Food web restructuring

INTRODUCTION

The food web manipulation programme currently in operation in the Hartbeespoort Dam aims to improve the overall aquatic health of the dam by facilitating improved aquatic ecosystem diversity and services. An integrated biomonitoring protocol to manage aquatic ecosystems for impoundments became evident early in the programme and serves as a comprehensive pilot initiative which will guide similar future implementations in other dams.

The need to develop a Resource Management Plan and to implement the Local Rules (May 2009) was clear from the commencement of the *Harties metsi a me* programme. Through this, the entire surface of the dam was zoned as a dedicated fishing area.

Food web restructuring entails the restructuring of the fish population, as well as the reconstruction and rehabilitation of various aquatic habitats, in order to achieve a balanced ecosystem. The rehabilitation of aquatic fauna and flora assemblages, with the aim to achieve efficient nutrient and energy flow throughout the food web in a dam does, however, not come without its challenges.

The hypertrophic conditions of the Hartbeespoort Dam favour certain undesirable fish species (mainly carp and catfish), which have an adverse effect on the ecological functioning of the dam ecosystem.

Three fish species (coarse fish) were identified for removal as part of the food web restructuring programme, due to their dominance in the Hartbeespoort Dam in terms of numbers and/or weight, and their negative impact on the dam ecosystem. A fish removal permit was therefore issued by the North West Province to Rand Water, and a fishery contract was awarded during 2007.

These undesirable fish species are responsible for the re-suspension of nutrients into the water column due to their benthic (bottom) feeding behaviour, when they churn the bottom sediments and nutrients back into the upper water layers of the dam in their search of detritus and benthic organisms as food source. The coarse fish species also greatly rely on the zooplankton and invertebrate population as food source during various life stages, causing an inefficient energy and nutrient flow-through in the natural food web. Catfish (*Clarias gariepinus*), carp (*Cyprinus carpio*) and canary kurper (*Chetia flaviventris*) were therefore selected for removal as part of the food web restructuring programme, due to their dominance in terms of numbers and weight, their negative impact on the dam ecosystem, and the resulting imbalance in the nutrient and energy flow in the food web.

These three fish species suppress other fish species and aquatic biota in the dam in terms of breeding success, recruitment (survival of the young), feeding, habitat and growth, thus resulting in competition for the desirable fish species.

One hundred and ninety tons of coarse fish were targeted for removal during the first period of the fishery (2008/2009). The removal of coarse fish was set to continue until the fish ecological studies indicated a shift in the fish population, when a more desirable table fish, the Mozambique tilapia (blou kurper), would be harvested in continuation with the coarse fish species.

Fishing quotas were, however, not met by the fishery contractor, and a parallel fishing operation was therefore initiated to boost the fish removal programme. This parallel fishing operation has since

taken over the fishery and is known as the SMME Fish Harvesting and Scientific Fish Removal Programme. This initiative makes use of trained local fishing rangers, who are equipped with the necessary fishing gear to harvest the fish. A fish ecological survey and study scheduled for later in 2012 will provide information on the fishery's way forward, i.e. shifts in the population, and species to be targeted with quotas.

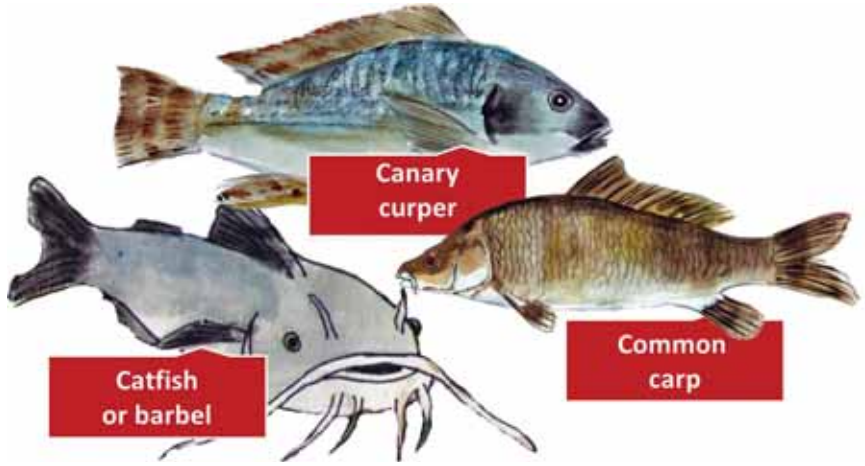
Parallel to this, shoreline remediation was developed, which also includes floating wetlands. The remediated shoreline, and more specifically the floating wetlands, create a spawning and feeding habitat, facilitating the establishment and succession of all aquatic biota (i.e. zooplankton, epi-biota, benthos, algae and diatoms, aquatic macrophytes, and fish).

