**Supplemental Table 1: Diversity of CNSS organisation in fish, with special focus on urophysis.**

Common names were found in FishBase, teleost orders from FishBase and WoRMS (World Register of Marine Species). Valid latin names (according to WoRMS and FishBase) are indicated when different from the latin names used in the publications. The absence or special features of the urophysis are indicated when applicable. Dahlgren cells (DC) are present in all species of this Table. + = proven urophysis; 0 = absence of urophysis ; ? = uncertain urophysis. Species, which appear in bold colors, are the ones presented in Figure 3.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Common name** | **Latin name**  **in the study** | **Valid latin name** | **Order** | **Urophysis** | **References** |
| **Chondrichthyes holocephali** | | | | | |
| Spotted ratfish | *Hydrolagus colliei* |  | chimaeriforme | 0 | [29] |
| **Chondrichthyes elasmobranchii** | | | | | |
| Picked dogfish | *Squalus acanthias* |  | squaliforme | 0 | [37] |
| Pacific spiny dogfish | *Squalus scukleyi* |  | squaliforme | 0 | [29] |
| Starry ray | *Raia radiata* | *Amblyraja radiata* | rajiforme | 0 | [37] |
| Blue skate | *Raia batis* | *Dipturus batis* | rajiforme | 0 | [37] |
| Shovelnose guitarfish | *Rhinobatos productus* | *Pseudobatos productus* | rhinopristiforme | 0 | [29] |
| Cowtail stingray | *Trygon sephen* | *Pastinachus sephen* | myliobatiforme | 0 | [86] |
| Pelagic stingray | *Trygon violacea* | *Pteroplatytrygon violacea* | myliobatiforme | ?  DC terminations form a tissue resembling that of the urophysis in teleosts | [37, 287] |
| Common torpedo | *Torpedo ocellata* | *Torpedo torpedo* | torpediniforme | ?  signs of condensation of the neurohemal region | [37] |
| Thornback guitarfish | *Platyrhinoidis triseriata* |  | torpediniforme | 0 | [29] |
| Banded houndshark | *Triakis scyllia* | *Triakis scyllium* | carcharhiniforme | 0 | [8, 24] |
| **Actinopterygians polypteriformes** | | | | | |
| Senegal bichir  Gray bichir | *Polypterus senegalus* |  | polypteriforme | ?  further studies necessary to determine whether the neurohemal area is functionally equivalent to the urophysis | unpublished studies of Fridberg (cited in [33]), [168] |
| Reedfish | *Erpetoichthys calabaricus* |  | polypteriforme | ?  whether the expanded area along the ventral surface of the spinal cord is functionally analogous to the urophysis awaits more detailed study | [47] |
| **Actinopterygians chondrosteans** | | | | | |
| Danube sturgeon | *Acipenser güldenstädti* | *Acipenser gueldenstaedtii* | acipenseriforme | 0 | [438, 439] |
| Green sturgeon | *Acipenser medirostris* |  | acipenseriforme | 0 | [71, 440] |
| Shovelnose sturgeon | *Scaphirhynchus platyrhynchus* | *Scaphirhynchus platorynchus* | acipenseriforme | 0 | [29] |
| Mississippi paddlefish | *Polyodon spathula* |  | acipenseriforme | 0 | [47, 441] |
| **Actinopterygians holosteans** | | | | | |
| Longnose gar | *Lepidosteus osteus* | *Lepisosteus osseus* | lepisosteiforme | ?  not certain whether urophysis | [7, 29] |
| Bowfin | *Amia calva* |  | amiiforme | 0 | [29] |
| **Actinopterygians**  **teleosts** | | | | | |
