EPIDEMIOLOGICAL STUDIES ON DRACUNCULIASIS IN OYO STATE, NIGERIA

BY

OLUWASEYI ADEGBOYEGA ADEYEBA

M. Sc., M. Phil. (Ibadan), AIMLS (London), F.I.M.L.S.(Nigeria) AMNIM

THESIS IN THE DEPARTMENT OF VETERINARY MICROBIOLOGY AND PARASITOLOGY

SUBMITTED TO THE FACULTY OF VETERINARY MEDICINE IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

UNIVERSITY OF IBADAN

FEBRUARY, 1995

DEDICATION

DEDICATED TO

The Glory of the Living and Everlasting
God through Jesus Christ our Lord.
For from Him and through Him and to Him
are all things.

ABSTRACT

The studies were designed to collect baseline information to form essential data base for effective planning and s~ubsequent evaluation of guineaworm control Jprogramme in Oyo State. In order to establish the epidemiology of dracunculiasis and assess the impact of the disease on the economic life of the affected population, pretested questionnaire data sheets were administered to 2,415 individuals and 257 heads of household in eight different villages in Oyo State. The data analysis was done by using analysis of variance and coefficient of determination and multiple range tests, using the IBM computer, utilizing the SPSSH package. The survey of concurrent parasitic diseases was carried out in one village by examining faecal and blood samples of 287 individuals. The antibiogram and profile of bacteria associated with secondary infection was determined. Simple methods of chemical, biological and physical control of guineaworm vector under laboratory conditions were described.

Of 2,415 individuals examined in eight villages of Oyo State in 1988, 76.9 per cent had history of dracunculiasis while the infection rate at the time of study was 47.9 per cent. There was no significant difference in the infection rate between the sexes. However, the risk of infection increased with age. Infection occurs at any age above 1 year and reinfection is common, indicating that on clinical grounds, no protective immunity is developed after infection.

There was a general awareness by individuals that they were infected before the formation of the guineaworm bleb. Mean percentage of 18.9 ± 1 had the sympoms in 1 day. The sites of guineaworm emergence differ significantly for each victim ($P < 0.05$), and no anatomical part of the body was apparently exempted with regard to worm emergence. Majority of the affected people (a mean per cent of 54 ± 6.7) became clinically ill in the dry season; and also a mean per cent of 54.3 ± 2.3 suffered severe infection. 5 - 8 weeks was the most frequently occuring period of incapacitation. 54.5% of the victims had no form of assistance on the farm during the period of incapacitation.

Majority of the heads of household held various wrong beliefs of causes and prevention of the diesease. 82 ± 3.6 per cent attributed the cause of guineaworm to the act of God and that there was no remedy for it. Only 6.53 per cent treated the drinking water before consumption. The disease has an adverse impact on agriculture, while an average of 20 - 41 per cent of the pupils were absent from school with attendant poor academic performances.

Of 487 samples examined for concurrent parasitic disease 278 (57.1 per cent) were infected with one parasitic disease or the other: Ascariasis (43.7%), hook-worm disease (27.1%), strongyloidiasis (2.5%), trichuriasis (31%), Entamoeba histolytical infection (3.9%) and plasmodiasis (43.7%). The haematocrit value of the individuals in the community was generally low (26 - 30%) whilst eosinophilia was a common feature. The health implication was discussed.

Klebsiella sp., Streptococcus sp., Proteus sp. and Staphylococcus aureus were common bacterial agents isolated from guinea worm ulcers. The phage types of Staph. aureus (the commonest agents) isolated were resistant to both penicilline and tetracycline. The epidemiological importance of the various phage types was discussed.

The ecology of the environment where the copepod intermediate hosts breed and transmit dracunculiasis was described and discussed. Cyclopoid copepods died within 60 minutes when the environment was manipulated to 24.6mg/1. oxidizable organic matter concentration from the natural average va~ue of 12.5mg/1. It was shown that cyclopoid copepods became inactive at 4 - 6°C in 4 hours and later regained activity in 15 minutes at room temperature.

The study showed that ponds in a study area had the highest density of cylops in November/December (1988) and lowest density in July/August (1988) with natural cyclops infection rate of 6.5% at the peak of transmission. It was also shown that the concentration of cyclops was greatest when water was drawn at the time the pond water was still and undisturbed, especially with the first caller at the pond, with attendant higher risk of infection.

The study also revealed that population mobility occasioned by marriage, socio-cultural and economic life of the people contributed to the diffusion and control of the disease.

A variety of chemicals found in natrual waters, or used in the treatment of water were added to pond water and their effects on the survival of the cyclopoid copepods were assessed. The possible use of such chemicals as calcium hypochlorite, potassium permanganate, lime, etc., in individual houses as a preventive measure against the transmission of the disease was discussed.

Furthermore, the study revealed that indigenous fishes like Hemicromis fasciatus, Barbus occidentalis, Tilapia nilotica and T. galilea; were very useful biological control agents of the vector of Dracunculus.

It is believed that provision of safe drinking water and good health education with active case search to monitor the intervention programme will reduce the disease prevalence.

ACKNOWLEDGEMENT

I am greatly indebted to my supervisors, Professor Oladele O. Kale, the former head, Department of Preventive and Social Medicine, College of Medicine and a Senior Consultant and National Facilitator of the Nigerian Guineaworm Control Programme; and Dr. Benjamin O. Fagbemi, a Reader in the Department of Veterinary Microbiology and Parasitology and former sub-dean (undergraduate), Faculty of Veterinary Medicine, who despite their very tight schedules still found time to offer very useful services at every stage of the course of this study. I thank them for their keen interest, guidance and encouragement.

I would like to express my profound appreciation to Professor M. K. C. Sridhar of the Department of Preventive and Social Medicine for allowing me the use of his laboratory and other facilities and critically going through the work. His technical assistance has contributed in no small measure to the success of my laboratory work.

My gratitude also goes to the following for the role they played during the period of registration for this programme: Professor Adelani Ogunrinde, the former Acting Head, Department of Veterinary Microbiology and Parasitology, Dr. Clement K. Ojeh, Professor Aderemi Kuku, Dean, Post Graduate School; Professor E. O. Ogunba, Professor Olowookorun and Professor O. O. Kale. I thank Professor Yemi Adetosoye for his support during my trying period.

My sincere appreciation goes to Dr. Akinmumi Akinyemi, the former Chief Medical Officer of Oyo State and pioneer chairman, Oyo State Task Force on Guineaworm Eradication and Dr. Olu Alabi, the then Oyo State Commissioner for Health for appointing me the (pioneer) Secretary and Co-Ordinator of the State Task Force on Guineaworm Eradication. I benefited immensely from their co-operation and support. I also wish to thank Mr. Isola, the Government Photographer who produced most of the photographs used in this thesis.

I must not forget to thank all the Local Government Authority Health Officials especially those from Irewole, Oluyole and Akinyele L.G.As who assisted during the epidemiological survey for their kindness. My appreciation also goes to Messrs Lekan Akinlabi and Dotun Adeyeba for assisting me throughout the period of water sampling and collection of cyclops for the study.

I am also profoundly indebted to Dr. Gabriel O. Adegoke of Department of Food Technology, University of Ibadan and Dr. C. Godard of Institut Pasteur du Brabant, Belgium for assisting in phage typing the Staphylococcus strains.

I must also thank Rev. Okeremi, the Director of Fisheries, Oyo State Ministry of Agriculture for supplying free of charge all the fishes used for my experiments. My special thank goes to Prince Adetogun of the same Ministry who introduced me to him.

I must place on record the various supports received from my friends especially Brother Yemi Obakin (who gave monetary support), Brother

Ranti Orioke (for supplying reams of photocopy papers), Brother Jide Soetan (for all the duplication), Dr. Oyewole Adeyeye (for arranging and paying for the computer analysis of my data and development of all figures and illiustrations), Prof. M. B. Ogunniyi, formerly of the Department of Teacher's Education (for his critical review of the questionnare), K&K Bookshop (for donating typing sheets for this work) and Mrs . R . O . Akindiya (for typing this thesis). I am greatly indebted to all the members of the Mobile Fellowship for their prayer support.

I am very grateful for the co-operation received from the members of staff and students of all the community schools in Mele, Ejitolu and Seriki villages and indeed all the Chiefs and elders of the entire study area, who literaly stood by us throughout the course of the study. Occasionally, they gave to us part of thier farm produce as gift.

I want to express my gratitude to members of my family for bearing with me during the period of this study.

ALL GLORY BE TO GOD through my Lord and Saviour Jesus Christ whose amazing grace I enjoy always.

CERTIFICATION

We certify that this work was carried out by O. A. Adeyeba in the Departments of Preventive and Social Medicine, and Veterinary Microbiology and Parasitology, University of Ibadan.

Professor O.O. Kale, B.A. (T.C.D)
M.B., B.C.H., B.A.O. (Dublin) D.T.M and H (Liverpool) D.P.H. (Bristol), F.M.C.P.H., F.W.A.C.P. (Nigeria),
Department of Preventive and Social Medicine, University of Ibadan.

Dr. B.O. Fagbemi, D.V.M. (Ibadan)
M.Sc., Ph.D (Ibadan)
Reader [illegible]
Department of Veterinary Microbiology and Parasitology,
University of Ibadan.

TABLE OF CONTENTS

PAGE

PAGE

PAGE

PAGE

CHAPTER SEVEN

CHAPTER EIGHT

LIST OF FIGURES

PAGE

LIST OF TABLES

PAGE

CHAPTER ONE

GENERAL INTRODUCTION

Dracunculiasis (guineaworm disease) the infection with Dracunculus medinensis has been recognised since antiquity (Linnaeucs 1758). This infection is caused by a large unsegmented cylindrical worm of the phylum nemathelminthes, class nematoda, sub-class phasmidia, order spirurida, sub - order camallanata, super family dracunculoidea, family dracunculidae genus Dracunculus and species medinensis. It is one of the oldest parasitic diseases ever known to man.

The disease had been described by many early Greek, Arabic and Persian authors who called it by many vernacular names: guinea worm, medina worm, "irk al medina", filaire de medine, le dragonneau phyraonswurm. The disease was first named and described as occuring around the Red Sea by Agatharcides of Chidus while Plutarch said it was common in Egypt and Mesopotamia (Hoeppli, 1959). The controversy on the origin of the disease as started by an early author Avicehna, who thought that it was of nervous origin was laid to rest by Velsichius (1674) and Bartet (1909) who also prepared a monograph containing other lists of historical references.

Many names have been coined for the worm all over the world in modern time depending, of course, on the part concerned. For instance, in Nigeria, it is called "Sobiya", "Zuba", "Bulutu", "Kunukuni", Ari ikwere" and "Odrogo" in Yoruba, Boko, Fulani, Hausa, Igbo and Idoma lands respectively. Other known names include "irkon" in New Guinea and "rishta" in Iran.

Dracunculiasis, by any assessment, is a terrible disease. It is primarily a rural problem. This fact partially explains the relative obscurity of the disease as weli as its continued prevalence and increase in magnitude. Until recently, the disease has not been the subject of sustained research or control efforts. It has been neglected because it rarely kills, but temporarily cripples people in rural communities located far from modern institutions. Hence, the notion that the disease is "a forgotten problem of the forgotten people."

There are no accurate national figures but some measure of the extent of distress caused by the disease can be gauged from various small scale epidemiological surveys carried out by a few authors (especially in Nigeria) like Kale (1977), in Ibarapa area; Nwosu et al (1982) in Anambra State; Edungbola (1983, 1984) in some parts of Kwara State and Udonsi (1987a, b) in Imo State. In the early fifties, Onabamiro reported many cases in some parts of the old Western Region now within Oyo and Ogun states of Nigeria (Onabamiro, 1952). Information on the distribution and prevalence of the disease is scanty. Therefore, precise numbers and locations of contaminated water sources, as well as the specific villages, towns and sizes of the populations which are affected by dracunculiasis are known.

In some countries, such as Uganda (WHO, 1984) the disease is thought to be restricted to specific regions, while in Nigera it is now known to exist in all but one of the 21 States (at the time of this study) of the federation as a result of a nationwide active search conducted in 1988. Prior to this data on disease prevalence in the country was based on sporadic reports from part of Anambra, Kwara, Ogun and Oyo States.

Up to the 1988 active case search in Nigeria it was estimated that about 2.5 million cases per year occur in Nigeria which would account for one-fourth of all the disease which occurs in the world. Thirty million Nigerians are thought to be at risk from the infection and this represent about 7596 of the annual African cases (Watt, 1987). The first active case search however revealed about 700,000 cases, although the (1988) active coverage was less than complete. Estimates of the magnitude of impact of dracunculiasis on the agricultural sector are relatively scarce, but those that exist either estimate lost workdays or the value of lost production in some parts of the world. The estimates of W.H.O. (1986) places the annual loss of workdays in India caused by dracunculiasis at 10.6 million. The average period of absenteeism from farms in South Ghana was about 15 weeks (Belcher et al., 1975). Current research assisted by UNICEF on the socioeconomic impact of dracunculiasis on rice out-put in Cross River, Anambra and Benue States is expected to reveal a more correct assessment in Nigeria, (Kale - personal communication). Dracunculiasis is the ma jor cause of absenteeism from sc hool in endemic areas of Anambra State and Idere in Oyo State (Nwosu et al, 1982; llegbodu et ai, 1986).

1.1 RATIONALE AND OBJECTIVE OF THE STUDY

From ancient times to the present and in spite of technological advancement, dracunculiasis still represents a serious health risk, social indignity, psychological distress and economic loss for several millions of rural villagers in parts of Africa especially, Nigeria, the Middle East and India.

The purpose of this present study was to collect baseline information 'from households in a small representative sample of villages in Oyo State especially during the peak transmission season as essential data base for effective planning and subsequent evaluation of a control programme as well as case treatment and management. In addition, the study was designed to evaluate simple methods of chemical, biological and physical control of the vector of Dracunculiasis.

The specific objectives of the studies are:

(a) To describe the prevalence of dracunculiasis in a sample of rural agricultural communities in Oyo State of Nigeria by specified demographic ecological variables viz. sex, age, religion; sources of drinking water; site of lesion; freqency of infection and seasonal variations.

(b) To ascertain or assess the health beliefs/and knowledge regarding dracunculiasis and water use behaviour in the communities .

(c) To describe the effect of the disease on daily routine of work and school attendance and academic performance of school children.

(d) To determine the pattern and level of concurrent parasitic infections in a guinea worm endemic area

(e) To determine the antibiogram pattern and phage types of the predominant microbial agent responsible for secondary infection of the guinea worm ulcers.

(f) To investigate the water supplies for monthly variations in the density of the vector, the cyclops, and physical and environmental factors affecting the survival and breeding of the vector.

(g) To determine the effects of some common chemicals found in water on the survival of the vector under laboratory conditions.

(h) To determine the effect of varied environmental factors on the survival of cyclopoid vectors under laboratory conditions;

(i) To examine the effectiveness of biological methods of controlling the vector using locally available species.

1.2 ABOUT OYO STATE AND THE STUDY AREAS AT A GLANCE

Oyo State is one of the twenty one States that constitute Nigeria (as at the time of this study). It lies between latitude 7° and 9°30' North of the

Equator and between 2°30' east of the Prime Meridian. It covers a land area of 35,743 sq. km. It is bounded in the North by Kwara State, in the West by the Republic of Benin, in the south by Ogun State and in the east by Ondo State.

Within the national setting, Oyo State represents the core of a homogenous Yoruba speaking people. It is one of the most densely populated States in Nigeria. With an estimated 1989 population of 11,909,039 projected from 1963 census figures at the rate of 3.3 per cent growth rate; it is the second largest state in the Federation. The State was divided into 24 Local Government Areas (LGA) at the time of this study (Fig.1.1). The state experiences two major seasons viz rainy and dry seasons with rainfall varying between 1500mm to 2000mm per annum.

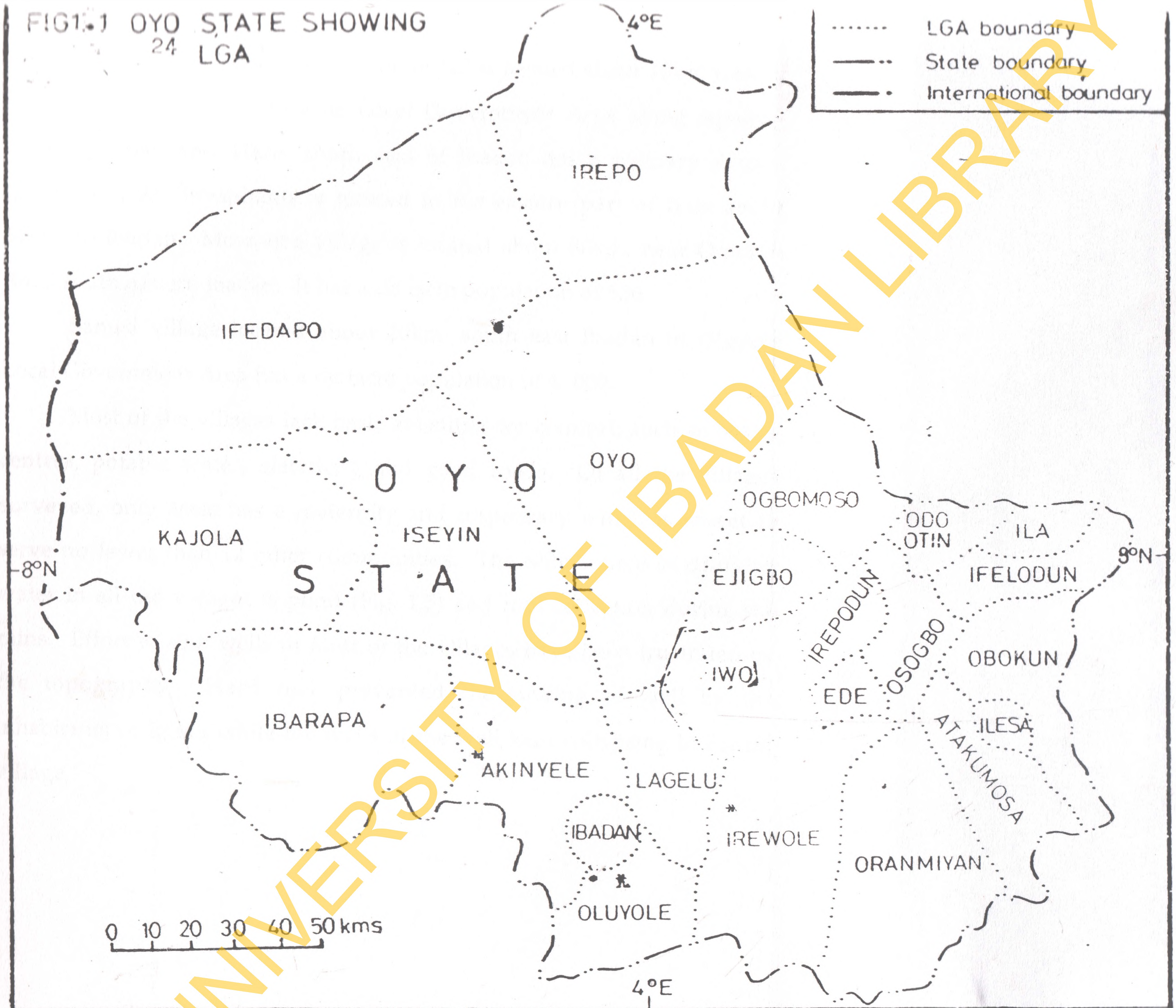
Farming or agriculture is the predominant occupation in the state, being practised by over 70% of the citizens. Women are more involved in the distributive trade and food preparation while men are involved ui!n the crop production and some of the retail trade. Farming in most parts of the States is still done in very crude forms and it is a labour intensive. This calls for the combined input of both the head of household as well as wives and children .

This study was conducted in nine villages selected by random sampling from among 3 LGAs. The villages are Abaepo/Asani, Ejitolu, Folarin, Mele and Seriki Okegbemi in Akinyele Local Government Area (Fig. 1.2); Igiidu, Mowooba and Papanla in Irewole Local Government

Area (Fig. 1.3); and Sanusi village in Oluyole Local Government Area (Fig. 1.4).

Mele village is situated about 8km. west of Moniya the Local Government Area Headquarters and north-west of Ibadan, the State Capital. The other villages viz Aba-epo/Asani, Ejitolu, Folarin and Seriki are situated west of Mele at an approximate distance of 2 to 5 km. each to one another (Fig. 1.2). A primary school is located in each of the following villages - Mele, Eij itolu and Seriki Okegbemi. Each school draws its pupils from other contiguous communities. Aba-epo/Asani, Ejitolu, Folarin, Mele and Seriki have de facto population of 72, 176, 202, 228 and 138 respectively.

FIG 1.1 OYO STATE SHOWING 24 LGA



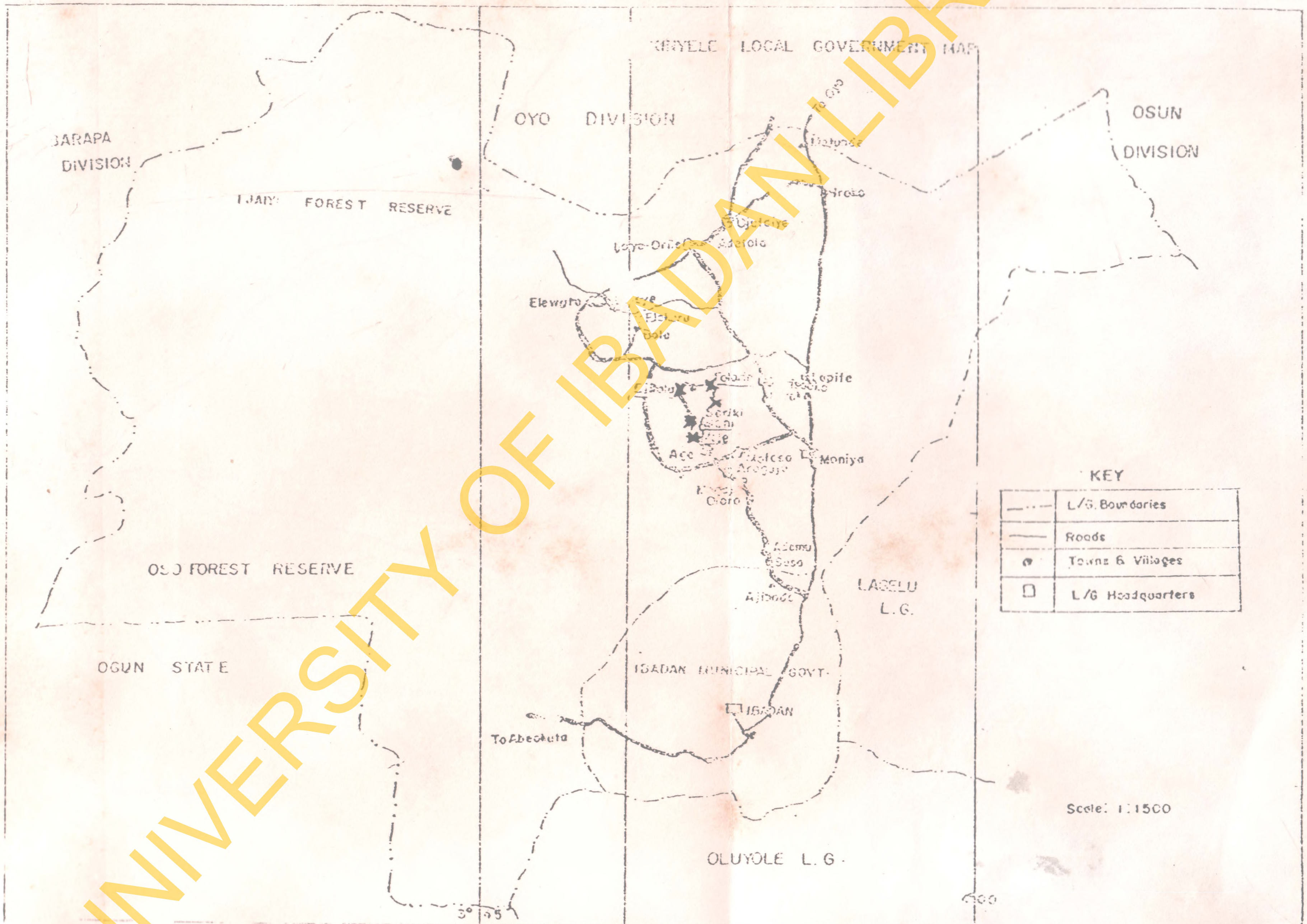
* STUDY AREAS

Dept of Geography UI

Papanla village with population of 125 is located about 10km west of Ikire, the Headquarter, Irewole Local Government Area along Apomu-Orileowu road and 41km. south east of Ibadan has a primary school. Igiidu with 938 inhabitants is located in the eastern part of Ikire about 64km. to Ibadan. Mowooba village is located about 80km. near Oranran Road south eastern Ibadan. It has a de facto population of 536.

Sanusi village located about 20km. south east Ibadan in Oluyole Local Government Area has a de facto population of 1, 000.

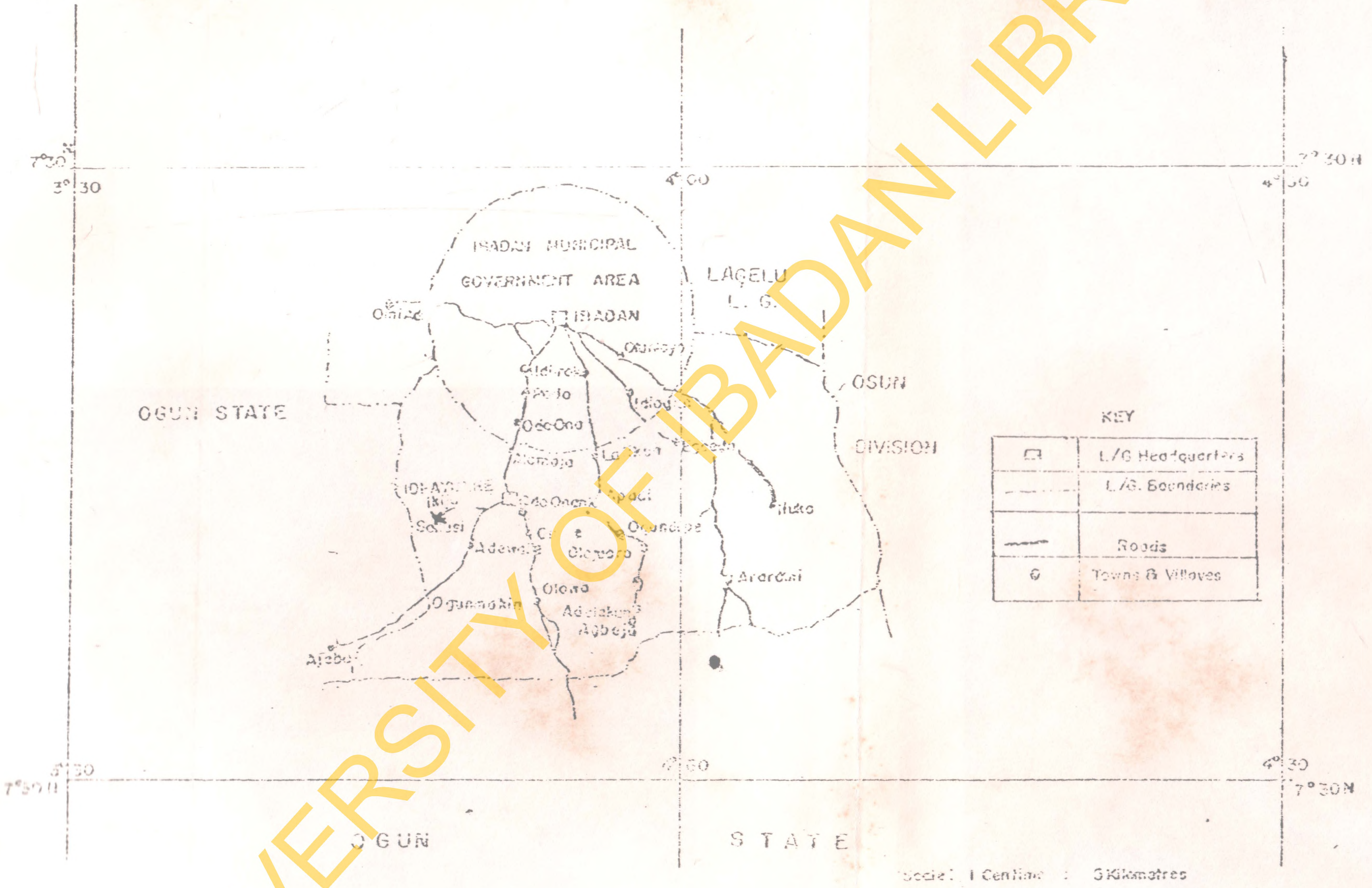
Most of the villages lack basic amenities for comfort, such as health centres, potable water, electricity and good roads. Of all the villages surveyed, only Mele has a maternity and dispensary which is meant to serve no fewer than 12 other communities. The only source of drinking water in all the villages is pond (Fig. 1.5) and roof collection during the rains. Effort to sink wells in most of the villages have been frustrated by the topography. Hard rock prevented the sinking of well by the inhabitants of Igiidu while the walls of the well kept collapsing in Sanusi village.


LOCAL GOVERNMENT MAP
OYO DIVISION
OSUN DIVISION
DIVISION
FOREST RESERVE
OGUN STATE
Moniya
LAGELU L.G.
IBADAN
OLUYOLE L.G.
To Abeokuta
KEY
L/G. Boundaries
Roads
Towns & Villages
L/G Headquarters
Scale: 1:1500

MAP OF IREWOLE LOCAL GOVERNMENT AREA

STUDY AREA

OLUYOLE LOCAL GOVERNMENT MAP



STUDY AREA *

Fig. 1.5 A typical pond in seriki village in Akinyele L.G. Area

CHAPTER TWO

LITERATURE REVIEW

2.1 THE PARASITE: DRACUNCULUS MEDINENSIS

Dracunculus medinensis is monoecious. The female Dracunculus is one of the largest nematodes known to man. In 1938, Moorthy and Sweet recorded a mean value of 690mm. Iong, 2.0mm. broad from specimens they surgically removed from patients in Pakistan when worms were about to emerge. Females removed from the dog measured 280 - 530mm long by 1.0mm broad, an indication that parasites from experimentally infected animals are often smaller.

