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# GRAY PARTRIDGE DISTRIBUTION AND RELATIVE ABUNDANCE

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CONTENTS



ABSTRACT

Gray partridge (Perdix perdix) continue to expand their range in central and southwestern Wisconsin while populations diminish in the southeast. Much of the sand plain to the forest fringe in the central area and the Wisconsin River outwash flats and the old prairie ridges in the southwest have been recently colonized by partridge. Furthermore, two isolated partridge populations are persisting in the old prairie area of St. Croix County and the farmland of Clark and Marathon Counties. The latter population very likely resulted from a stocking program on the McMillan Wildlife Area in the late 1960's while the former colony has been present since at least the 1930's. Currently, the heart of gray partridge range in Wisconsin lies firmly in the east central area on the Lake Michigan red clay soils. The region is typified by small farm units with a high percentage of land under cultivation and a cool, dry summer climate. Within the primary range, the better densities are found in areas of lesser acreages of woodlands and wetlands.

Partridge harvest trends in Wisconsin between 1932-74 were cyclic, paralleling harvest statistics for Canadian populations. Early in each decade the kill was higher than in the waning years of that period. Winter coveys in Wisconsin averaged 8.1 birds and experienced a 31 percent fall-to-spring mortality rate.

## HISTORIC DISTRIBUTION AND ABUNDANCE

Colonel Gustav Pabst introduced the first gray (or Hungarian) partridge (Perdix perdix) in Wisconsin through a series of releases between 1908-29 (Leopold 1940). Approximately 5000 partridge from Bohemia (Western Czechoslovakia) were liberated in Ottawa Township, Waukesha County. The early releases by Pabst were augmented by additional private planting and stocking by the State Conservation Department. Leopold (1940), McCabe and Hawkins (1946), and Besadny (1965) have provided the details of these early introductions and the ensuing range extension in Wisconsin from 1908 to 1965.

The spread of gray partridge from initial plantings averaged 4 miles per year through 1937 when the species occupied a 7000-square mile area of southeastern Wisconsin (Leopold 1940) (Fig. 1). Partridge were found from the eastern fringes of the driftless-prairie region to the southern limits of the Lake Winnebago red clay area across southeastern Wisconsin to Lake Michigan and into Illinois. Isolated populations were present in the west central counties of Polk, St. Croix and Buffalo and a northeast county, Outagamie (McCabe and Hawkins 1946). These small populations were discovered by a 1943 survey, but never plotted on a map.

The northward spread of gray partridge accelerated to 8 miles per year between 1944 and 1954 on the red clay soils along Lake Michigan (Besadny 1965) (Fig. 1). Partridge became most abundant in these east central counties as populations declined in the southeast. Sparse populations of partridge had penetrated the eastern fringes of the central sand counties and the driftless-prairie region.

An unusually heavy concentration of gray partridge appeared along the lakeshore counties during the 1950-51 winter. A count of 783 partridge was tallied on January 23, 1951 along a 100-mile lakeshore route between Milwaukee and Two Rivers. A concentration of 299 birds was present on the Manitowoc municipal golf course. High partridge populations combined with adverse winter weather were believed responsible for the shift of birds to the lakeshore (Pittman-Robertson Quart. Prog. Rep. X(1):205). Populations of partridge were temporarily reduced on the western fringe (Marinette, Shawano and Waupaca Cos.) of their Wisconsin range following the severe winter of 1950-51.

In 1965 the gray partridge occupied a 15,000-square mile area of eastern Wisconsin with the small pocket of birds still present in the west central area (Besadny 1965).

PROCEDURES FOR 1975 SURVEY

A current distribution map of gray partridge in Wisconsin was prepared from four mail questionnaire surveys. Two-part questionnaires were sent to 245 DNR field personnel, 311 Wisconsin Conservation Congress delegates, 631 conservation clubs and 200 members of the Dane County Conservation League.

Part I of the questionnaire to DNR field personnel requested the civil township or range/township/section of gray partridge observations during the period July 1, 1972 to August 31, 1974. The inquiry sent to Conservation Congress members and conservation clubs asked for the nearest road intersection from sightings of partridge for the same period. Part I of the questionnaires also solicited a subjective opinion as to whether gray partridge populations were declining, relatively stable or increasing during recent years.

Part II of the questionnaire was to be completed as a diary during the period September 1, 1974 to March 31, 1975 for DNR field personnel and October 1, 1974 to March 31, 1975 for the other groups. Observations of gray partridge were to be tallied in the same manner as Part I. Participants were asked to obtain covey counts and classify them as "very likely" or "not likely" complete.

Part II of the questionnaire also solicited information on partridge hunting and a collection of partridge wings. Cooperators were asked to record the total hours directed principally at hunting for gray partridge and the number of partridge shot either incidental to hunting other species or while hunting specifically for partridge.

Response to Part I of the questionnaire, which was to be returned at the "earliest convenience," was 14 percent (Table 1). A mere 3 percent of the conservation clubs returned completed questionnaires while 95 percent of the DNR field personnel responded. Only 6 percent of all questionnaire recipients returned Part II, which was to be completed as a diary.

TABLE 1. Response on the gray partridge questionnaire survey.*

| | Organization | No. Distributed | No. Returned: With Observations | No. Returned: Without Observations | Total | Percent Returned |
|---|---|---|---|---|---|---|
| PART I | Wis. Conserv. Congress** | 311 | 64 | 65 | 129 | 41 |
| | Conserv. Clubs[1] | 3,155 | 67 | 23 | 90 | 3 |
| | Dane Co. Conserv. League[2] | 200 | 59 | 48 | 107 | 53 |
| | DNR Field Personnel[3] | 245 | 90 | 143 | 233 | 95 |
| | TOTAL | 3,911 | 280 | 279 | 559 | 14 |
| PART II | Wis. Conserv. Congress | 311 | 17 | 20 | 37 | 12 |
| | Conserv. Clubs | 3,155 | 28 | 6 | 34 | 1 |
| | Dane Co. Conserv. League | 200 | 29 | 14 | 43 | 21 |
| | DNR Field Personnel | 245 | 47 | 63 | 110 | 45 |
| | TOTAL | 3,911 | 121 | 103 | 224 | 6 |

*The two-part questionnaires were mailed summer 1974; Part I was to be returned at "earliest convenience," while Part II was to be completed in diary form 1 October 1974 to 31 March 1975.

**Congress members in the Northwest District not polled in Part I and II.

[1]Five questionnaires sent to 631 clubs statewide except Northwest District, Part I and II.

[2]Dane County Conservation League given 200 extra questionnaires for intensive survey of Dane County area, Part I and II.

[3]Number of field personnel selected to participate in survey, Part I and II.

Observations reported on both parts of the questionnaires sent to all groups were combined and tallied by civil township to prepare the 1975 distribution map for gray partridge (Fig. 2). The range map is composed of about 1100 sightings; repetitive observations in a civil town were not designated.

