

Agnatha - Jawless

Class Myxini; Myxiniidae - hagfishes: marine temperate, no FW; 1 family, 6 genera with 32 species - Only one species in western North Atlantic *Myxine glutinosa* Biology - Brodal and Fange, 1963 and Hardisty 1979, systematics - Fernholm

Class Pteraspidomorphi, Order Pteraspidoformes – Fossil 3

Class Cephalaspidomorphi

Order Petromyzontiformes; Petromyzontidae - lampreys: Freshwater and marine N and S temperate; 1 family 6 genera and 40 species. One marine species, *Petromyzon marinus* in WNA. Biology- Hardisty and Potter, 4 volume set 1971-1982. Parasitic with non-parasitic sister species in most freshwater forms.

Order Anaspidiformes (Anaspida) – Fossil 2

Order Cephalaspidiformes (Osteostracida) – Fossil 1

GNATHOSTOMATA - Jaws derived from palatoquadrate and meckelian cartilage; collagen-fin rays; dermal ossifications; trunk muscles divided by horizontal septum; myelinated nerve fibers, gill skeleton arrangement and gills lateral to skeleton; total of 37 characters listed in Maisey.

Dichotomy of Living Chondrichthys (Elasmobranchii – Sharks, skates and rays; and Holocephali – Chimeras) and Osteichthyes (Bony Fish)

Two Major Extinct Groups – Acanthodii and Placodermi

CHONDRICHTHYS

Defining characteristics:

- 1) Perichondral prismatic calcified tissues (Made of hydroxyapatite)
- 2) Claspers in pelvic fin of adult males;
- 3) Formation of horny egg case by Nidamental (Nidamental) gland;
- 4) Maisey lists 10 additional characters.

Diagnostics: heterocercal tail

Two distinct subgroups Elasmobranchii (sometimes called Selachii) and Holocephali.

HOLOCEPHALI (Chimeras, rattails)

Defining characters: Teeth in the form of toothplates that are slowly replaced; Upper jaw element (palatoquadrate) fused to neurocranium; First dorsal spine erectile; Clasper organ on head of males

Diagnostics: Pectoral fins large; Tail heterocercal or diphycercal; 4 gill slits; Large head with conspicuous cephalic lateral line canal system; Membership: 3 families, approx 30 species, mostly deepwater marine, few species in coastal waters.

ELASMOBRANCHII (or Selachii)

Defining characters of recent forms: Basipterygium fused across midline; Nongrowing dermal denticles; Hypaxial caudal skeleton reduced

Diagnostics: fins non-erectile; gill slits 5-7.; Rapid replacement of jaw teeth.

Membership: Sharks and Skates and Rays

SHARKS (Euselachii, Pleurotremata) - Questionably monophyletic without Batoids.

Diagnostics: gill slits lateral, not covered dorsally by expanded pectoral fin - fin not joined to head

Major groups: Squalimorpha (Squaliformes) Deepwater sharks, with spiracle and without anal fin. Spiny dogfish, cookie cutter sharks, Galeomorpha (shallowwater sharks 'typical') Smooth dogfish, tiger, lamnids, carcharinids, whale, basking,

etc. Squatinomorpha? (angel sharks) sometimes placed with the squalimorphs, Heterodontus (horn sharks) a galeomorph? Membership: 350 spp. worldwide, marine.

BATOIDS (Rajiformes, Hypotremata) - Skates and Rays

Defining characters: ventrally placed gill openings, Pectoral fins fused anteriorly to head, no anal fin, palatoquadrate free from neurocranium, synarcual - anterior vertebrae fused together, ventral mouth, except in a few derived taxa. Included taxa: 425 spp., several families: sawfishes, torpedos, guitarfishes, skates and rays. Most marine, sawfishes may be brackish, potmotrygonid stingrays and some dasyatids freshwater.

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OSTEICHTHYES

Defining Characters: branchiostegal rays present; interhyal; sclerotic ring; basihyal and hypohyal ossifications; lepidotrichia; pleural ribs; pectoral girdle element dermal ossification pattern (Lauder and Liem, 1983); Endochondral bone; swimbladder[lung] derived from gut tissue; gular plate; "Jaw" teeth on dermal bones, not associated with chondral jaw elements (Maisey, 1986). Erectile unpaired finrays common gill opening; fin rays more numerous than supports.

