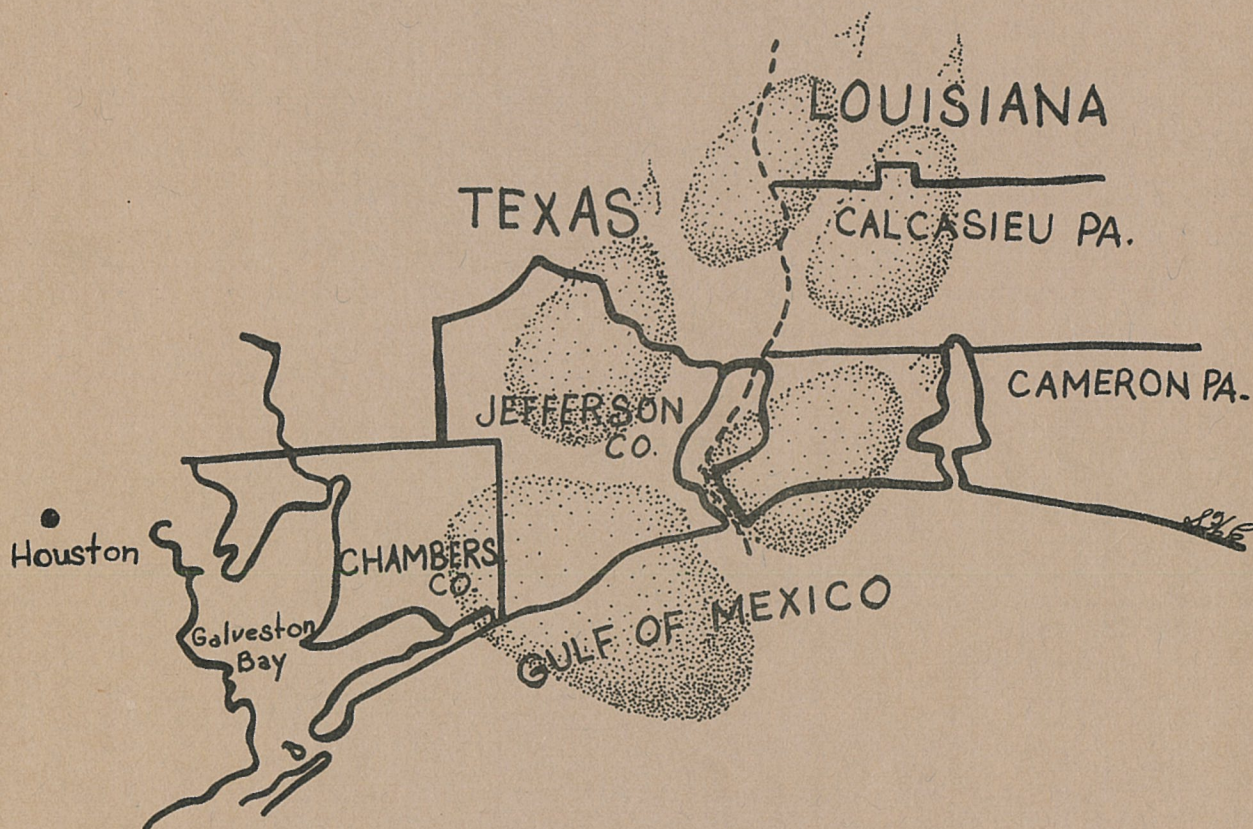


RECENT CHANGES IN
DISTRIBUTION AND STATUS
OF
WILD RED WOLVES
(CANIS RUFUS)



U.S. FISH AND WILDLIFE SERVICE
ALBUQUERQUE, NEW MEXICO
1979

Recent Changes in Distribution and
Status of Wild Red Wolves (Canis rufus)

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Completed under contract 14-16-0002-3596

U. S. Fish and Wildlife Service

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Draft Received September 18, 1978

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Abstract

The wild canid population in southeastern Texas and southwestern Louisiana was studied from Dec 1972 through May 1977. Data on the distribution and association of wild canids were derived from howl response surveys in which identification was on the basis of vocalization and from capture methods in which animals were caught, examined and identified.

The canid population in the study area was composed of 1) red wolves (Canis rufus), 2) coyotes (C. latrans), and 3) a wide spectrum of intermediate type canids (C. rufus x C. latrans hybrids). These three canid types were geographically intermixed and red wolves were the minority type canid. During the study period, the canid population remained stable in numbers, but red wolves declined and hybrids and coyotes increased. By May 1977 a few red wolves were possibly present in southern Jefferson County and in some few isolated parts of Cameron Parish. The extinction of the red wolf in this area was primarily the result of interbreeding with coyotes and resulting hybrids, a process that began here no later than the middle 1960's.

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Introduction

The precarious status of the red wolf (Canis rufus) was first noted by McCarley (1962). The occurrence of these rare canids in southeastern Texas and southwestern Louisiana was confirmed by Paradiso (1965) and Pimlott and Joslin (1968).

The taxonomic relationship between red wolves and coyotes (Canis latrans) is a long-standing problem. Young and Goldman (1944) described three subspecies of red wolves: 1) C. rufus floridanus, a large wolf found east of the Mississippi River and presumably extinct by about 1900; 2) C. r. gregoryi, a medium sized wolf found westward from the Mississippi Valley to Texas and Oklahoma, and 3) C. r. rufus, a small race regarded by McCarley (1962) as a form resulting from hybridization between C. latrans and C. r. gregoryi and therefore not a valid taxon. Paradiso and Nowak (1971) studied the taxonomic relationship of this canid complex and concluded that only those canids in extreme southeastern Texas, east of Galveston Bay (and presumably also in southwestern Louisiana) could be considered red wolves (C. r. gregoryi). Additional work

on canid distribution by McCarley in 1973 (unpub. data) and Carley and McCarley (1976) led to conclusions agreeing with those of Paradiso and Nowak (1971) on the distribution of red wolves. Pimlott and Joslin (1968) reported possible red wolves in Arkansas and in Louisiana along the Mississippi River. These areas were surveyed in 1975 and 1976 and no red wolves were found.

In Nov 1973, the U. S. Fish and Wildlife Service Red Wolf Recovery Program was implemented with the following objectives:

- 1) To restore surviving red wolf subspecies in their present ranges to desirable population levels.
- 2) To maintain an adequate gene pool.
- 3) To reestablish surviving red wolf subspecies in additional locations within their historic range.
- 4) To determine the location and abundance of each surviving red wolf subspecies.

This report deals with Item No. 4 and the changes in the canid population in southeastern Texas and southwestern Louisiana. The results and conclusions are based on research by McCarley from Dec 1972 through May 1975 and by the Red Wolf Recovery Staff from Nov 1973 through May 1977. Data were gathered in Chambers, Jefferson, Orange, and southern Liberty counties, Texas and Cameron and Calcasieu parishes, Louisiana.

These counties and parishes constituted the study area which was adequately described by Riley and McBride (1972). Because humans have lived and worked in the region since at least the early 1800's, it has not been a wilderness area in recent times. Continuing extensive agri-industrial developments have forced the red wolf into increasingly close contact with man.

Methods

Data on the distribution and association of wild canids in the study area during 1972-1977 were derived in two ways. 1) Howl response surveys in which identification was on the basis of vocalization, and 2) capture methods (trapping and helicopters) in which animals were caught, examined and identified.

Locating and identifying wild canids by howling responses was based on the work of Alcorn (1946), Pimlott (1960), and Pimlott and Joslin (1968). Sonagrams were prepared from tape recorded responses to provide a more objective diagnosis than from vocalizations alone. Red wolf vocalizations were distinguished from those of coyotes and coyote x red wolf hybrids (C. latrans x C. rufus) as discussed by McCarley (1978). The term, hybrid, as used throughout this report refers to a wide spectrum of canid types representing varying degrees of genetic mix between red wolves, coyotes, and in

some cases, dogs. In most instances the parentage and generation were unknown. There were, however, no absolute quantitative differences separating all red wolf sounds from all non-red wolf sounds. Recording and sonagraphically analyzing wild canid vocalizations within the red wolf range, did, however, allow rather quick locating of wild canids from which probable identities could be made. There was very good agreement between identification of vocalizations in particular areas and identity of canids captured later in those areas.

Wild canid trapping in the study area began on an organized basis in Jan 1974 and was primarily related to the Recovery Program objective of locating and determining abundance of red wolves and supplying a few additional wolves to the captive breeding program. There was also an effort to estimate movement and home range of radio-collared canids and to get vocal responses from these known animals.