No observations were excluded from the range map in Figure 2; however, only reasonable sightings were encompassed by the range delineated for comparative purposes in Figure 1. The observations of gray partridge in Wood, Monroe, Trempealeau and Juneau Counties (Fig. 2) are questionable since the respective civil towns with reported sightings are extensively forested. Wisconsin residents often refer to ruffed grouse as "partridge" -- a plausible explanation for the aforementioned unusual locations. Species misidentification was minimized in this survey since each questionnaire, except for those to DNR field personnel, included a picture of 3 gray partridge in appropriate agricultural habitat.

CURRENT DISTRIBUTION

The pattern of distribution for gray partridge in 1975 departed most notably from the 1965 survey (Besadny 1965) by the addition of sightings in Grant and western Iowa and Lafayette Counties (Fig. 1). Further range extension also occurred in the central sand counties, particularly, Adams and Portage.

The isolated population in St. Croix and Pierce Counties has persisted and is delineated for the first time on a range map (Fig. 1). The second pocket of partridge in Clark and Marathon Counties represents a new colony likely established from the stockings of 45 birds on August 22, 1966 and 8 birds on February 21, 1968 near the McMillan Wildlife Area. The stock was acquired from Saskatchewan, Canada and North Dakota by the Wisconsin Conservation Department. The covey in Eau Pleine Township, Marathon County was 6 miles from the McMillan release site while the sightings in Lynn and Grant Townships, Clark County, were 17 and 21 miles distant (Fig. 2). In another survey by the DNR Technical Services Section, a rural resident near Loyal, Clark County, reported sighting partridge in the spring of 1975. Loyal is about 16 miles west of the McMillan area. The Clark County sightings of partridge reveal a southwestward spread of 2.5 miles per year from the release site.

An index to the relative abundance of gray partridge was obtained from a rural mail carrier survey (RMC) conducted by the DNR Technical Services Section (Fig. 3). Since 1959 approximately 400 mail carriers in 25 eastern counties have recorded individual partridge coveys observed on their routes during January. In 1974, 8 counties in southwest and west central Wisconsin were added to the survey. The number of coveys per 100 miles is summarized by county; the collective length of all routes is roughly 32,000 miles.

The highest winter counts for a 14-year period, 1962-75, were obtained in Calumet, Brown and Manitowoc Counties. Roughly, 7-9 coveys per 100 miles were reported for the prime counties while second-ranked counties--Outagamie, Kewaunee and Door--had counts of about 5-6 coveys per 100 miles.

Besadny (1965) constructed a map showing the relative abundance of gray partridge from kill data for 1950-55 and from observations by Conservation Department field personnel (Fig. 4). In the 1950's the better partridge populations were found in the tier of counties adjoining Lake Michigan. The recent survey reveals an apparent reduction in the relative importance of the Lake Michigan populations south of Manitowoc (Fig. 3). The better populations (Common, Fig. 4) along the lake have now become mediocre or poor (2.8-0.2 coveys per 100 miles, Fig. 3) and the moderate populations (Fairly Common, Fig. 4) in the southeast (except Rock and Walworth Counties) have diminished to poor levels (0.7-0.8 coveys per 100 miles, Fig. 3).

The current relative abundance of gray partridge was further refined at the heart of Wisconsin range by plotting covey counts from individual post offices (Fig. 5). An average of 2.4 routes (range 1-15 routes) originated from the postal stations in this region. The area surrounding RMC routes with comparable covey counts were encircled. The resultant abundance map is influenced to an unknown degree by observer bias, (i.e., differences in ability to observe and identify partridge).

The best counts were obtained in 3 areas: (1) southern Brown County, east central Outagamie County, northern Calumet County and northwestern Manitowoc County, (2) central and southeastern Manitowoc County and (3) the eastern shore of Green Bay including portions of Brown, Kewaunee and Door Counties (Fig. 5). These areas of primary range adjoined secondary range which encompassed all of Brown and Kewaunee Counties plus portions of Manitowoc, Outagamie and Door Counties. Primary and secondary ranges were characterized by red clay soils and less acreage of woodland and wetlands than in tertiary range. The tertiary range in the 9-county area generally corresponds to the pattern of heavier concentrations of wetlands and swamps on loamy soils. All or most of Sheboygan, Calumet, Fond du Lac, Winnebago and Outagamie Counties comprise the tertiary range (Fig. 5).

CHARACTERISTICS OF WISCONSIN RANGE

The better gray partridge range in Wisconsin is typified by small farm units with a high percentage of land under cultivation and a cool, dry summer climate (Table 2). A comparison of the land use and climatic features between good and mediocre partridge range was accomplished by selecting representative townships from both range classes and summarizing their environmental features. The good range was represented by Holland and Scott Townships in Brown County, Centerville Township in

Manitowoc County and Center Township in Outagamie County while mediocre range included townships from a wide geographic area--Arlington Township in Columbia County, Monroe Township in Green County, Dodgeville Township in Iowa County, Erin Prairie Township in St. Croix County, Eau Pleine Township in Marathon County and Stockton Township in Portage County.

TABLE 2. A comparison of land use and climatic features between primary and secondary gray partridge range.*

| Feature | Good Range Mean | Good Range Range | Mediocre Range Mean | Mediocre Range Range |
|---|---|---|---|---|
| Land Use | | | | |
| Average size of farm (acres)** | 110.8 | 104.7-113.2 | 169.9 | 146.8-206.6 |
| Land area in farms (percent) | 92.5 | 87.0- 99.0 | 94.0 | 89.0- 99.0 |
| Cropland: Harvested | 63.1 | 60.2- 66.1 | 52.1 | 41.1- 68.8 |
| (percent) Pastured | 16.4 | 13.8- 18.0 | 14.4 | 7.0- 24.2 |
| Other | 0.8 | 0.8- 0.9 | 1.8 | 0.2- 4.5 |
| Woodland: Pastured | 9.2 | 2.0- 17.3 | 8.9 | 3.1- 19.4 |
| (percent) Not Pastured | 4.1 | 3.1- 5.1 | 4.2 | 1.0- 11.6 |
| Pastureland (percent) | 1.2 | 0.9- 1.7 | 14.2 | 2.9- 26.4 |
| Other farmland (percent) | 4.9 | 2.4- 8.1 | 4.1 | 2.2- 6.1 |
| Land area in woods (percent) | 12.4 | 7.0- 17.6 | 14.8 | 5.0- 30.0 |
| Climate[1] | | | | |
| Average Precipitation (inches): May | 2.9 | 2.5- 3.7 | 3.5 | 3.3- 3.8 |
| June | 3.7 | 3.4- 4.2 | 4.6 | 3.9- 5.3 |
| July | 3.0 | 2.6- 3.7 | 3.3 | 3.0- 3.6 |
| Year | 29 | 27 - 32 | 31 | 28 - 34 |
| Average Temperature (°F): May | 54 | 53 - 57 | 57 | 55 - 59 |
| June | 64 | 62 - 66 | 66 | 64 - 68 |
| July | 70 | 69 - 71 | 72 | 69 - 74 |
| Year | 44 | 43 - 45 | 45 | 42 - 48 |

*Land use and climatic data are from Wisconsin Rural Resources Crop and Livestock Reporting Service; the Wisconsin State Department of Agriculture had most of the statistics from a 1954 survey.

