Polymorphic Variation in *Herichthys minckleyi* (Teleostei: Cichlidae) from Cuatrocienégas, Mexico

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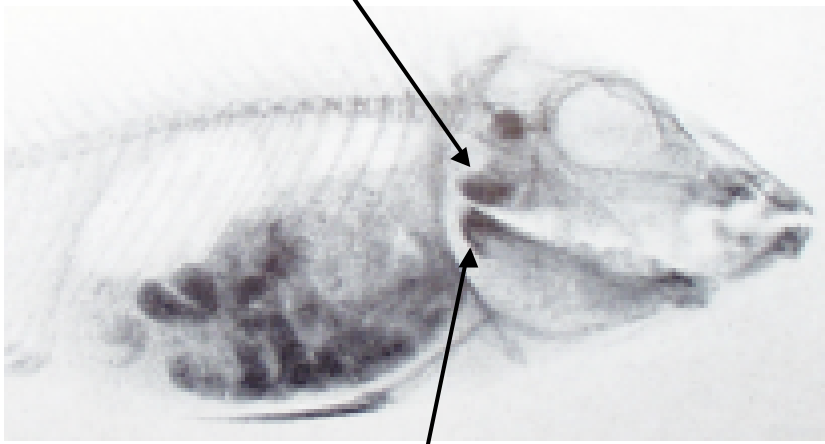
Cichlidae

- Large family of Perciform fish
- >1,000 species described
- Interesting behaviour and bright colors
- Numerous shapes and forms
- African species flocks-Evolutionary models
- Trophic adaptations

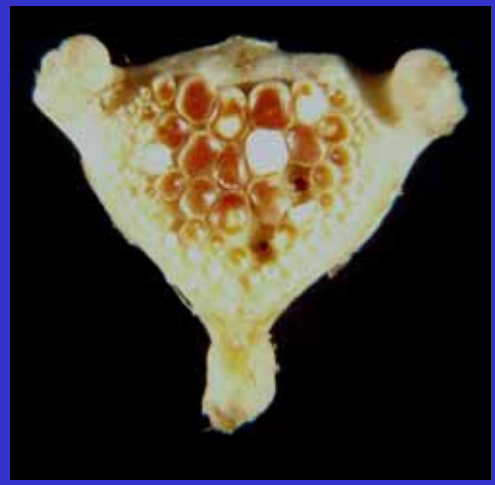
Upper pharyngeal surface



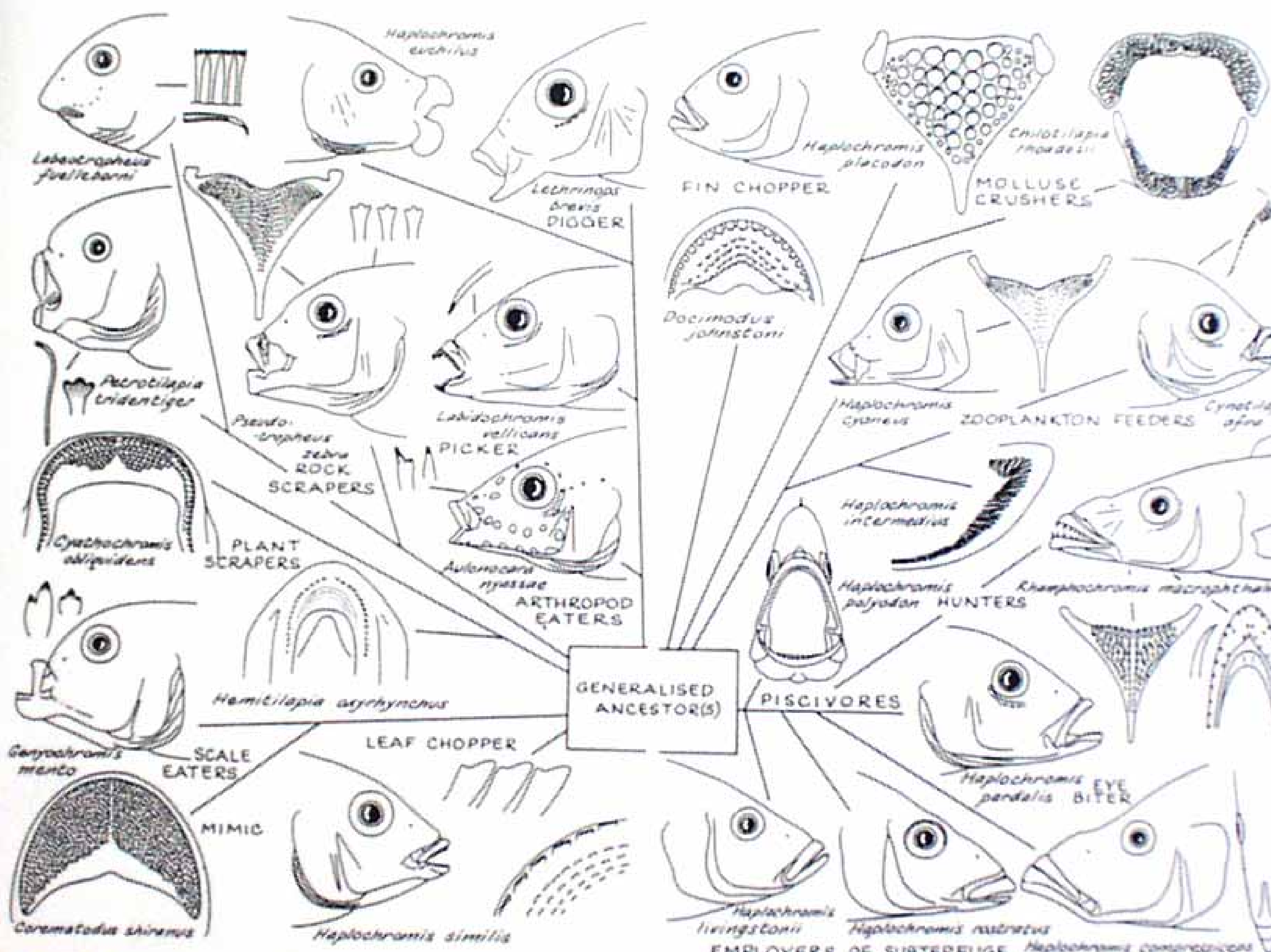
Lower pharyngeal surface

Herichthys minckleyi

Molariform (M)



Papilliform (P)


Labeotropheus fuelleborni
Haplochromis euchilus
Lethrinops brevis
DIGGER
FIN CHOPPER
Haplochromis placodon
MOLLUSC CRUSHERS
Chilotilapia rhoadesii
Docimodus johnstoni
Petrotilapia tridentiger
Pseudotropheus zebra
ROCK SCRAPERS
Labidochromis vellicans
PICKER
Haplochromis cyaneus
ZOOPLANKTON FEEDERS
Cynotila
afra
Cyathochromis obliquidens
PLANT SCRAPERS
Aulonocara nyassae
ARTHROPOD EATERS
Haplochromis intermedius
Haplochromis polyodon
HUNTERS
Rhamphochromis macrophthal
Hemitilapia oxyrhynchus
GENERALISED ANCESTOR(S)
PISCIVORES
Genyochromis mento
SCALE EATERS
LEAF CHOPPER
MIMIC
Haplochromis pardalis
EYE BITER
Corematodus shiranus
Haplochromis similis
Haplochromis livingstonii
Haplochromis rostratus
EMPLOYERS OF SUBTERFUGE
Haplochromis compressiceps

