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Survey on Birds' Damage to Fruits in Tobago

IICA

By
Brigitte Berthol
ISTOM

December 1992

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IICA OFFICE IN TRINIDAD AND TOBAGO

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**"The views expressed in signed articles are those of the authors
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Institute for Cooperation on Agriculture"**

FOREWORD

This study was executed by Ms. Brigitte Bérthol, a French student who is completing the requirements for her Master of Science degree at the Institut Supérieur Technique d'Outre-Mer (ISTOM) University level college of Tropical Agronomy in France.

Miss Bérthol has had overseas experiences in Martinique, and Chad. She has been involved in food processing, dairy farming, hydroponics, sugar refining and the European Development Fund

Because of the farmers complaints regarding the destruction of their fruit trees by the birds of Tobago, the Agriculture Division of the Tobago House of Assembly (THA) agreed with the Inter-American Institute for Cooperation on Agriculture (IICA) that a survey should be taken to assess the problem more fully.

Ms. Bérthol was supervised by Mr. Gérard Barbeau, Agronomist/Fruit specialist, seconded by the French Government to work in the IICA office in Trinidad and Tobago.

We are pleased to present the results of the survey and hope that it will be helpful in solving the problem.

Joan S. Wallace
IICA Representative in
Trinidad and Tobago

December 07, 1992

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Survey of Birds' Damage to Fruits in Tobago

Executive Summary

One of the objectives of the Division of Agriculture of Tobago is to develop the fruit sector. However, farmers are confronted with the problem of birds which damage the fruits.

In order to determine the extent of the damages, a survey was conducted from August to October 1992.

It reveals that the main birds involved are the Rufous-vented Chachalaca, *Ortalis ruficauda*, the Orange-winged Parrot, *Amazona amazonica*, the Crested Oropendola, *Psarocolius decumanus*, the Golden-olive Woodpecker, *Picus rubiginosus*, and the Red-crowned Woodpecker, *Melanerpes rubricapillus*. The fruits most damaged are cocoa, pommecytheres, mangos and oranges. The districts most affected are the ones situated near to the forest.

The farmers try to fight against birds by using guns and poison but they cannot obtain fire arm licenses easily and, on the other hand, some of the the birds are protected and, therefore, cannot be killed.

Appropriate solutions which respect the interest of the farmers as well as Tobago's natural heritage are proposed.

Keywords: Birds - Fruits - Pests - Trinidad and Tobago - Bird control - Legislation - Crop protection - Environment.

Introduction

Earlier in 1992, discussions were held between IICA and the Division of Agriculture of Tobago and it was discovered that finding a solution to bird pest damage was a priority in Tobago since a lot of farmers were complaining.

The Division of Agriculture of Tobago, therefore requested the assistance of IICA to do a study on the damage done by birds.

IICA had, at this time, received an application for an internship from a student of ISTOM, a college in France, who was interested in doing a similar work in the Caribbean and they took the opportunity of having her undertake the survey and analyse the results.

This survey aimed at finding out which birds were involved, the fruit crops most attacked by the birds and whether the extent of the damage varied according to the location of the fields.

Finally, appropriate solutions to solve the problem had to be proposed.

1. ANTECEDENTS AND HISTORY

1.1. Antecedents

The problem of damage caused by birds is not new and the fight against birds, traditionally guarding and scarecrows, has always existed. However, studies about bird control have been undertaken only quite recently and research progresses slowly, on one hand because bird ecology is not very well known and, on the other hand, because birds are intelligent and have a great ability to adapt (Ruelle, 1982).

In Tobago, the problem dates back to 20 years only. In 1981, a committee appointed to investigate the problem of wild life pest in Trinidad and Tobago, made several proposals, in particular concerning the damage caused by the Rufous-vented Chachalaca or "Cocrico", *Ortalis ruficauda* in Tobago (Ministry of Agriculture, Lands and Fisheries, 1981). For several years, the Division of Agriculture of Tobago has been trying to solve this problem, but to date, no solution has been found.

Many other countries also have to cope with this problem:

- In Africa, one particular bird, the Red-billed Quelea, *Quelea quelea*, causes severe losses to cereals (Manikowski, 1987) and it has sometimes been declared public calamity. Quelea control was organized since 1950 and several methods were tried to reduce their population: crop treatment (Ruelle, 1985), methiocarb repellency (Elmahdi, 1985), aerial spraying (Manikowski, 1988) ...Hundreds of millions of quelea are killed every year, but the problem still remains. These countries are now trying to collaborate through a regional research project (Manikowski, 1987).
- Wild fowl, which causes important damage to rice in Africa, was also the subject of many studies which aimed at estimating the damages and finding a solution (Treca, 1985; 1987).
- In France, a national working group has been established in order to address the new problem laid by starlings, *Sturnus vulgaris* which feed on corn and

orchards. Chemical control with birds in feeding areas are studied as well as methods for aerial spraying (Douville de Franssu et al., 1991) and protection of the crops and silos (Clergeau, 1990).

- Nearer to us, in the Dominican Republic, lethal control of woodpeckers, *Melanerpes striatus*, which attack cocoa, has been tested with poor success, as well as cocoa protection with repellents which seems to be more satisfactory (Mitchell and Brugger, 1985).

1.2. Laws Concerning Bird Protection in Tobago

It is very important to review these laws because bird control implies consideration of legal constraints.

Trinidad and Tobago were separate colonies until 1899. Each of them had its own laws.

The first conservation law in Tobago was introduced in 1885. It was "The Wild Birds" Ordinance No. 8, which aimed at protecting small birds and to introduce a Close Season for game birds like the Rufous-vented Chachalaca, *Ortalis ruficauda*, or "Cocrico", Ducks and waterfowl from April 1st to August 31st (Pyke, 1983).

After the union of Trinidad and Tobago in 1899, their own laws remained in force until 1915 when they were replaced by a single ordinance, "The Wild Bird and Animal Protection Ordinance" (Pyke, 1983).

After the Ordinance 35 of 1933, Game Reserves were created, Game Wardens appointed and a Crown Game license required to hunt in Crown Lands or in Forest Reserves. A Close Season was prescribed for the Pale-vented Pigeon, *Columba cayennensis*, or "Ramier" and the Rufous-vented Chachalaca from January to June and from April to October for the duck and other swamp birds. All other animals or birds were considered to be protected and therefore could not be hunted or kept captive (Pyke, 1983).

On 14th March 1963, Ordinance No. 16 of 1958, the presently in force law, was proclaimed. This law establishes:

- One Close Season for the whole of Trinidad and Tobago from April 1st to September 30th. It is stated that the sale, purchase or serving, during the close season, of the meat of those animals which

may only be hunted in the Open Season, is illegal.

- Game Sanctuaries, such as Little Tobago and Saint Giles Islands in Tobago, where no hunting is allowed.
- Forest Reserves, like the Tobago Forest Reserve, and Crown Lands where hunting is permitted only during the Open Season and only with a State Game License.
- Game animals, cage birds and vermins. All the others are protected.

It is specified that any animal classified as a protected animal cannot be hunted; this means it cannot be killed, wounded, pursued, captured or molested by any method. The meaning of animal is also given as eggs, carcass, meat, nest or young.

Concerning the animals classified as vermins, they can be hunted by anyone on his own land without license of any kind, whether during the Close Season or not. The birds classified as vermins are the Orange-winged Parrot, *Amazona amazonica*, usually called "Parrot" in Tobago, and the Crested Oropendola, *Psarocolius decumanus*, called "Yellowtail".

Finally, the Chief Game Warden can grant special licenses which shall entitle the holder to hunt any animal for any of the following purposes:

- scientific research.
- collection of specimens for zoological gardens, museums and similar institutions.
- the eradication of animals declared to be vermins.

1.3. The Reasons why Birds Attack the Farmers' Crops

All the farmers are unanimous in saying that, thirty years ago, it was very rare to see an Orange-winged Parrot or a "Cocrico" except in the forest while, now, "Cocricos" come even in the kitchens to find something to eat.

Certainly, there is not only one cause to this problem but the conjunction of several.

The main reason, according to the farmers, is the hurricane Flora which hit Tobago on 30 September 1963 and destroyed much of the forest. This

hurricane caused great damages and modified completely the natural environment. Most of the upper canopy was broken and the lower layers of vegetation were completely desiccated. The forest regenerates gradually but foresters estimate that the process may take 50 to 100 years (Ffrench, 1976). The natural habitat of the birds disappeared and there was a noticeable change in bird life: the White-tailed Sabrewing Hummingbird, for example, has been almost completely extirpated and other birds have changed their feeding habits (Ffrench, 1976). These birds could not find their food in the forest anymore and began to feed on farmers' crops.

The abandonment of many lands by their owners because of the damage caused by the hurricane made it easy for them to colonize these lands. Some of these farmers preferred to work in government jobs rather than lose time and money to restore their plantation.

A secondary type of forest began to grow in these abandoned lands. It suits the "Cocrico" which is a edge-feeding animal and it naturally began to feed in these clearings. Now, most of the farmers complain that they cannot get rid of the birds since these live around their fields in the abandoned lands.

Orange-winged Parrots, which usually live in the forest, discovered cocoa, which is mainly cultivated in this area and started to feed on it.

Another event occurred and worsened the situation. Before 1963, the number of "Cocricos" was controlled by the farmers who shot them both to protect their crops and for their meat (the meat of "Cocrico" is in great demand). In 1962, Trinidad and Tobago became independent and the "Cocrico" was declared Tobago's national bird. In 1963, the Conservation of Wild Life Ordinance of 1958 came into force and the "Cocrico" became fully protected. The number of "Cocricos" began to increase since it was not possible to shoot them anymore.

On the other hand, the issue of fire arm licenses was reduced.

All these reasons can explain the increase of the damage caused by birds and, therefore, the increase of complaints from farmers.

1.4. Bird Control in Tobago

Before the hurricane, farmers had few problems with birds and could handle them by shooting.

After the hurricane, when birds started eating farmers' crops, and, above all, when the "Cocrico" was declared protected bird, farmers were unable to cope with this new situation and began to complain. However, for a long time, they were not taken seriously, above all in Trinidad. A 1976 article from Richard Ffrench, the bird specialist of Trinidad and Tobago, says that the "Cocrico" is blamed for damages done by other pests such as the Orange-winged Parrot, the Crested Oropendola and the squirrels. Up to the present time, most people still believe that Tobagonian farmers exaggerate the damage because they want the authorities to cancel the status of protected species of the "Cocrico" and to make firearm licenses more available to them. Only these changes can allow them to hunt the "Cocrico" again.

Before 1971, there was only one Game Warden for the whole of Tobago and it appeared that this was not enough. Four more were appointed in 1971 to act as pest control officers and two more were recruited in 1972 (Ministry of Agriculture, Lands and Fisheries, 1981).

The Conservation of Wild Life Amendment Regulation of 13th August 1973 declared an Open Season for the "Cocrico" from 1st October to 31st December 1973 and the "Cocrico" was placed on the Third Schedule of the Conservation of Wild Life Ordinance of 1958 which concerns the animals classified as vermins (Ministry of Agriculture, Lands and Fisheries, 1981).