**Averaged by county rather than township.

[1]Data from weather stations nearest representative townships.

All 10 townships were arbitrarily selected; the 4 townships representing good range were from 3 areas of exceptional partridge numbers identified by the RMC survey (Fig. 5) and the 6 townships from mediocre range represented a variety of soil and topographic areas. Most of Arlington, Monroe, Dodgeville and Erin Prairie Townships were formerly prairie with rich silt loams which currently foster moderate to intensive farming. Stockton Township is from the central sand plain while Eau Pleine Township represents farmland carved from northern mesic forest. Except for Eau Pleine Township, the 6 representatives of mediocre range had more gray partridge sightings than adjoining townships in their region. Eau Pleine, Dodgeville and Stockton Townships became occupied by partridge during the past 20 years while Monroe, Arlington and Erin Prairie Townships had established partridge populations in the late 1930's.

Among the townships in good partridge range, average farm size was 110.8 acres versus 169.9 acres for the mediocre range group (Table 2). The actual land area farmed was slightly less in good range; however, the land was more intensively cultivated with less acreage devoted to pasturing. The percent of land area in forest and the use of wooded acreage for pasture was comparable between good and mediocre range. The average farm size increased statewide between 1954 and 1974; however, the average farm unit in good range remained smaller in 1974 than the smallest average farm unit in mediocre range in 1954 (Table 3).

The principal factors regulating partridge abundance appear to operate during the reproductive period with excessive precipitation and cool temperatures causing exorbitant chick mortality (Dale 1941, Middleton 1934, Jenkins 1961, Westerskov 1964 and Gates 1973). Climographs comparing European with North American range reveal summer climate in the Lake States to be warmer than the European optimum (Twomey 1936 and McCabe and Hawkins 1946); however, juvenile survival appears to be higher with warmer reproductive seasons (Dale 1941, Jenkins 1961 and Gates 1973). With an awareness of these relationships, we reviewed the climate of good and mediocre partridge range in Wisconsin (Table 2).

TABLE 3. The change in average farm size between 1954 and 1974.

| County | Average Size of Farm (Acres) 1954* | 1974** |
|---|---|---|
| Good Range | | |
| Brown | 112.6 | 144.1 |
| Manitowoc | 104.7 | 145.7 |
| Calumet | 109.2 | 144.7 |
| Outagamie | 113.2 | 145.4 |
| Combined | 109.9 | 145.0 |
| Mediocre Range | | |
| Columbia | 166.5 | 197.6 |
| Green | 164.0 | 197.4 |
| Iowa | 206.6 | 257.7 |
| St. Croix | 162.0 | 191.1 |
| Marathon | 146.8 | 179.3 |
| Portage | 173.8 | 212.5 |
| Combined | 169.9 | 205.9 |

*Statistics from Wisconsin Rural Resources, Crop and Livestock Reporting Service, Wis. Dept. Agri.

**Statistics from 1975 Wisconsin Agricultural Statistics, Wisconsin Statistical Reporting Service, Wis. Dept. Agri.

Precipitation was less and temperatures were cooler during May, June and July in the good range although none of the differences were statistically significant (P=.05). Gray partridge attain higher densities in the cooler, drier areas of Wisconsin either because of possible direct benefits to chick survival or indirect influence of agricultural activities. Alfalfa fields are highly preferred for nesting by partridge and Besadny (1965) speculated that nesting success might be higher in the lakeshore counties where hay mowing is delayed 7-10 days beyond southeast Wisconsin averages.

Dale (1941) and Gates (1973) concluded that excessive precipitation may be a more important influence of reproductive success than abnormal temperature. Therefore, I compared precipitation during June with the fall harvest of gray partridge for 1932-74 (Fig. 6). Precipitation data was taken from weather stations within the occupied range; that is, rainfall from additional recording locations was included in the average as partridge expanded their range.

A pattern of increased partridge harvest following drier Junes was not revealed by the comparison (r= .006, 41 d.f.). However, this may not disprove a relationship between June precipitation and fall abundance since harvest data may not reflect the actual abundance of partridge. The kill of partridge is influenced by the limitations of hunting regulations and possibly the availability of other game since most partridge are harvested incidental to other species.

The trend in partridge abundance portrayed by the rural mail carrier survey, 1959-75, does not parallel the harvest trend (Fig. 6) (r=0.047, 13 d.f.) and demonstrated only a slight inverse relationship with June precipitation (r=0.198, 15 d.f.).

The influence of June precipitation on immediate or long-term partridge abundance is not apparent using available indices of Wisconsin partridge populations. Recent partridge studies in England (Blank et al. 1967, Southwood and Cross 1969) support the hypothesis that variations in chick survival determine fall population levels; however, the principal determinant of chick survival is the relative abundance of insects during the reproductive period rather than unfavorable summer weather.

TRENDS IN ABUNDANCE

Recent trends in gray partridge abundance within the DNR administrative districts, except the Northwest District, were provided by the opinions of 223 respondents to the questionnaire survey (Table 4). During the previous 5-10 years, partridge populations were depicted as relatively stable or increasing in the North Central, Lake Michigan and Southern Districts while relatively stable or decreasing in the West Central and Southeast Districts. Apparently, partridge numbers are continuing to decline in the southeast counties where the best populations once existed.

Trends in gray partridge numbers are thought to show cyclic patterns. Gray partridge exhibit an 8-10 year cycle in Canada (Rowan 1948 and 1954) and Europe (Middleton 1934:241); however, McCabe and Hawkins (1946:15) and Besadny (1965) felt Wisconsin records did not demonstrate a cyclic tendency for partridge. The basis for Besadny's skepticism was the dubious value of harvest records for reflecting population abundance.

TABLE 4. Trends in gray partridge abundance among the DNR administrative districts as reported in the questionnaire survey.

| District | Trends in Gray Partridge Abundance, 1965-74 Decreasing | Relatively Stable | Increasing | Total |
|---|---|---|---|---|
| West Central | 5* | 5 | 0 | 10 |
| North Central | 4 | 8 | 7 | 19 |
| Lake Michigan | 11 | 36 | 23 | 70 |
| Southern | 15 | 46 | 38 | 99 |
| Southeast | 11 | 11 | 3 | 25 |
| TOTAL | 46 | 106 | 71 | 223 |

*Number of individuals reporting trend in gray partridge abundance.

With an awareness of the weaknesses of equating harvest with abundance, 43 years (1932-74) of partridge kill statistics were plotted (Fig. 7). Comparable data for ruffed grouse were also presented since a summary of Canadian investigations by Keith (1963:27,37) revealed a parallel trend (cycle) in the abundance of gray partridge, native grouse (sharptail and ruffed grouse) and snowshoe hare.

