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Planning for bird pest problem resolution: A case study

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Abstract

This paper presents a case history of a unique approach taken by the United Nations Food and Agriculture Organization (FAO) and the countries of Argentina and Uruguay to assess the need for and plan a binational, technical assistance project on bird pests in the two countries. It describes an intensive technical assistance and extensive planning effort based on 15 different consultancies to these countries in only a nine-month period during 1991. The paper presents an overview of the bird pest situation in the two countries and the technical findings and recommendations of these consultants to address the bird pest problem. While a number of important recommendations resulted, the main two stressed the need to obtain accurate assessments of crop loss by birds and develop alternative methods to toxicants to reduce these losses. This effort provided the framework for a project document "Integrated Management of Pest Birds Common to the Plata River Basin," that is being considered for funding support and joint implementation by the two countries.

1. Introduction

1.1. Background

Planning technical assistance projects in wildlife damage management historically has involved a minimal number of external consultants with general technical and project development expertise, in cooperation with host country counterparts who participate as part of their normal work duties. However, the project planning process for this situation in Argentina and Uruguay was considerably different, as it involved a large number of external consultants with expertise in specific areas and the selection of two national project coordinators over a very short time period seconded to the Food and Agriculture Organization (FAO) to facilitate and participate in all aspects of the consultancies and overall project planning. The purpose of this paper is to describe not only the results of the consultancies but also the strengths and weaknesses of this unique planning process.

1.2. History

The Governments of Argentina and Uruguay, aware of serious problems with bird pests in their countries, in 1987 signed a special agreement for joint and simultaneous management of agricultural pests. They prepared a management plan on the topics of bird pests, fruit flies, citrus canker, and biotechnology applied to plant propagation materials, disease diagnosis, and sanitation, basing the activity in the Salto Grande Binational Area (SGBA). Only the management plans related to bird pests are discussed in this paper.

The economy of both Argentina and Uruguay is based primarily on agricultural and livestock production. Technological development has allowed agriculture to increase and diversify toward a more intensive use of the land and a more efficient use of resources, resulting in higher productivity per surface unit, higher hand labor occupation, and an increase in required services. Bird pests, mainly pigeons and doves (*Columbidae*) and parakeets (*Psittacidae*), are among existing limitations to productivity, causing losses estimated by the Food and Agriculture Organization (FAO) of the United Nations at U.S. $6 million in Uruguay and U.S. $36 million in Argentina (FAO, 1980). However, no comprehensive, systematic assessment on the overall extent of the bird pest problem in the two countries was conducted prior to the analysis reported in this paper.

That bird pests in the region cause significant damage to agricultural crops was shown in previous studies (Bucher, 1985; De Grazio, 1985; Meinzingen, 1985) and other reports from Argentina, Uruguay, FAO, and USAID (Bucher and Bedano, 1976; Calvi et al., 1976;

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FAO, 1980; Martinez, 1976; Mott, 1973; Rodriguez, 1983; Zaccagnini and Bucher, 1983). This documentation and an increased concern by crop protection authorities in Argentina and Uruguay led to a joint meeting in 1987 to (1) discuss bird problems; (2) present results of research and control operations; and (3) formulate a proposal for technical assistance (IICA, 1987). This proposal called for international assistance to develop a comprehensive plan that would lay the groundwork for eventual joint implementation by Argentina and Uruguay of an integrated bird pest management strategy for the important bird pest problems common to the region. The resulting binational FAO Project TCP RLA 8965(A) "Integrated Control of Bird Pests" was approved in August 1989 and completed in December 1991. Under this project, FAO contracted with a number of international consultants to investigate bird pest problem needs and to propose recommendations and possible strategies to resolve them as part of a process to help design an applied, collaborative, binational Project Document. Dr. Rodriguez and Ms. Zaccagnini were designated by FAO as National Project Coordinators for Uruguay and Argentina, respectively. Dr. Bruggers coordinated all consultancies by USDA/National Wildlife Research Center (NWRC) scientists, prepared the final technical report for FAO and reviewed the proposed Project Document.

1.3. Consultants' plan and counterpart scientists

Mr. Lynwood Fiedler visited Argentina and Uruguay in February 1990, and with Ms. Zaccagnini and Dr. Rodriguez, identified 14 additional priority areas and specific consultants to develop a strategy for managing bird pest problems in the region. These consultancies were conducted by a variety of individuals from several different countries with particular expertise in these specific areas (Table 1). All were carried out during 1991. However, due to administrative funding constraints, consultancies to develop the eventual Project Document were not completed until January 1996. Consultants met with many individuals and organizations within and outside of government, including Ministries of Agriculture, pesticide registration bureaus, toxicology laboratories, experimental research stations, satellite imagery facilities, and individual farmers and cooperators; and made field visits to bird roosting and nesting colonies, agricultural damage sites, and control locations. Findings, conclusions, and recommendations of these consultants, along with an overview of the bird pest situation in the region, were summarized in a technical report submitted to FAO (Bruggers, 1994); that report forms the technical basis for this paper. Because some advancements in the knowledge of bird pest mangement have occurred since the 1991 consultancies, some selected, more recent references are included in this paper.

