IMPERIAL COLLEGE

OF SCIENCE & TECHNOLOGY

# MAURITIUS REPORT

1970

THE EXPLORATION BOARD

# THE IMPERIAL COLLEGE ZOOLOGICAL EXPEDITION

TO

MAURITIUS

1970

FINAL REPORT

EXPEDITION PERSONNEL

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# INTRODUCTION

Mauritius is a small oceanic island about 1,200 miles off the coast of East Africa, and is surrounded by coral reefs and the blue waters of the Indian Ocean. In the centre is a plateau encircled by volcanic peaks which betray the origin of the island. Mean air temperature ranges from 71°F. in August to September and 80°F. in January to March.

The population is very dense, i.e. approximately $\frac{3}{4}$ million and consists mainly of Indo-Mauritians, Sino-Mauritians, Creoles and French. The two principle languages spoken are French and English, although other languages are used by each racial group, e.g. hindoustani, tamoul, and urdu, by the Indians, and Chinese by the Sino-Mauritians. All the inhabitants, however, understand a patois derivative of French.

The island was probably first visited by the Arabs as early as the 10th century, but the first European visitor was in the 16th century, a Portuguese named Domingo Fernandez. Pedro Mascarenhas, another Portuguese navigator, gave his name to this group of islands. Apart from this name, the only present day remaining trace of the Portuguese are the animals and plants they introduced.

In 1638, the Dutch colonised the island and named it Mauritius in honour of their sovereign, Prince Maurice de Nassau. In about 1710, they abandoned it, and by this time most of the spectacular indigenous fauna such as the dodo and the aphanperzx had become very rare or disappeared. Sugar cane, that had been ontroduced from Java, grew wild and Javanese deer proliferated in the forests.

Until the arrival of the French, the island was used as a port of call for pirates and merchants on the Indes trading routes.

In 1715, the French took possession of this land-mark on the precious Indes route and renamed it the Ile de France. Under the administration of the Bourdonnais, the island developed into an important naval base. It remained under France until 1814 when, by the Treaty of Paris, the Ile de France (with its dependencies the Seychelles, Rodriguez and les Chagos) was ceded to England and from then on called Mauritius. In spite of the British influence since this time, the languages and religions of the inhabitants have been maintained.

The economic development of Mauritius is closely linked to the sugar industry, as sugar represents 97% of present exports.

Sugar cane was first introduced in 1639 by the Dutch and crude sugar is believed to have been produced at the end of this century but most progress has been made under the British administration. So that the economy is not wholly dependent on one crop, attempts have been made to introduce tea, tobacco, and some industries.

The cultivation of sugar is now well organised and scientific. The Mauritius Sugar Industries Research Institute (M.S.I.R.I.) in

Reduit keeps a watchful eye over the development ond growth of each year's crop. The director of the Institute is Mr. R. Antoine, who combines a very active scientific and administrative career with an extremely strenuous social life.

He and various other members of the M.S.I.R.I. are old students of Imperial College and with his invaluable help we managed to arrange and enjoy a memorable six weeks.

## HISTORY OF THE EXPEDITION

The question we were most frequently asked was "Why did you choose Mauritius for an expedition?" There is no single answer to this question, but the following points outline our main reasons for the choice.

At Imperial College, third year Zoologists follow one of two disciplines for their honours course, either Entomology or Parasitology. We were therefore looking for some place where projects concerning both disciplines were to be found. As underdeveloped tropical countries usually have more trouble with their parasites and insects than do other countries, our choice was limited to the Southern hemisphere. We also realised that both groups would have to be in close contact, mainly for financial reasons, so our choice was again limited to a country with a relatively small area. Other criteria were sea and sand, an English-speaking population and somewhere to camp safely, should this be necessary. Somehow, all these points seemed to indicate Mauritius as the ideal choice, and when we discovered that M.S.I.R.I. had close links with I.C. the matter was finally decided.

The Mauritian Embassy in London put us in contact with Mr. Eric Chung, who ran a charter flight service to Mauritius for only £110 return. He was very pleased to make nine seats available for us in his July flight, and did try to arrange that we stayed there longer than six weeks, but unfortunately this was not possible. He also invited us to several functions in London where we had the opportunity to meet some of the people from Mauritius before we went.

Mr. Antoine paid us a visit at I.C. and advised us on clothing, money and scientific projects and helped make us even more impatient for the date of departure.

On July 9th we boarded a Boeing 707 and began the 20-hour flight only one hour late. Our first stop was Benghazi, where the temperature was 90°F. at 2.00 p.m.! We arrived in Nairobi just as dawn was breaking and then took off over the rift valley and flew over the East coast of Africa in the thin light of the African morning. By midday on July 10th, we were far out over the Indian Ocean and just after lunch, we touched down at Plaisance Airport.

Mr. Antoine met us here and escorted us to Floreal where we were to stay. The M.S.I.R.I. and the School of Agiculture had combined resources and rented for us two comfortable and spacious government flats. We later hired two rather old cars which somehow managed to share the load of nine people and equipment on our daily sampling sorties, but for the first evening Mr. Antoine provided us with transport to a welcoming party where we first became acquainted with Mauritian hospitality.

Unfortunately, we could spend only the first three weeks of the time with us as he had to leave for Europe on business trip, but he arranged for us to meet many different people who made sure that we enjoyed Mauritius as much as possible.

In addition to providing us with laboratory space at the Research Institute, Mr. Antoine arranged for us to visit sugar factories, the Natural History Museum, Pamplemous gardens, a tea plantation, go deep sea fishing, visit places of historical interest on the island, and even a television interview!

Time passed very quickly as we were always occupied, and on August 19th we boarded the plane which carried us on an uneventful and comfortable journey back to England.

# GENERAL INFORMATION

## Essential Preliminaries

Passport

International driving licence

Yellow Fever vaccination (Yellow Fever Centre)

Small Pox vaccination (by College doctor)

Cholera vaccination (by College doctor)

Antimalarial tablets (precaution en route; donated by Burroughs Wellcome)

## Living In Mauritius

Public transport cheap but slow. Cars are very expensive to hire from Mautourco, so it is best to 'borrow' them from friends. Drinking water need not be boiled, but we eventually did as all of us became quite ill over a period of 2-3 days. Later found that the chlorine supplies to the water had been exhausted and a new consignment was awaited with impatience!

Mosquito nets, etc., not necessary as malaria was eradicated completely by the British. Never leave anything of value unguarded! No fresh milk available. Food keeps well, ie, not attacked by ants as in most of the tropics.

# FINANCES

The expedition was sponsored by the Imperial College Exploration Board who awarded £450 towards the total cost. The remainder was covered by individual contributions of £75 each plus donations from the following organisations to whom we are most grateful.

| Items | Estimated Cost | Actual Cost |
|---|---|---|
| Air fares | 990 | 990 |
| Food | 180 | 226 |
| Vehicle hires and running costs | 184 | 274 |
| Other transport costs | | 32 |
| Photographic work and materials | 50 | 31 |
| Postage, stationary and telephone calls | 40 | 51 |
| Loss of cash by theft | | 38 |
| Sundry expenses (accommodation, etc) | 200 | 14 |
| | £1,644 | £1,656 |

Sponsors

| | |
|---|---|
| Imperial College Exploration Board | £450.00 |
| Ministry of Overseas Development | 250.00 |
| Shell International Petroleum Company | 100.00 |
| Imperial Chemical Industries Limited | 10.50 |
| Fisons Limited | 10.50 |
| Ford Dagenham Trust | 100.00 |
| The Chemical Milling Company | 10.00 |
| Rionda de Pass Limited | 3.15 |
| Gilchrist Educational Trust | 50.00 |
| Total | £983.15 |

Total income was therefore -

| | |
|---|---|
| Donated | £983.15 |
| Members' contribution 9 x £75. | 675.00 |
| | £1659.15 |

The balance was borne by Imperial College Exploration Board. In addition, the Board paid £26.00 for insurance.

We should like to thank the following commercial firms for their gifts of goods :

Bass Charrington

Whitbread & Company Limited

Burroughs Wellcome

May & Baker Limited

A. Wander Limited

Mars Limited

Scribbans-Kemp Limited

London Rubber Company

Ogdens

Schweppe (Foods) Limited

Electronic Instruments Limited (for loan of a portable oxygen meter).

Our thanks also to the School of Agriculture, Mauritius and M.S.I.R.I. for providing us with accommodation.

We should like to thank all the people who gave advice and assistance, in particular -

Dr. J. Bridge of Imperial College, Sunninghill, Berkshire

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Prof. T.R.E. Southwood of Imperial College, Sunninghill, Berkshire

Miss F. Teare

Mr. A. Stephenson and the Imperial College Exploration Board

Mr. R. Antoine, Director of M.S.I.R.I.

