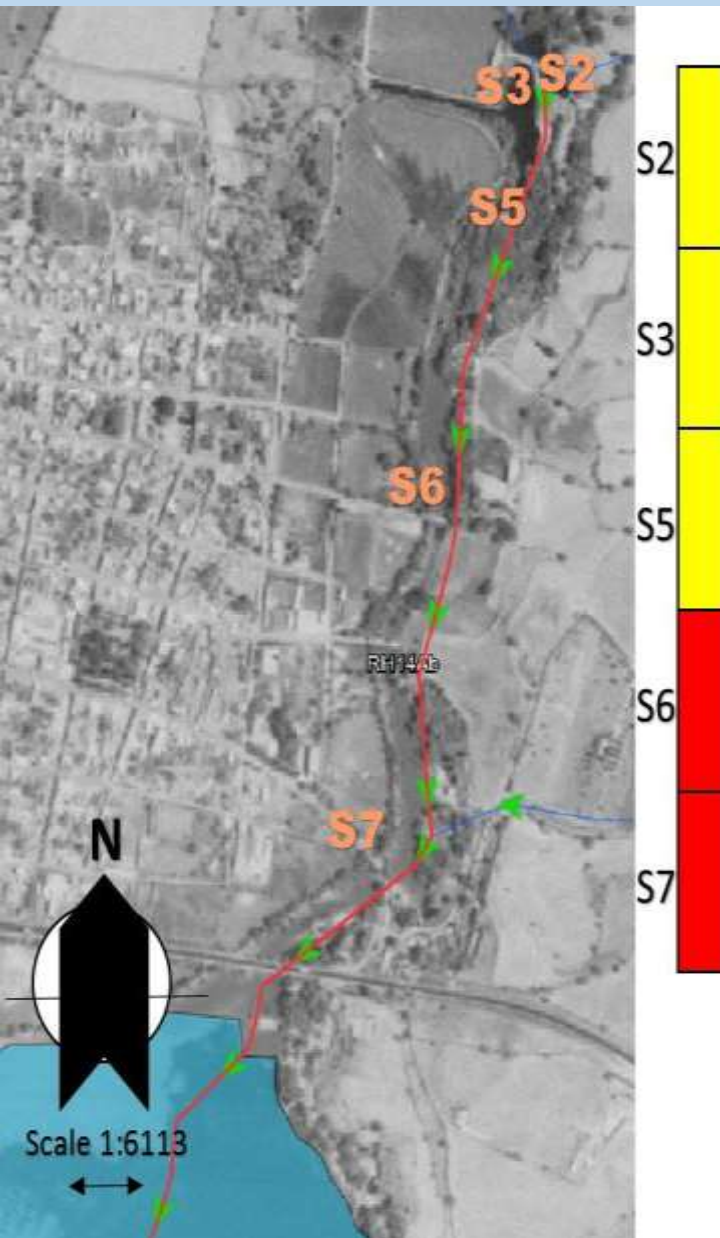




Integrity Biotic Index (IBI) using fish community as indicator.

- Express the degree of change in the system due to disturbance using the fish and invertebrate community.
- It is widely used in biomonitoring systems, because is easy and the local people can do it by their self.

General trend of Integrity Biotic Index (IBI).



