RECORD OF LACK OF INTERMUSCULAR BONES IN SPECIMENS OF *Colossoma macropomum* (Characiformes): UNUSUAL PHENOTYPE TO BE INCORPORATED INTO GENETIC IMPROVEMENT PROGRAMS.

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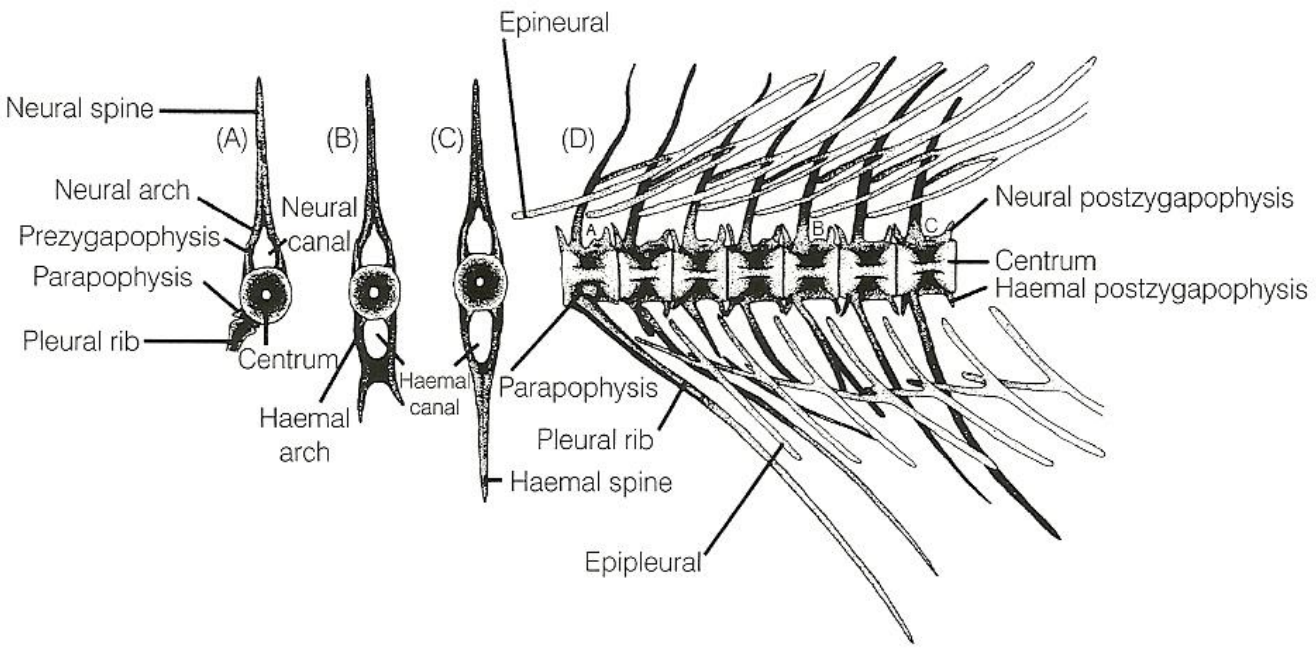
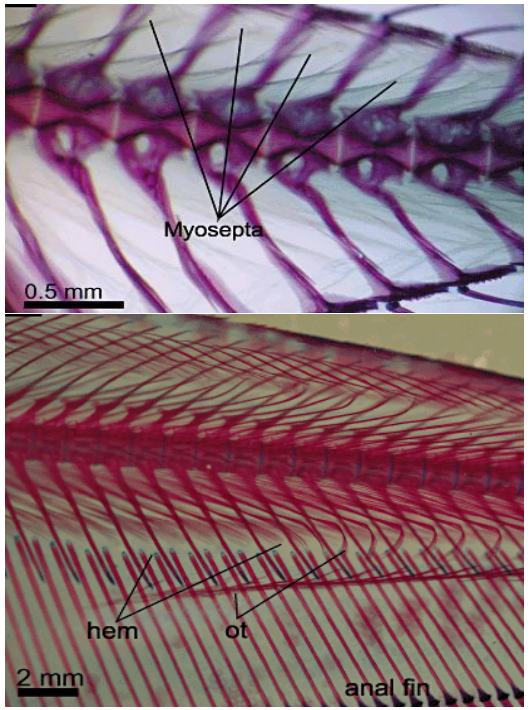
Laboratory of Aquatic Organism Genetics and Aquaculture

What are intermuscular bones or “Y” bones?





