

Croakin' at Casmalia

Endangered Frog Wages a Comeback At Toxic Superfund Site

By Nick Welsh

It was five years ago this spring that wildlife biologist Larry Hunt first encountered the perversity of miracles. An expert on frogs, toads, newts, and salamanders, Hunt was paddling his kayak around the edge of a vast rainwater storage pond on the southern edge of an abandoned toxic dump 10 miles outside of Santa Maria. There was no moon that night, and a cool breeze blew across the water's surface. Hunt could hear coyotes howling in the hills close by.

In this setting, Hunt had to remind himself where he actually was. Shining his headlamp across the water, Hunt saw tight clusters of tiny eyes beaming brightly back. He recognized them as spiders, which can have as many as eight eyes each. But Hunt wasn't being paid to find spiders. He was looking for signs of amphibian life where by all rights none should exist.

Hunt had been hired by a consortium of big companies and government agencies that for 16 years had sent vast quantities of some of the nastiest and scariest chemicals known to mankind to Casmalia Resources, a Class I toxic dump situated on 252 acres of seductively rolling hills near the tiny town of Casmalia.

Until it was finally shut down for leaking 11 years ago, Casmalia Resources had accepted 5.6 billion gallons of solvents, acids, pesticides, and PCBs. So terrifying was the witches' brew of industrial and agricultural poisons buried there, that in 1992 the federal Environmental Protection Agency declared the dump an official Superfund Clean-Up site. So frightening was the potential that some of the buried chemicals might migrate offsite, EPA administrators decided that not a single drop of rain that fell on Casmalia's grounds could be allowed to escape.

To stop any rainwater from running down the southern slope of the site, the EPA sculpted five enormous storage ponds—each two football fields long and one football field wide. It was in one of these five ponds that Hunt was quietly paddling when he stumbled onto something he never expected. As he pointed his headlamp towards the shore, he encountered significant pockets of eye-shine off the water's surface. As he got closer, he discovered the light was being reflected from frogs' eyes. Surprising perhaps, but as he drew closer—maybe two feet away from the frogs—Hunt saw the creatures had dark ridges running up and down their bodies along both sides of their spines. That could mean only one thing. Red-legged frogs were living there.

The species—formally known as *Rana aurora draytonii*—is now teetering on the brink of extinction, having been nearly eaten, dammed, farmed, grazed, and subdivided past the point of no return. The subject of Mark Twain's classic tale, "The Celebrated Jumping Frogs of Calaveras County," California red-legged frogs had long been one of the most common frogs in California. Physically, it was the largest frog native to the state. By 1996, however, the frog's grasp on existence had grown so tenuous that the federal government placed it on the federal Endangered Species list.

But there they were, staring, unblinking, out of the water in the most polluted place in Santa Barbara County at the blinding glare of Larry Hunt's headlamp. And there they've managed to remain. In the ensuing five years since the discovery, Hunt has surveyed Casmalia's ponds twice a year in search of amphibian life. In each visit, Hunt reported he encountered red-legged frogs in four of the five ponds, finding as many as 130 and as few as five.

Hunt also discovered that the frogs are not merely migrating from somewhere else—possibly the nearby Casmalia or Shuman creeks—but actually reproducing in the ponds. He said he consistently sees red-legged tadpoles and juveniles in the ponds as well as adults.

Contrary to what one might expect to find at a toxic dump, there's nothing particularly freakish about these frogs. "They appear to be normal," Hunt said. But he also said, "There are some very large individuals the size of a small dinner plate. In a natural population, they don't usually reach that size." That an endangered species could flourish in so daunting a habitat—an industrial San Quentin for carcinogens and mutagens—provides a much needed eco-parable on the virtues of perversity and perseverance. In a small but wonderful way, the red-legged frog reminds even the most pessimistic that reasons for hope still exist, especially for those willing to look for them in all the wrong places.

Frog in the Coal Mine

In the early 1990s, field biologists and ecologists began expressing alarm that so many amphibious creatures worldwide appeared to be dying off. Scarier still were reports—circulated by biologists just back from the jungles, forests, and swamps—of weird, unsettling mutations: frogs with two hearts, frogs with five legs, and frogs that were both male and female.

Scientists spun the threads of such disturbing anecdotal evidence into a detailed tapestry of despair. All of a sudden, frogs and other amphibious creatures, which had never enjoyed the popularity of more charismatic creatures like the grizzly bear or the California condors were the stuff of front-page news. Now the frogs were cast as the modern-day canary in the ecological coal mine. Because they live both an aquatic and terrestrial existence, as all amphibians do, many scientists argued that frogs were exposed to the pollutants of not one but of two worlds. And because they breathed through their skin and not their lungs, they were more vulnerable to the toxic effluvia of modern industrial and agricultural technologies.

