THE INCOMPARABLE PLATYPUS

BY ERIC HOFFMAN

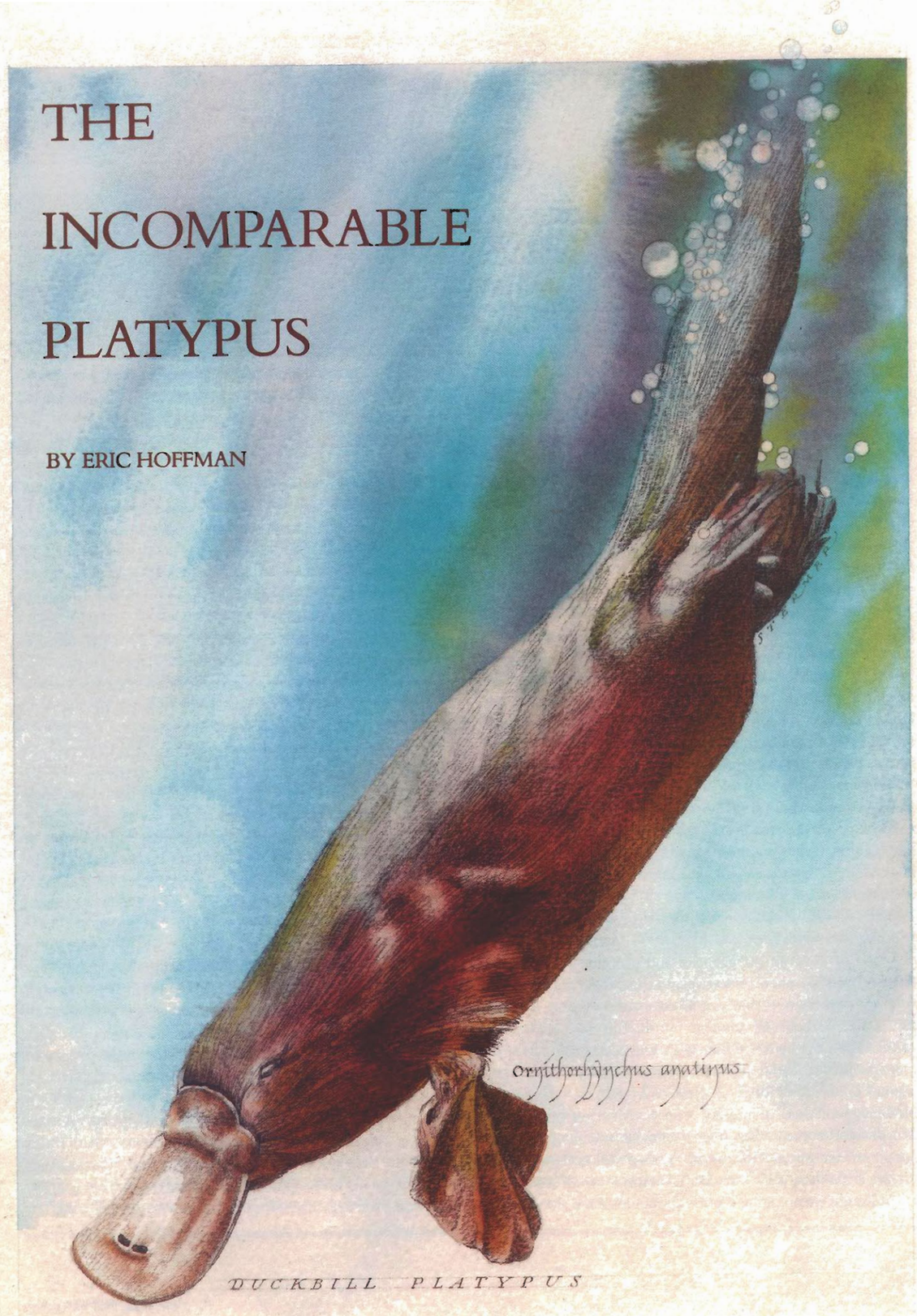


ILLUSTRATION BY DUGALD STERMER

After almost two hundred years of scientific bafflement and debate about its evolutionary origins, the elusive, egg-laying mammal is impressing biologists with its sophisticated adaptations to a watery lifestyle.

