

impregnated with salt at livestock licks and possibly taking salt from saturated ground at licks.

Present Sources of Mortality

The rapid development (urbanization and industrialization) of Cidra and the surrounding areas is the most serious threat to the species' existence in Puerto Rico. Essential habitat (Fig. 4) may presently be at a minimum level and further alteration and increasing proximity of human activity to this habitat will further reduce plain pigeon essential habitat and intensify human-pigeon interactions. A housing project caused the extirpation of a breeding group of plain pigeons from an adjacent hardwood canyon in 1975. Future development plans for Cidra include significant alteration of plain pigeon essential habitat and adjacent land.

During investigations at Cidra between December 1973 and September 1975 Wiley found nest failures were primarily due to human-caused disturbances (Table 3). The majority of "undetermined causes" of nest failures (accounting for 31 percent of the total) were probably related to human disturbances as well. The plain pigeon population at Cidra is interspersed between villages and urban areas. Plain pigeons have literally nested in the backyards of new homes. Disturbances to breeding birds by people moving through and around nesting areas, molesting nesting birds, and stealing squabs from nests accounted for most of the failures during 1974 and 1975. Plain pigeon nests were destroyed by children

whenever the nests were encountered, probably out of curiosity or for malicious purposes rather than for need of food. Other sources of nest failure (i.e., rats and pearly-eyed thrasher) apparently are not major problems. Rat predation is probably a secondary effect of human disturbance (e.g., rats may destroy the egg or chick after the adult has been flushed from the nest), at least in some cases.

Potential sources of predation are the red-tailed hawk (Buteo jamaicensis) and escaped squirrel monkeys (Saimiri sciureus).

Several squirrel monkeys have been sighted in the plain pigeon nesting areas at Cidra. The monkey is known to prey upon bird eggs and nestlings.

Table 3. Sources of reproductive losses of the Puerto Rican plain pigeon at Lago de Cidra, 1974-1975.

Stage when nest failure occurred	Source of nest failure (n = 48)			
	Human	Rat	Thrasher	Undetermined
Nest building	2			3
Incubation	11	2	1	9
Young squabs	2	2		3
Older squabs	12	1		
Total N	27	5	1	15
Percent	(56.3%)	(10.4%)	(2.1%)	(31.3%)

Red-tailed hawks are predators of the adults and chicks of the red-necked pigeon (Columba squamosa) and white-crowned pigeon, both of which are similar in size to the plain pigeon. Red-tailed hawks have been seen attacking plain pigeons although no successful captures have been reported. Red-tailed hawks are common nesting raptors at Cidra and surrounding areas.

One case of parasitization by the warble fly (Philornis [=Neomusca] pici) has been reported (Perez Rivera and Collazo 1976a). A nestling was infected with 12 warble fly larvae and died apparently from the parasites. Of more than 95 nestlings examined by Wiley none were infected with warble fly larvae.

Severe storms and hurricanes are potential threats to the plain pigeon population at Cidra-Cayey. Clark (1905) suggested losses of other birds due to starvation after hurricanes have stripped food trees clean of fruit and seeds. A hurricane could destroy essential habitat as well as kill adult pigeons. Birds roosting and nesting in the bamboo groves would be particularly susceptible to damage from a severe wind storm. Such a storm could reduce the population to a level where the birds could not recover. Approximately 1.5 hurricanes/year have been recorded for the Caribbean area surrounding Puerto Rico (Mariner's Worldwide Climatic Guide to Storms at Sea) which emphasizes the risk of maintaining only one local population of the pigeon.

Despite a Commonwealth regulation (1967) closing the municipality of Cidra to hunting, plain pigeons are still being shot. Wiley and N. Snyder encountered hunters at Cidra, and Wiley found spent shotgun shells at roosts and nesting areas, and remains of shot plain pigeons within nesting areas. The surrounding municipalities of Cayey and Caguas are open to hunting of other columbid species.

Plain pigeons from the main Cidra population have been observed flying into the adjacent municipalities and there have been recent records of plain pigeons nesting in Cayey (Perez Rivera and Collazo 1976b; Wiley, unpubl. data). Wiley interviewed a hunter who had killed a plain pigeon near Caguas. The plain pigeon is similar in size and shape to the legally-hunted red-necked pigeon and probably many are shot by mistake. Even experienced biologists studying both species have difficulty distinguishing between the two under field conditions.

Nest Success and Productivity

Thirty-nine percent of the 78 nests watched from egg-laying through fledging or termination (loss) during 1974 ($n = 28$) and 1975 ($n = 50$) were successful. Clutch size for all nests examined ($n = 82$; some nests were not watched beyond egg-laying) was one egg. The mean number of chicks hatched per nest was 0.7. The mean number of fledglings produced per nest was 0.4 (Table 4).

Theoretically, elimination of human disturbances during 1974 and 1975 could have resulted in an increase of nest success to about 70 percent provided all other sources of failure remained the same. In large measure multibrooding of the species makes up for its low productivity per nesting attempt, and it has demonstrated an ability to increase in numbers fairly rapidly in some recent years (Fig. 2).

Table 4. Plain pigeon productivity at Lago de Cidra, Puerto Rico, 1974-75.

Year	Clutch size		Chicks per nest		Fledglings per nest	
	# eggs	# nests	# chicks	# nests	# fledged	# nests
1974	<u>a/</u> 0	1	<u>b/</u> 0	10	<u>c/</u> 0	21
	1	31	1	22	1	11
1975	0	4	0	19	0	28
	1	46	1	31	1	22
Both years	0	5	0	29	0	49
	1	77	1	53	1	33

Mean clutch = 1.0

Mean # chicks = 0.7

Mean # fledged = 0.4

a/
Nests deserted prior to egg-laying.

b/
Nests lost between egg-laying and hatching.

c/
Nests failed between hatching and fledging.

PART II. RECOVERY

A. Recovery Objective

Achieve a minimum of two, distinct, wild Puerto Rican plain pigeon populations, each consisting of at least 250 nesting pairs (5-year average). Secure most of the existing pigeon habitat of the Cidra-Cayey population. Commit the Commonwealth Rio Abajo Forest or its equivalent as a reintroduction and management site for a second, disjunct population of the pigeon. When these objectives are accomplished, the plain pigeon could be considered for delisting.

B. Step-down Outline

1. Increase wild population at Cidra and surrounding areas to a self-sustaining level of 250 nesting pairs and maintain the population at that level.
11. Increase net recruitment of Cidra plain pigeon population until population reaches target level.
 111. Protect and manage essential habitat at Cidra and surrounding areas within range of plain pigeon population.
 1111. Zone essential habitat as sanctuaries for maximum protection of the plain pigeon from human disturbance.
 11111. Zone essential nesting habitat (R-0 with special restrictions).
 11112. Zone essential roosting habitat (R-0 with special restrictions).
 11113. Zone essential feeding and watering habitat (R-0 with special restrictions).
 1112. Establish buffer zones of low human use surrounding essential habitat sanctuaries.

