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SPRUCE BUDWORM IN MAINE, 1910-1976

INFESTATIONS AND CONTROL

Compiled by
David Weed

Maine Department of Conservation
Maine Forest Service 1977

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I. INTRODUCTION

This report is a compilation of historical data on infestations and control of the Spruce Budworm, *Choristoneura fumiferana*, for the years 1910-1976. The light trap data are expressed in both graphic and tabular form. Information on the light traps was gathered dating back to 1942, but graphs were only possible where data tables were available and this was from 1961 or 1962 on, depending on the station. A total of six stations were surveyed. Periodically the locality of a station was changed. This, along with the fact that all of the stations have not been in existence for the same period of years, lead to a problem that was resolved by using geographic ranges rather than specific sites. The ranges are as follows:

- 1) Allagash, Dickey, St. Francis
- 2) Caucomgomac (formerly Pittston), Chesuncook Dam
- 3) Garfield, Ashland, Camp Dana, Oxbow Road
- 4) Kingfield
- 5) Marion, Dennysville
- 6) Topsfield

Maps are enclosed to show the general areas listed above (Figure 45) as well as the specific localities of all the light trap stations (Figure 46). Included in each years' description of moth activity is an estimation as to whether the populations recorded were endemic (local) or immigrants from outside the State.

The material on defoliation is presented in the form of maps and a narrative description. For years where enough information could be obtained, maps were prepared. A summary table showing acreage defoliated is also provided (Table 1). A mixture of scales is found on some of the defoliation maps and in Table 1. This is due to the way the information was presented in the literature. The same scale was not used throughout all the years reviewed. When a map was not possible or information was too sparse, reliance on the narrative is necessary. Recommendations as to spray or not in the next year are also included in this article. A recommendation to spray an area of trees is based on the idea that the trees would not survive without the preventative measure. Spraying is conducted when an area of spruce-fir trees has shown moderate to severe defoliation for two consecutive years and the egg mass survey indicates that a third year of heavy defoliation is likely. Other factors are involved in making such a recommendation but these are outside the realm of this summary.

A set of maps is enclosed which show the areas of the State sprayed and the number of times they were sprayed for the years 1954-1976. The various aircraft employed in these spray projects are presented at the end of this report.

II. INFESTATION CHRONOLOGY

In this summary, certain years are left out due to the lack of information in the literature pertaining to the spruce budworm. Most of the information prior to 1941 deals mainly with defoliation and development of detection techniques. During the years 1920-1944 the budworm was existing at endemic population levels. Under such conditions, it was dispersed throughout the forest with very little if any defoliation concentrated to any specific areas. The budworm is in fact rare when it is found at this population density. Since 1944, the budworm has spread appreciably throughout the northern one half of the State. A more specific examination of the years 1910-1976 will now be presented.

INFESTATION CHRONOLOGY

1910-1918:

In some townships, 90% of the trees were reported to have died. Some 27,500,000 cords of spruce and fir were killed in Maine alone. Research lead to the development of light trap stations which were placed in strategic locations throughout the State in 1943 and thereafter. Growth of the Entomology Division of the Maine Forest Service concerning the budworm was increased in 1945 by the employment of six forest insect rangers and with formal budworm collections throughout the State. These were sent to the Augusta Insect Laboratory for identification.

1918-1919:

It was generally considered that the budworm problem was over in 1919. Forest Commissioner F. Colby did recommend that support and protection of parasites that would render this insect peril in check would be to everyone's benefit -- (economically as well as environmentally).

1921-1922:

There was really very little done to control the forest insects until 1921. Prior to that Professor M.W. Blackman of Syracuse University had made a partial investigation of the budworm in the State in 1919. In 1921, the first State Forestry Department entomologist in the United States was employed through contributions from the spruce-fir industry (in the person of H.B. Peirson).

1923-1924:

A recommendation was made to encourage and finance forest entomology work to control if not prevent insect ravages. The girdling of infested trees was started in 1924 as a possible measure for preventing the spread of spruce budworm. This was conducted on sample plots near Lake Moxie.

1925-1926:

Girdling experiments, started in 1924, were continued during these years. Studies in other sections of the State were continued in an effort to determine the rate of spread of an outbreak and the rate of death in different forest types. Sixty plots were taken to show the effect of hardwoods in diminishing budworm losses. Here again the results were very striking and illustrated without question the value of mixed stands from an entomological standpoint.

1931-1932:

In 1924, girdling of infested trees was started as an attempt to prevent the spread of spruce budworm. It was continued in an effort to study the succession of insects and fungi which attacked dead and dying trees. This was a possibility for controlling the budworm and attempted to show the length of time trees girdled at different seasons of the year would remain worth salvaging.

1935-1936:

The same girdling experiment was continued. There was still an attempt to find the length of time trees, girdled at different seasons of the year would remain worth salvaging. A publication on this topic was to be printed at a later date.

1941-1942:

Collections coming in from the field in 1941 and 1942 for the forest insect survey yielded only an occasional specimen from scattered places. The opinion was that owners of forest land could best take steps against this forest pest by checking up on susceptible stands and lowering the percentage of fir therein, especially the mature fir, before an outbreak started. Whether or not Maine was in line for a budworm outbreak was at that time a matter of conjecture. There was the feeling that such a serious pest should be prepared for, especially when the damage done in the 1910-1918 outbreak was realized. Many thought that the reduction of the fir percentage in stands would result in a less favorable habitat for the budworm.

1943-1944:

The insect, which had periodically ravaged the spruce-fir forest of the northeast, was again appearing in 1944 as a threat to Maine in the form of an extensive outbreak moving from Ontario eastwardly in Quebec towards Maine. There was an increase in light trap collections as well as a plan to make surveys from the air for defoliation. Research was also conducted on DDT through a cooperative project between the U.S. Entomology

Bureau and the Canadian Division of Entomology. This program was monitored by the State of Maine. The possibility of cutting or girdling trees in infested areas had been tried with apparently some success in localized outbreaks. A recommendation was made to continue the cutting of slow growing and mature balsam fir particularly in areas where it made up a considerable portion of the stand. There was also the desire to form a base map upon which prevention and control programs could be based. Lastly, a major concern was to educate the public as to the budworm problem and to build access roads to areas then difficult to operate.

1945-1946:

There were minor recommendations made at this time. An attempt was made to maintain a close watch on budworm movement and continue research on various possible measures that could be used to control this insect should it reach epidemic levels. A severe outbreak was moving eastward from Ontario, Quebec, and New York, toward Maine. Heavy flights of moths were observed in 1945 in Vermont and weather maps indicated that wind spread would definitely be across Maine. There was a plan to liberate parasites, supplied to the State, in the Mt. Chase, Garfield, and Cross Lake areas where there were indications of the infestation building up. Most entomologists who had studied the problem, believed that removal of mature balsam fir from the forest would greatly lessen the severity of an attack and might even prevent outbreaks. Spraying and parasites would also play important roles, particularly in outbreaks just building up.

1947-1948:

Since there had been no outbreak of budworm in Maine in the few years prior to 1948, the work by the State had been concentrated on detection. Very few defoliation surveys of major scale were done up until 1948. There were indications from light trap collections that small flights of moths might have been coming into the State as numbers of moths were caught at Oquossoc, Millinocket, and Augusta. A recommendation was made to research various controls of spruce budworm as well as monitor Canada's progress at controlling it. However, a recommendation was made to do some experimental spraying in some areas in 1948. The plans at that time were to spray 20,000 acres in cooperation with landowners and the Federal Government. In addition to this, a plan was made to start rearing parasites at the laboratory in Augusta. Due to the lack of appropriate funds the spray project was held off until 1950. Finally, there was an expectation that other areas would require spraying in future years.

1949-1950:

In 1949, the heaviest defoliation was concentrated between Caribou and Guerrette westward to Fish River chain of lakes, and along the St. John River just west of Allagash Plantation. Spraying was not recommended for 1950, but monitoring the progress of the spruce budworm was considered necessary. The experimental aerial spray project proposed for 1948 was carried out in 1950. Collections

4. from the light trap at Dennistown indicated a flight into that area on July 23-24, 1950. In 1950, a recommendation was made that the State and timberland owners be prepared to contribute toward the spraying of a large area if the population increased to the point where spraying was justified and trees were in danger of being killed. In addition, continued experimental spraying of small areas in order to obtain additional information on the timing of spray operations was recommended for 1951.

1951-1952:

In 1951, fairly heavy catches of moths were made for two nights late in the month of July at Enfield and Kellyland, indicating a possible flight from out of the State. These catches were concentrated on one night at each trap rather than distributed over a longer period as would have been expected from local dispersion of moths.

In 1952, there were 416,000 acres viewed in two areas of Maine and in this there were 90,000 acres recorded as continuous, and all (416,000) were noticeably defoliated. Twenty-one light traps were operated from July 7, 1952 to August 7, 1952 to detect flights of spruce budworm moths. Catches were obtained at sixteen of the traps. Only four of these, however, had what might be termed significant numbers: 76 at Square Lake (T16 R5), 60 at Enfield, 16 at Dennistown, and 8 at Kellyland. With the possible exception of Enfield, these represented normal catches from a local dispersion of moths and were an indication of the relative abundance of budworms within a short distance of the traps.

The first budworm suppression project in Canada involving aerial spraying was conducted in 1952. It was observed by R.W. Nash and C.S. Hood and a report was prepared which would be of great aid if spraying was needed in the future in this State. Spraying as an effort to suppress the spruce budworm was considered in 1952, but finally decided against.

1953-1954:

The total area mapped in 1953 was 155,000 acres. All defoliation was light except 20,000 acres of medium to heavy defoliation in the center of the Madawaska Lake area. Twenty-three light traps were operated by the Maine Forest Service from July 5 to August 5 of 1953 to detect flights of budworm moths into or local dispersion within the State. Budworm moths were caught in 22 traps. The most significant trap nights were the 16th, 17th, and 18th of July when 14 of the 23 traps made their highest catches. Moths were noted flying at the top of Mt. Katahdin on July 16th. This observation and the higher than usual catches at that time in certain light traps coincided with a large flight of moths which descended upon St. Johnsbury and Lyndonville, Vermont, on the night of July 16th. The peak of moth emergence in T16 R4 and other northern townships was from July 8th to 13th.

The later catches in the central and western parts of the State particularly - - indicated a possible infiltration from outside the State. In 1953, a recommendation was made to take action against the budworm and 21,000 acres were sprayed in 1954.

In 1954, defoliation was difficult to see and appraise, particularly from the air, as the noticeable feeding was mostly confined to the lower half of the crowns with the tops often appearing undisturbed and very green. This was probably due to the heavy rains during the larval period and the fact that fir and spruce made bush growth. Noticeable defoliation was picked up just east of the 1954 spray project and Madawaska Lake. Light traps were operated at twenty-four strategic locations in the spruce-fir region of the State. In general, the number of spruce budworm moths caught was light. Only two traps showed none, however. On the night of July 21 there was a heavy flight in northern Maine as indicated by the numbers caught in traps at Escourt, T17 R4 - both old type (Coleman) and new type (black light) --, Fort Kent, and a large collection on a store window at Portage. A total of 4479 were caught at the black light trap at T17 R4 on the night of July 21, and the flight continued for three more nights at this site. Two factors which tend to discourage local moth activity make the record of catches on these dates more pronounced: (1) cool weather, and (2) almost continual light to heavy rain. The source of these moths was unknown, but the Caribou airport reported an easterly wind on July 21st with wind velocities up to 20 miles per hour. This pointed to the heavy infestation in New Brunswick. No spraying was recommended for 1955.

1955-1956:

The only defoliation visible from the air in 1955 was very light in the northeastern corner of Aroostook County. High defoliation was seen in scattered fir stands between Route #161 and the New Brunswick line. Light traps were again operated in 1955 by the Maine Forest Service at 24 strategic locations in the spruce-fir region of the State. Many of the traps showed a definite increase over 1954 in the number of moths caught. The catches at Enfield, Lower Cupsuptic, T11 R8, T9 R5, T6 R7 and Kellyland appeared especially significant. Reports were received from a number of sources on flights of budworm moths on the 11th, 12th, and 18th of July. Large numbers were observed at Aroostook Farms in Presque Isle on the 12th. Ranger Holmes observed and collected a large number around Squapan Lake on July 12th. Dr. Brower of the Augusta Laboratory, who made all the identifications of light trap material, stated that these two flight periods were indicated also by unusually high trap catches of budworm moths on the nights of July 11th and 12th and July 18th to 22. Weather data for July gave a possible explanation for this unexpected moth activity. As recorded by the U.S. Weather Bureau Station at Caribou, local wind conditions throughout the period of moth flights, July 10-24, were variable both in direction and velocity with no very high winds. On the afternoon of July 10th, however, a cold front oriented in a northeast-southwest direction moved into Maine from the north. The cool air mass remained over Maine until the 15th. Another

6. cold front, similarly oriented, moved in from Canada on the 18th. It is possible that these weather fronts carried considerable numbers of budworm moths into northern Maine, with the variable local winds dispersing them in an uneven way. There was no spraying done in Maine in 1955 and the same recommendation was given for 1956.

In 1956, the survey revealed light, scattered defoliation in fir stands over the region east of a line roughly from Fort Kent to Haymock Lake to Lincoln and Woodland. In this area, three regions of light continuous defoliation were recorded: (1) from the northeastern corner of Piscataquis County running northeast to Grand Isle, Van Buren, Hamlin and Caswell (2) Chapman, Squapan area, and (3) Danforth to Baskahegan Lake to the boundary at Lambert Lake Town and Dyer. In addition to these areas, some defoliation was observed in Washington County. The 1956 season was unfavorable in general for moth activity. Cold, moist weather prevailed throughout the period of moth flight. The light trap records did not indicate any unusual activity or flight in 1956. The largest catches were made on July 12th, 13th and 14th with a lesser number recorded for July 27th and 28th. Larger numbers were again caught during the first week of August. All of the moths captured could have arisen from local populations. Spraying was not recommended for 1957.

1957-1958:

1957 marked the third consecutive year where no budworm spraying had been conducted in Maine. In 1957, cold nights prevailed throughout the flight period. No widespread flights were detected. Several traps did not take any budworm moths, especially in Western Maine. During one or two periods of more favorable weather for flights, numbers of moths were taken in traps near or at the area of heavy infestation. These were probably local moths. The heaviest catch was in traps in T17R5 and T15 R9 (Deboulie Mt.) on July 21-22. To check on the consequences of this flight, special egg mass collections were made in the Deboulie Mt. region. Nothing of significance was found. The spraying of 302,000 acres was recommended for 1958. This was carried out using DDT.

In 1958, there were about 1,012,000 acres showing defoliation. In these acres only spotted areas were classified as heavily defoliated. Many light trap operators reported nights so cold or rainy that no moths were taken, sometimes for a week at a time. Some good periods for moth activity occurred during the trapping season and large catches of Lepidoptera were made. The catch of spruce budworm was well distributed at most traps with the higher catches. For instance, the trap at T9 R5 took spruce budworm moths during fourteen nights, but a total of only 51 specimens. The same was true of catches at T17 R5 and T15 R9 (Deboulie Mt.).

These were thought to be local moths. The trap at Kellyland 7. got 36 of a total of 43 moths on July 25th and 4 of the remainder on July 26th. This was possibly a local flight, probably from the infestations in southern New Brunswick. Of the twenty traps operated, fourteen of them caught 115 male and 66 female spruce budworm moths. On account of the poor larvae survival (due to the unusually wet and cold weather conditions of that period) and the large reduction in population size (due to the effectiveness of the spray operation conducted in 1958), spraying was not recommended for 1959.

1959-1960:

No spruce budworm moths were caught in the southerly portion of the State in 1959. Very small numbers were caught in traps in the northern sections. Catches in all 24 flight traps operated yielded no indication of any flight of spruce budworm moths. Nor were any flights observed atop Mount Katahdin during the moth season. In 1960, 217,000 acres of spruce-fir were sprayed in northern Aroostook County.

In 1960, no flights were apparent in the 24 light traps operated except for possible local movement indicated by the number of moths caught at Cross Lake (19) and Deboulie Mt. (32). Eleven were taken at T9R5 (i.e. Garfield, Oxbow, and Camp Dana Region) and 13 at Greenville. Eight traps caught 1 to 6 moths while the other 12 caught none. Conditions were such in 1960 in the westerly parts of the then current infestation (unsprayed) that spraying was recommended for 1961. This project was conducted over 52,989 acres.

1961-1962:

In 1961, there was little if any moth activity. No flights of any significance were recorded for that period. Observations of defoliation were made from the air as well as the ground. Spraying was not recommended for 1962 although infestation remained high, particularly in the Squapan Lake region and north.

The same situation existed in 1962 in terms of moth flights. There was no major flight observed. In 1963, 479,000 acres in northern Aroostook County were sprayed.

1963-1964:

In 1963, as was the case in 1961 and 1962, moth activity was minimal at the light traps. No flights or significantly large numbers were recorded. However, a recommendation was made to spray the Oxbow area plus other more northerly locations of high populations which existed. This project was conducted over 58,100 acres in 1964.

In 1964, budworms were especially rare in catches from the western parts of the State. An unusual catch of about 218 budworm moths were taken on the night of July 21-22 from a trap in Dover, New Hampshire. A few lingering strays were taken on the following nights. The source of the flight is unknown. Control action was not recommended for 1965.

1965-1966:

Defoliation was less severe in 1965 and was largely confined to an area south of the Oxbow road and the Aroostook River, in an area which had never been sprayed. Other areas of defoliation were small and scattered or supported by insignificant budworm populations. Light traps were operated in 25 locations in Maine during 1965. All material was sent to Augusta for examination. There were no unusual catches. The trap in T9R5, Oxbow road is just northeast of the Oxbow-South area. Few budworm moths were captured elsewhere.

In 1966, defoliation was restricted essentially to the Oxbow, Cary, and Punchard Brooks section of Aroostook County. All other areas were in good condition with light populations found. Catches suggested very slight increases in the more westerly budworm populations, but otherwise there were no unusual catches. Recommendations were made to treat the heavy population areas with a spray operation covering 92,162 acres in 1967.

1967-1968:

For both years there was very little moth activity or flights observed. Nothing of major concern was recorded at the light trap stations. It became the policy of the department to avoid the use of DDT after the 1967 spray project. Thus attempts were started to find an effective substitute for DDT. This culminated in a pilot test using Sumithion (Fenitrothion) in the Oxbow area by the U.S. Forest Service during 1968. Four blocks of 2,640 acres were sprayed using 1 TBM plane on June 7th and 8th of 1968. The U.S. Forest Service also conducted a test using Zectran on 500 acres in that same year. This was applied by helicopter and achieved an unsuccessful 80% control of the budworm population in the area sprayed. At a summary conference in the fall of 1968, Federal and State entomologists recommended further control tests using Zectran during 1969. In addition, a recommendation was made to study the New Brunswick control operations using Sumithion (Fenitrothion) and to monitor its use of Zectran on an experimental basis.

1969-1970:

In 1969, the budworm moth catches from Georgetown and Brunswick indicated the possible spread of the insect for

there were no other signs of nearby budworm activity and it was assumed that these were "flights." A recommendation was made to spray 210,000 acres in the Oxbow road area southwest of Ashland using Accothion 8EC during 1970.

In 1970, the feeling was generated that with the present technology the emphasis should be shifted from population reduction to foliage protection as needed, with the overall goal of keeping the trees alive. The 1971 damage was expected to be severe and action was considered necessary in order to prevent widespread mortality. A pilot test using Zectran was recommended for 1971. The test was to cover four 2300 acre blocks of spruce-fir forests in the Oxbow area.

