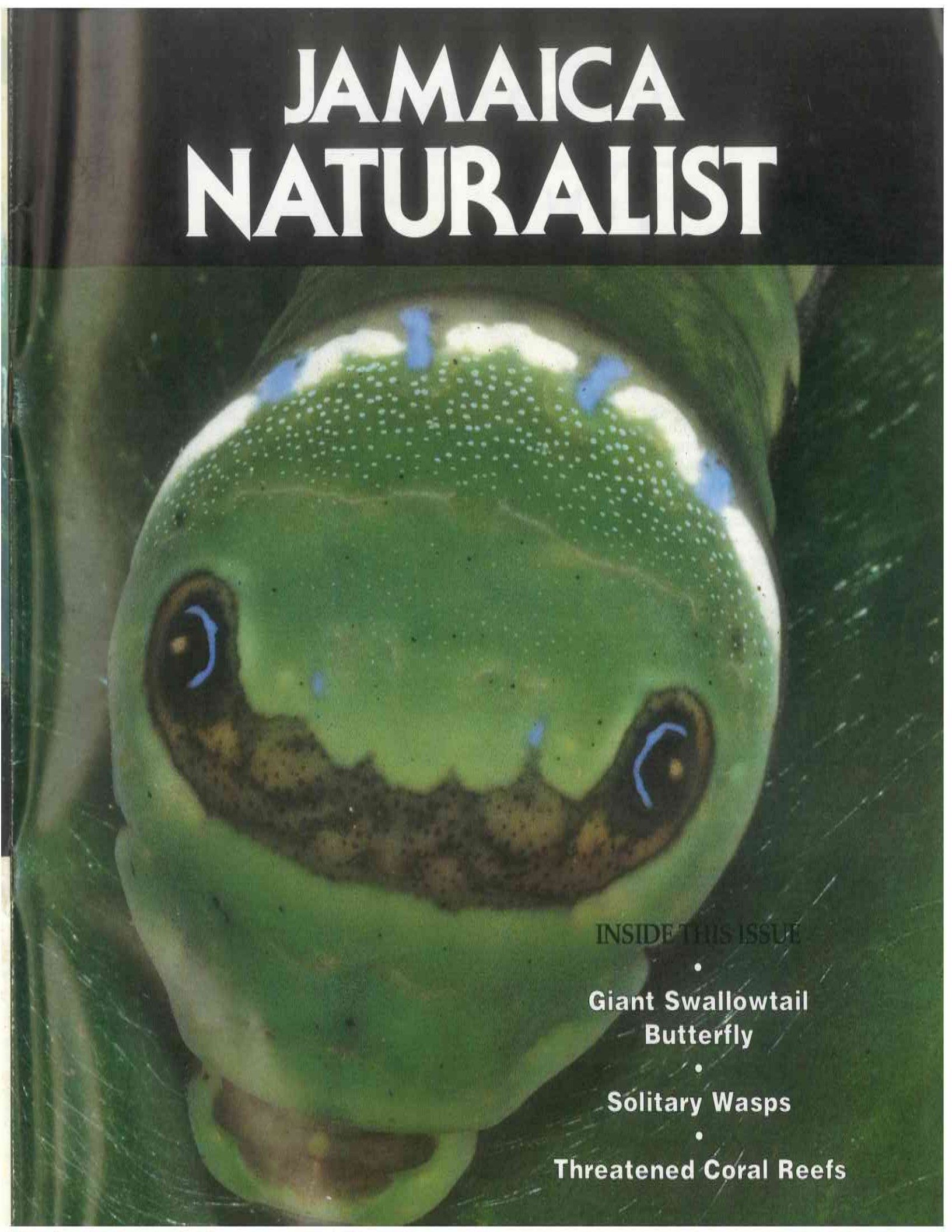
JAMAICA NATURALIST



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He's Jamaican Too

When we harm our environment, we harm ourselves.

Like this Jamaican Owl
(Pseudoscops Grammicus or Patoo),
every tree, river, fish and bird...every creature of Nature contributes to life on this planet and deserves our respect. In Jamaica we must take care to sustain the quality of our air, sea and land.

Shell is helping the cause of environmental conservation in Jamaica. Shell helped found the Jamaica Junior Naturalists which teaches our children to value our country's plant and animal life.
Shell uses its calendar to encourage the protection of endangered marine life. Company representatives have discussed with community organizations the need to balance economic progress with environmental preservation. They also have urged business groups to "bring the environment into the boardroom." Within its own operations, Shell uses many opportunities to show its customers how to use its products safely...and in ways that won't hurt the environment. It was Shell's marketing initiative that brought unleaded gasoline to Jamaica.

But Shell knows it still has some way to go in its own operations. The company conducted an exhaustive environmental audit at all its installations, then hired a full time, in-house environmentalist to carry out the improvements.

Everyone of us ... children, professionals, the man & woman in the street... must help make sure we have a healthy environment.
After all, we're all Jamaicans too!

The Shell Companies in Jamaica
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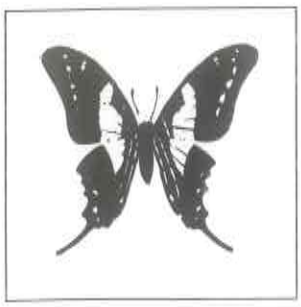

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Caterpillar of the
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EDITORIAL

Having backbones ourselves, we humans often forget that the vertebrates represent only a small fraction of the total number of animal species - about 3 out of 4 species are insects. The present issue of the Jamaica Naturalist is dedicated to the invertebrates, and especially the insects. It is a fascinating world, full of wondrous and seemingly bizarre life styles, forms and colours. Yes, some of these beasts are quite a nuisance - the cockroaches parading their dominance in the kitchen cupboard, termites annihilating wooden rooftops, mosquitos sucking our precious blood. Yet, we should keep in mind that many insects and other invertebrates fulfil important ecological functions which are not only useful to us but absolutely necessary: pollinating crop plants, building and maintaining soil, providing food, and much more.

Habitat destruction is affecting invertebrate as much as vertebrate animals. There can be little doubt that many more insects have become extinct or are on the brink of extinction than birds, mammals or any other group of vertebrates. However, the decline of an invertebrate species goes usually unnoticed, extinction often occurs before the species is even discovered and described. We can only hope that protecting habitats for the survival of vertebrate flagship species will also help survive many species of the lesser known groups.

Some endangered insects do get attention. Since many years with great dedication, Dr. Eric Garraway has developed a programme to conserve the Homerus Swallowtail butterfly. His breathtaking photograph of a Homerus caterpillar adorns the front cover. Eric's work has found worldwide attention; yet, sadly, the necessary funds are slow to come in and the continuation of this important endeavour is seriously threatened.

The majority of the articles in this issue are written by members of the Department of Zoology at the Mona Campus, University of the West Indies indicating the long and strong tradition of the science of entomology at this institution. It also demonstrates an important commitment of the Jamaica Naturalist: to build bridges between our scientists and their most important audience: the Jamaican public.

Peter Vogel

Charles Bernard Lewis

1913-1992

by Margaret Hodges

Bernard Lewis, who died in September 1992, was one of the principal founders of the Natural History Society of Jamaica.

He was born and brought up in the United States and attended Brown University, Providence, in 1931. He graduated with a B.A. in Biology, and went on to John Hopkins University as a graduate student in 1935. From there he was awarded a Rhodes Scholarship to Oxford where he studied three years.

He was a member of the Oxford University Biological Expedition to the Cayman Islands in 1938, which provided to be a fateful experience for him. Firstly, he gained valuable experience in collecting and analyzing the flora and fauna of the islands. Secondly, he met his future wife, Lucille Bodden, in Grand Cayman; and thirdly, on his return via Jamaica, he met with the Board of Governors of the Institute of Jamaica and proposed to them that a Natural History Museum should be set up. This they quickly agreed to, and invited him to do the job and become his curator for a year.

He started work in September 1939. In 1940, he married Miss Bodden and continued collecting material for the museum and writing up his observations.

It was in this connection that he and Christopher Swabey, the conservator of forests, initiated a summer camp at Clydesdale for teachers and scientists interested in studying and collecting specimens of the flora and fauna of the Blue Mountains. This group formed the nucleus of the Natural History Society of Jamaica. The Society inaugurated in January 1941, with Swabey as president and Bernard Lewis in charge of the Natural History Notes, the Society's publication. He continued in a leadership position for many years, writing in the Notes on everything from birds to crocodiles, form fish to fire flies. He also gave talks on the radio on natural history topics, and on Arawak history.

He was a man of wide interests, Biology, Geology, History, Archaeology and Art. He had the ability to enthuse and involve a considerable number of Jamaicans in discovering more about their natural environment, history, and culture, and through the Institute to set up institutional forms to continue the process. After the Natural History Society of Jamaica he helped set up the Historical and Geological Societies, both of which still flourish. More museums were started. He encouraged teachers and school children from nearby schools to visit the Natural History Museum, to bring in their own specimens, to ask questions and to visit the embryonic zoo which grew up around the Natural History section of the Institute. Later he helped plan the Hope Zoo and stock it.