excellent

regular

poor

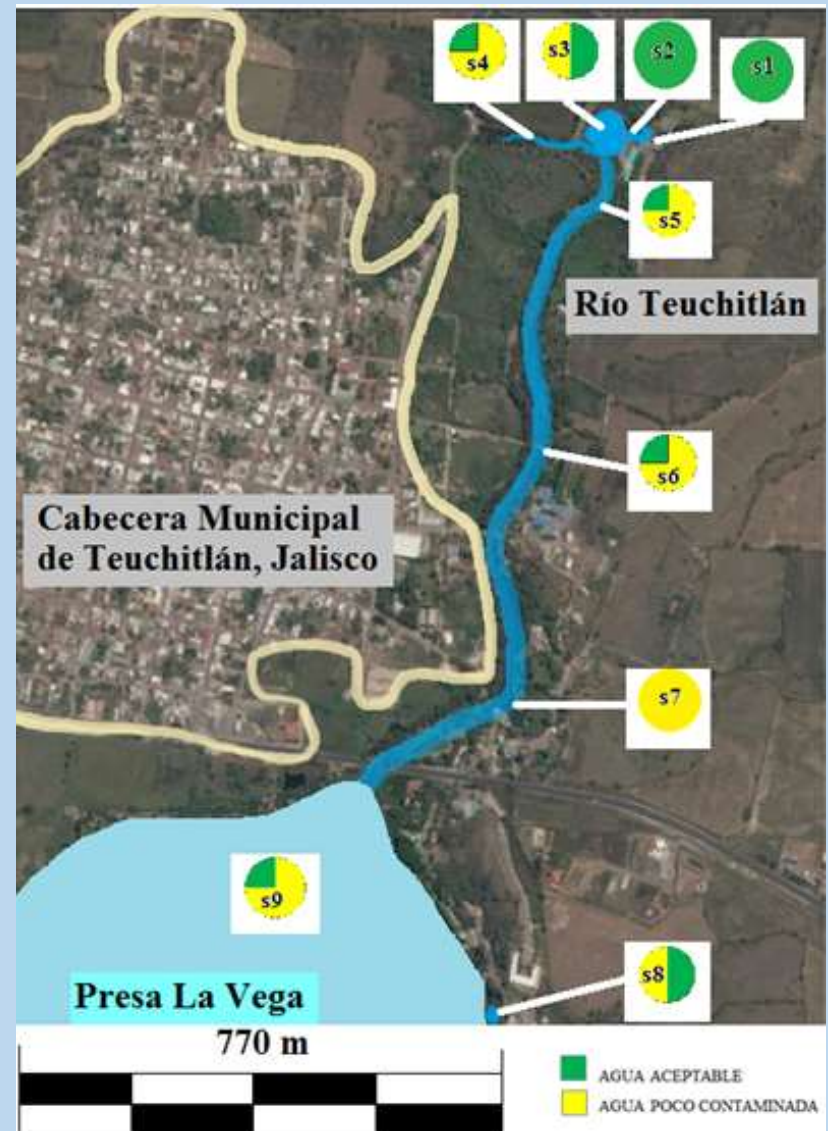


The decision is not easy

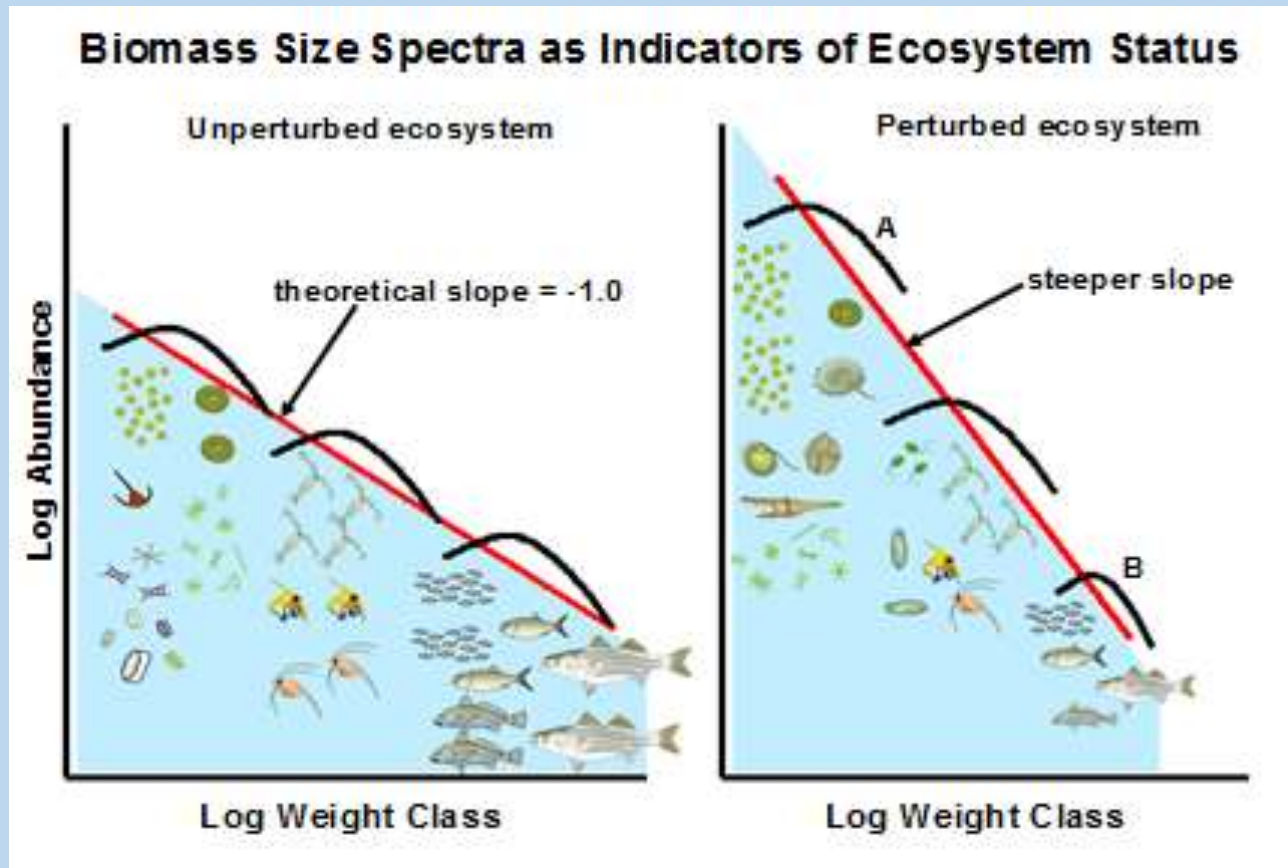
-Sites 1 to 3 and 8 with the best quality index

-The most invertebrates diverse (potential food) sites are the poorest quality index places

Were we need to reintroduce?



Fish community aspects



Competition

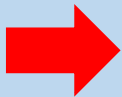
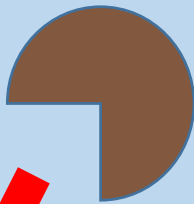
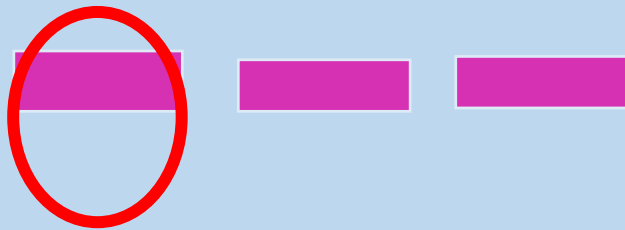
Exclusion