Canids were trapped with No. 4 Newhouse traps equipped with offset jaws and tranquilizer tabs. In areas not generally accessible to trapping, helicopters were used to flush animals from cover and a tranquilizer dart was used to capture the canids.

In-hand identification of wild canids was complicated because captured canids ranged from coyotes through a varying

spectrum of canids with both wolf-like and coyote-like characteristics to those animals clearly wolves. In all likelihood all wild canids in the area formed one interbreeding population. The immediate problem was not separation of wolf and coyote, but distinction between wolves and wolf-like intermediates. Available descriptions of red wolves were vague, inconclusive, or of little value in separating live wolves from live wolf-like hybrids (Bartram, 1791; Bailey, 1905; Young and Goldman, 1944; Hall and Kelson, 1959; Paradiso and Nowak, 1971). Shaw (1975) and Shaw and Jordan (1977) reported that red wolves could be distinguished from coyotes by a threat jaw gape, characteristic of coyotes, but not of red wolves. Our observations suggest that jaw gaping is a graded response and is an expression of defensive threat (Fox, 1975). Under certain conditions (capture) jaw gaping did occur in red wolves. Further, Young and Goldman (1944) show a photograph of a jaw gaping red wolf from Oklahoma.

The most reliable baseline reference was the skulls in the U.S. National Museum collected prior to 1940. A sample of 67 male skulls and 51 female skulls identified as C. r. gregoryi was selected by R. M. Nowak. These were adult skulls of known sex and age from areas and time periods from which hybridization was least likely. These skulls were x-rayed and skull x-rays of live canids were then compared to the x-rays of these known red wolf skulls. Live canids whose skull characteristics compared favorably in size and conformation with the museum skulls were

used to establish a range of variation of external characters providing additional criteria for identification of live canids. Table 1 shows those characters and the minimal standards used in the identification process. Some of these criteria were also used at an earlier date by Glynn Riley (Riley and McBride, 1972) and Aaron Long (pers. Comm.) to identify red wolves.

Even with the development of these standards (Table 1) there was no single character, morphological or behavioral, by which all red wolves could be distinguished from all hybrids. Therefore, the identification of a captured wild canid ultimately depended on an analysis of all available quantitative and qualitative characters. This meant that to receive the designation "red wolf" a live canid had to meet the minimal standards outlined in Table 1, and possess skull characteristics of the pre-1940 wolves. However, final determinations of the identity of some of these canids must wait for genetic studies from the captive breeding population.

Results

Data presented in Figs. 1-9 and Tables 2-3 represent results of field studies on the distribution of wild canids in the study area from Dec 1972 through April 1977. The data are not always directly comparable from year to year because of variable effort expended in different areas and changing priorities and objectives of the Recovery Program. Variable weather from year to year precluded random sampling. The lengthy waterfowl hunting season, averaging 80 days, often prevented trapping where hunting dogs might be present. Nevertheless, these data indicate the geographic distribution of the kinds and associations of wild canids in the study area. Each year's data cover fall through late spring because circumstances were unsuitable for study during the summer. Figs. 1-9 do not show the location of vocalization or trapping efforts where no response or capture was recorded. In addition, a symbol for a vocalization response may represent one or several animals.

1972-73 Vocalizations

The objective during this year was to tape record as many red wolf vocalizations as possible to develop identification criteria. Efforts were concentrated in those parts of Chambers County believed to have the highest concentration of red wolves (Pimlott and Joslin, 1968; Glynn Riley, Russel Clapper, Pers. Comm.). Ninety-two attempts to get vocal responses were made

from Dec 1972 through May 1973, with a response rate of 20 %. Fig. 1 shows the localities and dispersion of canid groups from which analyzable (identifiable) responses were recorded.

Responses were received from red wolves at five localities in Chambers County, but comparisons of recordings and sonagrams and proximity of some of the locations suggests that three or less red wolf groups were involved. Two additional responding groups in Chambers County and one in Jefferson County contained red wolves and hybrids (Fig. 1). Hybrids were recorded at six localities, but again, probably only three separate packs were involved. Two coyote groups were recorded in Chambers County. The coyote group in Liberty County was recorded only for comparative purposes. Thus, in about 1200 km² of southern and central Chambers County, an estimated eight to ten canid groups were present with less than one-third of them made up of wolves only (Fig. 1 and Table 2). Shaw (1975) reported that in about the same area in 1971-72, eight or nine canid groups were present, but he made no distinction between red wolves, hybrids and coyotes.

1973-74 Vocalizations

The objective in 1973-74 continued to be to obtain as many recordings of red wolves as possible. Work was concentrated in southern Chambers County, western Jefferson County and southern Calcasieu and northern Cameron parishes.

Eighty-seven attempts to get responses were conducted, with a 28 % response rate (Fig. 2).

No vocal responses were received in Chambers and Jefferson counties from wolves only. In Calcasieu Parish, just north of the Intracoastal Waterway, one pack, judged to contain only red wolves was recorded. All other wolves were heard in association with hybrids or hybrids and coyotes. Packs of varying makeup were recorded at 12 localities in southern Chambers County (Fig. 2) but they probably involved only eight packs. Four of these eight groups contained red wolves (the responses north and east of Anahuac National Wildlife Refuge (Fig. 2) were probably from the same pack). It appeared that in southern Chambers County in 1973-74, the number of canid groups was about the same as in 1972-73, but no groups contained wolves only. An additional five to six canid groups (Fig. 2) were found in areas not sampled the previous year.

1974 Trapping

A total of 52 wild canids were captured and, as in the vocalization results, hybrids predominated (Table 3). Red wolves were concentrated south of Interstate Highway 10 and only one red wolf was caught north of this landmark (Fig. 3). Ten red wolves were caught at eight localities. At four of these localities, only wolves were caught, while both hybrids and wolves were captured at four other locations. At an additional 10 trapping sites only hybrids were caught and both

hybrids and coyotes were captured at six other localities. The trap data confirmed that red wolves were present in the same areas shown by the vocalization results, and that red wolves, hybrids and coyotes inhabited the same geographic area. Trapping results in 1974 were biased because traps were not randomly dispersed and efforts were concentrated in areas where vocalization data showed wolves to be present.

1974-75 Vocalizations

During 1974-75 work was concentrated in southern Chambers and western Jefferson counties and 126 attempts were made with a 24 % response rate. Presumed red wolf responses were received at seven localities, but only from wolves associating with hybrids. We estimated that five canid groups were responsible for the responses at these seven sites. No wolf-like responses were received north of Interstate Highway 10 (Fig. 4) and the three canid types were geographically intermingled. There appeared to be no significant change in either total number of animals or of groups from the preceding two years.

1974-75 Trapping

During fall 1974, available enclosures for the captive breeding program were full and trapping efforts avoided areas where red wolves were believed to be present. The emphasis was on trapping and removing coyotes and hybrids, mainly to "buy more time" for the red wolf population. Thus trapping

was not random, and some areas were not investigated. A total of 55 wild canids were trapped in the 1974-75 trapping season (Table 3). All three canid types were intermixed in Chambers County, and intermixing was perhaps more pronounced than the preceding year (Fig. 5). Of interest is that in extreme southeastern Chambers County, all three canid types were caught at the same trap site. Red wolves still occurred sparingly in southern Chambers and Jefferson counties. One red wolf captured in the "Pines Inholding" area east of Sabine Lake established the presence of red wolves in Cameron Parish, Louisiana.

1975-76 Vocalizations

During this year priority was given to covering as many localities and habitats as possible to locate red wolves and to better assess the overall canid dispersion pattern in the study area. Two-hundred eighty-eight attempts were made, with a 20 % response rate. The distribution of these responses is shown by Fig. 6. The apparent increase of responding groups over the previous years was a reflection of the increased number of attempts. Therefore, the data in Fig. 6 and Table 2 should not be interpreted to mean the canid population increased over the 1974-75 season. In fact, many of the wolf-like responses were from the same group responding from different localities at different times. In those groups where responses were received from wolves and hybrids or wolves, coyotes and hybrids, wolves were the minority canid in each group. All

three canid types were south of the Intracoastal Waterway in southern Jefferson County in an area thought to be prime red wolf habitat (Fig. 6). Throughout the study area only 7 % of the wolf-like responses were from wolves alone (Table 2) and the intermixed relationship of the three canid types followed the pattern of 1974-75.