Major groups of recent osteichthyans: Actinopterygians and Sarcopterygians
Important fossil groups: Acanthodians (sister group to Osteichthyans) and Placoderms.

SARCOPTERYGII - (Lobe finned vertebrates fishes)

Defining characteristics: Enamel; pulmonary vein; Gill arch structures: loss of hypobranchials and pharyngobranchials, single basibranchial, and CB 4 articulates medially with the base of CB 3 and not basibranchial series (in *Squalus*). Paired fins with unique supporting skeleton and muscular basal-lobes.

Subgroups: Actinistia and Choanata (Dipnoa and Tetrapoda).

ACTINISTIA (Coelacanth)

Defining characters: Branchiostegals lost; freely moveable intercranial joint; loss of maxilla; swimbladder ossified; rostral organ present; 1st dorsal fin rays articulate with single basal plate.

Diagnostic characters: anterior and posterior nostrils, 2 dorsal fins; diphyccercal tail.

Membership: 1 living species *Latimeria chalumnae*, from Comoros Islands. Discovered 1938. Fossil membership: about 30 species ranging from middle Devonian to Upper Cretaceous.

CHOANATA

Defining characters: form of locomotion (but may apply to coelacanth); naso-lacrimal duct; similarities in circulatory system, especially associated with heart and pulmonary circulation; glottis and epiglottis, jelly-coated egg.

Widely used term Rhipidistians may be paraphyletic groups with part being more closely related to tetrapods and part to dipnoans. Often considered the ancestral form of tetrapods.

DIPNOI

Defining characteristics: Palatoquadrate fused to cranium, no marginal toothbearing jaw bones, and "Teeth" in form of paired, ridged plates.

Diagnostics: all recent lungfishes have continuous dorsal-caudal- anal fin (but fossil forms have primitive fin structures, including 2 dorsal fins), embedded scales, and reduced dermal ossifications.

Membership: Three recent genera: *Neoceratodus*, *Lepidosiren*, and *Protopterus* (4 species).

Fossils: Extensive record: at least from the Devonian.

ACTINOPTERYGII (ray-finned fishes)

Defining characters: Lepidotrichia forming segmented finrays; single rayed dorsal fin; rhomboid scales with anterior (and/or dorsal) peglike process, covered with ganoin; mandibular sensory canal encased in dentary bone; acrodin coating of teeth.

Groups: Cladistia, Chondrostei, and Neopterygii (=Ginglymodi, Halecostoma and Teleostei).

Notes: early groups still have heterocercal tail.

CLADISTIA (Bichirs)

Defining characters: Dorsal fin-spines with branches; Spiracular ossicles; shape of urohyal and parasphenoid.

Membership: 2 genera (*Polypterus* and *Erpetoichthys*), 10 species all tropical freshwaters of Africa. Young *Polypterus* have external gills, adults have highly vascularized lung.

Chondrostei + Neopterygii - Swim bladder connects to gut dorsally, three ossifications of hyoid bar and interhyal.

CHONDROSTEI (sturgeon and paddlefish)

Defining characters: fusion of Maxillae, premaxillae and dermopalatine; absence of myodome;

Diagnosics: heterocercal tail, one branchiostegal ray, spiral valve intestine, body w/ rows bony plates.

Sturgeon: (*Acipenseridae*) 23 species from northern hemisphere fresh and marine waters.

Paddlefish (*Polyodontidae*). 2 species: Mississippi R. and Yangtze R.

Defining characters: paddlelike snout, densely packed gillrakers, etc.

Source of American caviar. Recently introduced into Russia for same.

Neopterygii --- Gars + Halecostomi (=Amia, Teleosts and fossil semionotids)

Fin rays and supports in ratio of 1:1; others.

Ginglymodi (Gars)

Defining Characters: numerous, most evident from elongate body form,

Members: two genera: *Atractosteus*, *Lepisosteus*, seven recent species.

Distribution: Mississippi Drainage, Mexico, Central America and Caribbean, Fossils from broader range of N.America, northern South America, Africa, India and Central Europe. (Australia ?)

Note: Gars plus *Amia* traditionally called HOLOSTEI.

Halecomorphi (Bowfins)

Defining characters: Symplectic contributes to articular surface of quadrate.

