



# The Use of Limnological Education to Eradicate Cyclops (the Vector of Guinea worm *Dracunculus medinensis*)

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## ABSTRACT

Lentic waterbodies such as lakes and reservoirs are known to contain *Cyclops*, the intermediate host of Dracunculiasis or Guinea worm disease. Dracunculiasis is a debilitating neglected tropical disease which affects many people in rural areas of Africa and Asia. Although the disease is on the verge of being eradicated, it has not been completely eradicated, due to new routes of transmission via animals. Infection and transmission of the disease in humans and animals is through ingestion of *Cyclops*. In order to eradicate the disease and its intermediate host, limnological education which is the use formal and informal teaching, learning and enlightening experience of limnology to educate people about *Cyclops* identification, biology, prevention and control is needed. Limnological education involves the use of awareness and sensitization, public lectures, workshops and training, using pictorial charts, audio-visuals, handouts, field guides, demonstration on how to use pipe and filter cloths, temephos application and ways of introducing of natural predators of *Cyclops*. Limnological education to eradicate *Cyclops* also involve capacity building through monitoring and surveillance of *Cyclops* assemblages, water quality management of the waterbodies, building or improving water treatment facilities and providing equipment and resources for monitoring, prevention and control of *Cyclops* to the people. Evaluation of the success of limnological education in *Cyclops* eradication is done using interviews, questionnaire-based survey, quizzes and practical field work. The evaluation will allow for assessment and feedback so as to identify areas of weakness, adjustment, improvement and further involvement for successful prevention and control of *Cyclops* in waterbodies and ultimately eradication of Guinea worm in the community. Limnological education could help develop mobile applications to collect and transmit sampling and monitoring data of *Cyclops* and water quality in waterbodies to limnologists, public health officials, Government and Non-Governmental Organizations to develop policies, regulations and control and eradication of *Cyclops* assemblages in waterbodies and Guinea worm in the community. Limnological education which is simple, cheap socially and environmentally friendly is one of the best ways of achieving the eradication of the *Cyclops* and Guinea worm disease and meeting up with WHO new target date of 2030 of eradicating the disease.

## 1. Introduction

Lentic waterbodies such as lakes, reservoirs etc. provide many important functions which include provision of drinking water (Mustapha, 2008, 2009a) and also contain diverse species of planktonic organisms (Mustapha, 2009b, 2010) such as cyclops which are intermediate host of *Dracunculus medinensis* the organism causing Dracunculiasis or Guinea worm disease.

Dracunculiasis is a debilitating neglected tropical disease which affects many people in rural areas of Africa and Asia where it has been associated with reduced economic status and low levels of education (Hopkins et al. 2018). The disease is transmitted by people drinking contaminated, untreated open stagnant surface water from reservoirs, lakes and ponds that are infested with *Cyclops*. The transmission and life cycle of the parasite has been described by (Pellegrino et al. 2022). Although

the disease is on the verge of being eradicated, it has not been completely eradicated, but reduced from 3 million to 27 cases at the end of 2020 in Africa (Pellegrino et al. 2022). The deadline target date for the eradication of the disease was set at 2020 by WHO, but has now been postponed to 2030 due to new routes of transmission which was previously unknown coming from animals such as dogs (uagliardo et al. 2020), while baboons and cats have also implicated as reservoir host for the disease (Hopkins, 2022).

Infection in humans is through ingestion of *Cyclops* through drinking of contaminated water, while in animals is through eating aquatic animals such as frogs or fish that have ingested infected *Cyclops* which are in turn eaten raw or undercooked from which the parasite is released into gut. In both human and animal transmission of Dracunculiasis, the *Cyclops* is implicated in the transmission. In order to eradicate the disease, limnological education of the people on sampling, identification, life cycle, behaviour, transmission routes, prevention and control of *Cyclops* is needed. According to Moustafa et al. (2022), Guinea

worm eradication will be unachievable in the presence of high transmission potentials such as the intermediate host.

Limnological education which is the use formal and informal teaching, learning and enlightening experience of limnology (an integrative, interdisciplinary and multidisciplinary ecology/environmental study of the physical, chemical and biological characteristics of inland waters such as lakes, reservoirs, ponds and other stagnant waters) to solve challenges and problems, for sustainable use, to maintain the health status and for management of the inland waters and its vast resources can be a useful tool in the eradication of Cyclops and hence Guinea worm thereby making WHO deadline target date of 20230 achievable.

This paper focuses on various ways through the use of limnological education by which Cyclops the intermediate host of Dracunculiasis or Guinea worm disease could be eradicated by the people especially in rural communities in Africa and Asia where the disease has not been totally eradicated and new routes of transmission is emerging.

## 2.Using Limnological education on eradication of Dracunculiasis through control of Cyclops

The following activities should be done in rural communities where the people drink contaminated, untreated open stagnant surface water either from reservoirs, lakes and ponds in order to control Cyclops and ultimately eradication of Dracunculiasis

1. Awareness and sensitization of the community that Guinea worm has not been totally eradicated and new routes of transmission is emerging through animals. This could be done by advertisement, flyers, posters and banners where people in the community will be able to listen and see them.

2. Public lectures, workshops and training programmes which involve teaching and demonstrating to the participants on how to sample waterbodies for Cyclops with aid of plankton net/water sampler, their identification using powerful magnifying hand lens/microscope and field guides.

3. Educating the participants on the life cycle, behaviour, transmission routes of Cyclops which lead to Guinea worm infection and various ways of breaking their life cycle and transmission routes. These could be done using flip pictorial charts, audio-visuals, handouts, manuals, protocols, field guides and other interactive modules.

