

FT 274 Fish Groups



 fish "definition" (artificial):

 'cold-blooded' (poikilotherm)

 vertebrate

 aquatic (reproduction)

 respiration (internal 'gills')

 (paired) fin or fin-like limbs

 usually have scales or
modifications of them

 lateral line

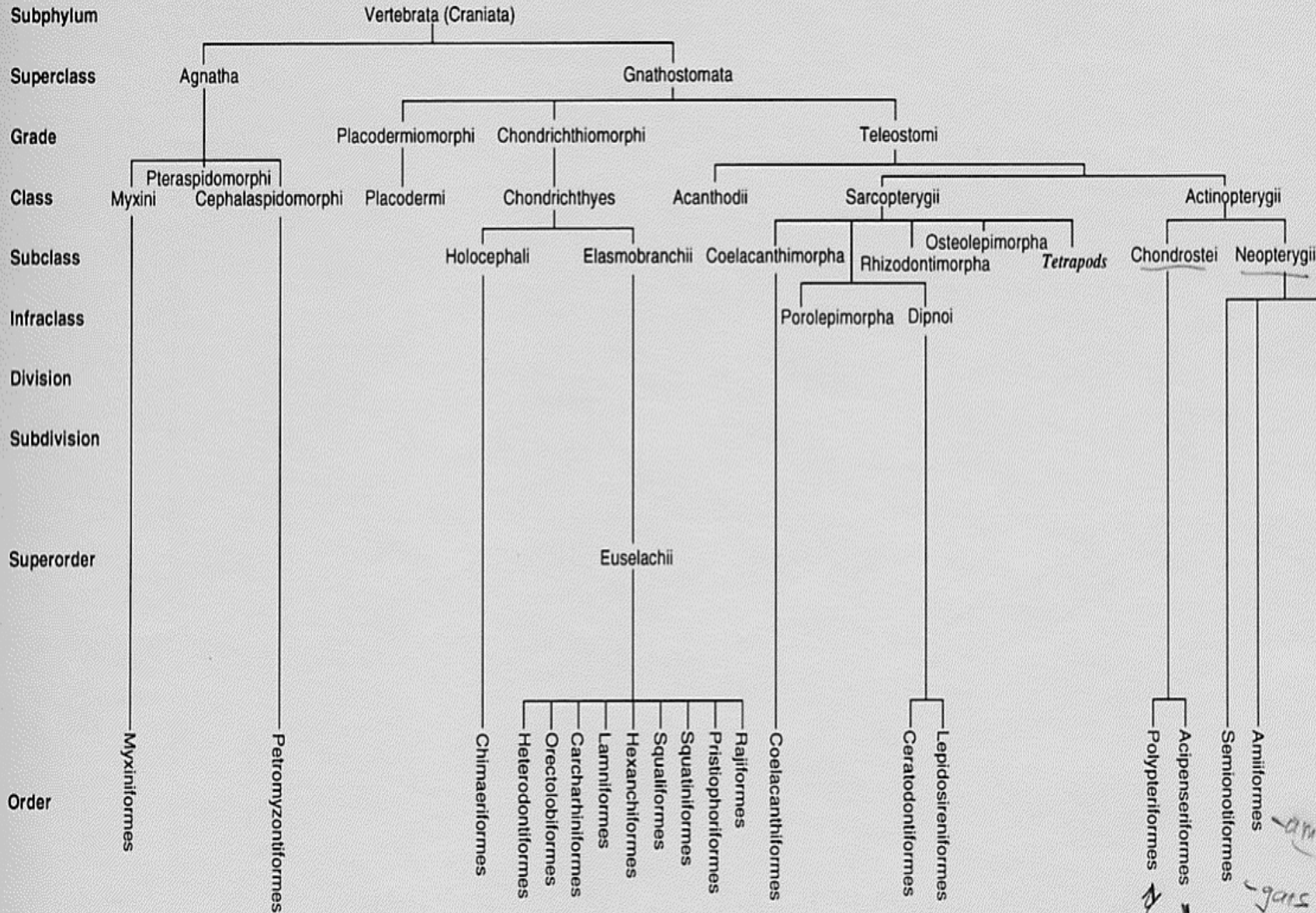
Part 1. Agnathans

Order Myxiniiformes - hagfishes

- 🐟 about 43 extant species (marine)
- 🐟 6 genera (diff. evol. 'levels')
- 🐟 paired gill pores (1-16) & eye size
 - 🐟 *Eptatretus* sp. (2 in N. Pacific)
- 🐟 'temperate' ocean distribution
 - 🐟 N. Pacific (20 - 1000 m deep)
 - 🐟 generally sandy bottoms ($\sim \leq 13^{\circ}\text{C}$)
 - 🐟 very locally abundant (SE AK)
 - 🐟 adults and eggs
 - 🐟 adults ~ 40 - 90 cm (♀ larger)

CATEGORY









HIERARCHY OF HIGHER CATEGORIES OF FISHES



ami
gans

Order Myxiniiformes - hagfishes

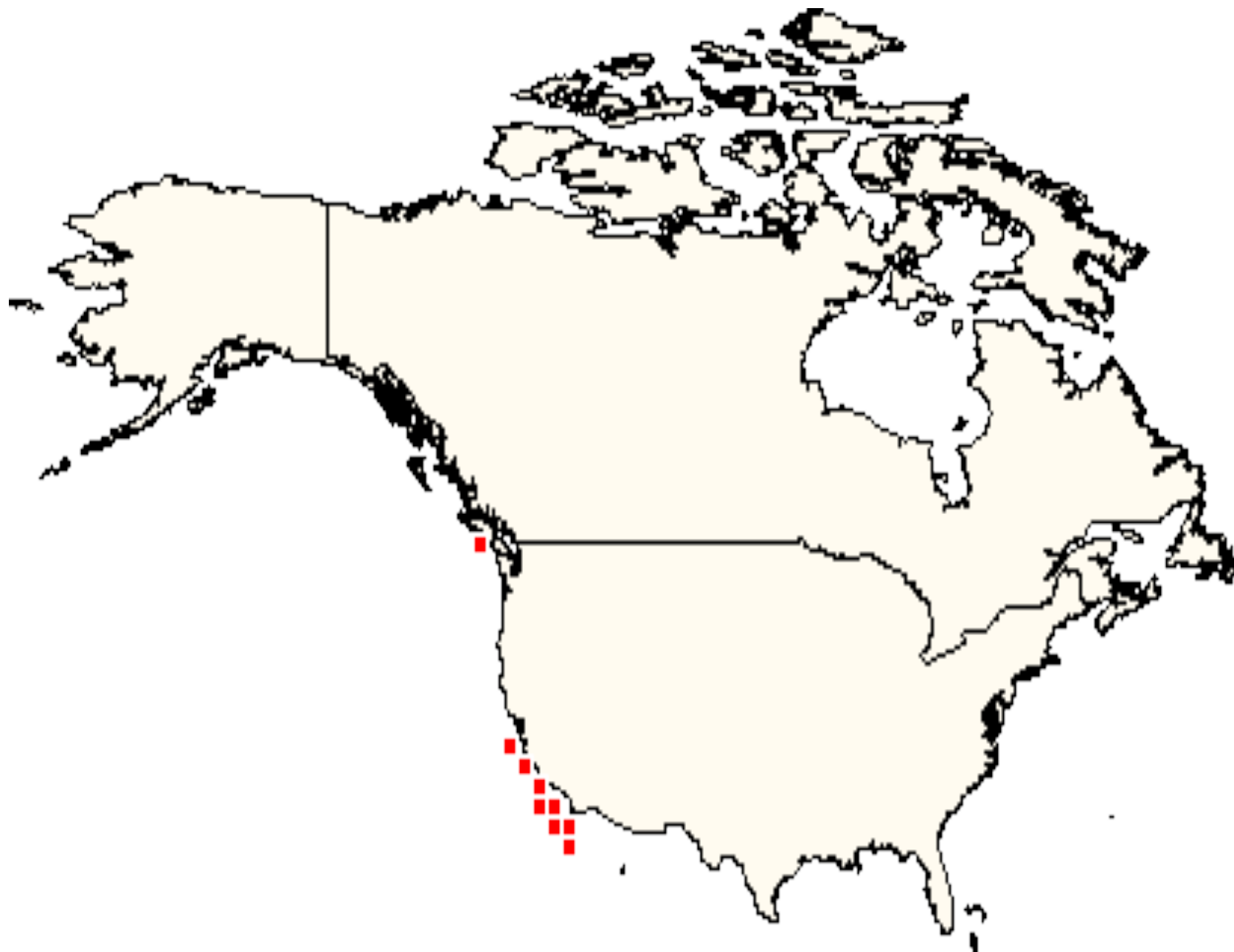
Slime-eels

-  can produce copious *slime*
-  slime glands / pores (70-200)
-  cohesive mucin ('jello')
 -  reinforced with fibers (keratin) from thread cells
 -  very strong and tough
-  predatory defence (few)
 -  burrow more likely defence
-  food coating / protection

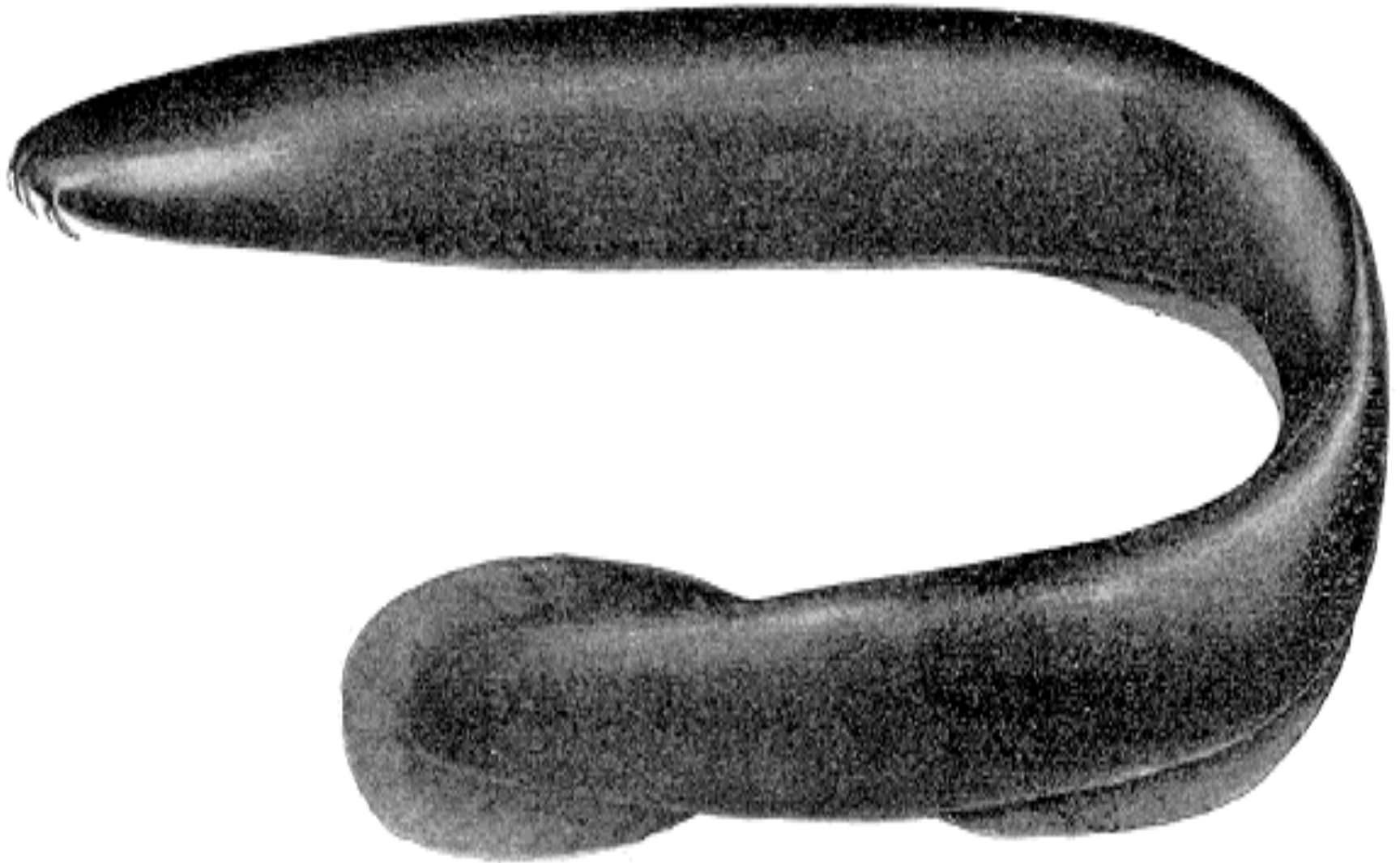
1) *Eptatretus stouti* - Pacific hagfish



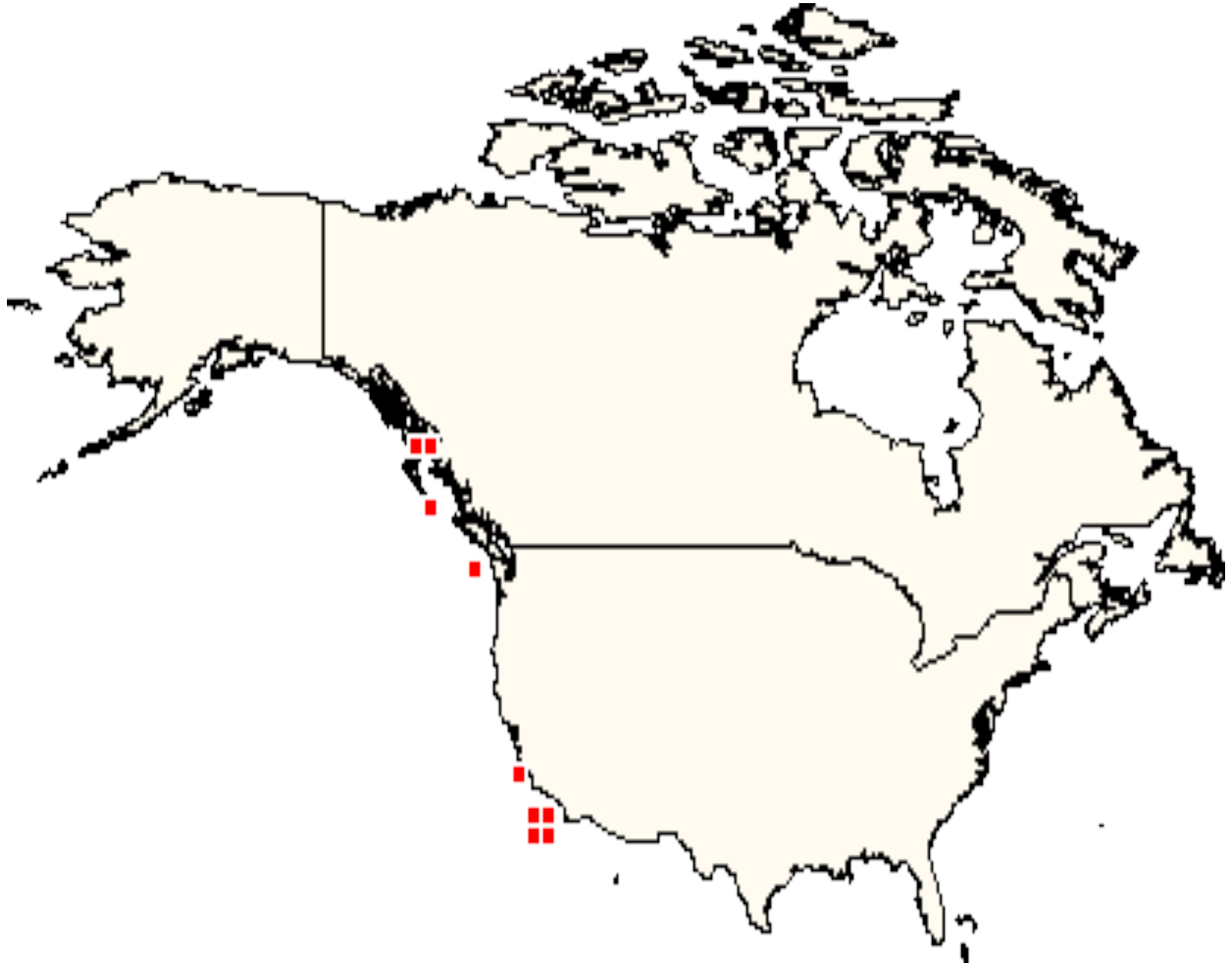
1) *Eptatretus stouti* - Pacific hagfish



2) *Eptatretus deani* - black hagfish



2) *Eptatretus deani* - black hagfish





Agnathans

Order Petromyzontiformes - *lampreys*

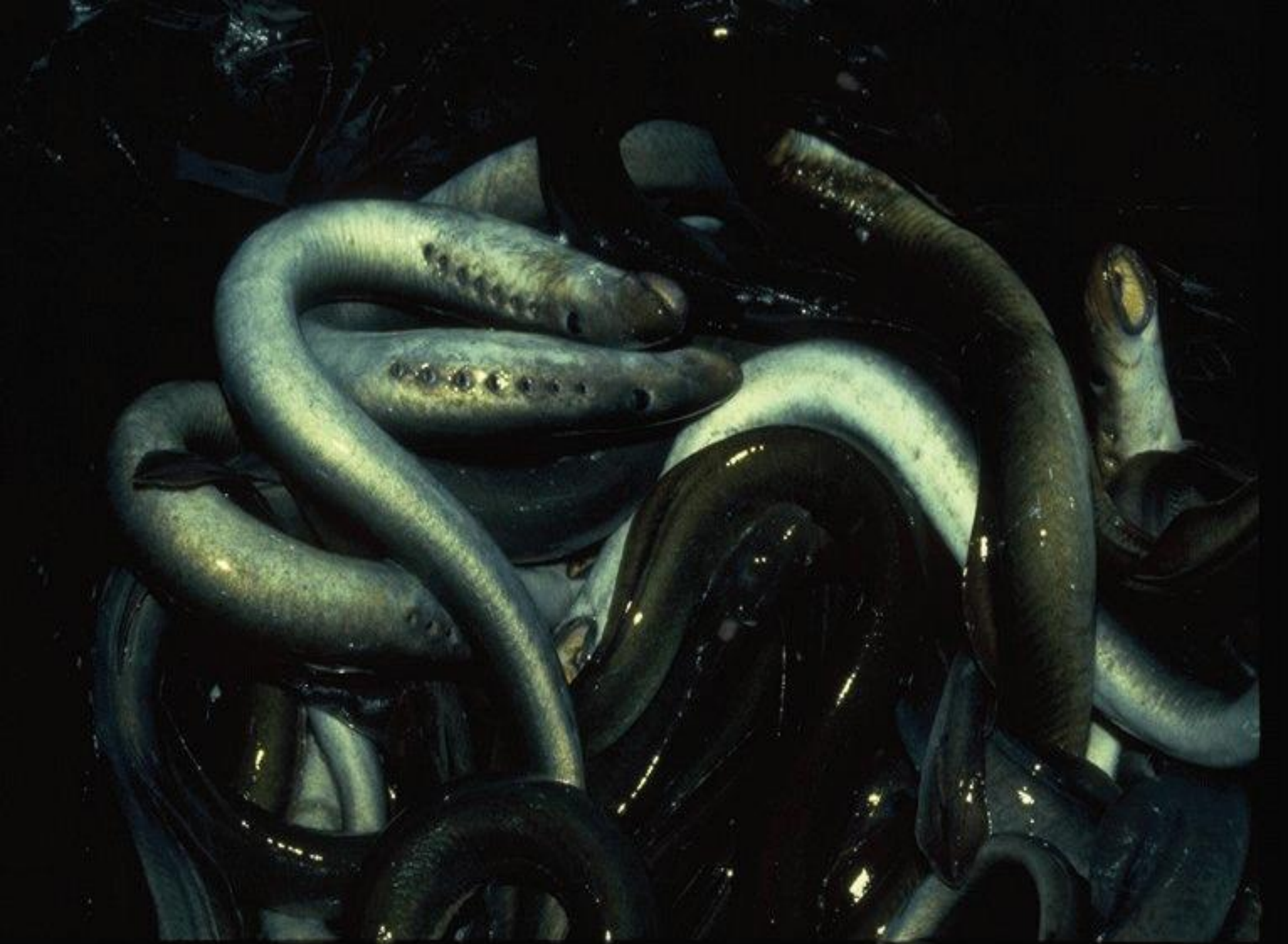
long classified with hagfish

- primitive paraphyletic state
- hagfish are a *distinct* group
- hagfish similarities superficial
- we study as one group (Agnatha)

