

Records in the fish world

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Shortest lived fish (and vertebrate): The pigmy goby *Eviota sigillata*
59 days after hatching.

These tiny (18 mm long) fish live on the Great Barrier Reef and other reefs in the Pacific and Indian oceans. They spend the first three weeks of their life as larvae in the open ocean and then they settle on the reef. They mature within two more weeks. In the next three and half weeks, the female can produce up to three clutches of eggs (about 400 eggs in total). The male stands guard over these eggs and fans them. Once the eggs hatch, adults disappear, never to be seen again. The pigmy goby's fast and furious lifestyle may be an adaptation to high predation rates which decrease an adult's chance of living for a long time anyway. Indeed, the reason why no pigmy goby over 59 days of age (as determined by daily growth rings in the otoliths, or ear stones) has ever been found is probably that they are systematically picked off by predators.

Runner-up: The turquoise killifish *Nothobranchius furzeri*, an extremely rare fish that lives in temporary pools in Africa, has a maximum lifespan of 84 days post-hatching, even in a lab without predators. Most of the fish's lifecycle is spent as eggs that are encased in mud for 5-7 months. They hatch only during seasonal rains. Pools exist only for several months, which explains the brevity of the post-hatching life.

Source: Guinness Book of Records; Depczynski, M., and Bellwood, D.R., 2005, Shortest recorded vertebrate lifespan found in a coral reef fish, *Current Biology* 15, R288-R289; Valdesalici, S. and Cellerino, A., 2003, Extremely short lifespan in the annual fish *Nothobranchius furzeri*, *Proceedings of the Royal Society of London B* 270 (Suppl. 2), S189-S191. See also *Nature* 528: 175.

Longest lived fish (and vertebrate): Greenland shark *Somniosus microcephalus*
At least 272 years

The Greenland shark is slow-growing, yet it can reach lengths of 5 m or more, which suggests a great lifespan. Radiocarbon dating of eye lens nuclei in 28 females has revealed a life span of at least 272 years (and maybe up to 500 years) in the largest ones among them.

Another technique for aging a fish, applicable to bony fishes but not to cartilaginous ones like sharks, consists of taking the fish's otoliths (ear stones) and counting their yearly growth rings, as in trees. This technique crowns the rougheye rockfish, *Sebastes aleutianus*, as the Methuselah of the bony fishes, at 140 years of age. Other long-lived scorpaenid rockfishes are *S. borealis* (120 years) and *S. alutus* (90 years). All these species live in the cold waters of the northeastern Pacific. Greenland sharks are also cold water denizens (the Arctic).

Other notables: Several sturgeon species include centenarians (i.e., the beluga *Huso huso*, the white sturgeon *Acipenser transmontanus*, and *Acipenser sturio*). The Guinness Book of Records also mentions a female European eel (*Anguilla anguilla*) named Putte which was 88 years old when she died at Hälsingborg Museum in Sweden in 1943.

Source: Nielsen, J, et al., 2016, Eye lens radiocarbon reveals centuries of longevity in the Greenland shark (*Somniosus microcephalus*), *Science* 353: 702-704; Helfman, G.S., Collette, B.B., and Facey, D.E., 1997, *The diversity of fishes*, Blackwell Science, Malden.

Smallest fish:

Paedocypris progenetica, female 7.9 mm long
Photocorynus spiniceps, parasitic male 6.2 mm long
Schindleria brevipinguis, less than 2 mg live weight

You seldom hear fishermen arguing about who's got the smallest fish. Good thing, because this category could indeed lead to prolonged (but hopefully good-natured) exchanges. It is not clear which species should win the title of smallest fish, and it probably depends on what you mean by "smallest".

Paedocypris progenetica was described for the first time in a 2006 publication. A relative of the carp, it lives in slow-moving, acidic waters in the peat swamp forests of Sumatra. The maximum length is 10.3 mm (0.4 inch) and females can reach maturity at 7.9 mm (0.3 in). Many bones are absent from the skull and jaws, and the female can carry only a few eggs. Peat swamps often harbour miniature fish species. Small size may be an adaptation to survive in shallow pools, in burrows, or even in moist peat when water levels fall.

Deepsea anglerfishes of the suborder Ceratioidei (often called "seadevils") are characterized by an extreme sexual dimorphism. The males are tiny and they attach themselves to the body of the much larger females (perhaps a reflection of how hard it is to find a mate in these widely scattered, deep sea fishes; once you find one, you hang on to it). In some species the circulatory systems of the male and female fuses so that the male becomes dependent on the female for nutrition. Such a male can be said to be parasitic on the female. He is kept

around solely for his eventual contribution to reproduction. Essentially, he is little more than a living gonad (indeed, his gonads can make up half of his body). In the species *Photocorynus spiniceps*, a 6.2 mm-long (0.24 inch) mature male has been found attached to a 46 mm (1.8 inch) female. Can a species claim the title of smallest fish if only half of its members qualify?

The stout infantfish *Schindleria brevipinguis* is a relative of gobies and so far it has been found only in the Great Barrier Reef of Australia. Females and males reach sexual maturity by 7-8 mm (0.27-0.31 inch) and 6.5-7 mm (0.25-0.27 inch) respectively. The largest specimen ever collected was 8.4 mm long (0.33 inch). Adults are paedomorphic – that is, they resemble juveniles, hence the name infantfish. They lack features such as teeth, scales, pigment and pelvic fins. Because this species is more slender than the two candidates above, it is probably lighter. A formalin-preserved specimen weighed only 0.7 mg; I am aware of no measurements on live specimens, but based on measurements on other similar-looking species, a live stout infantfish probably would not exceed 2 mg (that's 0.00007 ounce).

