Reclamation and Swamp Drainage— Their Impact on Fish and Fisheries

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RECLAMATION AND SWAMP DRAINAGE— THEIR IMPACT ON FISH AND FISHERIES

IN the past, and more so today, "wetlands" (swamps, lagoons, swampy creeks, and drains) have been regarded as a challenge to catchment board engineers and agriculturists, who have sought to free the flow of flood waters through swamps and creeks and have tried to convert these areas into productive farm land.

Though ornithologists and duck shooters have long been aware of the importance of wetlands to wildfowl, such as ducks, swans, pukekos, bitterns, and rails, few people seem to have realised that such lands are also important habitats for a wide variety of fishes.

There is a rapidly increasing demand for the drainage of wetlands. At the same time there is a developing awareness of the need to preserve the environment and conserve wildlife. A "tug-of-war" has therefore developed for control of these areas.

The whitebait fishery depends largely on swamp lands, coastal creeks, and drains for the support of adult stocks and on estuarine vegetation for successful spawning. The expanding and economically important eel fishery depends on the same waters to support the eel stocks. Thus the drainage of these wetlands is a direct threat to two economically significant fisheries.

Overseas many similar areas "developed" for agriculture have proved to be of marginal value as farm land, and programmes are being designed to re-establish wetlands and recover the sporting, fisheries, and natural history assets that were destroyed during "development". It would be unfortunate if New Zealand failed to learn this lesson.

The growing numbers of requests for information on the inhabitants of our swamps, creeks, drains, and tidal river estuaries indicate that people are becoming aware of the fish life of our wetlands. This leaflet deals with these seldom seen and little known fishes, and it is hoped that it will promote more serious consideration of the conservation of our wetlands.

The Wetlands

The characteristics of wetlands in New Zealand vary widely. Originally they were very extensive. There were once large areas of forest bog —shallow, clear, but brown-stained waters—lying beneath a forest of white pine either as totally enclosed waters or as boggy areas at the margins of larger, open swamps. There were also large areas of swamps comprising flax, raupo, and tall grasses, reeds, and sedges either at the margins of open waters or as areas of intermittently vegetated bog with shallow water lying between the clumps of plant growth.

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Close to the coast were areas of tidal swamp where water levels fluctuated with the tides and where sea water sometimes penetrated. In many of the estuaries themselves there were extensive areas of reedy salt marsh extending from below low-water mark, where there was always a ground cover of water, to areas where the water reached only at high spring tides.

Since the beginning of European settlement of New Zealand vast areas of these wetlands have been modified. Much of the forest has been felled either for timber or to open up the land for farming. Ditches have been dug to let the water drain away more freely. Meandering streams have been realigned and straightened, and marginal vegetation has been stripped away and kept clear by periodic drag lining. Estuarine lagoons have been filled with spoil ("reclaimed"), and catchment boards have constructed large systems of stopbanks, flood gates, and pumping stations to keep water in confined channels. The gently sloping estuarine banks, once clothed with thick growths of moisture-loving and salt-tolerant vegetation, have been replaced by sheer vertical banks with sparse plants struggling to maintain a foothold.

As a result of these activities there are no longer many large areas of inland swamp in New Zealand, and estuarine salt marshes have been much reduced in size. Many of the inland swamps that remain are now being drained, for example, the Hikurangi Swamp, near Whangarei, and the swamps along the eastern margins of Lake Wairarapa. Proposals for the drainage and conversion of 2,000 acres of swamp south of Karamea are now being evaluated.

This process is not easily reversible, and so serious thought should be given to the protection of wetlands. Consideration has already been given to this protection by wildlife organisations, in particular the Wildlife Branch of the Department of Internal Affairs and the acclimatisation societies. With the conservation of wetlands in view the Wildlife Branch is making a detailed and comprehensive wetlands survey, with both wildfowl and fisheries interests being considered and evaluated. This survey is certainly not premature; some may regard it as long overdue.