There are many reports on the detailed description of the morphology and structure of adult female and male worms from human sources (Charles, 1892; Chitale, 1912; Mirza, 1929; Moorthy and Sweet, 1936; Moorthy 1937). The male is usually smaller (12 - 29mm by 0.4mm broad) in size and the tail is curved into a spiral. However, the description has been based on worms mostly recorvered from animal sources (Leiper, 1906; Moorthy and Sweet, 1938; Muller, 1971).

Although nothing is known about the nutritional requirement of the Dracunculus and its physiology Bueding and Oliver Gonzalez (1950) felt that in D. insignis, the species of the parasite most common in lower animals, the main end-products of carbohydrate metabolism is lactic acid and the rate of its formation, or of glucose utilization is not affected by the presence or absence of oxygen. Histochemistry has revealed that glycogen stores in the mature female are mainly in the amoeboid portion of the musculo-cutaneous cells, in basement membranes, the wall of the uterus and in the cells of the intestine.

Detailed description of embryogenesis of Dracunculus was undertaken in 1970 by Muller. The uterus of the female worm at 8 - 9 months is filled with developing eggs and whereas poly spermy sometimes occurs, only one sperm fertilizes the ovum. The embryos break free of the egg shells and are usually fully formed by 10 to 14 months.

Many authors have described in detail the larvae of Dracunculus (Blacklock and O'Farrell, 1919; Moorthy, 1938; Muller, 1970b, 1971). The tail is long and pointed and the cuticle is characteristically striated with lateral ridges in the first stage larvae (L_1). Although the gut is fully formed with mouth and anus and a pharynx, the first stage larvae do not feed. The number of embryos released by the female worm usualiy decreases on each immersion in water (Muller, 1971). The total number of embryos contained on one female worm was estimated at 3 million in 1919 by Turkhud. While Muller (1971) gave an estimate of about 2 million in two worms dissected from rhesus monkeys just before emergence.

Despite the fact that the larvae remain active in pond water for 4 - 7 days (Moorthy, 1932; Southwell and Kirshner, 1938), there was reduction in the subsequent percentage infection rate in cyclops after 3 days of existence in pond water and more often than not nil after 6 days (Muller, 1971).

The subsequent third stage larvae (L3) was described in detail by Leiper (1907) and Moorthy (1938). The tail of the third stage larvae usually appears bifid (Brug, 1930 and Muller, 1971) or conical Roubard (1913). According to Moorthy (1938) the third stage larva measures 240 - 608µm long by 12 - 23µm broad at 21 days. The pharynx has an anterior glandular portion, the intestine contains transparent and brown globules. The anus opens from the short tail, the feature of which is variable depending on the observer.

2.2 TRANSMISSION OF DRACUNCULIASIS

Larvae from adult female worms protruding from the lesions on man's skin are washed into water in which they can survive for two or three days awaiting ingestion by the cyclops, a microcrustacean, in pond. In this intermediate host the larvae undergo powerful bending movements and penetrate the cyclops gut wall. There they move to the body cavity, where they develop, over a period of about fourteen days into the infective third stage larvae (L_3) (Leiper, 1907; Moorthy, 1938). Man becomes infected when he swallows the infected Cyclops while drinking from previously contaminated surface water. The gastric juice in the stomach destroys the Cyclops but do not kill the larvae, which penetrate the gut wall and proceed to wander in the tissue till they become adult. Copulation occurs at about the sixth month after ingestion. The male worm dies thereafter and is either absorbed by the body or become encysted or calcified. The greatest clinical problems are caused by the female worms which usually migrate down to the subcutaneous'tissue. After an incubation period of about ten to fourteen months in the host the fertilized female worm which measures up to 70cm long is ready to emerge and discharge larvae. To do so it migrates to tissues beneath the skin where it secretes a toxic substance that produces localized swelling, accompanied by intense burning and itching (Fairley and Liston, 1924) usually at a spot which is likely to come in contact with water.

In the gravid female, the uteri are packed with coiled up embryos which may be up to three million. Within a few days, a painful blister develops and rupture leaving a shallow ulcer on the skin from which a loop of uterus prolapses through the anterior end of the worm. When the ulcer comes in contract with water, a milky fluid containing Dracunculus larvae is discharged. The larvae are then intermittently discharged on subsequent contracts with water over a period of two to three weeks, until all larvae have been evacuated. The worm then dies or emerges spontaneously. If the larvae are not taken up by the cyclops, they can live for about a week in non-turbid water and from two or three weeks in muddy water.

The Cycle of the disease is continued with individuals immerse the affected parts of the body in water either in the course of normal activities such as collecting drinking water, bathing or washing clothes, or to get relief from deep-seated stinging and excruciating pain and other symptoms of the disease. Thus, a single individual can contaminate the water supply for an entire village. About two weeks after the larvae are ingested by cyclopoid copepods they develop into the infective third stage which in turn develop to dracunculiasis when consumed by man.

2.3 CLINICAL FEATURES OF THE DISEASE

It has been noted that Dracunculus lesions occur predominantly in the foot, leg and around the ankle of humans, (Blacklock and O'farrel, 1919; Adeyeba and Kale, 1988). The appearance of worms in the lower and upper extremities is about 97 and 15 per cent respectively. On a few occasions however, the sites of blister have been on the hips, abdomen, genitals and chest (Putta Bhatta, 1954). Examples of relatively less common sites where adult worms have been found are in the inguinal region and scrotum (Ray, 1920; Osoba and Oyediran, 1977, Adeyeba and Kale, 1988), upper eyelid (Wright, 1924), suprapubic region, (Makel and Devault, 1930) and tongue (Moorthy, 1932).

Infection is ususally asymptomatic until a few days before the emergence of the female worms. About 85 per cent of infected individuals had prodromal symptoms in Sanusi village in Oyo State of Nigeria (Adeyeba, 1986a). The patient exhibits some allergic manifestations like transient generalized pruritus (later localised) and urticarial rash culminating in a painful irritation and inflammation at the site where the worm eventually form a blister before its emergence (Kale, 1977; Adeyeba 1986a). Although a generalised urticaria has been found to be the first indication of Dracunculus infection in 30 - 80% of cases, Duke (1985), Fairley (1924) and Carayon et al (1961) observed that that this is sometimes accompanied by fever, giddiness, gastro intesinial symptoms and dyspoea. It was also observed that the urticarial eruption, may be accompanied by transient infra-orbital oedema (Carayon et al, 1961). Hodgson and Barret (1964) noted that an allergic pruritis may occasionally result from chronic infection with non emergent worm.

In many cases, 61 per cent (Fairley, 1924), or 63 per cent (Reddy et al; 1970) the local blister is the first sign of infection. The formation of the blister which is accompanied by local itching and often an intense burning pain may be relieved by immersion of the infected portion in cold water. All these disturbances in the host's body metabolism are believed to be due to the effect of toxic substances released from time to time of the formation of the bleb.

Worms that fail to emerge eventually gradually disintegrate and subsequently fluid from the worm's uterus produces a sterile abscess, which may later become secondarily infected by tetanus and other bacteria. Where this occurs near the synovial cavity of a joint, septic arthritis may result (Fairley and Liston, 1924). In some cases the dead worm becomes calcified and if not too deep seated, it may sometimes be palpable. Dracunculus are mostly found calcified in the lower limbs. Calcifications have been observed radiologically in other parts of the body, including the perineal tissue, the scrotum, the spinal muscles and the chest wall. The presence of calcified worm often elicits no clinical symptoms.

2.4 SEQUALE AND IMPACT OF DRACUNCUUASIS

Dracunculiasis is primarily a rural problem and this probably accounts for the relative obscurity of the disease and its continued and increased prevalence especially in Nigeria. Hitherto, there had been little or no attention given to the study or control of the disease because it rarely kills but tempararily incapacitates the victim in the rural communities. This explains why there is paucity of information on the disease as regard the impact of the disease on the socio-economic life of the endemic community.

The infection is usually followed by spontaneous recovery. However, in the course of the disease the patients may suffer to varying degrees from painful uclers and abscesses, which usually occur on the feet and legs, and which can last over a period of several months. A few patients are left with permanent locomot0ry disabilities usually resulting from involvement of the joints. A case of complication of dracunculiasis occasioned by paraplegia was reported by Lawrie (1987). Patnaik and Kapoor (1967) have estimated that permanent disability occurs in 0.5% and fatality in 0.03% cases.

In as much as the period of peak Dracunculus infection coincides with the period of peak agricultural activities, immediate economic impact of the disease is in the form of lost agricultural production. The degree of impact depends on the prevalence of the disease; whether the disability is total or partial; the duration of the disability; the agricultural activities which are prevented, the degree of involvement in agricultural activities and the extent to which other members of the household or village can compensate for diminished productivity of those who are disabled (Ward, 1982).

It is very difficult to quantify the impact of dracunculiasis on the economy of a disabled self employed farmer. Judging from the seasonality of crop production, its effect on agricultural input may be considerable. Estimates of the magnitude of impact of dracunculiasis on the agricultural sector are relatively scarce, but those that exist either estimate lost workdays or the value of lost production. In 1986, the World Health Organisation estimated the annual loss of workdays attributable to the disease in I ndia at 10.6 million.

Earlier on, Datta et al (1964) found in India that guinea worms took one to three months to emerge fully and this led to an average loss of 119.8 working days by males and 78.1 days by females. The average period of complete disability in untreated patients in Southern Ghana was about 15 weeks with the peak infection rate coinciding with the planting or harvesting period (Belcher et al, 1975). There was a similar situation in a part of South Western Nigeria where up to 25 per cent of the working population aged from 15 to 40 years may be incapacitated for at least 10 weeks in each year (Kale, 1977). The impact of the disease on the nomadic cattle Fulani in Babana District of Kwara State is adverse (Edungbola, 1983). The infected and incapacitated are confronted with threats of poverty and misery for thier most valuable cattle die of starvation and dehydration in significant numbers.

In addition to costs of lost productivity occasioned by dracunculiasis, costs of treatment can be significant and usually bey,ond what the disabled poor farmer can cope with despite the fact that modern medicine has little or nothing to offer but merely offer a palliative measure. The dignity of the disabled farmer is lost, his psychological distress increased as well as his socio-economic status diminished.

Dracunculiasis among school children is reported to be the cause of missed school in endemic areas of Anambra state and a principal contributing factor for 90% of the students who dropped out of school in the area (Nwosu et al, 1982).

2.5 SECONDARY BACTERIAL AND CONCURRENT PARASITIC INFECTION

Bacteria are responsible for the severe tissue inflammation associated with secondary infection (Fairley and Liston, 1924; Garayon et al, 1965; Muller, 1971). A list of the complications observed in cases of dracunculiasis as given by Fairley and Liston (1924) included acute abscess, cellulitis, arthritis, synovitis, epididymo-orchitis, chronic ulcerations, fibrous ankylosis of joints and contractures of tendons.

Streptococcus species, Staphylococcus aureus, Escherichia coli and Enterobacter species were commonly cultured from lesions occasioned by Dracunculus emergence (Fairley and Liston, 1924) described how the female worm withdrew into its connective tissue sheath if it is broken during extraction thereby drawing bacteria into the host tissues. Muller (1871) found that 50% of cases showed evidence of sepsis. Not surprisingly, lesions on the feet and ankles were much more likely to become secondary infected.

However, the role of bacteria in secondary Dracunculus infection has been a subject of controversy among authors. Kothari et al., 1969; Muller, 1970 and Muller et al. 1970 challenged the role of bacteria as the aetiologic agent in secondary infection on the ground that there had been no success in antibiotic therapy and that spontaneous quick healing of a secondarily infected ulcer or abscess has always been preceeded by removal of worms. However, it is imperative to carry out more detailed studies on the role of bacteria in secondary guineaworm infection and the antibiogram pattern.

Cases of tetanus following Dracunculus infection have been reported (Lauckner et al., 1961; Pirame and Becquet, 1963; Labegorre et al.,1969).

Gemade and Dipeolu (1982) have reported some cases of concomitant parasitic disease in area endemic of onchocerciasis in Benue State of Nigeria, no similar studies have been reported with respect to dracunculiasis .

2.6 EPIDEMIOLOGY OF DRACUNCULIASIS

People between the ages of about 10 and 60 years are usually most frequently infected. Peak infection is usually found in the 41 to 50 years age group. Nevertheless a considerable proportion of children below 10 years may also be affected. Children below 1 year seldom acquire the disease possibly because they do not drink untreated water except when boiled and because of the long incubation period of the disease. There is usually no significant differences in the over all mean age of first infection between sexes. However, in both sexes the incidence of first infection was significantly highest in the first decade life. The risk.of reinfection increases with age (Adeyeba, 1986a).

The prevalence of dracunculiasis shows marked variation with the season. This is determined by the mode of transmission of the parasite (Muller, 1982). An important factor that reinforces the seasonal nature of infection is that the female worm in the human body takes approximately one year to mature and release larvae into water to initiate the following year's infection. The larvae require a period of development of about a fortnight in fresh water cyclops before the disease can be transmitted to a new host.

Suitable conditions for infection occur only where water for drinking is taken from stagnat bodies of surface water such as ponds, large open wells with steps leading down to the water as found particularly in India, or the type of covered rainfilled cisterns that provide the only source of drinking water in rural areas of southern Iran. Infection is not associated with running water or with draw-wells with a circumference of less than 3 metres. Infection is also limited to tropical and sub-tropical regions because the larvae develop best in cyclops between 25 and 30°C and will not develop at all below 19°C (Muller, 1979).

The transmission season in different regions depends on the pattern of rainfall. In Sahel Savannah areas of Africa where the rainfall is less than 75cm per year, the ponds dry up for much of the year, as in desert areas. This occurs in Northern Nigeria (Ramsay, 1935; Onabamiro, 1952) and most of Burkina Faso (Steib and Mayer, 1988) Niger, Chad, Mauritania, Sudan and Senegal. This results in transmission being confined to the rainy season and the months immediately following until ponds dry up. In the Guinea Savannah areas of West Africa, with an annual rainfall of more than 150cm as in Benin, Ghana, Cote D'voire, Southern Nigeria, Guinea and Togo, the ponds have water all the year. There is a close correclation between the incidence of dracunculias in a community in a given year and the amount of rainfall in the preceeding year (Kale,1982).

For instance, in the rain forest belt, heavy, prolonged precipitation in one year, resulting in a relatively abundance of surface water, often presages a lower incidence of infection in the following season. Hence, during the raining season there is little or no transmission as there is so much surface water that many ponds turn into small streams (Adeyeba 1986a). The water becomes very turbid and the concentration of cyclops is low. Besides, there are many alternative sources of drinking water. For instance, in the village of Iwoye (Onabamiro 1952), as well as Igbon and Sanusi village in Oyo State of Nigeria (Edungbola, 1984; Adeyeba 1986a), infection was found to be confined to the dry season when the volume of pond water is low and the concentration of cyclops in pond water is high. It has also been demonstrated that infected cyclops sink to the bottom of a pond (Onabamiro, 1954), and so are more likely to be picked up when the level is low.

Generally, in the savannah regions infection is confined to areas which are away from rivers, and which rely on shallow ponds for drinking water (Onabamiro, 1954 and Scott, 1960).

In endemic areas draw wells appear to be of little importance as regard transmission since the risk of contamination by Dracunculus larvae is very low (Lindberg, 1946; Onabamiro, 1952; Scott, 1960; Ansari and Nasir, 1963), as they are usually protected by apron and Parapet fitted with a lid to cover. However, step wells which provide the main sources of drinking water in many rural areas in India are ideally situated for the transmission of Dracunculus medinensis because with steps leading down into the water, the affected parts of the body especially the limbs are often immersed in the process of dipping a water container into the well (Lindberg, 1946).

2.7 GENERAL CHARACTERISTICS OF THE VECTOR

The cyclops, the intermediate host is a semi-transparent fresh water crustacean, rarely exceeding one millimeter in length. It has a symmetrical pear shaped body, a tail which is forked, two pairs of antennae, five pairs of shinning legs and one eye (Onabamiro, 1954).

Cyclops are common and ubiquitous inhabitants of most fresh water bodies in both tropical and temperate regions. Some species of the genus Cyclops which exclusively transmit Dracunculus, are confined to large bodies of water, but those likely to be of importance in transmission exist also, or sometimes principally, in small ponds, tanks, or open wells. These are often seasonal in nature and in sahara and savannah areas of Africa are present only in the rainy season. When ponds refill at the beginning of the rain, cyclops populations build up over a matter of weeks. In humid guinea savannah areas, like Western Nigeria, with abundant rainfall cyclops population builds in the early dry season, and are reduced greatly during the rains because of the lower temperature, and the large volume and turbidity of the water (Muller, 1985).

Cyclops can be broadly divided into two, viz, carnivorous and herblvorous species. The carnivorous live on other microcrustaceans, annelids, insect larvae, protozoa and aquatic nematodes while the herbivorous cyclops live on algae and diatoms (Fryer, 1957). Examples of herbivorous genera and Sub-genera are Microcyclops Eucyclops and certain species of Acanthocyclops. In general, it is only the larger carnivorous genera which will ingest Dracunculus, larvae or free living nematodes, etc.

The most important factor determining whether a particular cyclopoid copepods will transmit Dracunculus rests on the mode of life;

unless it is a predatory species it will not ingest embryos or larvae in the water. Many species of cyclops are cosmopolitan in distribution. An easily recognised species, important for transmission of Dracunculus; cyclops (Mesocyclops) leukarti, can live in both large and small bodies of water (Miller, 1970) in Africa and India.

Some specific species of Cyclops found naturally infected with Dracunculus in various parts of the world are listed in the monograph by Muller (1970). They include Cyclops (Mesocyclops) leuckarti (Benin and Ghana); C (M. leuckarti equatorialis (Guinea Bissau); C (M. leuckarti, C (M. vermifer and C (M. iranicus (Middle East); C (M) Thermocyclops inopinus (Cote D'Voire); while in Burkina Faso, according to Steib and Mayer (1988), the species responsible for active transmission of Dracunculus are Thermocyclops inopinus (Kiefer, 1926), I. incisus (Kiefer, 1932) Mesocyclops Kieferi (Van de Velde, 1984) and Metacyclops Margaretae (Linberg, 1938).

The species of Cyclops which have been found naturally to act as intermediate host in Western Nigeria include Cyclops leuckarti (claus), C. leuckarti equitorialis (Kiefer), C inopinus Kiefer), Thermocyclops nigerianus (Kiefer), C. Vericans subaequalis (Kiefer) and C. hyalinus (Rehberg). They are capable of harbouring Dracunculus larvae for about fourteen days, by which time the larvae will have moulted twice and become infective to man (Onabamiro, 1956).

Uninfected T. nigerianus undergo vertical diurnal migration in ponds (Onabamiro, 1952). After about six days of infection the amplitude of the migration is reduced and by the 14th day the Cyclops are confined to the bottom few inches of a pond (Onabamiro, 1954). This effect is probably a result of the physiological action of the larval moults and it may be of importahce in confining transmission to man to the months when the water level is low.

Infection takes place more readily when the cyclops are immature than when they are adults (Moorthy and Sweet, 1936). Development of larvae in the Cyclops ceases at a temperature below 19°C.

Although in the laboratory as many as twenty larvae can be seen in one cyclops, in nature more than one is not generally observed (Moorthy, 1938). Cyclops infected with more than one or at the most two guinea worm larvae tend to die (Muller, 1971).

2.8 GLOBAL DISTRIBUTION OF DRACUNCULIASIS

Dracunculiasis occurs only in the third world mainly India, Pakistan, Africa and Middle East (Watts, 1987). The disease is scattered throughout the rural communities of the affected state where there are no safe or protected source of drinking water. In India the disease is limited to six States in the Western part of the country; about half of the cases are reported from Rajasthan State (Patnaik and Kapoor, 1967). Transmission in a State appears to have been interrupted recently by long standing control measures (Datta et al., 1964; Reddy et aN 1969; WHO, 1983. Another state Gujarat will probably become dracunculiasis free soon (Hopkins, 1987).

Dracunculiasis has been a bane of economic development in Pakistan (Ausari and Nasir, 1963 and Belcher, 1982); and parts of Africa (Stoll, 1947; Scott, 1960; Lyons, 1973; Belcher, et al, 1975; Kale, 1977; Muller, 1979; Edungbola, 1983; Udonsi, 1987a, Adeyeba and Kale, 1988), and Middle East (Sahba et al, 1973 and Belcher, 1982). It is estimated that 10 to 48 millions - cases occur annually, affecting one to six per cent of the total rural population (Centres for Disease Control, 1987).

In West Africa, where probably less than 10 per cent of cases are routinely reported, the zone of highest endemicity includes Cote D'voire Raffier, 1965); Ghana (Scott, 1960 and Belcher et al., 1982); Togo, Mali (Schneider, 1964); Niger and Chad (Simmon et al., 1951); Burkina Faso, Guinea and Senegal (Carayon et al; 1961, Schneider, 1964; Gretillat, 1965; Steib and Mayer, 1988). For West Africa as a whole, Hopkins (1983) estimated that only 1% to 5% of the actual cases were reported. Watts (1987) estimated the total at-risk population in Africa to be 120 million, about 4296 of the total population of affected countries. The estimated annual incidence is 3.32 million, 2.7% of the population at risk.

2.9 PREVENTION, CONTROL AND PROSPECT FOR ERADICATION OF DRACUNCULIASIS

Personal protection can be achieved by the simple measure of sieving drinking water through a fine mesh cloth. This will filter out any infected cyclops. Boiling of drinking water would destroy infected cyclops and Dracunculus larvae and thus prevent infection.

For control at community level, there are three possible lines of approach:

(a) the improvement of the water supply by providing alternate sources;

(b) treatment of existing water supply to render it free of infection and

(c) by well articulated health education programme. (Brieger et al, 1985).

The provision of treated piped water results in the elimination of dracunculiasis within a couple of years. Examples where this has been achieved included the towns of Fiditi, Igboora (Muller, 1971) and Igbo Elerin (Kale unpublished data) in Oyo State. In Fiditi and Igboora, the incidence of the disease was 20 per cent and over 60 per cent respectively prior to the introduction of piped water system 1n 1963 and 1965. Within two years no cases of infection were reported although the disease was still endemic in the surrounding villages (Muller, 1971).

Where their construction is technically feasible, bore wells and tube wells can also provide a constant supply of pure water. The water is not liable to the contamination that can occur in draw-wells when full and, if used with an elevated tank, can provide the convenience of water on tap. Example of where this has been of tremendous benefit were the group of villages making up Igbo-Elerin in Lagelu LGA of Oyo State (Kale - unpublished); Sanusi village in Oluyole Local Government Area of Oyo State where the incidence was over 23 per cent in 1985 (Adeyeba, 1986) prior to the siting of deep well in Sanusi in 1986, by Federal Government of Nigeria's Directorate of Food and Rural Infrastructure (DFRRI). By 1988, the disease has virtually vanished from the village with only one case reported (Adeyeba - unpublished observation).

The impact of a UNICEF - assisted rural water project on the prevalence of dracunculiasis in Asa, Kwara State, Nigeria has been reported by Edungbola et al. (1988). "Protected water supplies, in the form of boreholes, can reduce the prevalence of dracunculiasis in affected communities from a point prevalence of ≥ 50% to O or near 0% within 3 years of intervention".

Provision of safe water supplies has also caused a decline in prevalence of dracunculiasis in some rural areas of Imo State (Udonsi, 1987b). Improved water supplies have benefits, far greater than the control of dracunculiasis since this helps to reduce other water borne diseases such as cholera, typhoid fever, gastro-enteritis, hepatitis, poliomyelitis and schistosomiasis.

Chemical control of dracunculiasis by treatment of water sources has been advocated many times in the past but very few practical control schemes based on this alternative have been attempted. This is partly because of cost but also because of a lack of the basic epidemiological knowledge necessary to make such treatment effective. Various organic chemical compounds have been widely used - potassium permanganate (Turkhud, 1919); quick lime and slaked lime (Pradhan, 1930, Davis, 1931); temephos (Muller, 1970; Belcher, 1982), DDT (Ramakrishnan and

Rathnaswamy, 1953; Nugent et al. 1955). The molluscide zinc dimethy dithio carbamate ("Zirame") was reported to be effective against Cyclops (Gretillat, 1965 and Raffier 1966, 1969).

Biological methods of control have also been advocated in certain parts of the world. Successful field experiments using small fishes (Gambusia, and Barbus species and Rasbora doniconius have been reported (Moorthy and Sweet, 1936; Gideon, 1942).

CHAPTER THREE

DRACUNCULIASIS IN OYO STATE: EPIDEMIOLOGY, SOCIO-ECOMOMIC AND CULTURIAL IMPACT

3.1 INTRODUCTION

Many parts of Nigeria have been shown to be endemic for dracunculiasis (Stoll, 1947; Ramsay, 1935; Onabamiro, 1952; Kale, 1977; Muller, 1979; Abolarin, 1981; Nwosu et al., 1982; AdekoluJohn, 1983; Edungbola, 1984; Daniel and Osisanya, 1985 and Udonsi, 1988). Most of the literature on the status of the disease are restricted to reports from a few States, notably, south eastern parts of the country (Anambra and Imo States) and Kwara, Oyo and Ogun States. Very often, some of these literatures are either of scanty in terms/epidemiologic information or have gone out of date.

It is apparent that there is a dearth of information on the epidemiological status and impact of the disease in many parts of Oyo State. Since the knowledge and the impact of the disease will not only enhance effective control plan, it will be an asset in the evaluation and monitoring of any control efforts. It is this understanding that stimulated this study. Hence this study is designed to provide the base line epidemiological information on the disease caused by guineaworm and identifying the factors affecting the effective control in the locality.

3.2 MATERIALS AND METHODS

The survey was conducted between February and April, 1988 in eight villages randomly selected by balloting from among two Local Government Areas (LGAs) of Oyo State. The LGAs were randomly selected by lottery method. The villages are Abaepo/Asani, Ejitolu, Folarin, Igiidu, Mele, Mowooba and Seriki Okegbemi, (Fig. 1.2 and 1.3). Manpower support was provided by Local Government Area health officials and members of Oyo State Task Force on Guineaworm Control Programme. During this period guinea worm ulcers were dressed, haematinics and analgesic drugs like paracetamol and aspirin were administered at no cost to the victims.

The interview was conducted from house to house with two different questionnaire sheets directed at Heads of household and individuals members of the household respectively. In order to determine the prevalence of dracunculiasis, the questionnaire record sheets (Appendix 3.1) were completed for all 2415 subjects in the sample villages. Parents or guardians of toddlers/younger children provided relevant informations required in respect of their wards. The data so collected included the name, sex, occupation, religion, period of residency and source of drinking water. Where an individual was not able to give the correct age, major contemporary historical events were used as guides. Information on the season when disease became apparent was obtained as well as water treatment technique, duration of "lay-off from work" and degree of morbidity. The 257 heads of household were interviewed on the nature of assistance received during period of incapacitation and their perception of causes and prevention of dracunculiasis (Appendix 3.2). In effect, the administration of questionnaire applied to all individual subjects inrespective of whether they were infected or not, while clinical examination was made of subjects with patent infection (active cases) at the time of the study.

The attendance registers of three schools in Akinyele Local Government Area (located in Mele, Ejitolu and Seriki) were examined in order to determine the percentage of absenteeism due to guinea worm infection between January, 1986 and July, 1989.

3.2.1 <u>Method of data analysis:</u> The analysis of variance and coefficient of determination were obtained by using the IBM computer (1976 version) utilizing the SPSSH package. Where significant effects were obtained, treatment means were compaired using a multiple range test, the least significant Difference (LSD) proceedure (Steel and Torrie, 1960).

3.3 RESULTS

3.3.1 <u>Distribution of Persons with Dracunculiasis In Eight Villages of Akinyele, Irewole LGAs</u>:

Data for all the people of all ages in both sexes who have infection and who had previous history of infection in eight rural communities in Oyo State are shown in Figure 3.1 and Tables 3. la and 3.1b. Data indicate that co-efficient of variation is low (CV% = 19.94) and coefficent of determination is relatively high (r^2 = 0.66). Of 2,415 individuals interviewed, 1,857 (76.9 per cent) had history of infection with guineaworm. There was no significant difference in the infection rate between the male and female sexes ($P > 0.05$) but there existed significant variation in the infection rate among the age groups and villages ($P > 0.05$). Multiple range comparison test shows that the peak infection rate was among 61 - 70 years (93.7 per cent), this is not significantly different from 90.3 per cent and 83.6 per cent, respectively recorded from 71+ years and 51 - 60 years age cohort. The lowest infection rate was recorded among 31 - 40 years age cohort.

Analysis shows that Papanla village had the highest infection rate (92.05 per cent), followed by Igiidu (91.99 per cent) and Mowooba (84.07 per cent). The difference among the three villages is not significant ($P > 0.05$). But there is significant difference between the three and the remaining 5 villages ($P < 0.05$) which had no significant variation as regards infection distribution. Ejitolu (55.97 per cent) had the lowest infection rate.

Table 3.1 b shows the results on the incidence of dracunculiasis at the time of this study. 47.7 per cent had the infection with no significant difference between male and female sexes ($P > 0.05$). Papanla had the highest rate with 69.64 per cent while Seriki Okegbemi had the lowest with 25.68 per cent.