At least three species vie for the title of smallest shark. There is the male Spined Pigmy Shark *Squaliolus laticaudus*, which can mature when about 15 cm (6 inches) long and whose maximum recorded length is 22 cm (8.7 inch). The Cylindrical Lanternshark *Etmopterus carteri* and the Dwarf Lanternshark *Etmopterus perryi* mature between 15-20 cm, giving birth to live young, and they get no longer than about 21 cm.

Source: Kottelat, M., Britz, R., Hui, T.H., and Witte, K.-E., 2006, *Paedocypris*, a new genus of Southeast Asian cyprinid fish with a remarkable sexual dimorphism, comprises the world's smallest vertebrate, Proceedings of the Royal Society of London B 273, 895-899; Pietsch, T.W., 2005, Dimorphism, parasitism, and sex revisited: modes of reproduction among deep-sea ceratioid anglerfishes (Teleostei: Lophiiformes), Ichthyological Research 52, 207-236; Watson, W., and Walker, H.J. Jr., 2004, The world's smallest vertebrate, *Schindleria brevipinguis*, a new paedomorphic species in the family Schindleriidae (Perciformes: Gobioidae), Records of the Australian Museum 56, 139-142; Compagno, L., Dando, M., and Fowler, S., 2005, Sharks of the World (Princeton Field Guides series), Princeton University Press, Princeton.

Largest fish: Whale shark *Rhincodon typus*
Up to about 34,000 kg, 20 m long (about 75,000 pounds, 65 feet long)

This huge shark feeds mostly on plankton and small fishes. It is harmless to humans. A length of 20 m is exceptional; specimens are rarely longer than 12 m (which is still impressive).

In 2006, researchers present at the International Whale Shark Conference in Perth, Australia, reported that the largest whale sharks are getting scarce. Based on log books filled out by ecotourism operators at Ningaloo Reef, Western Australia, the average length of whale sharks has declined from just over 7 m in 1995 to 5.5 m in 2006. Over-fishing in unprotected waters and collisions with sea vessels may have been killing the oldest and largest members of the population.

The largest fish species in the world are all cartilaginous (their skeleton is made up of cartilage rather than bone): gold medal to the whale shark, silver to the basking shark, bronze to the great white shark. The also-rans are also cartilaginous: the Greenland shark, the manta ray, the sawfish, the six-gill shark, and the tiger shark. See the next entry for more on cartilage and body size.

Source: Fish Base www.fishbase.org ; Rohner, C.A., Richardson, A.J., Marshall, A.D., Weeks, S.J., and Pierce, S.J., 2011, How large is the world's largest fish? Measuring whale sharks, *Rhyncodon typus*, with laser photogrammetry, *Journal of Fish Biology* 78: 378-385.

Largest bony (teleost) fish: Ocean Sunfish *Mola mola*
2,300 kg, 3.3 m long (about 5,060 pounds, 10 feet long)

Molas have a funny shape. They are rectangular in side view and lack a true tail. Their pseudo-tail is made up of dorsal and anal fin rays. They attain their big size on a steady diet of jellyfish.

Interestingly, for a “bony” (teleost) fish the ocean sunfish has a rather large number of cartilaginous elements in its skeleton. The second largest “bony” fish, the great (or beluga) sturgeon *Huso huso* (up to 2000 kg, 5 m long) also has a skeleton made mostly of cartilage.

The thing with bone is that it is denser than water and makes a fish sink. Because of geometrical considerations, as body size increases, the weight of bones increases more quickly than the lift generated by the fish's fins and body. Above a certain size, sinking cannot be efficiently prevented.

Cartilage too is denser than water, but not as much as bone. Having a skeleton made up of cartilage rather than bone means you can grow to a larger size before you reach the point at which sinking cannot effectively be counteracted by lift.

The largest fishes with skeletons entirely made up of bones are the marlins. Many species are of similar size. The blue marlin *Makaira nigricans* can be used as an example. Its maximum dimensions are 5 m in length (16.5 feet) and 820 kg in weight (1808 pounds).

How can whales prevent sinking despite their huge entirely-bony skeletons, you will ask? Whales are mammals; they have air-filled lungs which act as floatation devices.

Source: Fish Base www.fishbase.org ; Summers, A., March 2007, No bones about 'em, Natural History 116(2): 36-37.

- Largest freshwater fish:** Many candidates, depending on whether you go for length or weight or a combination of both. Sturgeons that move between freshwater and saltwater are not included in the following list, but it is good to know that the beluga sturgeon *Huso huso* can weigh up to 2000 kg (4,400 pounds) and reach 5 m (16.5 feet) in length.
- The Wels catfish *Siluris glanis*
300 kg, 5 m long (660 pounds, 16.5 feet) in the 1800s
225 kg, 3 m long (500 pounds, 10 feet) contemporary
- The [Mekong giant catfish](#) *Pangasianodon gigas*
300 kg, 3 m long (660 pounds, 10 feet)
- The [Chinese swordfish \(paddlefish\)](#) *Psephurus gladius*
300 kg, 3 m long (660 pounds, 10 feet)
- The giant pangasius *Pangasius sanitwongsei*
300 kg, 3 m long (660 pounds, 10 feet)
- The [giant barb \(Siamese carp\)](#) *Catlocarpio siamensis*
300 kg, 3 m long (660 pounds, 10 feet)
- The [freshwater whiplay](#) *Himantura chaophraya*
600 kg, 2.4 m wide (1320 pounds, 9 feet wide)
[5 m long with the whiptail \(16.5 feet\)](#)
- The [arapaima](#) (pirarucu), *Arapaima gigas*
225 kg, 3.3 m long (500 pounds, 11 feet)
- The kumakuma (piraiba) *Brachyplatystoma filamentosum*
200 kg, 3.6 m long (440 pounds, 12 feet)
- The Nile perch *Lates niloticus*
200 kg, 1.9 m (440 pounds, 6.3 feet)

