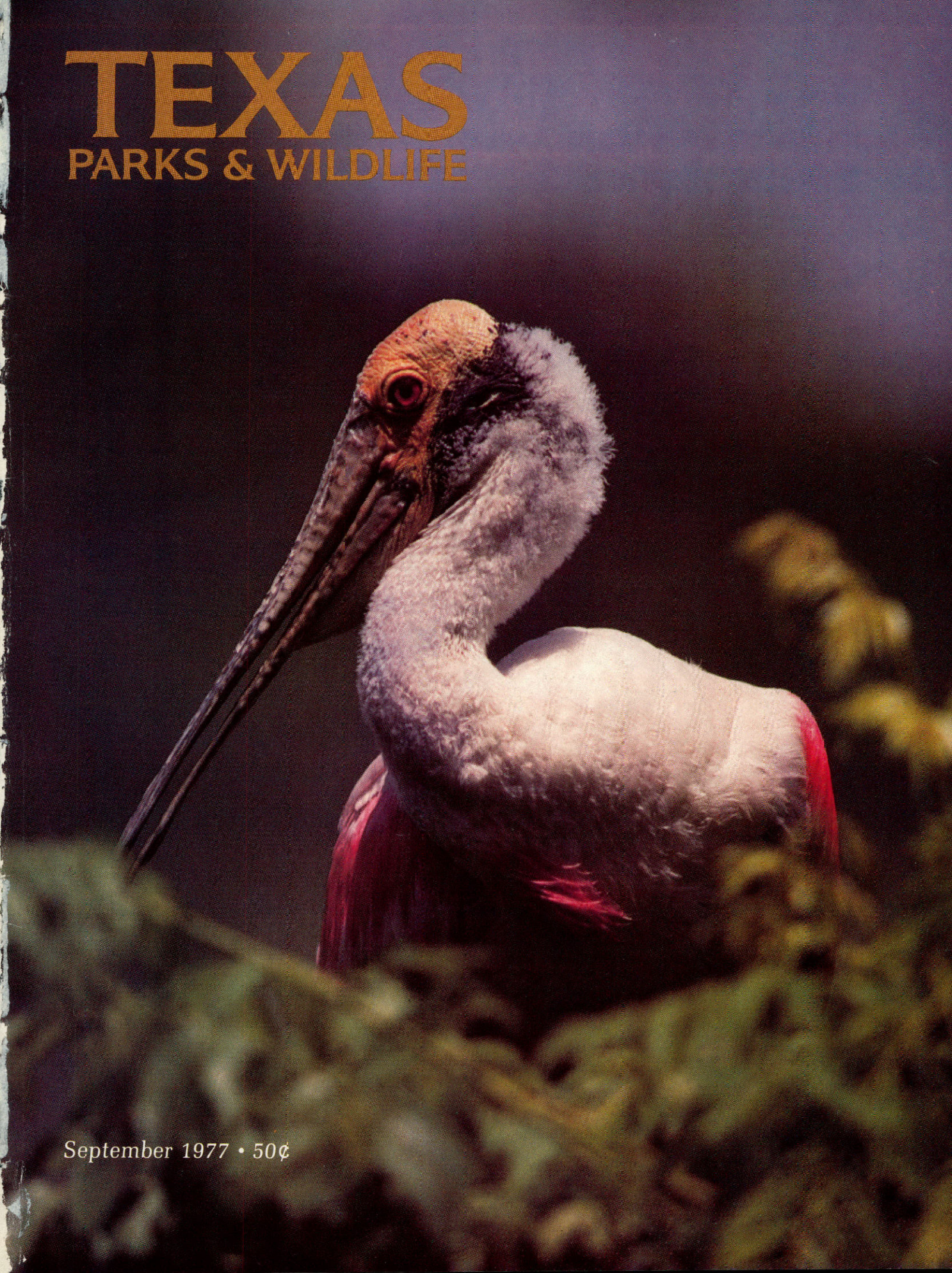
TEXAS
PARKS & WILDLIFE



September 1977 • 50¢

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Postmaster: If undeliverable, please send notices by form 3579 to 4200 Smith School Road, Austin, Texas 78744, Second class postage paid at Austin, Texas, with additional entry at Oklahoma City, Oklahoma.

Publication Number 541360

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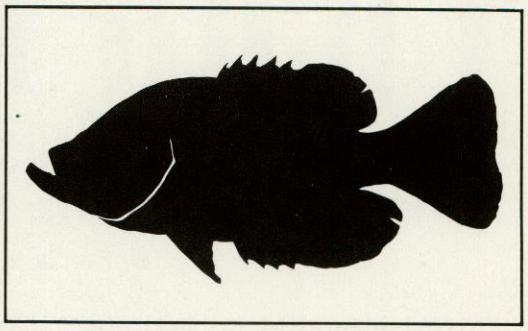

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TEXAS PARKS & WILDLIFE

September 1977, Vol. XXXV, No. 9

Front Cover: In addition to its distinctive spatula-shaped bill, coloration identifies the roseate spoonbill. It is the only wild pink bird likely to be seen along the Texas coast. Photo by Norm Arnold.

Inside Front: Gorman Falls, located in the heart of the Hill Country on a private campground near Bend, cascade over the rocks and flow into the Colorado River. Photo by C. J. Simmons.

Clean Water

Your Obligation to the Future

by Ken Jurgens

In recent months the news media have recounted many reports of pollution incidents which should serve to foster an intense public interest in pollution. There are many reports of oil spills from tanker accidents, pipeline breaks, spills of toxic or hazardous chemicals and fish kills. Some get national attention; others get only local attention. In spite of the publicity of pollution incidents, a great many people only vaguely understand the meaning and scope of pollution. By definition, to pollute is to make physically impure, to befoul, defile, dirty or taint, but modern usage encompasses yet another connotation — *to alter adversely* so as to degrade the environment and make it unfit to support life.

We all know that water is a fundamental requirement of all living things and that ideally clean natural waters are essential to all life. Changing the condition of our natural waters in any way which harms or excludes normally found aquatic life is an act of pollution whether or not it is done legally. It is the purpose of this article to give the reader a basic understanding of water quality and the effects of pollutants upon fish, plants and other wildlife found in and around our rivers, ponds, lakes, streams, bays and estuaries.

When natural surface waters are clean and support a wide variety of aquatic or marine life, they are said to be of good quality. Water is an almost universal solvent. Thus, natural waters may contain any number of dissolved substances. Moving waters may also carry many suspended or emulsified materials such as silt or oil and grease. Technically, water quality is judged by the amounts of dissolved or suspended substances water contains plus its acidity, alkalinity, turbidity and temperature. The yardsticks by which water quality are measured are the results of chemical and physical analyses of water samples. Natural substances and pollutants found present in water are usually reported either in parts per million (ppm) or in milligrams per liter (mg/l). When dealing with extremely toxic materials, where pollution can result from very limited amounts, the contaminants may necessarily be reported in micrograms per liter (μ/l). Dissolved salts in coastal or marine waters are often reported in parts per thousand (ppt).

Acid and Alkaline Waters

Natural waters are either slightly acid or alkaline depending upon the minerals of the region. When natural waters are acid it is usually due to dissolved carbon dioxide, sulfuric or other mineral acids. When waters are alkaline it is a result of dissolved carbonates, bicarbonates, silicates, phosphates and alkaline organic substances.

Acid and alkaline waters are both described in terms of potential hydrogen ion concentration (pH). A pH 7 is neutral. Less than pH 7 is acid and greater than pH 7 is alkaline. Uncontaminated natural waters most frequently range from pH 6.5 to pH 8.5.

Dissolved Oxygen

Fish and other aquatic and marine life require dissolved oxygen or they will suffocate. Some warmwater fish, such as carp, can live in water with as little as 3 ppm of oxygen, whereas largemouth bass require more dissolved oxygen and live best in water containing 5 to 8 ppm. Most natural waters with good fish populations contain ample dissolved oxygen.

Flowing streams, free of excessive oxygen-demanding pollutants, can regain oxygen by flowing a relatively short distance. The more riffles and rapids present, the sooner a stream recovers used oxygen.

Unfortunately, organic pollutants — which may consume excessively large amounts of dissolved oxygen — are often introduced into natural waters in great quantity. The bulk of these pollutants come from domestic sewage and

Leroy Williamson

industrial wastes. Unless properly treated they can make water unfit for aquatic life.

Another source of organic pollutants is urban and rural runoff, which currently is either untreated or minimally treated before entering surface waters.

Even with adequate waste treatment, some single industries release enough oxygen-demanding wastes to equal sewage wastes from cities of 50,000 to 100,000 population. The seriousness of organic pollution can be understood simply by looking at a Texas map to see the many cities and industrial plants along our rivers and some coastal bays. Of further significance is the fact that water in a river has to be reused many times before reaching the open sea.

In some streams and coastal bays, it's a marvel that fish life exists at all. In fact, certain waters have been so heavily polluted that authorities consider them unfit for production of fish life. The truth is, no fish can live in them, and when fish enter such areas by accident, they most likely will die.

Nutrients

Traces of nutrient materials such as phosphates, ammonia or nitrates in natural waters are required for the growth of aquatic plants. However, when present in large quantities they cause excessive growth of vegetation which often interfere with swimming, boating, fishing and water skiing. Such waters are often referred to as eutrophic. Heavy growth of aquatic plants may also cause bad tasting water, foul odors and extensive fish kills. When large quantities of plants die and decay, they use up dissolved oxygen in the water causing fish to suffocate.

Nutrient materials in surface waters often come from the land — in runoff waters carrying agricultural fertilizers, from sewage wastes, either raw or treated or industrial wastes.

Ammonia, a nutrient (fertilizer), is also toxic (poisonous) especially in more alkaline waters.

Oil

Oil which finds its way into surface waters is harmful to aquatic life in a number of ways. Free and emulsified oils can coat the gills of fish causing them to suffocate. They also coat and kill one-celled plants and animals which are vital sources of fish food.

Oily materials that settle to the bottom, coat the bottom, suffocate bottom-living animals, destroy fish habitat and render useless the areas used by fish for spawning. Water-soluble oils may cause fish to become unpalatable and may be poisonous to fish and other aquatic or marine life. In addition, thick films of oil floating on the surface can upset the natural self-purification of streams by preventing aeration.

Solids

In water quality studies, some substances are classed as solids which are defined as either dissolved, suspended or settleable. Dissolved solids include materials such as salts and sugars while suspended and/or settleable solids include such items as silt, paper pulp waste fibers, sewage solids, water treatment sludges, lime waste from treating industrial waste waters and municipal drinking water, oily sludges and street washings.

Dissolved solids result mainly from minerals leached from soils or geological deposits, although large amounts reach natural waters from industrial wastes. Dissolved solids naturally occurring in water used for cooling of electrical generation equipment are concentrated with a net result of increased solids after cooling. U.S. Public Health Service drinking water standards suggest not more than 500 ppm of total dissolved solids should be present in fresh water.

Salinity, or amount of salts dissolved in water, is particularly crucial to productivity of coastal waters. Many people think salt water is seawater regardless of where it is found — in the coastal bays or open sea — and that no matter how much salt it contains, marine animals won't know the difference. Actually, fish, shrimp, crabs, oysters and other marine animals have definite seasonal preferences for certain amounts of dissolved salts (sodium or magnesium chloride).

On the average, waters of the open sea contain a total salinity of 35,000 ppm. Bays and estuaries, depending on volume of river inflows to these waters, vary from almost no salinity where the rivers enter the bays to nearly the salinity of seawater where the bays meet the sea. These zones of varying salinity are very important to marine life. When changes are made by the unnatural addition of dissolved salts, the habitat is adversely altered — either the area becomes completely useless for marine organisms, causing them to leave, or destroys marine organisms outright. Similar changes occur when fresh water flows into the bays and estuaries are reduced or diverted.