1971-1972:

Again, there were very few large numbers of moths noted for these two years. The reduction in numbers or the small counts indicate reduced "flights." The 1971 situation appeared to be such that protective action would be needed for 1972. The inability to obtain drastic population reductions indicated that more frequent treatment would be necessary to achieve this goal than was formerly necessary with DDT in Maine. During 1971, a pilot test was conducted using Zectran on 9,200 acres in cooperation with the U.S. Forest Service. A rapid buildup of budworm populations during 1971 in the Oxbow and Cross Lake - Madawaska Lake areas resulted in the spraying of 500,000 acres using Zectran during 1972, the largest project conducted up to that time.

In 1972, Washington County showed about 40,625 acres with moderate to severe defoliation. A recommendation was made to spray 450,000 total acres using Zectran and this was carried out in 1973. This area included the Allagash-St. Francis area, and the Webster Lake-Telos Lake area. During this project, there was a Federal restriction that no area sprayed in 1972 was to be sprayed again in 1973 (regardless of need). This restriction was developed out of concern for the possible adverse effects that repeated spraying might have upon the environment.

1973-1974:

In 1973, there were some 66,912 acres showing moderate to severe defoliation in Washington County. A tremendous flight of spruce budworm moths was reported off the coast of eastern Maine from Boothbay Harbor to Machias Seal Island off Cutler. No determination was made as to whether the flights were made up of immigrants or local moths. A recommendation was made to spray 430,000 acres of spruce-fir forest in June of 1974. This operation was carried out using Zectran in a one quart of spray per acre mixture, rather the usual gallon for full operational use.

10.

In 1974, the moth flights covered the entire State south to Biddeford Pool. A determination was made that these flights came in on a cold front, as in 1973, accompanied by NE→SE winds. In Augusta, budworm moths were seen around lights and egg masses were found deposited on spruce trees. Field data showed that the predicted infestation for 1975 would be by far the most intensive and extensive that Maine, Quebec, and New Brunswick workers had ever experienced. A decision was made to spray an area of 2,233,500 acres in 1975. An additional 26,400 acres received experimental application of various insecticides.

1975-1976:

The 1975 operation far exceeded the size of any previous spray project. A major difference in the planning of the operation was the scarcity of insecticides revealed in 1974. This resulted for the first time in an inability to spray all the acreage recommended for treatment - of the 3.5 million acres recommended, 2.26 million acres were treated in the period of May 25th to June 12th, 1975. In general, the entire spruce-fir region of northern Maine and of eastern Washington County, excluding the sprayed areas, showed severe defoliation. Defoliation assessment within the spray areas was done in detail by ground and aerial observations. Although budworm seemed more frequent in the light trap collections in 1975, fewer seemed to come from outside of the infested spruce-fir forest type. Sprays used in 1975 were: Sevin 4-oil, Zectran, and Sumithion (Fenitrothion). A 3.5 million acre spray operation was recommended for 1976.

In 1976, all areas sprayed in 1975 showed improvement, with the Sumithion(Fenitrothion) treatment area improving to a lesser degree. The 1976 spray operation was the largest cooperatively funded spray operation ever conducted in the United States. Sevin-4 oil and Dylox were the sprays used in this project. Virtually all areas sprayed with Sevin -4 oil showed improvement. Aerial reconnaissance of the entire spruce-fir region of northern Maine and eastern Washington County during July, 1976 was used to map areas of current budworm defoliation. Based on light trap and moth flight reports, it seemed that Maine's spruce budworm population received little if any boost from an influx of new females from outside the State. A decline in the budworm populations was expected for 1977. Thus, a recommendation was made to spray 930,000 acres of spruce-fir forest during that year.

TABLE 1. AN ESTIMATION OF THE TOTAL ACREAGE OF DEFOLIATION
IN THE YEARS 1910-1976

DEFOLIATION (ACRES) *

YEAR	NEGL. TO LIGHT	MEDIUM	HEAVY TO SEVERE	TOTAL
1910-1918	2,948,000	7,568,000	44,000	10,560,000
1945	6,314,000			6,314,000
1946	9,240,000			9,240,000
1947	10,604,000			10,604,000
1957	3,410,000	572,000	374,000	4,356,000
1958	2,200,000	132,000	88,000	2,420,000
1960	374,000	286,000	264,000	924,000
1961	440,000	66,000	308,000	814,000
1962	330,000	154,000	352,000	836,000
1963	220,000	396,000	44,000	660,000
1964	1,804,000	44,000	22,000	1,870,000
1965	2,112,000	44,000	88,000	2,244,000
1966	2,992,000	88,000	88,000	3,168,000
1967	374,000	220,000	44,000	638,000
1968	396,000	220,000	88,000	704,000
1969	374,000	176,000	154,000	704,000
1970	770,000	396,000	264,000	1,430,000
1971	506,000	352,000	154,000	1,012,000
1972	1,078,000	352,000	418,000	1,848,000
1973	2,442,000	880,000	264,000	3,586,000
1975	1,166,000	616,000	7,106,000	8,888,000
YEAR	NEGL. TO LIGHT	MED. TO SEVERE		TOTAL
1918-1919	3,410,000	12,034,000		15,444,000
1948	9,724,000	1,386,000		11,110,000
1949	4,664,000	352,000		5,016,000
1950	4,114,000	660,000		4,774,000
1951	3,212,000	220,000		3,432,000
1952	2,112,000	132,000		2,244,000
1953	2,310,000	196,000		2,506,000
1954	1,892,000	88,000		1,980,000
1955	1,144,000	220,000		1,364,000
1956	3,894,000	880,000		4,774,000
1959	924,000	198,000		1,122,000
1976	5,714,000	1,304,000		7,018,000
	LIGHT TO MEDIUM	SEVERE		TOTAL
1974	5,500,000	4,774,000		10,274,000

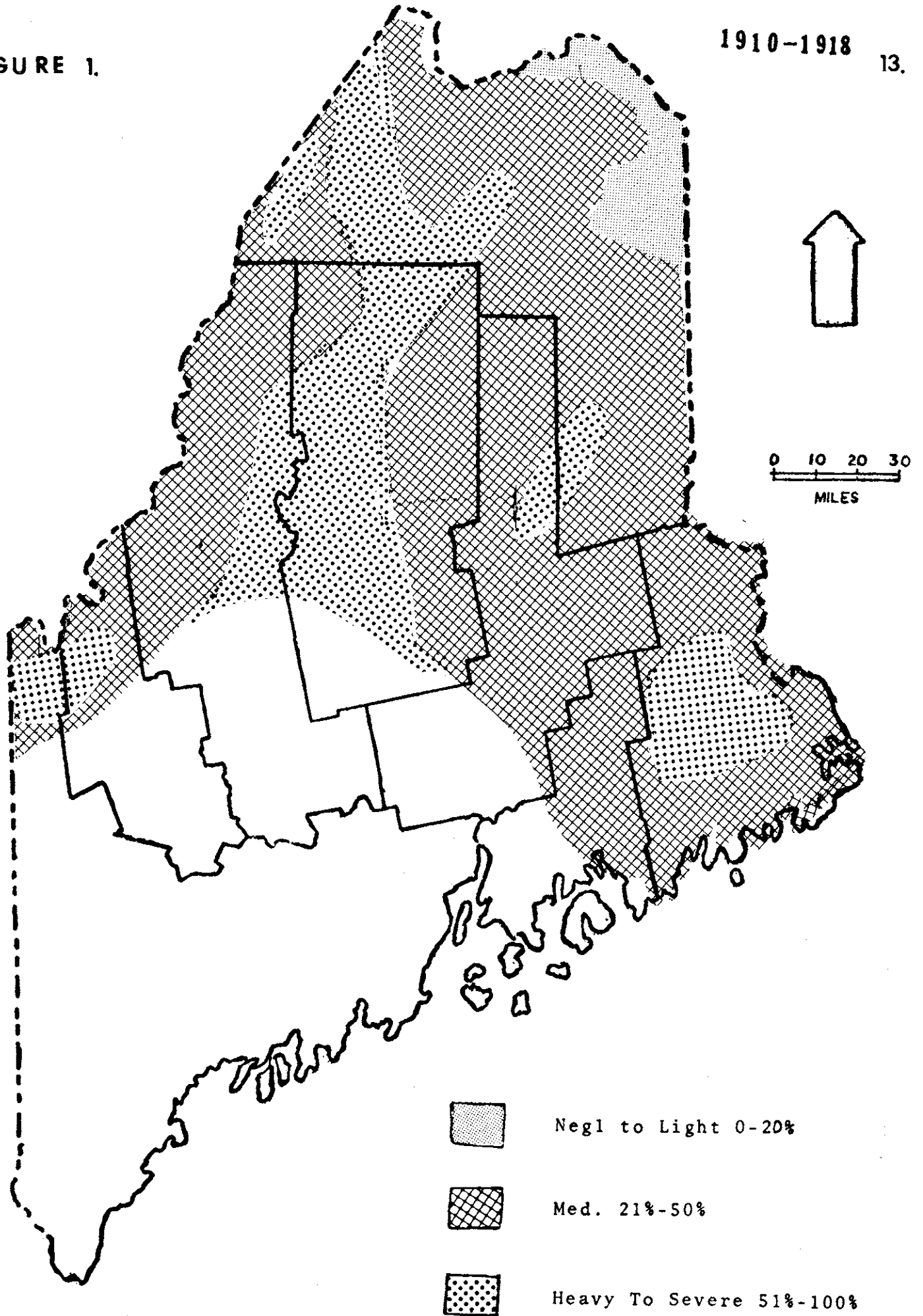
* All figures based on a value of 22,000 average land acres/township, Allagash counts 4x; Ashland, Presque Isle, Caribou, Fort Fairfield count 2x.

III. DEFOLIATION
1910-18 to 1976

FIGURE 1.

1910-1918

13.



14.
FIGURE 2.

1919

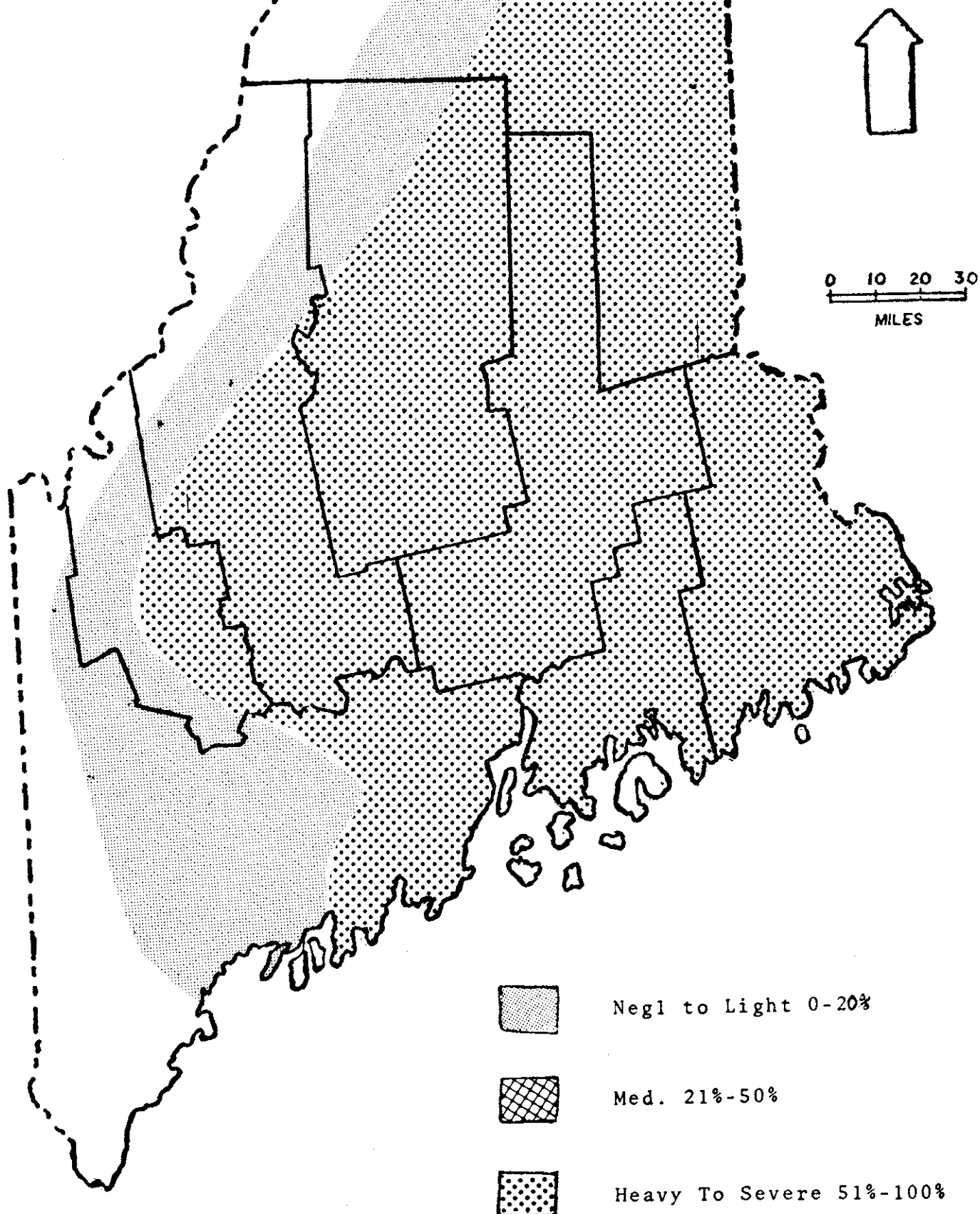


FIGURE 3.

1945

15.

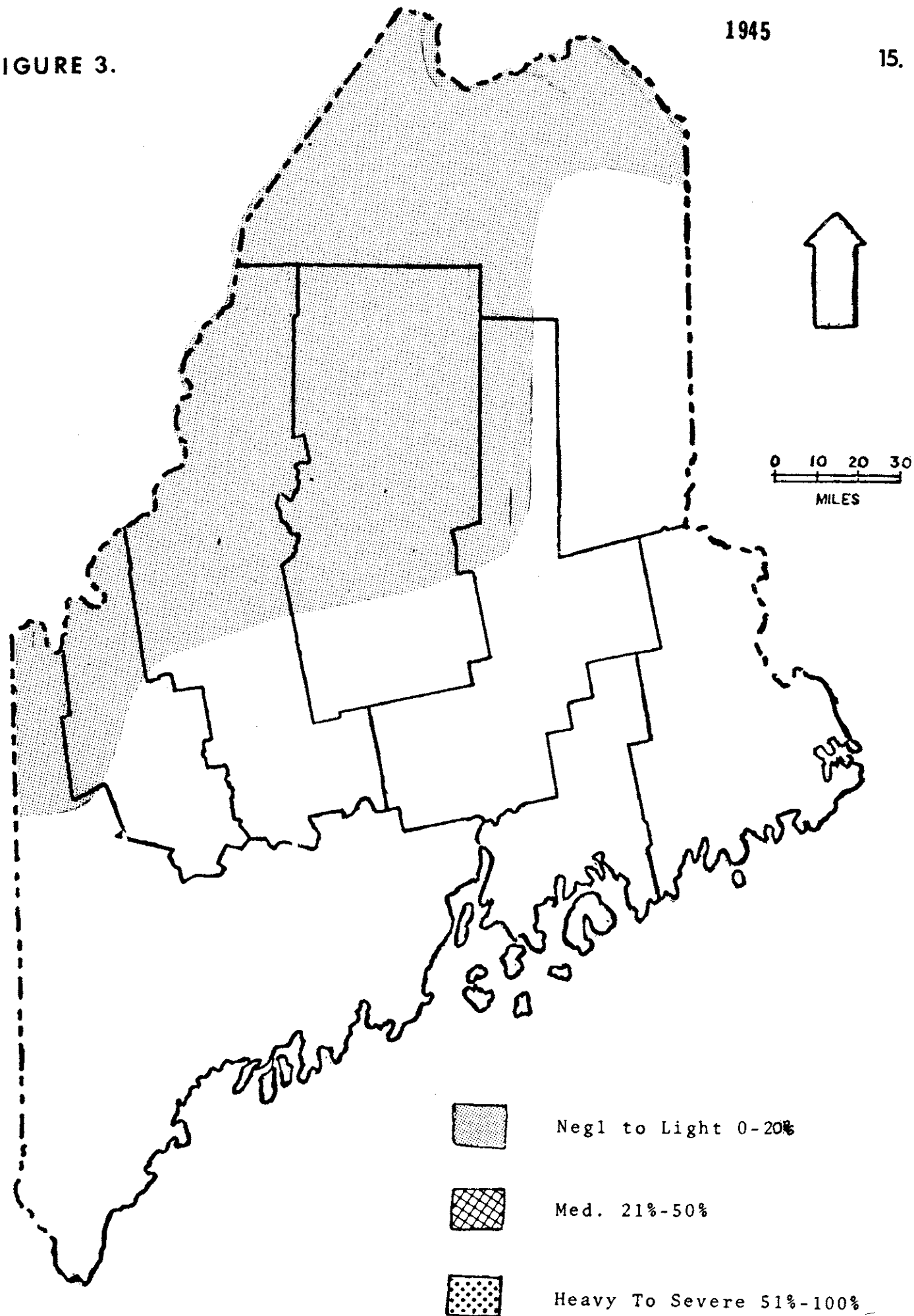


FIGURE 4.