Order Petromyzontiformes - lampreys

Simple Vertebrates

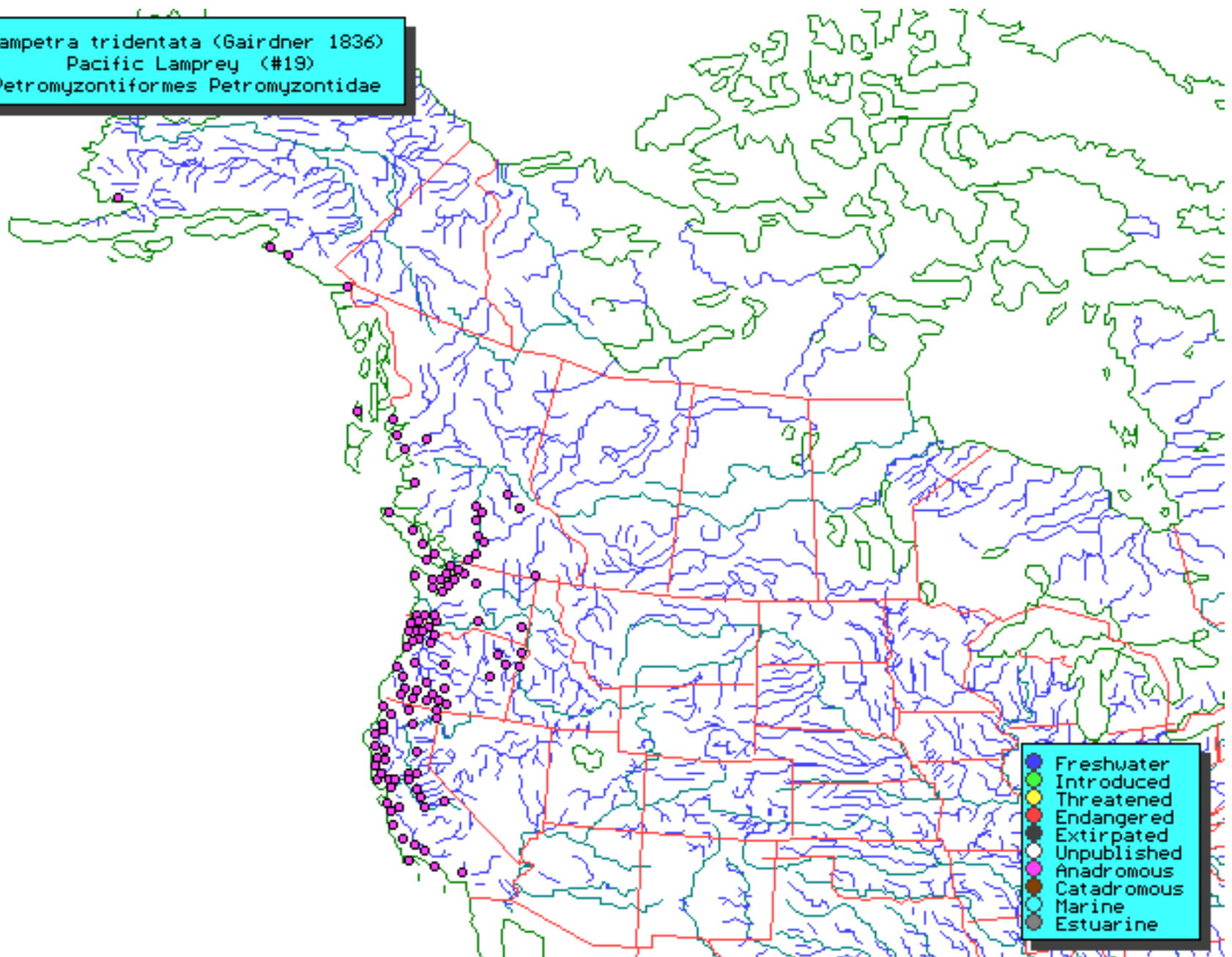
- no jaws, but two inner ear canals
- largely cartilaginous
- no scales, & 'reduced' eye
- seven or more paired gill pouches
- 1 median nostril
- reduced brain, but 'real' skull
- digestive system - no stomach
- both male/female gonads present
- only one set functional
- no paired fins



Konrad P. Schmidt



Lampetra tridentata (Gairdner 1836)
Pacific Lamprey (#19)
Petromyzontiformes Petromyzontidae







Part 2. Chondrichthyes

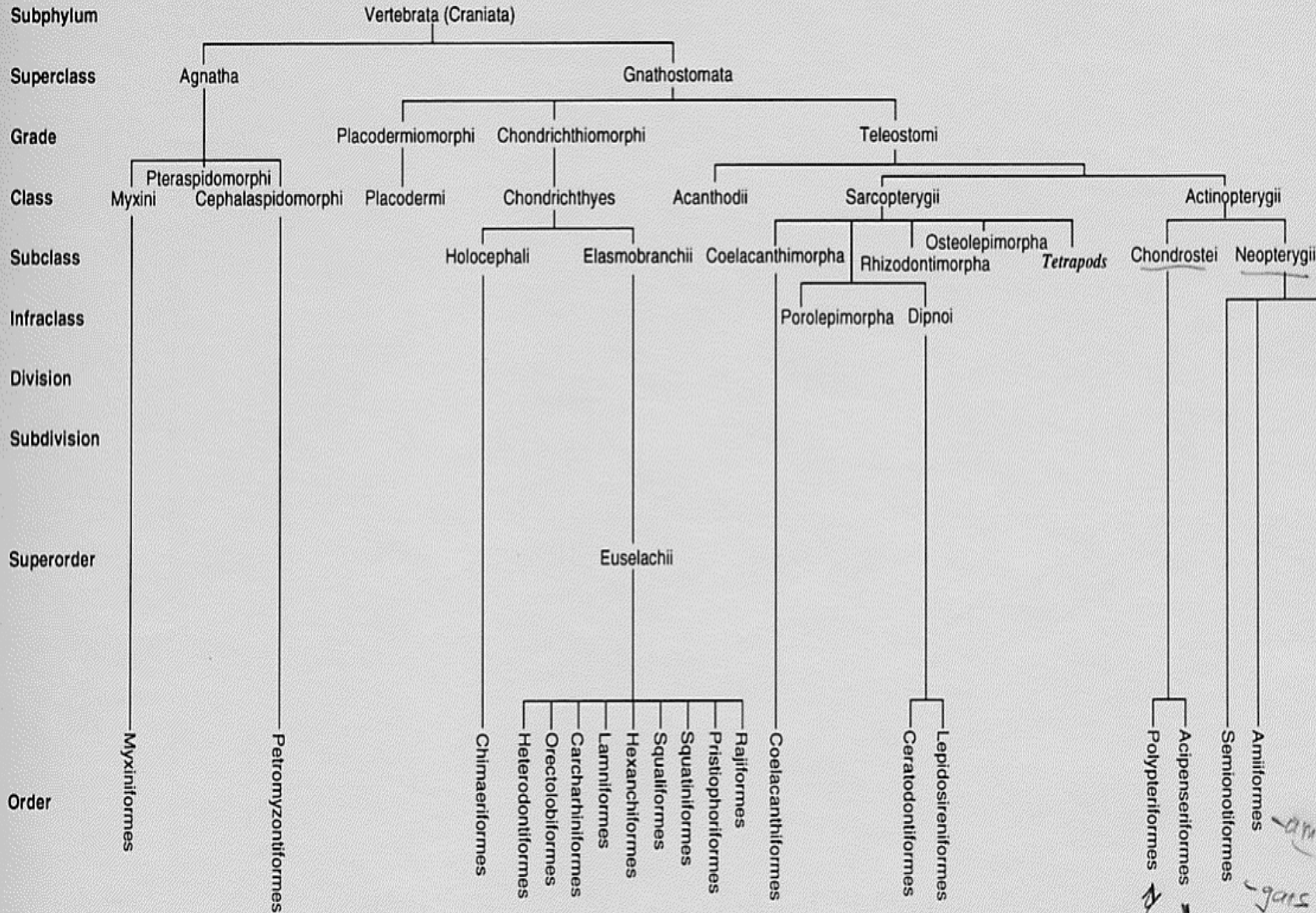
Subclass Holocephali

order Chimaeriformes ↔ ratfish

- ↔ 3 families, 6 genera, ~ 46 sp. (1m)
- 🐟 1 gill cover ('operculum') - 4 openings
- 🐟 no spiracle, stomach, & few scales
- 🐟 oral grinding plates (no teeth)
- 🐟 diphyccercal tail ↔ no cloaca (↓)
- 🐟 separate anal/urogenital openings
- 🐟 males additional head 'clasper'
- 🐟 4 body claspers instead of 2

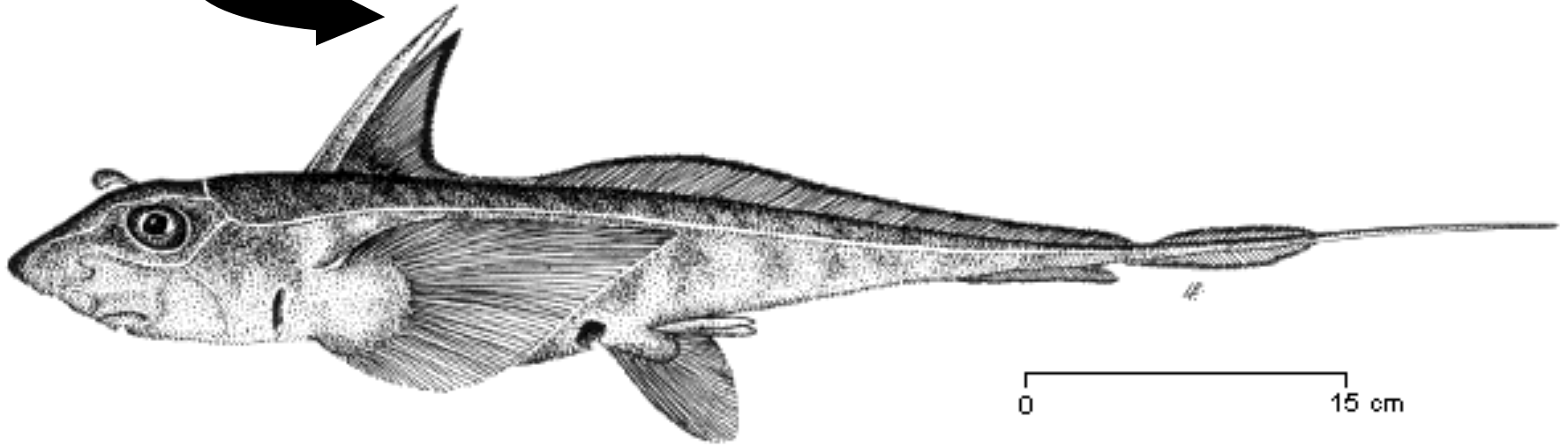
CATEGORY

HIERARCHY OF HIGHER CATEGORIES OF FISHES



ami-
gans
10

FYI - spine with poison gland



ratfish (or chimaera)



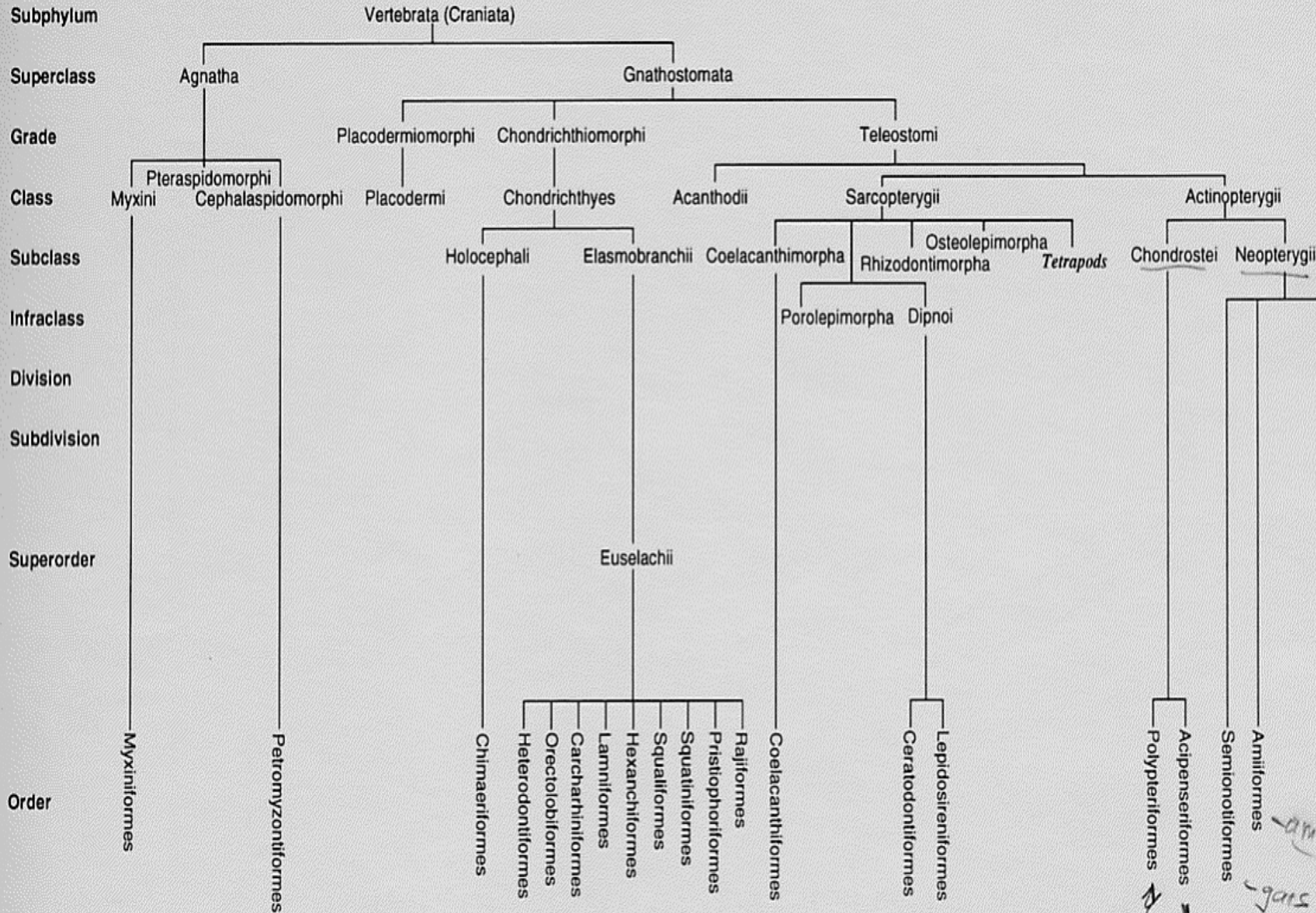


Subclass Elasmobranchii (extant - seven orders)

- 5-7 gill slits ➤ cloaca ➤ ~spiracle
- real teeth unfused (replaced rows)
- sharks - eye 'nictating membrane'
- specialized feeders (top predators)
 - larger species planktivorous
- olfaction, low freq. 'sound', vision
 - ampullae of Lorenzini (electric)
- oviparity to *viviparity*
 - uterine, placental, and cannibal

CATEGORY

HIERARCHY OF HIGHER CATEGORIES OF FISHES



amni-
gans

Part 3. Order Heterodontiformes

— 1 family, 1 genus, 8 species

— bullhead, (or) horn, (or)

Port Jackson sharks

— most < 1m, up to 1.6m

— oviparous (laid/hatch externally)

DAVID FLEETHAM © 2000 photo@maui.net



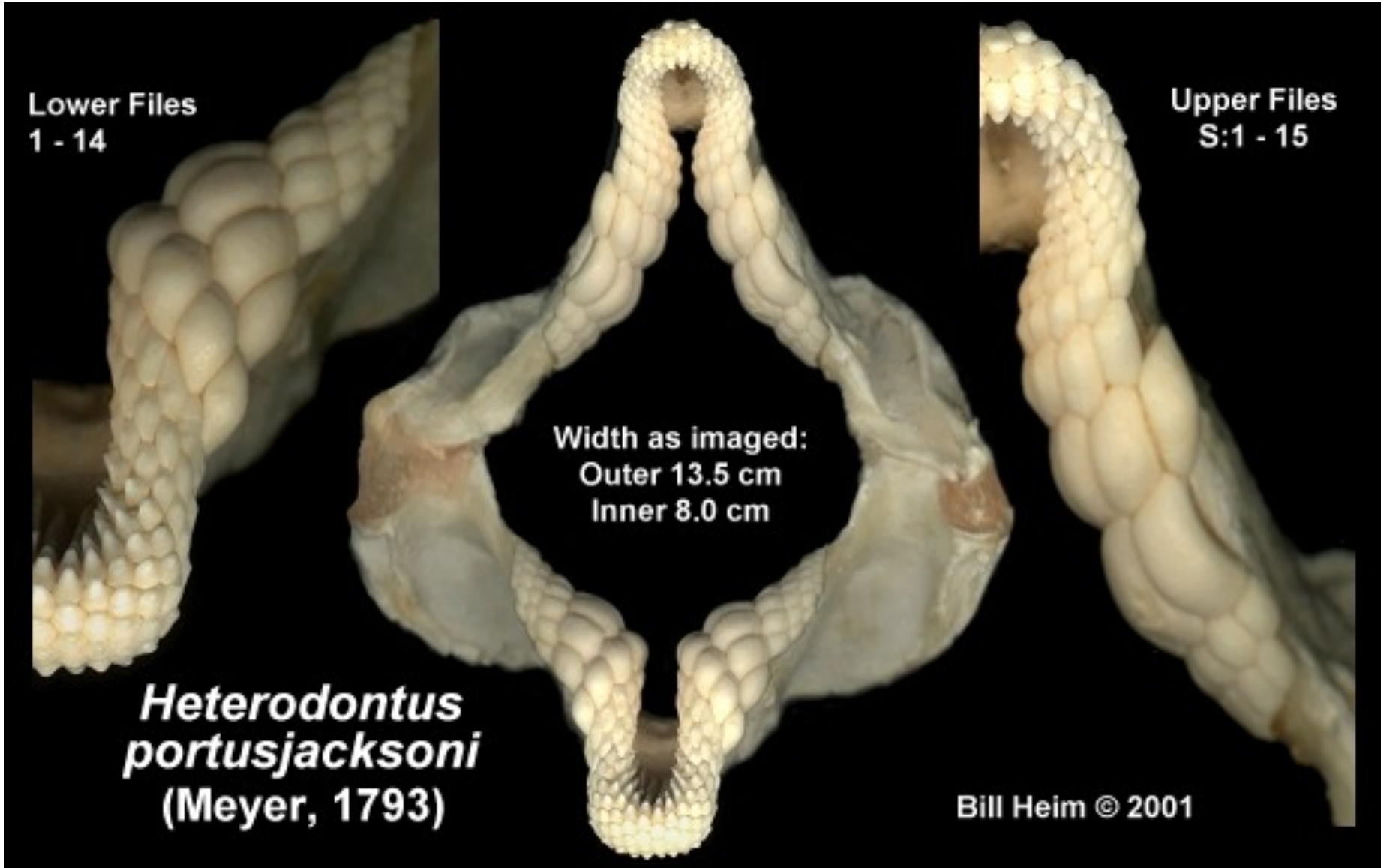
Lower Files
1 - 14

Upper Files
S:1 - 15

Width as imaged:
Outer 13.5 cm
Inner 8.0 cm

*Heterodontus
portusjacksoni*
(Meyer, 1793)

Bill Heim © 2001





Part 4. Order Orectolobiformes

- 7 families, 14 genera, 31 sp.
- carpet sharks
- (wobbegons & bamboo, nurse, zebra & whale sharks)
- most ~1m; wobbegons \leq 3.5m
- whale shark 12-18m (largest)

DAVID FLEETHAM © 2000 photo@maui.net



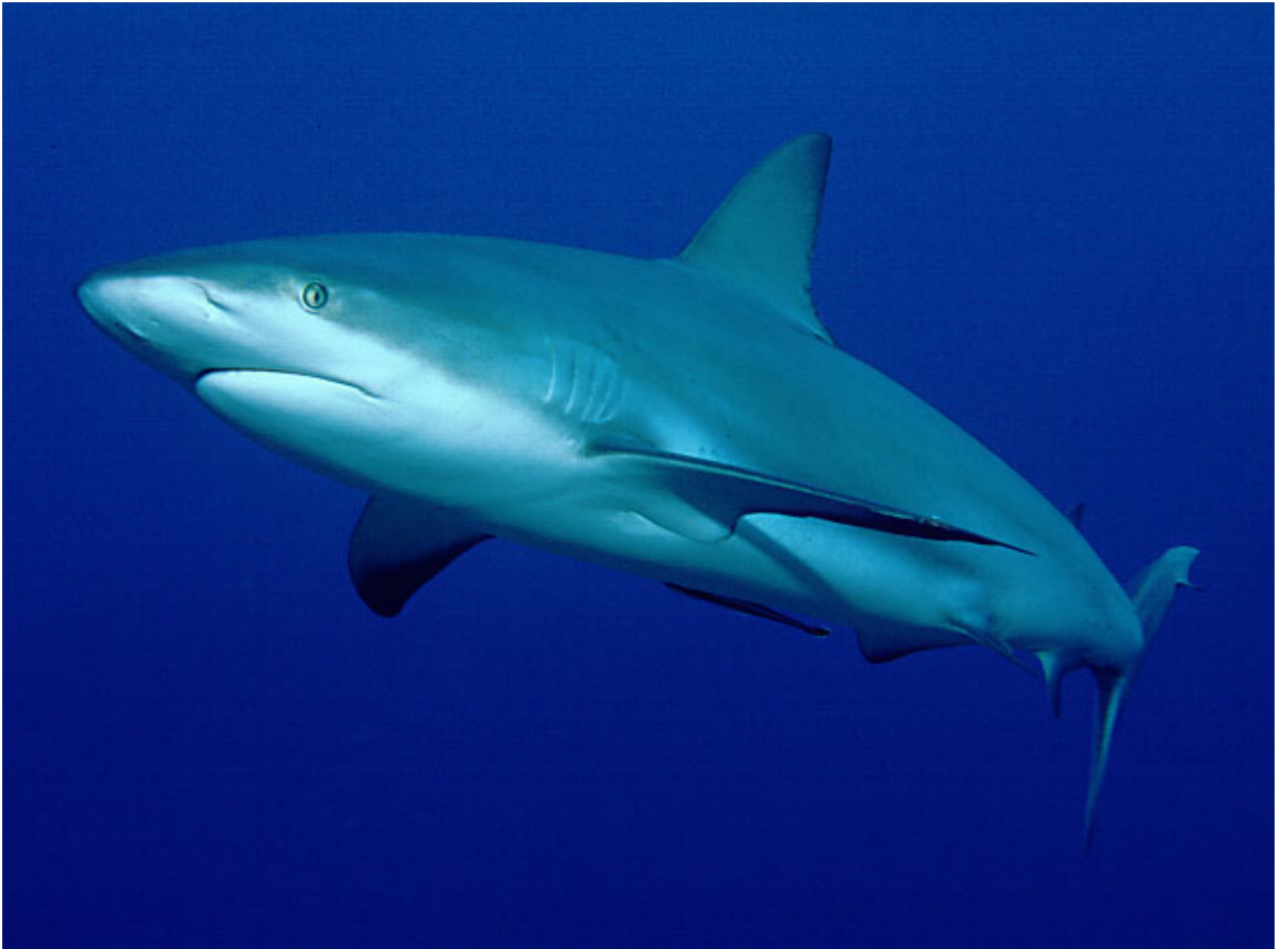






Part 5. Order Carchariniiformes

- 7 families, 47 genera, ~208 sp.
- largest groups of sharks
- ground sharks
 - (houndsharks & weasel, cat, swell, requiem sharks)
- most ~1-2.5m; houndshark ~8m
- 'bull shark' enters freshwater





