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VERTEBRATE DAMAGE CONTROL RESEARCH IN AGRICULTURE

INVESTIGACIONES SOBRE EL CONTROL DE DAÑOS CAUSADOS POR LOS VERTEBRADOS EN LA AGRICULTURA

1971 ANNUAL REPORT
INFORME ANUAL 1971

PALMIRA, COLOMBIA
RESEARCH CENTER
CENTRO DE INVESTIGACIONES

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CALI, COLOMBIA, FIELD STATION
1971 ANNUAL PROGRESS REPORT*

PRINCIPAL INVESTIGATORS:

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Instituto Colombiano Agropecuario

Nicaragua -

Banco Nacional de Nicaragua

United States -

Agency for International Development
Bureau of Technical Assistance
Bureau of Sport Fisheries and Wildlife
Denver Wildlife Research Center
(Work Unit DF-104.4)

*Results Incomplete and Not for Publication, Release, or Use Without Authority of the Director, Denver Wildlife Research Center

**Dr. Vogel and Mr. Bojorge are with the Banco Nacional de Nicaragua and not on the field station staff.

Fig. 1. Eared doves in a sorghum field, Cauca Valley, Colombia.

ABSTRACT*

Activities during the first full year of this station centered around more detailed investigations of previously reported vertebrate damage problems in Colombia. Efforts were made to delineate those considered serious and warranting intensive research. Those meeting this criteria include eared dove (Zenaida auriculata) in soybeans and sorghum; dickcissel (Spiza americana) in rice and sorghum; shiny cowbird (Molothrus bonariensis) in corn, rice, and sorghum; parrot (Psittacidae family) in sorghum and other crops; and rodent damage to coconuts and rice.

Data were accumulated on food habits, breeding seasons, and other aspects of eared dove biology.

Preliminary studies in the rice-growing areas of Nicaragua indicated high populations of cotton rats (Sigmodon sp.) and severe damage to the rice crop. Field trials using zinc phosphide achieved good control of the rats.

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*This research was conducted with funds provided to the Bureau of Sport Fisheries and Wildlife by the Agency for International Development under the project "Control of Vertebrate Pests: Rats, Bats, and Noxious Birds," PASA RA(ID) 1-67.

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INTRODUCTION

Objectives

The objectives of the program are to conduct research in developing safe, effective, and economical methods of reducing and/or controlling losses of food and fiber crops caused by birds and mammals and to develop Latin American capabilities in this specialized field.

Program

Mr. Danilo Valencia G., graduate of the Universidad de Narino, Facultad de Ciencias Agricolas, was assigned to the project by the Instituto Colombiano Agropecuario on June 7, 1971.

Research activities were somewhat limited by the lack of laboratory facilities and equipment. Two four-wheel drive vehicles were received by the project during the latter half of the year. All laboratory and office equipment has now been received and completion of project laboratory and office facilities is expected in January of 1972 (Fig. 2).

As intended, activities were expanded to include parts of Latin America other than Colombia. A research program was initiated in Nicaragua in response to a request from the AID Mission in Managua. Studies were in cooperation with the Banco Nacional de Nicaragua, Departamento Tecnico Agropecuario.

Two representatives from the Latin American Region were scheduled to attend the Vertebrate Damage Control Workshop at the Denver Center. Cancellation of the Workshop postponed this phase of the training program indefinitely.

RESEARCH ACTIVITIES

Investigations of the Extent and Economic Importance of Vertebrate Damage to Agricultural Crops in Colombia

Introduction

Prior to the establishment of this field station, DWRC biologists made several field surveys in Colombia and other Latin American countries to obtain information on vertebrate damage problems in agriculture. The results of the surveys in Colombia were summarized in the 1970 Annual Report. Most of these reports were based on conversations with personnel from the AID Mission, ICA, farmers, and others knowledgeable

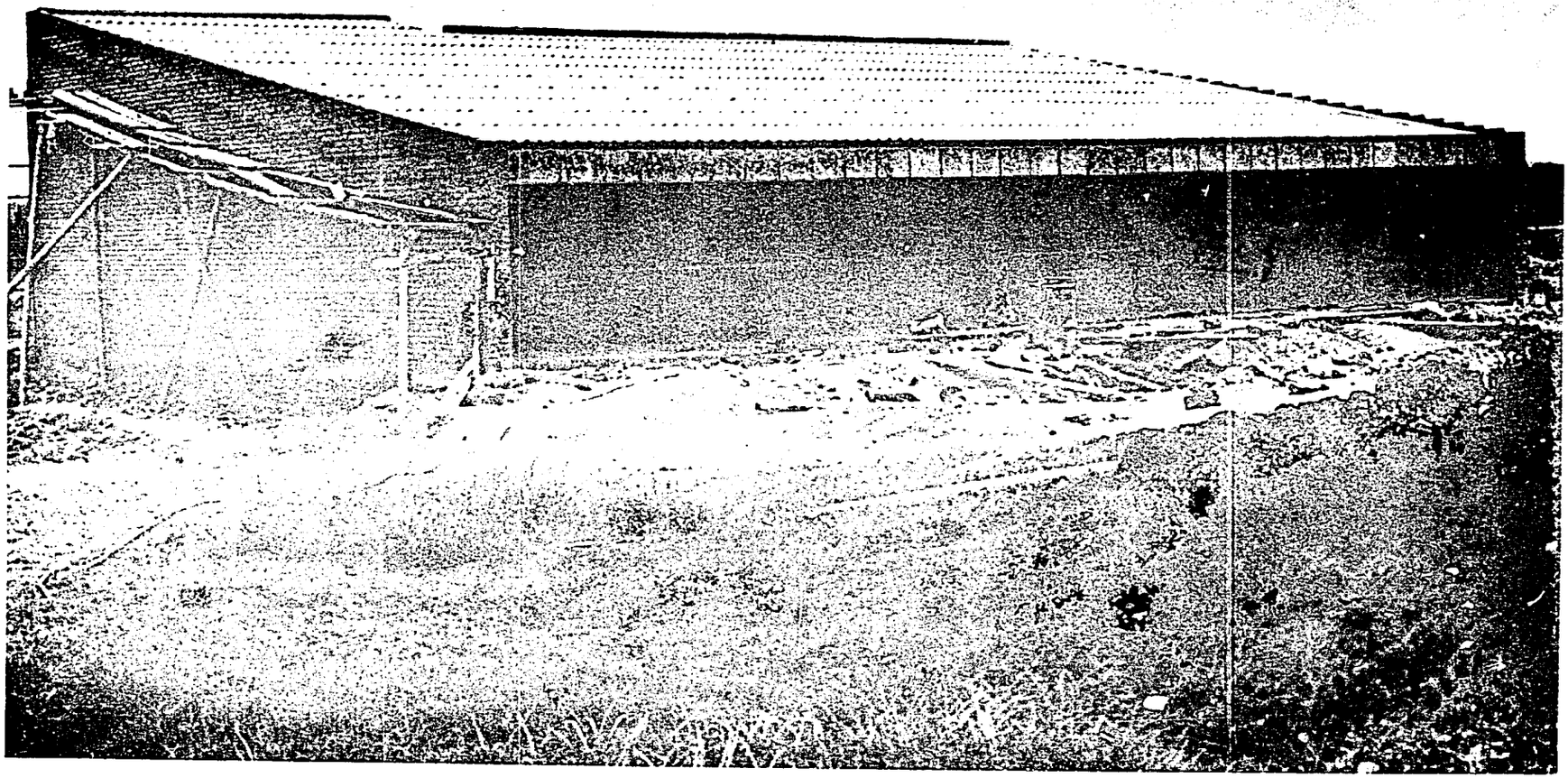

Fig. 2. Project laboratory and office facilities will eventually be housed in this building on the ICA Experiment Station at Palmira, Colombia.

about the vertebrate pest problems in Colombia. Limitations due to time, transportation, and other factors did not permit thorough and firsthand observations. During 1971, station personnel investigated these and other reports in an effort to delineate the most serious problems and determine where research should be directed.