During the following years, special Game Licenses were issued to the Forest Officers to shoot the birds which damaged agricultural crops on private lands. Presently, this policy is still applied when farmers request the pest control agents' help. The birds involved are the Rufous-vented Chachalaca or "Cocrico", the Orange-winged Parrot or "Parrot", the Common Gallinule, *Gallinula chloropus*, or "Swamp Hen", the Crested Oropendola or "Yellowtail", the Shiny Cowbird, *Molothrus bonariensis*, or "Blackbird" and the Golden-olive Woodpecker, *Picus rubiginosus*, or "Woodpecker". Two other pests are also shot, the squirrel and the rat (Ministry of Agriculture, Lands and Fisheries, 1981). Honorary Game Wardens have been appointed to supplement the inadequate Forestry staff (Phillips, 1991).

A project of farming of "Cocricos" was established in order to provide tourists with "Cocricos" and has generated much interest among the farmers (Phillips, 1991).

Forestry Division agents also give farmers advice to help them get rid of the birds, such as cutting the trees around the fields.

The replanting of fruit trees in the forest in order to keep the birds in the forest has also been tried on a small scale with little success.

It must also be stressed that many farmers still shoot the "Cocrico". For most of them, the "Cocrico" is a Game animal, since if one reads a copy of the Conservation of Wild Life Ordinance, he will see that the "Cocrico" has been placed by mistake in the Third Schedule of the law concerning animals classified as vermins.

1.5. Agriculture in Tobago

1.5.1. General Information

The area of Tobago comprises 30,000 ha with 16% in natural forest. There are 43 different soil series. The pH varies from neutral in the South West to acid in the North East.

The island is generally hilly, 64% of the lands have slopes of 20° to 30° and above. Average annual rainfall varies between 1,250 mm and 2,000 mm in the South West and 2,250 mm and 3,750 mm in the North East. Agriculture in Tobago is almost exclusively rainfed (FAO/MFPME, 1989).

The Land Capability Survey for Tobago (1973) reveals that 20% of the land is held in estates, both private and state-owned. The State is the largest owner in the island. Domestic agriculture accounts for some 6% of the area.

It is very difficult to know the number of farmers in Tobago. A report from the FAO in 1989 tried to estimate this number through discussions with the Extension Officers of the 8 agricultural districts of Tobago (Annex I), the results are the following:

- Charlotteville: 430 farmers
- Roxborough: 550 farmers
- Runnemedede: 250 farmers
- Goldsborough: 250 farmers
- Plymouth: 350 farmers
- Belle Garden: 200 farmers
- Bethel: 150 farmers
- Mount Saint George: 400 farmers.

These figures seem to be very high.

Another list, from the Division of Agriculture of Tobago, much older, gives the following information:

- Charlotteville: 58

- Roxborough: 93
- Runnemedede: 37
- Goldsborough: 79
- Plymouth: 86
- Belle Garden: 43
- Bethel: 221
- Mount Saint George: 73

This list, which also gives the farmers' names as well as what they produce, seems to be more reliable. However, since it is quite old, there has certainly been a lot of changes. In fact the problem is that, in Tobago, everybody has a few fruit trees or animals and can be considered as a farmer, moreover most of the areas are small and it is difficult to determine the minimum number of acres someone must possess to be qualified as a farmer.

It appears that in Tobago, a great number of farmers are squatters, more than 80% of the farmers are part time operators and they use mainly manual labour provided by the family.

1.5.2. Production

This information is given in the 1989 report of FAO and results from discussions with the Extension Officers.

- Charlotteville is said to be mainly composed of three estates. These estates were originally planted in cocoa, banana and citrus but have ceased to be worked by their owners because of the ravages of bird pests in addition to labour shortages and cost increase. The predominant production system is a mixed food cropping (cassava, sweet potato, Guinea yam, banana and plantain). A further 10% of the land is devoted to a cocoa, banana, vegetable system. Sheep, goats, cattle and backyard fowl appear in various combinations and numbers in almost all systems.
- The Roxborough district is divided into a number of private and government estates. 75% of the farmers operate a mixed food crop system which includes dasheen, yam, sweet potato, banana and plantain. Some farmers who can irrigate are able to add dry season vegetable production. A few farmers derive their main source of income from a cocoa, citrus mango, crop system. Cocoa suffers severely from birds' attack.
- Almost all the farmers in the Runnemedede

district have a food crop system which includes yams, sweet potato, dasheen, tannia, pigeon peas, corn, banana and plantain. When irrigation is available, some vegetables are planted. More than 400 acres of estate lands are planted with cocoa.

- Most of the farmers in the Goldsborough district produce food crops and cocoa, intercropped with citrus and banana. Damage to tree crops from rats and birds is said to be a major problem. There are also several pig and vegetable farms.
- In the Belle Garden district, farmers operate food crop and vegetable systems. Cattle and fruit trees are found on estate lands.
- In the Plymouth district, farmers produce root crops (cassava, sweet potato and yam) and vegetables.
- In Bethel, 80% of the farmers work with a system which combines vegetable production with a range of livestock. Other systems are observed in the district which include: corn-pigeon pea-poultry-sheep, sheep-root crops-coconut, cattle-sheep-orchard-vegetables-root crops, orchard-pigs.
- In Mount Saint George, 75% of the farmers are involved in the production of food crops and/or vegetables. About 20% of the farmers have a livestock based system, mostly sheep, beef or dairy cattle.

1.5.3. The Existing Infrastructure

The island is divided into 8 agricultural districts (Annex II). An Extension Officer is responsible for each of them.

In almost each district (except Plymouth and Bethel) there is a demonstration station which supplies the farmers with breeding stock, seeds, seedlings or feeding stock at a low price. Farmers can also get advice and these stations usually grow plants or breed animals to show the farmers what to do.

Some of them such as Runnemedede, Blenheim, Hope Farm and Charlotteville Demonstration Stations are only breeding units, others, like Goldsborough Demonstration Station and Botanic Gardens provide only seedlings (but in lim-

ited numbers for Botanic Garden). However, the principal propagating station is Louis D'Or Nurseries which produce and supply farmers with vegetable seedlings, ornamental and orchards plants and seeds. This nursery is situated in the North East of the island, and a lot of farmers of the South West complain that it is not convenient for them to go as far as Louis D'Or to buy what they need.

The Kendal Farm School is also a demonstration and propagating station but its main purpose is the training of future farmers. Initially, until 1991, the Farm School proposed an 18-month programme in general agriculture. After this course, the students were able to work as stock assistants, labourers in the stations or could set up their own farms but on a small scale. Since September 1991, the Farm School proposed 3-month specialized training courses in:

- poultry and ornamental production
- small stock and vegetable production
- pig production and fruit crops.

These courses are more intensive and more business oriented than the previous ones but to date, none of the students have set up their own business.

1.5.4. Development of the Fruit Sector

One of the priorities of the Division of Agriculture of Tobago is the development of the fruit sector in order to satisfy the tourist demand for fresh tropical fruits.

Paradoxically, while a wide range of fruits can be grown in Tobago, the hotels of the island stock up with fruits from Trinidad. The reason is that a wider range of produce is available in Trinidad than in Tobago (FAO/MFPME, 1989).

Tobagonian farmers would also like to satisfy the domestic market and to target the export market but presently their products cannot enter into the US market since fruits from Trinidad and Tobago infected by the fruit fly have been discovered.

Developing a citrus processing programme has also been considered. While this sector is very well developed in Trinidad, nothing has ever been done in Tobago. This would allow Tobago to produce and sell fresh citrus juices to the hotels and the domestic market (Griffith, 1991).

The Division of Agriculture has already begun

to produce orchard plants (citrus, papaya, cantaloupe and pineapple) for sale and to establish orchards. Their objective is to diversify their root stock and concentrate on disease resistant varieties. The programme also includes distribution of statelands as well as training of the Extension staff and the farmers (Phillips, 1991).

2. OBJECTIVES OF THIS STUDY

This study aimed at finding out:

- the birds involved and their feeding habits
- the fruit crops most attacked by the birds
- the districts most affected by this problem
- the methods of prevention traditionally used by the farmers.

The last objective of the study was to propose appropriate solutions to solve the problem.

3. METHODS

3.1. Selection of the Farmers

The farmers interviewed were chosen at random from among those who had fruit crops. The list used to select the farmers was an old one (done over 10 years ago) which gave names of farmers who had applied for subsidies. It was sometimes difficult to find some of the farmers because they had either died or given up agriculture.

The number of farmers to be interviewed in each district depended on the total amount of fruit crop farmers of the district and also on the time granted to achieve the survey (from August 1st to October 15th, 1992).

Finally, 110 farmers were interviewed but only 102 questionnaires qualified for analysis (Annex II). There were:

- 5 in Belle Garden
- 10 in Mount Saint George
- 10 in Runnemede
- 11 in Goldsborough
- 11 in Roxborough
- 12 in Charlotteville
- 21 in Bethel
- 22 in Plymouth.

3.2. Unfolding of the Survey

The survey was conducted with the help of the Extension Officer of each district who had to locate the farmers and to inform them in advance.

We spent a week in each district (from August, 1st to October, 15th). We interviewed the farmers and also visited their field to see the extent of the damages. This, however, was not always possible since there were not a lot of fruit trees bearing during this period of the year.

3.3. Presentation of the Questionnaire

This questionnaire (Annex III) was realized with the help of the Extension Officers. It aimed at finding out the following:

- the identity and address of the farmer
- the location of the fields
- the fruit species cultivated and the area devoted to each of them
- the birds causing the damages and the percentage of fruits damaged for each crop
- the birds' feeding habits: when and where they feed, at what stage the most critical damages are done
- the methods of prevention used by the farmers.

4. FINDINGS OF THE SURVEY

4.1. Reaction of the Farmers

Most of them collaborated without any problem. A few were reluctant to give information or were very suspicious because they were convinced that the survey would never be followed by any action.

Some farmers may have exaggerated the damages because they thought that the findings of the survey would allow them to collect subsidies to finance bird control or would make firearm licenses more available to them. However, since not all the fruit trees were bearing at the time, we were not able to estimate the damages and we had to trust them.

Some farmers could not answer the questions because they did not know the amount of fruit trees they had or because they had never really paid attention to the birds damaging their crops. Therefore, these questionnaires were incomplete and could not be analyzed.

In most cases, it was difficult to obtain figures (number of fruits trees, percentage of damages...) all the more since there were other animals such as rats, squirrels which also damaged the crops.

The questionnaire was printed before being

tested and after the first interviews, it appeared that a few things had to be changed:

- most of the farmers do intercropping and have a lot of different fruit species so there was not enough room to list them all
- farmers could not express the area devoted to each fruit crop, this was replaced by the number of trees
- the question about the part of the tree damaged turned out to be useless
- farmers could not tell us at what stage the most critical damage was done but at what stage birds begin to damage their crops,
- it would have been useful to know what the farmers do with their harvest (home consumption or sale) and if they are part-time or full time farmers.

Therefore, we had to modify the questionnaire.

4.2. Fruit Crops Cultivated and Size of the Holdings

The fruits mainly grown in Tobago are mangoes (grown by 89% of the farmers), oranges (79%), pommecytheres (67%), avocados (67%), bananas (61%), limes (51%), grapefruits (49%), cherries - (46%), pawpaw (36%), mandarins (36%). Cocoa is grown by only 22% of the farmers¹ (Annex IV).

The repartition of the fruit crops (besides cocoa and banana) is mangoes (25% of the fruit crops), oranges (20%), avocado (17%), grapefruit (8%), pawpaw (7%), limes (6%), mandarin (3%), pommecythere (3%) and cherry (3%) (Annex V).

