

In Nature and in the Aquarium

# The American Eel, *Anguilla rostrata*

Christopher Scharpf with photographs by John Brill

One morning, my Persian cat, Zeke, refused to come up from the basement. I called and called. No Zeke. I shook a box of his favorite food. No Zeke. Then I made the sound that any tuna lover like Zeke cannot resist. I ran the can opener. Still, no Zeke. Fearing he had met with misadventure—after all, my aquariums were in the basement—I descended the steps to investigate.

Zeke had found something better than tuna. Or even catnip. He had found a five-inch American eel that had escaped from its aquarium during the night and was now subjecting it to the most unspeakable torture. He batted it around with his paws. He ran with it in his mouth. He flipped it into the air and

batted it some more. Only when I settled back on his haunches, prepared for the death pounce, was I able to retrieve the eel from him.

Covered with cat fur and catnip, Zeke bunnies and dry like a piece of jerky. The eel sure looked like a goner. I quickly plopped it back into its tank and watched. Sure enough, it motioned. Not much, but just enough to show it was still alive. It remained motionless while shedding its cocoon-like covering of cat fur, dust, and dried slime. In two days it was just fine and ready to escape again.

Indeed, the secret to keeping American eels in the aquarium is keeping them *in* the aquarium.

Eels have a penchant for squeezing into tight places and will burrow under rocks or bury themselves in the substrate during the day. At night, they try to roam the house.





**Eels may be unusual in the aquarium, but they do have a certain appeal. If nothing else, their hearty appetites will appeal to many fishkeepers, especially those that really like to feed their fish heavily and are frustrated by the light appetites of many tropicals.**

Although easy to collect, easy to feed, and nearly indestructible (as the run-in with Zeke demonstrates), eels are amazing escape artists. But then, everything about the eel is amazing—where they're born, how they live, and how much mystery still surrounds basic elements of their biology. Since eels are secretive and rarely seen in their natural habitat, keeping eels in an aquarium has given me an opportunity to fathom their secrets and marvel at their adaptations, some of which I'd like to share with you here.

Of course, I will also share some practical, hard-earned advice on how to keep these amazing creatures from ending up on the fishroom floor.

### The Epic Life of the Eel

The life of the American eel (and its nearly identical cousin, the European eel, *Anguilla anguilla*), is one of the great epic odysseys of natural history. Every freshwater eel that eels its way

through the waters of North America and Europe begins its life as a microscopic egg up to 5600 km (3480 miles) away, in the unseen depths of the weed-choked Sargasso Sea.

Upon hatching between February and May, the newborn eel—a see-through, leaf-shaped waif of a fish called a leptocephalus—slowly travels north, passively drifting with the current. After six months to a year, the larval eel, now 4 to 7 cm long, begins the first and most dramatic of five transformations. Like a balloon deflating, its body reshapes itself into a recognizable eel-like form. The fish is now in its glass eel phase, so named because its heart, blood vessels, and backbone are clearly visible. Instead of drifting, the glass eel uses tidal currents to push itself shoreward.

From January to July, depending on how far north they have traveled, glass eels begin to enter estuaries from the West Indies to as far north as Greenland, rising in the water column during high

tide and retreating toward the bottom during ebb. During the two weeks or so it takes to ride the tides they complete their third transformation into the elver phase. As pigment begins to form, they begin looking like miniature eels.

Now the elvers face a choice. Do they move upstream into fresh water? Or do they hang back in the brackish waters along the coast? Male eels are more abundant in estuarine (coastal) and southern waters, where a greater food supply and warmer temperatures accelerate growth and lead to early sexual maturity at a smaller size (35 cm [13.8 inches]). Females, on the other hand, are more abundant in northern waters and in fresh water, ascending streams as far as 800 km (500 miles). In these colder freshwater systems, where food is less abundant, females mature more slowly but grow much larger than males (up to 1.5 m [5 feet]). Whether sex determines which direction the elver chooses or environmental conditions determine



which sex the eel becomes is a hot topic among eel biologists. What appears to be certain, though, is that it's to the species' benefit for eels in fresh water to be female. Females grow larger, and larger eels produce more eggs and contribute more offspring to the next generation than smaller eels.

Elvers that choose to head upstream are attracted to the odor of brook water, with its decaying leaves and distinctive microorganisms. This attraction must be strong, since the eel's persistence in getting above dams and waterfalls is legendary. Since eels can survive long periods out of water if kept moist (they're able to respire through mucous bubbles on the gills and skin), they will leave the water, usually on wet nights, and squirm their way through moist grass and mossy rocks to get around barriers. Some elvers literally force their way up small dams and spillways if the water flow is slight.