1975-76 Trapping

By fall 1975, limited space was again available for wolves in the captive breeding program and a few more wolves were captured. The facilities, however, were soon full so during winter and spring, trapping efforts were aimed at avoiding red wolves. Consequently trapping efforts were directed at previously untrapped sites and in areas of high coyote and hybrid density. A total of 44 wild canids were trapped in the 1975-76 trapping season (Table 3). Fig. 7 shows the almost complete absence of red wolves from southern Chambers County and Table 3 shows that hybrids continued to be the predominant canid in the study area. During this study period it was realized that hybridization in the southeastern Texas canid population was more extensive than had been believed. It was the judgment of the Red Wolf Recovery Team and their advisers that it was no longer feasible to try to preserve the red wolf in southeastern Texas.

1976-77 Vocalizations

One hundred ninety-five tests were conducted, with a 19 % response rate. No wolf-like vocalizations were heard in Chambers County (Fig. 8). In Jefferson County, responses from presumed wolves were heard only south of, and in the vicinity of, the Intracoastal Waterway. Nowhere were wolves heard in the absence of hybrids or coyotes. The increasing trend of all types of canids occurring together, and the proportional increase of hybrids was evident (Table 2).

1976-77 Trapping and Helicopter-Capture

One hundred and seven wild canids were captured in the study area during this period (Table 3). This represented an intensive effort to capture wolves for the captive breeding program and to evaluate as best we could the situation on numbers and distribution of canid types.

The distribution of canid types was similar to that shown by vocalization responses (Figs. 8 and 9). Red wolves were becoming much more difficult to locate, and the number of hours now necessary to capture wolves was much greater than in 1974-75. In March 1977, an additional capture technique was used. Six red wolves, eleven hybrids and two coyotes were darted from a helicopter (Fig. 9). Wolves in southwestern Calcasieu Parish were caught by cooperating Louisiana Game Officials in an area from which the last known red wolves were captured in 1974. Presumably these 1977 animals moved

into the area from inaccessible areas south of the Intracoastal Waterway. During this study period over half of the captured canids were hybrids (Table 3, Fig. 9).

DISCUSSION AND CONCLUSIONS

From 1972 through 1977, the number of red wolves and the geographic area occupied by them shrank steadily. By late 1975 it was obvious that extensive hybridization had progressed beyond the point where it was feasible to preserve a wild red wolf gene pool in this area, if indeed it ever was feasible. An effort then began to locate and capture as many red wolves as possible in an attempt to preserve the species and the gene pool in captivity. It was recognized by all concerned that such action would hasten the disappearance of wild red wolves in the area. However, since extinction of the red wolf in the wild appeared inevitable, this was the only practical means of preserving the species.

There are two explanations for the demise of red wolves. McCarley (1962) believed that hybridization between coyotes and red wolves began in central Texas and perhaps central Oklahoma producing a hybrid population that moved eastward. This wave of hybrids (and coyotes) eventually reached eastern Texas, Oklahoma, Arkansas, and Louisiana, interbreeding with the few remaining red wolves as it progressed eastward. Paradiso and Nowak (1971) believed the hybrid type canid was formed only in central Texas, but in eastern Texas, Oklahoma and Arkansas, "it was a case of initial extermination of the red wolf and then geographical invasion of the area by the other form," and that, "this form represents the expansion of the Texas hybrid swarm."

Our vocalization and trap data show that at least in Chambers County, as early as the fall of 1972 there were three types of canids: (1) coyotes, (2) red wolves, and (3) a wide assortment of intermediate canids (C. latrans x C. rufus hybrids); and some animals that appeared to be C. familiaris x C. rufus hybrids. Because Paradiso and Nowak (1971), Russell and Shaw (1971) and Shaw (1975) all indicated a relatively pure population of red wolves in this area, the first question to be discussed is when did these changes in the composition of the canid population occur?

Prior to the studies cited above, very little data are available. The information provided below is based on either personal communication or written reports in files of the U. S. Fish and Wildlife Service, Animal Damage Control State Supervisor's Office in San Antonio, Texas.

During 1960 and 1961, James Poor, retired District Supervisor for the Texas Rodent and Predatory Animal Control Service reported that one of his employees captured only large canids in Chambers and Liberty counties, and it was not until about 1968 that the coyote began to move into southeastern Texas. This latter date on coyote distribution may be in error because Young and Jackson (1951) recorded coyotes in Liberty and Harris counties prior to 1950. Some of these specimens were later identified as C. rufus showing some approach to C. latrans (Nowak, 1964).

Larry Boyd, Technician, U. S. Fish and Wildlife Service, reported that of the 46 canids collected in Liberty and Chambers counties in winter 1964-65, most animals north of Interstate Highway 10 were hybrids and those farther south were all "large" animals. This group of 46 animals is important because from these canids came the series of seven skulls from which Paradiso (1965) determined that red wolves were still present in southeastern Texas. Unfortunately, of these 46 canid skulls, only the largest were sent to the U. S. National Museum (Russel Clapper, Pers. Comm.). Consequently, the presence of any small canids (and Mr. Clapper assures us there were some) was not brought to the attention of the taxonomists.

Joseph Whitehead, D.V.M., of Smith Point in southern Chambers County, told us that prior to 1964 most of the canids were larger than animals from the 1970's, but during the 1955-58 period he observed several canids he considered to be C. familiaris x C. rufus hybrids. These may have resulted from cross-breeding of wolves with a pack of wild dogs killing livestock on the Brown and Root Ranch in the 1955-58 period.

John Karrenbrock, a supervisor of the Texas Rodent and Predatory Control Service, reported the capture of a 33 lb. female canid on the Middleton Ranch in southern Chambers County in Dec 1964, and Russel Clapper, Manager, Anahuac National Wildlife Refuge, recovered a 20 lb. female coyote five miles east of Hankamer in Jan 1965. Aaron Long, D.V.M.,

of Winnie, Texas reported seeing a coyote caught on the MacFaddin Ranch in central Jefferson County in 1964. John Steele, U. S. Fish and Wildlife Service, reported numerous non-wolves in the Anahuac area and throughout Liberty County in 1968. Coyote howls were heard by Steele south of Stowell, Texas in April 1968. Monte Dodson, U. S. Fish and Wildlife Service, reported evidence of large canids on the Anahuac National Wildlife Refuge in 1967, but in 1968 and 1969, canid sign was less abundant and tracks and scats were smaller than those observed the previous year.

Glynn Riley (Biological Technician, U. S. Fish and Wildlife) captured numerous hybrid-like canids in Chambers County, e.g., a 36 lb. female and two hybrid pups from 1 mile north of Anahuac National Wildlife Refuge in May and Nov 1971. A 54 lb. female caught by Riley east of Anahuac in April 1970 was identified as a red wolf x dog cross. In a progress report on the Red Wolf Management Area, covering Nov 1969 - April 1970, Riley stated, "I feel that hybridization has been taking place for many years and is not a recent phenomenon." On 16 April 1971, responding to a request from Frederick Knowlton, the Office of Endangered Species wrote, "The observations confirming the intrusion of coyotes into the last remaining population of C. rufus lead to the request for approval to take several litters of C. rufus into captivity to preserve the genetic stock."

Thus the 1972 sympatric occurrence of red wolves, hybrids and coyotes apparently began long before 1972. To the best of our knowledge, coyotes were present in southern Chambers County as early as the middle 1960's. During this time, distinctions were not made between wolves and large hybrids in this area. The evidence is, however, that mating of coyotes, hybrids and wolves and further backcrossing of their descendants was well underway by the late 1960's.

Because red wolves maintained themselves in the Gulf Coastal Region longer than in any other part of their historic range, were there any circumstances that triggered the decline of wolves and increase of non-wolf canids in this area? Was it a gradual process or was it sudden?

Shaw (1975) suggested that red wolf density may have been higher in 1962-64 than in subsequent years and implicitly that an intensive predator control program in 1964-65 may have contributed to the decline of the red wolf populations. It is on record in Fish and Wildlife Service reports that 46 "wolves" were killed in Chambers and Liberty counties during this period. What is not generally known is that government and private predator control programs had been in effect in this area for many years prior to 1964. For example, reports to the Regional Director, U. S. Fish and Wildlife Service, Albuquerque, document that 10 canids (identities unspecified) were killed in Chambers County in 1957, 8 in 1958, 23 in 1959,

31 in 1960, 33 in 1961, 46 in 1962, 6 in 1963, 41 in 1964, 2 in 1965, and 26 in 1968. Canid kills by private individuals in Chambers County totaled at least 9 in 1965, and 23 in 1967. Similar data were unavailable for Jefferson County, but we do know that at least 18 "wolves" were caught there in 1967 by private trappers. Apparently, the wild canids in this region had tolerated a human-imposed mortality rate for many years without becoming extinct. It is possible, as Shaw (1975) implied, that these predator control programs adversely affected the red wolf population, at least indirectly by increasing the movement of non-wolf canids into the study area from adjacent regions.