Diagnosics: abbreviate heterocercal tail, many branchiostegals.

Amiidae, Extant = *Amia calva*.

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TELEOSTEI

DEFINING CHARACTERS: externally symmetrical "homocercal" tail, with skeletal modifications: uroneurals, expanded haemal arches as hypurals, weakly developed ural centra. Modification of ventral throat musculature (allowing for branchiostegal pumping action). Loss of anterior portion of adductor mandibulae.

Living teleosts also defined by presence of chondral basihyal, single basihyal toothplate and basibranchials in unpaired row (Paired in early teleosts); 3 hypobranchials (primitive ?).

Notes: 20,000 living species (Cohen, 1960); first known from middle Triassic.

Four major subgroups: Osteoglossomorpha, Elopomorpha, Clupeomorpha and Euteleostei.

OSTEOGLOSSOMORPHA (bony tongues)

Defining characters: Gut coiling pattern: anterior part of gut passes to the left of esophagus and stomach (right in both nonteleosts and other teleosts); premaxilla firmly fixed to skull; bite between basihyal teeth and endopterygoid.

Diagnostics: generally large patch of parasphenoid teeth

Membership: all freshwater. Arawanas (Tropical species, 2 in Africa, 1 in Asia, 3 S. America and 2 ? Australia).

Airbreathing known in at least Arapaima, Heterotis unusual; primarily a planktivore, in having no parasphenoid teeth and reduced hyoid

Mormyrids (elephant noses, baby whales,) 300 spp. all electrogenic, weakly; enlarged cerebellum.

Notopterids - knife fishes of Asia and Africa: few species; Undulating locomotion, air breathers, large bony tongue.

Hiodontids only N. American representatives; 2 species.

Teleosts exclusive of Osteoglossomorpha: 2 uroneurals extend anteriorly over 2 nd preural centra.

ELOPOMORPHA (Tarpons, bonefishes, and "eels") 650 species, mostly anguilliform eels.

Defining Characters: leptocephalus larvae; fusion of angular & retroarticular; rostral & prenasal ossicles.

Membership: diverse array of forms: typical teleost body shape of Elops and Megalops, to deep sea eels. Nearly all are marine, with a few brackish water representatives. Only the Anguillid eels are truly freshwater, and even they require marine waters for reproduction.

Remaining teleosts: retroarticular excluded from joint with quadrate; gill arch toothplates fused to chondral bones; articular fused to angular; neural arch of PU1 absent.

CLUPEOMORPHA (Herrings and their relatives)

Defining characters: unpaired abdominal scutes; otophysic connection: swimbladder to posterior neurocranium w/ expansions of pterotic and prootic as bullae. Supratemporal canal passes through parietal.

Among living clupeomorphs: recessus lateralis, pareitals separated by supraoccipital; no foramen in anterior ceratohyal.

Membership: about 300 species; five families, Denticeps clupeoides[1], anchovies[139], wolfherrings[1-2], Pristogaster[?], herrings[190].

EUTELEOSTEI

Defining characters: adipose dorsal fin, nuptial tubercles.

Esocoids: posteriorly placed dorsal fin (adipose fin absent), Toothplates on BB4 (primitive), maxilla toothless. Pikes[6] and mudminnows[5], all northern hemisphere FWF

Argentoids and osmeroids (smelts): Including galaxiids: sometimes placed into the Salmoniformes, though there is no evidence of a monophyletic group. mostly marine, many deepwater(Mesopelagic) no bioluminescence,

Salmonidae (salmon, trout, whitefish, and grayling) 10 genera, 70 spp. Monophyly still questioned, position within euteleosts uncertain.

OSTARIOPHYSI

More than 3000 species, virtually all are FWF, and therefore 1/2 of all known FWF.

Defining characters: parietal reduced; dermopalatine absent; anterior hemal spines fused to centra, anterior 2 ribs attached to swimbladder; swimbladder divided into anterior and posterior portion, connection to gut at junction.

Includes: Gonorynchiforms and "Otophysi".

Gonorynchiforms include 5 genera African FWF, two genera/ families of coastal marine species.

OTOPHYSI

Defining characters: Weberian apparatus consisting of modifications of anterior neural arch elements, parapophyses and pleural rib elements into a chain of ossicles linking the swimbladder to the ear. Hypural 2 fused to ural complex (PU1, U1, U2, +UN).