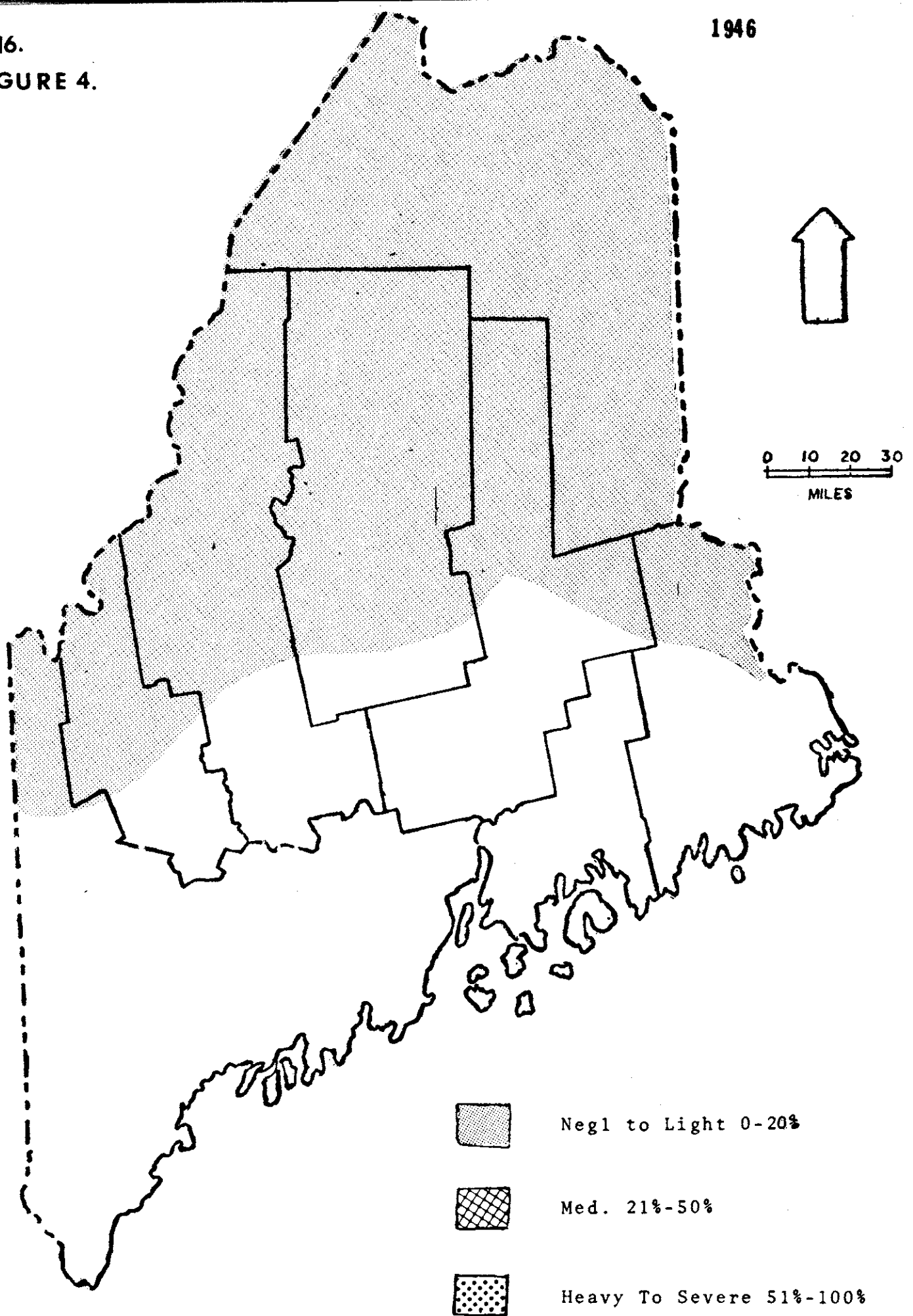


FIGURE 5

1947

17.

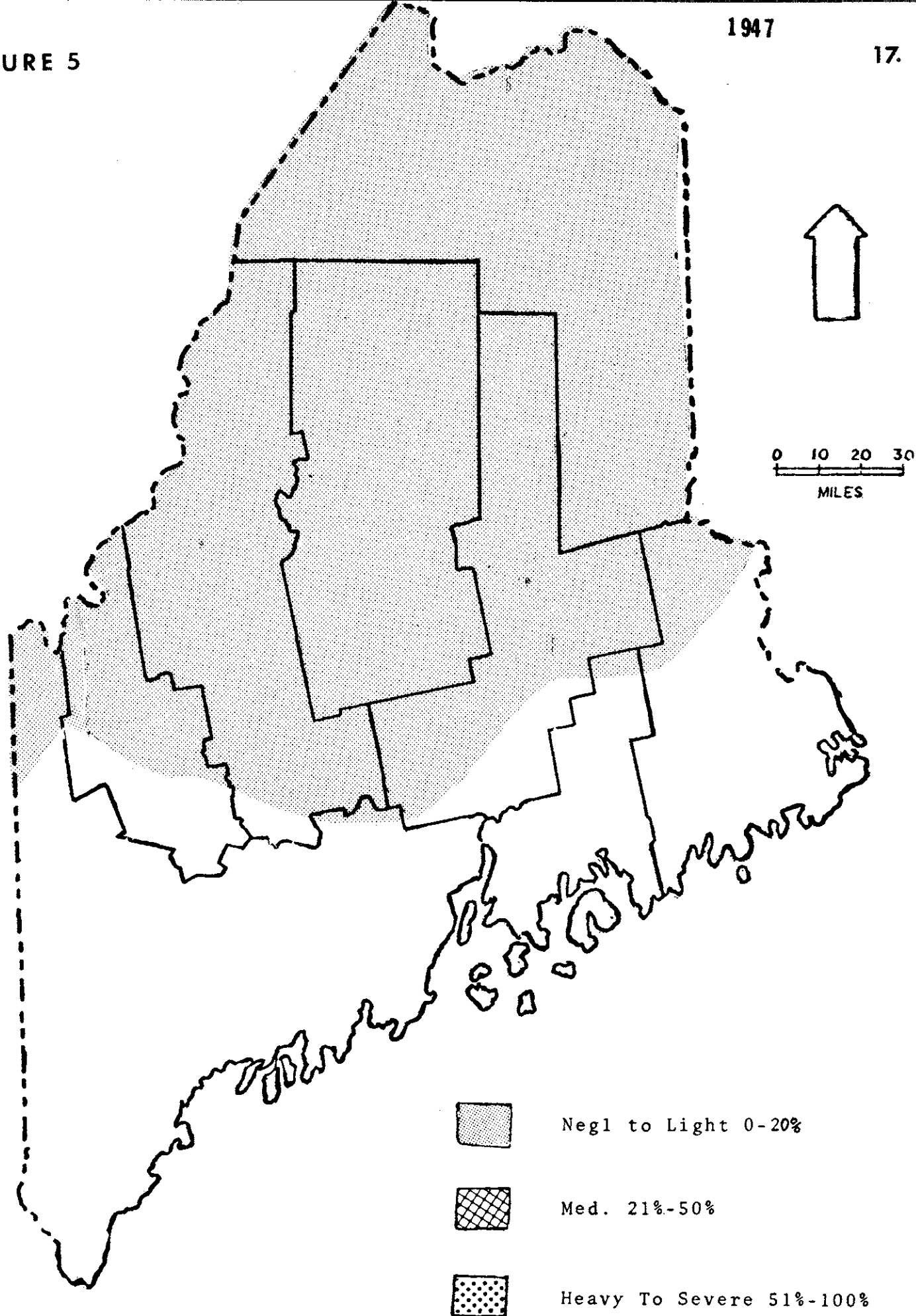


FIGURE 6.

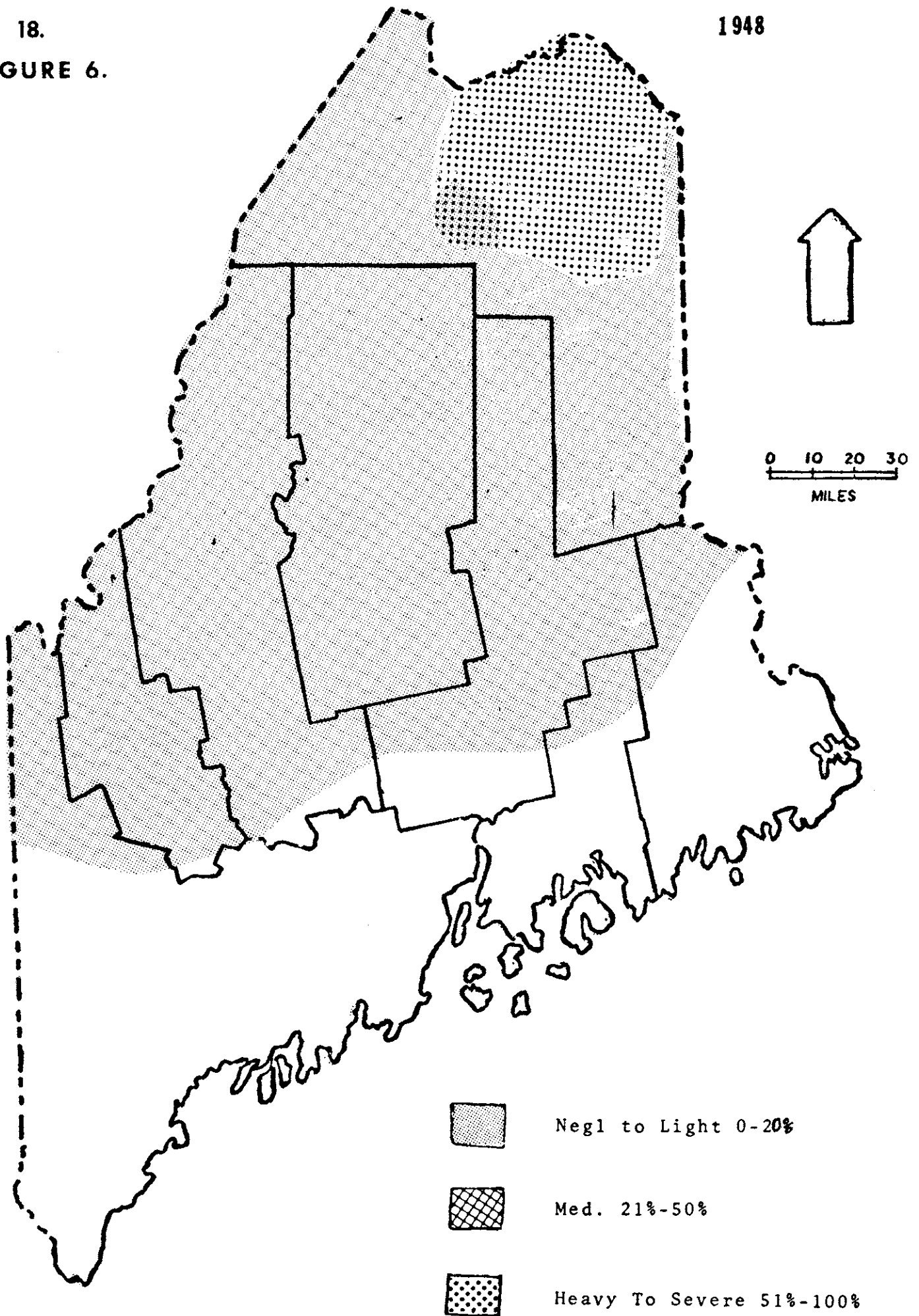
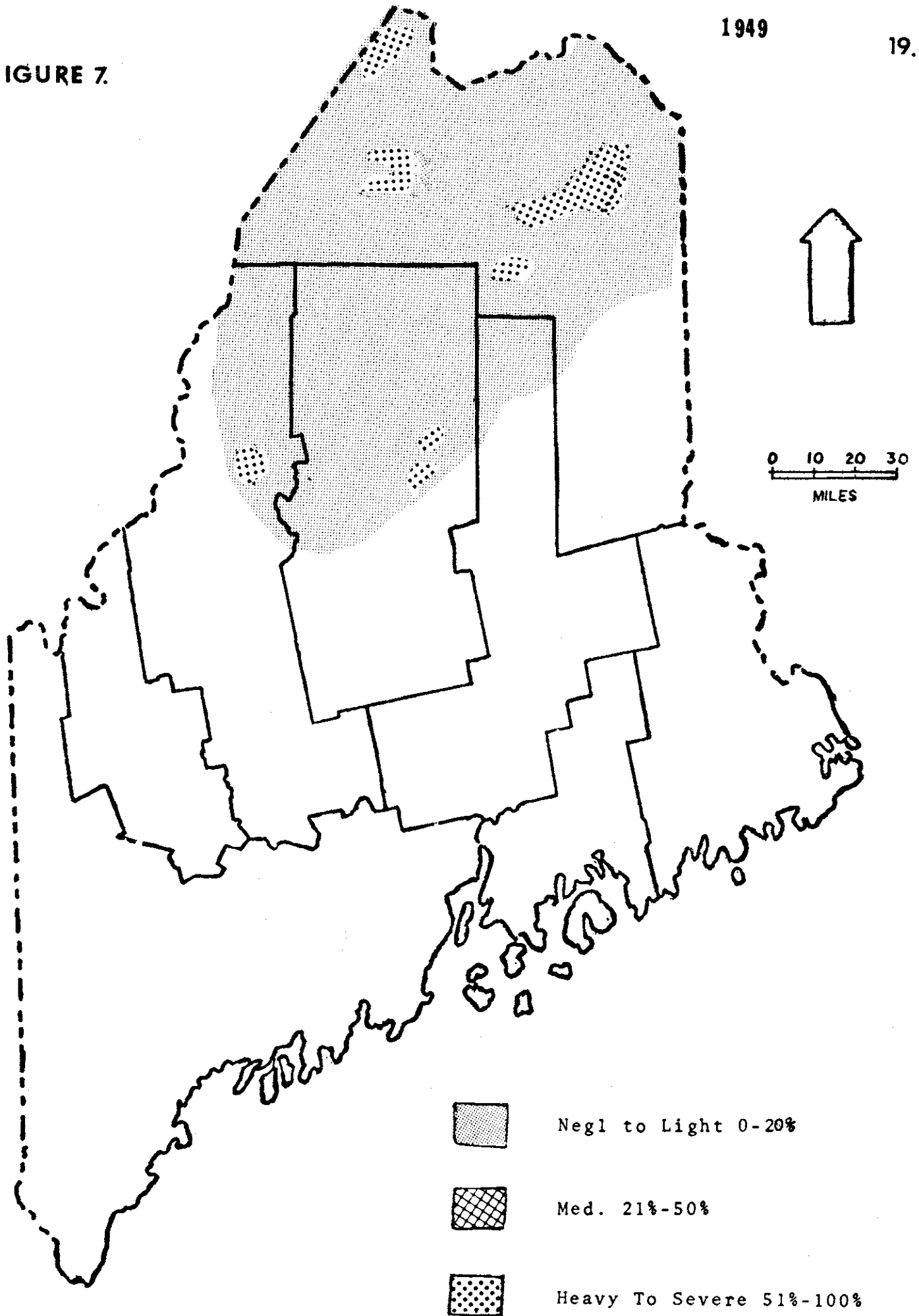


FIGURE 7.

1949

19.



20.
FIGURE 8.

1950

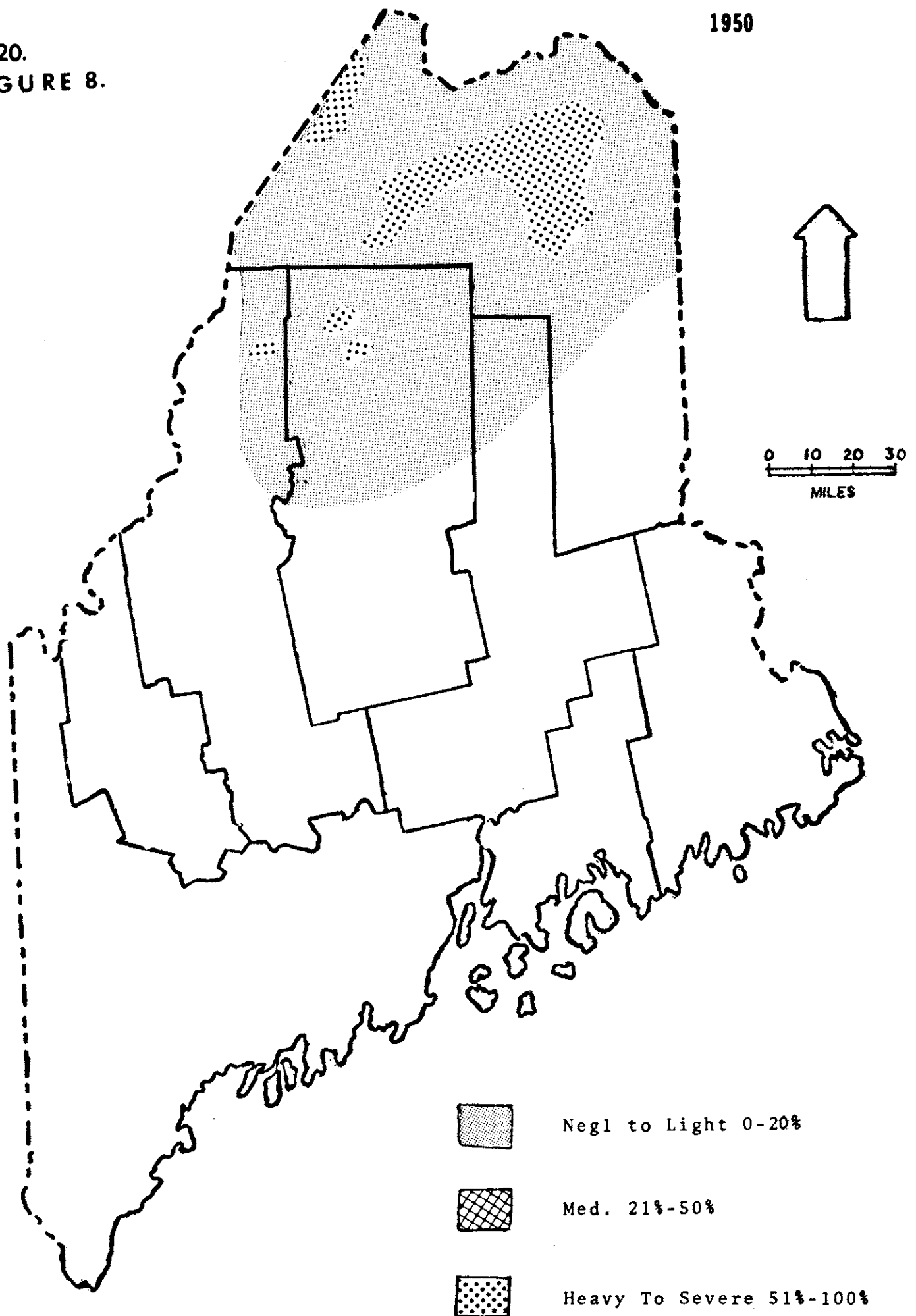
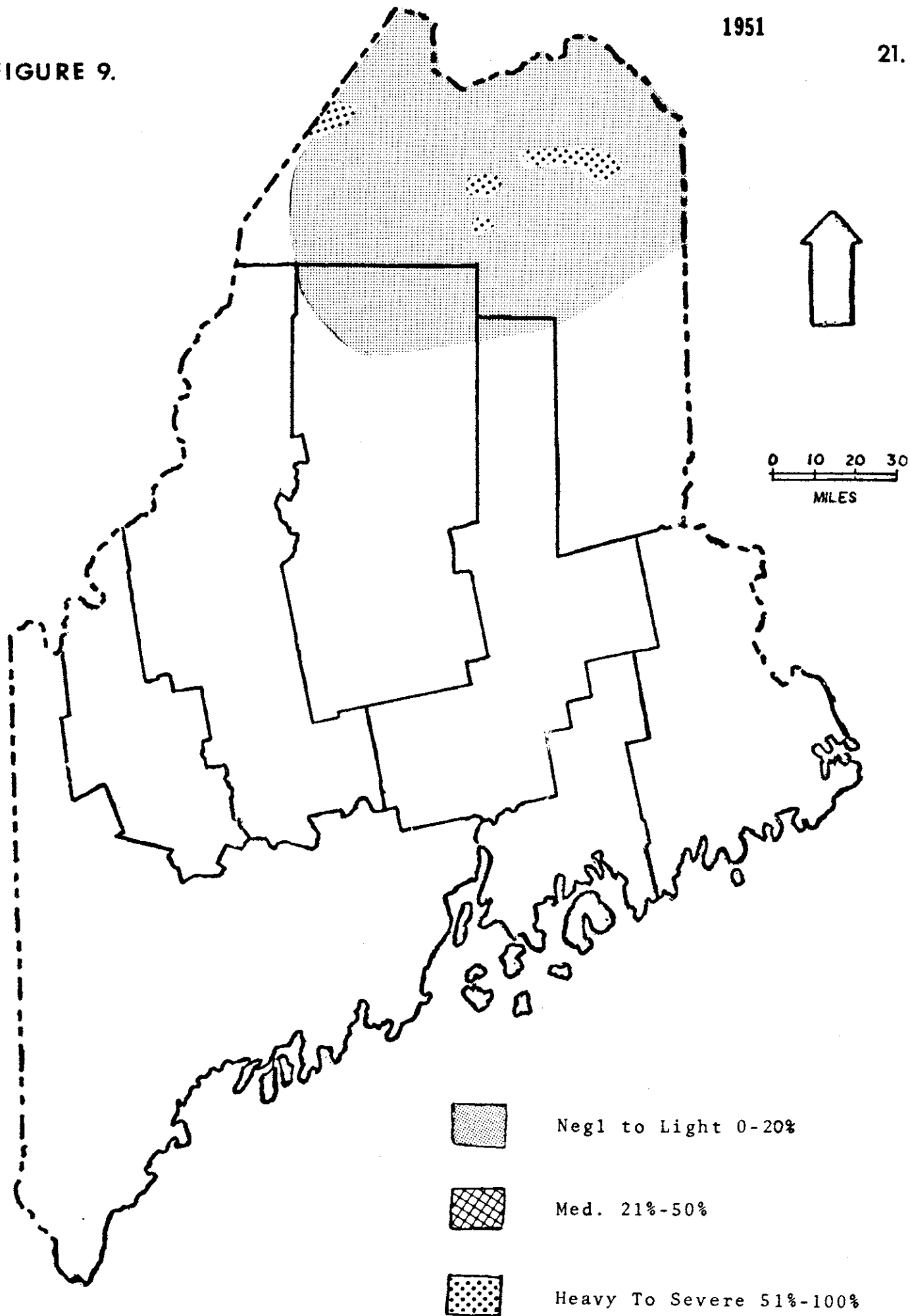


FIGURE 9.