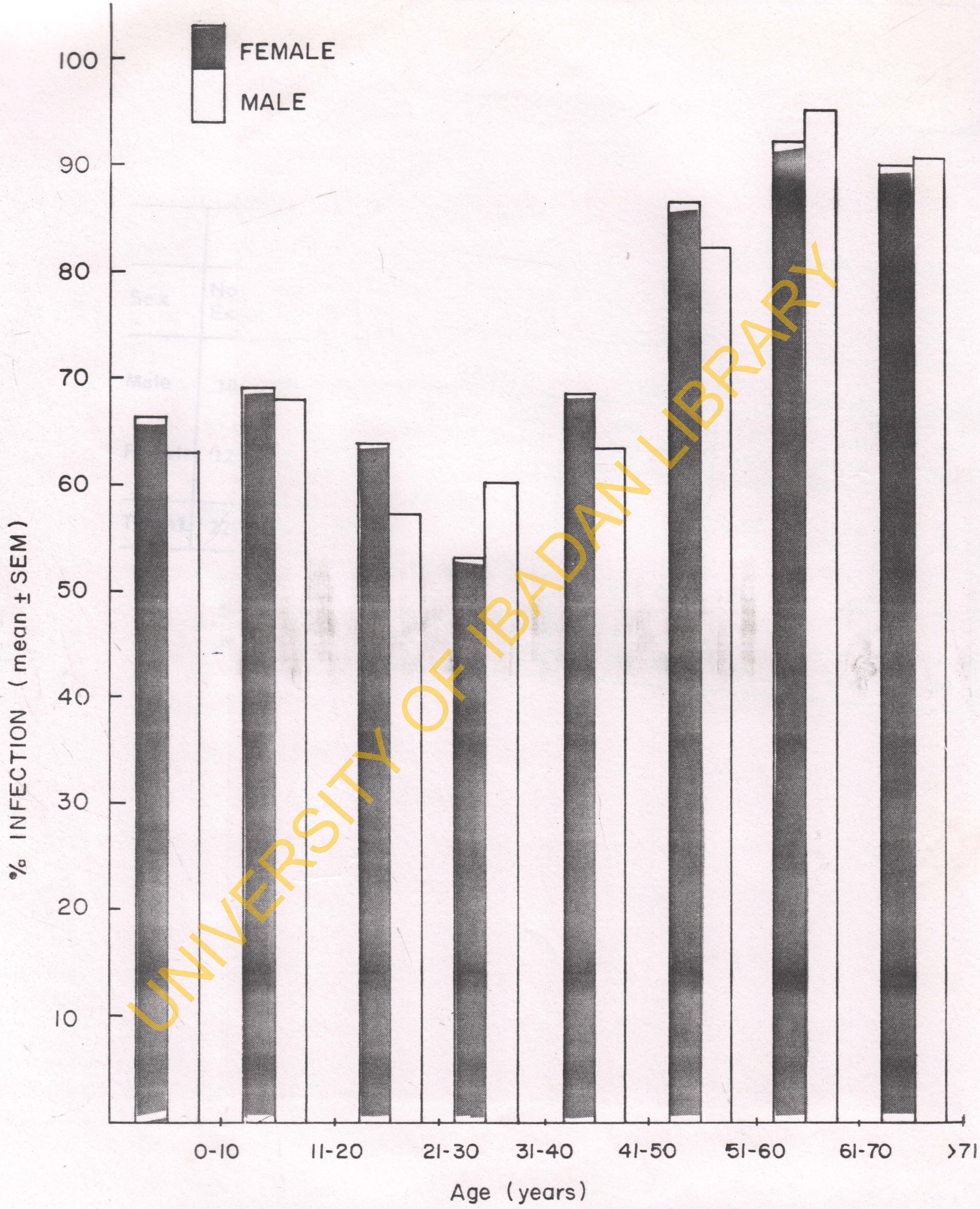


FIG. 3.1 HISTORY OF DRACUNCULIASIS IN OYO STATE. DISTRIBUTION BY SEX AND AGE.

Table 3.1a: Prevalence of Dracunculiasis in 8 Villages, Oyo State, by sex

	M e l e			Abaepo			Ejitolu			Folarin			Seriki			Papanla			Mowooba			Igiidu			TOTAL		
Sex	No Exam	No Inf	% Inf	No Exam	No Inf	% Inf	No Exam	No Inf	% Inf	No Exam	No Inf	% Inf	No Exam	No Inf	% Inf	No Exam	No Inf	% Inf	No Exam	No Inf	% Inf	No Exam	No Inf	% Inf	No Exam	No Inf	% Inf
Male	101	57	56.4	29	19	65.5	83	41	49.4	90	47	52.2	60	32	53.3	60	54	90.0	228	194	85.1	390	359	92.1	1041	803	77.1
Female	127	77	60.6	43	25	58.1	93	51	54.8	112	67	59.8	78	49	54.4	65	57	87.7	308	239	77.6	548	489	89.2	1874	1054	76.7
TOTAL	228	134	58.8	72	44	61.1	176	92	52.3	202	114	56.4	138	81	58.7	125	111	88.8	536	433	80.8	938	848	90.4	2415	1857	76.9

* No. Examined = the total population in the village.

$P > 0.05$

Table 3.1b: Distribution of Dracunculiasis in 8 Villages at time of Study (Feb. - April, 1988)

Sex	Mele			Abaepo			Ejitolu		
	No Exam	No Inf	% Inf	No Exam	No Inf	% Inf	No Exam	No Inf	% Inf
Male	101	33	32.7	29	8	27.6	83	19	22.9
Female	127	37	29.1	43	17	39.5	93	25	26.9
TOTAL	228	70	30.7	72	25	34.7	176	44	25.0

Sex	Folarin			Seriki			Papanla		
	No Exam	No Inf	% Inf	No Exam	No Inf	% Inf	No Exam	No Inf	% Inf
Male	90	22	24.4	60	12	20.0	60	47	79.3
Female	112	34	30	78	25		65	45	69.2
TOTAL	202	56	27.7	138	37	26.8	125	92	73.6

Sex	Mowooba			Igiidu			TOTAL		
	No Exam	No Inf	% Inf	No Exam	No Inf	% Inf	No Exam	No Inf	% Inf
Male	228	119	52.2	390	245	62.8	1041	505	48.5
Female	308	139	45.1	548	326	59.5	1374	648	47.2
TOTAL	536	258	48.1	938	571	60.9	2415	1153	47.7

No. examined = Total population in the Village

($P > 0.05$)

3.3.2 Percentage of Reinfected Patients by age and sex: The result of the percentage of reinfected patients by age and sex is presented in Table 3.2. The data show that there were significant differences in the ages of patients that were reinfected ($P < 0.05$). The percentage reinfectio~ increases with age. The difference in distribution of percent reinfection was significant among the villages ($P < 0.05$). There was no significant difference between mean of male and female sexes ($P > 0.05$).

3.3.3 Distribution by number of times of infection: Figure 3.2 shows the result in respect of distribution of victims by number of times of infection. Data show that the distribution of frequency differ significantly among the villages (P C 0.05). There were significant differences in the number of times victims were infected ($P < 0.05$). The percentage of the number of people infected once is significantly higher than those infected multiple number of times. The percentage of victims affected reduces with the number of times of infection.

Table 3.2: Percentage of Reinfected Patients by Age and Sex

Age Group (Year)	Sex	Mele	Abaepo	Ejitolu	Folarin	Seriki	Papanla	Mowooba	Igiidu	Mean ± SEM
		% Reinf.	% Reinf.	% Reinf.	% Reinf.	% Reinf.	% Reinf.	% Reinf.	% Reinf.	% Reinfection
0 - 5	M	30.7	100	47.1	81.1	75.8	81.7	78.8	100	74.4 ± 8.5^{bcd}
	F	18.1	52	53.4	100	41.6	49.0	59	92.5	582 ± 9.4^{d}
6 - 10	M	51.7	40	65	93.4	80.7	50	80	90	68.9 ± 7.1^{d}
	F	65.2	50.4	93.6	44	53.5	80	100	100	73.3 ± 8.2^{bcd}
11 - 15	M	78.5	64	37.9	86.1	80.0	52	96.7	77.8	71.6 ± 6.8^{cd}
	F	66.7	37.5	65.8	77.7	44.4	96.7	91.6	57.2	67.2 ± 7.4^{cd}
16 - 20	M	100	79	73.1	97.5	85.7	75.5	84.6	75	84.5 ± 4.1^{abcd}
	F	100	49.9	68.7	81.9	76.5	66.6	88.2	100	79 ± 6.1^{abcd}
21 - 25	M	100	86.4	85.6	85.3	73.8	78.7	59.1	85.7	81.2 ± 4.8^{abcd}
	F	100	65.7	77.1	56.0	65.2	65	81.9	85.7	75.9 ± 5.6^{abcd}
26 - 30	M	73.3	92.7	91.8	92.7	81.9	84.2	100.0	57.9	84.3 ± 4.8^{abcd}
	F	100.0	89.0	54.5	52.4	93.4	86.9	100.0	98	84.3 ± 6.9^{abcd}
31 - 35	M	100.00	82.7	88.3	84.2	83.3	100.0	100.0	100.0	93.5 ± 3.1^{ab}
	F	56.5	-	92.0	85.7	60	100.0	100.0	95.9	83.0 ± 8.1^{abc}
36 - 40	M	100.0	100.0	81.8	100.0	100.0	99	100.00	100.0	99.8 ± 0.2^{a}
	F	100.0	97.5	66.7	100.0	100.0	100.0	100.00	100.0	95.5 ± 5.6^{ab}
41 - 45	M	100.0	100.0	100.0	86.1	84.6	100.0	75.7	92.7	91.3 ± 3.6^{abc}
	F	100.0	100.0	100.0	100.0	99.1	100.0	55.5	100.0	95.3 ± 4.5^{ab}
46 - 50	M	100.0	-	50.9	100.0	50.0	100.0	100.0	100.0	87.5 ± 12.5^{abcd}
	F		100.0	100.0	100.0	100.0	-	100.0	100.0	100 ± 0^{a}
51 -	M	100.0	100.0	100.0	-	90.9	97.0	100.0	100.0	99.3 ± 0.8^{d}
	F	-	-	100.0	100.0	100.0	100.0	100.0	100.0	100 ± 0a

Mean ± SEM with different superscript differ significantly ($P<0.05$)

SEM = Standard error of mean

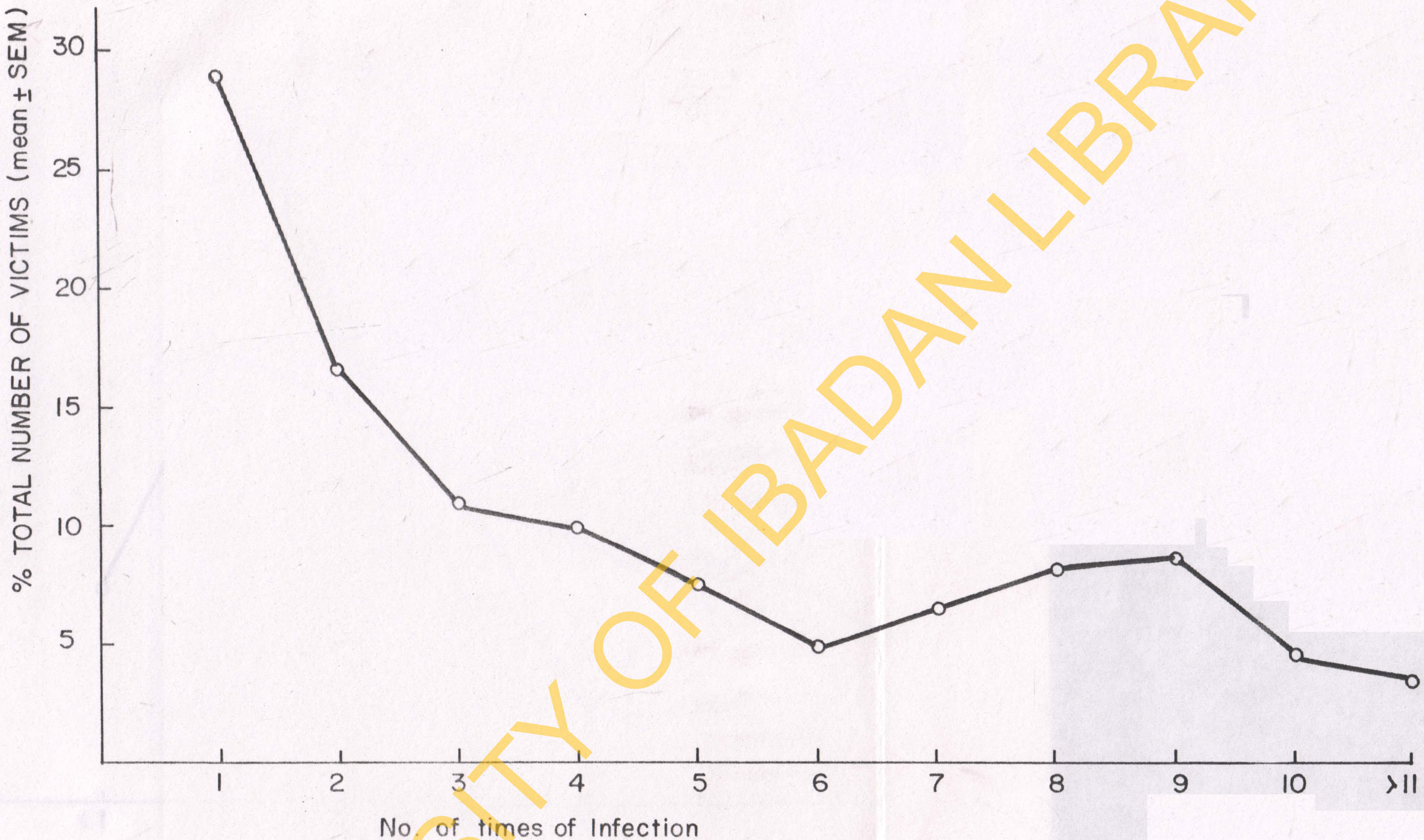


FIG. 3.2 DISTRIBUTION OF PATIENTS BY NUMBER OF TIMES OF INFECTION.

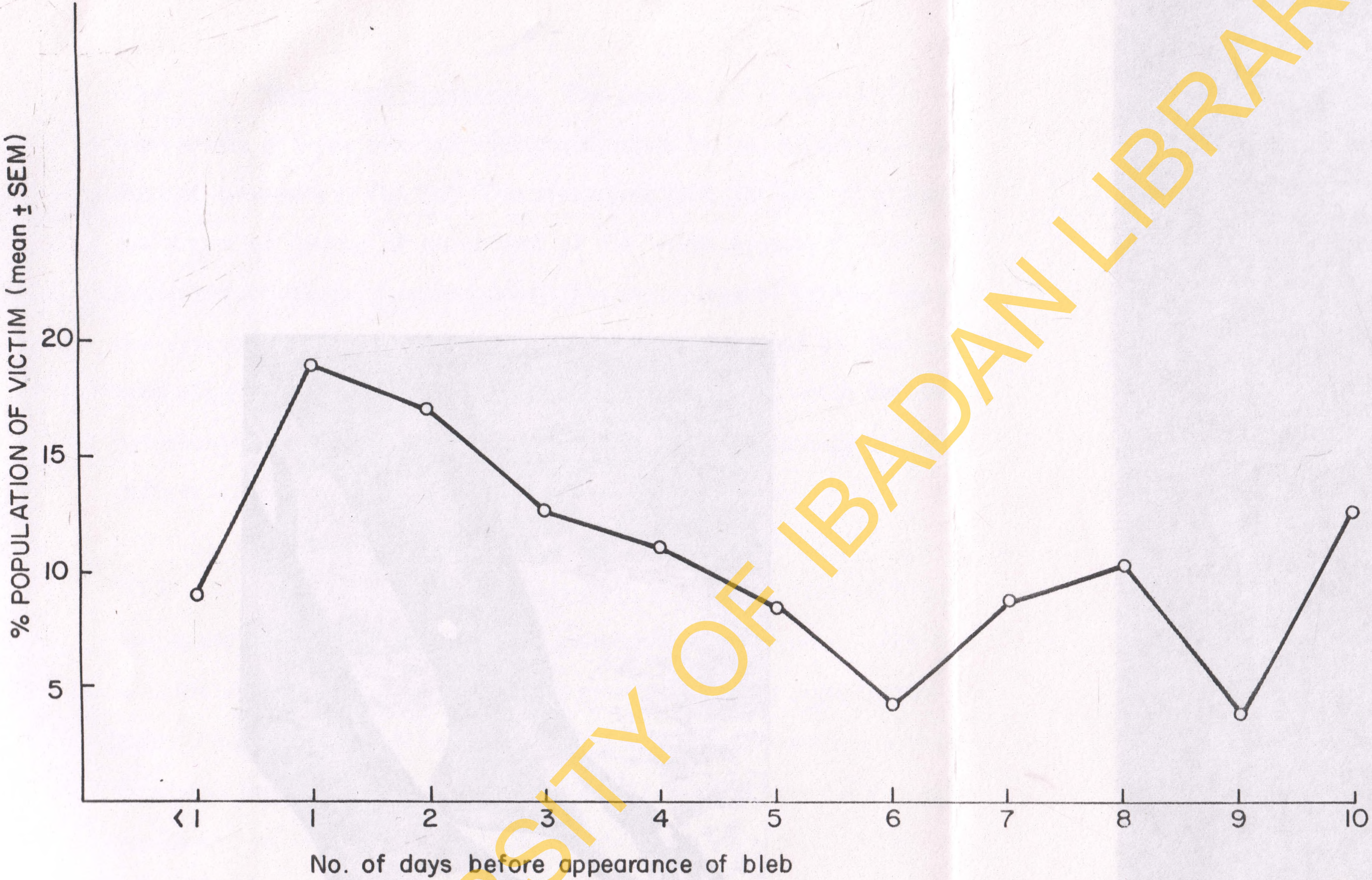


FIG. 3.3 DRACUNCULIASIS AND PRODROMAL SYMPTOMS.

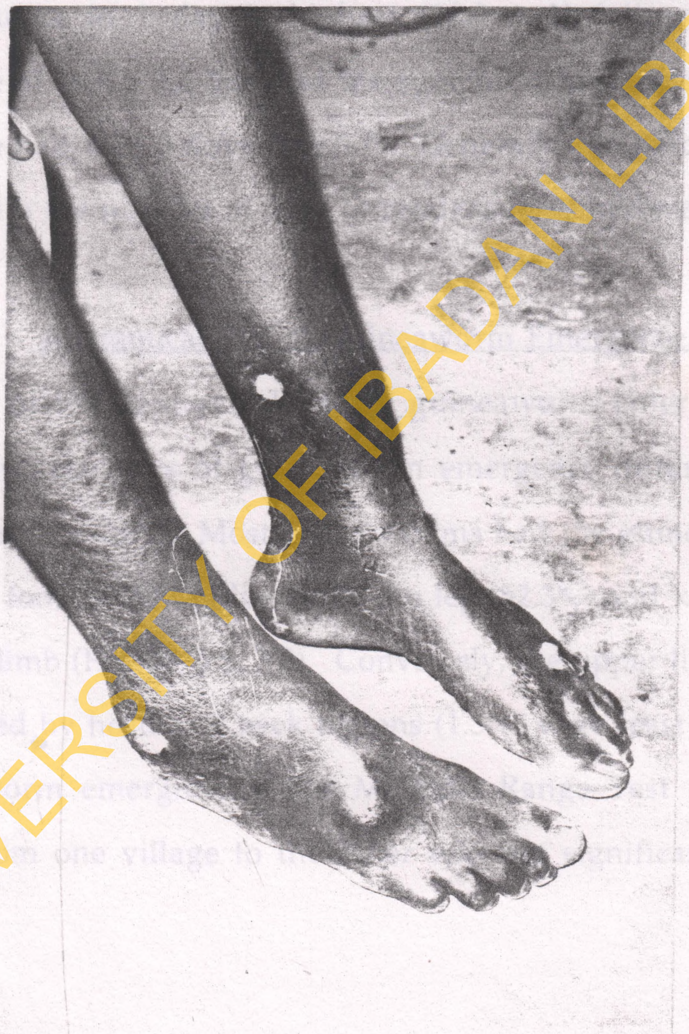


Fig.3.4 Guinea worms emerging from 5 sites on both legs of a housewife

3.3.4 Prodromal Symptoms: The population of the victims who were aware of being infected with guineaworm before the appearance of the bleb is shown in Fig. 3.3. This awareness took the form of palpating the worm or feeling of movement of the worm around the body or experience of allergic manifestations. The percentage of victims that had the symptoms in 1 day is highest (18.9 ± 1) followed by the mean percentage of 16.9 ± 3.1 that had the symptoms in 2 days while the lowest percentage had it in 9 days (3 ± 0.7). Generally the percentage of victims reduces with the number of days of prodromal symptoms.

3.3.5 Anatomical Site of Guineaworm Emergence: Table 3.3 shows the result of the anatomical site of guineaworm emergence. The data indicate that the sites of guineaworm emergence differ significantly for each victim ($P < 0.05$). Most of the victims had the guineaworm emerging from their foot (80.3%) followed by the leg (52.3%) and knee (26.8%), all in the lower limb (Fig.3.4, 3.5, 3.8). Conversely, the upper limbs (13.2%) - Fig. 3.7 followed by head and neck regions (1.5%) were least preferred sites as regards worm emergence. The Multiple Range Test revealed that the pattern from one village to the other was not significantly different($P > 0.05$).

Table 3.3: Anatomical Site of Guineaworm Emergence

Site	Mele		Abaepo		Ejitolu		Folarin		Seriki		Papanla		Mowooba		Igiidu		TOTAL		MEAN±SEM
	No of Vict.	%	No of Vict.	%	No of Vict.	%	No of Vict.	%	No of Vict.	%	No of Vict.	%	No of Vict.	%	No of Vict.	%	No of Vict.	%	%
Head/ Neck	-	-	-	-	-	-	1	0.9	-	-	2	1.8	5	1.2	19	2.0	27	1.5	1.5 ± 0.26^{e}
Back/ Abdomen	3	2.2	1	2.3	-	-	3	3.6	-	-	2	1.8	7	1.6	51	6.0	67	3.6	2.8 ± 0.7^{e}
Arm/ Hand	10	7.5	4	9.1	7	7.6	17	14.9	9	11.1	13	11.7	29	6.7	159	18.5	246	13.2	10.9 ± 1.5^{de}
Buttock	2	1.5	-	-	-	-	-	-	-	-	5	4.5	3	0.7	95	11.2	105	5.7	4.5 ± 2.4^{e}
Scrotum/ Vulva	7	5.2	-	-	2	2.2	3	2.6	2	2.5	5	4.5	12	2.8	74	8.7	105	5.7	4.1 ± 0.9^{e}
Thigh	45	33.6	11	25.0	8	8.7	21	18.4	5	6.2	11	9.9	35	8.1	129	15.2	265	14.3	15.6 ± 3.4^{d}
Knee	64	47.8	18	40.9	14	15.0	15	13.2	19	23.5	18	16.2	49	11.3	301	35.5	498	20.4	25.4 ± 5^{c}
Leg	106	79.1	25	56.8	52	46.5	56	73.0	57	70.4	44	39.6	221	51.0	411	48.5	972	52.3	59.4 ± 4.8^{b}
Foot	121	90.3	36	81.8	69	75.0	75	97.0	71	87.7	74	66.7	397	91.7	648	76.4	1491	80.3	83.3 ± 3.6^{a}
																	1857		

Mean ± SEM with different supercript differ significantly ($P<0.05$)

SEM - Standard error of mean

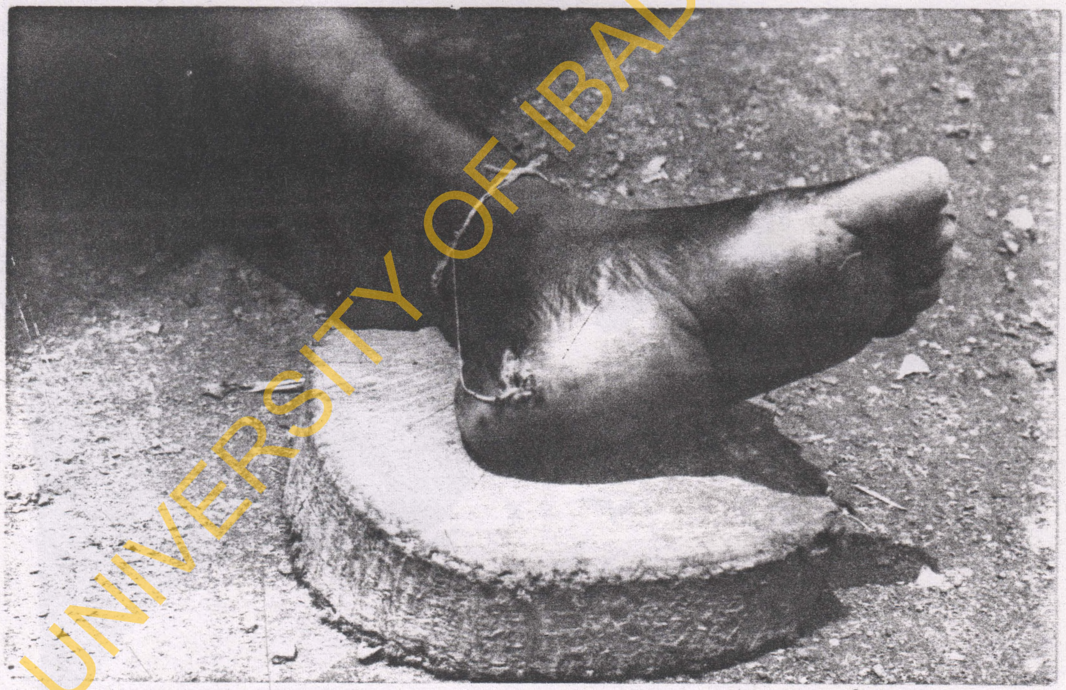


Fig. 3.5 Guinea worm from the foot of an incapacitated teenage school boy in Mele village.

Fig. 3.6 Guineaworm emerging from the penis of a 60-year old Head of a household

Fig.7.7 Guineaworm on the wrist of a woman

3.3.6 Seasonality of Dracunculiasis: Table 3.4 shows the result in respect of the distribution of infection by seasons of the year. There was a significant variation in the season the infection become apparent. The mean infection rate of 53.98 ± 6.65 during the dry season was significantly higher than the infection rate of 14.68 ± 2.17 that occured during the wet season ($P < 0.05$).

3.3.7 The Degree of severity of dracunculiasis: The result of the severity of infection is presented in table 3.5. An infection is said to be mild where the victim is mobile and suffers little or no discomfort; moderate when the victim is mobile but suffers considerable discomfort; and severe when the victim is immobile or unable to use the affected part and suffers considerable discomfort. There was significant difference among the per cent of the population affected and the severity ($P < 0.05$). But the difference among the villages as regards distribution of severity of infection and percentage of the population affected were not significant ($P > 0.05$). A multiple range comparison of the severity shows that victims with severe infection (54.3 ± 2.3) were significantly higher than those with mild (16.7 ± 1.2) and moderate infection (29.0 ± 1.6). The population that sufferd moderate infection was significantly higher than those with mild infection ($P < 0.05$).

3.3.8 Period of disability. The result of the study into the period of incapacitation is presented in Figure 3.9. The data show that coefficient of

Table 3.4: Distribution of Guineaworm patients by Seasons of Infection

SEASONS	Mele		Abaepo		Ejitolu		Folarin		Seriki		Papanla		Mowooba		Igiidu		TOTAL		MEAN ± SEM
	No of Vict.	%	No of Vict.	%	No of Vict.	%	No of Vict.	%	No of Vict.	%	No of Vict.	%	No of Vict.	%	No of Vict.	%	No of Vict,	%	%
Dry (Oct-March)	76	56.7	21	4.77	65	70.7	71	62.3	54	66.7	53	47.7	315	72.7	571	67.3	1226	66.0	61.5±6.7[a]
Wet (April-Sept.)	35	26.1	9	20.5	10	10.9	18	15.8	7	8.6	9	8.1	63	14.5	109	12.9	260	14.0	14.7±2.2[b]
Any season	23	17.2	14	31.8	17	18.5	25	21.9	20	24.7	49	44.1	55	12.7	168	19.8	371	20.0	23±3.5[b]

Mean ± SEM with different superscript differ significantly ($P<0.05$)

SEM = Standard Error of Mean

Table 3.5: Distribution of Victims by Degree of Severity of Dracunculiasis

Degree of Severity	Mele		Abaepo		Ejitolu		Folarin		Seriki		Papanla		Mowooba		Igiidu		TOTAL		MEAN ± SEM
	No of Vict.	%	No of Vict.	%	No of Vict.	%	No of Vict.	%	No of Vict.	%	No of Vict.	%	No of Vict.	%	No of Vict.	%	No of Vict.	%	%
Mild	24	17.9	7	15.9	11	12.0	17	14.9	16	19.8	25	22.5	69	15.9	121	14.3	290	15.6	16.7 ± 1.2^{c}
Moderate	41	30.6	14	31.8	26	28.3	35	30.7	29	35.8	32	28.8	93	21.5	209	24.6	479	25.8	29.0 ± 1.6^{b}
Severe	69	51.5	24	52.3	55	59.8	62	54.4	36	44.4	54	48.6	271	62.6	518	61.1	1089	58.6	54.3 ± 2.3^{a}

Mild - disability is where the victim is mobile and suffers little or no discomfort.

Moderate - disability is where the victim is mobile but suffers considerable discomfort.

Severe - Where the victim is immobile or is unable to use the affected part and suffers considerable discomfort.

Mean ± SEM with different superscript differ significantly ($P<0.05$)

SEM - Standard Error of Mean.

Fig. 3.8 Guineaworm victims of a household (Papanla village)

variation (CV%) is 44.96% and coefficient of determination is high (r^2 = 0.71). There was significant variation in the period of lay off from work among the population affected ($P < 0.05$). Multiple Range Comparison showed that 5 - 8 weeks followed by 9 - 12 weeks was the most frequently occuring period of incapacitation. Lowest percentage of the population (1.8 ± 0.5) were incapacitated for 25 - 28 weeks. Similar pattern was recorded in each village ($P < 0.05$) but there was no significant difference when grouped by village ($P > 0.05$).