Gray partridge and ruffed grouse in Wisconsin show a similar pattern of harvest. Early in each decade the kill was higher than in the waning years of that period. Harvest statistics for Canadian populations of gray partridge, native grouse and snowshoe hare followed the same pattern (Keith 1963:27,37). Gray partridge kill peaked in Manitoba during 1934, 1941 and 1952 and in Alberta during 1942 and 1951. Ruffed and prairie grouse harvest peaked during 1933, 1942, and 1951 in Manitoba. Rowan (1948) and Keith (1963:61) have referred to these periodic fluctuations of harvest as cyclic.

The peaks in gray partridge kill in Wisconsin are better defined in the early 1940's and mid-1960's than during the 1950's. The prolonged peak in partridge harvest during the 1950's in Wisconsin is also apparent in kill statistics from Minnesota (Erickson and Burcalow 1953). A major problem with identifying cyclic tendency is identifying peaks and lows.

The kill of a variety of game species may be similar over a large geographic area. Harvest statistics for gray partridge in Wisconsin show a crude periodicity; however, a statement that Wisconsin partridge populations are "cyclic" would be premature because of the questionable relationship between harvest and actual abundance.

COVEY SIZES

Covey counts reported as "very likely complete" on Part II of the questionnaire were averaged by month for the period September through March (Table 5). Mean covey size diminished from 10.7 birds in September to 7.4 birds in March suggesting a 31 percent fall-to-spring mortality rate. McCabe and Hawkins (1946:12) reported winter mortality to average 40 percent (range 19-67 percent) for the Faville Grove, Wisconsin population during 1936-43. The mortality rate did not account for egress which was known to have occurred; thus, average winter loss was actually less than 40 percent.

TABLE 5. Covey sizes by month reported as "complete" counts in the gray partridge questionnaire survey, 1974-75, compared with sizes for a North Dakota population, 1938-41.

| Month | Wisconsin Number of Individual Coveys | Wisconsin Mean Covey Size | Range in Covey Size | North Dakota* Number of Individual Coveys | North Dakota* Mean Covey Size |
|---|---|---|---|---|---|
| September | 4 | 10.7 | 7-15 | 43 | 11.0 |
| October | 40 | 9.2 | 1-25 | 125 | 10.4 |
| November | 45 | 9.7 | 2-30 | 66 | 10.2 |
| December | 23 | 8.8 | 1-18 | 48 | 10.3 |
| January | 32 | 8.0 | 1-18 | 79 | 9.4 |
| February | 40 | 7.7 | 1-25 | 164 | 8.7 |
| March | 107 | 7.4 | 1-25 | -- | -- |
| TOTAL | 291 | 8.3 | 1-30 | 525 | 9.8 |

*Hammond (1941:377)

A North Dakota sample of 525 coveys averaged 9.8 birds (Hammond 1941) and experienced a 21 percent mortality rate during a September through February period (Table 5). The Wisconsin cohort averaged one less individual per covey at 8.8 birds and experienced a 28 percent mortality rate for a comparable period.

The average size of winter coveys at Faville Grove (McCabe and Hawkins 1946:12) was 11.1 and 9.2 birds in 1941 and 1942, respectively. December and January covey sizes of 8.8 and 8.0 computed from the questionnaire survey are substantially smaller. McCabe and Hawkins (1946:12) reported that winter coveys ranged from 1-30 birds; however, the larger coveys often separated into smaller groups when flushed, suggesting 2-3 family units. Groups of 18-30 birds reported in the questionnaire survey probably represented 2-4 coveys using a common feeding or loafing site.

A tally of covey sizes was also available from Part I of the questionnaire survey; however, no effort was made to differentiate "complete" from "incomplete" counts. The covey sizes were reported from memory and may tend to be inflated. Winter (December, January, February) covey sizes averaged 10.3 birds (n=47) among observations reported in Part I as compared with 8.1 birds (n=95) recorded as "complete" counts in Part II of the questionnaire (Append. A). Nonetheless, we can glean a crude picture of the annual pattern of covey compositon from covey sizes reported in Part I.

Pairing begins in February and 3 of 14 sightings during the month were of pairs apparently segregated from the covey. Pairs and small groups of partridge were observed from March through May. Blank and Ash (1956) reported that true territorial behavior is absent in gray partridge and Johnsgard (1973:485) indicated pair formation is unstable until nesting begins. It is common for unmated males to associate with a pair or for 2 mated pairs to occupy the same area.

Five of 24 partridge sightings in May included multiple pairs or extra birds (4, 5, 5, 5 and 6 birds). Pairs were observed until October; 27 of 50 sightings during the summer (June, July, August) were of 2 individuals. Groups of partridge, excluding pairs, averaged 10.4 birds (n=23) during the summer period. Brood size would be 8.4 if the groups did not include nonbreeding adult birds. Gates (1973:6) found a comparable brood size of 8.3 birds (n=74 broods) at the Waupun Area, Wisconsin during 1960-66.

No pairs were observed in November and the slight increase in average covey size reported from "complete" counts (Table 5) suggests winter coveys may be formed at that time. Hammond (1941:376) also reported that covey sizes increased slightly in October and November from September counts (n=234 coveys) and presumed unsuccessful breeding adults were joining family units.

## HUNTING STATISTICS AND AGE AND SEX RATIOS

Only 60 individuals provided data on gray partridge hunting. Ten of the cooperators expended 80 hours hunting exclusively for partridge, harvesting 27 birds. A total of 52 partridge were shot incidentally to the hunting of other species suggesting that most gray partridge are havested secondarily to other game.

A collection of 21 partridge wings supplied by these hunters had an age ratio of 2.5 juveniles per adult and a sex ratio of 1 male per 2 females. An average age ratio of 3.9 juveniles per adult (range 1.4 to 4.3) was provided by a sample of 14,000 birds examined between 1950 and 1963 in North Dakota (Johnson 1964).

## RECOMMENDATIONS

1. Inaugurate an investigation of factors limiting productivity of partridge with emphasis on early chick survival in the Lake Michigan red clay area of Wisconsin.

2. Continue the Rural Mail Carrier Survey of gray partridge conducted by the DNR Technical Services Section. It remains our only measure of partridge abundance.