Fortunately, many oil producers, who produce vast amounts of concentrated brine, are disposing of it by reinjection into the geologic formation from which it was pumped. If all producers — including other mining interests — did this, none of these salty waters

would be able to contaminate surface waters, including "salt" waters, so necessary to fish and wildlife.

Suspended or settleable solids are another matter. Silt, sewage solids and industrial waste slurries, cause surface waters to become turbid and may contain substances which are poisonous or otherwise make water unfit for living creatures.

Large amounts of iron, either dissolved or suspended, can coat the gills of fish and other gill-breathing animals with iron deposits and prevent them from exchanging waste carbon dioxide for oxygen. This causes them to suffocate. The same problem is sometimes caused by pulping wastes from paper and paper board manufacture.

Throughout history until the recent past, industry and municipalities had traditionally used streams, rivers, bays and oceans as receptacles for disposal of unwanted wastes. Pollution of surface waters had been looked on by many as a "tradeoff," the "necessary result" of our economic and industrial systems. It has often been said that "the solution to pollution is dilution." This approach is now archaic and every effort must be made to keep it so.

Reagan Bradshaw

John Jefferson

Organic pollutants, the bulk of which come from domestic sewage and industrial wastes, consume excessively large amounts of dissolved oxygen. The number of cities and industrial plants along our rivers and some coastal bays compound the seriousness of this organic pollution since the same water is reused many times before reaching the open sea. When these oxygen-demanding wastes deplete the supply of dissolved oxygen, fish and other aquatic life will suffocate.

Temperature

In the United States today, almost one-half of all water used for all purposes is for cooling and condensing by power and manufacturing industries. The power industry alone used more than 40 trillion gallons in 1964. Other industries used in excess of another nine trillion gallons. With current energy shortages water use for these purposes is rapidly increasing. The amount of waste heat released into lakes and streams, bays and estuaries, even with some onshore cooling, is almost incalculable.

Generally, water used by the power industry in conventional steam plants for once-through cooling is raised 10 to 15° above its intake temperature and is then released into surface waters unless some form of onshore cooling is employed prior to discharge. With the currently increasing use of electrical energy, there is need for more and larger power plants and for nuclear plants. With escalating demand for power will come the need for disposal of greater amounts of waste heat. The danger is this: such discharges are capable of raising surface water temperatures to a point to which fish and other aquatic

Clarence Beezley

life cannot adjust. Therefore, they are forced to avoid over-heated areas or die. This has resulted in a shrinking of aquatic and estuarine habitat. In addition, increased temperature reduces the amount of oxygen the water can contain, increases rate of chemical reaction of other pollutants and increases toxicity of many poisonous substances.

In streams, excessive amounts of heated water can, and sometimes do, cause thermal blocks preventing fish moving upstream to the cooler waters above the point of discharge. In lakes that are sufficiently deep and large, warmwater fish species such as channel catfish and largemouth bass may not suffer too greatly, and in winter, the heated water often provides excellent fishing since such fish tend to move to the area with the most agreeable temperature. However, coldwater fish, such as rainbow trout and salmon, can be completely eliminated by increased water temperature.

In bays and estuaries along the Texas coast, waters are generally shallow in those areas used as nursery grounds by fish, shrimp, crabs and oysters. Summer temperatures may naturally read 95° F or more; therefore, any substantial releases of heated waters into these large areas can only remove such areas as habitat for marine life during the summer when they are needed most as nurseries.

Two examples of the direct effect of heated waters on marine life should suffice to point up the danger of releasing heated wastewater into coastal waters during the summer months. At prolonged temperatures above 95° F oysters close their shells and cannot feed properly. Since they cannot move, prolonged exposure to heated water may cause them to die of starvation, even if the water is not hot enough to kill them outright. Also, according to the U.S. Bureau of Commercial Fisheries, brown shrimp cannot live in waters with temperatures in excess of 95 to 97° F. Thus, areas affected by large volumes of heated discharges are destroyed habitat.

In most cases regarding Texas' *freshwater streams*, Texas Water Quality Standards (February 1976) state that surface water temperatures in streams are not to exceed a five-degree rise above ambient or natural conditions. In freshwater impoundments, not considered cooling ponds, the maximum rise in temperature over ambient (natural conditions) is 3° F. This does not apply to offstream or privately owned reservoirs constructed for cooling purposes. In *coastal waters* during fall, winter and spring, water temperatures are not to exceed a four-degree rise in temperature above natural conditions, while in summer this rise is not to exceed more than 1½ degrees. The maximum temperature for most coastal waters is limited to 95° F. In all cases, freshwater streams, lakes and reservoirs and coastal waters, these standards do not apply to mixing zones defined in waste discharge permits.

Because fish and other aquatic or marine life have no control over their body temperatures, environmental temperature is extremely important. Heated discharges can be beneficial during the cool and cold months of the year, but in the warmer months, especially in streams and shallow waters already heated by the sun, increased temperatures due to large releases of industrial cooling waters can be deadly or can completely eliminate large areas as valuable nursery grounds or fish habitat.

Because of the effect of temperatures on fish and aquatic life, the Federal Water Pollution Control Administration (which preceded the now existing Environmental Protection Agency) stated, "A temperature of 95° F is about the maximum acceptable for aquatic life." Therefore, it would be best if all waste waters released into surface waters did not exceed 95° F, especially where warmwater fish and other desirable aquatic life exist. Even here, the waters receiving the heated wastewater discharges must have sufficient volume to absorb the waste heat without ill effect to aquatic life. We realize that under today's circumstances this may not always be possible but should nevertheless be carefully considered.

Toxic Substances

Up to this point the natural or mechanical effects of pollutants have been reviewed. But, many substances introduced to natural waters are directly toxic or poisonous to living things. Just a few of these are phenolic compounds, sulfides, cyanides and heavy metals such as copper, chromium, mercury and zinc.

Phenolic compounds are used as disinfectants, such as carbolic acid, and are among wastes produced from wood preserving, petroleum refining and the manufacture of petrochemicals and coal tar products.

Extremely small amounts of phenolic compounds may not be toxic to fish but do cause them to have an unpalatable, phenolic taste. A dangerous aspect of phenolic wastes to fish is that the toxicity of phenol increases as oxygen concentration in the water decreases. Thus, the presence of small amounts of phenols magnify the effects of other pollutants which reduce the amount of dissolved oxygen.

According to the U.S. Public Health Service, not more than 0.2 ppm phenols are acceptable in the surface waters for fish. Also, there is evidence which suggests that the toxicity of phenolic compounds to aquatic life is even greater in the softer natural waters.

Metallic copper does not dissolve in water but many copper salts are very soluble and poisonous in varying degrees to fish and other aquatic life, including plants depending on water hardness and temperature.

Although soluble copper salts in minute amounts up to 0.05 ppm may be naturally present in some waters, more often they enter surface waters with industrial waste discharges. In industry, copper is used in electroplating, photography, textile manufacturing, pesticides and many other industrial processes.

There are reports of the toxic effects of copper to fish and other aquatic life in concentration of as little as 0.015 to 3.0 ppm. In salt water, only 0.13 to 0.5 ppm absorbed in the flesh causes oysters to be green in color and makes them unfit for human consumption. Oysters, as you know, permanently attach themselves to the bay bottom and pump water through their bodies to strain out whatever food it may contain. Once attached to the bottom, they either grow and multiply or die and are lost. Any pollutant which is absorbed, stored and concentrated in their bodies is hazardous because of the tremendous quantities of water they filter.

Zinc salts, such as zinc chloride and zinc sulphate, are used extensively in many industries — in the manufacture of paints, cosmetics, dyes and insecticides for example. They can therefore be expected to be present in industrial wastes as well as domestic wastes.

Soluble salts of zinc are very toxic to fish and other aquatic life and where soluble copper is present, zinc toxicity is increased.

It is known that fish eggs exposed to zinc in solution are delayed in hatching and the actual numbers of such eggs which do hatch are considerably reduced. Also, there are reports that young hatchery fish, transferred from pond to pond in galvanized pails for stocking purposes, suffered toxic effects of zinc contained in the galvanized coating.

In salt water, oysters are known to concentrate zinc, and very small amounts are reported to be dangerous to them. According to the U.S. Public

Health Service, concentrations toxic to fish range from 0.3 to 4.0 ppm — these toxicities depending on hardness of the water. The softer the water is, the greater the toxicity of zinc to aquatic life.

Like the salts of copper, chromium salts are toxic to aquatic life varying with temperature and particularly with water hardness.

The metal-finishing industry is the greatest single source of chromium wastes but chromium — as are chlorine and cadmium — is commonly used as a corrosion inhibitor in cooling water systems of steam-electric plants and other industries where waste heat is removed through cooling water systems.

Though the toxic effect of chromium salts on fish is not clearly understood, fish food organisms such as water fleas have been harmed by as little as 1.2 ppm chromium chloride. It is known that algae concentrate chromium one hundred or more times over the concentration contained in the water.

As little as 0.05 to 0.15 ppm of most cyanide salts have been reported to have killed fish. Cyanides can be present in waste waters from industries such as steel refining, metal cleaning and electroplating, chemical manufacturing and petroleum refining. They are poisonous substances which become even more toxic as temperature increases. The cyanide salts of zinc and cadmium are extremely toxic.

Waste sulfides are produced by such industries as pulp and paper mills, chemical plants, tanneries and oil refineries. Sulfides also are produced in the decomposition of sewage.

Research by the Texas Parks and Wildlife Department fisheries biologists has shown hydrogen sulfide to be a major factor in the death of young catfish in the softer, more acid waters of East Texas. In certain lakes it was learned that, although channel catfish

Reagan Bradshaw

Bill Reaves

Jim Whitcomb

Oil in waterways is harmful to aquatic life. Emulsified oils can coat fish gills and cause suffocation in addition to killing one-celled plants and animals that provide fish food. Oily materials that settle to the bottom destroy fish habitat and spawning areas. Thick films of floating oil prevent aeration and upset the natural purification of streams. For years oil producers allowed salt brine wastes to run off on the area surrounding the well where the brine killed vegetation and often found its way into streams and rivers. Now most oil producers inject it into the geologic formation from which it was pumped.

spawned, their eggs would not hatch properly and hatchery-reared catfish fry stocked in these waters would not live. Lethal sulfide concentrations ranged from 0.5 ppm for catfish fry to 1.4 ppm for adult catfish. Federal Water Pollution Control Administration sources suggest that sensitive fishes may be killed by concentrations of sulfides from as little as 0.5 to 1.0 ppm "even in neutral and somewhat alkaline solution."

Pesticides

A limited number of toxic substances have thus far been discussed. In most cases they were relatively simple, inorganic chemicals. Chemical industries today, however, have produced complex organic compounds faster than they can be evaluated. In terms of their immediate or, especially, their long-range effects on living things or upon the environment, little or nothing is known.

Perhaps the most insidious of all the organic compounds are the chlorinated hydrocarbons, polychloronated biphenyls (PCBs), and the organophosphates. These are the chemical groups to which many of the present-day insecticides belong. PCBs, although not normally used as a pesticide, have been commonly used as plasticizers and as coolants in electrical transformers in transmission systems. PCBs are roughly as toxic as DDT and are found throughout the environment in human and animal tissues.

Who would have believed that DDT, which had such promise toward controlling insect-transmitted diseases at the end of World War II, would today be found in the tissues of animal life at Antarctica? Who would have believed that fish such as the coho salmon in Lake Michigan would have been so contaminated with deadly DDT that some years ago tons of commercially harvested salmon would have to be confiscated to protect the health of unsuspecting consumers?

The truth about DDT in Lake Michigan coho salmon, according to the Federal Food and Drug Administration, is that confiscated fish contained DDT residues up to 19 ppm. Amounts of DDT tolerated in meats are only 7 ppm.