3.3.9 Effect of dracunculiasis on school attendance: Fig . 3 .10 shows the result of the effect of dracunculiasis on the school attendance. The data indicate that about 20 per cent to 41 per cent of the pupils were absent in the course of the year due largely to dracunculiasis. 10 pupils were reported to have withdrawn from Seriki Community School due exclusively to dracunculiasis since the beginning of second term of 1989 school year alone. Results show that most of the pupils that were absent from school had multiple infection which had been complicated by secondary bacterial agents. Results also revealed that about 60 per cent of the pupils present in class in Seriki Community School had mild infection (Fig. 3.12).

3 3 10 Assistance during absence from work: Table 3.6 shows the results of the interview on the assistance victims received during the period of "lay off from work". The nature of assistance received by victims

differs significantly among the population ($P < 0.05$). The data show that majority, 54.5 ± 2.3 per cent had nobody to assist during absence from work, while a few 22.9 ± 24 per cent depends on relatives. 31.6 ± 3.1 per cent of the victims were able to employ the service of labourers while 26.6 ± 2.3 per cent depended on their children.

Table 3.6: Assistance During "Lay Off From Work"

Assistance	Mele		Abaepo		Ejitolu		Folarin		Seriki		Papanla		Mowooba		Igiidu		TOTAL		MEAN±SEM
	No of Benef	%	No of Benef	%	No of Benef	%	No of Benef	%	No of Benef	%	No of Benef	%	No of Benef	%	No of Benef	%	No of Benef	%	%
Relatives	27	24.5	5	13.5	28	34.6	25	25.8	10	15.4	17	19.8	81	22.3	197	27.1	390	21.0	22.9 ± 2.4^{c}
Children	32	29.1	12	32.4	31	38.3	21	21.6	17	26.2	21	24.4	72	19.8	151	20.8	357	19.2	26.6 ± 2.3^{bc}
Labourer	31	28.2	9	24.3	34	42.0	35	36.1	25	38.5	16	18.6	89	24.5	293	40.3	532	28.6	31.6 ± 3.1^{b}
No Body	70	63.6	19	51.4	45	55.0	52	53.6	27	41.5	51	59.3	191	52.5	427	58.7	882	47.5	54.5 ± 2.3^{a}
																	1857		

Mean ± SEM with different superscript differ significantly ($P < 0.05$)

SEM - Standard error of mean

FIG. 3.9 PERIOD OF LAY OFF FROM WORK.

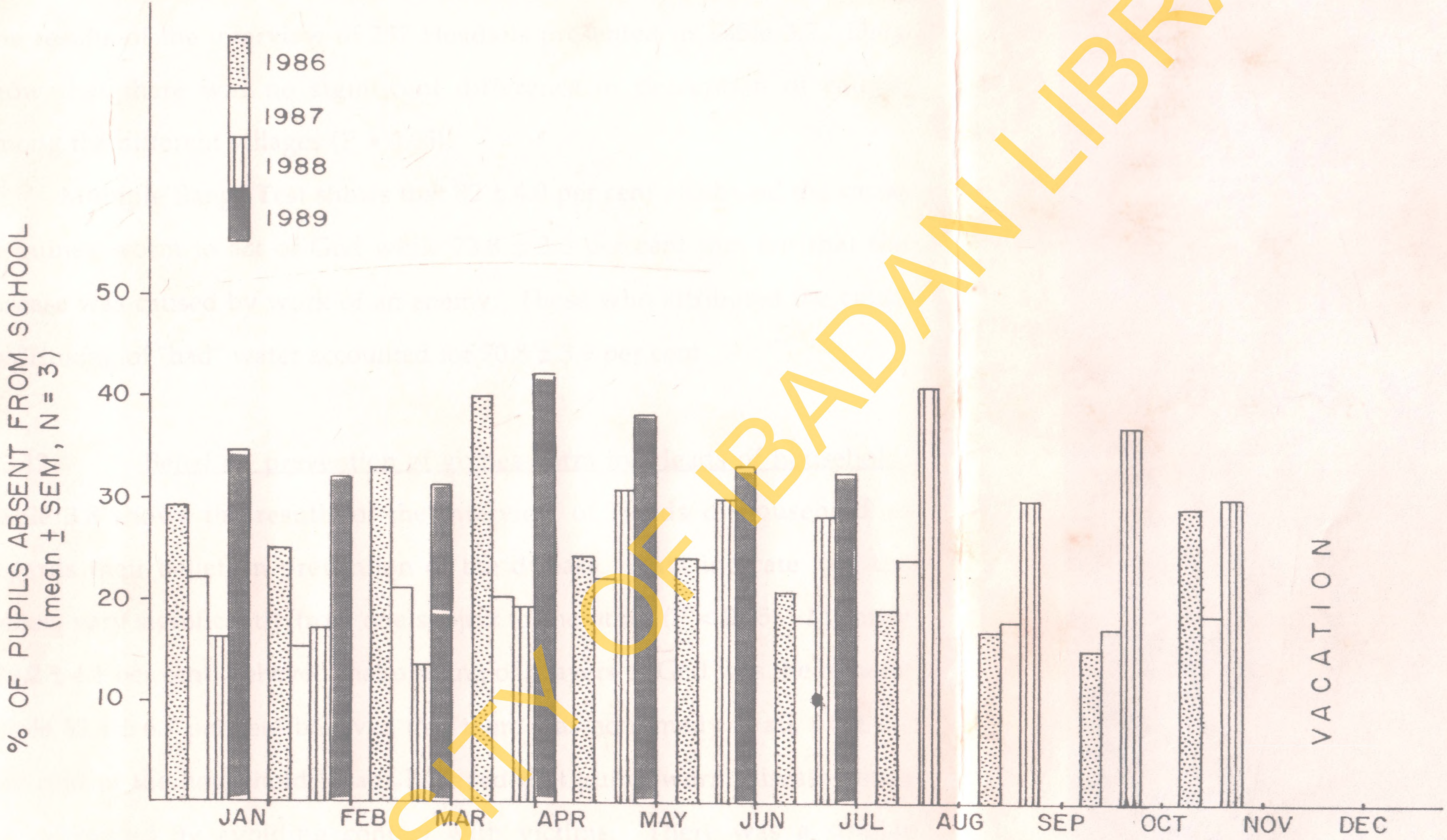


FIG. 3.10 IMPACT OF DRACUNCULIASIS ON SCHOOL ATTENDANCE IN OYO STATE (JAN.'86 - JUL. 89).

3.3.11 Perception of causes of guineaworm by Heads of household: The results of the interview of 257 Heads is presented in Table 3.7. Data show that there was no significant difference in perception of causes among the different villages ($P > 0.05$).

Multiple Range Test shows that 82 ± 4.0 per cent attributed the cause of guinea worm to act of God while 73.8 ± 3.6 per cent that felt that the disease was caused by work of an enemy. Those who attributed the cause to drinking of "bad" water accounted for 70.8 ± 3.9 per cent.

3.3.12 Belief on prevention of guineaworm bv Heads of household: Table 3.8 shows the resutls of the interview of Heads of household as regards their belief on prevention of the disease. Data indicate that the beliefs vary significantly from one subject to the other ($P < 0.05$). Majority (76.2 ± 4.1 per cent) believed that offering of prayers to God was the remedy while 53.4 ± 6.7 per cent believed that there was no remedy at all. 4.0 ± 1.1 per cent of the household Heads believed that guineaworm disease could be prevented by avoiding contact with victims. There was a similar pattern among the villages ($P < 0.05$).

3.3.13 Extent of water treatment among the household Heads: The results of the assessment of the attitude of household Heads to water treatment is shown in Table 3.9. The extent of water treatment varies significantly ($P < 0.05$). Data show that majority of the population (68.7 ± 5.3 per cent) did not treat water at all times before drinking while only

Table 3.7: Perception of Causes of Guineaworm by Household Heads

Perceived Causes	Mele		Abaepo		Ejitolu		Folarin		Seriki		Papanla		Mowooba		Igiidu		TOTAL		MEAN±SEM
	No of Heads	%	No of Heads	%	No of Heads	%	No of Heads	%	No of Heads	%	No of Heads	%	No of Heads	%	No of Heads	%	No of Heads	%	%
Evil Spirits	11	52.4	3	50.0	12	80.0	12	66.7	11	84.6	15	60.0	35	62.5	65	63.1	164	63.8	64.9 ± 4.3^{b}
Act of God	17	81.0	4	66.7	14	93.3	16	88.9	13	100	18	72.0	41	73.2	83	80.6	206	80.2	$82. \pm 4.0^{a}$
Work of Enemy	14	66.7	5	83.3	13	86.7	14	77.8	10	76.9	14	56.0	37	66.1	79	76.7	186	72.4	73.8 ± 3.6^{ab}
Heredity	-	-	-	-	1	6.7	1	5.6	1	7.7	-	-	3	5.4	-	-	6	2.3	6.4 ± 0.5^{c}
Drinking bad Water	16	76.2	3	50.0	11	73.3	11	61.1	11	84.6	18	72.0	45	80.4	71	68.9	186	72.4	70.8 ± 3.9^{ab}
Contact with Infected person	-	-	-	-	-	-	-	-	-	-	-	-	5	8.9	2	1.9	7	2.7	5.4 ± 3.5^{c}
TOTAL	21		6		15		18		13		25		56		103		257		

Means ± SEM with different superscript differ significantly ($P < 0.05$)

Table 3.8: Belief on Prevention of Guineaworm by Household Heads

REMEDY	Mele		Abaepo		Ejitolu		Folarin		Seriki		Papanla		Mowooba		Igiidu		TOTAL		MEAN±SEM
	No of Heads	%	No of Heads	%	No of Heads	%	No of Heads	%	No of Heads	%	No of Heads	%	No of Heads	%	No of Heads	%	No of Heads	%	%
Performing Rituals	11	52.4	2	33.3	6	40.0	13	72.2	9	69.2	14	56.0	31	55.4	56	54.4	142	55.3	54.1 ± 4.6^{b}
Offering prayers to God	16	76.2	4	66.7	10	66.7	14	77.8	13	100	17	68.0	39	69.6	87	84.5	200	77.8	76.2 ± 4.1^{a}
Avoiding contact with Victim	1	4.8	-	-	-	-	-	-	-	-	-	-	3	5.4	2	1.9	6	2.3	4.0 ± 1.1^{d}
Using Protective medicine	7	33.3	1	16.7	3	20	1	5.6	-	-	12	48	8	14.3	25	24.3	57	22.2	23.2 ± 5.3^{c}
No Remedy	13	61.9	4	66.7	9	60	7	38.9	11	84.6	11	44	13	23.2	49	47.6	117	45.5	53.4 ± 6.7^{b}
TOTAL	21		6		15		18		13		25		56		103		257		

Means ± SEM with different superscript differ significantly ($P < 0.05$)

SEM - Standard mean of Error

Table 3.9: Extent of Water Treatment Before Drinking by Household Heads

Extent	Mele		Abaepo		Ejitolu		Folarin		Seriki		Papanla		Mowooba		Igiidu		TOTAL		MEAN ± SEM
	No of Heads	%	No of Heads	%	No of Heads	%	No of Heads	%	No of Heads	%	No of Heads	%	No of Heads	%	No of Heads	%	No of Heads	%	%
Water treated all the time	1	4.8	-	-	-	-	1	5.6	-	-	-	-	5	8.9	7	6.8	14	5.4	6.5 ± 0.9^{c}
Water treated sometime	6	28.6	-	-	4	26.7	7	38.9	6	46.2	11	44	9	16.1	25	24.3	68	26.5	32.1 ± 4.2^{b}
No water treatment all the time	14	66.7	6	100	11	73.3	10	55.6	7	53.8	14	56	42	75.0	71	68.9	175	68.1	68.7 ± 5.3^{a}
TOTAL	21		6		15		18		13		25		56		103		257		

Mean ± SEM with different superscript differ significantly ($P < 0.05$)

SEM - Standard Error of Mean

32.1 ± 4.2 per cent occasionally treated their water before drinking. 6.5 ± 0.9 per cent of the population treated their water at all times. The extent of water treatment varies significantly among the villages (P < 0.05).

3.3.14 Methods of water treatment by Heads of household: Table 3.10 shows the result of the assessment of methods of water treatment among the Heads of household. Data revealed that methods of water treatment vary significantly among the population and the villages (P < 0.01). Majority (35.1 ± 3.6 per cent) who claimed to have treated their water did so with alum while only 14.0 ± 2.8 per cent boiled their water before consumption. None chose filtration as a method of treatment.

3.4 DISCUSSION

Dracunculiasis is a household name in the State especially in the rural areas where there is no safe water supply for drinking. This is so because this study had shown that in a total population of 2,415 in eight different villages located in two Local Government Areas, 76.9 per cent had been victims of dracunculiasis. The prevalence at the time of study was 47.7 per cent and this is higher than the rate reported from certain parts of the State like 17 villages north of Ibadan, 1971 - 1975 (Kale, 1977) and Sanusi (Adeyeba 1986), where 13.5 per cent and 28.7 per cent prevalence were recorded respectively; and in Egbejila near Ilorin with 45 per cent (Edungbola and Watts, 1984b). The rate recorded in this study is significantly lower than those reported in most parts of Kwara State like

Table 3.10: Methods of Water Treatment by Household Heads

Methods	Mele		Abaepo		Ejitolu		Folarin		Seriki		Papanla		Mowooba		Igiidu		TOTAL		MEAN ± SEM
	No of Heads	%	No of Heads	%	No of Heads	%	No of Heads	%	No of Heads	%	No of Heads	%	No of Heads	%	No of Heads	%	No of Heads	%	%
Boiling	2	9.5	-	-	-	-	2	11.1	-	-	3	12.0	14	25.0	13	12.6	34	13.2	14.0 ± 2.8^{c}
Filtering	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Adding Alum	7	33.3	-	-	4	26.7	8	44.4	6	46.2	11	44.0	13	23.2	29	28.2	78	30.4	35.1 ± 3.6^{b}
No treatment	14	66.7	6	-	11	73.3	10	55.6	7	53.8	14	56.0	42	75	71	68.9	174	67.7	68.7 ± 5.3^{a}
TOTAL	21		6		15		18		13		25		56		103		257		

Mean ± SEM with different superscript differ significantly ($P<0.05$)

SEM - Standard Error of Mean.

Asa with 53 per cent (Edungbola and Watts, 1984a), Babana District with 54.7 per cent (Edungbola, 1983) and Igbon in Oyo State with 75.0 per cent (Edungbola, 1984).

The absence of a significant difference in infection rates between the female and male sexes (P > 0.05) in the eight communities is similar to those obtained in Egbegila, a peri- urban community of Ilorin (Edungbola and Watts, 1984b), Babana District (Edungbola, 1983), Sanusi village (Adeyeba, 1986) and in Anambra State (Nwosu et al., 1982). By contrast Scott (1960), Lyons (1972) and Sahba et al., (1975) reported that more females than males were infected in their studies in Chana and Iran while the reverse was the case in the studies of Reddy et al. (1969), Belcher et al., (1975) and Kale, (1977) in India, Southern Ghana and Ibadan District, Nigeria respectively.

The occurrence of significant difference in prevalence rate among the age groups (P < 0.05) conforms with reports from other suthors (Rao, 1942; Lindberg, 1946, 1948, Belcher et al., 1975, Kale, 1977; Nwosu et al; 1982; Edungbola and Watts, 1984a, b; Edungbola,1983 1984). Infection in infants is uncommon. This is partly because of the long incubation of the infection (10 - 14 months) and also because water meant for infants consumption is often boiled. Adults who spent most of their time on the farms, and the older children who assisted them have the greatest exposure to infection, since they would quench their thirst directly from contaminated ponds in the vicinity of the farms (Fig. 3.11).

Fig. 3.11 A thirsty farmer in Asani Village in Akinyele LGA drinking directly from pond in the vicinity of the farm.

The water consumption habit of individuals is a principal factor in susceptibility to infection. The extent and method of water treatment differ significantly among the populations (P < 0.05). That 68.66 per cent of the population had never bothered to treat water before drinking by any method is not surprising in view of the input to be made which only 6.53 per cent could afford at all time. It is quite clear from this study that method of water treatment employed include boiling and addition of alum. It has been shown from another study that mere addition of alum in the form of aluminium sulphate in the quantity used by the villagers certainly can not kill the cyclopoid copepod vectors of the disease. Therefore this practice does not amount to effective treatment of water. Although boiling of water is an effective means of rendering water safe for human consumption, the practice could not be sustained. This is partly because of fuel requirement like firewood and kerosine which many peasant farmers could not afford and partly because the rural dwellers did not have the patience and perseverance that it is required at all time in boiling and cooling down of the water before consumption. Therefore, it is not surprising that only 14.04 per cent treated water by boiling. This meant that only a minority would drink less contaminated water. Since the volume of contaminated water consumed is directly related to susceptibility to infection (Kale, 1977) the majority of the rural dwellers are at risk of contacting the disease.

However, it is obvious from this study that not all that drink from contaminated pond water become infected. The reason for this is still a subject of debate. The suggestion by Scott (1960) that the gastric acid status of individual (hypochlorhydria) was an important factor in refractoriness to infection has been disputed by Gilles and Ball (1964). Other factors which protect some individuals from infection have been suggested (Onabamiro, 1958; George, 1975; Kale,1977 and Edungbola, 1983).

In this study, it has been shown that repeated infections were found to be very common in all the villages. The rate of reinfection increases with age. This conforms with observations from other studies (Scott, 1960; Belcher et. al., 1975; Kale, 1977), and this indicates that guineaworm infection does not confer any tangible protective immunity on the patients.

The results in respect of the site of emergence of guinea worm in the different anatomical parts of the body among the villagers is not different from those reported by previous authors (Lindberg, 1946; Onabamiro, 1952; Muller, 1971; Kale, 1977; Edungbola, 1983, 1984) with foot and leg being the most frequetly affected parts while the trunk and abdomen, scrotum and vulva were least affected sites of guineaworm emergence.

The findings of this study that infection is common in the area of study during the dry season and usually coincides with the time of harvesting and preparation of the land for the following planting season are similar to those of Scott (1960), Belcher et al., (1975), Kale (1977), Nwosu et al., (1982), Edungbola (1984) and Daniel and Osisanya (1985). The period of disability or "lay off from work" is the time patients are unable to perform their normal routine duties like farming, active trading and schooling. It is alarming to note in the study area that those with severe infection accounted for the highest percentage of 54.3 ± 2.3 which is significantly higher than the percentages of those with either mild or moderate disabilities. Any assumption that those with mild or moderate disability would not be adversely affected in terms of productivity would not be right as the input would be reduced in terms of coverage and scope. This meant in a sense that the coverage of guineaworm would be felt no matter the degree.

The average period of "lay off" is between 5 to 8 weeks and this as was found out in this study could extend to over 33 weeks in extreme cases. This finding is similar to those of Reddy et al, (1969). Because the period of disability usually coincides with the planting and harvesting seasons, the agricultural input is adversely affected compellfng the victim to seek assistance during the period of disability. Generally, the options opened to the disabled farmer are the services of relatives, or children or labourers and sadly enough no assistance. None of the options available is reliable as those that remain are few and more often than not they too soon become victims of the disease. Although 54.5 ± 2.3 per cent are unable to secure any form of assistance which meant a very serious and added sorrow. The 31.6 ± 3.1 per cent who could afford to employ the services of labourers had to pay heavily.

The wage bill is very high at least for a peasant farmer. It is estimated that a sum of about N600.00 to N960.00 would be required to engage the services of labourers for between 5 - 8 weeks, since a minimum of N20.00 is the fee chargeable per day per male labourer who assist in clearing or preparing the land for planting. The female labourer who helps in the cocoa and palm oil processing normally charges a minimum of N15.00 per working day depending on the prevailing circumstances. As it is expected in an endemic area the number of labourers and/or any other assistance dwindles as a result of infection since all are at risk from the disease. When this happens the remaining who are free of infection would charge exhorbitant fees for their services.

More often than not, the services of these emergency assistants were not promptly secured, they are unreliable and on many occasions this has led to a delay of work on the farm. Atimes the work is unfinished and usually not thorough. Consequently, the harvesting and/or planting is delayed which may contribute more to the frustration af the farmer who may have to contend with poor yield/harvest with the corresponding economic implication.

The adverse impact of this disease on the school attendance in three different primary schools over a period of about four years gives a pathetic picture. It was found out that about 20 per cent to 41 per cent of the student population were absent from school in the course of the year as a result of dracunculiasis. It is apparent from this study that dracunculiasis is increasing both in prevalence and magnitude with every passage of each year at least since 1986 using school absenteeism as an index of determination (Fig. 3.10). In a situation where over 60 per cent of the pupils present in a class were infected (Fig. 3.12) beside the number that were absent calls for an urgent attention. Although most of the infected pupils present in the school at the time of this study had mild infections, their fortnight academic performances were poor. A total of 10 pupils were reported to have withdrawn from school since the beginning of second term of 1989 school year in the community primary school in Seriki Okegbemi village. Investigation then revealed that the pupils who were residents of Seriki and Folarin villages had multiple infections that were complicated by secondary bacterial infection. Their academic performance would undoubtedly be adversely affected. Nwosu et al. (1982) and Ilegbodu et al. (1984) gave similar pathetic report in Anambra State and Idere village, Oyo State, respectively.

Fig. 3.12 School children with mild Guineaworm infection.

Apart from the adverse socio-economic effect and the psychological torture, the disabled farmer is not sure of his future as the available medicare is not within his reach. Although modern medicine has little or nothing to offer in terms fo cure of guineaworm disease, it is sad to note that the only village (Mele) of the eight that has a dispensary and maternity centre did not stock enough essential palliative drugs that may be administered to patients at affordable prices. It is normal behaviour to seek pleasure and to avoid pain. In man, where emotional life is of the greatest importance, pleasure and pain are as much concerned with psychology as with physical well-being. Based on the importance of pleasure-pain principle as shown by Tinbergen (1953) and Barnett (1955) the victims attempted to discharge their emotional tensions by a special behaviour pattern. Therefore, since most of the victims can not afford the cost of medication, they resorted to local treatment of their guineaworm ulcer by applying palm oil and a local herb called "Oluganbe" while the extraction of the guineaworm is done with cord tied round the affected part (Fig. 3.13). This indigenous approach has exposed the guineaworm ulcer to secondary bacterial agents which actually complicate the ulcer and prolong the period of incapacitation.

The future of the disabled farmers for a long time to come will remain bleak in view of their wrong perception and belief of causes and prevention of the disease unless they are given a new orientation.

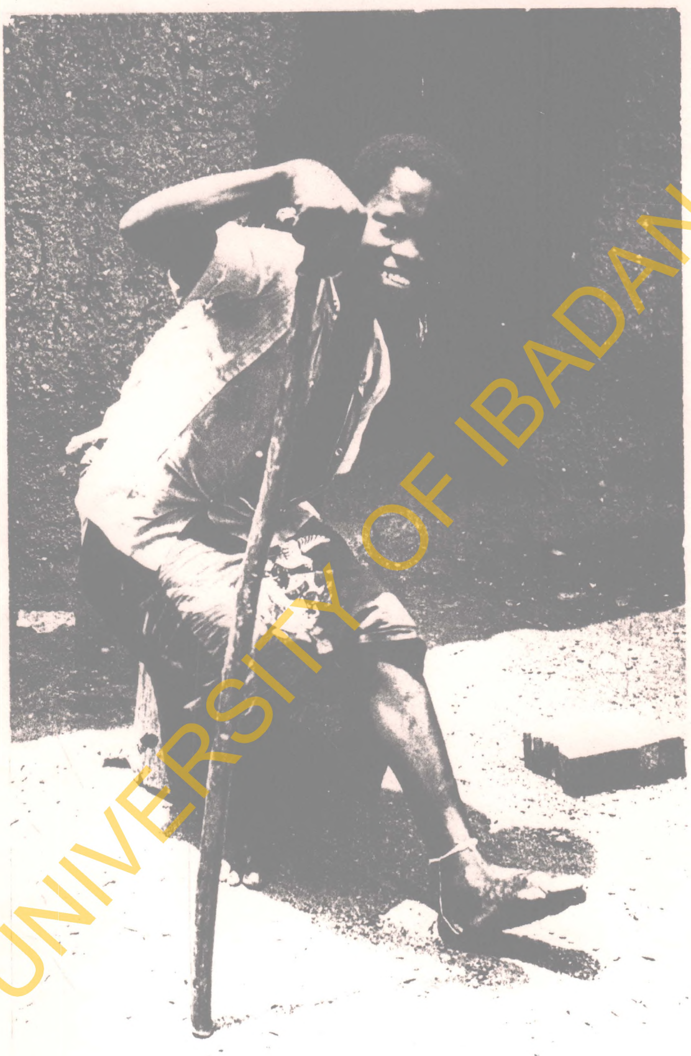


Fig. 3.13 Guineaworm extraction with string cord tied round.

It is unfortunate that towards the end of 20th Century, a section of Oyo State still believe that guineaworm is caused by act of God or an enemy and that it could only be prevented b~ offering prayers to God.

However, it is believed that only the improvement of water supplies like provision of draw well, deep well or piped water backed up with a well articulated health education programme, will reduce, if not completely eradicate the disease in the State. Meanwhile at individual personal level, boiling or filtering the water before drinking, will go a long way in controlling the spread of the disease.

CHAPTER FOUR

SECONDARY BACTERIAL INFECTION IN DRACUNCULIASIS: BACTERIAL ISOLATES, ANTIBIOTIC SUSCEPTIBILITY PATTERNS AND PHAGE TYPES OF STAPHYLOCOCCUS UREUS

4.1 INTRODUCTION

Guinea worm ulcers when left untreated often become infected with secondary bacterial agents which usually result in prolonged period of incapacitation. Studies have shown that certain bacterial agents are associated with secondary guinea worm ulcer (Muller, 1971). There has been no adequate report on the profile of bacterial agents isolated from guinea worm ulcers or the various phages and antibiotic susceptibility pattern of Staphylococcus aureus which is most frequetly associated with guinea worm ulcers.

Generally, there are differences between staphyloccocci isolated from lesions and those from carrier sites in the production of toxins and other extracellular products (Williams, 1963). The relationships between these micro-organisms and their hosts have been greatly influenced by the introduction of antibiotics into medicine (Adegoke, 1984) especially in the area of resistance to antibiotics.

Applying knowledge derived from isolation and sensitivity testing of the infecting strains of staphylococci to the choice of antimicrobial chemotherapeutic agents enhances response to treatment and reduces the emergence of resistant strains associated with indiscriminate use of antibiotics. There is paucity of information on the characteristics and importance of secondary bacterial infections associated with dracunculiasis in the world at large and in Nigeria in particular.

The present work reports specific bacterial agents associated with secondary guinea worm ulcers and highlights the epidemiological importance of Staphylococcus aureus. a dominant bacterium associated with septic guinea worm ulcers in the areas surveyed.

4.2 MATERIALS AND METHODS

4.2.1 Sample Collection And Isolation Of Bacteria: Swabs were collected aseptically from the ulcers of more than 75 guinea worm patients with bad ulcers irrespective of their ages and sex in villages in Akinyele LGA of Oyo State of Nigeria. In essence, only those patients with bad septic ulcers were targeted in the study area. The swabs were examined immediately in the laboratories using the methods described by Cruickshank, et al. (1975). All bacterial isolates thus obtained were characterised by using the standard methods described by Cowan and Steel (1974).

4.2.2 Strains: Only coagulase - positive staphylococci isolated from the guinea worm ulcers were tested further.

4.2.3 Antibiotic Susceptibility Test: Disc sensitivity tests were performed with all the strains of coagulase-positive staphylococci using the method of Kirby-Bauer (Bauer, et al., 1986). From the previously grown strains on trypticase Soya agar five similar colonies were transferred into 5ml. of trypticase soya broth (BAL). The broth was incubated at 30°C for 2 - 8 hours after which the turbidity was adjusted to correspond to that of 0.5% McFarlared standard barium sulphate solution. A sterile swab dipped into each dilution was used to streak Mueller Hinton agar in 140mm petri dish. Each plate was then allowed to air-dry for 3 to 5 minutes before applying the following antibiotics; **penicillin, oxaciillin, tetracycline, minocycline, gentamycin, oxcacillin (merieux, France); amykacin, erythromydin, clindamydin, ampicillin, fusidic acid and rifampicin** Table 4.1 shows the symbols and concentrations of the antibiotic used in this study.

The plates were later incubated at 37°C for 15 - 24 hours after being left for 15 to 30 minutes at room temperature. The zone diameters were measured with sliding calipers and the meter rule. Staph. aureus ATCC 25293 was employed as a control. Sensitivity to each antibiotic was interpreted as recommended by Lorian (1980).

4.2.4 Minimum Inhibitory Concentration (MIC): The minimum inhibitory concentration (MIC) of tetracycline and penicillin for strains resistant by disc-diffusion method was determined as described by Adegoke (1984).

5ml of broth culture of isolates were incubated for 5 hours at 37°C after which they were thoroughly mixed. 2.3.5 triphenyl tetrazolium chloride (sigma Co., St. Louis, U.S.A.) was dissolved in sterile distilled water to give a concentration of 0.1 per cent. 0.05ml. of nutrient broth was delivered into each of 8 wells in a row in a sterile WHO microtiter plate. 0.05ml of the antibiotic under test was then added to the first well and serial dilutions were made using a sterile graduated Pasteur pipette (Morse guage No. 55) and 0.05ml of the antibiotic solution was transfered at each dillution. This was followed by the addition of 0.025ml of 2.3.5 triphenyl tetrazolium chloride. Later, 0.025ml of each suspension was added. This gave an initial antibiotic concentraction of 5.0 mcg/ml, 2.5mcg/ml in the first and the second wells respectively, and 1.25mcg/ml in the third well and so forth. The procedure was repeated for the control Staph. aureus (ATCC 25293). The microtitre plates were then covered and incubated at 37°C for 18 - 24 hours and the results were recorded. The minimum inhibitory concentration (MIC) of each antibiotic was taken as the minimum amount of the antibiotic needed to inhibit the growth of the Staphyloccocus strain under test and it was indicated by no change in the colour of the indicator.