Mr. Claude Cabolot

Mr. Courtois and his field officers

Mr. Sam Gopal

Mr. Roger Ng

Mr. Mamet

Mr. Rajibali

Mr. G. Rouillard

Mr. J.R. Williams

Dr. Y. Wong

# BILHARZIA PROJECT REPORT

## INTRODUCTION

'Bilharzia' or Schistosomiasis is a human disease caused by a schistosome fluke parasite. It ranks second only to malaria in importance in tropical regions. In Mauritius, the species concerned is Schistosoma haematobium. A very complete account of the disease on the island and the relationship of the fluke with its intermediate host - the fresh water snail Bulinus cernicus - is given by J.R. Mamet (1968). An outline of the life-cycle of Schistosoma Haematobium is given in Figure 1.

Figure 1. - Schistosoma haematobium Life-Cycle

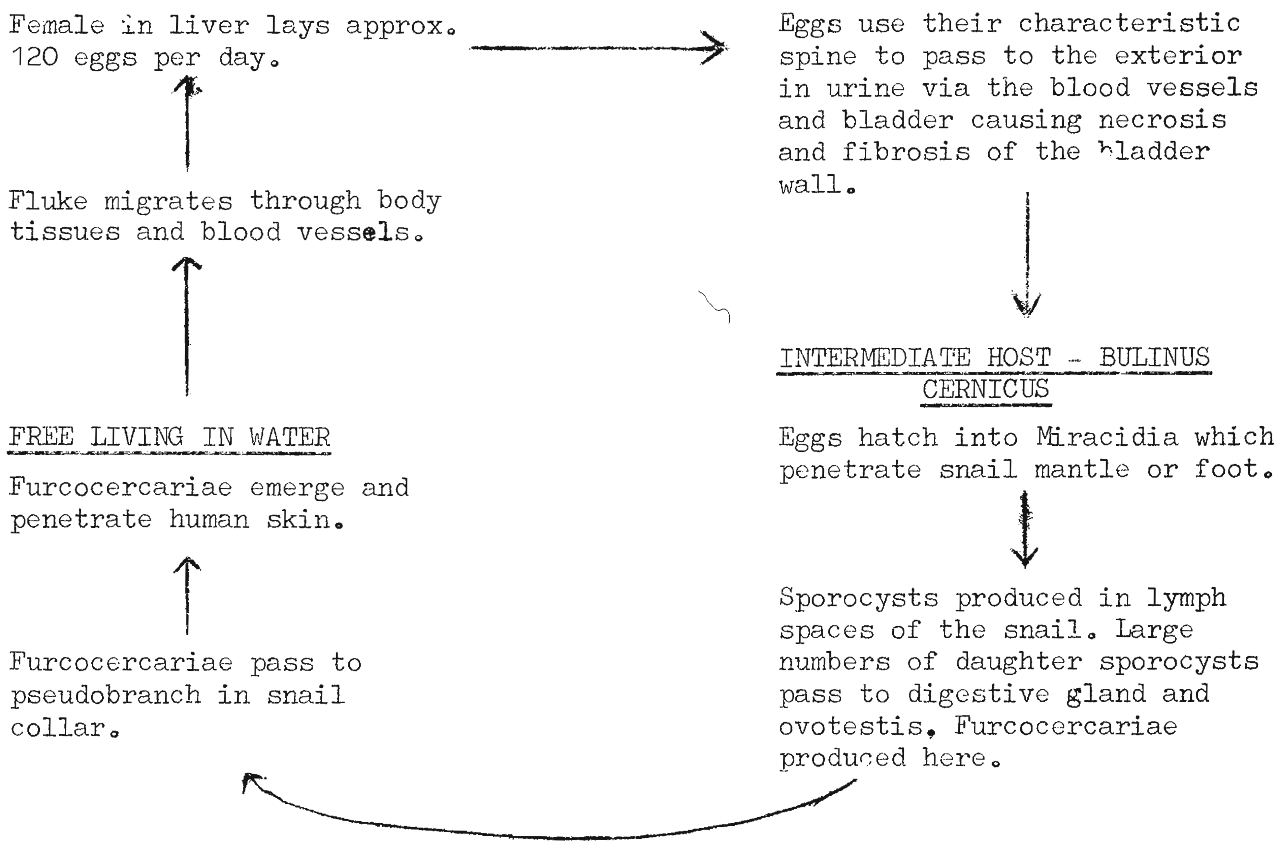

Figure 2. Photograph of Urine Samples

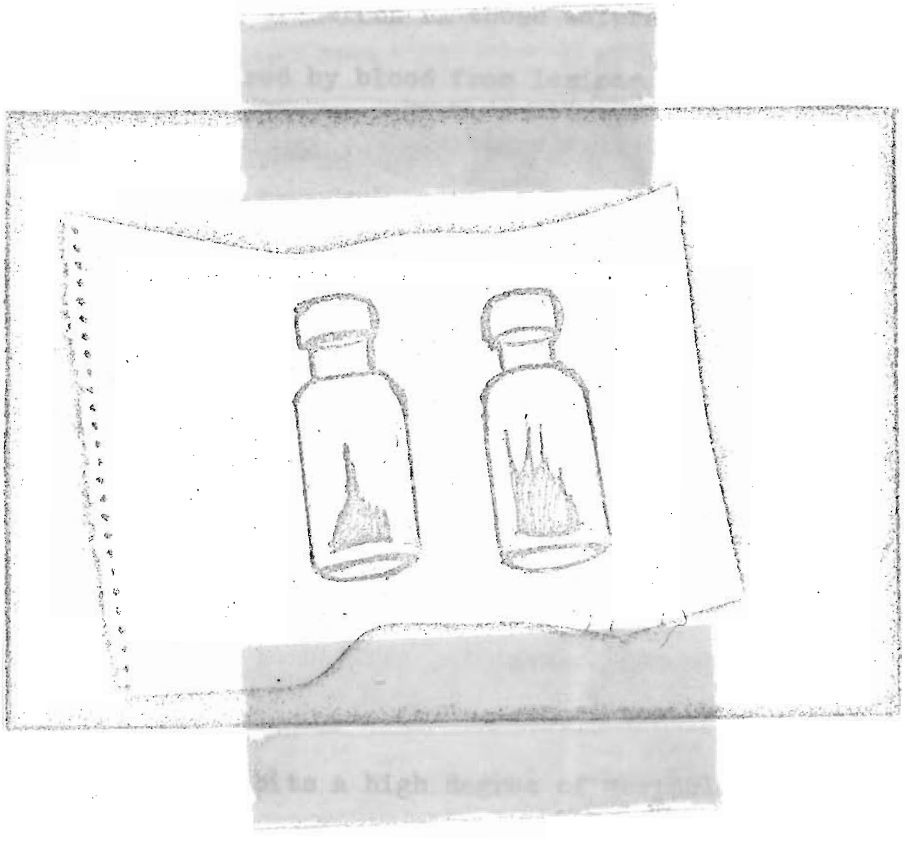

Figure 2 shows urine samples taken from a cress bed worker (left) and his son (right) from Carreau Acacia. The infection is picked up by working, swimming, or washing in infected waters. The family's washing is usually done in natural waters. Ignorance and lack of sanitation result in urination in these waters. The above urine samples are discoloured by blood from lesions of the bladder caused by penetration of the eggs. Laboratory analysis showed that these urine samples contained infective eggs. It is the destruction of the liver and bladder in man that result in the fluke's pathogenicity.

Wright (1966) and Wright & Ross (1966) point out the potential importance of physiological differences between snail populations in the differentiation of strains of parasites for which they act as intermediate hosts. Wright suggests that differences in intermediate host physiology may sometimes be responsible for the selection of a parasite strain which happens to be more pathogenic than usual in its definitive host.

B. Cernicus exhibits a high degree of morphological polymorphism on the island of Mauritius. An analysis of the causes of this variation seen in the snail may be variation in the constituents of the water, in which the snail lives, between different sites on the island. It was at Dr. Wright's suggestion that the expedition undertook to carry out a series of water analyses of known B. Cernicus habitats on Mauritius.

Method

1 litre water samples were collected from the sites shown in Figure 2. A portable oxygen meter was used to measure the oxygen concentration of each site in situ, at three different places, to give a range of values for the oxygen concentration. Also at each site a collection of B. Cernicus was made and preserved for later examination, so that the morphological variation could be correlated with the water analyses.

The water samples were analysed for pH, calcium concentration, total hardness, and total organic content according to the methods outlined in Mackereth (1963). These were the factors we thought most likely to cause morphological variation in the snail. The chloride concentration was also determined by titrating the sample against standard silver nitrate using potassium chromate as indicator. The end point was given by the appearance of a red-brown precipitate.