No one knew how these salmon accumulated so much DDT. But it is suspected that the concentration of DDT was a step-by-step buildup in the fish's food chain through what is technically called biological magnification. For example: DDT was applied on a widespread area to control some insect pest of agriculture or perhaps forestry. The residue washed off the land by rains and into the surface waters. Next, microscopic plants and animals absorbed and concentrated the DDT. They were then eaten by some higher form of life such as small forage fish or minnows. Minnows concentrated DDT even more and were in turn eaten by larger fish, more and more concentrating the DDT until 19 ppm were contained in the bodies of coho salmon.

It is known at present that DDT, its derivatives and other "hard pesticides," are stored in the fatty tissues of virtually all living things. What is not known, and what may not be known for generations, is the long-range effect of such pesticides on all life forms. We do know peregrine falcons are nearly extinct, reportedly because of DDT. We suspect the brown pelican, formerly common on the Texas coast, has almost disappeared possibly because of DDT. We do not know how this pollutant will affect life in years to come. We can be sure, however, that it will not be for the better.

Some pesticides are safer than others but none are completely safe and those that have long-term, residual toxicity are the least safe of all. To illustrate their extreme toxicity to aquatic and marine life, it is known that DDT in concentrations as little as 0.6 ppb (parts per *billion* parts of sea or bay water) will immobilize or kill a shrimp population in two days. Also, oysters stop feeding in water containing only 1.0 ppb DDT, and oyster shell production is prevented or stopped when only a few parts per billion of DDT are present.

Research studies have been conducted with many species in the presence of various pesticides. To compare toxicities with a familiar fish species, research reports show bluegills (a small sunfish known as "sun perch" or "bream" in various parts of Texas) have been killed by as little as the following concentrations of these pesticides: Chlordane — 22 ppb, Heptachlor — 19 ppb, DDT — 16 ppb, Aldrin — 13 ppb, Dieldrin — 7.9 ppb, Toxaphene — 3.5 ppb and Endrin — 0.6 ppb.

None of these values are absolute because lethal toxicity varies with the size and condition of the animals. In addition, if other pollutants are present, the animals already may be affected and very little additional pollution may cause them to succumb quickly. However, these values illustrate the comparative toxicity of these deadly chlorinated hydrocarbon compounds.

The reason so much is heard about DDT is because so much of it has been used and it lasts so long as a toxic residue. Imagine what could happen to fish and wildlife if, for example, a thousand

acres of land infested with fire ants were treated with 30,000 pounds of Dieldrin. Suppose, just after application a six or seven-inch rain fell on the area. The result of the runoff containing Dieldrin entering a river could wipe out all life along the entire course of the river to the sea. And life in the sea would also be affected. Shrimps and oysters, fish and crabs could be destroyed by the tons. The animals that would eat these dead and dying creatures might also be killed or in some other way harmed to the point that some species might slowly but surely head toward extinction.

Presently all of the chlorinated hydrocarbon pesticides, which have been widely used in the past, have been placed on the banned list of hazardous chemicals by the Environmental Protection Agency (EPA). EPA is presently studying a possible ban on the manufacture and use of PCBs.

We do not recommend that the use of all pesticides be halted. We do recommend that extreme care should be practiced in using any pesticides, particu-

Jim Whitcomb

Almost one-half of all water used is utilized by power and manufacturing industries for cooling and condensing. The amount of waste heat released into lakes, streams, bays and estuaries, even with some onshore cooling, is almost incalculable. When such discharges raise water temperatures too much, aquatic life must avoid the over-heated waters or die. The wise application of pesticides must be followed to avoid the possibility of dangerous contamination. A heavy rain following a fresh pesticide treatment can wash the chemicals into a nearby waterway and kill all aquatic inhabitants.

larly those that have long-term residual effect on living things. Serious consideration should always be given to the possibility of dangerous contamination of the environment before the decision is made to use pesticides. Plans for wide-scale applications particularly need very critical review.

What we have written has been for a single purpose: in some small way, to make people aware that sources of pollution are everywhere around us. In the volumes of scientific literature, much has been written in technical detail about the effects of pollutants on fish and wildlife and on the entire environment. But, such papers are difficult reading even for the scientist and are not published in places where the average person can find them.

We have a sufficiently advanced technology to purify and heat or cool water for our own use; however, fish and wildlife have no choice but to use the water available to them. If the water is unfit to support life, animals will either avoid such water or die unless we treat waters to make them harmless — not only to humans — but also to other forms of life. This is man's obligation, even if the cost is high.

This article has barely scratched the surface. But, hopefully, what is included here will bring to the reader an awareness of pollution and some of its hazards. Once the majority of people become aware of a serious problem, solutions will be found.

In the United States, where single-minded purpose and effort have fashioned the means to put man on the moon and to photograph Mars from a space vehicle, similar purpose and effort will find the means to protect and preserve the environment we share with our presently abundant but decreasing fish and wildlife resources. **

Reagan Bradshaw

Tire Reefs Worn-out Tires Bring New Life to Coastal Fishing

Article and photographs by Lynn Benefield, Biologist, Seabrook

How often have you seen a cartoon of a disappointed angler reeling in an old automobile tire?

Texas bays are often recipients of an occasional used tire, but thanks to funds provided by the Texas Coastal and Marine Council, old tires are now respectable bay residents. Coastal fisheries biologists of the Texas Parks and Wildlife Department have built six tire reefs to improve fishing. The one-fourth to one-acre reefs were completed in August 1977. Buoys or PVC pipes were used to mark the location of those reefs not built around a permanent marker.

Fishing reefs made of tires are not a new idea. In the early 1960s, tires were used specifically for reefs on the Atlantic seaboard. Numerous tire reefs have been built from Florida to the Carolinas. Most are in waters over 25 feet deep, and fishing has been improved at most reef sites.

Sportsmen's Clubs of Texas (SCOT) and other groups built the first tire reef in Texas waters. Modules, composed of several tires set in concrete, were placed in West Galveston Bay near the Chocolate Bay entrance. Good catches of speckled trout have been reported from this reef.

One of the more common questions asked is, "How long will the tires last before eroding away?" There isn't a good answer to this question as no one knows how long they will endure. Surely, most of us will be gone before the tires succumb to nature's assaults. Since studies have shown that there is no detrimental leaching of chemicals from the tires into the water, from an environmental standpoint, tires are an ideal material to use for reefs.

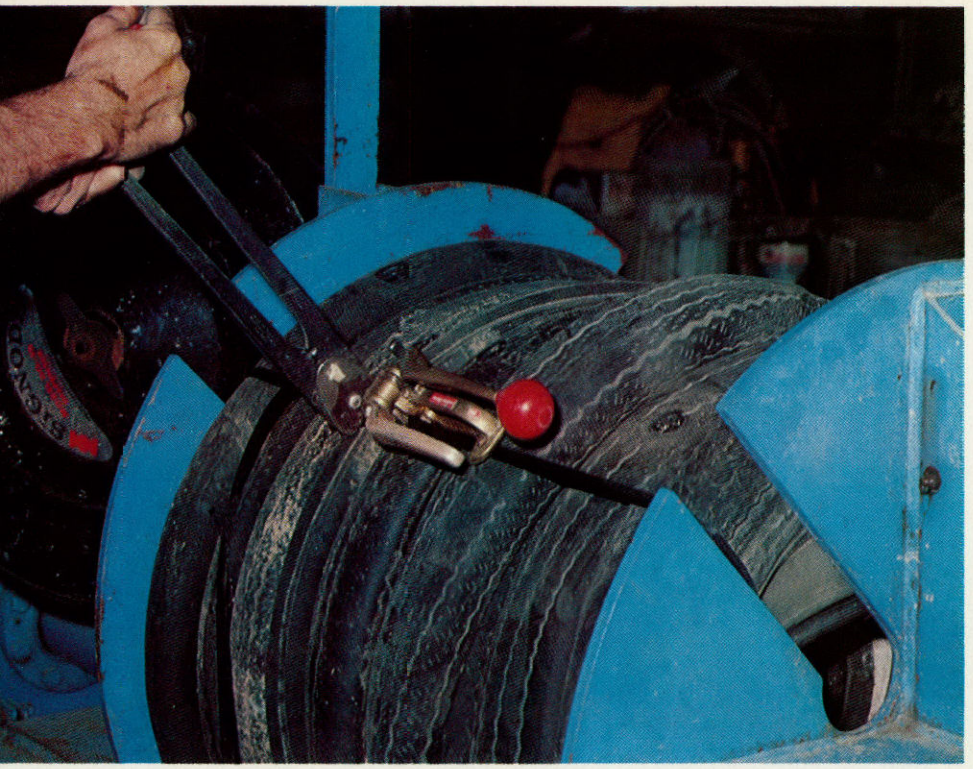
Several time-consuming requirements must be met before a tire reef can actually be placed in a bay.

First, a site must be selected that is accessible to fishermen, yet will not interfere with sports or commercial water activities. It also must have bottom sediments conducive to supporting reef materials. A sandy bottom is unsuitable because most objects placed on it quickly sink out of sight. A soft, muddy bottom produces the same results. A firm mud is ideal as objects sink to a certain depth and then stabilize.

Once a reef site has been chosen, ownership of the area must be determined. Most bay bottoms are owned by the state; however, navigational districts and cities often have jurisdiction over certain bay bottoms. Permission for reef construction must be obtained from these entities before a permit is applied for from the U.S. Army Corps of Engineers (COE). Upon receiving a permit application, the COE assigns it a number and places the application on public notice. Federal, state and local governments receive these notices for review. Any interested individual can present written comments pertaining to the project. If enough interest is generated, public hearings are usually required of the applicant.

Upon completion of the hearings, results are sent to the COE for evaluation, along with any comments submitted by other governmental agencies. The permit is then approved, denied or returned to the applicant for revision.

Following these steps, department biologists chose locations that provided access to pier, boat or wade fishermen. Each reef site was selected only after determining that no hazard to pleasure boats or commercial fishermen would be



Round holes are cut in the tread with a tire punch (below) to allow air to escape once the tires are submerged. The compactor (left) compresses 12 punched tires into a three- to four-foot bundle that is bound with noncorrosive plastic strapping. The resultant module, weighs between 250 and 300 pounds.

created by reef construction. Each site was situated near a well-known obstruction or near a pier where boats normally do not run. Bottom sediments were found suitable to support the weight of the tires.

Ownership was established and construction permits were applied for from the COE. Public hearings were held in March and April 1976 for each reef permit application and citizens' questions concerning reef construction were answered.

When the permits were finally approved by COE, the project was ready to start — full steam ahead.

Well, not quite. The equipment to be used to bale the tires is owned by the Goodyear Rubber Company, which happened to be engaged in a long strike during the spring and summer of 1976. The baling equipment, which could not be shipped until after the strike ended, arrived in Port Arthur in October 1976. Used tires were gathered by area tire dealers in Port Arthur and delivered to the baling site where the project was ready to commence.

The tire baling equipment consists of three separate units — a compressor, tire punch and compactor. The compressor provides air pressure to operate the tire punch and compactor. The tire punch simply cuts round holes in the tread to allow air to escape once the tires are put in the water. Twelve punched tires, when placed on the compactor, are compressed to form a compact bundle that is bound together by bands of commercial noncorrosive plastic strapping material. The resultant bundle, or module, is about three to four feet long, depending on tire widths, and weighs from 250 to 300 pounds.

After baling, the modules were loaded on a barge and transported to the reef sites. Six modules of tires were tied together by running a three-eighths-inch wire cable through the centers and fastening it with two cable clamps. This "rubber bracelet" configuration serves a twofold purpose — tire modules should not shift due to waves or current and, if by chance the strapping breaks, the cable will keep the tires in one place. A dragline was used to load the tire modules on a barge and unload them at the reef sites. Modules were placed side by side on the bottom so as not to produce a profile exceeding 3½ to four feet above surrounding contours. Initial reefs at Sabine Lake and Galveston Bay were constructed by this method.

The Sabine Lake reef contains about 6,000 tires and covers about one acre near an old sunken dredge boat. The one-fourth-acre Sylvan Beach reef required 1,200 tires. It is located 125 feet north of the Sylvan Beach Park public fishing pier.