In 1950 he was made Director of the Institute. The work he undertook then and other facets of his life are well described by his colleagues, Tom Farr and Elaine Fisher of the Institute in their article "A Tribute to Bernard Lewis" in the Jamaica Journal (February 1993).

Sadly, three years after his retirement in 1973 a severe stroke ended his active life, and he and his family returned to the United States. As Jamaicans concerned with the environment and with education in the broad sense we have good reason to pay our respects to Bernard Lewis.

The Ecology and Conservation Biology of Jamaica's Endangered Giant Swallowtail Butterfly, Papilio Homerus

by ERIC GARRAWAY
President, Natural History Society
Lecturer in Zoology, University of the West Indies
and
AUDETTE J. A. BAILEY
Department of Zoology, University of the West Indies, Mona.

HOMERUS! HOMERUS!

It is day five of our hike through the rain forest of the John Crow Mountains. Our guide is taking us along a path created by the trampling of wild pigs. For days we have endured this strange weather of 'passing sunshine' not the customary passing showers experienced in Kingston. At 12.43 pm the valley is bathed with sunlight and suddenly there is a loud shout of *homerus! homerus!*

We gaze spellbound as Jamaica's largest butterfly, its wings playing in the sunshine, came floating along. One minute later it was gone. We who had come to take photographs stood in silence, cameras forgotten, but the picture of that encounter was indelibly engraved on our minds.

Jamaica's Giant Swallowtail Butterfly, *Papilio homerus* Fabricius, is considered the largest of the true swallowtail species in the world. With an average wing span of 15 cm (6 inches) *Papilio homerus* is also the largest butterfly in the Americas. A few species of butterflies which occur in places such as Papua New Guinea and Malaysia are larger than *P. homerus* and these are so large that they are called the Birdwings; the largest is Queen Alexandrea's Birdwing, *Ornithoptera alexandrae*, which achieves a wingspan of over 25 cm (10 inches).

P. homerus is an endangered butterfly. It is found only in Jamaica (i.e., endemic); only two small population now exist. Although *P. homerus* has attracted much attention, there has never been a conservation program aimed specifically at the species. Recently, studies began with the initiative of Dr. John R. Parnell (formerly of the Dept. of Zoology University of the West Indies) who, aided by Garraway, produced in 1984 a film entitled "*Papilio homerus*, the Vanishing Swallowtail." This film recorded some aspects of the biology and ecology of the butterfly and highlighted the associated conservation problems. Garraway along with Professor Thomas Emmel, University of Florida, later developed a number of clear objectives necessary for the establishment of a strong conservation program. This present paper summarizes some of the findings of a research program aimed at realizing some of the suggested objectives.

RIO GRANDE VALLEY

P. homerus occurs in habitats that are remote and with very difficult terrain. Consequently, previous research have been limited to occasional one day trips. This report is based on the findings of the first intensive study of *P. homerus*. Over 350 days of observations were made during the period January 1991 to September 1992. This was augmented by observations made by Garraway between 1984 and 1990.

The major study site was the upper Rio Grande Valley, in the parishes of Portland and St. Thomas. Data were collected at elevations ranging from 150 m to 750 m, but there were exploratory exercises to higher altitudes. Little emphasis was placed on the Cockpit Country population because it is even more remote; this very remoteness and the difficult terrain makes this population less vulnerable.

The areas studied were a mixture of primary and secondary forest in various stages of regeneration; large areas have been cleared for shifting cultivation and commercial forestry.

LIFE CYCLE

Like other butterflies, *Papilio homerus* has a life cycle of several stages, egg, larva (caterpillar), pupa (chrysalis), then the adult which is known as the butterfly.

EGG: The egg is spherical, smooth, and average 2 mm across. A newly laid egg is pale green but changes to pale yellow and then dark brown before it hatches into a larva.

LARVA: The larva consumes quite a lot of food; the first meal is the shell of its egg but after that it feeds on leaves. The larva goes through five stages (instars) before finally changing to the pupa. The general appearance of the first three stages is like that of a lizard dropping (predominantly black with posterior 20% white). The fourth and fifth stages are predominantly green with lateral brown and purple marks. A newly hatched larva is only 2 mm in length but the mature larva can measure up to 7 cm when fully extended.

The larva finds it difficult to hang on to the smooth surface of the leaves and so it continually moves its head from side to side as it lays down a silken track to which its legs can grip. Larvae feed mainly during the night and return to the same place to rest during the day. A distinct silken mat (or bed) develops at this resting place. Occasionally two larvae may share the same silken mat. While at rest the larva is motionless, the green colour blends into the green of the leaf, while the lateral brown and purple marks resemble a coiled brown leaf. The duration of the larval stage is about 60 days. The caterpillars often migrate distances between 1.5 and 10 m before pupating on vines, shrubs or on the branches or leaf stalk of the food plant.

PUPA: The colour of the pupae varies and can be grey, brown, green or a combination of these colours. The pupal stage last about 24-26 days after which a full grown butterfly emerges.

THE ADULT: The butterfly occurs throughout the year, however, numbers are so low that in some months, few eggs and caterpillars were recorded but no adults were seen; such was the case in February and November 1991, and January 1992. The highest number of adult butterflies sighted by our study group (i.e., three researchers, five days per week, six hours per day) in any one month was 48 (April 1991), with numbers in June 1991 and 1992 being 28 and 23 respectively.

BEHAVIOUR

P. homerus often soars on air currents, the gold of its large wings glistening in the sun as it patrols open spaces in the forest; it is also capable of rapid flight. Adults generally rest for the night, hanging head upwards on large leaves, with their wings closed. Males often return to patrol the same areas for several days.

Males have been observed patrolling either along streams or in cleared areas. In their quest for mates they investigate butterflies and birds flying through the area being patrolled. Mating of *P. homerus* has been observed only once. In April 1991 a pair of adults was observed mating at 4.00 pm. The mating pair remained in tandem for twenty-five minutes before taking to flight, still in tandem, the male trailing the female.

Mated females lay their eggs on the upper surfaces of mature, as well as on the young and terminal leaves of the food plant but rarely on very old leaves. The eggs are oviposited 1 - 6 m above ground but more commonly between 1 and 3 m. Generally, they are laid singly but four eggs (three of which were of the same age) were recorded on a single leaf. Eggs are also laid on leaves with larvae and on leaves that had been partially eaten.

THE FOOD OF *P. HOMERUS*

The adults of *P. homerus* feed on nectar while the larvae feed on leaves. Adults have been observed collecting nectar from a wide variety of flowers including *Hibiscus rosasinensis* (Shoe black), *Lantana camara* (Orange Sage) and *Hernandia catalpaefolia*. Because adults feed on a wide variety of flowers, there is generally an ample supply of food.

The only food plant of the larva that was confirmed during this study was *Hernandia catalpaefolia*. *Hernandia catalpaefolia*, often called water mahoe, belongs to the family Hernandiceae; it is not related to the blue mahoe which belongs to the Hibiscus family, Malvaceae. There are two species recorded from the *Hernandia* family in Jamaica, *Hernandia catalpaefolia* found in the parishes of St. Thomas and Portland, and *Hernandia jamaicensis*, from the limestone regions of western parishes. The latter is believed to be the larval food plant of the western population. Larvae of all ages fed on young and mature leaves but not generally on very old leaves. Larvae have also been observed drinking water during and after a light shower of rain.

Only a small proportion of the *H. catalpaefolia* trees available was used at any time. In August 1992 when a relatively high number of eggs were recorded, only 27% (n = 205) of the trees at one study site had eggs oviposited on them, although, 82% had been used at least once during the study period. Generally, only a small fraction of the leaves on any tree is utilized. Hence, contrary to earlier perception, larval food is not in short supply.

A. The green of the old larvae blends well into the background, the brownish colour on the side look like dried coiled leaves. The marks on the thorax create the image of an animal with a huge mouth and large eyes; the true head is relatively small and hidden when at rest (see also photo on front cover). If the false head does not deter the predator the larvae has another line of defence, two bright red fleshy tentacles (osmeteria) which it shoots out rapidly to scare the predator, at the same time these give off a musty smelling chemical.

B. The young larvae are often overlooked by predators as they resemble lizard droppings.

C. The brown and green of the pupae also make them very difficult to spot by predators.

Photo by E. Garraway

HABITAT

Contrary to previous reports *P. homerus* is not restricted to virgin forests but rather breeding populations occur in secondary forests as well as in cleared areas. Immature stages were observed on isolated food plants even in the midst of agricultural plots, although moist, shaded areas near to streams are the preferred habitats.

DEVELOPMENTAL MORTALITY

EGG MORTALITY: Approximately 88% of the eggs are killed by a number of factors including very small wasps (hymenopterous parasitoids), fungus and occasionally small ants. The tiny wasps (less than 1mm long) lay their eggs in the eggs of *P. homerus* and their larvae consume the contents of the butterflies' egg, these wasps killed 77% of the eggs.