Procedures

Firsthand investigations were made of most of the previously reported problems as well as others which were received. This involved observations of reported damage and discussions with personnel involved with the problem. Whenever possible, the species were identified, population estimates made, and damage evaluated. The observations and information obtained determined whether intensive investigation was warranted.

Results and Discussion

Additional reports, to those listed in 1970, of vertebrate damage problems in Colombian agriculture are summarized in Tables 1 and 2.

Based on current knowledge, the following items appear to be the most serious vertebrate damage problems in Colombia and future research efforts will be concentrated in these areas. Station personnel will continue, as time permits, to investigate other reported problem situations and evaluate their relative importance.

Birds

The eared dove (Zenaida auriculata) is the most serious vertebrate pest in Colombia. The problem is most severe in the Cauca Valley, where doves damage emergent soybeans and maturing sorghum. This dove is also a pest in other countries of South America and causes serious damage to crops in Argentina and Uruguay where other workers are also seeking a solution to the problem. Contacts have been made with these investigators.

The dickcissel (Spiza americana), a migratory species, is an agricultural pest in Central and South America. Because of its migratory nature, damage is seasonal, sporadic, and irregular but most serious when it occurs. The dickcissel is implicated in rice and sorghum damage in Colombia, Venezuela, Costa Rica, Mexico, and Nicaragua and has been described by Slud (1964) as "the supreme pest of the rice fields." Although seasonal, the problem warrants considerable effort.

TABLE 1. Location of additional bird damage problems to agricultural crops in Colombia, 1971

Location	Department (State)	Common name of bird		Scientific name	Crop and stage	Time
		English	Spanish			
Los Llanos	Meta	Bobolink	Arrocero	Dolichonyx oryzivorus	Rice-Planting	March
Tumaco	Narino	Small birds	Chisquas	?	Rice-Maturing	?
Caucasia	Antioquia	Parrots Parakeets	Loros Periquitos	Family: Psittacidae	Cacao-Maturing	From 4 months before harvest
Aracataca	Magdalena	Vultures	Gallinazo	Family: Cathartidae	Oil Palm-Maturing	?
Turbo	Antioquia	Vultures	Gallinazo	Family: Cathartidae	Oil Palm-Maturing	?
Valle del Cauca	Valle	Shiny cowbird	Jolofo, Tordo azul, Pajaro vaquero, Chamon	Molothrus bonariensis	Sorghum-Maturing	Jan-March Aug-Sept
Valle del Cauca	Valle	Shiny cowbird	Jolofo, Tordo azul, Pajaro vaquero, Chamon	Molothrus bonariensis	Corn-Maturing	Dec-Feb July-Aug
Valle del Cauca	Valle	Shiny cowbird	Jolofo, Tordo azul, Pajaro vaquero, Chamon	Molothrus bonariensis	Corn-Emerging	March-Sept
Valle del Cauca	Valle	Shiny cowbird	Jolofo, Tordo azul, Pajaro vaquero, Chamon	Molothrus bonariensis	Sorghum-Emerging	March-Sept

(continued)

TABLE 1. (Continued)

Valle del Cauca	Valle	Shiny cowbird	Jolofo, Tordo azul, Pajaro vaquero, Chamon	*Molothrus bonariensis*	Rice-Maturing	Jan-Feb June-July
Valle del Cauca	Valle	Eared dove	Naguiblanca	*Zenaida auriculata*	Sorghum-Maturing	Jan-March Aug-Sept
Ibague	Tolima	Cattle egrets	Garzas el ganado	*Bubulcus ibis*	Rice-Standing (knocking over)	December ?
Roldanillo	Valle	Small birds Doves	Chisquas Torcazas	? ?	Sunflower-Maturing ? -Maturing	March ?
Tulua	Valle	Small birds	Chisquas	?	Grapes	October

TABLE 2. Location of additional mammal damage problems to agricultural crops in Colombia, 1971

Location	Department (State)	Common name of mammal		Family name	Crop and stage	Time
		English	Spanish			
Caucasia	Antioquia	Squirrels	Ardillas	Sciuridae	Cacao-Maturing	From 4 months before harvest
Caucasia	Antioquia	Rats	Ratas	Muridae	Cacao-Maturing	From 4 months before harvest
Turbo	Antioquia	Rats	Ratas	Muridae	Oil Palm-Maturing	?
ICA	Valle	Opposum	Chucha	Didelphidae	Pineapple-Maturing	November
Tumaco	Narino	Rats	Ratas	Muridae	Oil Palm-Young plants and maturing	All year
Turbo	Antioquia	Bats	Murcielagos	Phyllostomatidae	Bananas-Maturing	All year
San Andres	Intendencia de San Andres y Providencia	Rats	Ratas	Muridae	Coconuts-Maturing	All year
Tumaco	Narino	Rats	Ratas	Muridae	Coconuts-Maturing	All year
El Basto	Santander	Bats	Murcielagos	Phyllostomatidae	Misc. fruits-Maturing	All year
El Basto	Santander	Vampires	Vampiros	Desmodontidae	Goats (anemia)	All year

The shiny cowbird (*Molothrus bonariensis*) was previously reported as a pest in rice and sorghum. Station biologists have observed severe damage to corn by shiny cowbirds and received numerous reports of such damage from throughout the Cauca Valley. Evidence indicates that this is one of the more serious bird damage problems in Colombia.

Members of the parrot family (Psittacidae) have been mentioned as a problem in agriculture throughout the tropics. Although station biologists have found only local situations in Colombia where this type of problem would be considered serious, the problem warrants further scrutiny.

Mammals

A number of mammal species have been reported as serious agricultural pests, but further investigations have indicated that most of these reports were based on limited and rather localized problem situations which would not warrant intensive investigation.

Rats cause damage to coconut crops. This problem was investigated in two areas and is considered to be the most serious agricultural rodent problem in Colombia.

Rodent damage to rice has also been reported as a serious problem in Colombia. Although a severe damage situation is not evident in Colombia, we will continue to monitor the problem. In Nicaragua, there is a serious ricefield rodent problem, and similar problems have been reported in Venezuela, Honduras, El Salvador, and Bolivia. Our research in Nicaragua will receive primary emphasis and may be complemented by work in other areas.

Table 3 summarizes the vertebrate damage problems considered to be most serious in Colombia.

Questionnaire Survey of Vertebrate Damage Problems in the Cauca Valley

Introduction

In order to establish major vertebrate damage problems in the Cauca Valley, a broad spectrum of agriculturists were queried.