There is no shortage of scientific theories to explain the decline of certain frog species: Holes in the ozone layer, which increases ultraviolet radiation; female hormones from birth control pills that get into the waterways via urination and incomplete wastewater treatment; agricultural pesticides; the deadly chytrid fungus; and/or global warming are all suspects in the mayhem.

But the decline of the frogs is a fact, and many herpetologists worry that this signals something more dangerous than the canary in the coal mine. After, all, when that frail bird keeled over from the noxious gas, the miners still had time to get out of the tunnel.

When a creature as resilient and formidable as a red-legged frog finds itself in such dire straits, maybe it's too late for the rest of us to get out.

Push Comes to Shove

This unassuming amphibian has definitely made itself felt during its few short years on the endangered species list. In Santa Barbara, the presence of the red-legged frog proved pivotal in slowing down ARCO's plans to build the deluxe Dos Pueblos Golf Course along the Gaviota Coast. During that delay, opponents of ARCO's plans amassed other environmental evidence to persuade the California Coastal Commission to reject outright the Dos Pueblos plan.

To protect the red-legged frogs' habitat, the U.S. Forest Service has banned all motorized vehicles from several very popular back-country roads. And it's only a matter of time before Santa Ynez vintners find their expansion plans at least stymied by the red-legged frog.

Certainly, the politically powerful Washington Mutual bank has encountered serious difficulties in getting permits for its proposed 3,000-home subdivision on the eastern borders of Ventura and Los

Angeles counties when the frog was found in a creek where it had not been seen for 35 years. Although the developers have pledged to grow red-legged frogs—a mitigation many biologists question—they have yet to propose habitat protections sufficient to satisfy the U.S. Fish and Wildlife Service.

Given the stakes involved, the frog often encounters powerful opposition. When the U.S. Fish and Wildlife Service designated four million acres of prime Bay Area rural real estate as critical habitat for the red-legged frog, the Home Builders Association of Northern California argued that the designation would preclude any new development. And while environmentalists countered that an endangered species listing without the critical habitat was next to meaningless, the real estate lobbyists prevailed.

Ain't Got No Home

Lots of things have changed since Mark Twain wrote about red-legged frogs 140 years ago. Its leaping prowess, for example—six feet in a single bound—has been eclipsed by many of the exotic species that have since moved into the state. And, in fact, it never was all that red; its inner thighs and hindquarters are more a dark salmon pink, and the back is green covered with dark spots and blotches. But most disturbingly, the frog Twain described can no longer be found anywhere in Calaveras County. In fact, the red-legged frog can now be found in only 26 of the 46 California counties it once occupied. Simply stated, the main culprit for the frog's rapid decline is people. In 1867, when Mark Twain put the frog on the literary map—though some biologists insist it was the frog who made Twain a household name—California was home to 560,000 inhabitants. Today, California claims a total population of 35 million and grows by 560,000 people a year.

According to Marc Jennings—the biologist most responsible for the frog's listing as an endangered species—the once common red-legged has lost 75 percent of its traditional habitat. It was once commonly found from Point Reyes National Seashore to the north and to Baja California to the south. It ranged inland over the eastern slope of the Sierra Madre Mountains, as far as Shasta County. Perhaps the most dramatic disappearances occurred throughout the Central Valley east of the Sierra Mountains, once home to some of the most sizable wetlands in the state. In addition, agricultural pesticides—blown up and eastward from the valley floor—are suspected for the dramatic decline of frogs on the eastern slope of the Sierras. Today, Ventura County is the frog's southernmost domain. The best remaining habitats—and populations—can be found in Santa Barbara, San Luis Obispo, and Monterey counties, which still offer long undeveloped stretches of coastline crosshatched by a multitude of cool mountain streams upon which red-legged frogs depend for their survival.

Frog-Eat-Frog World

The single necessary ingredient that defines the life cycle of the red-legged frog is a permanent water source. That's no doubt why frogs moved to Casmalia. Adults prefer deeper, slow-moving pools surrounded by dense vegetation. Juveniles gravitate towards shallower bodies of water. Like most frogs, red-leggeds will eat anything that moves and is smaller than they are. That might be why juveniles have been hard-wired to seek separate swimming accommodations from their adult counterparts.