Danos and Ward, 2012

“Intermuscular bones, which occur only in teleosts amongst recent vertebrates, are segmental, serially homologous ossifications in the myosepta”.
Patterson & Johnson, 1995

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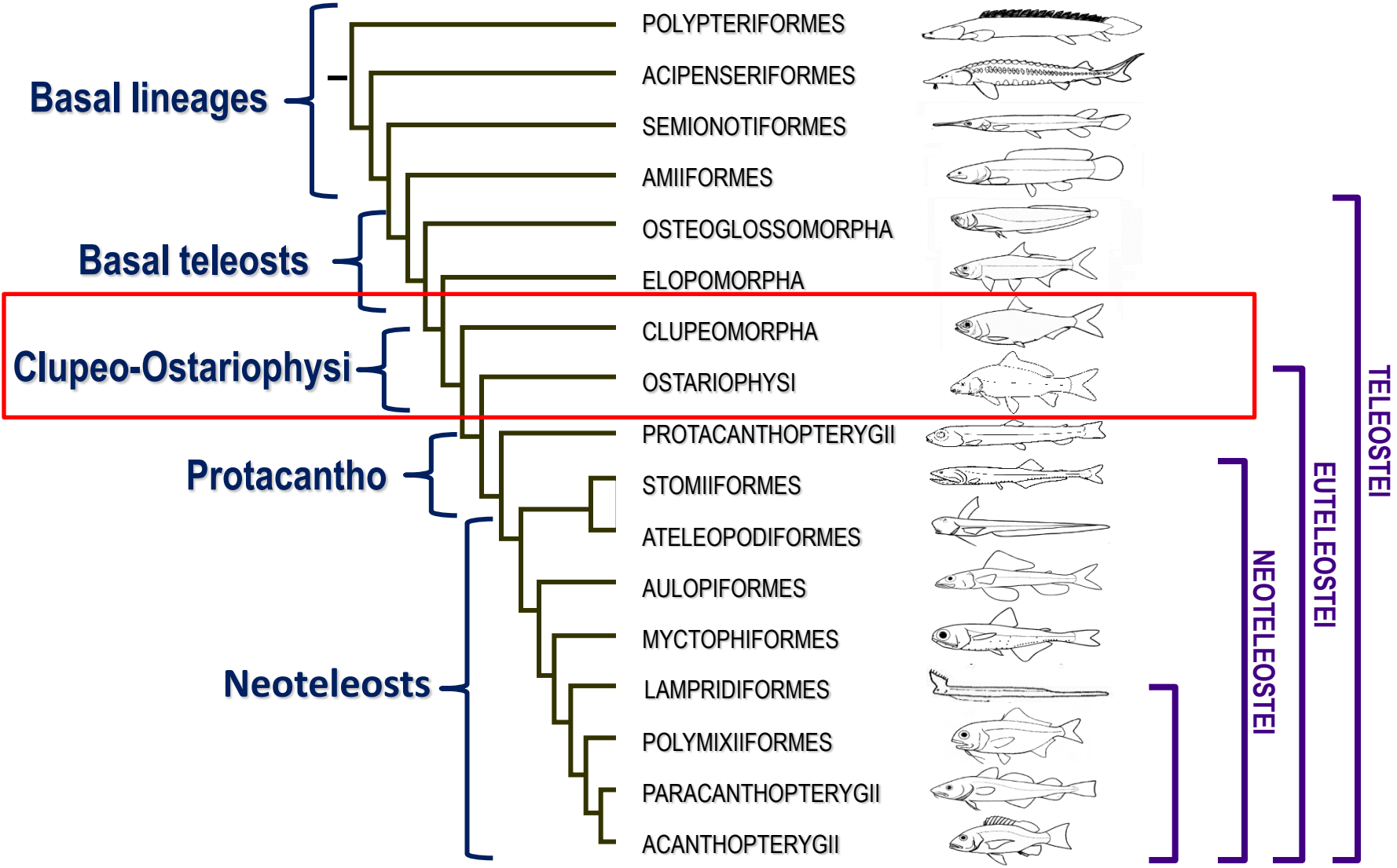
Which fishes do they occur?



Nelson, 1994 & Orti, 2015

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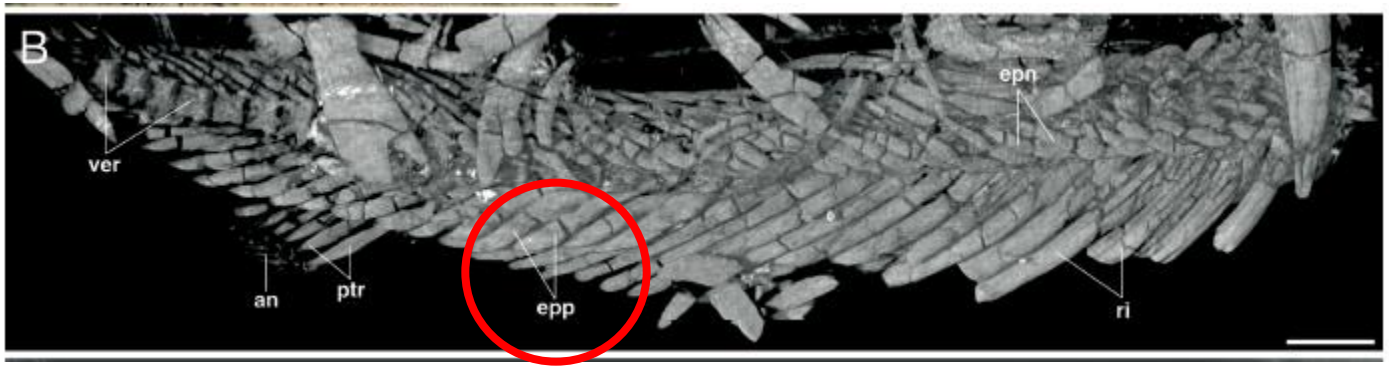
Fossil evidence