TABLE 3. Vertebrates considered to be of serious economic importance to agricultural crops in Colombia, 1971

Common name of animal		Scientific name	Crop	Stage	Location	Department	Time
English	Spanish						
Brown-throated parakeet	Cara sucia	*Aratinga pertinax*	Sorghum	Maturing	Valle del Sinu	Cordoba	January
Brown-throated parakeet	Cara sucia	*Aratinga pertinax*	Corn	Maturing	Valle del Sinu	Cordoba	Aug & Jan
Dickcissel	Sabanero	*Spiza americana*	Sorghum	Maturing	Espinal	Tolima	Nov & March
Dickcissel	Sabanero	*Spiza americana*	Rice	Maturing	Los Llanos	Meta	Dec & Jan
Eared dove	Naguiblanca	*Zenaida auriculata*	Sorghum	Maturing	Valle del Cauca	Valle	Feb-March & Aug-Sept
Eared dove	Naguiblanca	*Zenaida auriculata*	Soybeans	Emerging	Valle del Cauca	Valle	Sept-Oct March-April
Shiny cowbird	Jolofo, Tardo azul, Pajaro vaquero, Chamon	*Molothrus bonariensis*	Sorghum	Maturing	Espinal	Tolima	Dec-Jan
Shiny cowbird	Jolofo, Tardo azul, Pajaro vaquero, Chamon	*Molothrus bonariensis*	Sorghum	Maturing	Valle del Cauca	Valle	Feb-March Aug-Sept
Shiny cowbird	Jolofo, Tardo azul, Pajaro vaquero, Chamon	*Molothrus bonariensis*	Sorghum	Emerging	Valle del Cauca	Valle	March & Sept

(continued)

TABLE 3. (Continued)

Shiny cowbird	Jolofo, Tardo azul, Pajaro vaquero, Chamon	*Molothrus bonariensis*	Rice	Maturing	Valle del Sinu	Cordoba	September
Shiny cowbird	Jolofo, Tardo azul, Pajaro vaquero, Chamon	*Molothrus bonariensis*	Rice	Maturing	Espinal	Tolima	July & Aug
Shiny cowbird	Jolofo, Tardo azul, Pajaro vaquero, Chamon	*Molothrus bonariensis*	Rice	Maturing	Valle del Cauca	Valle	Jan-Feb & June-July
Shiny cowbird	Jolofo, Tardo azul, Pajaro vaquero, Chamon	*Molothrus bonariensis*	Corn	Maturing	Valle del Cauca	Valle	Dec-Feb & June-July
Shiny cowbird	Jolofo, Tardo azul, Pajaro vaquero, Chamon	*Molothrus bonariensis*	Corn	Emerging	Valle del Cauca	Valle	March & Sept
Rats	Ratas	*Rattus* sp.	Coconuts	All stages	San Andres Tumaco Turbo	- Narino Antioquia	All year All year All year
Rats	Ratas	*Sigmodon* sp.	Rice	40-80 days after planting	Various	?	?

Procedures

A questionnaire was designed in cooperation with the Oficina de Economia Agricola Regional No. 5, primarily to obtain information about the eared dove and the damage it causes. Information on other vertebrate damage problems was also obtained. Four hundred and seventeen questionnaires were mailed to members of La Sociedad de Agricultores y Ganaderos del Valle del Cauca.

Results and Discussion

Fifty-one (12.2%) responses were received. Of these, 78.4% reported vertebrate damage problems. Those not reporting problems were primarily cattle, poultry, and sugar cane producers. Ninety-five percent of the respondents reported damage by the eared dove, principally in soybeans and sorghum. Damage in soybeans was reported by 75%, in sorghum by 47.5%, and in corn and rice, 17.5% and 10% respectively. Sixty-seven percent of the respondents stated that they believed the numbers of eared doves has increased over the past 5 years. Damage by other vertebrates was reported by 55.6%, of which 40% was damage to corn and rice by the shiny cowbird. Parakeet damage, primarily in sorghum, was reported by 10% of the respondents. Rats were implicated as a problem by 10% of the replies, but all consisted of damage in storage facilities and/or poultry aviaries.

Eared Dove Damage in the Cauca Valley

Introduction

The eared dove of South America (De Schauensee, 1964) is represented by four subspecies in Colombia (Fig. 3). Agricultural damage caused by this species has been reported from several countries including Argentina, Uruguay, and Trinidad.

Bucher (1970) considers the major factors contributing to eared dove population irruptions and agricultural damage in Argentina to be (1) "The creation of a 'mosaic pattern landscape' made up of thornshrubs and croplands. This situation offers both roosting-breeding places and abundant food supply," and (2) "The intensive sowing of sorghum (for grain and grazing). That allows the existence of an important source of food during a long period of the year." A similar pattern is evident in the Cauca Valley of Colombia where agricultural losses by this species are severe.

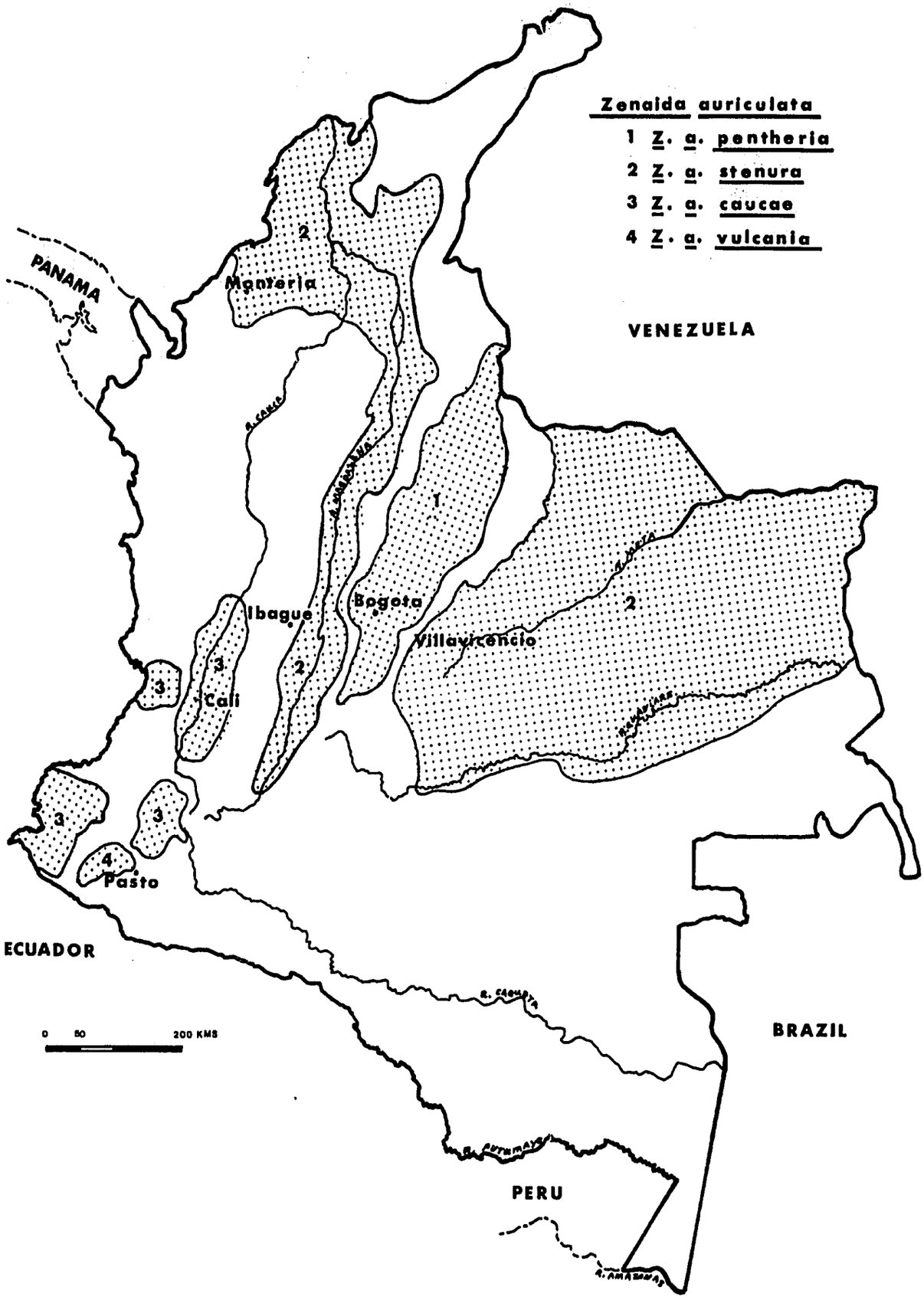

Fig. 3. Approximate distribution of the eared dove in Colombia.

