

# MAN VS. WILD

Scientists look to the animal kingdom for the next evolution in free speed

By Jim Gourley



Speedsuits work by mimicking the drag-reducing properties of shark skin.

For several years now, aerodynamic and hydrodynamic improvements in triathlon equipment have adhered to fairly conventional wisdom—adopting the most streamlined cross section of the bike, wheels, rider, helmet and clothing will make for the greatest gains in speed. While technology has provided drastic improvements in aerodynamics and hydrodynamics over the past century, when it

comes to cheating the Earth's atmosphere (or water), the science of mankind doesn't always have the answers. So a few years ago, Professor Alessandro Bottaro of the University of Genoa in Italy went to mother nature to find out how to make things move faster. What he found was that some of the greatest innovations in aerodynamics have been right in front of our faces since the dawn of time.

In a recently released research paper, Bottaro announced the discovery of a revolutionary aerodynamic technology in birds. Working with zoologists in the U.S., Bottaro examined the behavior of different types of feathers on birds during flight. What he found was that certain smaller feathers, called coverts, perform a unique trick during flight. As a bird lands, coverts on the top of its wings



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During landing small feathers on the ends of a bird's wings protrude upward to prevent stalling, while at the same time reducing drag by letting air pass through them.



fluff up. This might seem counterproductive to flight, but these feathers serve the same purpose as dimples on a golf ball. The coverts cause turbulent flow over the top of the wing, thus delaying flow separation and keeping the bird from stalling before it touches down. While it's true that flaps on aircraft have been performing a similar function for decades, the real discovery was in how the coverts reduce drag. Whereas flaps require air to pass over them, coverts allow air to pass through them. The drag reduction occurs as the tiny filaments that make up the individual feathers vibrate. On a minuscule level, they virtually throw air backward off the wing, thus getting rid of those pesky vortices we're told are trailing off our bikes and wetsuits.

And that's where the application to triathlon comes in. While his research is only in the preliminary, computer-modeled stages, Bot-taro projects a 15-percent reduction in pres-

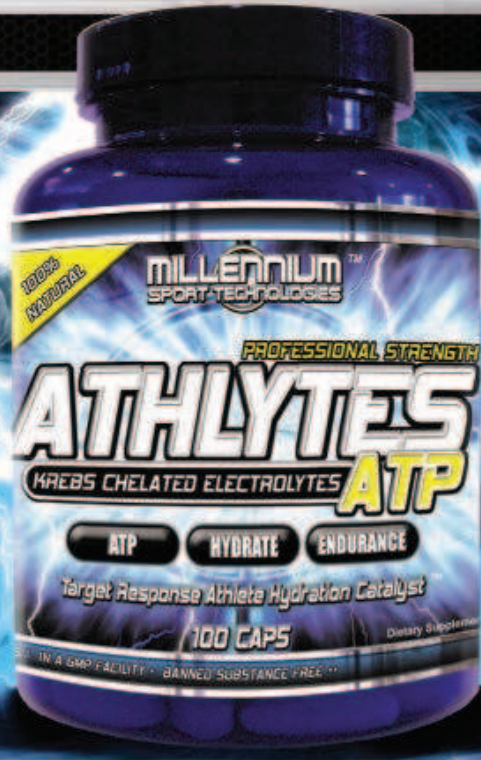
THE U.S. NAVY IS EXPLORING TECHNOLOGIES EVOLVED BY DOLPHINS, SPECIFICALLY THE FLUCTUATION IN THE SURFACE OF A DOLPHIN'S SKIN THAT HELPS IT MOVE FASTER THROUGH THE WATER.

sure drag through the application of a hair-like coating on the trailing edge of a sphere. The principle would work in either water or air, but there are qualifications. The size, shape and material composition of the individual filaments, as well as how closely they're grouped would be dependent on the speed of the airflow and shape of the object they cover. So

don't go tarring and feathering yourself before a race just yet. All of this is due to the fact that the individual filaments have to vibrate at the same frequency as the occurrence of vortices against the surface they cover. Because of the frequency issue, these kinds of coatings probably won't make it onto the back of tri-suits, since what's good for airflow won't work in the water. The most likely application of this technology appears to be on helmets, but there's no sign of helmet manufacturers feathering up their lids just yet.

Research on fluid dynamics is also being done in the ocean. The U.S. Navy is exploring technologies evolved by dolphins, specifically the fluctuation in the surface of a dolphin's skin that helps it move faster through the water. The motions are similar to sucking in your gut or flexing your abdominal muscles, except on a much smaller and more subtle scale. Scientists theorize that the creation of these ripples





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A dolphin's skin is able to change surface area to help it move faster through the water, and the U.S. Navy is looking to mimic this with the outer layers of ships.

along the surface of the skin helps to maintain turbulent flow. While the idea that dolphins have that level of fidelity in surface-area control and make conscious use of it is disputed, the results are not. The Navy's research is a bit more advanced, in this case. They're looking for a form of active control, in which they would continuously deform the skin of a ship, morphing the ripples to suit their speed requirements. Carbon fiber is a little less forgiving than a ship's hull, but that doesn't mean the pattern of ripples can't be optimized to help reduce drag at typical race velocities, and with five whole millimeters to play with on your neoprene suit, don't be surprised to see new designs trying to help make your next swim a breeze.

Bottaro points out that there's another animal out there that's cracked an element of the aero code. In the pursuit of faster forks, the humpback whale may have beaten us to the solution millennia ago. The leading edge of the whale's fins are lined with a series of bumpy protrusions known as tubercles. This peculiar and counterintuitive



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Photo: Eric Wynn

Chris McCormack rides the 808 Firecrest wheelset, Zipp Tangente Tubulars, and SRAM RED components



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Research shows that the tubercles on the fins of humpback whales generate power as they move through the water.

adaptation generated great interest in zoologist Frank Fish. After a series of tests conducted at the research facilities of the United States Naval Academy, Fish published his findings in 2005. The results were startling—tubercles on airfoil leading edges yielded significant improvements in performance. Wings could operate at much higher angles without stalling (a condition in which airflow separation causes the wing to lose all ability to generate lift), and even when stalls occurred they did so more gradually. This has already led to revolutionary designs in the wind energy industry, with a wind turbine manufacturer even taking the name “WhalePower.”

Some of the research is production-ready. Some is still in its primitive stages. In all cases, the fact that these species are still here to give us clues about their engineering marvels is a testament to the fact that they’ve endured centuries of field testing. From the wings of an eagle to the fur of a sea otter, the technology of tomorrow already exists today. It has for thousands of years. **A**

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