- 1113. Establish and maintain "no hunting" areas to protect the plain pigeon.
 - 11131. Maintain no hunting at Cidra
 - 11132. Establish and maintain a no hunting buffer zone to include portions of surrounding municipalities of Cayey, Caguas, Aguas Buenas, and Comerio.
- 1114. Consider essential habitat for designation as "Critical Habitat" as defined under Endangered Species Act.
- 1115. Secure through actual acquisition, easements, long-term leases or other methods lands essential to the plain pigeon at Cidra-Cayey.
- 1116. Manage habitat for optimal nesting, roosting, feeding and watering sites for plain pigeon.
- 112. Minimize non-reproductive mortality.
 - 1121. Minimize illegal hunting at Cidra.
 - 11211. Establish Department of Natural Resources game agent position at Cidra.
 - 11212. Establish federal game agent position in Puerto Rico with duties to cover endangered species enforcement, including the plain pigeon at Cidra.
 - 11213. Regular patrols of Cidra by enforcement personnel.
 - 11214. Education program in Cidra area.
 - 1122. Minimize predation from other sources.

- 11221. Evaluate predation potential of red-tailed hawk and manage if found to be significant source of pigeon loss.
 - 11222. Evaluate other possible sources of non-human predation and control.
113. Maximize reproduction of Cidra population.
- 1131. Minimize human activity in plain pigeon nesting areas.
 - 11311. Regular patrols for vigilance of plain pigeon nesting areas.
 - 11312. Education campaign.
 - 11313. Physical barriers around plain pigeon nesting areas (to keep livestock out) and posting against human entry.
 - 1132. Minimize reproductive losses to rats.
 - 11321. Evaluate rat threat.
 - 11322. Control rats in areas where these procedures do not pose a danger to livestock, pets or humans, using rodenticides placed in sites inaccessible to the pigeon.
 - 11323. Evaluate effects of control program.
 - 1133. Minimize reproductive losses caused by monkeys.
 - 11331. Determine if monkeys are present and the degree of threat caused by monkey predation.
 - 11332. Monitor pigeon nesting areas for monkey presence and develop management plans.
 - 11333. Remove monkeys if it is determined that they are a threat.

- 1134. Minimize reproductive losses to other potential predators, competitors, and parasites.
 - 11341. Evaluate red-tailed hawk as plain pigeon nest predator and minimize losses caused by this raptor.
 - 11342. Evaluate warble fly as a parasite of plain pigeon and determine methods of control if found to be a serious parasite.
 - 11343. Evaluate red-necked pigeon as a competitor of the plain pigeon and develop management plans.
- 12. Once target population is reached maintain population at this level by maintaining habitat quality and quantity, and by controlling enemies.
- 13. If wild population is decimated by predation, disease or natural catastrophe, re-establish population at Cidra with captive-bred stock as in 22, 23, 24.
- 2. Establish at least one new population of Puerto Rican plain pigeons within the historical range of the subspecies.
 - 21. Evaluate and secure adequate site(s) for release.
 - 211. Determine potential sites for re-introduction through literature search and site inspections.
 - 212. Determine secure sites where adequate protection can be maintained against disturbance and losses from humans.
 - 213. Evaluate habitats for availability of food species, nesting sites, roosting areas, and potential enemies.
 - 214. Choose most suitable release site(s) and arrange for use, zoning and vigilance of site(s) by cooperative agreement with Commonwealth and landowner(s).

22. Establish captive reproducing flock of Puerto Rican plain pigeons.
 221. Establish research aviary at the Puerto Rico Zoological Gardens, or other suitable facility within the Commonwealth.
 222. Develop techniques of captive propagation.
 2221. Secure captive stock from Cidra area as nestlings.
 2222. Maintain flock in good health.
 2223. Provide conditions to produce captive progeny suitable for release at selected site(s).
 22231. Maintain wariness of man.
 22232. Maintain wariness of other predators.
 2224. Experiment with techniques to produce maximum captive productivity of birds suitable for re-introduction.
 2225. Secure additional captive stock from Cidra area as needed.
23. Establish functional aviary at re-introduction site(s).
 231. Construct and maintain propagation facilities.
 232. Once optimal propagation techniques are developed, transfer and maintain breeding stock to re-introduction site aviary.
 233. Produce pigeons suitable for release in wild.
24. Implement release program until target population is reached.
 241. Prepare site(s) for release of birds.
 2411. Protect birds through hunting regulations.
 2412. Publicity
 2413. Construct and maintain aviary facility at release site(s) if separate from propagation facility. Release aviary established at site

suitable for releases and with guard to protect and maintain release flock.

- 2414. Condition birds for release.
- 242. Experiment with release methods until optimal technique is found.
 - 2421. Use of red-necked pigeons in experimental releases.
 - 24211. Captive-produced plain pigeons raised using same techniques as for red-necked pigeons.
 - 24212. Initial conditioning and release experiments using red-necked pigeons.
 - 2422. Experimental releases of captive-bred plain pigeons on limited scale.
 - 2423. Monitor experimental release success through visual and telemetric methods.
- 243. Conduct release of captives until target population is reached.
- 25. Determine feasibility of relocating birds from Cidra stock to new site(s).
- 26. Maintain population at target level by maintaining habitat quality and quantity, and maintaining predator control.
- 3. Monitor plain pigeon population levels and range.
 - 31. Establish a system of census stations and lookouts in known range and release site(s) for plain pigeon.
 - 32. Conduct regular simultaneous counts from census stations.

C. Narrative

1. Increase Cidra-centered wild Puerto Rican plain pigeon population.
11. Increase net recruitment of Cidra-centered plain pigeon population until population reaches target level of 250 nesting pairs. Recruitment would be enhanced by protection of free-flying pigeons from hunting and non-human sources of loss and by improving the reproductive success of the pigeon. Presently human disturbance to nesting birds is the major factor in preventing normal population growth.
111. Protect and manage plain pigeon essential habitat at Cidra and surrounding areas. Most of the existing habitat (approximately 890 ha or 2,200 acres of essential habitat plus an additional 1,080 ha or 2,660 acres as buffer habitat) will need to be secured to preserve the Cidra-centered population.
1111. (includes 11111, 11112, 11113) Zoning. Essential roosting, nesting, feeding, and watering habitats have been determined at Cidra and Cayey (Fig. 5). A small portion of the habitat near Cidra has been zoned "R-0" (low-use special area) by the Puerto Rico Planning Board. All of these areas need to be set aside as sanctuaries and zoned as low-use special areas to restrict human activities that would disrupt pigeon use of the essential areas. Although the Commonwealth "Zona R-0 Especial" does provide some of these restrictions; i.e., low density housing (minimum lots of 8,000 m²), with special provisions available for preservation of flora or fauna of economic, ecological, or scientific importance (Estado Libre Asociado de Puerto Rico, Reglamento de Zonificacion, 1978), additional zoning conditions should be declared for protection of the most important pigeon areas (Absolute Sanctuaries). However, zoning is not a secure long-term measure for protection and maintenance of the pigeon's habitat, particularly in the Cidra area with its rapid land development. As human population needs for industrial and urban lands increase, zoning ordinances can be expected to change under pressure for development.