1.4. Project implementation site

The provinces of Buenos Aires, Córdoba, Entre Rios, and Santa Fé in Argentina, and roughly the western one-third of Uruguay, comprise the binational region of more than 500,000 km^2 (Map 1). Climate and dominant vegetative communities vary considerably, ranging from semi-arid thorn-scrub regions in the west, to 'humid Pampas' near the Paraná and Uruguay Rivers. Land use is dominated by livestock and crop production, and the landscape is somewhat typical of agroecosystems: interspersion of pasture, cultivated land, woodlots, and shrub communities. The SGBA, which encompasses parts of both countries, was considered the appropriate area to base the project; it offered facilities, personnel, and accommodations to support the project headquarters site and was near the bird problem areas in both countries.

Consultancies to this FAO/TCP binational project on integrated bird pest management originally were to focus along the Uruguay River, which separates Uruguay and Argentina, and specifically at the SGBA. However, to realistically evaluate bird damage, current bird control practices, proposals for future methodology, and environmental concerns, a larger area, including the agricultural areas in the province of Entre Rios, Argentina and in western Uruguay, where cereal and oilseed crops are produced, also was considered during these consultancies.

The provinces of Entre Rios and Santa Fé and western Uruguay contain an abundance and diversity of wildlife. Although most land area is devoted to crops (20 percent) and grazing (70 percent), fields often are bordered by native vegetation (Keith, 1991). Drainages support additional habitat for wildlife, especially in the provinces of Entre Rios and Santa Fé where perennial streams and extensive wetland ecosystems support greater amounts of vegetation, and provide habitat and breeding sites for many species of wildlife. Birds, including raptors and scavengers, and carnivorous and furbearing mammals are present in great diversity. The land is highly productive and agricultural development for both crops and livestock probably has improved the conditions favorable to increased wildlife populations.

2. Overview of bird pest problems in the region

2.1. Background

Based to some extent on the previously described situation, both countries realized that addressing the major bird pest problems required a binational or regional approach. In addition, some bird control efforts carried out on only one side of the Uruguay River have been unsuccessful, perhaps due to movements of birds across this river border. Therefore, a cooperative program that

Table 1
FAO Consultancies to Argentina and Uruguay in Bird Pest Management during TCP RLA 8965(A)*

Consultant	Affiliation	Dates	Topic
L. Fiedler	USDA National Wildlife Research Center	Feb. 1990	Project planning
M. Jaeger	USDA National Wildlife Research Center	Apr. May. 1991	Evaluation and recommendations on the use of lethal methods to control bird damage in Argentina and Uruguay
O. Arregoces	Private Consultant	Apr. 1991 and Sep–Oct. 1991	Communication and training
R. Bullard	USDA National Wildlife Research Center	Apr. May. 1991	Repellents
J. Foronda	Private Consultant	Jun. 1991	Integrated control method
J. Keith	USDA/National Wildlife Research Center	Jun. Jul. 1991	Ecotoxicological evaluation of control programs
C. Feare	Min. Of Agr. Central Science Lab. UK	Aug.–Sep. 1991	Nonlethal control-chemosterilants
G. Schulten	FAO, Rome, Italy	Aug. 1991	Project evaluation
R. Bullard	USDA/National Wildlife Research Center	Sep. Oct. 1991	Repellent training and research
E. Bucher	Univ. Of Córdoba, Argentina	Sep. 1991 Feb. 1992	Bird population dynamics
D. Otis	USDA/National Wildlife Research Center	Sep. Oct. 1991	Statistical consideration
B. Bouglé	FAO Consultant	Oct. Dec. 1991	Integrated methods of crop management
R. Clark	Canadian Wildlife Services, Canada	Nov. Dec. 1991	Biological control-habitat management
M. Jaeger	USDA National Wildlife Research Center	Dec. 1991	CPT CPTH avicide evaluations
R. Bruggers	USDA/National Wildlife Research Center	Dec. 1991	Mass-marking and radiotelemetry techniques

*Two additional consultancies were conducted in 1995 under FAO TCP RLA 2363: G. Waggerman, Texas Parks and Wildlife, on the use of doves as a hunting and food resource, and J. Foronda on the development of a draft Project Document for future implementation.

considered bird biology, behavior, and crop damage in the region, not just in each country, was determined to be essential to reducing losses that now are considered to limit agricultural production in both countries.

Eared Doves (*Zenaida auriculata*), pigeons (*Columba* spp.), and parakeets (*Myiopsitta monachus*) are major bird pests, common to the region. In both countries, blackbirds (*Molothrus* sp., *Agelaius* sp., and *Pseudoleistes* sp.) and finches (*Sicalis* sp.) also damage crops. Bird damage occurs both during the germination and maturation of grain crops. Soybeans and sunflowers are particularly susceptible to damage during germination; but wheat, sorghum, corn, and rice are also affected. In Argentina, sunflowers, sorghum, corn, and wheat are the primary crops damaged by doves, parakeets, and pigeons. Geese (*Chloephaga* spp.), finches (*Sicalis* sp.), and ducks (*Dendrocygna* sp. and *Netta* sp.) damage wheat, and parrots (*Amazona aestiva*) damage citrus fruits. Blackbirds (*Agelaius ruficapillus*) and waterfowl (*Dendrocygna* sp. and *Netta* sp.) also damage rice. In both countries, maturing sorghum and sunflowers receive significant damage; but corn, wheat, barley, rice, and fruit crops (apples, pears, and peaches) are also affected. For a more detailed overview of the bird pest situation in Argentina, see Bruggers and Zaccagnini (1994).

2.2. Eared Dove

The Eared Dove is one of the most common species in the project region, in many areas being very abundant. It breeds in Córdoba, Entre Rios, and western Uruguay. There is some indication that its numbers have decreased, possibly associated with a reduction in the area of sorghum cultivation (Bucher, 1990). In contrast to its status as an important bird pest, the Eared Dove is valued as an important source of sport hunting, largely in Argentina.

