STATUS OF THE LYNX (Felis lynx, FELIDAE) IN COLORADO WITH COMMENTS ON ITS DISTRIBUTION IN WESTERN UNITED STATES.

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Abstract -- The current and historical status of Canada lynx (Felis lynx) in Colorado was evaluated. Eight sets of tracks and eleven unreported or new specimens located during this project indicate that relatively sparse populations of lynx persist in central Colorado. Lynx appear to be associated with dense spruce-fir forests on northern slopes with an abundance of large boulders and rock outcroppings. Since 1959, records of lynx have been restricted to elevations above 2730 m. The southern limits of lynx distribution in the western United States are disjunct, with Colorado, Utah, and perhaps Wyoming being separated from continuous range of lynx to the north. The southernmost specimen of the lynx was collected in Colorado at a location 3 km north of the New Mexico border. The apparently disjunct lynx populations in Colorado show some synchronization with population cycles in northern North America.

The distribution of the Canada Lynx (Felis lynx) in North America has been mapped by Deems and Pursely (1978), and Hall (1981). Information on individual states has been provided by Armstrong (1972) for Colorado, Bailey (1936) for Oregon, Dalquist (1948) for Washington, Durrant (1952) for Utah, Hoffmann et al (1969) for Montana, and by Long (1965), Clark and Stromberg (1987), Reeve, et al. (1986), for Wyoming. The lynx reaches its southern limits in Colorado and Utah (Hall, 1981).

Little is known about the historical abundance, distribution or status of lynx in Colorado, although records date from 1870. The Colorado Division of Wildlife (CDOW) has kept records of 1939, but did not differentiate lynx from bobcats (Felis rufus) until 1970. In 1970, the lynx was accorded the legal status of protected nongame mammal because of its apparent rare status. The lynx is currently listed as endangered in Colorado and the last verified specimen was trapped in 1974.

Interpretation of the small number of records from Colorado is hindered by possible misidentification of lynx as bobcats or vice versa, and by the apparent cyclic nature of lynx populations. During population highs, lynx may emigrate considerable distances from their usual range (Nellis and Wetmore, 1969; Mech, 1977), the range being defined by van Zyll de Jong (1971) as "those areas that support lynx populations during the low and high phases of the 10-year cycle." Additional knowledge about lynx distribution and ecology in Colorado is highly desirable because lynx are at their southern limits, their numbers may be decreasing, and, if still surviving, lynx are currently extremely rare.

We conducted a two-year study as part of a CDOW program on state endangered wildlife. The purpose of the study was to verify the presence of populations of lynx in Colorado, to estimate population sizes, to identify areas of significant habitat, and to understand the biogeographical role of the southernmost lynx populations in North America. The lynx project was

conducted in conjunction with a similar project on wolverine (Gulo gulo) (Nead et al., 1985) to maximize efficiency.

Study Areas -- An area outlined by a polygon formed by connecting the towns of Eagle, Vail, Aspen, Dillon and Leadville was selected for intensive field study. This area included parts of Summit, Eagle, Pitkin, Lake, and Park counties. In 1979, emphasis was placed on the Frying Pan River above Meredith (Eagle and Pitkin counties), because a lynx was shot near there in 1969 (Terrell, 1971). The terrain is very rugged, with elevations ranging from 2400 to above 4200 m. Vegetation types include lodgepole pine (Pinus contorta), spruce-fir (Picea sp. and alpine fir, (Abies lasiocarpus) stands, and alpine tundra. Large stands of aspen (Populus tremuloides and many open parks exist. Within the greater study area snowshoe hares (Lepus americanus) are abundant (Dolbeer and Clark, 1975) and white-tailed ptarmigan (Lagopus leucurus) also are found (Braun, et al., 1976).