Previous studies

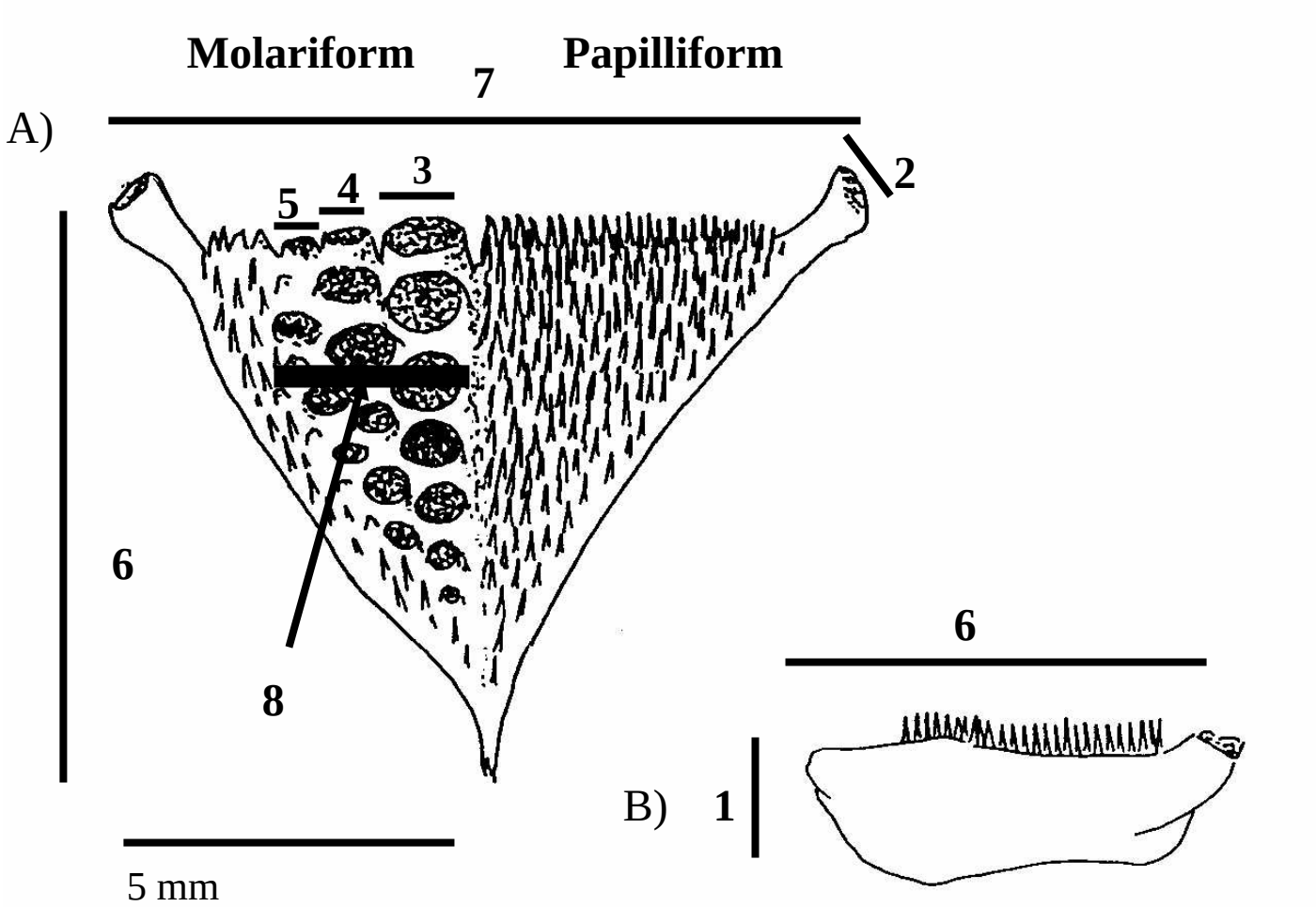
- Kornfield and Taylor (1983)- Sampled breeding population, and allozymes. >50% of breeding pairs were heteromorphic. Described *H. minckleyi* as a polymorphic species
- Molariforms and papilliforms, morpholgical differences
- Intermediates rare <5% of fish
- Mechanisms guiding polymorphism still unclear