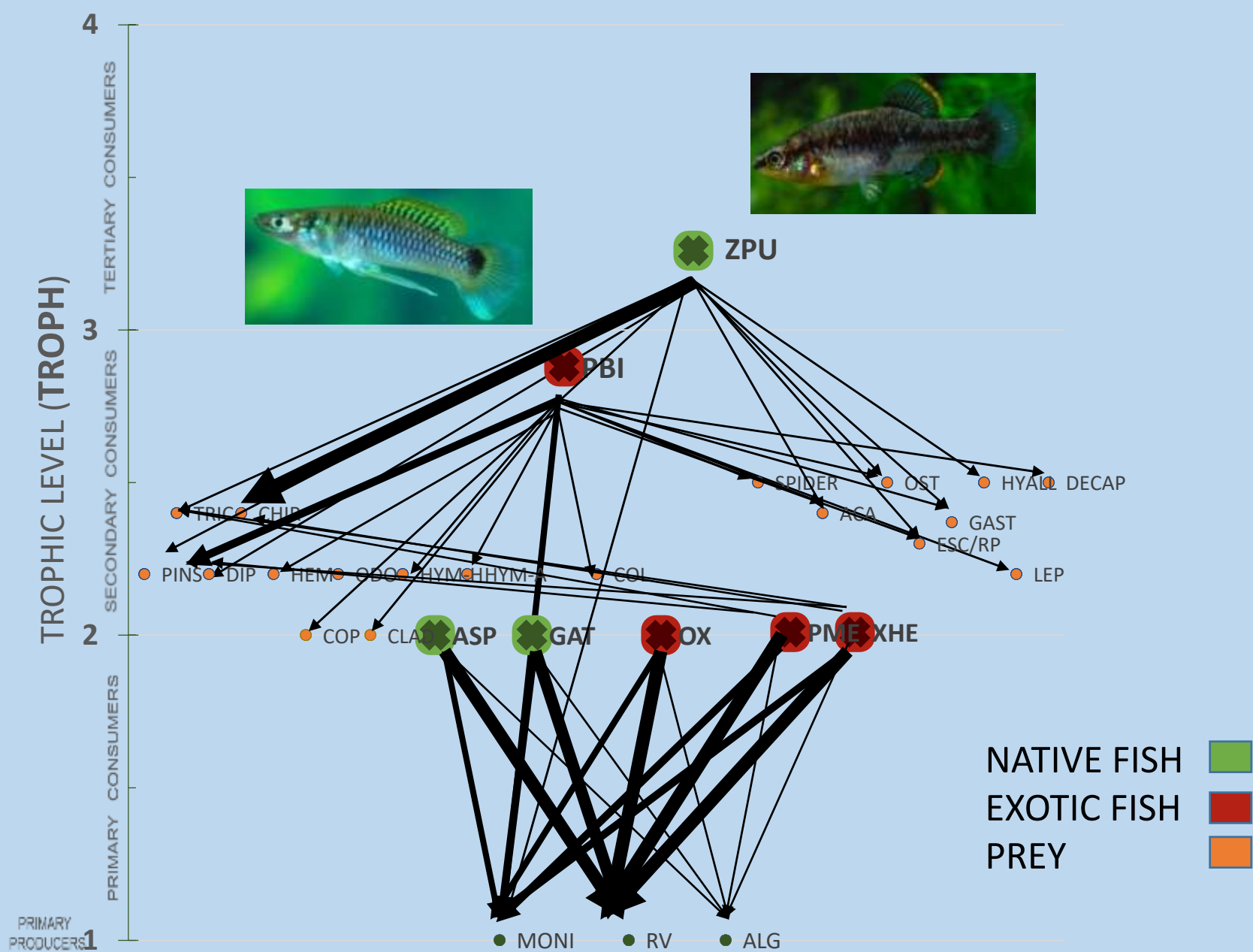
Coexistence

Survival

Extinction

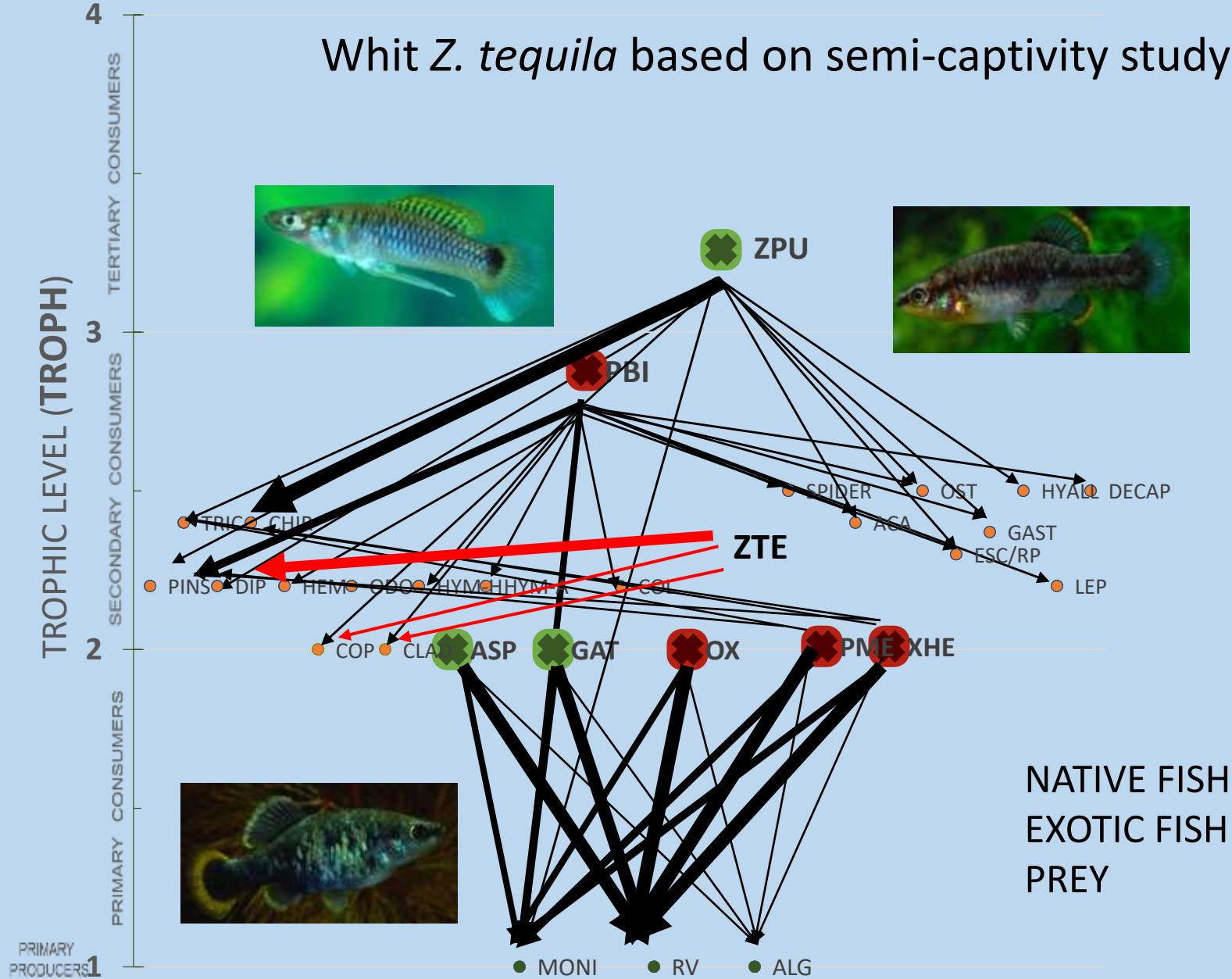
Trophic aspects of the fish community in situ and ex situ





Trophic relationships between fish. Stream Teuchitlán Jalisco.

Whit *Z. tequila* based on semi-captivity study



Community composition

Family	Species	Origin	Trophic guild
Cichlidae	<i>Oreochromis</i> spp.	Exotic	Omnivore
Goodeidae	<i>Ameca splendens</i>	Native	Omnivore
	<i>Chapalichthys encaustus</i>	Translocated	?
	<i>Goodea atripinnis</i>	Native	Omnivore
	<i>Zoogoneticus purhepechus</i>	Native	Carnivore-insect.
Poeciilidae	<i>Pseudoxiphorus bimaculatus</i>	Exotic	Carnivore-insect.
	<i>Poecilia mexicana</i>	Exotic	Carnivore-insect.
	<i>Xiphophorus helleri</i>	Exotic	Omnivore
	<i>Xiphophorus maculatus</i>	Exotic	Omnivore
Ictaluridae	<i>Ictalurus dugesii</i>	Native	Carnivore-insect.