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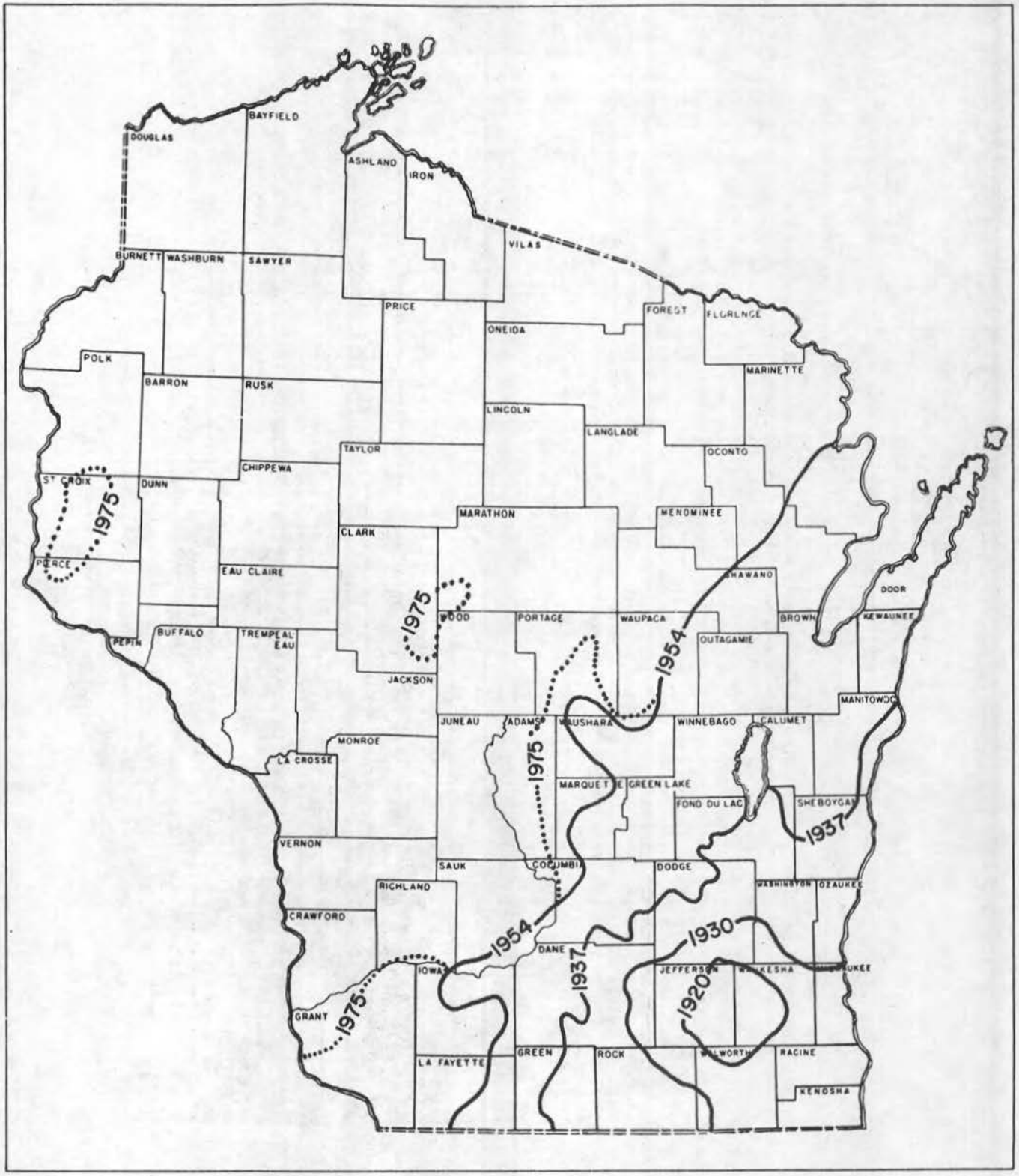


FIGURE 1. Changes in gray partridge distribution, 1920-75 (Leopold 1940, McCabe and Hawkins 1946 and Besadny 1965).

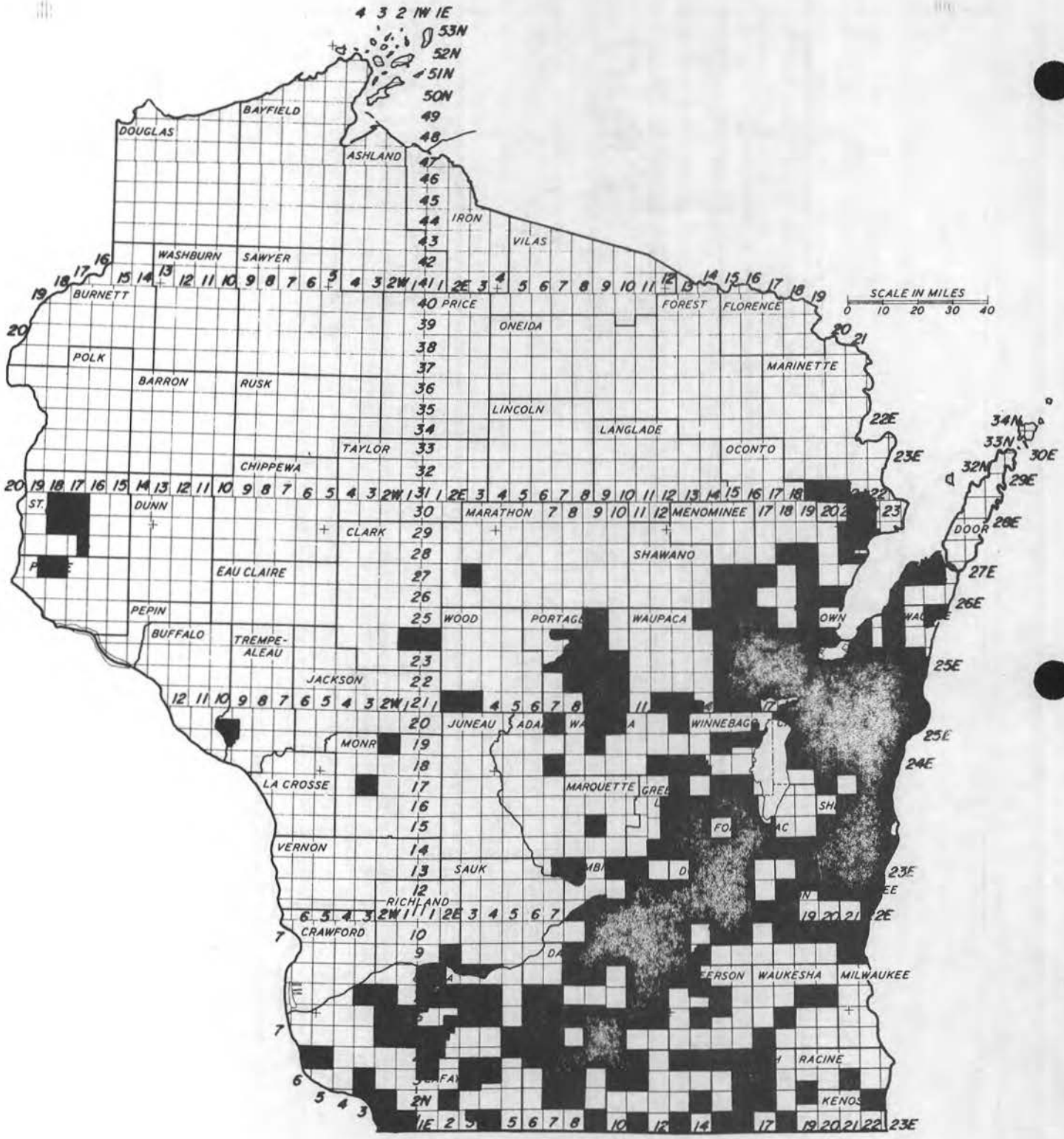


FIGURE 2. Gray partridge distribution, 1975, based on observations by Conservation Congress delegates, Conservation Clubs and DNR field personnel.