Upr RH 3

Upr LH 3



62 inch female



Upr LH 6



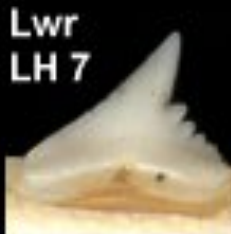
Upr LH 12

Galeorhinus galeus
(LINNAEUS, 1758)

As imaged:
outer width = 15 cm
inner = 12 cm



Lwr LH 5



Lwr LH 7



Lwr LH 9

Lwr RH 3

RH 2

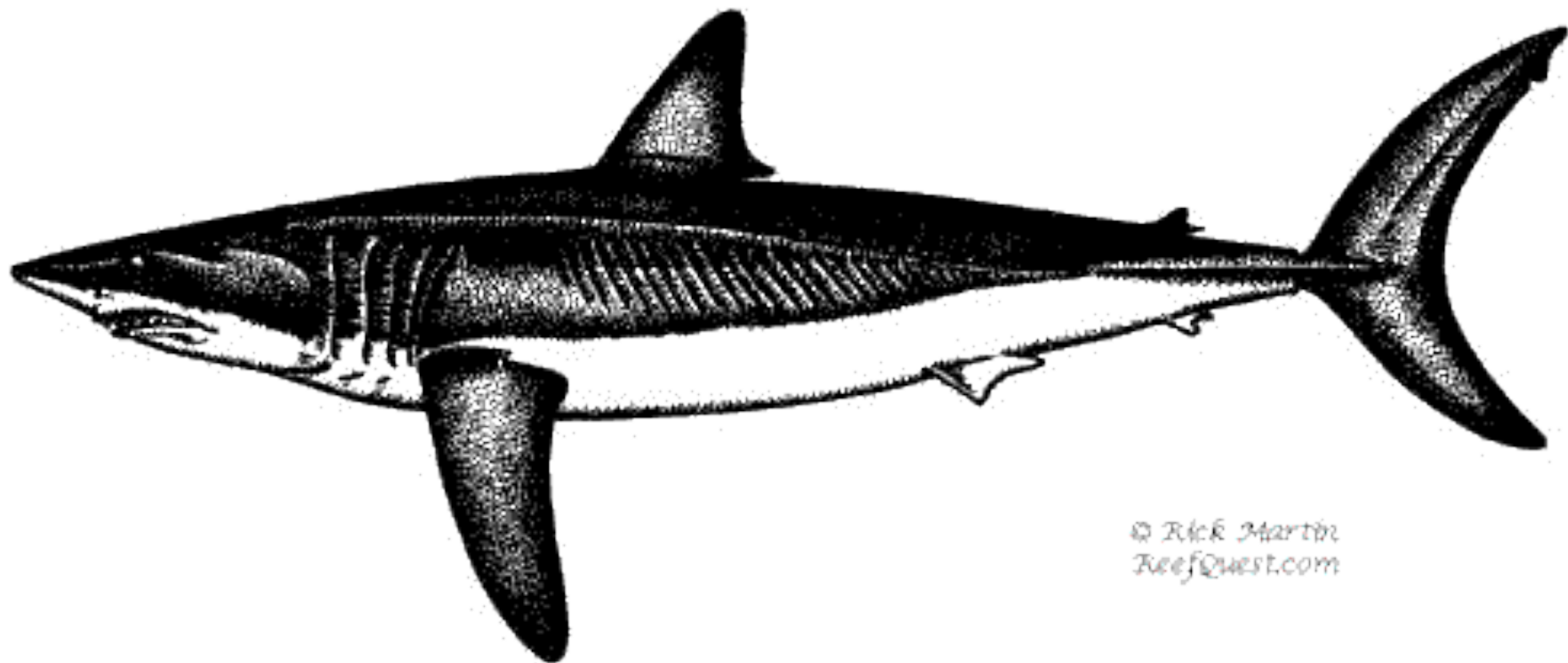




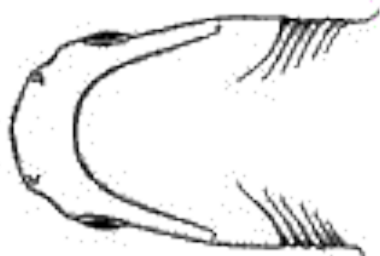


Part 6. Order Lamniformes

- 7 families, 10 genera, 16 sp.
- mackerel sharks
- (sand tigers, megamouth & goblin, crocodile, thresher & basking sharks)
- most ~3-5m; 'killers'(white ~8m)
- basking 10(-15)m & 12,000kg



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ReefQuest.com







Isurus paucus

Guitart Manday

1966

From the collection of
Gordon Hubbell



© Bourdon 2000

Carcharodon carcharias (LINNAEUS, 1758)





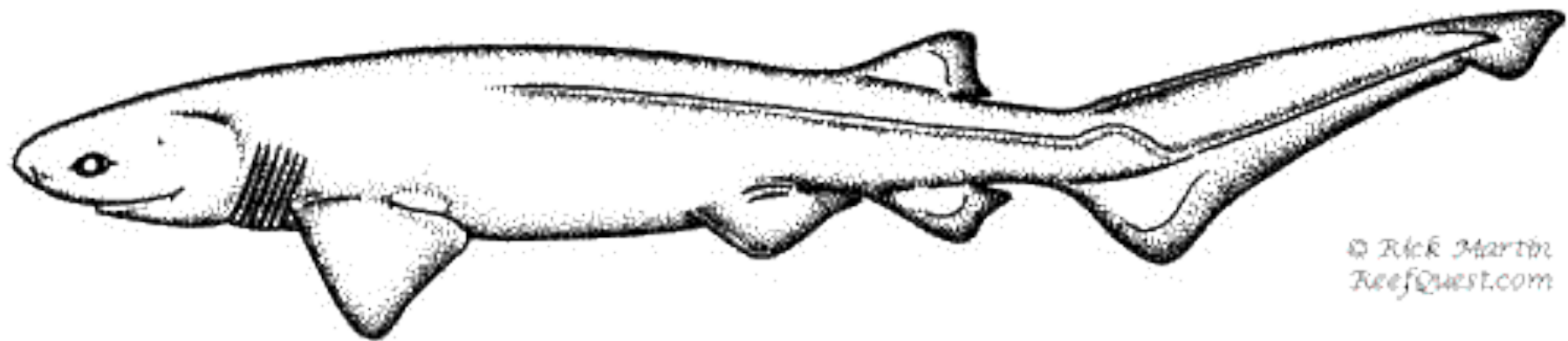


Part 7. Order Hexanchiformes

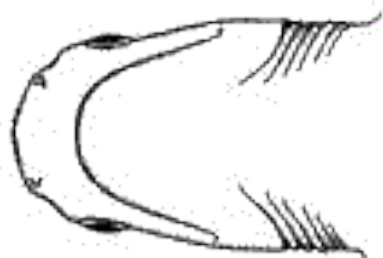
→ 7 families, 10 genera, 16 sp.

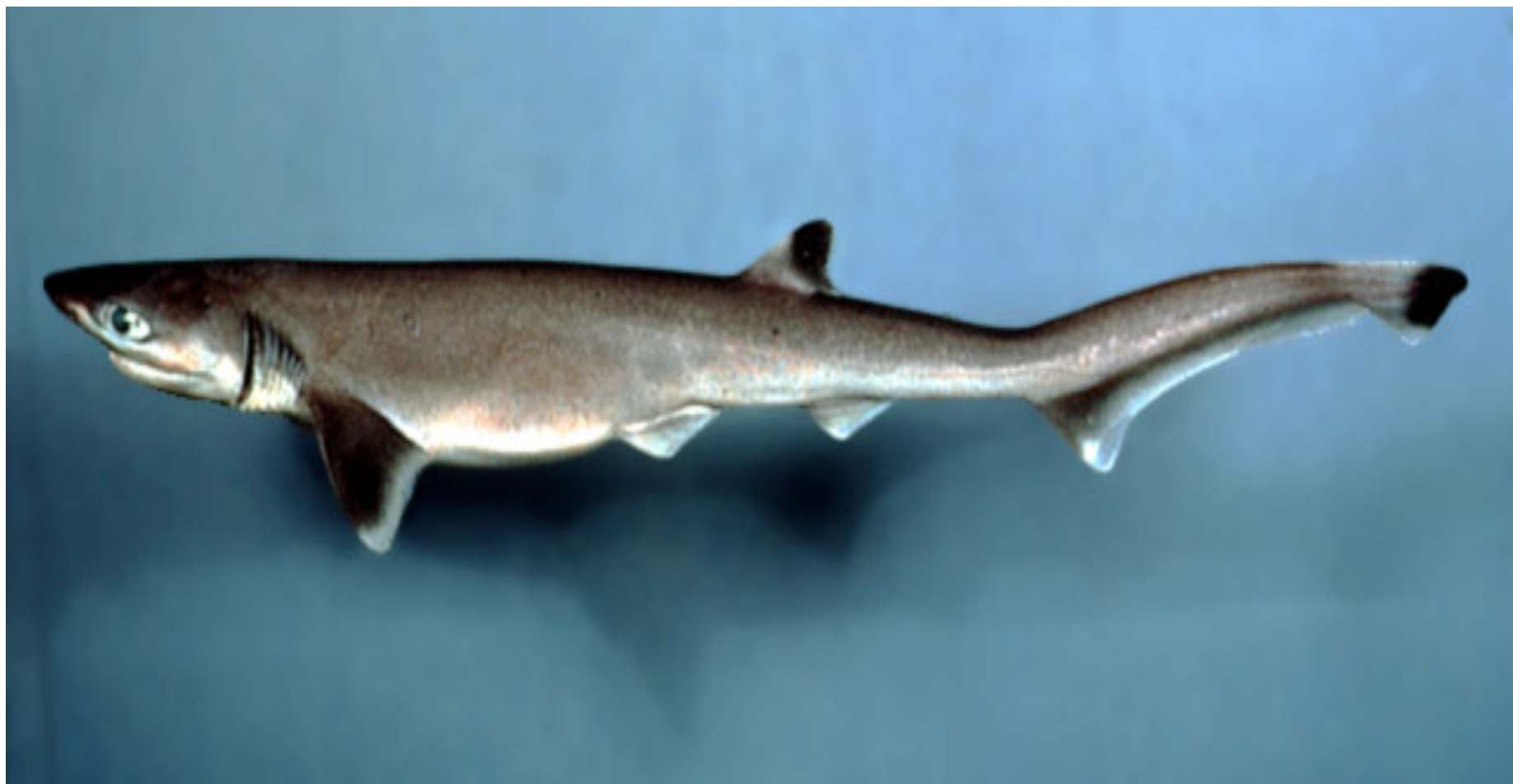
→ frill and cow sharks

→ most ~ 1- 5 m



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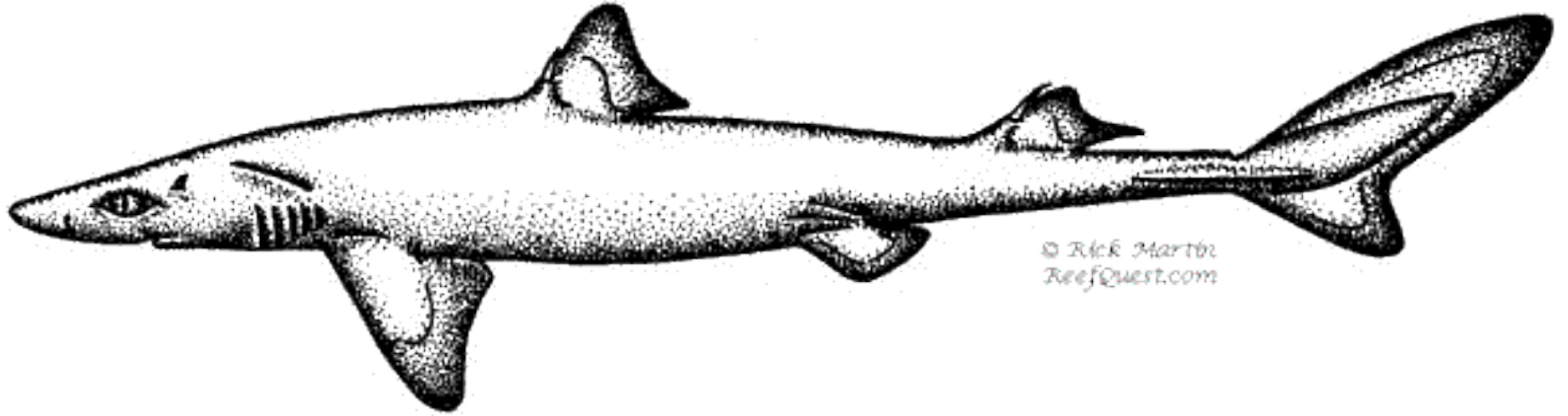




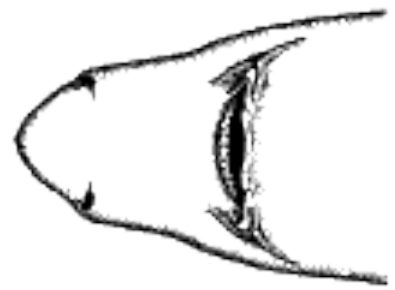


Part 8. Order Squaliformes

- 4 families, 23 genera, 74 sp.
- bramble, dogfish, and sleeper (Greenland) sharks
- bramble/dogfish ~ 0.25 to 2 m
- sleeper shark up to 7.5 m
- seasonal feeding pattern shift



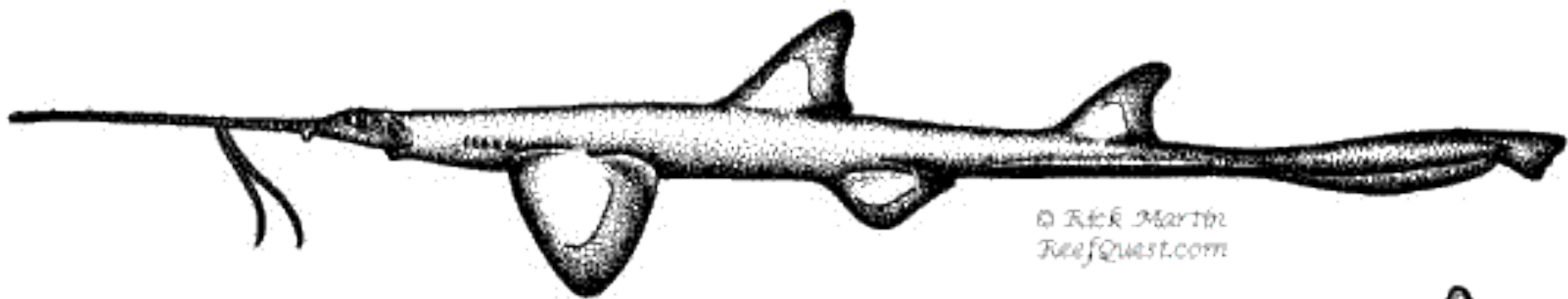
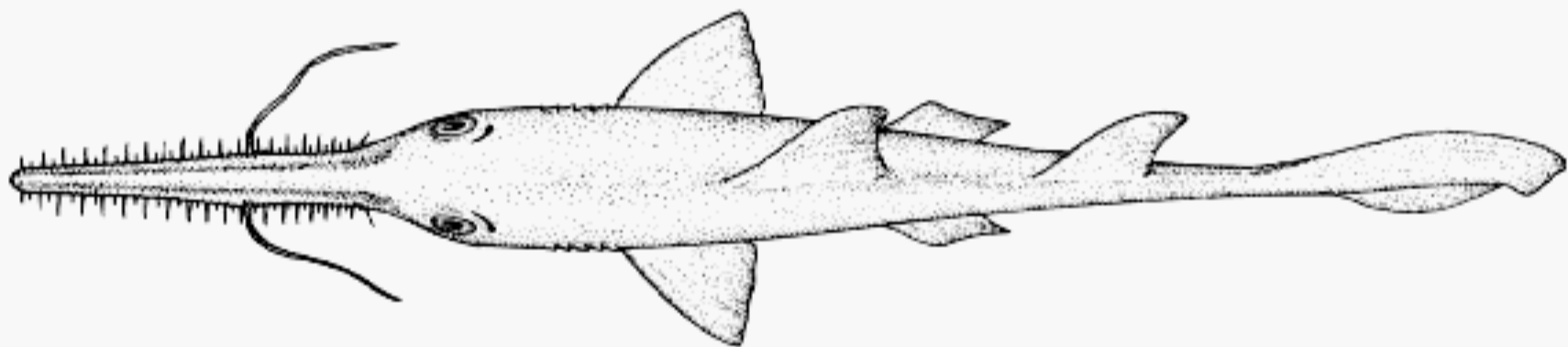
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KeefQuest.com



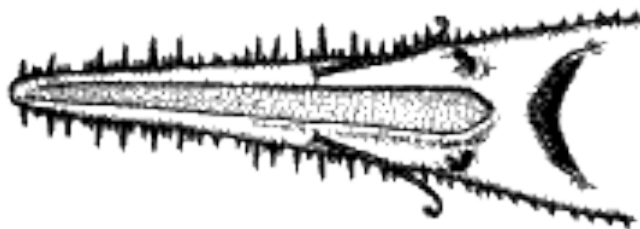


Part 9. Order Pristiophoriformes

- 1 family, 2 genera, 5 species
- saw sharks
- max. size ~ 1.4 m
- enlarged rostral cartilage
- unequal sized loose teeth

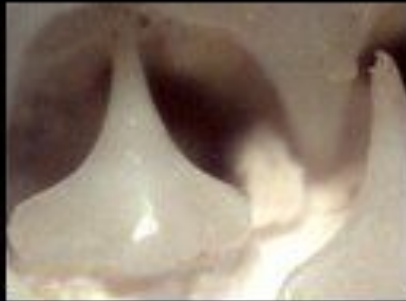


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Ventral view

Imaged length (including head) 31 cm



*Pristiophorus
cirratus*
(Latham, 1794)

Oral
teeth



Rostral
spines



Bill Heim ©2000

Part 10. Order Squatiniformes

➤ 1 family, 1 genus, 12 species

➤ angel sharks

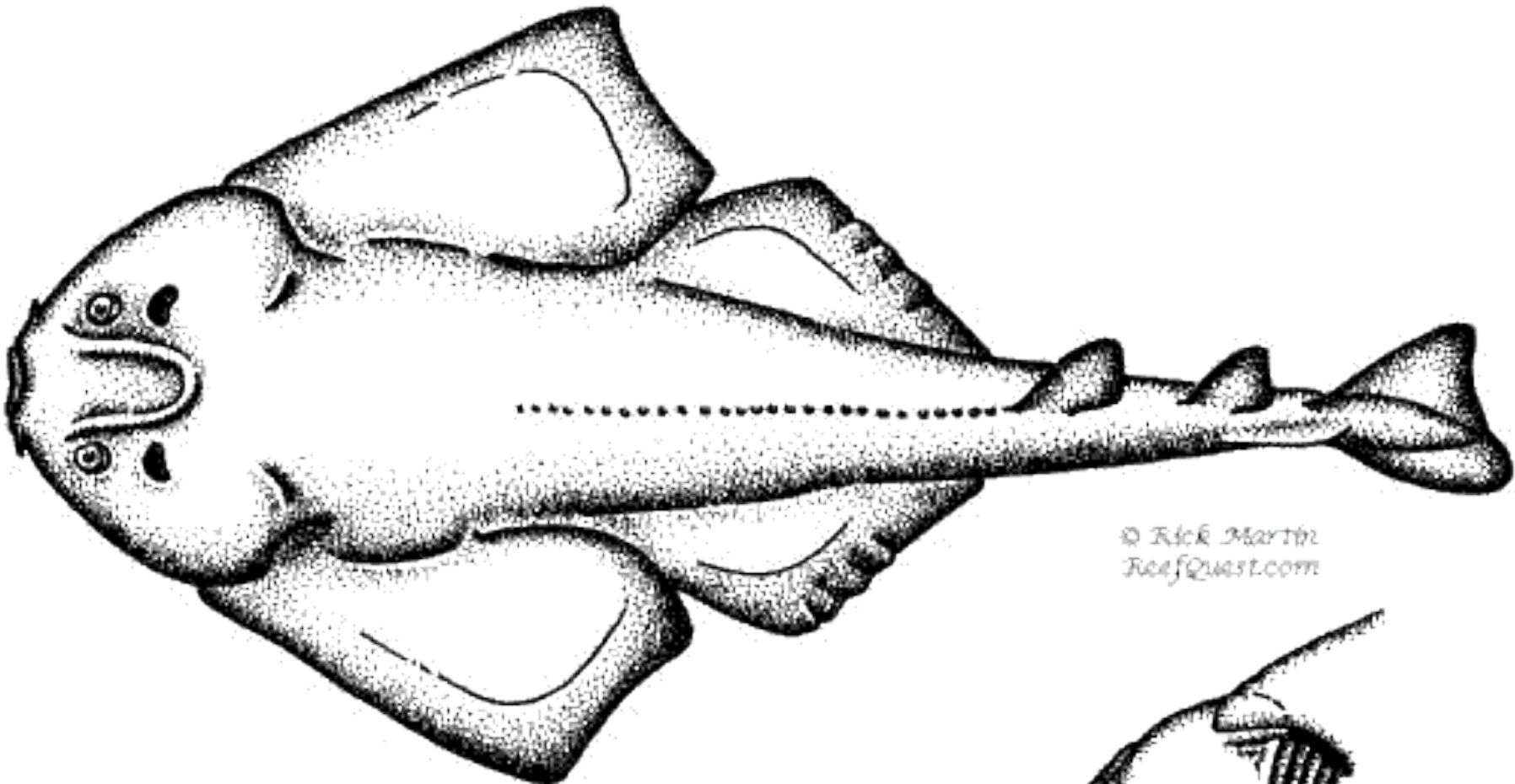
➤ max. size ~ 2 m

➤ shark/ray 'intermediate' (not)