The Wels catfish is a European predator; it feeds on other fishes, crayfish and even on ducks (a reversal of the normal food chain order). The giant pangasius will not say no to the carcass of a dog, and this item is sometimes used as bait by fishers. Monkey parts have been found in the stomach of kumakuma, a South American catfish. Not all giants are predatory, however; the Mekong giant catfish, for example, is herbivorous.

The arapaima lives in the Amazon River basin. Like a few other fishes (see the page on oxygen), this fish is an obligatory air breather. It must take gulps of air at the surface to obtain enough oxygen to survive. Surprisingly for a fish, it will drown if it cannot reach the surface. The noise it makes when taking gulps can be heard over fairly long distances. All this makes it fairly easy to find and harpoon, and large individuals are becoming rare. The Mekong giant catfish is also becoming rare, also because of overfishing. And the Chinese paddlefish is actually thought to be extinct, with the last specimen seen in 2003.

Source: Fish Base www.fishbase.org ; Stone, R., June 2007, The last of the leviathans, Science 316, 1684-1688; Ellis, R., 2009, Big Fish, Abrams, New York; Wade, J., 2011, River Monsters: True Stories of the Ones that didn't Get Away, Da Capo Press, Cambridge MA.

Longest bony (teleost) fish: Oarfish (King of herrings), *Regalecus glesne*
11 m long (36 feet)

The oarfish (aka King of herrings) has a ribbon-like body that has been reliably documented to grow to 11 m in length. It has no tail but a dorsal fin runs the whole length of the body. It lives at great depths in the Pacific, Atlantic, and Indian Oceans. The species used to be known only from dead specimens cast up on beaches, but a live one was filmed for the first time in 2008 (see http://news.bbc.co.uk/earth/hi/earth_news/newsid_8501000/8501251.stm). Despite being toothless, it feeds on other fishes and on squid, presumably catching them by sucking them in. Oarfishes may be behind some “sea-monsters” sightings. The name “oarfish” comes from the two very long pelvic fins.

Source: Fish Base www.fishbase.org

Largest carnivorous fish: Great white shark *Carcharodon carcharias*
Up to 3,400 kg, 7.2 m (7,500 pounds, 23.6 feet)

Greenland shark *Somniosus microcephalus*
Up to 775 kg, 7.3 m (1,710 pounds, 24 feet)

Most people would object to the Greenland shark being included here. It is little known and rather sluggish, not your typical image of a fierce predator. But they do feed on other fishes, and they get a bit longer than great whites, so...

Source: Guinness Book of Records; Fish Base www.fishbase.org

Most fecund vertebrate (not just fish): Ocean sunfish *Mola mola*
Up to 30 million eggs, each 2 mm in diameter, at a single spawning

It is not surprising that the largest “bony” fish should also be the most fecund, as adult size and egg number are positively correlated across and within species.

The largest cartilaginous fish, the whale shark, is no slouch itself: only one pregnant female has ever been dissected and she had a litter of 301 pups inside of her (like many sharks, the whale shark is ovoviviparous: eggs hatch and young develop inside the mother).

Source: Guinness Book of Records.

Fastest fish: The sailfin *Istiophorus platypterus*
109 km/h (68 mph)

Like its cousins the marlins, this oceanic fish pursues other fast swimmers such as mackerels. Its record swimming speed comes from one fish hooked by a sport fisherman that took out 300 feet of line in 3 seconds. For comparison, the fastest land vertebrate, the cheetah, runs at 60 mph tops.

The shortfin mako *Isurus oxyrinchus* is presumed to be the fastest swimming shark, with a burst speed of about 74 km/h (46 mph). It can jump up to 6 m (20 ft) in the air.

Source: Guinness Book of Records (sailfin), Wikipedia (shortfin mako).

Deepest-living fish: The cusk-eel *Abyssobrotula galathea*
8,370 m (27,455 feet)

A 20 cm long *Abyssobrotula galathea* (family Ophidiidae) has been collected from the Puerto Rico Trench at a depth of 8,370 m. It didn't survive the trip to the surface.

The deepest fish captured and brought back live was *Pachycara saldanhai*, a member of the eelpout family. The depth was 2,300 m (7,550 feet).

Source : <http://www.extremescience.com/DeepestFish.htm> (cusk-eel)
<http://news.bbc.co.uk/2/hi/science/nature/7525552.stm> (eelpout)

Most venomous fish: The estuarine stonefish *Synanceia horrida*

“Most venomous” is hard to define. But the Guinness Book of Records states that this stonefish, which inhabits coastal reefs and estuaries from India to Australia, has the largest venom glands of any known fish. The venom is delivered through the spines of the dorsal fin, which can pierce human skin. A single prick can be fatal. At the very least, the pain caused by the venom is said to be excruciating.

It is estimated that at least 200 fish species are venomous (among them: lionfishes, catfishes, scorpionfishes, weeverfishes, toadfishes, surgeonfishes, rabbitfishes, stargazers, pufferfishes, stingrays, some sharks even, and stonefishes of course). A paper published in 2006 argued that this number should be bumped up to 1,200, based on an analysis of genomes and evolutionary trees. This is quite an extraordinary number, but it must be put in context: there are over 24,000 species of fishes in the world.