Results

The results for the water analyses are given in Table 1. These results together with the specimens collected have been deposited with Dr. Wright (c/o Experimental Taxonomy Unit, British Museum, (Natural History), Cromwell Road, London S.W.7.).

TABLE 1. WATER ANALYSIS OF BULINUS ~~CERGINUS~~ CERNICUS HABITATS (A)

| AREA | OXYGEN p.p.m. | pH | $Ca^{++}$ Mgs/l | TOTAL HARDNESS ($Ca^{++}$ + $Mg^{++}$) Mgs/l | Cl– Mgs/l | ORGANIC CONTENT Mgs. $O_2$/litre | REMARKS |
|---|---|---|---|---|---|---|---|
| 1. Carreau Acacia | 8.1 → 8.3 | 7.04 | 1.39 | 3.19 | 40 | 0.1 | Cress – bed. |
| 2. Carreau Esnouf | 9.4 → 10.0 | 7.80 | 1.50 | 3.39 | 40 | 0.3 | Cress – bed |
| 3. Mon Desert | 8.1 → 10.8 | 7.52 | 1.51 | 3.33 | 35 | 0.6 | Cress – Bed |
| 4. Bel Air (South) | 7.4 → 8.8 | 7.34 | 1.70 | 4.04 | 48 | 1.2 | Cress – Bed. |
| 5. Lenneville | 8.4 → 8.8 | 7.62 | 0.88 | 2.64 | 38 | 1.0 | Cress – Bed. |
| 6. Cressonville | 8.1 → 8.6 | 7.6 | 21.2 | 30.2 | 35.5 | 0.6 | Cress – Bed. B. cernicus rare |
| 7. Cité la Cure | 3.6 → 16.0 High oxygen concentration due to presence of algae in some places | 8.4 | 33.2 | 70.6 | 74.6 | 13.0 | Small stream which had dried up to give a series of puddles. |

TABLE 1. WATER ANALYSIS OF BULINUS ~~CERCINUS~~ HABITATS

| AREA | OXYGEN p.p.m. | pH | $Ca^{++}$ Mgs/l | TOTAL HARDNESS ($Ca^{++}$ + $Mg^{++}$) Mgs/l | $Cl^-$ Mgs/l | ORGANIC CONTENT Mgs $O_2$/litre | REMARKS |
|---|---|---|---|---|---|---|---|
| 8. Terre Rouge | 7.2 → 9.8 | 8.6 | 31.3 | 93.7 | 212.9 | 1.5 | Stream, liable to drying up |
| 9. Beau Plan | 4.3 → 4.8 | 8.5 | 16.9 | 41.3 | 51.5 | 1.1 | Irrigation ditch few *B. cernicus* |
| 10. The Pound | 14.0 → 14.2 | 8.4 | 23.4 | 46.8 | 50.4 | 4.7 | Stagnant pool small *B. cernicus* quite common |
| 11. Clemencia | 7.2 → 8.1 | 7.4 | 13.9 | 26.9 | 32.7 | c.0 | Cress bed |
| 12. Bel Air (West) | 11.6 → 13.6 | 8.2 | 12.9 | 25.6 | 37.5 | 0.6 | Stream |
| 13. Roches Noires | c.16.0 | 8.4 | 26.6 | 36.9 | 78.4 | 22.0 | Stagnant temporary site liable to drying up |

TABLE 1. WATER ANALYSIS OF BULINUS ~~CERCINUS~~ HABITATS ( [illegible] )

| AREA | OXYGEN p.p.m. | pH | $Ca^{++}$ Mgs/1 | TOTAL HARDNESS ($Ca^{++}$ + $Mg^{++}$) Mgs/1 | Cl– Mgs/1 | ORGANIC CONTENT Mgs $O_2$ / litre | REMARKS |
|---|---|---|---|---|---|---|---|
| 14. CAP MALHEREUX | c. 17.0 | 8.3 | 64.6 | 151.3 | 637.4 | 25.6 | STAGNANT, LIABLE |
| | | | | | | | TO DRYING UP. |
| | | | | | | | B. CERNICUS RARE |

Discussion and Conclusions

Many of the known B. Cernicus sites given by Mamet (1968) had dried up. Also many of the habitats examined (e.g. No. 14, Cap Malheureux) are prone to drying up and hence the mineral content of the water varies according to the season and degree of evaporation that has taken place. A meaningful picture of the mineral content of the water of these sites can thus only be given by examination over a longer period of time. However, at sites such as the cress bed habitats (Nos. 1-6) where the water level is more constant, the figures given for the mineral concentration are probably fairly representative.

It was found that the values given for the oxygen content of each site were too crude to provide more than a general indication. The oxygen concentration of a particular site was only measured at the temperature prevalent at the time of visiting. Thus, where the water at different sites was at different temperatures (particularly in the case of stagnant pools which warmed up during the day), the oxygen concentration values may not be comparable. Also there was quite a striking degree of variation in oxygen concentration between different parts of the same habitat, e.g. between areas with and without algae or swiftly flowing water. A more serious criticism of the oxygen values is that they do not represent the oxygen concentration of the microclimate of the snails niche (e.g. beneath stones, or close to a plant leaf).

In spite of these sources of error, there may be a link between high calcium concentration and the larger varieties of B. Cernicus found on the island.

Acknowledgements

We wish to thank Dr. C. Wright of the British Museum (Natural History) for suggesting the problem. Mr. Courtois and the field officers of the Mauritius Department of Health for help in locating the sites and collecting material. Dr. Y. Wong of the M.S.I.R.I. for providing laboratory facilities, and Mr. Claude Cabalot for his help with the water analyses. The load of an oxygen meter by Electronic Instruments Ltd. (Richmond, Surrey), and the load or protective garments by the British Rubber Co. were invaluable.

References

Mamet, J.R. (1968) : La Bilharziose Vesicale a l'Isle Maurice et son Hote Intermediare, Bulinus Cernicus (Morelet). Proceedings of the Royal Society of Arts and Sciences of Mauritius, Vol. 3, Part 1.

Mackereth, F.J.H. (1963) : Some Methods of Water Analysis for Limnologists. Freshwater Biological Association publication No. 21, 71 pp.

Wright, C.A. (1966) : J. Helminth, 40.

References cont'd :

Wright, C.A. and Ross, G.C. (1966) : Bull. Wld. Hlth. Org. 35 pp. 727-731.

D.M.W.

# REPORT ON FISH PARASITE PROJECT

R.M. Anderson

The aim of this project was to investigate the helminth parasites of the commercially important freshwater fish species of Mauritius. It was hoped that an assessment of the effect of the parasites on their fish hosts would aid in the management of the fresh water and marine fish farms.

The Mauritian government has instigated the commercial farming of a variety of species of fish to aid in the production of a low cost protein food source. The Fisheries Division of the Agricultural service of the Ministry of Agriculture and natural resources and co-operative development of Mauritius is undertaking this project with the aid of the United Nations Food and Agricultural Organisation (F.A.O.).

## A. FRESH WATER FARMING:- (Lowe R.H. (1953))

A fresh water cichlid *Tilapia* which is common in both West and East Africa has been introduced into Mauritius comparatively recently and is now reared in small freshwater ponds in the centre of the island. The rearing farm is near the town of Curepipe. The main species bred is *Tilapia melanopleura*. This fish is a mouth breeder, which reproduces very rapidly. Because of this phenomenal reproductive rate, it is very useful as a food source and has often (c.f. East Africa) provided a practical solution to the problem of low cost protein, which is acute in Mauritius. This species grows to a maximum of around 2 pounds in weight, but is farmed usually after one year at around $\frac{1}{2}$ pound in weight. Not only does this fish breed very rapidly, but it also matures sexually at a very young age. The different size groups of fish are kept in separate ponds and at densities beneficial to a rapid growth rate, particularly with reference to growth in weight. They feed mainly on herbivorous matter and browse through the detritus on the bottom of the ponds. They can be artificially fed, but many ponds are self-supporting.

Fifty of these fish obtained from the Curepipe fish farm were examined over a period of three weeks. The fish examined ranged from 6 to 24 centimetres in length and were from 1 month to 2 years old. They were killed and examined for:-

1) External parasites
2) Gill helminth parasites
3) Gut helminth parasites
4) Evidence of protozoal or bacterial infections

None of the fish examined showed any trace of present or past parasitic infestations. A surprising observation since european fresh water fish harbour a variety of helminth parasites, in the vast majority of habitals.