To develop techniques of damage control, a knowledge of the biology of the animal involved is indispensable. The application and effectiveness of control techniques are often based on an understanding of reproductive patterns, population dynamics and behavioral patterns of the target species. In many cases this information is readily available, but little has been published on the eared dove. These studies were designed to learn more about the life history of the eared dove in the Cauca Valley.

Procedures

Data were accumulated by field observations and collection of specimens for later laboratory analysis during trips made throughout the Departamento del Valle (Fig. 4).

Results and Discussion

Populations and Damage

In 1971, searches for large concentrations of eared doves were fruitless until February 9 when, in an area between Zarzal and Roldanillo, between 200 and 300 pairs of doves were observed flying, loafing, and feeding near irrigation canals. Two days later, over 2000 doves were observed in the same location. On February 16, 9 doves were collected and examined. Necropsies revealed that all mature birds were preparing to nest. A nesting site was located on February 25. We extrapolated that a large number of young birds would fledge at the time soybean planting was at its peak. In areas close to this nesting site some damage to emergent soybeans was occurring. Due to the unusual amount of precipitation in March, the predicted dove/soybean problem did not materialize because the growers were unable to plant. This may be why the birds diffused throughout the area causing only minor isolated problems. Large concentrations of doves were located again in June near Bugalagrande and Palmira, where they were observed damaging sorghum. In July, sorghum damage was observed near Roldanillo. By the middle of July hundreds of doves were again nesting for the second time at the same site. Isolated reports and observations of dove damage to sorghum continued into December; the largest concentrations of doves were observed in September. In contrast to the period October through December 1970, doves were numerous and quite evident throughout the valley from Cali to La Union and numerous reports of damage were received. There were also large concentrations in and around ICA and CIAT facilities near Palmira.

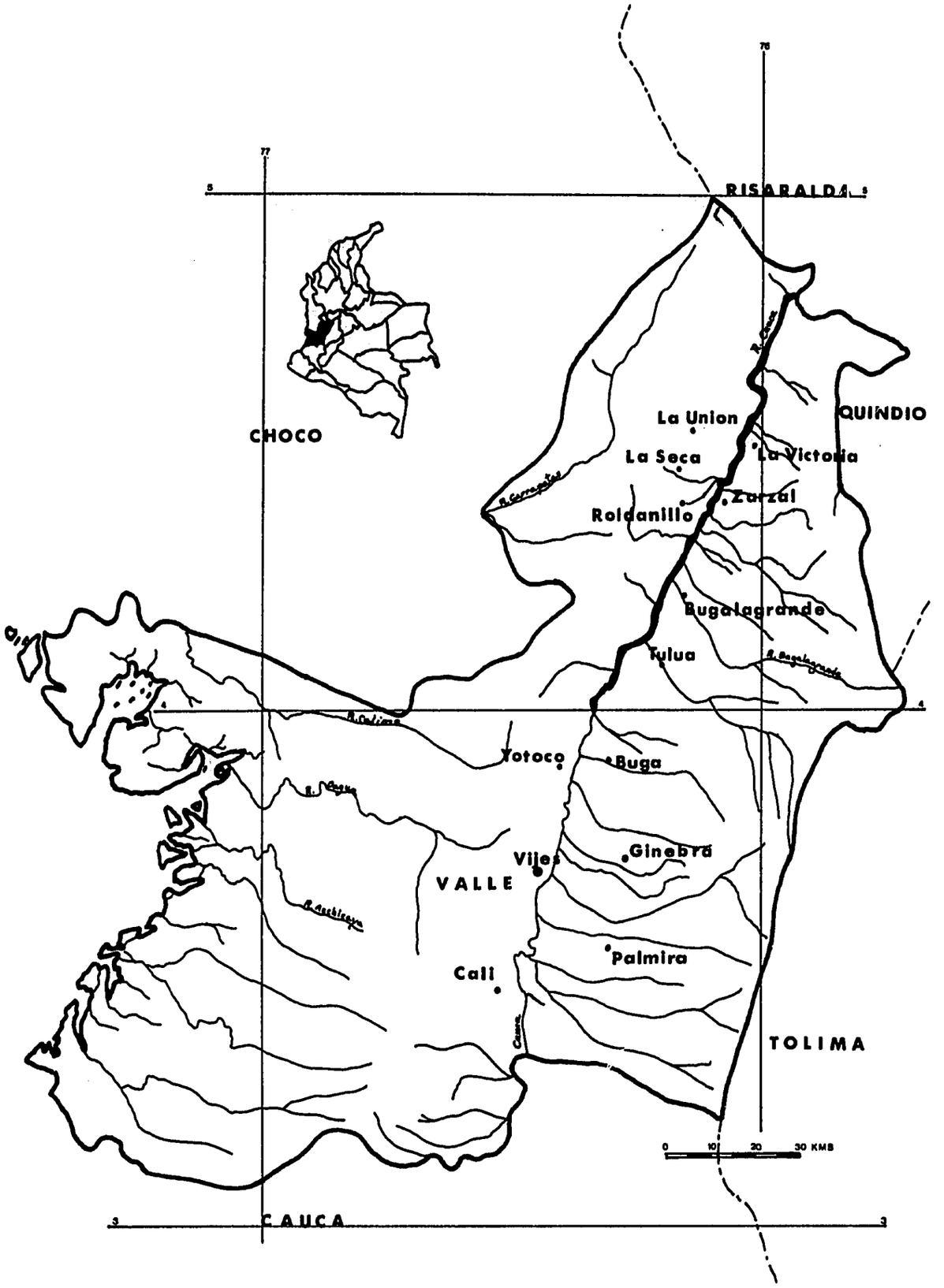

Fig. 4. Departamento del Valle (Cauca Valley) Colombia.

Nesting

On February 25, 1971, a nesting concentration of eared doves was located in the foothills near the village of La Seca in an area of approximately 20 hectares. The vegetation of the area is principally of a xerophytic type dominated by cacti and thorny shrubs.

Detailed examinations were made of 50 nests. They were simply constructed, consisting of small twigs, 6 to 8 inches long and lain together forming a shallow cup. The average height above ground was 2.5 m; however, nests were seen on the ground and in the tops of trees, cacti, and shrubs. A typical nest is illustrated in Figure 5.

Of the 50 nests examined, 19 contained one or two eggs. Three contained eggs that had apparently been destroyed by avian predators. Four nests contained one egg and one nestling and 26 nests contained one or two nestlings. One nest had three nestlings estimated to be 3 to 5 days old. Each nest examined was marked and checked again on March 17. Most were found empty at that time.