Search efforts centered around Vail Pass, Leadville, Mt. Evans, and Berthoud Pass during 1980. After tracks were found on West Chicago Creek (Clear Creek County), an intensive survey was made of the valley. West Chicago Creek consists of a narrow (less than 1 km wide), north-trending drainage with stands of spruce-fir forest, mixed spruce-fir and aspen. Spruce-fir stands varied from dense (3-4 m between trees) to very open (greater than 15 m between trees). Boulder fields and rock outcroppings were present and snowshoe hares were abundant.

Methods -- A literature review was conducted to compile reports of the lynx south of the Canadian border. In additions, more than 3000 requests for information about lynx in Colorado were distributed state-wide to District Wildlife Managers, taxidermists, trappers, outfitters, private individuals, and federal and state agencies. Knowledgeable people were interviewed and museums and private collections were visited. Information concerning lynx distribution was also obtained from a 1975 survey of 1249 licensed fur trappers in Colorado (Denney, 1975).

Thirty field days during the periods of January to April of 1979 and 1980 were spent specifically looking for lynx. We also searched other areas of Colorado as part of the CDOW wolverine verification program (Nead et al., 1985). An attempt was made to cover all trails above 2400 m in a given field area. Felid tracks greater than 85mm wide, with a straddle greater than 180mm, and a stride between 600 and 700mm, but only shallowly sinking into the snow, were classified as those of lynx (Murie, 1963; Halfpenny, 1986).

West Chicago Creek, Clear Creek Co. (selected due to the presence of lynx tracks in February, 1980) was surveyed to determine snowshoe hare density. After a fresh snowfall, the number of snowshoe hare tracks encountered on eight lines running both parallel and perpendicular to the valley bottom was recorded to give a relative index of hare density (Koehler, et al., 1979). The distance traveled and the type and density of trees on each line were recorded.

Results -- Tracks were found in the Frying Pan River and West Chicago Creek drainages during the two field seasons. Eight sets of tracks were found. Separation of the tracks by location and time indicated that the tracks represented from four to seven different animals. Tracks were observed on the

edges of dense spruce-fir stands near parks or aspen stands. Tracks were not found in any other vegetation association. All tracks found were above 2900 m. In both areas, tracks were found near large boulders and outcroppings. One of the five sets found in West Chicago Creek, crossed the open valley bottom between stands.

Snowshoe hares form the main prey base for lynx. Hares were abundant in the West Chicago Creek area where lynx tracks were located. Within the spruce-fir forest, 28 sets of hare tracks were observed in 1234 m of measured lines for an index of 23 hare tracks per km of trail. At some areas in the drainage, indices were as high as 75 hare tracks per km (21 hare/280 m). Snowshoe hares appeared to avoid open areas.

New information on the distribution of lynx in Colorado was obtained from several sources during the project. Museum collections and interviews with knowledgeable "old timers" provided eleven new or unreported specimens (Table 1). Personal interviews provided information on four more areas with lynx reports. The eight sets of tracks verified the presence of lynx at two other sites. New records from Colorado are mapped with all previously reported specimens of lynx from Colorado (Fig. 1). Some of our mapped sites taken from Cary (1911) differ slightly from Armstrong (1972) due to different interpretations of Cary's location descriptions. Locations of track reports taken from the 1975 survey of Colorado trappers (Denney, 1975) are included on this map.

The lynx in the Carter Collection, Denver Museum of Natural History (DMNH), taken at Cumbres Pass (Conejos Co.) represents the southernmost documented lynx in North America. The lynx taken in 1919 in the LaSal mountains (probably Montrose Co.) represents the last lynx taken in Colorado at an elevation below 2700 m. (approximately 9000 ft.). We recognized that the interviews presented in Table 1 represent personal opinion, but we accepted the reports, because the local individuals were knowledgeable about lynx. Their reports are significant in bridging the time span between reports of lynx listed by Cary (1911) and the lynx shot in 1969. In addition, Terrell (1971) reported a lynx trapped in 1929 at Red Cliff (Eagle Co.) and one trapped in 1931 at Marble (Gunnison Co.), and tracks observed in 1969 on the Roaring Fork River above Aspen (Pitkin Co.).