IN 1798, SCIENTISTS AT THE British Museum opened a box sent by colleagues in Australia. It contained the furry pelt of a creature with webbed feet, a flat tail like a beaver's, a long bill like a duck's, and various appendages and anatomical curiosities that made it unlike anything they had ever seen before.

The reaction was immediate disbelief: the scientists dismissed the specimen as a fake, the clever ruse of irreverent Australian colonials.

Today, that pelt is still in the museum's research collection, complete with scalpel marks where skeptical scientists tried to locate the stitchery that attached the bill to the body. The animal, it turns out, was no fake, but a real creature now commonly known as the duckbilled platypus, *Ornithorhynchus anatinus*.

To this day the curious creature still confuses and bemuses scientists. Only now are they finally beginning to solve the mystery of what it is and does, and the picture they are assembling is of an animal far more bizarre than anything the scientists at the British Museum could have imagined.

For the field biologist, part of the difficulty in piecing together the platypus's story is the animal's incredible wariness. Even though the animals are paddling about in substantial numbers in the slow-moving, shallow watercourses throughout eastern Australia's Great Dividing Range, the east coast tablelands, upper Murray River drainage, and in Tasmania, only the most dedicated and keen-eyed observers have seen one. Jack Throp, the former Director of Sydney's Taronga Zoo, estimates that "fewer that 5 percent of Australians have ever seen a platypus in the wild."

The platypus is nocturnal. The best time to catch a glimpse of one is at the crack of dawn, overlooking a glass-smooth pool in a secluded stream. Usually the first sign of a platypus is its small wake, which at first glance could be mistaken for that of a large fish or turtle swimming close to the surface. Just the eyes, the nostrils in the bill, and the upper back of the animal poke above the surface.

A platypus is surprisingly small. Adults seldom weigh more than four pounds (1.8 kilograms) and rarely measure longer than 24 inches (60 centimeters), bill to tail. Except for its broad bill and webbed feet, the animal's entire body is covered with dark, otter-like fur that is often the same color as the murky rivers it inhabits. Unlike other aquatic mammals, such as the beaver which pushes through water with its hind legs and tail, the platypus pulls itself along with its extensively webbed, oversized front feet. It is a strong swimmer, churning along at twice the speed of the ducks or geese that sometimes share its pools.

A platypus in a quiet pool is a delight to see. It dives, captures small invertebrates, and returns to the surface to eat. Ripples and faint splashing radiate out from its busy bill as it transfers its catch from cheek pouches to mouth and grinds its food between horny pads in the upper and lower jaws. It may interrupt its eating to groom, or paddle after other platypuses in courtship, to settle territorial squabbles, or to play. But at the slightest movement on the bank, the show is over. The animal disappears. It is the platypus's steadfast shyness and adherence to a nocturnal schedule that has kept such basics as how the animal catches food, reproduces, and behaves under wraps for the better part of the last two centuries.

During the 1800s, Australians used dogs to hunt platypuses. Probably because the animals are so difficult to locate and have such small, tough-skinned pelts, platypus fur never caught on as a commercial export, or even as a domestic

ESTHER BEATON/AUSCAPE

money-maker. It took around forty pelts to make a single rug or bedspread.

To supply humans with small apparel such as furry slippers and hats in the late 1800s, platypuses were victims of target practice, fishing nets, and hunting. While an animal relaxed on the surface, the hunter shot just below it. This stunned the platypus while a dog retrieved it. Shooting a hole in the platypus would defeat the purpose of collecting its pelt.

Hunters and dogs alike found that even a stunned or dying platypus could trade tit for tat. Male platypuses have sharp spurs on their hind legs that dispense a strong toxin. The struggling platypus would clamp its legs around the dog's muzzle, drive in the spurs, and release the poison, often killing the dog. Occasionally, people were spurred. That could result in severe pain, swelling, and weeks of partial paralysis.

Platypus-induced paralysis of another sort struck nineteenth-century taxonomists when they grappled with classifying the platypus. The battle raged over its paradoxical makeup. Though it suckles its young like a mammal, its reproductive tract was found to be more like a bird's, suggesting it laid eggs instead of bearing live young. The classification quandary was temporarily resolved when someone hit on the concept of the "primitive mammal," a possible bridging link to reptiles.