Venom seems to fulfill a defensive role in fishes. But there is one family that probably uses venom to kill prey. Onejaws (family Monognathidae) are deep-sea eels without an upper jaw but with a distensible lower jaw. A bone on the roof of the mouth is modified to form a fang which is connected to a gland that presumably makes venom. These fish catch large shrimps. The monognathids' body shape and use of venom to kill large prey (relative to their own body size – these fish are no more than 160 cm long) are reminiscent of snakes.

A related category could be “most poisonous fish to eat” (“venomous” means the poison is injected through a spine or a fang; “poisonous” means the poison is in the flesh and so it takes effect only when the fish is eaten). Some pufferfishes (family Tetraodontidae) contain the powerful poison tetrodotoxin in their ovaries, liver, intestines, and skin. In Japan, pufferfish (minus the offensive organs) is served as “fugu”. Eating fugu is flirting with death: if the cook makes a mistake in the dissection and preparation, you can become severely ill and even die from tetrodotoxin poisoning.

Source: Guinness Book of Records; Smith, W.L., and Wheeler, W.C., 2006, Venom evolution widespread in fishes: a phylogenetic road map for the bioprospecting of piscine venoms, *Journal of Heredity* 97, 206-217.

Longest parental care in fish: The Magellan plunder fish *Harpagifer bispinis*
4-5 months

This fish is found in shallow rubble coves along the Antarctic Peninsula. The female prepares a nest site by cleaning a patch of ground. After her eggs are laid and fertilized, she remains on the nest, cleaning the eggs and chasing predators until hatching occurs 4 to 5 months later. This is the longest brooding period reported for any fish. But it can be longer if you include live-bearing. Spiny dogfish (*Squalus acanthias*) and basking sharks can carry young inside of them for two years or maybe more. The coelacanth is thought to have a 3-year gestation period.

Source: Daniels, R.A., 1979, Nest guard replacement in the Antarctic fish *Harpager bispinis*: possible altruistic behavior, *Science* 205, 831-833.
Helfman, G. and Collette, B., 2011, *Fishes: The Animal Answer Guide*, John Hopkins University Press, Baltimore.

Best shot: The archerfishes *Toxotes* spp.

The archerfishes are found in the tropical mangrove swamps of India and Australasia. They take aim at insects that sit on plants above the surface, squirt a jet of water at them, and grab them after the bugs have been knocked off into the water. The jet of water is formed by the action of the tongue, which presses against a groove in the roof of the mouth. Some archerfish can score a direct hit up to 1.5 m (5 feet) above the water surface (though not necessarily on the first try). When aiming at larger prey, they use more water (it gives more force to the impact). They can even learn to shoot at moving targets, either through practice or by observing an experienced individual in action. Archerfish can be kept in aquaria, and they are not beyond shooting jets of water at the eyes of people who blink at them.

Source: Schlegel, T., Schmid, C.J., and Schuster, S., 2006, Archerfish shots are evolutionarily matched to prey adhesion, *Current Biology* 16, R836-R837; Schuster, S., Wöhl, S., Griebisch, M., and Klostermeier, I., 2006, Animal cognition: how archer fish learn to down rapidly moving targets, *Current Biology* 16, 378-383; Dill, L.M., 1977, Refraction and the spitting behavior of the archerfish (*Toxotes chatareus*), *Behavioral Ecology and Sociobiology* 2, 169-184.

Largest shoal: Millions and millions of fish!

A 2006 report in the journal *Science* (3 February 2006, Volume 311, pages 660-663) shows images of huge shoals taken with a remote sensing technique near the edge of the continental shelf off the east coast of North America. The shoals – most likely made up of Atlantic herring, scup, hake, and black sea bass – were said to contain “tens of millions” of fish and stretched for “many kilometers”. Changes in shoal shape could be followed throughout the day with this new technique.

Most abundant vertebrate (not just fish) genus: Bristlemouths of the genus *Cyclothone*

On its page about the family Gonostomatidae (the bristlemouths), Fish Base (www.fishbase.org) states that "*Cyclothone*, with 12 species, occurs in virtually all seas including the Antarctic and has, along with *Vinciguerria*, the greatest abundance of individuals of any vertebrate genus in the world." Bristlemouths live in the deep sea. *Vinciguerria*, for its part, is a genus of lightfishes (family Phosichthyidae) which also live in the deep sea.

Smallest distribution: Devil's Hole pupfish *Cyprinodon diabolis*
18 square meters

This endangered species is restricted to a single geothermal pool in the Nevada desert, and is found only over a limestone shelf of 18 square meters (200 square feet).

Most vocal: The plainfin midshipman *Porichthys notatus*

It is generally overlooked by the general public that many (in fact, probably most) fishes can produce underwater sounds by vibrating the swimbladder, by rubbing bones or teeth together, or by snapping tendons. Like birds and mammals, fishes vocalize to advertise territories and mating availability, intimidate adversaries, and startle predators.

Among some of the fish groups recognized for their chatty tendencies are the toadfishes (family Batrachoididae). Of these, the males of the plainfin midshipman are worthy of attention. During the reproductive season, they “hum” to attract females. They do this by vibrating their swimbladder. A single individual can hum for as long as an hour without pause, the longest uninterrupted fish sound ever reported. These fish are nocturnal like frogs, and as in frogs their combined output can create quite a racket. In San Francisco

Bay, houseboat dwellers sometimes complain that they cannot sleep because they can hear the fish's chorus through the bottom of their boats.

