JAMAICA NATURALIST

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JAMAICA NATURALISTS

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C·O·N·T·E·N·T·S

EDITORIAL

The West Indian islands are quite popular among North-American and European biologists for conducting field research. Every year, dozens of researchers visit Jamaica, and probably hundreds visit the West Indies. Most stay for only a relatively short period during which they focus all their efforts to collect data and often specimens as well. It has been a common pattern that many researchers slip in and out of a Caribbean country in the disguise of an ordinary tourist, without attempting to find and contact any local persons or institutions who might be interested in the research. They would smuggle the collected specimens and samples out of the country, without care for any local regulations; they would publish the results in a scientific journal which more often than not is unavailable locally; and they would ignore local libraries when sending out reprints. In the end, the results from many research activities remain totally unknown in the country where the research was conducted.

Not surprisingly, local people with interests in natural history have become very irritated by such attitudes. They feel that their countries are being exploited by the foreign researchers who use the local resources to advance their careers, but do not give anything back. I have witnessed prominent Jamaican and other Caribbean biologists who have expressed such feelings very strongly at important meetings.

Yet there is another side of the coin. An English herpetologist recently discovered a new species of snake in a small Caribbean country. He was very excited about it and tried to share his thrills with some local institution. But nobody seemed interested. Some visiting researchers offer to present talks but cannot find anybody to organize the event; or they end up talking to an embarrassingly small audience. Some make great efforts to observe any local regulations. Well in advance of their visit, they request permission for conducting research and collecting specimens from local authorities, but then have to wait for up to a year or more to get any reply. They might carry important research equipment and end up wasting most of their time getting it through customs. For all these reasons, many foreign researchers are very irritated as well. They want to contribute to the knowledge of Caribbean natural history, but cannot find local counterparts who would care to know.

There is some truth on both sides, and I think the two have not yet tried hard enough to overcome the obstacles. There are some good models which need to be extended:

- Collaboration with local universities and other research institutions.- Quite a few research projects are conducted with foreign and local researchers cooperating. Many forms of collaboration are possible from joint field work to co-funding and co-supervision of postgraduate students, training, sharing of resources, submission of joint research proposals for funding, and cooperative agreements between institutions.

- Collaboration with environmental NGO's.- This is becoming increasingly important with the proliferation of environmental non-governmental organizations in many countries of the Caribbean. In Jamaica, NGO's like the Natural History Society, the Gosse Bird Club, the Jamaican Conservation and Development Trust, the Jamaican Iguana Research and Conservation Group, and the South Coast Conservation Foundation have been at the forefront of such collaboration with visiting researchers.

- Collaboration with institutions managing natural resources.- The Natural Resources Conservation Authority (including its predecessors) and the Hope Zoo have a long history in collaborating with visiting researchers. More recently, NGO's with responsibilities in managing National Parks and Protected Areas have begun to collaborate with foreign scientists (occasionally to an extent that local scientists feel excluded).

- Regional and international societies. Collaboration between locals and visitors has progressed furthest among ornithologists. They have founded the Caribbean Society for Ornithology in 1989 and have since then kept annual conferences. This organization has played a crucial role in establishing and funding research projects throughout the Caribbean.

Let's face it. The number of professional and amateur biologists in the Caribbean studying local natural history is very limited. Though they have made very valuable contributions, much of what is known about Caribbean plants, animals and ecosystems has been the result of studies by visiting biologists. For instance, dozens of newly discovered Caribbean species are described every year, many of them endemic to the islands. With a few notable exceptions, this important taxonomic work has been achieved by visiting researchers. The article on Jamaican rotifers in the present issue of the Jamaica Naturalist is a point in case.

Research on Caribbean natural history has barely scratched the surface. Many species still await discovery, and for many discovered ones we have little more than a basic description of the exterior, and a type locality (the place where the described specimen was found). So much more needs to be known. Any number of local and visiting biologists will have more work on their hands than they can manage for many years to come. Thus, we should welcome the foreigners with open arms and help them to make their stay as productive as possible. At the same time, we appeal to all visiting scientists to forget about any previous frustrations and actively seek local collaboration - and to mail those reprints and free copies of books to the cash-starved regional libraries without even waiting for a request.

The present and forthcoming issue of the Jamaica Naturalist have received financial support from the Partners in Flight program, a North American initiative to conserve neotropical migrant birds. The next issue will be dedicated to this effort.

SOCIETY BRIEFS

by Dr. Eric Garraway
Past President, Natural History Society of Jamaica

During the period 1940 to 1980 there were few organizations concerned with the Jamaican natural history and the management of the environment. The Natural History Society of Jamaica (NHSJ) was thus the main torch bearer in the struggle for environmental awareness/education, environmental management, and Natural History.

Today there is a large number of Environmental Non-governmental Organizations (ENGOS); some 33 are registered members of the umbrella organization National Environmental Societies Trust (NEST), and this perhaps represents only half of the lot. The NHSJ must continue to find its place on this new stage. A cursory examination of the ENGOS will reveal a strong bias towards environmental activities and the obvious question which arises is "where are the Naturalists?"

"But what is important about natural history?" some might ask. The answer to this last question is 'elementary' since natural history is the study of all aspects of the flora and fauna. Natural history is one of the chief pillars on which the drive towards environmental management stands. The biological diversity in Jamaica is so great that at present we really have no idea exactly how many species exist; some will go extinct before they are known to us. We have been biased towards the large "pretty" organisms e.g. the birds, big butterflies and large trees, and have overlooked the more numerous but smaller groups. Moreover, we know precious little about the species we have already documented.

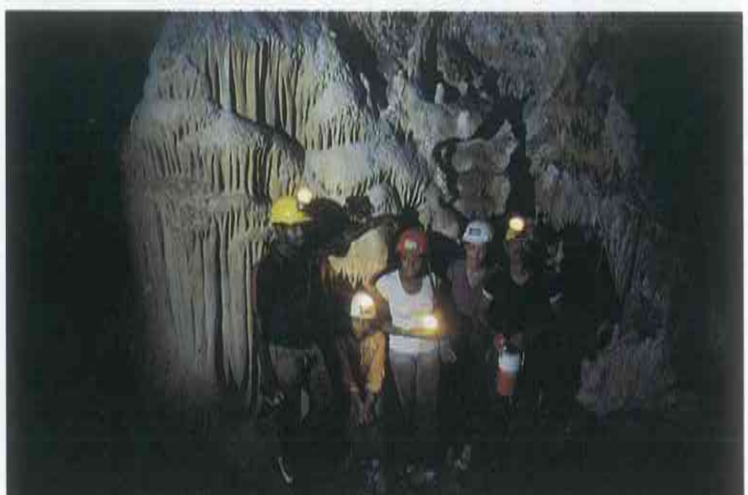
The NHSJ is one of the few organizations working on the Natural History of Jamaica. Against this background, it is essential that the society relentlessly peruses the study and dissemination of information on Jamaica's Natural Heritage. In this way it will be able to supply vital information to other ENGOS and government organizations.

The NHSJ has risen to the challenge by the recent publication of the Blue Mountain Guide and the continued publication of the Jamaica Naturalist.

The NHSJ is well suited for the task as it has among its membership a diverse group of citizens with tremendous knowledge and expertise. It also has in its archives five decades of "Natural History Notes" an inhouse magazine which was the predecessor of the Jamaica Naturalist. The Natural History Notes include not only contributions from stalwarts such as C. Bernard Lewis, R.P. Bengry, Lilly Perkins, Garth Underwood, Thomas H. Farr, George R. Proctor, James Bond and G.F Asprey, but importantly, contributions from the broad membership as well.

Steps are now being taken to make portions of this material available to the wider public. This would not be new, back in 1949 sections of the Natural History Notes were published by the Institute of Jamaica as "Glimpses of Jamaican Natural History" Vols. I and II.

The NHSJ must continue to strive towards its aim "to study the Jamaican environment and promote its conservation with special regard to the flora and fauna".

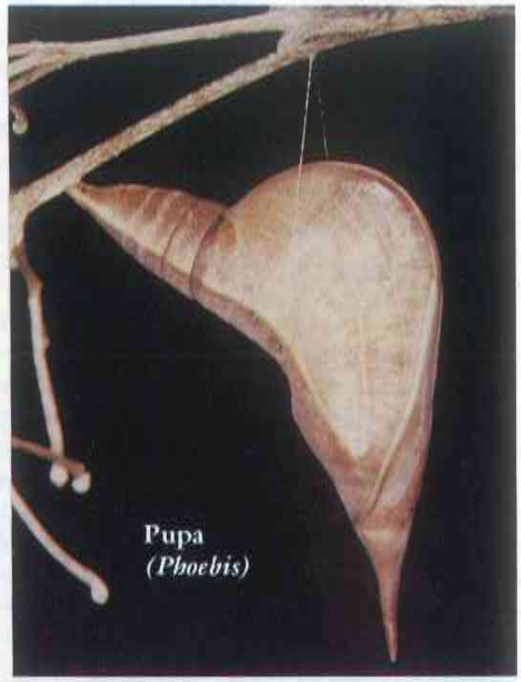


Field trip of the Natural History Society of Jamaica to Jackson Bay Cave.

The Blue Swallowtail and other Butterflies in Rozelle

by Audette J. A. Bailey, Department of Zoology, UWI, Mona.


Blue Swallowtail (*Eurytides marcellinus*)


Pupa (*Phoebis*)


Blue Swallowtail: 5th instar


Cassius Blue (*Leptotes cassius*)


Pyrgus oileus


Jamaican Dynamine (*Dynamine egaea*)

Jamaica is the home of 120 species of butterflies including seven swallowtails. Swallowtails are among the larger and more colourful butterflies worldwide. They are so named because the hindwings have extended tips called tails. The Blue Swallowtail (*Eurytides marcellinus*) and the Giant Swallowtail (*Papilio homerus*) are found only in Jamaica. The Natural History Society of Jamaica has adopted the Blue Swallowtail as its logo.

EARLY OBSERVERS

Eurytides was first illustrated by Sir Hans Sloane in 1725. Sloane you may recall, was the physician of Duke Abermale, former Governor of Jamaica and one of our naturalists in the 1700's.

The Natural History Society started collecting information on the Blue Swallowtail and other butterflies of Jamaica since its inception in the 1940's and these records are published in the Natural History Notes. Early observers of the Blue Swallowtail included Captain D. J. N. Walker of Up Park Camp, students of Jamaica College, and C. B. Lewis of the Institute of Jamaica.

In the 1940's and 50's it was not unusual to see large numbers of *Eurytides* flying in the vicinity of Jamaica College, Half Way Tree and Long Mountain. In 1953, C.B. Lewis reported seeing thousands of butterflies flying from east to west on May 31 through to June 2.

THE ONLY KNOWN BREEDING SITE

During the 60's and 70's, the Blue Swallowtail seemed to have declined dramatically though few people took notice of it. In the early 1980's interest in the Blue Swallowtail was revived and the only known breeding site in Rozelle, St. Thomas was visited by members of the Society. The team was led by Dr. Thomas Farr who later published the description of the fifth stage (instar) caterpillar in the Natural History Notes.

Soon after this visit, members of the society discussed the need for a detailed study of the ecology and biology of the butterfly and consequently a proposal was written and possible funding sources examined. Negotiations were also held with the managers of the Coptic Farms in St. Thomas on the preservation of the breeding site. The project was shelved due to lack of manpower and financial resources needed to implement it.

In November 1990 when Dr. Eric Garraway and myself began a detailed study of the Giant Swallowtail, we also set out to gather information on the life history of as many butterfly species as possible. Among them was the Blue Swallowtail. Time did not allow us to begin our search for the Blue Swallowtail until June 1992.

A FIELDTRIP TO ROZELLE

On the morning of June 17, 1992 we departed for Rozelle. We were accompanied by Dr. Margaret Hodges, a participant in the previous Natural History Society trip. Margaret remarked that she remembered very little - but throughout the day what appeared to be unimportant information to her, proved otherwise.

On arriving in Rozelle, we made our way up a dirt road that led to the more forested areas. The team was halted by a flash of blue, as a butterfly swooped to the ground. Thinking that this might be *Eurytides*, we parked the vehicles and went in search of the butterfly. We soon found the bright blue and black butterfly perched in the road. It was *Eurytides*!

We drove up the road for a few more minutes before we decided to continue on foot. As we hiked, we searched every tree that looked like the caterpillar's food plant, Black Lancewood (*Oxandra lanceolata*).

We also spent some time to observe other butterfly species: *Anteos maerula maerula* was seen drinking from recent deposits of cow dung (at least twelve were observed at one site) and *Battus polydamus jamaicensis* seemed to be enjoying the nectar of Orange Sage (*Lantana camara*). *Mestra dorcas*, by far the most abundant of the species in the area glided lazily in and out of the shrubs while *Marpesia eleucha pellenis* hovered in the distance over shrubs and trees. Other butterflies encountered were *Papilio thersites* and *Anaea troglodyta portia*.

We hiked for what seemed like forever, until the road narrowed into a track. We thought of abandoning the trip but on Margaret's persistence we continued.