4. Boat trips on the waterbody to sample for Cyclops and monitoring of water quality in terms of the physico-chemical and biological parameters that favour the development, composition, diversity, distribution and abundance of Cyclops should be regularly organized.

5. Prevention and control of Cyclops should be taught to participants by demonstrating how to use pipe and filter cloths to sieve the water which contains the Cyclops before drinking, how to apply temephos (a WHO approved larvicide) in right concentration to kill the Cyclops, and ways of introducing of natural predators such as fish species and the types of fish species into the reservoir to prey on the Cyclops.

6. Capacity building in the community to eradicate Cyclops could be done through monitoring and surveillance of the waterbodies to track Cyclops assemblages, management of the waterbodies to improve the water quality and prevent conditions that favour the assemblages of the Cyclops. Community engagement and advocacy for rational, healthy and sustainable management of waterbodies involving partnerships of the community with industries, local businesses and stakeholders to ensure economically viable, socially acceptable and practical solutions to the eradication of Cyclops in the waterbodies. Capacity building could also be through the community building

or improving water treatment facilities which will bring clean and safe water as well as providing equipment and resources for monitoring, prevention and control of Cyclops to the people.

7. Limnological data generated from the sampling and monitoring of Cyclops and water quality in the waterbodies should be made available to limnologists, public health officials, Government and Non-Governmental Organizations which can then be used to develop policies, regulations and control methods for Cyclops and Guinea worm in eradication in the community.

8. Evaluation of the success of Cyclops eradication in waterbodies should be done using interviews, questionnaire-based survey, quizzes, practical field work on

- (i) water sampling and Cyclops identification and biology,

- (ii) ways of using cloth and pipe filters to sieve water,

- (iii) application of temephos and introduction of fish species as natural predator of Cyclops.

The evaluation will allow for assessment and feedback on using limnological education to eradicate Cyclops in waterbodies in order to identify areas of weakness, adjustment, improvement and further involvement for successful prevention and control of Cyclops in waterbodies and ultimately eradication of Guinea worm in the community.

9. Through the use of limnological education to control Cyclops in waterbodies, mobile applications could be developed and made available to the community to collect and transmit sampling and monitoring data of Cyclops and water quality in waterbodies.

## 3. Anticipated outcome in using limnological education to eradicate Cyclops

By the use of limnological education to eradicate Cyclops in rural communities of Africa and Asia, the people in these areas will be able to know that

1. *Cyclops* is the intermediate host of Guinea worm infection and that Guinea worm has not been totally eradicated, with new routes of transmission emerging through animals. This will enable the community to have more knowledge, information and behavioural changes about drinking water from open surface waterbodies contaminated with *Cyclops* in particular and the Guinea worm disease in general.

2. The community will be able to sample and monitor waterbodies themselves regularly for *Cyclops*, identify them, break their life cycle and transmission routes, understand the factors (physical, chemical and biological) that contribute to their composition, diversity, distribution and abundance and the various methods (physical, chemical and biological) that can be used in controlling them.

3. They will be able to prevent and control *Cyclops* in waterbodies using cloth and pipe filters appropriately, know how to apply temephos (ABATE) in the right concentration to kill the *Cyclops* and types of fish species that can be introduced as natural predators of *Cyclops* in waterbodies.

4. Whole community involvement and capacity building in the sampling, monitoring, surveillance, prevention and control of *Cyclops*, improvement of the water quality and prevention of conditions that favour the assemblages of the *Cyclops*. Capacity building would enable the community to build or improve water treatment facilities which will bring clean and safe water as well as providing equipment and resources for monitoring, prevention and control of *Cyclops* to the people and ultimately to the eradication of Guinea worm in the community.

5. Community engagement and advocacy for rational, healthy and sustainable management of waterbodies involving partnerships with industries and local businesses and stakeholders to ensure economically viable, socially acceptable

and practical solutions to the eradication of *Cyclops* in the waterbodies

6. Mobile application would be developed to transmit data from sampling and monitoring of *Cyclops* and water quality in the waterbodies which could then be made available to limnologists, public health officials, Government and Non-Governmental Organizations etc. to develop policies, regulations, control and eradication of *Cyclops* assemblages in waterbodies and eradication of Guinea worm in the community.

7. The post-evaluation of using limnological education to eradicate *Cyclops* will show the effectiveness of limnological education to control, prevent and eradicate *Cyclops* in waterbodies and Guinea worm disease entirely. The post-evaluation would be followed up periodically to test the knowledge acquired by the participants from using limnological education to eradicate *Cyclops* from waterbodies. The results of the evaluation will be transmitted to public health officials, Government and Non-Governmental Organizations to justify or adjust the developed policies, regulations and limnologically education inclined prevention, and control methods of eradication of *Cyclops* in waterbodies towards the successful eradication of Guinea worm in the community.

#### 4. Conclusion

With the postponement of the deadline target date for the eradication of Guinea worm by WHO to 20230, and the new routes of transmission which was previously unknown coming from animals such as dogs, baboons and cats, in order to eradicate the disease by this target date, it is highly imperative to eradicate *Cyclops* which are the intermediate host of the disease. The best way of achieving the eradication of the disease and meeting up with WHO new target date is to use simple

limnological education which is cheap, socially and environmentally friendly and which people can key into. This is more pertinent since the disease is found in rural communities of Africa and Asia with reduced economic status and low levels of education and the people drink from contaminated, untreated open stagnant surface waterbodies such as reservoirs, lakes and ponds that are infested with *Cyclops*.

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