***Ameca splendens* (N)**



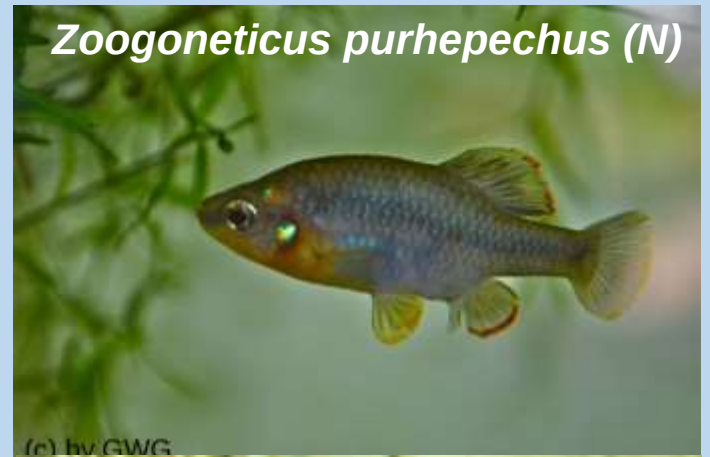
***Oreochromis niloticus* (E)**



***Poecilia mexicana* (E)**



***Zoogoneticus purhepechus* (N)**



***Goodea atripinnis* (N)**

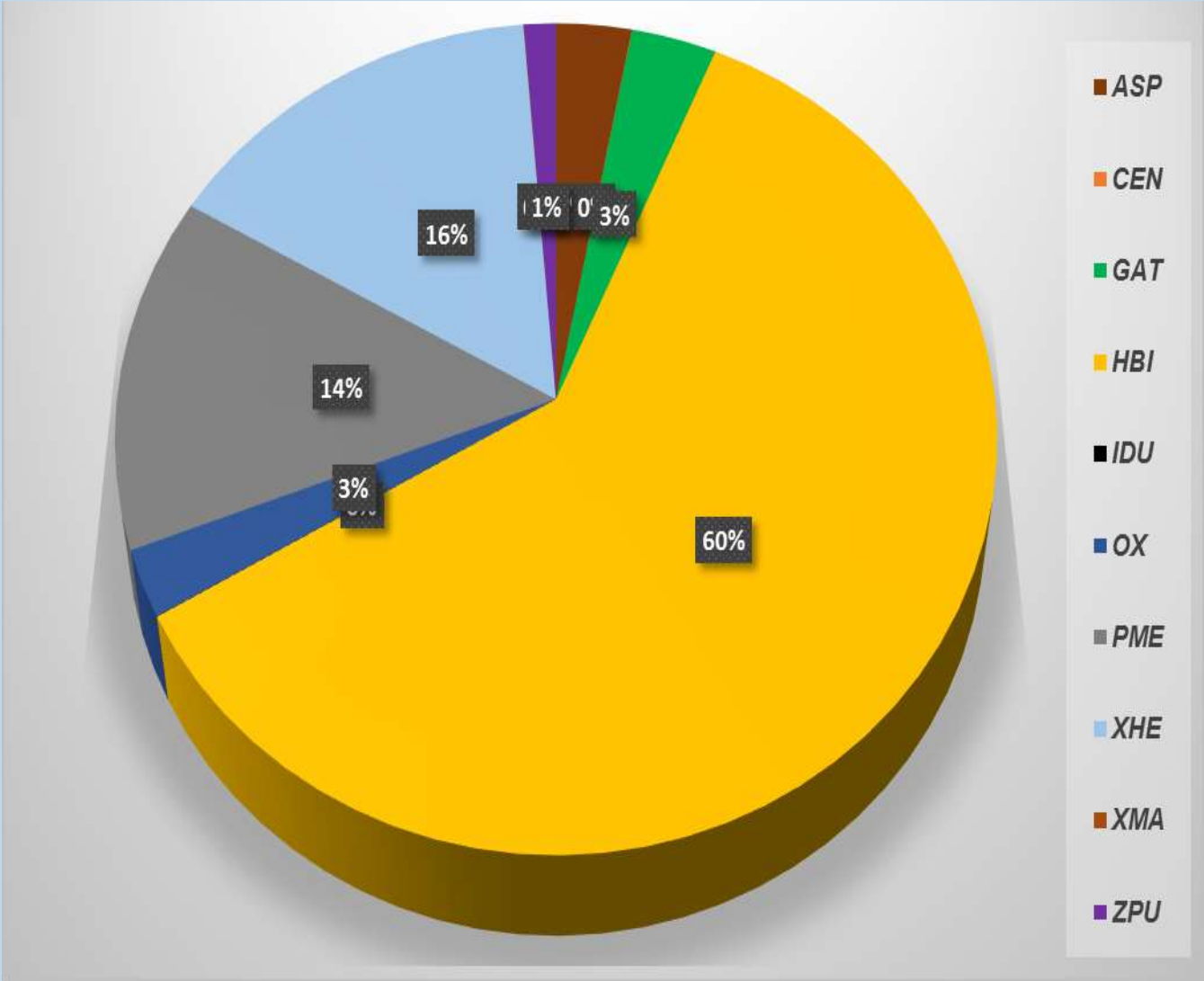


***Pseudoxiphophorus bimaculata* (E)**

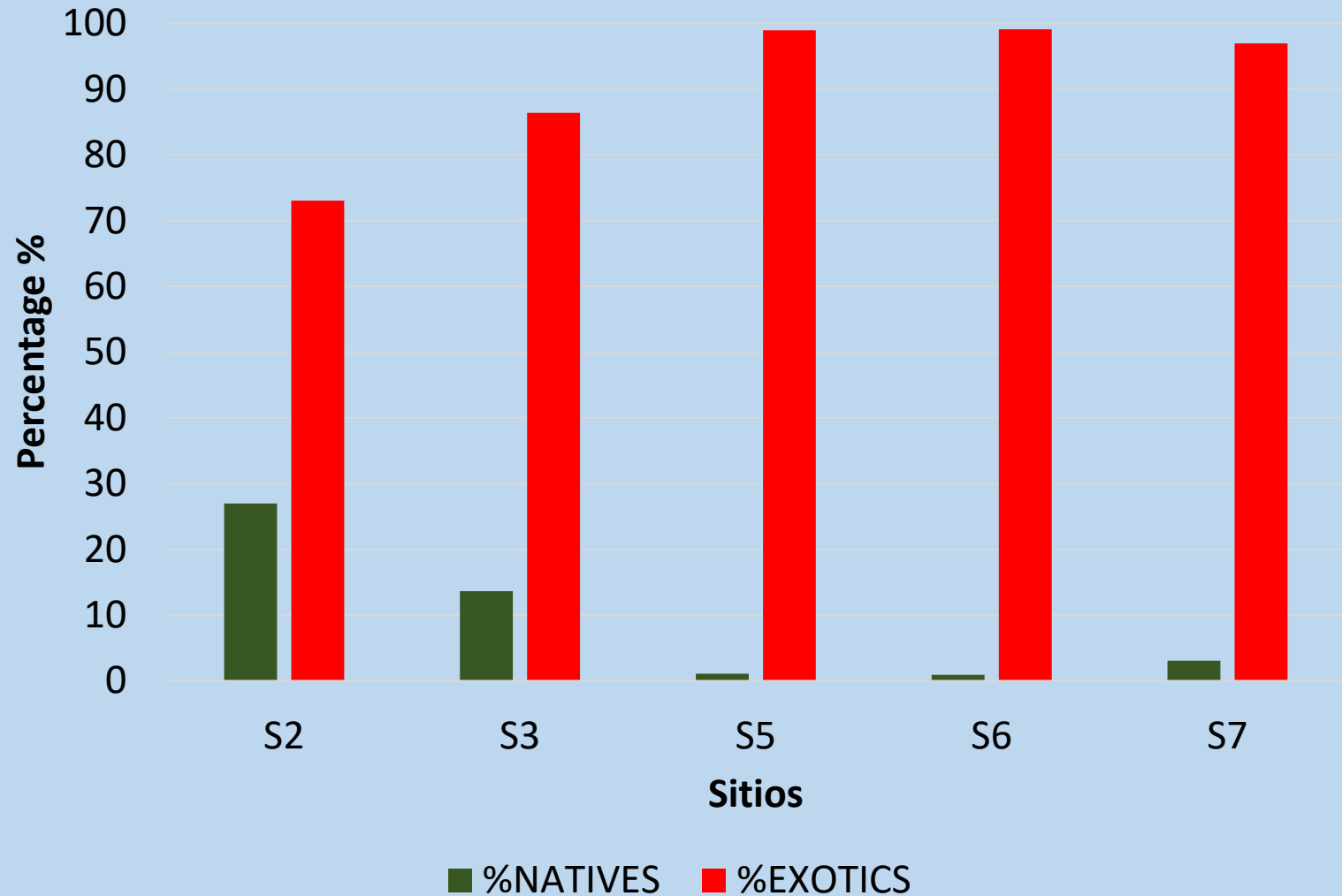


Abundance of species

90% represented by
exotics



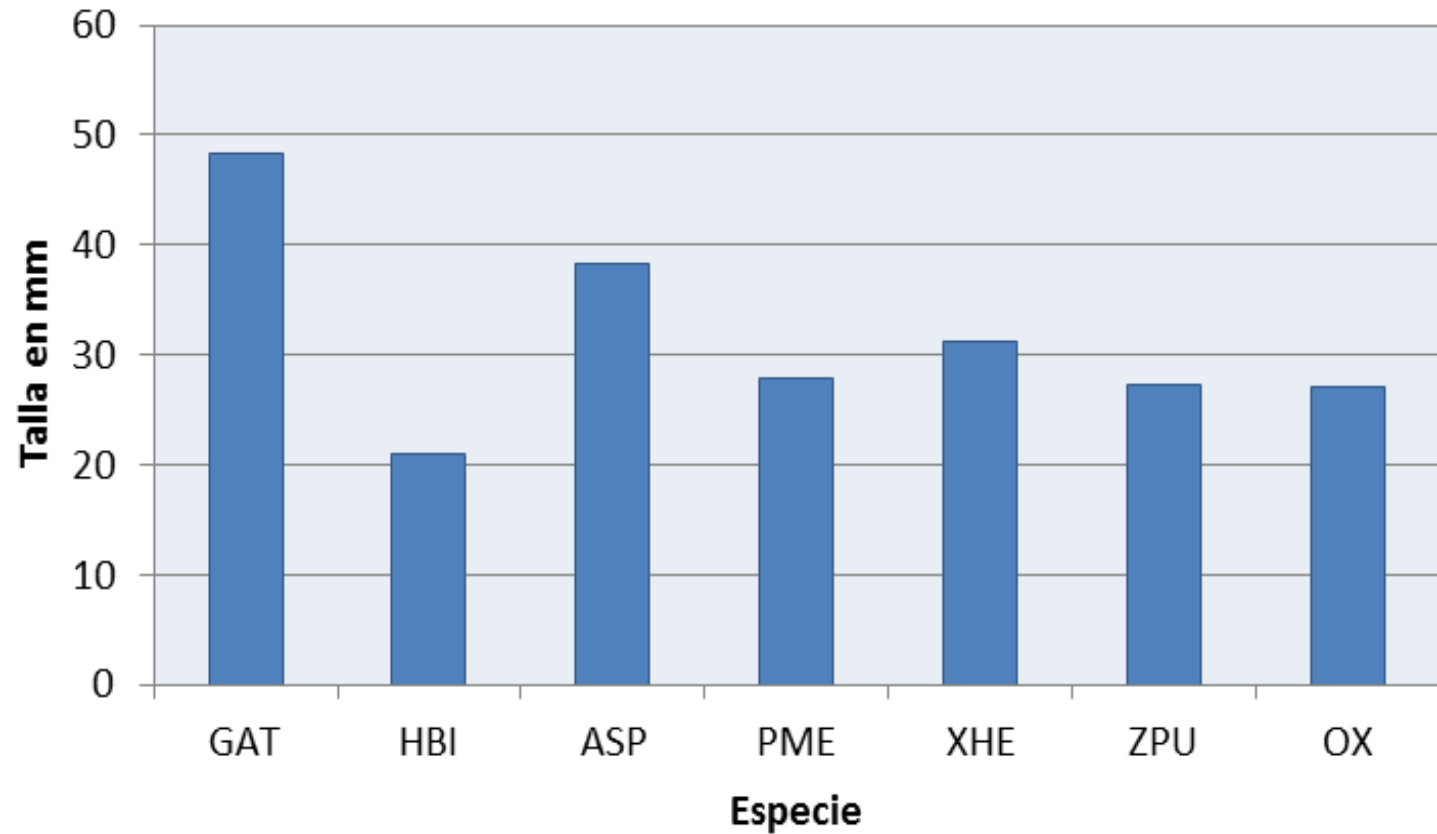
Density of fish community in the different locations



REPRODUCTIVE ECOLOGY



Minimum reproduction size



	ASP	GAT	HBI	PME	XHE	ZPU	ZTE
SEXUAL PROPORTION	0.25:4	1:1.3	1:2	0.68:1	1.38:1	0.75:1	1:1.8
FECUNDITY	5	8	6	20	7	6	4



FISH PARASITOLOGY IN THE WILD

Host	Parasite	Taxonomic group
<i>Goodea atripinis</i>	<i>Contracaecum</i> sp L2-L3*	Nematoda
	<i>Eustrongylides</i> sp L3*	
	<i>Diplostomum</i> sp Mc**	Platyhelminthes
	<i>Centrocestus</i> sp Mc**	Platyhelminthes
<i>Ameca splendens</i>	<i>Rhabdochona</i> sp	Nematoda
<i>Oreochromis niloticus</i>	<i>Bothriocephalus acheilognathi</i>	Platyhelminthes
<i>Poecilia mexicana</i>	<i>Contracaecum</i> sp L2-L3*	Nematoda
	<i>Eustrongylides</i> sp L3*	
<i>Xiphophorus hellerii</i>		
<i>Zoogoneticus purhepechus</i>	<i>Diplostomum</i> sp Mc**	Platyhelminthes
<i>Heterandria bimaculata</i>	<i>Contracaecum</i> sp L2-L3*	Nematoda
	<i>Diplostomum</i> sp Mc**	Platyhelminthes

* L = Larvae, **Mc = Metacercariae