Platypuses were assigned to the lonely mammalian order of Monotremata, which means "one hole" for both excreting waste and reproduction. Only the echidna, the two species of spiny anteater found in Australia and New Guinea, share the order with them. In the eyes of most scientists this classification placed platypuses below both placental mammals (humans, dogs, cats, etc.) and marsupials (kangaroos, koalas, wombats) in evolutionary development. Those trying to classify its genus and species were befuddled. Initially, the 'duck mole,' as many colonials had come to know it, was named *Platypus anatinus* (meaning flat-footed and duck-like). However, scientists scrubbed *Platypus* for *Ornithorhynchus* when it was discovered that a group of beetles was already known as *Platypus*. Probably because *Ornithorhynchus* is such a mouthful, the species name is used only by scientists. "Platypus" has survived for popular usage, despite the beetles.

The fact that the platypus lays eggs wasn't conclusively established until 100 years after the animal's discovery. The mammary glands of female platypuses are very large in proportion to the size of the animal, and the nipples have evolved to accommodate young platypuses' bills. The skeletal structure, with splayed front legs and distinctive pectoral girdle, is similar to a reptile's.

From 1800 until the 1930s the platypus was generally ignored by science. In the 1940s and 1950s Australian naturalists Harry Burrell and David Fleay, working on less than a shoestring budget, made great strides in understanding platypus behavior and diet. In 1944, Fleay's efforts culminated in the only hatching of a platypus in captivity — a feat that has never been duplicated.

During the century and a half of inattention to the platypus a wealth of misinformation and half-truths accumulated. It was popularly believed that platypuses breathe through their backs, because air bubbles rise from their bodies when they swim under water. This turned out to be nothing more than trapped air escaping from their thick, insulating fur. Among scientists it had become "common knowledge" that platypuses, like reptiles and unlike mammals, couldn't regulate their body temperatures in water. But in 1972, New South Wales University doctoral student Tom Grant, using telemetry equipment, found that platypuses thermo-regulate in near-freezing water as well as any aquatic mammal.

The scientific community was beginning to focus on the platypus. Interesting discoveries followed.

The platypus's bill, which had so often been compared to a duck's bill, proved to be astonishingly sophisticated. Both ducks and platypuses use their bills to collect food, but the platypus's bill is broader, pliable, and leathery, and possesses a sensory system that functions like a scanner in locating live food. Under water, a flap of skin covers the eyes and ears and the animal's nostrils close tight. A hungry platypus wags its bill back and forth as it paddles along in an attempt to get a fix on prey. "What guided them under water was the question we'd been asking for years," says Grant.

The mystery was solved in 1986, when Henning Scheich, of the Technical University Darmstadt in West Germany, received a platypus bill in the mail from Australian mammalogist Chris Tidemann. Scheich is an expert on electric eels. He, Tidemann, and other Australian scientists conducted experiments with captive platypuses and determined that the animals are extremely efficient at detecting very low-voltage electrical fields. The fields the researchers created using 1.5-volt batteries were similar to those created by the platypus's favorite food: small crustaceans, worms, larvae, and freshwater shrimp that hide in the nooks and crannies of murky river bottoms. Tidemann elaborates, "Their electroreception is passive — nothing is put out — but they're very good at pinpointing a source of low-voltage emissions, even if it's in a hollow brick."

Subsequent research has shown that the platypus's bill is highly sensitive. It possesses approximately 850,000 tactile and electrical receptors, which feed information to the brain.

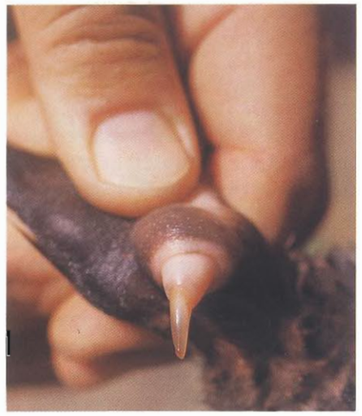
The platypus is the only creature in the world with aquatic and terrestrial sensory systems that work independently from

Platypuses live in a wide range of habitats in Eastern Australia, from sub-alpine streams to coastal waters. Opposite, early morning mist rises from Kambaa Pool in the Murrumbidgee River, New South Wales. Platypuses (Ornithorhynchus anatinus) *are largely nocturnal, but may occasionally be seen in daytime swimming or along shore near the entrances to their riverbank burrows.*

JEAN-PAUL FERRERO/AUSCAPE (2)

PETER TEMPLE-SMITH

A spur on the heel of male platypuses (below) can inject a highly poisonous venom into rival male platypuses or unwary humans. The poison is produced in a crural gland on the animal's thigh, and carried to the spur through a duct. Biologist Tom Grant (left) has worked with these animals for sixteen years, and was spurred once, in the back of the hand. "It was really painful for the first two days," he recalls, "and my hand was stiff for almost two weeks. But he only got me with one spur."