At about noon, we arrived at what seemed to be a small farm. An area of the forest was sealed off by a gate made from barbed wire and thin logs. We had encountered such barriers before in the Rio Grande Valley, where small farmers seal off areas of the forest for cattle rearing, so we assumed we could let ourselves in. Soon after that, we came across a stand of trees which looked familiar to Margaret and our search of all branches began in earnest; 'at eyelevel' according to Margaret.

BLUE SWALLOWTAIL 'AT EYE LEVEL'

Success came shortly after, when the stillness of the air was interrupted by an excited voice announcing a caterpillar find. Margaret had found a *Eurytides* caterpillar and we were now certain of the foodplant. With more adrenaline flowing through our veins we searched branch after branch. Soon we became familiar with the location of the caterpillars which were found resting singly, 'at eyelevel', and on the upper surfaces of leaves or stems.

At the end of the search we had nine caterpillars with a range of colours. We found out later that there are three colour forms of the caterpillar; thus the caterpillar is showing colour polymorphism.

Though we were pleased that we encountered these butterflies we were still hoping to see the large numbers of Blue Swallowtail recorded in the 1940's and 50's, but this was not to be. On our return trip we only saw two more *Eurytides* which stopped at a flower to feed. One did not escape the net of the collector and was photographed and released.

Continuing our descent, we sighted *Dynamine egaea egaea*, various *Eurema* species, some blues, *Dione vanillae insularis*, *Pyrgus oileus*, *Adelpha abyla*, more *Mestra dorcas* and numerous tortoise beetles and fiddler beetles (sometimes called policeman beetle (*Exopthalmus* spp.). As we neared the end of the dirt road we caught sight of pupa and stopped to investigate. We discovered 21 pupae of this kind (three different colour forms), green caterpillars feeding on a legume, two pale purple caterpillars feeding on *Passiflora perfoliata* (of the Passion fruit family), and brown iridescent caterpillars feeding on Blue Vervain (*Stachytarpheta* spp.). We collected all pupae and caterpillars along with larval food plant.

BACK IN THE LAB

Exhausted, but satisfied with our find we departed Rozelle and headed for Kingston. On returning to the laboratory, we placed the caterpillars and pupae in plastic cages which contained moist paper towel and waited patiently for metamorphosis to occur. The caterpillars were fed daily and the cages cleaned.

Five of the *Eurytides marcellinus* emerged within 7-10 days after pupation but one did not emerge until four months later. This adult emerged after the pupa was placed in contact with the moist paper towel.

All twenty-one pupae collected died. One parasitic wasp of the genus *Spilochalcis* (Family: Chalcidae) emerged from each of twenty pupae collected and one pupa was preyed on by an unknown predator. These pupae could have been those of a large yellow butterfly, *Phoebis* spp.

The butterflies produced from the brown iridescent, pale purple and green caterpillars were *Junonia genoveva* (Buckeye), *Heliconius charitonius simulator* (Zebra) and *Anteos maerula maerula* respectively.

MORE FIELD VISITS NEEDED

For avid and prospective butterfly observers Rozelle provides a wide variety of species which can be found in lowland areas. It is also less than an hour's drive from Kingston and interested persons need only spend half a day on a collecting/ photographing trip. The road to the forest though not paved, was drivable until after the heavy rains of May 1993. However, the trail to the forest is very good. The area is very hot and dry and collectors must equip themselves with plenty water.

We will continue to visit Rozelle as time allows but we hope that those interested in learning more about Jamaican butterflies and other insects will join us on future trips.

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Maerula (*Anteos maerula*)

Jamaican Goatweed Butterfly (*Anaea troglodyta*)

Dorcas (*Mestra dorcas*)

Buckeye (*Junonia genoveva*)

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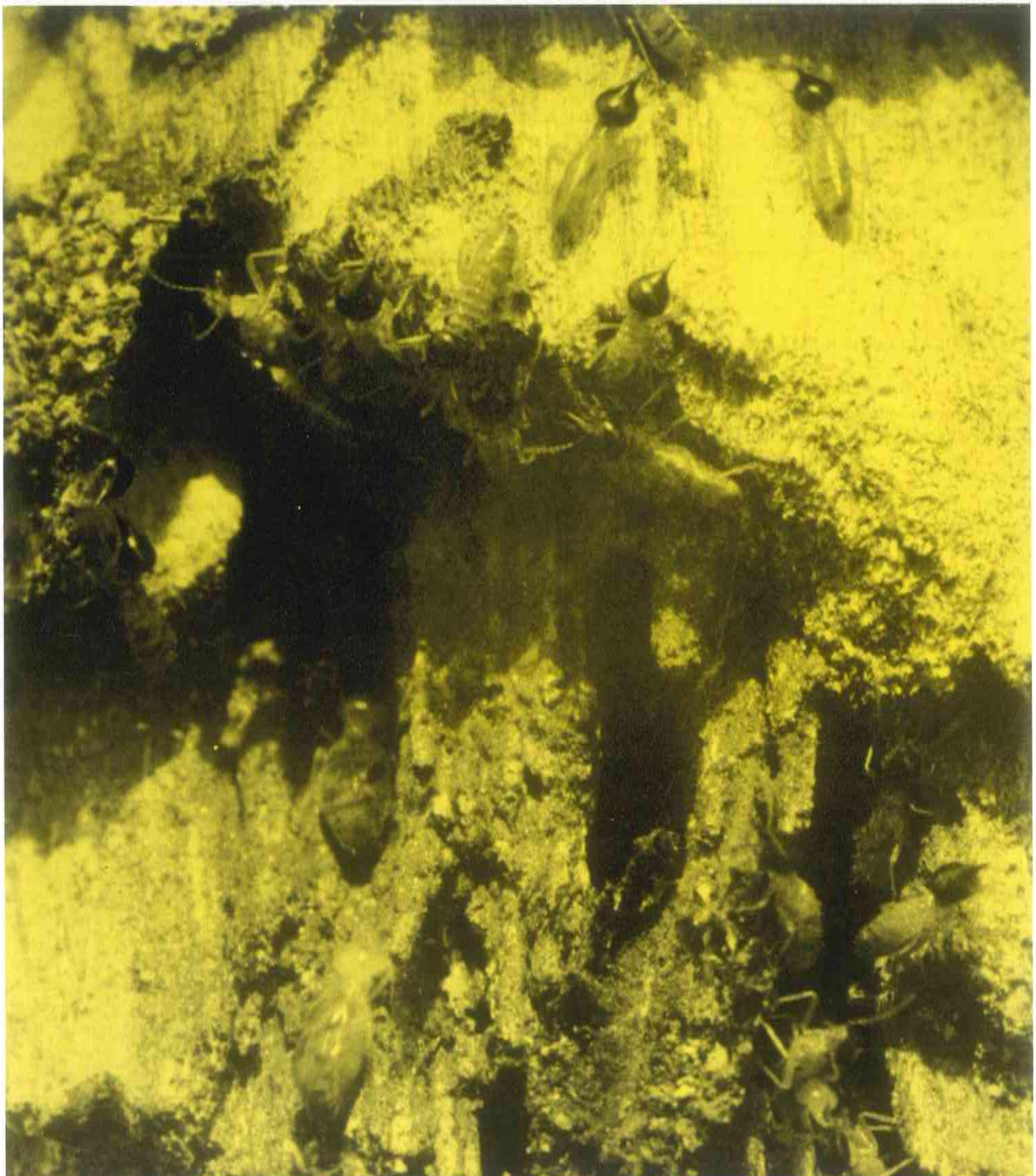
The Natural History of Termites of Jamaica

by Pamela Clarke, Department of Zoology, UWI, Mona



INTRODUCTION

Termites are distributed mainly in the tropics with species inhabiting forests and structures associated with human habitation. This chronic association has inspired numerous studies of the biology and control of termites. Intensive studies of Jamaica's termites commenced at the University of the West Indies in 1986.

The termites (order Isoptera) consist of five families: Mastotermitidae, Hodotermitidae, Rhinotermitidae, Kalotermitidae and Termitidae. The first four families are collectively termed lower termites, while species of the family Termitidae are referred to as higher or advanced termites.

THE TERMITES OF JAMAICA

Termites are commonly referred to as white ants and in Jamaica, they are colloquially called duck ants or chi-chi. This erroneous classification of termites as ants arises from their superficial resemblance. Two simple diagnostic features that may be used to distinguish termites are 1) their soft and generally white bodies and 2) the absence of a "waist" (constriction between the thorax and abdomen).

There are seventeen species of termites in Jamaica (see Box). In contrast to many other animal groups, none of these species are endemic to the island but also occur in other regions. Jamaica's termites represent three of the five families:

Kalotermitidae are collectively called dry-wood termites. As the name implies, they inhabit wood which provides both shelter and food. These species of termites are well-known to man because they voraciously consume domestic and commercial items containing cellulose (eg. furniture and wooden frames of buildings). *C. brevis* is the most common pest of building timber. The ingested wood particles are digested by flagellated protozoa (specific to lower termites and their ancestors). The excrement or frass is released as small, dry pellets, which filters through the holes of the wood. These pellets are used as indicators of the presence of drywood termites.

Rhinotermitidae consist of the popular subterranean and damp-wood termites. Subterranean termites build nests below the surface of the ground from which they radiate in search of food. They are rarely seen, but their presence can be confirmed by their trails that provide an indispensable link with the moist underground. The often complicated nests have many different parts and house large populations. The parent nest is the original nest containing the reproductives. The subsidiary nests constructed after the completion of the parent nest are usually designated for various functions such as brood chambers and food reserves. Multi-regional nests with specialized sections offers many escape routes and enhance the resilience of subterranean termites to insecticides. However, interaction between nests facilitates the spread of introduced toxic substances.

Termitidae include the arboreal termites which also construct large, complex multi-regional nests with intricately designed walls. Nests are not restricted to trees but are built on walls and roofs of buildings. These nests grow to very large sizes to accommodate the continuously increasing colony. The most common species is *N. nigriceps*, which is found in diverse habitats of Jamaica. The behaviour and social system of the family Termitidae are more complex and highly organized than in the lower termites; consequently, they are capable of more efficient foraging, defence of nests and regulation of colony size.

SOCIAL AND CASTE SYSTEM

All termites exhibit the highest form of sociality known in animals; the system (termed eusociality) is characterized by the presence of a non-reproductive caste ("workers", "soldiers" and other specialists), overlapping adult generations and cooperative brood care. The non-reproductive individuals develop from fertilized eggs; this is different from the social Hymenopterans (bees, ants, social wasps) where the workers develop from unfertilized eggs. The non-reproductive castes forgo reproduction of their own; instead they stay in the parent nest and help their mother and father to rear additional brothers and sisters. This is known as reproductive altruism.

Nine different castes have been identified in termite colonies, but the full complement never occur simultaneously in a single nest. Immature termites can be separated into two groups depending upon the presence of wings into apterous (wingless) and brachypterous nymphs; these two forms are also called larvae and nymphs, respectively. The remaining castes are referred to as adults because of their potential for further development and are subdivided into sterile and reproductive individuals. Both groups are morphologically and physiologically adapted for specific functions. Super-specialization of castes enables greater efficiency in the execution of jobs and ultimately enhances the success of colonies.

The sterile castes include the workers and soldiers. The true worker caste, characteristic of advanced termites, does not differentiate into other castes. Workers are the most numerous and frequently observed caste because they are responsible for carrying out the daily activities such as collecting food, cleaning, brood care, and nest construction. A more rigid body wall permits activities outside of nests (but restricted to self-constructed trails). They also possess well developed mandibles for manipulating nest material and food, which is stored in their elongated guts that occupy the space created by the reduced non-functional gonads.

Soldiers are a specialized group of workers and their sole responsibility is to defend the nest. The method of defense varies from species to species. In some termites, the soldiers have strong, well developed mandibles which are used to inflict physical damage to enemies. The structure of these mandibles range from the typical biting forms (eg. *P. corniceps*) to the symmetrical snapping mandibles (eg. *T. hispaniole*). In some soldiers, the heads are enlarged ("phragmotic") and used to block the entrance of nest entrances (eg. *C. brevis*).

Phragmotic soldiers are usually less numerous and shy away from combat outside of nests. Soldiers of the genus Nasutitermes engage in chemical warfare with their opponents. These soldiers possess black, elongated heads ("nasus") through which a sticky substance is emitted. Amazingly, nasute soldiers like other sterile castes do not have eyes, but still are capable of precise aim.

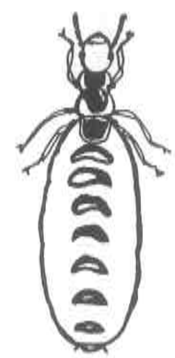
The reproductive caste, referred to as kings and queens, are highly prized in colonies and do not participate in daily menial chores. Their only function is for procreation. Founders and replacement reproductives are usually derived from seasonal "alates" which develop from immature apterous individuals. These winged forms are known as rainflies because their time of development and swarming coincides with the rainy season. Large numbers of alates are released simultaneously from nests and are frequently seen clustering around lightbulbs. Reproductives may also originate from sterile castes, which have rudimentary gonads that are activated in the absence of kings and queens. This phenomenon is more prevalent in lower termites.