A variety of possible reasons for this lack of parasitemia suggest themselves:-

1) Low densities of fish in the ponds, preventing the establishment of parasites (i.e. transmission)

2) Herbiverous diet of the Tilapia, preventing entry of larval parasitic stages.

3) Lack of invertebrate fauna in the culture ponds thus not sufficient intermediate hosts for the development of helminth parasites.

4) The rearing ponds were periodically allowed to dry out thus killing invertebrates and possible larval stages of the parasites.

5) Lack of bird fauna on Mauritius preventing transport of infective stages of parasites to new aquatic environments.

[Has been noted by other surveys that tropical fish lack helminth parasites.]

Since the Tilapia did not harbour any helminth parasites, thus no problems with parasitic diseases existing in the fresh water farms it was decided to examine the commercially important marine fish.

## B. MARINE FARMING

Two species of marine lagoon fish are farmed commercially.

1) The mullet *Mugil cephalus* called locally "Mulet voile".

2) *Siganus vermiculatus* called locally "Cordonniere".

Both species are lagoon fish and are harvested periodically by netting the lagoons enclosed by the coral reefs. The main fish farms are at Mahebourg on the east of the island. All fish examined in this project came from this area.

(i) Mugil Cephalus

Twenty of this species of fish were examined and ranged from 10 cms. to 23 cms. in length. The mullet, a torpedo-shaped, shallow water shoaling fish is ideal for farming in coral lagoons and has a quick growth rate, thus providing a viable food source. All the fish examined were free of helminth parasite infections. This can be attributed to two main facts.

1. The mullet is a herbivore, feeding in the detritus around the bottom of the lagoon.

2. The mullet has a strong muscular gizzard like the stomach which enables the fish to grind the food, before it starts through the exceptionally long digestive tract. Thus helminth would find it difficult to gain entry to the digestive tract.

10% of the fish (2) examined were lightly infected with a Protozoan myxosporidian Myxobolus sp. However, due to the light incidence and intensity of infection it was unlikely to be a lethal parasite infestation. This parasite can be lethal in heavy infections since it infects the gill tissues and impairs respiration.

(ii) Siganus Vermiculatus

The siganids popularly known as the rabbit fish due to their appearance are farmed in marine lagoons as well as being caught by local fishermen. Although they are an unpalatable fish, they are consumed in large numbers in Mauritius due to their abundance. They have rows of anal and dorsal spines plus one forward pointing spine in front of the dorsal fin, which has a deep groove along the side connecting to a venom gland. This poison can cause painful swellings. Siganus is a herbivore and browses on and around the coral reefs.

Fifteen of this species of fish were examined ranging from 15 cms. to 38 cms. in length. They were all free from gut helminth but harboured heavy infestations of a monogene gill parasite. This parasite belonged to the sub-family Tetronchinae and the genus Amphibdelloides. Only one species has been described for this genus, from the Torpedo ray. The species found on Siganus is a new species to science. 66.6% of the fish examined were infected with an average worm burden of 28.3 parasites.

This parasite causes damage to the gill epithelium and invokes a host response, a laying down of thick walled epithelia cells. The respiratory surfaces of the gills can be seriously damaged by heavy infestations of this monogene. Since this parasite is a monogene and has a direct life cycle, it would be advisable to farm the Siganus at low densities in the lagoons since overcrowding of the hosts would result in a build up of the parasite infestation levels and perhaps resulting in the death of the hosts.

A few other fish caught by local fishermen were examined for parasites. A list of parasites found and hosts examined is given in Table 1.

TABLE 1

| HOST | DIET | PARASITE | SITE OF INFESTATION |
|---|---|---|---|
| a) Fresh water fish | | | |
| Tilapia melanopleura | herbivore | - | - |
| b) Marine fish | | | |
| Mugil cephalus (mullet) | herbivore | Myxobolus (Protozoa) | gills |
| Siganus vermiculatus | herbivore | Amphibdelloides sp. | gills |
| Sarda sarda (bonito) | carnivore | Tetrahynchlarvae (Cestoda) | muscle |
| " | " | Acanthocephalan | intestine |
| " | " | Digenean | intestine |
| Diplodus trifasciatus (Zebrafish) | herbivore | - | - |
| Cheilinus trilobatus | herbivore | - | - |
| Tylorsaurus sp. (Garfish) | carnivore | Digenean | stomach |
| Rhineconthusaculeatus (Triggerfish) | herbivore | - | - |

## Conclusions

The fish examined, both freshwater and marine, were extremely lightly infested with helminth parasites, a fact noted by other surveys in tropical waters.

The only parasite found in large numbers was a Monogenean gill parasite, which is thought to be a new species and is at present being described. Other parasites found may also be new species but as yet have not been examined in detail. Very few parasites from the fish of the Indo-Pacific region have been recorded and identified.

From this survey it seems that parasitic helminths are not a problem in the management of commercial fish farms on Mauritius.

(For reference to methods of fish used on Mauritius, see Wheeler, J.F.G. (1953)).

## References


Lowe, R.H. (1952) : Report on the Tilapia and other fish and fisheries of Lake Nagasa 1945-47. Colonial Fisheries Publications.

Wheeler, J.F.G. (1953) : Report on the Mauritius-Seychelles Fisheries Survey 1948-49. Fishery Publ., Vol. 1, No. 3, Parts I and II.

Hornell, S. (1926) : Report on the Fishery Resources of Mauritius.

Baissac, J.B. (1968) : Contribution a l'étude des poissons de l'Ile Maurice. Procs. Royal Soc. of Arts and Sciences of Mauritius, Vol. III, Part 1, 1968.

## COMPARATIVE AMOUNTS OF CANE BORER DAMAGE

### INTRODUCTION

The larvae (caterpillars) of moths belonging to the genera Chilo and Diatrea can cause extensive damage to sugar cane. Loss in weight of cane results from cane tissues being eaten, from dessication and from impaired growth. Severe attack causes rotting and death of the whole stalk; and weakening of the nodes often results in breakage, especially on an island such as Mauritius which is periodically subject to severe cyclones. The use of bored planting material results in poor germination; the sucrose (sugar) content of millable cane is seriously affected. After harvesting, bored cane deteriorates more quickly than clean cane. Secondary organisms may increase the loss of sucrose to a significant extent for borer tunnels open the way to infection by bacteria and fungi. Loss caused by sugar cane moth borers therefore may be divided into field loss and factory loss, or reduced cane tonnage and reduced available sugar per unit weight of millable cane respectively. Further monetary loss due to the higher cost of processing damaged cane in the factory also occurs. (Metcalfe, 1969).

Sugar cane variety S17 is a very promising new variety currently being studied, before general release to planters, by the Mauritian Sugar Industry Research Institute (M.S.I.R.I.). It has been suggested that S17 is subject to a higher level of attack by the sugar cane moth borer, Chilo sacchariphagus, as compared to other varieties currently in cultivation. Due to the higher sugar yield of S17 one might expect this to be true for Pointel (1967) concluded from a comparative study of the levels of infestation that varieties such as S17, M134,32 and H32.85,60 were more susceptible to attack than R397, R445 and R447 and this is probably correlated with the higher sugar yield and less fibrous nature of the former canes.

Comparative data is not forthcoming from the M.S.I.R.I.'s replicated variety trials because plot size is small and interaction occurs.

Method

The thorny problem of the estimation of the real loss caused by sugar cane moth borers has been reviewed by Metcalfe (1969). The only important criterion is the ultimate loss of sugar that results from cane borer damage. However, this is extremely difficult to measure. Pointel (1967) estimated comparative amounts of damage by internode borers by considering the percentage number of stems and the percentage of internodes damaged. This was done by counting the number of larval galleries in each sample of 100 canes brought to the sugar factory. This gives an indirect index of loss. Metcalfe (1969) has pointed out potential errors in this type of assessment but it was adopted as being the most practicable method. Pointel (1967) however, sampled canes brought to the factory and this may have led to errors from rotten and broken canes being left in the field and bias in sampling techniques.

Thus for comparison, random samples were taken from adjacent fields of S17 and other varieties on estates. The fields were comparable as to age of cane (planting date), category of cane (virgin, first ratoon etc.), soil type, and cultural practice.

Sample size is extremely important especially as the distribution of the moth boreres may be aggregated. For reasons of expediency, Roja's (1954) level of sample size was adopted, 20 canes being taken at random from each of the 2 fields being compared. Moreover, no attempt was made to sample the whole field in each case, but the samples were only taken from the adjoining edges of the 2 fields being compared, in the hope that this would give the area of greatest comparability. Whole canes were cut at ground level and the number of joints per cane, the number of bored joints per cane and the total weight of the sample were noted. Sites were taken from all over the island in order to try and minimise local aberrations.