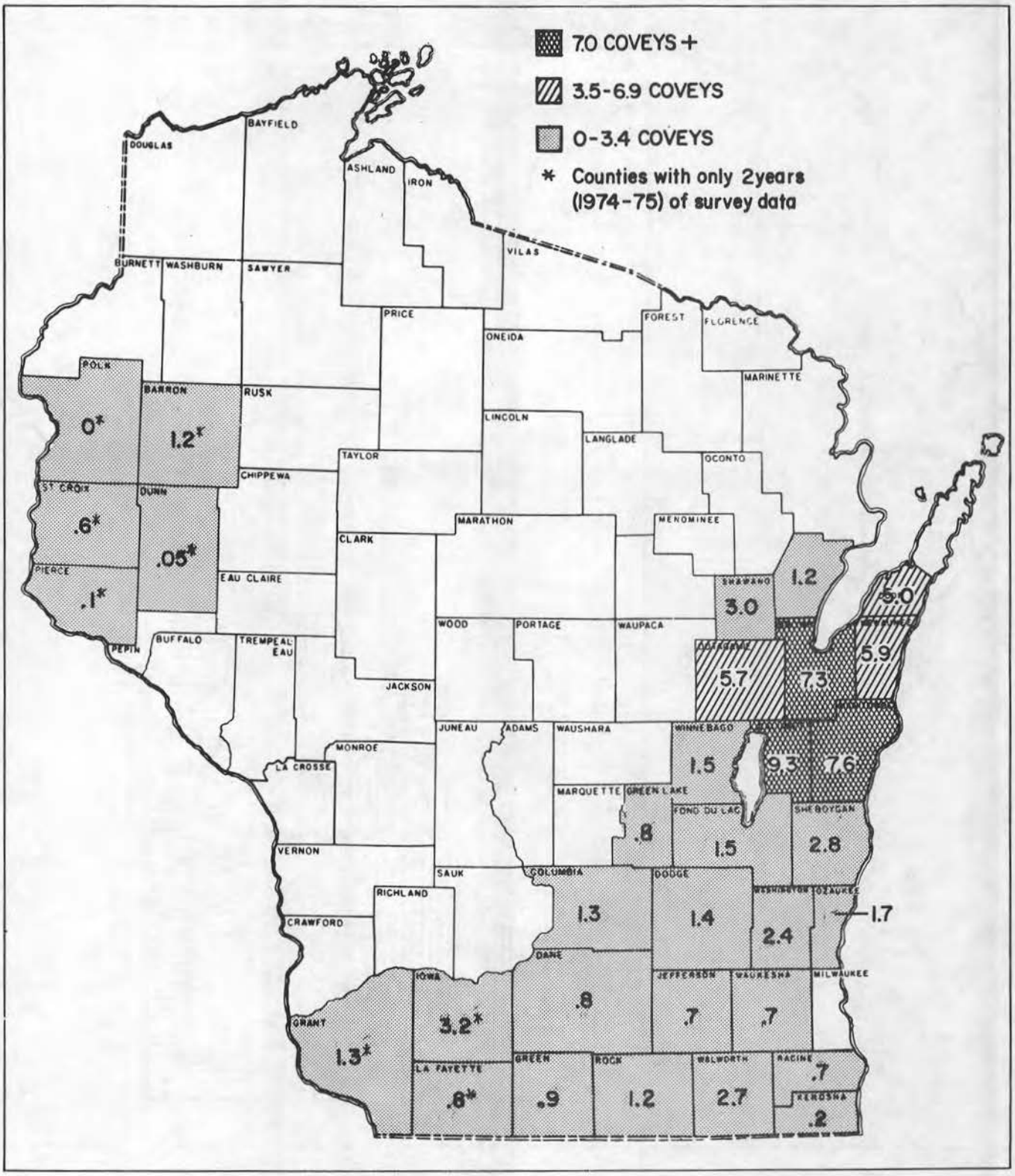


FIGURE 3. Relative density of gray partridge based on a rural mail carrier survey conducted by the DNR Technical Services Section, 1962-75.