Eventually the spaghetti-thin elver doubles in size to about 10 cm and takes on a yellow-green or yellow-brown color. This is the fourth, or yellow eel, phase, the one aquarists and anglers are most likely to see. Here the eel clearly exhibits its most eel-like behaviors. It moves by synchronous undulations of its elongate body, which allows it to enter crevices and burrows and exploit food sources inaccessible to other animals. Indeed, the eel is happiest when it's hidden under a rock or buried in the substrate.

At night the eel comes out to forage. It is not a finicky eater. Any organic material, dead or alive, including other eels, suits its palate just fine. Sometimes its penchant for eeling into things includes other fish. Spawning female shad have been collected with eels feeding inside their ripe ovaries. Should an eel encounter an item of food that's too big for its jaws—a big fish carcass, for example, or a molting

**Escape-proof the eel aquarium can. Otherwise you may spend an inordinate amount of time rescuing the faint-hearted members of your household.**

crab—it simply grabs the fish and spins around rapidly (100 rotations per second) until a sized chunk breaks off. This fast feeding strategy is easily observed in the aquarium.

After 6 to 12 years of feeding and growing, the yellow eel transfers to its final phase, called the silver eel, usually in late summer or fall. The eel changes from yellow-green to black on the top half of its body and strikingly white on the bottom half, presumably to make it harder for predators to see in the open ocean. The sides take on a silvery or iridescent sheen. The rest of the silver eel's metamorphosis remains unseen in ocean depths, but laboratory experiments injected with hormones give us a glimpse of what happens. In the silver phase, the eel's eyes grow dramatically larger, and it changes in pigment, probably to improve their vision in the deep. The pectoral fins grow larger, too, while the teeth disappear. The snout gets shorter and blunter. The gills show similar but less extreme changes.

At night, usually during the dark phase, silver eels migrate downstream, towards the estuary, and eventually back out to sea. Once they enter the open ocean, they are almost never seen again. One was once photographed by a submersible cruising along the bottom in water 2000 m (1.2 miles) deep.

By February, the silver eels are found in the Sargasso Sea. Whatever

muscle that remains in the female is converted to egg production. Her muscles and bones soften, and her alimentary canal reduces to a strand. Her ovaries, filled with several million eggs, make up half of her body weight. Hormone-injected European eels in the lab suggest that the male takes the lead in finding a mate, and initiates spawning by rubbing the female's swollen body with his head. Nothing more is known about how eels spawn. Once the floating 1-mm eggs are deposited and fertilized, the parents, weakened by their epic voyage, almost certainly die, ending their lives as mysteriously as they began.

### In The Aquarium (and occasionally on the floor)

The eel's ability to exploit different habitats and types of food in the wild makes them hardy, long-lived residents for the home aquarium. As

such, eels are not fussy about water conditions and will accept any aquarium fare. It's even possible to keep eels in unfiltered aquaria as long as they are not overcrowded and overfed, and partial water changes are performed regularly.

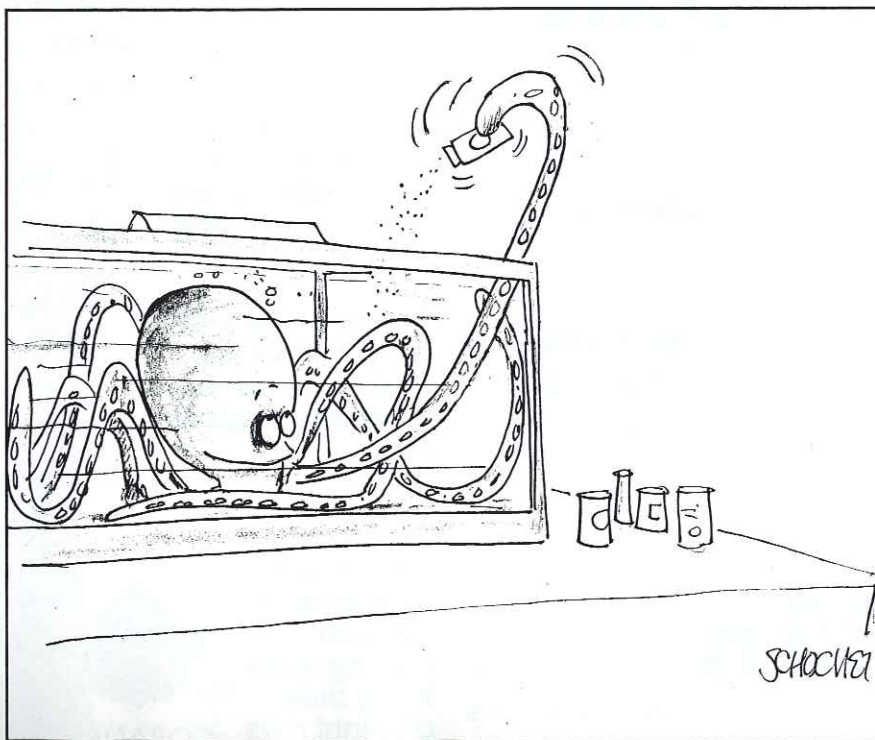
By day, captive eels usually remain buried in the aquarium substrate, or under rocks or other ornaments. By night, they are restlessly active and will try to eel their way out of the tank or up filter intake tubes, where they risk getting mangled by the filter's impeller blades. Eels are also fond of swimming up the outflow of "bio-wheel"-type filters and into the filter chamber.