The number of reproductives per colony varies from species to species, and even within a species. Some colonies are maintained by a single pair of reproductives. Generally, queens exhibit a high fecundity that is directly related to colony size. Queens of advanced termites generate and maintain larger colonies than those of lower termites, therefore they have more ovarioles in greatly swollen abdomens.

Since termite individuals perform specialized jobs, it is important for a nest that there is the right number of specialists for every job to be done. This is achieved by a complicated system of chemical communication between the nest mates. The "messenger" chemicals are distributed in various ways, for instance by exchange of food ("trophallaxis") and by grooming.

Worker

Nasute



Queen

ECONOMIC IMPORTANCE

The diet of termites is not only restricted to wood but includes a wide variety of plant material such as grass, herbs and roots. Many species consume both living and dead plant tissues and therefore are considered pests of household items, forestry and cultivated crops (e.g. sugar cane). Consequently, each year a large amount of money is spent on the development of efficient methods to control termites.

Man's narrow perception of termites is clearly evident in the word termite being synonymous to pest, but termites are of great ecological importance to the ecosystem of forest communities. They play an important ecological role in the recycling of nutrients by being primary decomposers of a wide range of cellulose and non-cellulose material. They consume food at varying degrees of decay and so participate at different levels in the decomposition process. Due to their high consumption rate, efficient assimilation, and large population size, termites are important agents of energy transfer in the ecosystem.

Subterranean termites not only improve the fertility of soil by translocating food material but, by their burrowing activity aerate and drain the soil and more importantly facilitate penetration of roots. The role of termites in maintaining soil quality in the tropics is now equated to that of earthworms in temperate regions.

The high protein content of termites (especially in queens and eggs) and their large perennial populations make termites a cheap and abundant food source. Some species of ants, birds and other animals depend almost exclusively on termites. Also, many tropical people supplement their diet with termites; it is believed that this food enhances reproductive ability. Oil extracted from termites may be used for cooking and is said to taste like butter. Cooked termites are very palatable to humans who have abandoned their prejudices; the flavour has been described as superior in taste to shrimps.

Uses of termites are not restricted to the insect per se, but may extend to their nests. Some termites construct huge nests which may be used for various purposes. As early as 1877, abandoned *Nasutitermes* nests were used as smudges to repel mosquitoes, and this practice is still very much alive in Jamaica's countryside. More recently, nests have been used to make roads, tennis courts, pottery and bricks.

Within their natural habitats, termites are of paramount importance to the sustainability of the community, whereas in man's surroundings, they are considered pests. One should therefore re-identify the pest: is it man who has invaded the habitats of termites and disturbed the status quo or termites that are making a remarkable endeavour to survive in a changing environment?

Some primal termite
knocked on wood,
Tasted it and found it good.
That is why your cousin May
Fell through the parlor
floor today.

Ogden Nash

TERMITES OF JAMAICA.

After: Snyder, T.E. 1956. Termites of the West Indies, Bahamas and Bermuda. Journal of Agriculture of the University of Puerto Rico 60: 189-201.

KALOTERMITIDAE

Cryptotermes brevis (Walker)
Glyptotermes liberatus (Snyder)
Glyptotermes posticus (Hagen
Incisitermes schwarzi (Banks)
Incisitermes milleri Emerson
Neotermes castaneus(Burmeister)
Neotermes n. sp.
Procryptotermes corniceps Snyder

RHINOTERMITIDAE

Heterotermes convexinotatus (Snyder)
Heterotermes tenuis (Hagen)
Coptotermes havilandi Holmgren
Prorhinotermes simplex (Hagen)

TERMITIDAE

Nasutitermes nigriceps (Haldeman)
Nasutitermes costalis (Holmgren)
Nasutitermes rippertii (Rambur)
Nasutitermes hubbardi Banks
Termes hispaniolae (Banks)

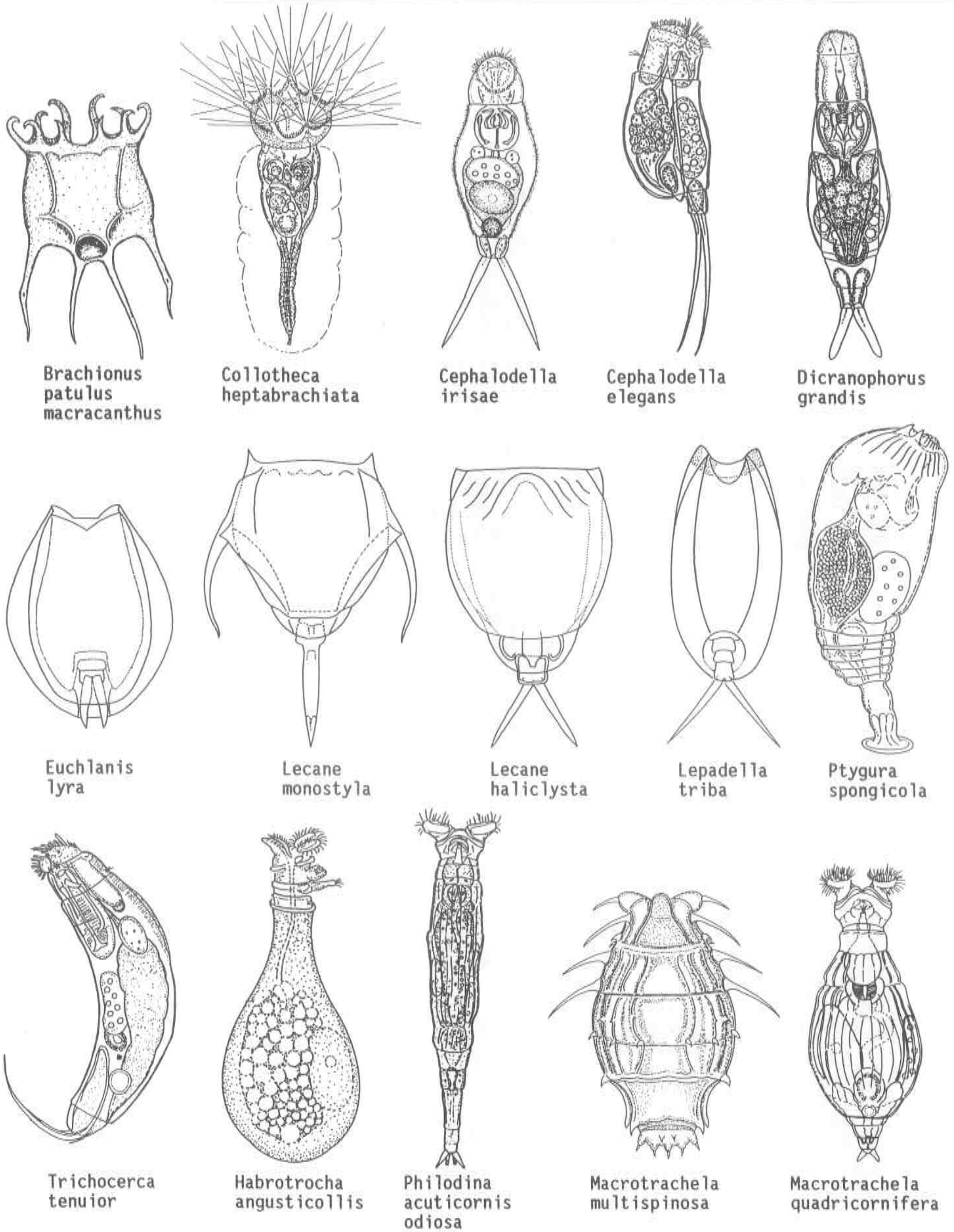


Fig. 1 - ***Rotifers of Jamaica***

Rotifer of Jamaica: Ecology, Diversity and Biogeography

Wolfgang Janetzky, Walter Koste and Ekkehard Vareschi, Carl von Ossietzky Universität Oldenburg ICBM - AG Aquatische Ökologie, Postfach 2503, 26111 Oldenburg, Germany

ROTIFERS !?

Rotifers (Rotatoria: Aschelminthes, Fig. 1) are microscopically small animals with a length of 0.04 mm to 2.5 mm. Their body can be divided into head, trunk and foot. The head bears the corona which can be formed in various ways. Especially within the bdelloid rotifers, such as *Philodina acuticornis odiosa* or *Macrotrachela quadricornifera* (Fig. 1), the cilia of the corona are separated into two parts, called trochal discs. In living animals, the trochal discs with their beating cilia resemble rotating wheels, which is why these animals were called 'rotifers' or 'wheel animalcules'. The trunk forms the major part of the body. Within the bdelloid and in some species of monogonont rotifers it consists of 15 to 18 pseudosegments which can be retracted like a telescope (e.g. *Philodina acuticornis odiosa*, Fig. 1), whereas in most monogonont rotifers the cuticle forms an encasement (lorica) often ornamented with ridges, spines or appendages (e.g. *Lecane monostyla*, Fig. 1). Instead of a lorica, some rotifers construct an encasement from their own secretion (e.g. *Collotheca heptabrachiata*, Fig. 1) for protection against predators. The foot is very short in planktonic rotifers, but fairly long in sessile and crawling ones. The long foot allows the latter species to attach themselves to the substrate and extend their corona as far as possible into the water in the search for food.

Depending on the structures of both corona and mastax, rotifers show various feeding strategies. Filter feeders are mainly sessile and planktonic organisms which produce a water current with their coronal cilia towards their mouth to sweep minute organic particles into a food groove. In contrast, *Euchlanis* (Fig. 1) grazes, feeding on epiphytic diatoms. Carnivorous rotifers like *Dicranophorus* catch and hold their prey with a forceps like trophi, break them up and commonly discard indigestible parts after feeding. Sessile Collothecacea (e.g. *Collotheca heptabrachiata*, Fig. 1) trap their prey with contracting cilia. Some rotifers are parasites: *Balatro clavus* lives as an endoparasite in enchytraeids and as an ectoparasite on limnetic oligochaetes.

Various forms of reproduction are found in rotifers, possibly as an adaptation to colonize various habitats, especially temporary waters. Strict bisexual reproduction is the exception and restricted to the marine family Seisonidae. In most rotifers, females reproduce by parthenogenesis, i.e. through the development of unfertilized eggs. Some species switch between parthenogenesis and bisexual reproduction (heterogony). Males are totally absent in many species; where they exist, they are much smaller and shorter lived than females and their bodies are not fully formed. Bisexual species produce fertilized resting eggs which are able to sustain harsh environmental conditions such as severe droughts.

LIVING IN A HIDDEN WORLD

A few rotifer species (ca. 50) are exclusively marine or capable of living in both sea and brackish water (ca. 150 species). However, most rotifers (ca. 1400 species) typically inhabit freshwater environments including extreme habitats such as hot springs (with temperatures up to 50 degrees Celsius), and the upper layer of the Antarctic ice, where the animals can only be active when the sun occasionally melts the surface. Within running water, rotifers are mainly restricted to areas of low current, such as the aquatic vegetation. Subtropical or tropical running waters often have 'swimming meadows' of aquatic plants such as the water-hyacinth Eichornia crassipes, a common species in the Black River Morass. In the root system of these plants, a special rotifer community may be established. Rotifers are most common in standing waters including lakes, pools and aquatic microhabitats such as 'Phytotelmata' and 'Gastrotelmata'.

Phytotelmata (Greek, meaning 'plant pool') are small water bodies within depressions provided by plants. Such habitats can be found in tree holes, in the blossoms of Heliconia species or in bromeliads ("wild pines"). The leaves of bromeliads are arranged so that rainwater is funnelled towards the leaf axils, where it forms a temporary or even permanent pool (Koste et al. 1991, 1993).

The term Gastrotelmata was given by Koste et al. (1993) to the small puddles of rainwater that collect in empty snail shells lying on top of the soil. The genesis of these microhabitats mainly depends on the wet season; the limnological features are determined by the chemical composition of the rain (pH, leaching of nutrients), debris stored in the shells (nutrients) and the buffering capacity of the shell itself, which is partly composed of calcium. Especially in karst regions such as the Cockpit Country where rainwater is drained immediately, these habitats are used for breeding, for example by the aquatic life stages of beetles (Janetzky et al. 1994, Koste et al. 1993, 1994).

So far, only 34 rotifer species have been described from Jamaica. De Ridder (1977) found eight species in a ditch near The Flashes (Great Salt Pond) and a concrete basin near the chapel of the U.W.I. campus. Collado et al. (1984) listed a further 7 species, and Koste et al. (1991; see Jamaica Naturalist Vol.2, 1993) detected 19 species in bromeliad phytotelmata. These results encouraged us to investigate the presence and distribution of rotifers in limnetic systems of Jamaica, which could be seen as 'terra incognito' with regard to the rotifer fauna.