Intensive nesting activity was again noted in the area in July and 57 nests were examined. Of these 33 contained two eggs, 7 contained one egg each, and 17 contained one or two young. Nesting activity was again observed in the area in December. Nests of eared doves containing eggs and/or young have been found throughout the year. However, these are usually found singly.

In December, one additional nesting site was located west of Buga. It is likely that there are other areas in the Cauca Valley where doves are nesting. Suspected areas are near Buga, Bugalagrande, Tulua, Ginebra, and Palmira, in the central mountains, and near Vijes, Yotoco, and Cali, in the Western Andes.

Table 4 shows the relative sizes of eared dove gonads collected at various periods during the year. Evidence to date indicates the major breeding period is from about December through February with some breeding activity occurring again around July-August. Collections will continue.

Of 14 eggs measured, the average was 29.78 x 22.86 mm. These eggs were slightly larger than those reported for the mourning dove (*Zenaidura macroura*) and slightly smaller than the white-winged dove (*Zenaida asiatica*).

Fig. 5. Eared dove nest and young.

TABLE 4. Measurements of reproductive organs of eared doves collected in the Cauca Valley, 1971.

	Number collected		Testes measurements		Ovary measurements	
Month	Male	Female	Mean	Range	Mean	Range
February	5	4	190 mm	160-210	56 mm	20-90
April	3	6	149 mm	70-180	31 mm	20-40
August	9	11	160 mm	90-190	38 mm	20-90
September	74	57	90 mm	20-190	25 mm	20-90
October	23	38	87 mm	20-190	21 mm	20-40
November	21	24	128 mm	30-200	24 mm	20-60
December	9	12	173 mm	130-210	44 mm	20-120
Total	152	144		20-210		20-120

Food Habits

Two hundred and seventy-three eared doves were examined during the year. One hundred and seven different food items were isolated. Most of these were weed seeds and seeds of various shrubs, trees, and other plants. The only nonvegetable material was grit and shells of small snails. Seeds and/or parts of five commercial agricultural crops were among the items identified. These are sorghum (*Sorghum vulgare*), rice (*Oryza sativa*), Adzuki bean (*Phaseolus angularis*), corn (*Zea mays*), and soybean (*Glycine max*). The relative percentages of items found in 278 eared dove crops are summarized in Table 5.

TABLE 5. Relative percentages of items found in eared dove crops.

Food items	No. of specimens	Frequency of occurrence
Soybean seed	42	14.09
Soybean cotyledon	7	2.35
Sorghum seed	180	60.40
Corn seed	7	2.35
Adzuki bean seed	27	9.06
Rice	2	0.67
Other	33	11.08

The incidence of soybean cotyledons was much less than expected since all previous information indicated damage was most severe after emergence and that cotyledons were the preferred item. These results may indicate that most feeding took place prior to emergence and that the seeds themselves were the preferred items. We suspected that soybean seeds found on the surface after planting were picked up by the birds and that the seeds attracted additional depredating birds possibly increasing damage to emerging plants.

Feeding on Adzuki bean may also result from spillage during planting or from shattered dry pods just prior to or during harvest.

We suspect that rice, corn, and sorghum are usually taken after harvest. Large numbers of doves were observed in partially harvested sorghum fields, where they apparently preferred the harvested portion to the standing sorghum.

Control

Current methods of eared dove control in Colombia include pajareros (bird scaring personnel), scarecrows, rockets, firecrackers, and shotguns. Observations and information received indicate that these methods are not very effective, at least as they are currently practiced. It is possible that considerably more damage to emergent soybeans or mature Adzuki bean results from trampling by pajareros running through the fields than that caused by doves.

Carbide exploders were not effective when used after a large concentration of doves had already become established in a field. However, some success was achieved when exploders were placed in soybean fields immediately after planting and operated several days after emergence. Concentrations of doves did not occur in fields when this technique was employed. Shotguns, cracker shells, firecrackers, and other frightening devices were also unsuccessful in frightening large flocks of birds out of fields; however, if employed before bird concentrations build up, results similar to those of exploders may be achieved.

Preliminary chemical trials were conducted with Methiocarb (DRC-736) and Avitrol (DRC-1327). Affected birds were observed only on three occasions. In none of these tests did the affected birds repel or frighten other doves in the area; however, more extensive studies are planned.

There is interest in the development of high tannin bird resistant varieties of sorghum. Doves seem to prefer low tannin varieties over those with high tannin. In plantings where both were available, the low tannin sorghum was severely damaged. However, where only the high tannin variety was present, birds did considerable damage.

A Bravis hybrid sorghum (Purina Company) is alleged to be bird resistant because of its very thin stalk which theoretically will not support the weight of a bird landing on the seed head. We have no data to support this.

Miscellaneous Observations

The following data were accumulated during investigations previously discussed and are documented for future reference.

Weights of 512 eared doves are presented in Table 6, and age composition by month of 196 eared doves collected in the Cauca Valley are presented in Table 7.

TABLE 6. Eared dove weights (grams).

	Number	Mean weights	Range of max-min weights	Standard deviation
Adult	222	132	108 - 159	± 17.83
Young	68	117	94 - 142	± 18.57
A. female	93	129	108 - 156	± 13.30
A. male	129	135	112 - 159	± 13.49

TABLE 7. Age composition by month of eared doves collected in the Cauca Valley, 1971.

Month	No. collected	% immatures	% sub-adults	% adults
February	9	11.1	0.0	88.9
April	9	22.2	0.0	77.8
August	20	25.0	20.0	55.0
September	131	38.0	6.9	55.0
October	61	23.0	24.6	52.5
November	45	0.0	17.8	82.2
December	21	19.0	4.8	76.2

A sick eared dove was captured in a harvested sorghum field near Buga on October 14. The bird was an adult male but weighed only 85 g. A large tumorlike growth was on the right side of the throat. Veterinarians at the animal pathology laboratory at ICA, Palmira, diagnosed the disease as trichomoniasis. The bird died shortly afterward and a necropsy revealed almost complete emaciation. A typical trichomonad canker was evident in the upper part of the esophagus. The disease is caused by a microscopic protozoan parasite, Trichomonas gallinae, and is a common disease in mourning doves, other Columbiforms (pigeons and doves), and other avian hosts.

The first period of intensive nesting and breeding activity (February - March) of the eared dove coincides with the first semester planting in the Cauca Valley. During this time, we observed numerous doves flying throughout the valley and the first damage in soybean plantings near municipalities of Roldanillo, La Victoria, Zarzal, and others. In addition, nesting activity noted in late July and August coincides with harvest of mature sorghum planted during the first semester. Apparently, the combined factor of large concentrations of nesting doves and the production of young when cultivated crops are vulnerable is the primary reason for the serious damage.

Rodent Damage to Coconuts in Colombia

Introduction

Rat damage accounts for serious losses of the coconut crop in nearly all coconut-growing countries.

Procedures

Field trips were made to two of the major coconut-producing areas of Colombia. Contacts were made with various persons including coconut growers, government officials, and agronomists from ICA. These persons provided much information on the problem, estimates of losses, and attempts at control. Observations of damage were made at San Andres and Tumaco.