The order is different because even if most of the farmers have pommecythere trees, cherry trees, lime trees (...), they usually have only a few of these trees, while they generally have bigger fields with mangoes, oranges, avocados. Cocoa and bananas are not included in this repartition because it was difficult to obtain an acreage or a number of trees for these crops.

¹Pommecythere = *Spondias cytherea*, Mango = *Mangifera indica*, Cocoa = *Theobroma cacao*, Orange = *Citrus sinensis*, Pawpaw = *Carica papaya* L., Avocado = *Persea americana*, Mandarin = *Citrus reticulata* Blanco, Cherry = *Phyllanthus acidus*, Banana = *Musa sapientum*, lime = *Citrus aurantifolia*, Grapefruit = *Citrus paradisi*

Other fruits are grown by the farmers such as guava, *Psidium guayava* L., shaddock, *Citrus grandis*, sugar apple, *Annona squamosa* L., custard apple, *Annona reticulata* L., soursop, *Annona muricata* L., star apple, *Chrysophyllum caimito* L., pineapple, *Ananas comosus*, passion fruit, *Passiflora edulis*, mamey apple, *Mammea americana* L., dong, *Ziziphus mauritania* Lam., tamarind, *Tamarindus indica* L., pommerac, *Syzygium malaccense*, sapodilla, *Achras sapota* L., carambola, *Averrhoa carambola* L., red cherry, *Malpighia glabra* L., ... Some of them like guavas, pommeracs are severely damaged by birds but they are not included in the following study since they are not grown on a commercial scale.

The average number of trees per farmer (beside cocoa and bananas) is 82, but this figure varies considerably according to the district (Annex VI).

The biggest holdings were found in Belle Garden (292 trees/farmer). But this figure is not very representative since only five farmers were interviewed in this district.

Belle Garden is followed by the two Western districts of Bethel (126 trees/farmer) and Plymouth (92 trees/farmer), then Roxborough (68 trees/farmer). In these districts, it appears that fruit production represents a great income for many farmers. The other districts (Mount Saint George, Runnemedede, Goldsborough, Charlotteville) count for less than 50 trees/farmer. Most of these farmers use the fruits for home consumption and seldom sell them. They live by other means such as vegetable production (Goldsborough) or a job.

Charlotteville, Belle Garden and Goldsborough traditionally grow cocoa (53% of the farmers). This crop has not been considered to determine the size of the holdings, therefore the areas are certainly much bigger.

4.3. Birds Involved

67% of the farmers interviewed complained about the "Cocrico" or Rufous-vented Chachalaca, *Ortalis ruficauda*, which is therefore the main pest. It is followed by the two species generally called "Woodpecker", the Golden-olive Woodpecker, *Piculus rubiginosus*, and Red-crowned Woodpecker, *Melanerpes rubricapillus*, (53%), the "Parrot" or Orange-winged Parrot, *Amazona amazonica*, (36%) and the "Yellowtail" or Crested Oropendola, *Psarocolius decumanus*, (25%) (Annex VII).

Other birds were mentioned during the survey such as:

- the Banaquit, *Coereba flaveola*, or "Sugar Eater"
- the Tropical Mocking Bird, *Mimus gilvus*, also called "Day Clean" or "Long-tail"
- the Carib Grackle, *Quiscalus lugubris*, generally known as "Blackbird"
- the Green-rumped Parrotlet, *Forpus passerinus*, or "Parrakeet"
- the Blue-gray Tanager, *Thraupis episcopus*, generally called "Blue Jean"
- the Common Gallinule, *Gallinula chloropus*, or "Swamp Hen".

But they are not as destructive as the four birds mentioned above.

4.4. Birds' Habits

As we will see later, the birds' habits (diet and feeding time) vary according to their condition of life (number of birds, availability of the fruits..). But when they can choose, they prefer certain fruits such as pommecythere, pommerac, cocoa which are sweet and easier to eat. They also eat them preferably when they are ripe and seem to be attracted by the colour.

"Parrots" are said to move in big flocks of hundreds of birds, while "Yellowtails" and "Woodpeckers", form smaller groups (10 to 20 birds), "Cocricos" move in groups of about 5.

4.4.1. Birds Diet

It appears that the Crested Oropendola ("Yellowtail") feed mainly on citrus (Annex VIII).

"Cocricos" eat pawpaw, mango, pommecythere, banana and citrus (Annex IX).

"Woodpeckers" feed mostly on citrus and also on mango and pommecythere (Annex X).

The favorite food of Orange-winged Parrots is cocoa. They also eat mango, pommecythere and citrus (Annex XI).

4.4.2. Feeding Time of the Birds

All these birds eat at any time of the day with two peaks at dawn and dusk (Annex XII).

4.4.3. Stage of Damage

According to the farmers, "Cocricos" and "Woodpeckers" eat above all ripe fruits but can also eat them when they are green or mature. "Yellowtail" eat fruits at all stages, "Parrots" eat mostly green fruits (Annex XIII).

4.5. Estimates of the Damages

4.5.1. Damages on Fruits

The fruit most attacked is cocoa (81% of the farmers lose more than 50% of their cocoa because of the birds), pommecythere (38%), mango (36%) (Annex XIV), orange (31%), mandarin (28%) and pawpaw (27%) (Annex XV).

On the whole in Tobago, 26% of the fruit crops are badly damaged by birds (more than 50% of the fruits are lost) (Annex XVI).

4.5.2. Districts in Detail

If we consider the districts, they can be divided in three categories (Annex XVII):

- Charlotteville, Roxborough and Belle Garden where 40% to 50% of the fruits are severely damaged by birds
- Goldsborough, Bethel and Plymouth where 75% of the fruits hardly suffer from birds' attacks
- Runnemede and Mount-Saint-George occupy an intermediate position: 25% to 35% of the fruits are badly damaged.

4.5.2.1. Charlotteville, Roxborough, Belle Garden

In these three districts, the percentage of fruits damaged is very high since 40% to 50% of the fruits are badly damaged (Annex XVIII). This could be explained by the fact that these districts are located in the tropical forest (Annex I) which is the natural habitat of the birds. Moreover, 53% of the farmers of these districts grow cocoa. The birds, in particular the Orange-winged Parrots, discovered this crop after the hurricane Flora and are now accustomed to feeding on it and destroy almost all the fruits. Some farmers who have a big area of cocoa told us that they do not harvest more than a bucket of cocoa. Other farmers have reduced the areas devoted to fruits because of the damage caused by birds.

Therefore, the bird farmers complain most about is the Orange-winged Parrot, then the Rufous-vented Chachalaca, the Crested Oropendola and the "Woodpeckers" (Annex XIX).

The most damaged fruits are cocoa, mango, citrus (orange, grapefruit, mandarin), pommecythere and pawpaw.

In these districts, Orange-winged Parrots and "Cocricos" eat almost every fruit. The farmers noticed that birds eat the fruits they prefer first (cocoa, pommecythere, pommerac) and when

there are no more of these fruits, attack the other fruits. But there are so many birds that they eat the fruits even when they are green and have to feed also on fruits which do not usually attract birds such as avocados, limes and shaddock.

Farmers also said that these birds come at any time of the day.

In these districts, 68% of the farmers used a method of prevention which is the higher percentage (Annex XX). In the face of the extent of the damages, farmers try to control the situation but most of them said that they cannot reduce the population of birds since not enough farmers have a gun.

4.5.2.2. Bethel, Plymouth

In these two districts, about 75% of the fruits hardly suffer from birds' attacks (damages inferior to 25%) (Annex XXI) because they are located far away from the forest (Annex I).

Orange-winged Parrots are hardly seen in these districts. The main pests are "Cocricos" and "Woodpeckers" which eat the fruits mainly when they are mature or ripe. Farmers also have problems with small birds like the Bananaquit ("Sugar Eater") and the Blue-gray Tanager ("Blue Jean") (Annex XXII).

The feeding time is mostly early in the morning and late in the afternoon.

Paradoxically, about 40% of the farmers use methods of prevention (Annex XX). Perhaps because they are more efficient on this small amount of birds. Certainly also because the main pest is the "Cocrico" which is easier to kill than the "Parrot" and which everybody likes to eat.

In these districts, a lot of farmers think that birds also have to feed and they leave some ripe fruits for them on the trees. It is obvious that they are well disposed towards birds because they do not have much problems with them.

However, their mentality is completely different to the mentality of the farmers of Charlotteville, Roxborough and Belle Garden who want to kill all the birds.

Plymouth and Bethel are the districts where fruit production seems to be more developed since the areas are the biggest. They are also the most suitable areas to grow fruit crops if one wants to avoid birds' damages.

4.5.2.3. Runnemedede, Mount Saint George

In these two districts, 25% to 35% of the fruits are badly damaged by birds (Annex XXIII). They are also located in the forest (Annex I), but fruit areas are smaller than in Charlotteville and Roxborough and it appears that birds are more attracted to big areas far from inhabited areas.

Birds eat the fruits mostly when they are mature or ripe. Orange-winged Parrots are an exception since they eat green fruits.

The main pest is the "Cocrico", then the Orange-winged Parrot and the "Woodpeckers". In Mount Saint George, the Crested Oropendola is also a major pest. In Runnemedede, small birds like the "Bananaquit and the Blue-gray Tanager also damage the fruits (Annex XXIV).

The most damaged fruits are mango, orange, pawpaw, pommecythere and also cocoa, but only 15% of the farmers grow cocoa.

Only 19% of the farmers use a method of prevention (Annex XX) which is the smaller percentage. The reason is perhaps that the areas are very small and it is not profitable to fight against birds, on the other hand, most farmers do not live on their fruit production, therefore, it is not worth spending money and time to get rid of the birds.

4.5.2.4. Goldsborough

This district is the least damaged (Annex XXV). Nevertheless, it is situated in the forest. The crops grown in this area are mainly vegetables and the farmers interviewed had only a few fruit trees around their house. This can explain the small extent of the damages.

4.6. Methods of Prevention used by the Farmers

Almost half the farmers use a method of prevention (Annex XXVI).

The most widespread method is the gun (47% of the farmers). The guns are used to shoot the birds (mostly "Cocricos" and "Parrots") or to scare them.

Poison comes after (28%). Farmers put it in ripe fruits (generally Lannate in pawpaw) and the birds which eat the fruits die. But most of the farmers are reluctant to use this method or do not use it any more because harmless

THE MAIN BIRD PESTS IN TOBAGO



Rufous-vented Chachalaca, *Ortalis ruficauda*, "Cocrico"



Crested Oropendola, *Psarocolius decumanus*, "Yellowtail"



Orange winged Parrot, *Amazona amazonica*



Red-crowned Woodpecker, *Melanerpes rubricapillus*

DAMAGES DONE BY BIRDS ON FRUITS AND VEGETABLES



Grape Orange

Pomme Grenate



Orange



Guava



Soursop



Banana



Mango



Ochro

animals can be killed as well (other birds, snakes, manitous...).

The other methods of prevention used are the presence of the farmer in his fields (14%) and scarecrows (12%). We noticed that most of the farmers are part-time farmers and are most of the time out of their fields.

Some farmers also use nets, slingshots, or put rum in the fruits to catch the birds. We found some original methods of prevention such as a farmer who got the birds accustomed to eating fruits from a feeding trough which he purposely displayed and several who would leave ripe fruits on the trees for the birds and even a farmer who put a "Cocrico" in a cage in the middle of his field to frighten the other birds.