1951

21.



22.

FIGURE 10.

1952

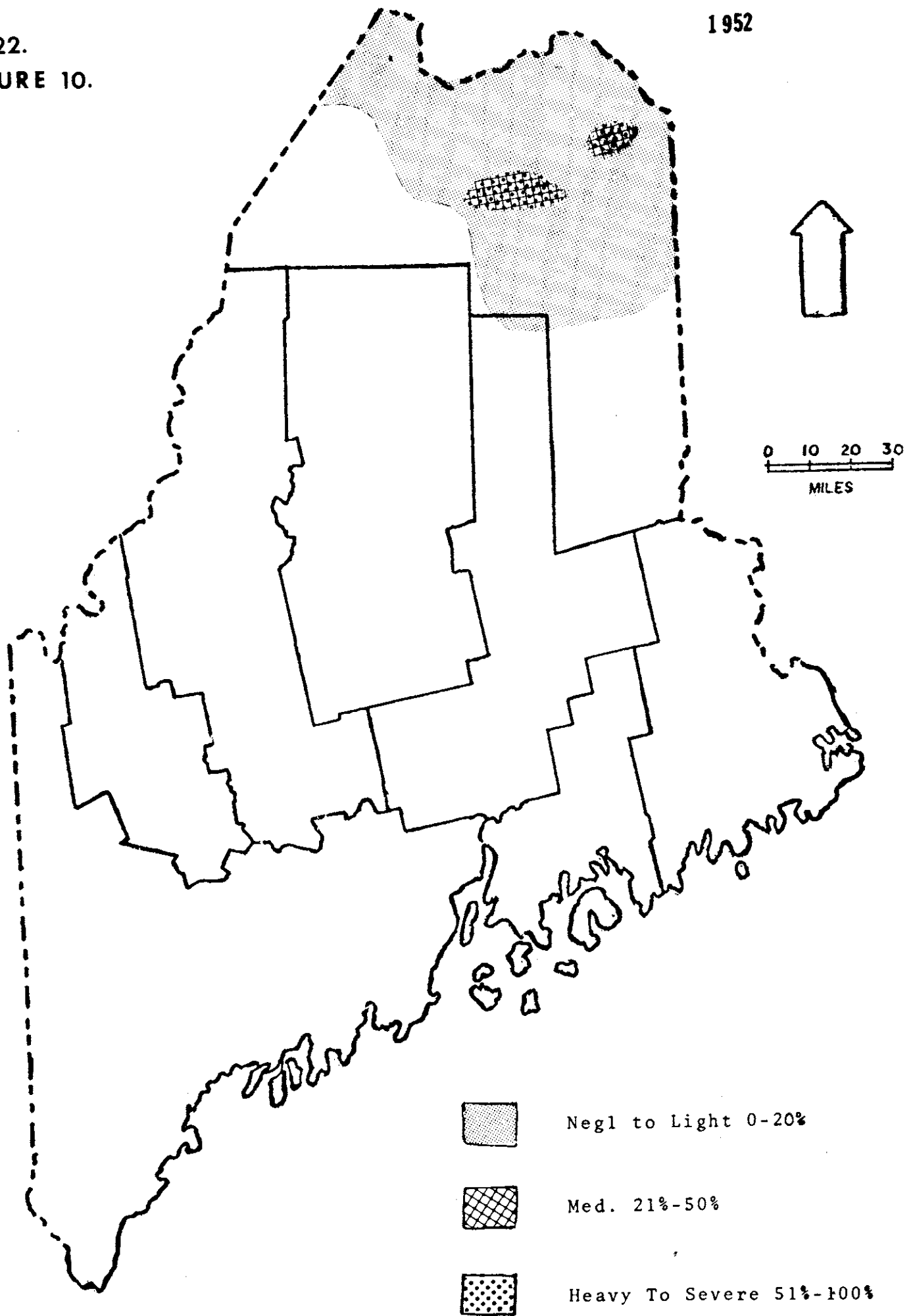
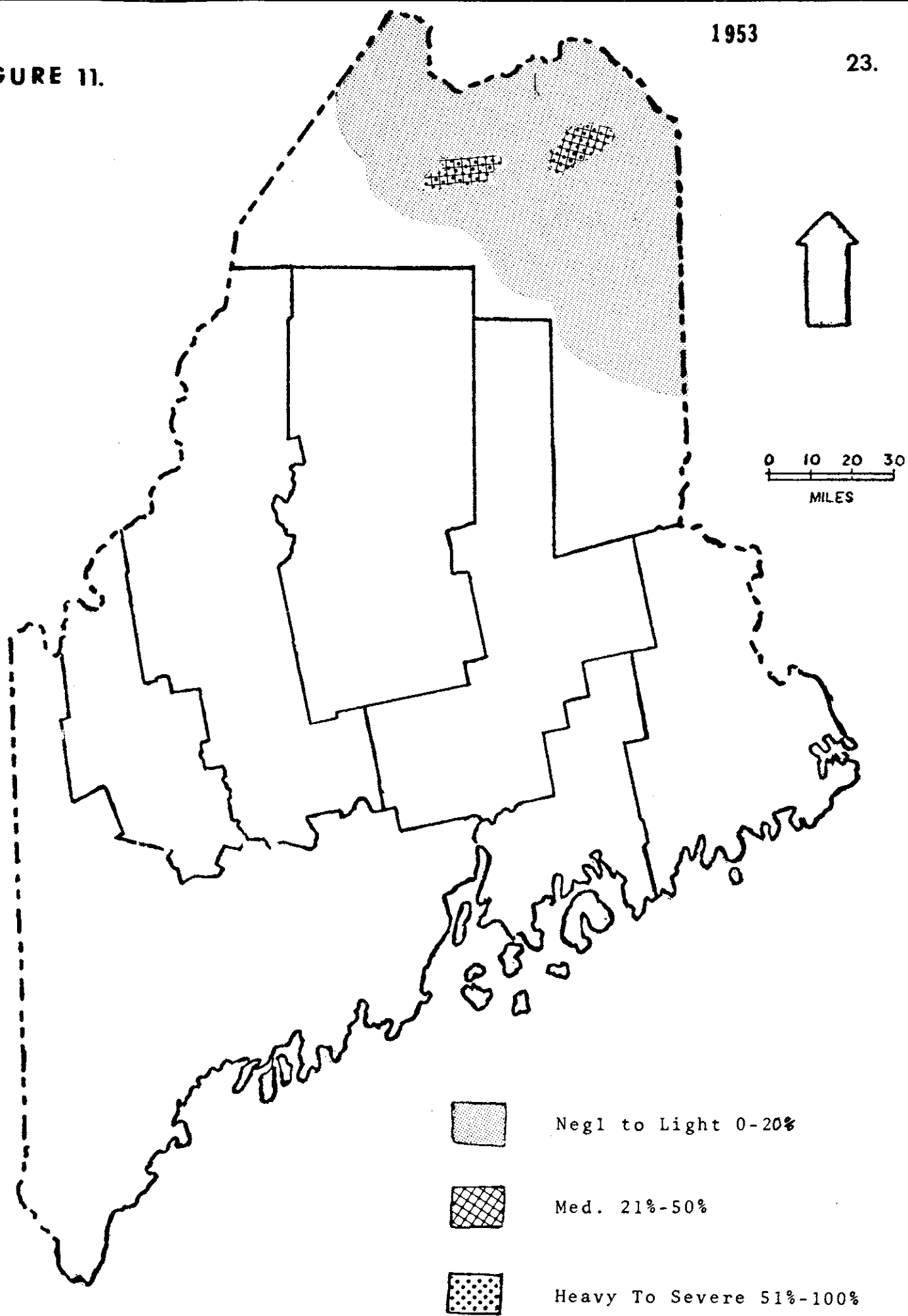


FIGURE 11.

1953

23.



24.
FIGURE 12.

1954

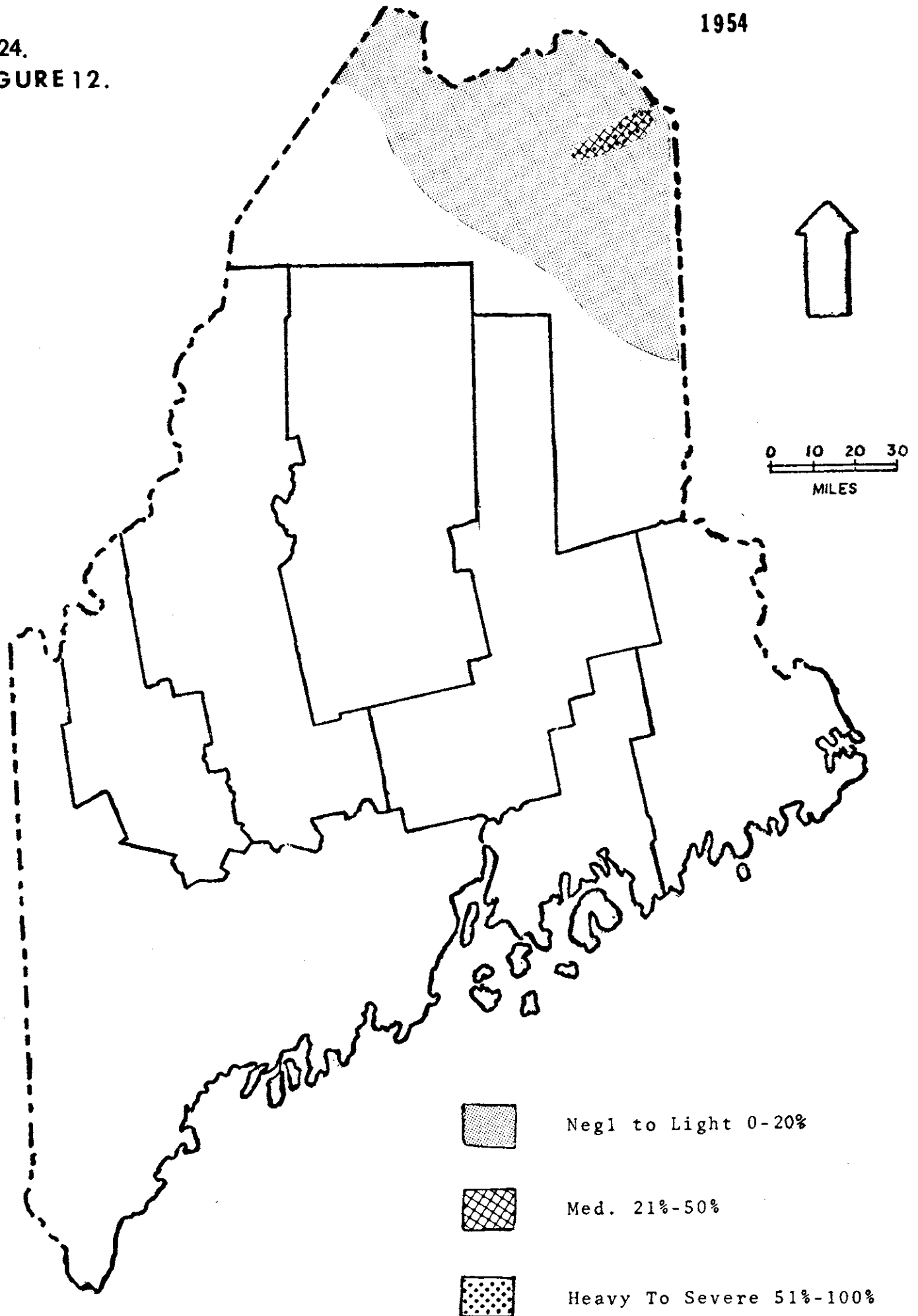
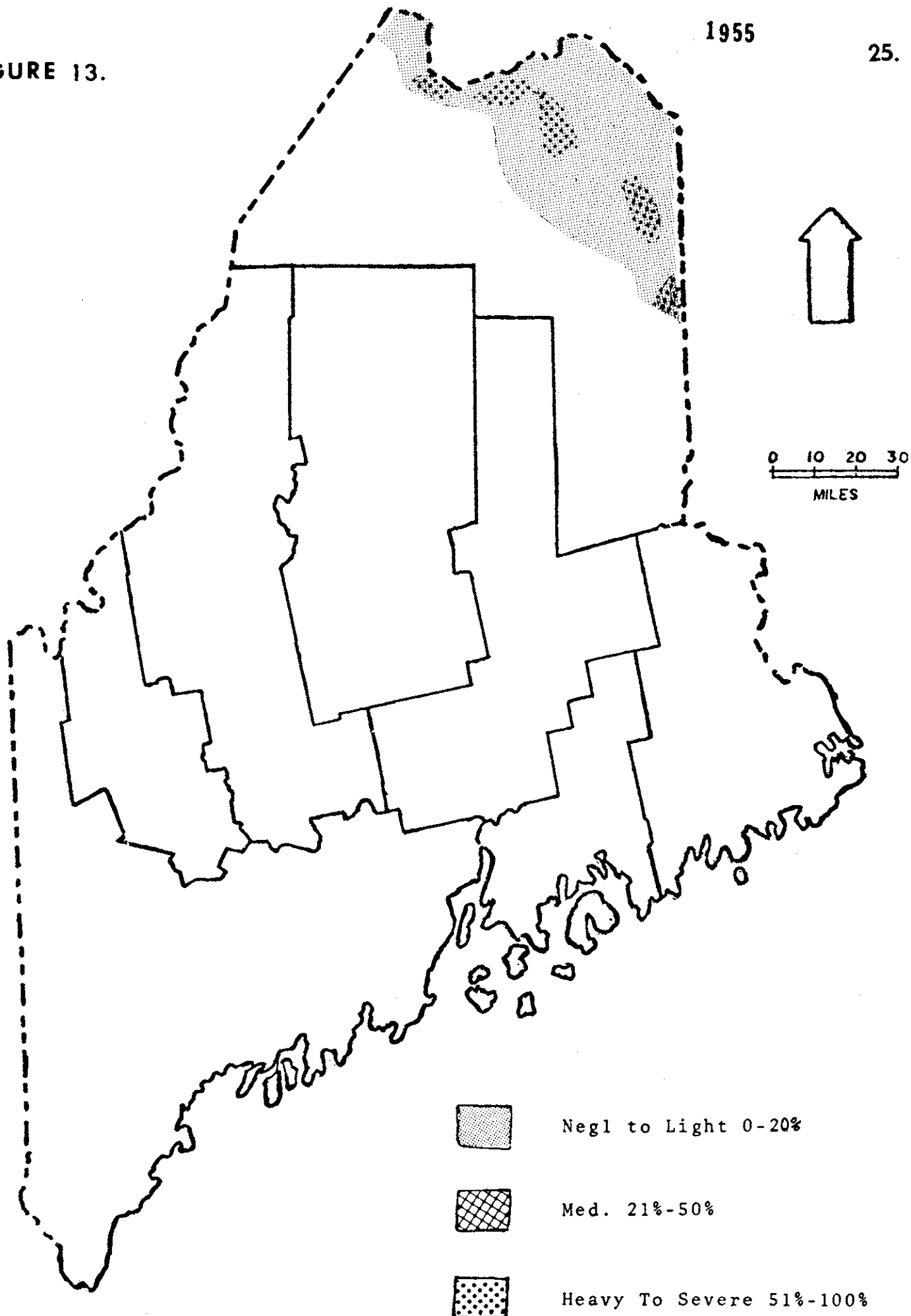


FIGURE 13.

1955

25.