➤ dorso-ventrally flattened

➤ pectorals not attached to head

➤ lateral gill slits














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Part 11. Order Rajiformes








-  pectoral fins attached to head
-  dorso-ventrally compressed
-  ventral gill openings  no anal fin
-  cartilaginous shelf under eyes
-  eye has no nictating membranes
-  12 families, 62 genera, ~ 456 sp.
-  rays
-  sawfishes
-  skates
-  guitarfishes



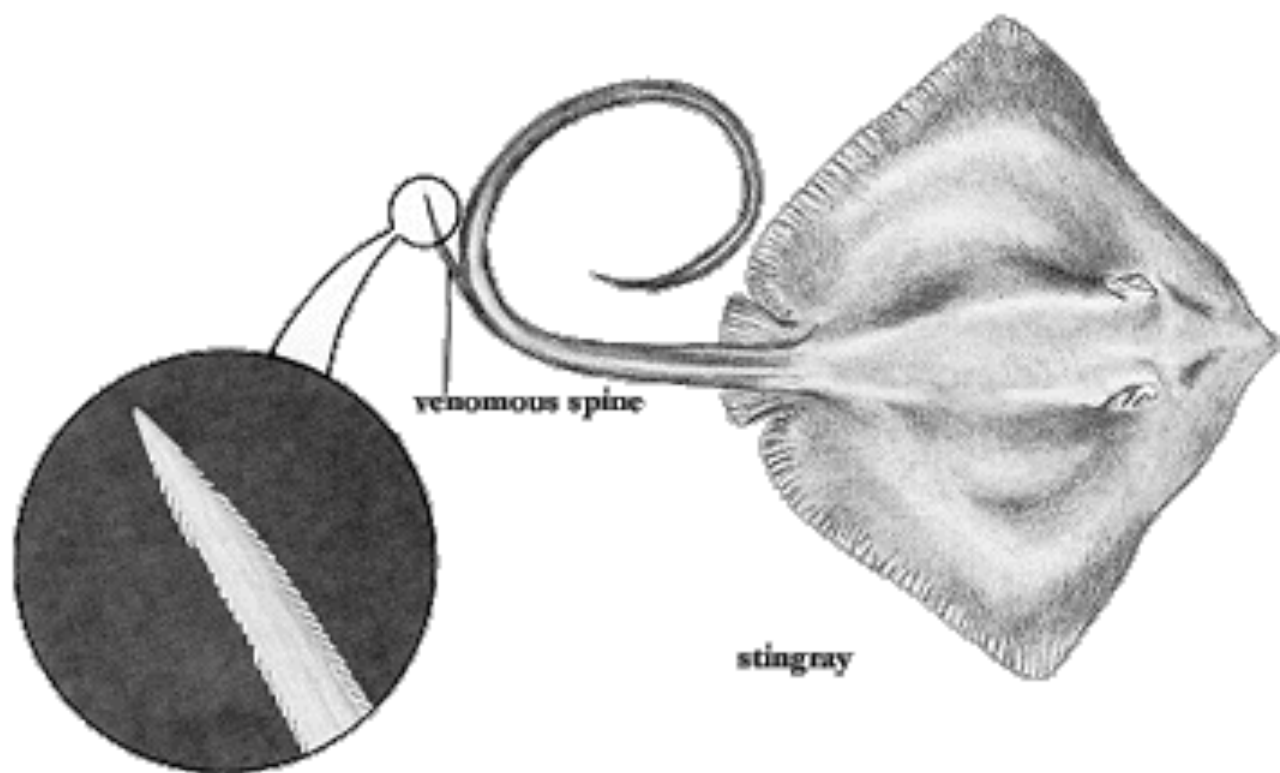
Jim Bourdon ©1997



Part 12. Order Rajiformes rays

-  electric rays (several freshwater)
 -  electric organs each side head
 -  50-200V (up to 50A & 1 kW)
-  some blind - navigation aid (?)
 -  mate location (and behavior?)
-  stingrays (some fw) -poison spine
-  manta/devil rays 6m wide (1300kg)





venomous spine

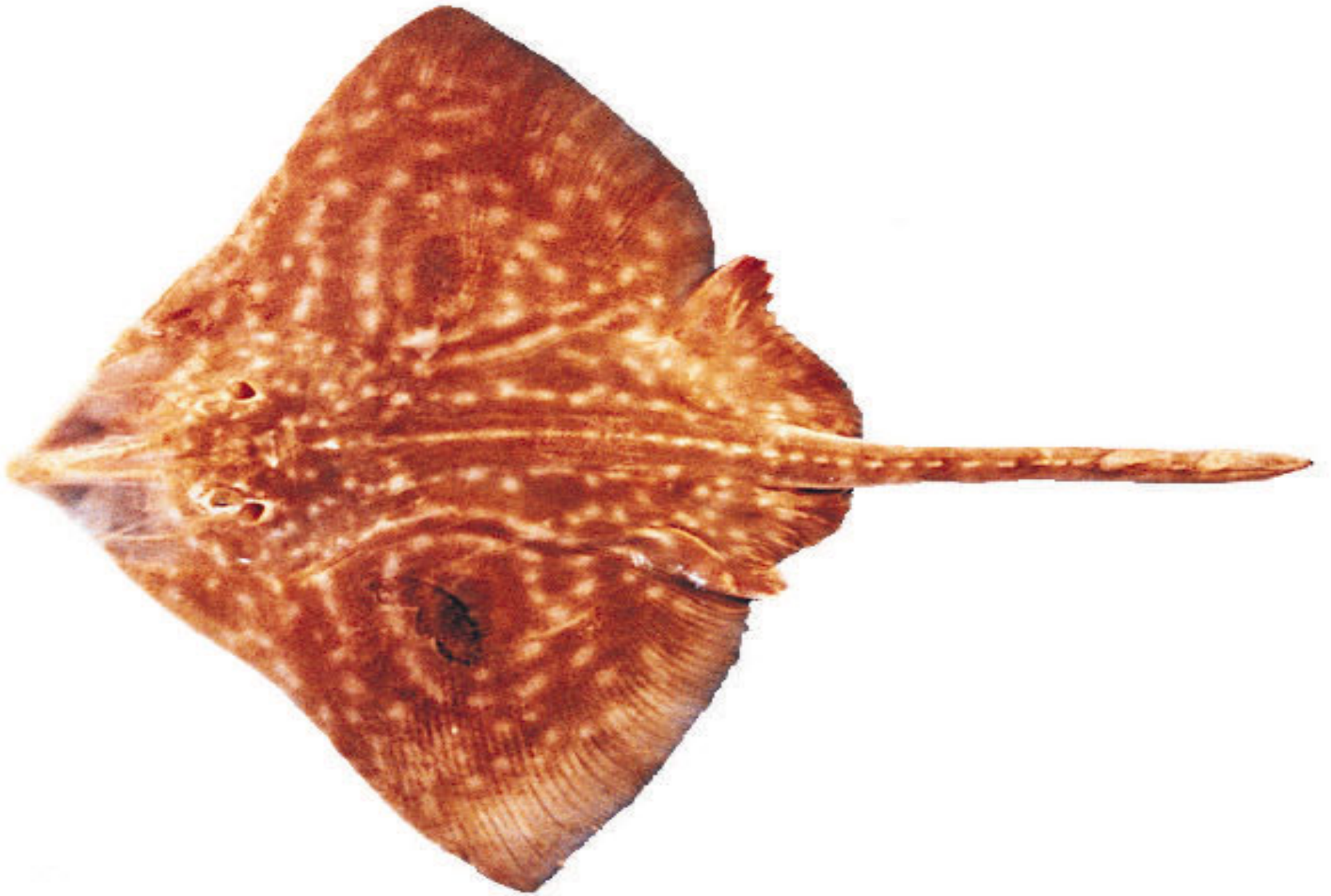
stingray



DAVID FLEETHAM © 2000 photo@maui.net




Order Rajiformes → skates

- skates largest group (>200 sp.)
- all oviparous (lay egg cases)
 - 'mermaid's purses'
- some sexual dimorphism in mouth and teeth patterns



Order Rajiformes

sawfishes

-  some freshwater stocks
-  enlarged rostral cartilage
-  used to assist prey capture



Order Rajiformes

➤ guitarfishes (shovelfishes)

➤ shark / ray intermediate

➤ small head

➤ pectorals attached to head

➤ dorso-ventrally flattened head

➤ more regular shaped tubular body

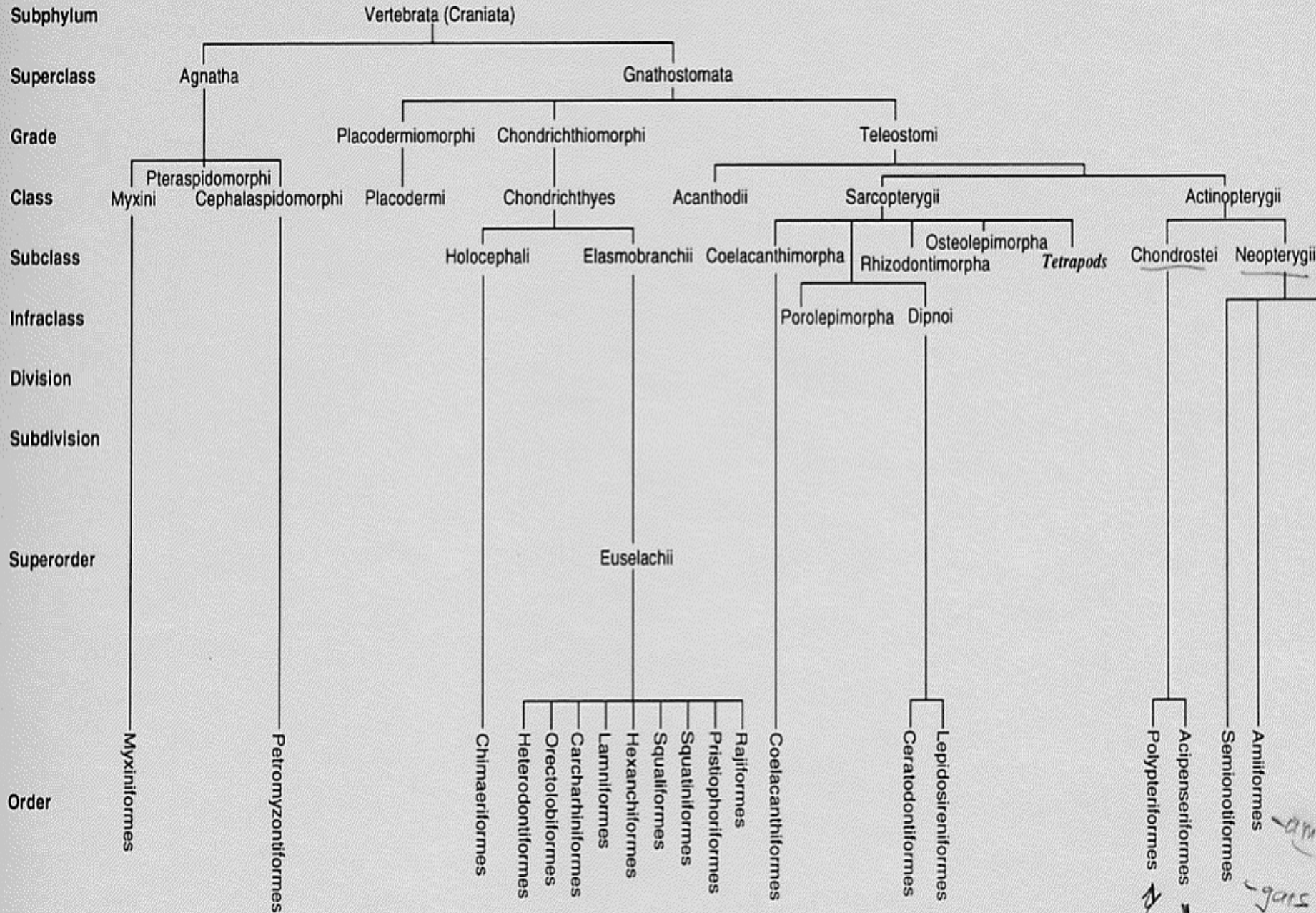


Part 13. Order Elopomorphes (Teleosts)

- *leptocephalus* ('ribbon') larval stage
- metamorphosis to juvenile stage
- completely unlike adults
- no connection between swim bladder and ear
- overall group has very externally different looking members

CATEGORY

HIERARCHY OF HIGHER CATEGORIES OF FISHES



Amiiformes
Semionotiformes
gans

Division

Teleostei

Subdivision

Osteoglossomorpha
Elopomorpha

Clupeomorpha

Euteleostei

Superorder

Ostariophysi

Protacanthopterygii

Stenopterygii

Cyclosquamata

Scopelomorpha

Lampridiomorpha

Polymixiomorpha

Paracanthopterygii

Acanthopterygii

Series

Mugilomorpha

Atherinomorpha

Percomorpha

Order

Osteoglossiformes

Elopiformes

Anguilliformes

Saccopharyngiformes

Clupeiformes

Gonorynchiformes

Cypriniformes

Characiformes

Siluriformes

Gymnotiformes

Esociformes

Osmeriformes

Salmoniformes

Ateleopodiformes

Stomiliformes

Aulopiformes

Myctophiformes

Lampridiformes

Polymixiiformes

Percopsiformes

Ophidiiformes

Gadiformes

Batrachoidiformes

Lophiiformes

Mugiliformes

Atheriniformes

Cyprinodontiformes

Belontiiformes

Stephanoberyctiformes

Beryctiformes

Zeiformes

Gasterosteiformes

Synbranchiiformes

Scorpaeniformes

Perciformes

Tetraodontiformes

Pleuronectiformes

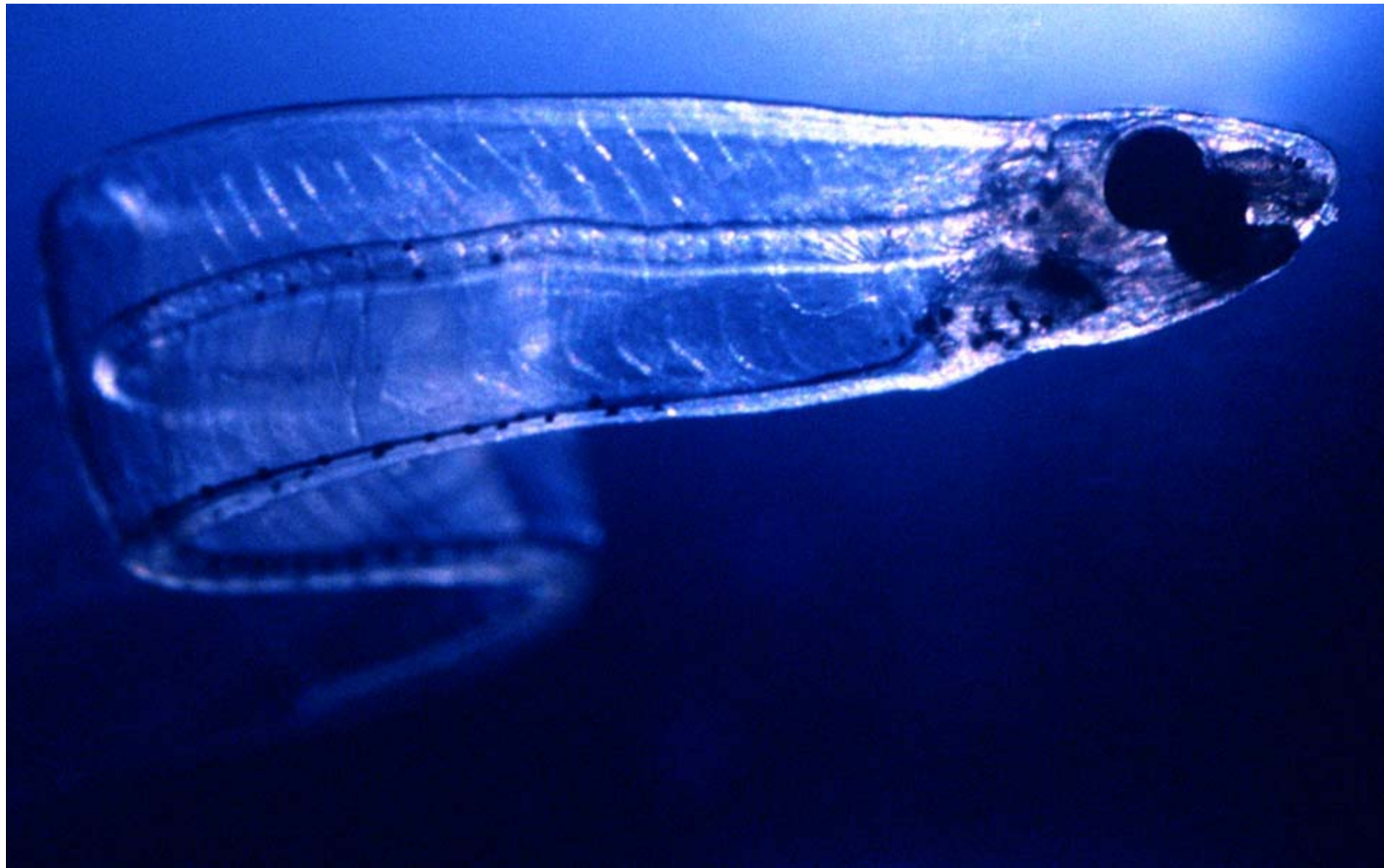
Handwritten marks

Handwritten bracket grouping Cypriniformes, Characiformes, Siluriformes, Gymnotiformes, Esociformes, Osmeriformes, and Salmoniformes.

Handwritten bracket grouping Stephanoberyctiformes, Beryctiformes, Zeiformes, Gasterosteiformes, Synbranchiiformes, Scorpaeniformes, Perciformes, and Tetraodontiformes.