RELAX WITH ROTIFERS

Fig. 2 *Map of Jamaica showing the main study sites.*

Samples containing rotifers were taken during our second research project on the community ecology in bromeliad-phytotelmata in the Cockpit Country. For additional sampling, different areas representing the geographical and meteorological variations of the Jamaican landscape were chosen (Fig. 2).

We collected samples with plankton nets (mesh size 56µm and 30µm, respectively) or with a syringe from microhabitats. In the Black River Morass we sampled from a boat, which gave us an opportunity to combine the hunting of rotifers with a crocodile photo safari. Most of the samples were fixed in formalin (final concentration 5%), but whenever there was a chance, we sent live specimens for determination.

ROTIFERS OF JAMAICA

During our field studies (in August 1993 and May 1994) 156 samples were taken and 205 different types of rotifers could be detected: 179 species in 38 genera belonging to the group of monogonont rotifers, 26 in 6 genera being bdelloid species. Especially the monogonont genera *Lepadella, Lecane* and *Cephalodella* showed high species numbers (18, 45 and 19 species, respectively), whereas other genera were represented with only one species (e.g. *Keratella, Taphrocampa*; Table 1).

We should mention the difficulties in identifying rotifers: bdelloid species as well as those rotifers without a lorica or with thin integument (e.g. *Cephalodella, Dicranophorus*) contract themselves when fixed with formalin; in these cases a determination to species level is not possible. Furthermore, bdelloid rotifers must be identified by their corona, which is only visible when the animals are moving. But very often they don't move for days and if they do, they might be too fast...

With regard to more cryptic microhabitats, we were able to give evidence of 42 species living in bromeliad phytotelmata, including *Colotheca heptabrachiata, Lecane monostyla, Ptygura spongicola, Trichocerca tenuior, Philodina acuticornis odiosa*, as well as *Macrotrachela multispinosa* and *M. quadricornifera* (Fig.1). Species numbers were lower in gastrotelmata, but at least 15 species were found, nine of them being bdelloid rotifers (e.g. *Macrotrachela multispinosa*, Fig. 1). Especially bdelloid species are capable of living in a thin water layer within mosses or leaf litter; the drying out of the habitat can be survived by drought resistance and it is most likely that species colonising gastrotelmata live in the surrounding leaf litter before the shells are filled with water.

The roots of *Eichornia crassipes* can be recognised as a separate habitat in a riverine system; the low current protects the animals from being washed away. However, the rotifer composition in these roots was very similar to those in other aquatic vegetation and the open water: Out of 82 rotifer species found in the Styx River and the Middle Quaters River, only 13 occurred exclusively in *Eichhornia*; compared to all investigated areas, only eight species were exclusively associated with *Eichhornia* (e.g. *Dicranophorus epicharis*, Fig. 1).

Out of the 205 rotifers detected during our research project, only 28 were previously known from Jamaica (Collado et al. 1984, De Ridder 1977, Koste et. al. 1991). Another six species had been listed for Jamaica but were not found in the present study. Future studies should include additional sample sites especially in central parts of Jamaica, and additional habitats such as mosses and leaf litter to show islandwide distribution patterns of rotifers. We expect that such studies will further increase the number of species known from Jamaica.

JAMAICAN ROTIFERS VS. THE WORLD

Comparing our results with data published for other islands of the Greater Antilles, it became clear that the low species numbers given for Cuba (31 species), Haiti (35), or the Dominican Republic (1 species) reflect low research activities, rather than the real diversity of rotifers (COLLADO et al. 1984, DE RIDDER 1977, LAIZ et al. 1994). As it stands, our species list shows that of the 211 rotifers known for Jamaica, only 63 have been found on other Caribbean islands, and none of these are bdelloid species.

Reviewing the literature, Pourriot (1982) stated that 'the rotifers of Central America and the Caribbean region, treated by only very few works, do not differ from those of Tropical South America'. Now that we have such a large sample to be compared with the published data on neotropical rotifers, we can say that 90% of the Jamaican species also inhabit South America.

There is more to learn about limnetic rotifers in Jamaica and elsewhere in the Caribbean. As an aid to research, we are planning an 'Atlas of Jamaican Limnetic Rotifers', which should comprise descriptions and figures of all those species so far known from the island.

ACKNOWLEDGEMENTS

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Table 1.

LIST OF JAMAICAN ROTIFERS BY GENERA AND NUMBER OF SPECIES.

	FAMILY	GENUS	SPECIES
MONOGONONTA			
Order Ploimida	Brachionidae	Anuraeopis	2
		Brachionus	11
		Brachionus (Plationus)	2
		Keratella	1
		Platyias	3
	Euchlanidae	Dipleuchlanis	1
		Euchlanis	3
	Mytilinidae	Lophocharis	1
		Mytilina	2
	Trichotridae	Macrochaetus	1
	Colurellidae	Colurella	7
		Lepadella	18
		Squatinella	1
	Lecanidae	Lecane	45
	Proalidae	Proales	3
	Lindiidae	Lindia	1
	Notommatidae	Cephalodella	19
		Itura	1
		Monommata	1
		Notommata	6
		Sphyrias	1
		Scaridium	1
		Taphrocampa	1
	Trichocercidae	Trichocerca	9
	Synchaetidae	Polyarthra	2
	Asplanchnidae	Asplanchna	1
	Dicranophoridae	Balatro	1
		Dicranophorus	5
Order Gnesiotrocha			
Suborder Flosculariacea	Testundinellidae	Testudinella	3
	Flosculariidae	Beauchampia	1
		Floscularia	2
		Lacinularia	1
		Limnias	2
		Ptygura	9
	Filiniidae	Filinia	2
Suborder Collothecaceae	Collothecidae	Collotheca	6
	Atrochidae	Cupelopagis	1
		Stephanoceros	1
BDELLOIDEA			
(DIGONOTA)	Habrotrochidae	Habrotrocha	8
		Otostephanus	1
	Philodinidae	Dissotrocha	2
		Macrotrachela	7
		Philodina	3
		Rotaria	5

Issues in the Conservation of the Marine Environment

by Ivan Goodbody, Professor emeritus, Department of Zoology, University of the West Indies

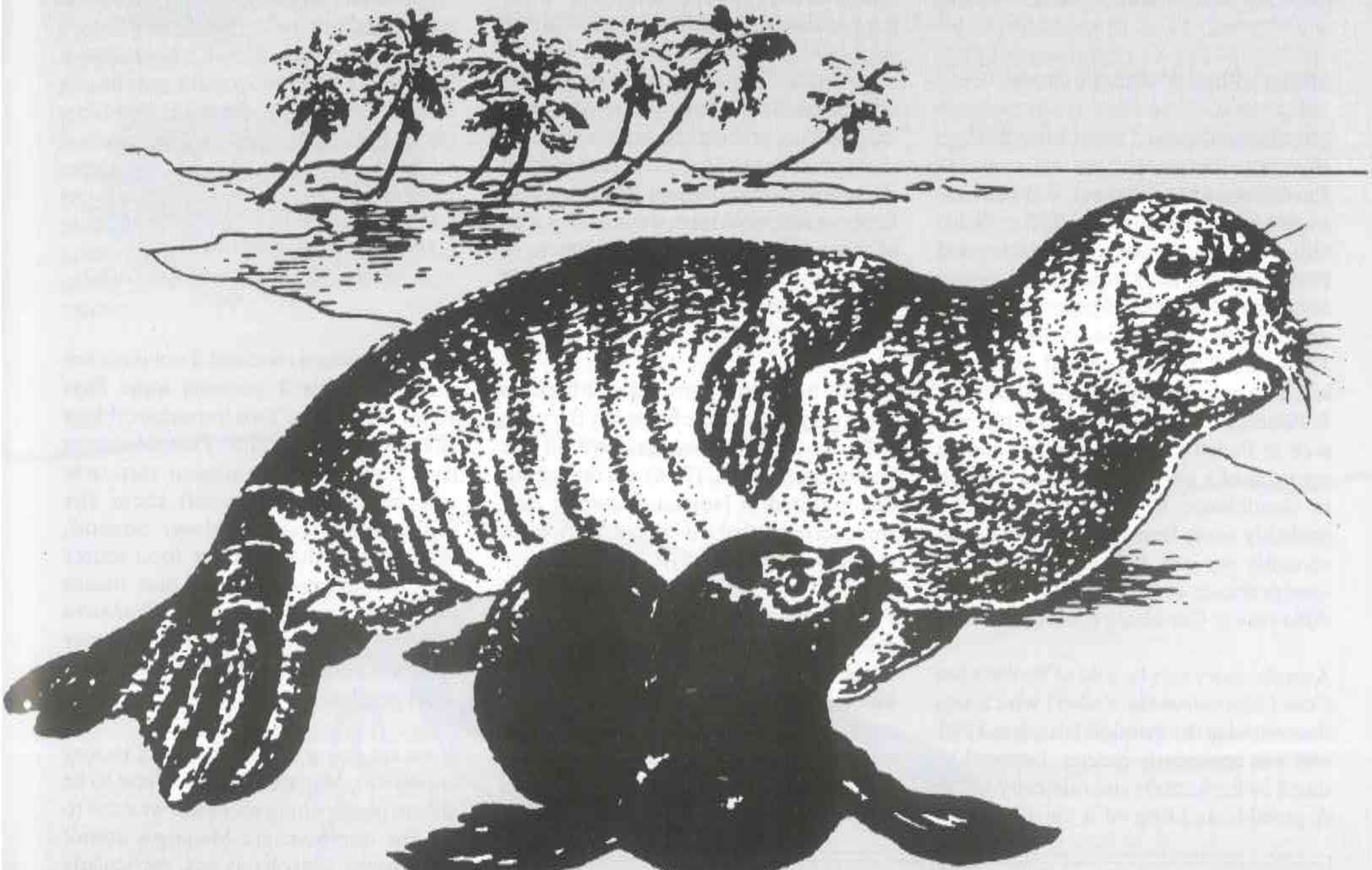

Fig. 1
THE CARIBBEAN MONK SEAL
This marine mammal was abundant in the last century, but is now probably extinct.

The purpose of this paper is to target certain issues of principle rather than focusing on one specific problem; to do that I am using certain case histories to explain my points. Briefly the paper examines the problem of an endangered species, the problem of a mismanaged resource and the opportunity for managing another resource. In a second article I will look at the issues of human use of the marine environment for recreation, tourism and research. Some of what I have to say is controversial and the views expressed are entirely my own.

MONK SEAL AND SEA COW

The animal depicted in on the title page (Fig. 1) is believed to be extinct: the Caribbean Monk Seal (*Monachus tropicalis*), sometimes called the Pedro Seal, was abundant in the last century and Phillip Gosse (1851) reports on how a Mr. George Wilkes and party clubbed to death eight of them on Pedro Cays in 1846. In 1920 two hundred seals were killed on a beach in Yucatan (Edinburgh & Fisher, 1970), in 1950 the last one was seen at Pedro Cays and the last known record is of a herd of twenty on a beach in Guadeloupe in 1970. Many reader probably never heard of the animal, and certainly we are not missing it - its disappearance seems to have made no difference to Caribbean ecology or has it?

A similar story may be told of Steller's Sea Cow (*Hydrodamalis stelleri*) which was discovered in the Pribiloff Islands in 1741 and was apparently extinct, battered to death by fur hunters and others by 1770. A possible sighting of a small herd in 1960 has never been proven (Edinburgh & Fisher, 1970). To all intents and purposes the disappearance of Steller's Sea Cow made little difference to the local ecology.

MANATEE

This leads us to consider our own Manatee (*Trichechus manatus*) (Fig. 2). once it must have been abundant in the Caribbean and certainly quite common in Jamaica. Phillip Gosse (1851) reports that " I had the pleasure of breakfasting on Manatee steaks which was delicious flavour without any oiliness." Then he goes on to describe a scene at Black River: "The Manatees were playing at the surface of the water at the river mouth, hardly a gun shot from the bridge. They continued their gambols for a considerable time yet no-one cared to pursue them - a fair specimen of Jamaican apathy." Phillp Gosse's views on conservation were clearly very different from ours of today.

We do not know how many Manatees there were at that time but today there are only about three thousand left in the Caribbean (NRCA, 1994) and only about one hundred in Jamaica. However they are so secretive that it is difficult to monitor the population properly.

We all want to preserve the Manatee but still we have to ask the question, why? Would it matter if the Manatee went extinct like the seal and the sea-cow? To help answer the question we may look at two statements about species diversity, one from Paul Ehrlich (quoted by Baskin, 1994) who considers every species to be an essential component of the system, like rivets in an aeroplane. The other is from an Australian scientist Brian Walker (Baskin, 1994) who thinks only a few key species matter:

> *"Diversity of life is like rivet in an airplane - each species plays a small but significant role. The loss of each rivet weakens the whole by a small amount until it loses airworthyness and crashes"*
>
> Paul Ehrlich

> *"Most species are superflous - like passengers not rivet. Only a few key species are needed to keep the system in motion."*
>
> Brian Walker, CSIRO

Is the Manatee a rivet and if not is it a key species? Table 1 presents some facts about Manatees. Two important things emerge from this Table. First, Manatees have a very slow population turn over and hence when we kill them the replacement rate is slow. Second, vegetation is their primary food source and in our environment that means primarily turtle grass (*Thalassia testudinum*). A fully grown Manatee may consume as much as 400 kilogrammes of grass per day.