26.
FIGURE 14.

1956

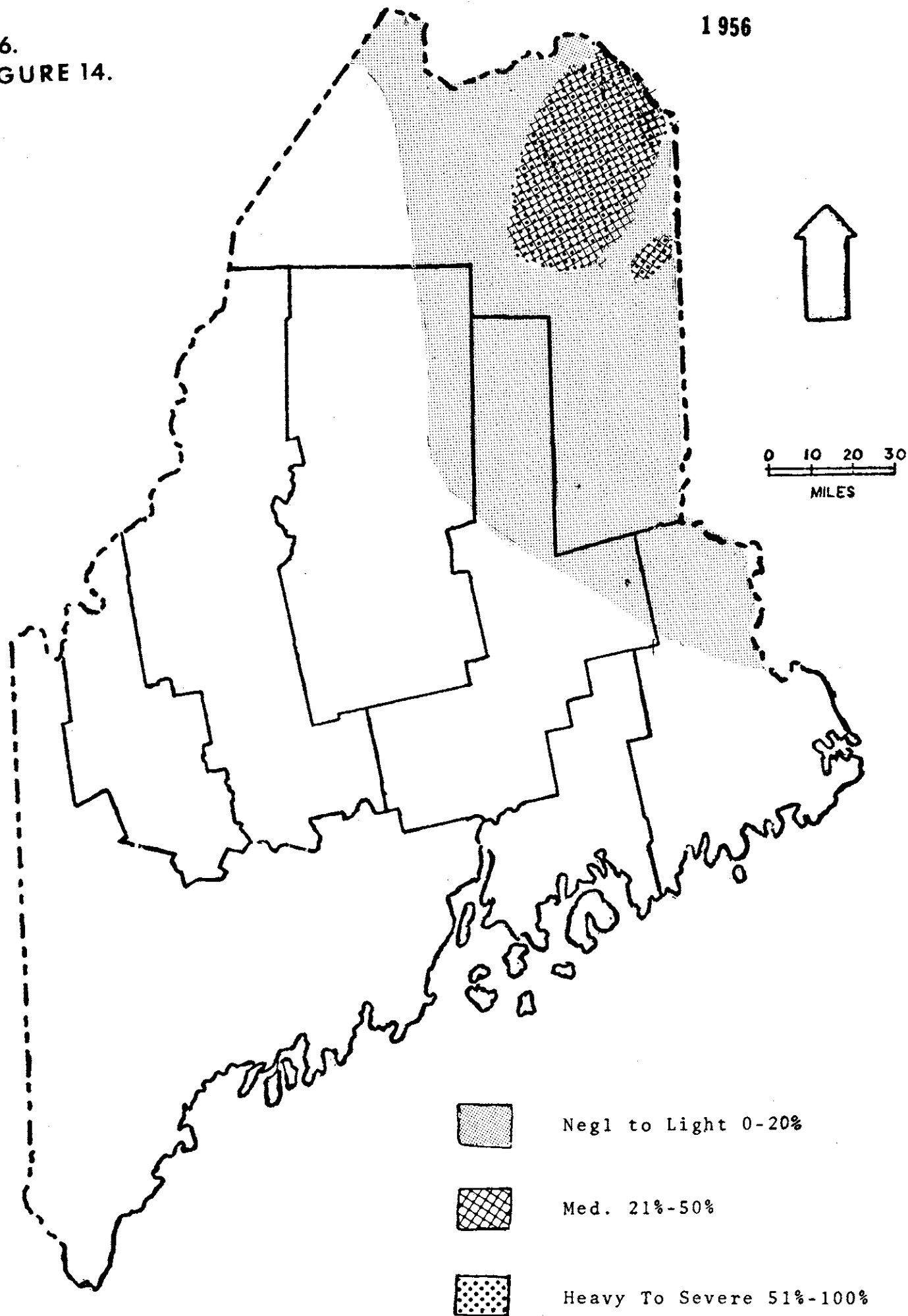
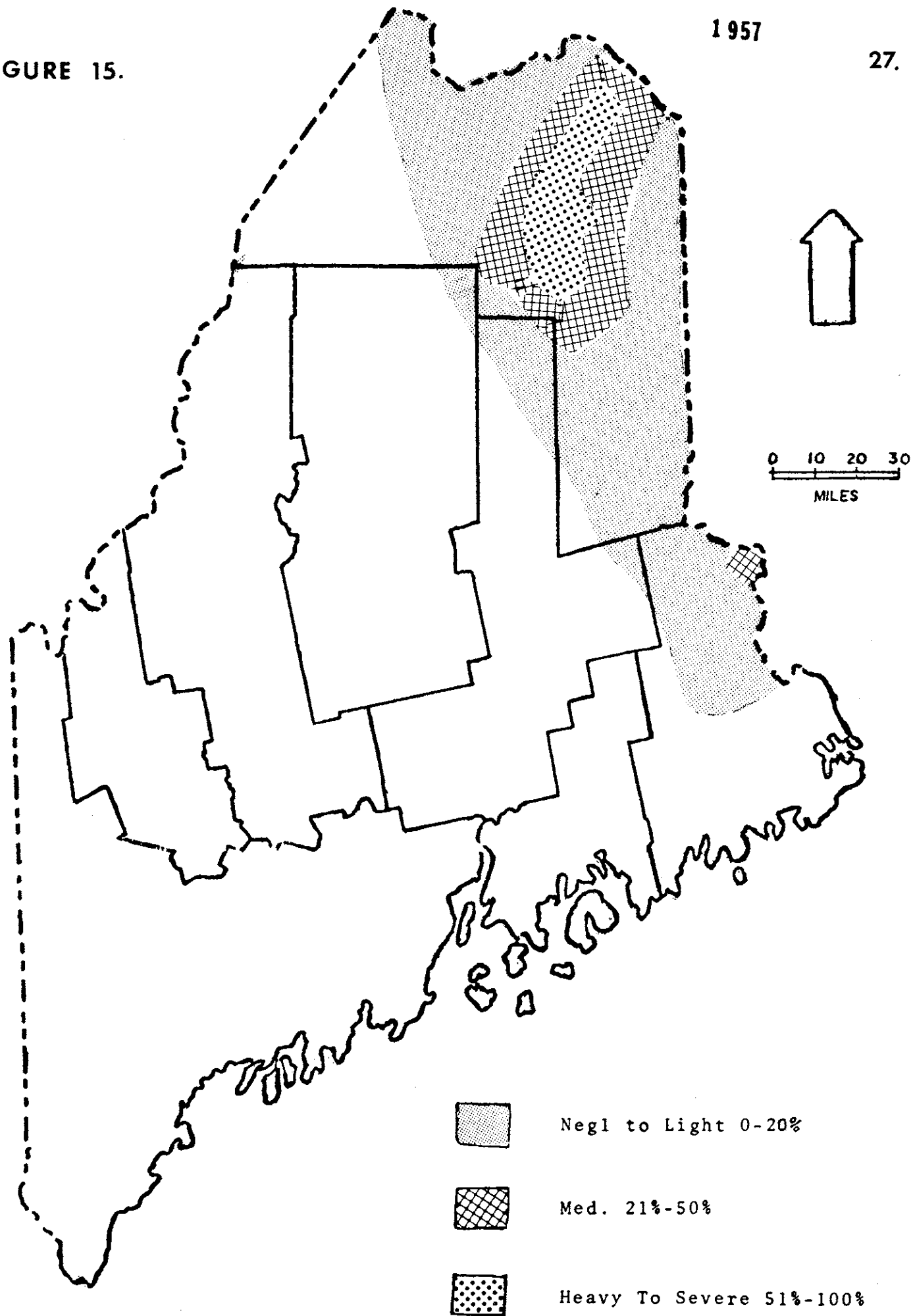


FIGURE 15.

1957

27.



28.

1958

FIGURE 16.

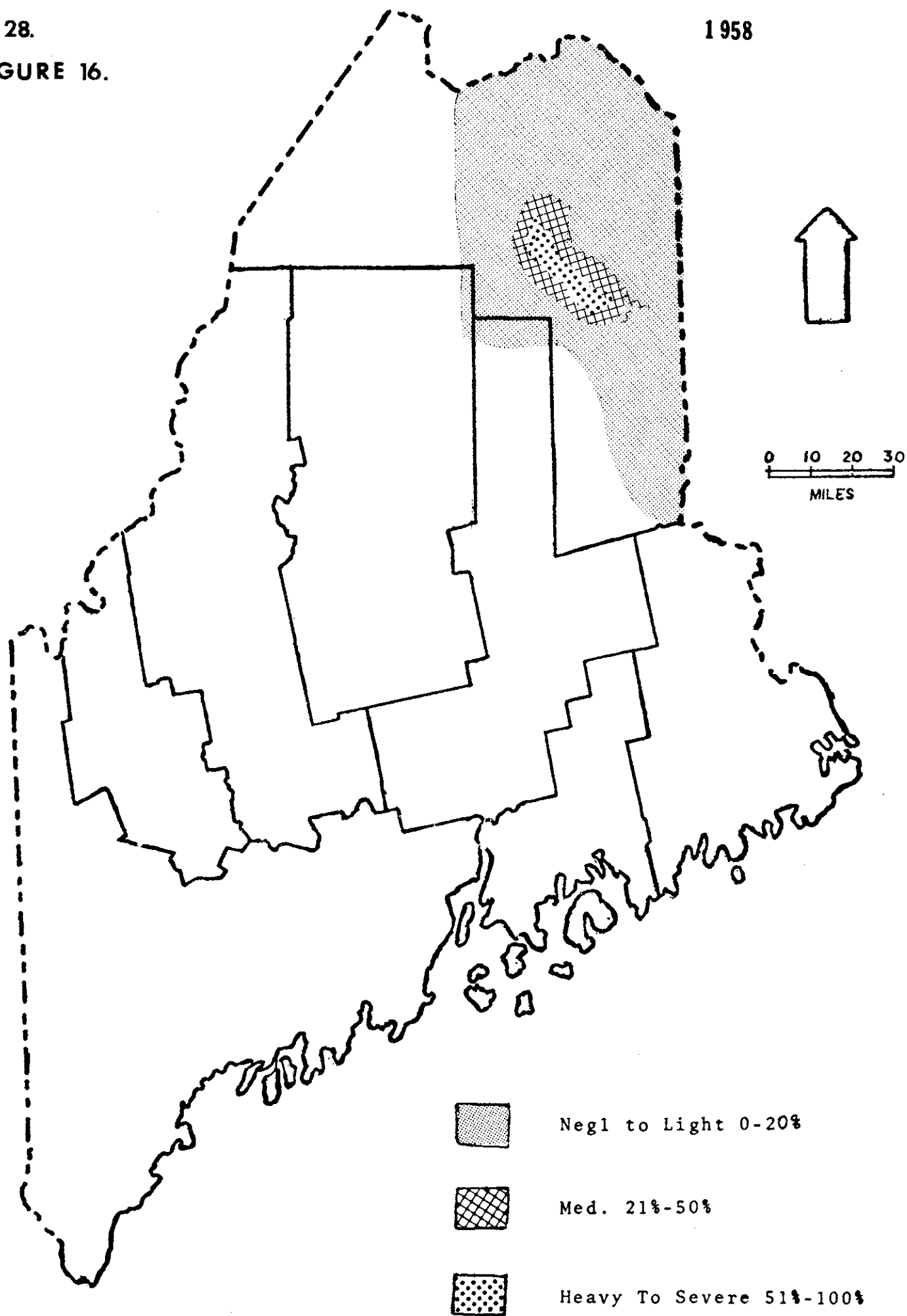
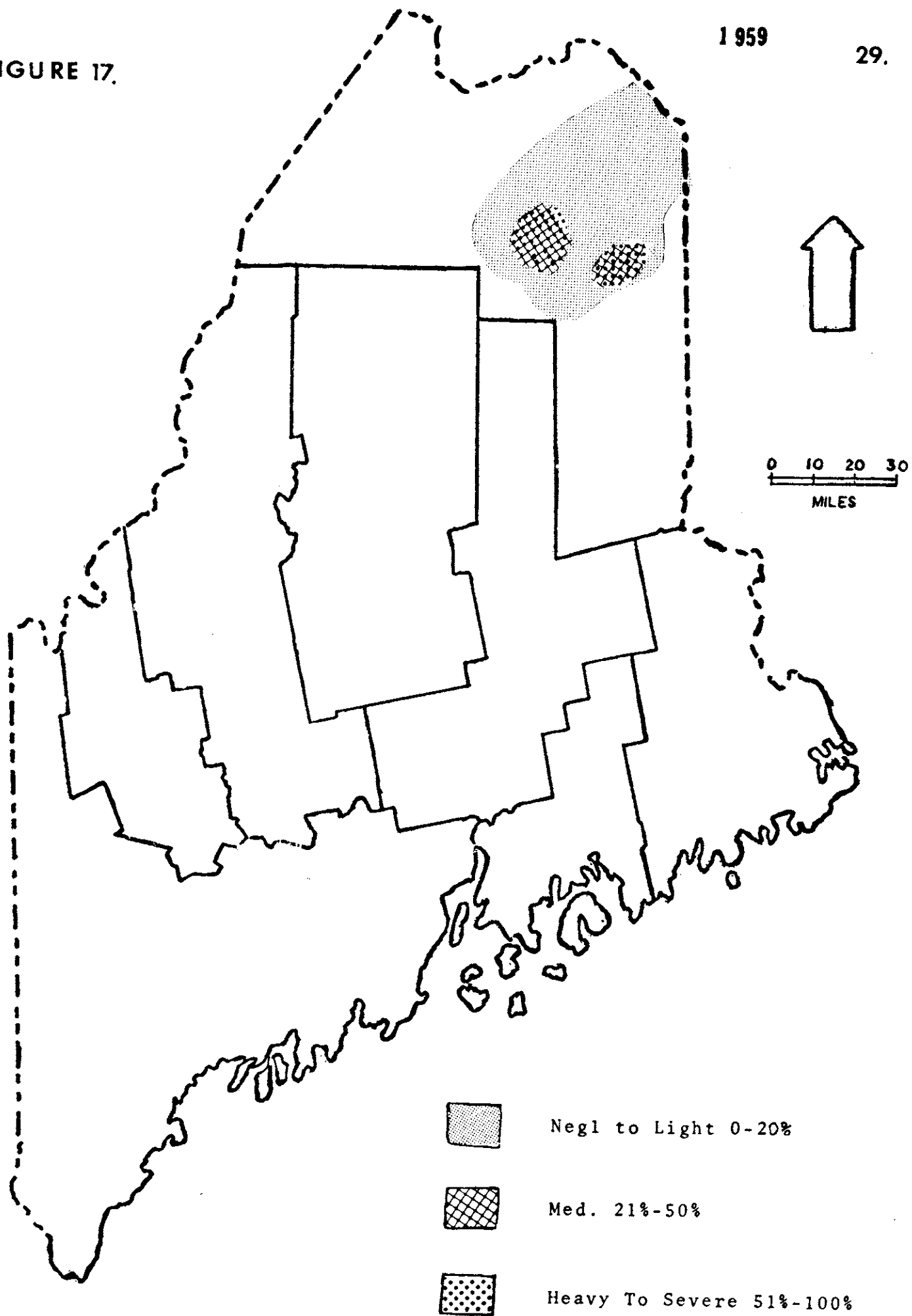


FIGURE 17.

1959

29.



30.

FIGURE 18.

1960

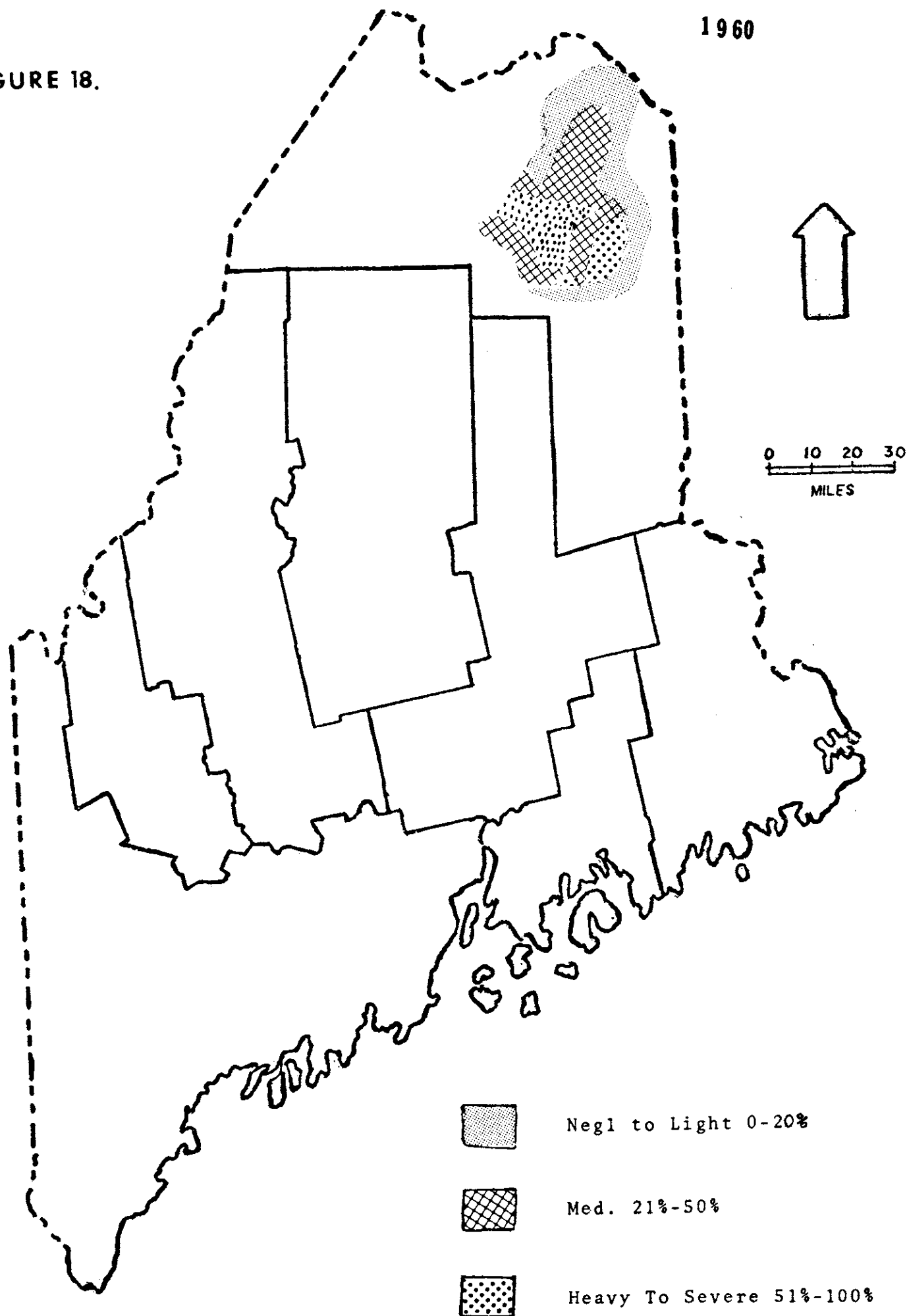


FIGURE 19.

1961

31.

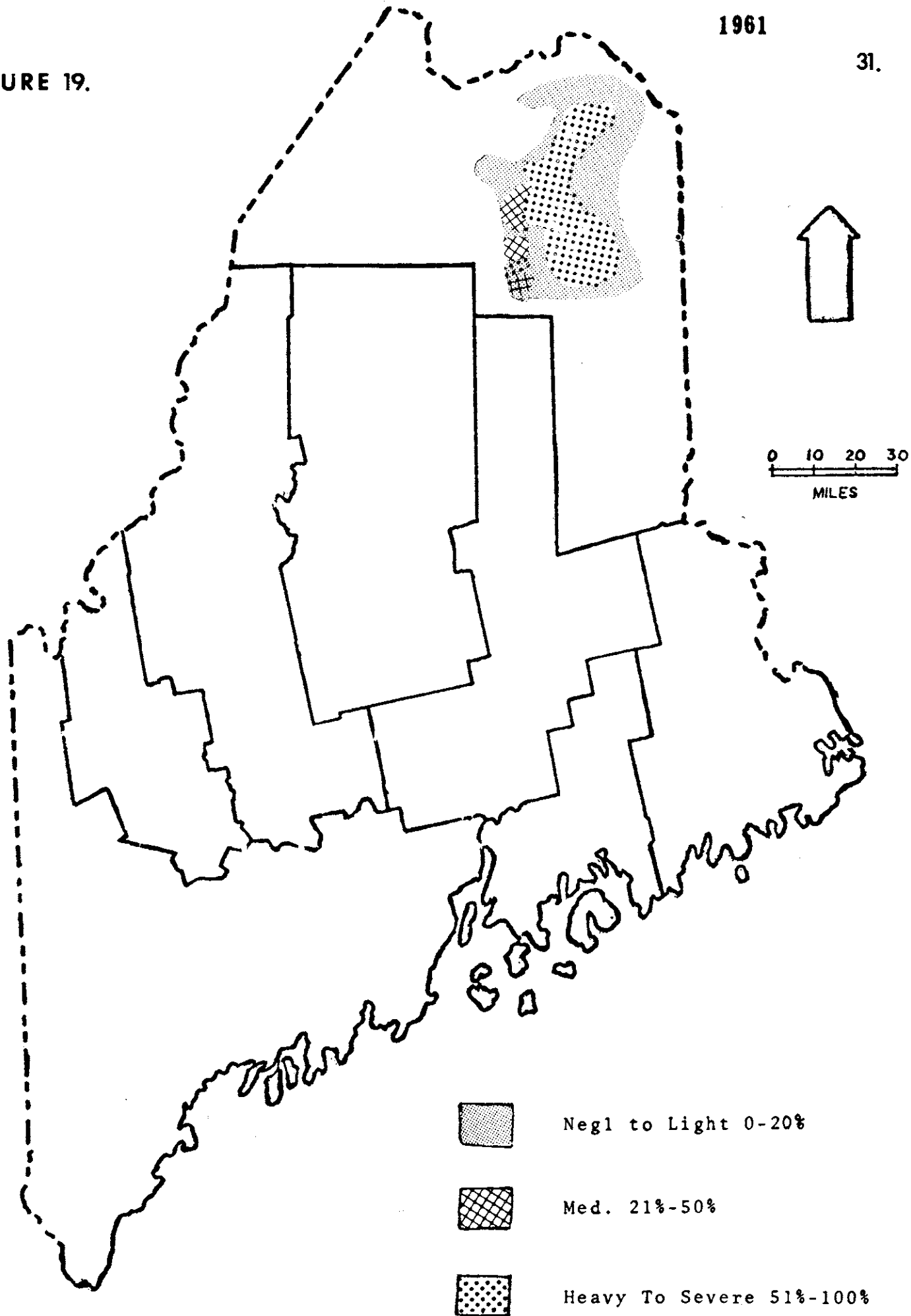


FIGURE 20.