| **Hawaiian ladyfish** | ***Elops hawaiensis*** |  | **elopiforme** | **+**  **poorly individualised** | **[29, 294]** |
| **Bonefish** | ***Albula vulpes*** |  | **albuliforme** | **+**  **poorly individualised** | **[29, 290]** |
| European eel | *Anguilla vulgaris* | *Anguilla anguilla* | anguilliforme | +  poorly individualised | [27] |
| Japanese eel | *Anguilla japonica* |  | anguilliforme | +  poorly individualised | [19, 273] |
| American eel | *Anguilla chrisypa* | *Anguilla rostrata* | anguilliforme | +  poorly individualised | [442] |
| Armless snake eel | *Ophichthys imberbis* | *Dalophis imberbis* | anguilliforme | +  poorly individualised | [27] |
| European conger | *Conger vulgaris* | *Conger conger* | anguilliforme | +  poorly individualised | [27] |
| Bandtooth conger | *Congromuraena balearica* | *Ariosoma balearicum* | anguilliforme | +  poorly individualised | [27] |
| **Whitespotted conger** | ***Astroconger myriaster*** | ***Conger myriaster*** | **anguilliforme** | **+**  **poorly individualised** | **[23]** |
| Kidako moray | *Gymnothorax kidako* |  | anguilliforme | +  poorly individualised | [71] |
| Liver-colored moray eel | *Gymnothorax hepaticus* |  | anguilliforme | +  poorly individualised | [71] |
| Mediterranean moray | *Muraena helena* |  | anguilliforme | +  poorly individualised | [27] |
| Clown knifefish | *Notopterus chitala* | *Chitala chitala* | osteoglossiforme | + | [86] |
| European pilchard | *Clupea pilchardus* | *Sardina pilchardus* | clupeiforme | + | [27] |
| Hilsa shad | *Hilsa ilisha* | *Tenualosa ilisha* | clupeiforme | + | [86] |
| Blueback shad | *Pomolobus aestivalis* | *Alosa aestivalis* | clupeiforme | + | [76] |
| Atlantic herring | *Clupea harengus* |  | clupeiforme | +  poorly individualised | [33] |
| River plate sprat | *Clupea melanostoma* | *Platanichthys platana* | clupeiforme | +  poorly individualised | [443] |
| **Japanese enchovy** | ***Engraulis japonicus*** |  | **clupeiforme** | **+** | **[22]** |
| **Japanese sardinella** | ***Harengula zunasi*** | ***Sardinella zunasi*** | **clupeiforme** | **+** | **[23]** |
| **Sardine** | ***Etrumeus micropus*** |  | **clupeiforme** | **+** | **[23]** |
| **Milkfish** | ***Chanos chanos*** |  | **gonorynchiforme** | **+** | **[29, 294]** |
| Eurasian minnow | *Phoxinus laevis* | *Phoxinus phoxinus* | cypriniforme | + | [27] |
| Chub | *Squalius cavedanus* | *Squalius cephalus* | cypriniforme | + | [27] |
| Italian riffle dace | *Telestes muticellus* |  | cypriniforme | + | [27] |
| **Goldfish** | ***Carassius auratus*** |  | **cypriniforme** | **+** | **[21, 73]** |
| Oriental loach | *Misgurnus anguillicaudatus* |  | cypriniforme | + | [21] |
| Zebrafish | *Danio rerio* |  | cypriniforme | + | [36] |
| **Common roach** | ***Leuciscus rutilus*** | ***Rutilus rutilus*** | **cypriniforme** | **+** | **[33, 272, 285], Fridberg thesis cited in [30]** |
| Tench | *Tinca vulgaris* | *Tinca tinca* | cypriniforme | + | [281, 444, 445] |
| Common carp | *Cyprinus carpio* |  | cypriniforme | + | [446, 447] |
| Hamilton’s barila | *Barilius bendelisis* | *Opsarius bendelisis* | cypriniforme | 0 | [70] |
| Sucker head | *Garra gotyla* |  | cypriniforme | 0 | [70] |
| Hill trout | *Schizothorax plagiostomus* |  | cypriniforme | 0 | [70] |