During the summer, the four additional reefs were placed in Aransas, Corpus Christi and Tres Palacios Bays. The Aransas Bay reef contains 100 modules, or 1,200 tires, and is located just off the rock jetty near the department's marine laboratory facilities at Rockport. Corpus Christi's tire reef is located adjacent to the Cole Park Fishing Pier and contains 1,200 tires. The wade fishing reef is located just off the Baptist Encampment near Palacios and contains 300 tires. The second reef in this bay contains 1,200 tires and is near Coon Island.

Fishing in the reef areas should improve within six months of their placement.

Estuarine organisms soon inhabit these tire reefs. Crustaceans, bryzoans, mollusks and small fish appear soon after the tires are placed on site to provide a food source that attracts larger fish to the reef. Saltwater fish, like freshwater fish, are attracted to structures in the water. Any experienced angler knows that oyster reefs, sunken boats and oil rigs often have schools of game fish milling around seeking food or shelter, thereby increasing the angler's chances of putting a big one in the ice chest.

This reef-building program, though initially planned on a small scale, should hold a bright future for Texas bay fishermen. Upon completing an evaluation of angler success, future reef construction on a larger scale may be warranted. Hopefully, anglers will have more success and fun thanks to a bunch of old worn-out automobile tires. **

After baling, the tire modules were loaded on a barge and transported to the reef sites. To prevent them from shifting with waves or currents, the tire modules were tied together in groups of six with a three-eighths-inch cable. In case the strapping breaks, this cable also will keep individual tires from drifting away from the group.

When trying to control the Norway rat, roof rat or house mouse, traps and poisons are worthwhile only when used in conjunction with environmental controls. These three rarely survive without man's food, water and shelter. Removal of one or all of these essentials should eliminate the rodents.

Waging War on Rodents

Roof rat, photo courtesy Rodent & Predatory Animal Control Service

by Vivian B. Ferreira

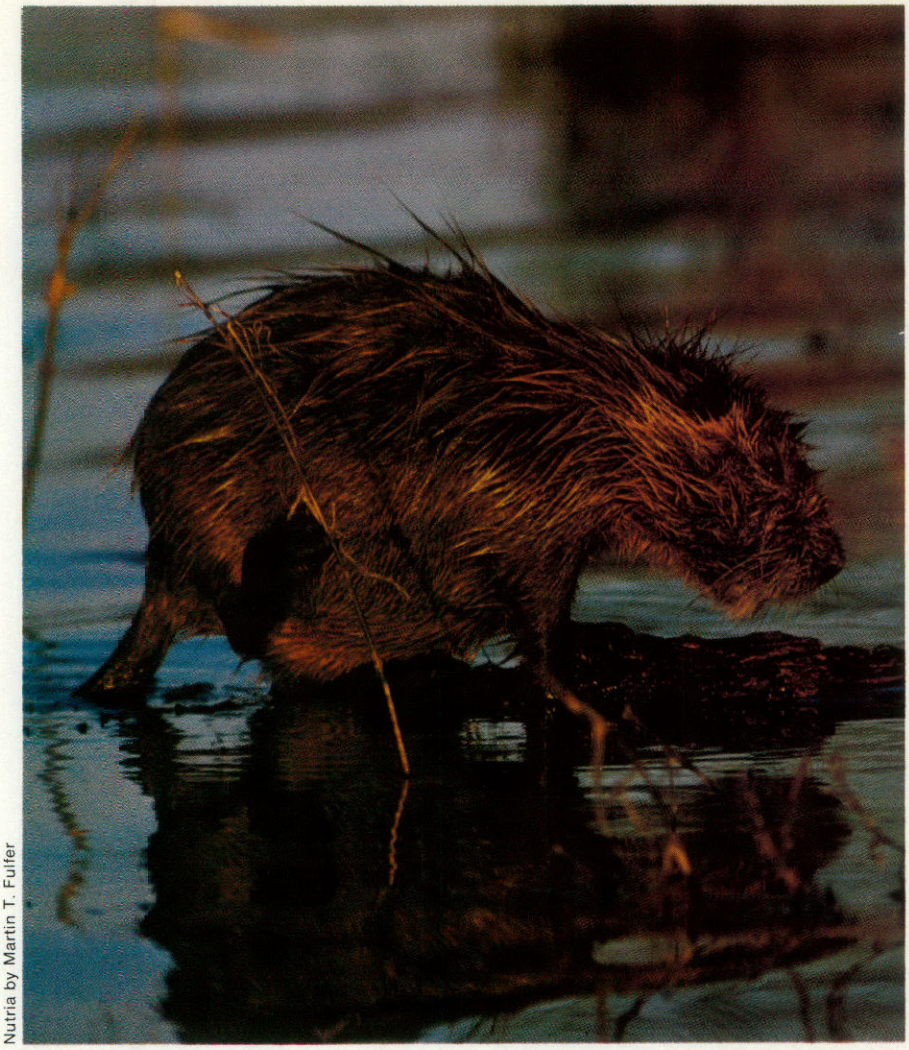
Man has been waging war on rodents since earliest times, and it seems that he has progressed very little in his effort to rid himself of these destructive and often deadly animals.

Most offensive in Texas are the imported species: the Norway rat, roof rat, house mouse and nutria, but often native rodents, such as squirrels, gophers and beavers, cause trouble in places where man has moved out into the rodents' habitat. Few people know to what extent these animals affect their lives nor everything that can be done to help alleviate the problem.

Not native to North America, the Norway rat, roof rat, house mouse and nutria by now are firmly established. The first three are land dwellers living either on or under the ground; the nutria is a semi-aquatic rodent denning usually not farther than a mile from water.

No one is immune to these pesty animals. They are a bother to all, regardless of color or socio-economic background, and strike urban and rural dwellers alike. Every consumer is affected by these rodents either directly or indirectly because the cost of rodent damage is included in the price of all goods. Over the years the rat has caused more deaths through disease than the number of deaths brought about by war.

Man usually attempts to control these animals through mechanical and chemical controls only, but except in the case of the nutria, these measures merely treat the symptoms and not the cause itself. Traps and poisons are worthwhile only when used in conjunction with environmental controls when trying to control the Norway, the roof rat and the house mouse. These three



Nutria by Martin T. Fulfer

Gray fox with squirrel by Perry Shankle Jr.

Gopher, photo courtesy Rodent & Predatory Animal Control Service

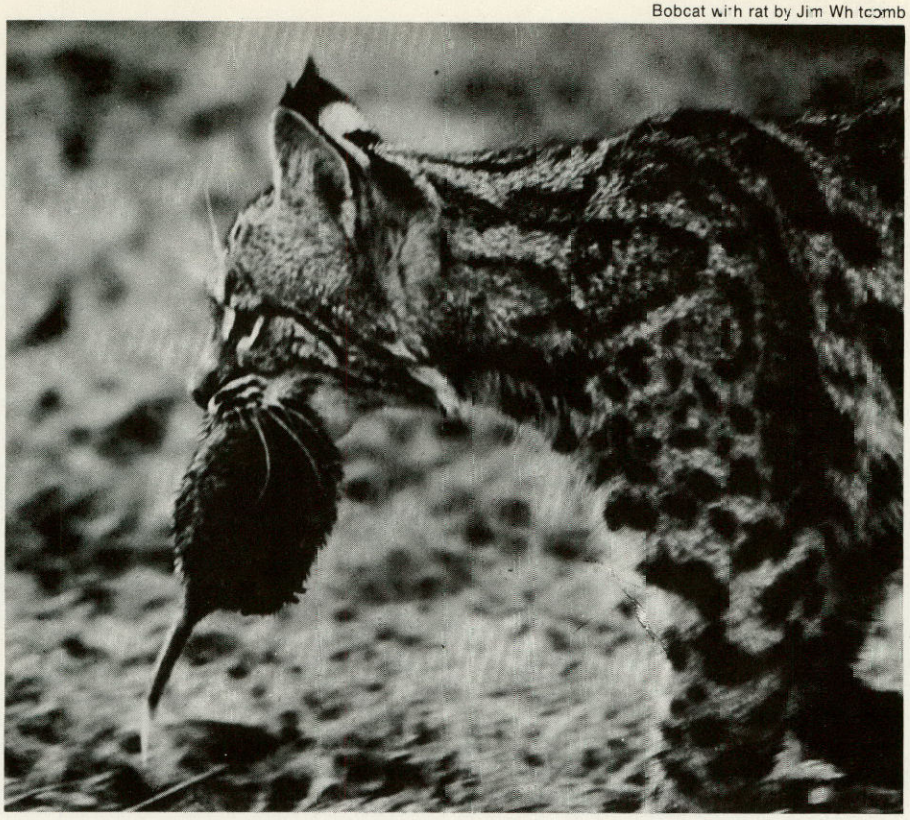
rarely survive without man's food, water and shelter. It is reasonable then to assume that only removal of one or all of these essentials will permanently eliminate the animal. Rats and mice find shelter in stacks of junk, old appliances and automobiles, high weeds, pieces of lumber or firewood.

The former should be removed from locations near man's dwellings. The latter two should be elevated as to present the least possible ground surface cover. Buildings in poor repair should be made as rodent-proof as possible by closing all openings with sheet metal or steel wool to prevent rodents from entering. Stored household food should be rodent-proofed by keeping it in metal or glass containers. This includes pet food.

Pets should never be fed outside at night. This is a little-considered source of rodent food and water. Another source of food that too often is ignored is garbage. It should always be stored in a closed metal container, preferably upon a stand.

None of these measures will control the nutria; therefore, it must be controlled by trapping with a cage or steel trap placed near the opening of the burrow, or by poisoning with

Bobcat with rat by Jim Whitcomb



Little can be done to control field rodents other than leaving natural predators to help reduce their numbers. Traps and poisoned baits are most effective for controlling nutria and gophers, but extreme care must be taken to insure that only the target animals have access to the poison.

zinc phosphide used on carrots. A raft is set in the body of water at a point near which the nutria are burrowing. The animals are offered carrots for a few days prior to adding the toxic material. Great care must be taken to insure that no other animal can eat the poison bait except the nutria.

Little environmental control can be used in situations where native field rodents present problems other than leaving natural predators to help control the rodents. Snakes, hawks, owls, bobcats and other predators will help keep rodent populations down.

Usually trapping and sometimes poisoning are recommended for use in field rodent control when natural predators are not a feasible solution. In rural and suburban areas, beaver and field rats and mice have become quite a problem. Beaver may be discouraged by protecting the lower trunks of trees with heavy hardware cloth or sheet metal. They also can be trapped with a large conibear trap placed beneath water level at the opening to the den. With large infestations of field rats or mice where rodent-proofing is impossible, strychnine-coated maize carefully placed in rodent runs reduces the population. This bait is available from feed or farm and ranch supply stores. Much thought and consideration should be exercised when using strychnine in open areas because the grain will kill whatever animals are attracted to it.

Strychnine-coated maize is safe to use in the control of gophers. A tablespoon of grain can be placed directly into the gopher run and the hole that the grain is dropped through covered with sod or a flat stone then only the target animal inside the run can find the poisoned bait.

On small areas of land with light infestations this process can be done easily by hand. Small numbers of gophers can be caught with pairs of traps placed in the runs. These traps are sold at hardware stores and are inexpensive and easy to use.

With larger areas a machine pulled by a tractor makes an artificial tunnel that connects with the gophers' natural tunnels, then grain is dropped automatically at intervals.