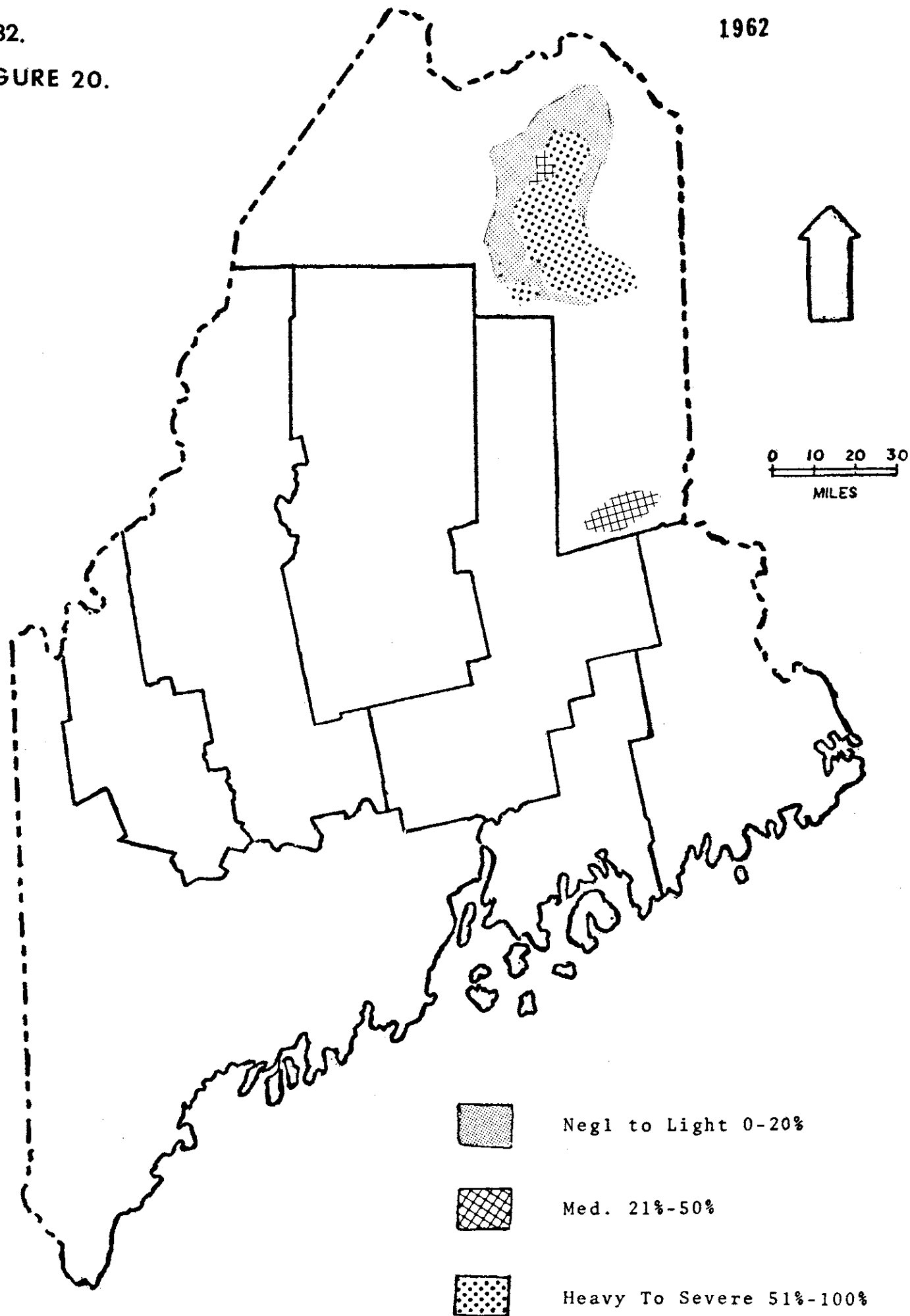
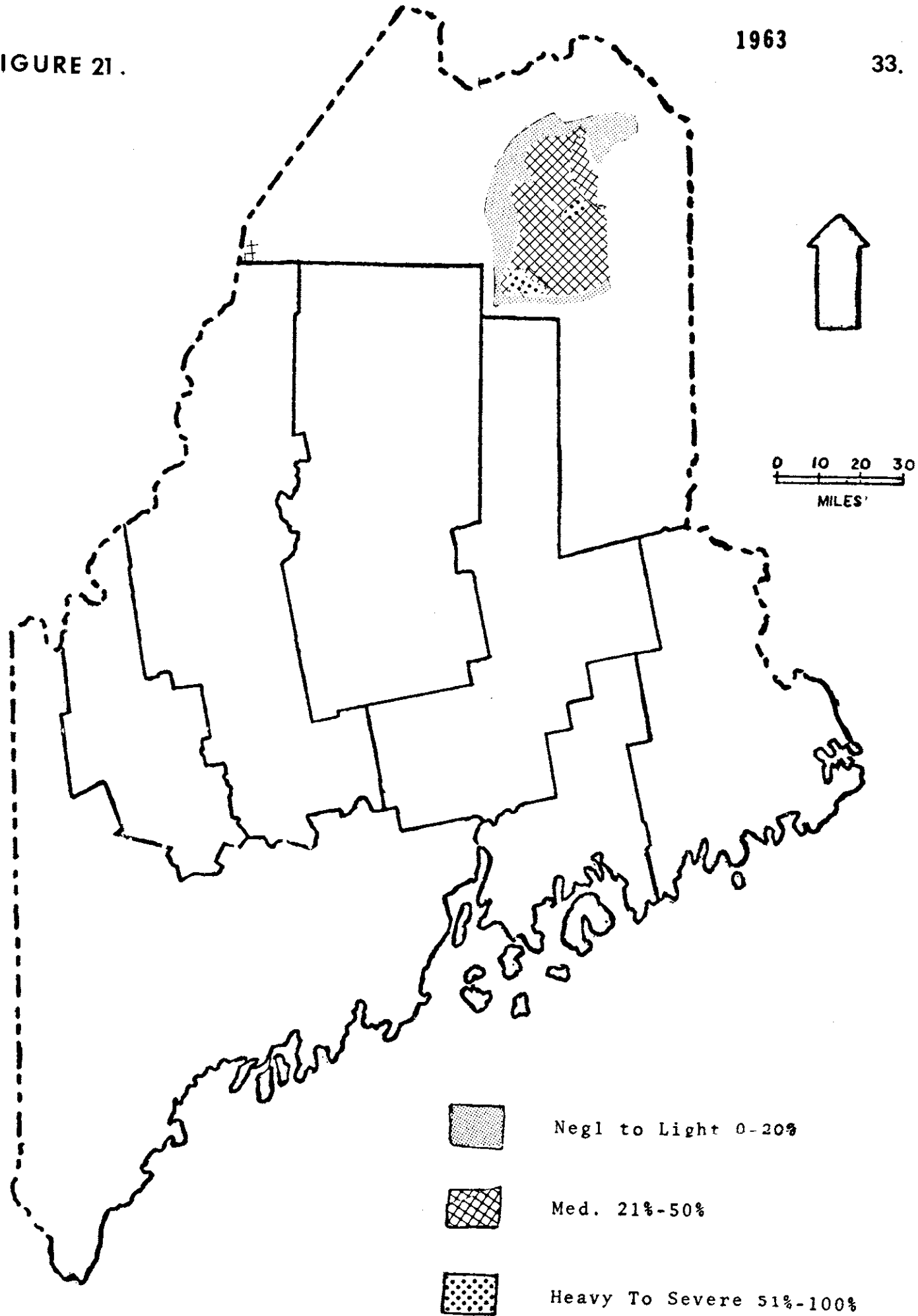


FIGURE 21.

1963

33.



34.

1964

FIGURE 22.

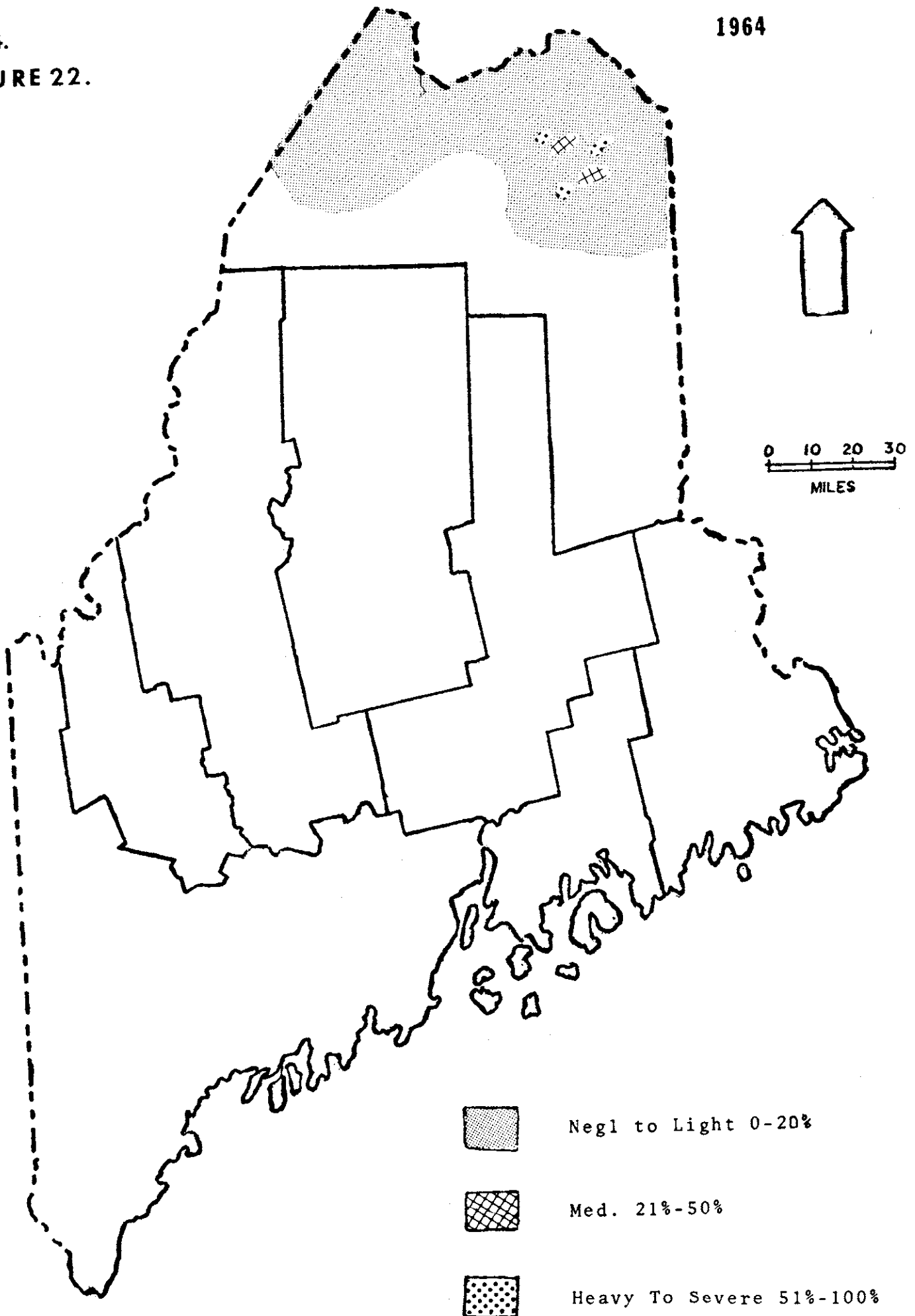


FIGURE 23.

1965

35.

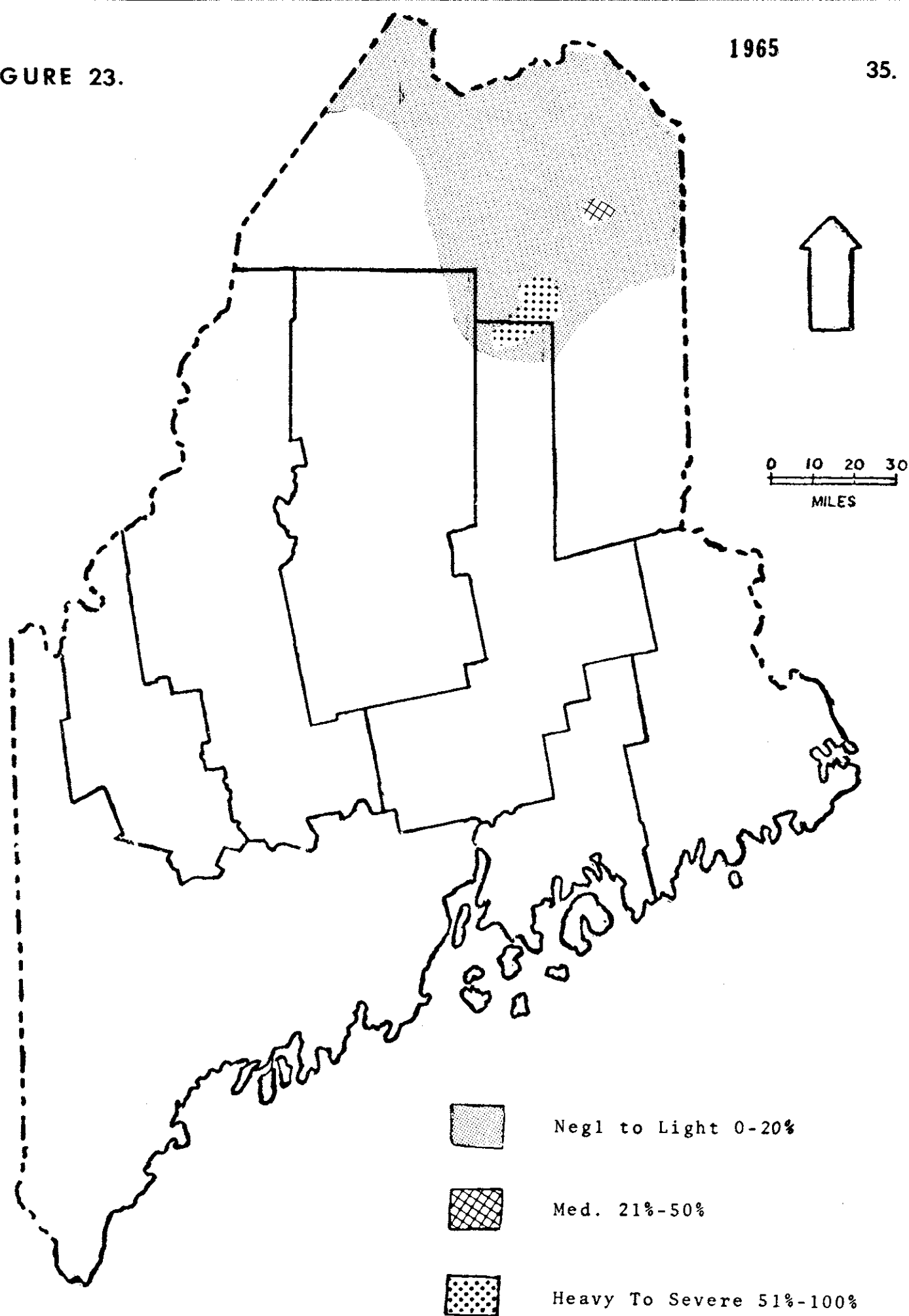


FIGURE 24.