Fishes in the Swamps

Of New Zealand's 27 native species of freshwater fish, at least seven are found habitually in various types of wetland and another four occasionally. So these waters are an important habitat for fishes.

Mudfishes

Wetlands are essential habitats for the three mudfishes. Mudfishes are elongate, tubular fishes which grow to about 150 mm long. They have small, blunt heads, tiny eyes, and either very reduced pelvic fins or none. The dorsal fin is far back on the body and is almost joined to the tail. Superficially the mudfishes are rather like small, stocky eels, and are known as mud eels by some people.

The **black mudfish** *(Neochanna diversus)* is found in northern New Zealand, from about Kaitaia south to the Waikato district. It is smoky grey to almost black, with fine,

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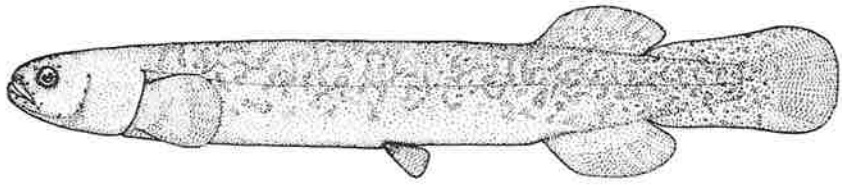
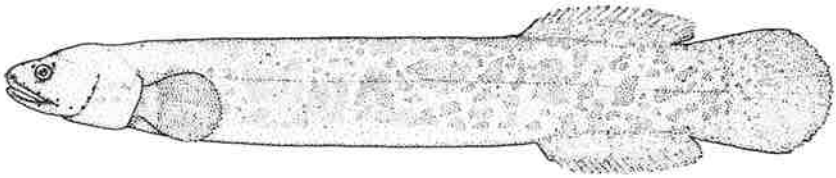
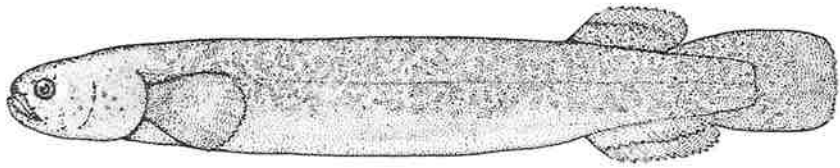
MUDFISH



Canterbury mudfish *(Neochanna burrowsius).*



Brown mudfish *(Neochanna apoda).*



Black mudfish *(Neochanna diversus).*

paler markings on the back and sides; the belly is usually greyish, but in some fish it is a reddish brown.

The **brown mudfish** *(Neochanna apoda)* is found in the southern North Island, from Patea southwards in the west and Masterton southwards in the east, and also on the west coast of the South Island as far south as Whataroa. It is sandy brown, darker on the back, and the sides are covered with irregular, greenish brown markings. The belly is creamish buff to pale grey.

The **Canterbury mudfish** *(Neochanna burrowsius),* as its name implies, is found only in Canterbury, from just north of Christchurch south to about Waimate. It resembles the brown mudfish in coloration.

Mudfish are seldom seen and little known, but they occur, sometimes in large numbers, in swamps, bogs, and boggy creeks and drains. They are not often found in free-flowing waters. All three species can live in a state of partial dormancy in the mud, or under tree roots, logs, or forest litter, when the water in which they live dries up in summer (aestivation). Fish in some populations are known to do this regularly each summer, sometimes for many weeks. However, their

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Wetland with a cover of mixed podocarp-broadleaf forest—a typical habitat of the brown mudfish *(Neochanna apoda).*

capacity to endure absence of water is not unlimited and if there is persistent drought throughout autumn, many of the aestivating fish are likely to perish.