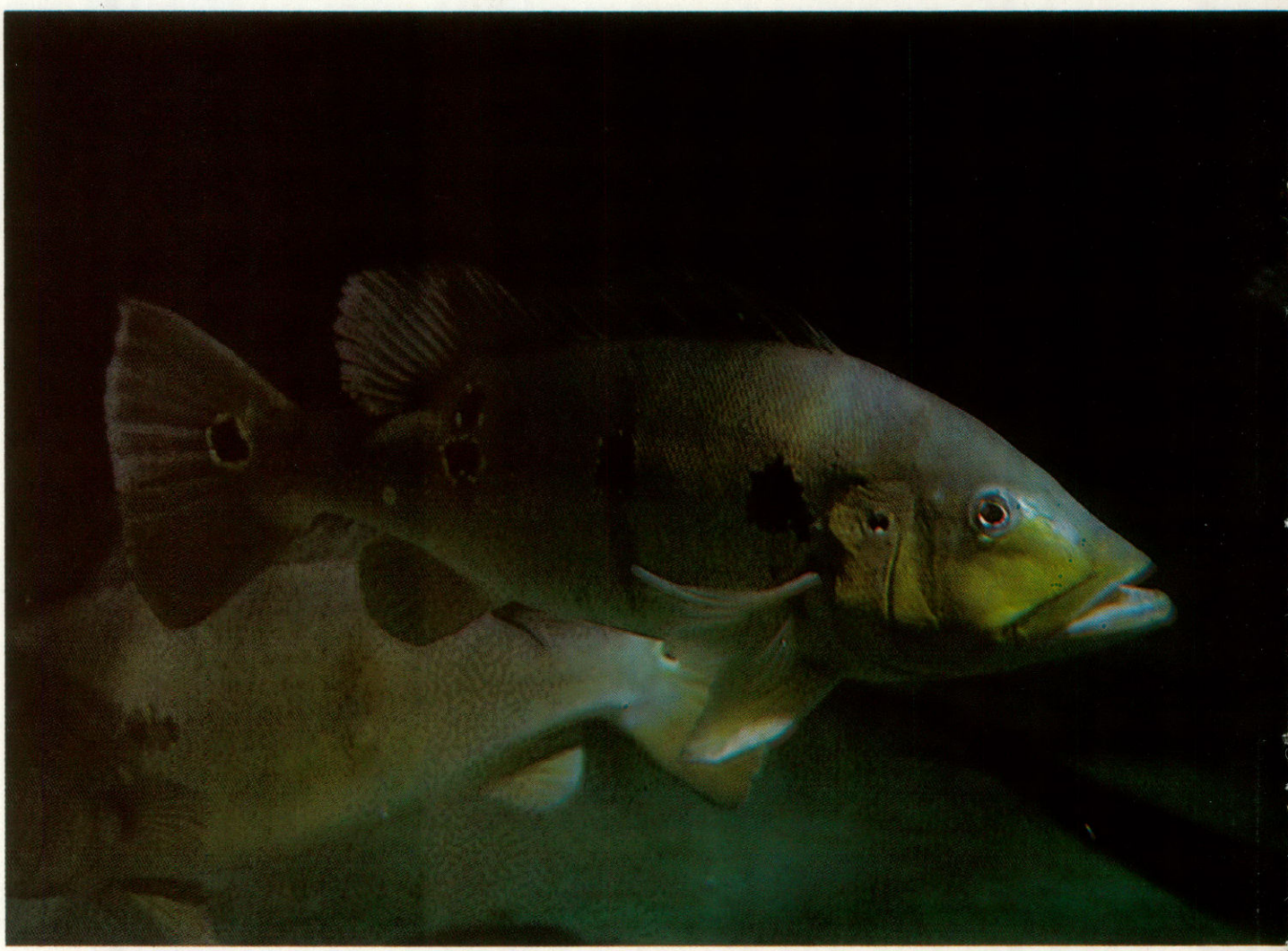
Control methods for squirrels depend on the type of squirrels and where they are. In urban areas live trapping is the only method recommended for tree squirrels. Neither poisons nor steel traps are advisable because of their potential hazard to nontarget species. A medium-sized live trap can be purchased from a hardware store, baited with pecan meats and placed where the bothersome animals are observed. Once caught, the animals can be removed by whatever method seems most desirable. A certain amount of rodent-proofing can be done in the case of tree squirrels. Small openings in buildings should be closed with metal; isolated trees can be protected by wrapping sheet metal around the trunks.

Trapping and strychnine-coated grain also can be used to control ground squirrels. Again, particular caution must be used to see that the grain is placed in the rodent burrows and not where nontarget birds might eat it.

For Norway and roof rats and house mice, environmental controls are the most permanent and effective although trapping and/or poisoning can be used on these and all other rodents depending on the circumstances.

At one time or another some type of rodent will be a nuisance. For more information about their control and how to contact a Wildlife Damage Control Specialist in different parts of the state, write or call: U.S. Fish and Wildlife Service, P.O. Box 9037, Guilbeau Station, San Antonio, Texas 78204. **

Fisheries Research Finds Exotic Predators for Warm-water Rough Fish



Peacock bass by Frank Aguilar

by Barry Lyons, Inland Fisheries Biologist, Kerrville

Maintaining quality sport fishing in the state's many man-made reservoirs that are used to cool electro-power plants is complicated by increased water temperatures and "bait bucket" introductions of undesirable exotic fish called tilapia. The warmer temperatures allow the tilapia to survive in the winter and build up large numbers of these undesirable fish. In some reservoirs the tilapia become so overabundant that native bass fail to spawn successfully.

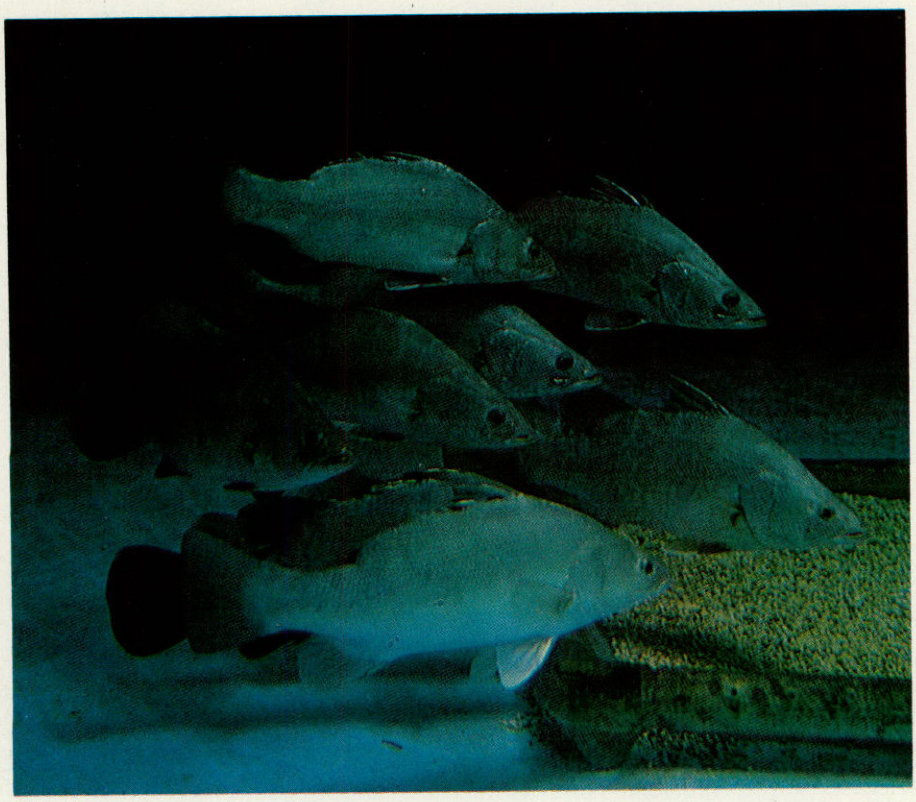
Since native predators, such as largemouth bass, are unable to sustain adequate populations to control overabundant rough fishes, the Texas Parks and Wildlife Department is investigating the possibility of introducing tropical predatory fish into these heated reservoirs for rough fish control.

Qualities considered for selecting tropical predators were their predaceous nature, angling quality and palatability. Nile perch from East Africa and peacock bass from South America were found to be the most likely candidates to meet the needs of Texas reservoirs. The various species of Nile perch can attain an adult weight ranging from 10 pounds to over 300 pounds, while adult peacock bass can weigh as much as 35 pounds.

Presently 203 Nile perch and 50 peacock bass are being maintained as brood fish at the Heart of the Hills Fisheries Research Station near Kerrville. The Nile perch were obtained from Lake Tanganyika, Tanzania, and Lake Rudolph, Kenya; the peacock bass came from a fish hatchery in northeastern Brazil.

These exotic fishes are being held in indoor, closed-recirculating aquariums. Water temperatures are kept at 80°F. A variety of food, consisting mainly of minnows, small carp, goldfish and sunfish, is used to feed these fish. Presently, 12 pounds of food are needed daily to maintain the exotics at the research station.

Some of the Nile perch and peacock bass have been placed in one-half to one-acre research ponds during the summer months to obtain better growth. All drains on these ponds have been sealed to prevent accidental escape. Should any of the fish reproduce, the initial spawn will be used in experiments to determine temperature and salinity tolerances. Additional fry will be used in experimental lake stockings to determine if Nile perch or peacock bass will be a desirable addition to the fish fauna of Texas. **



Nile perch by Frank Aguilar

Exotic peacock bass and Nile perch are being maintained and studied at the Heart of the Hills Fisheries Research Station near Kerrville while the department investigates the possibility of introducing these tropical predators into heated reservoirs for rough fish control. Adult Nile perch can attain a body weight ranging from 10 to over 300 pounds. Peacock bass can weigh as much as 35 pounds.

How To:

Prepare and Mount Trophy Tusks

by Bob Ingram

Attractive, low-cost trophy mounts easily can be made from javelina tusks.

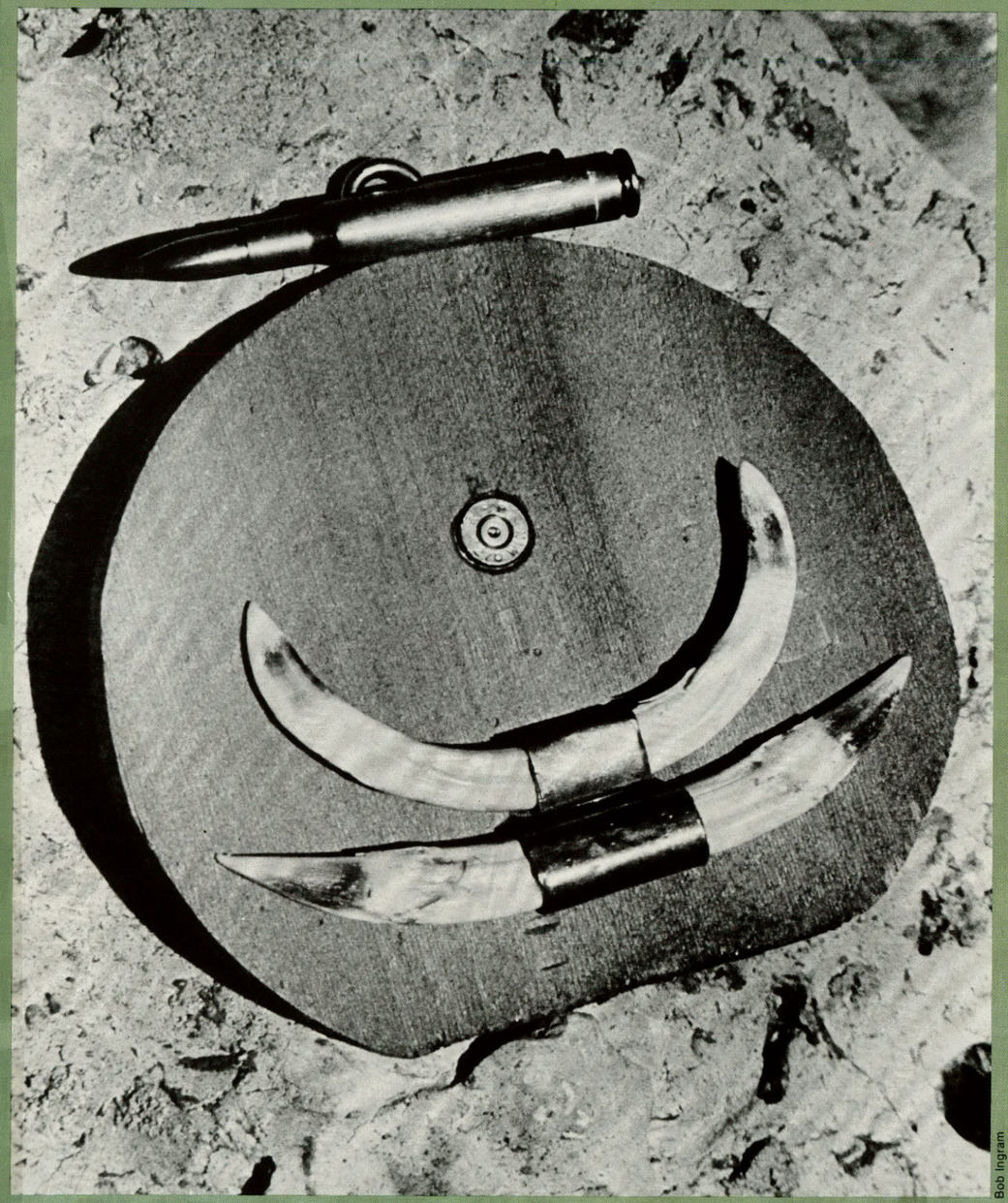
When a head mount is not appropriate, but a memento of a successful hunt is desired, a tusk mount may be the answer. This mount is patterned after the method used in Austria to display the tusks of the European wild boar. Actual working time is about one-half hour, although the total processing time is three hours or more. If desired, the work can be done in installments over three or more evenings. Construction proceeds in three steps: removal and cleaning of the tusks; designing and cutting of the mounting board; and attaching the tusks and incidental decorations. Once the mount is completed, an occasional dusting is all that is necessary to keep it looking good over several generations.