If we are going to spend a lot of money conserving Manatees then we have to be able to justify doing so; hence we need to ask the question, are Manatees useful? The answer is probably yes, particularly in helping to recycle nutrients locked up in seagrasses. They are the lawn mowers of seagrass beds ingesting and digesting the leaves. Certain turtles also eat seagrasses, notably the Green Turtle (*Chelonia midas*), but their populations have also been reduced. Certain fishes eat seagrasses notably some species of parrotfish (Scaridae), but they also have been overfished. If Paul Ehrlich is correct, then the rivets in the seagrass system may be getting very loose; if Brian Walker is correct then it may not matter unless any of these are key species.

Table 1.

FACTS ABOUT THE WEST INDIAN MANATEE

SIZE	1 - 4 METRES
LIFE SPAN	about 50 YEARS
MATURITY	3-4 YEARS
GESTATION	1 YEAR
SUCKLING	1 YEAR
REPLACEMENT RATE	SLOW
FOOD	HERBIVOROUS

(Compiled from information in NRCA 1994).

So we come back to the central question, would it matter if Manatees become extinct? Putting all emotion aside the answer is probably, yes. Since Phillip Gosse's encounter with Manatees one hundred and fifty years ago we have done several things to affect Manatees. We have reduced the available amount of seagrasses, we have reduced the numbers of several key species in seagrass habitats - Manatees, turtles, herbivorous fish, conch. I do not think that anyone has examined the impact of this on seagrass systems, but the most likely effect is to change the overall balance, probably negatively. Two things come to mind, one is that if seagrasses are not grazed they will trap excessive amounts of sediments and hence change the bottom environment; secondly they will lock up nutrients which might otherwise be recycled and used for more productive purposes. We need therefore to keep the grazers in there - Manatees, turtles and others - and not allow them to become extinct.

So we have to keep up the pressure to conserve the Manatee, but at the same time there should be no reason to panic. No-one has calculated the carrying capacity of Jamaican seagrass beds for Manatees. It is quite possible that we have so reduced the grass beds that they now can sustain less than two hundred Manatees. If that is the case perhaps the emphasis needs to be more one preserving the food supply than concentrating on the animal itself.

KINGSTON HARBOUR

The Manatee gives us an example of what may happen if populations of a single species, or group of species, are reduced and the resultant effect on biological balance in the system. My second case history is to look at an entire system and what did happen when we interfered. The story of Kingston Harbour is not new, it just is not always correctly told.

Stories that Kingston Harbour is dead, or is dying, are not true; what did happen is that the entire system altered and is now driven in a different manner to what was the case in its original pristine condition. Nearly thirty years ago many of us were involved in a controversy surrounding the preservation of the western part of the harbour. Developers wished to clear the mangroves around Dawkins Pond (Fig. 3) and to build a causeway across the mouth of Hunt's Bay, so as to provide access to the new Portmore housing development. Conservationists wished to preserve the mangrove as nursery for fish and shrimp and a centre for metabolism of excess nutrients in the harbour. To achieve this the road would have to go around Hunt's Bay instead of across it. One developer's comment on the issue went something like this: "What are a few fish and birds in comparison to housing for 150,000 people." This is a perfectly valid argument if it is the only option, but the alternative

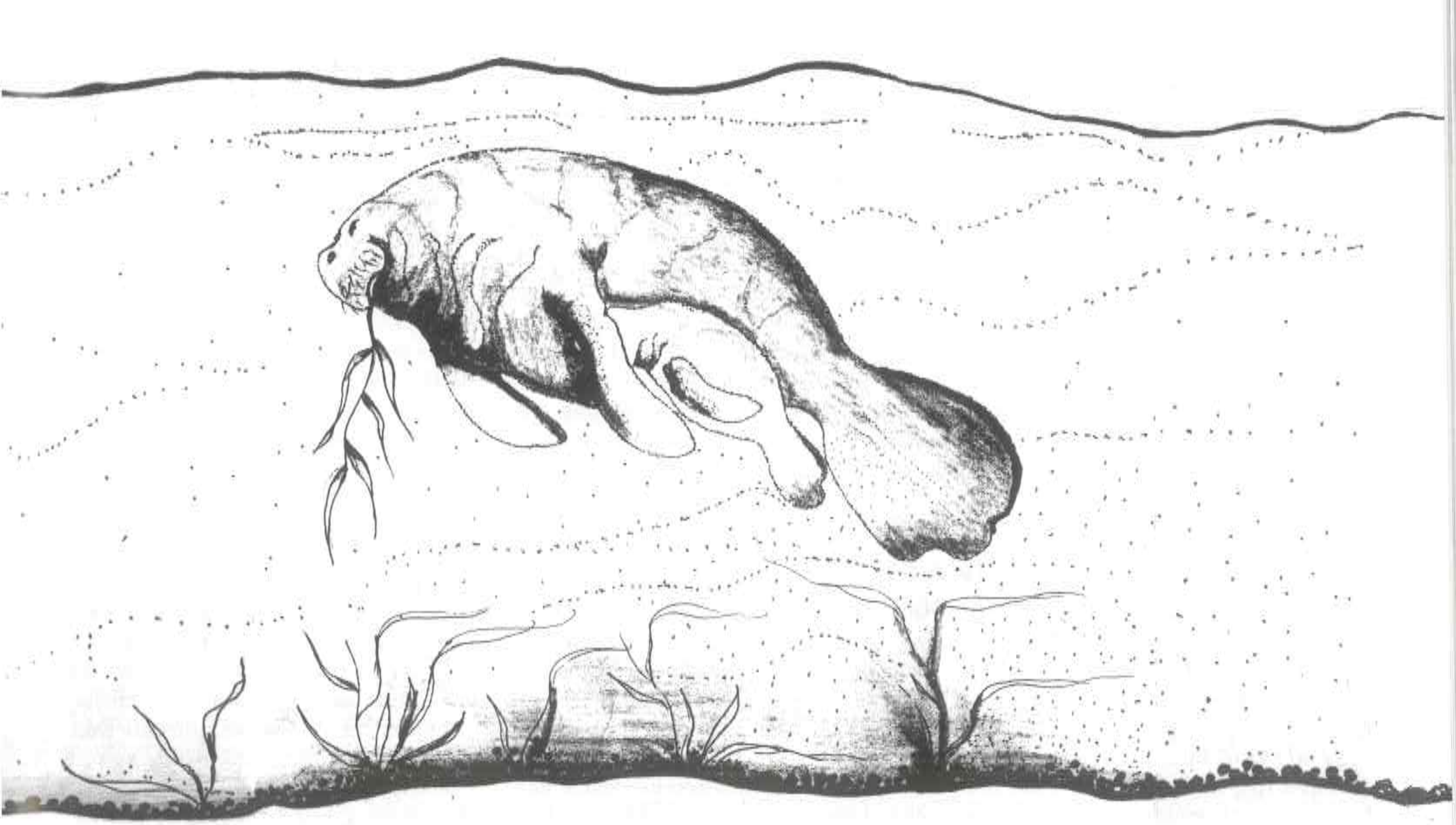

Fig. 2 *THE WEST INDIAN MANATEE*
In the coastal waters of Jamaica, only few individuals of this threatened species have survived. Drawing by Lisa Caleb.

option was ignored. So what happened:

- we lost about 50% of the mangrove in Kingston Harbour;

- we lost a major nursery ground for fish and shrimp;

- we altered the pattern of water circulation in the harbour.

If you look carefully at the area today you will see that the pond itself was not destroyed, only the mangrove, and most of that cleared mangrove area has not been build on. It seems that the housing scheme could have been build without destroying any of the environment, and the stability of the harbour system protected.

The overall effect of building a solid causeway across Hunt's Bay has never been determined and its effect is clouded by the fact that simultaneously with its construction we greatly increased the amount of sewage entering the harbour and which probably became an over-riding influence. So, there were several potential disturbing factors which altered the balance of the system - increased organic pollution, reduction of mangrove, alteration of the circulation pattern. In the very simplest terms the overall result is as depicted in Table 2. The surface waters have become enriched with nutrients and hence are immensely productive. The excess organic matter resulting from this production sinks to the bottom and oxidises thus reducing the amount of oxygen at the bottom. This has had a dramatic effect on fish populations. Benthic fishes were replaced by surface dwelling pelagic fishes (herring, sprat, etc.) making use of the new levels of production in the surface water. Sprat and herring are the natural food of pelicans and hence there was also a very dramatic increase in the numbers of pelicans living and breeding in Kingston Harbour. The harbour thus changed from being driven from the bottom to being driven from the top. Other changes also occurred such as the loss of many species of invertebrate animal from the harbour and mangrove areas (Wade, 1972; Goodbody, 1993).

We have looked at the consequences of losing a single species and the consequence of altering an entire ecosystem. Losing a single species, or even a group of species, is not necessarily critical. If the last manatee died tomorrow it would have only minimal effect on the marine environment in Jamaica. It is much more critical when we alter a habitat or system as we did in Kingston harbour. The system does not die, it finds a new balance, usually less diverse in which fewer species can hang on and in which the resource base is diminished. Manatees probably once lived in Kingston Harbour and probably we made their continued existence there impossible.

Our job as environmentalists and as scientists is not to wring our hands after the event, but it is to have vision about what may happen when changes are proposed and to translate that into scientific prediction. Scientific prediction of events in the environment requires that you already have, or can obtain, the basis information on what lives in the system, what are its physical attributes and how it functions. This is only possible if people of vision are constantly building up data bases on basic ecological science. You can only predict if you understand the fundamentals. Prediction should be the goal of applied environmental science, but it is only possible if it is backed up by a strong core of basic research on natural ecological systems.

Let us now turn attention to other issues. The three great threats to the marine environment at the present time are pollution, resource exploitation and recreation and tourism. What is at risk is genetic diversity, usable resources and the quality of life.

REEF FISHERY

The effects of pollution are so well known that we will not discuss them here but instead turn our attention to resource exploitation. We did have an abundance of living aquatic resources in jamaica, fin-fish, lobster, conch, etc. We have lost much of it today - why? If we go to Cayman or to Belize we find there is an abundance of fin-fish, lobster, conch, etc. - why? Take a look first of all at fish landings in Jamaica which fell by 60% in twenty years (Table 3). Why did this happen? The principal instrument for catching fish in Jamaica is the Antillean fish trap, made of mangrove poles and covered by chicken wire. The mesh size of that wire is critically important. As long ago as 1973 Dr. John Munro and his colleagues showed that fish catches were declining and attributed this to the presence of too many fishermen and to too small a mesh size in the traps; these traps were catching fish before they reached maturity and had an opportunity to breed. To cut a very long story short Munro showed that if mesh size were to be increased from the then standard of 4.13 cm to something between 4.95 and 8.25 cm it could in the long run considerably increase fish landings, primarily by letting fish grow to maturity. However, instead of mesh size increasing it is further decreasing (Clementson, 1994); some fishermen use a mesh size as small as one inch (Fig. 4): the simplest of all management techniques is being ignored.

The previous paragraph looks at only one simple management technique for fin-fish, control of mesh size in the traps. There are many other management techniques which one could discuss such as fish sanctuaries, marine parks, closed seasons, etc., but the essential point is made that we know, and we have known for a long time, how to manage the reef fishery but we do not have the will to do so. It was exactly the same in Kingston harbour, we knew but could not face the issue. The weary conservationist might well ask - why bother? Does anyone listen when scientific advice is given? This is not just a Jamaican problem. The collapse of several major fisheries around the world can often be linked to a failure to heed technical advice given by scientists. We need a new outlook on both environmental and resource management issues, based on the acquisition and use of hard scientific data, calculated prediction and mutual trust between science, development and management. However if scientists and environmentalists are going to provide advice and make predictions they must ensure that their data are accurate and that their predictions are based on sound scientific principles. To do otherwise is to place in jeopardy any successful relationship between conservation and development.

QUEEN CONCH

Finally let us look at one other case study of living resources, the Queen Conch (*Strombus gigas*),a large marine snail which is a popular food and has great export potential.

Conch live in seagrasses and soft bottom sediments, and eat plant material whether it be seagrasses themselves or other marine plants. By virtue of their dependence on plants they mostly live at depths of less than 25-30 metres. They used to be abundant in nearshore shallow areas, and still are abundant in Bahamas, Belize and also at the Pedro Banks in Jamaica.

Traditional fishing methods for conch were to free dive and look for them, or to search with a glass box and then fish up the shell with a hook at the end of a long pole. This limited the fishing effort and conserved the stock. Several years ago commercial fishing for conch commenced on the Pedro Banks using large boats equipped with SCUBA and teams of divers combing the banks down to about 25 metres. The first thing to notice about this is that we have introduced a lethal technique from which the resource (the conch) has absolutely no escape or protection. Secondly we have gone into the fishery with no conception of the size of the resource, what management techniques to apply or even an adequate assessment of the biology of the animal in the Pedro Banks context. In this supposedly enlightened age of resource management we have opened up the exploitation of a valuable resource without first putting a management strategy in place.