The overall **prevalence was 25%**, an abundance of 0.8 helminths per analyzed host and an average intensity of 3 helminths per infected host. During the year the overall results about the characterization of the **infection tends to remain at low levels**; which indicates the **absence of parasitological problems** in resident fish populations.



PARASITOLOGICAL ASPECTS OF *Zoogoneticus tequila* UNDER SEMICONTROLLED CONDITIONS

In the examination period two genera of parasites were found.



A crustacean ectoparasite *Lernaea cyprinacea* and a nematode *Spiroxys* sp Larva.



The prevalence infection values were 20% to 0% depending to the year season, which means, **the low percentage is not a risk for the reintroduction.**

SOCIAL ASPECTS

The pet



Communitarian water quality monitoring



12 people from Teuchitlan

Long term monitoring plan

Environmental education program





ENVIRONMENTAL EDUCATION WORKSHOPS





PLAYFUL ACTIVITIES

+ DYNAMICS FOR GENERATING ENVIRONMENTAL AWARENESS

+ KNOWLEDGE OF NATURAL RESOURCES

+ ACTIVITIES FOR CONSERVATION OF ENDEMIC SPECIES

LEARN IN THE GAME



- + VALUE OF BIODIVERSITY
- + CONSERVATION ACTIVITIES IN PROTECTED AREAS OF MEXICO
- + SOCIAL AND ECONOMIC VALUE OF BIODIVERSITY
- + ECOSYSTEM SERVICES
- + PRIORITY SPECIES
- + MECHANISMS FOR THE PROTECTION OF BIODIVERSITY

KNOWING THE BIOLOGICAL DIVERSITY



IMPORTANCE OF THE WATERSHED CONSERVATION



SPECIES INTERACTIONS



- + ENDEMIC SPECIES
- + INTRODUCED SPECIES
- + EXOTIC SPECIES
- + FOOD CHAIN
- + INTERSPECIFIC RELATIONSHIPS
- + REPOPULATION OF ENDEMIC SPECIES
- + VALUE BIOLOGICAL OF DIVERSITY