1112. Buffer zone. A "buffer zone" of at least 0.2 km (0.125 mi) should be established around all essential habitat where possible to lessen the effect of human activity in land surrounding the pigeon sanctuaries. Residential lots on these buffer zones would be restricted to a minimum of 4,050 m² (1 acre), with one house permitted per lot.

1113. (includes 11131, 11132) No hunting areas. In 1967 Puerto Rican hunting regulations were amended to specifically close the municipality of Cidra to all hunting to protect the plain pigeon (11131). In 1978 additional areas surrounding the municipality of Cidra were closed to hunting (Fig. 4) to protect the plain pigeons in those areas (11132).

1114. "Critical Habitat". This designation has not been made for essential habitat for the Cidra-centered plain pigeon population. Pigeon habitat should be evaluated for designation as "Critical Habitat" as defined in Section 3 of the Endangered Species Act. Declaring these areas as Critical Habitat would restrict some forms of development. In cases of Federal involvement it would provide for detailed evaluations of the impact of proposed land use changes on the pigeon population.

1115. Secure lands essential to the Cidra-centered plain pigeon population. Plain pigeon essential habitat acquisition for sanctuaries is vital to the survival of the Cidra population. Zoning and designation of Critical Habitat will not long preserve habitat with projected land-use concomitant with the rapidly growing human population. Therefore, habitat essential to the pigeon's survival (and its population growth) should be acquired by the U.S. Fish and Wildlife Service and designated as a special wildlife refuge for the purpose of managing the plain pigeon. Several acquisition options are available, including long-term or perpetual easements and fee-simple acquisition. Long-term easements (e.g., 15 or 25 years) would be established to eliminate private and commercial land use conflicts with habitat preservation for the plain pigeon. This would probably result in a temporary economic loss to

the area as no industrial, urban, or agricultural development would be allowed in the protected areas, although the municipalities would realize some profits from the FWS purchase of the easements. Some of the areas for inclusion in such easements are already excluded from development (e.g., lake frontage) or are areas of relatively little value as crop and pasture-lands (e.g., ravines). However, buffer areas around the critical pigeon areas will probably take good-sized swaths of land of potentially greater economic value. Easements of 15 to 25 years duration would provide protection crucial to the survival of the small population of plain pigeons at least until a second population of the species can be established elsewhere. Once the pigeon is secure at other sites and/or it is no longer feasible to continue protection of Cidra's pigeon population, natural areas held as sanctuaries could be opened up for recreation. The 15 year easement option probably would not be long enough to provide time for the establishment of healthy, self-sustaining plain pigeon populations in other parts of Puerto Rico. A 25 year easement should provide time enough for the establishment of new populations and would be the preferred option.

Perpetual easement and fee-simple acquisition would be the best among the options for preserving plain pigeon habitat indefinitely at Cidra and Cayey and, with no time restrictions, would provide maximum opportunity for establishing additional populations of plain pigeons at other locations on the island. These acquisition options would also provide optimal preservation of some natural areas and their wildlife and insure a certain degree of water quality and quantity for Cidra and other parts of Puerto Rico. However, perpetual easement or outright purchase of lands as pigeon sanctuaries would be the most detrimental of all legal options to social and economic growth in Cidra and Cayey; i.e., the land would not be available for future development for industry, housing, agriculture, or recreation.

In summary, while perpetual easements and fee-simple acquisitions are probably the best options for preserving habitat critical to the survival of the pigeon at Cidra-Cayey, a long-term (25 year) easement option may be the best all-around plan to maintain the plain pigeon populations until the species can be re-established in sites with better potential for sustaining healthy pigeon populations in the future (i.e., larger Commonwealth forests).

1116. Manage habitat. Assure that adequate quality and quantity of food plants are available year-round. Maintain shelter and nesting groves of appropriate vegetation through plantings and selective maintenance. Water and salt lick areas should also be provided within the management areas.

112. Minimize non-reproductive mortality. Illegal hunting has, at times, been a critical factor in limiting pigeon population growth and may still be so.

1121. Enforcement patrols. Patrols of the municipality of Cidra by federal game agent R. Cotte have been conducted since 1974. However, as the federal agent is responsible for all of Puerto Rico, its island possessions and the U.S. Virgin Islands, he is not able to devote adequate time to the Cidra-Cayey plain pigeon population.

During September and October 1974 a special game agent from the regional U.S. Fish and Wildlife Service Law Enforcement Office in Atlanta was on temporary assignment in Puerto Rico. One of the agent's duties was to investigate problems reported for the Cidra plain pigeons.

Commonwealth Department of Natural Resources enforcement personnel have been shown plain pigeon essential habitat and informed of the problems facing the Cidra-centered population. However, until recently there were too few Commonwealth agents to cover all areas of jurisdiction on the island and no enforcement personnel had been assigned to the municipality of Cidra and surrounding areas. In 1977 the Department of Natural Resources enforcement staff was substantially increased and the plain pigeon areas have been patrolled more often.

11211. DNR Agent. Assigning a full-time Commonwealth Department of Natural Resources game agent to the municipality of Cidra and those portions of the surrounding municipalities where plain pigeons occur. The agent would reside within the municipality of Cidra and his primary responsibility would be protection of the Puerto Rican plain pigeon. His duties would include patrolling of the plain pigeon nesting, feeding roosting, and other use areas to reduce human and livestock disturbances to the birds and habitat. Additionally, the Cidra game agent would serve as an education officer and representative to the Department of Natural Resources' plain pigeon management policies (11214).

11212. Federal agent. A federal game agent should be assigned to Puerto Rico to cover endangered species enforcement, including the plain pigeon at Cidra, the Puerto Rican parrot at Luquillo Forest, and the yellow-shouldered blackbird (Agelaius xanthomus) in coastal areas. The agent would work closely with the Commonwealth agent in enforcement and education.

11213. Conduct regular patrols of Cidra area.

11214. Education. In 1974 and 1975 the Department of Natural Resources, in conjunction with land-use and pigeon occurrence interviews, distributed illustrated pamphlets and posters on the plain pigeon at Cidra and surrounding areas. The educational material described the biological and legal status of the plain pigeon.

A further program of education is needed for the Puerto Rican plain pigeon. The program would focus on residents within the pigeon's range and would include an explanation of the pigeon's legal status, reasons for endangerment, and rationale behind the conservation efforts being implemented. The public would be reached through the local media (e.g., newspapers, television, radio) and by talks given to schools, civic and interest groups. An education program should also be initiated in those areas where additional pigeon populations are to be re-established (2412).

1122. (includes 11221, 11222) Minimize predation. Predation from red-tailed hawks and other sources should be evaluated and management plans developed if situations warrant. All control efforts should be closely monitored to determine their effect on pigeon populations and also on other wildlife in the area.