LARVAL MORTALITY: The 12% individuals which survive the egg stage faces an uncertain future during the sixty days as larvae; they may be killed by disease or become a tasty meal for a lizard or bird. Larval disease was caused by three species of bacteria, *Bacillus* sp., *Enterobacter* sp. and *Clebsiella* sp. An infected larva shows clear symptoms of septicaemia, a disease in which the bacteria attacks and breaks down the walls of the gut. An infected larva becomes sluggish, stops eating and tends to wander, brown fluid exudes from the anus (as though it has diarrhoea) about twenty-four hours after showing the above symptoms; the larva becomes flaccid and finally dies. Eighty-three percent of the larvae observed died from septicemia.

Mortality due to predators was not estimated. Body fluids dripping from leaves from which larvae had vanished indicated the occurrence of a predator which consumes larvae on the leaves. Likely predators include lizards and birds.

NATURAL REGULATION OF POPULATION NUMBERS

The data indicate that the population of P. homerus is being controlled by some factor(s) at a level below which food become scarce. Possible key factors include parasitic wasps in the egg and bacteria in the larval stages; that is, the population is probably regulated by natural agents.

It is still not clear, however, why the impact of these factors have increased so dramatically, resulting in the low butterfly survival. The effect of these mortality factors is much more marked in the cleared areas compared to the forested areas, i.e., very few of the eggs laid in the cleared areas survive to become adults. This is important as the butterfly lays a significant proportion of its eggs in the cleared areas, probably because the trees are more accessible. Their effect of these mortality factors will become more marked as we clear more of the forests.

CONSERVATION STATUS

There has never been an estimate of size of the population of *P. homerus* and so the actual number of individuals remaining is unknown. However, members of the Natural History Society, the University of the West Indies and the Natural History Division of the Institute of Jamaica (including C.B. Lewis, Bengry, D. J. R. Walker, and Garraway) have monitored the population for over five decades and there is clear evidence of a rapid reduction in numbers.

In the John Crow and Blue Mountains the habitat of *P. homerus* suffered major modification during the 1980's through the establishment of commercial plantations of *Pinus caribea* which extended over the 650 m elevation mark in some areas. There were further modifications by Hurricane Gilbert in 1988, which not only ruined the natural forests but devastated the commercial plantations. The butterfly would have weathered hundreds of storms over the centuries but not the large scale deforestation associated with shifting cultivation and commercial forestry.

These commercial plantations have not been replanted and local farmers continue shifting cultivation especially on the lower slopes. *H. catalpaefolia* is also found among these farms and the butterfly continues to lay eggs in these cleared areas with disastrous results.

Legal protection for sections of its habitat is now becoming a reality with the implementation of the Blue Mountain & John Crow Mountains National Park Project in 1990. The geographic range of the butterfly, however, extends outside the park into the area used by the local farmers and the recently implemented public awareness campaign may assist in further protection of the species.

The illegal international trade in *P. homerus* continues on a limited basis. Most poachers are local "opportunist collectors" and organized poaching is very limited. Organized poaching has become more difficult since *P. homerus* is protected under The Convention for International Trade in Endangered Species (CITES) Appendix I, 1987, and under the Jamaican Wild Life Act of 1988.

There is need to continue protection of the unique habitat especially in the higher elevations since the lower regions are unstable due to uncontrolled agricultural usage. The research and education programmes must continue if *P. homerus* is to be here for the generations of tomorrow.

ACKNOWLEDGEMENTS

The Jamaica Agricultural Research Program was the major funding agency for this work; financial aid also came from The University of the West Indies and The Nature Conservancy. Professor Thomas Emmel, University of Florida, assisted in some aspects of the field survey and offered useful suggestions. Drs. John R. Parnell, Chief Horticultural Analyst for the city of St. Petersburg, Florida, and Peter Vogel of the University of the West Indies, offered useful suggestions and information. Dr. Cedric Lazarus and staff of the Veterinary Division, Ministry of Agriculture, Jamaica, identified the bacteria. Drs. R. Robinson and P. Clarke of the University of the West Indies provided both academic and logistic support. Mr. Errol Francis of Millbank was the field assistant.

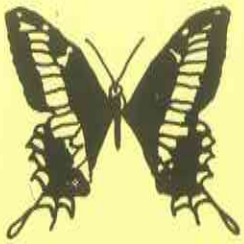
JAMAICA'S SWALLOWTAIL BUTTERFLIES

The hindwings of swallowtail butterflies usually have extended portions called tails. Seven species are found in Jamaica.

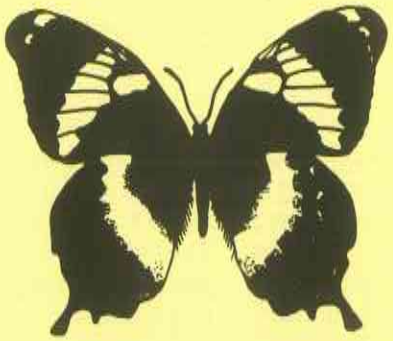
The Giant Swallowtail (*Papilio homerus*) occurs only in Jamaica and is the largest swallowtail in the Western Hemisphere. It is extremely rare. Unless you have visited the heart of the Cockpit Country, the John Crow Mountains, Corn Puss Gap or Cuna Cuna Pass, chances are you have never seen the Giant Swallowtail ... alive.

Papilio andraemon is known as the Citrus Swallowtail or Orange Dog. Native of Cuba, it is found throughout Jamaica and lays its eggs on citrus trees. It often is mistaken for the Giant Swallowtail having the same dark brown and gold colours. If you see a dark brown and gold butterfly hovering around your citrus tree you can almost be sure it is the very common Citrus Swallowtail.

The other swallowtail butterflies are *Papilio thoas, Papilio pelaus, Battus polydamus, Papilio thersites* and *Eurytides marcellinus;* the last two are endemic. *Battus* has no tail and is often seen in gardens; the others are rare.



The very common Citrus Swallowtail (P. andraemon); wingspan (from one wing tip to the other) not more than 3 inches (7.5 cm). The yellow band on the forewings extends towards the tip of the wings.



The extremely rare Giant Swallowtail (P. homerus); wing span 6 inches (15 cm). The yellow band bends across the forewings

Illustration by Lisa Caleb

THE BIOLOGY OF SOLITARY WASPS

by Brian Freeman
Reader, Department of Zoology
University of the West Indies

SOLITARY AND SOCIAL WASPS

Wasps are the product of a long evolutionary history. Fossil wasps are known from the Cretaceous era, the age of the dinosaurs, which ended about 100 million years ago. The bees are an early evolutionary offshoot of the wasps that arose as pollinators of the flowering plants, which started to flourish at about that time. Bees then, are effectively wasps which have evolved to exploit plant products, especially pollen and nectar. I will deal with these fascinating creatures in a subsequent article in the Jamaican Naturalist, but in this article I will confine myself to wasps.

Wasps are behaviourally of two sorts: the solitary species and the social species. In the former each female that builds a nest does so by herself, while in the latter, females that reproduce do so in the company of related females, some or all of whom are non-reproductive workers. In Jamaica there is a varied solitary wasp fauna while the social ones comprise only three species, all in the genus *Polistes*.

A - Sphex jamaicensis *B - Bembex insularis* *C. - Sceliphron assimile* *D - Zeta abdominale*

Photos by E. Garraway

EVOLUTION

Wasps, bees and ants are all are quite closely related. They arose in the dim evolutionary past from sawflies. These are not true flies at all, but primitive wasps possessing the precursor of a sting, a saw-like organ, or ovipositor, which slashes the plants in which they lay their eggs. While saw-flies still occur in many parts of the world, they are absent from Jamaica.

Sergei Malyshev, a Russian entomologist so committed to his subject they he passed away at the age of 85 during a field trip, has made a life's study of wasp evolution. In his view, the first stage of this evolution was the development of the parasitic wasps from the saw-flies. This they did by laying their eggs into more sedentary insects, rather than into plants. Consequently, their saws became modified over a long evolutionary period into an organ more suited for this purpose: a needle-like ovipositor. They also developed a "wasp-waist", a constriction of the abdomen designed to allow more effective use of the ovipositor.

These newly-evolved parasitic wasps, the Parasitica, radiated into numerous families and species. Such adaptive radiation took place at about the same time that the dinosaurs were also radiating. But the Parasitica are still with us! In countless abundance they have become specialised as parasites of other insects. It is these creatures which are the most often used in the biological control of insect pests.

Malyshev regards the Parasitica as the likely ancestors to both the wasps and the bees. While the Parasitica lay their eggs into a hapless insect host, and then abandon it to find another, the true wasps began to gather their parasitised hosts and tuck them away in a safe place where their developing progeny could feed on them in peace. At first these wasps attacked single individuals, so that one egg was laid on a single host.