Lynx still exist in Colorado and their presence was verified by the observation during this study of eight sets of tracks in Clear Creek, Eagle, Lake, and Pitkin Counties. The four lynx killed since 1969 further support their presence.

We compiled reports of lynx in Colorado by decade to investigate the possibility of continued existence of lynx from the mid-1800's to present (Table 2). Available sources of information included (Allen, 1874; Coues, 1879; Warren, 1906, 1942; Cockerall, 1927; Seton, 1929; Young, 1958; Armstrong, 1972; Terrell, 1972; Denney, 1975; Halfpenny et al. 1979: Carter Collection, DMNH; Lincoln Collection 1972;). No reports of lynx were discovered for the 1940s suggesting the possibility that lynx populations went extinct in Colorado. However, it is impossible to prove whether the high mountain populations actually went extinct or simply that there are no available specimens for that time period. Considering the remoteness of the Colorado mountains, we believe the later explanation more likely.

Records from Canada and elsewhere in the United States were compiled to better understand the spatial and temporal distribution of lynx reports in western United States (Fig. 2). Trends in the lynx harvest are shown by numbers of lynx taken by trappers, hunters, and control agents in Canada and the northwestern United States between 1960 and 1975 (Nellis, 1971; van Zyll de Jong, 1971; Deems and Pursely, 1978; Statistics Canada, 1979). The harvest from Minnesota, although not graphed, peaked in 1973-74 near the peak in the northwestern United States (Deems and Pursely, 1978). During this time period, lynx were taken in Colorado (Terrell, 1971; Halfpenny et al., 1979), Utah (A. Hegen, R. Hassenyager, and D. Peterson, Utah Division of Wildlife Resources, pers. comm.), and Wyoming (D. Crowe, Wyoming Game and Fish Department, pers. comm.; Long, 1965; Reeve et al., 1986; Clark and Stromberg, 1987). Additional reports of animals taken extralimitally to their usual range occurred in Iowa (Rasmussen, 1969), Nebraska (Gunderson, 1978), Oregon (Nellis, 1971), and South Dakota (Lee, 1962) from 1960 to 1975 (Fig. 1). All reports are indicated in Fig. 2. The temporal distribution of lynx reports suggests that extralimital reports and reports in Colorado tend to occur near peaks of populations in the northern U.S. and Canada.

Discussion -- Tracks, and specimens obtained since 1969 indicate that populations of lynx do exist in Pitkin, Eagle, Lake, and Clear Creek counties of Colorado. Lynx also probably exist in Summit, Grand, and Park Counties. However, it was impossible to estimate either population size or trends due to the small number of tracks encountered during the study.

During the 1969-70 season, the CDOW required separate reporting of lynx and bobcats taken by trappers. In that year, 26 lynx were reported (Denney, 1975). This number may be high since all CDOW personnel were not familiar with characteristics distinguishing lynx from bobcats. Since lynx received protected status, we have received additional reports of illegally trapped animals being shipped out of Colorado. These reports also suggest continued populations of lynx within Colorado.

Since our field work was in the central portion of the state, it is important to note that reports from southern and northern portions of the state suggest that lynx may exist there and further investigations are warranted. Of the ten trappers reporting lynx to the fur trappers survey, six reported lynx in the San Juans and one reported a lynx in Routt National Forest by Steamboat (Denney, 1975). Historical records also document lynx in these two areas.

We suggest that the lynx population in Colorado is now restricted to localized pockets because of low numbers. Other researchers (Berglund, 1971; Brand et al. 1976; Mech, 1980; Carbyn and Patriquin 1983) have reported localized concentrations of lynx. Localized concentrations of lynx may occur in areas where lynx survive during population lows and more knowledge is needed about what these localized areas offer lynx. Future studies in Colorado should try to locate and protect these localized concentrations.