leptocephalus larvae





bonefish



tarpon







'freshwater' eels





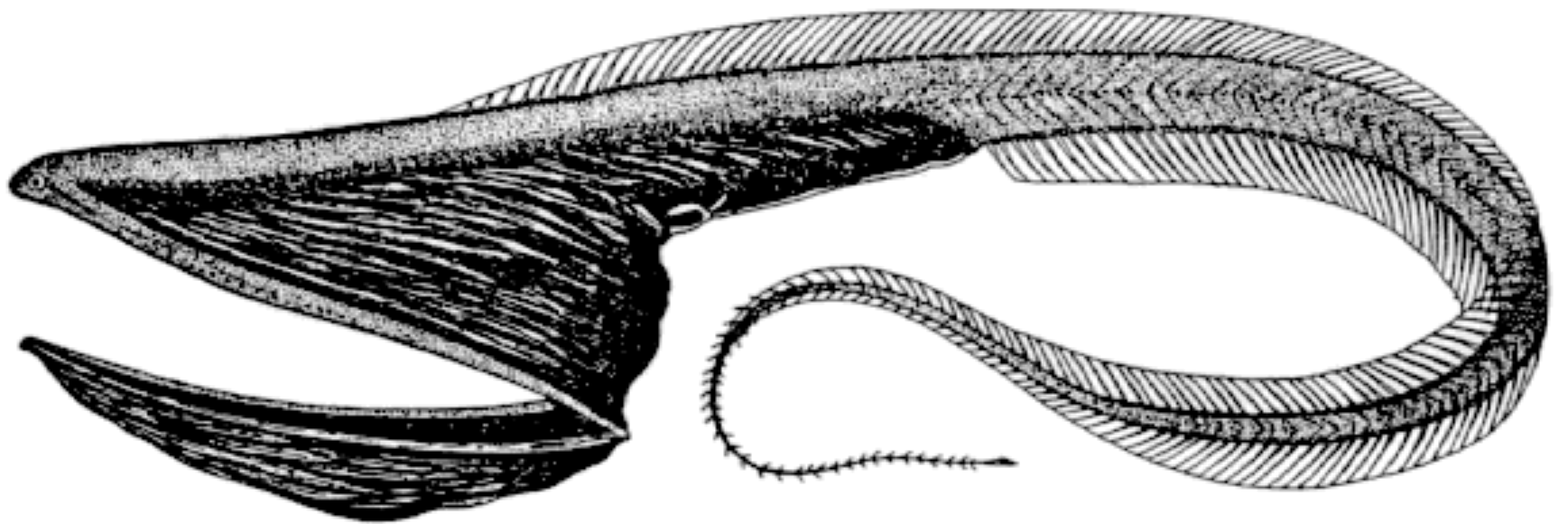




spiny eels

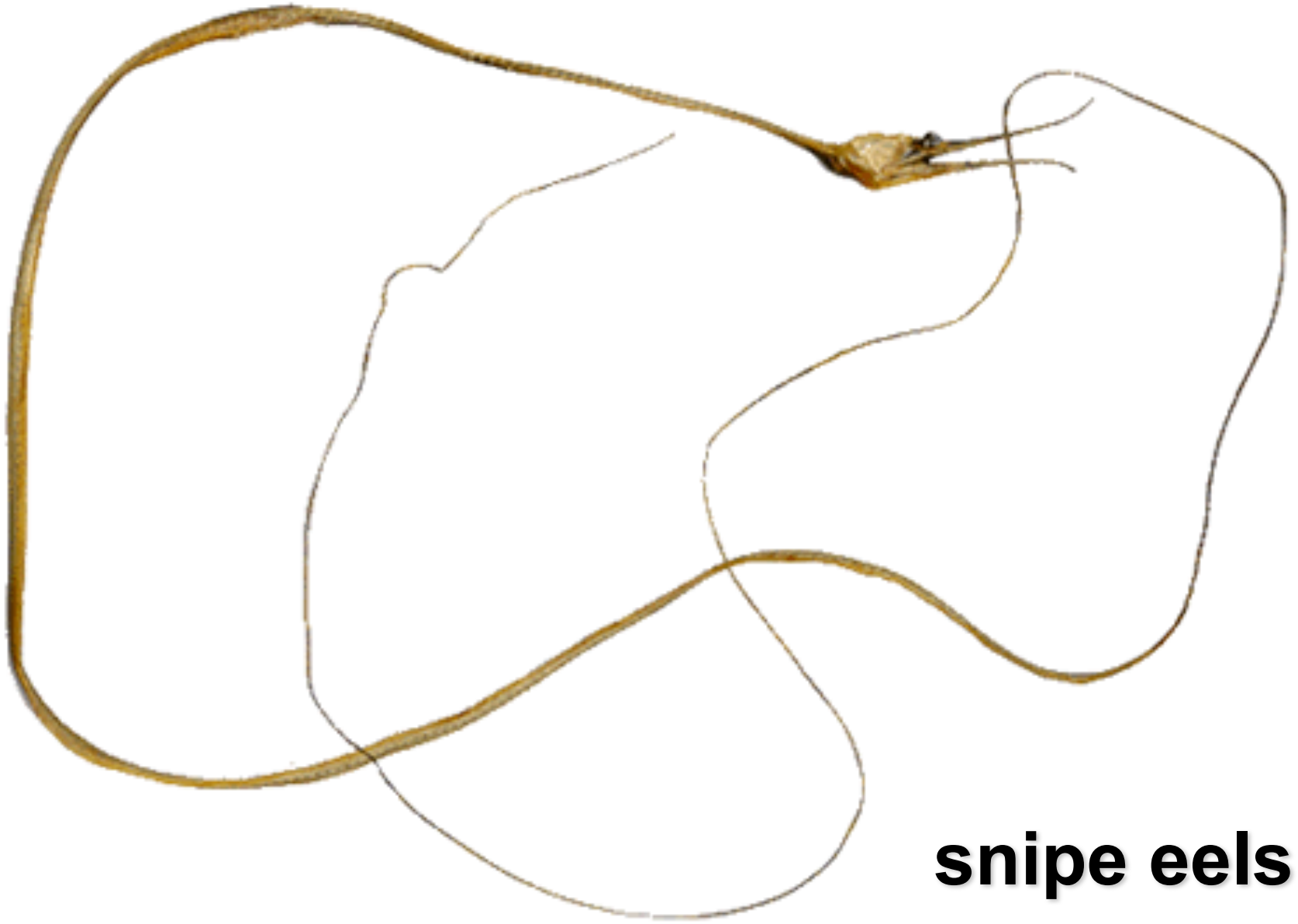


gulper eel






snake eels



snipe eels

Part 14. Order Clupeamorphes

otophysic

 swim bladder has pair of anterior projections entering skull & inner ear

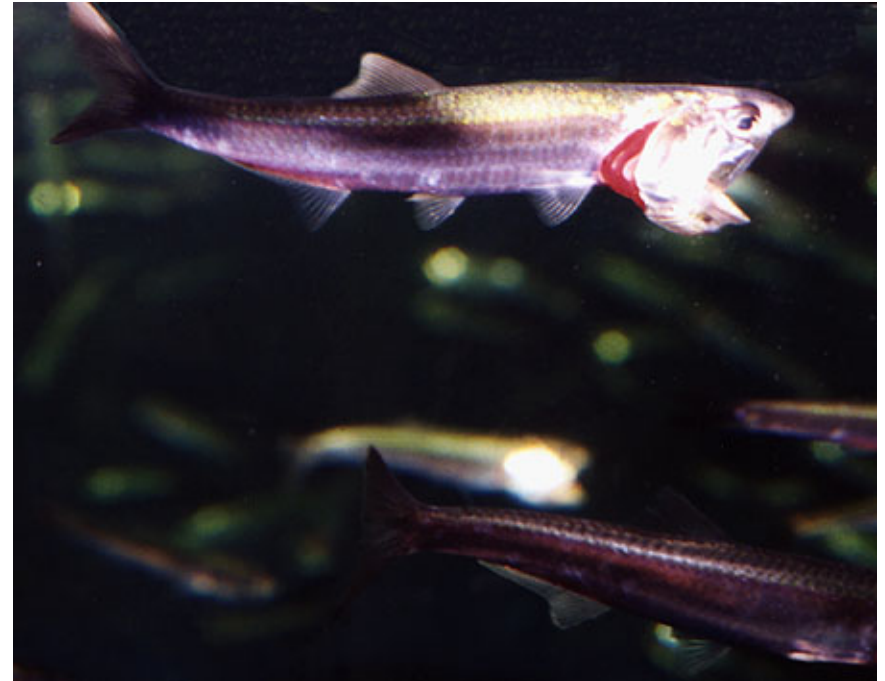
 pneumatic duct from swim bladder to or near stomach







anchovy

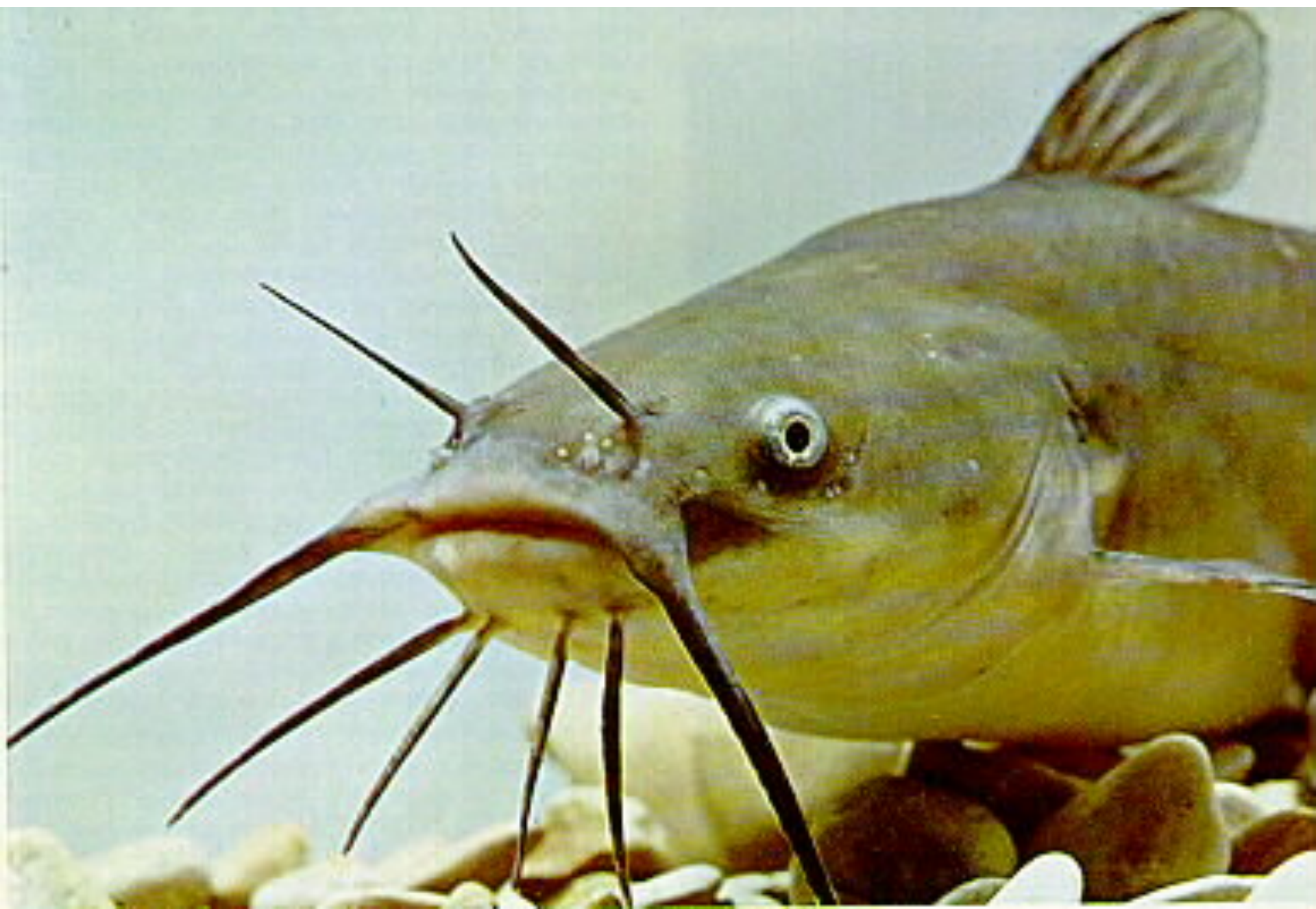




shad

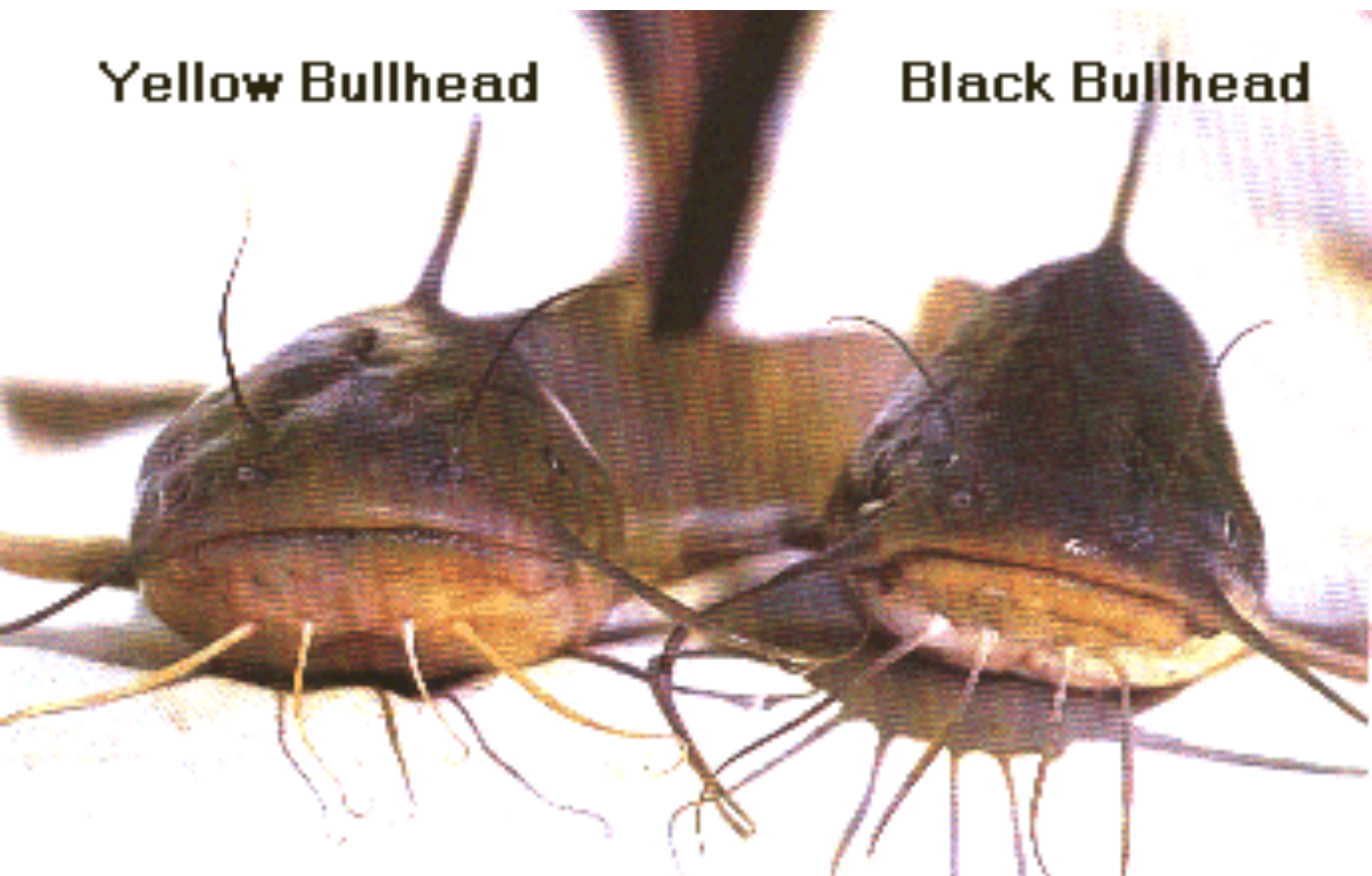
Part 15. Order Siluriformes - catfishes

- specialized for non-visual feeding
- nocturnal or turbid waters
 - small eyes ('indicative')
- *barbels* adipose fin usually present
- very distinct osteology (Nelson 1994)
- 34 families, 412 genera, ~2400 sp.
- South and North America
 - dominant in South & C. America



Yellow Bullhead

Black Bullhead



armo(u)red catfish



Part 16. Order Characiformes - characins

- most with teeth and big eyes
- majority with no mandibular barbels
- carnivores (visual/daytime feeders)
- extreme specializations
 - feeding
 - scale eating (lepidophagy)
 - eyeball eating, plant eating,...
 - reproduction
 - 'terrestrial' spawning

many popular aquarium fishes

• 1990's
estimate

• ~>\$10B annually



Black tetra



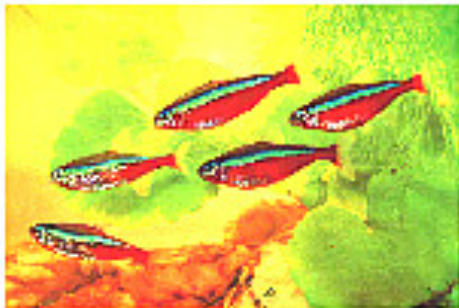
Blind cave characin



Cardinal tetra



Lemon tetra



Neon tetra



Penguin fish



Piranha



Red-eyed moenkhausia



neon tetra





bloodfin tetra



firehead tetra



**black neon
tetra**

piranha



5cm



piranha





Part 17. Order Cypriniformes

- always toothless (pharyngeal teeth)
- 5 families, 279 genera, ~2660 sp.
- Family Cyprinidae (N. America)
- dominant fw fish - NA and Eurasia
- not in South America (characins)
 - adipose fin usually absent

John Acorn ©1995



John Acorn ©1995



lake chub

longnose sucker










Catostomidae

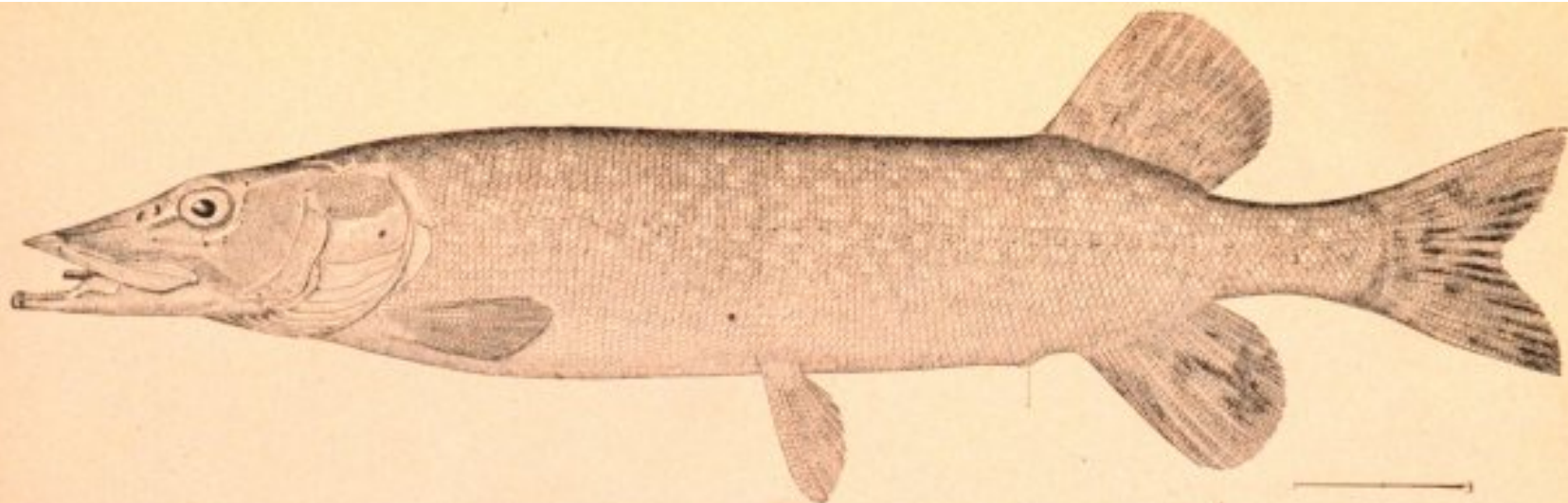
carp ("Dixie Bass")



Part 18. Order Esociformes

 pike, pickerels, & mud-minnows

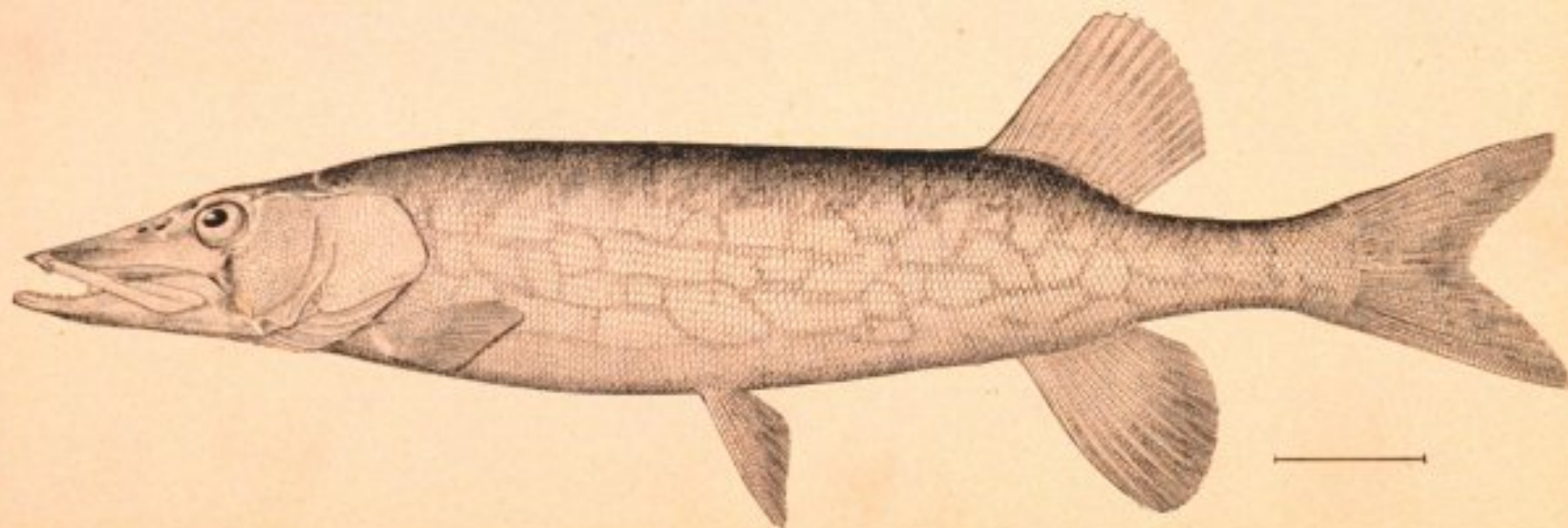
-  maxilla in gape, but toothless
-  no adipose fin (rayless fin)
-  dorsal & anal fins found posteriorly
-  no pyloric caeca
-  length from a few to 150 cm (32kg)



THE PIKE.

Esox lucius, L. (p. 461.)

Drawing by H. L. Todd, from No. 9289, U. S. National Museum, collected at Ecorse, Mich., by George Clark.



THE PICKEREL OR FEDERATION PIKE.

Esox reticulatus, Le Sueur. (p. 464.)

Drawing by H. L. Todd, from No. 2081, U. S. National Museum.



Part 19. Order Salmoniformes

most studied, poorly understood

 *Salmothymus* (Adriatic trout)

 *Salvethymus* (Long-finned char)

 taimen or huchen (*Hucho* sp.)

 lenok (*Brachymystax lenok*)

 char(r) (*Salvelinus* sp.)

 Atlantic trouts (*Salmo* sp.)

 Pacific salmon & trout
(*Oncorhynchus* sp.)