Another vocal group is the triggerfishes (family Balistidae). Triggerfishes are so named because their first dorsal spine is particularly strong and can be locked in an erect position, like a trigger. They are also quite vociferous, and the native Hawaiian name for two of the triggerfishes that live around the islands is *humuhumu nukunuku apua 'a*, "the fish that sews with a needle and grunts like a pig".

Other incorrigible blabbermouths include the aptly named croakers (family Scianidae) and grunts (family Haemulidae), the catfishes (order Siluriformes), the clownfishes and damselfishes (family Pomacentridae), and the gouramis (anabantoids), to name but a few.

Source: Helfman, G.S., Collette, B.B., and Facey, D.E., 1997, The diversity of fishes, Blackwell Science, Malden; Ibara, R.M., Penny, L.T., Ebeling, A.W., van Dykhuizen, G., and Caillet, G., 1983, The mating call of the plainfin midshipman fish, *Porichthys notatus*, In: Predators and prey in fishes (D.L.G. Noakes et al., eds.), Dr. W. Junk, The Hague.

Best hearing at high frequencies: The American shad *Alosa sapidissima*
180,000 Hz

Ultrasound is defined as any sound frequency above the maximum detectable by the human ear (20,000 Hz). Bats, dolphins and moths are animals that can detect ultrasound. In bats and dolphins, this ability is part and parcel of their echolocation system: they both produce and hear ultrasound. In moths, which are prey to bats, ultrasound detection is simply a way to detect the proximity of a predator. One might expect that some of the fish species on which echolocating dolphins feed would also have evolved ultrasound detection, like moths did. And indeed, several have: the Atlantic cod *Gadus morhua* (which can hear sounds up to 34,000 Hz in frequency), the Gulf menhaden (80,000 Hz), the alewife (128,000 Hz), the blueback herring (140,000 Hz), and the American shad (180,000 Hz).

Source: Higgs, D.M., 2004, Neuroethology and sensory ecology of teleost ultrasound detection, pp. 173-188 in (von der Emde, G., Mogdans, J., and Kapoor, B.G., eds.) The Senses of Fish: Adaptations for the Reception of Natural Stimuli, Kluwer Academic, Boston; Mann, D.A., Lu, Z., and Popper, A.N., 1997, A clupeid fish can detect ultrasound, Nature 389, 341.

Finest sense of taste: Channel catfish *Ictalurus punctatus*

Like many other fishes, catfishes have taste receptors not only in their mouth but also on their body, especially on the barbels. A 1975 paper reported that the barbel of a channel catfish could detect some amino acids at concentrations as low as 10^{-9} to 10^{-11} M, “the lowest electrophysiological thresholds reported for taste in any vertebrate”.

Source: Caprio, J., 1975, High sensitivity of catfish taste receptors to amino acids, *Comparative Biochemistry and Physiology* 52A, 247-251.

Most electric: Electric eel *Electrophorus electricus*

The electric eel of the Amazon and Orinoco rivers can generate electric pulses of about 500 volts (the Guinness Book of Records says 650 volts) at 1 amp. That is enough to stun a prey or discourage a predator, but it should not kill a person. Second place goes to the electric catfishes (family Malapteruridae) of Africa, with 300 volts, while third place belongs to the electric ray *Torpedo torpedo* of the Mediterranean, with 50 volts. Stargazers (family Uranoscopidae) can also discharge pulses of electricity up to 50 volts.

Going from production to perception: some fish can detect the very weak electric fields that are generated by the living tissues of other organisms. Sharks and rays use this ability to find prey hidden in sand. The bat ray *Myliobatis californica* can detect electrical fields as weak as 1 nanovolt (a billionth of a volt) per centimeter, the greatest electrical sensitivity known in the animal kingdom. Such a gradient would correspond to the two poles of an AA battery (1.25 V) being separated by 12,500 km (7,500 miles).

Source: Reeb, S.G., 2001, *Fish Behaviour in the Aquarium and in the Wild*, Cornell University Press, Ithaca; Jordan, L.K., Kajiura, S.M., and Gordon, M.S., 2009, Functional consequences of structural differences in stingray sensory systems. Part II: electrosensory system, *Journal of Experimental Biology* 212: 3044-3050.

Most sensitive to barometric pressure: Weatherfishes, sharks

I don't think any contest has ever been held to determine the winner of this category, but it's still interesting to mention that some fish are sensitive to barometric pressure.

Weatherfishes (loach family, *Misgurnus* spp.) are famous for becoming restless when atmospheric pressure drops ahead of a storm (hence their common name).

As for sharks: several hours before tropical storm Gabrielle struck Florida's Gulf Coast on September 14, 2001, all the juvenile blacktip sharks living in a

shallow coastal nursery moved to deeper and safer waters offshore. The only environmental cue that coincided with the departure time was a sudden drop in barometric pressure. The first sharks started to leave once the pressure had dropped by 4 mb, and by the time the last one was on its way out the pressure had dropped by 13 mb. The sharks returned to the nursery after the storm passed.

Source: Heupel, M.R., Simpfendorfer, C.A., and Hueter, R.E., 2003, Running before the storm: blacktip sharks respond to falling barometric pressure associated with Tropical Storm Gabrielle, *Journal of Fish Biology* 63, 1357-1363.

Fastest vertebrate muscle contraction: The oyster toadfish *Opsanus tau*

In the oyster toadfish (same family as the plainfin midshipman, see Most Vocal Fish above), the swimbladder can vibrate and produce a “boatwhistle call”. The vibration comes from muscles that can move at a rate of 200 individually defined contractions per second, a vertebrate record. Second place goes to the shaker muscles of the rattlesnake’s tail, which contract at only half that rate.