Otophysi include 4 orders of FWF, Cypriniformes, Characiformes, Gymnotiformes and Siluriformes. One or more form the dominant fish of each continent, except Australia.

Cypriniformes 6 families, 200 + genera, 2500 + species. (Northern Hemisphere and Africa) No jaw teeth, pharyngeal teeth ankylosed onto CB5, no adipose fin.

Characiformes: 10 families, 250 + genera, 1300 + species, (90 % in new World, remainder in Africa) Teeth replaced from crypts in dermal bones, hypural 1 separated from ural centrum.

Gymnotiformes: 6 families, 25 genera, 50+ species, S. and C. America) elongate eellike forms with electrogenic ability, all but electric eel swims with stiffened body & undulating anal fin.

Siluriformes: 31+ families, 400 + genera, 2300 + species, all continents (including Antarctica, fossils) typically FWF, but 3-4 families have species that tolerate or thrive in marine waters.

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NEOTELEOSTEI

Defining characters: retractor arcus branchialium or retractor dorsalis muscle, which attaches to pharyngobranchials and anterior vertebrae. Appears derived from esophageal muscles. Rostral cartilage between premaxillae and neurocranium - allows free movement premaxilla (i.e. protrusion).

Membership: Stomiiformes, Aulopiformes, Myctophiformes, Paracanthopterygii, Atherinomorpha, and Percomorpha.

STOMIIFORMES

Defining characters: Peculiar type of photophores, branchiostegals found on ventral hypohyal, peculiar type of tooth attachment.

Membership: 9 families with approx. 250 spp. Primarily deep-sea, tropical to temperate species. All have some luminescent organs. Including: Hatchet fishes, viperfishes, dragonfishes, etc. Mostly black and or silver.

AULOPIFORMES

Defining characters: Arrangement of pharyngobranchial elements: PB2 and PB3 diverge posteriorly; and expanded uncinata process of EB 2 contacts PB3 and provides structural bridge.

Membership: Diverse array of shallow-water & deep-sea marine fishes, both benthic and mesopelagic. Less than 200 spp. in 12 families. Including: Deepsea tripod fishes, Bombay duck, shallowwater forms include family Synodontidae, Lizard fishes: in W. North Atlantic 3 or 4 of the 25 species are found. Sometimes (E.G. Johnson, 1984) placed with Myctophiformes into Iniomi.

MYCTOPHIFORMES

Defining characters: PB3 enlarged, largest toothplate element. Members: Myctophidae & Neoscopelidae (6 spp): both deepsea and pelagic or benthopelagic. 240+ species.

Notes (Often placed together with the following groups as the Ctenosquamata, for widespread occurrence of well developed Ctenoid scales). But also placed together with Aulopiformes as one of several suborders of Iniomi.

Myctophids with rows of photophores along belly; pattern useful for species recognition and grouping. Undergo dramatic vertical migrations daily (Nelson's example: Day: 300-1200m; Night 10-100m.)

PARACANTHOPTERYGII

Defining characters: PU2 with full neural spine (primitively PU2 w/ only a basal arch or no arch. Other characters are suggested but not universally found or only in "advanced" forms (e.g. anterior vertebrae crowded, increased # abdominal vertebrae). Usually with jugular pelvic fins, and spiny dorsal elements.

Membership: Percopsiformes- troutperches Including Aphredoderus, and N.A. blind cave fishes (6 spp). only FWF Paracanthops: single rayed D fin with weak anterior spines

Gadiformes - Cods 7 families, 400 + species, including Cod, hakes, and FWF Burbot (Lota). Also Rattail macrourids (250 + species) benthopelagic. Often single mental barbel, always cycloid scales, D fin w/o true spiny rays, but with 2 or 3 D fins. W/o adipose D fin.

Often Ophidiiformes (cusk eels, pearlfishes, Brotulids, etc. included here, othertimes included within Perciformes, othertimes as a separate order (as a distinctive, well defined lineage).

Batrachoidiformes - toadfishes (3 families, 80-90 spp) Depressed benthic fishes with small anterior D fin; scaleless or nearly so; Temperate and tropical marine and Neotropical freshwater. Sounds produced by swimbladder movements and derived musculature.