This study provided an initial insight into the ecology of lynx in Colorado. The presence of boulder fields or large rock outcroppings may be an important habitat feature as these were present in areas occupied by lynx. Lynx habitat in Colorado appeared to be mainly in the spruce-fir association. However,

ecotones between conifer stands and aspen were also utilized. Koehler et al. (1979) have suggested that lynx concentrate their hunting activities within areas of high hare densities. Dolbeer and Clark (19765) found the densities of hares in central Colorado to be highest in the spruce-fir zone. Where lynx were located on West Chicago Creek and the Frying Pan River, we found hare densities to be high.

Several characteristics of lynx distribution in Colorado are apparent. First, the lower elevational limit of the distribution of lynx appears to be about 2500 m (approximately 9000 ft.) with local distribution partially restricted to densely wooded north slopes. Cary (1922:165) believed that lynx "...seldom...wander below 8,000 ft" (2400 ,). However prior to 1920, there were four reports of lynx at elevations between 2000 and 2400 m (Cary, 1911; Lincoln Collection, DMNH).

Second, some areas including small disjunct areas in Colorado above 2700 m do not appear to support lynx populations (Fig. 1). Further searching may located localized populations in these areas. It is interesting to note that we have no records of lynx from the Sangre de Cristos, Culebras and Wet mountains to the southeast of the main mountain mass.

Third, lynx populations in colorado are the southernmost in North America, with the Cumbres Pass specimen (DMNH) representing the southernmost documented lynx.

South of the Canadian border, information is lacking on the status, distribution, and ecology of lynx in the western U.S. Lynx are harvested annually in Washington, Idaho, and Montana (Deems and Pursely, 1978; Hoffmann et al., 1979). Canadian populations might provide a source for continued replacement for the more southern populations (Nellis, 1971) but populations in Colorado, Wyoming, and Utah may be disjunct from the continuous range. A brief review by state will help to clarify the biogeography of populations in Colorado.

A remnant population of lynx may exist in the Blue Mountains of Oregon (Nellis, 1971). However, lynx always have been scarce there (Bailey, 1936, reported only two specimens) and now have probably been extirpated (Deems and Pursely, 1987). One lynx was taken in 1964 (Nellis, 1971).

Although Long (1965) concluded that lynx had been either restricted to the high mountain ranges of Wyoming or extirpated, he still listed one lynx taken in 1963 at a location 13 km southeast of Laramie. Reeve et al., (1986) reported a study of 262 records indicating the continued existence of lynx in Wyoming. Most reports were centered in northwestern Wyoming. Clark and Stromberg (1987) reported a lynx from the Big Horn mountains in north, central Wyoming. In January, 1974, one of us (JCH) tracked a lynx near the Snake River Hot Springs, Yellowstone National Park.

Early authors (Barnes, 1927; also see Durrant, 1952) listed large numbers of lynx in Utah. However, Durrant (1952) believed that historical records were exaggerated due to confusion with the large gray form of the bobcat (Felis rufus). Only two specimens of lynx are available from Utah (Durrant, 1952). The Colorado specimen from the La Sal Mountains was taken very close to the Utah border.

Records of lynx in other states at the southwestern limit distribution are scarce. When Hall (1946) reviewed the mammals of Nevada, no lynx were known from that state. However, Schantz (1947) located one specimen taken in 1916 on the little Owyhee River Elk Co., North Central Nevada. The presence of lynx has never been documented in New Mexico (Findley et al., 1975), although the Cumbres Pass specimen from Colorado is from only three kilometers north of the border. No resident populations have been reported in North Dakota, although wandering individuals have been taken during the peaks of population cycles in the north (Bailey, 1926; Adams, 1963; Mech, 1973).

During cyclic population highs, lynx may emigrate greater distances than previously thought. Eruptive movements have been recorded into Minnesota, North Dakota, and locally elsewhere (Adams, 1963; Sauders, 1963; Nellis and Wetmore, 1969; Mech, 1973, 1977; Henderson, 1978) with the greatest documented travel distance, a 448 km movement in three years (Mech, 1977). The extralimital individuals killed in South Dakota, Nebraska, and Iowa might represent emigrations of approximately 540 km, 660 km, and 600 km, from the nearest known populations. Movements of lynx from Canada and North Dakota to these states would be facilitated by the Red and Missouri River systems.