To prevent escape, the aquarium should be covered with a tight-fitting hood or canopy. If the cover includes a plastic strip that attaches at the rear, make sure that the strip is completely flush with the top of the aquarium and

not turned up over tubes, air and other items that enter the tank through openings in the plastic strip snugly around tubes and hoses. If any openings remain, plug the filter floss as if you were adding insulation to a drafty window door. In addition, avoid the undergravel filters, since eels can swim down the lift tubes and get trapped under the filter plates. Be sure all filter intake tubes are covered with fry guards. And if it interferes with tank aesthetics, another precaution is to lower the water level a few inches from the top.

*Do not underestimate the eel's ingenious talents.* I'm slightly embarrassed to admit that every eel I've owned has foiled my attempts to confine it. When I've thoroughly sealed the top of the tank, I will knock something loose during feeding or maintenance and unintentionally leave the top open. Given an opening, an eel will find its way through it.

Why do eels try to escape? The answer may be found in their behavior in the wild. Yellow-phase eels live in home ranges of a quarter-acre and seldom stray from them. When eels are taken from their home ranges and moved to other streams, an amazing number of them find their way back. In one experiment, eels were captured from a New Brunswick river and driven by car to another 50 km (31 miles) away. Four eels returned to the original location. In another homing experiment, eels from a Maine estuary were moved



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17 km (6-10.5 miles). Nine of the 16 eels returned to their capture site within four days. Three others returned part of the distance. Considering the results of these experiments, it's possible that captive eels attempt escape simply because they are trying to find their way back home.

Once settled in the aquarium, eels will come out from their burrows as soon as food enters the water. I like feeding my eels live blackworms. I use a turkey baster to squirt the worms directly into the substrate, where the worms live until the eels find them. Eels will also perform a valuable service in the community tank by feeding on dead tankmates. Should a fish carcass get wedged behind a rock, piece of wood, or other decoration, an eel will gladly strip it to the bone

before it can foul the water. Given enough food, small eels will usually leave their *living* tankmates alone.

If an eel does not come out during feeding, it's best to assume it has gone AWOL. Immediately check under the aquarium stand or cabinet and the surrounding floor area, then expand the search in widening arcs away from the tank. Since eels can travel short distances across land in the wild, it may have traveled across the room. Check under rugs, floor mats, and anything else the eel could hide under. If there is another source of moisture or water in the room, like a drain pipe or a sump pump, check there.

If the floor search fails, then turn off the filter and dismantle the tubes while holding them over the aquarium. Check inside filter cartridges as well.

These packets often contain trapped food and provide a snug hiding place for secretive eels. Should an eel make it to the floor, don't despair. There's a good chance it is still alive no matter how desiccated it looks. My cat Zeke proved that for me!

Another clue that an eel has escaped is the performance of power or bio-wheel filters. If filter water flow has decreased, or if the filter sounds like it has run dry, then that's a good indication that an eel may be trapped inside its impeller housing or stuck in the intake tube. Again, turn the filter off and dismantle the tubes over the aquarium so the eel, if it is unharmed, can safely slip back into the water.

The downside of keeping American eels (aside from their inclination to escape) is that they will get too big to

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keep peacefully with other fish. When an eel begins posing a serious threat to its tankmates, you will need to keep it singly in a species tank, or have it humanely destroyed. According to guidelines recommended by the North American Native Fishes Association (NANFA), wild-caught native fish should not be released back into the wild, even to places from where they were originally collected, because potential aquarium-borne pathogens can be spread to wild fish. (For more information about NANFA and native fish, write P.O. Box 2304, Kensington, MD 20891, or visit [www.nanfa.org](http://www.nanfa.org).)

