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PROPOSED INTRODUCTION OF *ASTATOREOCHROMIS ALLUAUDI*, AN EAST AFRICAN MOLLUSC CRUSHING CICHLID, AS A MEANS OF SNAIL CONTROL.

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General background

The first record of schistosomiasis, a hieroplyph in the Kalum papyrus, dates back to 1900 B.C. in ancient Egypt. It lasted until 1851 before the responsible trematode worms were discovered by Theodor Bilharz and another 50 years passed before the life cycle of the parasitical worms was discovered by Manson (1902) and Castellani (1903). The sexual generation of adult schistosomes live in the definitive vertebrate host; the asexual stage lives in the intermediate host, freshwater snails. In the appropriate snail species, numerous free swimming cercariae are produced which are infective to the vertebrate host. Approximately 250 million people are affected by the disease worldwide.

Schistosomiasis control

Control is based on the interruption of the parasite's life cycle and was in the past mainly confined to snail control. Recently safe and reliable antischistosomal drugs have been developed which led to the formulation of an integrated control strategy, based on medication, sanitation, education and snail control. Medication only is unreliable due to the rapid reinfection of treated people in endemic areas. Consequently snail control still forms an important part of schistosomiasis control strategies.

Several methods of snail control can be distinguished:

A: Environmental management. By changing the habitat it may become unsuitable for snails. This method can be applied in artificial water bodies (e.g. irrigation systems) where vegetation clearing, concrete canal lining, and high water velocities may reduce snail populations.

B: Mollusciciding, the most commonly used practice. Snails can be successfully eradicated for a relatively short period (months). Application of molluscicides is therefore repetitive and hence expensive. It seriously affects other aquatic organisms and can even be lethal to fish. Promising experiments have been carried out with molluscicides derived from plants.

C: Biological control. In spite of several successful trials in the past, this control method has received little attention. Most commonly used are predatory fishes and competitive snail species. In the next section I shall discuss the possible introduction of the mollusc crushing cichlid Astatoreochromis alluaudi, into artificial and semi-natural water bodies in the North of Cameroon.

Possible introduction sites

In the Benue river, a tributary of the Niger, a dam is constructed near Garoua for the generation of hydro-electricity and for large-scale irrigation works on the former flood plains alongside the river. It is expected that with the formation of a permanent lake and the development of irrigation schemes the proliferation of parasitic disease vectors will increase. First observations confirm this expectation (Colenbrander & Dijkstra, pers. comm.).

Near the dam a fish culture station has been constructed where fry of a tilapia (Oreochromis niloticus) is produced. This fry will be introduced into rainfed permanent pools on the former flood plain. Since the yearly flooding and hence restocking with fish has stopped, these pools lost their fisheries potential for local inhabitants. Restocking of these pools will restore this local autoconsumption fishery. Experiments will be started on the combination of fish and rice culture in the irrigation system. Together with this fish culture program an experimental program of biological snail control will be carried out by introducing A. alluaudi together with O. niloticus. It is thought that with the combined stimulus of economic gain (fish production) and decreased infection risk, the local population is more motivated to cooperate.

Proposed introduction of an exotic fish species

Literature studies did not reveal any specialised snail eating fish species endemic to the Benue/Niger river system. Many species do include snails in their diet but forage in an omnivorous way. Before having reduced snail populations to a significantly low level such omnivorous fishes will already have switched to other food items. Therefore the introduction of a specialised snail eater from Lake Victoria (and surrounding waters), already successfully used in field trials, was proposed. The following reasons favour the proposed species:

1: Astatoreochromis alluaudi is a well investigated species, taxonomically unequivocally distinguishable from the other Lake Victoria haplochromines (cf. Verheyen, this issue).

2: It has already been introduced in Cameroon, Kenya, and Ruanda (Snoeks, pers. comm.) as a means of snail control, in some cases with considerable success. Adverse ecological impacts have never been recorded.

3: The fish inhabits shallow waters, especially those overgrown by reeds and papyrus. This is the habitat of pulmonate snail species, intermediate host of schistosomiasis. The fish can survive under low oxygen conditions in these swamp-like habitats, which is confirmed by preliminary laboratory experiments (See, pers. comm.).

4: Morphologically the fish can be classified as a pharyngeal crushing snail eater. With its enlarged pharyngeal jaws the fish can crush shells of considerable resistance. Stomach contents of Lake Victoria specimens showed that the fish feeds mainly on snails, when available. However, the fish is able to survive on other food items.

5: Pond experiments already showed that A. alluaudi (and other snail eating cichlids) can be successfully reproduced in combination with several tilapia species, cultured for consumption.
6: Last but not least; like many cichlid species, A. alluaudi is easy to handle and to breed. It is strong, has a high temperature tolerance, and outbreaks of diseases hardly ever occur in captivity.

However, since the introductions of exotic species have already caused great ecological disasters, every possible risk should be assessed in advance. Therefore the proposed introduction of A. alluaudi is evaluated with the help of a protocol described by Kohler & Stanley (1984) (fig. 1).