Parasitism was certainly a factor affecting the mortality rate of canids in the area. Heartworms (Dirofilaria immitis), hookworms (Ancylostoma sp.), and tapeworms (Taenia spp.) all have a debilitating effect on wild canids. Shaw (1975) suggested that there may be a relationship between rainfall and levels of parasite infection. Because hookworms are transmitted through wet soil, and heartworms are mosquito transmitted, infection rates may be higher during wet years than during dry years. Shaw points out that the years 1962-64 were drier than usual, particularly in the spring when pups were being whelped. The validity of this causal relationship is difficult to assess because there were no accurate population figures for the canids of the area to

correlate with available rainfall data. It is worth noting that for centuries prior to 1962 there have been wet periods and dry periods.

Russel Clapper and Aaron Long, D.V.M., have called our attention to the effect of the mange mite (Sarcoptes scabiei) which denudes the animal of hair, causes skin lesions and disrupts metabolic processes. Sarcoptic mange was not known to be present in canids of the area prior to 1968, and Dr. Long believes this parasite reduced the breeding population of red wolves after its appearance.

In the Gulf Coastal Region, the evidence points to a gradual replacement of red wolves by hybrids and coyotes. Certainly, there was no initial extermination of red wolves. Disease, parasites, human-caused mortality, and agricultural changes undoubtedly affected the wolf population, but these factors presumably operated on all canid types. The overwhelming evidence points to the fact that the near extinction of the red wolf in the wild was brought about primarily by genetic dilution of the red wolf gene pool through interbreeding with hybrids and coyotes.

A few red wolves still exist in southeastern Texas and southwestern Louisiana. Recent efforts to locate them in Chambers County have been in vain. A few may still be present in southern Jefferson County and in some of the isolated and inaccessible parts of Cameron Parish. Apparently, canid

groups made up only of red wolves no longer persist. Currently, hybrids, spanning the spectrum from near-wolves to near-coyotes, constitute the majority canid type in the area, and at least since 1972 the canid population in this region has remained relatively stable in numbers. The ecological niche of the red wolf has been usurped by a different type canid, which in turn may ultimately be replaced by animals more coyote-like than wolf-like.

ACKNOWLEDGEMENTS

The Red Wolf Recovery Team, including Russel Clapper, Joseph Herring, George Abraham and Pierce Uzell provided support and guidance during the course of this investigation. We are most grateful to Dr. and Mrs. Aaron Long for their invaluable assistance, advice and the many courtesies they extended. We appreciate the extensive efforts of the Red Wolf Recovery Program Field Staff and Austin College students for many hours spent in the field capturing animals, monitoring radio signals and recording canid vocalizations. These include: Glynn Riley, John Dorsett, Bill Wagner, Wayne King, Mike Coody, Emile LeBlanc, Rodney Nicely, Ray Hyde, Larry Reaves, Ray Thomas, Larry Driver and Paul Meriwether. David Kava provided meteorological information.

In addition we thank the following for assistance in gaining access to private land, and/or providing information on the canid populations of the Gulf Coast Area during earlier periods: Joseph Whitehead, Larry Boyd, Joseph Broussard, Dennis Burch, Milton Caroline, John Crain, Monty Dodson, Leroy Ezer, Steve Fitzgerald, Ocie Jackson, Quinton Jackson, Ted Joanen, Virgil Junk, Joseph Lagow, Roy McBride, David Middleton, Russie Odum, Mike Phelan, Jamie White and T. (Doc) Harris, the staffs of the Anahuac National Wildlife Refuge, Murphree Wildlife Management Area, Sabine National Wildlife Refuge and Sea Rim State Park.

L. David Mech and Ronald M. Nowak reviewed the manuscript

and we appreciate their suggestions and comments. Austin College and The University of Oklahoma Biological Station provided time, facilities and equipment. The award for gullibility goes to our wives who trustingly understood each time we claimed to "go out to howl."

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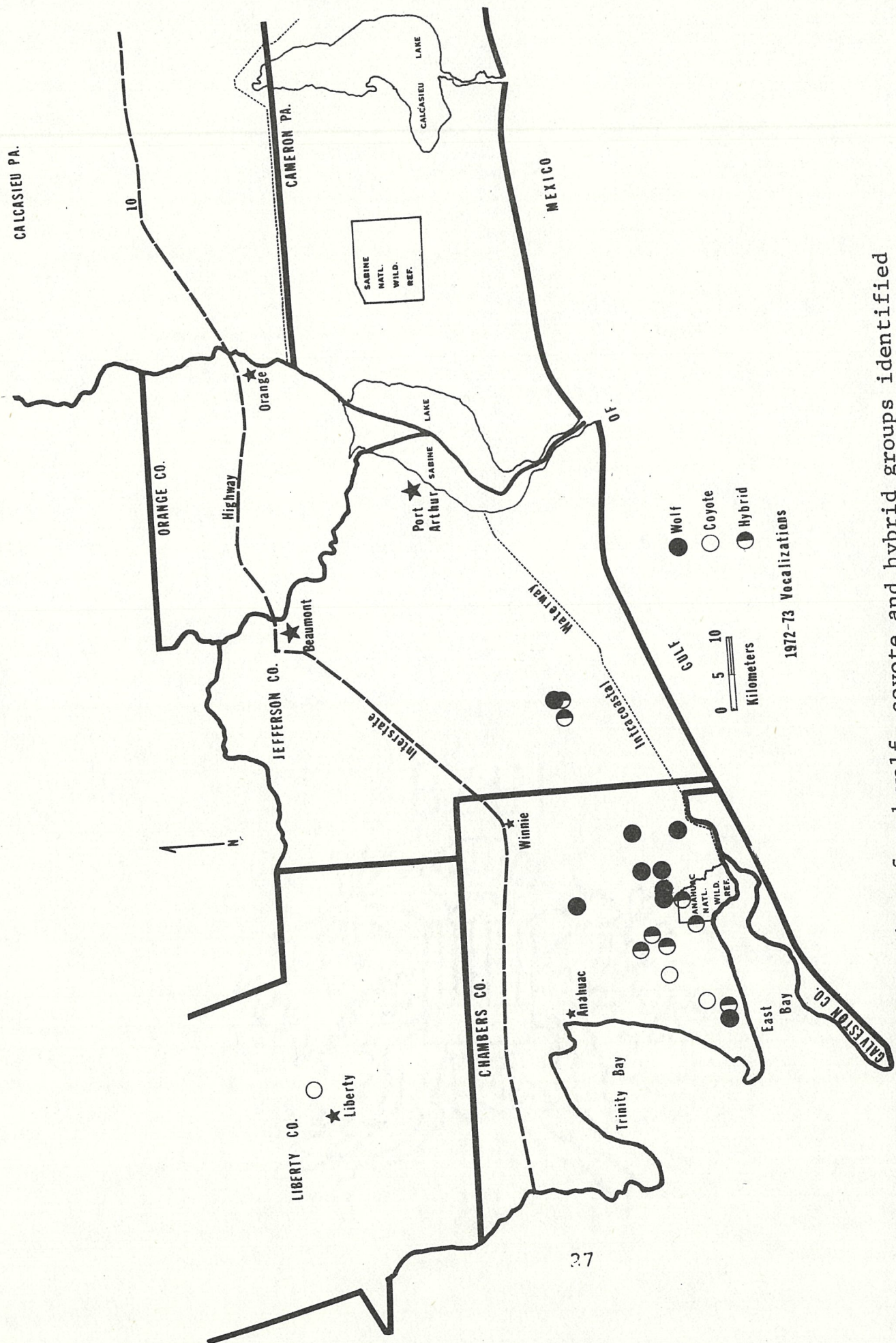


Fig. 1. The distribution of red wolf, coyote and hybrid groups identified by vocalization responses during the 1972-73 study period.