Table 4.1 Symbols And Concentrations of Antibiotics Used for Sensitivity Testing of Staph - aureus Strains

Symbols	Antibiotics	Concentration
P_{10}	Penicillin	10 units
DP_5 (Rosco)	Oxacillin	5 microgromme
TE_{30}	Tetracycline	30 microgramme (mcg)
MI_{30}	Minocycline	30 mcg
GM_{10}	Gentamycin	10 mcg
OX_1 (Merieux France)	Oxacillin	1 "
AN_o	Anikacin	O "
E_{15}	Erythomycin	15 "
OC_2	Clindamycin	2 "
AMP_{30}	Ampicillin	30 "
FA_{10}	Fusidic acid	10 "
RA_{30}	Rifampicin	30 "

4.2.5 Phage Typing: Lysotyping agar plates were flooded with 4 - 6 hours broth cultures of the strains under test. Excess fluid was removed and the plates were allowed to air-dry. One drop of each of the typing phages diluted to 100 times the routine test dilution (RTD x 100) was placed on the seeded plate with a sterile graduated pasteur pipette (1/50ml). A template was held underneath the plate after which each plate was allowed to air-dry again and then incubated at 30°C over night. Lytic reactions were read as described by Blair and Williams (1961).

4.3 RESULTS

4.3.1 Bacterial agents isolated from Guineaworm Ulcers: All the ulcers of the seventy five patients with secondary guinea worm infection were infected with one or more bacterial agents either singly or in combination of two or even three. The isolates were Staphylococcus aureus, Staph. epidermidis; Streptoccocus species; Escherichia coli; Klebsiella species; Proteus species. Pseudomonas species were not ilolated. Of all the bacteria isolated, staphyloccoci had the highest occurence rate either as a single aetiologic agent or in association with any other bacteria.

4.3.2 Phage Types of Staph. aureus Isolated from Guinea worm ulcers: The Staph. aureus strains isolated from septic ulcers of dracunculiasis were generally susceptible to human phages as only three strains were found to be untypable even at 100 x RTD concentration (Table 4.2). Four strains were susceptible to phage 52, three strains were refractory to phage 80 and 71 respectivlely.

4.3.3 Antibiotic susceptibility Pattern of Staph. aureus strains isolated from guineaworm ulcers: Of the fourteen strains of Staph. aureus examined in this study, only one strain was susceptible to penicillin. Isolates were also commonly resistant to tetracycline. The other antibiotics used were found to be effective against the strains of Staph. aureus examined in this study (Table 4.3).

Table 4.2 Phage types of S. aureus strains isolated from Guinea Worm Ulcers

Isolate No.	Phages RTD	Phages R.T.D. x 100
SA 1	N.T	52/52A/80/84/85/+
SA 2	No growth	
SA 3	29 (29/80 after re-isolation)	
SA 4	29+/52+/80/54+	
SA 5	N.T	6/54/77/81/+ (89/HK) only, after reisolation
SA 6	NT	29/52/80/54
SA 7	N.T	N.T
SA 8	N.T	71±
SA 9	N.T	N.T
SA 10	N.T	80/84+/+
SA 11	29/52+/80/+	
SA 12	N.T	N.T (Identification after reisolation)
SA 13	89	42E+/53/85/+
SA 14	N.T	N.T.

N.T. = Could not be typed.

TABLE 4.3

ANTIBIOTIC SUSCEPTIBILITY PATTERN OF PHAGE TYPES

Antibiotic dose (mcg)	P_{10}	DP_5	TE_{30}	M_{130}	GM_{10}	OX_1	AN_0	E_{15}	CC_2	C_{30}	FA 10	RA 30
SA 1	13_R	27_S	10_R	20_S	21_S	19_S	22_S	26_S	25_S	24_S	30_S	34_S
SA 3	17_R	30_S	12_R	29_S	20_S	22_S	20_S	26_S	26_S	25_S	28_S	36_S
SA 4	15_R	28_S	29_S	30_S	20_S	20_S	21_S	25_S	25_S	24_S	28_S	31_S
SA 5	11_R	25_S	13_R	30_S	21_S	17_S	19_S	24_S	25_S	24_S	29_S	34_S
SA 6	18_R	28_S	12_R	29_S	21_S	21_S	21_S	28_S	24_S	25_S	34_S	36_S
SA 8	15_R	27_S	29_S	29_S	20_S	20_S	22_S	24_S	25_S	24_S	28_S	33_S
SA 9	13_R	27_S	13_R	28_S	20_S	18_S	20_S	26_S	24_S	25_S	28_S	33_S
SA 10	12_R	26_S	11_R	22_S	20_S	18_S	21_S	27_S	24_S	24_S	28_S	34_S
SA 11	17_R	28_S	12_R	29_S	20_S	21_S	21_S	25_S	25_S	24_S	28_S	35_S
SA 12	14_R	27_S	12_R	28_S	20_S	20_S	20_S	26_S	24_S	24_S	29_S	34_S
SA 13	13_R	26_S	8_R	20_S	21_S	19_S	21_S	25_S	25_S	20_S	29_S	34_S
SA 14	15_R	27_S	12_R	28_S	20_S	18_S	20	26	25	25	30	36
ATCC 2593	35_S	29_S	30_S	31_S	231_S	23_S	23_S	26_S	26_S	24_S	30_S	34_S
425/81	11	$18tr_R$	12_R	23_S	11_R	$13tr_R$	20_S	0_R	$26tr_R$	10_R	32_S	36_S

KEY:- tr = trouble
S = Sensitive
R = Resistent

x x = zone of inhibition.

4.4 DISCUSSION

Infection with Dracunculus medinensis is usually asymptomatic until a few days before the emergence of the female worms. Thereafter, the victim exhibits some allergic manifestations and other generalised disturbances in the body, all of which are believed to be due to the effect of toxic substances released at the time of the formation of the bleb. Worms that fail to emerge eventually gradually disintegrate and subsequently fluid from the worm's uterus produces a sterile abscess, which may later become secondarily infected by tetanus and other bacterial agents. This study has shown that staphylococci Esch. coli, Klebsiella species and Proteus species were frequently isolated from secondary guinea worm ulcer. However, staphylococci infection had the highest occurence rate.

Several new antibiotics are now available for therapeutic use. Adegoke (1984) reported that vancomycin, ristocetin and the cephalosporins are amongst the active antibiotics against staphyloccoci. Marked resistance to these antibiotics are not common. Although minor and localised superficial infections usually respond to therapy as indicated by adequate testing procudures is often necessary where evidence of spread of the infection is apparent.

According to Kryaski and Becla (1981), strains of Staph. aureus belonging to phage types 94/96, 96 and 71/96 have been linked with epidemics. Also epidemic strains of Staph. aureus are known to be often associated with phage 80/81 complex (Poole and Baher, 1966). Thus, the isolation of some strains susceptible to phage 71 and 80 is of epidemiological importance as patients from whom the isolates were got could spread Staph. aureus amongst the populace exposed to wound infections associated with dracunculiasis.

Staphylococcal resistance to penicillin is generally coded for on a plasmid and only rarely on the chromosome (Dyke and Richmond, 1967; Peyru Wexler and Movick, 1969). Asheshov (1966), Poston (1966) and Sawai, et al. (1968) have reported the occurence of chromosomally located penicillinase gene in some strains of Staph. aureus. Although screening for Plasmids in the strains was not undertaken in this present study, the development of resistance to penicillin by Staph aureus is of clinical importance as some rare strains of staphylococci possess an inheritable resistance to penicillin G. (Dyke, Jerons and Parker, 1966; Smith, HamittonMiller and Knox, 1969).

In a survey of staphyloccocal infections in some of the hospitals in Lyon, France and Nigeria, (Fleurette, Forey and Gontheir (1981); and Adegoke and Adeyeba (1986) respectively found that hospital-isolated staphylococci had a greater resistance to antibiotics. The apparent resistance to penicillin and tetracycline in this study could confirm the indiscriminate use of these antibiotics which often results in resistance of Staph.aureus strains to them. Furthermore, these antibiotic - resistant Staph. aureus may be capable of prolonged carriage by patients (Boyce et al., 1981).

Although, dracunculiasis is rarely a disease that kills and the infection is usually followed by spontaneous recovery (Muller, 1971), in the course of the disease the victim may suffer varying degrees of discomfort like painful ulcers and abscesses in relation to complications arising from secondary bacterial infection. These may result in varying degree of incapacitations.

Economically, it is relatively difficult to accurately quantify the impact of dracunculiasis in Nigeria. However, there is loss in work force occasioned by prolonged absenteeism from work, decreased agricultural productivity and the patient is constantly exposed to haemoparasitic and other enteric parasitic diseases. Hence now that attention is being focused on the eradication of guinea worm infection globally, especially in Nigeria, considerable efforts need be directed towards taking care of disabled patients who can be foci for disseminating strains of <u>Staph</u>. <u>aureus</u> which clinically are of epidemiological importance.

CHAPTER FIVE

CONCURRENT PARASITIC DISE SES IN A DRACUNCULI SIS ENDEMIC AREA OF OYO STATE, NIGERIA

5.1 INTRODUCTION

Guinea worm disease alone has been shown to be a terrible disease as it causes a major set back on the socio-economic development of the afftected population (Kale, 1977). Similarly, blood and gastro-intestinal parasitic diseases have also been shown to constitute a major threat to public health in certain parts of Nigeria (Okpala, 1975; Ejezie, 1981). These parasitic diseases especially those caused by hookworm and Plasmodium falciparum have been incriminated with marked eosinophilia and severe anaemia resulting in iron store depletion and raised ferritin in man (Usanga, 1989). It has been shown that certain broad spectrums anti-thelmintic drugs like thiobendazole, mebendazole and niridazole that are active against many worms also effectively aid the extraction of guinea worms (Kale - personal communication).

Although Gemade and Dipeolu (1983) reported a high prevalence rate of concurrent parasitic infections in an onchocerciasisendemic area of Benue State, Nigeria, there had not been a similar report on the status of concurrent parasitic diseases in a guineaworm endemic area in Nigeria. Since chronic parasitism in synergy with the crippling dracunculiasis in a farming population could jeopardise their health and increase their mental distress with adverse effect on their agricultural productivity, it is considered necessary to report the status of concurrent parasitic diseases in an area endemic of dracunculiasis with a view of planning a control programme.

5.2 MATERIALS AND METHODS

This study was conducted in Sanusi village, a rural agricultural community known to be endemic of dracunculiasis in Oluyole Local Government Area of Oyo State (Fig. 1.4). The village was selected randomly by balloting from guinea worm endemic areas in the state. For the purpose of sample collection, all the houses in the village were numbered and those houses bearing even numbers were selected. Faecal samples were collected from 487 individual subjects of age 1 to age 60 and above and of both sexes irrespective of whether they were infected with guineaworm or not. The faecal samples were collected into stool carton with tight fitting lid which were promptly treated.

Samples were subjected to formol-ether concentration method (Riddle and Hawgood, 1956) for the presence of helminth over and protozoa cysts. Cysts were stained with 1% solution of iodine to facilitate identification. Those found containing strongyle ova were cultured for larvae. and for the purpose of distinguishing between larvae of Ancylostome duodenale and Necator americanus, the criteria of Muller (1975) were employed.

Blood samples were collected from the fingers of 160 individuals resident in the houses already selected as stated above. Individual subjects of all ages and sexes were targeted, irrespective of their state of health. A major constrait here is the low level of co-operation received from the people, majority of who were not willing to be sampled for superstitious reasons. The thick and thin blood films were stained with Giemlsa and Leishman stains respectively to screen for malaria parasites. The blood for P. C. V. was taken in heparinised capillary tubes and was processed using the micro method described by Dacie and Lewis (1977).

5.3. RESULTS

Of the 487 faecal samples examined, 278 (57.1%) contained helminth ova and protozoa in cysts. The ova and cysts of parasites encountered as per cent infection in males and females are shown in Table 5.1. Ascariasis (43.7%) was highest followed by trichuriasis (31%) and hookworm infection (27.1%). Incidence of infections in males and females were similar in all the parasitisms ($P > 0.05$). The culture of all the 132 faecal samples containing hookworm ova yielded larvae of N. americanus. Table 5.2 shows that incidence of A. lumbricoides, hookworm and T. trichiura was lowest in the young kids. While Ascaris incidence, however, was at its peak among the 1 - 10 years cohort, peak incidence was recorded in the case of Trichuris, hookworm and Strongyloides in the 11 - 20 years cohort. In these parasitism, per cent infections in the age group of 21 - 30 years and above were similar ($P > 0.05$).

Table 5.3 shows the result of the blood film examination and P.C.V. of all the 160 individuals screened. 43.7% of the people were infected with Plasmodium falciparum with the highest prevalence rate of 61.9% in 11 - 20 years age groups. The packed cell volume was found to be generaly low in all the age groups. The blood picture showed marked eosinophilia in most sub jects.

5.4 DISCUSSION

It is evident that many parasitic diseases are rampant in the study area. The situation is aggravated by the fact that there were many cases of polyparasitisms where the same individual has been infected by A. lumbricoides, hookworm, T. trichiura, D. medinensis and P. falciparum.

The study revealed that Ascaris, hookworm and Trichuris were the commonest human gastrointestinal parasitic infections in the study area, a situation that is not different from what obtains in some other parts of the country from where guinea worm cases have not been reported (Ejezie, 1981; Adeyeba and Dipeolu, 1984).

Table 5.1 Prevalence of Gastrointestinal Parasitic Infections in Area of Endemic Dracunculiasis

Parasitic Ova/Cysts	Male *(201		Female *(286)		Total *(487)	
	No. Pos.	% Pos.	No. Pos.	% Pos.	No. Pos.	% Pos.
A. lumbricoides	92	45.8	121	42.3	213	43.7
Hookworm+	57	28.4	75	26.2	132	27.1
T. trichiura	61	30.5	90	31.5	151	31
S. stercoralis	4	2	8	2.8	12	2.5
E. histolytica	6	3	13	4.5	19	3.9
E. coli	4	2	9	3.1	13	2.7

* Number examined

\+ Larval culture of the 132 positive cases yielded larval of N. americanus.

Table 5.2: Distribution of Intestinal Parasitic Infection by Age Group

Parasitic Egg/Cysts	1 yr. *(50)	1-10 yrs *(91)	11-20 yrs *(75)	21-30 yrs *(56)	31-40 yrs *(80)	41-50 yrs *(35)	51-60 yrs *(60)	61 yrs. *(42)
	No. Pos. (%)	No. Pos. (%)	No. Pos. (%)	No. Pos. (%)	No. Pos. (%)	No. Pos. (%)	No. Pos. (%)	No. Pos. (%)
A.lumbricoides	5(10)	52(57.1)	36(49.3)	25(44.6)	36(45.0)	15(42.9)	26(43.3)	18(42.9)
Hookworm	4 (8)	52(57.1)	27(37.0)	20(35.7)	29(36.3)	12(34.3)	19(31.7)	10(23.8)
T.trichiura	7(14)	16(17.6)	29(39.3)	22(39.3)	31(38.8)	12(34.3)	21(35.0)	13(31.0)
S.stercoralis	2 (4)	3(3.3)	4(5.5)	2 (3.6)	1(1.3)	0 (0)	0 (0)	0 (0)
E.histolytica	0 (0)	0 (0)	4(5.5)	13(23.2)	1(1.3)	1.(2.9)	0 (0)	0 (0)
E.coli	0 (0)	0 (0)	1(1.4)	10(17.9)	1 (1.3)	2 (5.7)	0 (0)	0 (0)

* Number examined

( ) Per cent infection

Table 5.3. Malaria parasites distribution by age group and packed cell volume.

	1 year	1-10 years	11-20 years	21 yrs. & above	Total
	*(32)	*(45)	*(21)	*(62)	*(160)
Malaria parasite %	37.5	42.2	61.9	41.9	43
P.C.V. % (Mean)	38.0	31.5	29.0	34.5	-

* No. examined.

The per cent Ascaris infection (43.7%) fell within the 30 - 60 incidence rate estimated for Africa twenty-two years ago (W.H.O. 1967). Though, the infection rate is higher than 39.9% in Iwo (Adeyeba and Dipeolu, 1984) it is significantly lower than the 74.2% infection rate amongst Lagos school children (Ejezie,1981). Although this investigation also reveals that there was significant fall in prevalence rate as the age increases. The level of hygiene was still very low in the area of study.

The percent infections of Trichuris and hookworm in Sanusi village as well as the distribution by age groups are similar to early report by Adeyeba and Dipeolu (1984) who also reported that only Necator americanus were reported in a LGA of south western Nigeria. It is shown that the incidence of 2.5% of strongyloidiasis is not significantly different from 2.2% in Lagos (Marsden, 1960) but marginally higher than 1.4% in Iwo (Adeyeba and Dipeolu, 1984).

This study has shown an over all malaria parasite infection rate of 43.7%, with the infection almost evenly distributed amongst all age groups except those in the 11 - 20 years age cohort which have a very high prevalence rate of 61.9%. The over all figure is slightly higher than 37.7% reported by Ejezie (1981) but marginally lower 65.9% reported by Fasan in 1969. There is ample evidence available from this work to show that people in Sanusi and other rural agricultural communities with similar situation are generally anaemic probably largely due to heavy burden of parasites, especially hookworm and malaria parasites which often result in iron store depletion and raised ferritin (Usanga, 1989). The problem is further compounded by the crippling dracunculiasis which accounts for an average work loss of 3 - 6 months amongst 52.296 of the entire population in 1986 (Adeyeba, 1986) and consequently the disabled farmer will have to experience hunger as a result of poverty. It is obvious that the high infection rate with gastro intestinal and blood parasites in synergy with dracunculiasis has deleterious effects on the health, mental well being and socio-economic life in the community. Due to the infection with parasites, and occurence of anaemia in this area, that is seemingly teeming with parasites. It is evident that the people will not be able to perform their normal farming activities.

Since the use of drugs cannot be effectively monitored by any agency to check abuse, the only option left which is even more reliable is a well organised and articulated health education programme on personal hygiene and community health. Essentially, indiscriminate defaecation should be discouraged while encouragement is to be given to clean surroundings devoid of broken containers and tins which could serve as breeding sites for mosquitoes.

CHAPTER SIX

VECTOR ECOLOGY AND POPULATION MOBILITY: ESSENTIAL FACTORS IN THE DIFFUSION AND CONTROL OF DRACUNCULIASIS

6.1 INTRODUCTION

Dracunculiasis belongs to a group of water-related diseases that includes Malaria, onchocerciasis; and schistosomiasis. All of these diseases depend in some way on water as the natural habitat of an intermediate host. Unlike the others, however, dracunculiasis is transmitted only through drinking cyclopoid copepods contaminated water and does not have any alternate pathways.

Although there are some reports on the epidemiology of dracunculiasis in Nigeria (Nwosu et al. 1982; Edungbola, 1983; Romsay,1947) and fewer reports in Oyo State (Kale, 1977; Adeyeba, 1986), there is scanty information on its control. Sridhar et al; (1985) recommended the use of sand-filter while Brieger et al (1985) advocated health education along with other interventions. Certainly there is a dearth of information on the ecology of the vector cyclopoid copepods.

In order to enhance effective control plan and implementation, the need for ecological studies of the vector has become more urgent than ever before. The need for ecological studies on the vector stems from the fact that both the vector and biocontrol agents are components of the same ecosystem and have to interact. It has been found that biological control requires much detailed information on the biology and ecology of vectors as well as on their environment. Besides, the knowledge of the ecology of cyclopoid copepods and their breeding habits are also very essential tools in chemical control programme. Essentially, a high level of physical control is enhanced by manipulation of the environment. Therefore, since the efficiency of any vector control method is dependent on the particular biological and physical environmental conditions prevailing in each habitat it has become imperative in developing effective vector control programme to carry out studies on such variables like life tables and population dynamics, distribution dispersal and movement of vector in a habitat, and physical and biological characteristics of the habitat.

Human mobility has been identified as part of the disease diffusion process which occur when people who move around acquire a disease to which they may not have been exposed previously, or spread an infection to a new area (Protherto, 1977). In the case of dracunculiasis, Watts (1985) described population movements as very important with regard to the understanding of the dynamics of how the disease spreads locally from community to community in endemic areas as well as how it is transmitted over long distances.

Essentially, knowledge of human behaviour associated with contamination of water sources is relevant to control strategies since it takes only one visit by an infected person to the pond for the entire community to be exposed to infection.

Therefore this study is designed to highlight the effect of vector ecology, environmental manipulation and human behaviour in the process of disease diffusion and control.

6 2 MATERIAIS AND METHODS

The ecological community of the pond was carefully observed. In order to determine the biological and physical characteristics and peculiar chemical composition of the pond water where cyclopoid copepods breed and transmit Dracunculus Standard methods for water analysis described by the American Public Health Association (1976) was employed. The water obtained from pond was filtered through a net made up of monofilamentous polyester with a mesh size of 75μm which retained all the cyclops and other biological mates. The parameters determined in the water include the temperature (°C), pH, suspended matter (mg/1); colour (co-pt scale) oxidizable organic matter (mg/1); Biochemical oxygen Demand (BOD) (mg/1); Dissolved oxygen, DO (mg/1); Total alkalinity (mg/1 as CaC03); Total hardness (mg/1 as CaC03); Calcium (mg/1); Magnessium (mg/1); and Chloride (mg/1).

6.2.1 Estimation of Biochemical Oxygen Demand (BOD): A narrow mouth 250ml reagent bottle was filled to the brim with 50% filtered pond water diluted with normal supplements pure water, covered with a stopper and left on the bench at 20°C for 5 days. The water was filtered in order to remove all biologicals thereby reducing theorganic content which might interfere with the true value of BOD. 1ml each of manganese sulphate solution and alkaline potassium iodide solution were added respectively and mixed thoroughly before adding another 1ml of concentrated sulphuric acid. This was mixed until a clear yellow solution was formed. 100ml of the liquid was titrated against N /80 thiosulphate using starch indicator. The end point was colourless. The control value was also determined using distiled water instead of pond water. The value of BOD was calculated thus: the blank (control) reading minus the test reading multiplied by 100 and divided by % sample liquid for dilution. (Blank titre - test titre) x 2 = xmg/1. BOD.

6.2.2 <u>Dissolved Oxygen (DO) Estimation:</u> The procedure is similar to that of BOD estimation and the only difference is that the waterwas fresh and undiluted. The test titre was expressed as mg/1.

6 2 3 <u>Total Alkalinity Estimation:</u> A few drops of mixed indicator (see appendix 6.1) was added to 100ml of fresh pond water in a conical flask and titrated against 0. 02N sulphuric acid. The end point was orange colour. Calculation: titre reading X 10 = ymg/1 as CaC03.

6.2.4 <u>Total Hardness Estimation</u>: To 100 pond water in a conical flask was added 1ml ammonia buffer (Appendix 6.1) and a pinch of Eriochrome Black T indicator and titrated against EDTA solution to reach end point of blue coloration. Calculation: titre reading X 10 = zmg/1 as $CaC0_3$.

6.2.5 Chloride Estimation: To 100ml pond water in a conical flask was added 0.5ml potassium chromate solution and titrated agaisnt silver nitrate solution until the end point of flesh colour was reached. Calculation: titre reading X S = tmg/1.

6.2.6 Calcium Estimation: A pinch of murexide indicator (Appendix 6.1) was added to 100ml pond water with 1 ml 1 N NaOH in a conical flask and titrated with EDTA solution to reach an end point of pink coloration. Calculation: Titre X 4 = fmg/1.

6.2.7 Oxidizable Organic Matter Estimation using 4hr. Permanganate value (4hr. - P-V): 4hr-PV was used to determine the oxidizable organic matter. To 25ml pond water in conical flask 5ml each of 1 : 3 sulphuric acid solution and N/80 potassium permanganate solution was added consecutively, and this was left on the bench at a room temperature for 4 hours in dark. Thereafter, 2 drops of potassium iodide solution and starch solution (indicator) were added to give a blue coloration. Titration with thiosulphate solution was followed until the colourless end point was reached. The control blank was done with distiled water.

Calculation: [control blank titre - test titre] X 10 = tmg/1 oxidizable organic matter.

6.2.8 Effect of Organic Matter on Cyclops: Varying concentrations of sewage i.e. organic matter in pond water was prepared as follows: 0% (Omg/1); 10% (4.1mg/1); 2096 (8.2mg/1); 50% (20.5mg/1); 75% (24.6mg/1); 10096 (41mg/1). The value in parenthesis represents the 4hr-PV (the oxidizable organic matter) in the various sewage concentration, as determined. 200 active cyclops were introduced into each concentration in the conical flask. The flasks were left on the bench at room temperature. The survival rate (per unit time)of the cyclops in each concentration was followed by examining a sample at regular intervals under the compound microscope. The chlorine demand of each concentration was also estimated. The whole experiment was carried out in replicate.

6.2.9 Storage of Cyclops at Low TemDeratures: A series of 200ml pond water containing 200 active cyclops in conical flasks were kept in a refrigerator at a temperature of 4-6°C. At regular intervals, a flask was taken out and examined under the compound microscope for active cyclopoid copepods. The same flask was kept on a laboratory bench at 26°C till the contents attained room temperature was carried out in replicate.

6.2.10 Monthly Cyclops Distribution: Study on monthly and seasonal distribution of Cyclops in ponds was carried out by examining pond water twice a month right from the month of March, 1988 through +May, 1989 in Folarin village where guinea worm was hyperendemic. 10

litres of pond water was filtered through a net made of monofilamentous polyester with a mesh size of 75μm attached to a plain tube which retained all the Cyclops in 10ml volume of water. The 10ml pond water Cyclops concentrate was counted under a compound microscope. Drops of 10% formalin or alcohol was added to the plastic cuvette containing the filtered pond water in order to inactivate the Cyclops to ease the counting exercise.

6.2.11 Effect of Disturbance of pond water on Cyclops Concentration: A vigil was kept on the pond in Folarin village from 06.30hr to 19.16hr each day for two consecutive days in order to sample pond water after a villager had drawn water for use. 10 litres of pond water was thus collected and examined after every visit by the villagers. This was done in replicate. The time of the day and frequency of visit were noted against each sample. The count of the Cyclops was done under the compound microscope.

6.2.12 Socio-economic activities and population mobility: Investigations were carried out on the effect social and economic activities had in the communities on the population mobility and the spread (or otherwise) of guineaworm in the study areas. The individual subjects of both sexes and school age and above were interviewed on the effect their vocational and social activities had on their movements within and outside their villages. Notes were also made of.residents who were non-natives and their places of origin.

6.3 RESULTS

6.3.1 Characteristics of the Vector Habitat: Physically, the pond in Folarin village like in most other rural communities in the State under survey are situated under tree shades and roots of these trees were seen to be projecting into the ponds (Fig. 1.5). Leaves of the trees were usually dropping into the pond. Physical and chemical properties of the pond water are presented in Table 6.1. Tadpoles, fishes, dragon fly, crabs,, mosquito larvae, rotifers were common aquatic mates observed in most ponds. It was a common site to see falling woods on the surface of water.

6.3.2 Effect of Low Temperature on the Survival of Cyclops: Cyclops became inactive at 4 - 6°C but become revived and active again when the medium attain higher temperature of 15 - 20°C. (Table 6.2). The Cyclops never regained activity when kept at 4 - 6°C beyond 48 hours and at -4°C (freezing point) for any length of time.

6.3.3 Effect of Organic Matter on Survival of Cyclops: Table 6.3 shows that Cyclops can not survive for more than 15 minutes in any medium, including water, whose organic matter concentration is above 41 mg/litre. The chlorine demand of the various concentration is Omg/l.

Table 6.1. Characteristic and properties of pond water in which Cyclops breed and transmit dracunculiasis.

Characteristics	Value
PH value	7.6
Temperature °C	25
Suspended matter, mg/l	32.0
Color, co-pt scale	3.2
Oxidizable organic matter (4-hr permanganate value, mg/l	12.5
Biochemical Oxygen demand, mg/l	5.7
Total alkalinity, mg/l as $CaCO_3$	94.0
Total hardness, mg/l as $CaCo_3$	199.3
Calcium, mg/l	69.2
Magnesium, mg/l	42.0
Chloride, mg/l	74.0

Table 6.2 Effect of low temperature on the survival of Cyclopoid Copepods.

Time kept at 4-6^oC (hr)	Percentage Cyclops Active immediately after removal from cold	After reaching the room temp. (26^{o}C in % cyclop active 5 mins.
At start	100	100
0.5	100	100
1	60	100
2	50	100
3	25	100
4	0	100
5	0	100
6	0	100
12	0	100
24	0	100
48	0	80
72	0	0

The cyclops became inactive in the refrigerator at 4-6^{o}C but became revived and active at higher temperatures of 15-20^{o}C. They did not become reactivated after being kept in the deep freezer.

Table 6.3. EFFECT OF ORGANIC MATTER (SEWAGE) ON SURVIVAL OF CYCLOPS.

Oxidizable Organic Matter Time (Mins)	0 0% (Sewage)	4.1 mg/1 10% (Sewage)	8.2 20%	20.5 (50%)	24.6 (75%)	41 mg/1 (100%)
0"	*100%	*100%	*100%	*100%	*100	*100
15	"	"	"	"	*80	*50
30	"	"	"	"	*50	0
60	"	"	"	"	"	"
1	"	"	"	"	"	"
1						
1						
6 days	"	"	"	"	"	"

6.3.4 Seasonal and monthly Distribution of Cyclops in Folarin Ponds: The highest concentration of Cyclops was recorded in the dry months of December, 1988 to February, 1989. There was a slight drop in the months of March and April, 1989 probably because of early rains. There was a significant drop in May and it is estimated that further drop will be recorded to a great extent during the rest of the year. Whereas a sharp drop was recorded in March the previous year by July and September, 1988 the volume of the pond had increased significantly with resultant low density of Cyclops (Fig. 6.1). The pond did not turn into a stream at any point in the year. The concentration of Cyclops increased with every passing month from October.