Results and Discussion

San Andres is a small island located 150 miles off the east coast of Nicaragua. It is approximately 45 km^2 in area of which about 35 km^2 contain coconut palms. Coconuts are the major agricultural commodity. Approximately 1 million coconuts are produced monthly, most of which are shipped to a vegetable oil factory at Cartagena, Colombia. There are about 100 large producers (100 palms or more) and some 6000 small producers (10-30 trees).

Nuts are damaged when they are immature, between 4 and 9 months of age. Rats gnaw into the cavity to consume water, meat, and the soft shell (Fig. 6). Between 4 and 12 days following attack, the nuts fall and decay. Estimates of damage on the island ranged from 25% to 40%.

Serious damage is also reported near Tumaco on the Pacific Coast of southwest Colombia. No damage estimates were obtained for this area, but observations indicated severe losses.

The species of rodent causing damage is unknown. The black rat (Rattus rattus) is known to cause similar damage in Jamaica, French Oceania, and other areas and is suspected in this case.

Considerable research on rodent control in coconuts has been conducted by the Coconut Industry Board of Jamaica. They have developed a control technique and report excellent results. The product used is produced commercially in Jamaica and we plan to test this material in field trials in Colombia in 1972.

Rodent Damage to Rice in Nicaragua

Assessment of Damage

Introduction

Concern over rodent damage to rice prompted the AID Mission in Managua to request assistance from the Denver Wildlife Research Center. Although no measurements or damage surveys had been made, damage estimates ranged from 10% to 50%. We conducted preliminary damage assessments to substantiate these estimates.

Procedures

One field containing about 50 manzanas (1 acre - 0.45 manzanas) of rice (3-4 weeks prior to harvest) was divided in half and examined for rodent damage. Four transects (rows) were randomly located in each half and 100 hills (plants) at 7 m intervals along each transect were checked for total number of tillers and number of tillers cut.

Results and Discussion

Results are summarized in Table 8. There were obvious differences in field conditions and stages of rice development. In general, the first one-third of the field (heavy damage area) was semi-dry whereas the last two-thirds had standing water. Portions of the rice in the center one-third were less mature than that of the remainder of the field. These factors may have contributed to the differences in degree of damage between the two halves.

Fig. 6. Rodent damaged coconuts.

TABLE 8. Rodent damage to rice measured on Finca Finlandia--January 1971

	First half	% damage	Second half	% damage	Entire field	% damage
No. hills damaged	316	79	148	37	464	58
No. tillers cut	1134	34.9	358	15.2	1492	26.5
No. tillers not cut	2148		1990		4138	

These figures and field observations indicated that damage caused by rodents is a serious problem. Based on the figures obtained, the USAID Rural Development Officer estimated annual losses at 2 million dollars in Nicaragua. There is a need to expand the damage survey in order to more accurately measure the economic impact.

Population Comparison of Different Habitat Types

Introduction

This study was done to obtain an estimate of comparative rodent population density in various habitat situations.

Procedures

A series of single traplines with 30 traps each at 10 m intervals were set for 1 night in five different habitats. Victor 4-way rat traps were baited with peanut butter and rolled oats. The sex of all animals captured was recorded to obtain an estimate of the male/female ratio. Age classes were not determined.

Results and Discussion

Results of trapping efforts are summarized in Table 9. This method of population density estimation requires the assumption that the catch is proportional to the population. High trap success (40%-74%) in all but the plowed field and zinc phosphide-treated plots (see section on Field Baiting Studies) indicated very high populations. A total of 1470 trap-nights (including field baiting studies) produced 500 rats (34% trap success). Sex was not determined on 5 animals which were partially destroyed by scavengers. Of the remaining animals, 182 were males and 313 were females, a male/female ratio of 1:1.72. This relatively high female ratio would have a positive influence on the population density.

TABLE 9. Number of cotton rats captured in five habitat types, Finca Finlandia.

Site	Total animals	Male	Female	% trap success
Irrigated growing rice	20	8	12	66
Barren field - dike perpendicular to green rice field	19	8	11	64
Barren field - dike perpendicular to gravel road	22	12	10	74
Plowed field	4	1	3	14
Woods - scrubby woodland, cactus, small trees, dry grass	12	4	5*	40**

*Three animals had been partially eaten by scavengers and sex could not be determined.

**One trap was missing. It is assumed it contained a rat and was carried off by scavengers; thus, trap success could be 44%.

The relatively low trap success for the plowed field suggests that plowing may reduce animal numbers either directly by killing or indirectly by causing them to leave the area.

The trap success in the adjacent woodlands, although lower than that of the agricultural lands, indicates a potential source for reinvasion.

Bait Selection Tests

Introduction

A test was run to determine the best carrier for a toxic control agent by offering caged rats nine different baits.

Procedures

This test consisted of three consecutive 24-hour feeding periods. Consumption was measured at the end of each period. Nineteen animals were held in a 10 x 10-ft aluminum sheeting enclosure covered by poultry screening. The sides of the enclosure were buried approximately 8 inches in the ground. About 4 inches of gravel and soil were spread over the floor of the enclosure to provide soft earth into which the animals could burrow. Dry grass and weeds were also scattered in the enclosure for cover. Nine candidate baits were randomly placed in aluminum feeding dishes which were fixed to three boards on the floor of the enclosure (Fig. 7).

Results and Discussion

Locally captured rats (Sigmodon sp.) were offered yucca, carrot, potato, rice, corn, sorghum, jicaro, plantano, and bean. Water was provided ad libitum. Results are summarized in Table 10. Analysis of the data shows that acceptance of potato was significantly higher than rice, and that acceptance of rice was significantly higher than all others. However, rice was chosen as the bait carrier for the following reasons: (1) less expensive, (2) more readily available, (3) more easily prepared and treated with toxicant, and (4) bait can be prepared in advance and held for several days.