A CFRAMP study in 1991 suggested that the sustainable yield for conch on Pedro Banks was in the region of 600 metric tonnes per annum, although we now believe that it is probably twice that figure. notwithstanding this advice we have permitted harvests far in excess of the more generous figure of 1200 metric tonnes. It is difficult to obtain accurate figures for actual harvests but in 1993/

Fig 2. ***DAWKIN'S POND IN 1968***
This photograph was taken before the construction of the causeway to Portmore which led to the destruction of about 50% of the mangrove in Kingston Harbour.

Table 2.

SOME SIMPLE BIOLOGICAL CHANGES WHICH OCCURRED IN KINGSTON HARBOUR BETWEEN 1955 AND 1985

1955	1985
BENTHIC FISHERY	NO BENTHIC FISHERY
FEW HERRING SPRAT	ABUNDANT HERRING SPRAT
FEW PELICANS	ABUNDANT PELICANS

Table 3.

CHANGES IN FISH LANDINGS IN JAMAICA 1968-1990.

YEAR	NO. CANOES	YIELD/CANOE (Metric Ton)
1968	1768	2.62
1981	2137	1.98
1990	963	1.03

(Abbreviated from Clemetson, 1992)

94 we appear to have harvested between 2000 and 3000 metric tonnes of conch from the Pedro Banks. In simple terms we are exploiting the stock at about twice its sustainable yield. Whatever pressures may exist to maintain this level of exploitation it is abundantly clear that at present we are over-exploiting the stock and we have to bring the fishery under some form of control.
There are three options:

- We can ban the use of SCUBA as a fishing technique as is done in most other countries.

- we can remove all controls and let the industry fish it down to uneconomic levels. At that point the major participants will have to withdraw and remain outside until the stock rehabilitates, which would probably take ten years. Jamaica's accession to the CITES convention rules out this option.

- we can establish a proper scientific management programme.

The last option is the only rational option but has serious difficulties.

- It requires considerable amounts of money to obtain all the scientific information.

- The regulations surrounding a management plan have to be enforced, and that also costs money.

- It is necessary to prevent cheating in respect of any declared quota. Cheating is easily done by selling the harvest at sea and never bringing it ashore in Jamaica.

- Poaching by foreign vessels has to be curtailed, and that also costs money.

The greatest of all difficulties in this and similar issues is to get consensus among fishermen, and between fishermen and administrators on how to maintain the fishery without damaging the stock, and to ensure that once a plan has been established everyone adheres to it.

INFORMATION NEEDS

All of the issues which are discussed in this article, protection of the Manatee and its food supply, solving the problems of Kingston harbour and managing stocks and shellfish, have one thing in common. They all require scientific information for their solution. We need as a community to develop the capacity to use accurate scientific information for scientific prediction of issues concerned with conservation and environmental management. The emphasis, however, must be on accurate information. In the past many issues in conservation have been discussed as much on speculation and emotion as on the basis of hard scientific data. However, all of us scientists, naturalists, conservationists, must accept that if we are to have credibility with developers and administrators then the facts and figures we present to them must stand up to rigorous appraisal. It is equally necessary for developers, managers and administrators to recognise the value of accurate scientific information and scientific prediction. Success in the management and conservation of natural resources depends on mutual understanding and trust between these groups and scientists, naturalists and conservationists.

In a later article I hope to discuss the remaining issues in marine conservation relating to recreation, tourism and scientific research.

(Adapted from a presentation to the Natural History Society, June 9th. 1994)

Fig. 4 ***A Fish pot of the one inch mesh size.*** Photo by Andrew Bruckner

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JAMAICA'S CORAL REEFS HAVE COLLAPSED

by Peter Vogel

On September 9, 1994 an article on Jamaica's coral reefs appeared in Science, one of the most prestigious scientific journals. The article went virtually unnoticed in the Jamaican public, and so far I have not seen any reference to it in the Jamaican media. However, the article is of utmost significance to the island. It reports what might be the worst case of environmental degradation at a national level over the last 15 years anywhere in the world. Here is the quintessence of the study carried out by Terence P. Hughes:

JAMAICA HAS LOST OVER 94% OF ITS CORAL STOCK IN THE LAST 15 YEARS.

You have read correctly, 94% (ninety-four!). This figure is not the guesswork of an overzealous environmental bigot, but based on a careful scientific study which has passed the rigorous review process of Science.

The author extensively assessed coral coverage from 1977 to 1980 at Negril, Chalet Caribe, Montego Bay, Rio Bueno, Discovery Bay (two locations), Pear Tree Bottom, Port Maria, Port Antonio and Port Royal. He repeated these measurements in 1990 to 1993 with the addition of five more north coast sites. The dramatic coral decline showed up at all 10 sites with repeat measurements.

Why did this happen? It all started out with the overfishing of the reefs. By the late 1960s fish biomass had already been reduced by up to 80% because of intensive fish-trapping in previous decades. Large predatory fish such as sharks, snappers, jacks and groupers had almost disappeared, and the fishermen increasingly caught smaller herbivorous fish including parrotfish and surgeonfish. These species feed mainly on algae. This problem of overfishing was carefully documented by the pioneering studies of John Munro while he was a lecturer at the University of the West Indies.

As the herbivorous fish declined, a competing algae grazer was able to increase: the sea-urchin *Diadema antillarum*. Many Jamaicans will still remember the tremendous number of these black ball-shaped animals with their long spines during the late 1970s. They became so common that it was difficult to enter the sea at many places. On shallow fore-reefs their density averaged 10 per square meter. However, they provided a good job for the corals. With most of the herbivorous fish gone, the sea-urchins kept down the algae which threatened to overgrow and eventually kill the corals.

All this changed in 1982. A killer disease rapidly spread through the *Diadema* populations in all Caribbean waters. Marine biologists at Discovery Bay observed a 98% loss within 10 days. The sea-urchins never recovered. Probably, there numbers have fallen below a critical threshold where spawning is no longer successful.

With nothing left to keep them short, the algae started to increase tremendously, thereby overgrowing and killing the corals. On average, corals covered about 52% of Jamaica's coastal shelf before the *Diadema* die-off, but declined to a 3% cover in the early 1990s. During the same period, algae cover increased from 4 to 92%.

Two hurricanes greatly shook the reefs recently: hurricane Allen in 1980 just before the *Diadema* die-off, and hurricane Gilbert several years later in 1988. After Allen, the marine biologists noticed a gradual recovery of the reefs until the die-off reversed it. However, after Gilbert no recovery occurred; the algae had become so dominant that no space was left for coral recruitment.

Pollution of coastal waters is another possible contributor to algae growth. However, it seems that pollution played a minor role in the recent dramatic spread of the algae and the disappearance of the corals, with possible exceptions of coastal waters close to large cities.

Once famous for its beautiful and diverse reefs, Jamaica today has no coral reefs left to speak off. Instead they have become piles of dead rubble overgrown by algae. Just here and there a lone coral clings to life.

There are many lessons to be learned from this extreme example of environmental degradation. I would like to emphasize two of them.

- A damaged ecosystem may appear healthy for a long while and then collapse suddenly because of relatively minor events. The fish stock was severely damaged long before the extinction of the coral reefs. The ecosystem had a certain amount of resilience in that the sea-urchins took over the role of the herbivorous fish. However, the system was weakened and crashed as a result of natural events which it otherwise could survive: hurricanes and the disease of a single species.

- We cannot sit back and hope that the scientists will fix the problems. Jamaica's coral reefs were the best studied in the whole world. At least since the 1960s, both local and foreign scientists have presented warning signals of the decline. However to change the course, the society as a whole needs to respond.

Hughes, T. B. 1994. Catastrophes, phase shifts, and large-scale degradation of a Caribbean coral reef. Science 265: 1547-1551.

A NEW THREAT TO JAMAICAN BIRDS

By The Gosse Bird Club

Twenty-six species of birds occur in Jamaica that are found nowhere else in the world. Most of these live in forests or woodlands. Today, less than 7% of Jamaica's natural forest remains, and even this is under serious threat of degradation and destruction.

Evidence has reached the Natural Resources Conservation Authority (NRCA) from the Gosse Bird Club of Jamaica, that a new species of bird, the Shiny Cowbird, *Molothrus bonariensis*, has been found in the wild. This bird does not build a nest of its own, it is a brood parasite - it lays its eggs in the nests of other birds. The host bird then incubates the eggs and feeds the young cowbirds which are sometimes larger that the parent host. The offspring of the host species lose out as either their eggs do not hatch or the more aggressive cowbird young receive the majority of the food.

For some years, the Shiny Cowbird has been spreading its range in the Caribbean where it has adversely affected populations of some species such as the Yellow Warbler (Mangrove Warbler), Flycatchers (Tom Fools), and birds such as Vireos (Sewi-sewi in Jamaica), and Orioles (Aunty Katy in Jamaica).

Cowbirds have been seen near Yallahs Ponds in St. Thomas, and Salt Island Lagoon, St. Catherine. Subsequently, it was seen near Luana Point, St. Elizabeth. It may occur in other places on the island, we need your help to find out the extent of its range.

The bird is between 7 and 8 inches long (18-20cm), the male is shiny black, while the female is grayish brown. Since there are at least six other species of birds in Jamaica that are black, care should be taken to distinguish the Shiny Cowbird from other native species. These include the Greater Antillean Grackle (Kling-kling), Smooth-billed Ani (Black Parrot), the Jamaican Blackbird (Wildpine Sergeant, Black Aunty Katy). The medium-sized body and tail, and the dark conical or pointed beak help identify the cowbird.

The Shiny Cowbird is most likely to be found in open areas and at the edges of woodland, and may be seen feeding in groups where there is grain for domestic animals. The birds gather in the evening and fly in flocks to their roost. This is often along the edges of mangroves or on coastal areas and offshore cays.

Experiences from Puerto Rico show that it is not found in natural forests or well-developed woodlands, but will penetrate a short distance if there are openings due to fragmentation. This situation can have as detrimental an effect on populations of native wildlife as complete destruction of the forests. Small fragmented patches of forest and woodland provide more access to the habitat, and thus increases the vulnerability of bird species to threats such as the Shiny Cowbird.

Since it is virtually impossible to remove the cowbird from the wild, it is most important that Jamaicans realize that in order to protect native and indigenous species, special care must be taken to conserve intact the remaining natural forests and woodlands on the island and so preserve our invaluable natural heritage.

Reports on sightings of the Shiny Cowbird should be made to the Gosse Bird Club, 2 Starlight Avenue, Kingston 6, Tel & Fax: 927-8444, or the Natural Resources Conservation Authority, 53 1/2 Molynes Road, Kingston 10. Tel: 923-5155; 923-5166.

ADDITIONAL NOTE:
The Shiny Cowbird, a brood parasite, was recorded for the first time on the Bahamas in July 1994. The cowbird has had a negative effect on endemic species in other islands, and there are fears it may have a similar impact in the Bahamas.
BirdLife International, Pan American News, 10(1) March 1995

A recent report from the Cayman Islands Bird Club records the first sighting of the Shiny Cowbird on Grand Cayman.
Society of Caribbean Ornithology

Glossy Cowbird

AMERICAN EEL IN THE MONA RESERVOIR

by Charlotte Goodbody
& Ivan Goodbody

NATURALIST'S NOTE BOOK

The Mona Reservoir is a popular place for joggers and walkers who go there for exercise. If the walkers are observant they can indulge in another interest at the same time and study some of the birds and animals. For years bird watchers have made notes of the birds at the dam but there are also other animals to look at. There is at least one terrapin (freshwater turtle) and on Saturday May 21, 1994 the authors observed a large freshwater eel at the western end of the reservoir. The animal was obviously dying and so it was relatively easy to catch it and get it out of the water.

On taking it to the laboratory it was identified as the American Eel {*Anguilla rostrata* (Le Sueur, 1877)}. There are only two freshwater eels occurring on the coasts of the North Atlantic: the American Eel and the European Eel {*Anguilla anguilla* (Linnaeus, 1758)}. The main difference between these two freshwater eels is in the number of vertebrae; the European Eel has from 110 to 119 vertebrae (majority 113-117) and the American Eel has from 103 to 111 (majority 105-109). The vertebrae in the Mona Reservoir specimen have not been counted but other critical measurements indicate that it is the American Eel; one such measurement is the difference between the distance from the snout to the origin of the dorsal fin and the ventral fin, taken as a proportion of the length of the head. However it must be noted that some specialists consider that the American Eel and the European Eel are merely varieties of the same species as the differences between them are so small. Our specimen is 105 cm in length and weighs 2.2 kg. It is probably a female because males seldom exceed 61 cm, while females have been found up to 122 cm and weighing 7.3 kg (Eales, 1968). The Mona specimen has small puncture wounds on its left side going into the gill chamber.