Hsianwenia wui

Cyprinid fish from Pliocene , characterized by an extraordinarily thick skeleton that occupied almost the entire body

(Chang et al., 2008)

Other species with intermuscular bones

Cypriniformes

Common carp
Cyprinus carpio

Major Indian carp
Catla catla

Wuchang bream
Megalobrama amblycephala

Rui-Rohu
Labeo rohita

Silver carp
Hypophthalmic molitrix

Grass carp
Ctenopharyngodon idella

Clupeiformes

Ilish
Tenualosa ilisha

American shad
Alosa sapidissima

Pacific herring
Clupea pallasii

Neotropical Characiformes

Characiformes is an order of ray-finned fish, mostly Neotropical and some of aquaculture importance.

All of them have intermuscular bones

Matrinchã

Brycon amazonicus

Curimbatá

Prochilodus lineatus

Pacú

Piaractus mesopotamicus

Traíra

Hoplias malabaricus

Piapara

Leporinus friderici

Tambaqui

Colossoma macropomum

Importance of Y bones for aquaculture

Hirsch, P. (1938). Les arêtes dans le poisson d'étang. Bull. Fr. Piscic. 114: 36-3?

In a report, the translation of which was published by Dr. Emile Unger has rightly highlighted the disadvantages of some bones of freshwater fish

Theoretical and Applied Genetics 42, 130–135 (1972)
© by Springer-Verlag 1972

Untersuchungen über die genetisch muskelgräten des

H. KOSSMANN

Bundesforschungsanstalt fü
Institut für Küsten- und Binnenfischerei, Au

Studies on Genetic Variability of Intermu

Summary. The number of intermuscular bones was determined. Differences between groups were found to be highly significant an different populations in different ponds and for progeny of crosses of intermuscular bones in different body segments also showed high number of intermuscular bones between two neural spines was deter coefficients for number of total intramuscular bones to number $r = 0.1$ to $r = 0.6$, while the correlation coefficients for the numbe vertebrae to total number of spines ranged, with one exception, fr

condition, soit de hacher menue la chai

Theoretical and Applied Genetics 46, 33–43 (1975)
© by Springer-Verlag 1975

Variability of Intermuscular Bones, Vertebrae, Ribs, Dorsal Fin Rays and Skeletal Disorders in the Common Carp*

Rom Moav and A. Finkel
Department of Genetics, The Hebrew University of Jerusalem, Jerusalem (Israel)
and G. Wohlfarth
Fish and Aquaculture Research Station, Dor (Israel)

Summary. The number of intermuscular bones, vertebrae, ribs, dorsal fin rays and an index of bone disorders were determined from x-ray photographs of over 1000 common carp. These carp represented a broad genetic range, including five distinct lines of the domesticated European carp, one group of the Chinese race *Big-Belly* and 12 crossbreds. The genetic, and even the phenotypic, variation in intermuscular bones were much smaller than those found in earlier experiments. Variation of other bone characters was also analyzed and the relationship of intermuscular bones and ribs to vertebrae was determined.

World Journal of Fish and Marine Sciences 4 (4): 382-385, 2012
ISSN 2078-4589

DOI: 10.5829/idosi.wjfms.2012.04.04.62118

Record of Skeletal System and Pin Bones in Table Size Indian Major Carps: Rohu (*Labeo rohita* Hamilton 1822), Catla (*Catla catla* Hamilton 1822) and Mrigal (*Cirrhinus mrigala* Hamilton 1822)

B.B. Sahu, R.P. Samal, M.R. Raghunath, S. Mohanty, S. A

Central Institute of Freshwater Aquaculture (ICAR), Kausalya

Abstract: The number, shape and sizes of intermuscular bones ha rohu, catla and mrigal after microwave cooking and dissection. Car size. These bones are of two types, Y pin bones and straight pin b in mrigal (110 nos.) followed by catla (108 nos.) and rohu (104 n lowest followed by catla (68) and mrigal (70). Straight pin bones in has 40 straight pin bones. Some of the Y and straight pin bones a were located on the dorsal broad muscle and unbranched pin bones are located in the tail region. Mrigal bones were longer and stouter. Rohu pin bones were found to be bold and straight; however catla pin bones were shorter, curved and thinner.