Removing the tusks from the bones is the most difficult and time-consuming part of making the trophy. Don't ask your dentist to extract them for you. I tried that, but his equipment is not adequate for the job. Use a saw to cut the jaws from the head, and make the cut well behind the protruding part of the tusks to avoid damage to the roots. Trim the skin and as much meat as possible away from the bones. Boil the bones until the tusks are loose in their sockets—usually about one hour. (The resulting broth can be set aside for soup stock.) Clamp the bones firmly to a hard surface; a vise is best, but any method for holding the bones firmly will do. With a hammer and chisel, or old screwdriver, chip the bone away from the outside of the tusks until they can be lifted from the sockets by hand. Remove the nerve ends from the cavities in the roots. Boil the tusks in salted water for ten minutes for a final cleaning, and set them aside to dry. When the tusks have dried, fill the nerve cavities with a firm wax. This provides support to the root ends and prevents splitting during the mounting process. One method of filling the cavities is to light a candle and let the drippings fall into the cavities. Softened beeswax would do as well.

Once the wax has hardened, the tusks can be moved about on various backgrounds until the desired pattern is determined. The pattern in the illustration is only one of many possibilities. Design the mounting board to match the size and shape of the selected pattern. The board can be made from any available wood, and can be rustic or finished, as individual taste dictates. The mount shown was cut with a coping saw from the thick end of a cedar shingle.

After the mounting board is cut to the selected shape and size, and finished as desired, the tusks are attached in the chosen pattern. The easiest and quickest method is to use epoxy glue to attach the tusks directly to the board. Since the root ends of the tusks are jagged, they need to be covered with some decorative item. Sections of the cartridge case were used here, but other formed metal, carved wood or leather could also be used.

Attaching a hanger and recording the date and place of the hunt completes the trophy. The result is an attractive memento which requires little care, can be displayed in home or office and is guaranteed to turn the conversation toward outrageous tales of outdoor prowess. **

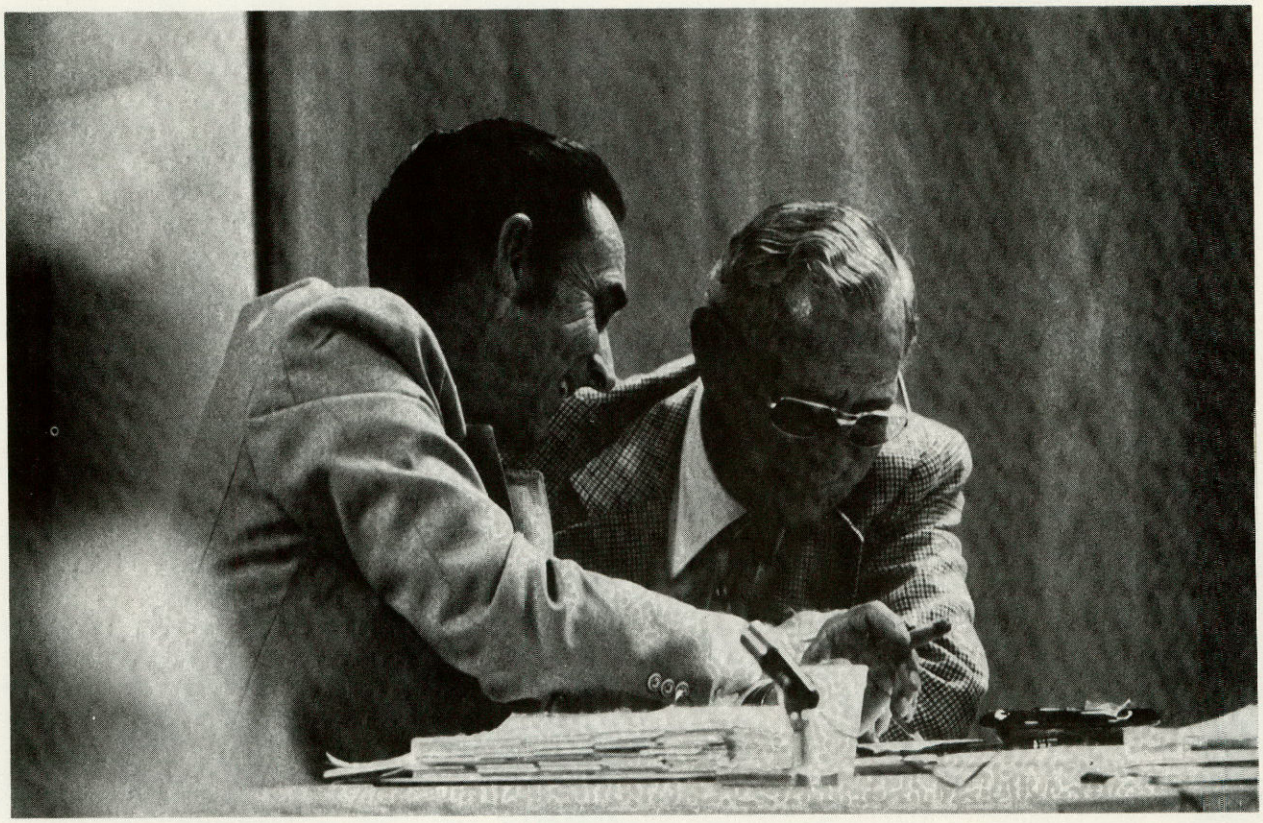


Bob Ingram

Part of a cedar shingle serves as a mounting board for these javelina tusks, and sections of a cartridge case were used to cover the jagged ends of the tusks. This arrangement is only one of many possibilities.

around the state...

News of the Texas outdoors from the Parks & Wildlife Department's news service.



Former Parks and Wildlife Department Executive Director Clayton Garrison, left, made his final appearance before the P&W Commission August 31, effective date of his resignation. Incoming director Henry Burkett, right, assumed charge of the department September 1. Burkett, a 30-year veteran with the P&WD, has been Law Enforcement Division director since 1974.

On Friday, August 31, 1977, Clayton T. Garrison concluded his last public meeting before the Texas Parks and Wildlife Commission. At the same time, he ended a 16-year tenure with the department.

The last five of those years were spent as Executive Director of the multi-faceted state agency. They were five years of growth and change, marked with a welcomed stability.

Stability was needed in 1972 when Garrison was named Executive Director. He was the sixth man in the job since '69, although three of them were considered interim directors at the time they were appointed. The press and the public alike had much to say about the turmoil and unrest.

With the appointment of Garrison, though, the game of executive musical chairs came to a halt. His administrative talents, knowledge of the department and sharp pencil on the ledger sheet stood him well. Having served as Director of Finance and Data Processing, he was well equipped in fiscal matters, something of a necessity when directing an agency whose budget has an eight figure bottom line.

The fact that he had no professional game or fish background was only academic. He recognized the talents the department needed, and the organizational changes necessary to fit them into the lineup.

Very quickly he reorganized the Fish and Wildlife Division into two separate divisions, and created a new Division of Law Enforcement. Able leadership in all three new divisions directed the professional aspects of the respective operations, while Garrison rode herd over the general overall functioning of the department.

This is not to say that his interests and background were totally devoid of outdoor expertise. He is an acknowledged wing shot and takes pride in a good bird dog. And it has been observed that it takes a truly remarkable skipper to navigate Onion Creek while fishing in Garrison's flat-bottom boat without capsizing.

Keeping on course through troubled waters became a Garrison trademark. His years in the executive office have seen the coastal finfish evaluation emerge as a model to be copied by other states, accelerated restoration of Eastern turkey

and pheasants to huntable populations, reestablishment of more endangered bighorn sheep in West Texas, wildlife habitat mapping by use of satellite and an 83 percent increase in state park acreage.

Under Garrison's administration, the Parks and Wildlife Commission officially adopted a "Policy for the Administration of the Texas State Park System," which established a new classification system for parks and outlined criteria for their selection, development and operation. State park acreage increased by 63,494 acres, representing an 83 percent increase since 1972. Twenty-four new sites were added to the system, and additional acreage was acquired at 18 existing parks. Included in the list of parks opened were the Texas State Railroad State Historical Park, Galveston Island State Park, McKinney Falls State Park, Lake Livingston State Recreation Area and Fairfield Lake State Recreation Area.

This same period saw an increase in annual park visitation of 62 percent. Additionally, studies have been completed on statewide waterway and trails systems and the Texas Outdoor Recreation Plan was revised, thus ensuring Texas' continued eligibility for Federal matching funds. The Parks Division staff also provided technical planning assistance to 88 small Texas communities. An experimental park campsite reservation system was initiated in late June, 1977 to provide greater convenience for campers to the state parks system.

Striped bass and marine fish culture reached unheard of levels and nonnative fish such as walleye were stocked in the large open water reservoirs where such predator fish were needed.

The first efforts to restock the bays with hatchery-raised redfish took place in 1976. Approximately 1.5 million red drum fry were reared to fingerling size in the Palacios Research Station ponds, with 100,000 fingerlings being stocked in coastal waters. Growth and feeding studies were conducted on 12,000 fingerlings, showing an increase from 1.5 inches to 6.5 inches in five months. Approximately 6,000 of these were tagged and released in Matagorda Bay.

Striped bass were also reared at Palacios and 190,000 fingerlings were stocked into San Antonio Bay.

Deer and antelope were placed on previously unoccupied new ranges. Twenty-four additional counties came under the department's regulatory authority, and additional hunting opportunities were made possible as a result. In order to maintain the quality of deer in South Texas, though, a limited buck permit system was initiated in Webb County, thus restricting the deer harvested.

Also effected during Garrison's administration was the establishment of a Program Evaluation function and cost accounting system to ensure that all funds were spent in accordance with the statutes and in order to realize maximum cost effectiveness. The Hobby-Clayton Commission recommended a similar type cost accounting system be studied for use within all major state agencies.

Garrison is leaving the Department to take over as Assistant Executive Director of the Employees Retirement System, where he anticipates he will be doing more work from an accounting/budgeting angle.

No doubt that in the future his phone at home will ring a little less on weekends.

The new Executive Director is Henry Burkett, a man who has seen the department from every level during a distinguished 30-year career.