Lophiiformes - Anglerfishes 16 families, 250+ spp. Strictly marine, many deep, bathypelagic. First D fin w/ 3 rays on head, and first spine modified into Illicium or "lure" for prey attraction. Sometimes lure capable of producing light. Gill

opening restricted, tubular, near Pectoral fin base (but not anterior to); Pect fin often used to prop up body and "Walk" at least in benthic forms.

Inc. Tropical frogfishes (Pietsch 1986); Batfishes (tropical/sub seas) and deep sea Ceratioid families.

Gobiesociformes - clingfishes (2 families, 115 + spp) Body strongly depressed; pelvic fins modified into clinging disc, which helps fish adhere to hard substratum; Distinctly assymetrical heart.

Includes shallowwater benthic marine species in tropical and temperate zones, occasionally in FW.

Paracanthopterygii joined together with Atherinomorpha and Perciformes into Acanthomorpha. Characters: Ctenoid scales, ascending process of premaxilla allowing for protrusion. Also movement of pectoral fin onto lateral flank of body.

ACANTHOPTERYGII

True spiny rays in D and A fin, great mobility of upper jaw, but protrusability varies within group and may have evolved independently several times.

Term has varied useage: either Atherinomorpha plus Percomorpha or just for Percomorpha. In broader context, defined by presence of interarcual cartilage: extending between the uncinat process of EB1 and the PB2; Elongate symphyseal process of premaxilla allows for upperjaw protrusion.

ATHERINOMORPHA - Silversides, killifish, flying fishes, etc. 1080 species, 18 families.

Defining characters: Unique pattern of upper jaw suspension that allows for independent left and right movement of premaxillae differs from percimorph condition in lacking ball and socket joint between palatine and maxilla; Eggs with long adhesive filaments and numerous oil droplets (except in viviparous forms). Characterized by poorly developed 1st dorsal fin with feeble spines or none (in Cyprinodontiformes and Beloniformes)

Memberships: Several shallow water marine and/or freshwater groups lumped into "atherinoids", including Atherinidae (silversides: Menidia, grunion, Labidestes NA FWF); Australian/New Guinea rainbow fishes (Melanotaeniidae); and several other small families. Generally very highly set pectoral fins and small 1st dorsal.

Cyprinodontiformes: 9 families, 600-700 spp.; killifishes fresh/brackish fishes of tropical and temperate waters throughout the world. Characterized by true symmetry of caudal skeleton

Numerous spp in NA FW; Also worldwide. Viviparous: guppies & mosquito fishes, and Goodeids.
Annual species - complete life cycle in several months in coastal drainages w/ extended dry seasons.

Beloniformes: needlefishes, halfbeaks, and flying fishes. sometimes called Exocoetoids 160 + spp. reduced epibranchials 2 and 3, EB 1 dominant, PB1 lost.

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PERCOMORPHA

Poorly defined group that may not be monophyletic. "primitive" percomorphs tend to have separate dorsal fins and pelvic girdle attached to cleithrum of pectoral girdle. All except earliest groups have Pelvic I,5; Several subgroups: some well defined others probably wastebaskets waiting for further resolution.

BERYCIFORMES: Squirrelfishes and their relatives: "primitive" percomorphs having Acanthop characters but lacking several derived percomorph derived characters (e.g. loss of orbitosphenoid, 18 caudal rays, rather than the more derived 15; 3, rather than the more derived 2, epurals) but may be natural based on peculiar form of caudal procurent ray form.

Marine fish widely distributed in tropical and temperate coastal waters. Include Squirrel fishes, flashlight fishes, pinecone fishes, etc. Nocturnal or lowlight fishes, not found in daylight in shallow waters. Heavily armored heads, thick bones, etc. All heavily scaled with stout spines on fins

GASTEROSTEIFORMES: Sticklebacks, pipefishes and seahorses. Name from bony stomach; indicating typical bony plating around body. Mouth usually small and tubular.

Gasterosteidae (sticklebacks, 7 spp., many morphs), Syngnathidae (pipefishes and seahorses, 230 spp), Centriscidae (Shrimpfishes and snipefishes), Aulostomidae and Pegasidae (seamoths, 5 spp).

