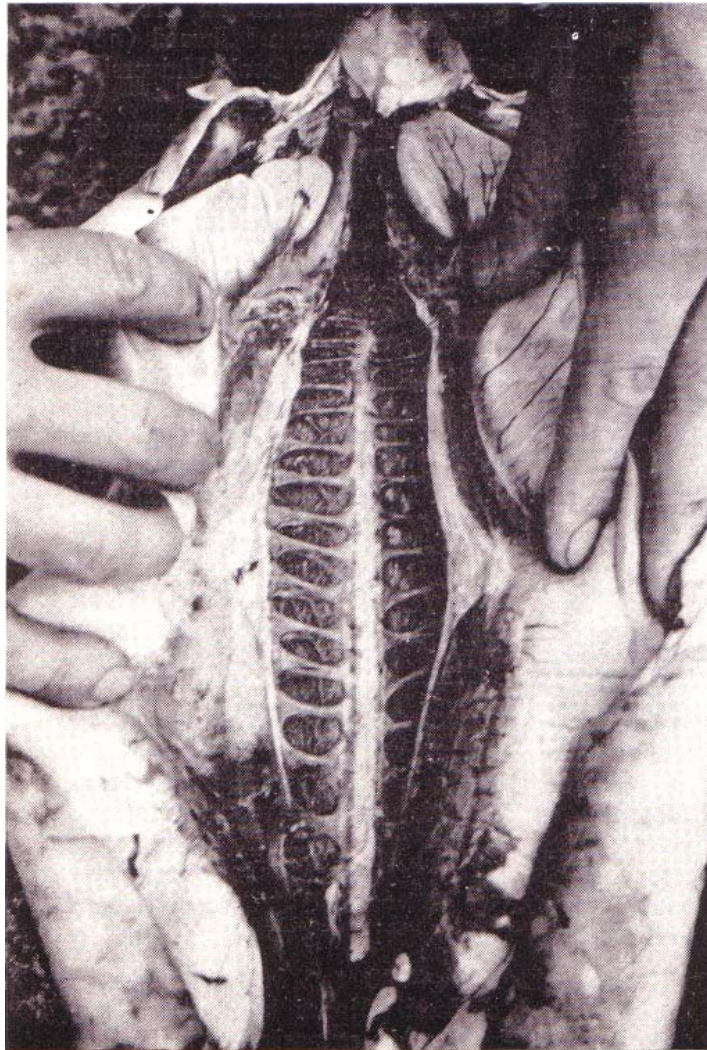


The Lungfish-Creature from the Past

by GORDON C. GRIGG

The survivor from prehistoric times, the salmon-fleshed Queensland lungfish, may fall victim to agricultural destruction of its habitat.

Along the more remote reaches of Queensland's Burnett River, particularly toward evening, it is easy to believe that prehistoric creatures exist in the still, dark pools. Yet despite the heavily primeval atmosphere of the river it has so far produced only one genuine survivor from prehistoric times—the Queensland lungfish, *Neoceratodus forsteri*.



Dissection of a lungfish (above) reveals the structure of its single lung. The lungfish also has a set of gills and can breathe air or water at will.

Photo by Gordon C. Grigg.

Fossil evidence suggests that this fish has remained essentially unaltered by any evolutionary processes for at least the last 150 million years.

The lungfish is a member of an extraordinary group of fishes, the Dipnoi, which have lungs as well as gills, allowing them to breathe air as well as water. Of the once widespread Dipnoan fish, only three survive today: *Neoceratodus* in Queensland, *Protopterus* in Africa and *Lepidosiren* in South America. *Neoceratodus* appears to be more primitive than its overseas cousins. It is the closest surviving relative of

the fish from which the first land vertebrates, the labyrinthodonts, arose about 325 million years ago. This makes it of particular interest to zoologists.

The Queensland lungfish inhabits waterholes in rivers where the channel widens, deepens and flows more slowly. During the day it remains on the bottom and can sometimes be seen in the shade of overhanging trees. It is active mainly at night, when it moves into the shallows to feed on waterweed.