Environmental education program

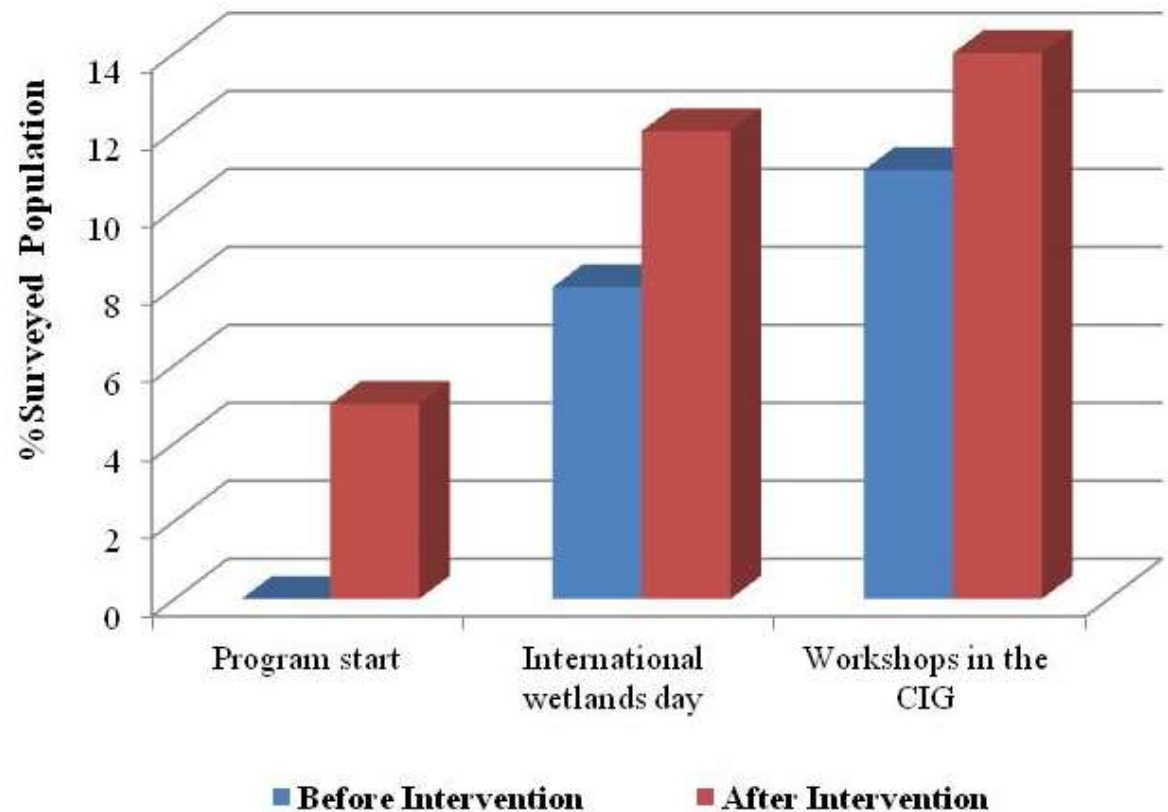


EVALUATION OF ENVIRONMENTAL EDUCATION PROGRAM

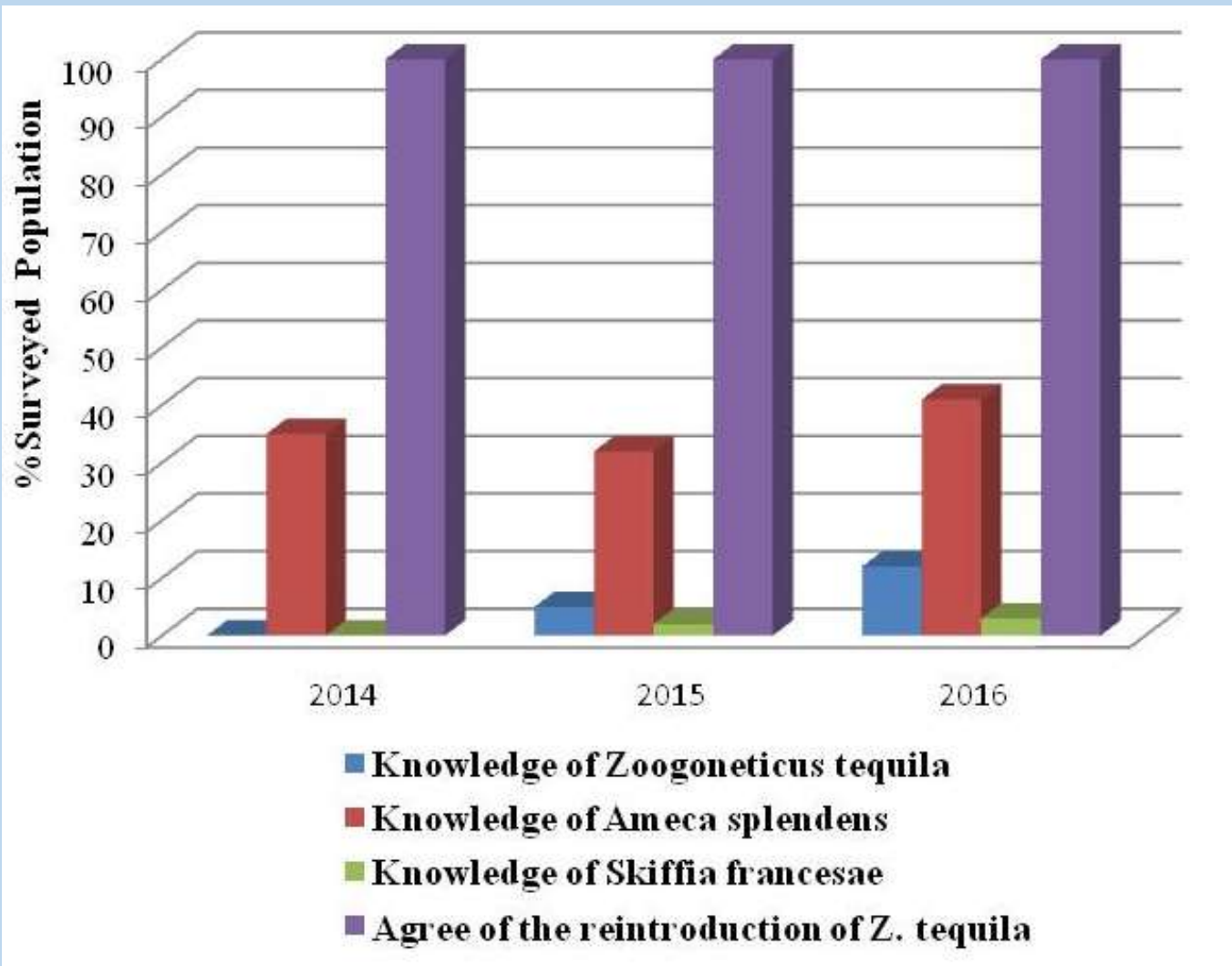
RESULTS

PROGRAM IMPACT

% of people aware of the value of species conservation



KNOWLEDGE OF SPECIES ENDEMIC AND PUBLIC OPINION ABOUT THE REINTRODUCTION



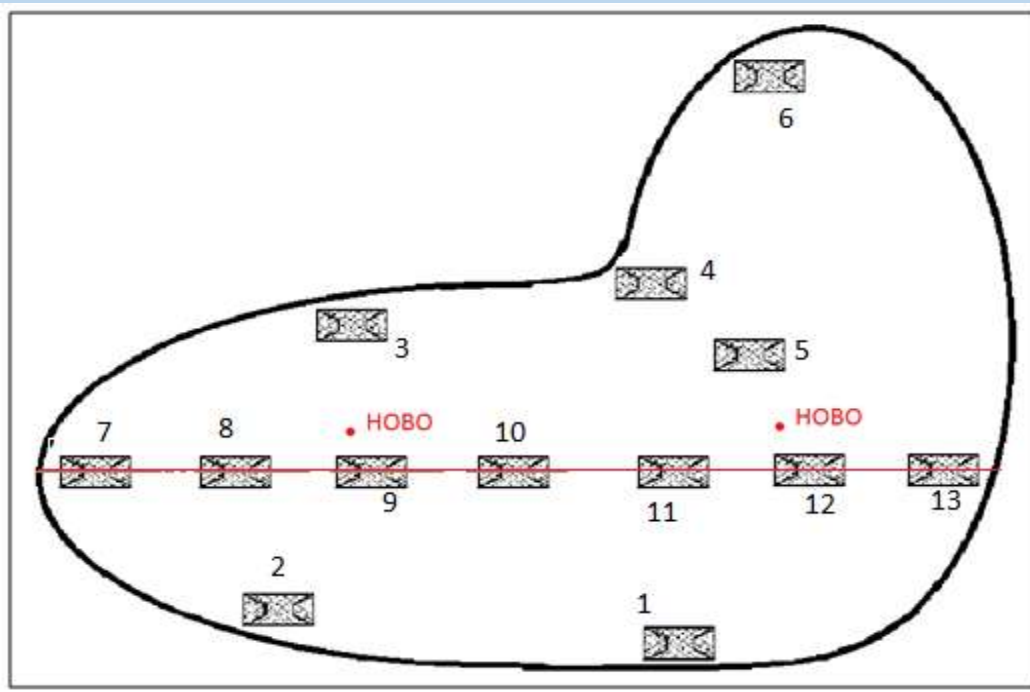
RESULTS

PROGRAM IMPACT
% surveyed people

Phase two (years two and three)