Whitebait

The **inanga** *(Galaxias maculatus)* is the adult of a large proportion of the whitebait caught in New Zealand rivers. When the whitebait migrate up stream from the sea in spring, they move through the small tributaries and into large areas of forest, flax, or raupo swamp. It is not known what proportion of the whitebait move into swamp waters, but they are abundant there. The inanga is a small, scaleless fish,

A fence erected on the banks of the Manawatu River in the 1930s to exclude cattle from whitebait spawning grounds.

greenish, and speckled on the back and silvery on the belly. It normally grows to about 90 mm; some rare specimens reach 140 mm.

The inanga spends summer and early autumn in the rivers, creeks, and swamps and reaches maturity in autumn. Shoals of fish then move out of these habitats and down stream into the river estuaries. At the high spring tide river water backs up and covers grassy estuarine flats marginal to the rivers, and the fish move across these flats and spawn there. The tiny eggs drop down among the bases of the

A spawning area for the inanga *(Galaxias maculatus)* at the mouth of the Waimeha Stream, near Waikanae. Whitebait eggs were plentiful in the plant growth near the water before the locality was disrupted by a drag line clearing the banks.

grasses and other vegetation. When the tide falls, the eggs are stranded and depend on the high humidity of the river bank vegetation to avoid complete dehydration.

After spawning, most of the adults die. When the next series of spring tides occurs, about 2 weeks after the eggs were laid, the water again covers the vegetation, the eggs hatch, and the larvae are washed out into the estuaries and then into the sea as the tide falls and the estuary empties.

A related species, the **giant kokopu** *(Galaxias argenteus)*, is also found in swamps, lagoons, creeks, and drains. It is not yet clear where its "typical" habitat is, but large numbers have been taken from flax swamps and weedy and swampy creeks.

The giant kokopu is scaleless like the inanga, but is large and bulky, with a big head and a large groper-like mouth. It is greenish olive with small gold spots on the back and irregular, gold, hieroglyphic-like markings on the sides—rings, spots, crescents, and lines. The colour pattern is most distinctive.

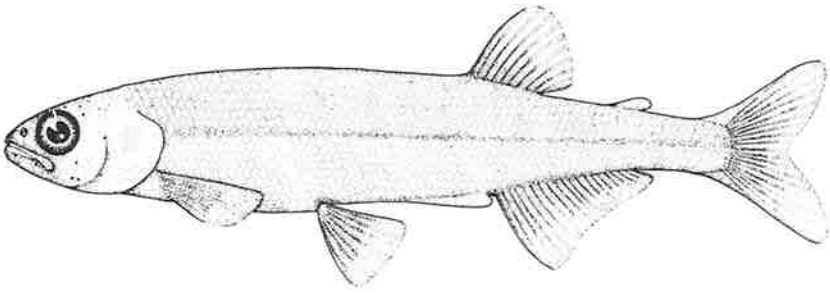
Like the inanga, the giant kokopu has whitebait juveniles that move in from the sea during spring, rather later than the other whitebait species, usually in November. These whitebait move into the swampy adult habitats, where they grow to maturity, probably not maturing for at least 18 months or longer.

Little is known about the spawning habits of this species, but it seems most likely that the fish spawn in or near the adult habitats during autumn or early winter. The newly hatched larvae go out to sea. Unlike the inanga, the giant kokopu appears to survive after spawning, as the fish grows to a large size. Those caught in recent years have been up to almost 400 mm long and have usually exceeded 300 mm.

The **banded kokopu** *(Galaxias fasciatus)* also occurs in swamps, though its most usual habitat seems to be small rocky streams tumbling down through the forest. Some banded kokopu have been found both in forest bog and in more open swamp lands. One of the most critical factors is probably the presence of adequate cover for the fish to hide in.

The banded kokopu is like the giant kokopu in shape, being a stocky fish with a large mouth and smooth, scaleless skin. Its colour varies from sandy brown to dark grey and it has vertical bands along its sides. These bands extend from behind the pectoral fin to the tail in smaller fish, but in larger fish are confined to the tail, where the bands tend to become broken up into an irregular network and cross the back.