SPIDER HUNTERS

This ancestral habit is still found today in the spider-hunting wasps, the Pompilidae. These are generally species which hunt on the ground; pompilid wasps have not learnt the trick of plucking unsuspecting spiders out of the middle of their orb webs, as some more advanced wasps have done. They are most usually brilliant metallic blue in colour, and can often be found in the remaining forests in the mountainous interior of Jamaica. They can always be recognised by their habit of curling and uncurling their antennae in the form of a spiral. Most pompilid wasps also hide their prey on the ground, finding a small crevice in a piece of dead wood or a cavity in a rock. Pompilids, and all other solitary wasps, use their ovipositors to inject their hosts with a paralysing venom. Thus this organ, which is necessarily confined to females, has a double function: offence and egg-laying. Our most interesting pompilid wasp is undoubtedly *Auplopus bellus*. This creature builds a row of mud cells in a loose chain. Each one is provisioned with a paralysed spider, but in order to get a large spider into a small cell, *Auplopus* females chew the legs off their prey before incarcerating it. They also make each cell before going hunting, an advanced order of proceedings compared to other pompilids.

From the pompilid wasps two evolutionary lines developed, the Eumenidae and the Sphecidae. These wasps capture a variety of prey, but each group specialises in a particular type. Additionally, they all mass provision, that is they stock several prey into one cell. This means that they can capture smaller prey that are easily dealt with, but, in sum, these prey supply adequate food for larval development. It also means that females can regulate the supply of food to their offspring. Since male wasps are usually smaller than females, mothers provision less food for them. Additionally, they can have regulate the size of their daughters by giving the more, or less, food.

SOLITARY WASPS OF JAMAICA

While Jamaica has a somewhat impoverished island fauna compared to the mainland tropics, many representatives of these two families can be found here. Eumenid wasps in Jamaica comprise no more than half a dozen species. All of them prey on the caterpillars of moths. We can divide the eumenids into the small ones and the large ones. The former have compact bodies barely a centimetre long and are black and yellow. The most common is *Pachodynerus nasidens*, a species found throughout much of the tropical world and spreading its range. Females can frequently be seen carrying a paralysed caterpillar underneath them as they return to their nest, often in holes in old wooden structures in buildings or even in the disused nests of mud wasps. *Pachodynerus jamaicensis* is a species unique to our island and may be distinguished from its congener in having only two yellow bands on its abdomen. It seems to prefer to nest in little cavities in rocks.

The large eumenid wasps have more elongated bodies and are two centimetres in length or more. *Zeta abdomenale*, a large spectacular wasp, makes cells like little mud igloos about a centimetre across. These are perfectly circular in plan unlike those of its newly introduced relative *Delta randalii*, whose cells are slightly wider than deep. *Delta* was previously known only from the Congo and was first discovered here by undergraduates at U.W.I. in 1984. Over the last eight years it has become well established in St. Andrew. The last of these large eumenid wasps is *Monobia mochii*, a rather rare species which makes its nest only in the disused nests of other mud wasps. It was first described about twenty years ago and is confined to the dry lowlands of the southern parishes. One reason why it took so long to be discovered is that it is a perfect mimic of the common social wasp *Polistes crinitus*.

The Sphecidae are a larger and more diverse group of solitary wasps which include the ground-nesting sand wasps and the cliff-nesting mud wasps. The former group are commonly met with on sand hills near to the sea. Small

black species belong to the genus *Larra*, while the short-bodied, bee-like, greenish-yellow and black species belong to *Bembex* and *Microbembex*. The latter provision their cells with flies, but they do this in a distinct way. Instead of provisioning the cell with many prey items and then closing it once and for all as in mass provisioning, they feed their several larvae individually as they grow up. This is called progressive provisioning.

Two other genera of sphecid wasp found in sandy locations are *Sphex* and *Ammophila*. The latter literally means the "sand-lover". *Sphex jamaicensis* is a large, robust, rusty-red species which provisions crickets in its subterranean cells. It is often found inland blythly digging its nest in piles of sand destined for construction work! *Ammophila* is a more willowy, red and black species usually found by the sea. This is the genus that the famous Dutch ethologist Bearends studied on the sand dunes of his country during the second world war. Bearends was able to show that these wasps could find their nests by the use of marker objects both close to, and far away from, their nest entrances.

Sceliphron assimile is the most numerous of the cliff-nesting species of sphecid wasps. Cliff-nesting was undoubtedly the primitive habit of these attractive wasps. Today they have the proclivity of using houses and bridges for their nesting activities, and these black and yellow, thread-waisted wasps are a frequent sight in lowland Jamaica. Their nests of mud cells, like short cigars, are found in clusters of five to fifteen units. Their prey are spiders, and these advanced wasps can pluck their victims right out of the centre of an orb web. They also collect crab-spiders from flowers and jumping spiders like the common black and white *Marpissa bivittata*. One lady they do not mess with is the black widow *Lathrodecta mactans*, since she always lurks in the centre of a complex, amorphous web.

While householders justifiably sweep away their *Sceliphron's* waspy homes few people know that this local wasp has yielded scientific information of great value in two separate areas: parental investment and population dynamics. The latter we will deal with together with that of other wasps at the end of this article while the parental investment we shall consider now.

In 1973 the great evolutionary biologist Robert Trivers together with a co-worker Ed Willard, writing in the journal "Science", made the startling announcement that some female mammals, in this case wild African cattle, could to some extent bias the sex of their progeny. In other words they could influence the sex of an offspring not yet born. Trivers suggested that a small mother, having little milk to invest in her offspring, should bias them toward the female sex, since all heifers small or large reproduce, while small bulls are reproductively useless. On the other hand, a large mother, with plenty of milk, should attempt to produce a big, strong son, since such a gentleman would give her numerous grandchildren! A major criticism made of this work was that the mechanism by which these cattle were supposed to do this biasing was unknown.

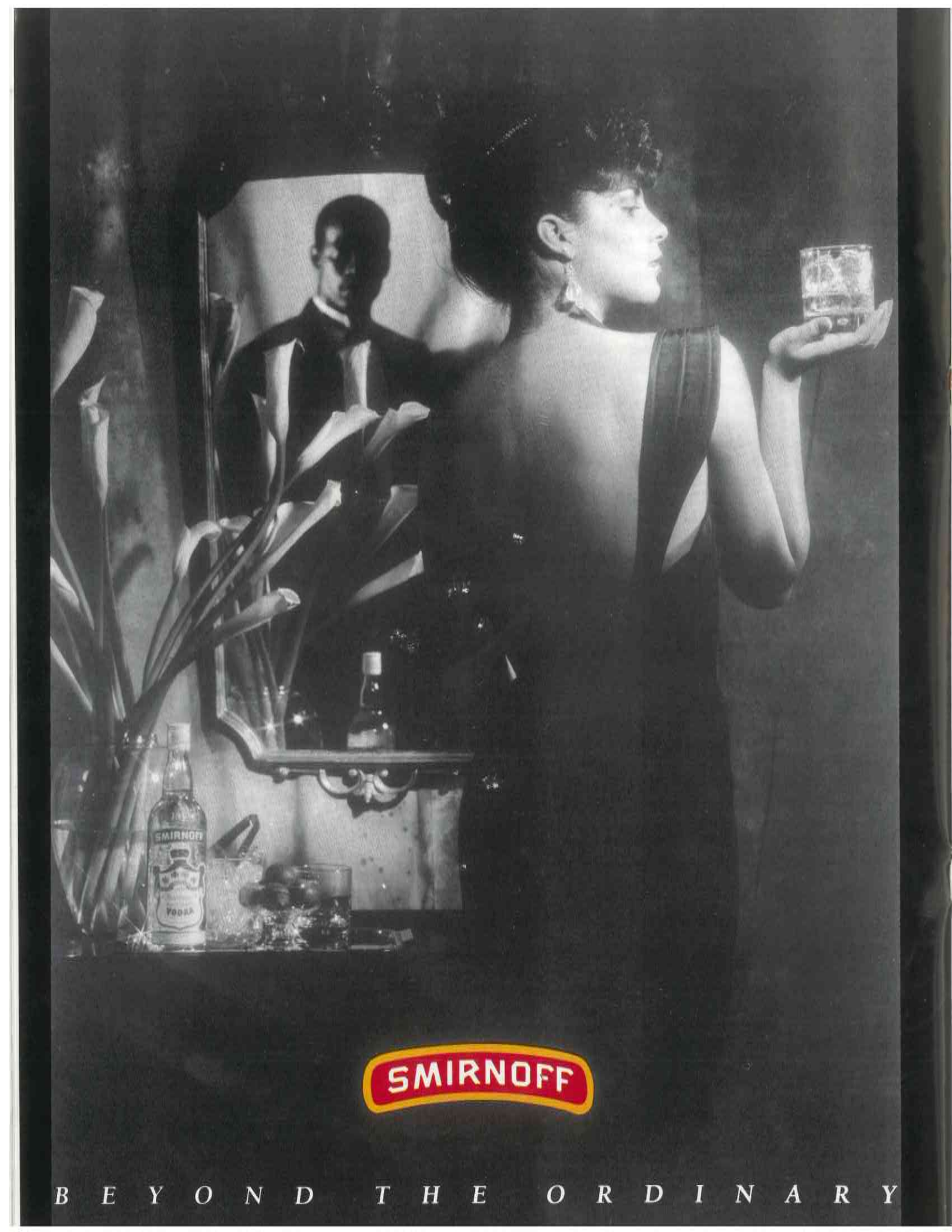
Now, it has long being known to entomologists that all female bees and wasps can do just that. That is how the ratio of worker females do drone males in honeybee nests is controlled. In the late 1970's I investigated the ability of *Sceliphron*, according to her size, to do this sex-biasing of her progeny. The results, in a very subtle way, vindicated Trivers' general thesis. Small *Sceliphron* females biased their progeny to a ratio of two sons to one daughter, while large ones biased them to one son and two daughters. *Sceliphron* is the obverse case to cattle: all males have a similar chance to mate, but large females produce three to four times the number of eggs that small ones do, and hence produce more grand-children for their mothers. Thus females of both cattle and mud wasps of different sizes, bias the sex of their offspring in order to fulfill the evolutionary prerogative of maximising the number of their grand-children. It has yet to be investigated whether humans do this!