113. (includes 1131, 11311, 11312, 11313) Maximize productivity for Cidra pigeon population. Most reproductive loss of the Cidra-centered plain pigeon population has been the result of man's activities. Disturbances such as trash dumping, picnicking, and children playing have been found to cause nest desertions, egg dumping, and temporary periods of adult absence during which time egg or chick predators have access to the nest contents. These disturbances can be reduced through regular patrolling of nesting areas (11311) to keep people from entering sensitive areas at critical times (i.e., nesting season), and through an education campaign (11312) to inform residents of the importance of not disturbing the pigeons during the breeding season. In addition, such physical barriers as fences should be placed around pigeon nesting areas (11313) to minimize disturbances (particularly livestock), and the areas posted to warn humans against entry.

1132. (includes 11321, 11322, 11323) Minimize reproductive losses to rats. Although rats are known plain pigeon egg and chick predators, readily destroying the contents of deserted or poorly attended nests, they are not a serious threat to well-attended nests. However, disturbances (e.g., person or livestock walking near pigeon nest) to the nesting adults will cause the birds to flush and remain off the nest for long periods. The threat of rat predation at nests should be evaluated in light of the current situation with the Cidra-centered pigeon population (i.e., high level of disturbance from humans and livestock) and projected degradation of the pigeon's habitat and numbers. If the rat is determined to be a significant source of nest loss, a control program should be instituted using rodenticides in areas where these agents would not pose a danger to livestock, pets, or humans. These agents should also be placed in sites not accessible to the pigeon (e.g., low on tree trunks). Any such control program should be monitored throughout and evaluated for effectiveness in improving pigeon productivity.

1133. (includes 11331, 11332, 11333) Minimize reproductive losses caused by monkeys. Squirrel monkeys are known bird egg and chick predators and may pose a threat to the plain pigeon at Cidra where several escaped pet monkeys have been sighted. There is a need to determine if there is a monkey population in pigeon habitats and to what degree it threatens the pigeons. If monkeys do pose a threat they should be removed using techniques that would not disturb the pigeon or other wildlife.

1134. (includes 11341, 11342, 11343) Minimize losses to other potential predators, competitors, and parasites. Other predators (e.g., red-tailed hawk), parasites (warble fly), and (possible) competitors (pearly-eyed thrasher, red-necked pigeon) should be evaluated as to their impact on the plain pigeon. If these species should prove to be of significant detriment to survival and population growth, a management plan should be developed to control the adverse factors. Any such control program would need close monitoring for its effect on the target species and the plain pigeon's reproductive response.

12. Maintain habitat quality and quantity. A management plan should be developed that incorporates the findings of the research discussed above in order to maintain the plain pigeon at the target population level.

13. Replenish decimated wild population with captives. If the Cidra-centered population is depleted to a substantial degree by predation, disease, or other causes prior to the time that additional, disjunct populations are self-sustaining, and the Cidra-Cayey habitat is still adequate for the species, release captive-produced birds to replenish population.

2. Establish new population(s) with captive-produced birds. In view of the tenuous status of the Cidra-centered plain pigeon population (i.e., less than 100 birds and projections of extensive habitat destruction) a program of captive breeding and release is imperative. The captive flock would also serve as a reserve stock in the event a sudden natural catastrophe (e.g., hurricane, disease)

were to wipe out the Cidra population. In the Dominican Republic the species has been successfully bred in captivity and the Puerto Rican subspecies will most likely adapt to captive situations as well.

By establishing one or more plain pigeon populations in sites outside of Cidra-Cayey some insurance would be gained against the elimination of the Puerto Rican subspecies from a severe storm or other natural catastrophe such as a local epizootic, or from excessive pressure from habitat disturbance at Cidra.

Initial reintroduction efforts will be concentrated at one site. A sizeable (more than 1,000 ha) tract of contiguous habitat for the second, disjunct population must be secured. The Commonwealth Rio Abajo Forest is perhaps the best of the options available as a release site. Other potential release sites include the Commonwealth forest of Cambalache, Guajataca, Toro Negro, and Susua. Rio Abajo Forest is in a limestone karst area similar in structure to forests used by plain pigeons in the Dominican Republic. The Puerto Rican plain pigeon formerly occurred in the northwest karst of Puerto Rico (Westmore 1922 Gundlach 1878).

During the nineteenth and early twentieth centuries these karst forests were cleared for agriculture. With the shift away from an agrarian economy and protection under the Commonwealth Forest System, the Rio Abajo area has reforested. The Forest has a low human density and presently there is relatively little disturbance to the region. Department of Natural Resources guards and management crews reside in the forest. The area is also being considered as a future release site for the endangered Puerto Rican parrot (Amazona vittata). A cooperative program of release site aviary use and monitoring of populations for both species could be achieved on a single release site, the coordination effort and dual-use aviary facilities for the parrot and pigeon being much more efficient than establishing separate facilities for each species. Funding for the aviary facility could possibly be covered by a federal grant-in-aid under the Pittman-Robinson Act.

21. (includes 211, 212, 213, 214) Evaluate and secure the site(s) for release. The release site(s) should be evaluated for security from human disturbance (212), shelter, nest sites, year-round availability of food, and freedom from natural enemies (213). The most favorable site(s) would be determined by its potential to harbor viable populations of plain pigeons. The chosen area(s) would be zoned against hunting and development (2411, 214), a pre-release education campaign begun (2412), and regular enforcement patrols established (214). Use of the land(s) would be arranged (214).

22. (includes 221) Establish a captive flock. An initial program of developing captive propagation techniques for the pigeon could be conducted at the Puerto Rico Zoological Gardens in Mayaguez or other suitable facility, with possible advisory assistance from the endangered species unit at the Patuxent Wildlife Research Center (221). Researchers at Patuxent have captive breeding experience that would be valuable in formulating an experimental breeding program and for dealing with problems which might arise during the course of conducting such a program.

222. (includes 2221, 2222, 2223, 22231, 22232, 2224, 2225) Develop captive propagation techniques. Puerto Rican plain pigeon captive stock would be taken as nestlings to minimize the impact on the Cidra/Cayey populations (2221). The initial breeding stock of 10 plain pigeons would be sexed (cloacally) at maturity and paired off into separate breeding cages. Further procurement of captive stock may be necessary to insure equal sex ratios among the captive flock (2225). Techniques to increase productivity (e.g., photoperiod stimulation, multiple clutching, foster parenting) would be developed (2224). Captive-produced pigeons would be conditioned to be suitable for release in the wild, i.e., efforts would be made to maintain wariness of man (imprinting avoidance) through minimal association with feeding, and wariness of other predators (such as red-tailed

hawk) by exposing birds to mock attacks by these animals prior to release (2223, 2224). Captive-produced offspring would be raised to independence of the parents and then transferred to the release site (231) where experiments on conditioning and release methods would be conducted (2422).

23. (includes 231, 232, 233) Establish a functional aviary at re-introduction site(s). Propagation facilities would be constructed (or converted from existing sites in the case of Rio Abajo) and maintained in condition conducive to pigeon health and reproduction at the release site(s) (231). The Department of Natural Resources has alternative plans for some of the proposed Rio Abajo aviary sites and existing buildings (e.g., lumber mill, research station) and use of the sites/facilities will need to be coordinated so that the results would meet the needs for the propagation program. The propagation facility needs to be isolated from human activities and excessive noise.