FOOD WEB MANIPULATION

The preferred indigenous fish species, which were dominant in the dam as recently as 25 to 30 years ago, include yellow fish and the Mozambique tilapia (blou kurper), especially due to their recreational value for angling and as table fish (tilapia). The other smaller indigenous fish species (barbs), which may not be of importance as angling species, are of importance for the proper ecological functioning of the dam (energy and nutrient flow in the food web). Yellow fish, currently occurring in low numbers, is of major importance in terms of the socio-economics of the dam (angling), and as a predator at the top of the food chain in an artificial, man-made system, thereby completing the energy and nutrient flow in the food web.

Taking the above-mentioned information into consideration, a food web manipulation and restructuring programme was developed to achieve the desired aquatic ecosystem, as depicted in the sketch below. Following this is an integrated biomonitoring programme to consolidate the available and future biological research data into a comprehensive document. This programme includes the fish, plankton and invertebrate assemblages, incorporated and as associated with their habitats.

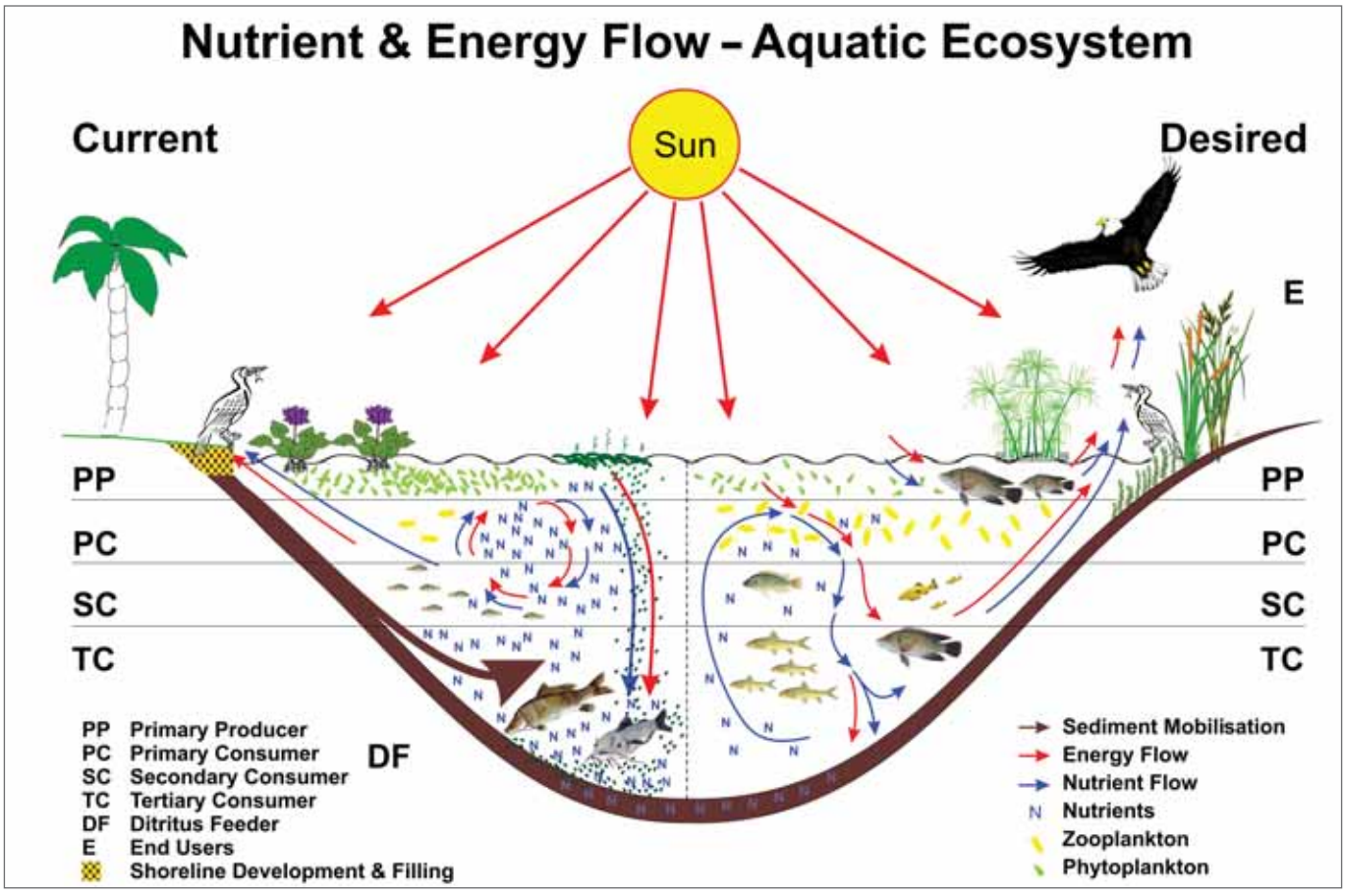
Coarse fish species in the Hartbeespoort Dam