Reintroducing tequila-Understanding tequila

- Continuing working in first and second year studies
- Reintroduce *Z. tequila*
- Evaluate *Z. tequila* reintroduction success:
 - Stomach content
 - Water quality preference
 - Competition with other fish species
 - Population dynamics
 - Reproduction ecology
 - Parasitology



Botanical garden pond

Sexual proportion

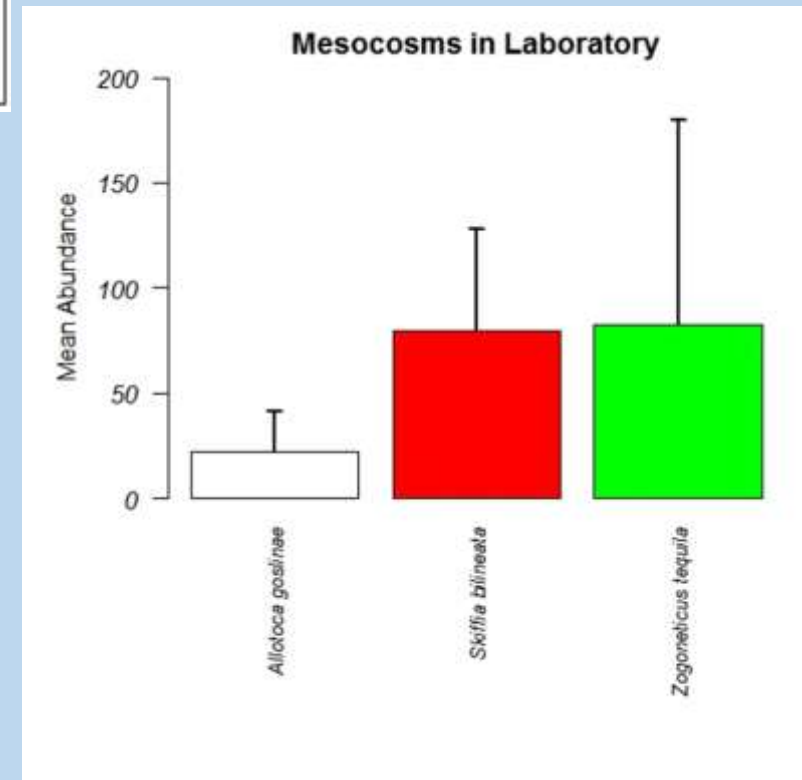
1:1 *A. goslingae*,

1:3 *N. bilineata*

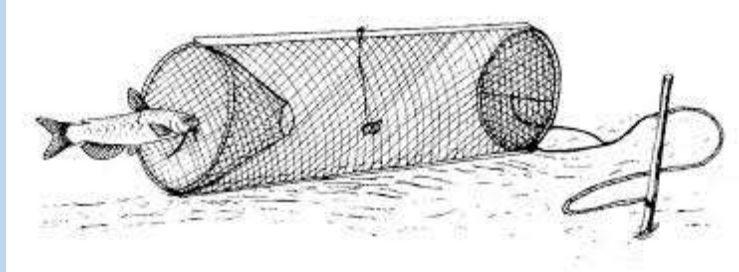
1:2 *Z. tequila*

Fish for all size

9000 specimens of
Zoogoneticus tequila



Parasitological treatment



50 pairs from
Botanical garden



6 pair per five treatment with
stable conditions



Antihelmintic
and external
parasite :
Metronidazol
during 48 hours
+ 48.