Freshwater eels have an interesting life cycle. As adults they live in rivers but when ready to reproduce they migrate to the sea to spawn and then die. The larval form (known as the Leptocephalus) of both the American Eel and the European Eel are found to be concentrated in the Sargasso Sea, the large area of ocean lying between the Azores and Bermuda. This indicates that the Sargasso Sea is the principal spawning ground for both species. The European species is carried back across the North Atlantic in the Gulf stream or North Atlantic Drift over a period of about three years. During this time the leptocephalus larva slowly alters and finally metamorphoses to a juvenile form known as an elver just before they ascend the rivers where they will spend their adult life. The American Eel only takes one year to reach the rivers of North America, the Gulf of Mexico and Caribbean Islands and hence development and metamorphosis to the elver is considerably faster than in the European species. It is believed that A. rostrata breeds to the south-west of where A. anguilla breeds, but one authority (Tucker, 1959) believes that these eels are all the same and that the European strain never reaches the breeding grounds in the Sargasso Sea and that it is offspring of the American strain which re-stock European rivers each year. Tucker's ideas have been vigorously refuted in a critical paper by Bruun (1963). So there is still a great deal to be learned about these fishes.

Even if it had not been injured and had continued to live, the eel from Mona Reservoir would never have been able to escape and return to the sea to breed. One can only speculate as to how it got into the reservoir in the first place. The reservoir has two sources of water, one from the Hope River, the other through a pipe line from the Yallahs River. Since the Hope River very seldom has any discharge into the sea, it is most likely that the eel came from the Yallahs River and was carried down the pipe line. Perhaps in the course of such a journey it received the injury to the gill chamber.

Another dead eel was seen floating in the reservoir on 1st July 1995.

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THE JAMAICAN FIG EATING BAT

(Ariteus Flavescens)

by Margaret Jones
Conservation Data Centre-Jamaica
University of the West Indies

Except for the Jamaican Coney (*Geocapromys brownii*), bats are the only surviving mammals native to Jamaica; twenty-one species are known to occur on the island of which two are endemic: *Ariteus flavescens* and *Phyllocentris aphylla* (Koopman 1989). Bats occupy a variety of habitats and niches that are similar to those occupied by birds; however, the two groups of animals are separated ecologically due to their different activity schedules with most bats foraging at night. There are insectivorous, nectarivorous and frugivorous bats, and some even catch fish. There are no vampire bats in Jamaica.

Information on the Jamaican Fig Eating Bat (*Ariteus flavescens*) is quite scarce. The species is considered uncommon or rare (Allen 1942, Goodwin 1970). Four specimens were collected by Howe (1974) in 'heavily disturbed habitat'. The Fig Eating Bat is said to feed on a variety of fruits including naseberry and rose apple as well as on insects. Despite its fruit-eating habits, it is not a serious pest.

The International Council for Bird Preservation (ICBP) recently held a regional workshop on Caribbean forest ecology and conservation training. During one of our field exercises in the Discovery Bay area a bat was accidentally caught in a mist net that was set up for birds. The area was ruinate limestone forest with small scale cultivation. Using a field key to Antillean bats (Baker et al. 1984; see also Pine 1980), we identified the animal as a Fig Eating Bat, *Ariteus flavescens*.

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THE SILK COTTON TREE AT ALLEY CHURCH

by Sonia Serrant

A very old Silk Cotton Tree (*Ceiba pentranda*) stands beside the Alley Church, Vere in Clarendon. According to stories handed down it was damaged by a French cannon ball from one of Admiral DuCasse's guns at the Battle of Carlisle Bay in July 1694. The cannon ball is preserved in the grating of the root. The huge tree has a girth of fifty feet and throws a shadow of seventy-five yards in diameter. Silk Cotton Trees are known to commerce as 'kapok'; canoes are dug out of the trunk.

ALBINO FROG STARTLES WORK CREW

by K.N. Williams

Some years ago in St. Thomas a guango tree collapsed. A gang of men were employed to chop it up. While doing so, an albino bromeliad frog jumped out. There was much consternation as the belief is: 'a duppy frog wi jump down yu troat an i gwine kill yu'. The gang chopping the tree did not return and a second gang had to be employed to finish the job.

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THE LIZARD LOUNGE: *AECHMEA PANICULIGERA* AND *HOHENBERGIA INERMIS*

by Dr. Iris Beck & Wolfgang Janetzky
Hullmannstrasse 7
26125 Oldenburg/ Germany

In 1992/1993, we studied the aquatic fauna associated with the water bodies stored in leaf axils of 'wild pines' (Bromeliads) in the Cockpit Country, Trelawny. During the field work in the hills, we had the chance to observe the behaviour of *Anolis* lizards. Beautifully coloured, with attractive ornamentations and interesting behaviour, they are an exciting part of the fauna. However, it soon became obvious that the scientists were an important part of the *Anolis* world as well, at least with regard to their food supply. When we were standing or sitting more or less motionless (usually while taking specific measurements), and swarms of mosquitoes gathered around us, the lizards jumped on our shoes and took the opportunity for a substantial mosquito-meal.

However, in addition to these amusing meetings, we became aware of behavioral patterns which showed how *Anolis* form part of the bromeliad fauna. The lizards often sat or moved around on bromeliads. They especially liked to visit flowering *Aechmea paniculigera* and *Hohenbergia inermis*. Older or bigger lizards chased away the smaller or younger ones. Observing a flowering *Hohenbergia* more intensively, we discovered the reason for this 'fight for the lizard lounge': it was not the 'place on the sun deck' but a 'very special liquid' which attracted them. The lizards stripped the tips off the petals and then fed on anther and stigma of the flower. We assume that they did so to ingest the nectar and pollen.

Beside the lizards, we only observed hummingbirds - especially Streamertails (*Trochilus polytmus*) - visiting the bromeliad flowers. The hummingbirds serve as pollinators. In the co-evolution of flower and pollinator, pollen and nectar have become hidden in the inner part of the blossom; this protects the plants from unwanted exploitation of these resources. The hummingbirds penetrate the flowers with their long and extremely thin beak and lick the nectar off the stigma. Nectar, a solution mainly composed of sucrose, fructose and glucose, and small quantities of other organic substances (e.g. amino acids) is an important source of energy for these birds.

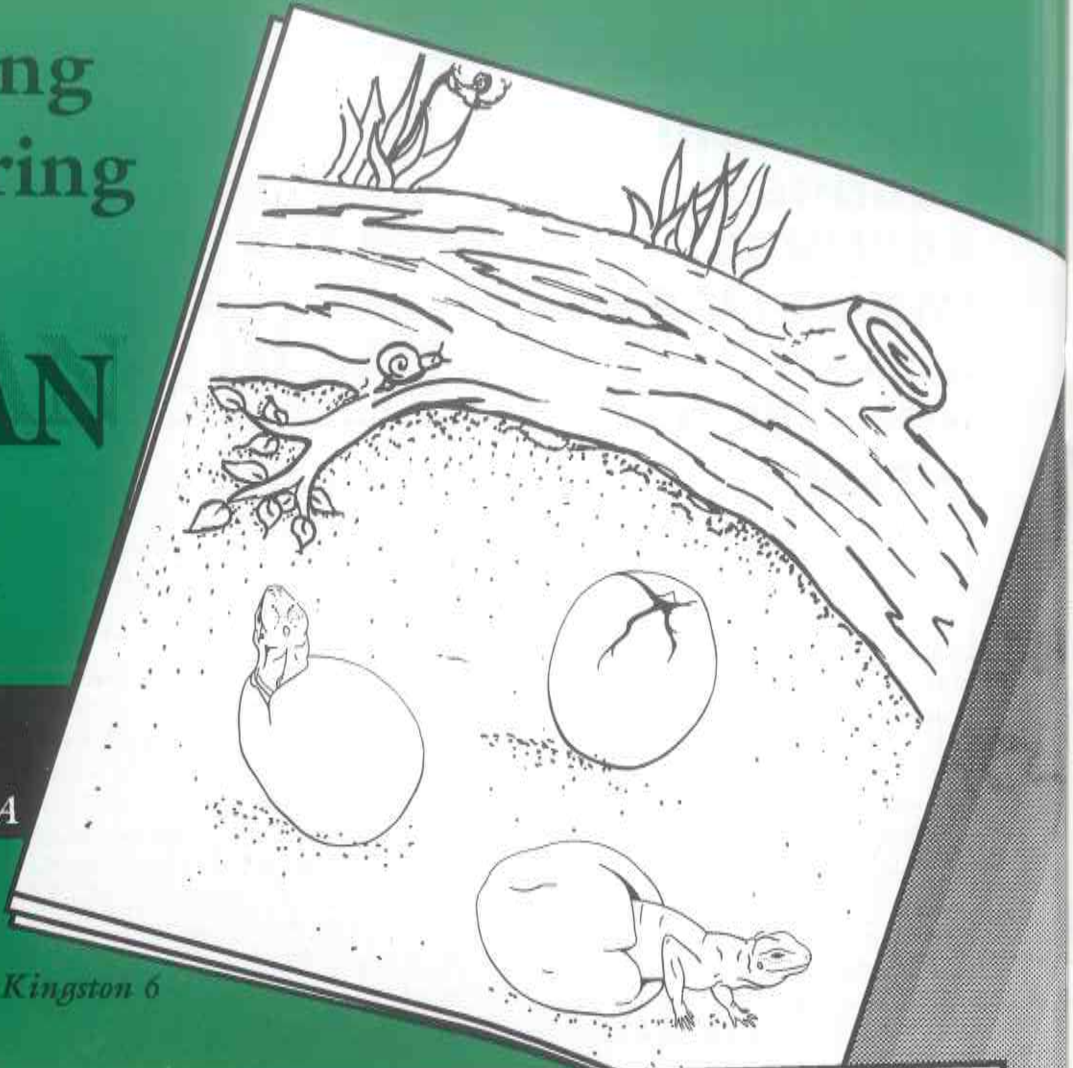
Eventually, we made another observation which further supported that nectar is an important food for the lizard. The field station accommodated a lot of lizards because of mutual benefits: we attracted mosquitoes and other insects, and the lizards helped us to get rid of them. One morning, we found to our astonishment that one of the lizards was not doing his job, but participated in our breakfast by licking off sugar from the kitchen table.

By feeding on bromeliad flowers, the lizards competed with the Streamertails which were very common at our study sites. The Streamertail males fiercely defended feeding territories against each other. They were most active in the morning and in the afternoon when they visited the plants and fed on the nectar. They also attacked the Vervain Hummingbird (*Mellisuga minima*) which occasionally visited the flowers. The Jamaican Mango (*Anthracothorax prevostii*) seemed to prefer feeding on the bananas in the valley, and we never saw them at the bromeliads on the hill.

Despite their pronounced territorial mood, we never observed Streamertails attacking a lizard feeding on the flowers. This may be so because the lizards usually hid themselves or became motionless when a Streamertail appeared and thereby escaped detection.

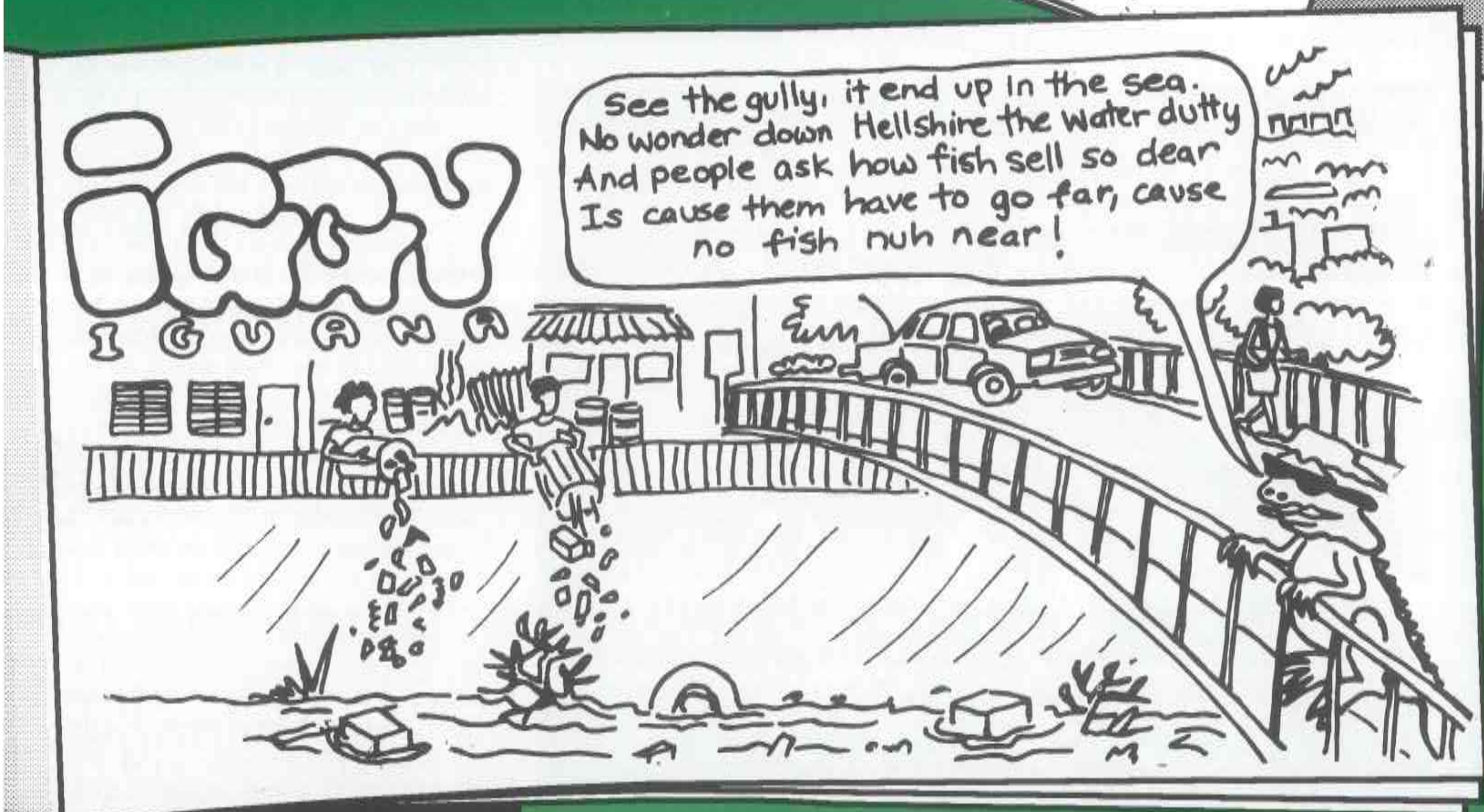
Fig. 1 *Anole visiting bromeliad blossom.*