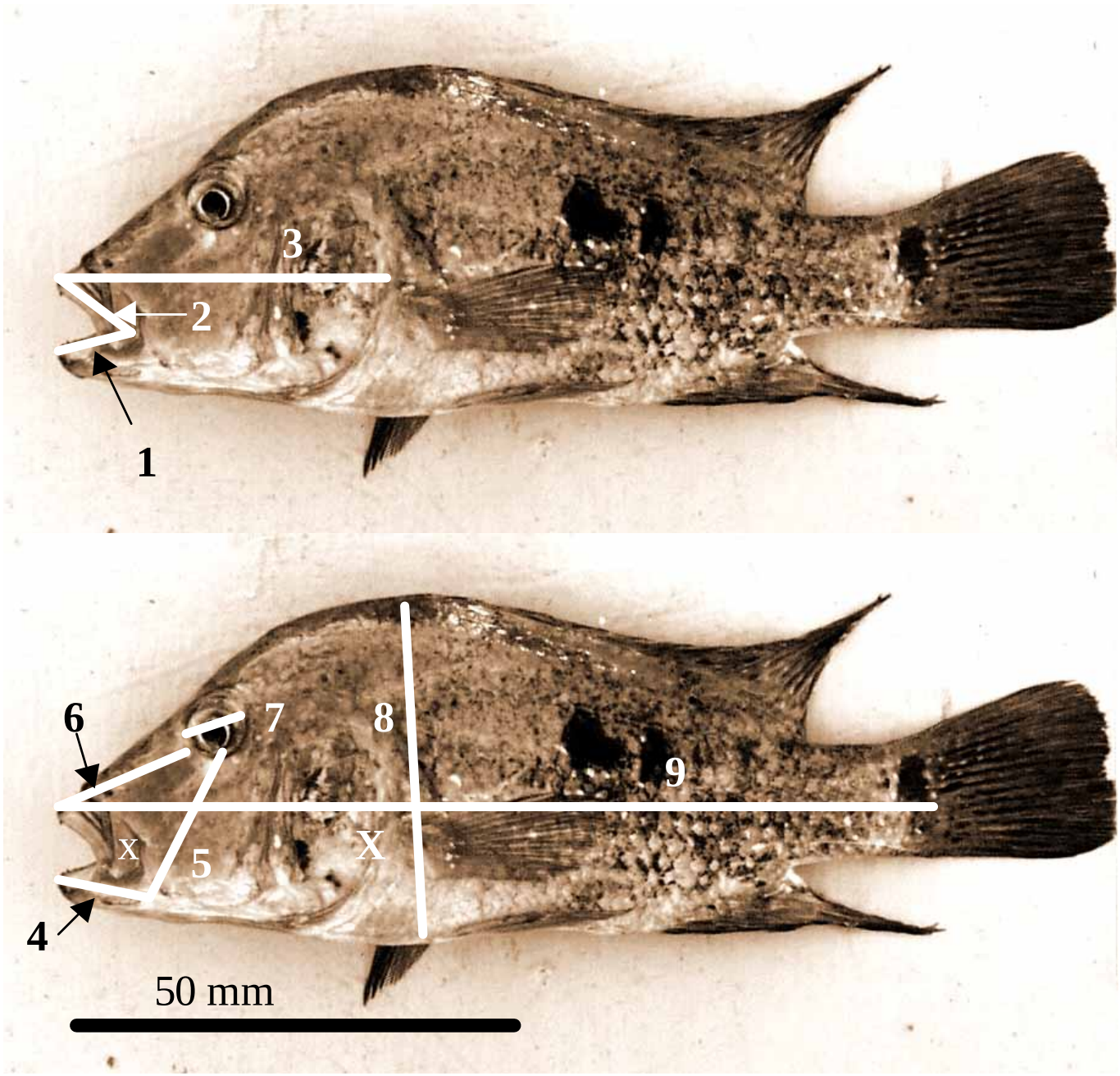
Objectives

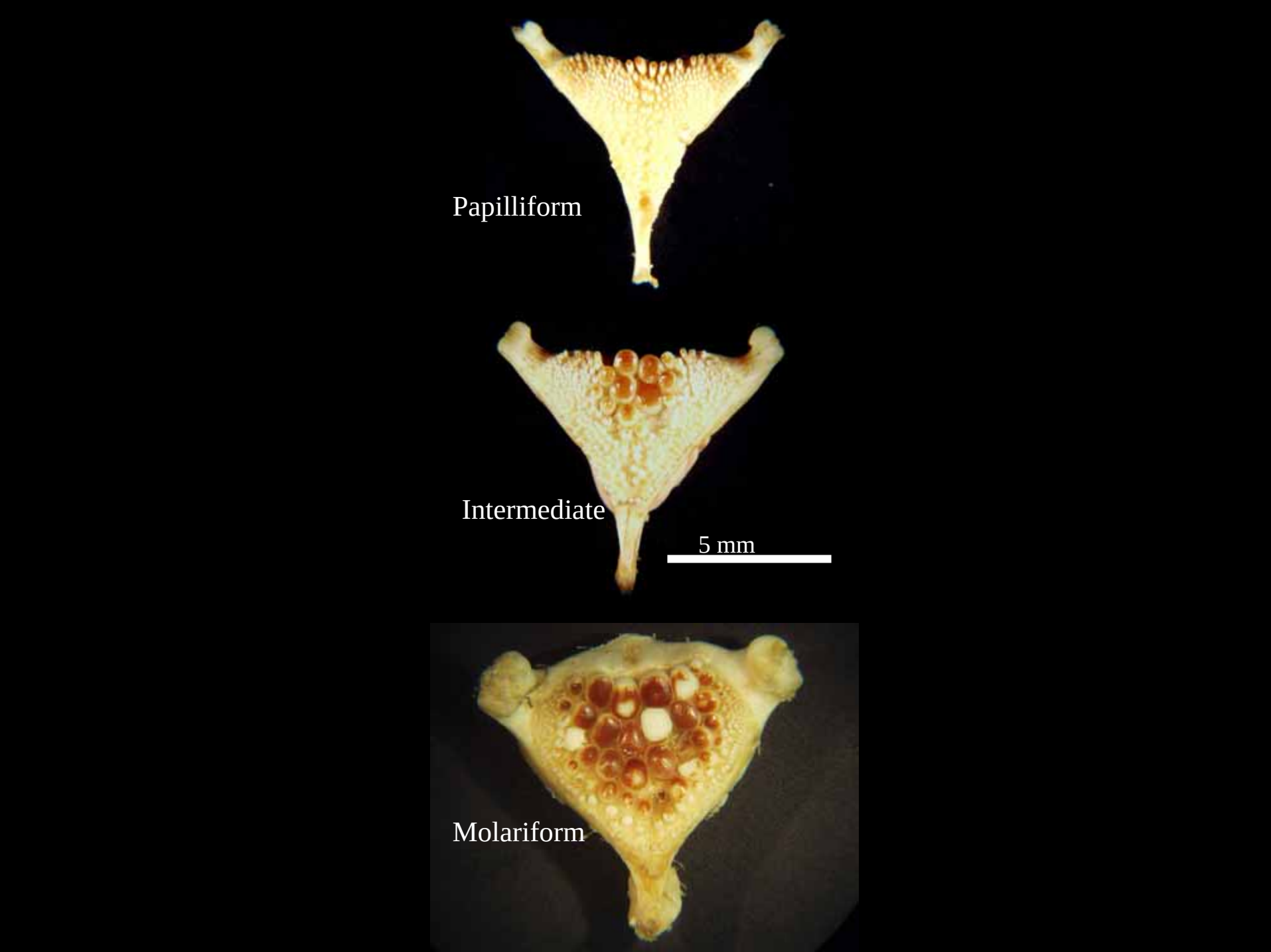
- Characterize the morphological variation in greater detail

