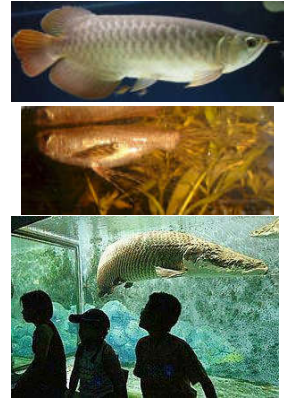


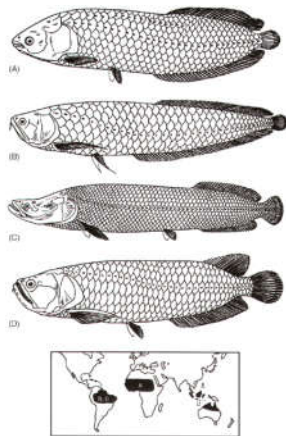
**Order Osteoglossiformes**

- 4 families, 28 genera, 218 species
  - Large (1-3 m)
  - All freshwater
  - Physostomous
  - suprabranchial organ
  - 'bony tongues'
  - Elongate – 60-100 vertebrae
- 2 major lineages
    - 1) Osteoglossidae – arrowana, arapaima, butterflyfish
    - 2) Notopteridae, Mormyridae – knifefishes, elephantfishes



**Order Osteoglossiformes**

- Gondwana origin, current African, South American and Australian distribution



**Order Osteoglossiformes**

- Group also includes knifefishes, elephantfishes, mooneyes
- Knifefish (featherbacks) –
- Elephant fishes –



knifefishes

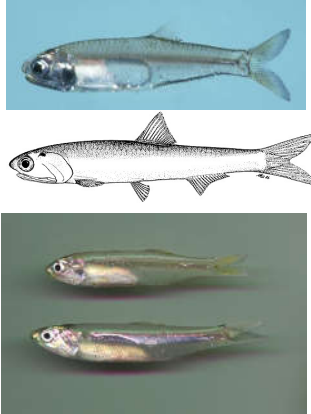


elephant fishes



Order Clupeiformes, Family Engraulidae

- Hyomandibular well in front of quadrate
- Mostly marine, Atlantic, Indian, Pacific
- Planktivores



Clupeimorph "FRTing"



Pacific and Atlantic herring produce burst pulse sounds

Ben Wilson<sup>1,2\*</sup>, Robert S. Batty<sup>3</sup> and Lawrence M. Dill<sup>4</sup>

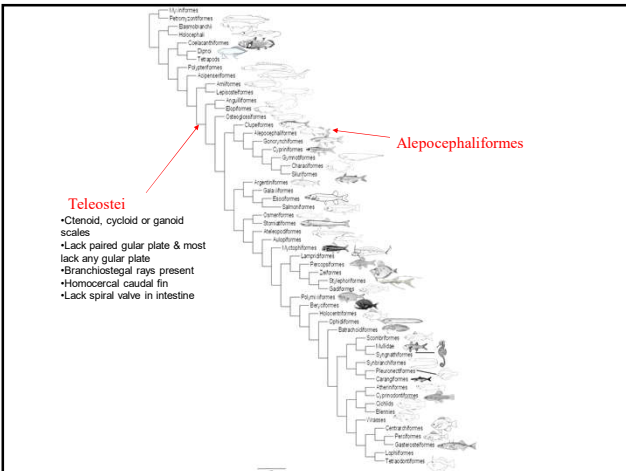
<sup>1</sup>Banfield Marine Science Centre, Banfield, British Columbia V9R 1B9, Canada

<sup>2</sup>Behavioural Ecology Research Group, Department of Biological Sciences, Simon Fraser University, Burnaby, British Columbia V5A 1S6, Canada

<sup>3</sup>Scottish Association for Marine Science, Dunstaffnage Marine Laboratory, Oban PA47 1QA, UK