Collecting eels is almost as easy as keeping them. Netting elvers or small yellow eels is as easy as spending a few hours with a seine in just about any freshwater or brackish stream along the western Atlantic and Gulf coasts. Baited minnow traps will also attract eels, but only large ones will remain in the trap (where they often gorge on other trapped fish). Be sure that local regulations allow for the

collection of elvers and yellow eels. Occasionally small yellow eels are available at aquarium stores, where I've seen them labeled as the more exotic-sounding "Sargasso eel." Coastal bait shops are also a good source for yellow eels, but the eels tend to be rather large, and usually available only during striped bass fishing season, which runs from April to December depending on the region.

### A Few Words About Conservation

I would be remiss in my appreciation for eels if I didn't mention that their numbers are reducing in the wild. Even though the American eel is an adaptable species, it cannot adapt to everything man throws in its way. Populations of the eel—historically one of the most populous fish along the western Atlantic coast—have gone down in just about every river system in which it occurs.

Research into eel conservation is just beginning, but all experts agree that the eel is declining not from any one problem, but from a combination of pressures on all life stages that have a cumulative deleterious effect on the species as a whole. These pressures include dams and other obstructions, pollution, oceanographic changes that are influencing the drift and migration of leptocephali, the spread of exotic disease, and overfishing.

Although the American eel is not a protected species, aquarists should be mindful of its declining status and not take home more specimens than they need or are capable of keeping.

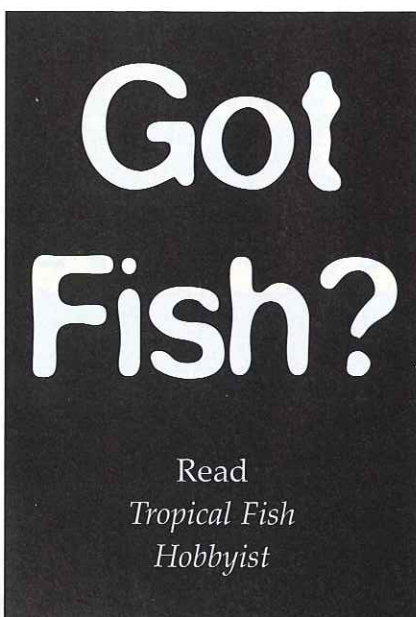
### Mysteries to Ponder While Watching an Eel

Despite their familiarity, American eel remains a tantalizing biological mystery. I am drawn to this mystery every time I watch one at the aquarium. Here is a creature that has traveled thousands of miles to where I could pluck it from its corner. But why did it choose the particular stream that it did? What made it decide how far inland it will ascend?

Had I not seined this eel from the river, what navigational cues would it have used to return to the Sargasso Sea? The stars? The earth's magnetic field? The scent of its birthplace imprinted on its memory and detected thousands of miles away?

As I watch an eel, transfixed by its continuous open-and-shut rhythm of its mouth pumping oxygen-rich water through its gills, I can't help but to ponder a bigger, more profound mystery: why do eels live such complex, epic lives? One theory is that eels evolved when Europe and North America were closer together and the Atlantic Ocean was much smaller. As the continents slowly drifted apart, the eels gradually adapted to traversing greater and greater distances in order to reproduce. Another theory is that one ecosystem is not capable of providing enough food for both large and maturing eels. Other research suggests that eels simply did not evolve the more advanced physiological systems required for eggs to survive the osmotic stress of fresh water.

Whatever the explanation, it's clear that eels represent a single ecological thread that runs through three different



ecosystems—marine, estuarine, and fresh. The billions of leptocephali that hatch in the Sargasso become food for countless ocean creatures. Glass eels and elvers are eaten by predatory fish and birds. And the dead and rotting parents that sink in the Sargasso provide nutrients to the ocean abyss.

In nature's grand design, everything is interconnected. It's amazing to think that the eel population in a small South Dakota stream has some bearing on the ecology of the Sargasso Sea. But then, everything about the American eel is amazing.

### More Amazing Eel Facts

- Ascending into streams, lakes, rivers, underground springs, swamps, and salt marshes, the American eel probably has the widest naturally occurring geographic and environmental range of all freshwater fish in the world.
- Eels are not scaleless. Their scales are merely fine and embedded in the skin. Its "slippery as an eel" feel is the result of copious body slime, a convenient adaptation for living in confined spaces.
- The eel's sense of smell is second only to the dog's. In one experiment, captive eels were able to perceive the scent of roses at a dilution of 1:2,857 trillion!
- In Sweden, a captive European eel named Putte achieved celebrity status for living in various owners' tanks for 88 years. 🐟

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