A purple heart recipient in World War II, he paid his own way to game warden school in 1947. For 11 years he pursued game law violators in West Texas, working Kimble, Sutton, Schleicher and Tom Green Counties. In those days, game wardens furnished their own cars.

Burkett was named game warden supervisor in 1958 and Regional Director for the Panhandle and Trans-Pecos area in 1963. All operations of the department were under supervision of the Regional Directors then, so he directed functioning of wildlife and fisheries biologists, game wardens and even park superintendents when the merger of the Game and Fish Commission and the State Parks Board was implemented. No one else in the department has had that experience, a factor no doubt considered when he was selected to replace Garrison.

Burkett and Garrison have worked well together. In 1972 Burkett moved to Austin as staff assistant to the Executive Director, and became Director of Law Enforcement in 1974.

Since that time, the number of game wardens has increased substantially and 24-hour communications centers have been established in Austin and Houston. Better equipment has been obtained for wardens, including heavier cars capable of handling the large boats utilized in the water safety section developed to enforce the Water Safety Act.

Patrolling the Gulf and the bays has been facilitated by the acquisition of the 65-foot all-weather *Capt. Sprott* and four 30-foot boats.

An in-service training program has also been reinstated to retrain all game wardens annually on court decisions and enforcement techniques. Parks and Wildlife Department wardens are certified peace officers and are responsible for enforcing all the laws of the State of Texas and assisting in disaster relief.

Burkett becomes the first game warden in history to become Executive Director, and is one of the few "field men" to attain the post. His understanding of field operations and his kinship with biologists, technicians, wardens and other employees in the "trenches" throughout Texas should make for a smooth transition in the front office.

The Parks and Wildlife Commission obviously felt so. Burkett was the unanimous choice. In announcing the appointment, Chairman Pearce Johnson expressed satisfaction with the organization and operation of the Department under Garrison's direction, and emphasized that stability, continuity of operation and cooperation between divisions were of utmost importance.

Employees who have worked with Henry Burkett in the past quickly attest to his qualifications to carry out these goals due to his impartiality and decisiveness.

Burkett's work will be cut out for him. Department funding has reached the critical point, and cuts have been made in every division. Roughly 200 less positions exist this September than last year.

Keeping the boat afloat with a diminished, though dedicated, crew will no doubt be a challenge.

What types of varied vegetation the forest trail visitor sees depend upon the time of year, but rest assured that pine trees will always dominate the scene or provide a green backdrop to accentuate the other colors of nature. Some of the trails, such as the Tejas Timber Trail, encircle picturesque bodies of water that reflect the beauty of the abundant forest resources.

John Suhrstedt

Glen Mills

Mission Tejas State Historical Park by Bill Reaves

Texas Trails

Part 3 Forest Trails

by Ilo Hiller

Daingerfield State Park by Ed Dutch

During a recent study conducted by the Trail and Waterway Section of this department, it was determined that there were 37 city, state, federal and privately administered trails that exhibited sufficient qualities at the time of the study to merit their inclusion as initial components of a proposed statewide system of trails.

In an effort to acquaint you with these 37 trails, they are being featured in the magazine by region. Comments concerning length, location, primary uses, terrain and vegetative character and unique features are included.

This month the Forest Trails are being presented.

Forest Trails

Cargill Long Park Trail, administered by the Longview Parks and Recreation Department, is a 5¾-mile recreational trail located on an abandoned railroad right-of-way in the City of Longview. The trail has a gentle gradient and has been surfaced with asphalt for the benefit of bicyclists. Vegetation along the trail is dense, consisting primarily of pine and sweetgum. Various clubs and organizations have participated in a landscaping program and a display garden. Introduced plants are blended into the natural landscape. The trail receives heavy usage from bicyclists, children going to and from school,

While strolling along the forest trails, take time to relax in the beauty that surrounds you. Enjoy the flowering dogwoods or rest for a while in the shade by the water's edge. Look closely at the vegetation and see how many little creatures you can find sharing the forest habitat. The colorful beetle below gets its nourishment from the juices found in decaying vegetation.

Net-winged beetle by Glen Mills

people walking for pleasure and joggers.

Tejas Timber Trail, administered by the Texas Parks and Wildlife Department, is a one-half mile recreational trail in small, but scenic, Mission Tejas State Historical Park in Houston County. It is primarily used for walking and nature study. The terrain is gently rolling to hilly and contains a small creek that has been dammed to form a three-acre pond. Dominant vegetation is pine, with numerous hardwoods such as oaks, hickory, sweetgum, redbud and dogwood. One unit of the trail encircles the picturesque pond, and the abundant forest resources are the central theme of the trail.

Atlanta State Park Trail, administered by the Texas Parks and Wildlife Department, is a 2.4-mile recreational trail located in the Atlanta State Recreation Area in Cass County. It is primarily used for walking and hiking. The gently rolling to hilly terrain is covered with a dense pine forest. Several extensions of the trail form loops that are designed for those who wish to enjoy walks of a shorter duration. As the trail winds through the undeveloped areas of the park, it also passes through a bottomland hardwood forest by Wilkins Creek and, eventually, terminates along the shore of scenic Wright Patman Reservoir. Deer, rabbits, opossums, nutria, red and gray foxes and bobcats have been sighted from the trail.

Daingerfield State Park Trail,

Caddo Lake State Park by Leroy Williamson

Angelina River by Glen Mills

administered by the Texas Parks and Wildlife Department, is a 2½-mile recreational trail located in Daingerfield State Park in Morris County. It is used primarily for walking and nature study. Dense pine and hardwood forests, consisting mainly of loblolly and shortleaf pines, oaks, hickory, sweetgum, dogwood and redbud trees, cover the rolling hills. Many species of trees and other vegetation have been identified along the trail which encircles the park's 80-acre lake. The most scenic times occur during the spring when the dogwood and redbuds are in bloom and during the fall when the colorful changing leaves of the hardwoods contrast with the greens of the pine trees.

Caddo Forest Trail, administered by the Texas Parks and Wildlife Department, is a three-quarter mile scenic trail located in Caddo Lake State Park in Harrison County. It is used primarily for walking and nature study. The trail, with its dense canopy of shade, has numbered stops that correspond to a brochure that explains the various features of the diversified vegetation. Plants commonly seen along the trail are loblolly pine, dogwood, white oak, water oak, southern red oak, willow oak, baldcypress and redbud. The park, located on the banks of Caddo Lake, contains cypress swamp, hardwood bottomlands and pine forests.

Old Tram Hiking Trail, ad-

Harvestman "Daddy-long-legs" by Glen Mills

Moscow Trail by Glen Mills

Farkleberries by Glen Mills

ministered by the U.S. Forest Service, is a 3.6-mile scenic trail located in a heavily forested area adjacent to the Neches River in the Davy Crockett National Forest seven miles north of Ratcliff in Houston County. The trail is accessible from two points on Forest Service Road 519. It is used primarily for walking, hiking and nature study. This Big Slough Area, which consists of about 5,100 acres of river bottomland and upland flats, contains seven specific ecotypes. Because of its diversity of plant life and the relative naturalness of the area, it has been proposed as an addition to the National Wilderness Preservation System. Vegetation includes red oak, white oak, sweetgum, sycamore, loblolly pine, shortleaf pine, hickory, elm and walnut. This trail gives the forest visitor an opportunity to explore this unique community of marshlands, creek and river bottoms, and uplands. Numerous animals, particularly birds and waterfowl, have been observed from the trail.

Old River Trail, administered by the Texas Forestry Association, is a 1½-mile scenic trail located on Owens-Illinois, Inc. land in western Jasper County near the historic river port of Bevilport. To reach the trail, travel 2.9 miles down an unpaved road off Farm Road 1747.

Old River Trail is used primarily for walking and nature study. Situated within the low-lying floodplain of the Angelina River and its oxbow lake, the area contains numerous species of East Texas trees, shrubs and vines. Several orchids, ferns and violets also are a part of the understory. The trail is self-guiding with over 50 species of plants identified. It begins on an old logging roadbed that was constructed in the early 20th century and later abandoned, and follows the Angelina River to the oxbow. Then it crosses the oxbow to Shelby Lake Island by way of a natural bridge formed by siltation. In addition to its scenic beauty and profusion of plant life, this trail gives the visitor a rare opportunity to witness a stage in the geological progression of a river system — the recently developed oxbow.

New Birmingham Trail, administered by the City of Rusk, is a 2.6-mile historic trail located beside Farm Road 343 southeast of Rusk in Cherokee County. It is primarily used for historical interpretation, walking and nature study. Originally developed by Southland Paper, Inc. in conjunction with the Texas Forestry Association, this trail is especially noted for its rugged terrain and dense vegetation. Loblolly and shortleaf pines, blackjack, shumard and post oaks, sweetgum, redbud, sumac, hickory and sycamore are common. This interpretive trail identifies a number of plant species for the visitor.

Historic aspects of the trail stem from the fact that it has been developed on the site of New Birmingham, one of the most famous ghost towns in Texas. In 1891, New Birmingham was a bustling iron-producing center of nearly 3,500 residents. It boasted two railroads; two blast furnaces (The Tassie Bell and The Star and Crescent), a brick business, ice plant, electric plant, school, bank and the palatial Southern Hotel. A combination of events, which included the unfortunate explosion of the Tassie Bell furnace and the nationwide economic panic of 1893, reduced the city to a ghost town before the turn of the century.

Moscow Trail, administered by the Texas Forestry Association, is a two-mile trail located on Southland Paper Company land in northern Polk County one mile south of Moscow on U.S. 59. It is primarily used for walking and nature study. Since the trail wanders along the banks of Long King Creek, the visitor can observe the many types of fern and aquatic plant life of the creek bottom habitat as well as a large variety of forest vegetation including tall pines and various hardwoods.

Lone Star Hiking Trail, administered by the U.S. Forest Service, is a 100-mile expedition trail located in the Sam Houston National Forest in Montgomery, Walker and San Jacinto Counties. The trail extends from near Richards in northwestern Montgomery County to near Huntsville State Park in Walker County to Evergreen and just northwest of Cleveland in San Jacinto County. The western trailhead is located at the junction of Forest Service Road 149-A and Highway 149 about 3.7 miles east of Richards. The eastern trailhead is located on Farm Road 2025 a few miles northwest of Cleveland. Several intermediate trailheads exist along the route.

As would be expected, the Lone Star Hiking Trail is primarily used for hiking and backpacking. This trail, the longest overland trail existing in Texas, follows primitive Forest Service roads, tram roads, pipeline rights-of-way, game trails, highways and paths cleared through the understory. Well defined and marked, the trail traverses rolling hills and forests composed of pines, hardwoods and dense undergrowth. Numerous streams, creeks and the West Fork of the San Jacinto River are encountered by the hiker.

Since the national forest land is not one large unit, but composed of many small tracts of land interspersed by private tracts, a small amount of private property is crossed as the trail follows continuous units of national forest lands. Three main sections — western, central and eastern — and one loop extension compose the trail. Primitive campgrounds are available as well as the established Stubblefield Lake and Double Lake campgrounds.

If your vacation plans take you near any of the Forest Trails, take time to enjoy their scenic, historical or recreational opportunities yourself. They have been created and are maintained for your pleasure. **

Editor's Note: Hill Country, Mountain, Valley and Coastal Trails have already been published. Post Oak Belt, Prairie and Plains Trails will be presented in a future issue.