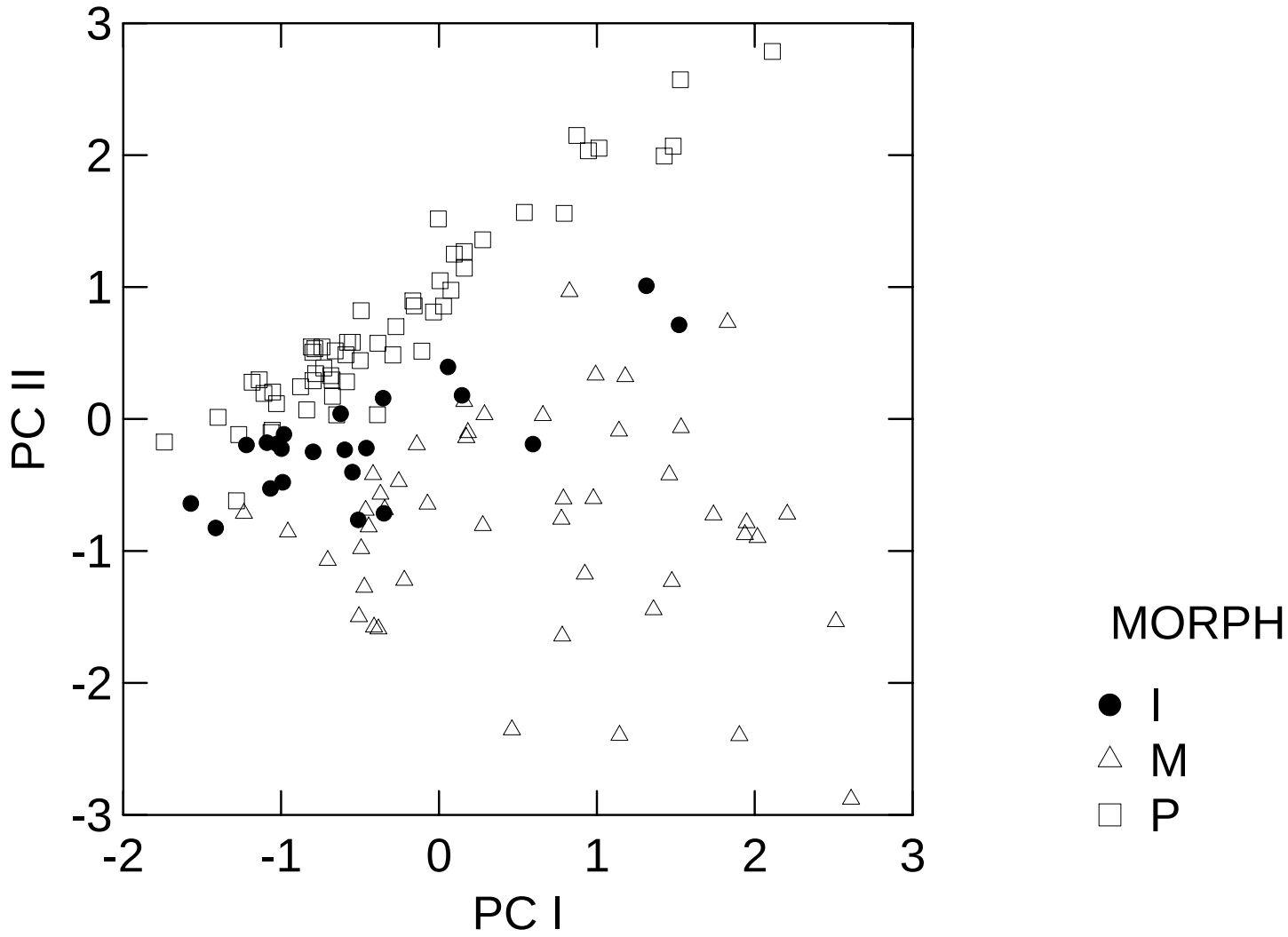
Materials and Methods

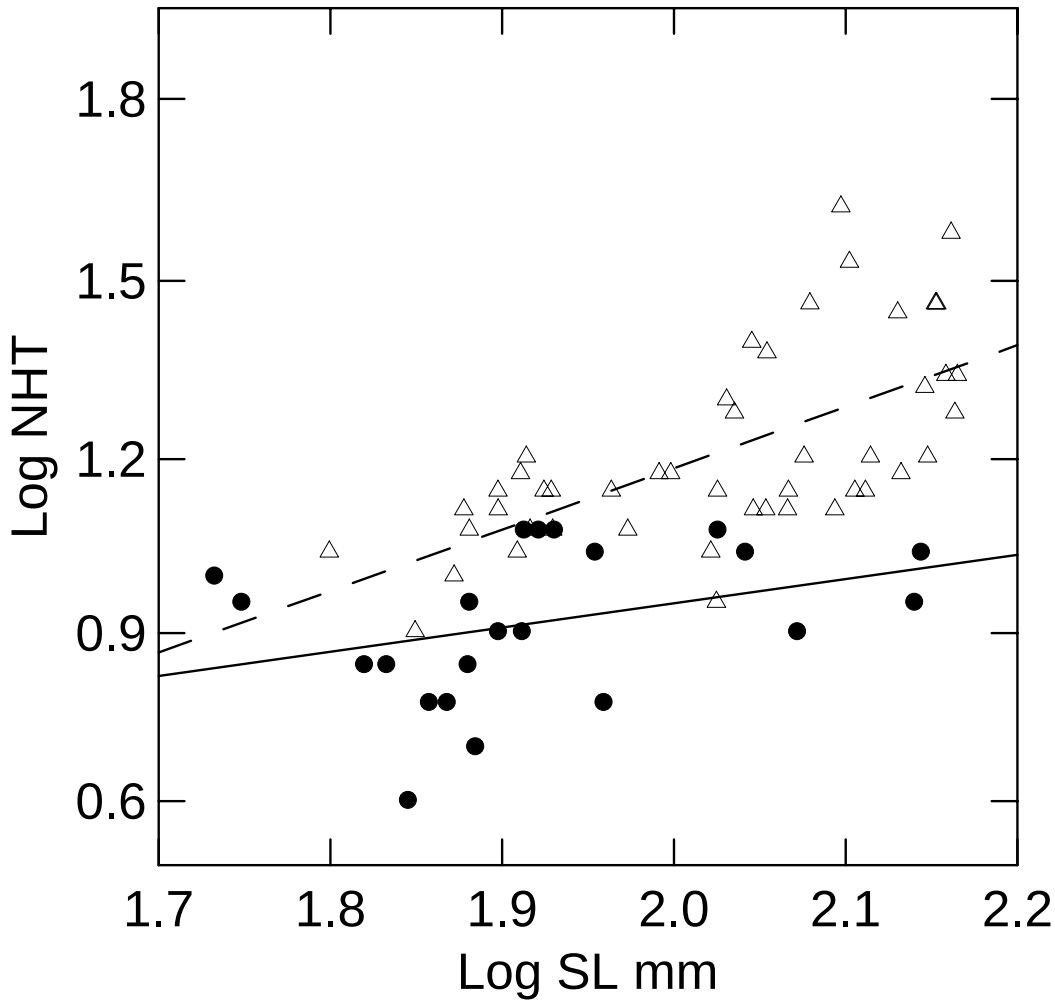
- 125 specimens randomly selected from museum collections
- *A priori* classified each as intermediate, molariform, or papilliform
- 21 morphological characters
- Principal component analysis (PCA)
- ANCOVA with SL as covariate on characters that differ between morphs


Molariform
Papilliform
7
A)
2
5
4
3
6
8
6
B)
1
5 mm


3
2
1
6
7
8
9
x
5
X
4
50 mm


Papilliform
Intermediate
5 mm
Molariform


3
2
1
0
-1
-2
-3
PC II
-2
-1
0
1
2
3
PC I
MORPH
I
M
P


1.8
1.5
1.2
0.9
0.6
Log NHT
1.7
1.8
1.9
2.0
2.1
2.2
Log SL mm

Conclusions

- First study to characterize and quantify intermediate pharyngeal morphology
- Lumpers vs. splitters
- New characters measured

Temporal and spatial dynamics of the pharyngeal morphologies of *H. minckleyi*

Objectives

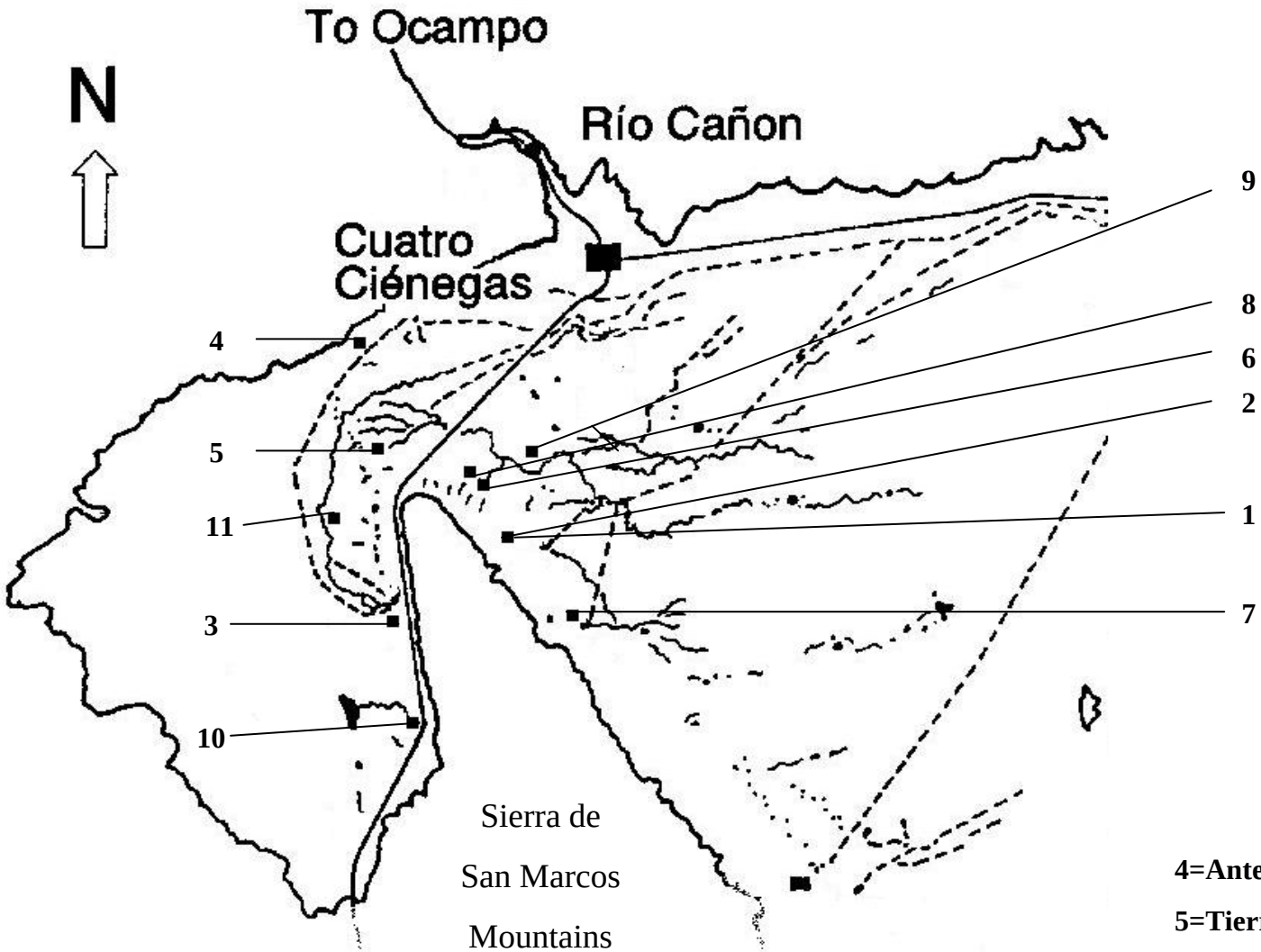
- Determine if spatial and temporal variation exists in the relative abundance of the three trophic morphs of *H. minckleyi*.
- Gain a better understanding of role of resource polymorphism in trophic diversification