SCORPAENIFORMES: mail-cheeked fishes scorpionfishes and their relatives. Mail cheeked comes from character that unites the fishes - the suborbital stay - a posterior extension of the 3rd suborbital that connects the preopercle; also hypurals plate-like and fused to centrum. Usually dermal bones of head with spiny processes, caudal fin rarely forked.

Mostly benthic shallow water marine fishes but with groups that seem to have secondarily invaded freshwater (cottids, cottocomephorids, etc. Over 1000 species in 20 families.

Scorpaenoids: Include many venomous fishes; often slow moving, lie and wait predators, diversity of forms makes characterization difficult. Internal fertilization common, internal development in some species, most deposit eggs in clusters with toxic coating. Included here: stone fishes, rockfishes, lionfishes, seabass, searobins,

Cottoids: loss of basisphenoid- 300 spp.- sculpins, poachers (agonids) and lumpfishes.
Hexagrammoids - greenlings dominant - N.Pacific fauna.

TETRAODONTIFORMES: (Often called Plectognathi- twisted mouth) Pufferfishes, boxfishes, triggerfishes and relatives. 300 species, 8 families. restricted gill opening; branchiostegals covered with thick skin; loss of infraorbitals, nasals, and parietals, and anal-fin spines. All have peculiar scales as spiny plates; one family with bony armor encasing entire body, except tail.

Balistidae - triggerfishes and filefishes: pelvic fin modified: entire girdle movable; body appears to enlarge when girdle is depressed. Dorsal spines modified into locking mechanism that keeps spines erect until proper sequence of spine depression occurs. 135 spp.

Ostraciidae - Box fishes, cowfishes, marine tropicals; 30 spp.

Molidae - Ocean sunfishes - 3-4 spp. no caudal skeleton or fin; no spines in unpaired fins;

Pufferfishes: 3 families; fused teeth: all but Triodontidae (1 spp) capable of swelling by swallowing water or air into branch of stomach); 130 spp. no spines in fins; tetrodotoxin. Most nearshore marine, few spp in freshwater.

PLEURONECTIFORMES: - flatfishes;

Not bilaterally symmetrical, one eye migrates to opposite side of head in post larval fishes. Asymmetry shows in cranial bones, muscles and nerves. Optic nerves become twisted. long

dorsal and anal finbases Although flat they are considered compressed not depressed.

500 + species, 6 families. Nearly all marine coastal and continental slope. Few spp found in freshwater. Important foodfish worldwide. most are benthic and carnivorous. Some are active swimmers, nearly like that of symmetrical spp.

Relationships not based on side of migration. Soles & tongue soles opposite sides, apparently close. Psettodidae - nearly symmetrical PV I,5; 2 spp.

Citharidae - 5 spp. both sinistral and dextral.

Bothidae - sinistral - lefteye flounders 100 + spp.

Pleuronectidae - righteye flounders 100 spp,

Soles 2 families preopercle not free, no ribs, jaws strongly asymmetrical.

Soleidae - dextral - 120 spp, tropical and temperate.

Cynoglossidae - sinistral - continuous connection of D, C, A fins. Burrowing forms 100 + spp.

CHANNIFORMES-Snakeheads; 12 spp often placed w/ Anabantoids, Lauder place close Swamp eels

SYNBRANCHIFORMES - swampeels; (15 spp) diagnosed by conjoined branchial openings midventrally. Eellike freshwater fishes, no pectoral fins.

DACTYLOPTERIFORMES - flying gurnards; (4spp.) tropical marine spp. look superficially like triglids in form and habits.

LAMPRIIFORMES - 11 families 40 species; Primitive percomorphs with no spines in fins, pelvics with many rays (more than 5).

PERCIFORMES: All remaining percomorphs little to unite the group and probably not natural. 150 families and 7000 species.

Ruling perches - dominant fishes of nearshore marine environments and, together with Ostariophysi dominant fishes of freshwaters.

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PERCIFORMES

Percoidei - Generalized perciforms that cannot be related to any of the other suborders.

Labroidei - or Pharyngognath perciforms - all have some level of union of CB5 across the ventral midline. In advanced forms, the two elements are fused, without visible suture. In addition, esophageal sphincter muscle; and PB3 articulates directly with ventral surface of neurocranium.