Once optimal propagation techniques are developed, the breeding stock would be transferred to the re-introduction site aviary (232). There, pigeons suitable for release into the wild would be produced (233) using guidelines developed from the captive breeding studies.

24. (includes 241, 2411, 2412, 2413, 2414) Implement a release program. Prior to releases, the site(s) would be prepared for the program (241), i.e., area closure to hunting if not already protected, publicity campaign to inform public of program (2412), construction and maintenance of an aviary facility at the release site(s) if that area is to be separate from the propagation facility (2413), and conditioning of birds for release (2414). If the location of the propagation facility is not optimal as a release site, an additional facility may be constructed at a site where the pigeons have the greatest chance of locating food, water, and shelter (2413).

242. (includes 2421, 24211, 24212) Surrogate research. Before releasing plain pigeons, preliminary techniques would be developed using the common red-necked pigeon, which is already resident in the Rio Abajo Forest (as well as other Commonwealth forests). The surrogate species would be raised in the same manner as the endangered plain pigeon flock (24211). Release methods would involve release site feeding with gradual reduction of pigeon dependence on the facilities (similar to the conditioning back to the wild, or "hacking back" procedures, used in some raptor releases) (24212).
- 2422-2423. Experimental releases of plain pigeons. Once suitable release techniques have been developed for the surrogate species, a limited release of captive-produced plain pigeons will be attempted. The released birds will be closely monitored for survival and movements through visual (color marked birds) and radio telemetry methods (2423).
243. Conduct releases. When suitable release techniques have been achieved, conduct releases of captives until the target population is reached. Survival and movements of released captive-produced birds will be closely monitored.
25. Translocation of birds from Cidra to new site(s). If habitat quality and quantity at Cidra-Cayey continues to decline despite efforts to preserve it, a feasibility study on the possibility of relocating wild birds from that area to the re-establishment sites should be made.
26. Population maintenance. Plain pigeon populations at the re-establishment sites should be maintained at the target level by maintaining habitat quality and quantity, and by maintaining predator control.
3. (includes 31, 32) Monitoring. A system of census stations within the range of the plain pigeon should be established for monitoring population levels (31). Once stations are established and suitable censusing methods developed, regular surveys of the populations should be conducted (32).

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PART III.

IMPLEMENTATION SCHEDULE

Priorities within this section (Column 4) have been assigned according to the following:

Priority 1 - Those actions absolutely necessary to prevent extinction of the species.

Priority 2 - Those actions necessary to maintain the species' current population status.

Priority 3 - All other actions necessary to provide for full recovery of the species.

IMPLEMENTATION SCHEDULE

Puerto Rican Plain Pigeon

General Category	Plan Task	Task Number	Priority	Task Duration	Responsible Agency			Estimated Fiscal Year Costs			Comments/Notes
					FMS Region	Program	Other	FY 83	FY 84	FY 85	
R 9	Evaluate red-tailed hawk predation potential	11221, 11341	3	3 yrs.	4		DNR*	1,000	1,000	1,000	
R 9	Evaluate other sources of non-human predation	11222	3	3 yrs.	4		DNR	500	500	500	
R 9	Evaluate rat threat	11321	2	3 yrs.	4		DNR	850	850	850	
R 9	Evaluate rat control	11323	2	3 yrs.	4		DNR	700	700	700	
R 9	Evaluate warble fly problem and develop controls	11342	3	3 yrs.	4		DNR	850	850	850	
R 10	Evaluate red-necked pigeon as competitor	11343	3	2 yrs	4		DNR	750	750		
I 13	Determine potential sites for reintroduction	211, 212	1	3 yrs.			DNR	100,000	100,000	100,000	Proposal under Pittman-Robinson Act being processed. Includes Task 213.
I 3	Evaluate habitats for suitability	213	1	3 yrs.	4		DNR				
R 7	Develop captive Propagation techniques	222	1	4 yrs.			DNR, Other				Ongoing at University of P.R.
R 13	Develop release methods	242	1	3 yrs.	4		DNR	2,350	2,350		
O 3	Critical Habitat evaluation	1114	3	1 yr.			DNR				
O 3	Zone Cidra/Cayey essential habitat as Sanctuaries	1111	1	1 yr.			DNR				
							* Puerto Rico Department of Natural Resources				

IMPLEMENTATION SCHEDULE

Puerto Rican Plain Pigeon

General Category	Plan Task	Task Number	Priority	Task Duration	Responsible Agency			Estimated Fiscal Year Costs			Comments/Notes
					FMS Region	Program	Other	FY 83	FY 84	FY 85	
O 3	Establish buffer zones	1112	1	1 yr.			DNR	Unknown	Unknown		
A1, A2	Secure essential habitat thru lease or easement	1115	1	3 yrs.	4		DNR	Unknown	Unknown		
O 4	Arrange for reestablishment site	214, 241	1	2 yrs.			DNR				
M 4	Manage red-tailed hawk	11221 11341	3	Cont.*			DNR	500	500	500	
M 4	Control other non-human predators	11222	3	Cont.	4		DNR	500	500	500	
M 4	Control rats	11322	2	Cont.	4		DNR	1,200	1,200	1,200	
M 4	Evaluate and control monkey problem	11331 11332	2	1 yr.	4		DNR				1982 evaluation revealed no monkeys; further action unlikely.
M 6	Control warble fly	11342	3	Cont.	4		DNR	1,000	1,000	1,000	
M 4	Manage red-necked pigeon	11343	3	Cont.	4		DNR	400	400	400	
M 7	Physical barriers and posting around nest sites	11313	1	3 yrs.			DNR				
M 3	Habitat maintenance	12, 25	1	Cont.			DNR				
M 7	Construct research aviary	221	1	1 yr.	4		Other				Ongoing at University of Puerto Rico
M 7	Constr. aviary Rio Abajo	23	1	2 yrs.	4		DNR	12,500	12,500		
M 7	Construct field aviary at release/conditioning site	2413	1	2 yrs.	4		DNR	5,000	5,000		

* continuing

IMPLEMENTATION SCHEDULE

Puerto Rican Plain Pigeon

General Category	Plan Task	Task Number	Priority	Task Duration	Responsible Agency		Estimated Fiscal Year Costs			Comments/Notes
					FWS Region	Other	FY 83	FY 84	FY 85	
03, 02	Establish and maintain no hunting at Cidra	1113	1	Cont.		DNR				
03, 02	Establish and maintain no hunting buffer zones	11132	1	Cont.		DNR				
0 4	Establish DNR game agent at Cidra	11211	1			DNR				
0 4	Establish Federal game agent in P. R.	11212	1		4					
0 2	Conduct regular patrols	11213 11311	1	Cont.	4	DNR				
0 2	Vigilance at re-establishment site	214	1	Cont.	4	DNR				
0 1	Education program	11214 11312	1	Cont.	4	DNR	6,600	6,600	6,600	
0 1	Re-establishment publicity	2412	2	3 yrs.	4	DNR	5,000	5,000	5,000	
M 1	Establish and maintain captive flock at PR Zoo	221	1	Cont.		DNR				
M 1	Maintain captive flock reintroduction site	232	1	Cont.	4	DNR	8,300	8,300	8,300	
M 2	Conduct releases	243	1	Cont.	4	DNR	1,160	1,160	1,160	
M 2	Contingency release of Cidra birds at new site	25	3	3 + yrs.	4	DNR	1,500	1,500	1,500	
I 1	Monitor Cidra/Cayey population	32	2	Cont.	4	DNR	400	400	400	
I 1	Monitor re-establishment effort	2423	1	Cont.	4	DNR	1,300	1,300	1,300	