6.3.5 Effect of Disturbances on Cyclops Density: Fig . 6.2 shows that there is little patronage of the pond before 6.30hr (i . e 6.30 am .) each day, whereas there is increased activity with respect to water fetching during the evening time starting from 17.00hr. When many came to draw water at the same time. The first caller at the pond collected more Cyclops with her bucket or container than the one who came in to draw after the pond has been disturbed by a number of immediate drawers.

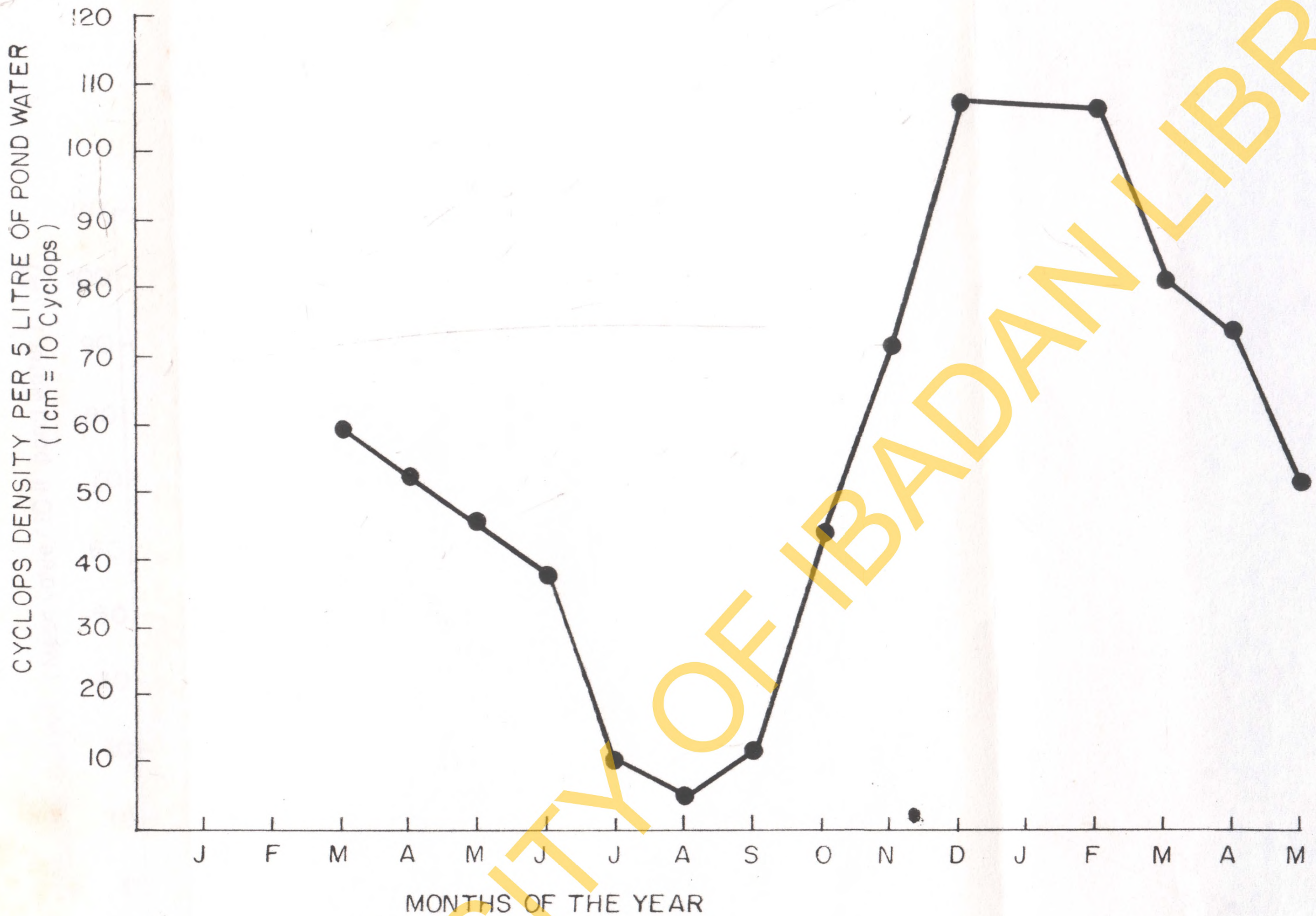


FIG. 6.1: MONTHLY DISTRIBUTION OF CYLOPOID COPEPODS IN A POND IN FOLARIN VILLAGE. (March 1988 – May 1989)

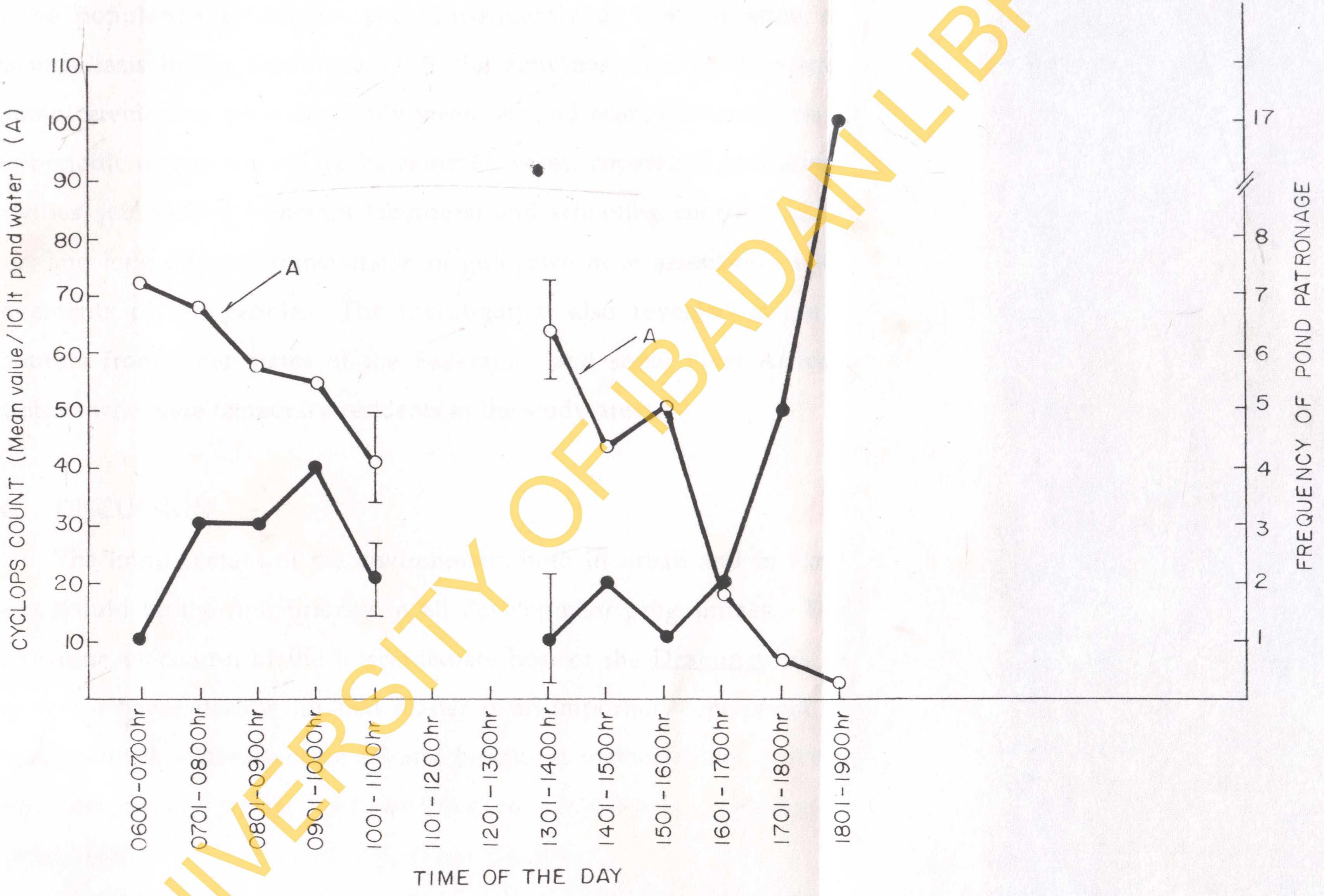


FIG. 6.2 : EFFECT OF FREQUENCY OF POND PATRONAGE/DISTURBANCE ON CYCLOPS DENSITY.

6.3.6 Socio-economic Activities and population mobility: The results of investigation revealed that socio-economic activities had effect on the population circulation and consequently on the diffusion of dracunculiasis in the study areas. Social activities such as marriage, naming ceremonies, festivals, family meetings; and economic endeavours like periodic marketing, village hawking of wares, coperative movement activities, job seeking (itinerant labourers) and schooling contributed to short and long distance transmission of guineaworm in association with movements of the people. The investigation also revealed migrant labourers from other states of the Federation and some West African countries who were temporary residents in the study areas.

6.4 DISCUSSION

The improvement of the environment, both in urban and in rural areas should be the first priority in all development programmes. The elimination or control of the intermdediate host of the Dracunculus or any vector borne disease for that matter is an important component of disease control. Whereas chemical and biological methods may provide only temporary control of vectors, environmental (physical) improvements may lead to more permanent control.

Knowledge of the ecology of the Cyclops and their breeding habits will in many instances make a high level of control possible by manipulation of the environment. Since such measures are likely to produce definitive and permanent results they should be the basic approach to effective control of the vector.

It has been observed that most ponds in the study area (presumably, the same situation in other rural communities in the State) are situated under tree shades, and usually, the roots of these trees project into the pond. This situation provides conducive environmental conditions for the cyclops to breed and transmit the infection in the area. The characteristics and properties of the pond whose factors favoured cyclops breeding and transmission of guinea worm as elucidated in Table 6.1 has been subjected to experimental study in the laboratory. This present study has shown that cyclops can not survive beyond 15 minutes in a pond water or any water at all in which the concentration of oxidizable organic matter is high beyond 41mg per litre. It is concluded therefore that any water containing more than 41mg/litre of oxidisable organic matter will not support the breeding of Cyclops and therefore transmission of the disease.

It has been observed that some ponds do not contain or harbour Cyclops in certain parts of the State. However, it was discovered that the pond water in these communities have high concentration of organic matter which is inimical to the existence of Cyclops. Observation also revealed that this type of situation occurs in areas where certain local fruit called "Afon" in the local language is preponderant. These fruits often fall into the pond and decompose or disintegrate in there.

The current study revealed that when Cyclops are kept in the refrigerator at 4-6°C they become inactive. However, they are reactivated when the temperature reaches 15°C and above. These Cyclops are killed when kept or stored in the freezer at -4°C. It is not yet certain whether larvae inside the inactive Cyclops could stimulate an infection in a subject if consumed. This could be investigated. However, it is known that development of larvae inside the Cyclops ceases at any temperature below 19°C (Muller, 1979). The normal temperature of pond water (as it occurs in nature) where Cyclops breeds and transmits dracunculiasis is between 25-27°C. It therefore follows that any deviation from this condition might be deleterious to Cyclops activities in respect to disease transmission. The attainment of such low temperature may be difficult in nature especially in this part of the world, but privileged individuals in the society could store their drinking water at 4-6°C for at least 48 hours for personal protection.

It has been shown that density of Cyclops goes up in the dry months of October through February and early March of the following year with the peak at around December to February (Fig . 6.1). This is the time the community is at greatest risk of infection more so that there is no alternate source of drinking water beside the pond. The water level in most ponds in the area had gone down considerably at this particular time. In-fact most ponds had dried up at the peak of dry season resulting in acute water shortage compelling the villagers in the contiguous communities around Folarin to travel on foot many kilometres in search of water (Fig. 6.3).

This is a very effective means of disease diffusion. More often than not the water is not fit for human consumption as it is very turbid and heavily contaminated with infected Cyclops. This has to be so since infected Cyclops are said to undergo a vertical diurnal migration (Onabamiro, 1952) and the infected Cyclops are confined to the bottom few inches of a pond (Onabamiro, 1954). Therefore the risk of getting infection increases with every drop in water level.

In the rural environment, Cyclops density may often be increased by such agricultural and industrial activities as the construction of dams, large scale irrigation projects and deforestation (WHO, 1975). Examples of these human activities are apparent in Nigeria espcecially in Kwara State (Edungbola, 1983; Edungbola and Watts, 1984; 1985).

Fig. 6.3   The Villagers returning from the pond after collecting water

This study has shown that very few villagers draw water from the pond in the early hours of the day (06.30Hr.) and those who come early to draw are likely to catch more Cyclops than those following immediately. The heavier the traffic to the pond (which means that pond water has been disturbed) the less number of Cyclops that will be caught along with the water drawn. The level of pond patronage is usually very low in the early morning and tends toward nil in mid-day. Conversely, there is usually unprecedented heavy traffic and patronage to the pond in the late afternoon towards evening time at around 17.00 hr. This is the time the villagers especially women fectch water for domestic use after the day's farming and trading activities. The water is usually stored overnight and might last till the evening of the following day. Since the volume of contaminated water consumed is directly related to acquisition of infection (Adeyeba, 1986) a consumer of water drawn when the traffic was heavier is less likely to acquire infection. It could be inferred therefore, that disturbance of pond water occasioned by heavy traffic and patronage of pond is inversely related to level of contamination i.e, Cyclops contaminated water drawn for drinking.

The introduction of guinea worm into new communities in rural parts of Oyo State is frequently associated with short distance movement by school children, local women, schooling, trading and visiting kin for family, social and religious festivals. Villagers in some highly endemic areas usually claim to know the origins of the infection in their communities.

This study has shown that very few villagers draw water from the pond in the early hours of the day (06.30Hr.) and those who come early to draw are likely to catch more Cyclops than those following immediately. The heavier the traffic to the pond (which means that pond water has been disturbed) the less number of Cyclops that will be caught along with the water drawn. The level of pond patronage is usually very low in the early morning and tends toward nil in mid-day. Conversely, there is usually unprecedented heavy traffic and patronage to the pond in the late afternoon towards evening time at around 17.00 hr. This is the time the villagers especially women fectch water for domestic use after the day's farming and trading activities. The water is usually stored overnight and might last till the evening of the following day. Since the volume of contaminated water consumed is directly related to acquisition of infection (Adeyeba, 1986) a consumer of water drawn when the traffic was heavier is less likely to acquire infection. It could be inferred therefore, that disturbance of pond water occasioned by heavy traffic and patronage of pond is inversely related to level of contamination i.e, Cyclops contaminated water drawn for drinking.

The introduction of guinea worm into new communities in rural parts of Oyo State is frequently associated with short distance movement by school children, local women, schooling, trading and visiting kin for family, social and religious festivals. Villagers in some highly endemic areas usually claim to know the origins of the infection in their communities.

In Papanla village, one of the study areas, the villagers claimed that infection was first introduced to the area by an unknown person who visited from the surrounding endemic settlements in the year 1985. Similarly, the settlers in Folarin village blamed their calamity on the villagers from neighbouring villages like Oloyin, Seriki, Okegbemi, etc. who came especially during the dry season to fetch water from their own ponds. There was information that women from the neighbouring villages who engage in palm oil processing often draw water from the pond during the time especially those who have their local oil mills close to the ponds.

Most schools in the endemic areas draw their students from the surrounding villages usually as close as 5 to 6 km. For example the primary school in Papanla village draw her students from six other neighbouring villages while students from Folarin village in Akinyele L.G.A. have to travel 2 to 3 km each day to schools in either Ejitolu or Seriki Okegbemi both of which are also known to be endemic for dracunculiasis. This scenario is very efficient in the diffusion of the disease.

It was discovered that there is a high level of mobility both by local residents and by indigenes visiting other areas during festivals and social ceremonies like funeral outings, naming and wedding. These women are usually engaged in the fetching of drinking water during which process they wade into the pond.

The network of periodic markets in the study areas provided for women migration a useful instrument of guinea worm spread. Some married women in the study area moved in and out (just like students on vacation) of their settlement.s to join their kitt and kins though some moved relatively short distances . Watts (1984) made similar observation in llorin.

Long - distance transmission of dracunculiasis in association with the movements of migrant labourers and their families into the area is a possibility. Migrant labourers move into the areas from the Northern States like Kano, Sokoto and Benue; some Eastern States and even outside the country. For example an investigation has shown that two palm wine tappers who claimed to be citizens of Ghana were incapacitated in the month of April, 1988 in Seriki Village. Several reports have shown that dracunculiasis is found in those areas earlier on mentioned (Scott, 1960; Belcher, et al., 1975, Nwosu et al., 1982; Daniel and Osisanya, 1986).

It is apparent that every effort must be geared towards reducing the exposure of man to contaminated pond water. This could be achieved by constructing a barrier round the pond leaving only one point of entry into the pond through a platform hanging over the pond on one side. To achieve any reasonable success there is need to direct a well articulated health education measure to all concerned most especially women, and also school children, who are the main contaminators of pond water.

Fig. 6.4 A woman collecting water from the pond with legs inside

CHAPTER SEVEN

INFLUENCE OF SOME WATER TREATMENT CHEMICALS ON SURVIVAL OF CYLOPS IN POND WATER

7.1 INTRODUCTION

Species of Cyclops which act as intermediate vectors in the transmission of the infection of Dracunculus medinensis from man to man have been reported by Onabamiro (1954) and Sridhar and Kale (1985). While potable water supply is the surest way and means of avoiding the consumption of cyclops contaminated water, many countries in Africa especially Nigeria are not yet able to provide it despite the increase in prevalence and magnitude of guinea worm disease due to limited social and economic resources. An alternative approach is to break the transmission cycle by eliminating Cyclops from the waters either at the community level or at an individual or household level. The use of a variety of chemicals, plant extracts (Singh and Raghavan, 1957; McCullough, 1983), filtration (Sridhar- et al, 1985) and a combination of physical and chemical treatment of waters, and health education to the community (Brieger et al, 1985; Olajide et al, 1987) have yielded some encouraging results over the years.

However, there has been a dearth of information on the influence of some of the chemicals commonly present in waters on the survival of cyclops under laboratory conditions. Even though such studies may have limited application in poorer communities scattered far apart, an understanding of Cyclops will be useful in the control of the disease under certain situations especially at the household level.

This work reports some of the laboratory studies carried out on the influence of a variety of common chemicals on the survival of cyclopoid copepods.

7.2 MATERIALS AND METHODS

Large quantities of pond water were obtained from Folarin village near Ibadan in Akinyele Local Government Area of Oyo State where guinea worm is endemic. The analysis of the pond water was carried out according to the standard methods described by American Public Health Association (1976). The water samples from the pond were filtered through a net made of monofilamentous polyester with a mesh size of 75μm which retained all the cyclopoid copepods. The cyclopoid copepods were recovered and preserved separately for survival studies in the laboratory. The filtered pond water was used in all the experiments by adding a variety of chemicals: aluminum sulphate, potassium permanganate, calcium hypochlorite, calcium hydroxide, calcium carbonate, ferrous sulphate, ammonium chloride, and copper sulphate. All the chemicals used except aluminum sulphate (alum) and calcium hypochlorite were of analytical grade.

In some experiments, pH was adjusted by using standard sulphuric acid or sodium hydroxide.

The Cyclops were counted under the compound microscope after concentrating them in a polyester filter net and keeping in a plastic cuvette. The Cyclops used were those commonly found in this part of the country and consisted of Thermocyclops neglectus decipiens, Thermocyclops crassus, Afrocyclops gibsoni, Microcyclops varican, Mesocyclops major and Tropocyclops sp. No effort was made in singling out any species as all these species were involved in the transmission of the disease (Sridhar and Kale, 1985) .

All the experiments were carried out in 250ml beakers or conical flasks at 23-26°C in replicates.

7.2.1 Effect of pH on Cyclopoid Copepods (Cyclops): The pond water of 200ml in each beaker was adjusted to varying pH values: 4, 5, 6, 7, 8, 9, 10 and 11. To each of them were added 200 active live Cyclops and kept on the laboratory bench at 23-26°C in order to observe the survival rate at various intervals.

7.2.2 Effect of aluminum sulphate (Alum): A 5 per cent solution of aluminum sulphate was added drop by drop to the pond water while stirring to reach an alum dosage of 160ml when the floculation was formed. In this case, 0.65ml of 5% aluminum sulphate solution was added to 200ml pond water. The contents were examined for active Cyclops.

7.2.3 Effect of potassium permanganate on cyclops: Potassium permanganate was added to pond water at concentrations (mg/1): O, 10, 20, 30 and 50 respectively. It was prepared by adding respectively to a set of flask countaining 100ml pond water, 0.1ml, 0.2ml, 0.5ml, 1.Oml, 2.5ml of N/80 $kmN0_4$.

In another experiment the various concentrations of organic matter in the form of domestic sewage were added to the pond water to reach concentrations 7, 11, 15, 28, 32 and 49mg/1. To each of them were added potassium permanganate at 50mg/1 and introduces 200 active live Cyclops. The contents were examined for active Cyclops for varying periods.

7.2.4 Effect of calcium hypochlorite on Cyclops: Varying amount of calcium hypochlorite was added to 200ml pond water to reach a residual chlorine level of 0.5, 1.0, 2.0, 3.0, 4.0 and 5.0 mg/1. This was achieved by dissolving 200mg $CaOCI_2$ in 100ml distilled water to form stock solution (200mg/100ml or 1000µg or 2mg/1 chlorine i.e, 4mg/1 $CaOCl_2$). 0ml, 0.1ml, 0.2ml, 0.4, 0.6, 0.8, 2.5ml of the stock was added in series to give the concentrations. To each of them were added 200 active Cyclops and their survival was followed.

7.2.5 Effect of some water treatment chemicals on Cyclops: Some chemicals occasionally used in the water treatment operations or commonly present in the waters were examined for their effect on the

Cyclops. Varying concentrations of the chemicals: calcium hydroxide (lime), calcium carbonate, ferrous sulphate, ammonium chloride and copper sulphate were added to pond water and the survival of cyclops was followed.

7.3 RESULTS

7.3.1 Effect of pH on the survival of Cyclops: It was observed that within 30 minutes, all the Cyclops were dead at pH values 4, 10, 11 respectively. But at pH 5 they died in 4 hours. At the other pH values 6, 7, 8 and 9, the cyclops remained active for seven days. There was a slight but insignificant decrease in pH values when rechecked after 24 hours.

7.3.2 Effect of aluminum sulphate on Cyclops survival: It was observed that for up to the end of 30 minutes, the cyclops were still active and moving. Between 30 minutes and one hour, they were seen in the flocs settling from the centre of the beaker to the bottom. At the end of two hours they became less mobile and restricted to the alum sludge at the bottom of the beaker. At the end of three hours, all the Cyclops were found dead and the pH value reached 5.4.

7.3.3 Effect of potassium permanganate on Cyclops survival: It was observed that a concentration of 50mg/1 inactivated the Cyclops within 30 minutes and lowering the concentration to 10mg/1 increased the survival period up to 100 minutes (Table 7.1) .

Table 7.1 Effect of potassium permanganate on the survival of Cyclops.

Concentration mg/1	Percent cyclops active at the end of:				
	30 min	40 min	50 min	60 min	100 min
0	100	100	100	100	100
10	100	100	70	50	0
20	70	50	0	0	0
30	50	0	0	0	0
50	0	0	0	0	0

At start cyclops were 100 per cent active.

Table 7.2. Effect of organic matter on the survival of cyclops

Concentration of Organic matter mg/l	Percent cyclops active at the end of:			
	10 min	20 min	30 min	40 min
(Pond water content) 7	80	20	0	0
11	100	100	50	0
15	80	50	0	0
28	80	50	0	0
32	50	0	0	0
49	50	0	0	0

The results as shown in Table 7.2 indicate that organic matter above 30mg/1 has a toxic effect on the survival of Cyclops and it affords some protective effect against potassium permanganate at low concentration.

7.3.4 Effect of calcium hypochlorite on Cyclops survival: The results as shown in Fig. 7.1 indicate that lmg/1 residual chlorine inactivated the Cyclops in thirty minutes contact time.

7.3.5 Effect of some water treatment chemicals on Cyclops: The results as shown in Table 7.3 indicate that the various chemicals inactivated Cyclops at different concentrations which were rather high as compared to the guidelines set by WHO for drinking water (World Health Organisation, 1971). Ammonium chloride at 200mg/1 concentration inactivated Cyclops in 30 minutes while 200mg/1 CaOH killed the Cyclops in 3.5hr. The Cyclops were inactivated in 5 minutes in 500mg/1 CaOH. 10mg/1 and 20mg/1 $CuS0_4$ respectively inactivated the Cyclops in 3hr and 2hr whereas the Cyclops became inactivated after 18hr in 500mg/1. Ferrous sulphate and sodium chloride at 200mg/1 did not affect the Cyclops even at the end of 14 days.

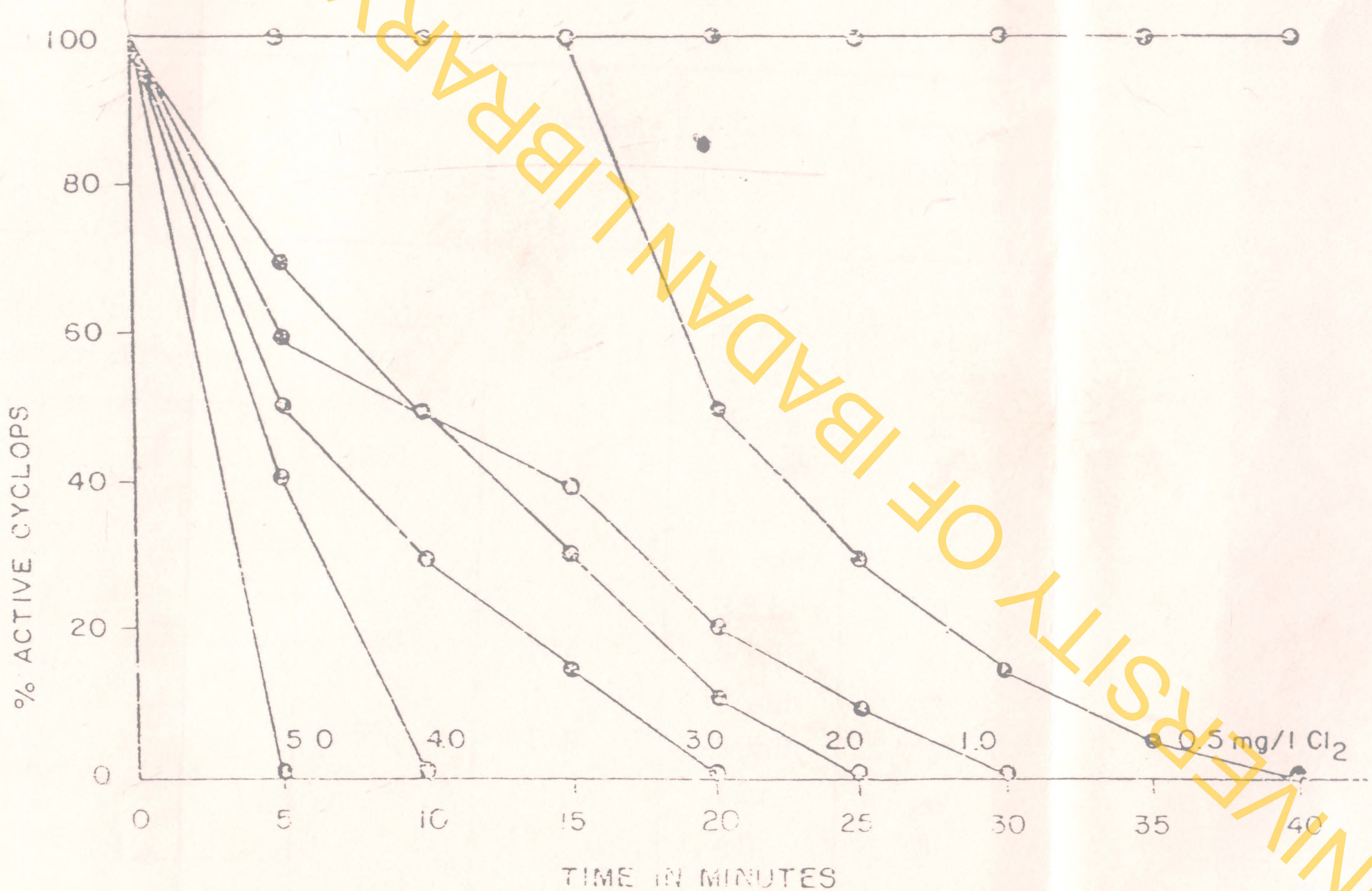


FIG 7.1 EFFECT OF CHLORINATION ON THE SURVIVAL OF CYCLOPS.

Table 7.3 Effect of some Water Treatment Chemicals on the Survival of Cyclops

Chemicals	Concentration mg/l	PH change (if any)	Time	Percent cyclops survival
Ammonium chloride	200	-	30 min	0
Calcium carbonate	1,000	8.7	4 hr.	100
Calcium hydroxide	150	9.7	15 min	80
	200	9.9	10 min	80
			15 min	50
			30 min	20
			3.5 hr	0
	300	10.6	5 min	50
			10 min	0
	500	10.8	5 min	0
Copper sulphate	10		1 hr.	60
			2 hr.	30
			3 hr.	0
	20		1 hr.	40
			2 hr.	0
Ferrous sulphate	500	7.3	40 hr	50
			18 hr	0

Sodium Chloride at 2000 mg/l did not inactivate the cyclopoid copepoid even at the end of 14 days.

7.4 DISCUSSION

A careful review and analysis of the impediment to progress in vector control as practised currently or even in the past are pre-requisites for the consideration and testing of new developments in the future. During the early period of work on the control of dracunculiasis some experiments were carried out on the effect of chemicals on the intermediate host, Cyclops and the worm Dracunculus medinensis. Turkhud (1919) reviewed the earlier work on the effect of water treatment on the Cyclops. It was recorded that steaming the water to 43°C or addition of 0.15 per cent potassium hydroxide to water killed all the Cyclops. He further conducted experiments in India and reported that addition of potassium permanganate to a well till the water turned pink (0.395g/1) resulted in the complete destruction of Cyclops in one hour. However, longer periods were required when the chemical was added in lesser concentrations. He also recorded that the Cyclops reappeared after some time. This study has revealed that the concentration of 50mg/1 potassium permanganate had resulted in the complete destruction of cyclops in less than 30 minutes. The low level of acceptability of colour in drinking water would however be a disadvantage. However, the colour disappears with time.