Source: Reeb, S.G., 2001, *Fish Behaviour in the Aquarium and in the Wild*, Cornell University Press, Ithaca.

Longest tail: Thintail thresher shark *Alopias vulpinus*
Tail 3 m long (10 ft), half of the total body length

Thresher sharks swim around or into dense fish shoals and use their long tail to whack at prey. See: Aalbers, S.A., Bernal, D., and Sepulveda, C.A., 2010, The functional role of the caudal fin in the feeding ecology of the common thresher shark *Alopias vulpinus*, *Journal of Fish Biology* 76, 1863-1868.

Most roundabout digestive system: The pirate perch *Aphredoderus sayanus*

The anus of this fish is not near the anal fin, as in any self-respecting fish. Instead, the anus opens up in the throat region, close to the mouth. This may be related more to the reproductive system than the digestive system, as both open up in the cloaca (anus). This fish lives in habitats with lots of tangled vegetation. During the reproductive period, the female lays eggs by poking her head in vegetation; the eggs come out of her cloaca (anus) near her head. The male follows and pokes his head in the same spot, and sperm is released out of the cloaca close to where the eggs are.

The anus of pearfishes (Carapidae) is also in a forward position. These fish commonly take shelter in clams, oysters, and sea cucumbers. When they need to defecate, they come out headfirst a little to check for the presence of predators, then a little more to defecate. The forward position of the anus means they do not need to leave their shelter entirely, which is safer.

Source: Helfman, G.S., Collette, B.B., and Facey, D.E., 1997, The diversity of fishes, Blackwell Science, Malden.

Biggest mouth (relative to body size): Gulpers (Saccopharyngidae)
 Swallowers (Eurypharyngidae)

The hinged jaws of these deep-sea dwellers allow their mouth to expand to a volume 10 times bigger than the volume of the whole body. It has been said of these fishes that they were “perhaps the most anatomically modified of all vertebrate species” (Page 115 in Nelson, J.S., 1994, *Fishes of the World*, 3rd ed., John Wiley and Sons, New York). Not only do they have huge mouths, they also lack scales, pelvic and pectoral fins, ribs, gas bladders, and a number of bones.

Other deep-sea fish, such as dragonfishes, viperfishes, sabertoothfishes, and ceratioid anglerfishes can also swallow prey bigger than themselves (in fact, three times bigger, in the case of some anglerfishes). It looks like food is so scarce in the deep sea that these fishes can't afford to pass up a meal just because it might be too big to swallow. Large mouths have evolved as a result.

Source: Helfman, G.S., Collette, B.B., and Facey, D.E., 1997, The diversity of fishes, Blackwell Science, Malden.

Best goggles: The barreleye *Macropinna microstoma*

Barreleyes are deep-sea fishes with tubular eyes that point upward. In 2004, a live barreleye (*M. microstoma*) was photographed off the coast of California by a remotely operated underwater vehicle. A transparent, fluid-filled dome covered the top of the fish's head, including its eyes. The structure looks like the canopy of a jet fighter but was too fragile to have survived on previously caught specimens, which had all died on the way up to the surface. It probably protects the eyes from the stinging tentacles of the jellies on which the fish feed. And it adds one more justification for the barreleyes' other name – spookfishes.

Source: Robinson, B.H., and Reisenbichler, K.R., 2008, *Macropinna microstoma* and the paradox of its tubular eyes, *Copeia* 2008, 780-784.
<http://www.youtube.com/watch?v=RM9o4VnfHJU>

Most vertebrae (of all vertebrates): Slender snipe eel *Nemichthys scolopaceus*
About 750 vertebrae in its backbone.

This deep-sea dweller is very thin (it weighs only a few ounces) but it can be 1.5 m long (5 feet). Its mouth is made up of two long jaws that curve upward and downward at the tip, reminiscent of a duck bill. The fish is sometimes called the deep-sea duck.

Source: [Wikipedia](#)

Largest difference between male and female: The anglerfish *Ceratias holboelli*

Females (up to 127 cm total length) can be 60 times longer and 500,000 times heavier than free-living males. Once attached to a female, males grow to a tenth of the length of their mates.

As you already know, anglerfishes of the suborder Ceratioidei live in the deep sea. The males are dwarves. Free-living while searching for a mate, each male eventually attaches himself (temporarily or permanently) to the body of a female. The sexual size dimorphism towards heavier females in *Ceratias holboelli* is a record for all vertebrates.

In the other direction (males larger than females), the record is held by the Lake Tanganyika cichlid *Lamprologus callipterus*, in which males are 3 times longer and 12 times heavier than females. Once again this is a record not only for fish but also for any vertebrate. The females live and lay eggs in empty snail shells which the males accumulate and defend within their territories. So the females have to be small enough to enter the shells, whereas the males have to be big enough to defend a territory and carry shells into it. Interestingly, some males are genetically programmed to be small, smaller than the females even, and they enter the snail shells and sometimes fertilize the eggs laid there by the females, much to the annoyance – one would like to imagine – of the big territorial males. So overall, *Lamprologus callipterus* males show an amazing range of body sizes at maturity.

Source: Pietsch, T.W., 2005, Dimorphism, parasitism, and sex revisited: modes of reproduction among deep-sea ceratioid anglerfishes (Teleostei: Lophiiformes), *Ichthyological Research* 52, 207-236; Schütz, D., and Taborsky, M., 2000, Giant males or dwarf females: what determines the extreme sexual size dimorphism in *Lamprologus callipterus*, *Journal of Fish Biology* 57: 1254-1265.