Because there appears to be a greater tendency to document lynx in Colorado, Utah and Wyoming during the peak populations in the north (Fig 2), these disjunct populations may be synchronized with northern population cycles or alternatively the populations may receive emigrants from areas to the north. The current, continuous southern limit of lynx distribution includes the mountainous regions of Washington, Idaho, and Montana with disjunct populations in Colorado, Utah, and Wyoming. Although lynx emigrations to Utah and Wyoming are possible due to the proximity of the northern mountain ranges, east-west trending rivers reduce the likelihood of such an event. Colorado is also isolated by the Red Desert of Wyoming, a habitat seemingly unsuited for lynx and possibly large enough to prevent successful dispersal. Therefore, it is likely that Colorado populations are isolated completely and represent remanents from the last glacial period.

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Table 1. New records of lynx or lynx tracks from Colorado.

Location	Sex	Date	Source	Documentation
Cumbres Pass, Conejos Co.	?	late 19th century	Edwin Carter Collection	DMNH
Breckenridge, Summit Co.	?	"	"	DMNH
Breckenridge, Summit Co.	F	18 Sept. 1878	"	DMNH
Soda Gulch, Clear Creek Co.	M	30 Jan. 1878	"	DMNH
No Locality	?	3 Aug. 1883	"	DMNH
No Locality	F	15 Feb. 1889	"	DMNH
No Localtiy	M	1 Mar. 1897	"	DMNH
La Salle (sic) Mts., CO (Probably Montrose Co.)	?	23 May 1919	Burns, Collector Frederick C. Lincoln	DMNH (Since the main massif of the La Sal Mountains is in Utah, this specimen would have been obtained at approximately 2,400 m or less)
Upper Homesteak Cr., Eagle Co.	?	1930	Charles Colby,	Personal interview. Mr. Colby described a completely black tip on the tail of the cats indicating that they were Felis lynx (see below)
Eagle Co. (two lynxes)	?	1936	Charles Colby	See above
South side of Vail Mtn., Eagle Co. (3,000 m)	?	1969	Durbin McIlnay	Personal interview Very good description
SE Leadville, Lake Co. (3,200 m)	?	1969	Anton Purkat, Leadville	Trapped 1 of 2 lynx determined present by tracks
Guanella Pass, Clear Creek, Co.	?	1972	Bill Buxton	Trapped. Specimen is in the posession of Jefferson County Outdoor School of Evergreen, CO
Vail Ski Area, Eagle Co.	?	1974	Illegal trapping	DOW Law Enforcement Office, Denver
Frying Pan River, Eagle Co.	?	since 1969	Pete Shearwood Eagle	Has observed 5 sets of tracks since 1969
Frying Pan River	?	1979	Lynx Verification	3 sets of tracks, 2 or 3 lynxes
West Chicago Creek, Hell Hole, Clear Creek, Co.	?	1980	Lynx Verification	5 sets of tracks, 2 to 4 lynxes

DMNH = Denver Museum of Natural History

Table 2. Distribution by decade intervals of lynx records in Colorado.