| Tor barb | *Tor tor* |  | cypriniforme | 0 | [70] |
| Mrigal carp | *Cirrhina mrigala*  *Cirrhinus mrigala* | *Cirrhinus mrigala* | cypriniforme | + | [86, 448] |
| Rohu | *Labeo rohita* |  | cypriniforme | + | [86, 448] |
| Orangefin labeo | *Labeo kalbasu* | *Labeo calbasu* | cypriniforme | + | [86] |
| Ticto barb | *Puntius ticto* | *Pethia ticto* | cypriniforme | + | [448] |
| Coito | *Rohtee cotio* | *Osteobrama cotio* | cypriniforme | + | [448] |
| Catla | *Catla catla* | *Labeo catla* | cypriniforme | + | [86] |
| Amur catfish | *Parasilurus asotus* | *Silurus asotus* | siluriforme | + | [21] |
| Stinging catfish | *Heteropneustes fossilis* |  | siluriforme | + | [86] |
| Striped dwarf catfish | *Macrones vittatus* | *Mystus vittatus* | siluriforme | + | [86] |
| Wallago | *Wallago attu* |  | siluriforme | **+** | [86] |
| Walking catfish | *Clarias batrachus* |  | siluriforme | **+** | [86, 276, 284] |
| **Channel catfish** | ***Ictalurus punctatus*** |  | **siluriforme** | **+** | **[179]** |
| **Butter catfish** | ***Ompok bimaculatus*** |  | **siluriforme** | **+** | **[366, 449]** |
| **Striped eel catfish** | ***Plotosus anguillaris*** | ***Plotosus lineatus*** | **siluriforme** | **+** | **[22]** |
| Northern pike | *Esox lucius* |  | esociforme | +  poorly individualised | [27, 33, 37] |
| **Brown trout** | ***Trutta fario, Salmo trutta*** | ***Salmo trutta*** | **salmoniforme** | **+**  **poorly individualised** | **[27, 29]** |
| **Rainbow trout** | ***Oncorhynchus mykiss*** |  | **salmoniforme** | +  **individualised** | **[72]** |
| Chum/keta salmon | *Oncorhynchus keta* |  | salmoniforme | + | [277, 279] |
| **Sockeye salmon** | ***Oncorhynchus nerka*** |  | **salmoniforme** | **+**  **poorly individualised** | **[294]** |
| Atlantic salmon | *Salmo salar* |  | salmoniforme | + | [450] |
| Brook trout | *Salvelinus fontinalis* |  | salmoniforme | +  poorly individualised | [298] |
| Whitespotted charr  Japanese charr | *Salvelinus leucomaenis* |  | salmoniforme | +  poorly individualised | [274, 330] |
| **Boa dragonfish** | ***Stomias boa*** |  | **stomiatiforme** | **+**  **dorsal** | **[27, 69]** |
| Scaleless dragonfish | *Bathophilus nigerrimus* |  | stomiatiforme | + | [27] |
| Veiled anglemouth | *Cyclotone microdon* | *Cyclothone microdon* | stomiatiforme | + | [27] |
| **Sloane's viperfish** | ***Chauliodus sloani*** |  | **stomiatiforme** | **+** | **[27]** |
| Half-naked hatchetfish | *Argyropelecus hemigymnus* |  | stomiatiforme | + | [27] |
| Lightfish | *Coccia ovata* | *Ichthyococcus ovatus* | stomiatiforme | + | [27] |
| Silvery lightfish | *Maurolicus pennanti* | *Maurolicus muelleri* | stomiatiforme | + | [27] |
| Slender lightfish | *Vinciguerria attenuata* |  | stomiatiforme | + | [27] |
| Bristlemouth | *Gonostoma denudatum* |  | stomiatiforme | + | [27] |
| Atlantic lizardfish | *Saurus griseus* | *Synodus saurus* | aulopiforme | + | [27] |
| Yellowfin flagfin | *Aulopus filamentosus* |  | aulopiforme | + | [27] |
| Balbo sabretooth | *Odontostomus hyalinus* | *Evermannella balbo* | aulopiforme | + | [27] |
| Barracudina | *Paralepis hyalina* | *Sudis hyalina* | aulopiforme | + | [27] |