REGULATION OF ANIMAL NUMBERS

More importantly, *Sceliphron*, as well as other Jamaican wasps such as *Pachodynerus nasidens*, *Zeta abdomenale* and *Monobia mochii*, have provided important tools in the study of the regulation of insect numbers. In general, the study of the regulation of animal numbers is central to both conservation and pest control.

It is often held that the balance of animal populations lies in their fecundity on the one hand, and in their mortality from egg to adult on the other. Studies on our native solitary wasps have shown that a third factor, losses of young females between emergence from the cocoon and their starting to reproduce, has also to be considered. In *Sceliphron* only one out of every three newly-born females survives to make a nest, and this factor is only slightly less important in the other wasps listed above. Moreover, further studies show that among insects at least, *Sceliphron* is not an extreme case. In Trinidad another sphecid mud wasp, *Trypoxylon palliditarse*, shows a five out of six loss, while other insect groups in Jamaica also show massive losses at this stage: 19 out of 20 in the gall-midge *Asphondylia* and 211 out of 212 in the minute parasitic wasp *Melittobia* (itself a parasite of wasps and bees).

While solitary wasps have fascinating lifestyles in their own right, more importantly in my view, they have provided excellent research material which has allowed us to address two important scientific problems. The area of parental investment is an important segment of the new science of "Sociobiology", which is properly the root-science of Sociology. The regulation of animal numbers is a central part of several disciplines: conservation, pest control and evolutionary theory itself. Next time, don't spray that wasp, they still have many secrets to reveal.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BEYOND THE ORDINARY

FISHING IN THE DARK: UNUSUAL HABITS OF A JAMAICAN FLY

by Ian Stringer
Ecology Department, Massey University, New Zealand
and
V. Benno Meyer-Rochow
Electron Microscopy Unit and Zoology Department, UWI

HAMMOCKS IN THE CAVE

Hidden within some Jamaican caves is an insect with the unusual habit of using a sticky web to catch other insects for food. Each larva of this insect lives in a gallery of silken threads covered with mucus. This is slung hammock-like from beneath an overhanging surface by many single or branching silken threads. It therefore resembles a web which can be up to 20cm long and 10cm wide when there is plenty of available space. Numerous fine "fishing lines" are hung vertically from the threads supporting the galleries. Each fishing line is formed from a pair of silken threads with a total diameter of only 3 microns (0.003mm). These threads lie alongside each other and are covered with a very thin coating of adhesive mucus. These larvae, which are the immature forms of a kind of fly, usually occur in groups and when they are illuminated by a flashlight their massed fishing lines form a beautiful and delicate curtain of vertical hanging threads.

DEVELOPMENT

The larvae grow to about 2 cm in length and each usually makes between 30 to 50 fishing lines, 10 to 20 cm long. Some fishing lines can reach 50 cm or more in length if there is sufficient space to the floor of the cave. Unwanted prey and faeces are lowered some distance down fishing lines and then dropped to the cave floor. A larva backs the hind ends of its body a short distance down a fishing line first before producing a thin elongate faecal mass up to 2-3 mm long.

When mature the larvae stop feeding, pull up all their old fishing lines and replace them with a series of new ones, 1-3 cm long, that are arranged in a roughly circular pattern with a diameter of about 4 or 5 cm. These shorter fishing lines usually have rows of small beady droplets instead of being coated uniformly with mucus. The larvae then shorten their gallery to about 1 to 1.5cm long leaving attachments only at either end. Finally, the larvae become less active, shorter and thicker and eventually pupate. The whole process takes between one and two days and the resulting pupa is left suspended horizontally by a silken thread at either end.

Five to eight days later eclosion occurs and the adult fly emerges head first from its pupal exuviae. It is about 7 to 9 mm long and rather mosquito-like. Males soon struggle free and fly about in the dark but females remain motionless for up to three days with the tips of their abdomens still within the exuviae and their thoraxes attached by the anterior thread. They stay in this position until a male arrives and then they struggle free.

Copulation usually occurs with the female holding on to the exuviae and the male hanging free in mid-air from her.

CARNIVOROUS FLIES

These larvae have been seen for many years by cavers and guano collectors but, despite this, the species has not yet been given a scientific name. The reason is that this insect only occurs in Jamaica as far as we know and it has had to wait for an overseas specialist to describe and name it. This is being done right now by Dr Edward Coher of Long Island University, New York.

The fly belongs to a large family of flies, the Mycetophilidae or fungus gnats, and as the name suggests many of their larvae eat or are associated with fungi. The larvae of the subfamily Ceroplatinae, however, form webs and it is amongst these that the Jamaican fly belongs.

Interestingly, a series of fly species in this subfamily give us a clue as to how this web-spinning carnivorous trait may have arisen from a fungus feeding ancestor. There are species elsewhere that eat fungal spores collected in simple flat horizontal webs that they construct beneath fungi. Predacious species probably evolved from this habit when they found that other insects attracted to decaying fungi also became trapped in the webs and were a good source of food too.

Some predatory species are no longer associated with fungi but form simple adhesive webs for catching other insects in. A few of these web makers can produce light and they use this

bioluminescence to attract other insects into their snares. Bioluminescent species are known from Japan and there is a well known one, *Ophelia fultoni*, in North American caves. The latter forms webs over bat guano and feeds on the small insects that are associated with this food source.

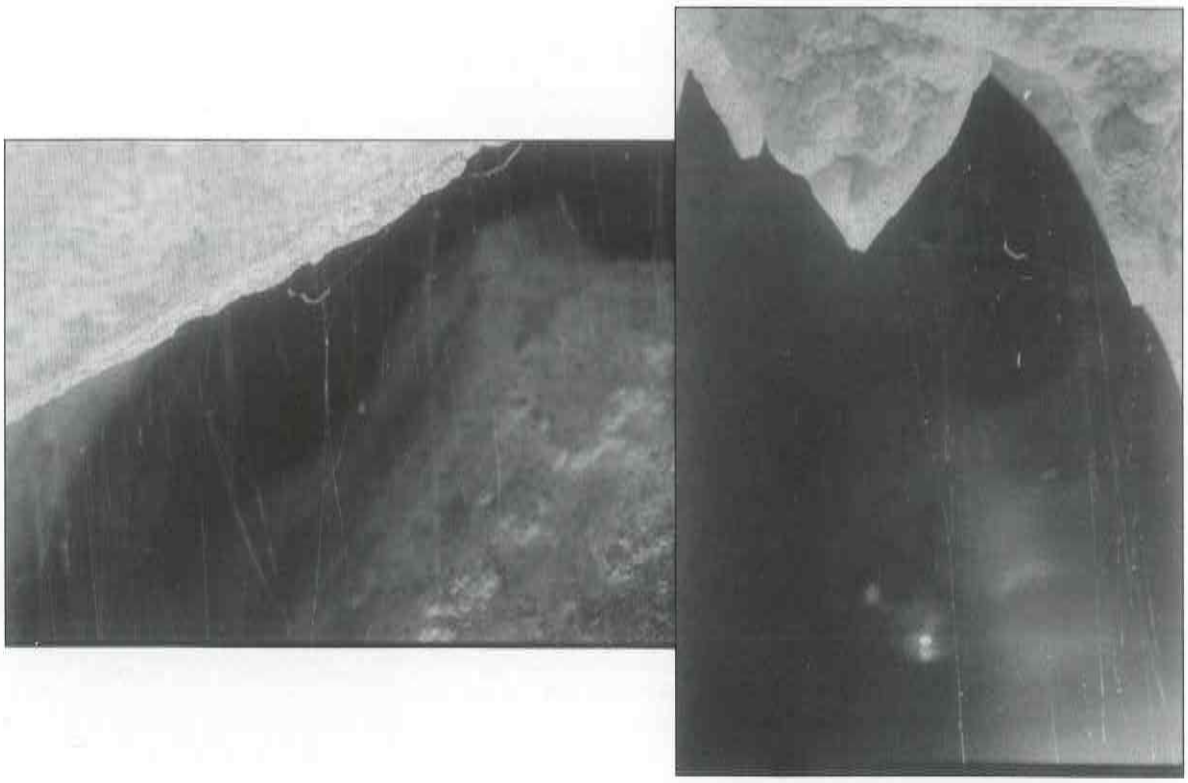
The next modification is the production of hanging fishing lines - like those made by the larvae of our Jamaican fly. Other species with this habit are known from both North American caves and from tropical South America. Australasian glowworms of the genus *Arachnocampa* go one step further. They form small regularly spaced adhesive droplets on their fishing lines and produce a bright blue-green light to lure flying insects into these.