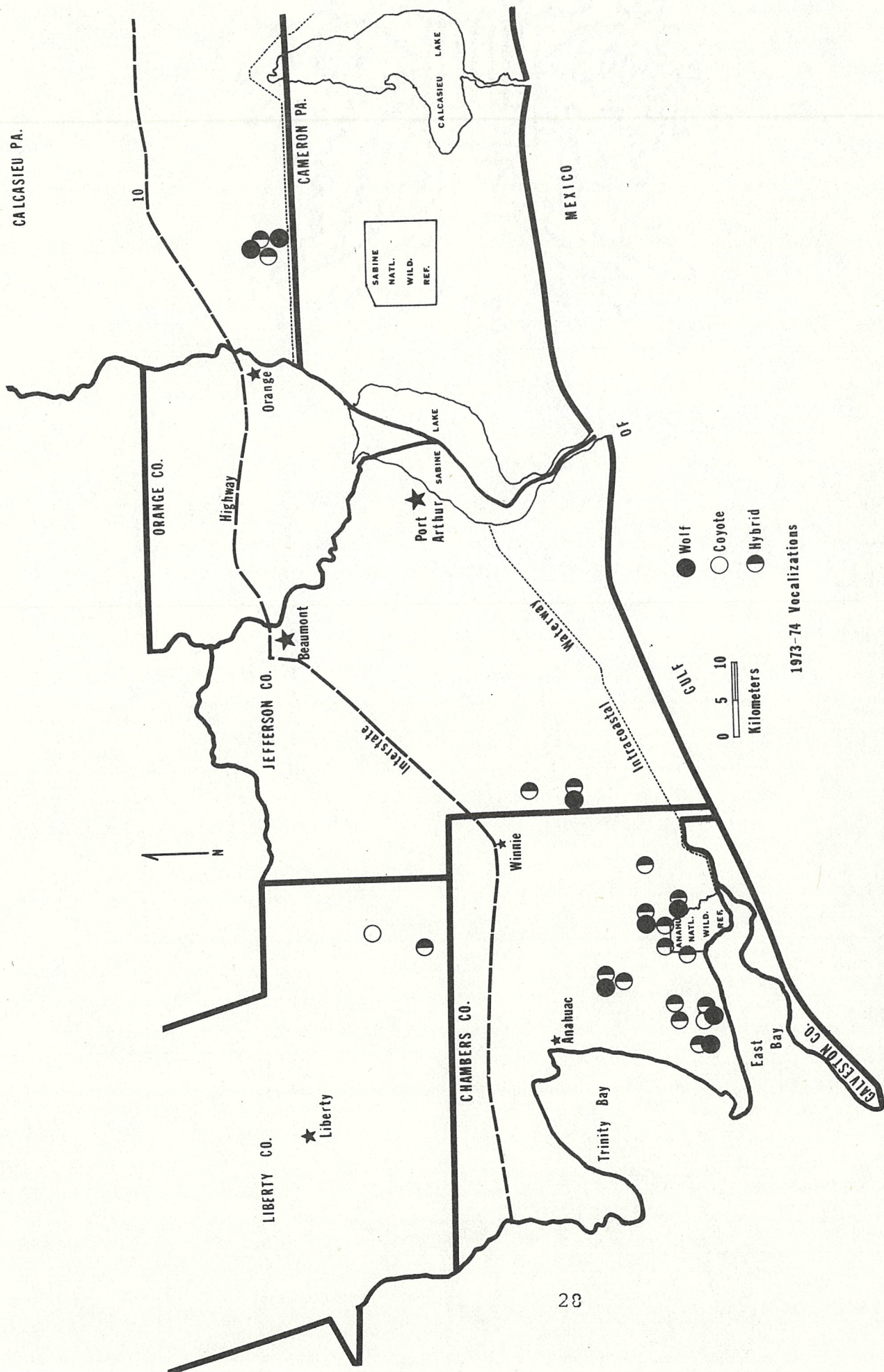


Fig. 2. The distribution of red wolf, coyote and hybrid groups identified

by vocalization recordings during the 1973-74 study period

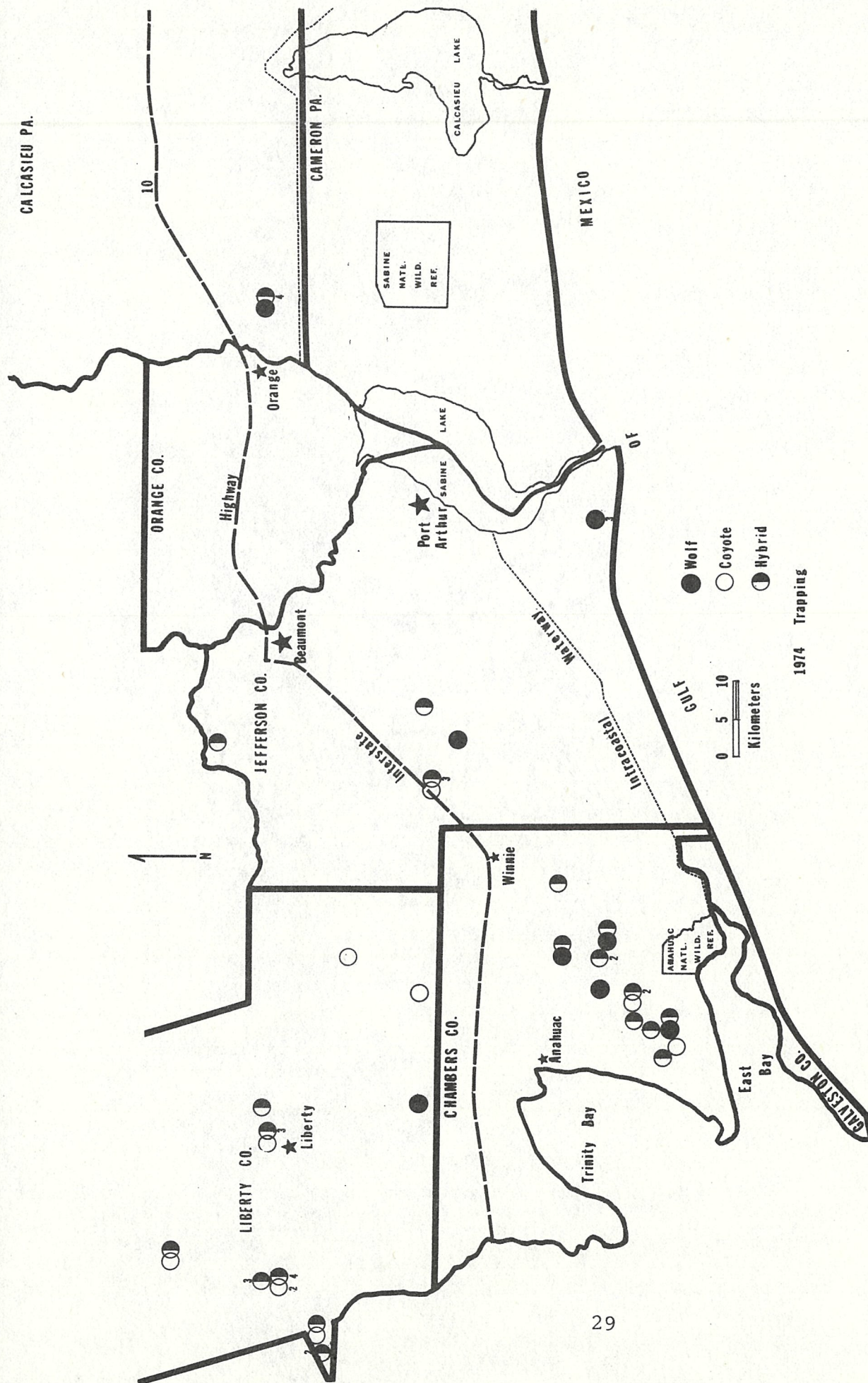


Fig. 3. The distribution of red wolves, coyotes and hybrids captured during the 1974 study period. Numbers adjacent to symbols indicate number caught at that location if more than one animal.