Slimiest: Hagfishes (family Myxiniidae)

Hagfishes are also called slime eels. They have 70-200 pairs of slime glands on their sides and belly. These glands produce a protein and a carbohydrate that combine with water to form mucus. A 50-cm (20 in) hagfish can fill an 8-liter bucket (2 gallons) with slime in a few minutes. The mucus is extremely gooey and may have an anti-predator function. Slime eels can rid themselves of their own mucus by tying a knot in their body and then sliding the knot forward, squeezing the mucus into a mass from which the fish backs out.

Also worth mentioning are some species of parrotfish that secrete a mucus envelope around themselves during their “sleep” at night. Except for a small hole through which they can breathe, the envelope completely surrounds the body. It may act as a barrier to the diffusion of odours, making the fish less detectable by nocturnal predators such as moray eels. (See the page on sleep)

Source: Helfman, G.S., Collette, B.B., and Facey, D.E., 1997, The diversity of fishes, Blackwell Science, Malden.

Most inflatable (and most spherical): Porcupinefish, balloonfish, pufferfish (Tetraodontidae and Diodontidae)

When threatened, these fish pump water into their greatly extendable stomach. In about 15 seconds the whole body becomes almost as round as a ball. Inflation has become the sole function of these fish’s stomach; food passes through it undigested and goes straight to the intestine. The skin is also remarkably stretchable and is not attached to the underlying musculature. Body scales are modified as spines (these could in fact earn the title of longest modified body scales in any fish) and these spines are normally held against the body, pointing backwards. But when the body is inflated the spines stick straight out and the fish looks like a burr. Inflation and erect spines make the fish unswallowable.

Source: Helfman, G.S., Collette, B.B., and Facey, D.E., 1997, The diversity of fishes, Blackwell Science, Malden.

Longest travel: Various species

Many fish species are migratory. If at least part of this migration takes place in the ocean, then there is scope for very long travels indeed. Such movements are studied through tagging (the fish is captured in on spot, is given a numbered tag,

which can be recognized when the fish is recaptured at another spot) or through telemetry (the fish is captured at one spot and receives a tag that can transmit a signal, or that can be detected passively, by receivers mounted on boats or even by satellites). Here are some numbers gleaned from the literature.

Many large sharks travel long distances. Among them, the white shark: 19,870 km (12,350 miles), return trip between South Africa and Western Australia, in nine months; the blue shark: 16,000 km (9,950 miles), round trip between North America and Europe; the whale shark: 13,000 km (8,100 miles), going west across the Pacific Ocean, over about three years; the basking shark: 9,600 km (6,000 miles) single trip from the British Isles to Newfoundland, diving to a maximum depth of 1,264 m (4,170 feet) along the way, or migrating between the coast of New England and the coast of South America.

Bluefin tuna tagged off Florida have been recaptured 10,000 km away (6,200 miles), in Norway.

Adult North American eels travel as much as 5,000 km (3,100 miles) from streams along the eastern seaboard of North America to the Sargasso Sea, where they spawn. European eels also spawn there, and for them the trip is even longer, for they come from European rivers.

Now here's a non-migratory movement: on November 2000, a Patagonian toothfish (*Dissostichus eleginoides*) was captured by a fishing boat off the coast of Greenland. This species is a Southern hemisphere dweller and had never before been seen north of Uruguay. To reach Greenland, the hardy traveller had to swim at least 10,000 km (6,200 miles) at depths of at least 500 m (1600 feet) to avoid the warm surface temperatures that would otherwise have killed it.

And finally, for movements entirely within fresh waters: the Amazonian catfish *Brachyplatystoma rousseauxii* swims (or lets itself be carried away) as a larvae from the Upper Amazon at the base of the Andes to the lower Amazon, where it grows up to adulthood, at which point it migrates back up to the stream of its birth to spawn, a round-trip of 8000 km (5000 miles). Such movements were inferred from the profile of the ratio of strontium isotopes deposited in the fish's otolith throughout growth. It's not surprising that the longest freshwater migration should be in the longest river on Earth.

Source: Martin, R.A., and Martin, A., 2006, Sociable killers, *Natural History* 115 (8): 42-48; Wilson, S.G., 2006, The biggest fish, *Natural History* 115 (3): 42-47; Gore, M.A., Rowat, D., Hall, J., Gell, F.R., and Ormond, R.F., 2008, Transatlantic migration and deep mid-ocean diving by basking shark, *Biology Letters* 4: 395-398; Skomal, G.B., Zeeman, S.I., Chisholm, J.H., Summers, E.L., Walsh, H.J., McMahon, K.W., and Thorrold, S.R. 2009. Transequatorial migrations by basking sharks in the Western Atlantic ocean, *Current Biology* 19: 1019-1022; Block, B.A., Teo, S.L.H., Walli, A., Boustany, A., Stokesbury, M.J.W., Farwell, C.J., Weng, K.C., Dewar, H. and Williams, T.D., 2005,

Electronic tagging and population structure of Atlantic bluefin tuna, *Nature* 434: 1121-1127; Møller, P.R., Nielsen, J.G., and Fossen, I., 2003, Fish migration: Patagonian toothfish found off Greenland, *Nature* 421: 599; Helfman, G.S., Collette, B.B., and Facey, D.E., 1997, *The Diversity of Fishes*, Blackwell Science, Malden; Compagno, L., Dando, M., and Fowler, S., 2005, *Sharks of the World* (Princeton Field Guides series), Princeton University Press, Princeton; Duponchelle, F. and 18 others, 2016, Trans-Amazonian natal homing in giant catfish, *Journal of Applied Ecology*, doi 10.1111/1365-2664.12665 .