The Eared Dove is an opportunistic breeder, taking advantage of favorable conditions, nesting in colonies of sometimes up to 10 million individuals. Colonies are formed in vegetation patches varying is size from less than 20 ha in the province of Entre Rios (Zaccagninni, pers. obs.) to at least 200 ha (Bucher, 1990) in agricultural areas, woods, and forests, and within 100 km of water (Bucher, 1990). Another adaptive factor is its ability to migrate long distances and take advantage of available food sources. Movements of greater than 500 km are known in areas of Argentina and Brazil (Bucher, 1991). This implies that large mortality rates can be compensated for by individuals immigrating from other regions and that birds causing damage may not be affected by control efforts.

Bucher (1991) suggested that control of dove populations was impractical. If birds are killed, there is a possibility of new birds immediately migrating in from other areas. In addition, these birds have a high reproductive potential, allowing local populations to recover quickly. For these reasons, widespread control programs using toxic baits have not been successful in Argentina and have not been evaluated in Uruguay where they were used between 1975 and 1981 (Rodriguez, pers. comm.). Sport hunting also has had no effect on reducing the population because of rapid population recovery; there

are no examples of sport hunting reducing dove populations anywhere in the world. The application of toxic chemicals to nesting colonies, as used in Africa to kill large numbers of weaver finches, has never been considered due to possible secondary hazards to nontarget species in the highly-biodiversity areas of Argentina and Uruguay. Bucher (1991) speculated that Eared Doves, because of their breeding potential and adaptability, will remain a pest species, since no acceptable means to reduce dove populations is available in the region.

2.3. *Picazuro and spot-winged pigeons*

These species occur near the project area, although the Picazuro Pigeon (*Columba picazuro*) prefers more wooded and humid areas. Both species are granivorous and herbivorous, consuming an important quantity of seeds and sprouts during the winter months and causing damage to both sunflowers and soybeans at the time of emergence. The Picazuro Pigeon has expanded its range westward during the past 20 years into the province of Córdoba. The Spot-winged Pigeon (*C. maculosa*) apparently also has increased its range. In both cases, changes in land use patterns likely have resulted in these range expansions (Bucher, 1990).

In Argentina and Uruguay, doves and pigeons are considered to be moderately controlled through the use of toxic baits placed in cultivated crops, mainly during the emergence of the plants (sunflowers and soybeans) and during flowering (barley). The idea, by baiting in specific fields, is to eliminate only those birds actually causing damage. The effectiveness of this technique has not been evaluated, and the use of toxic baits in fields likely will adversely affect other species of wildlife.

A few studies have been conducted on the population dynamics of these species (Llano de Diez, 1979; Zaccagnini and Bucher, 1986; Bucher, 1992). It is possible that populations are also limited by the availability of food, particularly during the winter months (Bucher, 1992). Likewise, the onset of breeding may vary widely, perhaps related to extensive migratory movements.

2.4. *Monk Parakeet*

The Monk Parakeet, considered an agricultural pest, is widely distributed throughout the project region. It is characterized by its use of sticks to construct large communal nests. Originally nesting in natural woodlands, this parakeet has expanded its range with increasing development of eucalyptus plantations, reaching densities in western Uruguay estimated at about one individual per ha (Bucher, 1985). The increasing use of electrical transmission lines as support structures for these nests also has been of considerable concern (Bucher and Martin, 1987). In all situations where large-scale control has been implemented, parakeet populations have decreased, yet have recovered within five years. Parakeets have been exploited by the international bird trade market and a considerable number have been exported from Argentina and Uruguay (50,000 in 1991; see Bucher, 1991).

