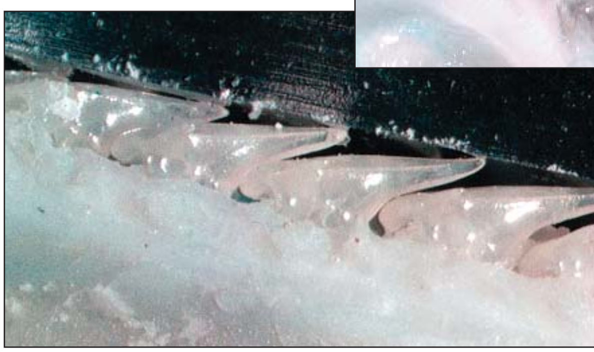
New Orleans, Louisiana—About 1500 biologists met here 5 to 9 January to discuss, among other things, how turtles develop, how sharks eat, and how birds interact with snakes and plants with bacteria.

Shark Flexes Its Teeth For Tough Meals

Sharks are among the most feared marine animals; even pictures of their bared rows of sharp teeth send shivers down the spine. Their teeth grip and slice prey, tearing off limbs with a single bite. But at least one shark can flatten its teeth, momentarily making its jaws much less frightening—except perhaps to crabs and other hard-bodied invertebrates, Jason Ramsay reported at the meeting.



Versatile dentition. The teeth of some bamboo sharks flatten (*bottom*) when they crunch crabs.

CREDIT: J. RAMSAY

Until now, most researchers thought that bamboo sharks hunt only fish and sometimes squid. But one day, Ramsay, an undergraduate at the University of Rhode Island, Kingston, tossed a crab into the shark tank, just to see what would happen. "The shark decimated it," he says. "We were slightly shocked." He couldn't figure out how the sharks could use their sharp, spiky teeth for crushing; other crab-eating shark species grind their prey in molarlike plates.

A quick check of the scientific literature turned up a report on the stomach contents of a related bamboo shark indicating that crustaceans made up more than 40% of its diet. Intrigued, Ramsay removed the jaws from a freshly dead specimen and pressed its teeth onto a glass slide. The broad ligament in which the teeth were imbedded seemed unusually flexible. And when he pressed down hard enough, all of the teeth bent backward, each row overlapping the row behind it. The same happened when he substituted a crab for the glass. The folded teeth provided a flat surface that was well suited to cracking up the crab's tough shell.

Ramsay and his adviser, functional morphologist Cheryl Wilga, developed a biomechanical model for how the teeth could be used for both munching and crunching. They determined that once the teeth bend down, the crushing force is distributed across the flat front surface of each tooth and across all the teeth contacting the prey, thereby protecting any one tooth from harm. And when the jaws slam shut, the teeth are squarely on top of one another. This is a bit like how the jaws of herbivores work, Ramsay explained.

But unlike in herbivores, once the job is done, "all the teeth spring right back up," ready to snare another fish, Ramsay noted. The ligaments supporting the teeth contain a relatively high proportion of elastic proteins, he found. Control of bending is built into the tooth, which has a thick root and a relatively small cusp sticking out. This configuration creates a lever that resists bending initially but flattens quickly once the tooth is pushed down hard enough.

"Sharks have come up with a lot of neat tricks to be very effective predators," says Mark Westneat, a functional morphologist at the Field Museum of Natural History in Chicago. "I think we knew there was some flex in the base of these teeth, but having mobile, bendable teeth is pretty unique."

Estrogen May Disrupt Nitrogen Fixation

Over the past decade, there has been fierce debate about the potential harm that estrogen-like compounds can do to wildlife. Many pesticides and other chemicals released into the environment by humans alter hormone signaling, apparently feminizing male fish and frogs and causing reproductive abnormalities in other animals.

New research suggests that the effects of so-called endocrine disrupters may be more widespread than anyone guessed. The compounds can rob plants of key nutrients, says Jennifer Fox, an environmental endocrinologist at the University of Oregon in Eugene. They block communication between a legume and a nitrogen-fixing microbial partner it needs to thrive, preventing a crucial symbiotic relationship from being established. Plants "may be affected like animals," says Fox's colleague John McLachlan of Tulane and Xavier universities in New Orleans.

All organisms engage in chemical chatter. The interplay between steroid hormones and their receptors is ancient, and it allows for cross-talk between species as well as between cells.

Fox and her colleagues looked at how endocrine disrupters might garble a phytoestrogen dialogue between alfalfa and nitrogen-fixing bacteria. They focused on a bacterial protein called NodD, which sits on the bacterium's surface and binds to phytoestrogens released by its host plant. In response, the bacteria send out their own molecular messenger as a white flag to gain access to the plant's roots. "Receipt of the right phytoestrogen signal is the first and most crucial step for setting up the symbiosis," Fox explained at the meeting. Once communication is established, the partners build nodules, called rhizomes, on the plant roots that house and protect the bacteria, in return for a steady supply of ammonium.

Fox tested 100 endocrine disrupters for their effects on nodule formation. In the lab, she added each compound to alfalfa. About half of the compounds inhibited nodule formation to varying degrees, she reported. "She had very clear experimental results," says Robert Stevenson, a conservation physiologist at the University of Massachusetts, Boston.

The two worst offenders were the insecticides pentachlorophenol and methylperathion: With their use, NodD activity dropped 90% and nodules failed to form, slowing plant growth. These compounds are used on crops up to four times a season. Fox's preliminary field studies indicate that it takes about 6 weeks after exposure for alfalfa to begin to grow nodules. That "could be a really big problem," notes Stevenson. If endocrine disrupters become more common, legumes such as alfalfa, "instead of contributing to soil health, are going to mine the soil" for nitrogen compounds as other plants do; thus, sprayed fields would need hefty doses of fertilizer to be productive.