Trophic polymorphisms

- Polymorphism is involved in the diversification of trophic forms in diverse vertebrate taxa
- In Cuatrociénegas variation over space and time is an opportunity to study evolutionary processes
- *H. minckleyi* represents a tractable system to study how different trophic morphologies of cichlids vary in a natural experiment setting

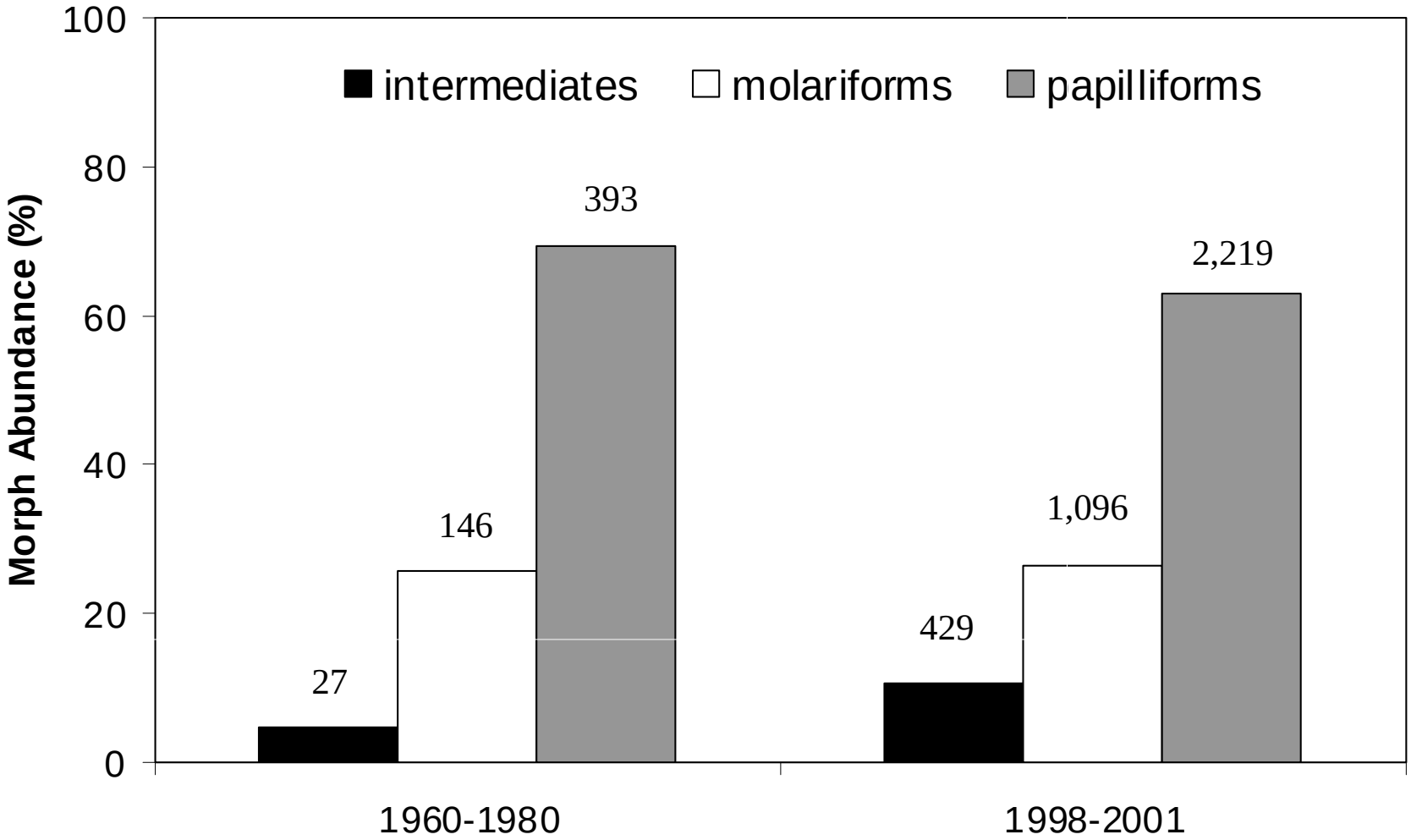
Methods

- Temporal and spatial comparisons of abundance of different morphologies from historic (1960-1980) and recent collections (1998-2001). ca. 25-30 years
- Otoscope- determine morphology
- 641 specimens from 9 sites from historic collections
- 3,744 specimens from 11 sites to estimate current abundance
- Spearman Rank Correlation test to test for temporal and spatial differences
- Mann Whitney U test to test for differences between sites with and without exotic cichlid *Hemichromis sp.*