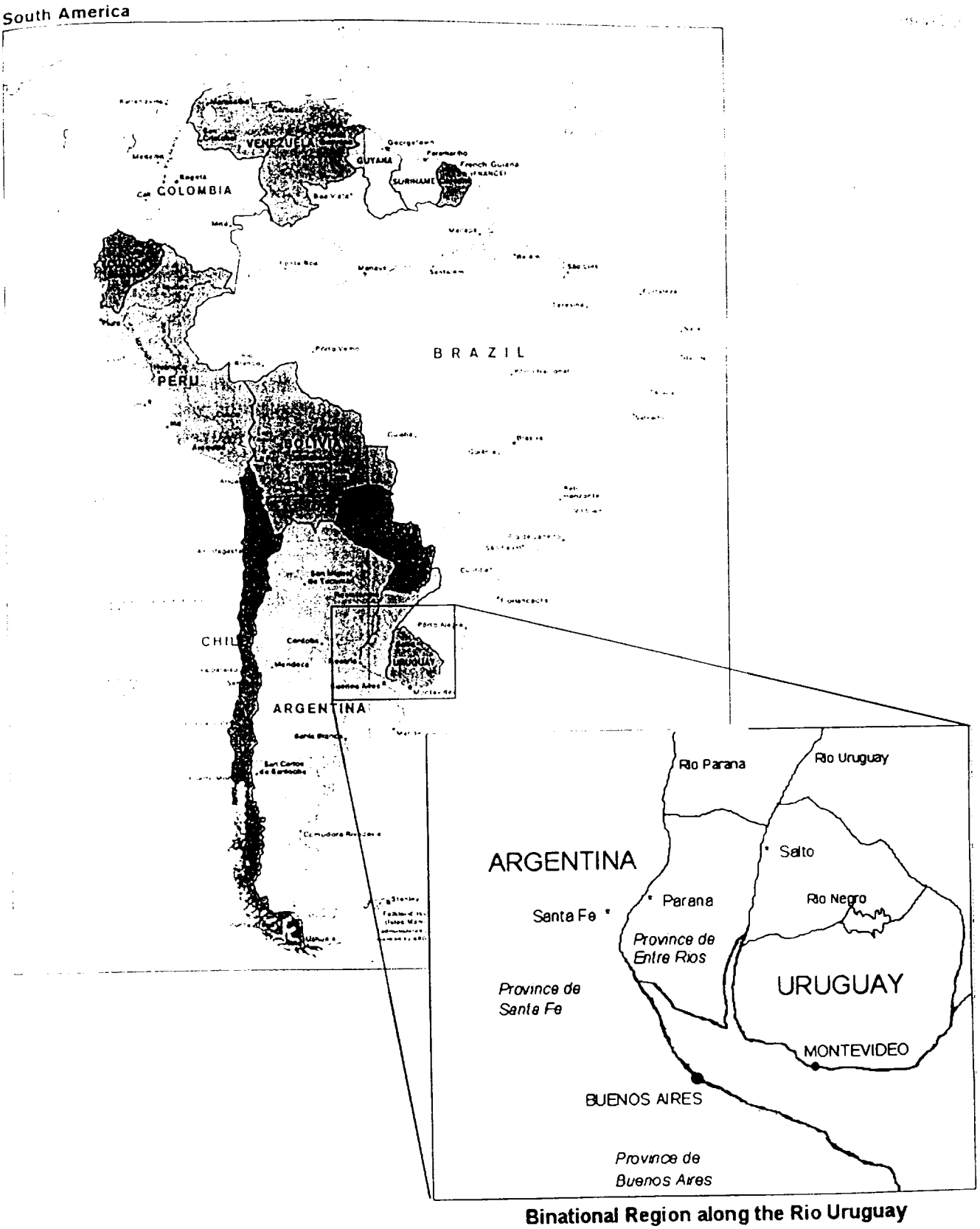
Parakeet populations have a lower recruitment rate than those of the Eared Dove. It is possible that the level varies based on the circumstance and density of the population. In studies in Córdoba, Argentina, the recruitment rate was about 10 percent. In Uruguay, data from evaluations following periods of widespread control indicated that the rate of population increase was 87 percent in one year (Bucher, 1985).

The Monk Parakeet breeds between November and January. Birds reach reproductive condition between two and three years of age. A variable proportion of the population does not breed each year, a factor that may be important when considering population regulation (Bucher et al., 1991). Parakeets have long life spans, compensating for their low reproductive and recruitment rates. The need for tall trees in which to construct nests and the increased planting of eucalyptus has been important to this species. Parakeets were not considered a problem in either Argentina or Uruguay prior to the introduction of eucalyptus when very little natural vegetation existed that was favorable for nesting.

Parakeets have a very small home range, generally staying in the same area throughout the year. The average distance of dispersion between their place of birth and their breeding nests is about 3 km (Bucher et al., 1991).

Based on available information, it is not possible to elaborate on the external factors that may control Parakeet populations, other than that food and nest tree availability are likely to play important roles. This species, probably, is not as dependent as Eared Doves on cultivated grain since its diet includes fruits, sprouts, and wild seeds.

The combination of a relatively low reproductive rate, delayed sexual maturation, one breeding cycle per year, and a portion of adult birds not breeding are population characteristics very different from those of Eared Doves. This results in an increased susceptibility to control measures for parakeets. It has been demonstrated that control using toxic grease at entrance holes of nests can greatly reduce populations. However, the relatively high cost of using this technique to control a species with a density of only about one bird per hectare, the difficulty of eradicating an entire population from an area, and the need to minimize the impact of the control on nontarget wildlife are important considerations. Finally, any control efforts should be restricted to those birds known to cause damage in a particular area where damage is sufficiently great to justify the control. The protection of small and isolated farm areas by using expensive and large-scale control techniques is not justified, either ecologically or economically.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ARGENTINA
Salto
Parana
Rio Negro
Santa Fe
Province de Entre Rios
URUGUAY
Province de Santa Fe
MONTEVIDEO
BUENOS AIRES
Province de Buenos Aires
Binational Region along the Rio Uruguay

Fig. 1

3. Estimates of crop losses due to birds

3.1. Argentina

The bird pest problems in Argentina have recently been summarized by Bruggers and Zaccagnini (1994) and Fiedler (1990). Sunflowers, sorghum, corn, wheat, peaches, and soybeans, in that order, were the crops attacked by pigeons, doves, and parakeets. In Argentina, most crop losses occurred in Entre Ríos, Córdoba, Santa Fé, and Buenos Aires provinces. Damage in Argentina by birds was valued at U.S. $36 million by FAO (1980). Otis (1991) could find no source for this estimate and concluded that no statistically meaningful large-scale assessments of bird damage in soybeans, sunflowers, wheat, and barley had ever been made. However, Clark (1991) summarized a number of unpublished damage assessment study reports conducted primarily by M.E. Zaccagnini and other personnel of INTA, on smaller plots of agricultural crops, such as sunflowers, corn, sorghum, and wheat. These studies showed considerable variance in loss estimation, and confirmed the relationship of needing intensive sampling efforts to obtain reliable data (Zaccagnini, pers. comm.).

