Frequently Asked Questions

A flatback turtle, endemic to Australia, rises toward the surface to breathe. Scientists continue to learn more about how sea turtles sense their environment, from what they see and smell to how they feel pain. © Doug Perrine

How Do Sea Turtles Sense Their Environment?

By Samantha Trail and Jeanette Wyneken

Sea turtles live mostly in the ocean, though they spend brief portions of their lives on nesting beaches as hatchlings or adult females. Science is beginning to understand what external stimuli are important to them in the different environments.

VISION—With relatively small eyes for their large body size, sea turtles do not initially appear to have stunning visual capabilities. Indeed, they have low visual acuity (spatial resolution), "slow" temporal resolution, and eye structures that are best suited for the kinds of bright light conditions found on the shade-free ocean surface, where they spend much of their time. When sea turtles are on land, most of their activity is at night, when sea-finding and nest site selection occur. Sea turtles do have color vision and can sense the shorter, near-UV light wavelengths emitted from the stars and moon that humans do not see. Hatchlings use those dim light cues to crawl toward the sea from the nest, and adult females respond to such cues during nest site selection.

HEARING—Sea turtles do not have an external ear, but they do possess a tympanum (eardrum), a middle ear bone (stapes), and an inner ear, within which the basilar papillae (hairlike filaments) detect sounds. In both aquatic and terrestrial environments, regardless of life stage, sea turtles are especially sensitive to low sound frequencies, with maximum sensitivity at or below 400 Hz; for perspective, humans hear sounds ranging from 20 Hz to 20,000 Hz. Why sea turtles are so sensitive to such low frequencies is unknown, but such sounds are more prevalent in underwater environments and can travel long distances, which could be advantageous. Unfortunately, sea turtles ignore continuous sounds, such as those emitted by approaching powerboats, and consequently they are often injured or killed during collisions with vessels.

CHEMORECEPTION—Smell and taste are often associated with food detection in many animals, and sea turtles are no exception. In the presence of the odors and of the chemical dimethyl sulfide (a byproduct of injured prey), sea turtles will show foraging behavior (diving, biting, an increase in swimming speed). Yet visual cues appear to be the primary way food is detected at close range, while smell may play a role in orientation toward distant foraging areas.

MAGNETORECEPTION—Cues used by sea turtles for migrating to distant goals depend, at least in part, on an ability to detect two properties of the Earth's magnetic field: strength and inclination angle (to learn more, see *SWOT Report*, vol. XVI, p. 46). Those two features combine to create a sort of GPS sense that allows emerging hatchlings to navigate to distant nursery areas and to return, as adults, to their natal nesting regions.

Science continues to search for what sea turtle sensory systems are able to detect and perceive. Lab studies have attempted to identify what their sensory receptors detect. Yet detection is not perception. For example, light wavelengths and intensities that sea turtles behaviorally respond to (perception) during sea-finding is only a small subset of what their eyes are physiologically capable of responding to in lab experiments (detection). Similarly, the neural processes that respond to noxious stimuli, such as pain (nociception), only trigger defensive behavior if the stimulus is perceived. How sea turtles feel pain remains inferred from humans' perceptions rather than understood from the turtles. •

What Are the Natural Predators of Sea Turtles?

By Michael Heithaus

When we think about threats to sea turtles, we often think only about human-related pressures. But sea turtles face a multitude of risks from natural predators throughout their life cycles.

Predation pressure on sea turtles starts before they hatch, when nests may be raided by mammals such as raccoons or foxes; several species of crabs; or countless forms of microbes, insects, mites, and more.

Hatchling turtles are at even greater risk from mammals, birds, and crabs as they cross the beach to the sea. Once they reach the water's edge, things don't get any easier. During their frenzied swim to reach deeper water, hatchlings are eaten by large bony fish, sharks, and sea birds. And when they reach deeper waters or the safety of mats of floating algae, the risks decline but don't disappear. In those habitats, too, the turtles are consumed by large bony fish and sharks, though we still cannot quantify the magnitude of this predation, nor do we know what other risks turtles may face during the posthatchling portion of their lives.

Once they have survived hatchlinghood and have large bodies and hard shells, adult sea turtles might be more immune to predators. But in Central and South America, American crocodiles and jaguars are a threat to nesting females, and in the Indo-Pacific, saltwater crocodiles prey on adult turtles both on nesting beaches and in inshore waters. At sea, large sharks are the primary threat to adult sea turtles, although killer whales may occasionally take sea turtles. Although white sharks and bull sharks have been recorded eating sea turtles—including accounts of white sharks taking adult leatherbacks—those two species rarely dine on sea turtles. But tiger sharks frequently prey on large juvenile and adult sea turtles. In fact, tiger sharks may have evolved specifically to feed on sea turtles. Tigers grow to over 4.5 meters (about 15 feet) and have broad heads that can accommodate large prey and curved, serrated teeth that cut in both directions when the sharks shake their heads, an adaptation that enables them to cut through a turtle's thick shell. Indeed, sea turtles worldwide are at risk from tiger shark predations in shallow seagrass ecosystems, coral reefs, and the open sea. In response, turtles have likely adopted behaviors, like choosing lower risk habitats (for instance, green turtles basking on shore), to reduce the hazard posed by tiger sharks.

Tiger sharks certainly play an important role in regulating turtle populations. Overfishing of sharks in the Pacific, for instance, along with diminished human take of turtles over decades, is likely one of the factors behind the rise in Hawaiian green turtle numbers in recent decades. And in the Atlantic, the disappearance of seagrasses off Bermuda may be due to reductions in tiger sharks and the consequent increase in turtles, which are major seagrass grazers. Maintaining natural predator-to-prey interactions in the oceans by conserving tiger sharks and turtles and all such symbiotic relationships is important to ensuring the overall health of ocean ecosystems. •

Sea turtles have many natural predators throughout their life cycles, and are especially vulnerable as hatchlings. © Jake Wilton