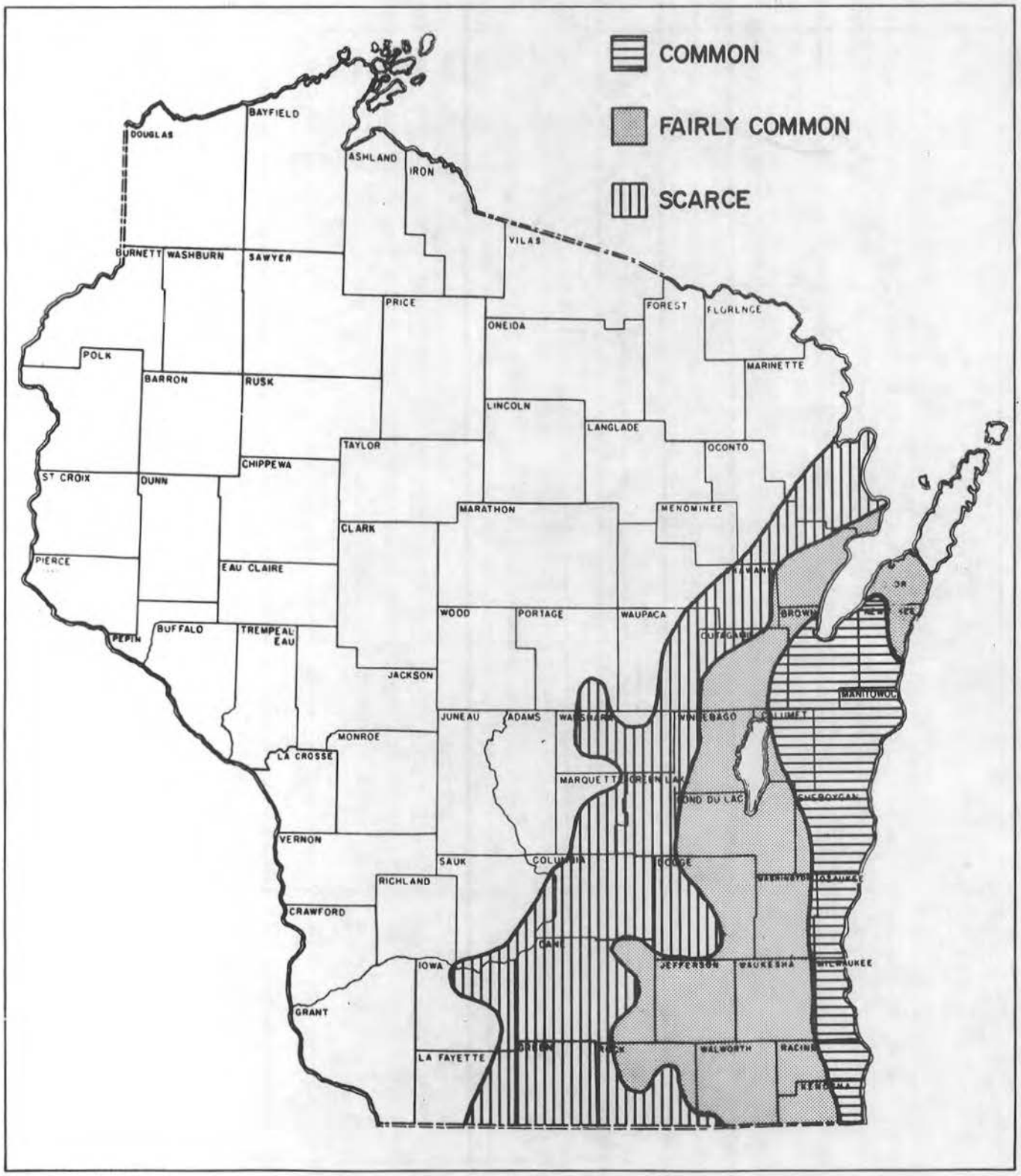


FIGURE 4. Relative density of gray partridge based on kill data, 1950-55, and observations by Conservation Department personnel (Besadny 1965).

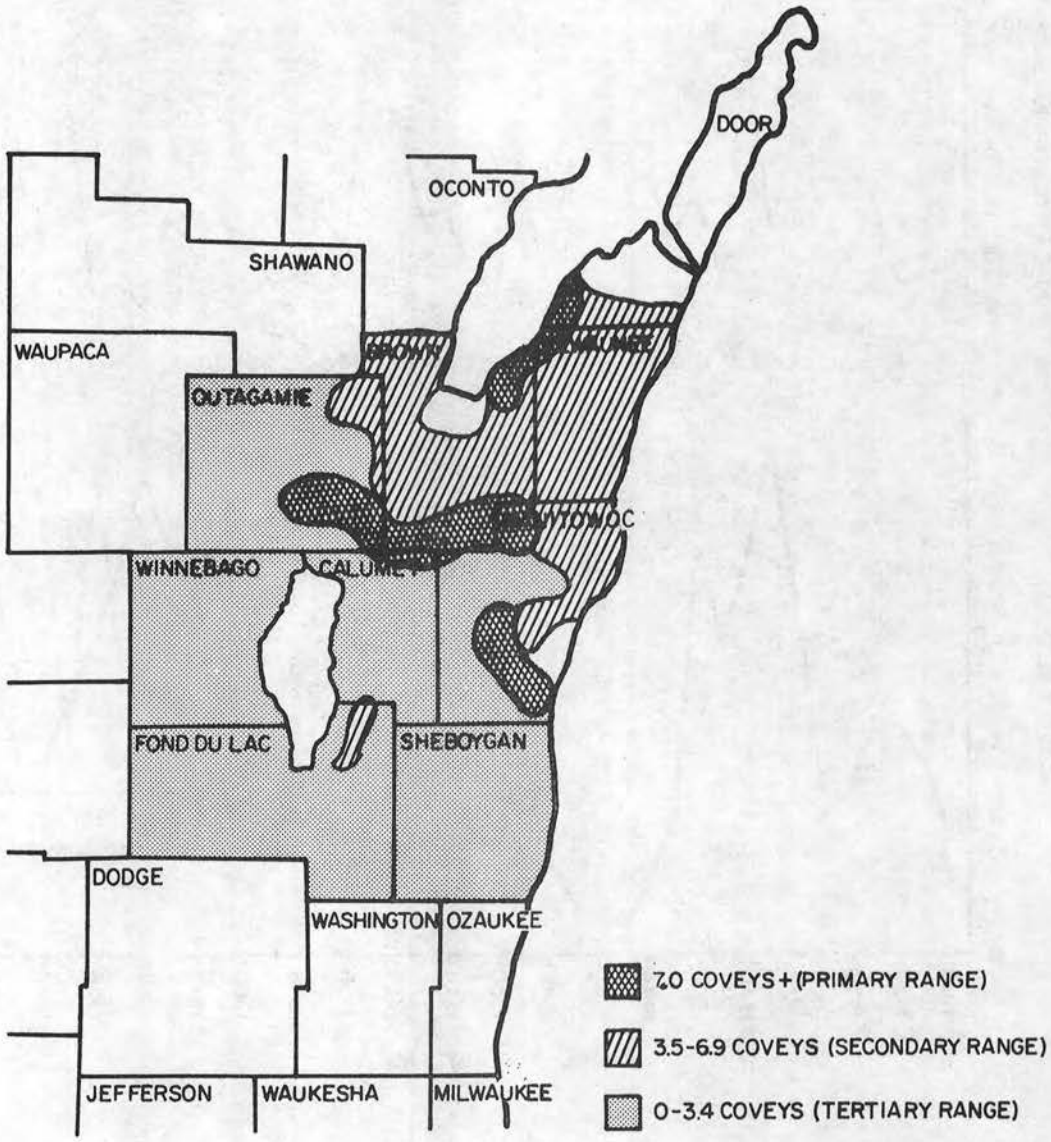


FIGURE 5. Relative density of gray partridge in an abundant area based on a rural mail carrier survey conducted by the DNR Technical Services Section, 1971-74.