3.2. Uruguay

De Grazio (1985) and Meinzingen (1985) have summarized bird pest problems in Uruguay. Sorghum, sunflowers, barley, corn, wheat, rice, fruits, soybeans, and peanuts, ranked in that order, were the crops attacked. Most crop losses occurred in the regions of Salto, Paysand, Rio Negro, Soriano, and Colonia. Damage estimates caused by birds was valued at U.S. $6 million by FAO (1980), but Otis (1991) could find no basis for this estimate.

4. Current control methods

4.1. Argentina

Bird control practices vary among the provinces in Argentina. No pesticides currently are registered for bird control, and no campaigns and few bird control activities are in progress by the government. Bird control now being undertaken is conducted by farmers using organophosphate insecticides that are not registered for such use, and the Government of Argentina has had little success in trying to restrict nonregistered uses, even though legislation regulating pesticide use exists in many provinces.

There is minor use of 20 percent carbofuran in grease to treat Monk Parakeet nest openings. Control has resulted in nontarget mortality that is especially evident with raptors. There is no current control of Eared Doves, but pigeons are killed in sprouting soybean and sunflower fields with grain baits containing parathion, chlorpyrifos, monocrotophos, or other insecticides. There is no organized strategy for lethal control of doves; instead it is left to the farmers, many of whom are believed to place toxic baits in and around fields. It has been reported that raptors and other wildlife associated with agroecosystems have been killed secondarily by this practice (Canavelli and Zaccagnini, 1997). Although not related to toxic baiting for controlling pests, nontarget poisoning of raptors associated with grasshopper control in agricultural fields in La Pampa, Argentina has been documented (Woodbridge et al., 1995; Goldstein et al., 1996). In rice-growing areas, parathion, either as an aerial spray or a field bait, was also widely used to kill blackbirds (*Agelaius ruficapillus* and *Molothrus* spp.), and these practices have caused considerable mortality in nontarget birds, mammals, and fish (Zaccagnini and Mathern, 1991); parathion has now been replaced with monocrotophos. However, Novartis, a major manufacturer of monocrotophos has announced that it will begin phasing out all manufacture and sale of this chemical globally (Winegrad, 1998).

4.2. Uruguay

The Government of Uruguay is not currently conducting any campaigns or control activities against birds. Endrin and methiocarb were the only pesticides registered by the government for bird damage control, and the endrin registration expired in November 1991. In the past, the Plant Protection Service prepared toxic baits for dove control in barley with the organophosphate insecticides mevinphos (Phosdrin®) and dicrotophos (Bidrin® 85 percent), as well as Endrin, a chlorinated hydrocarbon insecticide. (See Meinzingen, 1985 for a more complete description of the methods of formulation and application.) Many farmers shoot parakeets and sometimes use 20 percent endrin in grease to treat parakeet nest openings, the latter causing mortality in raptors and other nontarget wildlife. Both government and farmers contributed to a government control campaign (1981 and 1985) but farmers currently use dicrotophos and probably other insecticides on wheat bait to kill Eared Doves. Methiocarb is applied to emerging cereal crops and maturing grapes by farmers to protect crops from bird damage. The Government has little capability to restrict pesticide use and registration is by product, not by specific use.

5. Summary of consultants' findings

This section summarizes the findings and recommendations of consultants to the project development in the order in which site visits were made.

5.1. Evaluation and recommendations on the use of lethal control methods

Jaeger (1991a) recommended systematic research on two large (180 km^2) sites in Entre Rios, Argentina, and southwestern Uruguay to relate bird problems to specific crop damage, habitat type, and land use patterns. Aircraft and aerial photos might be used to aid in such sampling. Jaeger (1991a) recommended that CPT (3-chloro-*p*-toluidine) and its hydrochloride salt CPTH (DRC-1339, Starlicide) be evaluated as alternatives to the various toxicants presently being used in bird control. However, in later tests with CPT against parakeets (Jaeger, 1991b), the material failed to kill any birds when applied to their breast feathers and killed only a few individuals when applied to nest entrances or perches (Zaccagnini et al., 1995) in several formulations and concentrations. Nonetheless, CPT/CPTH are known to be toxic to pigeons and doves, perhaps making additional field and laboratory evaluations of these chemicals justified if lethal control methods are to be considered.

5.2. Communication and information transfer

Arregoces (1991) noted the importance in all research and extension activities for close coordination among all decision-making levels and the need for this to be a continuous process for effective technology transfer. He found that due to the personnel shortage and time constraints, researchers generally had minimal or no contact with extension and funding services. Arregoces further found that both countries had experience in research and in Monk Parakeet control campaigns and that there was a good exchange of information among researchers in this subject area. He showed the importance of (1) developing an information dissemination program for the binational region on the problems and benefits of birds, using videos, press releases, extension brochures, magazine articles, radio broadcasts, newspaper articles, and public meetings to inform and allow public discussion of the bird problems and their solutions, and (1) assuring distribution of all information to farmers, cooperators, and the general public.

For management and control of Monk Parakeets, doves, and pigeons, Arregoces noted that varied perspectives and strategies should be employed, including an integrated management strategy in both countries. He noted other areas of need: simple methods for farmers to determine a minimum acceptable level of damage, ways to effectively transfer technology, encouragement of seed producers to use bird-resistant varieties, and implementation of a survey by extension services focusing on deficiencies in agricultural operations. In Argentina, the concepts of the earlier "Proyecto Pérdidas de Cosecha Project (PROPECO)" (a project for preventing grain losses at harvest) could be used to include bird pests that cause harvest losses and to assure an emphasis on the importance of harvesting on time. In Uruguay, private companies could be encouraged to cooperate with PROPECO. He also suggested asking representatives from Argentina, Uruguay, Paraguay, and Brazil to promote establishing an international center for bird pest management in Salto Grande.