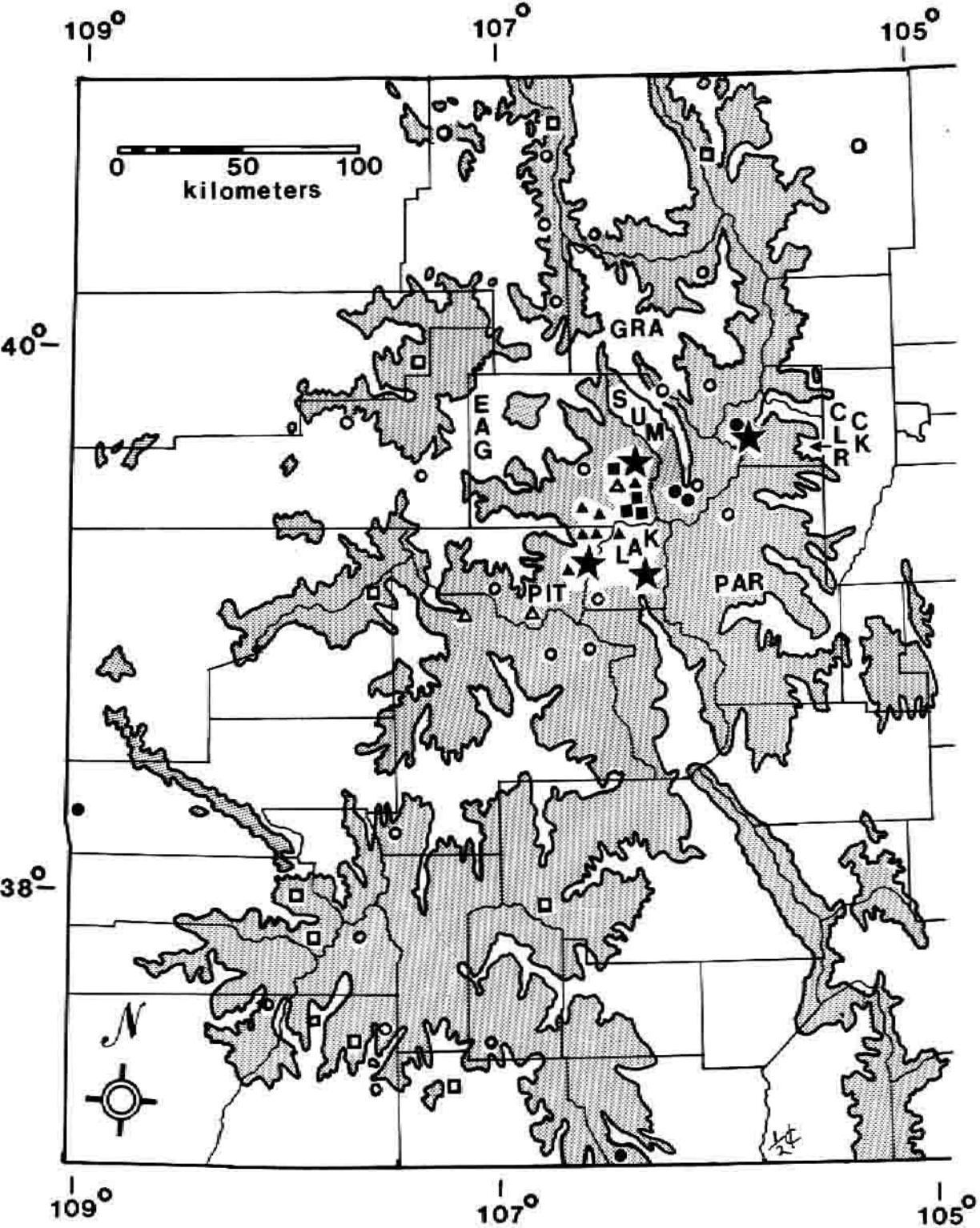
Decade starting	Area	Number of	Source and comments
1870	Mt. Lincoln, South Park	"skins"	Allen (1874)
	Breckenridge, Soda Creek	2	Carter Collection
		several	Coues (1879) Probably gray variety of Lynx rufus
1890	Area not specified	1	Carter Collection
	Taylor River, Snow Mass Peak. Independence Pass	30-40	Cary (1911)
1900	Silverton, La Plata Mtns, Grand Lake, Mud Springs (White River Plateau), Williams Fork (Grand River), Arapahoe Creek (Rabbit Ears), Park Range, Mt. Jackson, Middle Park, Hahns Peak, Elk Head Mts, Bayfield, Williams Rvr Mts, South Fork White River, North Pagosa Springs, Vallecita, Laramie River, Grand Encampment Rvr, Wet Mts (or Sangre de Cristos)	about 80	Cary (1911)
1910	San Juan Mts, La Plata Mts. Gore Range, Rabbit Ears Vasquez Mts, South Pitkin Co., Eagle Co. La Sal Mts.		"Canadian lynx are still decreasing" Cary (1911)
1920	Red Cliff	1	Terrell (1971)
	Dotsero	1	Seton (1929)
1930	Marble	1	Terrell (1971)
	Homestead Creek, Eagle Co.	3	Colby (personal interview
1950	Jefferson	1	Young (1958)
1960	Roaring Fork, Pitkin Co.	1	Terrell (1971)
	Frying Pan River, Eagle Co.	1	Shearwood (1 shot)
	S of Vail, Eagle Co.	1	McIlnay (1 shot (elevation 3,800 m)
	SE of Leadville, Lake Co.	2	Purkat (1 of 2 was trapped)
1970	Guanella Pass, Clear Creek Co.	1	Buxton (trapped)
	Vail, Eagle Co.	1	1 trapped, 2 present
	Frying Pan River, Eagle Co.	2-3	Lynx Verification Program
1980	West Chicago Creek, Clear Creek Co.	2-4	Lynx Verification Program