RESULTS

Daily fishery or fish removal

Fish removal occurs on a daily basis during weekdays using scientifically predetermined and prescribed fishing methods, which target the selected coarse fish species. The types of fishing gear prescribed and used are selected particularly for the



targeted species, with the desired results, as is proved by a consistently low by-catch.

Fishery catches

Between February 2008 and June 2012, 190.4 tons of coarse fish were removed. The sustainable annual yield for fish biomass produced from the Hartbeespoort Dam is estimated at 300 to 350 tons. By removing fish within this quota, the total fish stock in the dam is expected to remain the same. No change in fish behaviour is expected as a result of fishery activities, although a variation in size distribution and species population, as desired, is becoming evident. Fish move around freely in the dam, and will continue to repopulate fished areas.

Scientifically selected gill nets

Training of the fish rangers

Recording the daily catch

Fishery team

Ideally a full fishery team for the scale of work as proposed for the Hartbeespoort Dam should consist of around 32 personnel (four store workers, 24 fishermen, and four skipper managers). The four skipper managers are needed to run the different fishing operations independently (with rotation of tasks). The fishery model has not yet been fully implemented in terms of staff, but has been up and running with about half of the proposed personnel, with relatively good outcomes. An increase in the number of personnel will further improve the fishery successes.

Fishing gear and operation

The following types of fishing gear are used/envisaged/implemented in accordance with the fishery model:

- Scientifically selected gill nets are used in the daily fishery to catch the target species.
- Long lines are implemented to catch catfish only, as 'meat' baits are used, such as liver, which is not utilised by other species.
- Electro-fishing is done with a scientifically designed fish electro-shocker, of which the design adheres to international best practice. The electro-fisher was designed not to damage, harm, or kill, but to stun fish, thereby allowing the operator to selectively scoop target fish species. The design and functioning of the electro-fisher relies on the principle of natural electron flow from negative to positive, whereby the fish are attracted to the positive poles (anodes) of the electro-fisher where it can be safely caught.

In addition to the above methods, a purse seine net is also implemented. The purse seine net is deployed from a barge in the open water, which rules out public interference (land owners and anglers) and damage to the net (as associated with land-based seine netting). Targeted fish are removed from the net on the water, and non-targeted species are returned to the dam.

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