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MBER OF INTERMUSCULAR BONES, ARP IN AQUARIA *)

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Kulturpflanzenzüchtung, sdorf, Germany

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2014 · ·11· · ACTA HYDROBIOLOGICA SINICA Nov., 2014

DEVELOPMENTAL AND MORPHOLOGICAL OBSERVATION OF INTERMUSCULAR BONES IN *MEGALOBRAMA AMBLYCEPHALA*

WAN Shi-Ming[1,2], YI Shao-Kui[1,2], ZHONG Jia[1,2], WANG Wei-Min[1,2], JIANG En-Ming[3], CHEN Bo-Xiang[3] and GAO Ze-Xia[1,2]

; without bitterness from the bitter lupin, s of the laws of parallel mutations and upins ot con- sired g hun- day's ack-In- room body. a par-

科学通报 2015年 第60卷 第1期: 52 ~ 57
论 文 www.scichina.com csb.scichina.com
《中国科学》杂志社 SCIENCE CHINA PRESS

Normally grown and developed intermuscular bone-deficient mutant in grass carp, *Ctenopharyngodon idellus*

Journal of Applied Ichthyology
J. Appl. Ichthyol. 31 (2015), 32-36
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DWK
Received: December 18, 2013
Accepted: March 1, 2014
doi: 10.1111/jai.12483