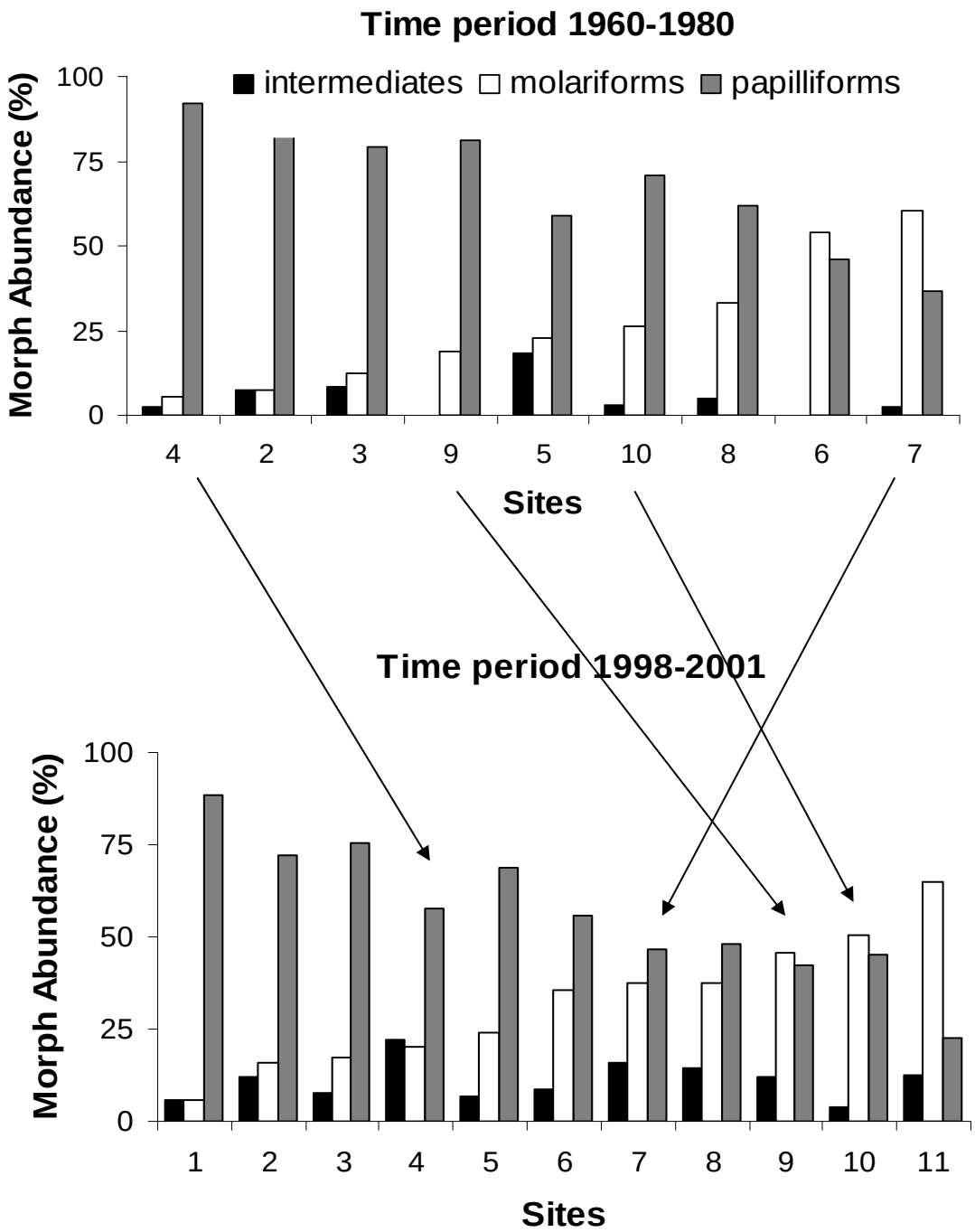


4=Anteojo
5=Tierra Blanca
11=Juan Santos
3= Poza de la Becerra
10=Churince
9=Rio Mesquites at las Palapas
8=Mojarral Oeste
6=Mojarral Este
2=Escobeda
1=Canal de Escobeda
7=Tio Candido