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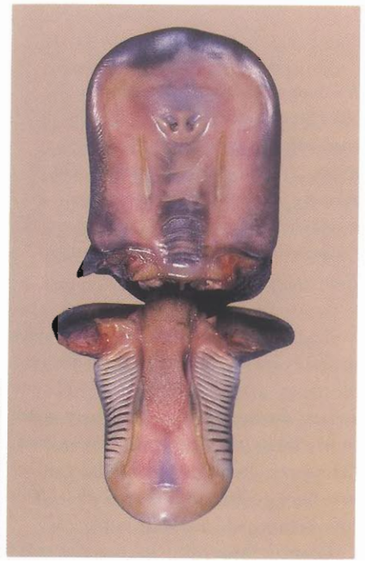
one another. The eyes, ears, and nose let the platypus know what's happening on land. The highly sensitized bill directs the foraging platypus to food and warns him of submerged boulders and logs.

"It makes sense that the bill is highly developed," says Grant, "considering that the platypus is a nocturnal animal that feeds on dark nights at the bottom of even darker rivers." Because the sensory system is so unique in structure, Scheich and Tidemann are confident the finely tuned bill is an independent adaptation. It's not related to any other known biological electro-receptor system, such as those common to some sharks.

Though it is not a high-tech appendage like the bill, the platypus's tail has also been misunderstood. It is often compared to a beaver's tail, perhaps because it is broad and flat and both animals share an affinity for water. But a beaver's tail is hairless, scaly-looking, muscular, and used to propel the animal through the water. In contrast, the platypus's fur-covered tail is a fat-filled appendage used not for propulsion but as a rudder. For scientists conducting field research, the tail has become a useful barometer to judge an animal's health. "Generally, the fatter the tail, the healthier the animal," says Grant. The tail also acts as a portable heater. When they curl up to sleep or incubate their eggs in their riverbank burrows, platypuses wrap their tails around the front half of their bodies.

Out of water, platypuses steadfastly pursue an underground lifestyle. They block their burrow entrances by backfilling them. Nesting burrows, which are the most elaborate, may extend 100 feet (30 meters) or more. Resting burrows may be just a few yards long.

Scientists have never observed copulation between wild platypuses, and much of how they care for their young is not known. During nesting in the spring and summer females will seal themselves into their burrows for days. Gestation is thought to take about a month, and the eggs hatch in ten to fourteen days. Young are born naked and blind, the size of a quarter, and three months of vigilant care are required before the mother brings



JEAN-PAUL FERRERO/AUSCAPE

This view of a dissected upper and lower jaw of a platypus shows the horny pads which grind up small mollusks, crustaceans, and insects. These pads are extremely important because the stomach, which has a cornified lining, produces no digestive juices. Mud and sand ingested while feeding are thought also to assist in grinding up the platypus's food, which the animal captures underwater and stores in cheek pouches before transferring it to the mouth.

them out for their first swim. The babies spend their first months literally confined to a plugged hole in the ground. This behavior intrigued Grant. "It's a great strategy against predators, but I wondered how they acquire enough oxygen to survive in their burrows. Especially since the oxygen they use is replaced by exhaled carbon dioxide."

Grant took blood samples and found platypuses have an inordinate number of red blood cells. "Their high red blood cell count is similar to that of a prairie dog," explains Grant. "The two species aren't related, but they've come up with a similar evolutionary response to combat hypoxia [low amounts of oxygen]."

Dr. Frank Carrick of the University of Queensland has studied platypus reproduction and ecology for twenty years, and has come up with surprising findings. "To begin with, the platypus egg is extremely porous. It is so porous that nutrients and waste can pass through it." According to Carrick, this is unique. He has also found that the hormonal changes in a pregnant platypus are remarkably similar to changes in other mammals.