The banded kokopu resembles the giant kokopu and the inanga in that it has a sea-run whitebait juvenile. The adults are thought to spawn during autumn in or near their normal habitats, and later the newly hatched young move out to sea, where they spend winter. Whitebait migrate back to fresh water during the middle of the whitebait



Common smelt *(Retropinna retropinna).*

season—from about October onwards. They reach maturity about 18 months after leaving the sea, that is, at about 2 years old. The adults survive spawning, probably several times, and grow large, to at least 280 mm.

Smelt

Another inhabitant of coastal lagoons and, especially estuaries, is the **common smelt** *(Retropinna retropinna).* This fish is a small slender species (up to 140 mm, usually 80-100 mm) with delicate, thin, and very easily dislodged scales. It is bright silver, with a somewhat greenish olive back and an iridescent purplish sheen along the middle of the sides. It has a distinctive and strong cucumber-like smell that is pleasant enough when the fish is freshly caught, but which later becomes sour and almost offensive.

During spring common smelt move into river estuaries, coastal swamps, and lagoons in large, roving shoals. They are often caught by whitebaiters, who regard them as a nuisance and who interpret their arrival as a sign that the whitebait season is over (this is incorrect).

The smelt spawn during spring and summer—it is not known just where—probably in the river estuaries or up stream, a little beyond the influence of the tide. The eggs are probably laid in sandy backwaters, where there is little water flow, to avoid the eggs being washed away. The tiny larvae go out to sea soon after hatching, but the spent adults die.

Eels

Estuaries, coastal swamps, and lagoons are important habitats for the **short-finned eel** *(Anguilla australis),* which is very much a swamp, lagoon, and swampy creek fish and is the major resource in the rapidly growing commercial eel fishery. The eels grow to about the right size for the market, are of good quality, and occur in dense concentrations in fairly easily fished waters. They live for many years in fresh water, even though spawning and early larval life are in the sea.

The short-finned eel is the smaller of the two New Zealand species and can be distinguished by its greenish olive back and greyish belly. It grows to about 150 cm.

Less common in these habitats—in fact something of a straggler—is the **long-finned eel** *(Anguilla dieffenbachii)*. Some long-finned eels occur in swampy habitats, but usually they are found in larger rivers. The long-finned eel is darker than the short-finned, having a darker grey-black back and yellowish grey belly. It grows to a very large size—at least 200 cm.

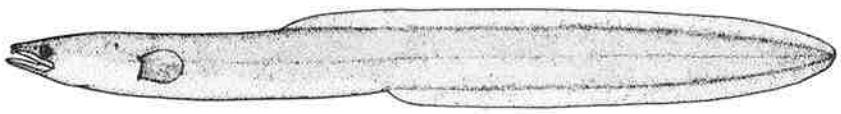
Bullies

In the more open waters of coastal swamps and lagoons, and in creeks and drains, the **common bully** *(Gobiomorphus cotidianus)* is common and widespread. It is a small stocky fish living openly on the bottom or among plant growth around the margins. It has a rather large head, prominent groper-like mouth, and large scales. It is an unimpressive grey-black with dark blotches along the sides and back.

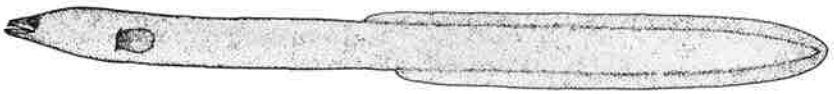
The adults spawn in the creeks and lagoons, laying their eggs in a primitive nest on the flat under-surface of a log, a big stone, or other similar objects. The larvae hatch and go out to sea. The young migrate from the sea into coastal waters from late spring through summer; they are tiny fish, 15-20 mm long, with little colour and look a little like miniature whitebait. Fishermen catch them and know them as "whalefeed" or "Dan Doolin spawn". Soon after they enter fresh water they become pigmented and more stocky in build. They also become easily recognisable as small bullies. The common bully grows to about 150 mm and is usually 110 mm or more long.