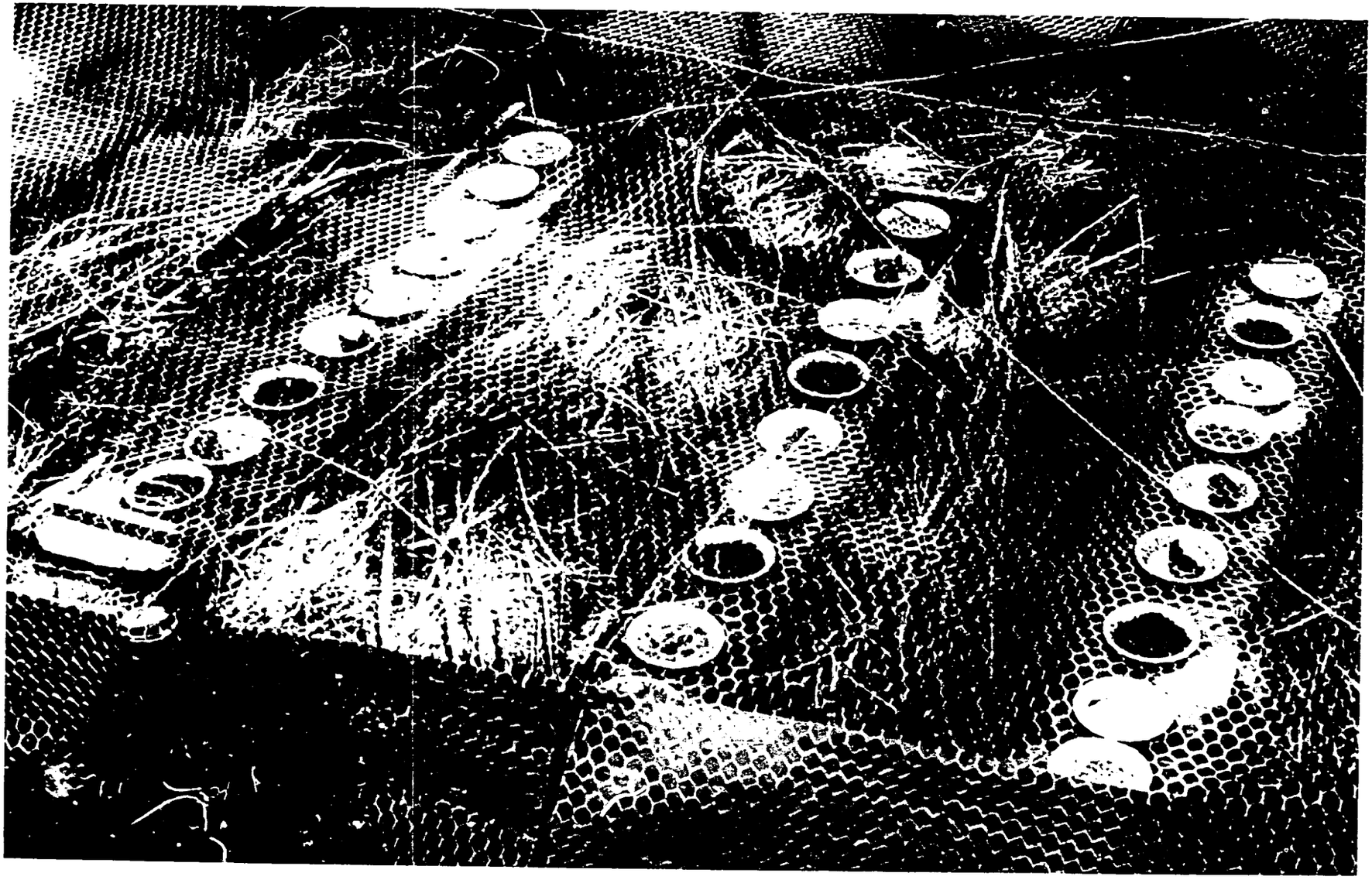

Fig. 7. Bait acceptance study in rat enclosure.

TABLE 10. Consumption of candidate bait materials by cotton rats*

	Grams consumed				
	Day 1	Day 2	Day 3	Overall total	$\bar{X}$
Yucca	10.35	12.31	68.27	90.93	30.31
Carrot	0.20	5.57	13.67	19.44	6.48
Potato	15.15	110.43	100.13	225.72	75.24
Rice	32.80	68.70	49.80	151.30	50.43
Corn	10.80	19.60	27.90	58.30	19.43
Sorghum	1.40	23.60	22.60	47.60	15.87
Jicaro	1.10	8.70	0.80	10.60	3.53
Plantano	4.10	13.29	16.20	33.55	11.18
Bean	6.20	5.60	1.90	13.70	4.57

*Moisture loss of succulent materials was measured and adjustments made.

Field Baiting Studies

Introduction

Three techniques are presently in general use by rice growers in Nicaragua to reduce rodent populations. These are (1) Racumin bait, (2) Endrin bait, and (3) Endrin and molasses spray. It may be assumed that these materials are not effective as being used; ineffectiveness continues in spite of regular and frequent applications. Endrin spray is hazardous and, because of its persistence, is an environmental contaminant.

Research at the Rodent Research Center in the Philippines has shown that effective control of ricefield rodents can be achieved with zinc phosphide (ZnP) treated baits. These studies were undertaken to determine the effectiveness of ZnP under Nicaraguan conditions and to compare it with the local Racumin control method.

Procedures

Two field tests using ZnP were conducted. A 2% (by weight) bait formulation of 94% active ingredient was used. No correction factor was applied to account for the 6% inactive ingredients. Corn oil was used as an adhesive and approximately 75 ml/10 lb of bait gave the best results.

The first test was in a barren (harvested and burned) ricefield. The site was in a field containing approximately 40 manzanas. Half of this field was baited with treated puntilla (broken rice) at the rate of 2.98 lb bait per manzana (approximately 12 g ZnP/acre).

The second test was in a field of growing rice which was approximately 45 days old and had not reached booting stage. The field was about 25 manzanas. Half of the field was treated with approximately 2.31 lb of bait per manzana. The other half was the reference plot.

Another test using Racumin was conducted. It was established in the second half of the 40-manzana barren field described earlier. The Racumin bait used at Finca El Triunfo was distributed following the current procedure (bait enclosed in plastic bags and dipped in molasses).

A field of approximately the same size and physical appearance as the ZnP/Racumin test plots and located directly across an access road was the reference plot.

Treatment effect was determined by comparing trapping results. Each plot was evaluated with three lines of 30 traps each placed at 10 m intervals and set for 3 consecutive nights. Victor 4-way rat traps were used; peanut butter and rolled oats was the bait.

Results and Discussion

Results of posttreatment trapping in the barren field plots are summarized in Table 11 and those from the growing rice plots in Table 12. No control was achieved with the Racumin (Table 13). Only a single application of Racumin was made, rather than the customary five consecutive applications. A single application of ZnP resulted in a marked reduction and indicates that it is more economical than Racumin, at least in terms of time and labor.

TABLE 11. Results of posttreatment trapping on barren field test plots, Finca El Triunfo

Treatment	Total animals	Male	Female	% trap success
Reference				
Day 1	50	9	41	56
Day 2	36	6	30	40
Day 3	23	9	12*	26
Total	109	24	83	41
Zinc phosphide				
Day 1	5	0	5	6
Day 2	3	2	1	4
Day 3	3	1	2	4
Total	11	3	8	4
Racumin				
Day 1	57	18	39	64
Day 2	55	28	27	62
Day 3	41	10	31	46
Total	153	56	97	57

*Two animals had been partially destroyed by scavengers and sex could not be determined.

TABLE 12. Results of posttreatment trapping on ricefield test plots, Finca El Triunfo

Treatment	Total animals	Male	Female	% trap success
Reference				
Day 1	60	25	35	67
Day 2	45	17	28	50
Day 3	34	18	16	38
Total	139	60	79	52
Zinc phosphide				
Day 1	10	4	6	12
Day 2	15	5	10	17
Day 3	6	5	1	7
Total	31	14	17	12

TABLE 13. Comparison of difference in numbers of animals trapped on treated and reference plots, Finca El Triunfo

Treatment	No. rats captured on treated plot	No. rats captured on reference plot	difference
Zinc phosphide* barren field	11	109	-90
Racumin** barren field	153	109	+29
Zinc phosphide* ricefield	31	139	-78

*Trapping initiated 2 days after treatment.
**Trapping initiated 5 days after treatment.

Although the reductional control in the ricefield test was lower than that achieved in the barren field test, 24 of the 31 cotton rats caught in the ricefield test plot were caught on the main canal along one edge of the field. This success involved only one-third of the traps.

On the reference plot, 72 of 139 cotton rats (52%) were captured on the canal. This suggests that rats were crossing the canal and entering the test site from the barren field.

The high trap success in the ricefield reference plot (Table 12) indicates that little reductional control was achieved by a previous baiting with Endrin around the periphery of the field approximately 5 days prior to this test.

Comparative Bait Acceptance Study

Introduction

A major objective of any toxic baiting program is the development of a bait that is readily accepted by the target animal. Another is the development of an application technique which makes the bait available and effective for a reasonable period of time. This study was conducted to determine the effect on bait acceptance of various treatments, additives, and packaging materials.