Figure Legends

Fig. 1. Lynx distribution in western Colorado. Southern distributional limits in North America and extralimital reports are shown in inset. Key counties in Colorado are Clr Ck = Clear Creek, Eag = Eagle, Gra = Grand, Lak = Lake, Par = Park, Pit = Pitkin, and Sum = Summit.

Fig. 2. Canadian and northwestern United States (Idaho, Montana, and Washington) lynx harvest by trapping season. The year indicates the fiscal year starting in the fall. Letters, which indicate by year the states where notable reports of lynxes were obtained, are C = Colorado, I = Iowa, N= Nebraska, O = Oregon, S = South Dakota, U = Utah, and W = Washington.

COLORADO LYNX DISTRIBUTION



★-RECENT SPECIMEN

LYNX VERIFICATION PROGRAM

▲-TRACKS

■-ACCEPTED REPORT

●-DENVER MUSEUM NATURAL HISTORY

△-REPORTED BY TERRELL

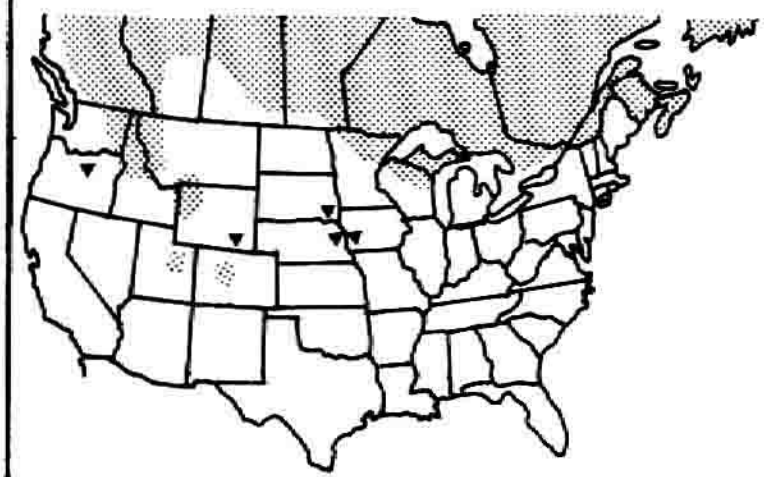
□-COLORADO TRAPPER'S SURVEY

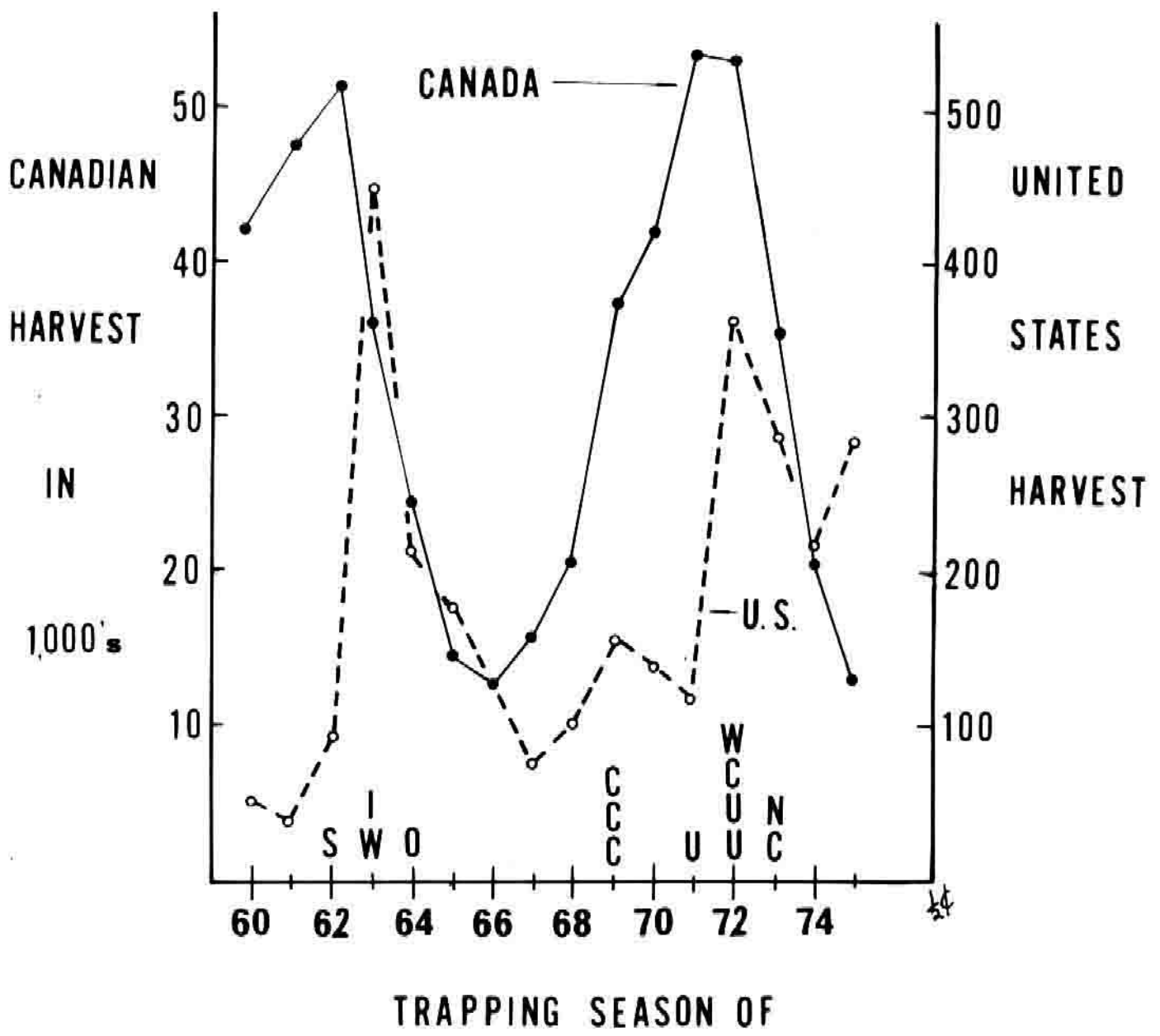
○-LITERATURE PRIOR TO 1912

SHADED AREA IS ABOVE 2,730 METERS

SOUTHERN LYNX DISTRIBUTION AND EXTRALIMITAL REPORTS

▼-EXTRALIMITAL REPORT




CANADA
U.S.
CANADIAN HARVEST IN 1,000's
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50
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TRAPPING SEASON OF