Streamlined sharks are legendary for their effortless swimming. George Lauder from Harvard University explains that the fish have long inspired human engineers, but more recently attention has focused on how the fish’s remarkable skin boosts swimming. Coated in razor sharp tooth-like scales, called denticles, the skin is thought to behave like the dimples on a golf ball, disturbing the flow of water over the surface to reduce the drag. But something didn’t quite sit right with Lauder. ‘All of the shark skin studies were done on flat shark skin mimics that were held straight and immovable. But shark skin moves’, recalls Lauder. So, when Masters student Johannes Oeffner joined his lab, Lauder suggested that they take a look at the fluid dynamics of shark skin and its analogues to find out how the fish’s motion affects fluid flowing over the rough surface (p. 785).

But first the duo had to get hold of some fresh shark skin, so they went to a market in Boston where they found several large makos. Back in the lab, Oeffner carefully removed sections from a mako’s skin and attached them to both sides of a rigid aluminium foil. Then he immersed the foil in a flow tank, reproduced the swimming motion of a fish by wiggling it from side to side and measured the rigid ‘swimming’ foil’s speed by matching it with the flow of water moving in the opposite direction.

Having measured the foil’s swimming speeds with intact skin – complete with denticles – Oeffner carefully sanded off the denticles and set the foil swimming again. However, instead of slowing down – as the duo had expected – the denticle-free foil speeded up. So the shark skin’s denticle surface impeded the rigid swimmer. ‘But then we remembered our premise that the sharks aren’t rigid’, remembers Lauder, so how would the shark skin perform when flexing like a real fish?

Gluing two pieces of shark skin together to produce a flexible foil, Oeffner repeated the swimming experiment, and this time the denticles had a dramatic effect. The intact skin foil swam 12.3% faster than the sanded skin. The shark’s rough surface improved the swimming performance spectacularly. However, when the duo tested the swimming performance of two shark skin mimics – a sharp-edged riblet design and the famous Speedo® Fastskin® FS II fabric – they were in for a shock. Although the riblet surface improved the flexible foil’s swimming speed by 7.2%, the dented surface of the Speedo® fabric had no effect at all. However, Lauder points out that figure-hugging Fastskin® swimming costumes probably enhance the swimmer’s performance in other ways.

After proving that the denticles on shark skin significantly improve the fish’s propulsion, Lauder and Oeffner were keen to find out how they affect fluid flows around the body. Returning the flexible shark skin foil to the swim tunnel, Oeffner and Lauder captured the water’s swirling motion with laser light and realised that in addition to reducing drag, the skin was actively generating thrust.

‘That’s the number one surprise. It’s not just the drag-reducing properties, but the denticles alter the structure of flow near the shark skin in a way that enhances thrust’, explains Lauder. He is now keen to design physical models to see how altered denticle arrangements affect fluid flows over the skin and to build a computational model to tease apart the beneficial effects of the skin’s thrust and drag reduction. 10.1242/jeb.070698


**Kathryn Knight**

**OLD FLIES LOSE SEX APPEAL**

Let’s face it, growing old isn’t appealing. Stiffer joints, wrinkly skin, senior moments; it’s all just a matter of time. But, to add insult to injury, it seems a dwindling sex life is unavoidable too – at least if you’re a fruit fly. That’s the inescapable conclusion of work by Tsung-Han Kuo and Scott Pletcher of the University of Michigan and Baylor College of Medicine and their colleagues (p. 814).

For any animal, reproduction is top of the to-do list. But since only the fittest attract a mate, it seems reasonable to assume that animals become less attractive as they grow older. Fruit flies use pheromones to entice the opposite sex, so Kuo, Pletcher and colleagues wondered how flies’ pheromone profiles and sex appeal alter with age. To examine the link between attractiveness and age, the team used mass spectroscopy to take a closer look at pheromones on the