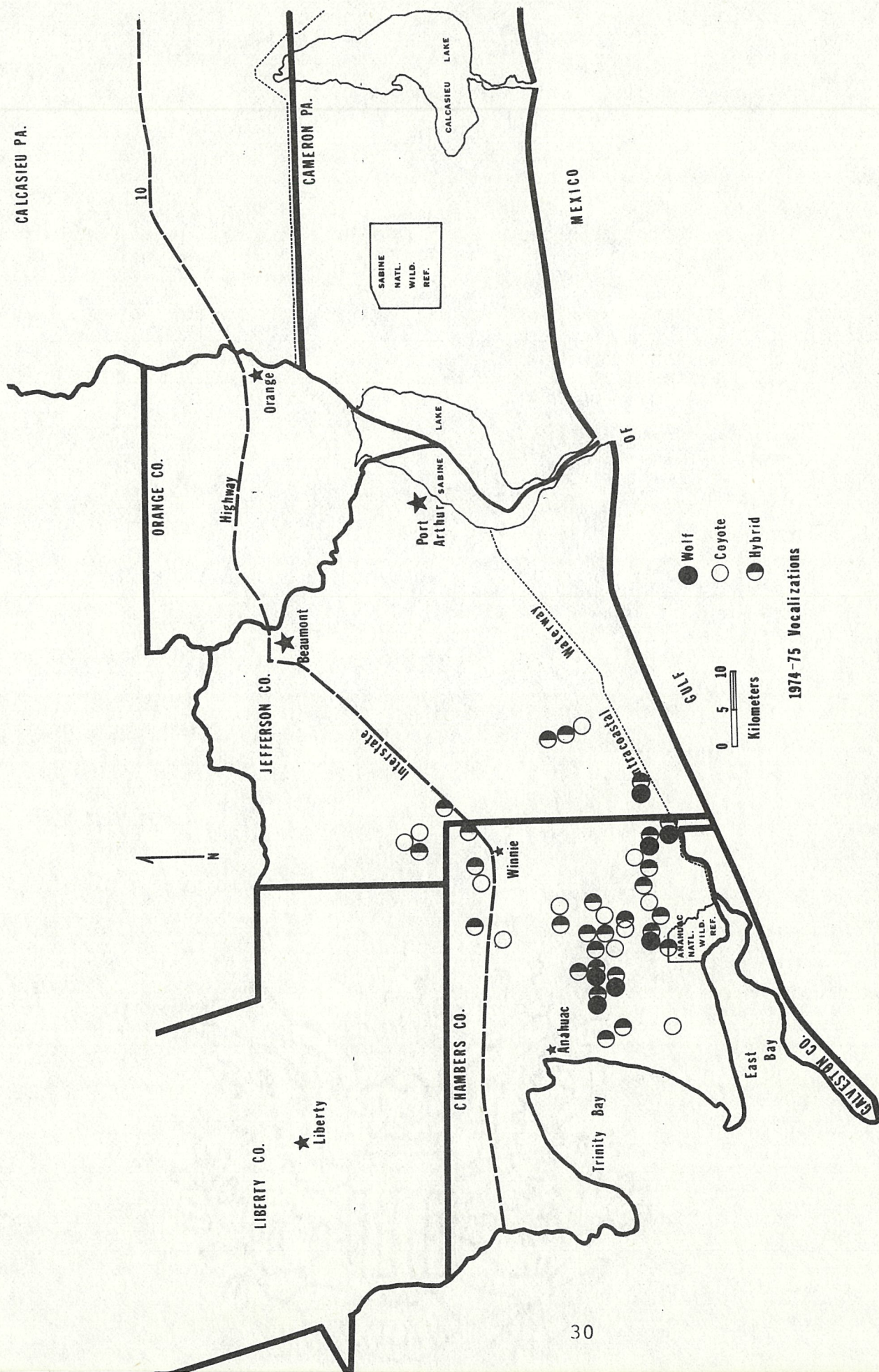


Fig. 4. The distribution of red wolf, coyote and hybrid groups identified by vocalization responses during the 1974-75 study period.

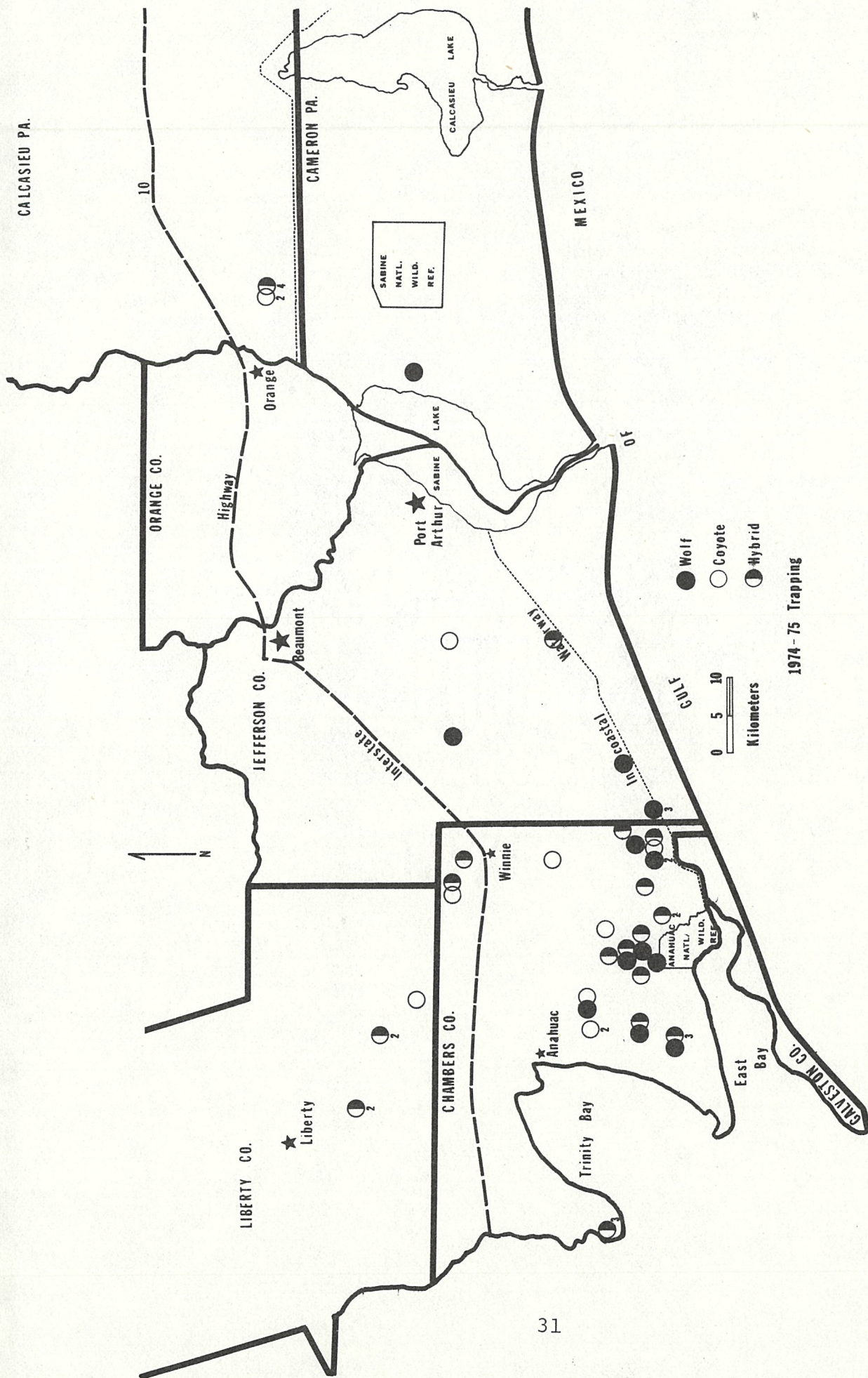


Fig. 5. The distribution of red wolves, coyotes and hybrids captured during the 1974-75 study period. Numbers adjacent to symbols indicate number caught if more than one animal.