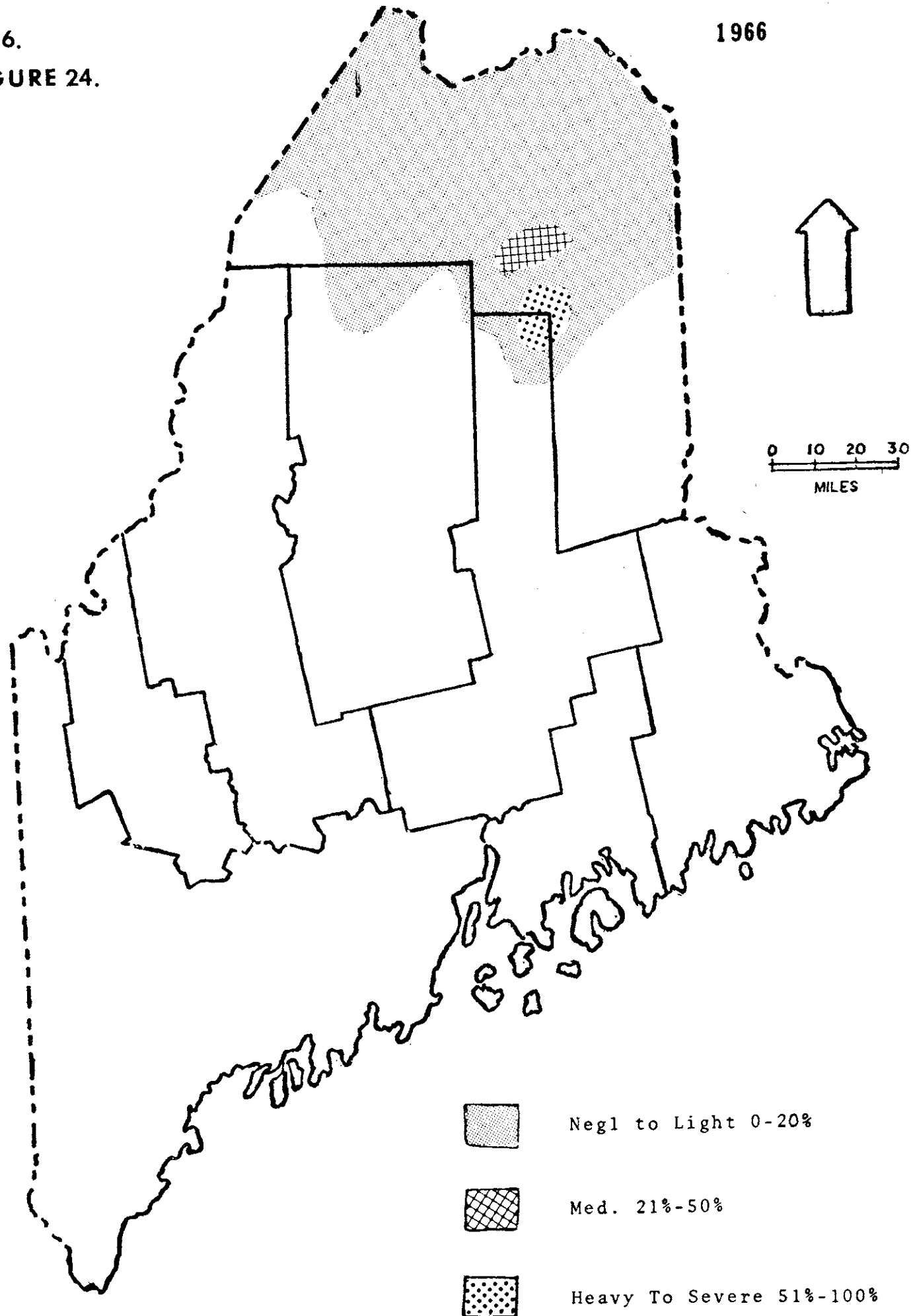
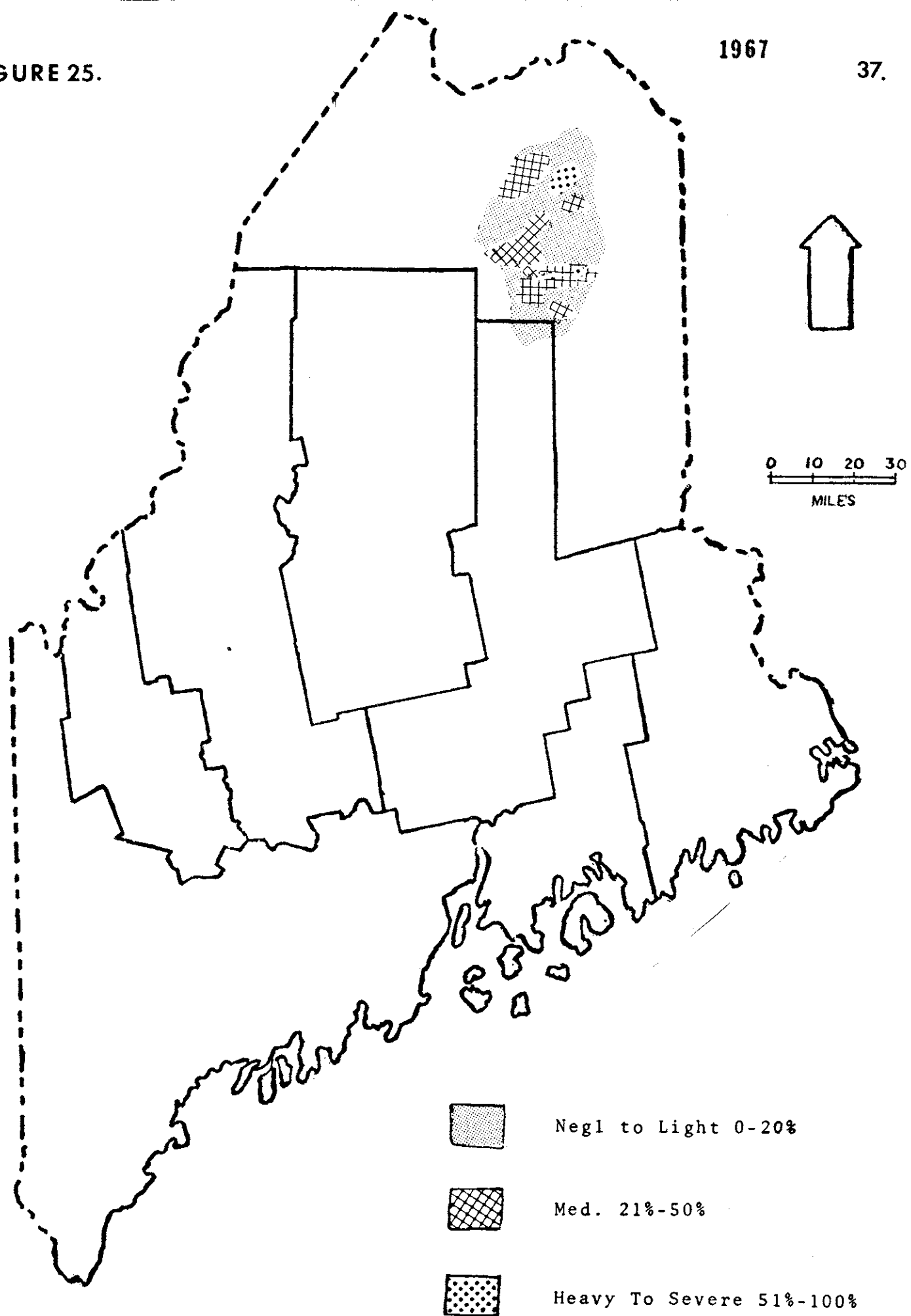


FIGURE 25.

1967

37.



1968

38,
FIGURE 26.

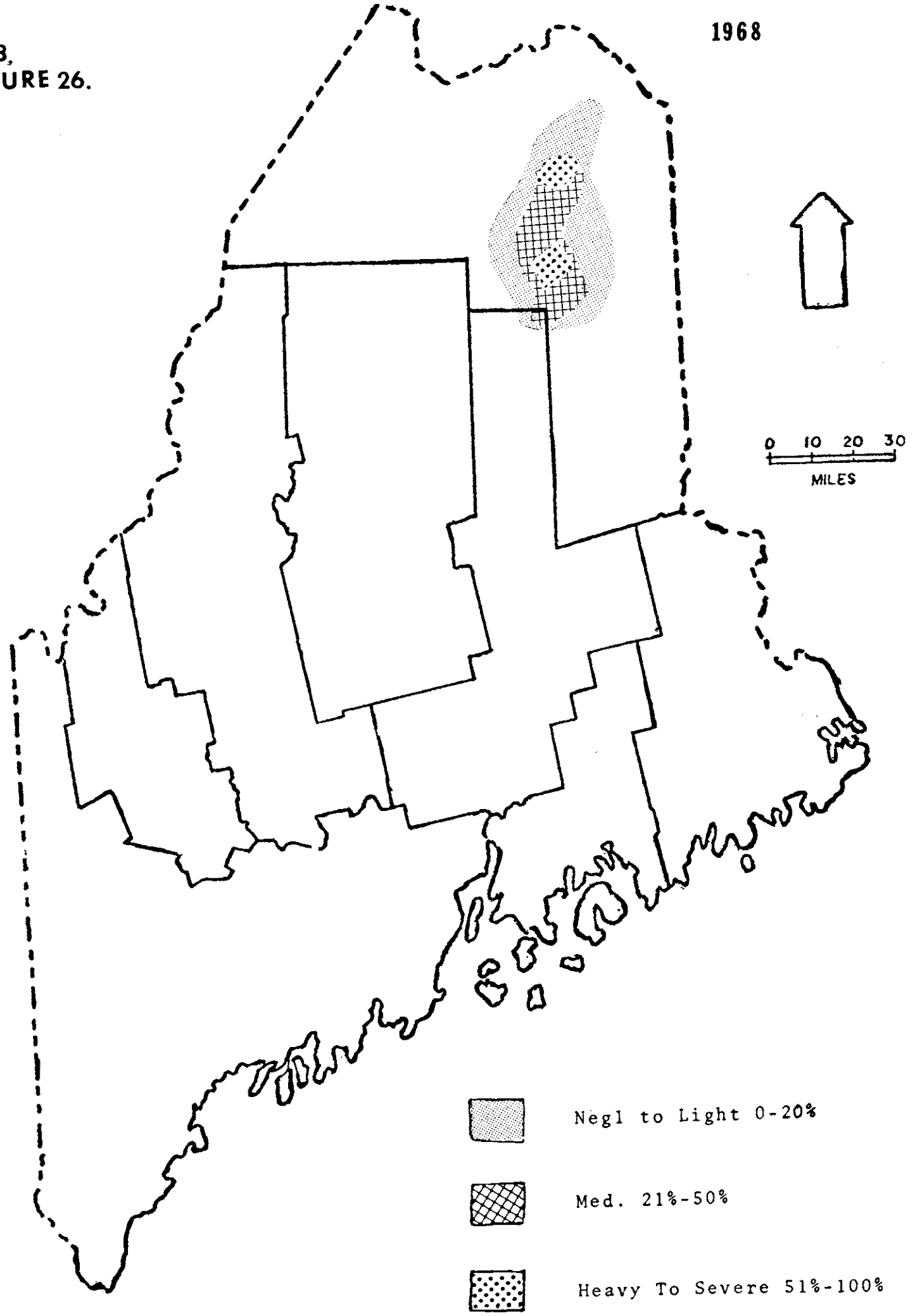
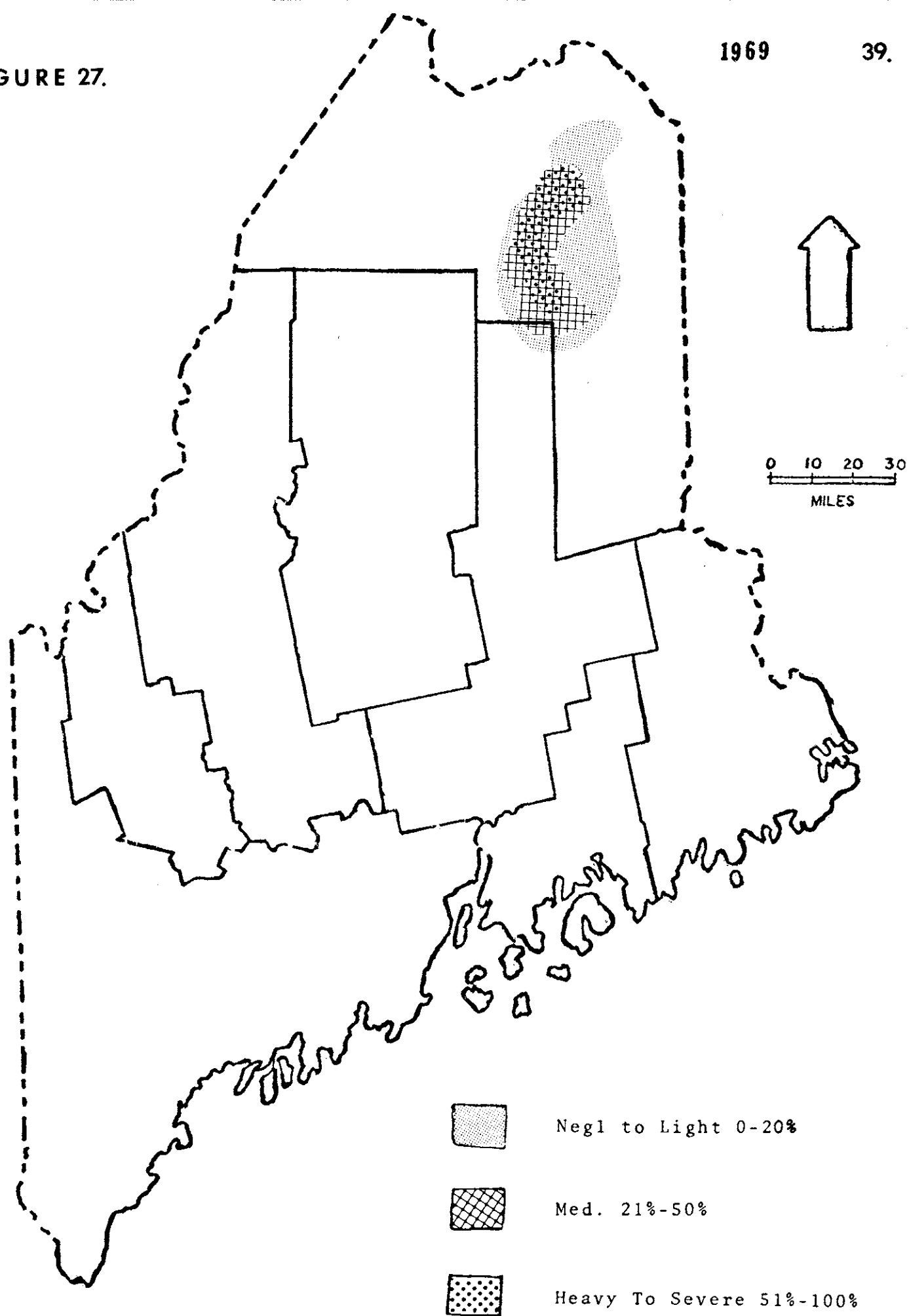


FIGURE 27.

1969

39.



40.
FIGURE 28.

1970

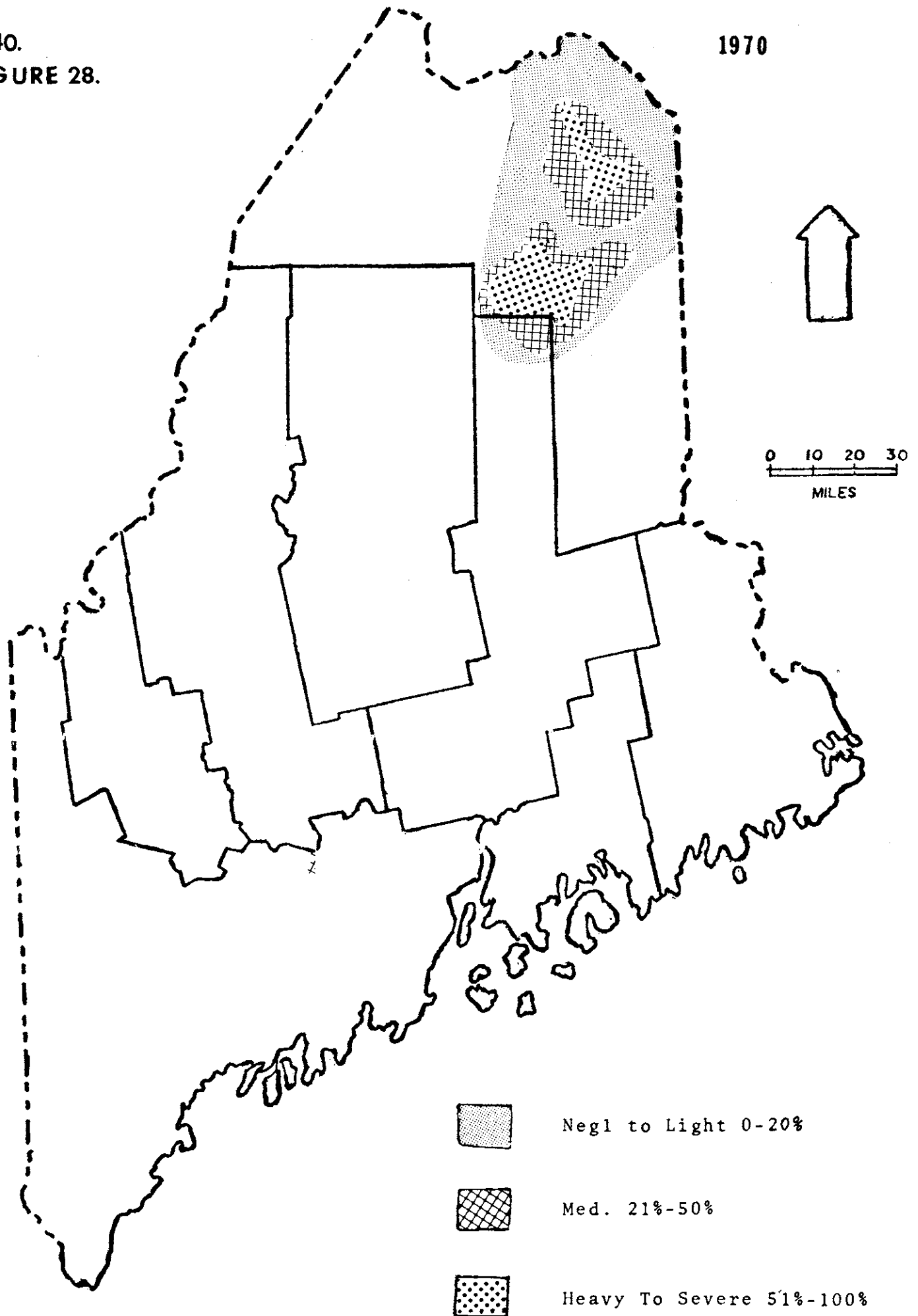
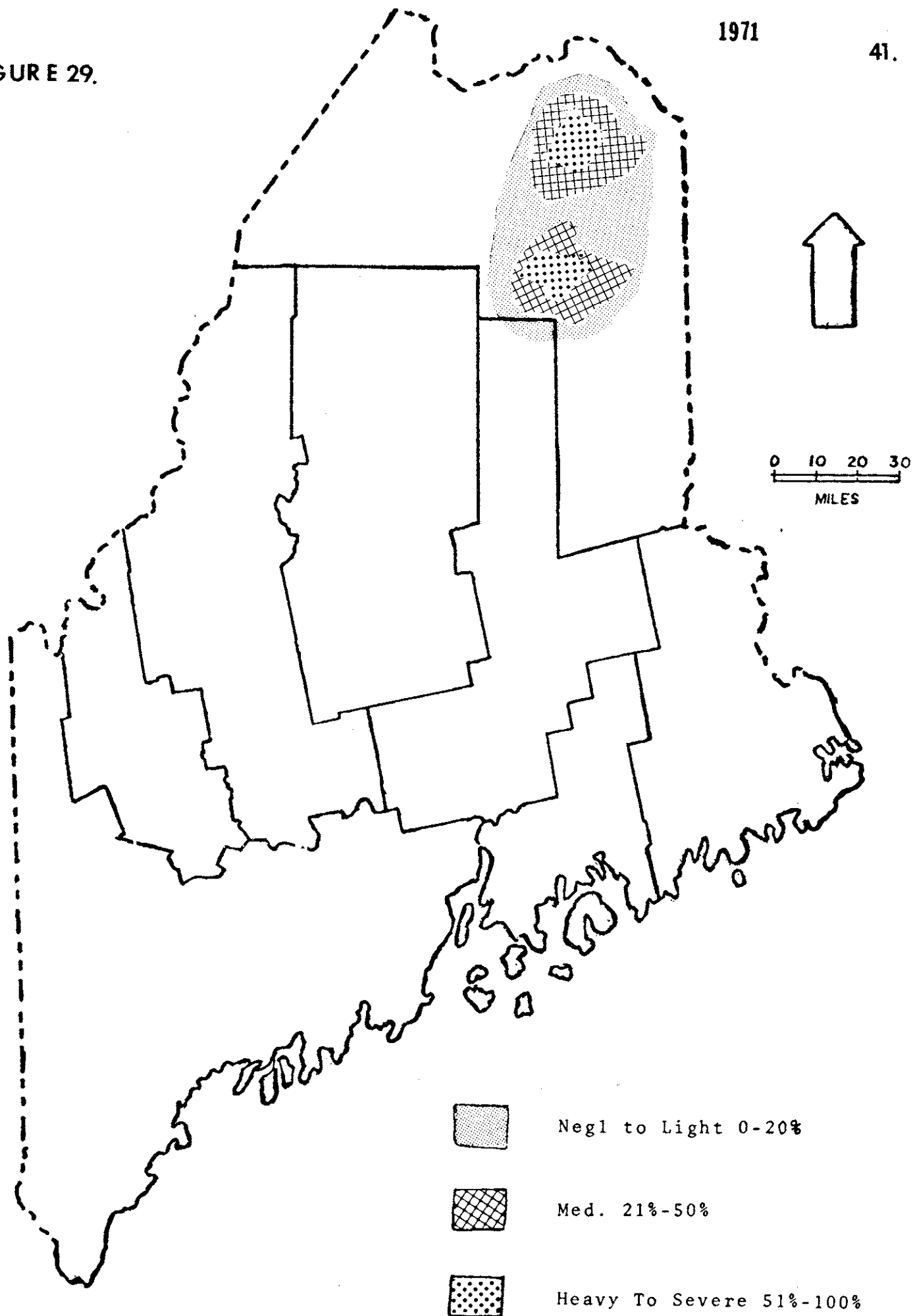


FIGURE 29.