1. King Salmon
 2. Coho Salmon
 3. Steelhead Trout
 4. Rainbow Trout
 5. Chinook Salmon
 6. Sockeye Salmon
 7. Pink Salmon
 8. Silver Salmon
 9. Dolly Varden
 10. Arctic Char



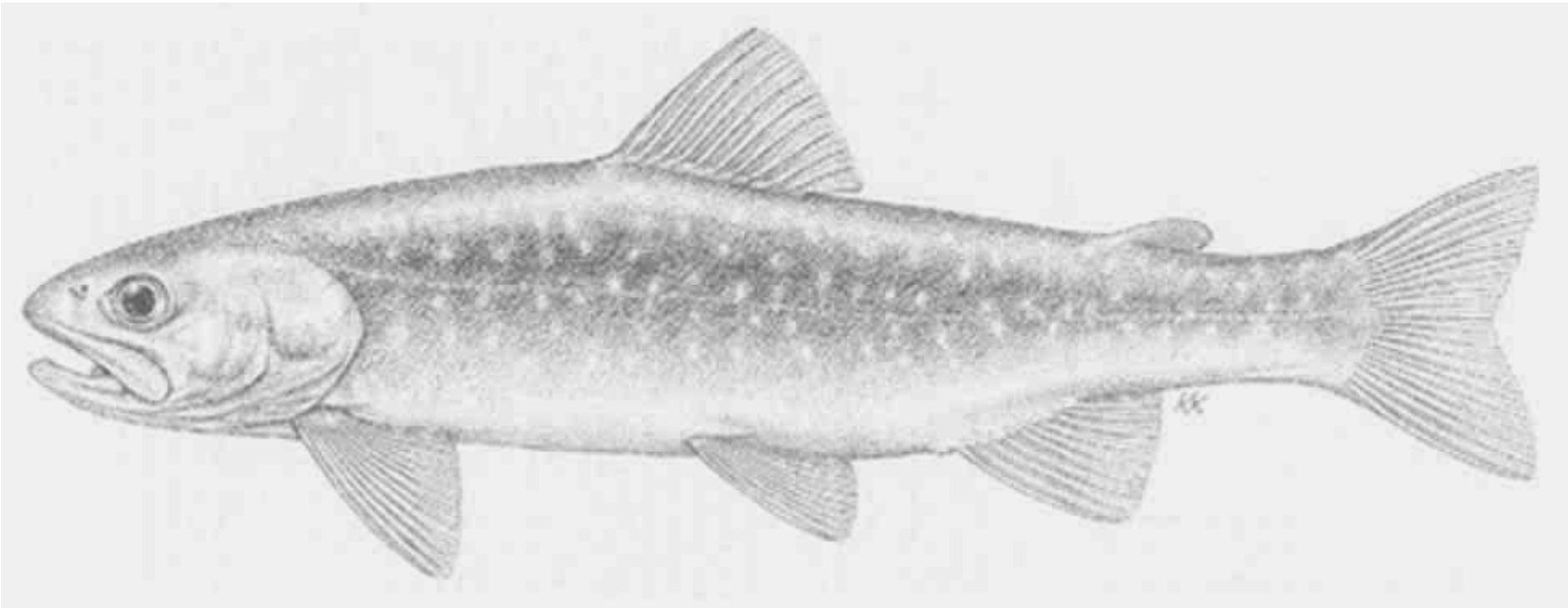
SALMON IN ALASKA
 Have salmon just
 started up in my
 wild world, some
 for the salmon
 are in it



***S. alpinus* - Arctic char**



The rare forms of charrs (*G. Salvelinus*)
of the hydrosystem of the Hantayskoye Lake (Lake Kutaramakan)



***S. malma* - Dolly Varden**



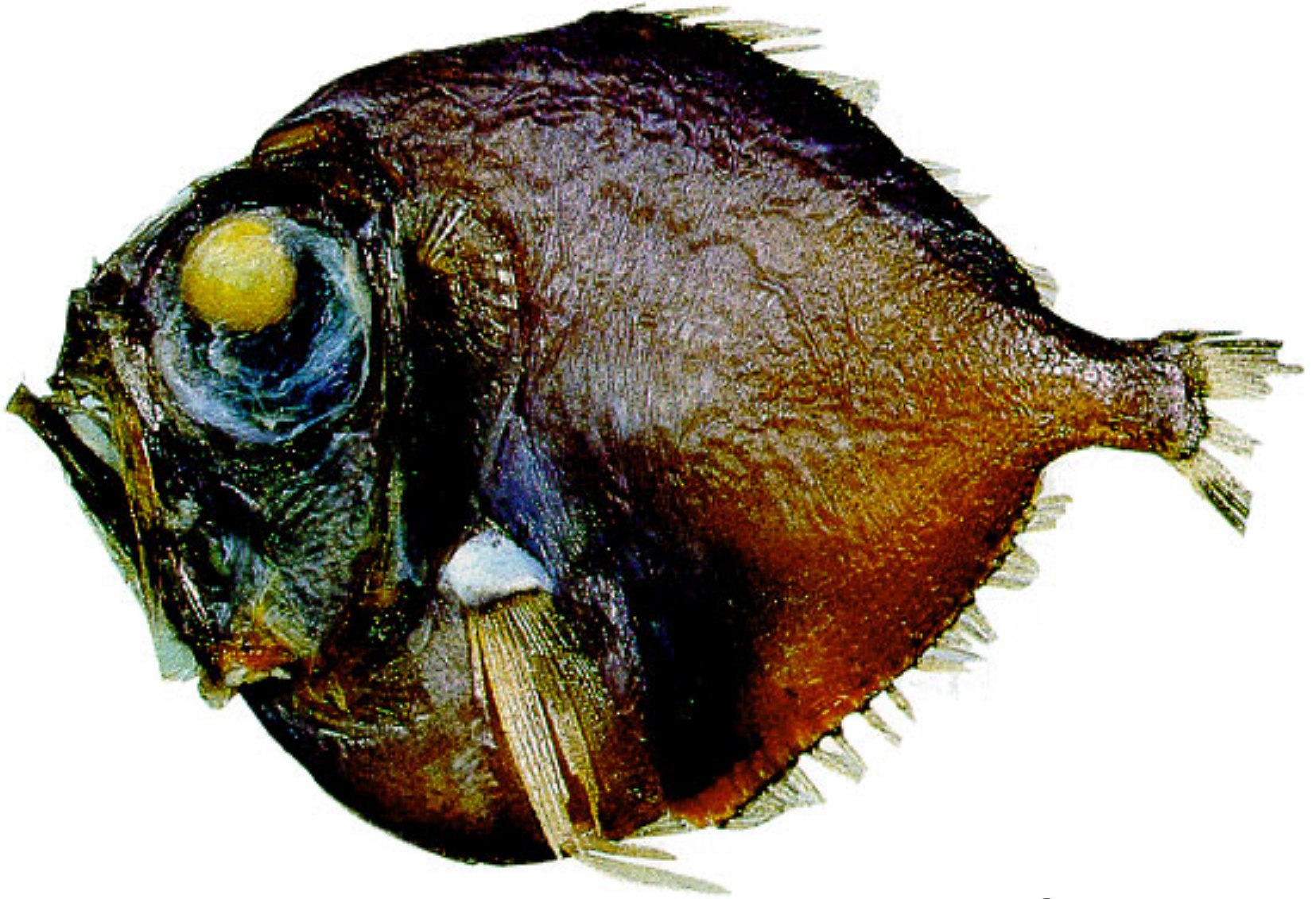
***S. namaycush* - lake trout**

Part 20. Order Beryciformes

- 7 families, 28 genera, and 123 species
- all marine (max 60cm, most smaller)
 - bathypelagic (small & chunky)
 - in-shore (nocturnal & abundant)
- sawbellies, fangtooths, & spinyfins
 - flashlight or lanterneye fishes
 - pinecone fishes and alfonsinos
 - roughies or slimeheads
 - squirrelfishes and soldierfishes



fangtooth



spinyfin



spinyfin



**flashlight fish
(lanterneye**



**flashlight fish
(lanterneye**

Part 21. Order Gasterosteiformes

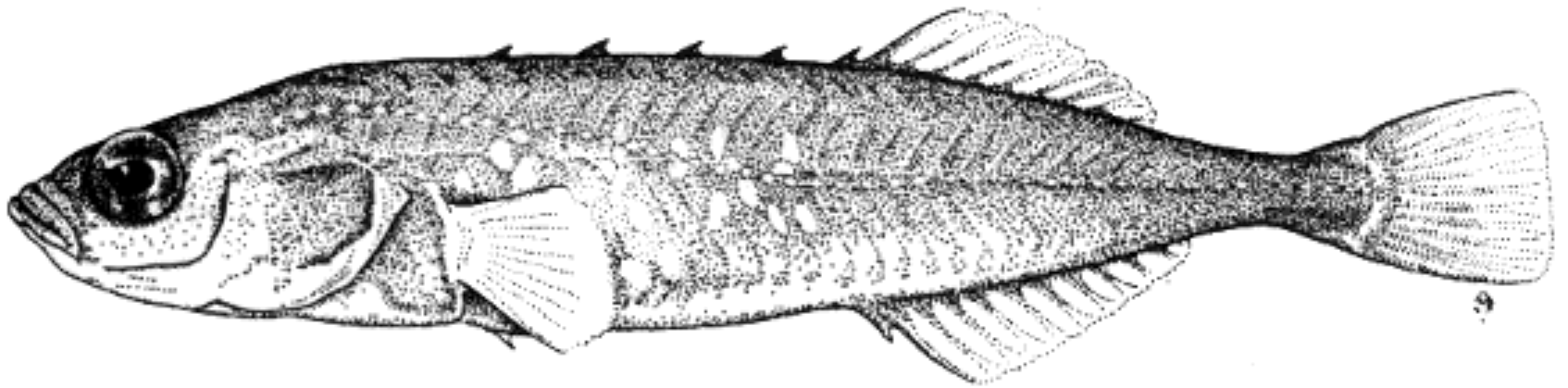
- 11 families, 8 genera, and 257 species
- most marine (40 brackish & 11 fw)
 - some anadromous or sea-run
- up to 1.8m, but most <<15-20cm
- often with dermal plate 'armor'
- usually with small mouths
 - sticklebacks and pipefishes
 - tubesnouts and sandeels
 - seamoths and seahorses
 - cornetfishes and trumpetfishes
 - snipefishes and shrimpfishes



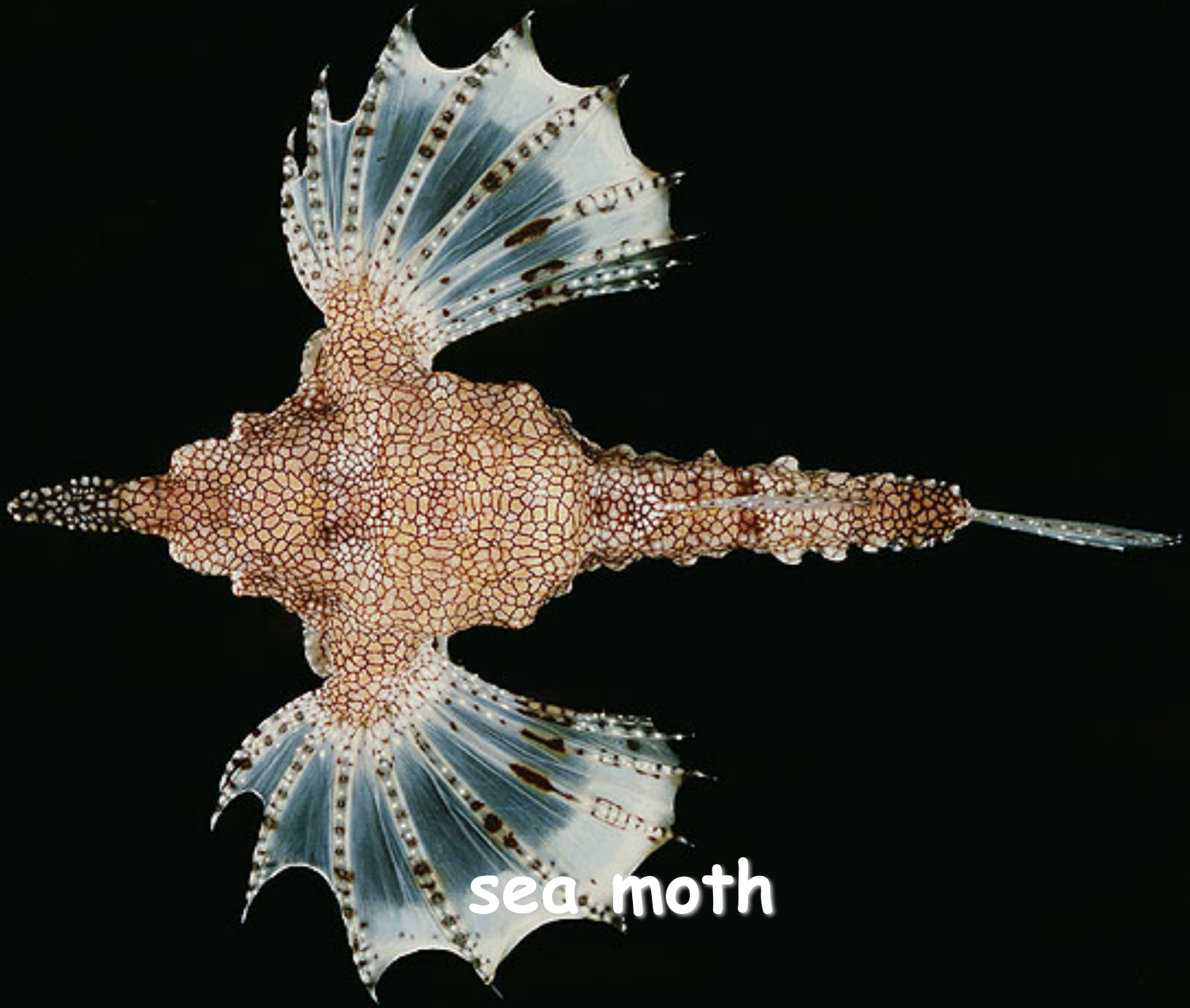
*threespine
stickleback*



ninespine stickleback



brook stickleback



sea moth



sea moth



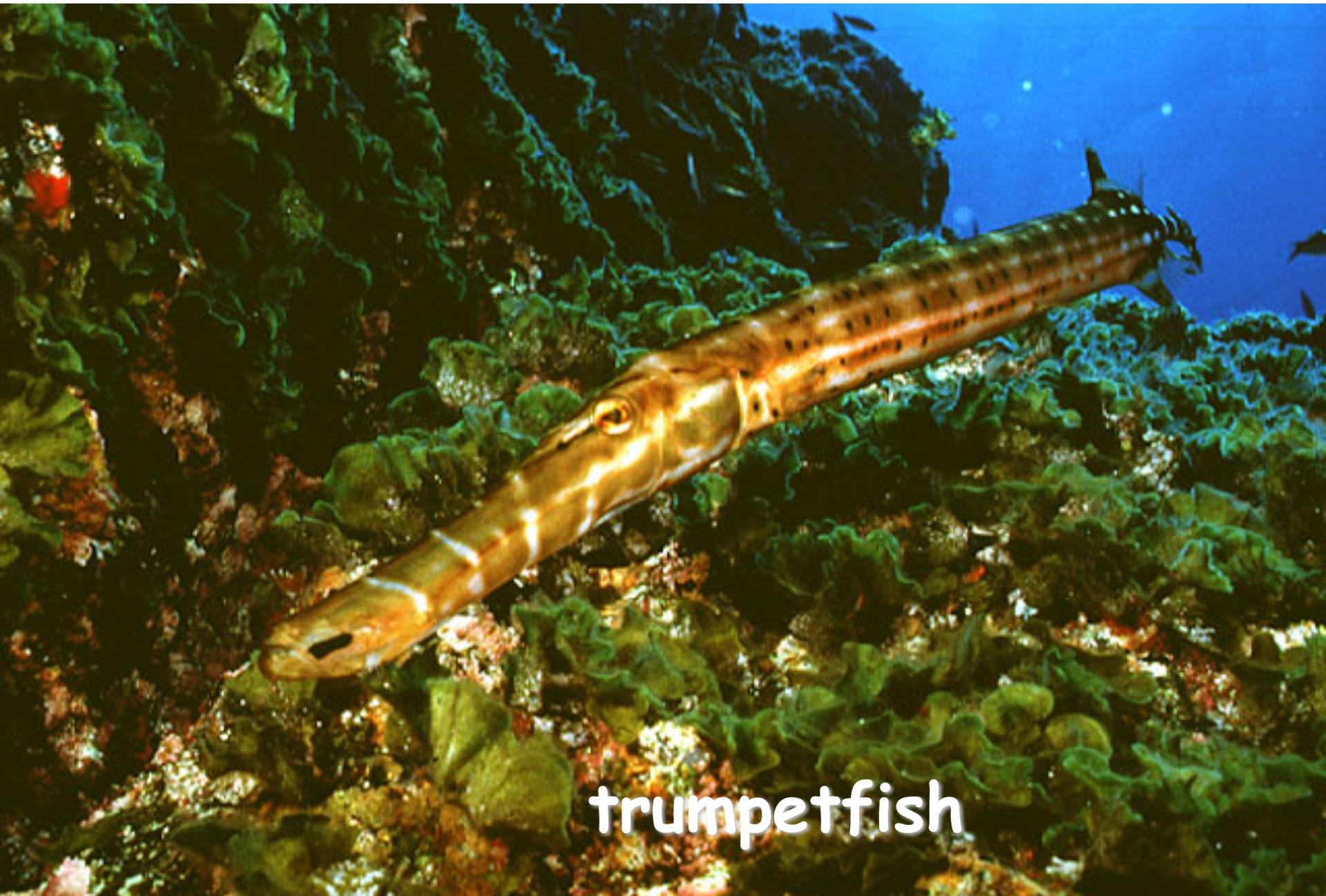
cornetfish



trumpetfish



trumpetfish

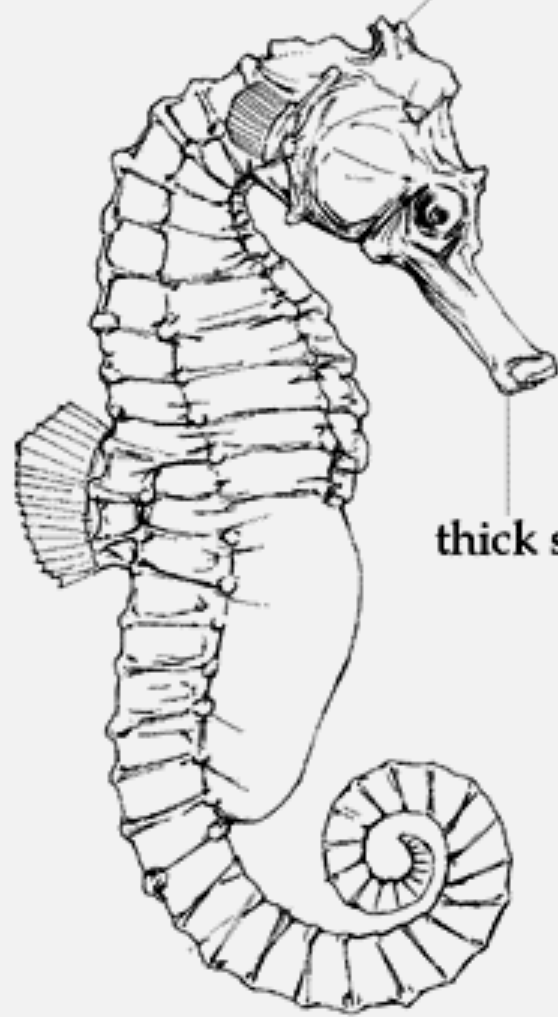


trumpetfish



snipefish

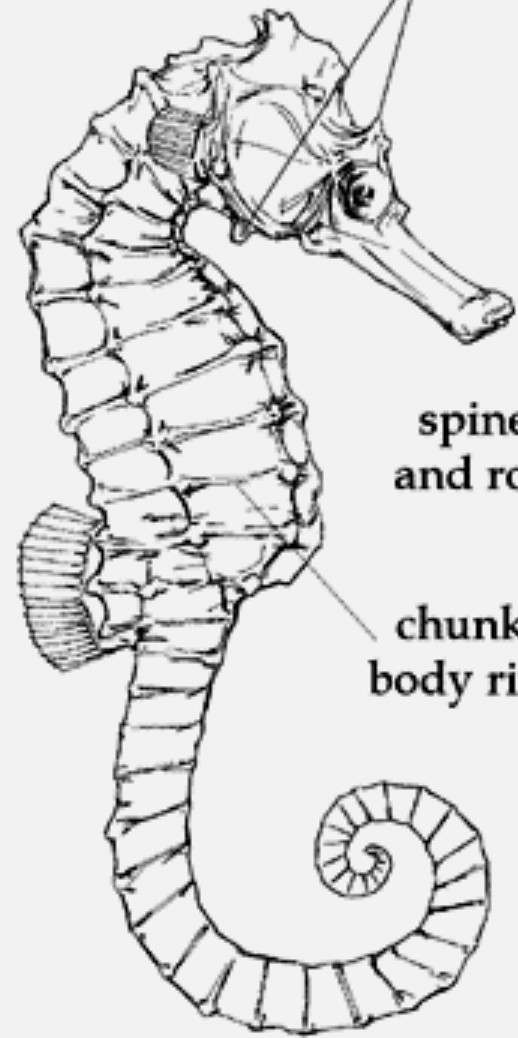
cm
1
2
3
4
5
6
7
8
9



rounded, turned
back coronet

thick snout

MALE

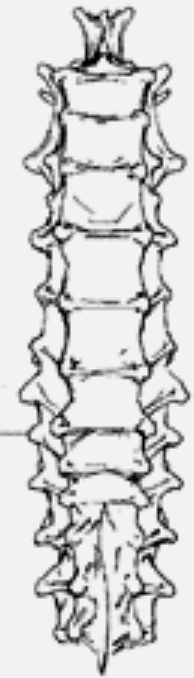


broad, almost double
eye and cheek spines

spines low
and rounded

chunky
body rings

FEMALE



DORSAL

seahorse



seahorse ♂

Part 22. Order Pleuronectiformes

- 11 families, 123 genera & 570 species
- most marine (20 brackish & 4 fw)
- benthic carnivores (depth & food)
- up to 3m, but most <<15-20cm
- very distinctive group
- dorso-ventrally compressed
- adults not bilaterally symmetrical
- almost always no swimbladder
- dorsal and anal fins with long bases
 - flatfishes and tonguefishes
 - flounders and halibut
 - soles and plaice
 - dabs and turbot



halibut



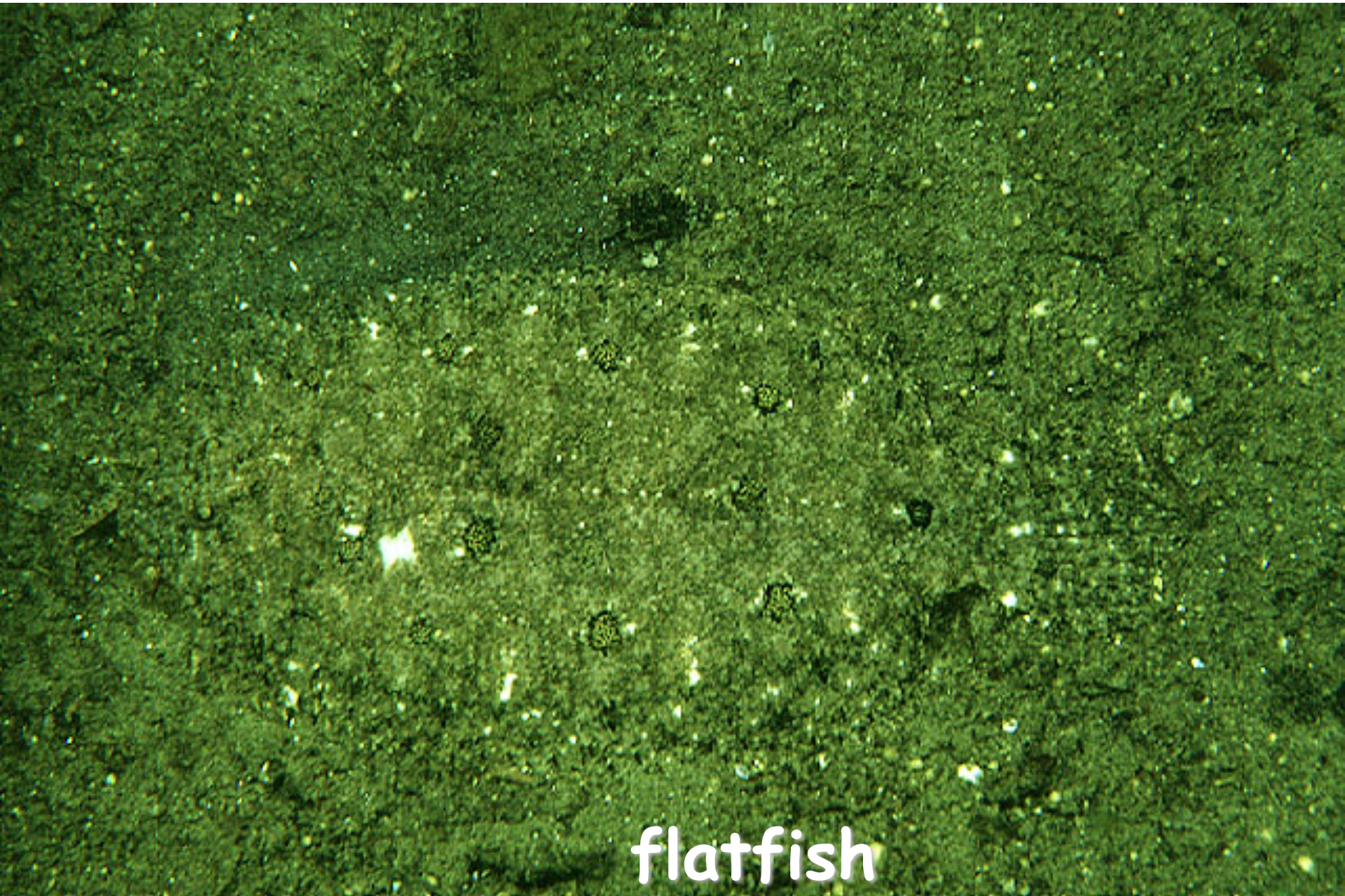
Eopsetta



Glyptocephalus



Lepidopsetta



flatfish

Part 23. Order Scorpaeniformes

- provisional & controversial systematics
- 25 families, 266 genera, & 1271 sp.
- mostly marine and benthic
 - 52 freshwater sculpins (more sp.)
- diagnostic character - *suborbital stay*
- 'mail-cheeked' fishes
- spiny heads and bodies
- pectoral & caudal fins usually rounded
 - rockfishes, waspfishes, & combfishes
 - sablefishes, greenling, & poachers
 - lumpfishes, snailfishes, & stonefishes
 - (flying) gurnards, sea robins & sculpins
 - prowfishes, flatheads, & velvetfishes



rockfishes I



rockfishes II



rockfishes - 'tropical'