## Results

The sampling results are given in Table 1. Data is given on both the percentage of bored joints and also the number of bored joints per kilogram of cane, for as Metcalfe (1969) states, it is impossible to decide as yet whether the number of bored joints per unit of weight of cane has any advantage over the traditional percent bored joints for comparative purposes.

| AREA | SITE | FIELD No. | VARIETY | AGE | SAMPLE SIZE (CANES) | TOTAL No. OF JOINTS | AVERAGE No. OF JOINTS PER CANE | TOTAL No. OF BORED JOINTS | % BORED CANES | % BORED JOINTS | TOTAL WEIGHT (Kgs) | No. OF BORED JOINTS PER KG OF CANE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NORTH | | | | | | | | | | | | |
| Belle Vue | Belle Vue | 29 | 377/56 | V | 20 | 460 | 23.0 | 92 | 95% | 20% | 31.3 | 2.94 |
| | | 37/38 | 5.17 | V | 20 | 414 | 20.7 | 144 | 100% | 34.78% | 23.05 | 6.25 |
| | | | | | | | | | | | | |
| | Mon Rocher | 94 | 13/56 | V | 20 | 513 | 25.65 | 44 | 65% | 8.58% | 19.85 | 2.22 |
| | | 104 | 517. | V | 20 | 483 | 24.15 | 77 | 90% | 15.94% | 35.15 | 2.19 |
| | | | | | | | | | | | | |
| | Mauricia | 46 | 377/56 | V | 20 | 413 | 20.65 | 39 | 85% | 9.44% | 28.0 | 1.39 |
| | | 38 | 5.17 | V | 60 | 1265 | 21.08 | 262 | 96.2/3% | 20.71% | 84.0 | 3.12 |
| | | | | | | | | | | | | |
| Nouvelle Industrie | Amitiè | 39 | 377/56 | V | 20 | 521 | 26.05 | 26 | 60% | 4.99% | 26.40 | 0.985 |
| | | 32 | 517 | V | 20 | 505 | 25.25 | 40 | 75% | 7.92% | 32.55 | 1.23 |

| AREA | SITE | FIELD No. | VARIETY | AGE | SAMPLE SIZE (CANES) | TOTAL No. OF JOINTS | AVERAGE No. OF JOINTS PER CANE | TOTAL No. OF BORED JOINTS | % BORED CANES | % BORED JOINTS | TOTAL WEIGHT (Kgs) | No. OF BORED JOINTS PER KG OF CANE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EAST & CENTRAL | | | | | | | | | | | | |
| Reunion | Trianon | 119 | 13/56 | V | 20 | 567 | 28·35 | 47 | 85% | 8·29% | 34·75 | 1·35 |
| (central) | | 117A | 5.17 | V | 20 | 489 | 24·45 | 26 | 55% | 5·32% | 33·85 | 0·768 |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| M.D.A. | Minissy | 57 | 377/56 | V | 20 | 384 | 19·20 | 13 | 40% | 3·38% | 37·15 | 0·350 |
| (central) | | 56 | 5.17 | V | 20 | 364 | 18·20 | 6 | 20% | 1·65% | 22·50 | 0·267 |
| | | | | | | | | | | | | |
| | | 55 | 93/4-8 | V | 20 | 386 | 19·30 | 8 | 30% | 2·07% | 19·90 | 0·402 |

| AREA | SITE | FIELD No. | VARIETY | AGE | SAMPLE SIZE (CANES) | TOTAL No. OF JOINTS | AVERAGE No. OF JOINTS PER CANE | TOTAL No. OF BORED JOINTS | % BORED CANES | % BORED JOINTS | TOTAL WEIGHT (Kgs) | No. OF BORED JOINTS PER KG OF CANE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SOUTH | | | | | | | | | | | | |
| Savannah | Savannah | F13/19 | 377/56 | V | 20 | 447. | 22.35 | 21 | 45% | 4.70% | 46.6. | 0.450 |
| | | F13/16 | 5.17. | V. | 20. | 468. | 23.40 | 24 | 75% | 5.13% | 36.35 | 0.660 |
| Bel Ombre | St. Marie | Bois Noir 15 | 13/56 | V | 20 | 528 | 26.4 | 20 | 65% | 3.70% | 24.30 | 0.820 |
| | | Bois Noir 14 | 5.17. | V | 20 | 489 | 24.45 | 18 | 45% | 3.68% | 31.25 | 0.580 |
| Ferney | Le Vallon | 114 | 377/56 | V | 20 | 445 | 22.25 | 74 | 100% | 16.63% | 31.00 | 2.39 |
| | | 106 | 5.17 | V | 20 | 458 | 22.90 | 91 | 95% | 19.87% | 23.55 | 3.86 |
| Union | Combo | 59 | 377/56 | V | 20 | 393 | 19.65 | 24 | 70% | 6.11% | 30.10 | 0.80 |
| | | 60 | 5.17 | V | 20 | 413 | 20.65 | 18 | 55% | 4.36% | 27.00 | 0.67 |

| AREA | SITE | FIELD No. | VARIETY | AGE | SAMPLE SIZE (CANES) | TOTAL No. OF JOINTS | AVERAGE No. OF JOINTS PER CANE | TOTAL No. OF BORED JOINTS | % BORED CANES | % BORED JOINTS | TOTAL WEIGHT (Kgs) | No. OF BORED JOINTS PER KG OF CANE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SOUTH (CONT.) | | | | | | | | | | | | |
| St Aubin | St Aubin | 167. | 377/56 | V | 20 | 422 | 21.10 | 11 | 30% | 2.61 % | 36.75 | 0.30 |
| | | 167 | 5.17 | V | 20 | 432 | 21.60 | 12 | 35% | 2.78% | 35.28 | 0.34 |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| Benares | Benares | 82 | 377/56 | V | 20 | 394 | 19.70 | 4 | 10% | 1.02 % | 37.85 | 0.105 |
| | | 83 | 5.17 | V | 20 | 595 | 29.75 | 12 | 50% | 2.01 % | 51.50 | 0.235 |

| AREA | SITE | FIELD No. | VARIETY | AGE | SAMPLE SIZE (CANES) | TOTAL No. OF JOINTS | AVERAGE No. OF JOINTS PER CANE | TOTAL No. OF BORED JOINTS | % BORED CANES | % BORED JOINTS | TOTAL WEIGHT (Kgs) | No. OF BORED JOINTS PER KG OF CANE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WEST | | | | | | | | | | | | |
| Medine | Medine | 69-71 | 13/56 | V. | 40 | 1395 | 34.9 | 281 | 100% | 20.14% | 71.15 | 3.95 |
| | | 72-75 | 5.17 | V | 40 | 1,171 | 29.30 | 180 | 95 % | 15.37% | 74.15 | 2.43 |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | Albion | 24 | 377/56 | V | 20 | 541 | 27.05 | 81 | 95% | 14.97% | 46.35 | 1.75 |
| | | 22-23 | 5.17 | V | 20 | 572 | 28.60 | 79 | 100% | 13.21% | 46.16 | 1.71 |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | Pierrefonds | 96 | 13/56 | V | 20 | 604 | 30.2 | 47 | 90% | 7.78% | 20.53 | 2.29 |
| | | 102 | 5.17 | V | 20 | 486 | 24.3 | 36 | 70% | 7.41% | 21.60 | 1.67 |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | Cascade | 21 | 13/56 | V | 20 | 595 | 29.75 | 46 | 75% | 7.73% | 24.45 | 1.88 |
| | | 20 | 517 | V | 20 | 545 | 27.25 | 72 | 95% | 13.21% | 32.50 | 2.22 |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | V= virgin. | | | | | | |

The data was then analysed using the number of bored joints per cane as the raw data. The variances of each sample were found and those of each of the two samples being compared were then tested for equality by means of the variance-ratio ('F') test. This ensures that the two variances are estimating the same population if 'F' is not significant. The means ($\bar{x}$) of the two samples were then compared using the 't' test if 'F' was not significant. The results of this analysis are given in Table 2.

The data from each sample was then pooled for each variety. The mean number of bored joints for S17 was then compared with the mean for each of the other two major varieties sampled - 377/56 and 13/56 - by computing 'd' (the normalised deviate) for each pair of varieties. It should be noted that this comparison may not be strictly valid on biological grounds. In the same way, differences between different geographical or climatic areas, in terms of the level of borer infestation, could be compared.

Discussion and Conclusions

The following sources of error must be kept in mind when considering the results :

(a) The small sample size. However, the small standard errors given in Table 2 indicate that the sample size was sufficiently large to yield valid results. Use of the 'F' test also helps to avoid comparison of two different populations of borer.