Like most frogs, red-leggeds cannot see things that do not move—even things right in front of them—which explains why they can starve to death while surrounded by the carcasses of dead crickets. Adult red-leggeds are nocturnal hunters, and will eat a wide array of insects, small snakes, mice, and even baby birds. Typically, they use their tongues to stun their prey, and then, according to UCSB's frog and newt biologist Sam Sweet, "They'll open their mouths and dive on it, and cram it in with their front legs," he said. "You have to remember frogs have giant mouths relative to their body size and no teeth to get in the way, so they can swallow things that seem unusually large."

But lacking throat muscles, they really need to cram their prey down. To this end, red-leggeds will deploy their eyeballs as extra appendages to secure their prey as they pounce. In fact, the only time a red-legged will ever close its eyes is when using them to help pack in its meal.

Almost always, they eat their prey live, giving rise to frantic, but short-lived intestinal struggles visible to anyone watching the frog's belly, concluding with the release of hydrochloric acid in the frog's gastric juices. It may not be pretty, but that's nature.

For most of their lives, red-legged frogs do not socialize. They come together only to mate after the winter rains. Males—typically smaller than the females—show up at a watering hole first to claim their spots. There, they bleat out their low percussive calls, competing with one another to attract a mate—these mating choirs are why a group of frogs is known as a “chorus.”

After three or four weeks, the females finally arrive, and they are drawn to the males with the lowest calls. “The bigger the frog, the lower the call,” Sweet explained. “They [the females] go for the bass voices.”

The males, distinguished by their larger, more muscular front arms and swollen thumbs, hook their forearms under the females’ armpits so they don’t fall off as the females back up in search of just the right spot to lay their eggs. Typically, females like to attach their necklace of some 3,000 jelly-coated eggs to a tall blade of grass or cattail protruding from the water. After the males fertilize the eggs, both parents depart, leaving their offspring to fend for themselves.

It usually takes one or two weeks for the tadpoles to hatch, and another four to five months before the tadpole—strictly an underwater creature—metamorphoses into a terrestrial juvenile. But even as a tadpole, the frog’s resilience is evident. Biologists have discovered that some red-legged tadpoles can go up to 30 days without food and still survive.

That same toughness is apparent in adults as well, especially during California’s long dry summers. Sweet says he’s encountered red-legged frogs in the mountainous back country, squatting in water so encrusted with salts and other minerals that it would make humans sick to drink. Frogs, he pointed out do not drink water, they absorb it through their skin, especially that of their thinner and smoother hindquarters, or seat patch. Red-leggeds, like other frogs, process and excrete the salts through special cells in their skin.

Herpetologists tend to agree that the red-legged frog isn’t the brightest creature, but once caught and let go, it is almost impossible to catch again.

They also have a great sense of direction. Lawrence Hunt described a study of red-legged frogs found in a concrete trough by the Guadalupe Dunes. Bar-coded identification tags were implanted under the frogs’ skin, and then the frogs were taken nearly three miles from where they were caught. Two months later, they had figured out how to get back.

One of the red-legged’s more ingenious survival strategies is that the frogs will keep one foot on a submerged branch in the water, using it to detect vibrations—and the size—of oncoming parties. “If it’s smaller than they are, they try to eat it,” said Jennings. “If it’s bigger, it dives.” And it dives deep and long. Red-legged frogs can remain submerged for hours on end; as many as 24 if the water’s cool and rich with enough oxygen.

Although many native creatures like the blue heron and the garter snake will readily feast on red-legged frogs, the now-endangered frog manages to discourage many predators by secreting a toxic milky substance on its skin that stinks like burnt rubber, burns the eyes, and causes the throat to constrict. For those pharmacologically foolhardy souls seeking psychotropic adventure by licking the skins of toads and frogs, the red-legged, according to Sweet, promises nothing but “the worst asthma attack you could possibly imagine.”

Deep-Fried Death

Although Sweet is keen to the misery humans have inflicted upon the red-legged frog, he suggested the frog’s real troubles started about 12,000 years ago, with the beginning of a global shift in climate. “Twelve thousand years ago, there were lakes in the Mojave Desert, and Death Valley was a rich oak forest,” he said. As a result of global melting and the climate shift, all the water we used to get is now going to the Pacific Northwest.” The good news, he said, was “There’s no evidence it won’t come back again.”

It’s perhaps coincidental that 12,000 years is about the same time the Chumash—and their ancestors—have inhabited California. Chumash scholar John Johnson of the Santa Barbara Natural

History Museum said it was safe to assume the Chumash ate the frogs “because they ate practically anything that moved.” And according to ethno-botanist Jan Timbrook—also with the museum—the Chumash regarded the frog, usually in female form, as the keeper of the waters that feed the springs and creeks. By withholding her urine, the female frog created drought. By releasing it, she created abundance. Even today, the proximity of an old Chumash village near Ojai is indicated by the name of a nearby stream—Frog Urine Creek.