<sup>4</sup>Author and address for correspondence: Marine Mammal Research Unit, Fisheries Centre, University of British Columbia, Vancouver, British Columbia V6T 1Z4, Canada (bwilson@zoology.ubc.ca)

The commercial importance of Pacific and Atlantic herring (*Clupea pallasii* and *Clupea harengus*) has ensured that much of their biology has received attention. However, their sound production remains poorly studied. We describe the sounds made by captive wild-caught herring. Pacific herring produce distinctive bursts of pulses, termed Fast Repetitive Tick (FRT) sounds. These trains of broadband pulses (1.7–22 kHz) lasted between 0.6 s and 7.6 s. Most were produced at night; feeding regime did not affect their frequency, and fish produced FRT sounds without direct access to the air. Digestive gas or gulped air transfer to the swim bladder, therefore, do not appear to be responsible for FRT sound generation. Atlantic herring also produce FRT sounds, and video analysis showed an association with bubble expulsion from the anal duct region (i.e. from the gut or swim bladder). To the best of the authors' knowledge, sound production by such means has not previously been described. The function(s) of these sounds are unknown, but as the *per capita* rates of sound production by fish at higher densities were greater, social mediation appears likely. These sounds may have consequences for our understanding of herring behaviour and the effects of noise pollution.



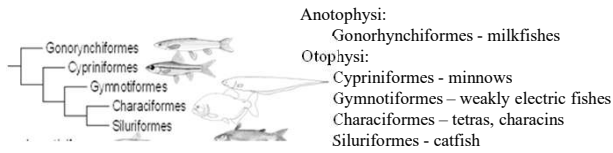
Alepocephaliformes, slickheads and tubeshoulders

- 3 families, 14 genera and 38 species
- Deep sea
- Uniform dark bodies
- Reduced ossification of opercle



**Subdivision Euteleostei, Superorder Ostariophysi**

- 5 Orders, 59 families, 960 genera, 6507 species
- 75% of freshwater species, 27% of all species
- Found on all landmasses (except Greenland & Antarctica)
- Characteristics
  - club cells in dermis
  - trend of increasing development of olfactory system
  - 2 series: Anotoptysi & Otoptysi –
  - Larvae not leptocephalus



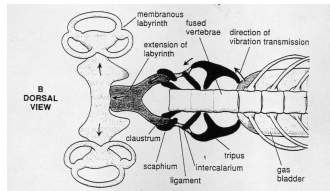
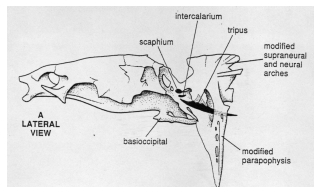
**Anotoptysi, Order Gonorhynchiformes, milkfish, sandfish and shelleaters**

- 4 families, 7 genera, 37 families
- No Weberian apparatus
- Mostly marine
- Single short dorsal and anal fin, no adipose fin
- Some obligate air breathers
- Clear pelagic larvae
- Patch of conical teeth on gill arches



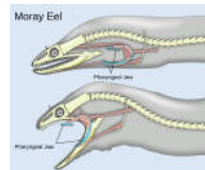
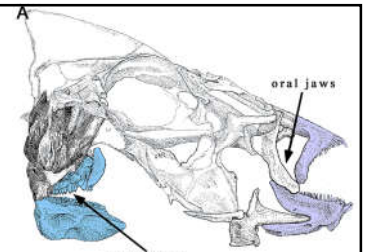
**Otoptysi**

- Orders
  - Cypriniformes
  - Characiformes
  - Siluriformes
  - Gymnotiformes
- Characters
  - Weberian apparatus
  - Most have adipose fin
  - Schreckstoff (other taxa possible)



**Pharyngeal Jaws/Teeth**

- Pharyngeal Arch or Jaw
  - Second distinct (from the oral) jaw
  - Modified from portions of the remaining bronchial arches