(b) The small number of sites examined for each area. This was largely unavoidable due to the fact that many useful comparisons had already been harvested by the time of the investigation and also because the planting of S17 was not yet widespread.

(c) The number of internodes per cane may be very different in two varieties being compared.

(d) The presence of the borer itself may result in reduced joint size. Thus the number of bored joints may not reflect the amount of damaged tissue.

(e) External examination for borer holes may not reveal all the larvae present as longitudinal splitting of the cane invariably shows more joints bored. However, Valsechi et al. (1960) have shown that there is a very close correlation between the two methods.

(f) A single larva may produce two or more holes in the joints, resulting in an overestimate of the number of bored joints from external examination.

(g) The level of infestation by borers is only an indirect index of loss and <u>may be</u> totally unrelated to loss of sugar.

In ten comparisons of S17 with variety 377/56, only two (Belle Vue and Mauricia) gave significantly higher means for the level of borer attack on S17 than 377/56 (Table 2).

Table 2 also gives six comparisons of S17 with variety 13/56 and of these only one, (Medine), gave a significantly higher level of attack by the borer on 13/56 compared to S17.

A single comparison between S17 and 93/48 showed no significant difference between the two means for the number of bored joints per cane. An overall comparison of S17 with 377/56 gave the following results :

| | | |
|---|---|---|
| Mean number of bored joints per cane | = | 2.87 for S17 |
| $s^2$ (variance) | = | 9.12 |
| Mean for 377/56 | = | 1.93 |
| $s^2$ | = | 5.68 |
| d | = | 3.65*** |

Hence there seems to be an overall greater susceptibility to borer attack in S17 than in 377/56.

Pooled sample comparison for S17 and 13/56 gave :

| | | |
|---|---|---|
| Mean number of bored joints per cane | = | 2.92 for S17 |
| $s^2$ | = | 8.02 |
| Mean for 13/56 | = | 3.46 |
| $s^2$ | = | 11.93 |
| d | = | 1.43 u.s. |

Here there seems to be no significant difference between the mean level of borer attack on S17 and 13/56.

In conclusion then, S17 may be slightly more susceptible to borer attack than 377/56 but is certainly no more susceptible than 13/56, an already widely cultivated variety. Thus there is no reason why S17 should not be grown as widely as 13/56 especially if other measures are taken to control the borer. Moreover, the number of borer attacks decreases with age, according to Pointel (1967), for the virgin crop is most often attacked as itis exposed longer in the field ( and all our samples were of virgin cane), it is richer in sugar, less fibrous and canes already attacked are more susceptible to attack. Although our results cannot be taken as more than a preliminary guide, they are broadly in agreement with those of Pointel (1967) in as much as we found varietal differences in susceptibility to attack. Moreover, Pointel (1967) found differences in borer populations between different regions on Reunion. The same in probably true of Mauritius and using the methods outlined here, it may be possible to find canes most suitable for each area with regard to borer attack.

Acknowledgements

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References

Metcalfe, J.R. (1969) : The estimation of loss caused by sugar cane moth borers. In 'Pests of Sugar

Cane', Ed. Williams, J.R. et al. Elsevier, Amsterdam, pp. 61-79

Pointel J.R. (1967) : Contribution à l'étude des chenilles mineuses de la canne à sucre à l'Ile de la Reunion, AGRON. TROP. 22 No. 11 1053-1077.

Rojas, B. (1954) : Design of a sampling for the estimation of degree of intensity of borer attack, Proc. Int. Soc., Sug. Cane Technol. 8, 310-317.

Valsechi et al, (1960) : The correlation between numbers of sugar cane internodes externally perforated and the numbers internally damaged by the borer (Diatraea Saccharalis) (In Portuguese) An. Esc. Sup. Agric. Queiroz 17 : 293-345.

TABLE 2

| AREA | SITE | FIELD NO. | VARIETY | AGE | MEAN ($\bar{x}$) NO. OF BORED JOINTS PER CANE | STANDARD ERROR OF $\bar{x}$ | 'F' | 't' |
|---|---|---|---|---|---|---|---|---|
| NORTH | | | | | | | | |
| Belle Vue | Belle Vue | 29 | 377/56 | V | 4.6 | ± .67 | 1.45 | 2.49* |
| | | 37/38 | S17 | V | 7.2 | ± .80 | n.s. | |
| | Mon Rocher | 94 | 13/56 | V | 2.2 | ± .68 | 1.19 | 1.65 |
| | | 104 | S17 | V | 3.85 | ± .74 | n.s. | n.s. |
| | Mauricia | 46 | 377/56 | V | 1.95 | ± .40 | 1.8 | 3.2** |
| | | 38 | S17 | V | 4.43 | ± .31 | n.s. | |
| Nouvelle Industrie | Amitié | 39 | 377/56 | V | 1.3 | ± .30 | 2.5 | 1.25 |
| | | 32 | S17 | V | 2.0 | ± .48 | n.s. | n.s. |
| SOUTH | | | | | | | | |
| Savannah | Savannah | F13/14 | 377/56 | V | 1.05 | ± .28 | 1.5 | 0.42 |
| | | F15/16 | S17 | V | 1.2 | ± .05 | n.s. | n.s. |
| Bel Ombre | St. Marie | Bois Noir 15 | 13/56 | V | 1.0 | ± .22 | 1.43 | 0.87 |
| | | Bois Noir 14 | S17 | V | 0.9 | ± .07 | n.s. | n.s. |
| Ferney | Le Vallon | 114 | 377/56 | V | 3.7 | ± .51 | 1.97 | 1.12 |
| | | 106 | S17 | V | 4.6 | ± .71 | n.s. | n.s. |
| Union | Combo | 59 | 377/56 | V | 1.2 | ± .26 | 1.27 | 0.87 |
| | | 60 | S17 | V | 0.9 | ± .23 | n.s. | n.s. |
| St. Aubin | St. Aubin | 167 | 377/56 | V | 0.55 | ± .24 | 1.25 | 0.16 |
| | | 167 | S17 | V | 0.6 | ± .21 | n.s. | n.s. |

TABLE 2 (cont'd)

| AREA | SITE | FIELD NO. | VARIETY | AGE | MEAN ($\bar{x}$) NO. OF BORED JOINTS PER CANE | STANDARD ERROR OF $\bar{x}$ | 'F' | 't' |
|---|---|---|---|---|---|---|---|---|
| SOUTH | | | | | | | | |
| Benares | Benares | 82 | 377/56 | V | 0.2 | ± .16 | 1.05 | 1.8 |
| | | 83 | S17 | V | 0.6 | ± .15 | n.s. | n.s. |
| CENTRAL | | | | | | | | |
| Reunion | Trianon | 119 | 13/56 | V | 2.35 | ± .43 | 1.46 | 1.89 |
| | | 119a | S17 | V | 1.3 | ± .36 | n.s. | n.s. |
| M.D.A. | Minissy | 57 | 377/56 | V | 0.65 | ± .24 | 2.75* | - |
| | | 56 | S17 | V | 0.3 | ± .15 | | |
| | | 55 | 93/48 | V | 0.3 | ± .15 | 1.32 | 0.45 |
| | | 56 | S17 | V | 0.3 | ± .15 | n.s. | n.s. |
| WEST | | | | | | | | |
| Medine | Medine | 69-71 | 13/56 | V | 13.41 | ± .58 | 1.87 | 3.52*** |
| | | 72-75 | S17 | V | 7.18 | ± .42 | n.s. | |
| | Albion | 24 | 377/56 | V | 10.58 | ± .73 | 1.54 | 0.12 |
| | | 22-23 | S17 | V | 6.89 | ± .57 | n.s. | n.s. |
| | Pierrefonds | 96 | 13/56 | V | 2.98 | ± .37 | 1.02 | 1.01 |
| | | 102 | S17 | V | 2.91 | ± .38 | n.s. | n.s. |
| | Cascade | 21 | 13/56 | V | 2.3 | ± .21 | 2.65* | - |
| | | 20 | S17 | V | 3.6 | ± .75 | | |

V = virgin cane
n.s. = not significant at the 5% level
* = 5% P 1%

** = 1% P .1%
*** = P .1%

# LEPIDOPTERA

## INTRODUCTION

Several papers have been published from time to time on the lepidoptera of the Mascarene Islands. The latest of these, which includes Mauritius, is one published by J. Vinson (1939). Several short papers have been published since this date, but on one or two species only.

Vinson's list includes some 313 species of Lepidoptera which have been found in Mauritius.

During July and August of 1970 Lepidoptera were collected mainly by means of a Robinson type mercury vapour light trap which was kindly loaned to us by the Mauritius Sugar Research Institute. For the first two weeks the light trap was run at Reduit and was then moved to Floreal for the final four weeks.