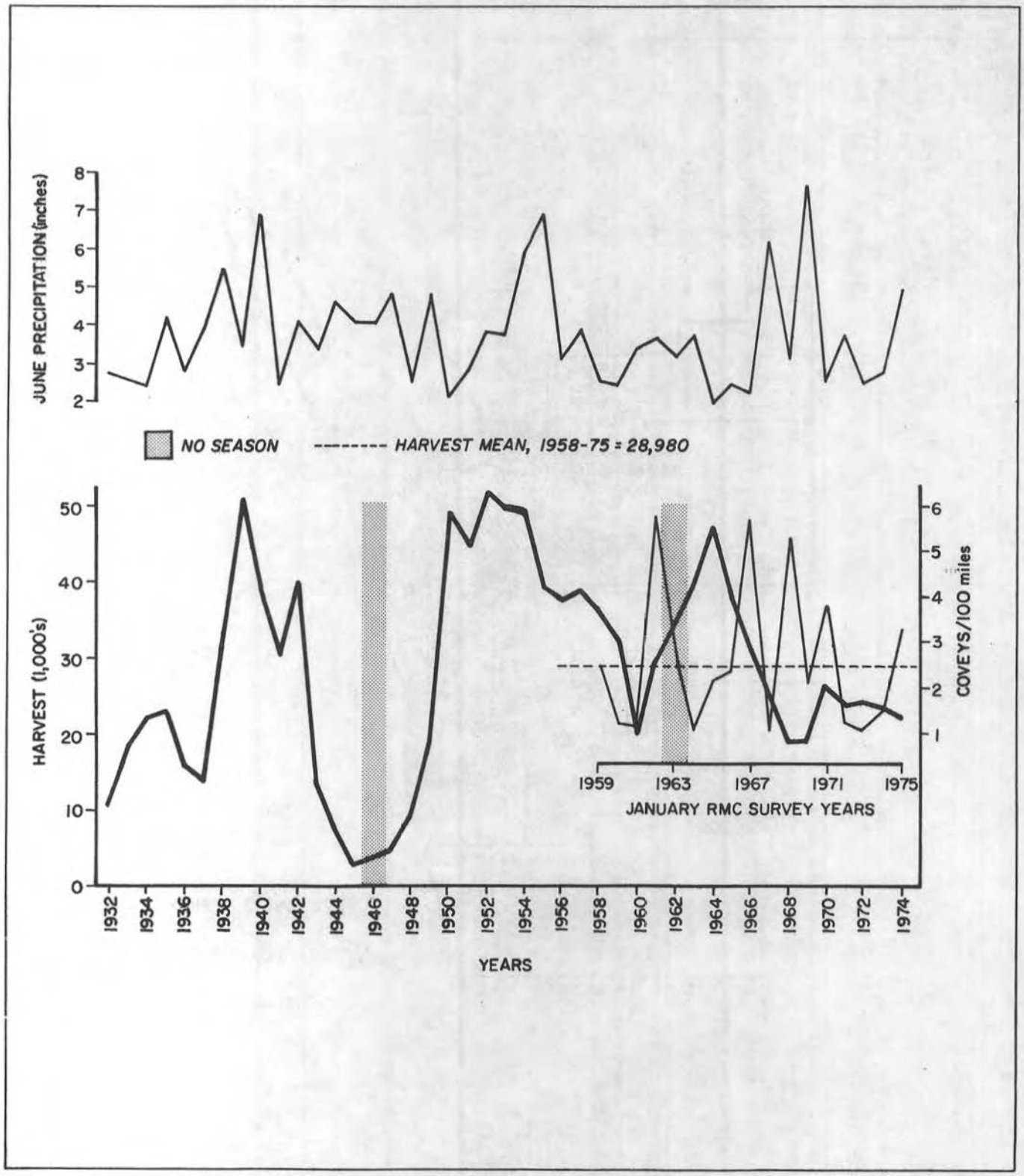


**FIGURE 6.** A three-way comparison involving two gray partridge population indices -- harvest and January covey counts by rural mail carriers -- and one climatic factor, June precipitation. Precipitation data received from weather stations at Lake Mills, Racine, Waukesha and Williams Bay, 1932-39; the aforementioned plus Plymouth, West Bend, Burnett and Fond du Lac, 1940-49; and the average of South Central and East Central regions, 1950-74 (Climatological Data, U.S. Dept. of Commerce).

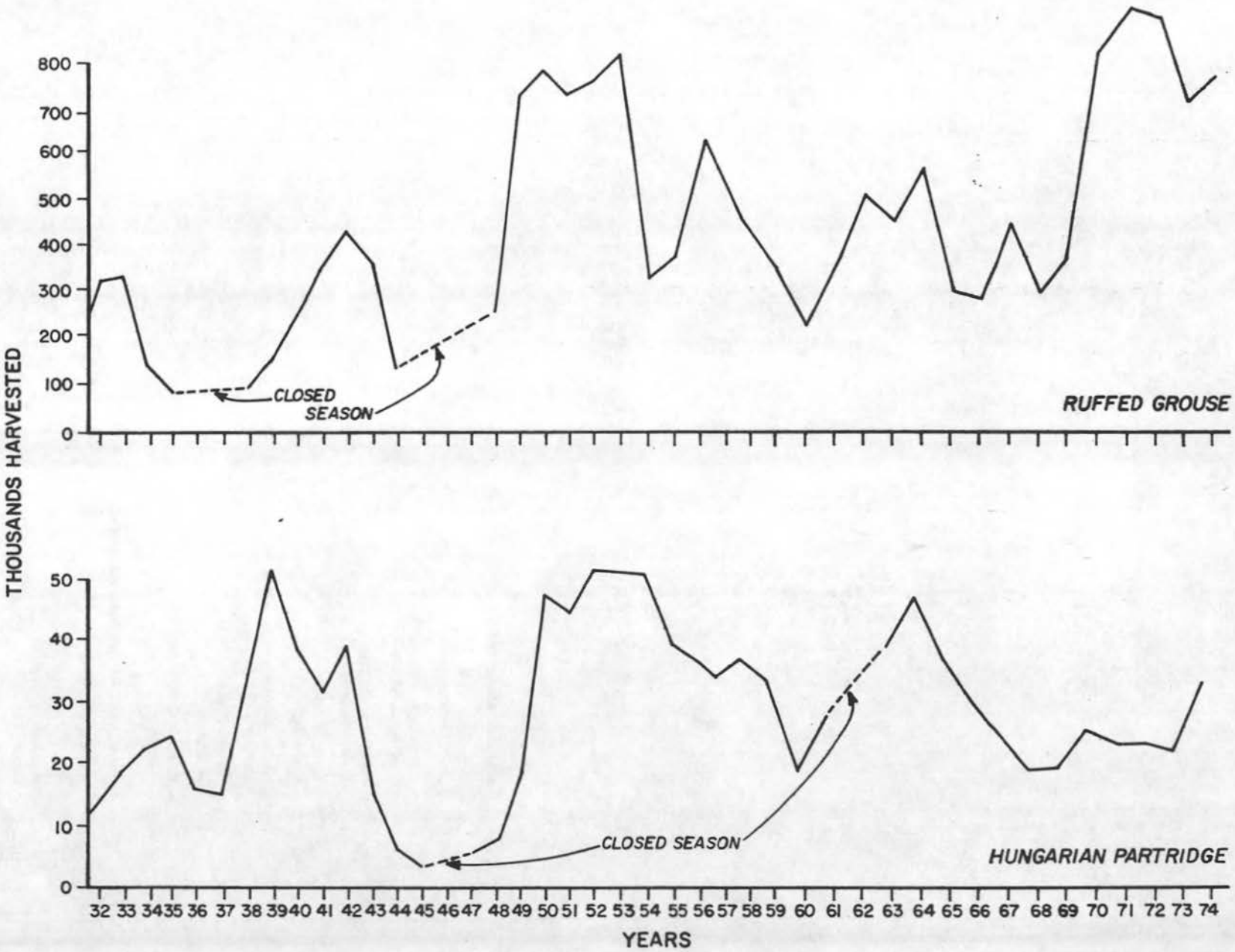


FIGURE 7. Harvest estimate of gray partridge and ruffed grouse, 1931-74.

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