All fish from both time periods



Intermediates increased ~6%



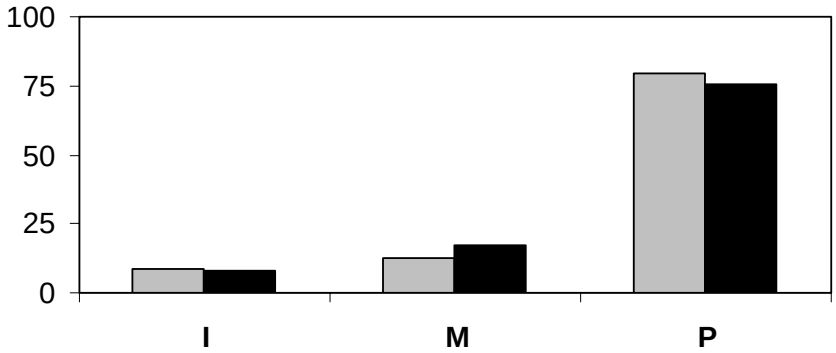
intermediate

molariform

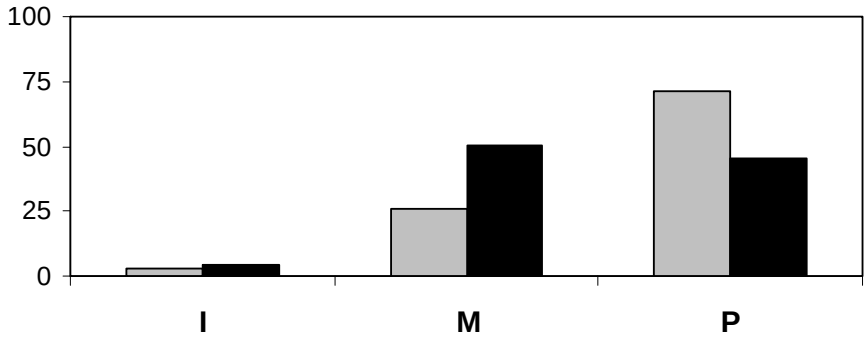
papilliform

P=0.05

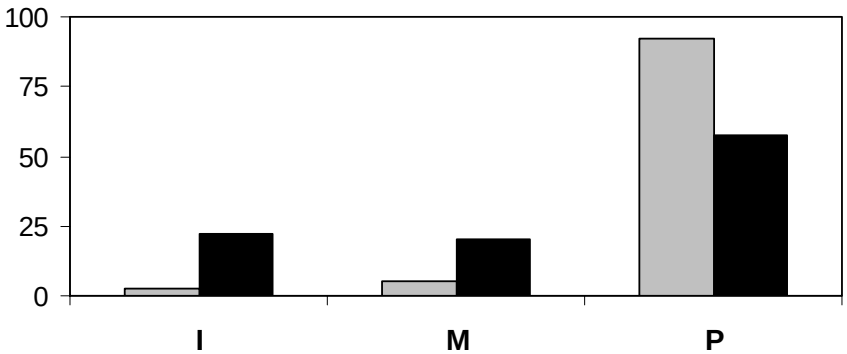
Poza de la Becerra



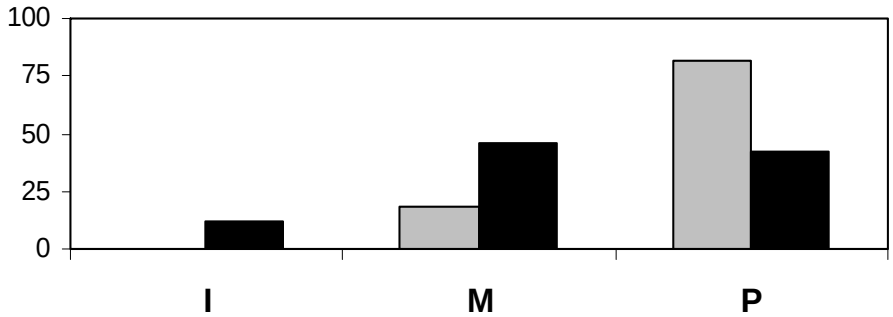
Poza Churince



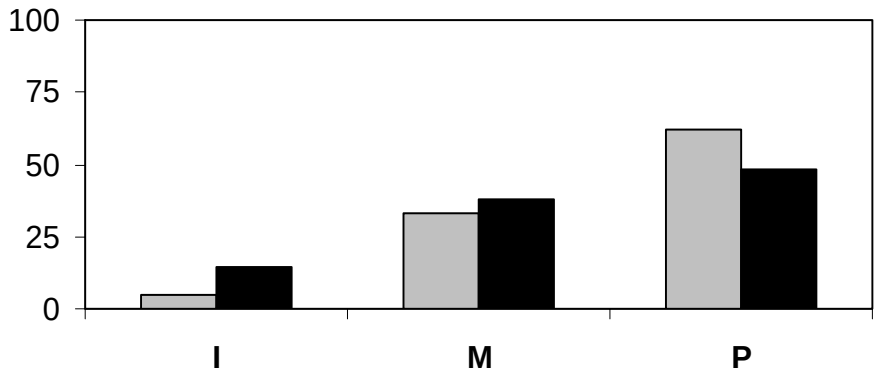
Poza Anteojo

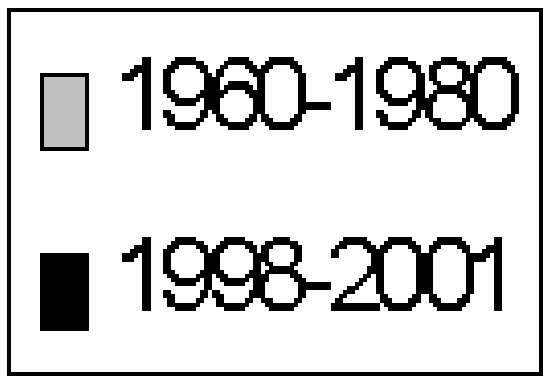


Rio Mesquites

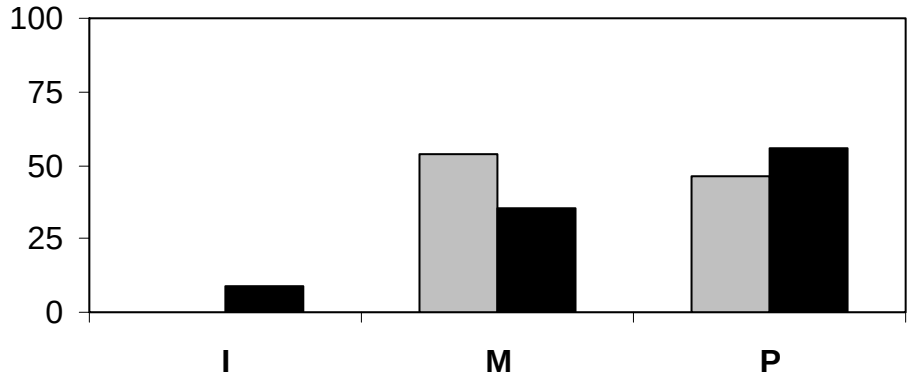


Poza Mojarrral Oeste

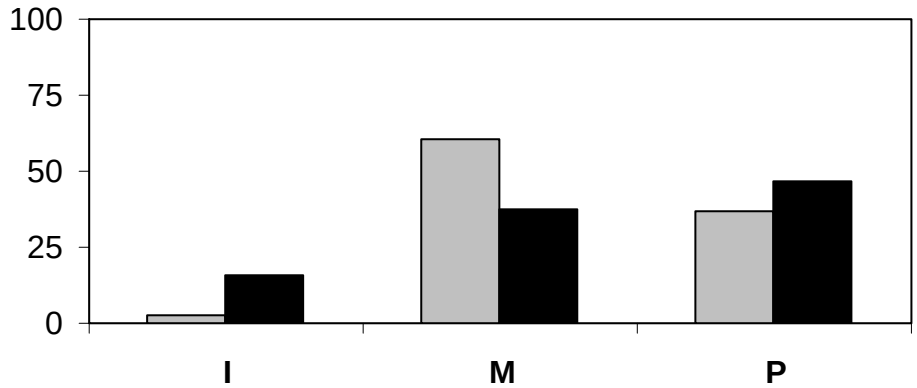




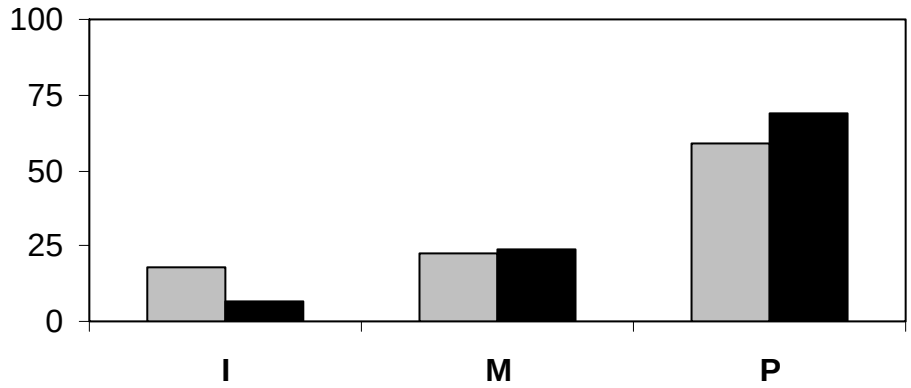
Poza Mojarral Este

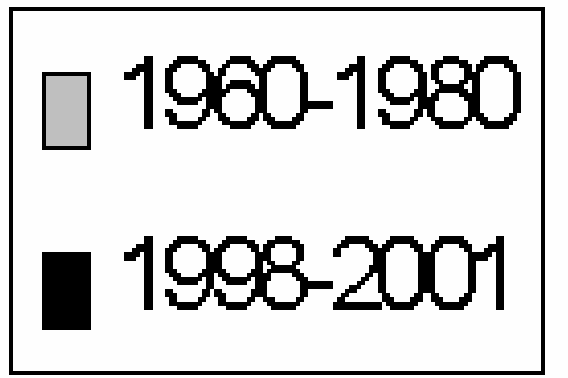


Poza Tio Candido



Tierra Blanca





Hemichromis guttatus

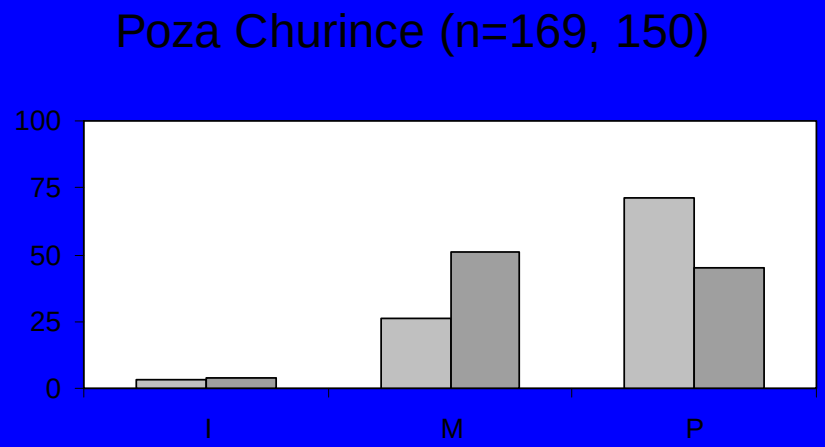
Papilliform pharyngeal morphology

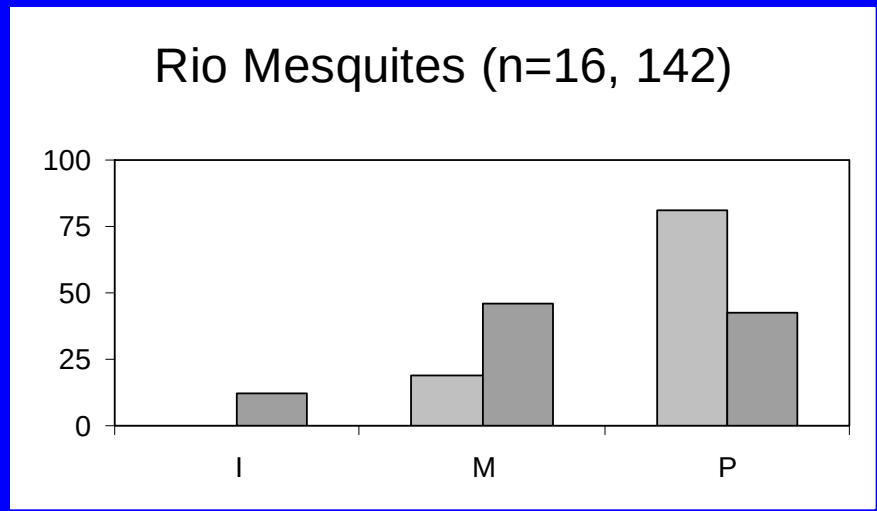
25%

Could be competitor with papilliform

