# THE USE OF THE AUSTRALIAN LUNGFISH, (*NEOCERATODUS FORSTERI*) FOR THE CONTROL OF SUBMERGED AQUATIC WEEDS

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*Summary.* Analysis of faecal samples from captured lungfish (*Neoceratodus forsteri*) and experiments on the type of food eaten in captivity show that they feed on certain plants including hydrilla (*Hydrilla verticillata*), eel weed (*Vallisneria spiralis*) and filamentous algae,as well as on animal material. Further work is necessary to determine how important weeds are in the diet of lungfish and how well they are able to control these weeds in a natural situation.

## INTRODUCTION

Fish of several species have been used overseas for the control of submerged aquatic weeds like hydrilla, e.g. the Chinese grass carp (*Ctenopharyngodon idella*) (Shireman 1980) and some species of tilapia (*Tilapia* spp.) (Shell 1962). While there is no doubt that the grass carp eats large quantities of submerged weeds, it is important to know if native Australian fish are also able to control these weeds. If the grass carp were unable to breed here but had an encouraging effect on the weed problem, costs of maintaining the population at a useful level could be prohibitive. If grass carp were able to breed here the species could become a pest itself, escaping from the original situations and destroying the environment for native fish, or competing with species valuable for sport or commercial purposes. Similar objections apply to tilapia.

The use of a native species for the control of a native or introduced pest organism is not a new idea, and is being used successfully overseas, e.g. the use of the moth *Namangana pectinicotnis* in Thailand to control water lettuce (*Pistia stratiotes*) (Napompeth 1980). Native fish populations are already under threat in many places for various reasons, usually through man's interference with their environment i.e. dam building or flood mitigation schemes (Lake 1971). The introduction of exotic species for the purposes of weed control could endanger them further.

The use of Australian native fish for weed control should be comparatively inexpensive, although it is likely to involve the introduction of a species to new areas where it may result in environmental change, or compete with other species to their detriment. Alternatively the species may be unable to breed or become established in the new area, requiring fresh introductions to keep a controlling population going. Research has to be done to ensure that the species is going to be able to settle and breed in the new area, that it will not disturb the environment for other species, and that it will effectively control the target weeds.

Three types of native fish in Queensland have potential for the control of submerged plants. The sooty grunter (*Hephaestus fuliginosus*), the spangled perch (*Madigania unicolor*) and the silver perch (*Bidyanus bidyanus*) are known to eat weed, but the spangled perch is a small fish and the sooty grunter and silver perch have rather specific requirements for breeding (Lake 1978). Mullet (*Mugil cephalus*) also feed on water weeds, but these fish are difficult to transport live. Lungfish (*Neoceratodus forsteri*) are usually at least one metre in length, can be transported for long distances without damage in suitable containers, and are able to withstand some variation in climatic conditions. Preliminary investigations into the usefulness of lungfish for the control of submerged aquatic plants have been commenced.

## MATERIALS AND METHODS

Information on food preferences of lungfish was collected from adults captured in Queensland from the Mary River and Enoggera Reservoir and juveniles from the Brisbane River and Enoggera Reservoir. The fish were offered a variety of food and the food accepted was noted. Faecal samples were collected from the tanks and examined to see what had passed through the digestive tract. Faecal samples were also analysed from the Enoggera adults when they were caught, and from the Brisbane River juveniles within 24 hours of capture. Plants were identified using Aston (1973).

## RESULTS

The results of the analysis of faecal samples are given in Table 1, and the types of food taken by lungfish of various ages and from different areas are given in Table 2.

Table 1. Analysis of faecal samples from lungfish.

| Food type | Food type present[1] | | | |
|---|---|---|---|---|
| | Brisbane River on capture | Juveniles from tank | Enoggera adult on capture | Mary River adult from tank |
| Fish | * | - | - | - |
| Insect Larvae | * | - | - | - |
| Crustaceae | * | - | - | - |
| Molluscs | *** | *** | - | - |
| Tadpoles | - | *** | - | - |
| Hydrilla | - | - | ** | - |
| Filamentous algae | ** | - | - | - |
| Water hyacinth[2] rootlets | - | - | - | ** |

[1] * = a small number, ** = a fair quantity, and *** = a major proportion of the sample; - = not found.

[2] *Eichhornia crassipes*.