The **giant bully** *(Gobiomorphus gobioides)* is not at all well known.

EELS

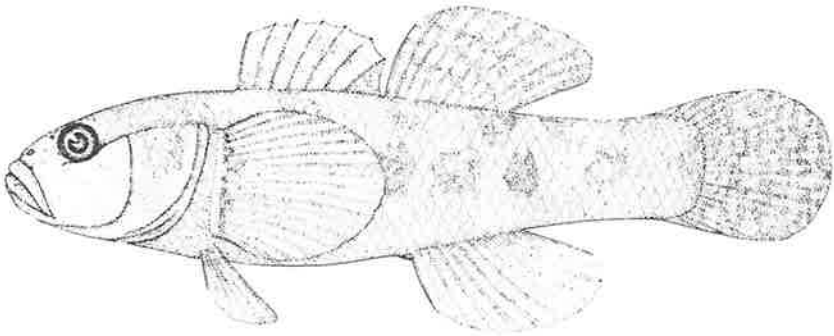


Long-finned eel *(Anguilla dieffenbachii)*.

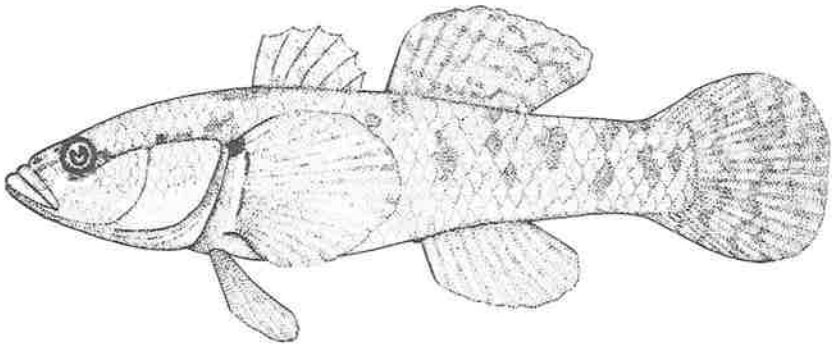


Short-finned eel *(Anguilla australis)*.

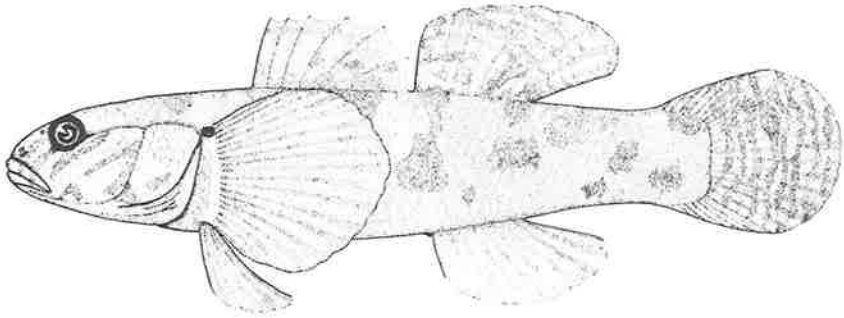
BULLIES



Common bully *(Gobiomorphus cotidianus).*



Giant bully *(Gobiomorphus gobioides).*



Red-finned bully *(Gobiomorphus huttoni).*

It certainly inhabits river estuaries, but it may also move up into the swamp lands nearby. The giant bully closely resembles the common bully in appearance and habits, but it grows larger, to at least 220 mm.

A rare inhabitant of swamp waters, and much more characteristic of tumbling rocky streams, is the **red-finned bully** *(Gobiomorphus huttoni)*. The red-finned bully is distinguished by diagonal stripes across its cheeks and opercula. The male has bright orange to red coloration in the fins and on the trunk. It usually grows to about 85 mm and can reach a length of 120 mm or more.