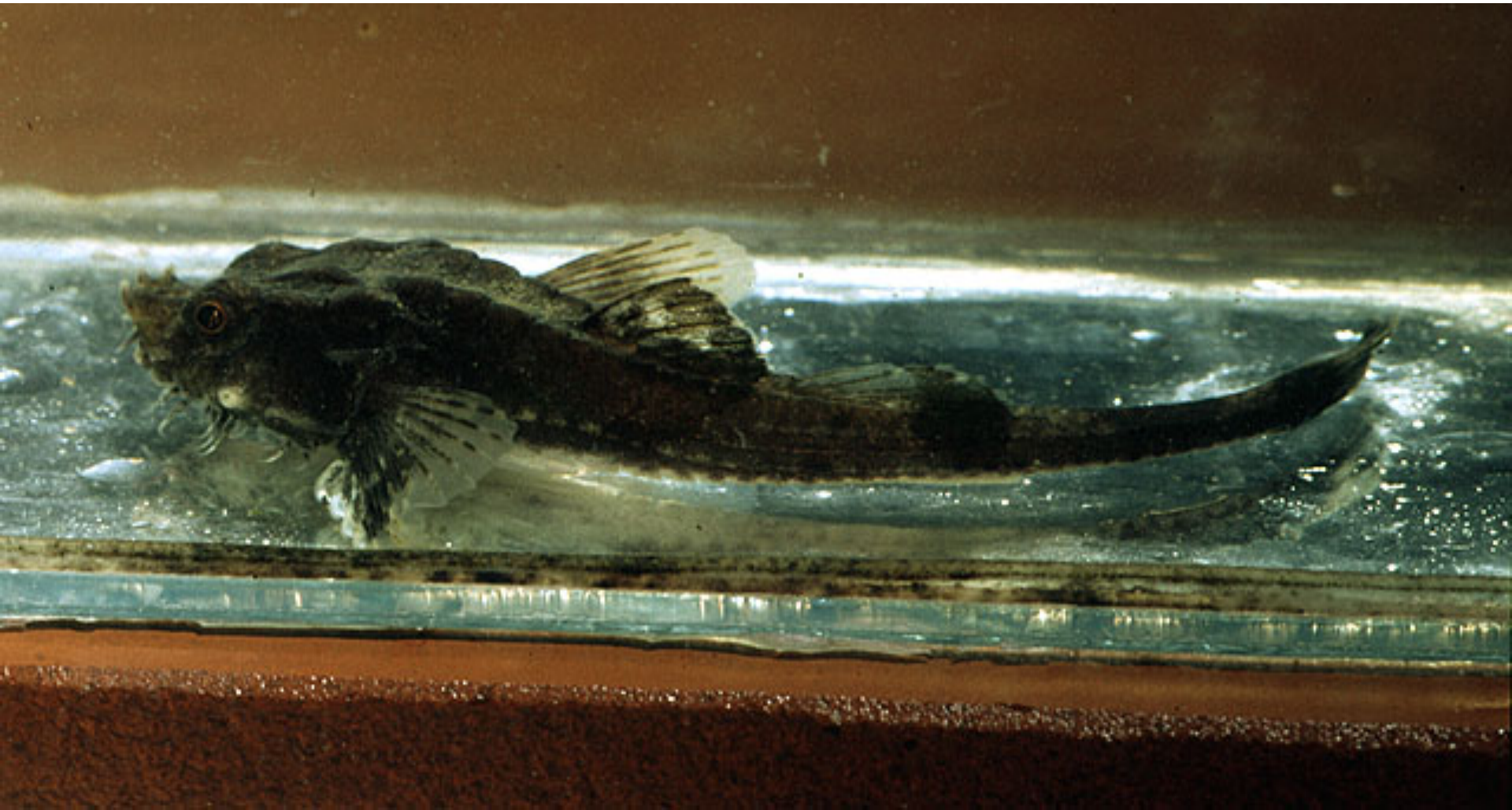
lingcod



greenling



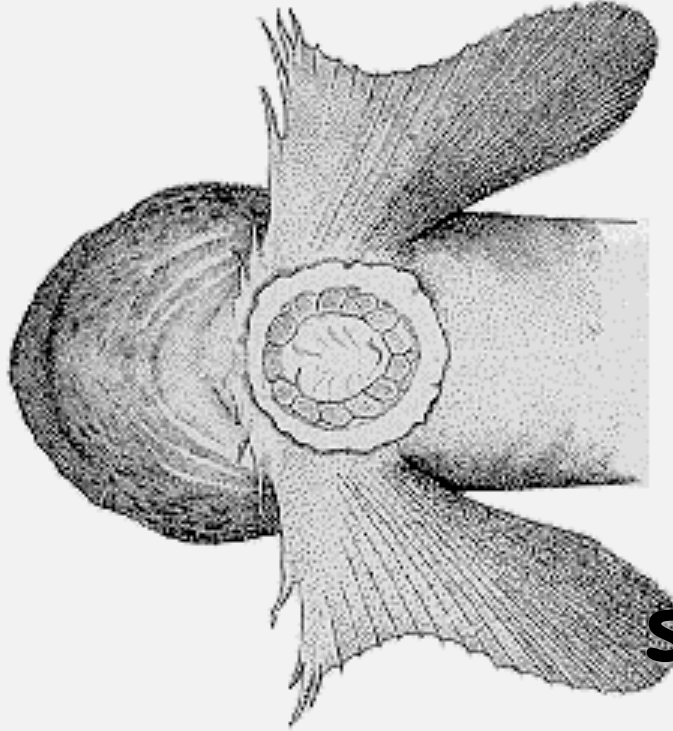
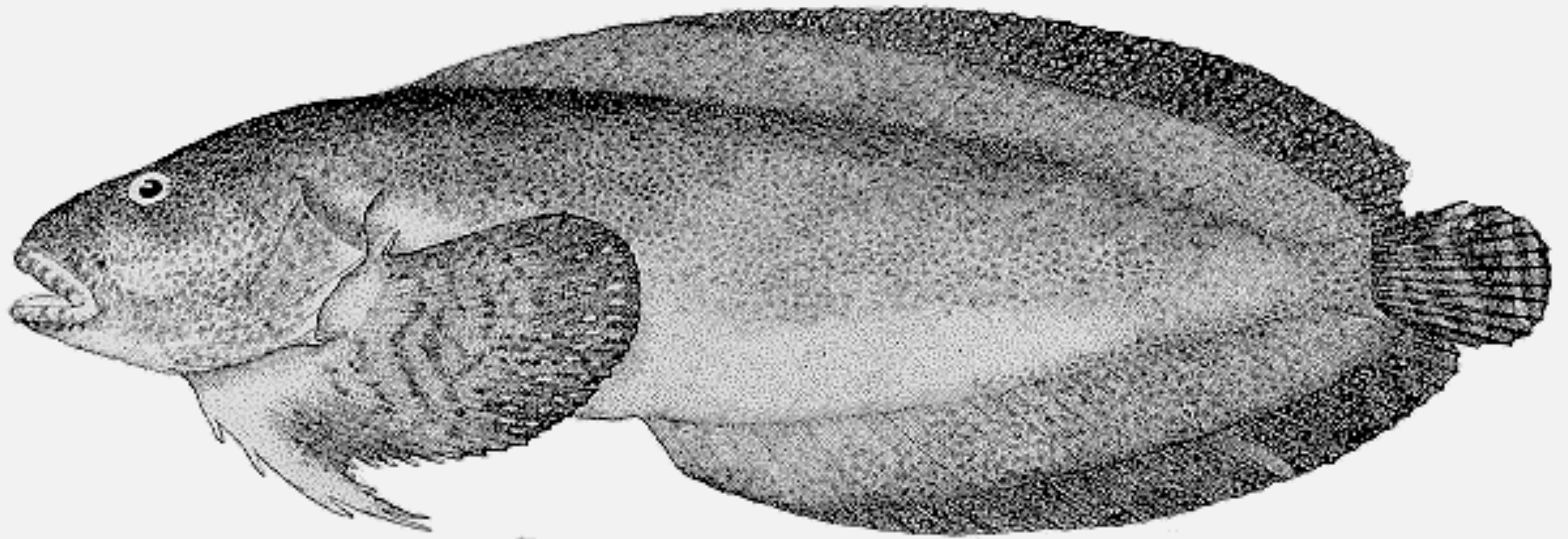
sablefish



poacher



poacher



snailfish (lumpfish)



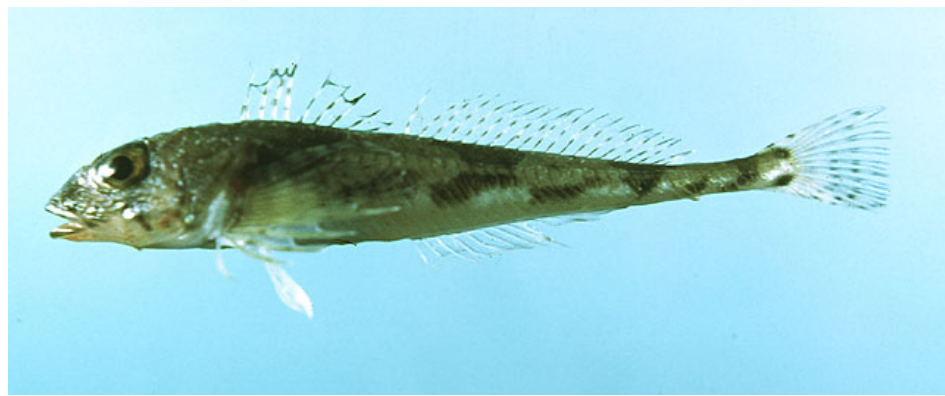
snailfish (lumpfish)



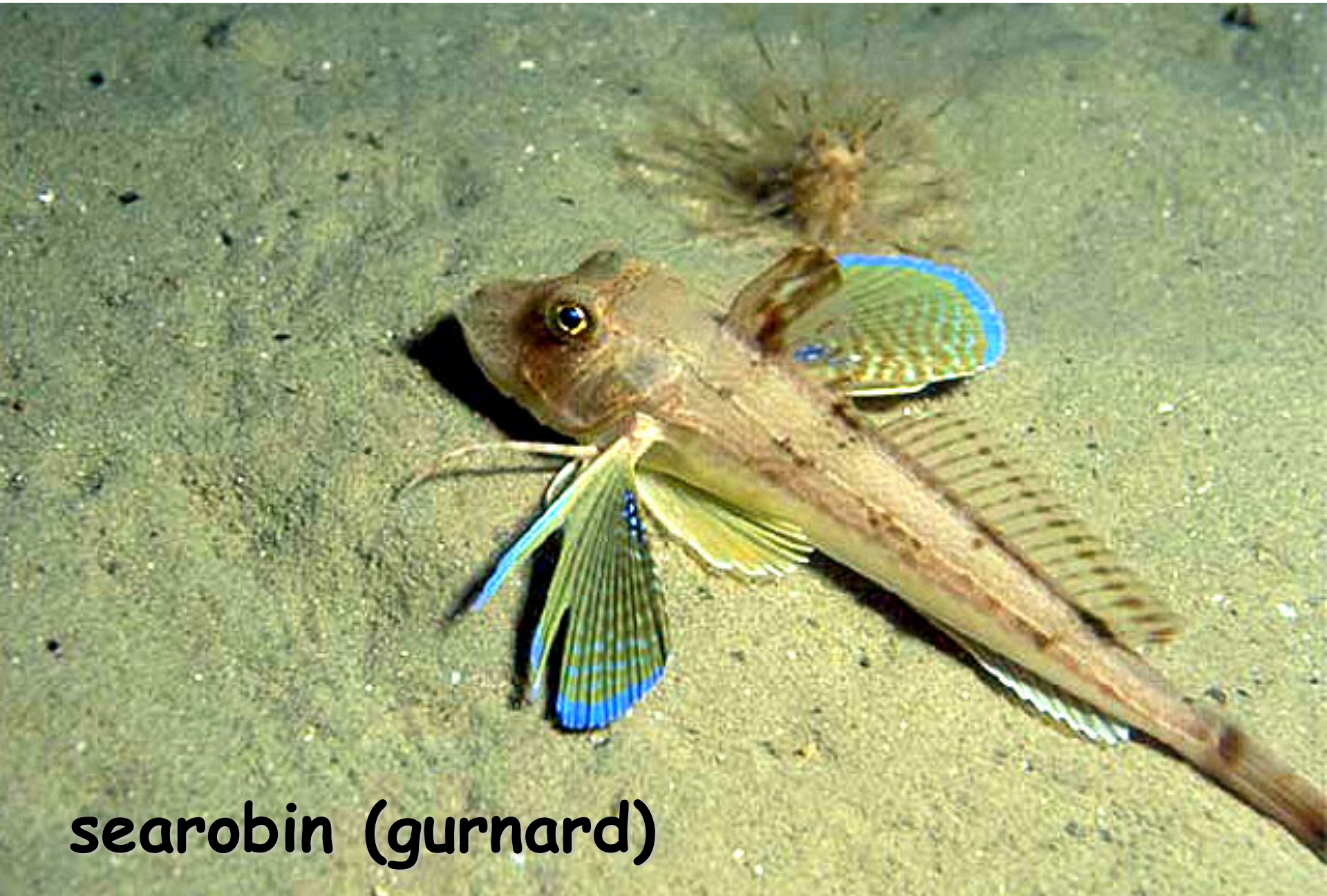
lumpsucker



lumpsucker



sculpins (cottids)



searobin (gurnard)









flying gurnard





flying gurnard

Part 24. Order Tetraodontiformes

-  **provisional & controversial systematics**
-  **9 families, ~100 genera, & ~339 sp.**
 -  **most marine (12 fw, 20 fw capable)**
-  **restricted gill openings**
-  **scales modified into armo(u)r & spines**
 -  **puffers, porcupinefishes, & triggerfishes**
 -  **leatherjackets, filefishes, & triplespines**
 -  **molas & boxfishes (cowfish & trunkfish)**



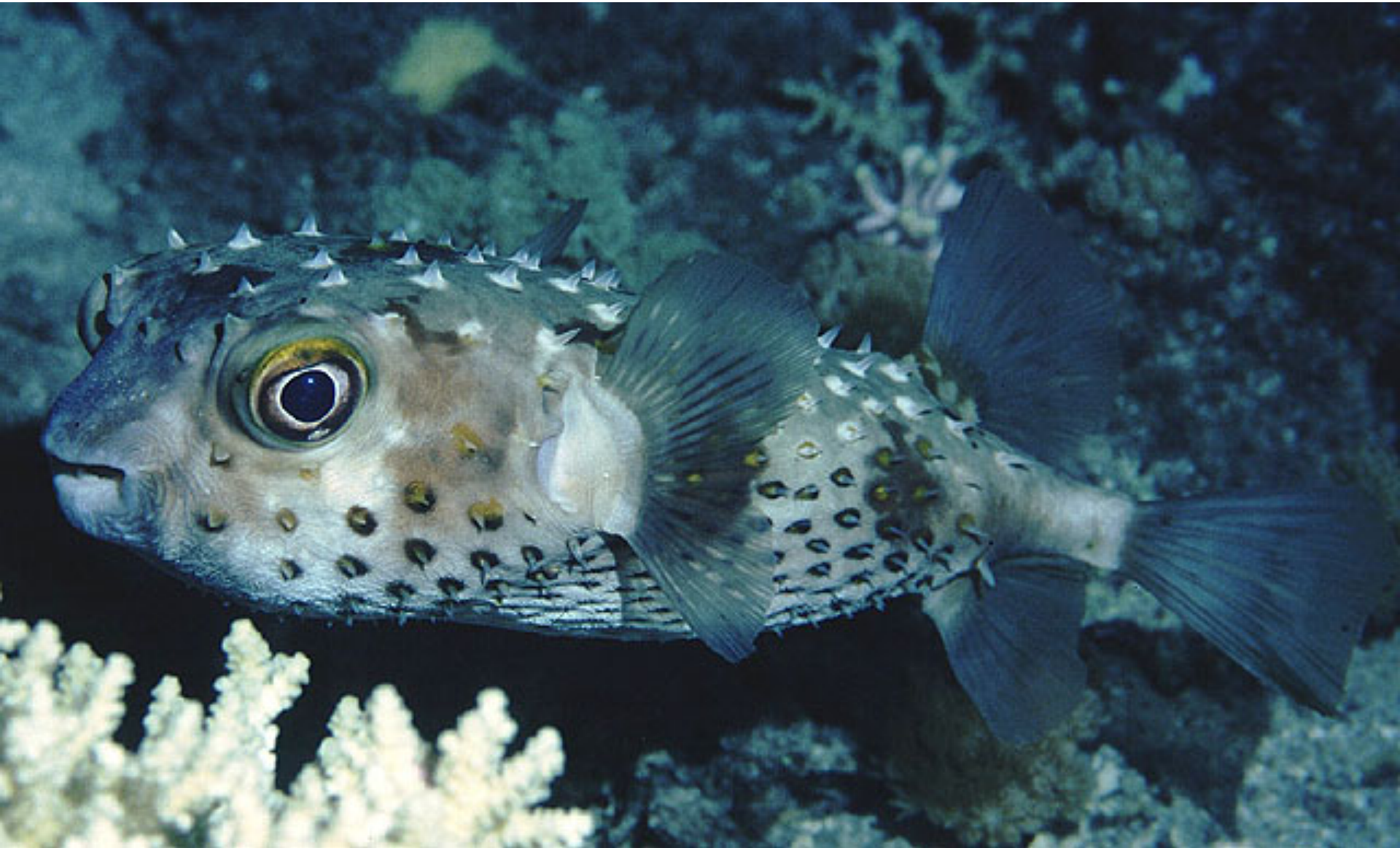
triggerfish



filefish



boxfish



porcupinefish



ocean sunfish (*Mola*










ocean sunfish (*Mola*



puff...