As for the male part in reproduction, Carrick says, "The sperm is unique among mammals. It resembles the sperm of a bird in its structural simplicity."

While Carrick's findings may not explain conclusively where the platypus fits into the evolutionary development of mammals, he believes new information uncovered by him and others dispels many popular erroneous notions. "Simplistic dogma that attempts to explain evolution as a lineal process doesn't hold up with the platypus," he explains. "For example, all reptiles with venomous systems have modified salivary glands. How do you explain the platypus's venomous system placed on the hind legs?"

Some scientists feel that the platypus's splayed legs and reptilian-like pectoral girdle link it with reptiles. Carrick believes this can be explained just as easily as ". . . mole-like. After all, both mammals dig tunnels. Their skeletal structure is as apt to be a response to function as it is anything else."

While new knowledge about the platypus has eroded most of the old myths, sensational platypus-related

TOM GRANT

Biologists rarely have opportunities to observe young platypuses. The animal at right, estimated to be less than a month old and with eyes still closed, was found out of its burrow during a severe drought. Attempts to hand-rear it at the Taronga Zoo failed after about ten days.

JOHN FIELDS/THE AUSTRALIAN MUSEUM

A portion of lower jaw of an animal called Steropodon galmani *was found in an early Cretaceous deposit at Lightning Ridge, New South Wales, in 1985. This discovery is believed to indicate that an ornithorhynchid-like monotreme, Australia's first known Mesozoic mammal, existed in Australia 100 million years ago.*

paleontological work has changed the thinking of scientists about mammals throughout Australia. In 1984, Drs. Alex Ritchie and Tim Flannery of the Australian Museum in Sydney and Dr. Michael Archer of the University of New South Wales combined their talents in the discovery.

Ritchie visited the Lightning Ridge opal fields in New South Wales to look over a collection of opalized fossils that overseas collectors were about to purchase. His trained eye riveted on a small fragment. "The hair literally stood up on my back," says Ritchie. "I knew that the opal-bearing rocks of Lightning Ridge are 100 million years old. But here was an opalized jaw bone and three teeth of a cat-sized mammal. The oldest known Australian mammal was 24 million years old." Ritchie phoned Archer, who oversees Australia's famous Riversleigh dig, which has yielded the fossil remains of over 100 unknown species.

The next day Archer, Ritchie, and Flannery met in a dingy Sydney hotel room with opal miners Dave and Alan Galman, who had found the jaw. Archer recognized the jaw as belonging to a platypus-like creature.

News of the discovery ricocheted throughout the scientific community overnight. Archer explains why. "The discovery is heraldic. This platypus-like creature lived when dinosaurs dominated the earth. The find has started new thinking and proves that continuing the search is worth it," he declares.

The fossilized adult jaw, which was given the species name *galmani* in honor of the Galman brothers, has teeth. But today's platypus has only degenerative teeth that disappear with maturity. The lack of teeth has kicked off a lively debate about the future of the living platypus. Archer theorizes the evolving-out of teeth is not good for the species over the long haul. "Today's platypus is more specialized than his extinct cousin. Without teeth it has limited dietary options, which makes adaptation to dietary changes more difficult." Yet Archer sees a bright side. "Today's platypus is operating in a niche with no competition."

Flannery isn't worried about the platypus's future. "There will be platypuses in Australia as long as there are healthy freshwater habitats available for them. The varied smorgasbord of invertebrates that comprises the platypus diet provides tremendous latitude."

Over-specialized or not, the platypus seems to fare well enough, if it's left alone. Besides its wide distribution and broad-spectrum diet, the combination of extreme wariness and adherence to tunnel living has made it nearly predator-proof (though a crocodile may gulp one down in the tropics, or an eagle or dingo might snatch one traveling across land).

Seasonal cycles and human activity probably weigh more heavily on platypus mortality than anything else. "They're aquatic animals, so they must have water to live safely and find food," says Grant. "However, droughts and floods cause severe fluctuations in water levels that affect food sources and inundate burrows."

Grant is impressed by the platypus's ability to withstand hardships. "They often live a long time, up to thirteen years in the wild, which gives them good reproductive potential," he notes. Through a tagging program, Grant monitored platypus populations before and after a severe flood that changed a river from a series of deep pools to a raging mass of brown water that rose eight times above the normal level. "Amazingly, many of the animals I tagged before flooding were found in the same pools when the river subsided. How they accomplished that nobody knows," he says.