FISHING IN THE DARK

How does the Jamaican fly get enough food? The answer seems to be related to where it lives. All the larvae we have seen have been in caves near deposits of bat guano although we have been told of one sighting of them under a rock overhang in the forest. Certainly such "ratbat" caves can have enormous numbers of tiny flying insects associated with the guano. Most are flies belonging to the families Scatopteridae, Phoridae and Milichiidae. Representatives from these families can perhaps be expected because most of their species outside caves are associated with decaying products or excrement. There are also a few other small flying insects as well in these caves such as predatory staphylinid beetles, streblid flies which are ectoparasitic on bats, and even other species of mycetophilid flies.

When you use a flashlight in a cave containing a large bat population enormous numbers of flies belonging to the first three families can be attracted to the light and create a nuisance by getting into your eyes, mouth and nose. Even without light we have caught up to 7000 of these flies per square metre in adhesive traps during a period of 24 hours. So there seems to be plenty of food available for the web spinning larvae without their having to use light as an attractant. Perhaps bioluminescence would even be a disadvantage in such a situation because their fishing lines would soon become choked and overloaded.

The fishing lines are so fine that they move with the slightest breath of wind and easily become tangled together. When this happens the larva laboriously pulls the lines up and forms new ones again from silk and secretions produced by its mouth. In addition, these fishing lines easily dry out unless the humidity is high. Thus, it seems that caves offer the ideal environment with a humidity close to 100%, with regions of still air and with the added benefits of a constant temperature of around 25 C and total darkness. The prey cannot see the fishing lines in order to avoid them and so the mycetophilid larvae catch prey 24 hours a day while growing and maturing in an air conditioned environment.



Photos by I. Stringer

THE THREATENED CORAL REEFS OF JAMAICA:

THE PROBLEM AND POTENTIAL FOR CONSERVATION

by Andrew Bruckner
Hofstra Marine Labaratory
Priory, St. Ann

Closeup of** Montastrea annularis* ***boulder coral showing bleaching. Photo by A. Bruckner

SHRINKING REEFS

Coral reefs fringing the north coast of Jamaica are shrinking. Once dominated by many closely related corals competing vigorously for space, the reefs are becoming a graveyard of skeletons with few living corals sprinkled within an algal lawn. Researchers in Discovery Bay measured a sixty percent decline of living coral cover between 1980 and 1983 alone (Hughes *et al.* 1987). Reef corals have deteriorated at an accelerating pace in the past five years as matting algae and crusts of tunicates smother living tissue; bioeroding sponges, urchins and worms riddle skeletons, and disease and mistreatment afflict coral polyps (Goreau 1991).

THE REEF ECOSYSTEM

Corals, closely related to jellyfish and anemones, are distinct among the cnidarians in their ability to extract calcium from sea water and simultaneously absorb carbon dioxide, an ozone depleting greenhouse gas. In a time consuming process, these elements are combined and deposited as limestone skeletons forming the mass of the reef's structure. Fragile staghorn coral *Acropora cervicornis* may accumulate 20 cm of skeletal material each year, while the dominant reef building boulder coral *Montastrea annularis* takes 20 years to add on similar amounts. The corals are artists, their skeletons, sculptures - each species grows into a characteristic branching, boulder, brain, tree-like or fungus shape.

The resulting reef, produced by a community of corals in close contact, furnishes food and shelter for algae, invertebrates and fish which coexist in a delicate balance. Thomas F. Goreau, in his 1959 paper, described the zonation of shallow water Jamaican corals. From back reef corals and the bands of *Acropora* to the remarkable buttress formations on the seaward slopes of Jamaica's north coast, this was the first indication of the complexity of the reef system and the interrelationships among its organisms. Widespread disturbances on Jamaican reefs have altered the equilibrium, leading to degeneration of reef building organisms, bioerosion of reef structure and a significant alteration of community composition.

CAUSES OF MORTALITY

Weakened by natural disaster, bouts of warmer than normal water temperatures and pressure from a growing human population, corals have become easy targets for disease and mortality. Waves associated with hurricane Allen (1980) dislodged entire colonies, tumbling them along with sand and rubble over the living reef, scouring its surface (Woodley *et al.* 1981). Shortly after Allen, a fatal epidemic crushed Caribbean populations of herbivorous *Diadema* sea urchins - tests surrounded with spines littered the benthos. Urchin feeding grounds became carpeted in mats of algae, leaving little space for new coral recruitment. The surviving corals were struck again in the midst of repairing their wounds by hurricane Gilbert in 1989.

Corals are under yet another form of attack - humans. The island's expanding population places greater pressure on land and sea. Tourism has stimulated large-scale development of prime waterfront locations; resort complexes draw visitors to the reef. As the frequency of reef trips and the number of divers and snorkelers increases, incidence of boat grounding, anchor damage and human contact with corals escalates. Dredging, landfill dumping and deforestation associated with new developments - marinas, port facilities, waterfront hotels - are causing extensive sediment damage to reef systems.

Agricultural runoff and improperly treated sewage indirectly affect the corals by promoting lush algal growth. Algal blooms are usually short-lived as a corresponding rise of herbivores restores the balance. Today, in Jamaica, algae eaters are being driven toward extinction and algae flourishes. In response to economic incentives, fishermen have depleted reef populations by trapping, spearing and netting fish well before maturity (Munroe 1983). Reproducing adults have diminished, directly affecting future larval recruitment. In the absence of primary consumers - fish which prefer delicate, short-lived filamentous algae - resilient perennial algae has taken over, thriving at the expense of corals.

Caribbean coral reefs have experienced widespread bleaching in the past ten years, a possible indication of global climatic change (Glynn 1991). Healthy stony corals, normally shades of green, gold and brown, become stark white (bleached) when millions of photosynthesizing single celled microscopic dinoflagellates (zooxanthellae) contained in their tissues are released. If bleaching occurs, corals are more susceptible to disease and their skeletal accumulation halts. Only healthy, unbleached corals remove CO from the ocean as they deposit CaCO skeleton, thus reducing greenhouse gases. With each bleaching, construction of the reef framework slows and less CO is metabolized.

In addition to bleaching, black band and white band disease have been observed on reefs between Drax Hall and Landovery, St. Ann's Bay. Here, black band disease has attacked the dominant reef building coral, *Montastrea annularis*, as well as *Montastrea cavernosa, Siderastrea siderea, Diploria clivosa* and an encrusting gorgonian, *Erythropodium*. Darkly colored interwoven filaments of a blue green algae (Cyanobacterium) *Phormidium corallyticum*, the basis of black band (Rutzler and Santavy 1983), first invade susceptible, stressed portions of a coral. Visible as a black ribbon separating living coral tissue from white skeleton, it spreads in an outward ring like a smoldering fire. *Phormidium* is most active at its outer margin, extending filaments into the openings of surrounding polyps, which anchor the algae to the coral. As it spreads, the algal patch dissolves living coral tissue with the aid of bacteria. Dead areas are rapidly colonized by opportunistic algae while boring organisms begin bioeroding the limestone skeletons.

White band disease has swept through elkhorn and staghorn (*Acropora* sp.) populations in Priory and St. Ann's Bay. Arising either at the base of the coral or in holes and cracks on the branches, it appears as an interface of snow-white coral skeleton encroaching upon living coral tissue. In our study site, White Band spreads rapidly over a branch, kills a portion of the colony, then disappears. Areas weakened by white band are easily fractured during storms.

REEF CONSERVATION

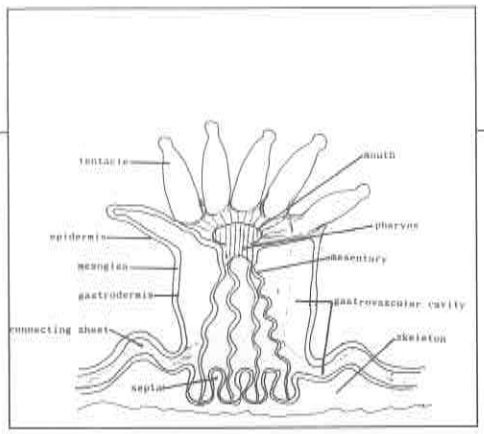
To some degree, the future of the reefs are in our hands. Watersports instructors must educate tourists to refrain from touching, standing on or kicking living coral. Divers must practice neutral buoyancy and also avoid heavy kicking which stirs up sediment and silts corals. Permanent moorings on frequented reef sites would prevent further anchor damage, and areas in addition to Montego Bay Marine Park must be set aside and protected as marine reserves.

Several insightful regulations have been imposed, offering hope that Jamaica's reef communities may stabilize and begin to recover. Legislation requiring minimum size lobsters for capture (3 inch carapace, no egg bearing females), closed harvest of lobsters (April 1 - June 30) and conch during breeding season and a ban on the sale of white and black coral has begun to protect reef invertebrates. In Discovery Bay, fishermen are invited to trade 1 fish pot (10 yards) of 3/4" and 1" mesh for 2 pots (20 yards) of

WHAT IS A CORAL?