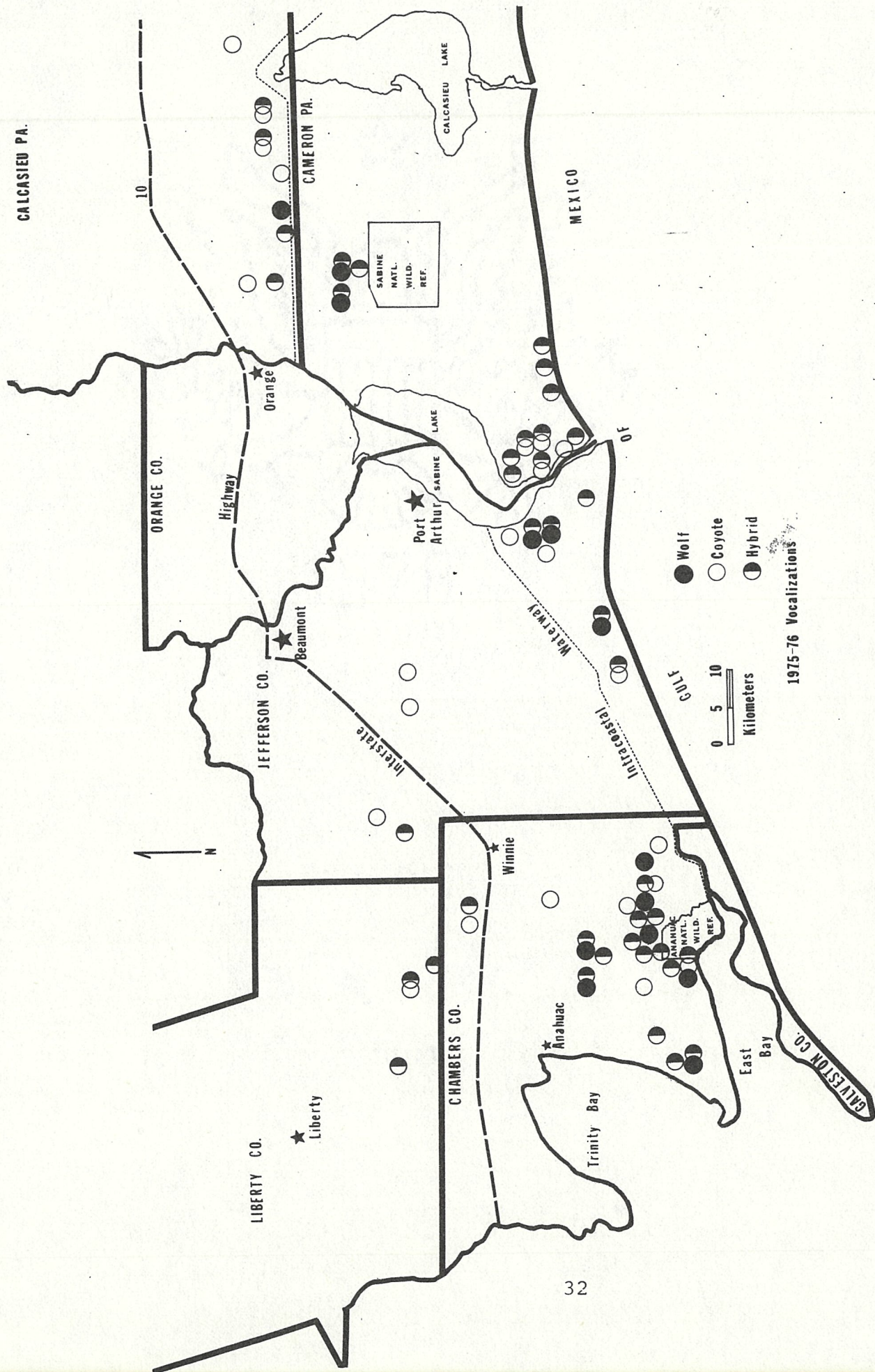


Fig. 6. The distribution of red wolf, coyote and hybrid groups identified by vocalization responses during the 1975-76 study period.

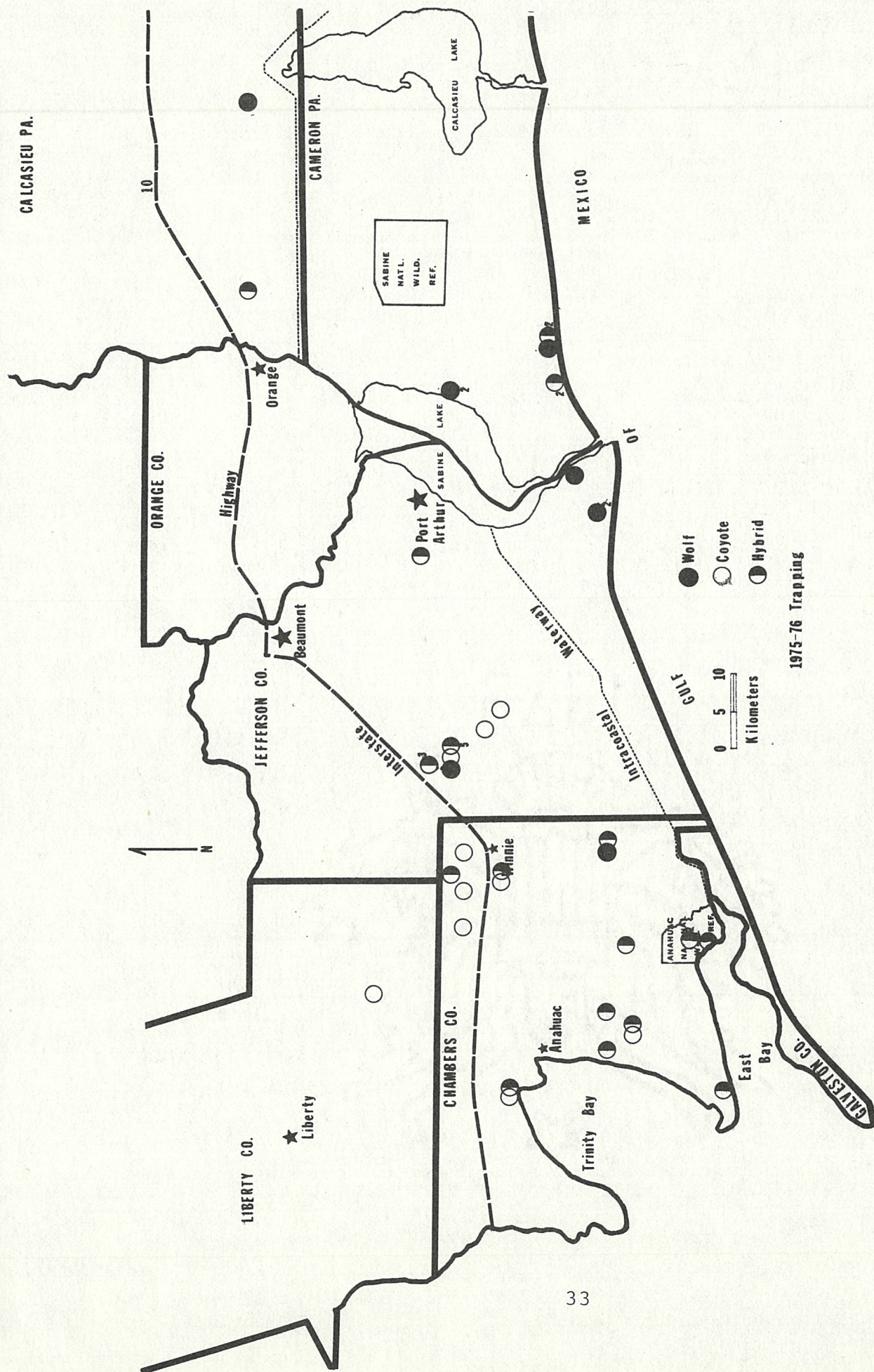


Fig. 7. The distribution of red wolves, coyotes and hybrids captured during the 1975-76 study period. Numbers adjacent to symbols indicate number