H. minckleyi

20%



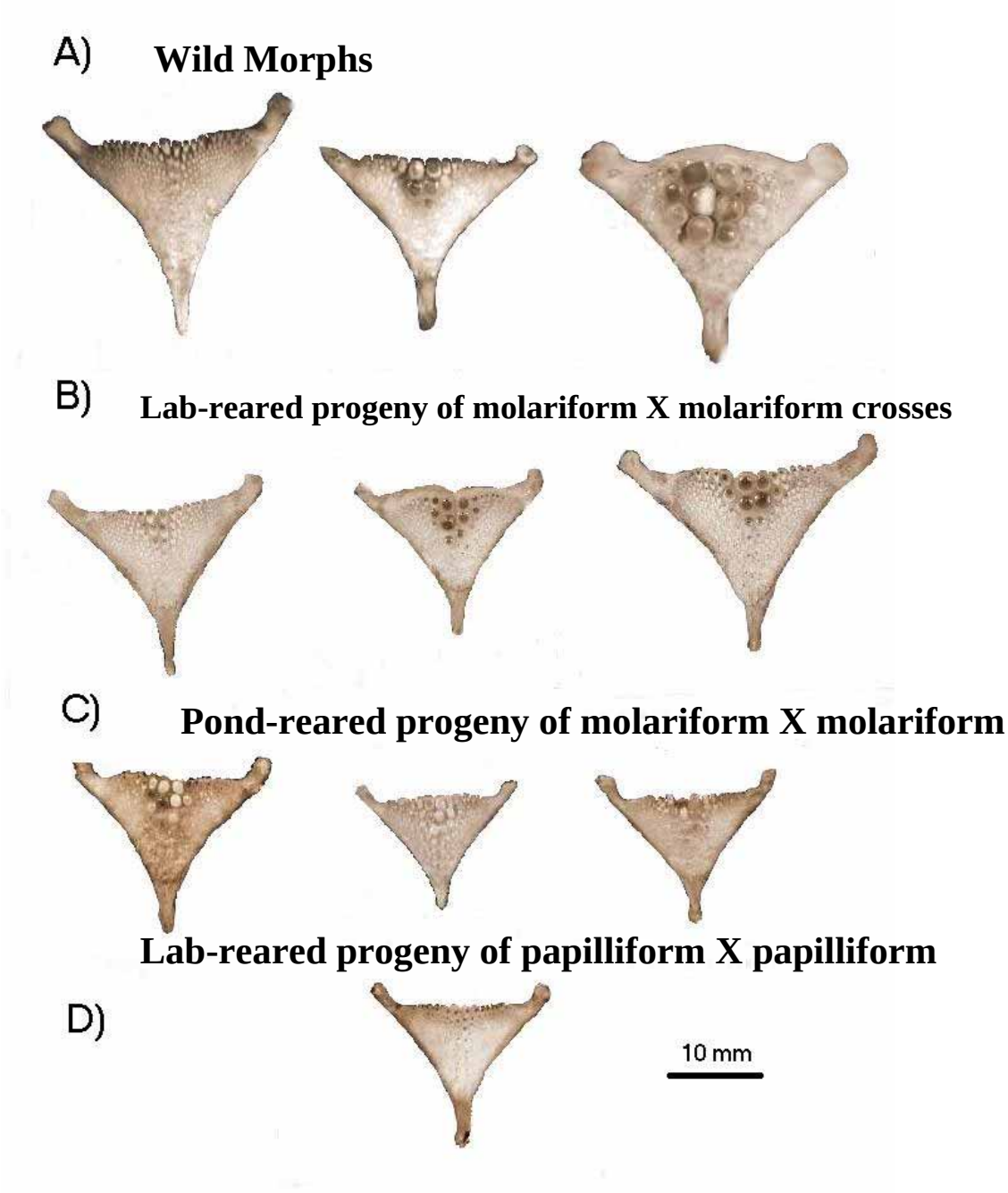


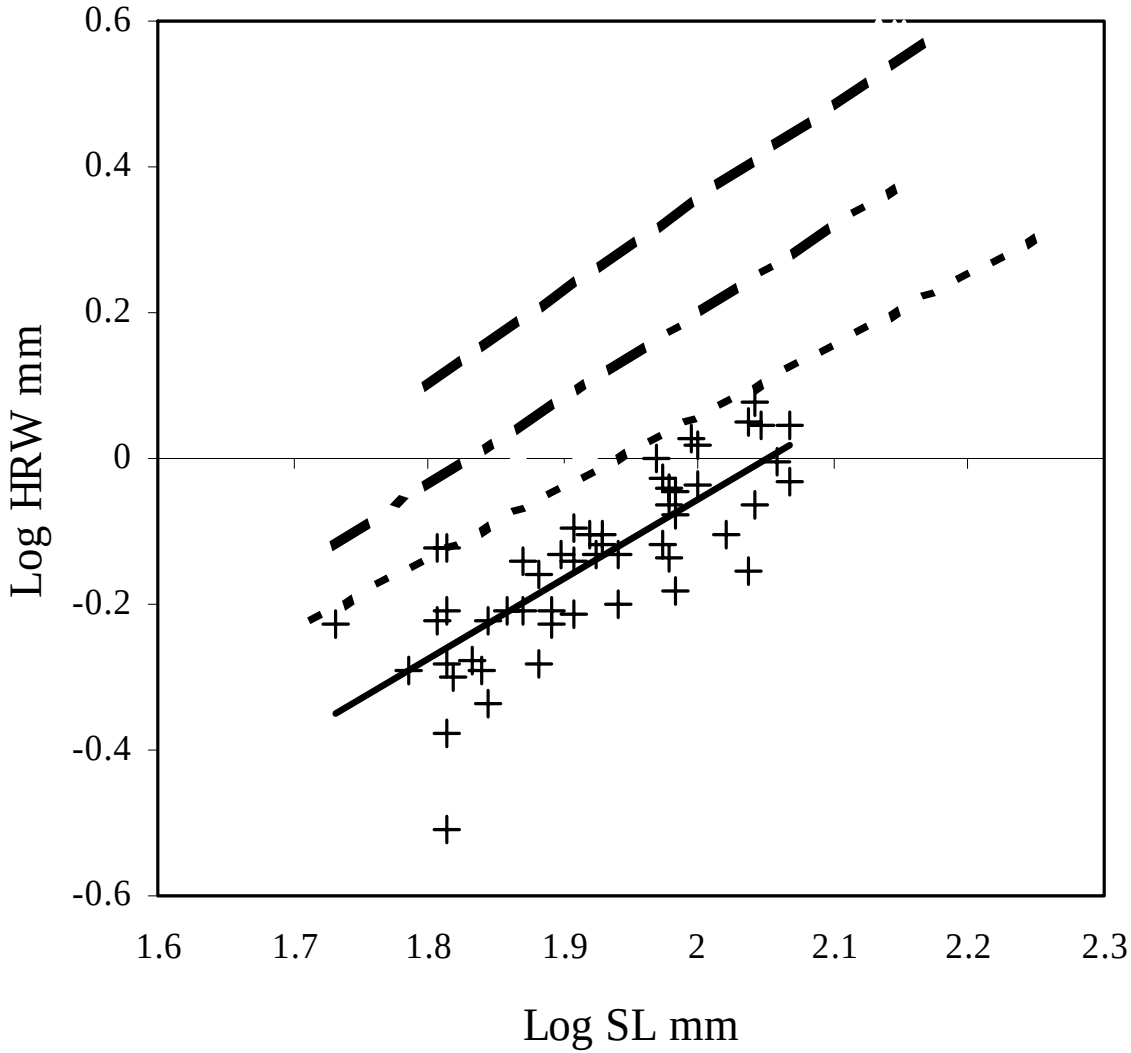
Mean morph frequencies at sites with and without exotic *Hemichromis*

	Exotic	None	*P*
M	49.3%	22.6%	0.006
P	41.5%	65.3%	0.023

Conclusions

- Temporal and spatial variation of morphs
- Resource availability and exotics may be important factors affecting the distribution of morph abundance


A)
Wild Morphs
B)
Lab-reared progeny of molariform X molariform crosses
C)
Pond-reared progeny of molariform X molariform
Lab-reared progeny of papilliform X papilliform
D)
10 mm


0.6
0.4
0.2
0
-0.2
-0.4
-0.6
Log HRW mm
1.6
1.7
1.8
1.9
2
2.1
2.2
2.3
Log SL mm

Environmental

Genetic

Factors

Acknowledgments

- **The SEMARNAP office in Cuatro Ciénegas for assistance with collecting specimens. Numerous volunteers**
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