Comparative analysis of intermuscular bones in three strains of common carp

By D.-C. Cao, Y.-Y. Kuang, X.-H. Zheng, G.-X. Tong, C.-T. Li and X.-W. Sun

Intermuscular bone trait: a disadvantage for fish processing and consumption







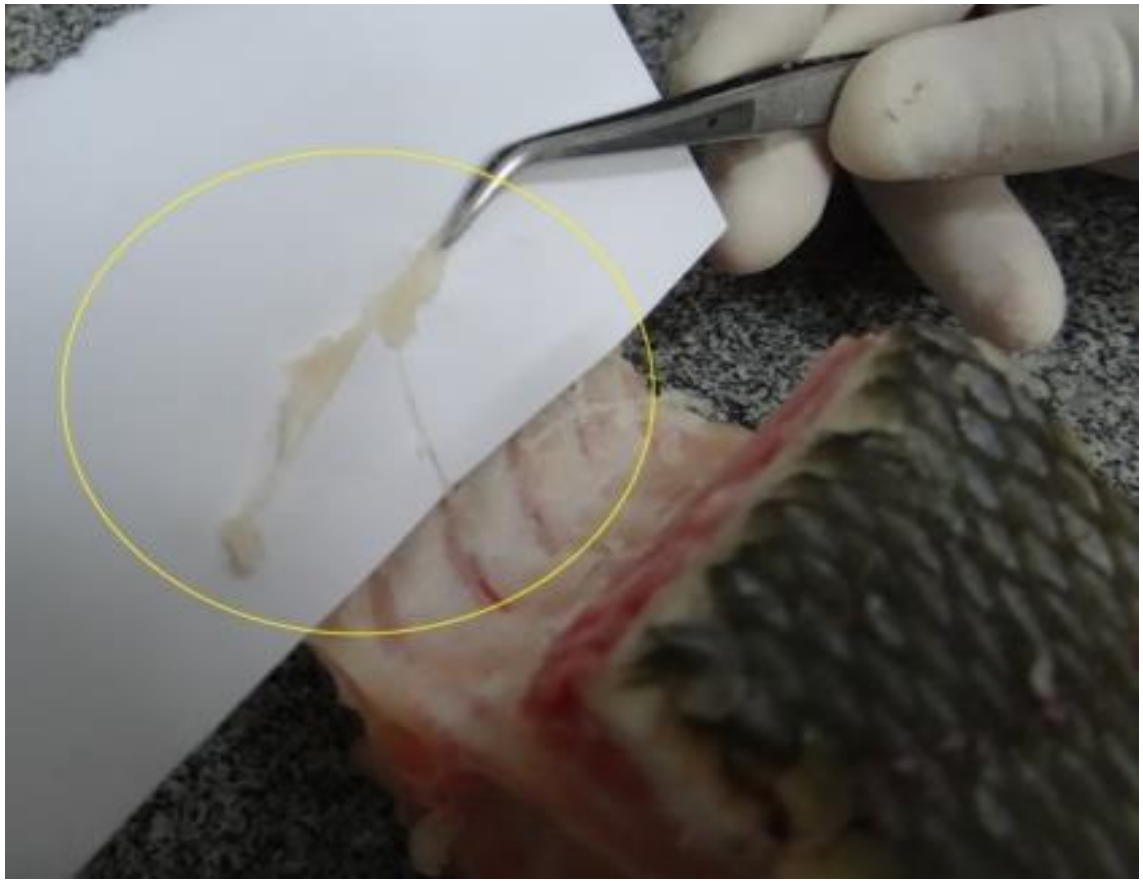

Colossoma macropomum: Tambaqui - Cachama – Black pacu

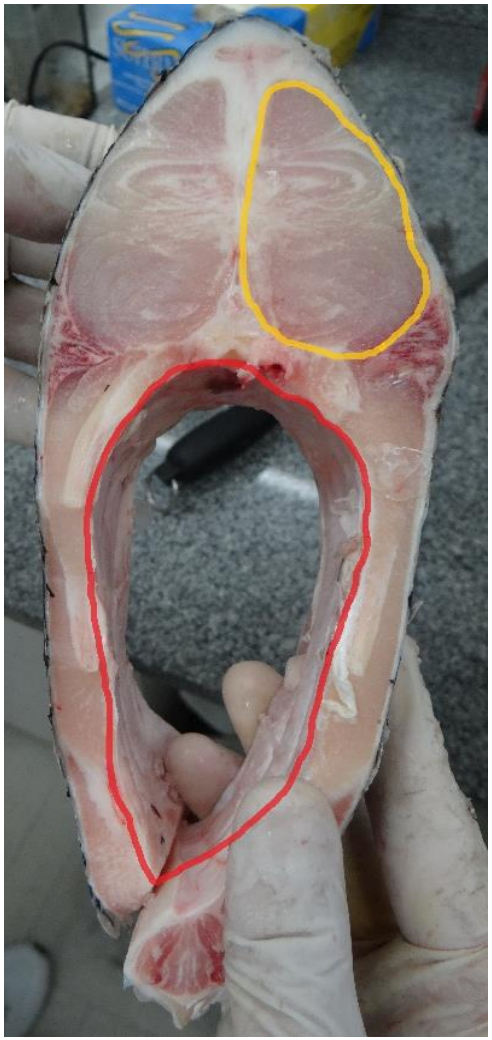
Brazilian farming production in 2013
88,718,502 t

- ✓ **Tambaqui is the second largest fish in the Amazon basin.**
- ✓ **It can reach one meter long and 30 kg in weight**
- ✓ **In wild, it consumes fruits and seeds, and in farming conditions is considered omnivorous.**
- ✓ **It needs long upstream migration for reproduction.**
- ✓ **It is esteemed as food fish in South America.**
- ✓ **In Brazil, tambaqui is the main native farmed species.**

Tambaqui cuts and deboning process

Intramuscular Y bone in tambaqui





Unusual traits in fish used in aquaculture

Leather carp
Cyprinus carpio* var. *nudus

Mirror carp
Cyprinus carpio* var. *specularis

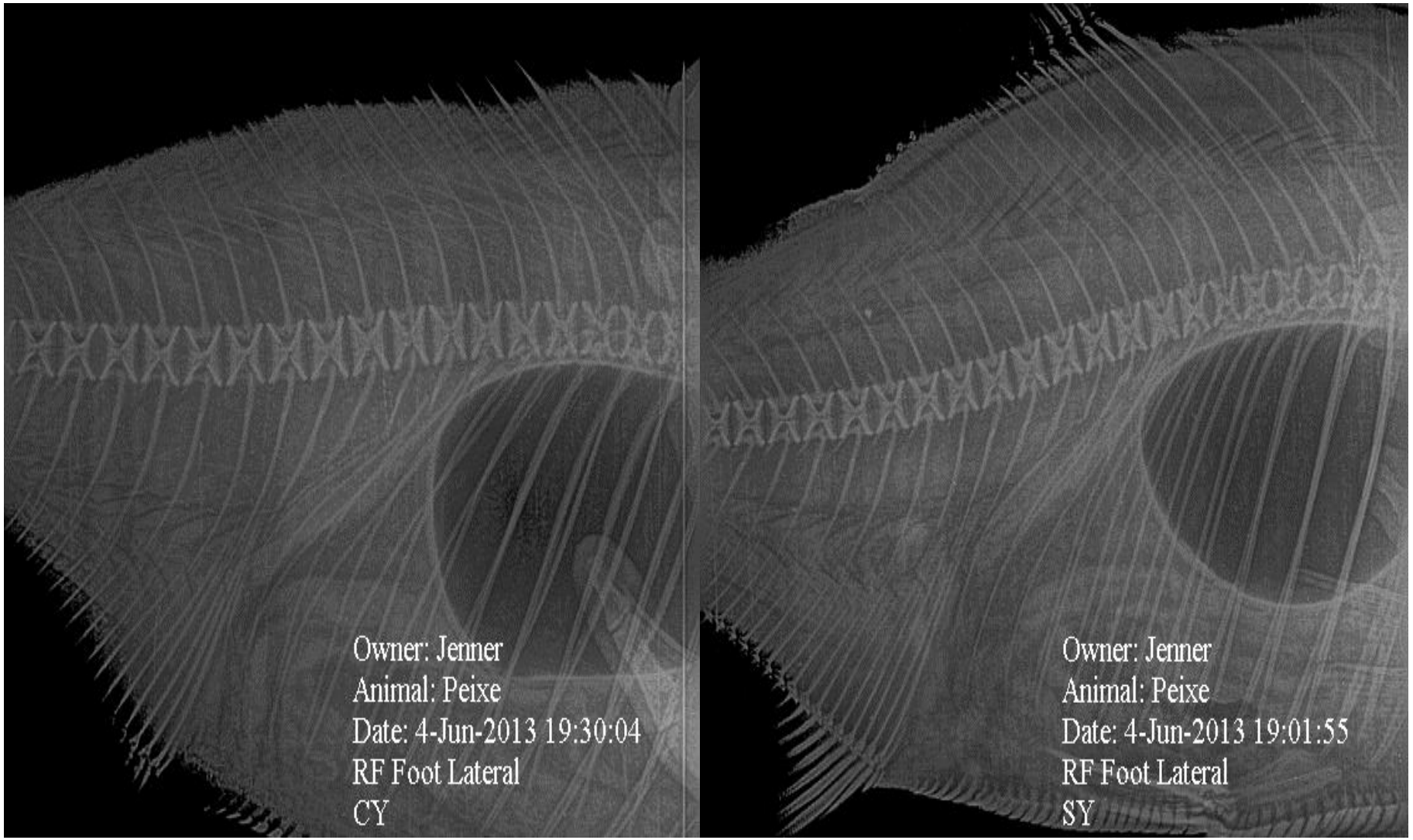
Y boneless tambaqui
How have we found it?