Corals are soft-bodied animals belonging to the phylum Cnidaria, a group of invertebrates which includes jellyfish and anemones. An individual coral, called a polyp, resembles a double walled cylinder with jelly-like mesoglea sandwiched between. At the oral end of this cylinder is a circular disc with a single central opening, the mouth, encircled by tentacles. The tentacles are armed with stinging cells; some act to entangle their prey, some are sticky, while others function like hypodermic needles, injecting a poison after impaling microscopic zooplankton. Most corals are colonial, having begun life as a solitary floating planula larvae. A larval coral attaches to bare, hard substrate and immediately begins building an external calcium carbonate skeleton. When conditions are favorable the coral will divide in two, asexually reproducing an identical copy of itself. Coral polyps continue dividing and growing, adding on to their limestone skeleton; the polyps of colonial corals are interconnected by a horizontal sheet of tissue. Each coral species has its own design, with names like brain, star, elkhorn, lettuce leaf and finger coral.

Reef building corals are restricted to warm-water oceans; they require sunlight and tolerate minimal siltation and fresh water. Their success is due to a relationship they have evolved with a symbiotic form of algae called zooxanthellae. Like plants, zooxanthellae photosynthesize, capturing the energy of the sun to produce food. The algae live within the corals in a relationship which benefits both organisms. The coral provides shelter, CO_2 and nutrition - in the form of nitrogenous waste products. In turn, zooxanthellae release nutrients and oxygen that the polyp consumes.



ANATOMY OF A CORAL POLYP

Coral polyps sit in a calcareous skeletal cup which they have secreted. Radiating from the centre of each cup are thin calcium carbonate walls or septa which extend between the mesentaries, providing support for the coral. The central body cavity, called the gastrodermis, is partitioned into sections by paired mesentaries. Tentacles form a circle around the oral disc, surrounding the mouth. The mouth leads, via the pharynx, into the gastrodermis. All living tissue overlies the skeleton, and neighbouring polyps are interconnected.

1 1/2" mesh wire. Although only half the weight of fish are caught per pot, two fish pots with larger mesh will produce an equivalent catch, but all of a larger size fish.

Living surfaces of Caribbean reef terraces are in a constant state of turnover - both algal lawns and coral reefs form, grow, collapse and consolidate, reforming through invasion by surrounding organisms and newly settled spores or larvae. In Jamaica, the natural cycle of events has been disrupted and the algae are winning in this head to head competition. If recruitment of coral larvae is prevented and if preexisting corals stop depositing calcium carbonate, growth of the coral-based reef structure will halt and erosion and physical devastation will take over. Should this natural breakwater disintegrate, the island's shoreline will be hit harder by storms. Fishermen will face inadequate catches and tourists will have little to see, seriously impacting the Jamaican economy. Unless immediate action is taken, an ecologically and aesthetically priceless community may collapse, adding to the crisis in species extinction and accelerating global warming.

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Stall selling dead conch and trumpet triton shells as well as *Eusmilia* flower coral skeletons after legislation was passed outlawing sale of white coral.

Photo by A. Bruckner

RESEARCH NEWS

MORE SURPRISES FROM JAMAICAN CAVES

by Benno Meyer-Rochow

In 1990, Dr. Thomas Iliffe of Texas A&M University came to Jamaica for a vacation and visited several well-known tourist caves and some lesser known sink holes and fissures. Now the results from this "working holiday" in Jamaica have been published: three new species of musselshrimp (Ostracoda) were described, showing that occasional collecting trips into Jamaican caves can be fruitful indeed.

Ostracoda, on the whole, are very tiny members of the Crustaceans, characterized by a reduction of appendages and, most of all, the possession of hinged, enclosing shells, giving the little beasts the appearance of minute bivalves - hence the popular name "mussel shrimp". Musselshrimps occur in the sea, in freshwater, and very occasionally in terrestrial environments as well. Very few musselshrimps have become parasites, amongst them the Antarctic *Acetabulastoma meyer-rochowi*. The newly discovered species from Jamaican caves appear to be free-swimming in the water column and prefer salty or at least brackish water. The three new species were given the beautiful scientific names *Danielopolina elizabethae, Spelaeoecia jamaicensis,* and *Pontopolycope mylax*. All of them are less than 1 mm long and appear to be detritovorous, feeding on tiny particles of organic matter.

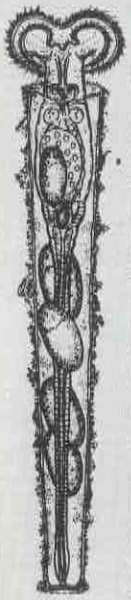
The discovery of three new species highlights the fact that Jamaican caves represent a relatively untouched and unexplored environment with a tremendous potential for the eco-tourism industry. However, caves also represent a very vulnerable habitat that is easily damaged and before any cave tourism can really "take off", reliable faunal registers for the various caves are required, likely environmental impacts have to be considered, suitable tourist caves have to be identified and tolerance levels in connection with the adaptive capacity of cave organisms will have to be tested.

Back to our (or should I say Dr. Iliffe's) ostracods: without the love and dedication for the cave environment that this young and enthusiastic American scientist displays, we might never have known about the treasure of musselshrimp species beneath our feet. In at least two cases, Dr. Iliffe had to free dive through two approximately 10 m long underwater passages in total darkness to reach a "series of small air-rooms and pools". If you can hold your breath for at least two minutes while free-diving in the dark, you could ask Dr. Iliffe if you can accompany him when he next visits Jamaica on a collecting vacation.

Kornicker L.S. and T.M. Iliffe 1992. Ostracoda (Halocypridina, Cladocopina) from anchialine caves in Jamaica, West Indies. Smithson. Contrib. Zool. 530:1-20.

ROTIFERS IN BROMELIAD WATERTANKS

by Peter Vogel



The large elongated leaves of many bromeliads are arranged in a rosette which causes rainwater to be funnelled towards the centre where a temporary or even permanent pool of water is formed. Large bromeliads contain several litres of water. These tanks are inhabitated by a diverse fauna of specialist animals including the unique Jamaican Bromeliad crab (see Jamaica Naturalist 1). In 1961, A.M. Laessle was one of the first to publish an extensive list of species living in bromeliads based on work he carried out in Jamaica (Ecology 42:499-517). More recently, a number of biologist have continued this work in Jamaica including Wolfgang Janetzky and Ekkehard Vareschi from the University of Oldenburg (Germany).

As one part of their studies, the researchers from Oldenburg took a series of water samples from the bromeliad *Aechmea paniculigera* in the Cockpit Country, and extracted tiny animals known as rotifers. Most species of rotifers are between 0.1 mm and 1 mm long and live free-swimming in freshwater. Some species are sessile and a few are parasitic. Rotifers mainly feed on minute organic particles or prey on other small organisms. The bodywall is covered with an often ornamented cuticle. Females frequently reproduce by parthenogenesis (development of unfertilized eggs) and males only occur at certain times. In the bdelloid rotifers males have never been found.

The water samples from the bromeliads in the Cockpit Country yielded 19 different species of rotifers, all of them new for Jamaica including a new species, *Lecane janetzkyi*. The study more than doubled the number of rotifers known from Jamaica from 15 to 34. In the meanwhile, additional sampling carried out by the same researchers suggests that this may represent not more than 10% of the species occurring on the island. This is but one example which shows that the fauna of Jamaica is far from being known completely. With regard to Jamaica's rotifers, the age of discovery has just begun.

Koste, W., W. Janetzky and E. Vareschi 1991. Ueber die Rotatorienfauna in Bromelien-Phytotelmata in Jamaika (Aschelminthes: Rotatoria). Osnabruecker naturwiss. Mitt. 17:143-170.

NATURALIST NOTE BOOK

AN UNUSUAL BUTTERFLY

by Margaret Hodges,
Red Hills, St. Andrew

The bushy, limestone hill top (1600 Ft.) where I live is a good place to see some of the larger butterflies that circle around and between the bushes. The more easily distinguished species quite frequently seen are Orion *Historius odius*, Yellow Dog *Papilio thersites* including the strikingly dark coloured female, Malachite *Siproeta stelenus*, and Zebra *Heliconius charitonius*.

In September 1992 I saw a butterfly that I had never seen before. It was so strikingly marked that it could not be mistaken for any other when I consulted the illustrations and description in Brown and Heineman's book (Jamaica and its Butterflies). It came out of the bushes and hovered low over the grass in the sunlight so that I had a good close view of it before it flew off.

The wings appeared black except for three white circles on each. The forewing had a small circle at the apex and a larger one below, and the hind wing had one large circular patch.

According to Brown and Heineman, this was a male Hypolimnos misippus. They describe it as an introduced species from Africa, recorded in America for two centuries. They suggest it might have been brought to the New World in the early days of the slave trade.

