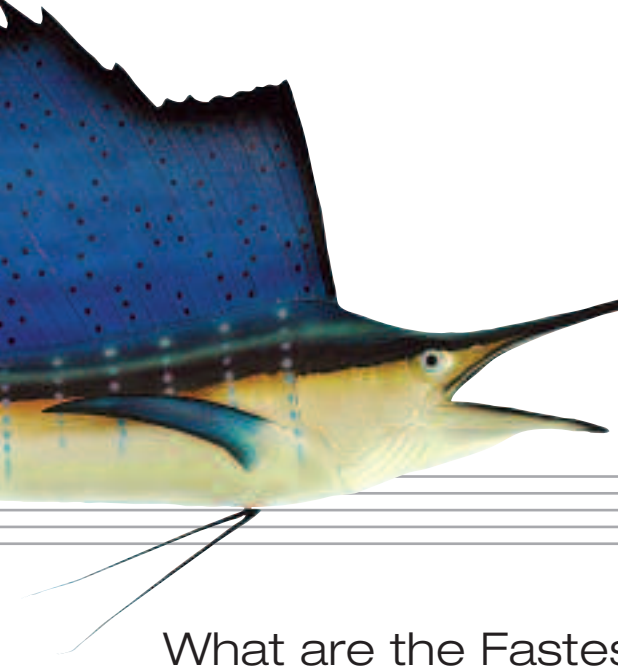


DON'T GO HEAD-T WITH A

What are the Fastest Swimmers on Earth?

by Jim W. Harper >>>

"You swim like a fish" seems the right thing to say to natural-born swimmers, but with more than 30,000 species of fish to choose from, the compliment leaves much to the imagination. Some fish are not exceptional swimmers, because they rely on camouflage, body armor, or other devices to avoid predators, and the deep-sea male anglerfish actually ceases to swim after attaching permanently to his mate. So, if you really want to compliment a swimmer, say, "You swim like a sailfish."

Jim Harper is a freelance writer from Miami. He is a swim coach, a Masters individual All-American, and former director of the Pew Fellowships in Marine Conservation

The world's fastest fish is *Istiophorus platypterus*, the cosmopolitan sailfish, which can sprint at an amazing 68 miles per hour, according to the *Guinness World Records*. This speed makes the fish even faster than all land animals, as the record-breaking cheetah tops out at 65. Race horses register 40, the same pace as the mighty tuna. Elite human swimmers, by the way, clock in at a meager 5 mph. That speed places them somewhere between a herring (3.8) and a salmon (8.0) in a hypothetical 50-meter "man versus beast" race.

The top swimming speeds of fish are debatable, however, because it turns out to be quite difficult to get a fish onto a starting block. The sailfish world record was recorded at the Long Key Fishing Camp in Florida by fishermen who measured the amount of line carried out for three seconds by a leaping sailfish. Scientists call this style of sprinting "burst" swimming, as compared to the slower technique used for hours of "sustained" swimming. One scientist estimated the burst speed of the black marlin at 81 mph, but editors of the record books say there is not adequate proof yet—so for now, at least, the sailfish stands atop the podium.

How is this feat possible moving through water?

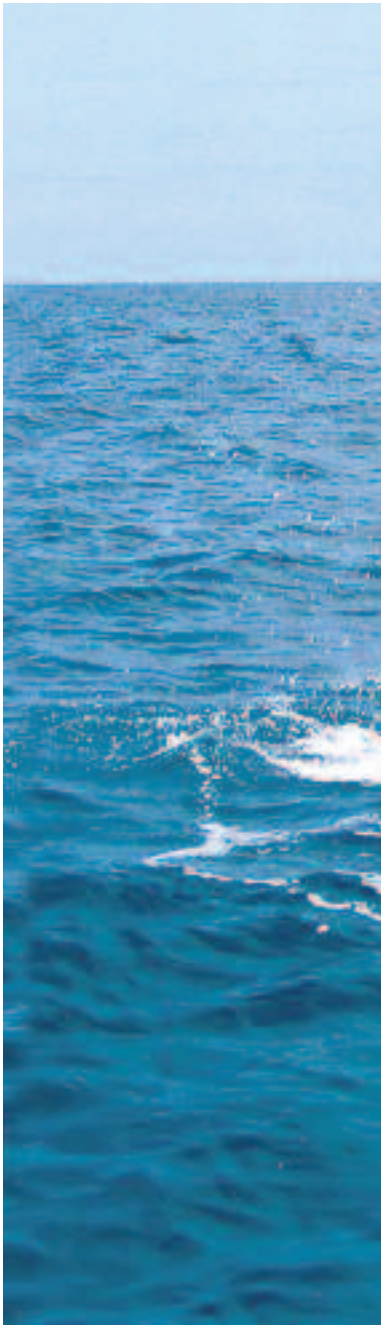
With their incredible speed, top predatory fish hold the secret to efficient and powerful swimming. Scientists are studying them for the development of underwater robots, but human swimmers have not plunged very far into the subject. Are there lessons that we can learn from the ocean's top sprinters? Masters swimmers in particular will want to know any tricks of nature for turning back time.