Two Colouring Books Featuring the JAMAICAN IGUANA



CONSERVATION OF THE JAMAICAN IGUANA

Design and Artwork: ***Krista Kovach***
Available from: ***Hope Zoological Gardens, Kingston 6***



IGGY IGUANA CARTOON COLOURING BOOK

Design and Artwork: ***Juliet Thorburn;*** *Lyrics:* ***Nicholas stephenson;*** *Text:* ***Susan Anderson.*** *Available from* ***Conservation and Development Trust****, 95 dumbarton Ave., Kingston 10*

Birds of Jamaica, A Photographic Field Guide

Audrey Downer and Robert Sutton. Photographs by Yves-Jacques Rey-Millet. Cambridge University Press, 1990 Cambridge, New York, Melbourne.

As an amateur ornithologist of some years but a neophyte to the birds of Jamaica, one of the first tasks accomplished upon my arrival was the search for the definitive field guide to Jamaican species. North Americans generally feel quite insecure or lost without their trusty Peterson or Golden Guide; so I quickly acquired the standard guide, Birds of the West Indies by James Bond. It wasn't long before I realized that not only is there an active internationally affiliated birdwatching club, the Gosse Bird Club, but two local authors who have combined their expertise and years in birdwatching with the production of 'Birds of Jamaica'.

Audrey Downer and Robert Sutton have teamed up with photographer Yves-Jacques Rey-Millet to produce this wonderfully informative guide. The authors' expressed purpose is that more people will come to know and love the many unique and special endemic Jamaican birds and through that may work to protect and enhance the variety of habitats that shelter them.

All of the species that occur on the island are dealt with but only those endemic at the species or subspecies level, and those that are unique to the Caribbean are described in detail.

Especially helpful is the section on how to use this guide and a very informative portion for newcomers, novices, and tourists on specifics of Jamaica itself including various birding "hot spots". A description of the principal habitats of Jamaica leaves the reader with a deep appreciation for the widely diverse landscape of the island.

The authors do a superb job of discussing migration and the various migratory patterns that account for Jamaica's large number of birds that visit, in addition to the 25 endemic species, and 21 endemic subspecies. Through review of this work it can be appreciated that Jamaica is home or harbinger to over 200 separate species, and in addition, some 50 or more vagrants or rare winter visitors.

Glossy Ibis on Refuge Cay Photo by Peter Vogel

Perhaps the strongest recommendation for the book, in addition to the excellent text, is the beautiful photography by Yves-Jacques Rey-Millet, who has managed to capture so many of the species in full colour and in their natural habitats.

Anyone wishing to fully enjoy the many unusual and beautiful birds of Jamaica is strongly encouraged to add this field guide to their day-pack and add to their knowledge and appreciation for the island and its avifauna.- ARLENE GARDNER.

Blue Mountain Guide

Margaret Hodges (ed.) published by the Natural History Society of the Jamaica, 1993, 56 pp., Pear Tree Press, Kingston. ISBN 976-8092-74-2.

The following review is reprinted with the permission of the author, Jeanne Wilson; it first appeared in the Sunday Gleaner, March 27, 1994.

There is a much over-worked cliche that states that "good things come in small packages". That could be applied to this invaluable Blue Mountain Guide. One's first impression is, "Oh, but it's very small", but immediately one realises that it is a guide to be

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BOOK REVIEW

used when climbing the Blue Mountains - one certainly doesn't want to be weighted down by a heavy tome. This one can slip into a shirt or jacket pocket, to whip out to refer to the flora and the fauna along the trail.

It is amazing how much information is packed in this slim publication, from a variety of experts on the subjects explored. This must be due to good, tight editing: no extraneous information is allowed, everything is strictly to the point. There is an interesting introduction by Dr. Ivan Goodbody which sets the scene and the tone of the production. The Blue Mountain Peak Trail follows, written by Paul Steege in which there is a good map of the area, with mileage between given points. Also, accommodation in the areas is given, and the facilities available at each place, and whom to contact. There is much useful information in this section, of what to wear, the etiquette needed to exhibit when climbing, and a list of do's and don'ts. This segment is followed by The Blue Mountain Approach - otherwise "how to get to the point of departure" to start up the trails. This is by Jill Byles and also has a useful map and gives a brief historical background of the various locations.

The Jamaican Rose (Blakea trinervia). An endemic plant from mountain forests.
Photo by S. Hodges.

THE IMPACT OF MAN

This section, written by Mary Langford also traces historical events and how the encroachment of men have eroded the mountainsides and because of this the Blue Mountain and John Crow National Park was set up.

GEOLOGY OF THE BLUE MOUNTAIN RANGE

This is a fascinating segment and traces the geology of the Blue Mountain Range back 140 million years. Mineral springs and metal abound and the damage done in recent years by hurricanes, floods, landslides and of course man, is listed and decried. The Low Layton Volcano is pinpointed - it last erupted between 9.5 - 5 million years ago, so there is no cause for immediate alarm! Two useful maps are included in this segment.

FLORA OF THE BLUE MOUNTAIN PEAK

This section is written by Jim Dalling, which is again a fascinating subject and whets the appetite of the reader to learn more of this subject.

BLUE MOUNTAIN INVERTEBRATES

This section, written by Eric Garraway, gives us information about crickets, Katydids, Blinky, Peeny-wally, some butterflies found only at that height, black ants and a strange little fellow called an Amphipod.

VERTEBRATES

Reptiles, amphibians and mammals are described by Thomas Farr, whilst Catherine Levy describes birds of the Blue Mountain area.

PHOTOGRAPHS, ILLUSTRATIONS

There are many beautiful photographs throughout the book and some delightful illustrations of flora and fauna.

FUNDED

The Environmental Foundation of Jamaica and Tourwise Ltd. provided funding for this publication, which is an all Jamaican publication, as it was printed by Pear Tree Press/Hyde, Held and Blackburn Ltd., of Kingston. This book should encourage an awareness for environmental control, also it might act as a spur for more people to take to the mountain trails and discover for themselves the beauty and joy of the mountains. It might even encourage them to join the Natural History Society of Jamaica, which was formed in 1941.

SOUVENIR

This guide would make a marvellous souvenir for visitors and a good small gift to send to friends and relatives abroad. It is luxuriously produced on thick glossy paper which shows off the superb photography to great advantage. The cover design, both back and front, a wide sweep of the mountains, is enough to lure the most cynical visitor - or resident - to spend a modest sum on what is a mine of information about the most beautiful part of our island. There are the minimum of printing errors "wettestmonths" as one word on page 21 and a lower case 'g' used for Hardware Gap on page 10, which make not the slightest detraction from what is a pure joy to read.- JEANNE WILSON

NATURALIST

BOOK REVIEW

The Natural History of the West Indian Boas

by Peter J. Tolson and Robert W. Henderson
R. & A. Publishing Limited, Somerset, England
ISBN 1 872688 04 7, 125 p., 1993.
Distributed in the Americas by Eric Thyss, Serpent's Tale, 464 Second Street, Excelsior, MN 53331, USA.

The name "boa" is being used in rather bewildering different ways. In the strictest sense, the name refers to the giant snake Boa constrictor and is used to distinguish this species from the other giants, the anacondas (genus Eunectes) and pythons (genus Python). In a broader context, the boas are a group of related snakes which comprise either the New World species of the subfamily Boinae, the whole family of Boidae, or even different snake families including Boidae and Tropidophidae. It is in the last sense that the word is applied in the present book "The Natural History of West Indian Boas".

The authors are accomplished North American herpetologists with a very strong interest in West Indian amphibians and reptiles. Peter Tolson is a conservation biologist at the Toledo Zoo. He has held and bred many species of West Indian snakes in captivity, but also conducted field research on the islands. One of his major projects is the conservation of the endangered Puerto Rican Boa. Robert Henderson works as Curator in Herpetology at the Milwaukee Museum for Natural History. He has conducted extensive field work in the West Indies and written numerous papers and books on his research.

The book begins with a discussion of climates and habitats of the region. A discussion of the origin, phylogeny and zoogeography of the boas follows. These chapters highlight that - like many other groups of animals and plants - the boas of the West Indies are very unique:

- The genus *Epicrates* is represented with nine species which are all endemic to the islands (i.e.occurring nowhere else); only one other Epicrates species exists in Central and South America. The Cuban Boa (*Epicrates angulifer*) grows up to 4 m in length, and several others reach about 2 m, including the Jamaican Boa (*Epicrates subflavus*).
- The genus *Tropidophis* has 13 species on the islands, and again, all of them are endemic to the region. Only three additional species are known from the Central and South American mainland. Most of these snakes remain below 1 m in length. Jamaica has one species (*Tropidophis haetianus*) which it shares with Cuba and Hispaniola.
- *Boa constrictor* occurs with two endemic subspecies in Dominica and St. Lucia; these snakes grow quite large - up to about 3 m - though not as large as mainland specimens.
- Similar to the preceding snake, *Corallus enydris* is a South American species; it has extended its range into the Lesser Antilles northwards to St. Vincent.

The main body of the book consists of accounts of all species and subspecies. The accounts are clearly subdivided in useful sections: Taxonomy, Description, Distribution, Habitat, Food Habits, and Reproductive Notes (all West Indian boas bear live young!). Very commendably, the authors also assess the conservation status of the rarer snakes. In addition, they provide maps and colour photographs for most species. Some species are shown with several photographs - three in the case of the Jamaican Boa (a male, the head of a female close-up, and a newly born).

The text of the accounts are strongly based on the earlier monumental work, "Amphibians and Reptiles of the West Indies - Descriptions, Distributions and Natural History" by Albert Schwartz and Robert W. Henderson (University of Florida Press, Gainesville, 1991). Also, the maps appear to be identical in the two books. If you possess the earlier book then quite a bit of the information in the new one will be redundant.

The distribution maps are very helpful though they may not reflect the present distribution accurately. The authors have applied an understandably conservative approach in accepting records, and many of the records are probably quite old. In the case of the Jamaican Boa, the map and the text actually disagree. The map shows only six records, all along the south coast (including one on Goat Islands). However, the authors write that due to deforestation and introduced mammals the species is now limited to "scattered localities in the Cockpit Country, Dolphin Head, the Hellshire Hills, Negril Hill and areas of Portland and St. Thomas. Except for Negril (a record with a question mark), the map does not indicate any of these areas.

The authors conclude their work with two chapters on reproductive biology and conservation. Information on the reproductive biology is basically derived from two sources: the collection of gravid females in the field, and reproduction in captivity (mainly in North American zoos).

The authors recognize that for most species there is not enough information available to reliably assess the conservation status. However, for several species they point out evidence suggesting a strong decline. They recognize that nearly all factors adversely affecting populations are human-mediated: habitat destruction, introduced predators, killing by humans, and collecting for the pet trade. While pointing out progress which has been made with regard to international legislation, captive breeding, and management of wild populations, they also stress that "there can be no substitute for protection of critical habitat of endangered snake species".

The present book summarizes virtually anything which has ever been reported on West Indian boas. Sadly enough, this amounts to rather little for many species since very few have been studied in any detail. Most of the field knowledge is based on individuals collected for taxonomic research. The authors are well aware of these shortcomings: "It will immediately become obvious to the reader that there are large gaps in the information presented, and it is our hope that this work will serve as a reference point for the direction of future work". Indeed, the authors have been very successful in providing such a reference; no bookshelf dedicated to the West Indian natural heritage should be without it.- PETER VOGEL.