GENERAL CATEGORIES FOR IMPLEMENTATION SCHEDULES *

Information Gathering - I or R (research)

1. Population status
2. Habitat status
3. Habitat requirements
4. Management techniques
5. Taxonomic studies
6. Demographic studies
7. Propagation
8. Migration
9. Predation
10. Competition
11. Disease
12. Environmental contaminant
13. Reintroduction
14. Other information

Management - M

1. Propagation
2. Reintroduction
3. Habitat maintenance and manipulation
4. Predator and competitor control
5. Depredation control
6. Disease control
7. Other management

Acquisition - A

1. Lease
2. Easement
3. Management agreement
4. Exchange
5. Withdrawal
6. Fee title
7. Other

Other - O

1. Information and education
2. Law enforcement
3. Regulations
4. Administration

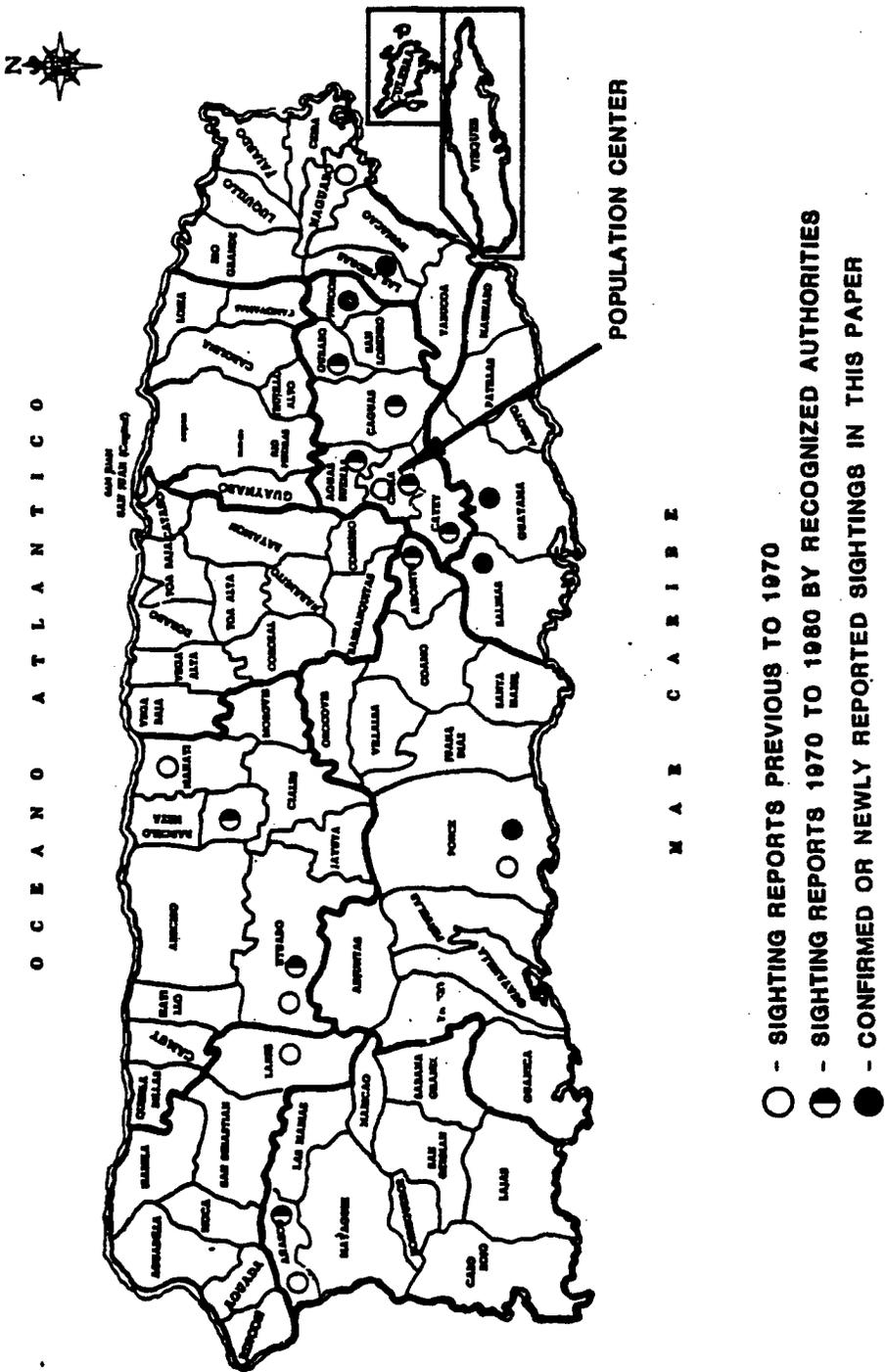
* (Column 1) - Primarily for use by the U.S. Fish and Wildlife Service.

APPENDIX

FIGURES

- Figure 1. Map of Puerto Rico showing location of the Cidra-Cayey plain pigeon population and other recent records from sightings and interviews.
- Figure 2. Results of 13 plain pigeon population censuses conducted at Lago de Cidra, Puerto Rico, January 1973 to January 1981.
- Figure 3. Breeding activity of the Puerto Rican plain pigeon at Lago de Cidra, January 1974 to September 1975.
- Figure 4. Additional areas surrounding the municipality of Cidra closed to hunting since 1978.
- Figure 5. Puerto Rican plain pigeon essential habitat at Cidra and surrounding areas.

Puerto Rico



(ADAPTED FROM PEREZ-RIVERA, 1981)