For most of the farmers, the best control method is the gun. The only disadvantage is the high cost of the ammunition. They stressed also that it is very difficult to obtain gun licenses.

4.7. Stage of Harvest

Harvesting the fruits at an early stage can be considered as a method of prevention against birds' attacks since they occur mostly when the fruits are ripe.

Some fruits are traditionally harvested when they are mature (avocado, pawpaw, banana). On the other hand, farmers are reluctant to harvest citrus before they are ripe because they taste sour.

Surprisingly, the survey reveals that fruits, with the exception of avocado, pawpaw and banana, are mainly harvested when they are ripe. The reason is that many farmers do not have a secure market for their products and have no choice but to leave them on the trees. They would like help from the government to organize the marketing of their products in Trinidad. This seems strange when it is known that the hotels in Tobago get their fruits mostly in Trinidad (FAO/MFPME, 1989). Some of the farmers manage to produce fruits which meet the hotels' requirements, others organize the marketing of their fruits for Trinidad. But they represent a minority.

This means that a great number of farmers are concerned that birds eat their fruits whereas they have not been able to sell the fruits that the birds have not eaten. Therefore, even if the birds are pests for these farmers, they do not have a great economic impact at present.

4.8. Damages on Vegetables

The survey dealt only with the damage caused by birds on fruits but during the interviews, we also collected information about the damages on vegetables.

The main pest when it comes to vegetables seems to be the "Cocrico" or Rufous-vented Chachalaca. This bird eats leaves, flowers, from a wide range of vegetables (pigeon peas, sweet potatoes, cassava, yams, tomatoes, corn, sweet pepper...). The problem is that when the "Cocrico" has eaten all the leaves and flowers, the growth of the plant is slowed down and the yields are very low.

A lot of farmers complain also about the "Parakeet" or Green-rumped Parrotlet, *Forpus passerinus*, which feeds on vegetables particularly ochros.

Other birds are involved such as:

- the Tropical Mocking Bird, *Mimus gilvus*
- the Carib Grackle, *Quiscalus lugubris*
- the Orange-winged Parrot, *Amazona amazonica*..

The damage seems to be important and a study is therefore necessary.

5. PRESENTATION OF THE BIRDS

5.1. Orange-winged Parrot

SCIENTIFIC NAME:	<i>Amazona amazonica</i>
FAMILY:	Parrots
LENGTH:	32 cm

This very common species of Trinidad and Tobago is also called "Green Parrot", "Amazon Parrot".

The plumage is green with orange on both wings and the tail and forehead are blue.

In Tobago, it inhabits the lighter areas of forest and cultivated lands.

It feeds on fruits, seeds and flowers.

It nests in holes, often in palm trees (Ffrench, 1986). According to farmers, the nesting period is November and December.

The Orange-winged Parrot is classified as a vermin in the conservation of Wild Life Ordinance.

5.2. Crested Oropendola

SCIENTIFIC NAME: *Psarocolius decumanus*
 FAMILY: Orioles
 LENGTH: 32 cm

The Crested Oropendola is also called "Yellowtail" or "Corn-bird".

It is a common resident of both the islands and frequents the forest edge and cultivated areas with large trees.

It is black with a chestnut rump. It has a long tail which is mostly bright yellow, a long whitish bill and bright blue eyes.

"Yellowtails" nest in colonies from January to March. They are omnivorous, feed on insects, blossoms, berries and also fruits and corn (Ffrench, 1986).

As the Orange-winged Parrot, the Crested oropendola is classified as a vermin in the Conservation of Wild Life Ordinance.

5.3. Golden-olive Woodpecker

SCIENTIFIC NAME: *Piculus rubiginosus*
 FAMILY: Woodpeckers
 LENGTH: 20 cm

It is also called the "Carpenter bird".

A common resident of both islands, it frequents the forest and cultivated areas with trees at all levels.

This species is golden-olive above and barred dark and yellow below. The nape and moustachial streak are red.

Breeding is said to take place from March to June.

Its food consists of insects and also fruits (Ffrench, 1986).

Golden-olive Woodpeckers are classified as protected animals and are therefore fully protected throughout the year.

5.4. Red-crowned Woodpecker

SCIENTIFIC NAME: *Melanerpes rubicapillus*
 FAMILY: Woodpeckers
 LENGTH: 20 cm

It is a common resident in Tobago. It is not recorded in Trinidad. It frequents the secondary growth and cultivated areas.

This species is black and white above, the rump is white, the nape is red, the face and underparts are generally olive brown, the tail is black.

Breeding is recorded from March to July. The nest is usually a hole in a dead tree.

It feeds on insects, especially ants, but also fruits and berries (Ffrench, 1976).

This species is protected as well.

5.5. Rufous-vented Chachalaca

SCIENTIFIC NAME: *Ortalis ruficauda*
 FAMILY: Guans
 LENGTH: 55 cm

Also known as the "Cocrico", this species exists only in Venezuela, Colombia and Tobago. It is Tobago's national bird.

It frequents hill forests and is widespread in the secondary growth adjoining cultivated lands.

It is olive brown above with gray head and neck. The long broad tail is bronze and the flanks are rufous.

This species feeds on berries, fruits and young shoots of a variety of plants (Ffrench, 1976; 1986).

The Rufous-vented Chachalaca is protected by the law.

6. SOLUTIONS PROPOSED

6.1. The Environmental Aspect

The findings of the survey showed that birds' depredations are in conflict with farmers' interest.

The solutions proposed by most of the farmers to solve this problem is the issue of firearm licenses which are presently so difficult to obtain. They would like a big campaign against these birds in order to reduce the population to a tolerable level or even to exterminate them. But they do not think about possible consequences.

One of the major difficulties when it comes to finding a solution to this problem is that the environmental aspect must also be taken into account.

Birds are important for farmers because they take an active part in the fight against insects and also because they provide a natural fertilizer.

Moreover, in Tobago, bird-watching represents a great income through tourism. Most of the tourists come to Tobago because they know that the island counts for nearly 200 species of birds of which 20 cannot be found in Trinidad (Ffrench, 1972). Of course, the island counts for fewer species than in Trinidad but, in Tobago, the bird watcher does not have to go deep into the forest to see birds such as the "King of the Woods", *Momotus momota*, the "Parakeet", *Forpus passerinus*, or the "Parrot", *Amazona amazonica*. On the island of Little Tobago also, colonies of birds such as the Red-billed Tropicbird, *Phaethon aethereus*, can be seen. The Bird-of-Paradise island has played host to a bird from New Guinea called the Greater Bird-of-Paradise from 1909 until a few years ago to safeguard the remnant of this species. Finally, the bird of Tobago is certainly the "Cocrico", this turkey-like bird which exists only in Venezuela, Colombia and Tobago.

We have to keep in mind that the goal is the protection of the crops rather than a reduction of the pest population which can only be one of the solutions.

Finally human and financial means must also be considered.

6.2. The Methods of Protection

They fall into three categories:

- limitation of the population
- agronomic solutions
- direct protection.

6.2.1. Methods of Limitation of the Population

These methods are aimed at reducing the number of birds. The usual methods of limitation of the population are aerial and ground spraying with avicides, poisoning of drinking water, poisoning of food, killing by explosives or shooting, manual nest destruction, removal by mist nest capture or by trapping (Manikowski, 1987; Douville de Franssu et al., 1991).

Avicides and poison are not harmful to one species of birds, so they can be toxic for non-targeted animals. Moreover, they can also cause contamination because they remain for a long time in the soil.

The use of guns, traps or the destruction of the nest is possible, but need intensive labour.

Moreover, the high cost of ammunition, chemi-

als and labour makes all these methods very expensive.

However, the survey shows that guns and poison are the methods of prevention most used in Tobago. Shooting the birds is also the technique chosen by the Forestry Division Officers when the farmers request their help.

Concerning the application of the methods of limitation of the population in Tobago, we have to make two remarks:

- nobody seems to know or to be able to estimate the population of birds. Obviously, the number of "Cocricos" has increased considerably, "Woodpeckers" and Crested Oropendola can also be seen everywhere. However, several farmers said that they saw less Orange-winged Parrots this year than the other years and a naturalist said that he can hardly find "Parrots" when tourists want to see them. On the other hand, most farmers said that "Parrots" come by thousands. Therefore, it will be necessary to make a census of this species, and only after this census will it be possible to know if some drastic measures have to be taken to reduce the population or if, on the contrary, this bird has to be protected.
- concerning the "Cocrico" and the "Woodpeckers", they are, according to the survey, the main pests. But since they are fully protected by the law, these methods of prevention cannot be used against them. The Conservation of Wild Life Ordinance specifies that they cannot be killed, wounded, pursued, captured or molested by any method. In order to solve the problem of birds eating the fruits, it will be necessary to change the status of the "Cocrico" and the "Woodpecker" by placing them on Schedule 3 of the Conservation of Wild Life Ordinance.

This method of limitation of the population can be used in Tobago but only after a census of the birds is done and which proves that there is an over-population of a certain species of birds in Tobago. It must be applied in a scientific way so as to control the number of birds killed in order not to go under the viable level.

Therefore, it is out of the question to issue fire-arm licenses to all the farmers. The result could be an extermination of all the birds considered

as pests and also the elimination of other animals of Tobago. Then it would be necessary to increase the number of Pest Control Officers.

6.2.2. Agronomic Solutions

The goal of the agronomic methods is to create an unsuitable environment for birds that damage the crops. They are not harmful to birds and have a permanent effect. They comprise of modification of the crop calendar, and use of bird resistant cultivars, modification of cropping practices, habitat manipulation aimed at dissuasion or repulsion of birds (Manikowski, 1987; Douville de Franssu et al., 1991).

It is obvious that none of these methods, beside the last one can be applied in Tobago, The only agronomic method which can be used is the destruction of roosting sites. In Tobago, since a lot of lands are abandoned, birds roost and nest around agricultural holdings. Farmers must cut this vegetation in order to make this area less attractive.

6.2.3. Methods of Direct Protection

The purpose of direct protection is to scare birds from the fields. This may be classified as techniques of mechanical protection and techniques of dissuasion.

The techniques of mechanical protection are aimed at preventing birds from accessing the crops, for example, protecting the fruits with bags. These techniques are very constraining for the farmers and require great investments. Moreover, they cannot be used on a large scale.

In the case of techniques of dissuasion, the fields are still accessible to the birds but they stop frequenting them voluntarily. The techniques of dissuasion may be divided as follows:

- chemical protection which repels the birds. These chemicals provoke a poisoning and birds react by not eating the crops.
- optical protection such as scarecrows, coloured flags, trips which reflect sunrays... These methods cannot be used on a large scale or for a long period.
- sound protection. They frighten birds by emitting sounds (gun shooting, shooting of blank cartridge...).
- acoustic protection which is the emission of sounds which have a psychological

meaning for the birds (broadcasting of distress calls...) (Manikowski, 1987; Douville de Franssu et al., 1991).

Some of these methods have already been used in Tobago (scarecrows, gun shooting...) but with poor success because birds get accustomed and lose quickly their fear of scarers.

These methods can be successful only if alternative food is available which is not the case in Tobago, since in 1963, hurricane Flora destroyed the tropical rain forest. Therefore, the ideal solution would be to restore this balance by planting fruit trees in the degraded forest areas and around the forest in order to keep birds in the forest.