Oldest pregnant mother:

A placoderm fossil
380 million years old

Not everyone knows that some fishes are viviparous (give birth to live young). Yet in many sharks, all rays, eelpouts, brotulids, some halfbeaks, goodeids, four-eyed fishes, livebearers (obviously), rockfishes, Baikal oilfishes, surfperches, clinids, labrisomids, and the coelacanth, young develop inside the mother, who supplies nutrition to these young via a placental connection or special secretions. In 2008, a team of Australian paleontologists reported discovering the 380 million years old fossil of a placoderm (an ancient, armoured, jawed fish) with the bones of embryos clearly visible inside it. These fossilized bones were not crushed and did not appear etched by acid, as they would have if they were the remains of a prey inside the digestive system. What's more, a putative umbilical cord could be seen. This is the oldest evidence of livebearing in any vertebrate (the previous record was held by an ancient marine reptile, based on a fossil 180 million years old). Placoderms do not exist anymore. They were the first branch of jawed vertebrates. Yet it seems they were sophisticated enough to give birth to live young.

Source: *Nature* 453 (29 may 2008): 575; Helfman, G.S., Collette, B.B., and Facey, D.E., 1997, *The Diversity of Fishes*, Blackwell Science, Malden.

Oldest fossil fish:

Myllokunmingia fengjiaoa
525 million years old

This fossil fish, 3-4 cm (1.2-1.6 in) long and thought to be an ancestor of lampreys, was found in Yunnan Province, China.

Source: [Wikipedia](#).

Strongest bite

Great white shark
1.8 tonnes (18,000 Newtons)

This record was not measured directly. It was estimated with a computer model and applied to the largest great white ever weighed. The authors of the study reported the value of 18,216 Newtons (for the posterior bite) as “the highest thus far calculated for any living species”. With the same model, they also estimated that the closely related, now extinct, whale-hunting, probably 50 ft long, Megatooth shark *Carcharodon megalodon* had a bite force 10 X higher. These huge bite forces are made possible by the great size of these predators.

Source: Wroe, S., Huber, D.R., Lowry, M., McHenry, C., Moreno, K., Clausen, P., Ferrara, T.L., Cunningham, E., Dean, M.N., and Summers, A.P., 2008, Three-dimensional computer analysis of white shark jaw mechanics: how hard can a great white bite? *Journal of Zoology* 276, 336-342.

Largest genome

Marbled lungfish, *Protopterus aethiopicus*
130 billion base pairs

At the end of 2010 this was known as the largest genome of all animals, and the 2nd largest of all organisms (the Japanese flower *Paris japonica* has 149 billion base pairs). For comparison, we humans have only 2.9 billion base pairs. Much of our genome, and presumably much of the lungfish’s too, is made up of so-called “junk DNA” that, for the most part, does not code for anything. In fact, the huge lungfish genome is probably explained by a greater amount of junk DNA rather than by a greater number of functional genes. The reason why some organisms seem to have more junk DNA than others is still a mystery.

Source: <http://www.genomesize.com/statistics.php>

Best climber

The goby *Lentipes concolor*

On Hawaii, this fish can surmount waterfalls as high as 130 m (about 425 feet) by climbing on the rocks behind or next to the falls, using a special suction cup formed by the fusion of their pelvic fins to cling to the vertical surfaces. They do this amazing feat not as adults, but as juveniles no more than 2.5 cm (1 inch) long. Soon after hatching above coastal waterfalls, the young of this species are swept downstream and out to sea, grow up in the ocean, and then, still relatively young, they climb the falls to reach the predator-free streams above and start breeding attempts of their own.

Source: Sherman, P.T., and Eason, P.K., October 2004, Climb every waterfall, *Natural History* 113(8), 33-37.

Strongest armor

The alligator gar *Atractosteus spatula*

The body of gars is covered with hinged, diamond-shaped, interlocking, bony scales coated with ganoine, a substance that resembles the enamel of our teeth. This is a primitive trait (in the sense that it evolved in fishes a long time ago). With a maximum length of 3 m and weight of 140 kg, the alligator gar is the largest species of gar and the second largest freshwater fish of North America (after the white sturgeon); its scales are heavier and thicker than those of any other fish.

Source: Helfman, G.S., Collette, B.B., and Facey, D.E., 1997, *The Diversity of Fishes*, Blackwell Science, Malden.

Most extreme brain-to-body weight ratio

The cusk eel *Acanthonus armatus* currently holds the all-vertebrate record for the lightest brain relative to body size. It lives at great depth in the ocean, in an environment devoid of most stimuli. The parts of its brain devoted to processing sound and lateral line stimuli are well developed, but the rest is much reduced.

The current all-vertebrate record holder for heaviest brain relative to body size is also a fish: the elephantnose fish *Gnathonemus petersii*. It produces an electrical field around itself and uses its electroreceptors to find prey, navigate, and communicate with conspecifics.

Source: Fine, M.L., Horn, M.H., and Cox, B. 1987, *Acanthonus armatus*, a deep-sea teleost fish with a minute brain and large ears, *Proceedings of the Royal Society B* 230: 257-265. Nilsson, G. 1996, Brain and body oxygen requirements of *Gnathonemus petersii*, a fish with an exceptionally large brain, *Journal of Experimental Biology*, 199: 603-607.