Note: PROPECO has now ended. A follow on project "Intensification of Grain Production (IPG)" is now concentrating its efforts in IPM extension.

5.3. Bird pests-repellents

Bullard (1991a)) discussed the concept of using chemical repellents and recommended experimental use of methiocarb and trimethacarb to create conditioned aversion to the treated crops. He listed dimethyl and methyl anthranilate (DMA and MA), synergized aluminum ammonium sulfate (CURB ®), copper oxalate, and copper oxychloride as additional candidate repellents. Condensed tannins and sorghum varieties that have high levels of tannins in immature, but not in maturing, grains should also be considered as possible repellents to reduce bird damage. The chemical frightening agent Avitrol® might be appropriate in certain corn growing areas to reduce parakeet damage in fields.

He further explained that the efficacy of a repellent depends, among other things, on the bird feeding pressure (i.e., population size, alternate foods, feeding preferences, and repellent properties) on whichever crop the repellent is intended to protect. Some repellents produce a stronger, longer, and more dependable response, but will also fail if bird feeding pressure is extremely high. The abundance of alternate foods from field crop stubble, fields planted to grass or clover, native livestock pastures, and riparian habitat during much of the year would indicate that repellents could be used successfully. Bullard further described the primary and secondary crops and cropping patterns in the binational area, giving their planting phenology, acreage, and probability of damage by one or more of the four bird pest species.

Note: the status and availablity of bird repellent products has changed considerably since these consultancies were completed. For an overview of recent literature on bird repellents, please see Mason (1995) and Clark (in press).

5.4. Integrated control of bird pests, an overall plan

Foronda (1991) suggested a need for several components in an overall bird pest management plan: (1) clearly defined goals, areas of interest, and sources of influence; (2) identification available organizations and technical specialists within both countries with appropriate expertise; and (3) determination of actual agricultural losses caused by birds. His report provided the

framework for planning of a formal multi-year project to address the bird pest situation in these two countries: Integrated Management of Bird pests Common to the Plata River Basin (Foronda, 1996).

5.5. Ecotoxicological evaluation of bird pest control programs

Keith (1991) reported in both countries that very little monitoring of pesticide use occurs. Farmers using highly toxic pesticides have great potential for poisoning nontarget species and causing environmental contamination. Some persistent pesticides (endrin, carbofuran) being used to treat nests of Monk Parakeets might present serious hazards to nontarget animals that use empty parakeet nests or consume carcasses of dead parakeets. Other, less hazardous pesticides and the use of oil on eggs should be evaluated; the latter would kill embryos but allow incubation to continue, thus reducing the likelihood of renesting attempts by the adults.

Keith considered any proposed government plans to spray pigeon and dove roosts in native woodlands would be unacceptable since these remnant riparian woodlands provided the major habitats for the rich terrestrial fauna present in both countries. Areas used for roosting and breeding are large (60–500 ha), doves are numerous (up to 3.5 million) and nest densities are high (4,000 nests ha; data from Bucher, 1985). Any use of poison baits for dove, pigeon, and blackbird control in maturing grain fields should be done selectively to avoid nontarget species mortality; use of repellents would clearly be preferable. Pest management has evolved toward techniques designed to control pests with a minimum of ecological disturbance to the areas they occupy. Widespread applications of avicides that kill other desirable forms of life lack the specificity that is expected and even demanded, in pest management today.

Note: Considerable new information is available on the technique of egg oiling. Please see Christens and Blokpoel (1991), Christens et al. (1995), Cummings et al. (1997), Pochop et al. (1998), and Pochop et al. (in press). Also, since 1996, an ecotoxicological program to monitor the use of pesticides in agroecosystems is underway in Argentina as a result of pesticide-related mortality of Swainson Hawks (Zaccagnini, pers. comm.).

5.6. Nonlethal control: chemosterilants

Feare (1991) noted that chemosterilants, used in integrated bird management programs to assist with immediate crop protection, should be considered in situations where juveniles are causing significant damage close to a breeding colony immediately after fledging. Reduction in the number of juveniles emanating from such colonies could thus reduce damage. But chemosterilization of the adults in these colonies would have to be undertaken as an insurance before damage commenced, and the practice would not influence any damage that the adults might do. Because of these concerns and the characteristics of currently available chemosterilants, as well as the characteristics of target bird species (doves, pigeons, and parakeets), he felt the method was not appropriate. In his view, bird research should address dietary habits and bait evaluations and overall control strategies should be directed at immediate protection of crops from damage, giving priority to those fields in which past experience predicted the greatest risk of damage. Secondary concern should be given to distributing damage more evenly among fields through synchronized crop plantings.

Feare recommended: (1) evaluating alternative toxicants and formulations to replace the highly toxic, hazardous chemicals presently in use; (2) developing better knowledge of bird biology and crop phenology; (3) experimenting with highly vulnerable (decoy or lure) crops at experiment stations, allowing weeds to develop, using repellents, and introducing resistant plant cultivars; (4) using the technique of radiotelemetry to better understand movements of bird pests; (5) conducting dietary studies to develop baits; (6) carrying out studies to determine the impact of bird pests on oilseed rape; and (7) developing basic information on the biology and behavior of the Picazuro and Spot-winged Pigeons.