Evaluation of the protocol

Box I: The hazards of schistosomiasis infection are well known and the absence of suitable local fish species makes the introduction valid. A. alluaudi is not endangered in its native habitat. (In Lake Victoria the fish lives in a habitat less threatened by the Nile perch, and it can also be found in other areas in East Africa.) The fish are laboratory bred and selected before transportation, giving safeguards against disease introduction. Although initially the experiments will be carried out in ponds, the chance of escape can never be excluded (flooding, unintentional release). The answer here is thus unclear.
Box II: The ability of the fish to survive under the riverain conditions in the Benue system can be doubted. The conditions of this flowing water habitat differ widely from the lacustrine conditions in its native habitat. Its reproductive strategy may not be suitable for this environment (cf. Goldschmidt; Ribbink, this issue). However, some shallow tranquil areas of the river system may be suitable for the fish to survive, making the result of this box unclear too.
Box III: As mentioned before the earlier introductions in reservoirs and fish culture stations never had adverse ecological impacts. The fish are anatomically best fitted to eat snails, although they occasionally also include insect larvae in their diet. No adverse ecological impacts are expected, and I can not think of any hazard to man. The introduction of the fish can therefore be approved, although safeguards will be taken to prevent the fish from escaping from the initial pond experiments. A possible unforeseen ecological risk can be assessed through these experiments.

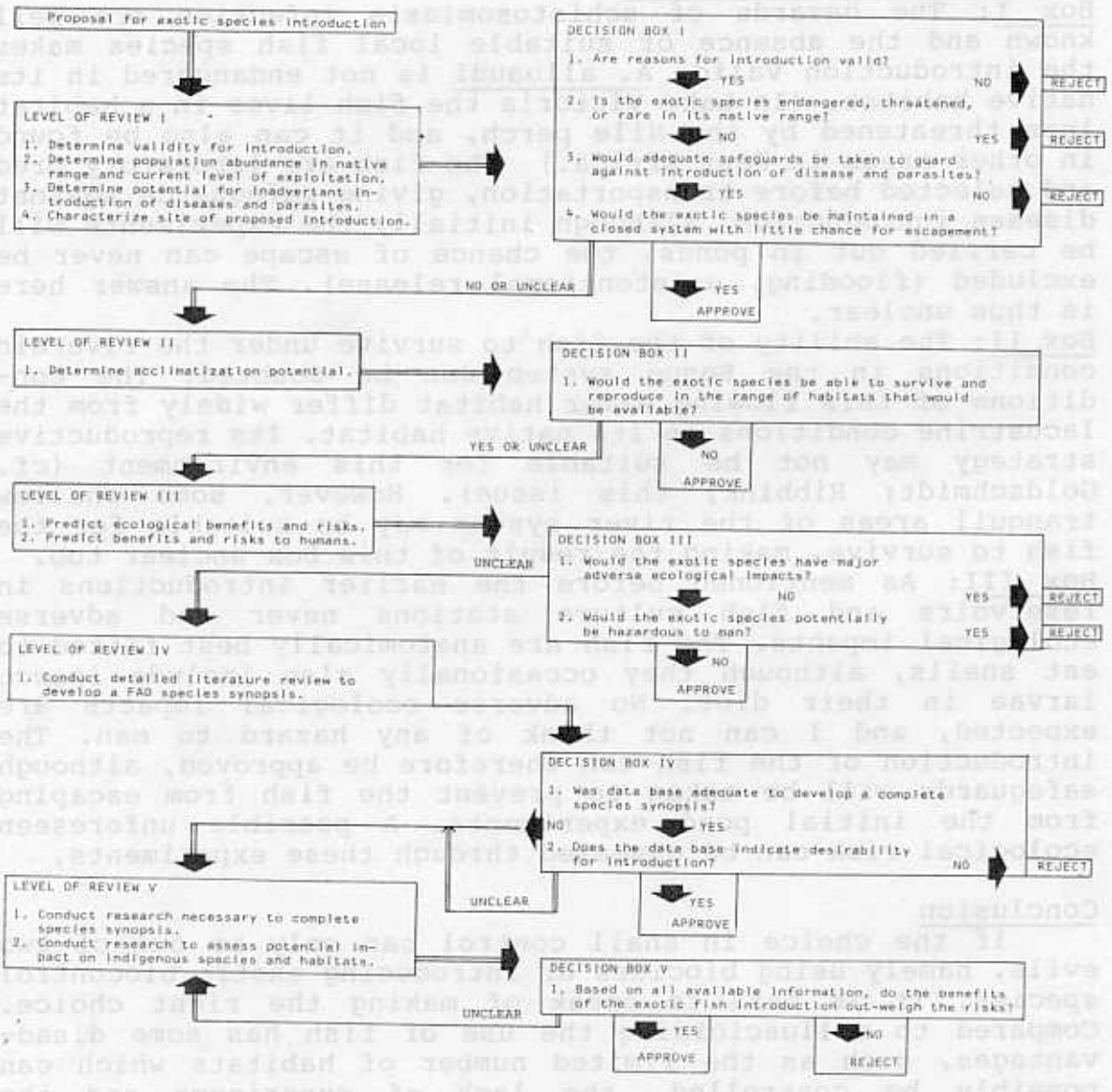
Conclusion

If the choice in snail control can only be out of two evils, namely using biocides or introducing exotic biocontrol species, it is hard to speak of making the right choice. Compared to molluscicide the use of fish has some disadvantages, such as the limited number of habitats which can possibly be controlled, the lack of experience and the uncertainty about the ecological impacts. Advantageous are the reduced need of foreign currency and the simplicity of the method which allows the involvement of the local

inhabitants. Taking into account the disastrous ecological impact of molluscicides, the use of fish deserves to be explored as a helpful tool in the integrated control of schistosomiasis.

Literature

KOHLER, Ch.C. & J.G. STANLEY (1984). A suggested protocol for evaluating proposed fish introductions in the United States. In: Courtenay & Stauffer (eds.). Distribution, biology and management of exotic fishes. John Hopkins University Press, Baltimore/London, pp. 387-407.



Review and decision model for evaluating proposed exotic introductions (Kohler & Stanley, 1984).