The creation of reserve or protected areas of that type has been already tested with success in Senegal for granivorous birds (National Parc of Djoudj), in North America and Great Britain for wild fowl (Treca, 1985). Therefore, it can be considered in Tobago since its area is small.

CONCLUSION

Planting fruit species in the forest in order to provide birds with food is the only solution which preserve farmers' interests and the natural heritage of Tobago.

To be more efficient, this solution will require methods of dissuasion in the fields and possibly the "scientific reduction" of the population of one or several species if the census proves that this is necessary.

This solution is, of course, a long-term measure and farmers will certainly demand more immediate solutions. But this should have been done 30 years ago, just after Hurricane Flora and now, Tobagonians need time to put this error right.

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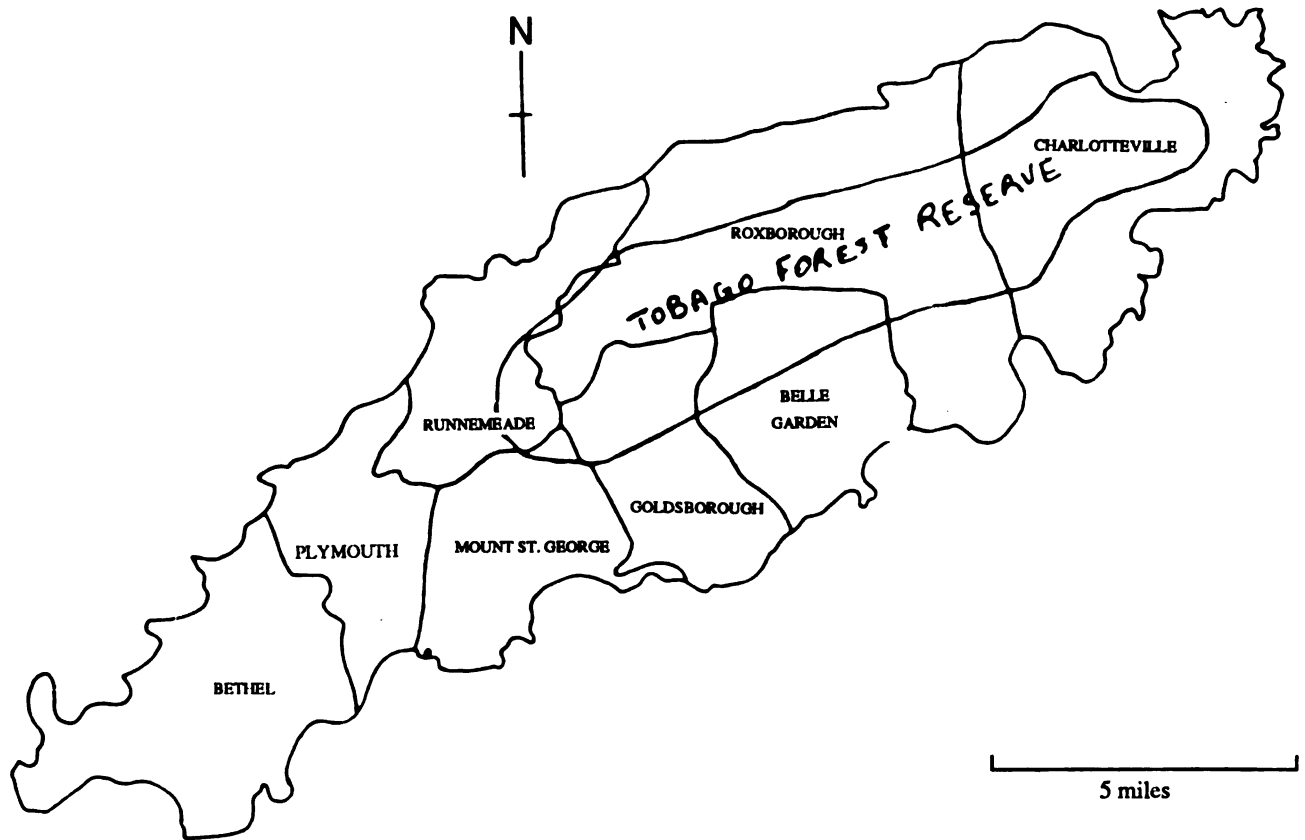
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- Annex XXI: Estimation of the damages in Plymouth and Bethel
- Annex XXII: Birds involved in Plymouth and Bethel
- Annex XXIII: Estimation of the damages in Runnemedede and Mount Saint George
- Annex XXIV: Birds involved in Runnemedede and Mount Saint George
- Annex XXV: Estimation of the damages and birds involved in Goldsborough
- Annex XXVI: % of farmers using a method of prevention per district

SURVEY ON BIRDS' DAMAGE TO FRUITS IN TOBAGO

ANNEX I



Map of Tobago showing districts

SURVEY ON BIRDS' DAMAGE TO FRUITS IN TOBAGO

ANNEX II

LIST OF THE FARMERS INTERVIEWED

Charlotteville:

- Randolph Adams
- Lucien Kent
- Lloyd Mac Donald
- Arthur Moore
- Johnston Taylor
- Simeon Williams
- Isaac Augustine
- Celestine Robley
- Wellington Robley
- James Quashie
- Oscar Braithwaite
- Vanley Perry

Belle Garden:

- Samuel Sylvester
- Sullivan Sargeant
- Gene Alley
- Elizabeth Taitt
- Sydney Des Vignes

Mount Saint George:

- Ivy Dunse
- Theophilus Jack
- Arlene Blade
- Philip Couri
- Charles James
- Duport Ewing
- Arthur Catterson
- Irvin Adams
- Carl Hector
- Leo Jordan

Roxborough:

- Darvy Lewis
- Linda Arthur
- Leon Kirk
- Heathcote John
- Frederick Brooks
- Sydney Wilson
- Hugh Beckles
- Clifford Joseph
- Uriah Celestine
- Everol Clarke
- Hawthorne Andrews

Runnemede:

- Lloyd Quashie
- Donald Frank
- Lawrence Marichao
- Sandra Gopaul
- Rita Rampersad
- Ruben Bruce
- Elmond Eastman
- Ernest Mac Knight
- Lloyd Saunders
- Samuel Scotland

Plymouth:

- Augustine Soveral
- Nathaniel Kennedy
- Elton John
- Cuberth Grant
- Edward Allen
- Augustine Groome
- Prince Williams
- Hilford Soveral
- Clyde Waheed
- Mitchell Bauy
- President's quarter
- Lionel Craig
- Lenore Wallace
- Garth Dennis
- Egbert Reid
- Omega Patrick
- Dennis Joseph
- Ivan Luke
- James Harris
- Victor Forde
- O. Charles
- John Ali

Bethel:

- Piarni
- Scott
- Oswald Phillips
- Harriet Dalrymple
- Enid Koo
- Samuel Nelson
- Elizabeth Cowie
- Leslie Nunez
- Jim Johns
- Adolphus Edwards
- Wellington Cowie
- Harrilal Kissoon
- Curtis Campbell
- Lawrence Mundy
- Margareth Keens—Dumas
- Harry Alexand
- Lennon Sheete
- Thomas George
- Lloyd Anthony
- Dove

Goldsborough:

- Lennox
- Rupert Arthur
- Victoria Kennedy
- Standford Baptiste
- Warrington Benjamin
- Elsa Wilson
- Doyle Reid
- Fitroy Ramsey
- Godfrey Smith
- Agnatus Wood
- Myriam Henri
- Debbie Roberts

SURVEY ON BIRDS' DAMAGE TO FRUITS IN TOBAGO

ANNEX III

SURVEY ON BIRDS' DAMAGE TO FRUITS IN TOBAGO

Farmer

Number: _____ Name: _____

District: _____ Address: _____

Date of Survey: _____

Farm address: _____

Crops Species cultivated

Pure Stand/	Species	Area	Period and stage of harvest	Estimated % damage	Type of birds
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

Intercropping/	Species	Area	Period and stage of harvest	Estimated % damage	Type of birds
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

Notes: Information on Birds' Habits:

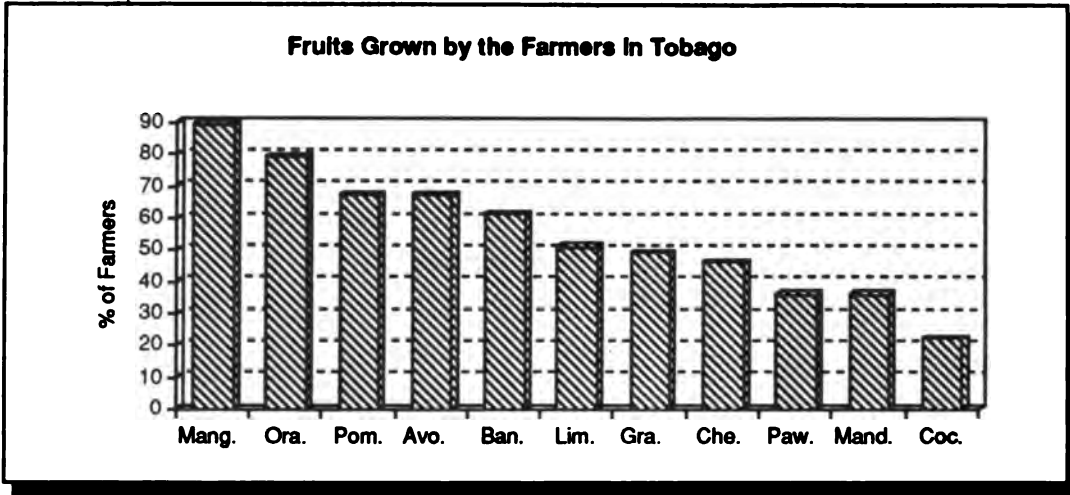
Species	Feeding time	Part of the tree	Most critical damage (stage)
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Methods of Prevention Used, If any:

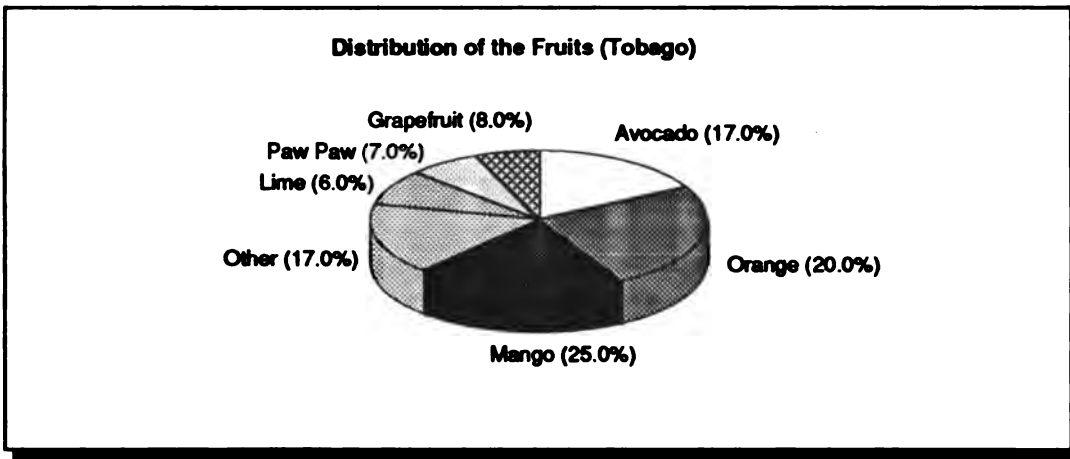
Additional information:

SURVEY ON BIRDS' DAMAGE TO FRUITS IN TOBAGO

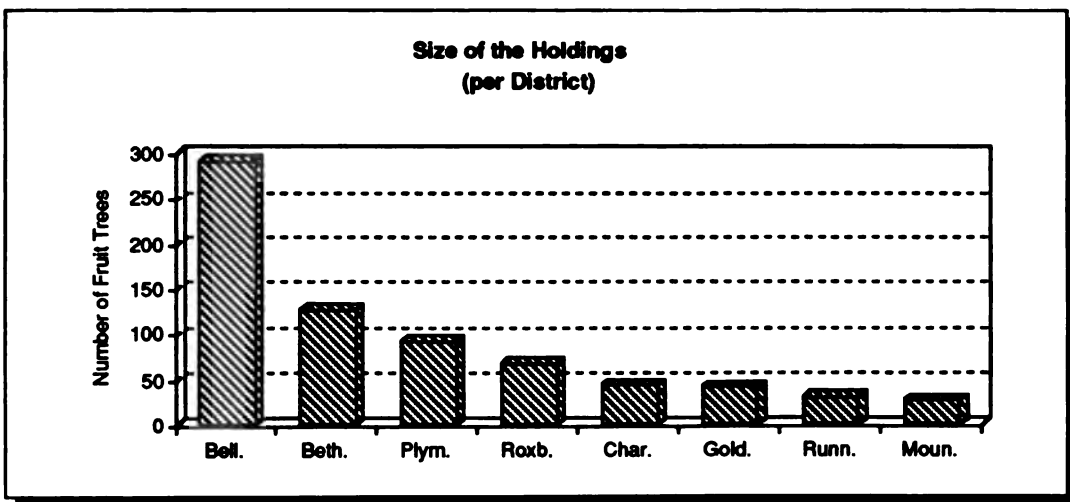
ANNEX IV



ANNEX V

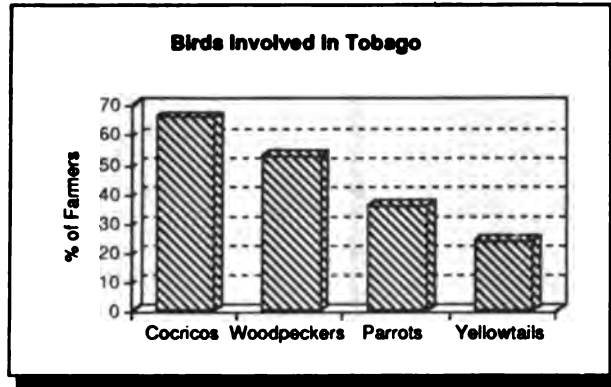


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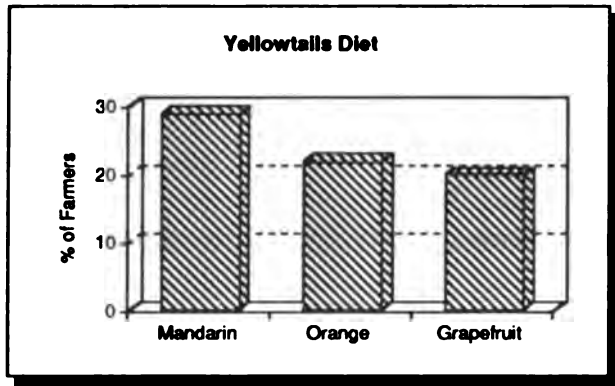


SURVEY ON BIRDS' DAMAGE TO FRUITS IN TOBAGO

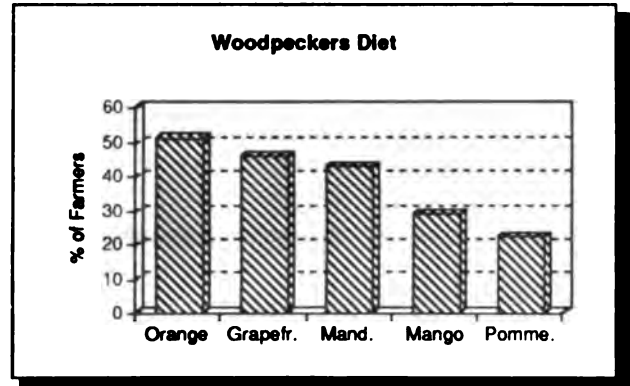
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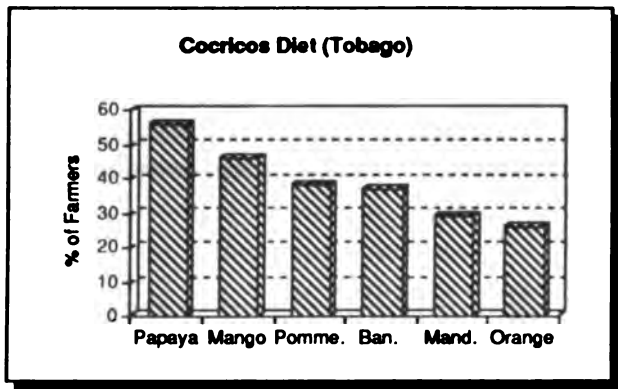
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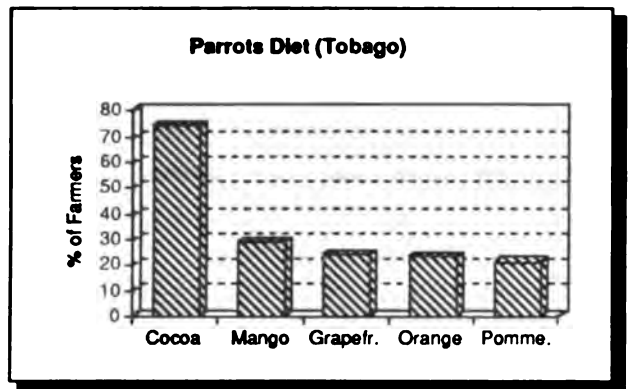
ANNEX X



ANNEX IX

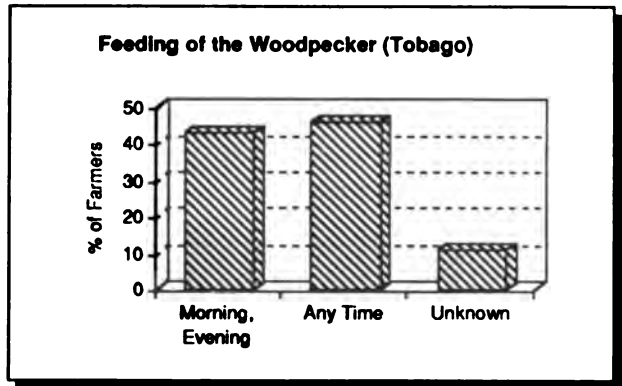
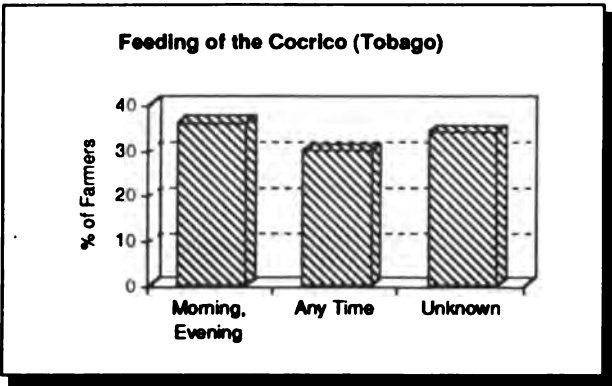
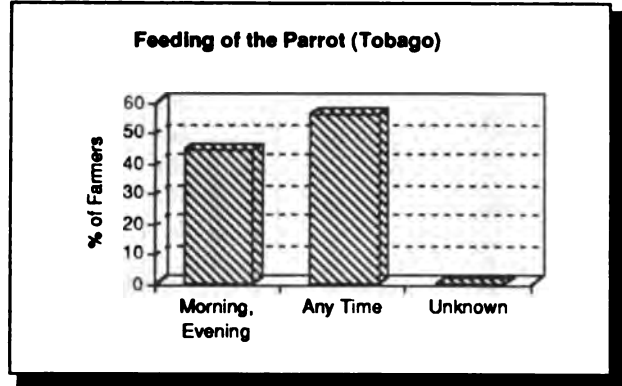
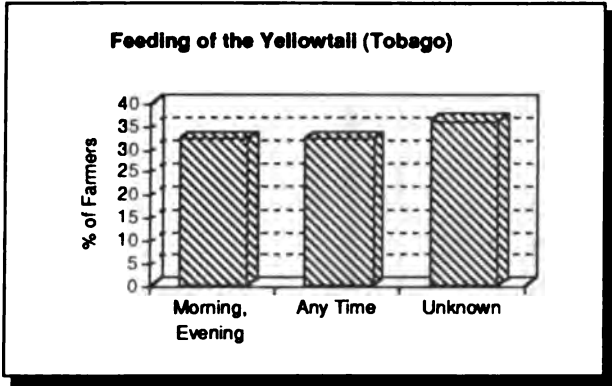


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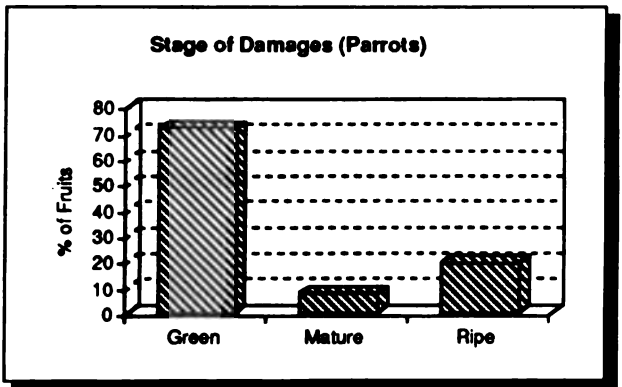
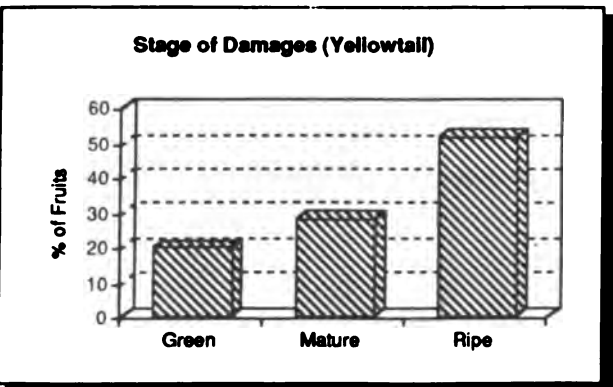
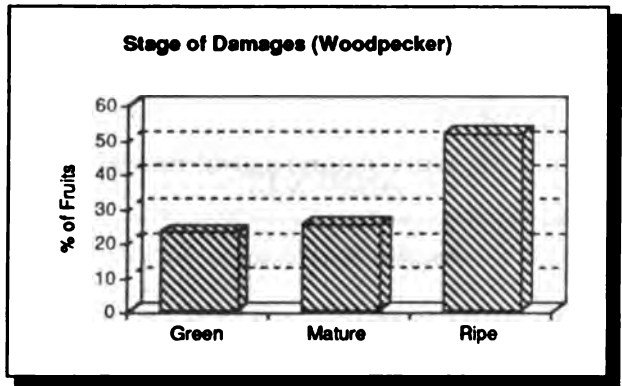
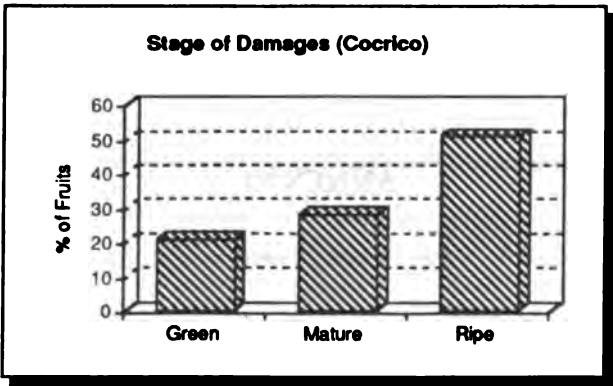