Part 25. Order Perciformes

-  *largest order of vertebrates*
-  *most diversified of all fish orders*
-  *somewhat united by osteology*
-  *18 suborders, 148 families, 1496 genera, & 9293 sp.*
 - *most marine /inshore (dominate tropics)*
 -  *1922 species (\approx 21 %) freshwater*
 -  *mostly cichlids (Africa)*
 -  *2185 occur in freshwater sometime*

Series Percomorpha

common body plan:

 *physoclistus* swimbladder (or absent)

a) neutral buoyancy

 *pharyngeal* teeth

 *protractile* upper jaw (premaxilla)

 *thoracic* or *jugular* pelvic fin placement

 pectoral fins placed *high* on body

b) highly maneuverable

 well developed *eyes*

c) specialized feeding and; **d)** habitat

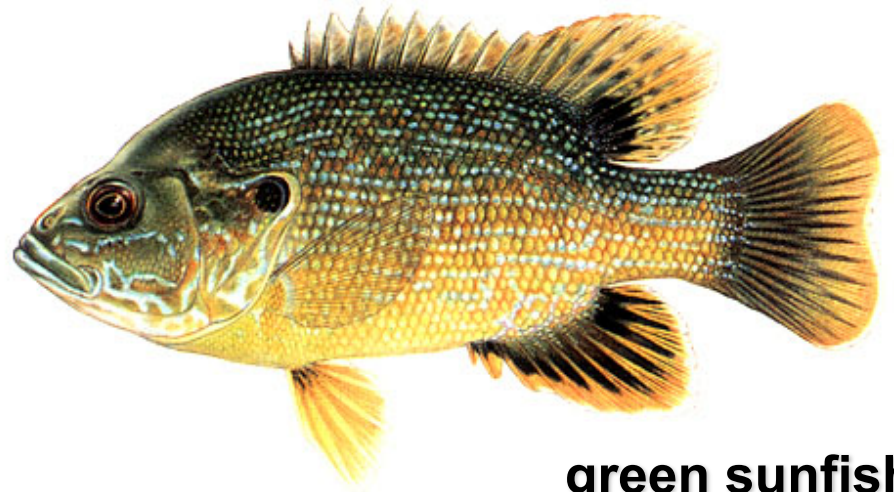
 fin *spines* (always some; not caudal fin)

 usually *ctenoid* scales

e) antipredator and; **f)** hydrodynamic



redbreast sunfish



green sunfish



pumpkinseed



longear sunfish

• **four 'northern' sunfish species (*Lepomis* sp.)**



smallmouth bass



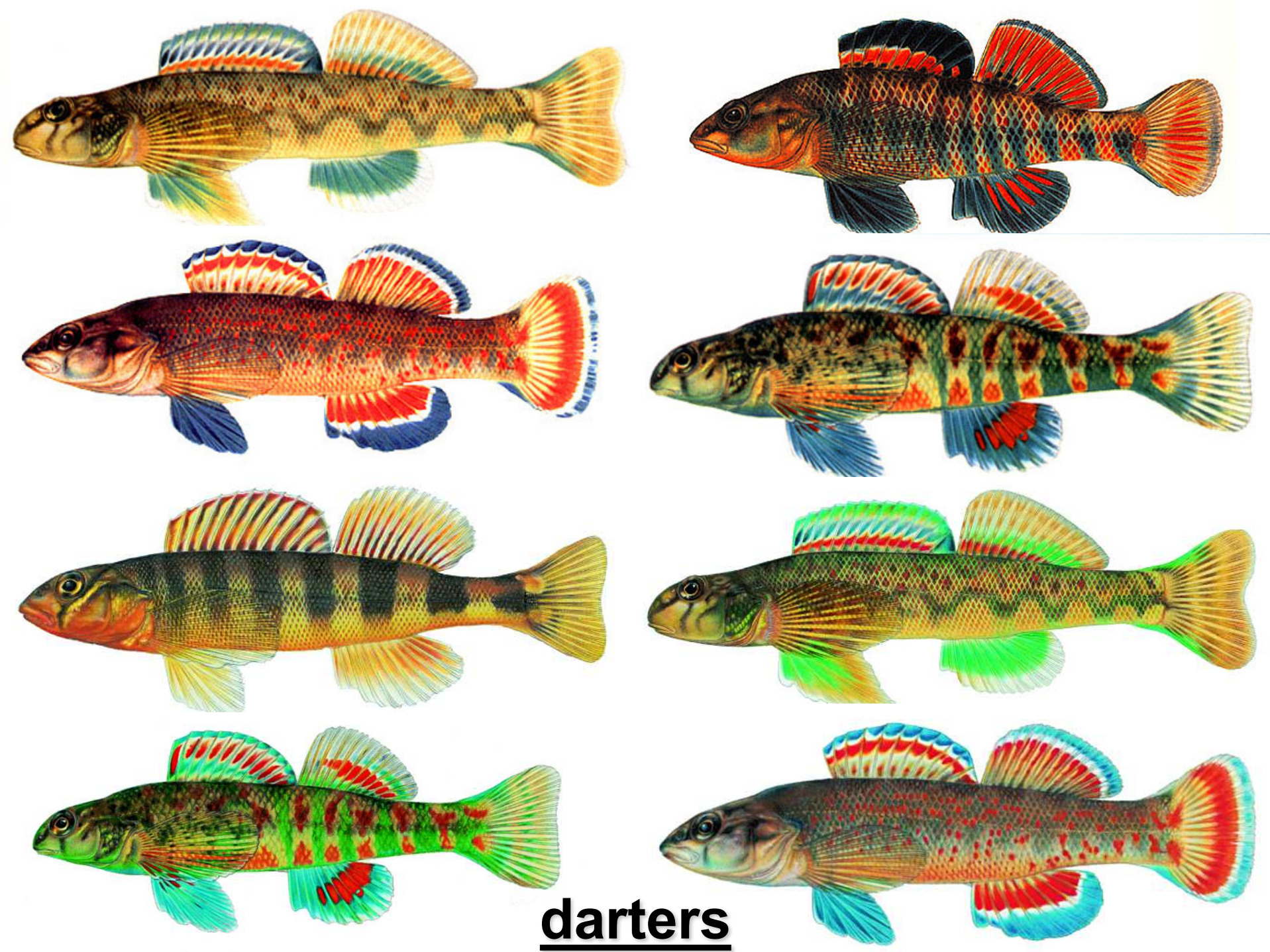
largemouth bass



walleye



yellow perch



darters



remora ('sharksucker')



remora ('sharksucker')



remora ('sharksucker')



© Milton Love



shiner perch



wrasse - female



wrasse - male



crocodile icefish



sandlance





gobies

• from Masuda et al. (1984)
(Dr. J. McEachran – Texas A&M)



gobies





beta (gourami)



cichlid



Nile perch



A



B



C



D



E



F

stargazers (Family Uranoscopidae)

• from Masuda et al. (1984)
(Dr. J. McEachran – Texas A&M)

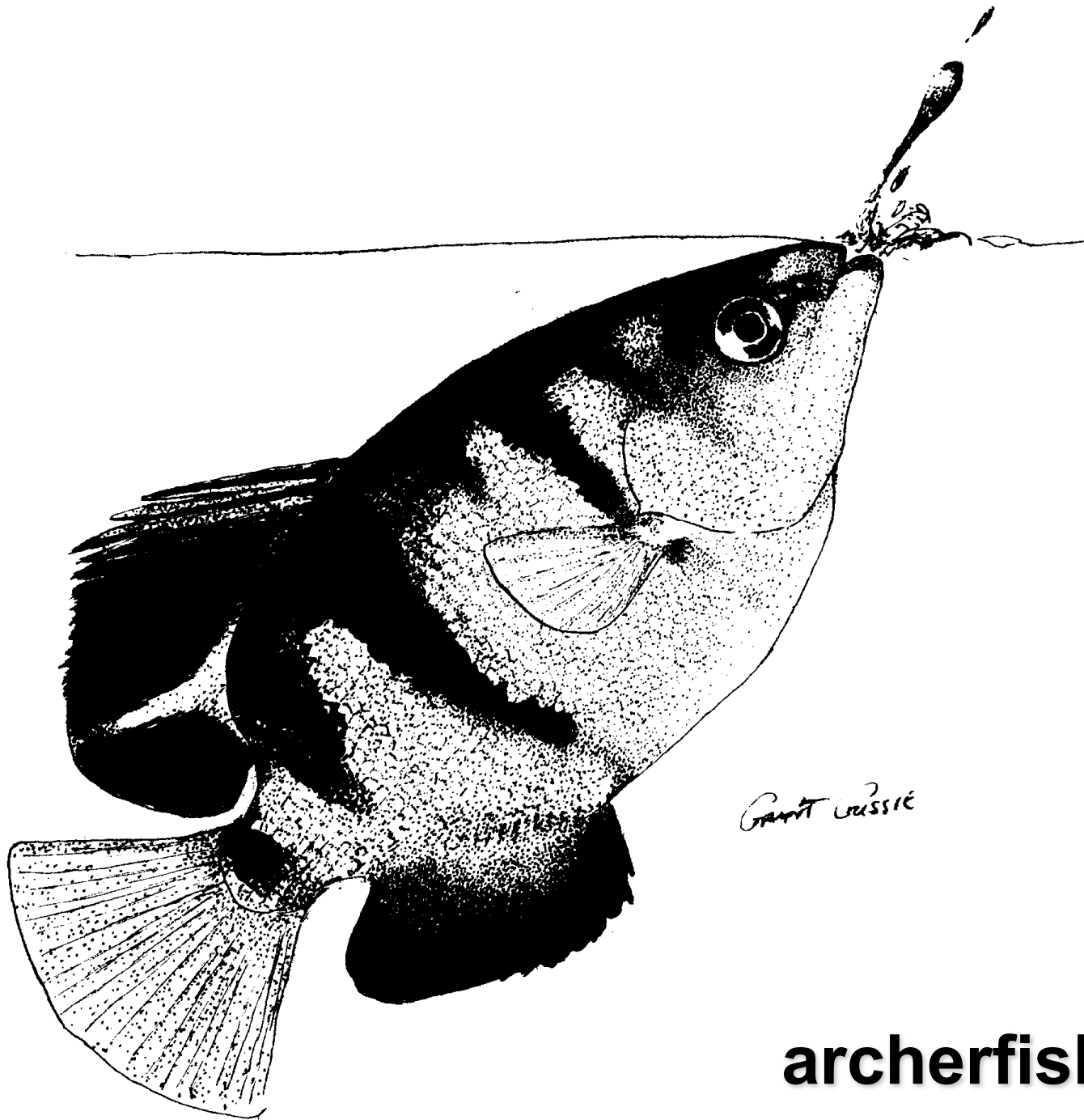


stargazer

©NHPA



archerfish



Grant Crossie

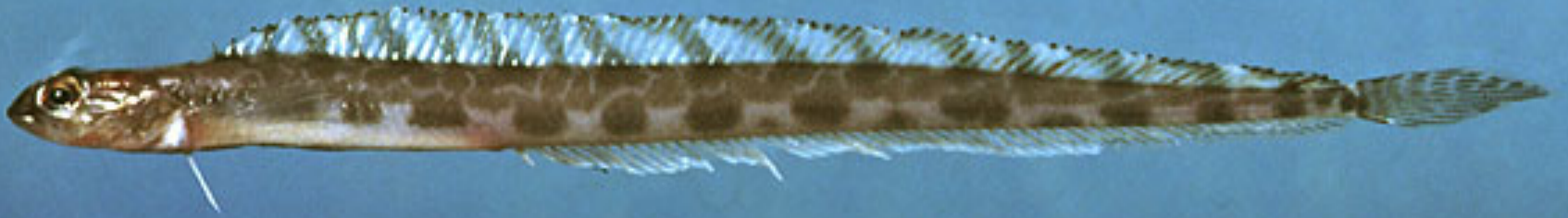
archerfish



eelpout



gunnel



prickleback



wolffish

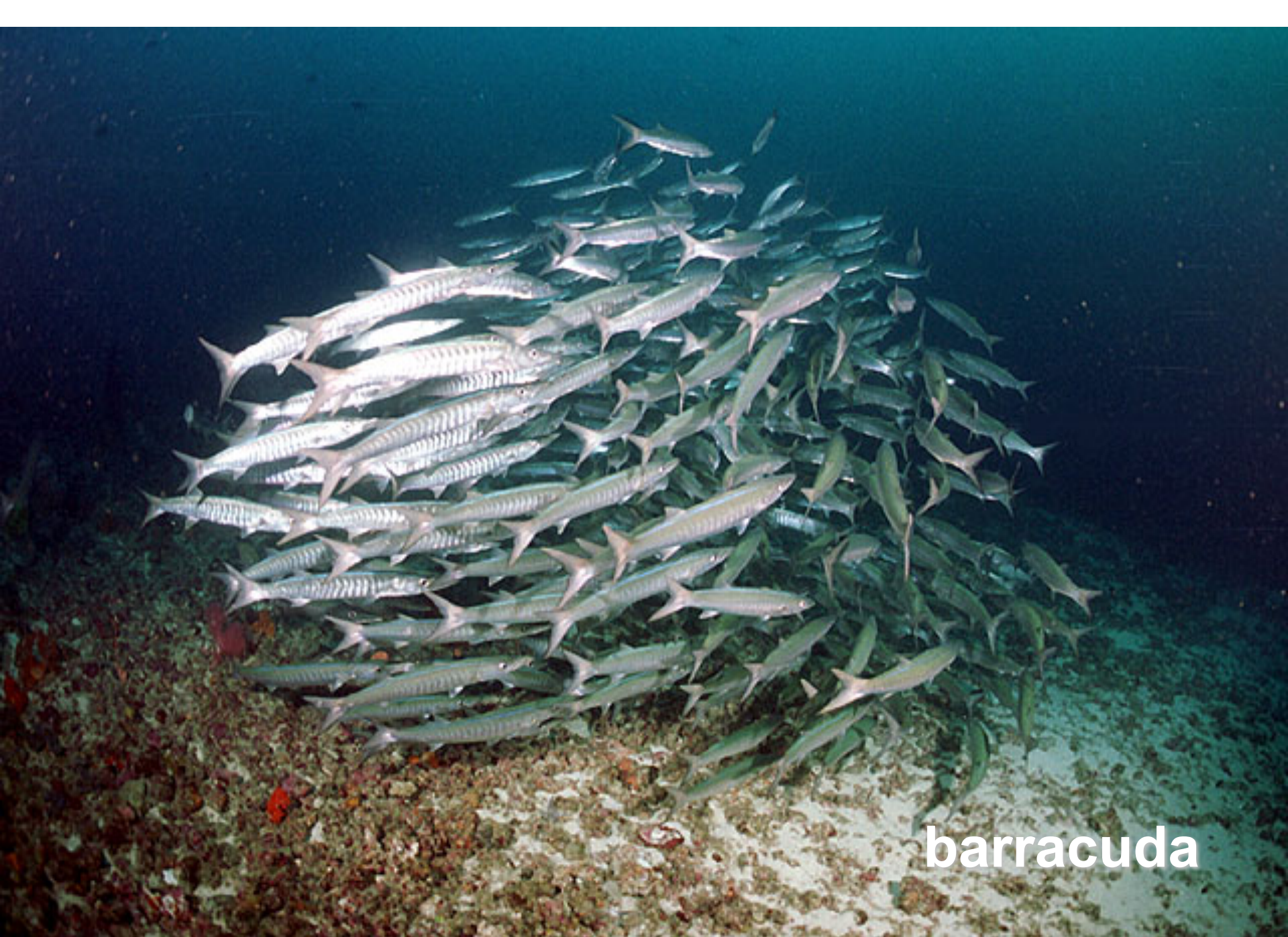


tunas and mackerels

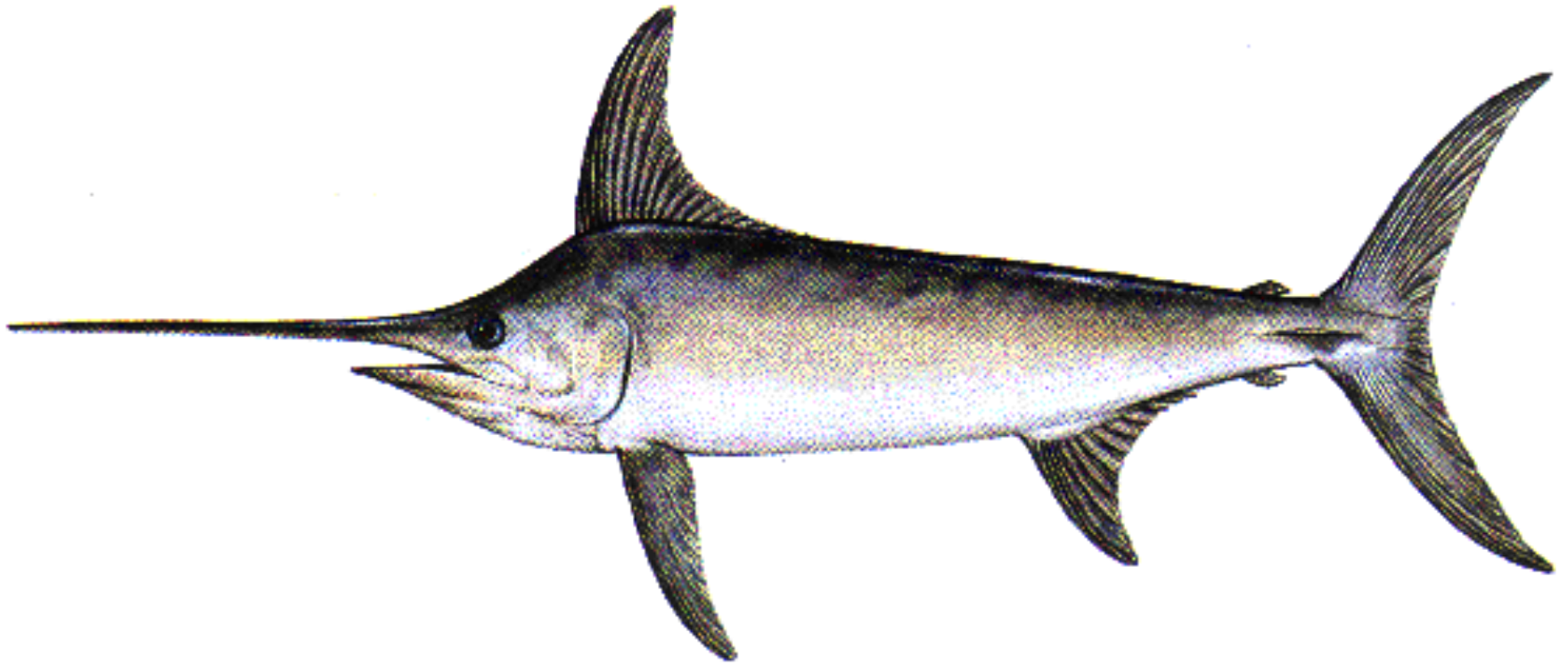
• from Masuda et al. (1984)
(Dr. J. McEachran – Texas A&M)



barracuda (not a tuna or mackerel)



barracuda



swordfish

An illustration of a Striped Marlin, showing its long, pointed snout, dorsal fin, and characteristic dark vertical stripes along its body.

Striped

Gunniston

The Marlins

An illustration of a Blue Marlin, showing its long, pointed snout, dorsal fin, and solid blue coloration.

Blue

An illustration of a Black Marlin, showing its long, pointed snout, dorsal fin, and solid black coloration.

Black

marlin



damselfishes & anemonefishes (I)

• from Masuda et al. (1984)
(Dr. J. McEachran – Texas A&M)



butterflyfishes

• from Masuda et al. (1984)
(Dr. J. McEachran – Texas A&M)

surgeonfishes



• from Masuda et al. (1984)
(Dr. J. McEachran – Texas A&M)



groupers

• from Masuda et al. (1984)
(Dr. J. McEachran – Texas A&M)



sea basses

• from Masuda et al. (1984)
(Dr. J. McEachran – Texas A&M)



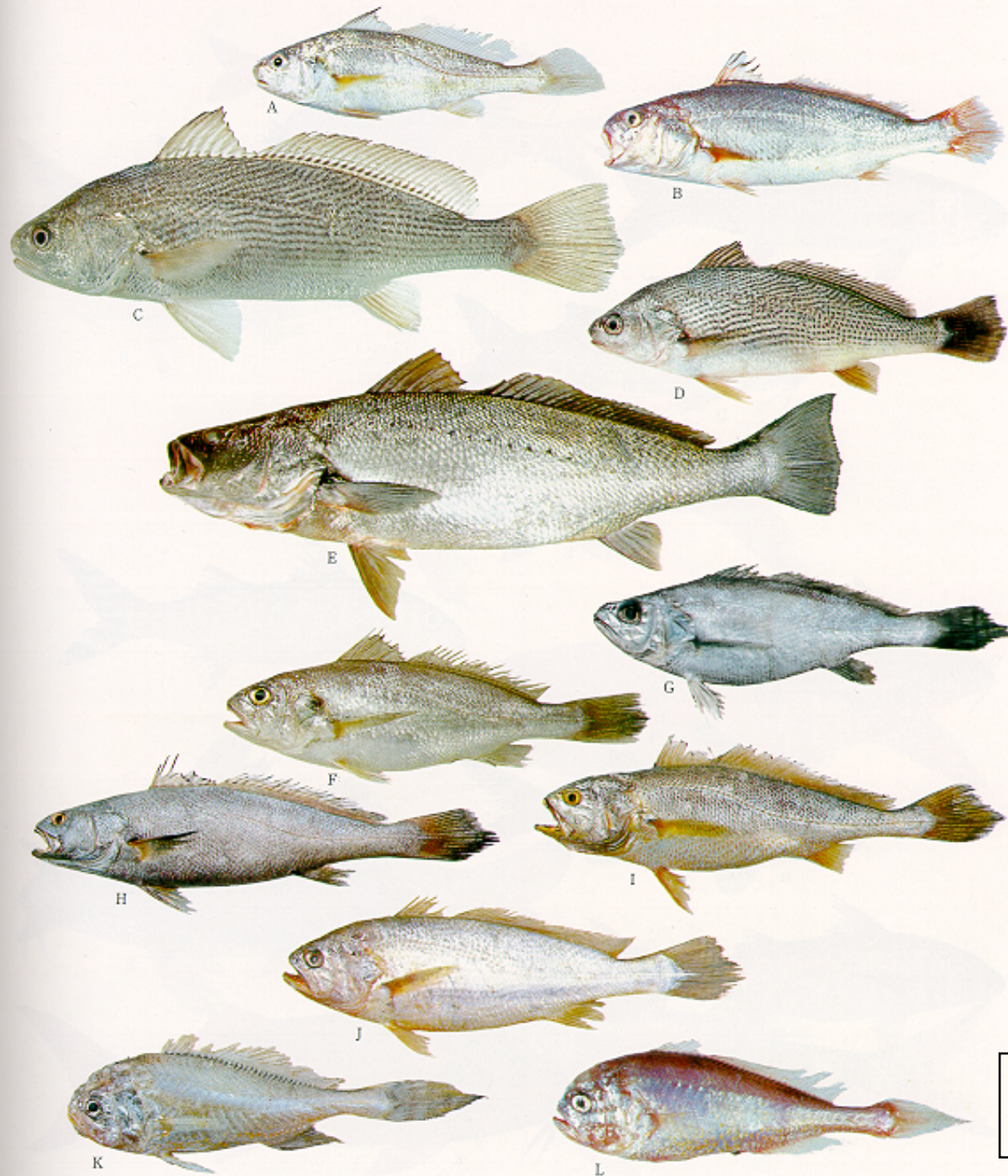
cardinal fishes

• from Masuda et al. (1984)
(Dr. J. McEachran – Texas A&M)



jacks and pompanos (I)

• from Masuda et al. (1984)
(Dr. J. McEachran – Texas A&M)



drums (croakers)

• from Masuda et al. (1984)
(Dr. J. McEachran – Texas A&M)



porgies

• from Masuda et al. (1984)
(Dr. J. McEachran – Texas A&M)



snappers and fusiliers

• from Masuda et al. (1984)
(Dr. J. McEachran – Texas A&M)