Procedures

Twenty rats (Sigmodon sp.) captured locally were held in a 10 x 10 ft aluminum sheeting enclosure on Finca "El Triunfo." One hundred grams each of eight candidate bait treatments were randomly placed in small aluminum feeding dishes which were fixed to three feeding boards (three replications) on the floor of the enclosure. The test consisted of three 24-hour feeding periods, consumption being measured at the end of each period.

Results and Discussion

Consumption of the candidate bait materials is summarized in Table 14. Analysis of the data shows that acceptance of hulled rice treated with vegetable oil was significantly higher than all other treatments. There was a marked reduction in acceptance of samples in plastic bags as compared to loose samples (Fig. 8). Plastic bags could significantly reduce acceptance and thus offset any possible benefits such as protection of the bait from adverse weather. Molasses apparently has no value as an attractant. Both plastic bags and molasses are currently accepted techniques in rodent control programs in Nicaragua.

TABLE 14. Consumption (grams) of candidate bait treatments

	Treatment	Total Day 1	Total Day 2	Total Day 3	Daily $\bar{X}$
1	Untreated hulled rice	29.00	52.50	65.00	48.83
2	Hulled rice - vegetable oil	42.00	43.00	102.00	62.33
3	Hulled rice - molasses	41.00	16.00	78.00	45.00
4	Untreated hulled rice - plastic bags	0.00	3.00	8.00	3.66
5	Hulled rice - vegetable oil in plastic bags	10.00	10.00	11.00	10.33
6	Hulled rice - molasses in plastic bags	2.50	0.00	2.00	1.50
7	Untreated hulled rice in plastic bag - vegetable oil on outside	1.00	1.00	0.00	0.66
8	Untreated hulled rice in plastic bag - molasses outside	0.00	0.00	3.00	1.00

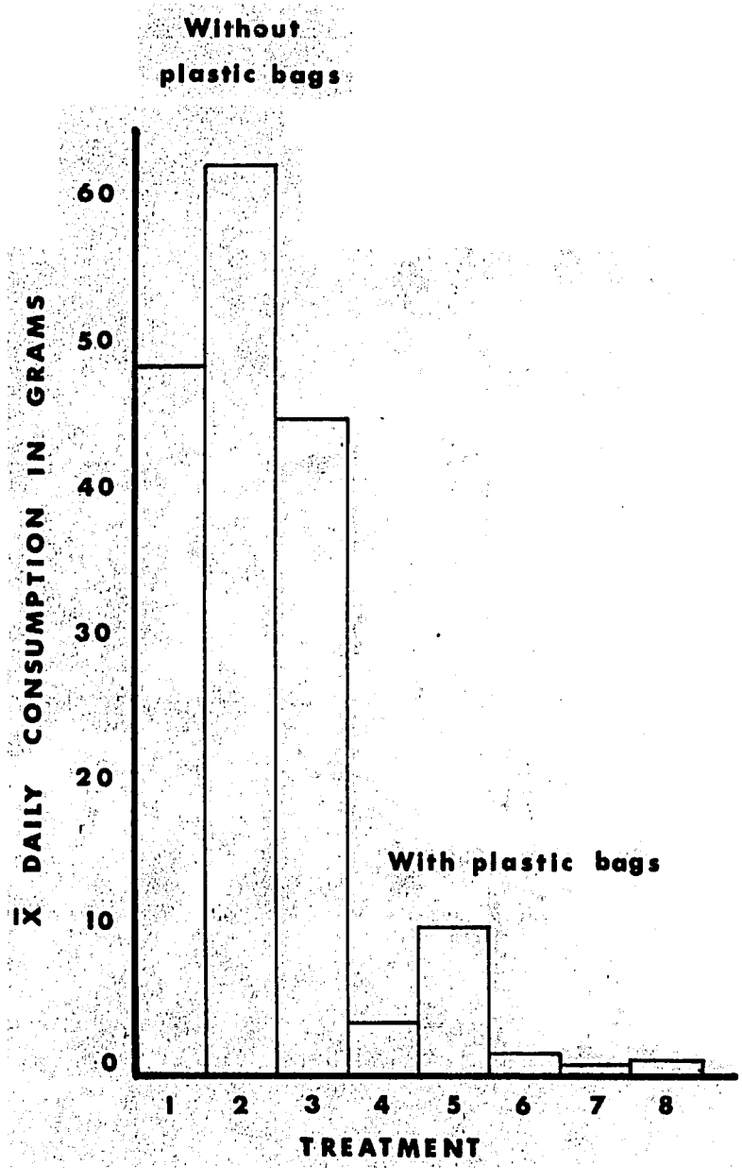

Fig. 8. Comparison of average daily consumption of candidate treatments.

PUBLICATIONS

The following were published and/or distributed as indicated:

1. Londono, Jose F. 1971. Murcielagos, ratas, pajaros y hambre. Revista Esso Agricola No. 3 May-June 1971. (Spanish translation of Bats, rats, birds and hunger, by Charles L. Cadieux)

2. Londono, Jose Fernando, Donald J. Elias, Danilo Valencia G. y Paul P. Woronecki. 1971. Informe preliminar sobre la incidencia de torcaza naguiblanca (Zenaida auriculata) y su relacion con problemas de danos a algunos cultivos en el Valle del Cauca, Colombia. (Published by Instituto Colombiano Agropecuario Regional 5 in mimeograph form)

3. Woronecki, Paul P., Jose Fernando Londono, and Donald J. Elias. 1971. Investigaciones sobre el control de danos causados por los vertebrados en la agricultura, Informe Anual 1970. (Spanish version of Colombia Station 1970 Annual Report distributed in mineograph form to more than 250 persons in Colombia including agronomists of both government and private industry, agriculturists, and other interested persons)

4. Kverno, Nelson B., Donald J. Elias, Everardo Vogel, and Rene Bojorge. 1971. Exploratory studies to reduce cotton rat damage to rice in Nicaragua. (Over 150 copies distributed in mimeograph form to interested persons in Nicaragua and Colombia)

CONFERENCES AND PRESENTATIONS

On July 9, 1971, Biologists Woronecki, Elias, and Londono attended a conference at the ICA Experiment Station Nataima near Ibague. The conference was attended by agronomists and agriculturalists involved in rice production. Biologist Londono made a brief presentation concerning the problems and control of bird and mammal damage in rice. Following the presentation, Woronecki, Elias, and Londono answered questions from participants.

During the year, project personnel presented talks to student groups from the Facultad de Agronomia de Bogota, Facultad de Agronomia de Ibague, and the Facultad de Zootecnia de Bogota. These presentations centered around vertebrate damage problems in Colombian agriculture, their implications, possible solutions, and the organization and methods of work of the project.

LITERATURE CITED

Bucher, E.H. 1970. Consideraciones ecologicas sobre la paloma *Zenaida auriculata* como plaga en Cordoba. Ministerio de Economia y Hacienda. Direccion Provincial de Asuntos Agrarios. Serie Ciencia y Technica No. 1. Cordoba, Argentina. 11 p.

De Schauensee, R.M. 1964. The birds of Colombia and adjacent areas of South and Central America. Livingston Publishing Company. Narberth, Pennsylvania. 430 p.

Slud, P. 1964. The birds of Costa Rica, distribution and ecology. Bull. Amer. Mus. Nat. History 128. 430 p.