SURVEY ON BIRDS' DAMAGE TO FRUITS IN TOBAGO

ANNEX XII

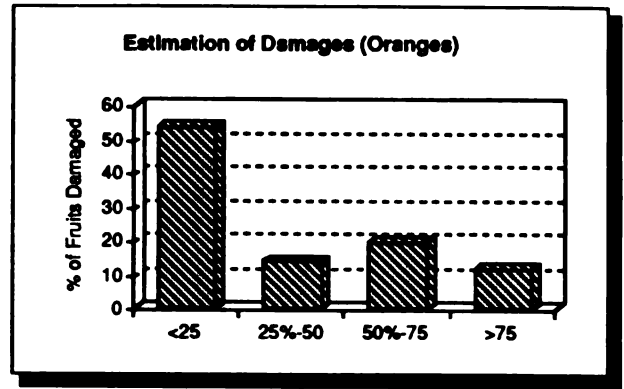
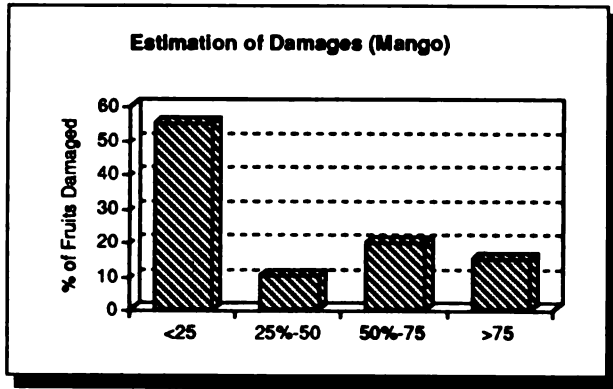
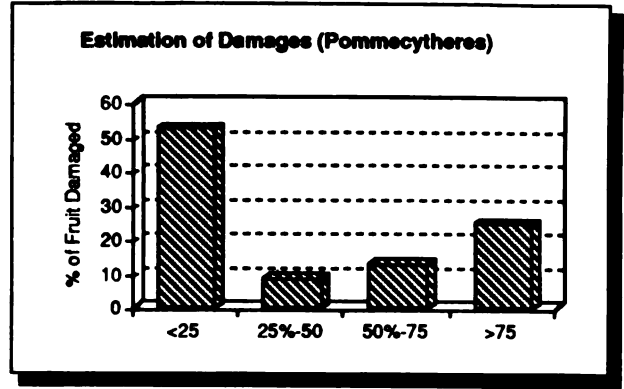
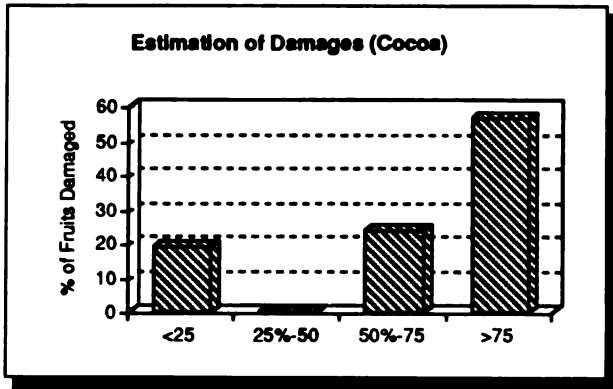


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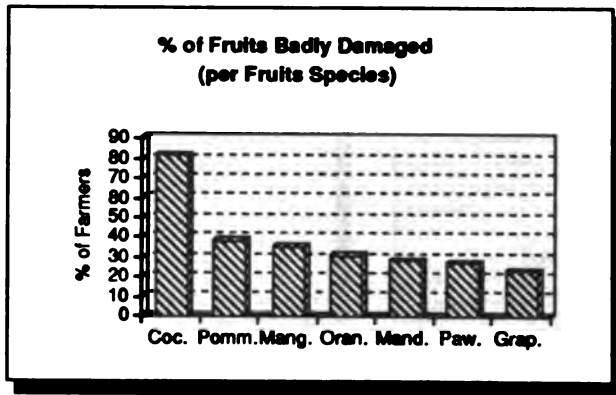


SURVEY ON BIRDS' DAMAGE TO FRUITS IN TOBAGO

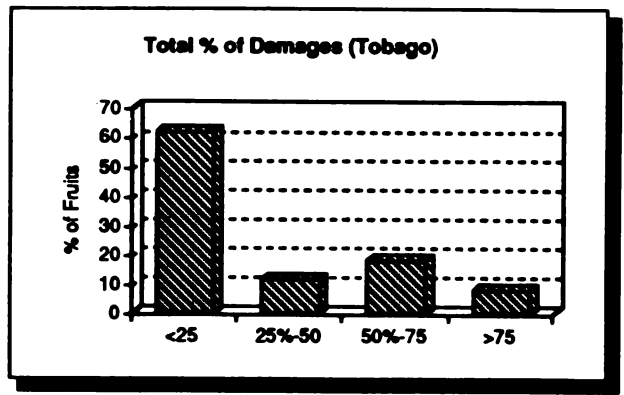
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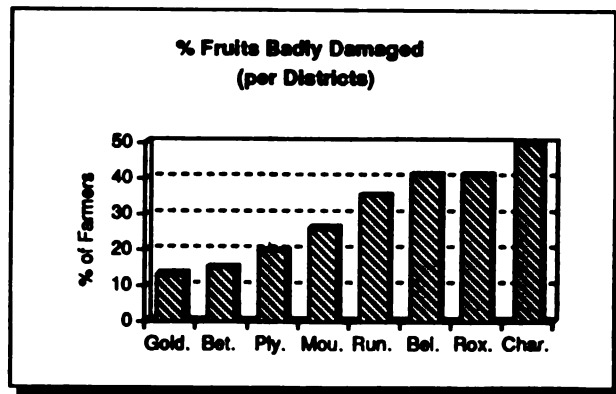
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ANNEX XVI

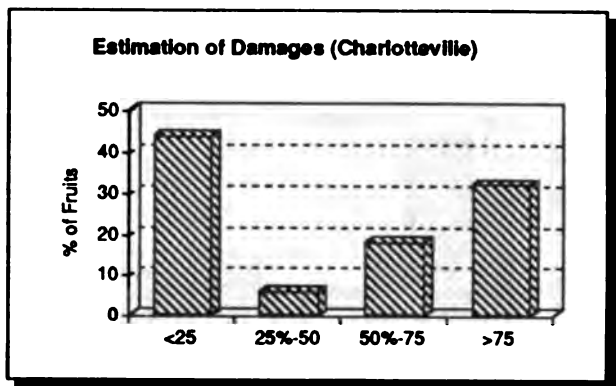
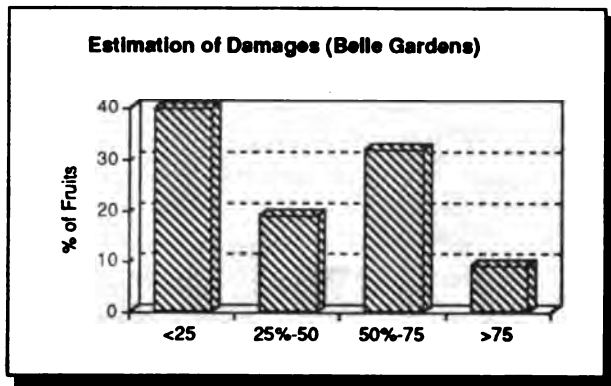
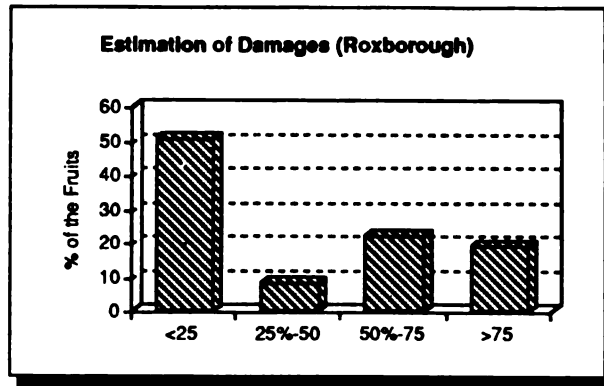


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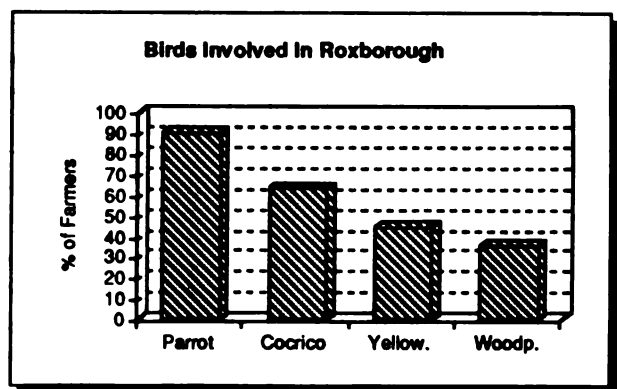
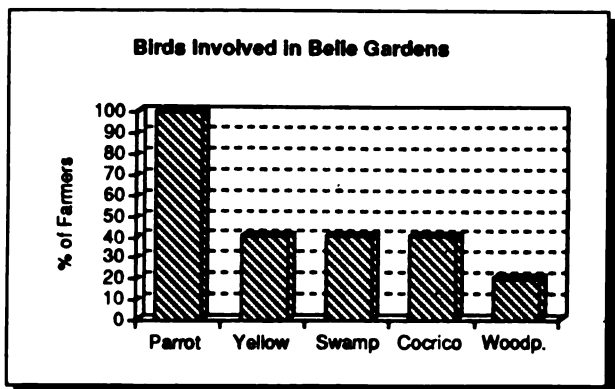
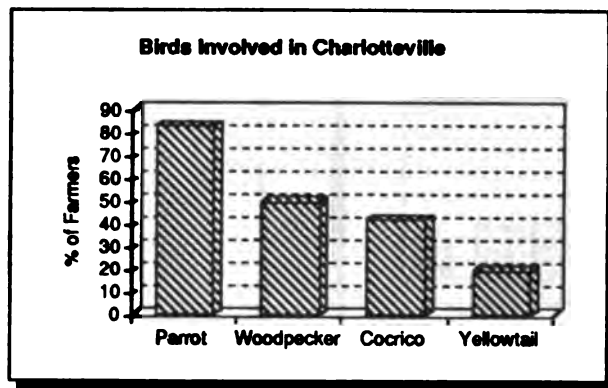