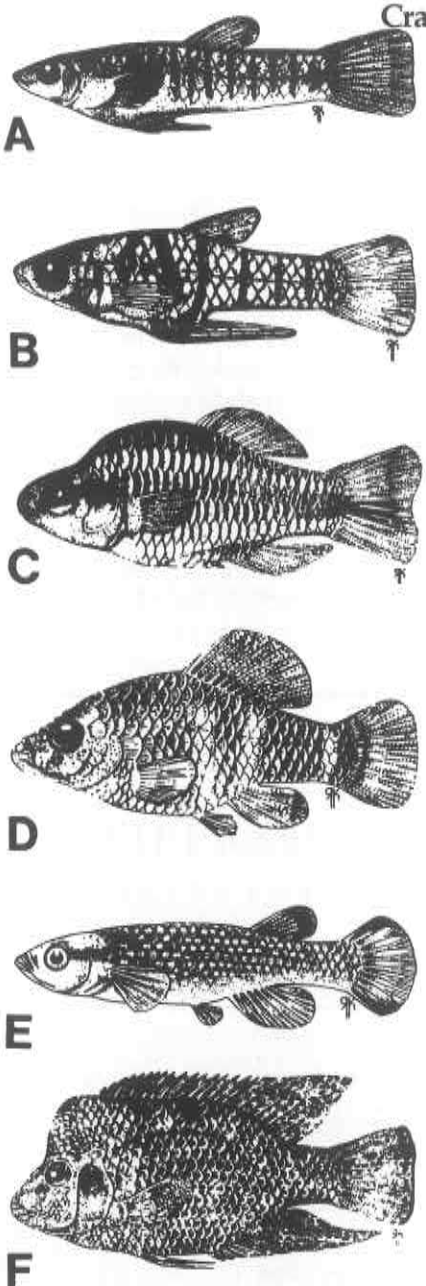
Hypolimnos misippus
(male)

The female is quite unlike the male, resembling the Danaus butterfly, and infrequently seen. The larvae are described as black with grey bands and rows of whitish branched spines. The head is reddish with two branched spines. One was found in Miami on parsley. So I have been inspecting my parsley crop as well but with no luck so far. I would be interested to hear if others have seen this butterfly recently.

BOOK REVIEWS

BIOGEOGRAPHY OF THE WEST INDIES: PAST, PRESENT, FUTURE.

- Charles A. Woods (Ed.). Gainesville, Florida, Sandhill Crane Press, Inc. 878 pp. ISBN 1-877743-03-8.



Some native Antillean fresh water fishes. (A) *Poecilia hispaniola;* (B) *Quintana atrizona;* (C) *Cubanichthys pengelleyi;* (D) *Cyprinodon variegatus;* (E) *Rivulus cylindraceus;* (F) *Cichlasoma ramsdeni.* Jamaica has six species of native freshwater fishes, four of them are endemic to the island including *Cubanichthys pengelleyi.* From Burgess and Franz: *in* Zoogeography of the Antillean Freshwater Fauna.

On March 2-5, 1987, Charles Wood and Hugh Genoways brought together at the Florida Museum of Natural History an impressive group of experts for a symposium to explore "all aspects of West Indian biogeography". The proceedings of this Symposium, from 48 contributors, are presented in this large book as a review of the status of the biogeography of the West Indies in the 1980's. The collection of papers thus serves as a synthesis of current knowledge of a broad range of topics of relevance to West Indian biogeography. Toward that goal, the book includes evaluations of historical factors, such as anthropology and geology, as well as conservation of endemic species. Editor Charles Woods hopes that the publication will also serve to stimulate further work in West Indian biogeography, and to encourage conservation of endemic species in the fragile but resilient West Indian Archipelago.

Ernest Williams, who has been studying the biogeography of the West Indies longer than any other active biologist, launches the book with a review that is intended to link earlier studies with suggestions for future directions. That historical survey is followed by five papers that consider the influences of change because of past geologic events of human activities on the modern distribution of organisms. The bulk of the book consists of a series of papers on the biogeography of various West Indian organisms including plants (junipers), invertebrates (snails, fossil spiders, butterflies) and many groups of terrestrial vertebrates including fresh water fishes, reptiles, birds, bats, rodents, and the introduced mongoose. In addition, the status of the West Indian manatee is reviewed.

The book concludes with five chapters on conservation. Ann Haynes, Robert Sutton, and Karen Harvey review consideration trends in Jamaica, with an emphasis on the status of Jamaica's birds. K.C. Jordan (Bahamas), J.A. Ottenwalder (Dominican Republic), and Peter Ortiz (Puerto Rico) review conservation trends in the Greater Antilles. Finally, P. Paryski, C. Woods and F. Sergile discuss conservation strategies in Haiti. The rationale for this chapter is that if conservation programs can be successful in Haiti, they can work anywhere in the Antilles, and the mechanics of conservation activities in Haiti, therefore, are of widespread interest and importance.

Several chapters will be especially welcomed by students of Jamaican biology, including Williams' discussion of Jamaican fossils; Perfit and Williams' fascinating presentation of geological factors in the evolution of the region; Goodfriend's biogeographical history of land snails in Jamaica; Miller and Miller's biogeography of West Indian butterflies; Burgess and Franz's discussion of the freshwater fish fauna of Jamaica, including a list of exotic species established; Hedges' and Joglar's treatments of the evolution and biogeography of *Eleutherodactylus* frogs; Henderson and Crother's description of biogeographic patterns in West Indian colubrid snakes; Lefebvre et al.'s analysis of the distribution, status and biogeography of the West Indian manatee; Hoagland, Horst, and Kilpatrick's biogeography and population biology of the mongoose in the West Indies; Koopman's

BOOK REVIEW cont'd

updated distributional table for West Indian bats; Woods' exhaustive biogeography of West Indian rodents; and Haynes, Sutton and Harvey's discussion on conservation trends in Jamaica.

Although the book's substantial price tag places it beyond the reach of the casual naturalist, it is an important addition to the recorded knowledge for the region and should be in the library of serious students of West Indian biology. Charles Wood is to be commented for his success in drawing together such a diverse array of experts to participate in the symposium and for quite successfully producing this excellent and monumental compilation of papers produced at that historic meeting. - JAMES W. WILEY.

INTRODUCING THE MANATEE.

- Warren Zeiller. University Press of Florida, G ainsville, Florida, 1992. 151pp.

Warren Zeiller has given us a timely introduction to the manatee. The manatee, dugong or sea-cow as these large, docile, herbiverous marine mammals are variously known are the source of the mermaid myth of early mariners. Today they are an endangered species, whose only real predator is man.

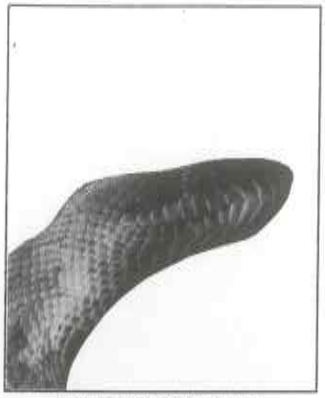
The first half of the book is a personal account of the authors experiences with manatees at the Miami Seaquarium, where he worked for 25 years. Starting with early attempts to capture a manatee for the aquariums collection to the conception, birth and rearing of manatees in captivity. The adventures of the Mermaid Rescue Squad are also recounted, including Sewer Sams return to the wild which was filmed by Jacques Cousteau.

The second half of the book is more technical. It examines the evolution of the manatee and describes seacows in different geographical regions of the world, Stellar sea cows in the Bering sea, dugongs in the South Pacific and Australia, Amazonian and West African manatees, and our own West Indian manatee.

Throughout the book is well illustrated with black and white photographs and line drawings. It also has an extensive bibliography which should prove useful for those who wish to delve deeper into the subject.

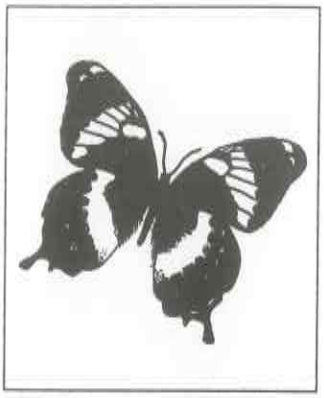
In all *Introducing the Manatee* manages to arouse ones interest and heighten ones awareness of this little known endagered species, without preaching. An important achievement since man is its major predator and public education the route to its survival. The Jamaican manatee population has been guesstimated to be as few as 30, with 5 in captivity at the Canoe Valley reserve. - JUDITH MENDES

THE MANATEE
(Endangered Species)



THE YELLOW SNAKE
(Endangered Species)

THE IGUANA
(Endangered Species)



THE SWALLOWTAIL BUTTERFLY
(Endangered Species)

THE JAMAICAN PATTOO
(Endangered Species)

THE TROPICAL RAIN FOREST
(Endangered)

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would we make the same mistakes...

...polluting the air,
...plundering the earth,
...wasting, depleting, destroying the
wonderful resources that we depend on?

But then, that's a big "IF". So let's start doing our share
today... cleaning, protecting, preventing, conserving
so that when our children's children are grown,
there'll be more answers than questions.

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