Various other chemicals such as lime, perchlorite, copper sulphate, rock salt, bleaching powder, asafoetida (a common spice) and tender bamboo leaf extracts were added to water which showed varying cyclopscidal effects (Moorthy, 1932; Singh and Raghavan, 1957). As was also observed in this study, most of those chemicals killed the adult cyclops. The water source would be kept safe but for a short periods. This has to be so since the chemicals are suspected to have no lethal effect on the eggs of Cyclops which developed into adult after a few weeks. Essentially, periodic application of the chemicals is necessary in order to achieve the desirable result.

Another study by Khanna and Saraswet (1985) in India indicated that Pot chlorination of step wells in Rajasthan to a residual chlorine level of 0.18mg/1 at 30°C and 0.15mg/1 at 20°C resulted in complete destruction of Cyclops in 12 hours. In the present study, higher concentrations of chlorine were required as the pond water showed higher organic matter content and the number of cyclopoid copepods used in the experiments were high. The required time was indeed less than one hour and the chlorine demand depends on the quality of water. In all the studies so far made none of the chemicals were found to have any application for single dose treatment under field conditions.

It has been shown in this present study that any treatment of water which might result in a condition whereby the pH values of the water is reduced or adjusted to 4, 10 and 11 would be valuable in the control of the vector, since this has resulted in the destruction of cyclops within a short period. However, the water may have sharp taste which might render it less acceptable for drinking.

Abate (Temephous) an organophosphorous compound has however been used in different areas by treating the ponds at frequent intervals (Law et al. 1968; Olajide et al. 1987). Even though it is reported to have no adverse effects on human beings and other acquatic flora and fauna, the long range effects are still not ruled out when ingested in low concentrations.

The appearance of second order problems of steadily increasing severity in vector control, such as vector resistance, environmental contamination, and increasing costs has seriously jeopardized successful vector control operation in large areas, which are inhabited by many people. These setbacks make it imperative to re-examine strategies for the use of chemicals in vector control in general and cyclops control in particular. Refinements of techniques are required in order to ensure more efficient and economic utilization of these chemicals.

In view of the foregoing discussion, use of the milder chemicals normally used in water treatment may be of value in small water supplies or in the individual houses. They may be applied to water collected for use immediately or within a short period. Among the various chemicals tested, calcium hypochlorite, potassium permanganate, lime and copper sulphate seem to have cyclopscidal effect which may be used in practice in the storage pots for individual households. Presence of organic matter in water beyond 30mg/1 also seems to promote unfavourable conditions for the survival of cyclops even though such higher levels are not commonly found in nature. However, the waters may receive periodic organic shocks due to storm run-off. Normal tropical water temperatures (25°C) are favourable for the longer survival of cyclops but lower temperatures

(4-6°C) seem to promote faster death. This study seems to throw some light on the behaviour of cyclops in waters of varying chemical quality which may pave way for possible control of dracunculiasis at the individual's level.

CHAPTER EIGHT

EFFECT OF FISHES AS BIOLOGICAL CONTROL AGENTS OF VECTOR OF DRACUNCULIASIS UNDER LABORATORY CONDITIONS

8.1 INTRODUCTION

The use of certain common chemicals in water treatment by individual households had been recommended in chapter seven of this dissertation. Although the use of certain small fishes (Gambusia spp, Barbus spp and Rasbora doniconius) as biological control agents had been recommended in India by Moorthy and Sweet (1936) and Gideon (1942), there is no record of the use of indigenous species of fish as biocontrol agents of dracunculias is in Nigeria. Therefore there is a need to search for new biological control agents to be used under the local condition by the afflicted communities to control and possibly eradicate the disease.

This study was stimulated by an observation made at a village in the State which indicate that the common indigenous fishes may act as biological control agents by predating on the intermediate host, cyclopoid copepods. This observation was further substantiated with a series of laboratory experiments preceeded by pilot studies on the efficiency of predating biological agents.

8.2 MATERIALS AND METHOD

Samples of water were periodically collected and filtered through a plankton net made up of monofilamentous nylon gauze with mesh size - 75um attached to a plastic tube. Adult and nauplii stages of different species of Cyclops retained on the filter and collected in the tube were transferred to a glass container, their numbers were counted under the low power of a compound microscope and use in the laboratory experiments. The dominant species in this part of Nigeria were shown by Sridhar and Kale (1985) to be: Thermocyclops neglectus decipiens; T crassus; Afrocyclops gibroni; Mesocyclops major; Tropocyclops prasinus; Microcyclops varicans; Thermocyclops species; Cryptocyclops linjanticus and Tropocyclops onabamiroi.

8.2.1 STUDY WITH FISHES

8.2.1.1 Pilot Study: A pilot study on the role of fish as biological control agents of cyclopoid copepods was first carried out. Four active fishes were caught from a pond in the course of water sampling. Into a jar containing 500 ml pond water and 50 live cyclops were introduced the 4 live and active small fishes identified as Tilapia species (courtesy of 5tate Fishery Department). A jar containing only 50 live cyclops and 500ml pond water was also set up as control. The cyclops count was followed at various time intervals.

The possibility of the use of the species of fish obtained in the area as a biocontrol agent was confirmed.

8.2.1.2 Experimental Study: In order to determine the predating capability of indigenous species in Western Nigeria, the following species of fish obtained from the Oyo State Fishery Department at Agodi, Ibadan were used for the experiments. *Hemicromis fasciatus; Barbus occidentalis; Tilapia nilotica* and *T. galilea*. The physical characteristics of the pond water used in these experiments was determined before the start of the experiments in order to ascertain the prevailing ecological characteristics (Table 6.1).

Samples of pond water were collected and filtered as described earlier on. Into each 15 litre plastic aquarium containing 10 litres of Cyclops free pond water and 16,000 active *Cyclops* were introduced 10 active young fish of the same species (that is *H. fasciatus B. occidentalis* and *Tilapia species*). The experiment was done in replicate with a control tank which contained only pond water and *Cyclops* but no fish. The experiment was maintained at room temprature (26°C - 28°C). The *Cyclops* counts were recorded over a period of hours and days. The cyclops density per unit time was determined in the system and expressed in percentage.

In another experiment, alternate food was provided for the fish in order to assess the predating effectiveness of the fish on the *Cyclops* in the presence of alternate food. Into each 15 litre capacity plastic aquarium containing 10 litres of Cyclops free pond water, 16,000 active *Cyclops* and 10 active fish of the same species were introduced 4 gramme of fish meal (brewery waste used in feeding fish in Oyo State fish ponds at Agodi) as an alternate food supply to Cyclops. The experiment was carried out in replicate with a control aquarium which contained only pond water, cyclops and fish meal but no fish. The experiment was similarly maintained at room temperature 26° - 28°C and observed over a period of hours and days. The cyclops density per unit time was determined and expressed in percentage.

8.3 RESULTS

8.3.2 Effect of predating fishes on Cyclops: Results from the pilot experiment shows that the Cyclops population was reduced by 75 per cent in 7 days and by 90 per cent in 14 days. It was observed that 2 of the 4 fishes died on day 7 (Fig. 8.1). There were no drop in Cyclops counts in the control beaker.

The result of the experiment involving Hemicromis fasciatus is shown in Fig. 8.2. Data indicate that these relatively big fishes of about 4cm long reduced the Cyclops population by 50 per cent in 60 hours and by 75 per cent, 90 per cent in 72 hours and 84 hours respectively. The Cyclops counts in the control tank did not drop throughout the duration of the experiment.

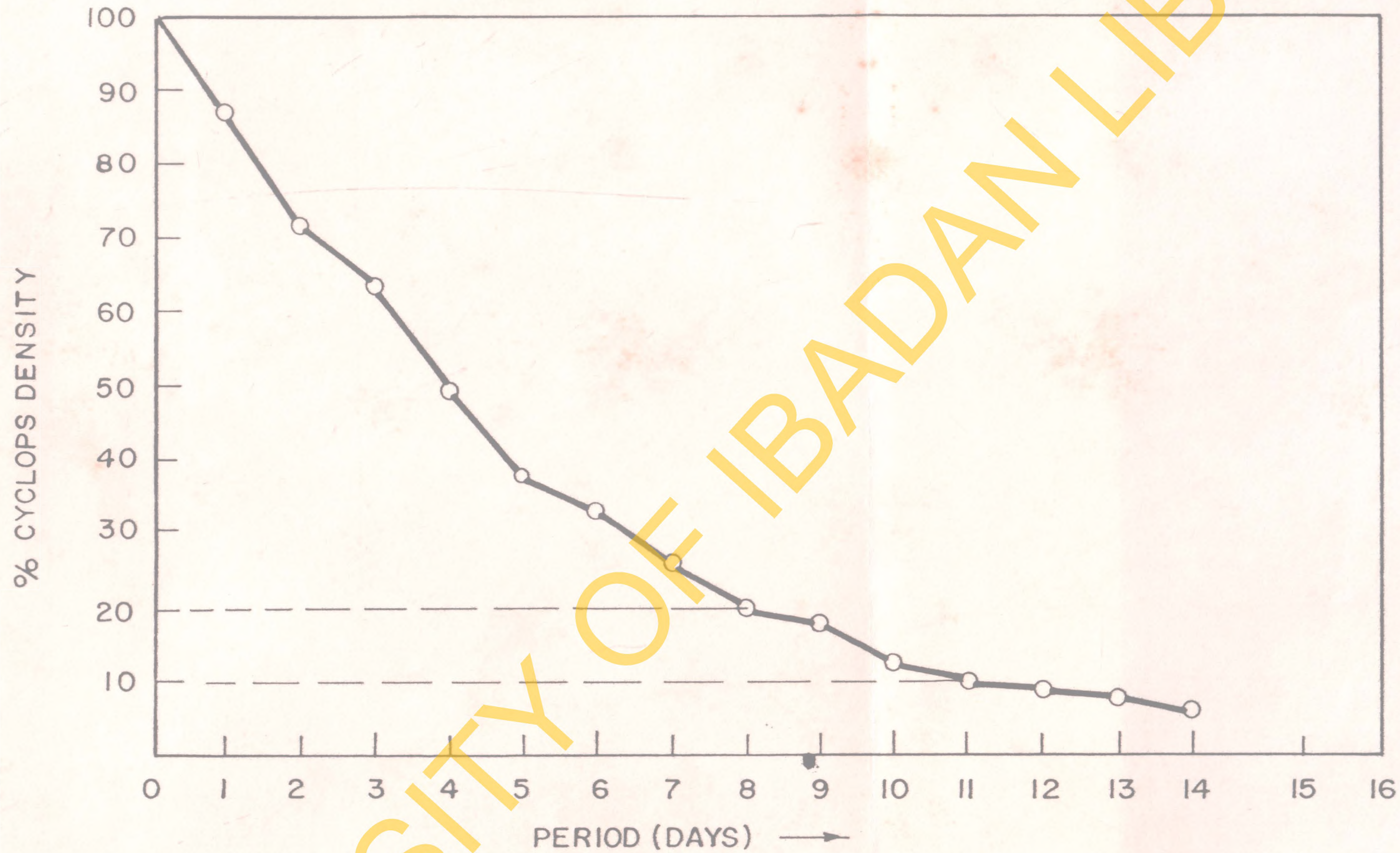


FIG. 8.1 EFFECT OF PREDATING FISH (*TILAPIA SP*) ON CYCLOPS DENSITY IN POND WATER UNDER LABORATORY CONDITION.

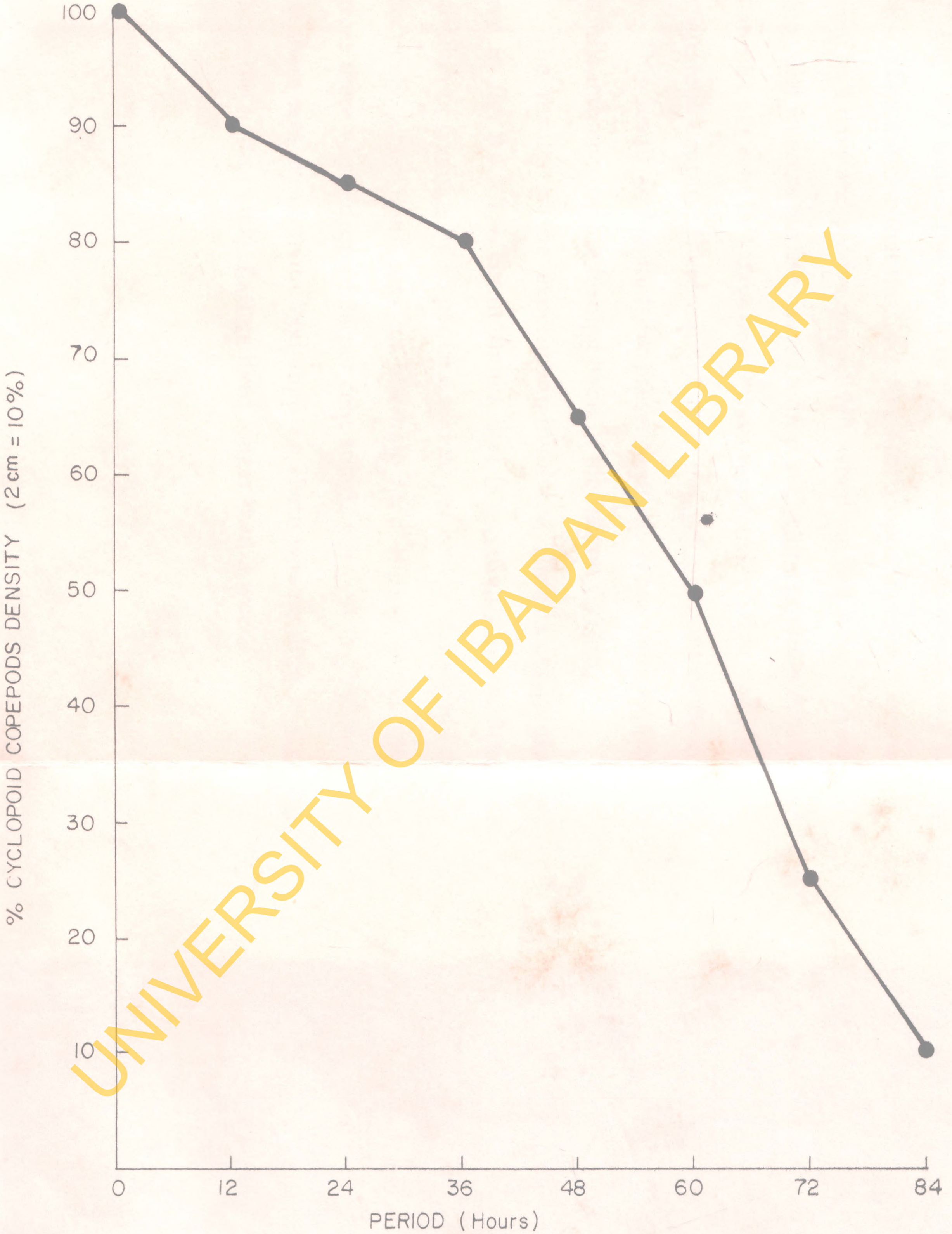


FIG. 8.2: EFFECT OF PREDATING FISH (Hemicromis Fasciatus) ON CYLOPOID DENSITY IN POND WATER UNDER LABORATORY CONDITION. (2cm = 12 hrs)

Fig . 8.3 shows the result of the experiment involving the Tilapia species. Data indicate that the Cyclops count droped by 45 per cent and 90 per cent in 4 days and 9 days respectively when the fish were kept on pure Cyclops diet whereas the fish caused a drop in Cyclops population by 33 per cent and 84 per cent in 4 days and 9 days respectively when there was an alternate food supply. There were no drop in Cyclops count in the control tank. This result shows that the presence of alternate food supply had very little influence on the feeding habit of the fish on Cyclops.

The results of the experiment involving Barbus occidentalis is shown in fig. 8.4. The result shows that B. occidentalis reduced the population of Cyclops by 48 per cent and 90 per cent in 3 days and 6 days respectively when there was no alternate food supply in the medium whereas there was a drop of 38 per cent and 52 per cent in Cyclops count when there was an alternate food supply. There was no drop in Cyclops count in the control tank. Barbus lived longer than 3 weeks.

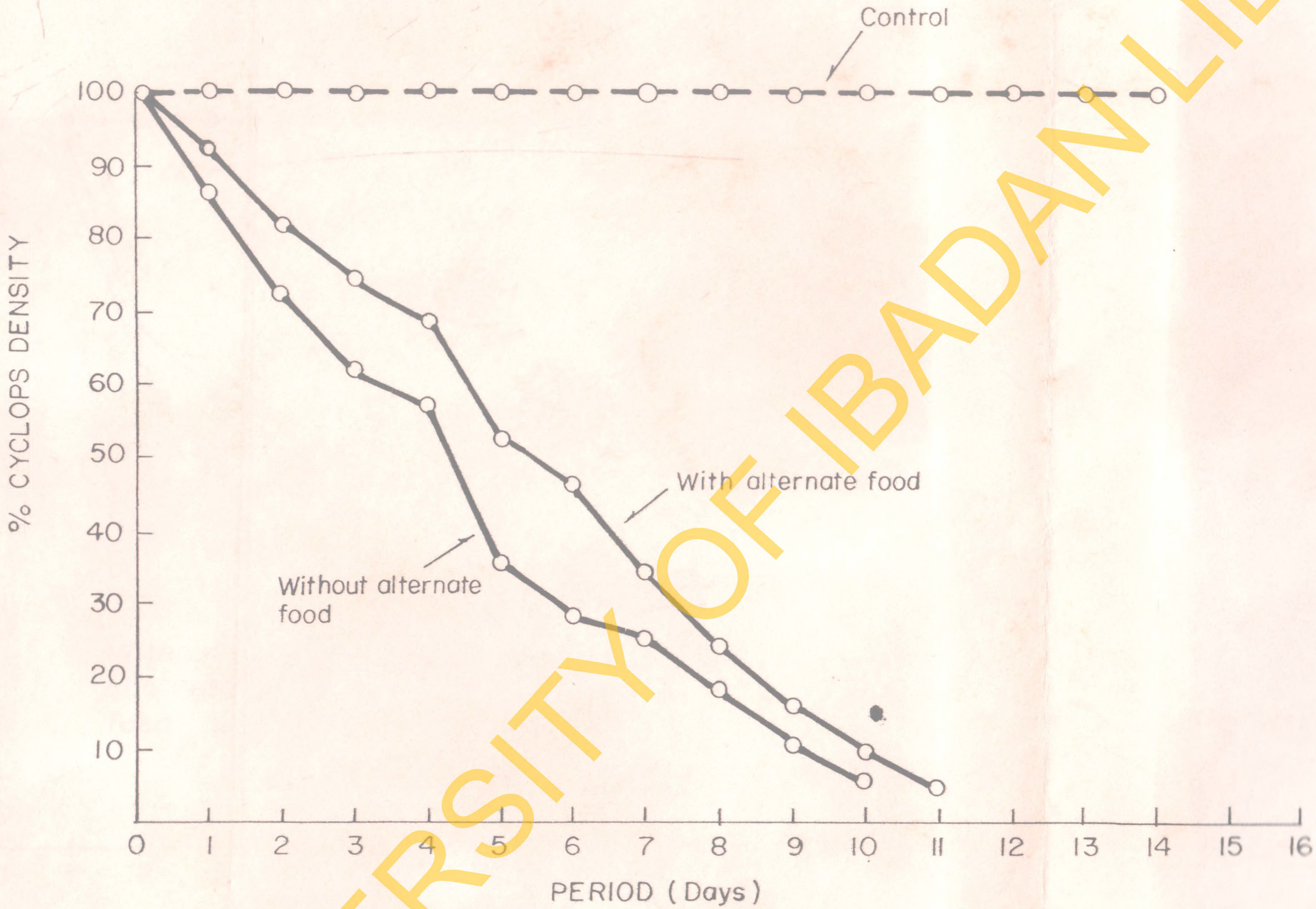


FIG. 8.3: EFFECT OF PREDATING FISH (Tilapia Nilotica x T. Galilea) ON CYLOPS DENSITY IN POND WATER UNDER LABORATORY CONDITION.

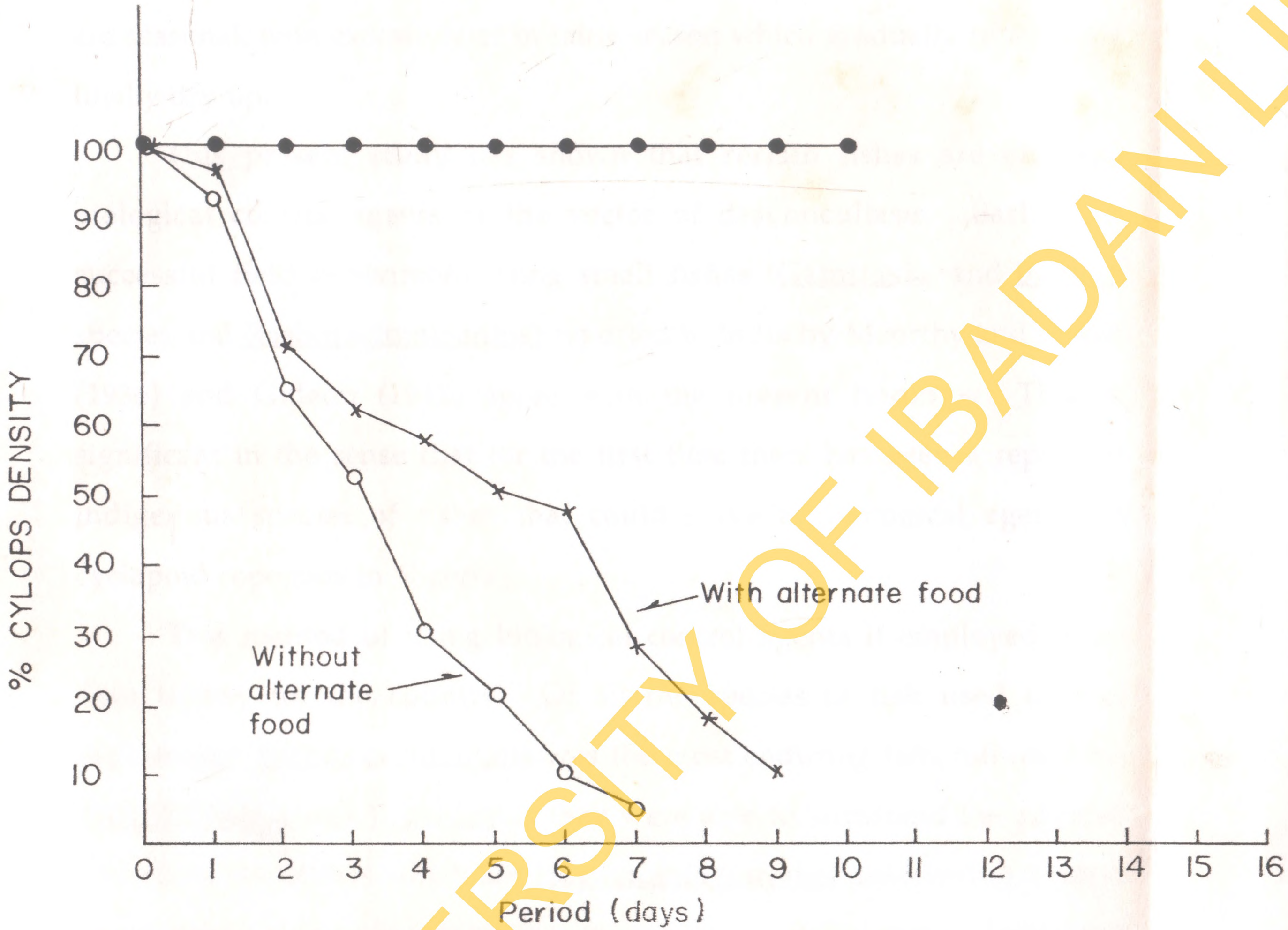


FIG. 8.4 : EFFECT OF PREDATING FISH (Barbus Occidentalis) ON CYLOPS DENSITY IN POND WATER UNDER LABORATORY CONDITION.

8.4 DISCUSSION

The observations reported here seem to be applicable in the control of dracunculiasis in the tropicaL areas. In most of these areas the ponds are seasonal, with excess water in rainy season which gradually recede and finally dry up.

This present study has shown that certain fishes are efficient biological control agents of the vector of dracunculiasis. Earlier on successful field experiment using small fishes (Gambusia, and Barbus species and Rasbora domiconius) reported in India by Moorthy and Sweet (1936) and Gideon (1942) agree with the present findings. This is significant in the sense that for the first time there has been a report of indigenous species of fishes that could serve as biological agents of cyclopoid copepods in Nigeria.

This method of using biological control agents if employed, may save money for the country. Of all the species of fish used in this experiment, Barbus occidentalis was the most enduring fish, followed by Tilapia nilotica and T. galilea as they were able to withstand the adverse laboratory conditions which left Hemicromis fasciatus dead within 4 days. Despite the inadequate facility for aeration in the course of the experiment Barbus and Tilapia species survived as long as the experiments lasted; and even beyond. This is an indication that these small fishes would be invaluable tools in the biological control of Cyclops in the field where the conditions are more natural. Hemicromis fasciatus, though a very voracious predator of Cyclops could not be regarded as a good experimental model animal as it could not withstand the laboratory stress. Besides, it was discovered that the fish did not only prey on cyclopoid copepods but predated also on the other small fishes like Tilapia species within the same enclosure, a situation that does not augur well for the other mates that are expected to be more efficient biocontrol agents.

Tilapia fish could be safely regarded as the most reliable of the indigenous fish as it is found to be naturally occuring in most ponds in villages South Western Nigeria. The fish could also endure to a large extent the adverse conditions occasioned by dry season. It has also been demonstrated that the presence of alternate food supply in the ecosystem had very little negative effect on the predating ability of Barbus and Tilapia fishes on cyclopoid copepods. This further supports the adoption of fish as biological control agents of cyclops.

Although field trials have not yet been undertaken, the prospect is very bright. It was discovered from an unpublished observation that those ponds in which fishes were more preponderant had lower density of cyclopoid copepods than others in some villages South Western part of the country. In addition, it was observed that the level of acceptability of presence of fishes in drinking water supply is very high among all the household heads interviewed (Adeyeba, 1989 - unpublished observation). Infact the fishes are given maximum protection possible by the villagers. It is a general belief of Yoruba people that the presence of fishes in pond water meant for drinking is an indicator or index of water fit for drinking. The water is deemed to be free of all undesirable elements such as poison, etc. In addition, fishing activity in the pond is strictly forbidden because of the belief that the pond might dry up as a result.

Although certain fishes had been recommended for biological control in India (Moorthy and Sweet, 1936; Gideon, 1942), it is believed that this report has made a landmark in the search for new biological control agents of vector of dracunculiasis in Nigeria. Therefore, during this hard time of economic recession in the country, indigenous biocontrol agents like fishes could be adopted as an alternative to the expensive imported chemical used for water treatments in the country.

CHAPTER NINE

CONCLUSION

Dracunculiasis is the only communicable desease that is transmitted exclusively by contaminated drinking water. It is easy to prevent. Despite the fact that the disease is a serious impediment to development with severe impact on health, agricultural production and school attendance, until recently it has not received any serious attention by the various levels and succeeding governments in the country. Majority of the victims of the disease reside in remote and seemingly neglected rural communities where basic amenities like safe water supply are absent.

In recent years, efforts have been increased in the global attempt to control dracunculiasis as a result of the advent of the International Drinking Water Supply and Sanitation Decade (IDWSSD) (1981 - 1990). Barely a year to 1990, the end of IDWSSD this study shows that the impact of its activities is yet to be felt in the study area where a prevalence rate of 47.7 per cent was recorded in 1988. Although, demographic variables like sex or religions had no differential bearing on infection rate, infection rates increased with age. Worm burden and risk infection are very important parameters that suggest that the study area is endemic for dracunculiasis. The rural dwellers of the State had been victims of the infection for many years. It is apparent that the infection occurs at any age above one year and reinfection is not uncommon indicating that on clinical groups no protective immunity is developed after an infection just like any other helminthic diseases.

Basically, this study showed that the level of awareness of the danger inherent in drinking untreated water is very low in the study area. Where the poeple are aware of the danger, they are not able to do anything about it. This is demonstrated in the lackadaisical attitude to water treatment before drinking. Over 68 per cent of the householdheads did not treat their water before drinking while 6.5 per cent treated their water at all times by either boiling or adding alum. This study has shown that mere addition of alum to drinking water at the concentration used by individuals had no lethal effect on the cyclops. The taste of water becomes objectionable and unbearable when a lethal dose of alum is added to the water and so such dosage is never used by the people. Therefore, an individual who drank such water that is not properly treated is still at risk of infection. The populace is also at the risk of other water borne diseases like gastro-enteritis, typhoid fever and schistosomiasis. The problem is further heightened by the wrong perception of the causes and prevention of the disease and might probably account for the high prevalence rate of the disease in the study area.

Since bacteria were isolated from ulcers of varying degree of morbidity, it is concluded that bacteria play an important role in secondary guinea worm infection. The phage types of the coagulase positive staphylococcus strains, the most common bacterial agents, are commonly resistant to penicillin and tetracyclines. Therefore, both penicillin and tetracycline based drugs are most unhelpful in case treatment of secondary guinea worm ulcers. This study shows that the drug of choice for case treatment include amikacin, oxacillin, fusidic acid and erythromycin.

Concurrent parasitic diseases like ascariasis, hookworm diseases, strongyloidiasis, trichuriasis and malaria have been shown to contribute more to the health problem of the victims. This study has confirmed that malaria and hookworm disease have contributed to low haematocrit values (anaemia), that plagued infected individuals in the study area.