| Shortnose greeneye | *Chlorophthalmus agassizi* |  | aulopiforme | + | [27] |
| **Greater lizardfish** | ***Saurida argyrophanes*** | ***Saurida tumbil*** | **aulopiforme** | **+** | **[23]** |
| Variegated lizardfish | *Synodus variegatus* |  | aulopiforme | + | [29] |
| Benoit’s lanternfish | *Scopelus benoiti* | *Hygophum benoiti* | myctophiforme | + | [27] |
| Mirror dory | *Zenopsis nebulosa* |  | zeiforme | + | [270] |
| Poor cod | *Gadus minutus* | *Trisopterus minutus* | gadiforme | + | [27] |
| Greater forkbeard | *Phycis blennoides* |  | gadiforme | + | [27] |
| Atlantic cod | *Gadus callarias* | *Gadus morhua* | gadiforme | + | [33] |
| Cardinal fish | *Apogon imberbis* |  | gadiforme | + | [27] |
| **Indian perch** | ***Apogon lineatus*** | ***Jaydia lineata*** | **kurtiforme** | **+** | **[22]** |
| Half-line cardinal | *Apogon semilineatus* | *Ostorhinchus semilineatus* | kurtiforme | + | [22] |
| Bandfin cardinalfish | *Apogon menesemus* | *Pristiapogon taeniopterus* | kurtiforme | + | [294] |
| Sand goby | *Gobius minutus* | *Pomatoschistus minutus* | gobiiforme | + | [27] |
| **Longjaw mudsucker** | ***Gillichthys mirabilis*** |  | **gobiiforme** | **+** | **[292]** |
| Yellowfin tuna | *Neothunnus albocora* | *Thunnus albacares* | scombriforme | +  multiple | [71, 270] |
| Atlantic bluefin tuna | *Orcynus thynnus*  *Thunnus thynnus* | *Thunnus thynnus* | scombriforme | +  multiple | [27, 71, 270] |
| Bigeye tuna | *Parathunnus obesus* | *Thunnus obesus* | scombriforme | +  multiple | [71, 270] |
| Largehead hairtail | *Trichiurus lepturus* |  | scombriforme | highly developed | [71] |
| **Pacific rudderfish** | ***Psenopsis anomala*** |  | **scombriforme** | **+** | **[23]** |
| Straightnose pipefish | *Nerophis ophidion* |  | syngnathiforme | 0 | [33] |
| Broadnosed pipefish | *Siphostoma typhle* | *Syngnathus typhle* | syngnathiforme | 0 | [33] |
| Thorntail pipefish | *Syngnathus brevirostris* | *Micrognathus brevirostris* | syngnathiforme | 0 \* | [27] |
| Seaweed pipefish | *Syngnathus schlegeli* |  | syngnathiforme | 0 | [71] |
| Long-snouted seahorse | *Hippocampus guttulatus* |  | syngnathiforme | 0 \* | [27] |
| Japanese seahorse | *Hippocampus japonicus* | *Hippocampus mohnikei* | syngnathiforme | 0 | [71] |
| Climbing perch | *Anabas testudineus* |  | anabantiforme | + | [86] |
| Spotted snakehead | *Ophiocephalus punctatus* | *Channa punctata* | anabantiforme | + | [86] |
| Striped snakehead | *Ophiocephalus striatus* | *Channa striata* | anabantiforme | + | [86] |
| Northern snakehead | *Channa argus* |  | anabantiforme | + | [447] |
| Banded gourami | *Colisa fasciata* | *Trichogaster fasciata* | anabantiforme | **+** | [451] |
| Swordfish | *Xiphias gladius* |  | carangiforme | + | [27] |
| **Japanese jack mackerel** | ***Trachurus japonicus*** |  | **carangiforme** | **+** | **[23]** |
| **Whitefin trevally** | ***Caranx equula*** | ***Carangoides equula*** | **carangiforme** | **+** | **[23]** |
| **White trevally** | ***Caranx delicatissimus*** | ***Pseudocaranx dentex*** | **carangiforme** | **+** | **[23]** |
| Golden trevally | *Gnathanodon speciosus* |  | carangiforme | + | [294] |
| Common sole | *Solea vulgaris* | *Solea solea* | pleuronectiforme | + | [27] |