FIGURE 1

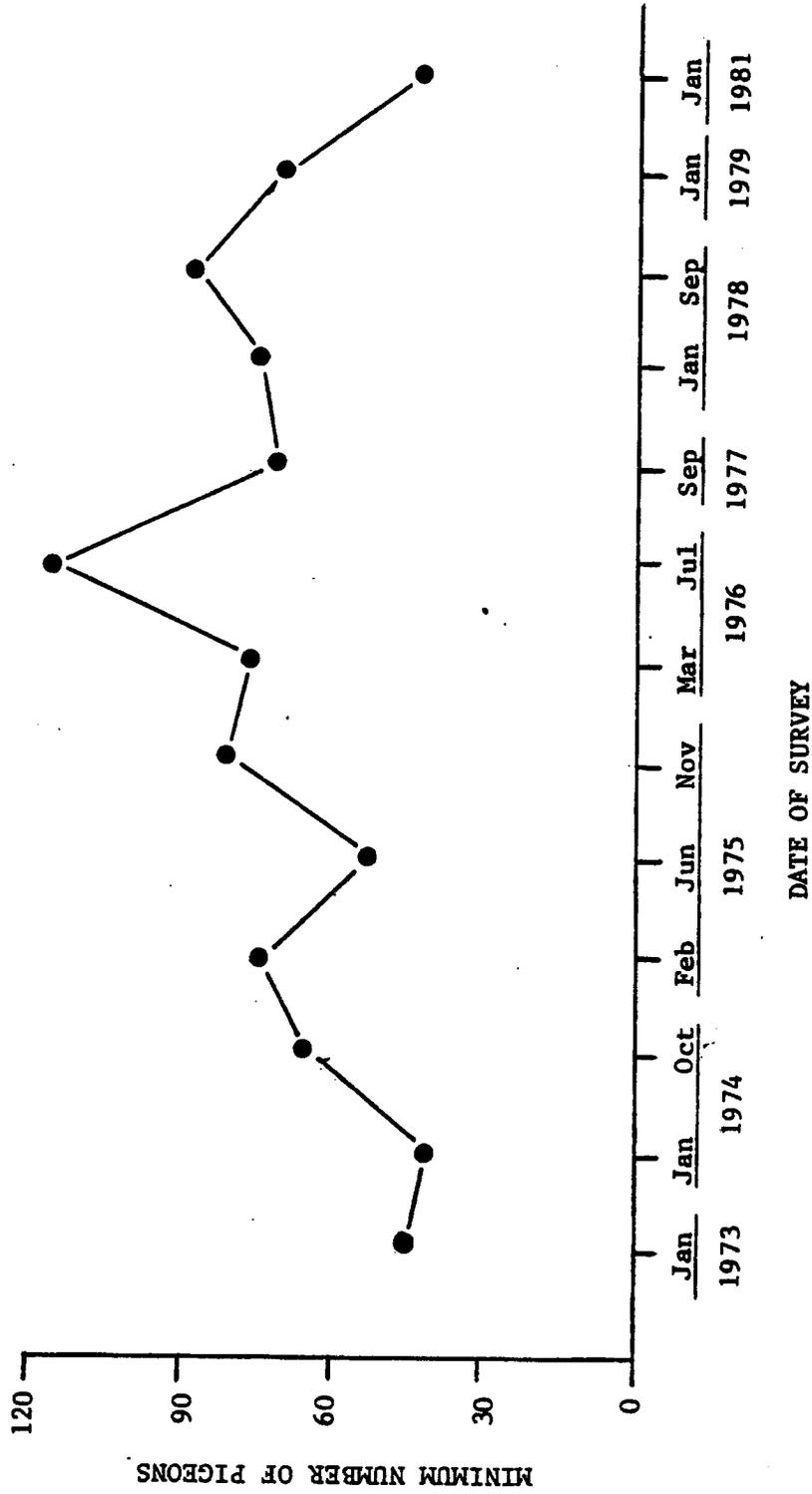


FIGURE 2

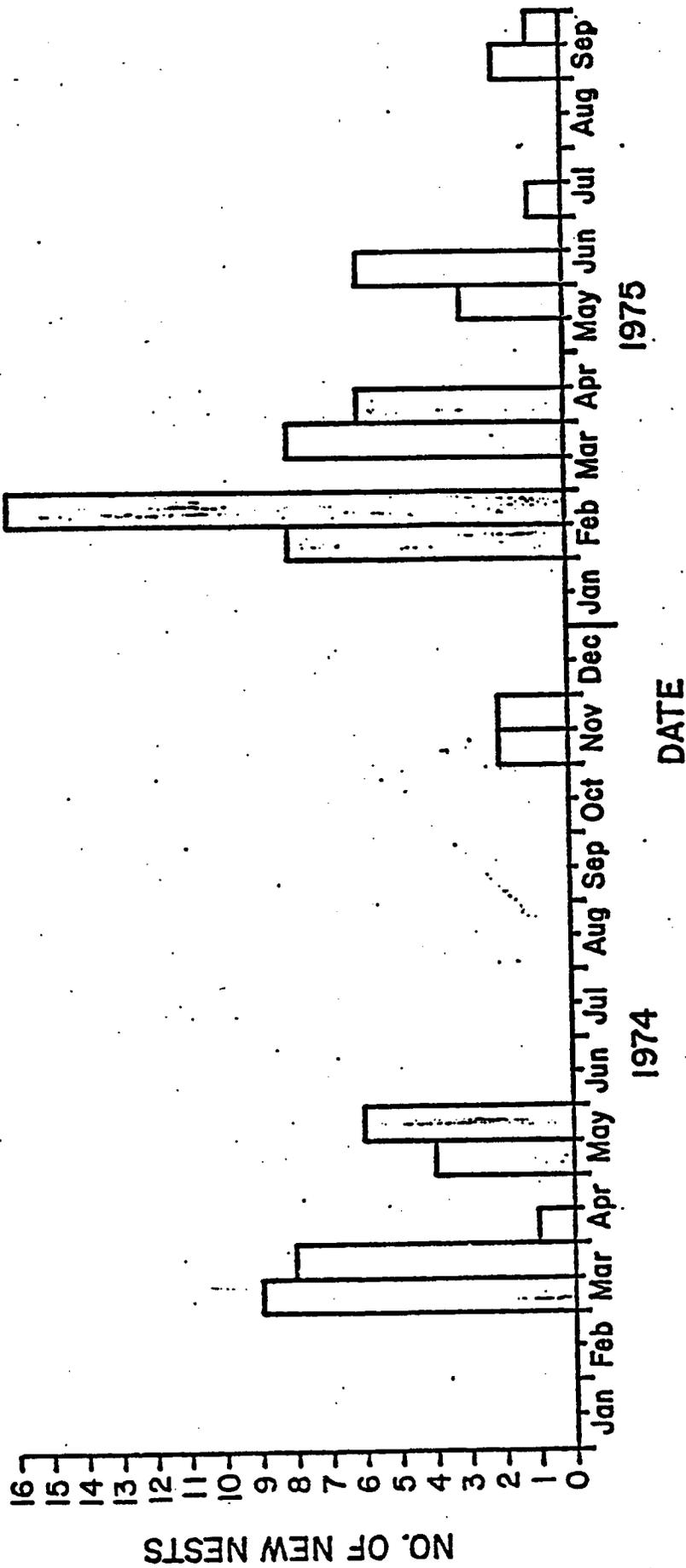