Note: Considerable research has recently been conducted in wildlife contraception. For a general overview, please see Kreeger (1997), and for specific studies related to birds, please see Locombe et al. (1986) and Locombe et al. (1990) and Yoder (1996).

5.7. Project administration

Schulten (1991) recommended that all current research should focus on improving current chemical control strategies. He specifically felt research should focus on (1) Monk Parakeets relative to alternative toxicants; (2) dove control using poisoned-bait strategies; (3) repellents in large-scale trials; and (4) registration of pesticides for bird control. Schulten further recommended that extension efforts be directed toward binational activities and preparation of extension leaflets to increase public information and awareness of the bird problems and environmental concerns.

5.8. Repellents: training and research

An important component of this project development plan was implementation of a training workshop. Bullard (1991b) in his second consultancy, participated in a "Binational Training Course on Integrated Control Methods for Pest Birds" with a number of Argentinian and Uruguayan scientists and instructors from a variety of centers and institutions during September 1991 in Salto, Uruguay. Twenty-eight participants attended this course, 14

from each country, including extension specialists, representatives from agricultural cooperatives, university faculty, and technicians. Topics covered nonlethal methods of bird damage control, bird repellents, general ecotoxicological concepts, ecotoxicology applications, and the environmental implications of pesticide residues and general aspects of their measurement. Areas stressed during this workshop included: (1) an introduction to bird pests and their management; (2) principal bird pest problems in agriculture; (3) methods to evaluate losses; (4) methods to manage habitat to reduce losses; and (5) a round table discussion on perspectives of managing doves and parakeets in the project area.

Bullard further outlined five project needs: (1) alternative lethal chemicals, such as CPT and CPTH in amorphous silicon gels and vegetable oils, for Monk Parakeet control; (2) field and aviary studies of methiocarb seed treatments to protect sprouting sunflowers from pigeons; (3) field evaluations of CPTH toxic baits for Eared Dove control; (4) establishment of research aviaries in both countries; and (5) development of the capability to conduct cholinesterase assays in both countries for tissue and blood residue studies.

5.9. Bird pests of argentina and uruguay: population dynamics

Bucher, in his 1991 and 1992 consultancies suggested that: (1) reconsideration of the criteria in Argentina and Uruguay for permanently declaring a species a pest was needed; (2) implementation of an adequate mechanism of coordination and interaction within government plant protection organizations was needed to develop more uniform provincial criteria for managing bird pests in the region; (3) investigations were needed to improve farming practices and crop harvest technology to reduce losses and waste at harvest; (4) evaluations of the impact of other species such as ducks and blackbirds, which cause damage in rice, needed to be addressed in future binational management programs; and (5) investigations should continue into the biology of the pest species of the region

5.10. Statistical surveys for evaluating the impacts of bird damage to crops

Otis (1991) recommended that crop losses due to birds be surveyed in the entire binational area. Such a survey would provide objective, statistically reliable data on which to base assessment of current bird management practices and governmental policies and information critical to the planning of a long-term project for development of integrated bird control strategies. He suggested two different survey methods, a farmer interview/field assessment design and a two-stage cluster design, in which farmers are both interviewed and their fields surveyed for damage. He suggested that barley and sunflower fields be assessed in Uruguay and sprouting and mature sunflower fields in Entre Ríos.

5.11. Integrated management of agricultural systems

Bouglé (1991) recommended that reduction of damage be approached in integrated pest management programs to achieve tolerable levels. He suggested: (1) developing bird resistant crops; (2) shortening the time of seeding to reduce the period of susceptibility; (3) synchronizing seeding times among farmers in a region; (4) reducing harvesting losses; and (5) convincing farmers that improving agricultural practices would reduce both bird losses and increase crop production. In addition, Bouglé stressed the need to identify appropriate toxicants; conduct field trials; evaluate cost and benefits of various control methods including lure crops; investigate factors that permit damage to occur; learn more about the biology, behavior, and food habits of the pest species; and ultimately involve field extension specialists in project activities.

5.12. Biological control habitat management

Clark (1991) reviewed a number of habitat management options. He determined that attempts to reduce crop damage by eliminating riparian and gulley forest habitats along rivers and the xeric woodland and montane chaparral in which doves breed and roost would not only fail but would have severe negative impacts upon other wildlife and the environment. Further, modification of nesting habitats to reduce Monk Parakeet numbers would be ineffective and uneconomical, and ultimately would erode the quality and quantity of woodland habitats. He viewed parakeet control at nest sites as the most cost-effective, short-term remedy; but indicated that as cropping and harvest practices changed in the region, the need to control parakeets should be reviewed frequently, lest the practice continue as a tradition rather than a justifiable action. He further viewed attempts to modify nesting and roosting sites of the two pigeon species as futile.

Clark also called attention to the beneficial and recreational aspects of foraging doves, pigeons, blackbirds, and ducks, such as removal of noxious weed seeds and waste grains. He considered estimates of numbers and information on the distribution of the bird species and damage as urgently needed and critical to the design of an integrated bird management program. Other suggested studies included: (1) determining features of fields that attract bird pests, including crop types, phenology, field characteristics and surrounding landscape features on the distribution and abundance of doves, blackbirds, and ducks; (2) marking doves, blackbirds, and ducks to determine movements of individuals and turnover of birds

within fields; (3) measuring rates of grain depletion in fields in relation to flock size or daily individual grain demands; and (4) testing the effectiveness of alternate 'lure' crops to attract and maintain flocks of birds.