These swamp lands thus contain a moderately diverse fauna of freshwater fishes. Five of them—the inanga, giant kokopu, banded kokopu, and the short- and long-finned eels—are part of the commercial fisheries, though only the inanga and the short-finned eel are the swamp inhabitants with much commercial significance. The mudfishes are of no commercial importance, but they are unique.

The Doyleston Drain, near Lake Ellesmere. Left: The drain before the banks were cleared of vegetation, when the fish population was estimated at about 30 kg per hectare. Right: The drain after the banks were cleared of vegetation, when the fish population was reduced to less than one-tenth of what it was before clearance.

A typical farm drain with barren, muddy bottom, very little life, and no cover for most fishes.

Effects of Development

The effects of swamp "development" vary with the extent of the development. Where wetlands are converted to pasture and drained by creeks and drains the fish habitats are seriously modified or destroyed and the effect on the fish is the most serious. Where the swamps are less completely developed the harmful effects on the fish life are proportionately reduced.

Creeks and drains that are "properly maintained" are usually kept in a condition unsuitable for fishes, because they are largely vegetation

free, with open mud, sand, or loose gravelly beds to allow free flow of water through the channel. Drag lining drastically disturbs the environment and causes complete depopulation of fishes, as there is little food left for the fish. Even when drains are not "properly maintained", only a minimal amount of habitat remains for species needing cover.

Though swampy areas sometimes remain at the margins of the developed areas, the process of development usually leads to such a lowering of the water table that the swamp remnants are more prone to drying up than they would have been before development. Thus, the retention of small areas of wetland for conservation within a large development may have little ultimate value.

In addition to the conservation of wetlands it is very important that access for fishes to the swamps is retained. All the swamp fishes except the mudfishes migrate between fresh water and the sea. Thus, if conservation areas are to be of any value, the fish must be free to move in and out of these areas. Culverts and pumping stations create barriers to fish movement, though some species are able to climb obstacles with ease.

Straightening of stream courses has effects on fish life similar to those of swamp development. The area of habitat available to the fish is reduced, and its character is usually so extensively changed that it is no longer suitable for the fishes that formerly lived there. This type of change has probably affected the common smelt, which is thought to spawn in muddy backwaters.

Development of tidal estuaries does not affect the habitats of most fish species very seriously, but it is most important in its effects on the spawning grounds of the inanga. These spawning grounds are the gently sloping, marshy, vegetated areas covered by water at the spring tides. Their loss is of vital significance to whitebait and the whitebait fishery.

One of the critical factors in the effects of swamp development on the whitebait is that the fish grow to maturity in the swamps during summer, when the weather is warm and rainfall tends to be low. Lowering of water tables leads to reduced areas of shallow water, and removal of aquatic and sub-aquatic vegetation reduces the shade. Together these changes lead to higher water temperatures and increased loss of water through evaporation in summer.

It seems likely that swamp drainage, development, and the reclamation of estuaries have been among the most serious contributors to the decline in the New Zealand whitebait fishery, especially in the North Island and the east coast of the South Island. Districts where good whitebait fisheries persist, as in south Westland, are those where large areas of unmodified wetlands remain.

There is no doubt that the demands being made by water engineers and agriculturalists for the

development of wetlands, to enable so-called "maximum production" to be achieved, are having an impact on the wildlife and fisheries of our wetlands. Society has to decide whether wildlife and fisheries interests are going to be seriously considered in the face of these demands. Some decision must be made deliberately and soon to establish safeguards to protect the fauna of our wetlands before the remaining areas of swamp are developed and lost.

Already the Canterbury mudfish, with very limited areas of habitat remaining, is regarded as being endangered, and the giant kokopu is not nearly as common as it once was. The short-finned eel is being exploited very heavily, and continuing heavy demands are being made on the whitebait fishery. Survival of these wetland fishes and continued production of these important fisheries will be possible in the future only if serious efforts are made to conserve the wetlands in which they live.

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