Methodologies used to find the IM boneless brodstock

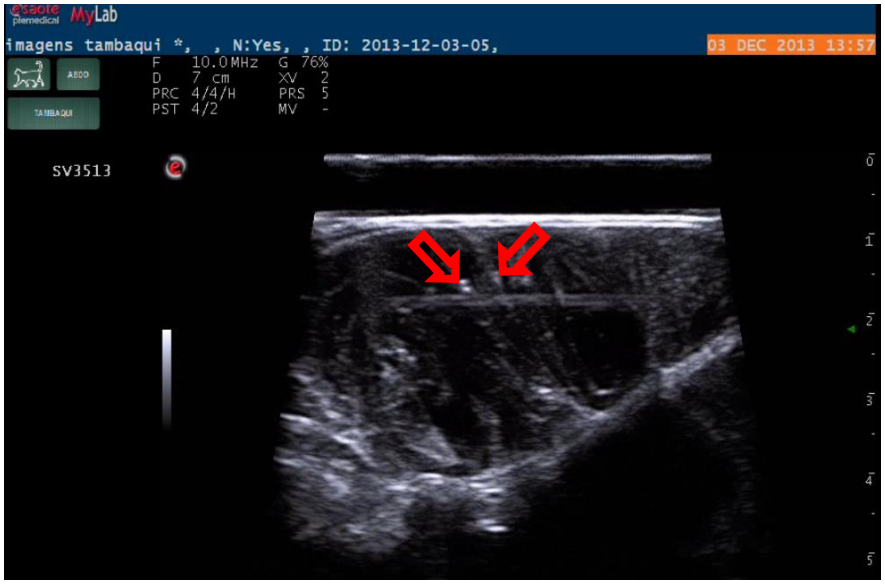
- ✓ A total of 120 tambaqui was assessed by X-ray using Ajex Meditech 135H/A digital x-ray system.
- ✓ Images were processed using a Scan-X ALLPRO Imager (AllPro Imaging, Melville, USA) and then digitized for displayed with Metron-DVM 7.07 software

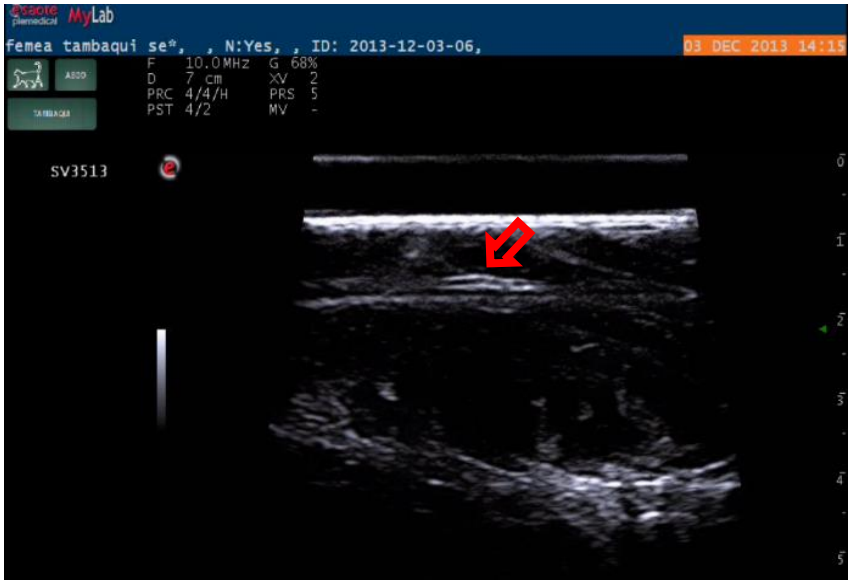
- ✓ Ultrasound imaging was also used as an alternative and more practical approach with a portable MyLab™One VET digital ultrasound machine using multi-frequency rectal linear transducer (6.0/10 MHz).
- ✓ Detection of intermuscular bones consisted of gently moving the ultrasound probe back and forth along both sides of the loin area.