The first lesson might be called the Zen of swimming, or "going with the flow." Fish do not fight the element they live in; they ride its currents, glide through it, and appear to move with little effort. When effort is required, to avoid being eaten or to migrate upstream, they adjust instinctively.

There is a widely circulated story that one of the favorite books of former Australian Olympic coach Gennadi Touretski is the scientific tome, *Fish Swimming*, which he used to teach hydrodynamics to his elite swimmers, including gold-medalist sprinter Alexander Popov. Popov practiced Tourestski's method of super slow swimming to perfect a low-drag, low-splash, hyper-efficient stroke. Instead of a fast turnover, Touretski's preferred long stroke cycle imitates how animals gain speed—by increasing their distance per movement.

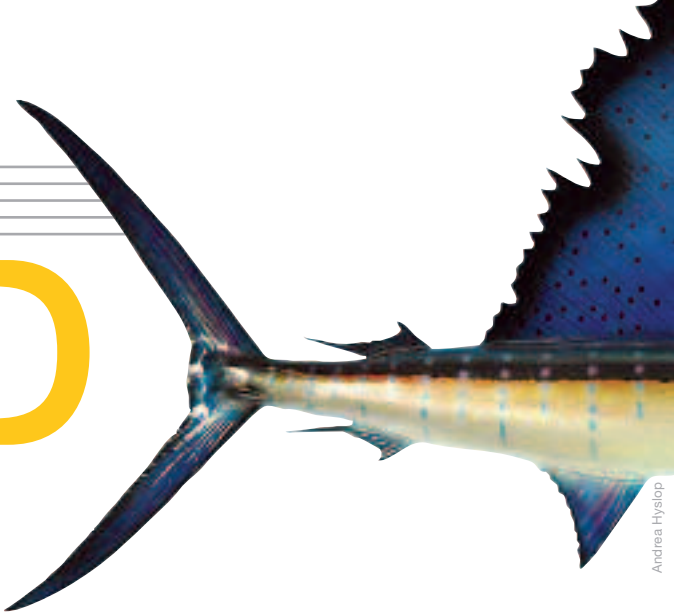
Open water guru Terry Laughlin, creator of the Total Immersion Swimming school in New Paltz, N.Y., also believes in fish as role models for swimmers. Laughlin promotes the concept of "fishlike" swimming.

"Fish are the world's most efficient swimmers, so it's obvious that we can learn from them," Laughlin says. He notices that world-class human swimmers move more similarly to fish than to an average human who thrashes about in the



Victor Maffe

O-HEAD SAILFISH



Andrea Hyslop

water. "You want to be conscious of moving through the water without disturbing it. Being fishlike changes your whole thinking about swimming."

Humans can imitate fish only to a limited extent, however—and vice versa. A "fish out of water," doesn't last long (an exception is the freakish walking catfish), just as a human underwater will quickly expire. Bridging this gap between land and water creatures is the aquatic mammal.

The fastest swimming mammal is the killer whale, which can move at a whopping 35 mph. A few other top-flight dolphins and whales are not far behind, and they are all experts at exploiting fluid dynamics. You may have seen images of dolphins riding the waves from a motorboat's bow with superior grace.

Despite their need for air, these mammals do not swim much at the surface, because turbulence makes swimming there a real drag. Like fish, they propel themselves mainly with their tails, and this approach allows a boundary layer or slipstream of water to flow around their bodies. It turns out that the key to fast swimming in nature is not brute force but drag reduction.

Sea otters made the discovery about the limitations of surface swimming well before humans did.

"When it (a sea otter) wants to swim fast it switches from


Tammy Wolfe

surface paddling to a submerged mode of undulatory swimming," says Terrie Williams, a triathlete and professor of ecology and evolutionary biology at the University of California, Santa Cruz. Human swimmers find this advantage by extending time underwater during starts and push-offs.

Williams's research found that fully aquatic mammals like whales, dolphins and seals are up to five times more efficient in energy usage than the next group of swimmers, called semi-aquatic mammals, which includes humans. But humans can out-swim the sea otter, the mink and the muskrat.

Williams found that the swimming efficiency of marine mammals is equivalent to fishs' when their physiological differences are accounted for. And, perhaps of more interest to humans, the type of propulsion they use does not matter. Dolphins and whales undulate; seals use their hind flippers; but sea lions primarily use their fore flippers for propulsion, and they clock in at 25 mph. All swim incredibly fast and efficiently. Compared to these mammalian torpedoes, humans are simply splashing at the surface.

If nothing else, the sprinters of the ocean deserve our awe and respect. The sailfish does not have the iconic status of the cheetah, yet it moves faster in a medium that is 800 times denser and 60 times more viscous (stickier) than air. Likewise, the swordfish, tuna and the mako shark are as worthy of admiration as any lion, tiger or bear. While few people would consider eating these fur-bearing land animals, humans hunt and consume these fish, at levels that cannot be sustained, without a second thought.