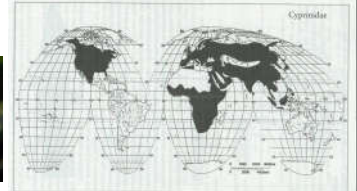
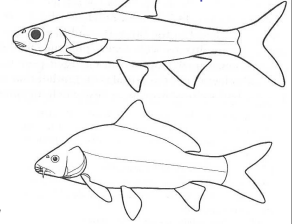
Otophysi, Order Cypriniformes, minnows, carps and suckers

- 6 families, 321 genera, 3268 species
- North America & Europe
- Mouth toothless (jaws and palate)
- Pharyngeal teeth
- No adipose fin
- Spinelike ray in dorsal fin
- Oviparous
- Omnivores, detritivores, few piscivores



Otophysi, Order Cypriniformes, Family Cyprinidae, minnows and carp

- 2420 species, 220 genera
- All freshwater
- 1-3 rows pharyngeal teeth, <10 teeth/row
- North America: 1-2 rows, <5 teeth/row
- Spinelike ray in dorsal fin



Otophysi, Order Cypriniformes, Family Cyprinidae, minnows and carp



William Pflieger

Otophysi, Order Cypriniformes, Family Cyprinidae, minnows and carp

**Bighead and Silver Carp WATCH**

**How To Identify Bighead and Silver Carp**

**General Characteristics**

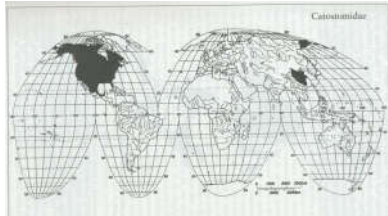
- Bighead Carp: 1-2 rows of pharyngeal teeth, 1-5 teeth/row
- Silver Carp: 1-3 rows of pharyngeal teeth, 1-10 teeth/row

**EXPLANATION**

- RED: Bighead and Silver Carp
- GREEN: Other Cyprinidae
- BLUE: Other Fish

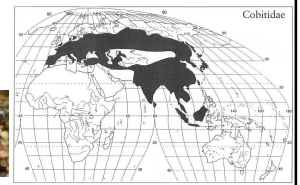
Order Cypriniformes, Family Catastomidae, Suckers

- 75 species, 13 genera
- MS – 20 species, 6 genera
- 1 row of >16 pharyngeal teeth



Order Cypriniformes, Family Cobitidae, loaches

- 3-6 pairs barbels, subterminal mouth
- Erectable spine
- Weather loaches



Order Cypriniformes, Family Balitoridae, river loaches

- 251 species in 31 genera
- Southern and eastern Asia

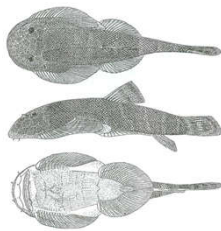
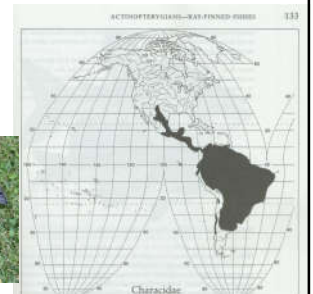


FIGURE 64. *Neogastromyzon stewartianus* as *Gastromyzon borneensis* (Weber and DeBeaufort, 1916, Fig. 1).

Otophysi, Order Characiformes, characins

- 18 families, 270 genera, 1674 species
- freshwater
- South & Central America, Mexico, Africa
- Well developed jaw teeth



Otophysi, Order Characiformes, Family Prochilodontidae

- Mouth forms suckerlike disc
- Important detritivore, tropical ecosystem engineer



Otophysi, Order Characiformes, Family Gasteropelecidae, freshwater hatchetfish

- Compressed body
- Superior mouth
- Protruding breast
- Surface feeders, superior mouth
- Large pectoral fins



Otophysi, Order Characiformes, Family Characidae, characins

- Largest family of Characiformes, ~1000 species
- One North American species
- Ecologically important



Characidae – Mississippi Exotics

*Piaractus brachipomus*  
Pirapitinga



*Colossoma macropomum*  
Tambaqui