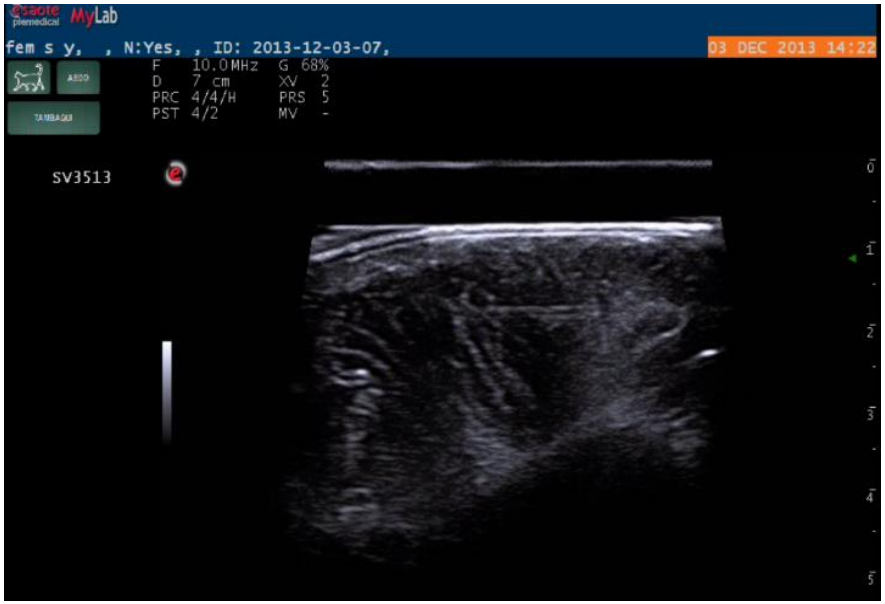
Results: we have found them.
By X-ray

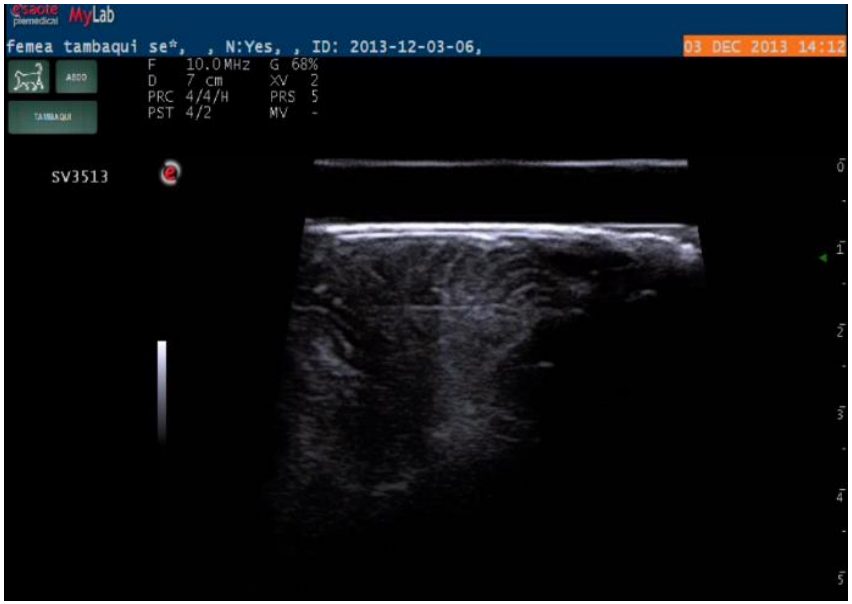


Results: we have found them.
By ultra-sound









Some questions to be answered

How is this trait genetically transmitted? It´s through a simp
monogenic mendelian inherit
more complex polygenic one o
micro RNAs

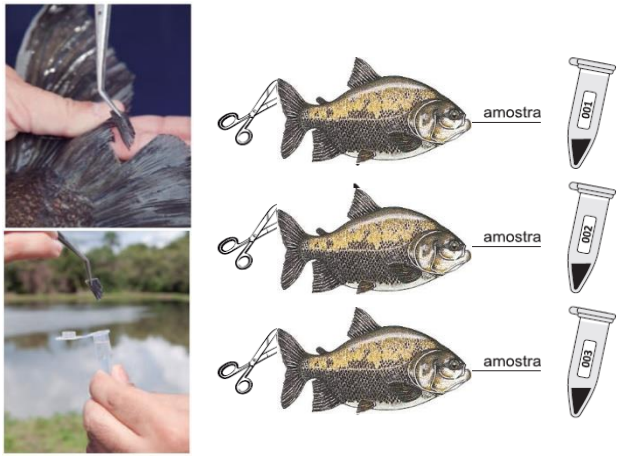
What are the anatomically and physiologically implications of absence of Y bones for the tambaqui welfare?

How can we incorporated this
breeding program to deve
boneless tambaqui with su
growth rate?

Once the genetic mechanismis this trait has been discovered, would we be able to generate Y boneless in other fish species by some molecular methodology?

What are we currently doing?