The specimens were identified using the collections at the British Museum (Natural History).

About 185 species were found in Mauritius and at least 44 of these were new to Vinson's list (marked*). Also several possibly undescribed species (marked **) were taken, the most notable of which is one listed under Gracilariadae . This is probably a new species as the specimen has a rather characteristic pattern of markings on the wings which should lend it to easy identification if the species has already been described. The wing venation is also somewhat uncharacteristic and the wing shape differs from that of most other species of this family.

## References

Vinson, J. 1939. Lepidoptera of the Mascarene Islands. Mauritius Institute Bulletin 1

## List of species

Danaidae

Danaus chrysippus Linn.

Common Flicq, Belle Mare, Pointe aux Sables.

Papilionidae

Papilio manlius Fab.

Common Floréal.

Papilio demodocus Esp.

Generally abundant throughout the island.

Nymphalidae

Hypolimnus misippus Linn.

Common Flicq en Flacq, Pointe aux sables.

Precis rhadama Bdv.

Common Pointe aux sables.

Nepta froebenia Fab.

Uncommon Macchabee Forest, Perièr Reserve.

Phalanta phalanatha Dr.

Pointe aux Sables, Floréal.

Satyridae

Henotesia narcissus Fab.

Generally common.

Melanitis leda Linn.

Generally common.

Pieridae

_Catopsilia florella_ Fab.

Fairly common Florèal, Pointe aux Sables.

_Eurema floricola_ Bdv.

Very common Pointe aux Sables.

Lycaenidae

_Syntarucus telicanus_ Lang.

Common Pointe aux Sables.

_Cacyreus lingeus_ Cr.

One at Florèal in the beginning of August.

_Zizeeria knysna knysna_ Trim.

Generally Common.

_Lampides boeticus_ Linn.

Common Pointe aux Sables.

Hesperiidae

_Panara marchalii_ Bdv.

One taken in Florèal 25.7.70

_Pelopidas borbonica_ Bdv.

Common Florèal, Pointe aux Sables, Pointe aux Pimentes.

Sphingidae

_Acherontia atropos_ Linn.

Common Reduit, Florèal.

_Macroglossum milvus_ Bdv.

Common Florèal.

Coelonia solani Bdv.

One at Reduit and one at Floreal.

Daphnis nerii Linn.

One at Reduit and one at Floreal.

Herse convolvuli Linn.

One at Reduit and one at Floreal.

*Hippotion aurora gloriosana Roths. & Jord.

One at Reduit and one at Floreal.

Hippotion celerio Linn.

Common Floreal, Reduit.

Hippotion eoson Cr.

Common Floreal, Reduit.

Noctuidae

Erebus walkeri Butl.

One taken at Reduit.

Achaea mercatoria Fab.

Common Floreal and Reduit.

Achaea finita Guen.

Common Floreal and Reduit.

Achaea trapezoides Guen.

Common Floreal and Reduit.

Achaea lienardi Bdv.

Common Floreal and Reduit.

Spodoptera mauritia Bdv.

Common Floreal and Reduit.

*_Spodoptera littoralis_ Bdv.

Common Floreal and Reduit.

_Spodoptera cilium_ Guen.

Common Floreal and Reduit.

_Plusia chalcites_ Dsp.

Common Floreal and Reduit.

*_Plusia transfixa_ Walk.

Fairly common Floreal and Reduit.

_Plusia indicator_ Walk.

Common Floreal and Reduit.

_Plusia orichalcea_ Fab.

Common Floreal and Reduit.

_Plusia limbirena_ Guen.

Common Floreal and Reduit.

_Grammodes goemetrica_ Fab.

Fairly common Floreal.

_Chalciope hyppasia_ Cr.

Not uncommon Floreal, Isle aux Cerfs, Port Louis

*_Sesamia calamistis_ Hmps.

One at Reduit 29.7.70

_Sesamia vuteria_ Stoll.

Common Floreal and Reduit.

_Leucania loreyi_ Dup.

Common Floreal and Reduit.

*Leucania pyrausta* Hmps.

Common Floreal.

**Leucania infrargaurea* Saalm.

Common Floreal.

*Borolia dialeuca* Hmps.

Common Floreal.

*Caradrina ignava* Guen.

Common Floreal.

*Caradrina pigra* Bdv.

Common Floreal and Reduit.

**Parastichtis nigricostata* Hmps.

One taken at Floreal.

*Brithys pancratii* Cyr.

One at Floreal and Reduit.

*Laphygma exigua* Hubn.

One taken at Floreal.

*Perigea pauperata* Wlk.

Common at Floreal and Reduit.

*Perigea conducta* Walk.

Common at Floreal and Reduit.

*Trichea consumma* Wlk.

Two taken at Floreal.

*Mocis rependata* Fab.

Common at Floreal and Reduit.

*_Nigramma polymorpha_ Hmps.

Two taken at Floreal.

_Callopistria maillardi_ Guen.

Common at Floreal and Reduit.

_Anua tirrhaca_ Gram.

One taken at Reduit.

_Gonitis leona_ Sahs.

One taken at Floreal.

_Polydesma umbricola_ Bdv.

One taken at Reduit.

_Ericeia inangulata_ Guen.

Common at Reduit.

_Anomis flava flava_ Fab.

One taken at Reduit and two taken at Floreal.

_Eutelia blandiatrix_ Guen.

Two taken at Floreal.

*_Hypocala rostrata_ Fab.

One taken at Floreal.

*_Polia consanguis_ Guen.

Not uncommon Floreal.

_Paradesna virgulana_ Mab.

Common Floreal and Reduit.

_Nycteola mauritia_ Joan

One taken at Floreal.

*_Gyrtothripa pusilla_ Moore

One taken at Floreal.

*Erias biplaga* Walk.

One taken at Floreal.

*Heliothis armigera* Hubn.

Common Floreal and Reduit.

*Agrotis ipsilon* Hufn.

Common Floreal and Reduit.

*Gesonia obeditalis* Wlk.

Common Floreal and Mt. Ory.

*Megaluba moestalis* Wlk.

Common Reduit and Mt. Ory.

*Ozarba perplexa* Saalm.

One taken at Floreal.

**Hydrillodes uliginosalis* Guen.

Several taken at Floreal and Reduit.

*Rivula dispar* Joan.

One taken at Floreal.

**Rivula dimorpha* Fryer

Two taken at Floreal.

**Luceria* sp.

One taken at Reduit.

*Hypena varialis* Wlk.

Two taken at Floreal.

*Araeoptera obliquifasciata* Joan.

One taken at Floreal on Aug. 12.

*Pseudocraspedia punctata* Hmps.

On taken at Floreal on July 11.

Eratriinae

One specimen of this sub-family was taken at Floreal.

*Hypena laceratalis* Wlk.

Two taken at Floreal.

**Hypoepa* sp.

Fairly common at Reduit and Floreal.

**Myxomelia* sp.

One taken at Floreal.

*Hypena erastrialis* Wlk.

One taken on Mt. Ory.

**Simplicia pannalis* Guen.

One taken at Reduit.

*Simplicia inarcualis* Guen.

Common Floreal.

*Simplicia inflexalis* Guen.

One taken at Reduit.

*Eublemma apimacula* Mab.

One taken at Floreal.

**Eublemma neocochylioides* Guen.

One taken at Reduit.

Arctiidae

*Utethesia cruentata* Butl.

Common Belle Mare.

*Argina cribraria* Clerck

One at Floreal and Reduit.

Geometridae

Scopula minorata Bdv.

Two taken at Floreal.

Camelopteryx multicolor Joan.

One taken at Reduit.

*Gymnoscelis Rouselli Prout

Several taken at Reduit and Floreal.

Chloroclystis spp.

Four species were taken and at present these are in the Paris museum awaiting identification. ( See page 52b)

Ascotis antennaria Mab.

One taken at Floreal.

Pyralidae

Lamoria clathrella Rag.

Common Floreal and Reduit.

*Angustalius hapalscus Zell.

Not uncommon Floreal and Reduit.

*Culladia achroellum Mab.

Common Reduit, one taken at Floreal.

Crambus seychelellus Fletcher

Common Floreal.

*Crambus auronivellus Fryer

Two taken at Floreal.

Etiella zinckenella Tr.

Two taken at Reduit and one taken at Floreal.

Ephestia cautella Linn.

Common Reduit and Floreal.

Scoparia dulcis Joan.

One taken at each of the following localities:- Perier Reserve, Floreal, Petrin, Macchabee Forest.

**Scoparia sp. nov.

One taken at Floreal.

Terastia meticulosalis Gn.

One taken at Reduit.

*Diasemia monostigma Hmps.