FIGURE 3

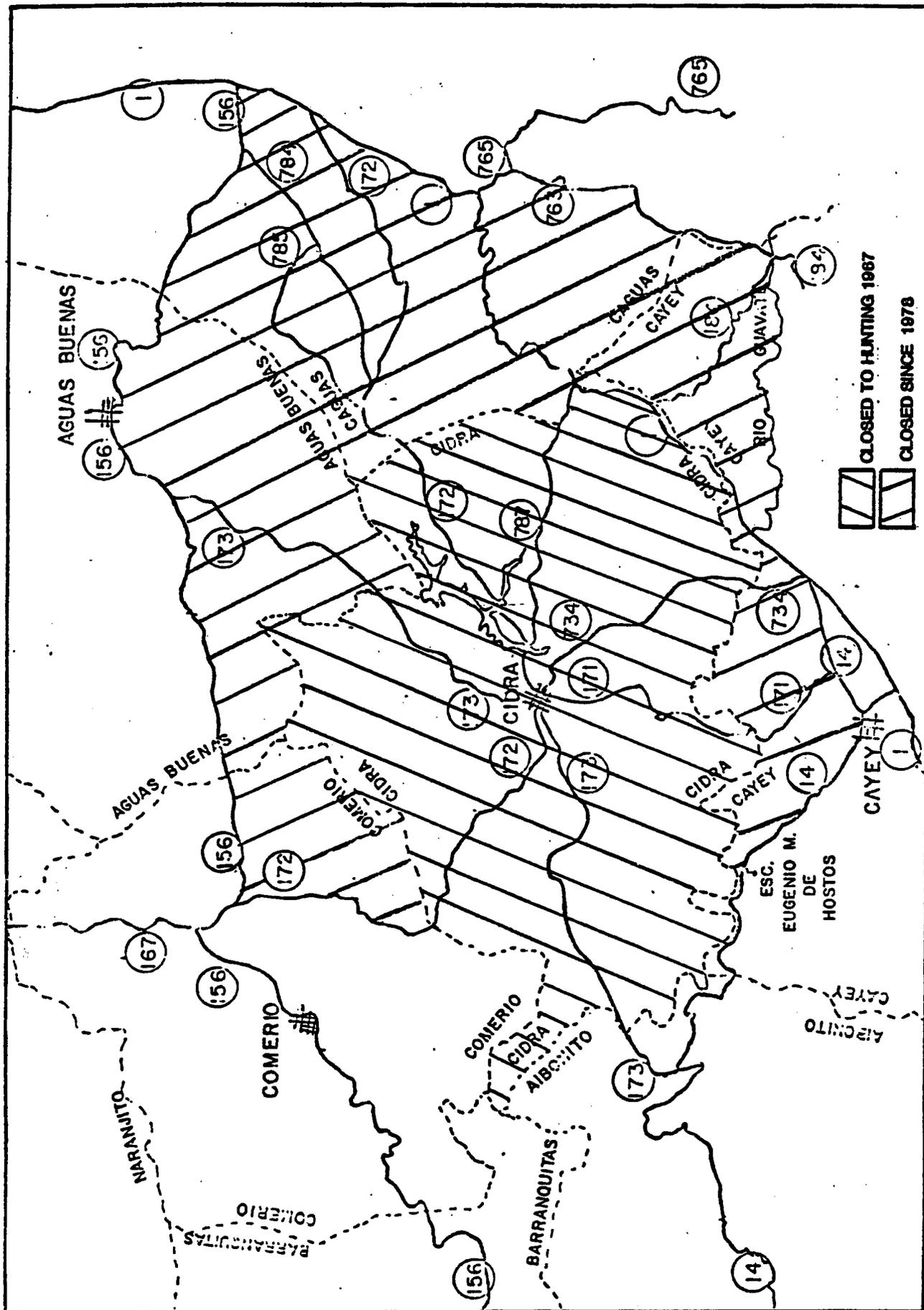


FIGURE 4

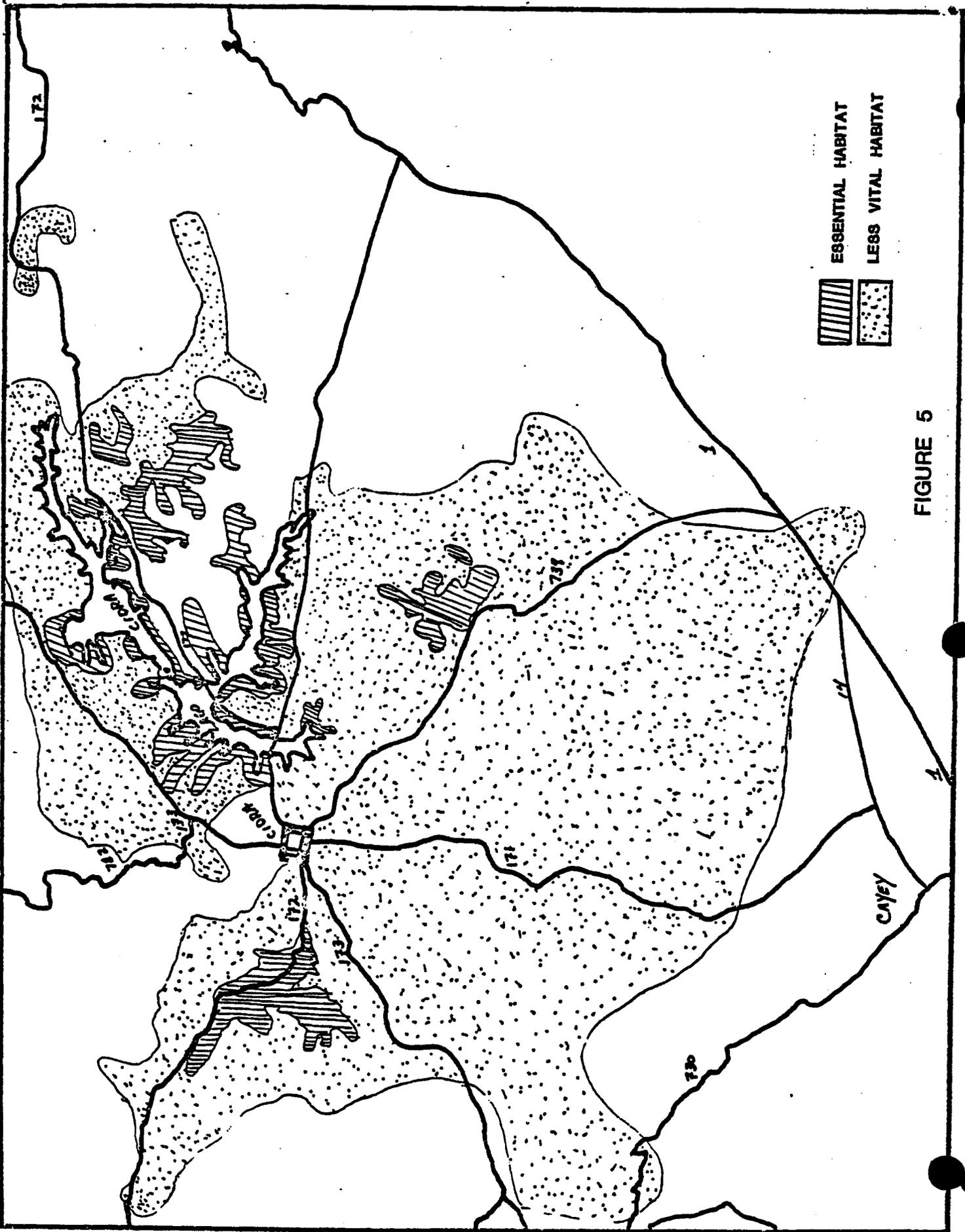


FIGURE 5