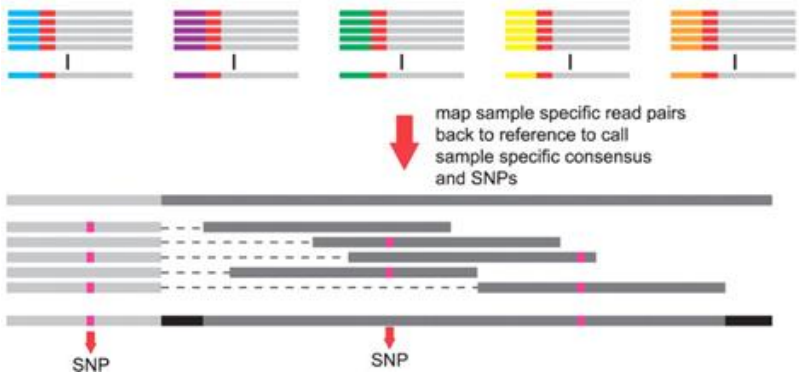
Using Genotype by sequencing to map SNPs in wild and Y boneless tambaquis



DNA library

NGS

Sequence alignment



SNP discovery

Willing E et al. Bioinformatics 2011;27:2187-2193

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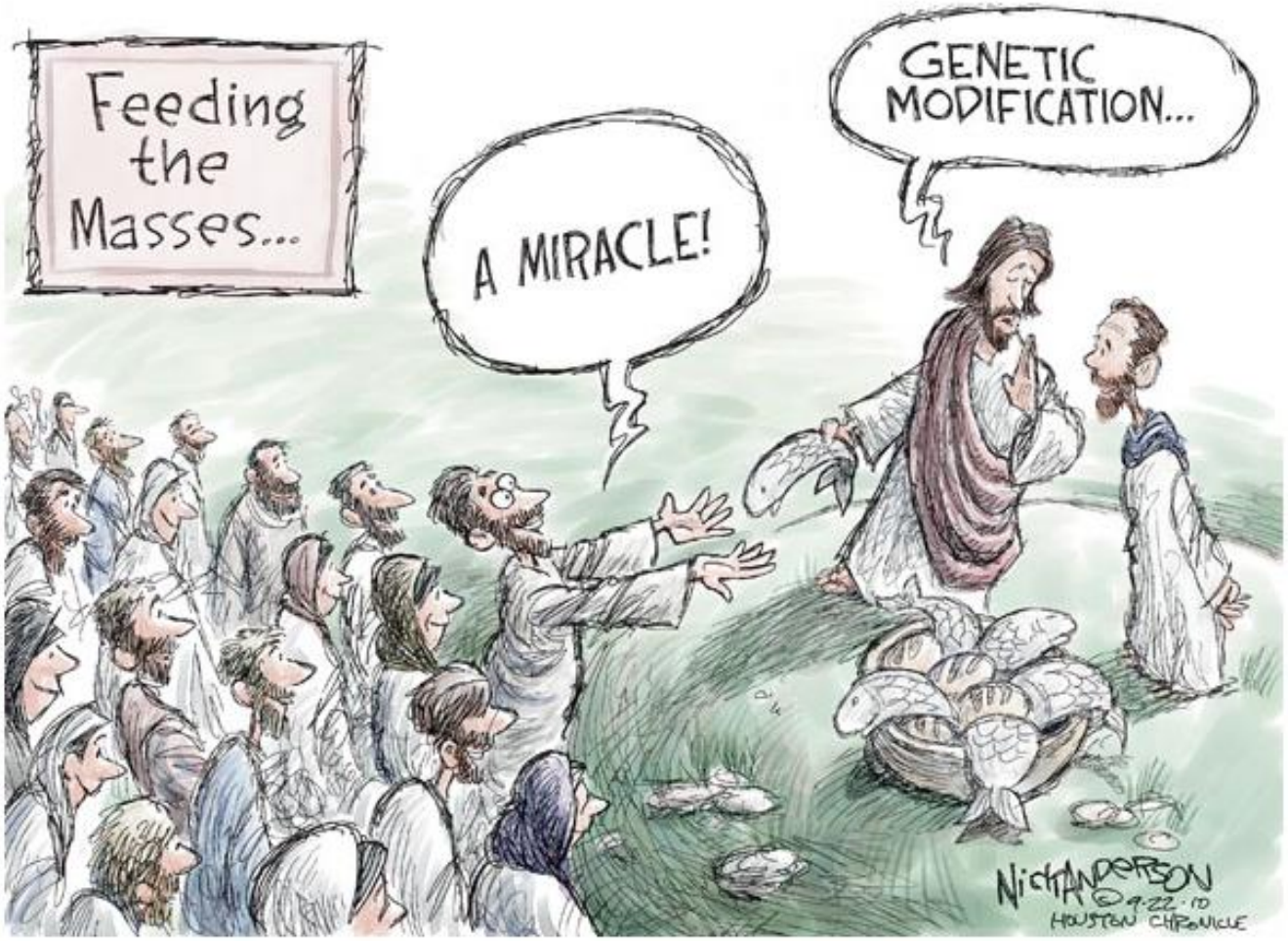
FAEP (F esearch)

UMC (U

All peop

NDAÇÃO DE AMPARO
ENSINO E PESQUISA

Thank you



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