After sixteen years of nonstop research, Grant is still in awe of the furry little odd ball. He is not about to back off from trying to solve its many riddles. "As far as I'm concerned the platypus is the Australian mammal of all time," he declares.

Carrick adds, "Success of a species is the only final measure of its evolutionary development, and the platypus has 100 million years under its highly sophisticated mammalian bill. That's success."

CONCERNS ABOUT PLATYPUS CONSERVATION

THERE ARE NO national or state-run conservation programs in Australia involving the platypus. Both Drs. Frank Carrick and Tom Grant are guardedly optimistic, but concerned about the animal's future. Since 1911 legislative protection has banned platypus hunting in the four states where the animals live, but bullets may no longer be the chief threat.

Land use and the landscape itself is changing rapidly in Australia's river systems. "Platypuses are widely distributed along most of the east coast," says Carrick, "but the distribution is markedly discontinuous. The species has a limited capacity to recolonize, so fishing activities, chemical pollutants, and dams lead to the rapid reduction or extinction of local populations. Moreover, because of the animal's secretive habits it's difficult to assess how well a population is doing."

Grant is particularly concerned about the harmful impact of large dams. By the year 2000, nearly 50 percent of the major rivers of the southern state of Victoria will be controlled by dams. New South Wales already has eighty-four dams greater than 30 feet (9 meters) high, with twenty more on the drawing boards. The other two playtpus states, Tasmania and Queensland, have been slow to react on environmental issues in the past. Tasmania has made hydro-electric development a priority.

A large dam impacts a great portion of any river system. It floods some areas, while restricting water elsewhere. Grant sees a number of unpleasant scenarios for the platypus. "If the new water level doesn't offer suitable soil along the bank, establishing new burrows may be impossible. If a dam is filled during the months mothers care for their young, the babies will be lost."

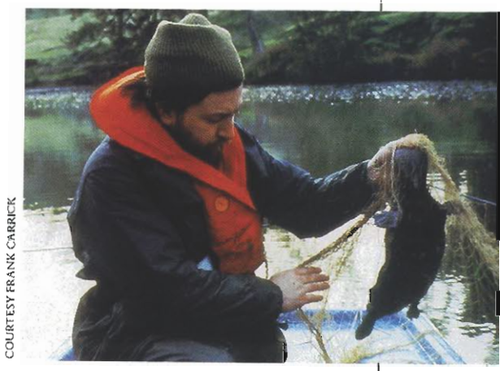
According to Grant, platypuses may not do well in deep water reservoirs. "The duration of a platypus's dive is only about ninety seconds," he says. "It needs a relatively shallow body of water to reach the bottom and still have time to search for food." Dams don't necessarily guarantee a ready food source in the shallows near the shore. "Drastic fluctuations caused by releasing water for irrigation and metropolitan areas would severely impact some food items," Grant warns.

Carrick worries about pollutants. "For the most part, river systems collect pollutants. Legislation has banned hydro-chloride pesticides, but these and others have shown up in tail fat. The levels haven't been particularly high, but we don't know if they are dangerous. We don't know how the platypus metabolizes its reserves or at what levels pollutants affect platypuses."

A third concern arises over fishing activities, especially in Tasmania and Victoria where netting eel is a profitable undertaking. Researchers counted a dozen drowned platypuses tossed on a bank from a single fisherman's efforts. There is presently little effort to curb the conflict between fishermen and the platypuses.

Funding platypus-related projects has always been difficult. Even with the current high level of public interest, scientific research is spotty. Most wildlife research funding in Australia is marked for either pests or endangered species, and the platypus is neither.

There may be some help on the way. Dr. Dedee Woodside, curator of mammals at Sydney's Taronga Zoo, is pushing for an expanded effort to breed and study the platypus in captivity. "It should be approached as a national undertaking. There's no reason, with an expanded facility that replicates nature, we can't reproduce the platypus and provide the kind of facility that allows people like Tom Grant to work." Woodside envisions ". . . a 'platypusary' that would provide the capability to replenish depleted populations in the wild, when the need arises." — E.H.



COURTESY FRANK CARRICK

Dr. Frank Carrick nets a platypus for tagging.