Labridae Scaridae Pomacentridae Cichlidae Embiotocidae (500+) (75+) (250) (1000) (25) wrasses parrotfishes damselfishes surperches widespread tropical widespread Africa, S. Pacific coast America

Blennioidei - benthic inhabitants - 900-1000 species usually large pectoral fins; anteriorly placed, small pelvic fins; long D and anal fin bases (1 Dorsal if separate is often small.) Many tropical families but included here are the "Ice fishes" of Antarctic waters that have little or no hemoglobin, but have an antifreeze glycoprotein that keeps blood circulating.

Gobioidei - gobies 1500 - 2000 spp. Primarily in Gobiidae; several smaller families.

Loss of several cranial elements including parietals, infraorbitals, and lateralline canal system.

Scomberoidei - Tunas, mackerals, etc. Fast swimming, open water teleosts. United by fusion of upperjaw elements to cranium. Less than 100 spp. Including billfishes.

Anabantoidei - gouramis; FWF Africa and Asia. 70-80 spp. Best known for airbreathing ability, due to creation of suprabranchial chamber partially separate from branchial chamber.

Acanthuroids - coral reef associated fishes: 100 + spp; compressed bodied, small mouthed fishes, D fin continuous; mostly herbivorous; have peculiar larval form called acronurus.

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NOMENCLATURE

The need for names: 1) communication, early names were often cumbersome and as much a diagnosis as a form of communication; History of Scientific names: Pre-Linnaean names consisted of a Genus or 'name' followed by a series of descriptive terms that serve to qualify the name. Because of the difficulty in remembering all of these terms Linnaeus invented a shorthand name, consisting of only one descriptive term, that would be easier to remember. This wasn't intended to replace the formal name.

Binomial nomenclature however, quickly took over as only name with extensive multiterm name having been lost.

Two problems: use two different names for same species and use of same name for two different species.

International code of zoological nomenclature: Principle of priority: Species should be known by the first name given to it, any subsequently used names are invalid.

Providing that the name was binomial and first proposed after January 1, 1758 and follows minimal rules of format. Gave rise to continuing problem of discovery of older names that have been lost in the literature (especially in later 18th Cent and early 19th Cent names) but has resurfaced as a problem in fishes with the advent of the aquarium hobby and, with it, aquarium journals in which new names can be proposed but not seen by systematists.

Any animal given a name previously used for another species must be renamed.

Second set of problems arises from idea of linking relationships of organisms to names. Genus name serves two functions which sometimes conflict. Genus name is often used to emphasize distinctiveness of a species; other times it is used to join species into groups that are of generally similar appearance; yet other times the genealogical closeness is used. Each of these three approaches may result in providing a species with a different "correct" genus name.

Same trichotomy of uses occurs at higher levels, for example family, with same result.

Common or vernacular names - American fishery society acted in 1940's to standardize vernacular names for American freshwater and marine fishes. Currently an updated version of "A list of common and scientific names of fishes from the United States and Canada" is published with a vernacular name and the currently accepted scientific name.

The AFS has decided to expand the concept of standardized common names to include all species that have some commercial importance in the US. That includes food and aquarium fishes ...

NOMENCLATURE

Robins, C.R., R.M. Bailey, C.E. Bond, J.R. Brooker, E.A. Lachner, R.N. Lea, and W.B. Scott. 1980. A list of common and scientific names of fishes from the United States and Canada, Fourth Edition. American Fisheries Society, Special Publication No. 12., Bethesda, MD 174 pp.

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Fish and man -

Sport - Angling, spearfishing

Hobby - Aquarium keeping, photography, UW photo sightseeing

Food - 1987 catch in US estimated at 2.5 million metric tons, or 5.6 billion pounds. Valued at 1.6 billion dollars (landed).

Worldwide, 92.2 million metric tons of fish and shellfish taken in 1986.

Consumer expenditure for fishery products in 1987 = \$28.8 billion. Including: restaurant /carryout; retail; and products. Americans eat 15.4 pounds per person per year. Salmon most valuable fish in total sales, Pollock and menhaden were caught in larger quantities, but command a much lower price.

Personnel involved in fishery: 346 thousand in 1987.

Aquaculture: Only catfish as food fishes: trout cultured as recreational fish and various minnows in baitfish industry.
Catfish culture very new, 5 million pounds cultured in 1970 in 1987: 280 million.

Clothing - "Eel" Skin leather; Politics - Tellaco Dam, Westway,