Billfish—a group that includes swordfish and marlin—are the fastest burst swimmers. These fish are known for their large size (up to 1,700 pounds), their fighting ability (think, *The Old Man and the Sea*) and their unique, extended nasal bones, which can be imagined as a permanent streamlined position. Their technique is called "carangiform" swimming, whereby the main undulation comes from the rear half of the body. Thrust comes from the tail and directionality from the other fins. The beautiful dorsal fin of the sailfish is folded down during bursts, reducing drag, and raised when the fish is excited.

When it comes to distance swimming, the champion of the sea may well be the tuna. During cross-ocean migrations, tuna can average 40 miles a day for months at a time. They are also champion sprinters and hunters, churning up the water at speeds reaching 46 mph.

Coach Laughlin points to the typical body shape of nature's swimmers as a form of inspiration for our positioning in the water. Indeed, even the gigantic blue whale viewed from above looks like a slender torpedo, thicker in the middle and tapered in the back. Laughlin says that we can imagine this shape while our arms are outstretched.

"There are fishlike moments in the stroke. In each stroke cycle, spend a little more time in the fishlike position," says Laughlin. "Keep your body as sleek as possible."

To really imitate a fishlike position, however, humans would need to swim on their side, as fish bodies and tails tend to be laterally compressed. But body rotation and extended arms in the freestyle may enable the fishlike moment described by Laughlin. Imitating cetaceans (whales and dolphins) is much easier, as anyone knows who has put on flippers and practiced the dolphin kick. Our gangly arms correspond to their pectoral fins, and their mermaid-like flukes can be imagined as our feet fused together. Too bad our breathing "blowhole" is only upwards during the backstroke.

In her recent study of dolphin undulation, Williams found a correlation with human swimming that she calls "propulsive peaks" or moments of extra force. The dolphins flick their tails at the end of each stroke. "It is nearly identical in form to the propulsive peaks created by the human downstroke and end of the stroke flick of the wrist. Trained human swimmers are doing really well when it comes to taking advantage of what whales and dolphins have known for 50 million years about moving through water," Williams says.

If we can't beat these swimmers, we can use technology to

Other Fishy Facts

Finfish species: 30,033
Threatened species: 1,115
Largest fish: Whale shark, up to 65 feet, 75,000 pounds
Oldest fish: Shortraker rockfish, 157 years
Most fecund: Greasy grouper, 340,000,000 eggs

Source:
FishBase
www.fishbase.org
[Froese, R. and D. Pauly. Editors. 2007. FishBase. World Wide Web electronic publication. www.fishbase.org, version (05/2007).]

simulate some of their advantages. The skin of sharks has provided the inspiration for the latest craze in competitive swimsuits, and manufacturers of body suits like Speedo's Fastskin boast they have achieved even more shark-like qualities than previous incarnations. Sharkskin is rough and covered with dermal denticals, or tiny teeth, that vary in shape and size across their bodies. These denticals make the water less "sticky" by breaking up vortices or water-whirls that would otherwise create drag.

Without the suit, it would be impossible for humans to imitate sharkskin, yet the idea of reducing drag is perhaps nature's most important lesson for swimmers.

Dolphin suits may be next. Scientist Ann Pabst from the University of North Carolina, Wilmington, found that the blubber under dolphin skin acts as an internal spring that helps to propel the dolphin with little muscular effort. (Finally, an excuse to gain cellulite—as long as you keep a torpedo-like figure.)

Coach Laughlin summarizes the three lessons that anyone can learn by observing fish: 1) they are always impeccably balanced, and never sinking at the tail; 2) they maintain a tapered shape; and 3) they use whole body movements that create no turbulence.

Somehow, aquatic animals can swim as fast through water as animals can run on land. Which leaves us wondering how to finish this riddle: "A dolphin, a tuna, and a sailfish walk into a natatorium. Who will win the 50 meter gold?" Hypothetically, it should be the sailfish, but some might put their money elsewhere.

"In a sprint, I'd bet on the tuna," says Williams. "The body is perfectly streamlined, and they are still the quintessential swimmers to beat. Killer whales are remarkably fast for such a large animal, but the tuna is the one that will get away." <<<

Top 20 Fastest Large Aquatic Animals (mph)

	**Sailfish** (*Istiophorus platypterus*), leaping	68 mph
	**Black Marlin** (*Makaira nigricans*)	50 mph
	**Yellowfin Tuna** (*Thunnus albacares*), leaping	46.4 mph
	**Killer Whale** (*Orcinus orca*)	34.5 mph
	**Shortfin Mako Shark** (*Isurus oxyrinchus*) (estimated burst swimming speed of 46 mph)	31 mph
	**Leatherback Turtle** (*Dermochelys coriacea*)	22 mph

Closet Competition to Human Swimmers

	**Pacific Salmon** *(Oncorhynchus)*	8 mph
	**Human** (*Homo sapiens*)	5.04 mph
	**Herring** (*Clupea harengus*)	3.6 mph

Source:
Reef Quest Center for Shark Research. www.elasmo-research.org/education/topics/r_haulin'_bass.htm