SURVEY ON BIRDS' DAMAGE TO FRUITS IN TOBAGO

ANNEX XVIII

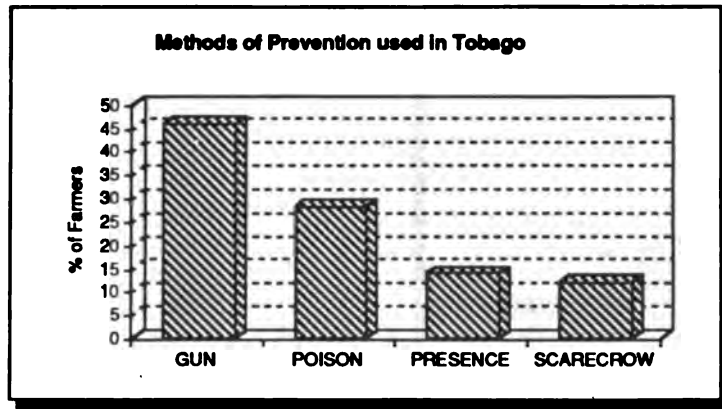


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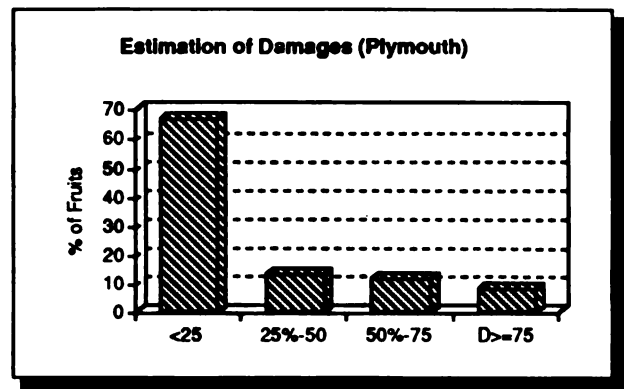
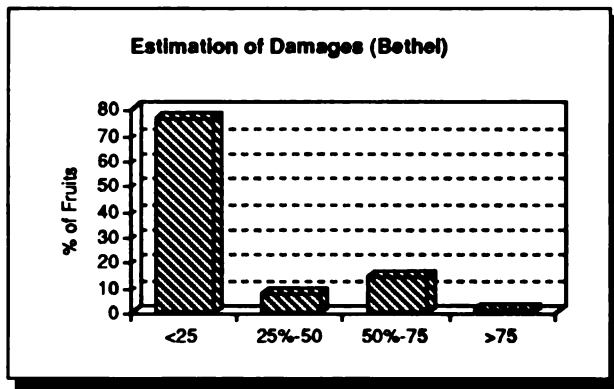


SURVEY ON BIRDS' DAMAGE TO FRUITS IN TOBAGO

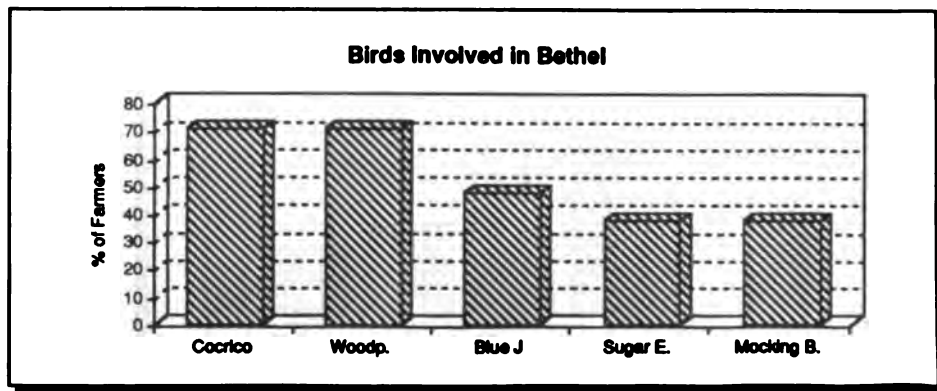
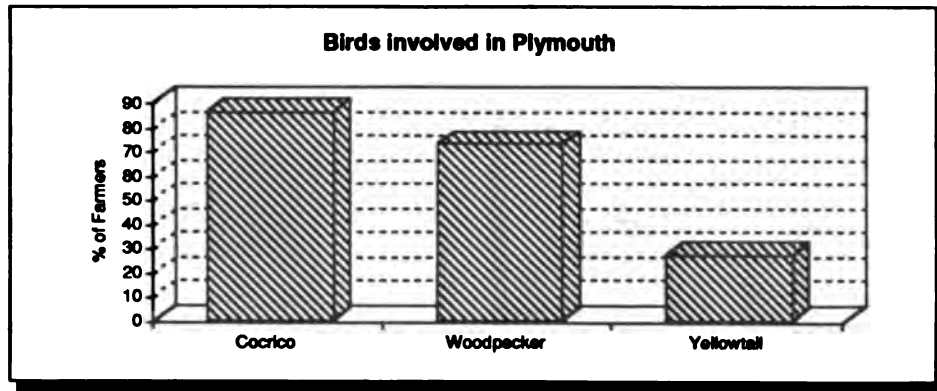
ANNEX XX



ANNEX XXI

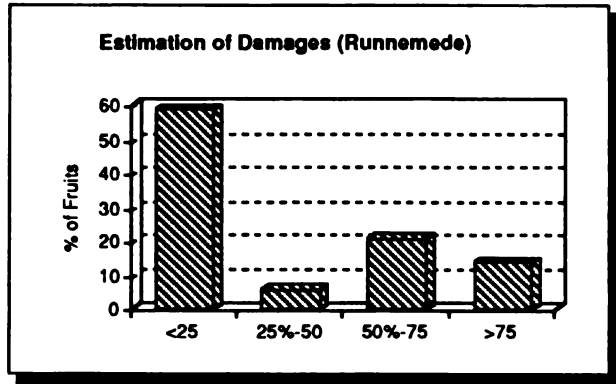
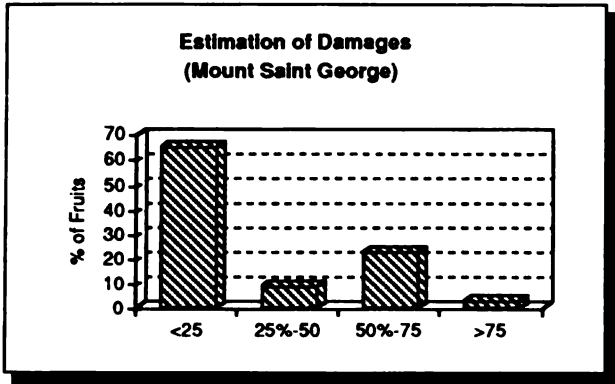


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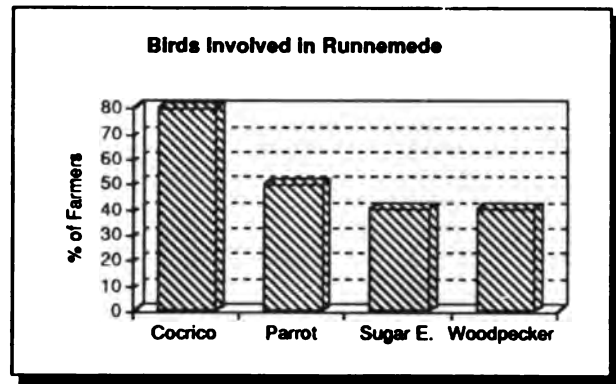
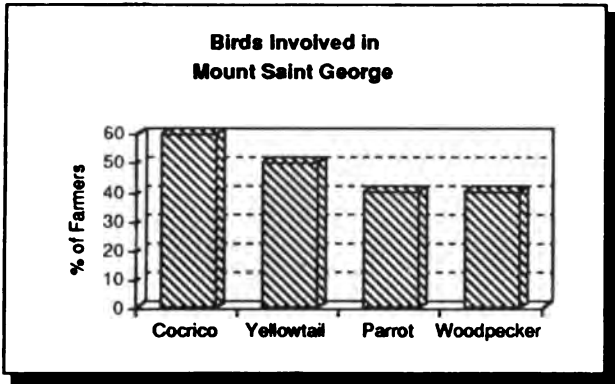


SURVEY ON BIRDS' DAMAGE TO FRUITS IN TOBAGO

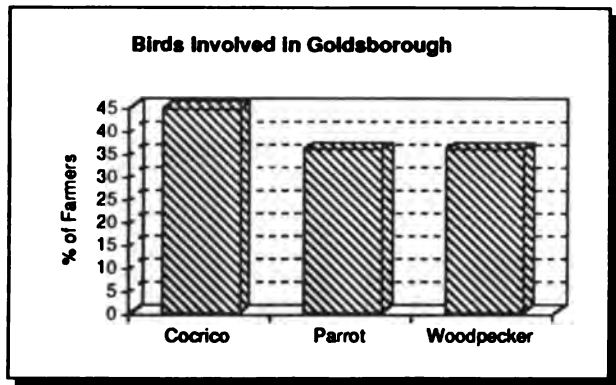
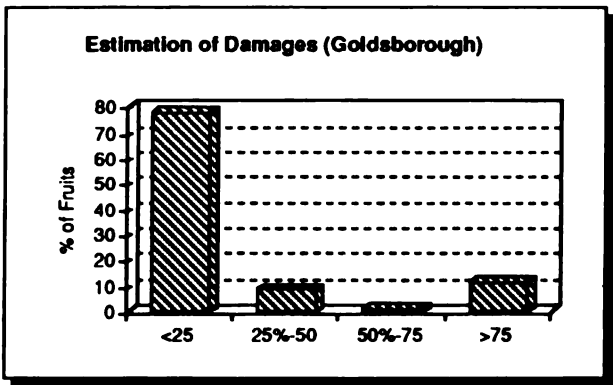
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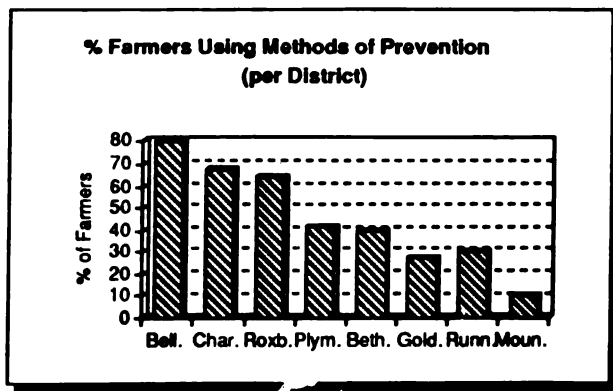
ANNEX XXIV



ANNEX XXV



ANNEX XXVI



FECHA DE DEVOLUCION

15 MAR. 1997

IICA-PM-A2/TT-93-01

Autor

Título Survey on birds' damage to
fruit in Tobago

Fecha
Devolución

Nombre del solicitante

15 MAR. 1997

Gustavo Enrique

**INTER-AMERICAN INSTITUTE FOR COOPERATION ON AGRICULTURE
OFFICE IN TRINIDAD AND TOBAGO**

THE "APPLE COMPLEX" 155-157 Tragarete Road, Woodbrook, Port of Spain, Trinidad and Tobago.
Tel: 622-2373/4. 622-2381/3 Cable: IICAPOS. Fax: 628-7058