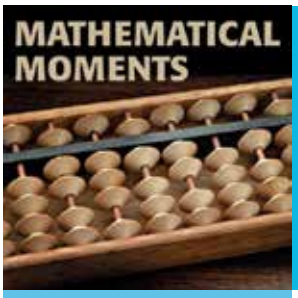

Analyzing Mako Motion

The shortfin mako shark, often described as a "torpedo with teeth," can move at speeds estimated at 45 mph. You'd think achieving such speed would require a smooth skin, but it's actually the rough features of the mako's skin—tiny teeth-like structures called *denticles* (pictured in the inset)—that help it go so fast. Denticles are found on the skin of other sharks too, but the mako's denticles are especially flexible and bend away from the skin at angles up to 50 degrees in places. This may seem counterproductive, but a study using math, hydrodynamics, and experiments over real mako skin specimens to measure velocity has shown that the denticles impede a phenomenon known as reversing flow near the skin and diminish the resulting slowdown in the layer of water around the skin and therefore the body of the shark. They thus decrease drag (resistance proportional to either an object's velocity or the square of the velocity) and allow the mako to attain top speed and maneuverability.

People are now researching how to use man-made skins inspired by denticles on the surfaces of aircraft and water vessels to overcome the flow separation described above. The separation occurs when pressure variation from the shape of a body causes the velocity of the boundary layer around an object relative to that object to reverse direction. Delaying or controlling this would decrease drag and lower fuel costs. Features on the top surface of the denticles called riblets have also inspired application in swimsuits, but the suits had to be outlawed because they made world-class swimmers **too** fast, perhaps causing designers and athletes to declare: "We're going to need a slower suit."

Image: © Getty Images.
Inset: Scanning electron microscope closeup of scales, Dr. Philip Motta.

For More Information:

"Experimental study of laminar and turbulent boundary layer separation control of shark skin," Farhana Afroz et al., *Bioinspiration and Biomimetics*, Vol. 12, no. 1, 016009.

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