It was observed during this study that conducive conditions naturally exist in ponds located under tree shades for Cyclops to breed and transmit guinea worm. However, when these conditions were manipulated from the natural estate, they become lethal to Cyclops existence. Factors which effect the density of the Cyclops include pond water level which is greatly influenced by the season of the year. The populace is at great risk when water is drawn from still and undisturbed pond during which time there is high concentration of Cyclops. This meant that early callers at the pond stand more risk of infection as more Cyclops would be collected in the water meant for drinking.

The population mobility of the people occassioned by such socio-cultural economic ventures as marriage, periodic market, village/street trading, festivals, schooling holidaying or even search for water appear to be principal factors affecting the disease diffusion.

Various chemicals such as potassium permanganate, lime, perchlorite, copper sulphate, rocks salt, and bleaching powder were shown to be cyclopscidal when used in correct dosage/concentration and so are recommended to individual household for prevention.

In view of the identification of some indigenous fishes like Hemicromis occidentalis, Barbus fasciatus, Tilapia nilotica and T. galilea as biological control agents of dracunculiasis, it would be commendable to rear such fishes in the village ponds with the additional advantage of providing protein supplement to the community and individuals.

In the light of the above, it is quite certain that the disease can be controlled and indeed eradicated within a reasonable time scale. It is obvious that the combination of health education and epidemiological surveillance are essential components of any strategy to eradicate the disease. Therefore, there are essentially three basic options which can be followed to control or eliminate the disease: preventive measures, case treatment, vector control based on chemical treatment of drinking water, and use of biocontrol agents, development of protected and safe sources of water.

In order to achieve the set goals, it would be desirable to incorporate guinea worm control programme into special programmes of the Federal Government, such as MAMSER, Better Life for Rural Women, and Directorate for Food, Road and Rural Infrastructures (DFRRI) in addition to the services being provided by Water Corporation, and Health Education Unit of the Ministry of Health.

REFERENCES

Abolarin, M O. (1981): Guine worm infection in Nigeria villaae. Tropical and Geographical Medicine, 33: 83-88.

Adegoke, G . O. (1984): Characterisation of Staphylococci isolated from man and animals in Nigeria. Ph.D. Thesis, University of Ibadan, p. 163.

Adegoke, G . O. and Adeyeba, O. A . (1986): Antibiogram and Phage types of S. aureus isolated from man and animals. African Journal of Applied microbiology (in press).

Adekolu-John, E. O . (1983): The impact of Lake creation on Guinea worm transmission in Nigeria on the Eastern side of Kainji Lake, International Journal of Parasitology 13: 472 - 452.

Adeyeba, O. A. and Dipeolu, O. O. (1984): A survey of gastrointestinal parasites in a Local Government Area of South Western Nigeria. International Journal of Zoonoses, 11: 105 - 110.

Adeyeba, O. A. (1985a): Secondary infections in dracunculiasis: Bacteria and morbidity: International Journal of Zoonoses, 12: 147 - 149.

Adeyeba, O. A. (1985b): Hyperproteniaemia in dracunculiasis. International Journal of Zoonoses, 12: 150.

Adeyeba, O. A. (1986): Studies in Dracunculiasis in Western Nigeria. M. Phill. Thesis, University of Ibadan.

Adeyeba, O. A. and Kale, O. O. (1988): Epidemiology of dracunculiasis and its Social Economic Impact in a Village in South-West Nigeria. West African Journal of Medicine (In Press) .

American Public Health Association: 14th Edition (1976) Standard Method for the Examination of Water and Waste Water. Washington D. C.

Anon (1983): Opportunities for Control of Dracunculiasis Report of Workshop. National Academy Press, Washington D. C.

Ansari, A. R. and Nasir, A. S. (1963): A survey of Guinea worm Disease in the Sind Desert (Tharparkar District) of West Pakistan. Pakistan Journal of Health 13: 152 - 167.

Asheshov, E. H. (1966): Chromosomal Location of the Genetic elements controlling Penicillinase Production in a Strain of Staphylococcus arueus. Nature 210: 802 - 804.

Barnett, S. A. (1955): "Displacement" Behaviour and "Psychosomatic" Disorder: Lancet, 2, 1203.

Bartet, A. J. A. L. (1909): "Le Dragonneau (Ver de Guinee Filaire de Medine)" A. Maloine, Paris.

Bauer, A. W., Sherris, W. M. M.; Sherris, J. C. and Turck, M. (1966): Antibiotic susceptibility testing by a standardise single disc method. Acta of American Journal of Clinical Pathology. 493 - 496.

Belcher, D. W.; Wurapa, F. K.; Ward, W. B.; and Lourie, I. M. (1975): Guinea worm in Southern Ghana; Its Epidemiology and impact on agricultural productivity. American Journal of Tropical Medicine and Hygiene, 24. (2): 243 - 249.

Belcher, D. W. (1982): Opportunity for Control of Dracunculiasis transmission and epidemiology. Contributed paper to Workshop on Opportunity for Control of Dracunculiasis, p. 1 - 9. National Academy Press, Washington . C. 1985.

Boyce, J . M. ; Laudry, M. ; T. R. and Dupout, H. L. (1981): Epidemiological Studies of an Outbreak of Nosocomia (Methicillin Resistant Staphyiococus aureus) infections. Infect Control 110 - 116.

Blacklock, B. and O. 'Farrell, W. R. (1919): Note on a case of Multiple Infection by Dracunculus medinensis Annals of Tropical Medicine and Parasitology 13, 189 - 194.

Blair, J. E. and Williams, R. E. O. (1961): Phage Typing of Staphylococcus, Bulleting of World Health Organisation, 771 - 884.

Brieger, W. R.; Ramakrishna, J. and Adpovi, S. U. (1985): Selecting alternative strategies for community health education in guineaworm control. Conference Proceedings of First National Conference on dracunculiasis in Nigeria. P. 82 - 88.

Brug, S. L. (1 930): Dracunculus medinensis in the Dutch East Indies. Mededeel Dienst, Volksgezondheid Nederl Indie, 19: 153 - 157.

Bueding E. and Oliver-Gonzalez, J. (1950): Aerobic and anaerobic production of lactic acid by the filarial worm, Dracunculus insignis British Journal of Pharmacology and Chemotherapy, 5, 62 - 64.

Carayon, A.; Camain, R.; Guirand, R. and Havret, P. (1961): Aspects Chirurgicaux des helminthiasis en Afrique de louest (ascaridiose, dracunculose, Filariose, bilharziose) 11. Pathologie de migrations habituelles, aberrantes on manquees de la filaire de medine (A propose de 25 localisations chirurgicales) Medicine Tropicale 21, 538 - 549.

Charles, R. H. (1892): "A contribution on the life history of the Male Filaria medineusis removed from abdominal cavity of man." Scientific Memoirs by medical officers of the army of India, Calcutta (quoted by Mirza, 1929).

Chitale, P. K. (1912): Observations on three hundred cases of guineaworm, Indian Medical Gazzet, 47: 318 - 320.

Cowan, S . T. and Steel, K. J. (1974): In : Manual for the identification of medical bacteria. 3rd edition, University Press Cambridge.

Cruickshank, R.; Duguid, J. P.; Marmion, B. P. and Swain, R. H. A. (1975): In: Medical Microbiology. The practice of medical microbiology, 12th Edition. Churchill, Livingstone.

Dacie, J. V. and Lewis, S. M. (1977): In: Practical Haematology", 5th Edition, Churchill, Livingstone, p. 39 - 40.

Daniel, S. Ola and Osisanya, J. O. S. (1986): Dracunculiasis in Sub-Saharan Zone, Sokoto State Nigeria. Proceedings of First National Conference on Dracunculiasis in Nigeria, p. 77 - 81.

Datta, S. P.; Stanislas, L. and Veeraraghavan, M. (1964): Dracontiasis in Pondicherry Settlement. Bull Indian Soc. Mal. I: 11 - 18.

Davis, J. L. (1931): A note on some experiments with agents Lethal to Cyclops. Transactions of the Royal Society of Tropical Medicine and Hygiene, 24. 631 - 633.

Dipeolu, O. O. (1983): Studies on aids of efficient diagnosis of strongyle infection in Ruminant in Nigeria and investigations on suitable preservations for helminth eggs in tropical environment. Bulleting of Animal Health and Production. 31

Duke, J. (1895): Notes on the symptoms of Filaria medinensis or guineaworm. Indian Medical Gazzet. 30: 64 - 65.

Dyke, K. G. H. and Richmond, M. H. (1967): Occurrence of various types of penicillinase phasmid among a hospital staphyloeoccus. J. Clin. Pathol. 20: 75 - 79.

Dyke, K. G. H.; Jevons, M. P. and Parker, M. T. (1960): Penicillinase and intrinsic resistance to penicillins in Staphylococcus aureus lancet I: 835 - 838.

Edungbola, L. D. (1983): Babana Parasitic Diseases Project II. Prevalence and impact of dracontiasis in Babana District Kwara State Nigeria. Trans, Roy. Soc. Trop. Med. Hyg. 77(3): 310 - 315.

Edungbola, L. D. and Watts, S. J. (1984): An outbreak of dracunculiasis in a peri-urban community of llorin, Kwara State, Nigeria. Acta Tropica 41: 155 - 163.

Edungbola, L. D. and Watts, S. J. (1985): Epidemiological assessment of the distribution and endemicity of guineaworm infection in Asa, Kwara State, Nigeria, Trop. Geog. Med. 37: 22 - 28.

Edugbola, L. D. Watts, S.J.; Alabi, T. O. and Bello, A.B. (1988): The Impact of a UNICEF - assisted rural water project on the prevalence of guineaworm disease in Asa, Kwara State, Nigeria . Am. J. Trop. Med. Hyg. 39(1): 79 - 85.

Ejezie, G. C. (1981): The parasitic diseases of school children in Lagos State, Nigeria. Acta. Tropica 38; 79 - 84.

Fasan, P. O. (1969): Malaria in the school of Lagos City. Lagos State. West African Medical Journal, 18, 176 - 180.

Fairley, N. H. (1924): Studies in dracontiasis, IV: The clinical picture - analysis of 140 cases. Indian Journal of Medical Research, 12, 351 - 367.

Fairley, N. H. and Liston, W. G. (1924): Studies in the pathology of dracontiasis. Indian Journal of Medical Research, 11, 915 - 932.

Fryer, G. (1957): The Food of some fresh water cyclopoid copepods and its ecological significance. Journal of Animal Ecology, 26. 236 - 263.

Gemade, E. I. and Dipeolu, O. O. (1983): Prevalence of Castro Intestinal parasites and urinary schistosomiasis in Benue State of Nigeria. International Journal of Zoonoses, 10: 53 - 58.

Gideon, P. W. (1942): Experiments in the control of guineaworm infections in step wells by means of carnivorous fish, Rasbora doniconius and chlorogen (abstract). Proceedings of 28th Indian Science Congress, p. 225.

Gretillat, S. (1965): Le dimethyldithiocarbanate de zinc dans la prophylaxie de la dracunculose. Med. Afrique Noire, Dakar 12: 93 - 96.

Hoeppli, R. (1959): In "Parasites and parasitic infection in early medicine and science." University of Malaya Press.

Hodgson, C. and Barret, D. F. (1964): Chronic Dracunculosis British Journal of Dermatology, 76: 211 - 217.

Hopkins, D. B. (1982): "Guineaworm disease - a chance of eradication?" World Health Forum 3(4): 434 - 435.

Hopkins, D. R. (1987): Dracunculiasis eradication: a mid-decade status report. Am. J. Trop. Med. Hyg. 37(1): 115 - 118.

Hopkins, D. R. (1988): Dracunculiasis eradication: the tide has turned. Lancet 2 (8603); 148 - 150.

Ilegbodu, V.A.; Kale, O. O.; Wise, R. A.; Christensen, B. L.; Steele, J. H.; Jr. and Chambers, L. A. (1986): Impact of guineaworm disease on children in Nigeria. Am. J. Trop. Med. Hyg. 35: 962 - 964

Kale, O. O. (1977): The Clinico-epidemiological profile of guineaworm in the Ibadan District of Nigeria. American Journal of Medicine and Hygiene, 208 - 214.

Kale, O. O. (1982): "Fall in incidence of guineaworm infection in Western Nigeria after periodic treatment of infected persons." Bull. World Health Org. 60. 951 - 957.

Khanna, P.; Sarraswat, N. (1985): Lair of the guinea worm World Water: 31 - 32.

Kiefer, F. (1981): Beitrag Zur Kenntnis von Morphologic, Taxonomie and Geographischer Verbreitung Von Mesocyclops leuckarti auctorum. Archiv fur Hydrobiologie, Suppl. 62. 148 - 190.

Kryaski, S. and E. Becla (1981): Staphylococus aureus strains isolated in poland. Zbl, Bakt, Mikrobiol, Hygl, Abt. Supply. 925-929.

Laws, E. R.; Sedhak, V. A.; Miles, J.W.; Jeseph, C. R.; Lacomba, J. R.; Dias Rivera, A. (1968): Field study of the safety of Abate for treating potable water and observations on the effectiveness of a control programme involving both Abate and Malathion. Bull. Wrld. Hlth. Org., 38: 439 - 445.

Lawrie, J. (1987): Paraplegia complicating dracontiasis (letter) J. R. Coll. Surg. Edinb. 32(4): 259 - 260.

Leiper, R. T. (1906): Some results of the infection of monkeys with guineaworm. Rep. Br. Ass. Adv. Sci. 76: 600.

Leiper, R. T. (1907): The etiology and prophylaxis of dracontiasis. Br. Med. J. i, 129 - 132.

Lidberg, K. (1946): Enquete epidemioligique sur les dracunculose dans un village du Deccan (Inde) Bull, Soc. Path, Exot. 39. 303 - 318.

Lorian, V. (1980): Antibiotics in Laboratory medicine, Williams and Wilkin Baltimore.

Lyons, G. R. L. (1972): Guinea worm in the WA District of North West Ghana. Bull, Wrld Hlth Org. 47: 601 - 610.

Marsden, P. O. (1960): Clinical trials with Entamide Furorate, piperazine sulphate and emetine bismulth iodide. Trans. Roy. Soc. Trop. Med. Hyg. 54(4): 396 - 399.

Manson-Bajr. P. (1966): In: Manson's Tropical Diseases, 6th Ed. Bailliere Tindall and Cassel London, p. 712.

McCullough, P. S. (1982): Cyclopid copepods: Their role in the transmission and control of dracunculiasis: in Opportunities for Control of dracunculiasis. Report of Workshop, Washington D. C., 46 - 49.

Mirza, M. B. (1929): Beitroige zur Kenntnis des Baues Von Dracunculus medinensis, Velsch Z . Parasitenkde 2 129 - 156.

Moorthy, V. M. (1932a): An epidemiological and experimental study of dracontiasis in Ochitaldrug district. Indian Medical Gazett. 67: 498 - 504.

Moorthy, V. M. (1932b): Treatment and prophylaxis of dracontiasis. Indian Medical Gazett, 67: 617 - 619.

Moorthy, V. M. (1937): A redescription of Dracunculus medineusis Journal of Parasitology: 23, 220 - 224.

Moorthy, V. M. (1938): Observations on the development of Dracunculus medinensis larvae in cyclops. American Journal of Hygiene, 27: 437 - 460.

Moorthy, V. M. and Sweet, W. C. (1936a): A bioogical method for control of Dracontiasis. Indian Medical Gazzet, 71: 565-568.

Moorthy, V. N. and Sweet W. C. (1936b): Guineaworm infection of cyclops in nature. Indian Medical Gazzet, 71: 568 - 570.

Moorthy, V. N. and Sweet, W. C. (1938): Further notes on the experimental infection of dogs with dracontiasis. American Journal of Hygiene, 27, 301.

Muller, R. (1970a): Laboratory experiments on the control of cyclops, transmitting Dracunculus. Bull. Wrld. Hlth. Org. 42: 563 - 567.

Muller, R. (1970b): In "Diseases of Children in the sub-tropics and tropics" 2nd Ed. (D. B. Jelliffe ed.). p. 893 - 898. Edward Arnold, London.

Muller, R. (1970c): Egg Division in Dracunculus medinensis (demonstration) Trans. Roy. Soc. Trop. Med. Hyg. 64. 473.

Muller, R. (1971): Dracunculus and dracunculiasis Advances in Parasitology, 73 - 151.

Muller, R. (1975): In "Worms and Diseases" A manual of medical Helminthology, p. 68 - 85, Heinemann.

Muller, R. (1979): Guineaworm Desease: Epidemiology, control and treatment. Bulletin of World Health Organisation, 57(5): 683 - 689.

Muller, R.; Ellis, D. S. and Bird, R. G. (1970): Election Microscope studies of the phasmids in Dracunculus medinensis larvae (Demonstration). Trans . Roy. Soc. Trop. Med. Hyg . 64. 24.

Nugent, D. A. W.; Scott, D. and Waddy, B. B. (1955): Effect of water point treatment.with DDT on the incidence of guineaworm infection. Trans. Roy. Soc. Trop. Med. Hyg. 49: 476.

Nwosu, A. B. C.; Ifezulike, E. O. and Anya, A. O. (1982): Endemic dracontiasis in Anambra State of Nigeria: Geographical distribution, clinical features, epidemiology and socio-economic impact of the disease. Annal of Tropical Medicine and Parasitology. 76: 187 - 200.

Okpala, I. (1975): The incidence of malaria in school children in Western and East Central States of Nigeria. Paper Read at the Scientific Conference on Malaria in Nigeria, p. 27 - 28.

Olajide, I; Sridhar, M. K. C.; Kale, O. O. (1987): Guineaworm control in an endemic area in Western Nigeria. Aqua, 6: 333 - 339.

Onabamiro, S. D. (1952): The Geographical distribution and clinical feature of Dracunculus medinensis in South-west Nigeria. West African Medical Journal, 1: 159.

Onabamiro, S. D. (1954): The diurnal migration of cyclops infected with the larvae of Dracunculus medinensis (Linnaeus), with some observations on the development of the larval worms. W . Afr. Med. J., 3: 189 194.

Osoba, A. O. and Oyediran, A. B. (1977): Guinea worm and inguinal adenopathy. British Journal of Venereal Disease, 53: 63 - 64.

Peyru, G.; Wexler, L. F. and Novick, R. P. (1969): Naturally occuring penicillinase phasmids in S. aureus. J. Bacteriology, 98: 215 - 221

Poole, P. M. and Bacher, J. R. (1966): An outbreak of infection due to Staphylococcus aureus phage type 80/81 in a Veterinary School Bull. Min. Hlth (U. K.), 116 - 123.

Position, S. M (1966): Cellular location of the genes controlling penicillinase production and resistance to Streptomycin and Tetracycline in a strain of S. aureus. Nature 210: 802 - 804.

Pradhan, Y. M. (1930): Observations on experiment designed to combat dracontiasis in an endemi area by Col. Morision's Method of "liming wells". Indian J. Med. Res., 18 443-465.

Patnaik, K. C. and Kapoor, P. M. (1967): Incidence and endemicity of guineaworm in India. Indian J. Med. Res., 55, 1231-1242.

Protherto, R. M. (1977): Disease and Morbidity a neglected factor in epidemiology. Int. J. Epid 6: 259.

Raffier, G. (1965): Note Preliminaire sur l'activite du CIBA 32644 Ba dans la dracunculose Acta Tropica 22 350.

Raffier, G. (1966): Preliminary note on the activity of a new antihelminthic agent in dracunculosis. Med. Trop., 26: 29-46.

Raffier, G. (1969a): Efficiency of thiabendazole in the treatment of dracunculiasis. Texas Report on Biology and Medicine, 27 (Suppl. 2) 601 - 609.

Raffier, G. (1969b): Activity of Niridazole in dracontiasis Ami . N. Y. Acad. Sci., 160: 720 - 28.

Ramakrishnan, N. R. and Rathnaswamy, G. A. (1953): Use of DDT for control of cylops breeding and as an anti-dracontiasis measure. Indian Med. Gaz. 88: 386 - 390.

Ramsay, G. W. St. C. (1935): Observation on intradermal test for dracontiasis. Trans. Roy. Soc. Trop. Med. Hg. 28: 399-404.

Rao, C. K. Paul, R. O.; Sharma, M. D. and Sharad Kumar (1981): Guineaworm disease in India: Current status and strategy of its eradication. J. Comm. Dis. (Delhi) 13: 1 - 7.

Reddy, C. R. R. M.; Narasaiah, I. L. and Parvathi, G. (1969): Epidemioogical studies on guineaworm infection. Bull, Wrld. Org., 40, 521 - 529.

Reddy, C. R. R. M.; Prasautha Murthy, D. sita Devi, C. Lakshmi, S. and Sivaramappa, M. (1970): Pathology of acute guineaworm synovitis. J. Trop. Med. Hyg., 73: 28 - 32.

Roubard, E. '(1913): Observation sur la biologie du verde Guinee infection intestinale des cyclops. Bull. Soc. Path. Exot. 6: 281 - 288.

Riddle, D. S. and Hawgood, B. C. (1956): Conservative and quantitative methods for ova and larval stages of helminths. J. Clin. Path., 9: 74.

Sawai, T.; Mitsuhashi. S. and Yamagishi, S. (1968): Comparison of the chromosomal and extrachromosomal genetic determinants controlling staphylococcal penicillinase production. Japan J. Microbiol, 12: 521 - 533.

Schneider, J. (1964): Probleme diagnostique et therapeutique de medecine tropicale daus la pratique medicale courante en France. Bull. Soc. Path. Exot. 57: 669 - 715.

Scott, D. (1960): An epidemiological note on guineaworm infection in north-west Ashanti, Ghana. Ann. Trop. Med. Parasit., 54: 32 - 43.

Singh, J.; Raghavan, K. C. S. (1952): Dracontiasis in: Public health importance and control. Bull. Nat. Soc. Ind. Mal. Mosq. Dis., 5: 141 - 160.

Simmons, J. S.; Whayne, T. F.; Anderson, G. W. and Horack, H. M. (1951): In "Global epidemiology" Vol. 2, Lippineott, Philadelphia.

Smith, J. T.; Hamilton-Miler, J. M. T. and Knox (1969): Bacterial resistance to penicilline and cephalosporins. J. Pharm. Pharmacol, 21: 337 - 358.

Southwell, T. and Kirshner, A. (1938): Some observations on guineaworm larvae. Ann Trop. Med. Parasit. 32: 193-196.

Sridhar, M. K. C.; Kale, O. O.; Adeniyi, J. D. (1985): A simple method and filter to reduce guineaworm disease in Nigeria. Waterlines, 4: 16 - 19.

Sridhar, M. K. C.; Kale, O. O. (1985): Some observations on the control of guineaworm in Oyo State. Proceedings of the First National Conference on Dracunculiasis in Nigeria. 136 - 140.

Steel. R. D. and Torrie, J. H. (1960): Principle and Procedure of statistics with special reference to biological science. McGraw-Hill Book Co., Inc. New York, pp. 106 - 107.

Steib, K. and Meyer, P. (1988): Epidemiology and vectors of Dracunculus medinaisis in northwest Burkina Faso, West Africa. Ann. Trop. Med. Parasit, 82(2): 189 - 199.

Stoll, N. R. (1947): This wormy world. J. Parasit, 32: 1 - 18.

Tinbergen, N.(1953): The herring Guell's world, London: Collins.

Turkhud, O. A. (1919): Prophylaxis of Dracontiasis. India J. Med. Res., 6: 217 - 225.

Udonsi, J. K. (1987a): Dracontiasis in Igwum River Basin, Nigeria: Its distribution, epidemiologgy and transmission dynamics. Trop. Med. Parasitol, 38(4) 304 - 308.

Udonsi, J. K. (1987b): Control of endemic dracontiasis by provision of water supply in rural communities of Imo State, Nigeria. Public Health, 101 63 - 90.

Usanga, E. A. (1989): Iron status of Nigeria in health and disease. A paper presented at the 14th Annual Scientific Conference of Association of Medical Laboratory Scientists of Nigeria at University of Benin, October, 11 - 14th.

Velschius, G. H. (1674): "Exercitationes de vena medinensis et de vermiculis capillaribus infantium." Augsburgh.

Van De Velde, I . (1984): Revision of the African species of the genus Mesocyclops SARS, 1914 (Copepoda: Cyclopidae), Hydrobiologia.

Watts, S. J. (1984a): Marriage migration, a neglected form of long term mobility; a Case Study from llorin, Nigeria. International Migration Rev . 17: 682 - 698.

Watts, S. J. (1984b): Population Mobility, urban development and dracunculiasis in Kwara State, Nigeria. Soc. Sci. Med., 19: 471 - 472.

Watts, S. J. (1986): Human Behaviour and disease control: The implication of population mobility for the control of dracunculiasis. Conference proceedings of First National Conference on dracunculiasis in Nigeria, p. 97.

Watts Susan J. (1987): Dracunculiasis in Africa in 1986: Its geographic extent, incidence, and at risk population. Am. J. Trop. Med. Hyg. 37(1): 119 - 125.

Ward, W. B. (1982): The Impact of dracunculiasis on the household: The challenge of measurements. Paper Presented at Workshop on Opportunites for control of Dracunculiasis, National Research Council, Washington, D. C. (June 16 - 19).

World Health Organisation (1967): Control of Ascariasia, WHO, Technical Report Series, No. 379.

World Health Organisation (1975): Ecology and control of vector in Public Health. WHO Technical Report Series, No. 561.

World Health Organisation (1983): Dracunculiasis Surveillance. Wkly. Epidem. Rec. 58(4): 21 - 23.

World Health Organisation (1986): Dracunculiasis in Africa. Final Report on Workshop held in Niamey, Niger, 1 - 3.

APPENDIX 3.1

EPIDEMIOLOGICAL STUDIES ON DRACUNCULIASIS - QUESTIONNAIRE

A. PERSONAL DATA

1. Name ....
2. Address ....
3. Age ....
4. Sex ....
5. Household size ....
6. Religion ....
7. Occupation ....
8. Period of Residency in the Area ....

B. HISTORY OF INFECTION

(Indicate with 'YES' or 'NO' with respect to the 9 and 10).

9. I am currently infected with guinea worm (YES/NO).
10. I have been previously infected with guinea worm (YES/NO).
11. How many times have you been infected before ....

12. Indicate the sites on your body where the worms are Emerging:

    (a) Head and neck region ( )

    (b) Back and abdomenal region ( )

    (c) Arm and hand ( )

    (d) Buttock ( )

    (e) Scrota or vulral areas ( )

    (f) Thigh ( )

    (g) Knee ( )

    (h) Leg ( )

    (i) Foot ( )

13. What season of the year do you notice an infection?

    (a) Any season ( )

    (b) Wet season ( )

    (c) All season ( )

14. Did you feel any sign before the emergence of the worms (Yes / No)

15. If 'Yes' in (14), for how many days? ....

16. State whether or not you experienced the following sympoms:

    (a) Feeling of movement of worms around the body (Yes/No)

    (b) Feeling queer all over (Yes/No)

    (c) Sudden fever and high temperature (Yes/No)

    (d) Loss of appetite and sleep (Yes/No)

    (e) Generalised urticarial rash later localised (Yes/No)

    (f) Painful blister (Yes / No)

17. How long have you been incapacitated (in weeks) ....

18. State the degree of incapacitation: tick appropriately.

(a) Mild - mobile but suffers little or no discomfort. (   )

(b) Moderate: mobile but suffers considerable discomfort. (   )

(c) Severe: immobile or is unable to use the affected part and suffers considerable discomfort. (   )

19. What is your average monthly earnings from the proceeds of you r occupation ? ....

20. Who assisted you to look after your business during your absence ?

(a) Relatives (   ) (c) Labourer (   )

(b) Children (   ) (d) Nobody (   )

21. If labourers are engaged, how much do you pay per day?

....

22. Is the service of the labourers/children prompt?

(Yes/No/ Not Always)

EPIDEMIOLOGICAL STUDIES ON DRACUNCULIASIS - QUESTIONNAIRE 11

FOR HOUSEHOLD HEADS ONLY

A. Express your candid opinion about the following by ticking appropriately in terms of agreement or disagreement. Guinea worm is caused by/or acquired through the following:

Agree/Disagree

(a) Evil spirit ....

(b) An act of God ....

(c) The work of the enemy ....

(d) Heredity ....

(e) Drinking bad water ....

(f) Poorly cooked vegetable/food ....

(g) Contact with an infected person ....

B. Guinea worm can be prevented by doing the following:

		Agree/Disagree
(a)	Performing rituals	....
(b)	Offering prayer to God	....
(c)	Running away from a victim	....
(d)	Using a protective medicine	....
(e)	No remedy	....

C Water utilization - indicate with Yes or No

(a)	I drink from a village pond	(Yes/No)
(b)	I drink from a well	(Yes/No)
(c)	I drink pipe-borne water	(Yes/No)
(d)	I drink from pond while working on the farm	(Yes/No)
(e)	I drink boiled water	(Yes/No)
(f)	I drink filtered water	(Yes/No)
(g)	Alum is added to the water I drink	(Yes/No)
(h)	I always drink treated water	(Yes/No)
(i)	I drink treated water sometimes	(Yes/No)
(j)	I drink untreated water	(Yes/No)

APPENDIX 6.1

MUREXIDE INDICATOR SOLUTION FOR CALCIUM

It is prepared by mixing 200 mg of murexide with 100g of solid NaCI and grinding the mixture to 40 to 50 mesh. A pinch of it is added to the sample and titrated against standard EDTA till the indicator changed from pink to purple.

MIXED (BROMOCRESOL GREEN METHYL RED) INDICATOR SOLUTION

Dissolve 20 mg methyl red and 100 mg bromocresol green in 100 ml 95% ethyl alcohol or isopropyl alcohol.

AMMONIUM BUFFER SOLUTION PH 10.1

Dissolve 6.75g NH_4CL in 500ml distilled water. Add 57ml Conc. NH_40H and dilute to 1 litre with distilled water. Adjust PH to 10.1 and store in a polyethylene bottle.