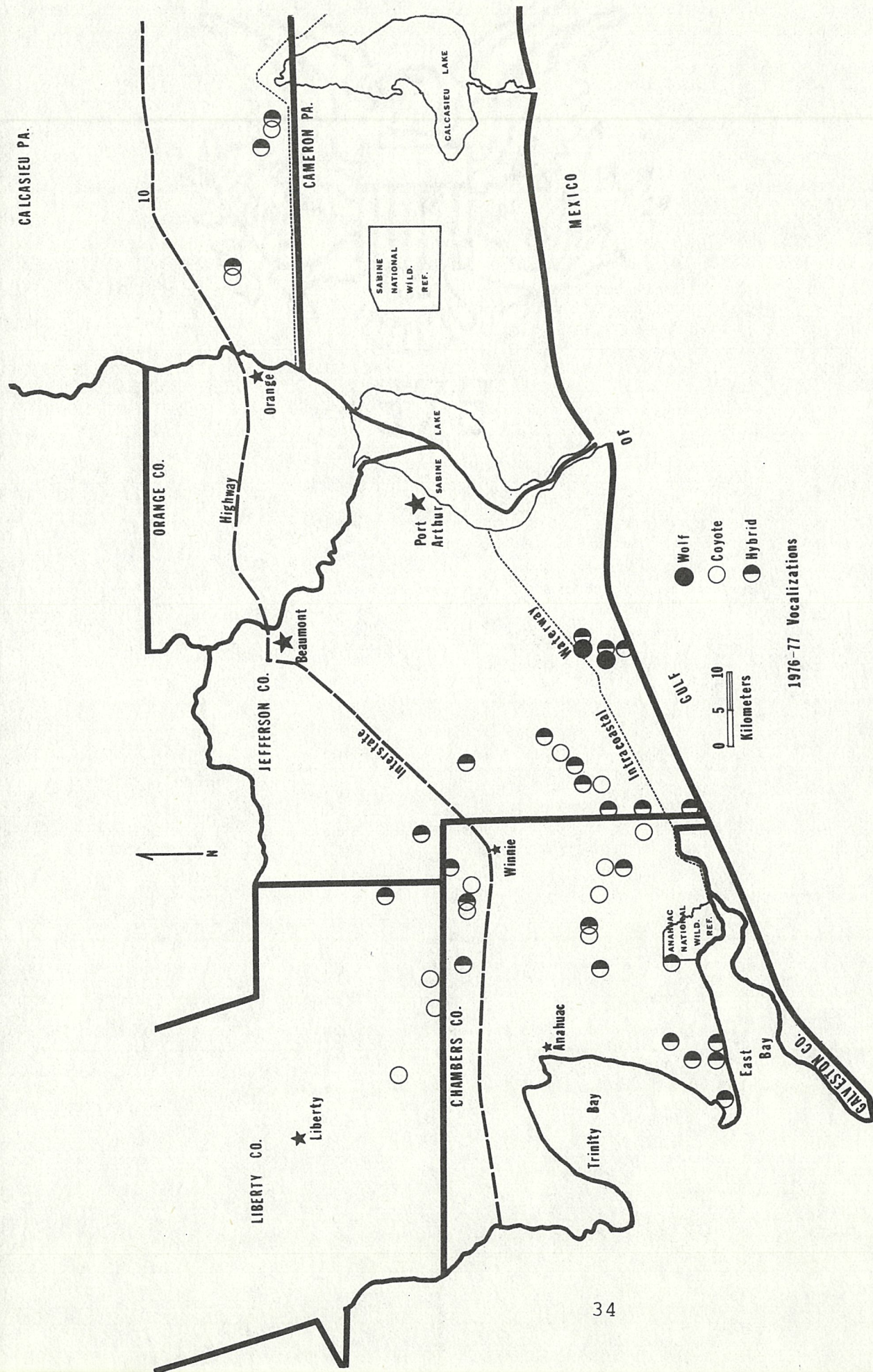


Fig. 8. The distribution of red wolf, coyote and hybrid groups identified by vocalization responses during the 1976-77 study period.

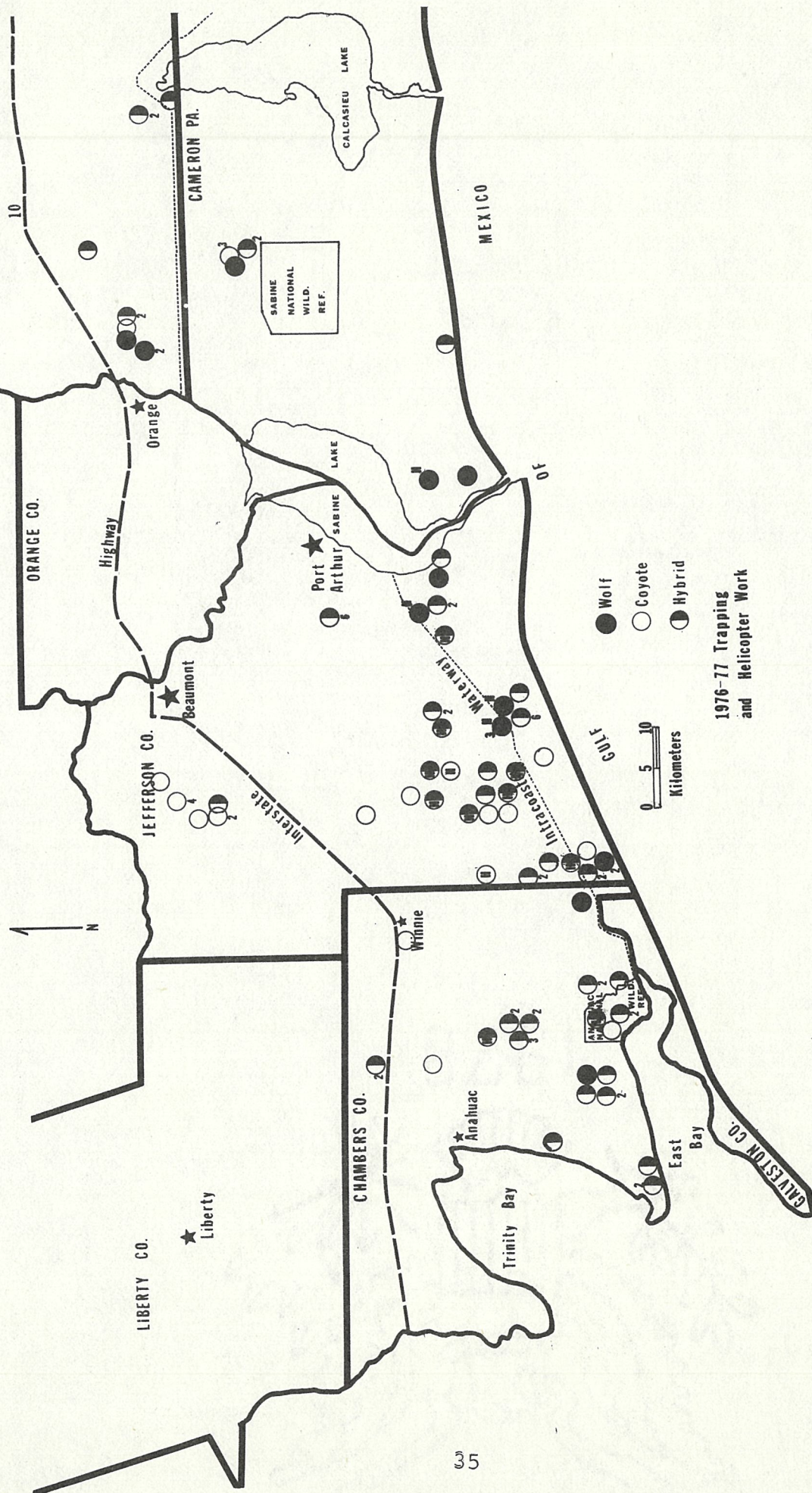


Fig. 9. The distribution of red wolves, coyotes and hybrids captured during the 1976-77 study period. Numbers adjacent to symbols indicate number caught if more than one. "H" designates canids captured by helicopter

TABLE 1. Standards for smallest acceptable wild adult red wolf.

	<u>Male</u>	<u>Female</u>
Skull length	215 mm	210 mm
Zygomatic breadth	110 mm	110 mm
Weight	50 lbs (22.5 kg.)	42 lbs (19 kg)
Total length	53 in (134.6 cm)	51 in (129.5 cm)
Hind foot length	9 in (22.9 cm)	8 3/4 in (22.2 cm)
Ear length	4 3/4 in (120.6 mm)	4 1/2 in (114.3 mm)
Shoulder height	27 in (685.8 mm)	26.5 in (673.1 mm)

TABLE 2. Kinds of wild canids responding to artificial howling for each of five years. N = number of localities.

Canid Associations	1972- 73	1973- 74	1974- 75	1975- 76	1976- 77
	<u>N</u> <u>%</u>	<u>N</u> <u>%</u>	<u>N</u> <u>%</u>	<u>N</u> <u>%</u>	<u>N</u> <u>%</u>
Wolves only	5 (31)	1 (5)	0	4 (7)	0
Hybrids only	6 (37)	10 (53)	19 (50)	22 (39)	21 (58)
Coyotes only	2 (13)	1 (5)	11 (29)	14 (24)	9 (25)
Wolves/Hybrids	3 (19)	6 (32)	7 (18)	8 (14)	2 (6)
Wolves/Coyotes	0	0	0	0	0
Hybrids/Coyotes	0	0	1 (3)	8 (14)	4 (11)
Wolves/Hybrids/Coyotes	0	1 (5)	0	1 (2)	0
 Total Localities	 16	 19	 38	 57	 36
 Total Trials	 92	 87	 126	 288	 195
 Response Rate (%)	 20	 28	 24	 20	 19

TABLE 3. Types, numbers (N) and per cent of canids captured in study area for each year.¹

	<u>1974</u> <u>N</u>	<u>1974-75</u> <u>N</u>	<u>1975-76</u> <u>N</u>	<u>1976-77</u> <u>N</u>
Wolves	10 (19%)	15 (27%)	9 (20%)	16 (15%)
Hybrids	33 (63%)	29 (52%)	25 (57%)	67 (63%)
Coyotes	9 (17%)	11 (20%)	10 (23%)	24 (22%)
Total	52	55	44	107

¹Trapping efforts and locations changed from year to year, so only very rough comparisons are valid. (See text p. 7.)