5.13. Mass-marking and radiotelemetry techniques

Bruggers (1991) discussed the usefulness of mass-marking and radiotelemetry in research on Eared Doves and Monk Parakeets. Both techniques would seem to be useful to study foraging behavior relative to damage patterns, roost interchange relative to developing a baiting strategy, and nontarget, particularly raptors, and environmental impacts relative to improving control methods. These kinds of studies require considerable logistical input, need to have clearly defined hypotheses to achieve maximum results, and must be developed within the context of a long-term, applied research project.

Doves are considered both an agricultural pest and a unique resource, particularly in terms of their international appeal to hunters and the resulting income they generate to hunting guides and the landowners on whose estates they roost. Parakeets also seem to be appreciated in situations in which they do not cause damage. A need exists to better understand many of the complexities of these and of other birds considered pests, primarily through applied, problem-oriented research. Areas of emphasis should include: (1) defining, in more detail, the impact of doves and parakeets on agriculture; (2) clarifying the circumstances under which the various species of concern actually are pests; (3) determining the usefulness of control; and (4) developing economical control techniques and strategies that, when necessary, can be used with little or no adverse impact to nontarget wildlife and the environment. Marking techniques available for birds should be able to help provide some of the data necessary to clarify these various situations.

6. Summary of recommendations

Of the numerous recommendations made by the consultants, two areas were most frequently stressed: the need for (1) obtaining bird pest damage assessment data from the several crops being attacked by birds; and (2) developing alternative approaches to toxicants or, at the least, more effective, environmentally sound chemicals and application methods for their use. Surveys of crop losses could be conducted in major crop areas either within the entire binational region (southwestern Uruguay and provinces of Entre Rios, Santa Fé, Córdoba, and Buenos Aires in Argentina) or solely in the area of the proposed two study sites. This data would be important to designing and planning an integrated bird pest management program. However, accurately assessing bird damage is difficult and time-consuming; therefore, it should be carefully planned around existing personnel and logistical concerns.

Other important recommendations of the various consultants included: (1) conducting short and long-term research on the biology and ecology of the bird pests within the binational agroecosystem; (2) obtaining data on crop phenology and timing of bird damage; (3) investigating the development of sport hunting for doves as both a source of income and food for livestock and perhaps, human consumption; and (4) evaluating alternative and or improved toxicant and bait delivery systems in crop fields to reduce bird damage. In particular, it was felt that research on Monk Parakeets should concentrate on finding an appropriate alternative toxicant and dosage rate that is cost-effective and environmentally acceptable, and research on doves and pigeons should concentrate on developing an appropriate toxicant and improving the currently used poison-baiting strategy. In addition, the general need to establish a capability for pesticide residue analysis for ecotoxicological studies was stressed.

Many important concerns need to be considered when planning problem-oriented, applied bird pest management projects. Addressing these research needs adequately for each of the main pest species, in this or any other similar planning project process, requires considerable time, personnel, funding, and effective cooperation. While many consultants recommended short-term, applied research to improve present control programs, particularly, finding better chemicals to use either as toxicants in nests for parakeets or baits in fields for doves and pigeons, we suggest this short-term strategy be thoroughly assessed before being implemented and that research emphasis should shift from toxicants and their delivery systems to alternative nonlethal approaches to reduce damage by bird pests. The protection of crops from bird damage, rather than the killing of birds, should be the main objective in developing an integrated approach to bird pest management.

As in all applied vertebrate pest projects, consideration should be given to whether a particular species is truly an economic pest for which losses need to be reduced and, if so, whether chemicals, particularly toxicants, are the correct approach, considering their obvious potential adverse impact on the environment and nontarget species, particularly in countries with diverse and magnificent wildlife populations. All studies need to be clearly defined, organized in a problem-solving fashion, and integrated into an overall approach that must be carefully planned before being implemented.

7. Conclusions

International project development planning in wildlife damage management generally has been conducted with

only a few individuals with general expertise in this specialized area. Sometimes other methods have been used, including the: (1) formation of a larger team of specialists with a variety of expertise to visit countries simultaneously and/or (2) use of resident, host country specialists in this area, a situation that can provide considerably more overall insight into the actual situation but perhaps a corresponding decrease in the breadth of expertise.

The project planning process used to develop this binational Project Document included aspects of both of these options and was successful in many ways. Host country National Project Coordinators were involved in all aspects of planning, implementing, and reporting the outcome of all activities. Information and ideas were obtained on a wide variety of technical and administrative topics necessary for future project planning. A wide range of potential, in-country stakeholders and user groups was sought for advice and input, and some preliminary laboratory and field investigations, training, and equipment procurement was undertaken as a part of many consultancies.

However, the approach did present some concerns. The large number of consultants and the broad terms of reference (involving both a variety of administrative and technical activities) in a short time period created logistic and administrative problems around travel to critical sites and meetings with appropriate individuals. While the initial phase of consultant activity around planning an eventual project occurred only during nine months, it took an additional four years to complete the summary technical report and prepare Project Document proposal needed to seek funding support. In addition, the short and intensive period of initial consultancies resulted in materials not being available on schedule for implementing project-related field research activities, demonstrations, or training. It proved equally difficult to schedule consultants in the most logical chronological sequence. The approach also basically took the National Project Coordinators away from their jobs within their respective governments for nearly two years. Nonetheless, the approach did provide for some of the best expertise available to assess and provide recommendations on a variety of specific technical and administrative approaches for consideration in planning a long-term, applied integrated bird pest management project. The sustained funding and interest by FAO, as well as the governments of Argentina and Uruguay, made this approach possible.

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