Table 2. Food taken by lungfish in captivity.

| Food type | Mary River adults | Enoggera adults | Enoggera juveniles | Brisbane River juveniles | Brisbane River juveniles |
|---|---|---|---|---|---|
| Fish | * [1] | - | * | @ | @ |
| Insect Larvae | @ | @ | @ | * | * |
| Crustaceae | * | * | * | * | @ |
| Molluscs | ** | * | ** | *** | * |
| Worms | *** | @ | *** | @ | *** |
| Tadpoles | ** | * | * | *** | ** |
| Meat | ** | @ | - | @ | - |
| Egg yolk | - | @ | * | - | ** |
| Dried food | ** | * | ** | ** | ** |
| Hydrilla | ** | * | * | * | - |
| Eel weed | * | ?* | ** | @ | @ |
| Filamentous algae | @ | ** | @ | ** | ** |
| Water hyacinth rootlets | * | - | @ | @ | @ |
| Fruit | * | @ | @ | @ | @ |

[1]* = the fish ate a small quantity, ** = a moderate amount, *** = this food formed a major part of the diet, - = the fish would not eat the food and and @ = food was not offered.

## DISCUSSION

The faecal samples indicated that plants form a part of the normal food supply for lungfish in different areas. It is likely that the plants were deliberately ingested and not simply taken in with the animal food. Snails of the species *Plotopsis ballonnensis* which were found in large numbers in the faeces of the Brisbane River juveniles, occur on rocks and on weeds like hornwort (*Ceratophyllum* spp.) and eel weed which were not found in the faeces, as well as on filamentous algae which were found in the samples. This suggests that both snails and filamentous algae are being selected as food.

The records of food eaten come from captive specimens, and in this situation lungfish took almost any food offered, including plant material. Juveniles less than 2 cm long ate filamentous algae. This material disappeared rapidly from the tanks of the Brisbane River juveniles, and from the pond in which the Enoggera adults were kept. Hydrilla disappeared more slowly from the tanks with juvenile fish and eel weed was also eventually cropped down.

The Brisbane River is a vast source of plant and animal food. Small molluscs, insect larvae, fish and crustacea are plentiful, as well as submerged water weeds like eel weed, hydrilla and filamentous algae. Other weed eating fish like mullet and spangled perch also occur there.

Enoggera Reservoir contains less animal food, mostly small prawns and fish but very few snails, as well as hydrilla. There are few other fish of any size in this reservoir, including catfish (*Tandanus tandanus*), the freshwater eel (*Anguilla reinhardtti*), a species of carp (*Carassius carassius*) and the spangled perch. Only the latter possibly eats plants.

Lungfish are surprisingly adaptable. They have been introduced and have become established in a number of rivers and reservoirs to which they are not known to be native, notably the Coomera River. This river is further south and colder than their presumed "ancestral home" in the Mary and Burnett Rivers (O'Connor, quoted by Welsby 1905 and Longman 1929). There is also a record of a juvenile lungfish from the Fitzroy River (Castelnau 1876). They appear to be able to tolerate a range of temperatures, and as they can survive in rivers with fluctuating levels, they are presumably able to cope with changes in water quality as well.

There is some suggestion that lungfish are useful for weed control. Hydrilla and filamentous algae are difficult to find in Enoggera Reservoir, but this is not the case in the Brisbane River, where hydrilla and eel weed are more common. This may simply reflect the availability of animal food, which is much greater in the Brisbane River than in Enoggera Reservoir. It does appear that lungfish are not able to control hydrilla or eel weed in an extensive region like a major river, but do well in a confined situation like Enoggera Reservoir. This is not a real disadvantage, as many aquatic weed problems are found in artificial situations such as reservoirs, drainage or irrigation channels, flood mitigation projects or recreational lakes.

Adult lungfish produce faeces which consist mostly of slime and a few scraps of plant material. In contrast, juvenile faeces contain plant and animal specimens which are still identifiable.

The difference in content of faecal samples between adult and juvenile lungfish may reflect a change in diet from omnivorous to herbivorous as the animal grows older, or it may mean an increased efficiency of the digestive process with age. However, lungfish of all ages and from different areas include plant material in their diet.

Further work is necessary to determine the optimal conditions for lungfish and the conditions that they will meet in new situations. Field trials are also needed to determine the effectiveness of lungfish in a natural situation, and to assess the likely effect on the environment of introducing large omnivorous fish to an area that has not been exposed to such animals before.

## LITERATURE CITED

Aston, H. 1973. Aquatic Plants of Australia. Melbourne University Press, Melbourne.

Castelnau, M.F. de. 1876. J. Zool. 5: 129-136.

Lake, J.S. 1971. Freshwater Fishes and Rivers of Australia. Thomas Nelson Australia Ltd, Melbourne.

Lake, J.S. 1978. Australian Freshwater Fishes. Thomas Nelson Australia Ltd, Melbourne.

Longman, A.H. 1929. Qld. Mus. Mem. 9: 161-173.

Napompeth, B. 1980. Weed Abstracts 29 (8) no. 2586.

Shell, E.W. 1962. Weeds 10: 326-327.

Shireman, J.V. 1980. Proceedings of the grass carp conference: Florida.

Welsby, T. 1905. Schnappering and fishing. Brisbane. p. 175-190.