The fish are quite large, up to about 12 metres long. The largest recorded specimen weighed in at nearly 48 kilograms. They are stout fish, dark brownish-grey above and yellow-orange below, and armoured by large, overlapping scales. The paired fins are leaf-like and control the direction of swimming; thrust comes from sinuous movements of the body and the large symmetrical tail. The mouth is small and the large crushing teeth are borne on the palate and lower jaw. The gill chamber is covered by a muscular flap, the operculum, which overlaps slightly the base of the front fin.

In appearance the sexes are similar, although females tend to grow larger than males. The stomachs of both are packed with waterweeds and animal remains, but it is not certain whether lungfish digest the plant material or simply ingest it for the animal life it contains—insect larvae, small snails, shrimps, and so on. In captivity the fish can be fed on beef, liver and earthworms. They are reputed to feed on flowers of *Eucalyptus* and *Callistemon*, which drop onto the water, and the aborigines once supposedly speared lungfish after luring them with flowers.

The lungfish came to the attention of the scientific world in a relatively quiet way at a time when mass media did not blast the news around the world. Nevertheless, it must have thrilled those associated with the story. The curator and secretary of the Australian Museum in the 1860s was Gerard Krefft, who told of the discovery in a letter to the editor of the Sydney Morning Herald of January 18, 1870. He noted the similarity of the unusual tooth plates to those of an extinct genus of Mesozoic fishes known as *Ceratodus*, and he called the fish *Ceratodus forsteri* after its collector, William Foster, agent general of New South Wales. Subsequently this name was changed to *Neoceratodus forsteri* to distinguish between the living and the fossil genera.

The discovery created much interest among biologists all over the world. Specimens were sent to Dr. Albert Günther at the British Museum. He dissected them and published a very full anatomical description. Interest centred on a number of anatomical features which indicated without doubt that this was a survivor of the order Dipnoi (lungfishes), which is related to the group of fish which gave rise to the Amphibia, the first terrestrial vertebrates.

In the early years after 1870 various fantastic claims were made about lungfish behaviour. They were reported to climb out on logs to sun themselves, walk about on the banks at night and even, according to one gentleman, graze along the shore, gnawing bark from trees. Undoubtedly this all stemmed from the observation that the fish had lungs.

Ideas that they are amphibious and can survive dry seasons by burrowing in the mud have been very persistent. *Protopterus* and *Lepidosiren* can burrow in the mud—but *Neoceratodus* cannot. Further, none of the living lungfish (and probably none of the extinct ones either) can (or could) walk on land. The fins are far too weak to support the body on land, and the fish dies from desiccation when removed from water for a few hours unless it is kept moist.

The very name "lungfish" indicates the remarkable mode of respiration. The lung is a single vascular sac dorsal to the gut, with an air duct opening into the oesophagus through a muscular slit, the glottis. The gills, which are well developed, are sufficient to oxygenate the blood at low levels of oxygen demand, but when the fish are more active (at night, or when fighting floodwaters), or in deoxygenated water, the lung is used as an accessory respiratory organ. When the fish surfaces, the inrush of air into the lung often causes a grunting, bubbling sound.

In Queensland the lungfish spawns between August and December. On August 10, 1964, at Bon Accord Crossing over Barambah Creek, a tributary of the Burnett, Norman Milward (now Lecturer in Zoology at James Cook University, Townsville) and I observed lungfish mating, an occurrence which had never previously been described. The two fish were a metre or more in length and were gambolling in clean shallow water between 4 1/2 and six metres away from the rock outcrop where we were standing. They were apparently unconcerned about our flashlights, and after some time playing follow-the-leader in and out of clumps of waterweed the leading fish began shedding eggs into the weeds, apparently being stimulated by the male as he nudged her along the flanks. The male then repeatedly dived through the weeds in this area, sometimes turning a little on his side, presumably shedding milt on the eggs. Next morning we collected fertilised eggs adhering to the weed in this locality.

The eggs are very like those of frogs, about the size of a small pea, and adhere individually to the waterweeds. Larvae hatch in about two weeks and live on the bottom. Juvenile fish are very hard to find, so hard in fact that Dr. Thomas Bancroft from Eidsvold (famous for his research into filariasis) considered that lungfish were no longer reproducing successfully and were on the verge of extinction. It is, however,

not uncommon for the juveniles of freshwater fish to be hard to collect, and the population of lungfish seems to be thriving.

