



CYCLOPOID COPEPODS: THEIR ROLE IN THE TRANSMISSION
AND CONTROL OF DRACUNCULIASIS

by

Fergus S. McCullough¹



1. INTRODUCTION

Leiper stated, as long ago as 1906, that the "practical study of dracontiasis, one of the oldest known and, in some regions, the most prevalent of tropical diseases, has been singularly neglected". Until very recently Leiper's opinion has remained largely unchallenged in spite of the major socioeconomic advances and outstanding technological achievements of the last 50 years.

"Why have practical studies, with a few notable exceptions, aimed at the prevention and control of dracunculiasis, been so rarely and spasmodically undertaken during the present century?" This question is perspicacious, as Dracunculus medinensis may be considered to be one of the few human parasites with so few evolutionary options, ipso facto, as to put it on the endangered species' list, especially if, added to its own limitations, mankind's concerted efforts to bring about its demise could be enlisted.

The main reasons for the long neglect of these studies are as follows:

- (a) Globally, the distribution and public health importance of the disease does not compare with such other parasitic infections as malaria, schistosomiasis, soil-transmitted helminths, etc.; at global level, therefore, its priority is relatively low.
- (b) Nationally, the disease is seasonally restricted to small, often isolated communities located in impoverished areas without political influence and with little chance of benefit from concerted public health activities.
- (c) Neither effective drugs nor a vaccine to treat or prevent the disease exist. Infected villagers have, therefore, little incentive to seek treatment at dispensaries/hospitals and tend to rely much more on traditional methods: consequently, the true gravity of the malady is often hidden. The villager accepts the infection fatalistically and mostly without complaint; the overworked clinician realizes that there is little he can effectively do to prevent/cure the patent parasite; and public health workers are mostly overburdened with other more urgent health priorities.
- (d) While the methods of preventing dracunculiasis are simple, their organization and effective implementation in remote, rural areas are surprisingly complex and, not infrequently, daunting. However, recent advances in primary health care concepts give rise to more promising control prospects.
- (e) Prevention and control of dracunculiasis demands a multidisciplinary approach.

¹ Ecology and Control of Vectors Unit, Division of Vector Biology and Control, World Health Organization, Geneva, Switzerland.

The issue of this document does not constitute formal publication. It should not be reviewed, abstracted or quoted without the agreement of the World Health Organization. Authors alone are responsible for views expressed in signed articles.

Ce document ne constitue pas une publication. Il ne doit faire l'objet d'aucun compte rendu ou résumé ni d'aucune citation sans l'autorisation de l'Organisation mondiale de la Santé. Les opinions exprimées dans les articles signés n'engagent que leurs auteurs.

(f) Biologists have, for obvious reasons, concentrated mainly on medical entomology, occasionally on malacology and hardly ever on the Subclass Copepoda, probably because so few important human parasites are transmitted by the latter group.

In the present paper an attempt will be made to summarize the role of cyclopoid copepods in the transmission and control of dracunculiasis.

Attention will be drawn to some unresolved problems, with special regard to the intermediate hosts and their preferred habitats, particularly those deserving to be more fully studied with the aim of developing more cost-effective, integrated control strategies.

2. FRESHWATER CYCLOPOID COPEPODS

These minute, pin-head sized crustaceans are biologically very successful, comprising many genera with diverse feeding habits. They are found almost exclusively in standing or slow-flowing waterbodies and are distributed worldwide in marine, brackish and freshwater habitats. For example, the pelagic, marine forms occur in enormous quantities and play a crucial role in the food chain of many fishes and whales. In addition, parasitic copepods are a favourite subject of study in many biology departments: the parasitic way of life has been exploited by numerous members of many different copepod families, and every stage of parasitism, from ordinary free-living forms to the most complex or degenerate parasites, is exhibited.

The free-living, freshwater cyclopoid copepods (known also, for brevity, as cyclops), are pear-shaped organisms, comprising a cephalothorax, an abdomen and a telson with a tail of two caudal rami. The sexes are separate and from the egg hatches a typical nauplius larva, which is then succeeded by several metanauplius stages before moulting into the first of five successive copepodid stages. Almost nothing is known of the susceptibility of the different instars to the infective larvae of Dracunculus. Moreover, few publications specify confirmation of the taxonomic status or the exact age or size class of infected cyclopoids.

3. TAXONOMY AND BIOLOGY OF CYCLOPS ACTING AS INTERMEDIATE HOSTS

Dr Ralph Muller (1971), in his review entitled "Dracunculus and dracunculiasis", has listed 17 species of cyclops which can potentially act as intermediate hosts in different endemic areas; in addition, Cyclops vernalis americanus has proved an excellent experimental host (Mueller, 1959; Muller, 1968), although it has not been recorded in dracunculiasis endemic regions. More recently, Steib (1982), working in Upper Volta, has added two more species (Thermocyclops incisus and Metacyclops exsulis) to the list of potential intermediate hosts. Further species will no doubt be incriminated as more research in natural transmission sites is undertaken in the future.

Concerning the taxonomy and biology of cyclops, the following aspects are salient, but few have been exhaustively studied:

(a) Only large, predatory species can readily ingest D. medinensis larvae and can thus act as potential intermediate hosts. Of these carnivorous species the older and larger copepodid stages are more predatory than the younger and smaller ones (Steib, loc. cit.). The smaller herbivorous species are excluded as natural intermediate hosts.

(b) In each endemic zone usually only one of the local predatory species, by virtue of its preferred habitat and/or its seasonal population dynamics, is the dominant intermediate host.

(c) Even among carnivorous species, some are more susceptible to D. medinensis infection than others. While intermediate host specificity does not strictly occur, there exist some species of predatory cyclops which are more refractory to infection than others.