National Hunting and Fishing Day is September 24, 1977

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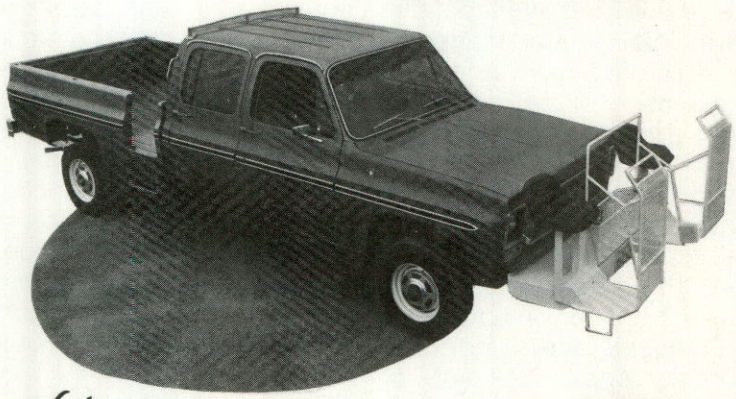

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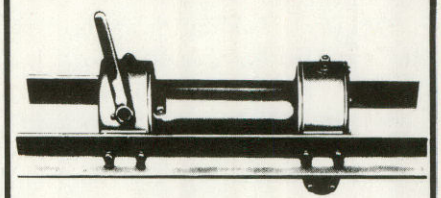

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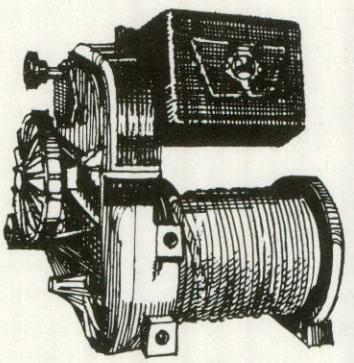


Warn Electric Winch

Young Naturalist

Identifying Fish Silhouettes

by Ilo Hiller

Catching a fish is lots of fun, but once you land it, do you know what kind of fish you've caught?

Quick identification of the popular freshwater species is usually based on body shape, coloration or the presence of special whiskers (barbels). Once you learn a few of these basic characteristics, you should be able to identify most of them. However, if you want to be able to recognize the different basses, sunfishes, catfishes and gars, identification gets a bit more complicated.

To help the angler, this department has published an identification guide "Freshwater Fishes of Texas." This 40-page, magazine-style booklet contains full-color illustrations of 35 fish species and information about their description, life history, angling importance and distribution in the state. Copies may be purchased from this department for only 63 cents, which includes the tax.

Check your skill at identification by seeing how many of these fish silhouettes you can recognize. Here are some clues to help you.

As the name suggests, the largemouth bass has a big mouth. Its body is streamlined and its back (dorsal) fin is almost divided into two parts. Many anglers may not know it, but this fighting game fish is a member of the sunfish family.

A favorite with anglers of all ages is the bluegill sunfish. It has an almost round, flat-looking body and a small mouth. Its gill cover has a flap that is commonly called an "ear." The length of this ear flap and its coloration varies with the different species of sunfish.

Another popular member of the sunfish family is the crappie. Its body is more streamlined than the bluegill and its mouth is larger. Although coloration cannot be shown in a silhouette, the crappie's silvery-green body, shading to darker green on the back, and its dark vertical side markings easily identify this tasty fish to the anglers.

The snakelike shape of the American eel leaves no doubt as to its identity. Because its scales are tiny and deeply imbedded in the skin, this fish looks as scaleless as a catfish. When captured, it produces a great quantity of body slime.

If it weren't for its long, broad snout, the paddlefish would look very much like a shark. It has a deeply forked tail, high back fin and sharklike shape, but its large mouth is toothless. The skin is smooth and has no scales.

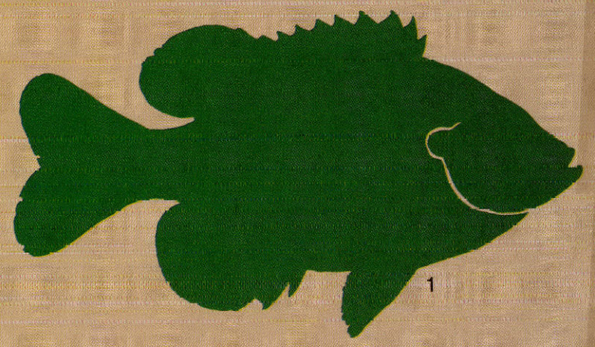
The bowfin, last survivor of a prehistoric group of fish, has a long body, large mouth, sharp teeth and nasal whiskers. Its back fin runs more than half the length of its body. Its skin, which feels smooth and leathery, is actually covered with round, hard scales.

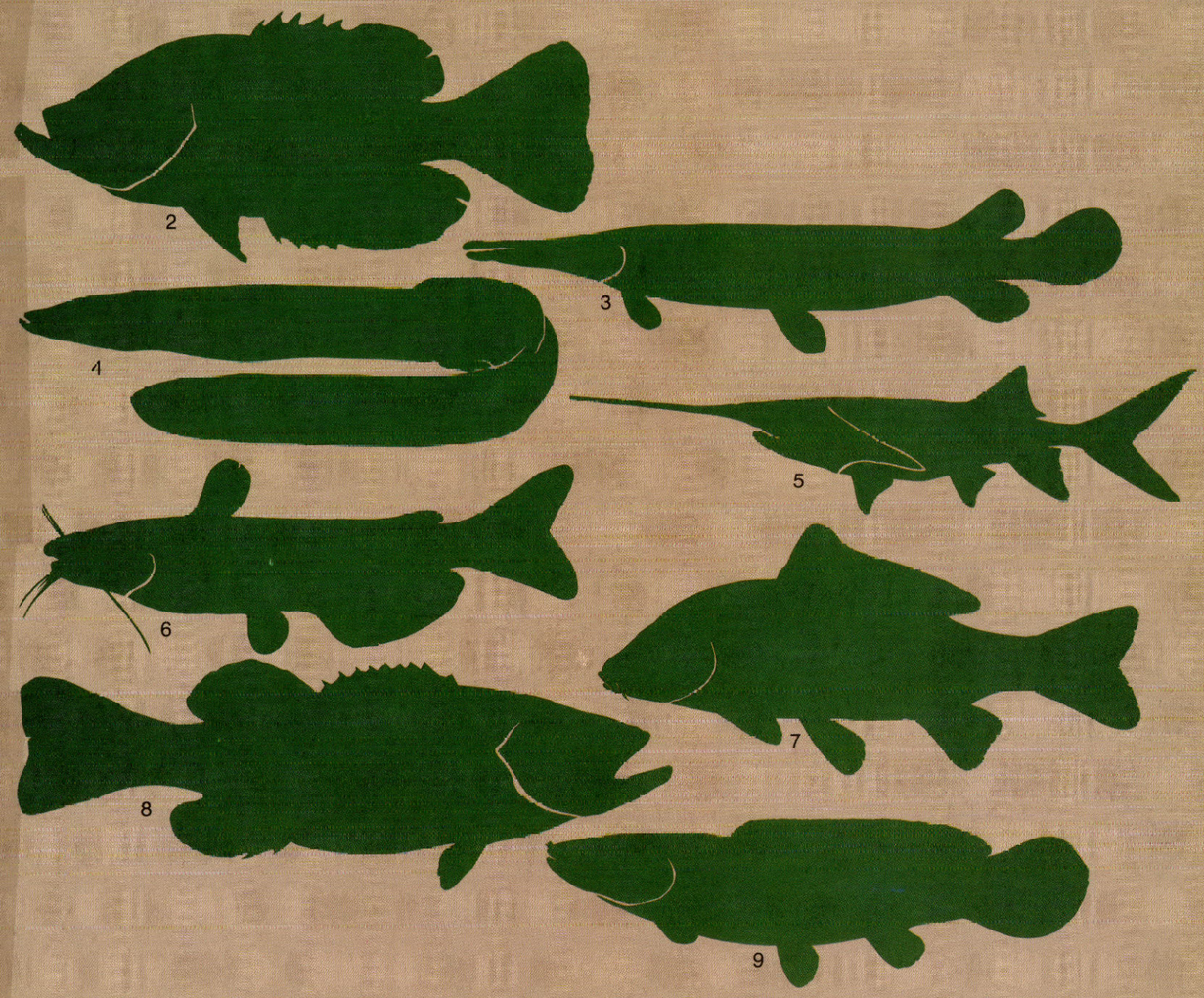
Another surviving primitive fish is the alligator gar. Its beaklike snout is lined with sharp teeth and it has a long, cylinder-shaped body. The alligator gar is the largest member of the gar family and often weighs more than 150 pounds.

Long nasal and chin whiskers identify members of the catfish family. The channel catfish has a small, narrow head and can be distinguished from other catfish (except the blue) by its forked tail. The upper jaw is slightly longer than the lower one.

Two whiskers on each side of the upper jaw identify the carp from other members of the sucker family. It has the typical sucker mouth and a thick body. Growth is rapid and carp may reach a size of 50 pounds or more.

If after reading these clues you are still unable to identify the fish silhouettes, turn to page 32 for the answers and consider ordering your own copy of "Freshwater Fishes of Texas." **





LETTERS TO THE EDITOR

Outlook for Red Wolves

We enjoyed reading the article on wolves in the May 1977 issue and appreciate your bringing the plight of the red wolf to the attention of your readers. It is considered to be our most endangered mammalian species.

Your readers might like to know that although they will often hear the canids of East Texas referred to as "wolves," the majority of these animals are actually coyotes. Those that are not coyotes are hybrid animals resulting from crossbreeding among wolves, coyotes and dogs. The last true red wolves in Texas, (probably less than 50) are to be found only in Chambers and Jefferson Counties in extreme southeast Texas. A few wolves may remain in an adjacent area of Louisiana.

We anticipate that the red wolf will be extinct in the wild within a year or two. We are now completing our field operations, the present objectives being to place as many red wolves as possible in a captive breeding program, and to pursue the possibility of establishing a wild population in other areas of the species' historic range. We have just been informed that several litters of red wolf pups have been born at the Point Defiance Zoo in Tacoma, Washington. It is with these new born pups that the future of the red wolf rests.

Curtis J. Carley
U.S. Fish and Wildlife Service
Red Wolf Recovery Program
Beaumont

Mushroom Identification

The picture of the mushroom on the back cover of the February 1977 issue, which was not identified, looks like *Armillariea tabescens*. This member of the family Tricholomataceae of the Basidiomycetes is common in the fall in East Texas and is reported to be edible. It is found in clusters (caespitose) and grows on decaying trees and sometimes from buried wood.

David Lewis
Vidor

■ Making a positive identification of most fungi is extremely difficult unless the specimen can be examined firsthand. Willard A. Taber, professor in the Department of Biology at Texas A&M University, states:

"The photograph does not contain sufficient information for me to identify the fungus. The fungus could be a species of Clitocybe or perhaps of Pholiota. The spore print and make up of internal tissue are needed for identification. It would also help to know if the tree is a conifer or deciduous tree. Color below some individuals suggest that the spores may be ochre or rust colored, but that color may be an artefact due to lighting.

"I am sorry I cannot identify this mushroom for you."

Sunburn Relief

You had an interesting article on sunburn in the June issue. I would like to suggest what I consider to be the best remedy for sunburn: Apply Barbasol shaving cream generously and look for relief.

L. G. Fincher, Sr., M.D.
El Dorado, Arkansas

Answers to Young Naturalist

1. Bluegill sunfish
2. Crappie
3. Alligator gar
4. American eel
5. Paddlefish
6. Catfish
7. Carp
8. Largemouth bass
9. Bowfin

BACK COVERS

Inside: Contrary to popular opinion, cougars, also known as pumas, mountain lions and catamounts, seldom use caves as dens. The area under an overhanging ledge, a dry cavity in a jumbled pile of rocks, a dense thicket or a cavity under the roots of a tree seem to be more desirable. The main item on their menu is deer, but a variety of other mammals, as well as vegetation, also are eaten. Photo by Perry Shankle Jr.

Outside: A strictly hands-off policy should be observed with the man-of-war. Each individual tentacle may contain as many as 750,000 stinging cells, called nematocysts, that can inject a painful neurotoxin upon contact. In water, these tentacles may extend up to 100 feet from the floating bladder. The stinging cells are still effective when the creature is dried and stranded on the beach. Photo by John Jefferson.