| **Ridged-eye flounder** | ***Pleuronichthys cornutus*** |  | **pleuronectiforme** | **+** | **[23]** |
| **European flounder** | ***Pleuronectes flesus*** | ***Platichthys flesus*** | **pleuronectiforme** | **+** | **[33]** |
| **Flathead grey mullet** | ***Mugil cephalus*** |  | **mugiliforme** | **+** | **[23, 27, 29]** |
| Combtooth Mediterranean blenny | *Blennius trigloides* | *Lipophrys trigloides* | blenniforme | + | [27] |
| **Nile tilapia** | ***Oreochromis niloticus*** |  | **cichliforme** | **+** | **[66]** |
| Mozambique tilapia | *Tilapia mossambica* | *Oreochromis mossambicus* | cichliforme | + | [29, 283] |
| Garfish | *Belone acus* | *Belone belone* | beloniforme | + | [27] |
| Medaka | *Oryzias latipes* |  | beloniforme | +  stalk | [21, 286] |
| **Pacific saury** | ***Cololabis saira*** |  | **beloniforme** | **+** | **[23]** |
| **Japanese flyingfish** | ***Cypsilurus agoo*** | ***Cheilopogon agoo*** | **beloniforme** | **+** | **[23]** |
| Big-scale sand smelt | *Atherina boyeri* |  | atheriniforme | + | [27] |
| **Sumatran silverside** | ***Atherina bleekeri*** | ***Hypoatherina valenciennei*** | **atheriniforme** | **+** | **[23]** |
| Mediterranean banded killifish | *Cyprinodon calaritanus* | *Aphanius fasciatus* | cyprinodontiforme | + | [27] |
| Mummichog | *Fundulus heteroclitus* |  | cyprinodontiforme | + | [442, 452] |
| **Guppy** | ***Lebistes reticulatus*** | ***Poecilia reticulata*** | **cyprinodontiforme** | **+**  **stalk** | **[33, 269]** |
| Molly | *Poecilia sphenops*  *Mollienisia sphenops* | *Poecilia sphenops* | cyprinodontiforme | +  stalk | [303, 304] |
| Eye spot toothcarp | *Poecilia vivipara* |  | cyprinodontiforme | + | [317] |
| Onesided livebearer | *Jenynsia lineata* |  | cyprinodontiforme | + | [453] |
| Small sandeel | *Ammodytes tobianus* |  | perciforme | + | [27] |
| Three-spined stickleback | *Gasterosteus aculeatus* |  | perciforme | + | [27] |
| Black scorpionfish | *Scorpaena porcus* |  | perciforme | + | [27] |
| **Chub mackerel** | ***Scomber japonicus*** |  | **perciforme** | **+** | **[23]** |
| Sublet | *Coricus rostratus* | *Symphodus rostratus* | perciforme | + | [86] |
| Barramundi | *Lates calcarifer* |  | perciforme | + | [86] |
| **European perch** | ***Perca fluviatilis*** |  | **perciforme** | **+** | **[33]** |
| **Largescale blackfish** | ***Girella punctata*** |  | **perciforme** | **+** | **[22]** |
| **Chicken grunt** | ***Parapristipoma trilineatum*** |  | **perciforme** | **+** | **[22]** |
| Pearl-spot chromis | *Chromis notatus* | *Chromis notata* | perciforme | + | [22] |
| **Spottedtail morwong** | ***Goniistius zonatus*** | ***Cheilodactylus zonatus*** | **perciforme** | **+** | **[22]** |
| **Sea chub** | ***Ditrema temmincki*** |  | **perciforme** | **+** | **[22]** |
| **Sunrise** | ***Pseudoblennius percoides*** |  | **perciforme** | **+** | **[22]** |
| Hawaiian flagtail | *Kuhlia sandvicensis* |  | perciforme | + | [294] |
| **Threadfin butterflyfish** | ***Chaetodon auriga*** |  | **perciforme** | **+** | **[29]** |
| **Gnomefish** | ***Scombrops boops*** |  | **perciforme** | **+** | **[23]** |
| **Mottled spinefoot** | ***Siganus fuscescens*** |  | **perciforme** | **+** | **[23]** |