One at Floreal 27.7.70

Ercta ornatalis Dup

Common Floreal.

*Epipagis cancellalis Zell.

One at Reduit 15.7.70

Nymphula fluctuosalis Zell.

One at Reduit.

Nymphula depunctalis Guen.

One at Floreal.

*Ambia sp.

Two taken at Floreal.

Bradnia acrospila Meyr.

One taken at Floreal.

Cataclysta coloralis Guen.

Common at Floreal and Reduit.

*Psara bipunctalis Fab.

Not uncommon, Floreal and Reduit.

*Psara pallidalis Hmps.

One taken at Belle Mare 11.8.70

Psara minoralis Warren

One taken at Floreal and one at Macchabee Forest.

Psara phaeopteralis Guen.

Common at Floreal and Reduit.

Palpita stolalis Guen.

Common at Floreal and Reduit.

Palpita unionalis Hubn.

Common at Floreal and Reduit.

Palpita indica Saund.

Common at Floreal and Reduit.

Palpita mascarenalis Joan.

Common at Floreal and Reduit.

Nomophila noctuella Schiff.

Common at Floreal.

Botys poeyalis Bdv.

Common at Floreal and Reduit.

Sylepta derogata Fab.

One taken at Floreal.

**Sylepta sp. nov.

One taken at Floreal 14.7.70

*Lamprosema indicata Fab.

One taken at Floreal 3.8.70., one at Reduit 3.8.70.

*Lamprosema sp.

One taken at Petrin 13.8.70

*Lamprosema fuscifusalis Hmps.

Not uncommon at Floreal.

Maruca testulalis Geyer

Common at Floreal.

*Lepyrodes geometralis Guen.

One at Point aux Pimentes 20.7.70, one at Floreal 29.7.70.

Hymenia recurvalis Mab.

Common at Floreal.

Bocchoris imspersalis Zell.

Not uncommon at Floreal.

Eurrhyparodes tricoloralis Zell.

One taken at Macchabee Forest, one taken at La Nicoliere.

Hapalia martialis Guen.

Common at Floreal and Macchabee Forest.

Marasmia trapezalis Guen.

Not uncommon Floreal.

Pterophoridae

*Leioptilus sp.

One taken at Floreal 12.8.70.

Trichoptilus defectalis Walk.

Common at Floreal and Reduit.

Platyptilia molopias Meyr.

Common at Floreal.

Tortricidae - Tortricinae

Crocidosema plebeiana Zell.

One at Floreal and one at Reduit.

Argyrotoxa sp.?

One taken at Reduit.

Tortricidae - Olethreutinae

Argyroploce schistaceana Snell.

One taken at Floreal 11.7.70.

*Cryptophlebia williamsi Brad.

One taken at Floreal 12,8.70.

Cryptophlebia peltastica Meyr.

One taken at Floreal 10.8.80

*Bactra venosana Zell.

Two taken at Floreal and two taken at Reduit.

Strepsicrates sp.

One taken at Floreal.

*Strepsicrates rothia Meyr.

Two taken at Floreal 10 & 11.8.70.

*Argyroploce* sp.

Several taken at Florèal.

**Laspeyresia* sp.

One taken at Reduit 15.7.70.

1 sp. unidentified

One taken at Florèal 26.7.70

Gelachiadae

*Stroga cercatella* Oliv.

One taken at Reduit 21.7.70.

Cosmopterygidae

*Cosmopteryx flavofasciata* Wlk.

Two taken at Florèal.

**Batrachedra* sp.

One taken at Reduit 21.7.70.

**1sp. unidentified

One taken at Reduit 15.7.70.

Metachandidae

Unidentified spp.

Six unidentified species, all except one taken singly at :

Florèal, Reduit, and Belle Mare.

Glyphipterygidae

*Glyphipteryx* sp.

One taken at Floreal 11.8.70.

Hyponomeutidae

*Argyresthia* sp.

One at each of the following localities : Floreal 7,8.70, Petrin 13,8.70., Macchabee Forest 13,8.70.

Gracilariadae

*Aspilpteryx grypota* Meyr.

Petrin 12.8.70.

Unidentified species

Four unidentified species each taken singly at the following localities : Macchabee Forest, Floreal, 3,8.70., Floreal 10.8.70, Reduit 15.7.70.

**1 sp. nov.

One taken at Reduit 21.7.70.

Plutellidae

Plutella maculipennis Curt.

Common Floreal

*Acrolepia* sp.

One at Reduit 21.7.70.

Metachandidae

<u>Metachanda astrapias</u> Meyr.

Common at Reduit and Floreal

Unidentified species

Possibly five species all taken at Belle Mare 16.8.70, except one which was taken at Floreal 11.8.70.

Tineidae

1 unidentified sp.

Floreal 10.8.70.

Lyonetiadae

<u>Opogona subcervinella</u> Wlk.

Common at Floreal and Reduit.

<u>Opongona omascopa</u> Meyr.

Common at Floreal and Reduit.

<u>Bedellia autoconis</u> Meyr.

One taken at Macchabee Forest

1 species unidentified

Floreal 11.8.70.

Geometridae

The four species of Chloroclystis have been identified as follows :

*Chloroclystis costicavata* Joan.

A specimen was taken at Floreal on August 10.

*Chloroclystis exilipicta* Joan.

Common Reduit and Floreal.

*Chloroclystis latifasciata* Joan.

One specimen was taken in the Perrier Reserve on August 13.

*Eupithecia graphiticata* Joan.

Common at Petrin. August 13.

# THE NEMATODE PROJECT

Sugar cane roots in Mauritius are known to be infected by the eudoparasites Meloidogyne, Pratylenchus, Radopholus, and the ecto- parasite Rotyleuchus. The frequency of these is not known, neither has the presence of Heterodera sacchari been investigated.

## Procedure

The collection of root samples from various climatic regions and soil types was carried out with the aid of Ordinance Survey, Rainfall and Soil maps.

Motile forms from washed roots were extracted by standard qualitative methods, and the roots were also examined directly after straining with cotton-blue lactophenol method.

Some soil and root samples and preserved nematode specimens were brought back to Imperial College for further examination.

Results

| No. of nematodes per 150cc. soil roots | Sample Number | % genera found |
|---|---|---|
| 0 | 13 | |
| 10 - 80 | 12<br>3, 4, 5, 6,<br>7, 8, 9, 10,<br>11, 14, 15,<br>16, 17, 18,<br>19, 20, 21,<br>22, 23, 24 | all free-living<br>Pratyle chus 70%<br>Helicotylenchus 25%<br>Radopholus - rare<br>no Heterodera |
| 640 | 2 | ditto |
| 1,500 | 1 | ditto |

Discussion

The fertility of Mauritian soils decreases with increasing rainfall and increasing age of the parent rock. Generally, the late lava flows have produced the most fertile soils. Even fields in lower rainfall areas can be productive if given sufficient overhead irrigation together with proper treatment of the rocky substrata.

Our samples were thus taken mainly from soils in such areas, i.e. those under most intensive cultivation.

As so few nematodes were obtained from each soil sample, only the most tentative conclusions can be drawn from the results. This fact is rather remarkable, as some idea of the prevalence of nematodes in cane soils and roots in other parts of the world make interesting comparisons e.g. Martin in Rhodesia found 1,000 - 25,000 per pint; in Jamaica, Mnes and Chinloy recovered 780 - 17,500 Tylenchid nematodes per pint of soil and roots.

However, Mauritius is a volcanic oceanic island and any soil and root nematodes present must therefore have been transported from other land masses. This could account for their paucity, as perhaps few were even brought here, and for some reason have not proliferated.

The most common genus found was Pratylenchus, and then Helicotylenchus. Radopholus was rare, and not Heterodera sacchari was detected.

Conclusions

(1) Very small numbers of nematodes were recovered and these did not seem to show and distinctive regional variations in the composition of their populations.

(2) No H. sacchari was recovered.

I should like to thank Mr. Williams of M.S.I.R.I. for suggesting the above project; Mr. R. Antoine for providing laboratory equipment and space; Dr. J. Bridge, Miss N. Collen and Miss F. Teare for helping

in the identification of some of the material.

N.B. - A new and undescribed species of the genus Tylenchorynchus from Reduit has been deposited with Dr. J. Bridge at Imperial College, Ashurst Lodge, to await further identification.

## References

Parish, D.H. and Feillafe, S.M. (1965) - 'Notes on the 1:100,000 soil map of Mauritius', M.S.I.R.I. occasional paper No. 22.

William, J.R., Metcalfe, J.R., Mongomery, R.W., Mathes, R. (1969) - Pests of sugar cane, Elsivia Publishing Company, New York.