After one week

Antibiotic:
Eritromicin and
Tetracilin 48 +
48 hours

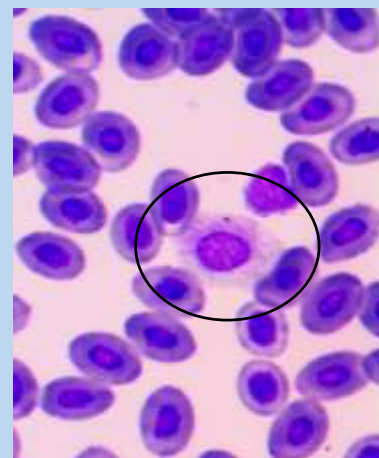




After one week



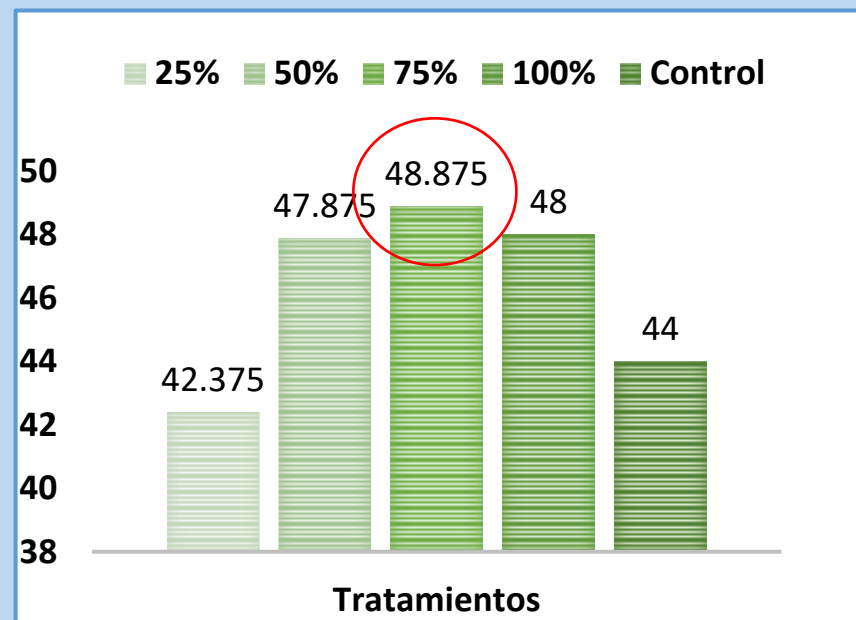
Treatment success



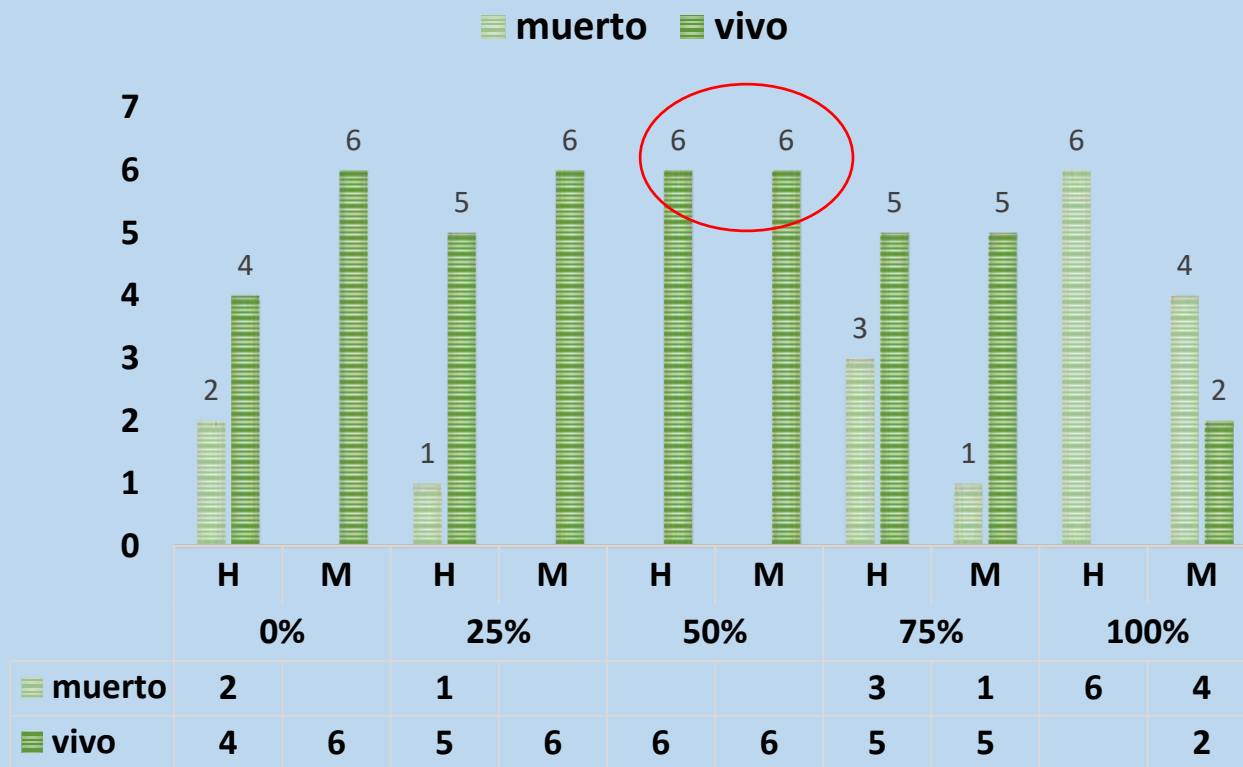
Leukocytes and hemo-parasites counts



Parasites revision **100% free of parasites >50%**



TREATEMENT SURVIVAL



Tetraciclina

CZT7 – 50% (0.562 g)

Eritromicina

CZT7 – 50% (0.590 g)

Metronidazol

CZT7 – 50% (0.584 g)

Mesocosm experiments...

In sites where reintroduction of *Z. tequila* can have higher potential of surviving



Environmental variables in water (e.g. pH, oxygen, temperature, dissolve solids, etc.), zooplankton, fish community (native or non native species) and phytoplankton (food for fish) are constantly monitored.



Mesocosms technic



Is a closed population...

We can evaluate:

- Ecological and biological responses of *Z. tequila*.
- The population growth rate in the “new environment”
- Local parasite susceptibility
- Reproduction and trophic ecology.

Additionally:

- Evaluate the competitive effects and responses with native and no-native species.





The data obtain from these experiments will give us a perspective of the potential success of the reintroiduction of a native species to its original environment, and to implement long term monitoring technics available for the local people.

The repopulation of *Z. tequila* is one of many steps on this project, develop managements and conservation strategies, recover the other extinct species and control/eradicate the no-native species are just some of the goals for the near future.





- Reduce the number of introduce species
- Eradicate from some places



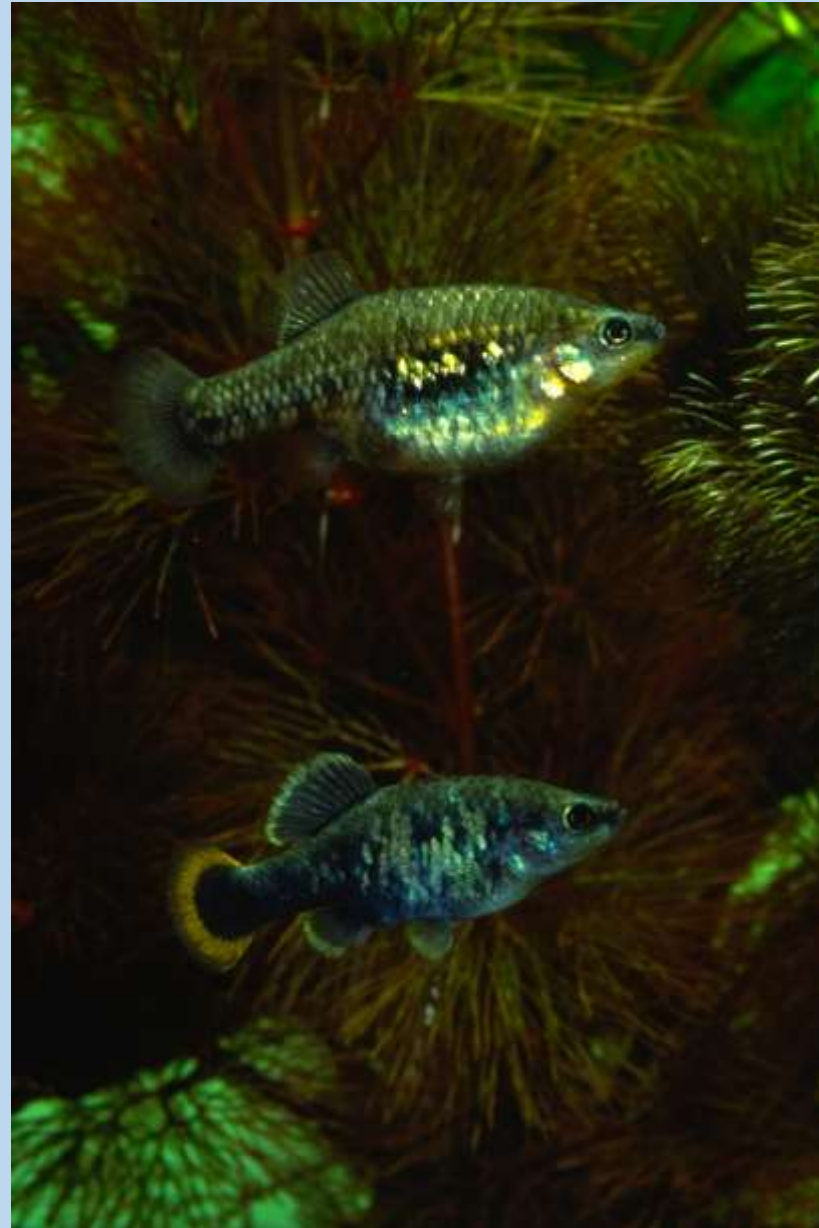
Reintroduce 200 pairs in the main pool in 1st November



Phase three (year four)

Following tequila

- Water quality parameters as explain in point 1.1
- Recollection and measurement of potential food in the water
- Stomach contents analysis on different fish species
- Fecundity index
- Parasitological analysis
- Population's trends and other biological parameters of interest (growth rate, recruitment rate, body mass, etc.)**



Preparing people for the future

1 PhD Thesis

5 Msc Thesis

7 Bachelor Thesis



THANK YOU FOR THE SUPPORT



AQUA TERRA ZOO
Haus des Meeres