| Tidepool gunnel | *Enedrias nebulosus* | *Pholis nebulosa* | perciforme | + | [23] |
| European sea bass | *Dicentrarchus labrax* |  | perciforme | + | [300] |
| **Luna lionfish** | ***Pterois lunulata*** |  | **perciforme** | **+** | **[22]** |
| **Dark banded rockfish** | ***Sebastes inermis*** |  | **perciforme** | **+** | **[22]** |
| Midget flathead | *Wakiyus spinosus* | *Onigocia spinosa* | perciforme | + | [23] |
| **Bluefin gurnard** | ***Chelidonichthys kumu*** |  | **perciforme** | **+** | **[23]** |
| Shorthorm sculpin | *Cottus scorpius* | *Myoxocephalus scorpius* | perciforme | + | [33] |
| **Red barracuda** | ***Sphyraena pinguis*** |  | **perciforme** | **+** | **[23]** |
| **Spectacled parrotfish** | ***Scarus perspicillatus*** | ***Chlorurus perspicillatus*** | **labriforme** | **+**  **stalk** | **[29]** |
| **Spotted knifejaw** | ***Oplegnathus punctatus*** |  | **centrarchiforme** | **+** | **[23]** |
| **Orangespine unicornfish** | ***Naso lituratus*** |  | **acanthuriforme** | **+** | **[29]** |
| **Sixplate sawtail** | ***Prinosurus microlepidotus*** | ***Prionurus microlepidotus*** | **acanthuriforme** | **+** | **[23]** |
| **Spotnape ponyfish** | ***Leiognathus nuchalis*** | ***Nuchequula nuchalis*** | **acanthuriforme** | **+** | **[23]** |
| **Common pandora** | ***Pagellus erythrinus*** |  | **spariforme** | **+** | **[27]** |
| Angler | *Lophius piscatorius* |  | lophiiforme | +  stalk | [27] |
| Painted frogfish | *Antennarius chironectes* | *Antennarius pictus* | lophiiforme | +  stalk | [29] |
| Humpback puffer | *Tetraodon palembangensis* | *Pao palembangensis* | tetraodontiforme | +  multiple | [289] |
| Green pufferfish | *Tetraodon fluviatilis* | *Dichotomyctere fluviatilis* | tetraodontiforme | +  multiple | [289] |
| Honeycomb filefish | *Amanses pardalis* | *Cantherhines pardalis* | tetraodontiforme | + | [29] |
| **Whitespotted filefish** | ***Amanses carolae*** | ***Cantherhines dumerilii*** | **tetraodontiforme** | **+**  **multiple** | **[29]** |
| **Fantail filefish** | ***Pervagor spilosoma*** |  | **tetraodontiforme** | **+** | **[29]** |
| Brown-lined puffer | *Canthigaster rivulatus* | *Canthigaster rivulata* | tetraodontiforme | +  multiple | [270] |
| **Threadsail filefish** | ***Stephanolepis cirrhifer*** |  | **tetraodontiforme** | **+**  **stalk** | **[22]** |
| Whitespotted boxfish | *Ostracion lentiginosus* | *Ostracion meleagris* | tetraodontiforme | +  stalk | [24] |
| **Grass puffer** | ***Fugu niphobles*** | ***Takifugu niphobles*** | **tetraodontiforme** | **+**  **stalk** | **[23]** |
| **Whitespotted pygmy filefish** | ***Rudarius ercodes*** |  | **tetraodontiforme** | **+** | **[23]** |
| Grey triggerfish | *Balistes capriscus* |  | tetraodontiforme | + | [27] |
| Ocean sunfish | *Mola mola* |  | tetraodontiforme | 0 | [71] |
| Slender sunfish | *Ranzania laevis* |  | tetraodontiforme | 0 | [71] |

\* [27] classified the two syngnathiformes *Syngnathus brevirostris* and *Hippocampus guttulatus* as ‘teleostei ad ipofisi caudale non differenziata’, but [33] and [71] proved that four other syngnathiforme species lack an urophysis. We thus assume that urophysis is absent in the syngnathiforme order.