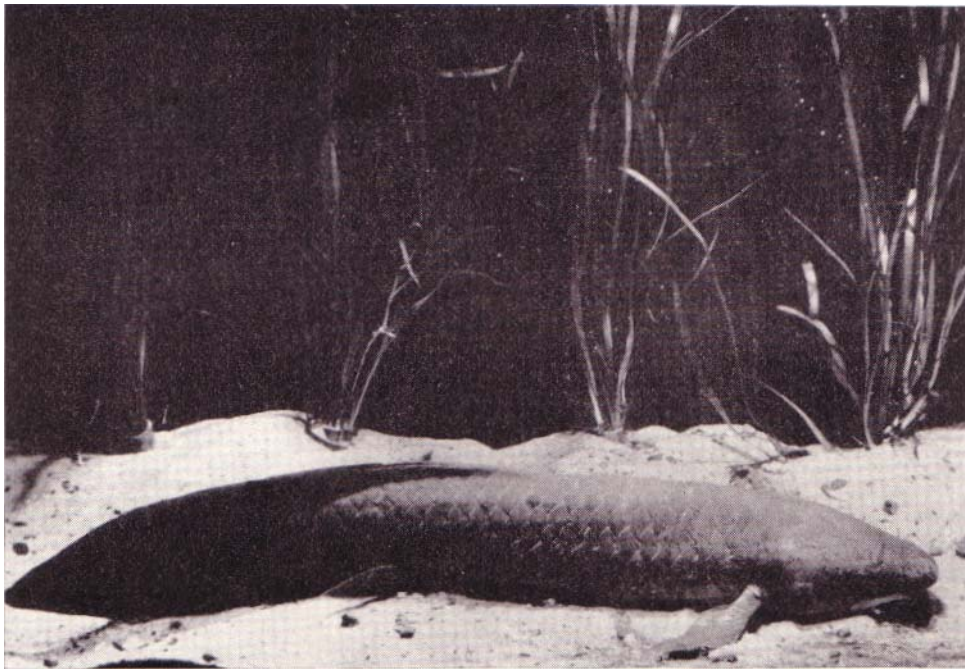
In the Mesozoic-120 to 180 million years ago-a genus of fossil Dipnoi known as *Ceratodus* was distributed extensively in India, Europe, North Africa, North America, parts of South America and Australia. A direct ancestor of *Neoceratodus*, and somewhat larger, it is known mainly from fossilised teeth. Its very wide distribution is in direct contrast to the current natural distribution in only two rivers, the Mary and Burnett, both fairly small waterways, several hundred miles north of Brisbane.

Early this century, partly as a result of Dr. Bancroft's fears that they may become extinct, lungfish were introduced successfully to the Brisbane River, the Pine River and a few other places, and there are now lungfish in many reservoirs, lagoons and farm dams throughout Queensland.

Lungfish have been protected by law for many years, and permits must be obtained for their collection for study or for export to zoos or museums. This conservation policy recognises the importance of maintaining a thriving population of these unique fish.

Perhaps the greatest danger to their survival in their native habitat comes from agricultural development along the rivers. Trees have been felled and scrub cleared, opening up the rich alluvial plains to citrus orchards and farming, and also causing much erosion and infilling of deep holes which are favoured haunts of the lungfish. Furthermore, increasing use of irrigation on the farms reduces the amount of water in the rivers, so that in the dry season they become mere chains of waterholes. On many occasions in recent years local residents have had to go to the aid of lungfish, rescuing them in large numbers from areas being pumped dry and transporting them to more permanent waterholes.

Fortunately the lungfish has been dispersed to other river systems where its future is more secure. It would be a great pity if a creature which has survived the ravages of eons of time were now to fall a victim to development.



A Queensland lungfish demonstrates its species' favorite occupation: lounging on the bottom of a stream. Myths that the lungfish uses its paddle-like fins to walk on land are unfounded.

Photo by Gordon C. Grigg.