Statewide, red-legged frogs fared well until California was seized by Gold Fever in the late 1840s. The quest for gold and, later, silver which drew so many outsiders to California in the mid-19th century laid waste to entire mountain ranges. Streams and marshes upon which the frogs depended were choked with river debris washed down from the mines.

As cities like San Francisco grew fat with the wealth these miners created, a quest for newfound sophistication quickly ensued. By the late 19th century, frog’s legs became the rage in Bay Area restaurants and hotels. According to frog biologist Marc Jennings, frog’s legs—typically served deep-fried—were the second most valuable commodity in the San Francisco Fish Market for a while. (Whale bones were first.)

In one year, 100,000 frogs were taken. With the red-legged populations seriously depleted, restaurateurs began importing bullfrogs—native to Maryland and Florida, but foreign to California. Bullfrogs are insatiable eating machines that never stop growing. When in close proximity, they tend to make quick meals of red-leggeds. Worse, the female lays about four to five times as many eggs as a red-legged.

Other creatures proved problematic, too. Raccoons—also not native to California—it turns out, are undaunted by the frog’s toxic ooze. Just one family of hungry raccoons can devastate a red-legged population. Equally disastrous has been the introduction of aquatic exotics—like bass, sunfish, catfish, and crayfish. “These fish will eat every last red-legged frog tadpole, but they don’t eat the bullfrog tadpoles,” said Sue Christopher, a UCSB graduate student studying frog populations at Vandenberg Air Force Base.

Resurrection

Sweet expressed skepticism about this strategy. In some places, scientists seek to restore red-leggeds by raising them in captivity and releasing them into the wild. Such efforts have been tried en masse with other frog species, with the result being, according to Sweet, “They all died horrible, agonizing deaths.” He added, “It doesn’t make much sense to raise new frogs until you understand what wiped them out in the first place.”

In Riverside County, a large nature preserve was created at considerable cost and effort to protect the last remnant red-legged population there. Today, that project is relying on the reproductive enthusiasm of just two males for its very survival. Part of the problem, said Jennings, is that nearby golf courses have hired pest control operators to transplant raccoons from the links to the frog preserve. In addition, Jennings said, a well-intentioned but badly misinformed public school teacher had scooped up several bullfrogs and relocated them on the preserve.

Home Sweet Home

In Santa Barbara County, however, the red-legged frog is doing relatively well from Gaviota northward. Vandenberg Air Force Base is home to some of the state’s largest remaining wetlands as well as vast tracts of open land. The backcountry of the Los Padres Forest remains a prime frog habitat. As long as humans are not present, it seems the frogs can thrive even in the weirdest of places.

And not just the forlorn wasteland of Casmalia. Christopher reported that red-leggeds have been found near the Guadalupe Dunes—where Unocal is still cleaning up the largest underground toxic spill in state history. “I’ve found California red-legged frogs in a lot of wastewater ponds,” she said. “These sites were the kind of places that you don’t really see much in the way of living organisms.” (Some sites at Vandenberg are so contaminated that frogs found there are deemed unfit for relocation. If predators at another site were to eat them, the fear is they would get sick. When Vandenberg sought to clean up one such site, the frogs there were ordered destroyed. Their execution was put off,

however, due to a nasty feud between the U.S. Fish and Wildlife Service and California Fish and Game over who had jurisdiction to permit their killing.)

If that sounds strange, it's probably no weirder than the bureaucratic tango that's likely to occur when the EPA proceeds with its plans to close the Casmalia toxic dump once and for all. That time is still many years away, and will cost close to \$300 million to accomplish. If EPA engineers get their way, they'll cover anything that ever contained toxic materials—even the retaining ponds—in layers of earth alternated with blankets of a porous Kevlar plastic. If and when that time comes, the red-legged frogs now living in Casmalia's ponds could be a distinct nuisance. After all, it's against the law to disturb members of an endangered species.

Already, students at UCSB's Donald Bren School of Environmental Science and Management sought to solve this riddle, suggesting various strategies to relocate the Casmalia frogs to the nearby Shuman Creek. But as any biologist can attest, maybe relocation efforts don't always succeed.

In hindsight, maybe the parable of the red-legged frogs at Casmalia is about something so simple and basic as water. Maybe it's as much about desperation as it is hope. In light of what's already happened to red-legged frogs statewide—and what continues to happen—there really is no riddle why they roost at Casmalia. The fact is, they can't afford not to.