1971

41.



42.
FIGURE 30.

1972

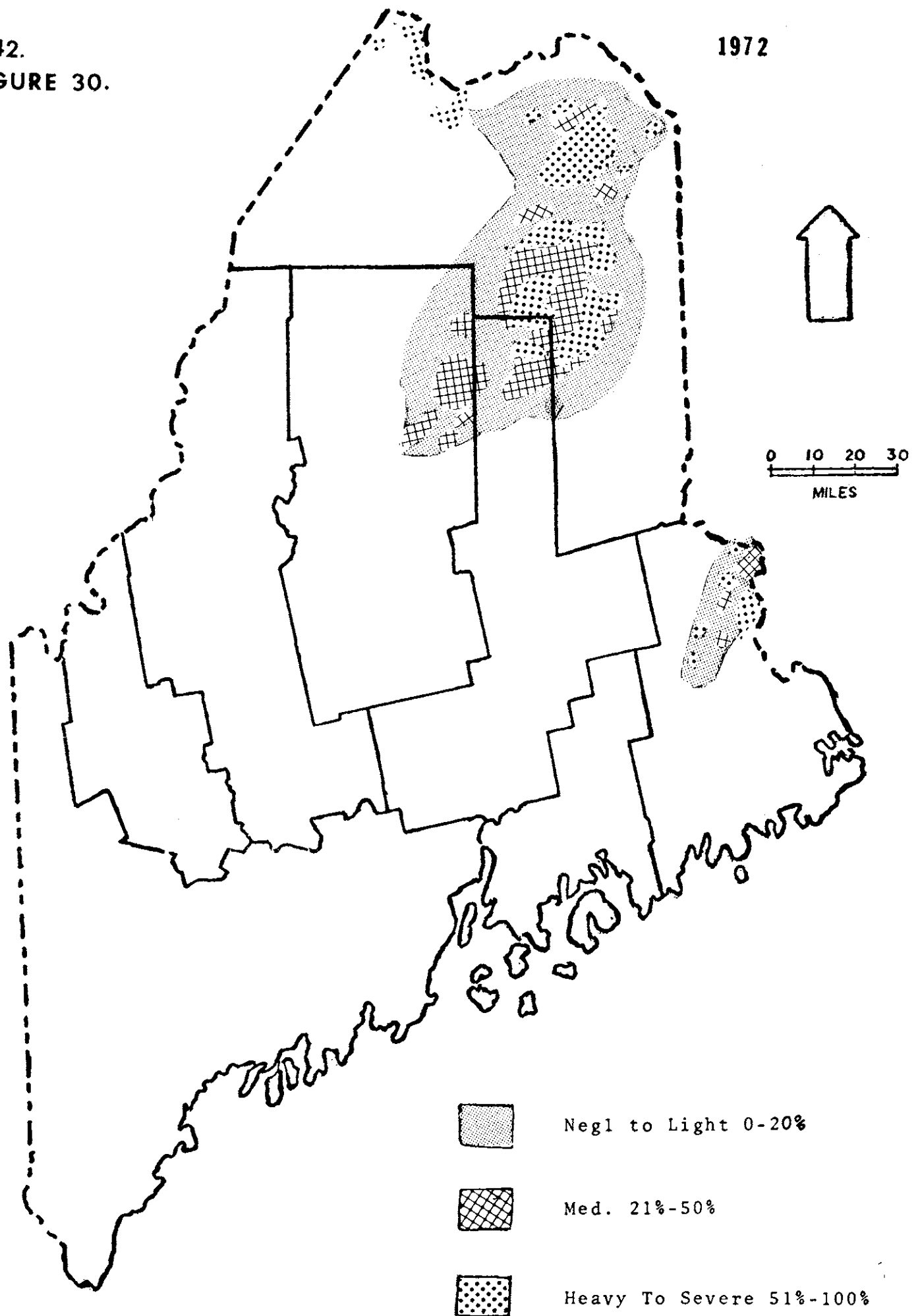


FIGURE 31.

1973

43.

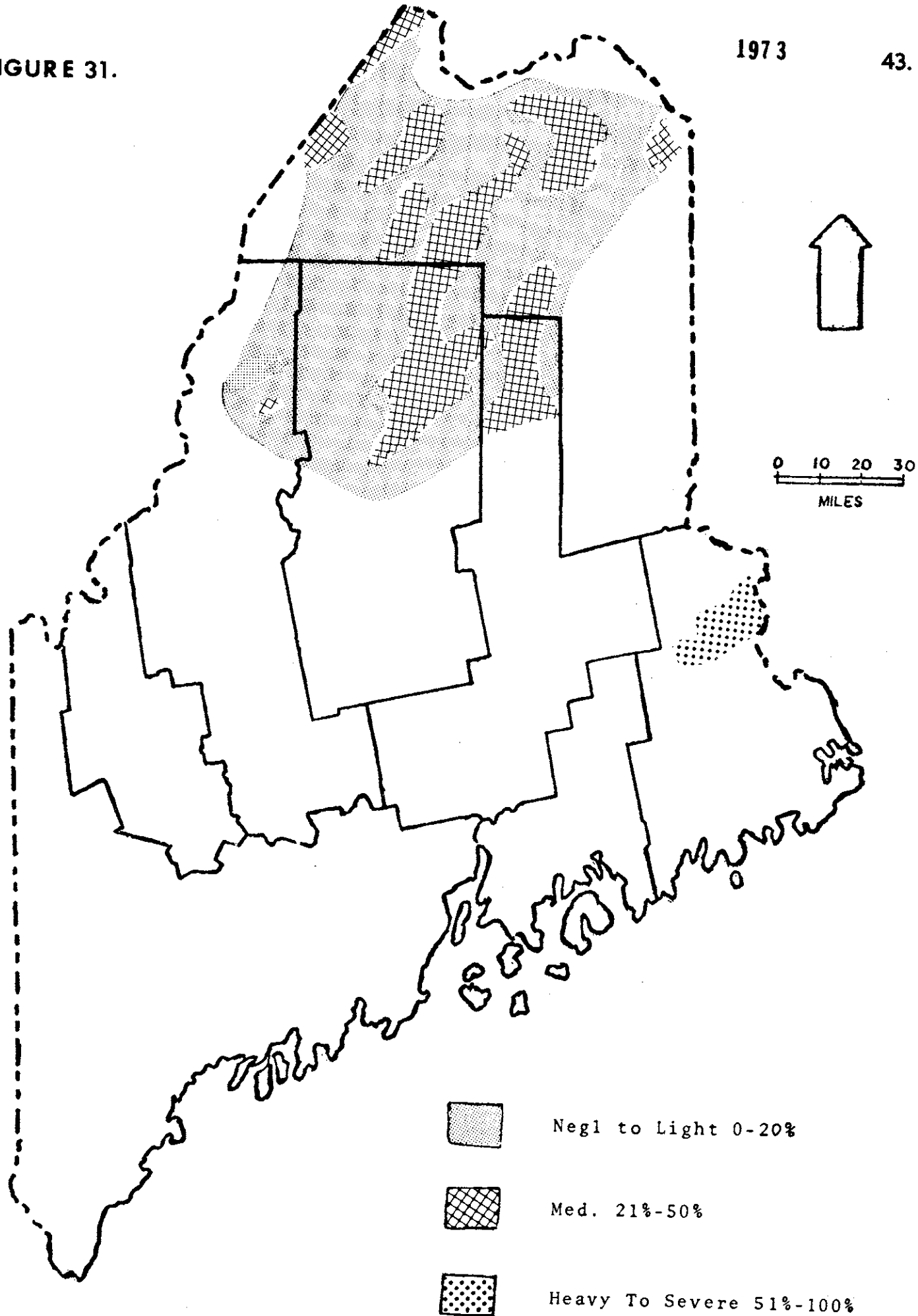


FIGURE 32.

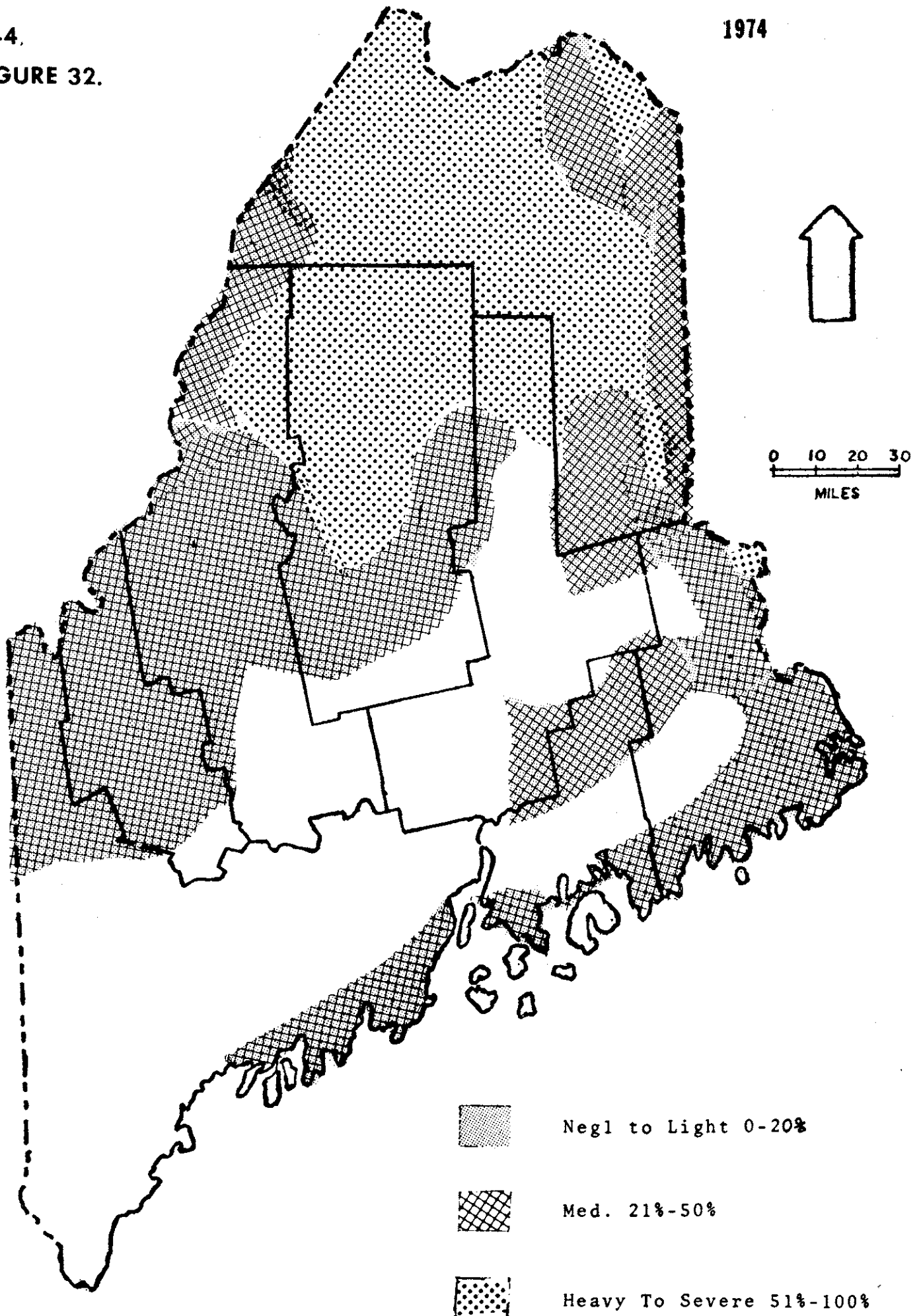


FIGURE 33.

1975

45.

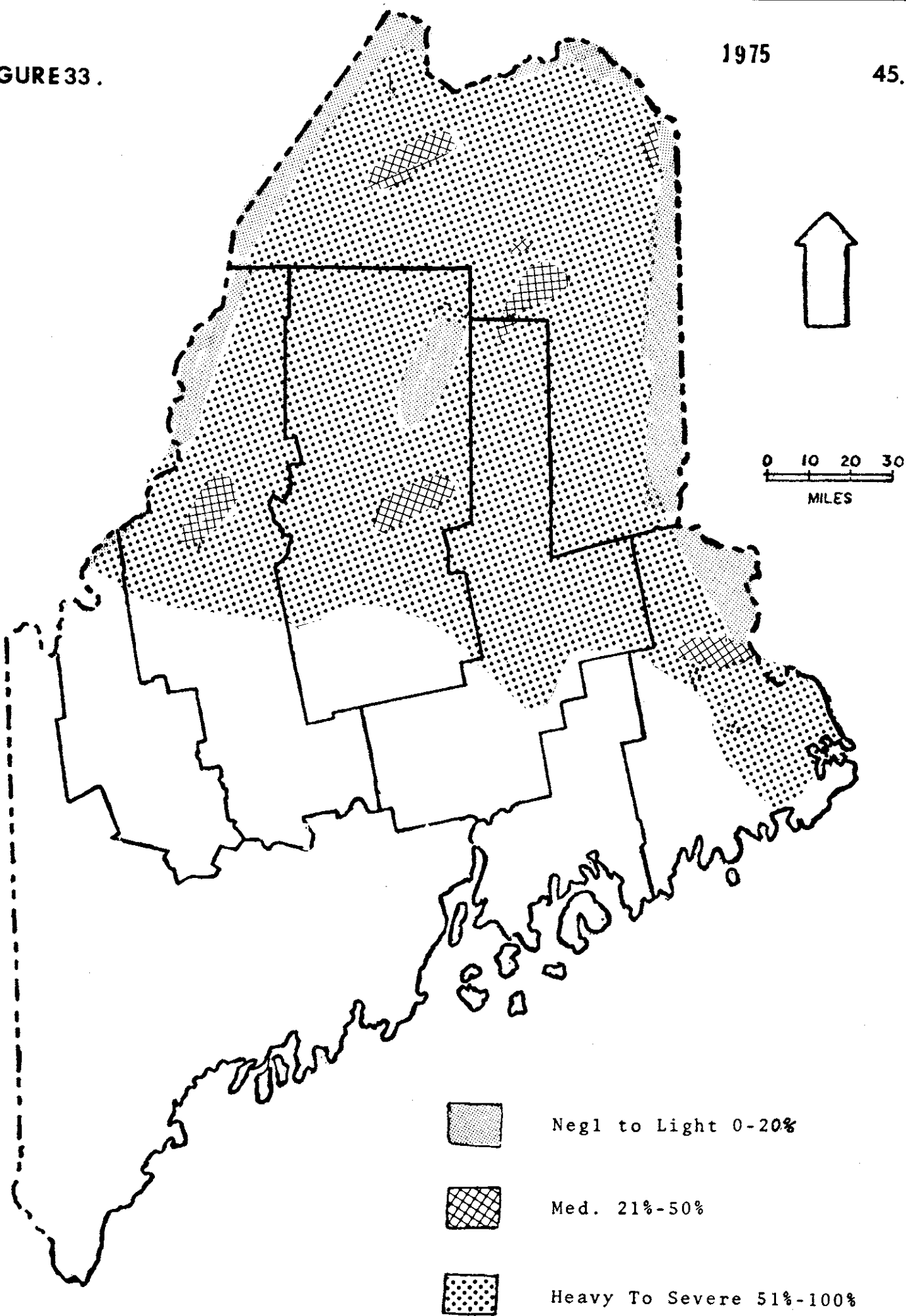
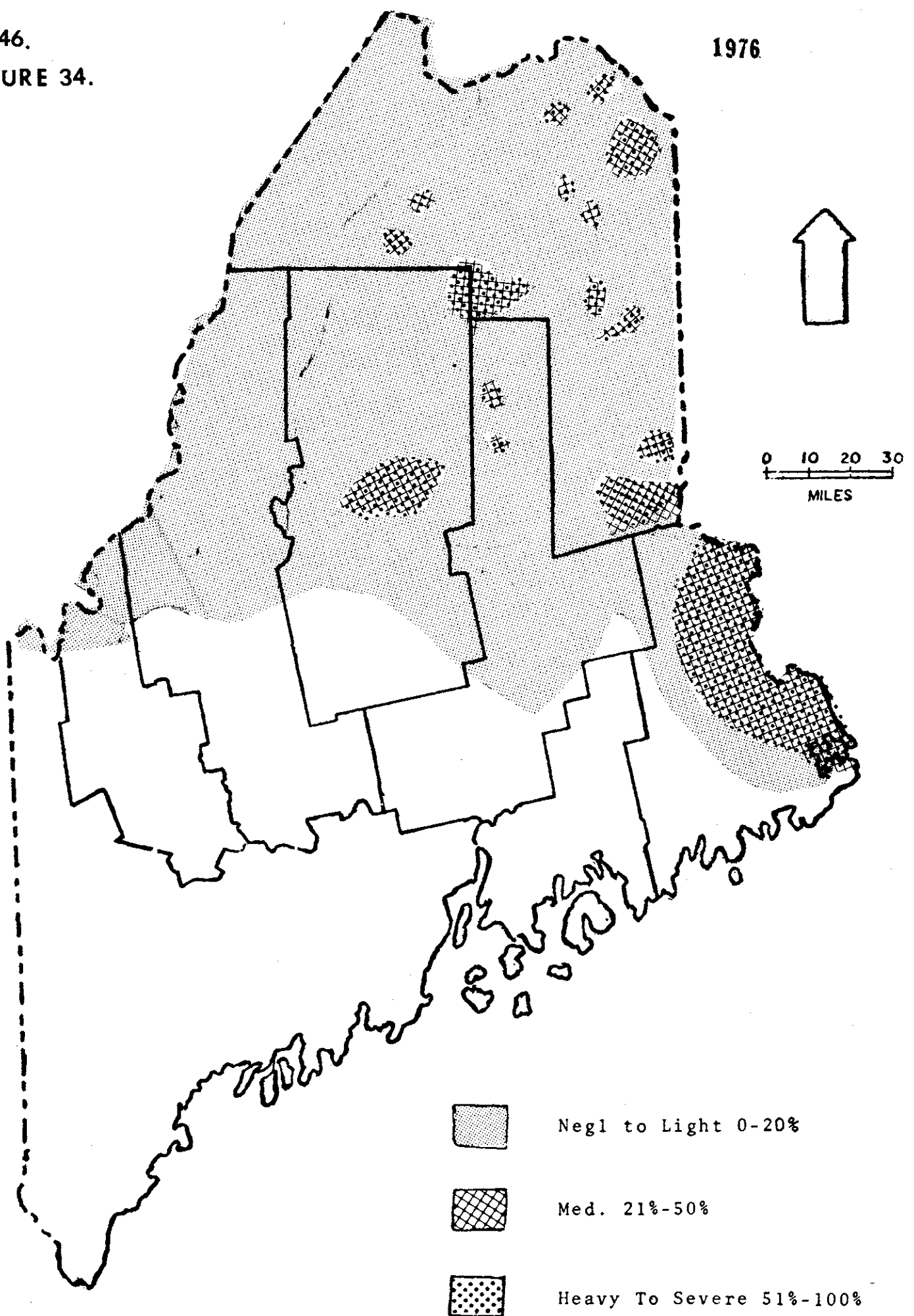


FIGURE 34.

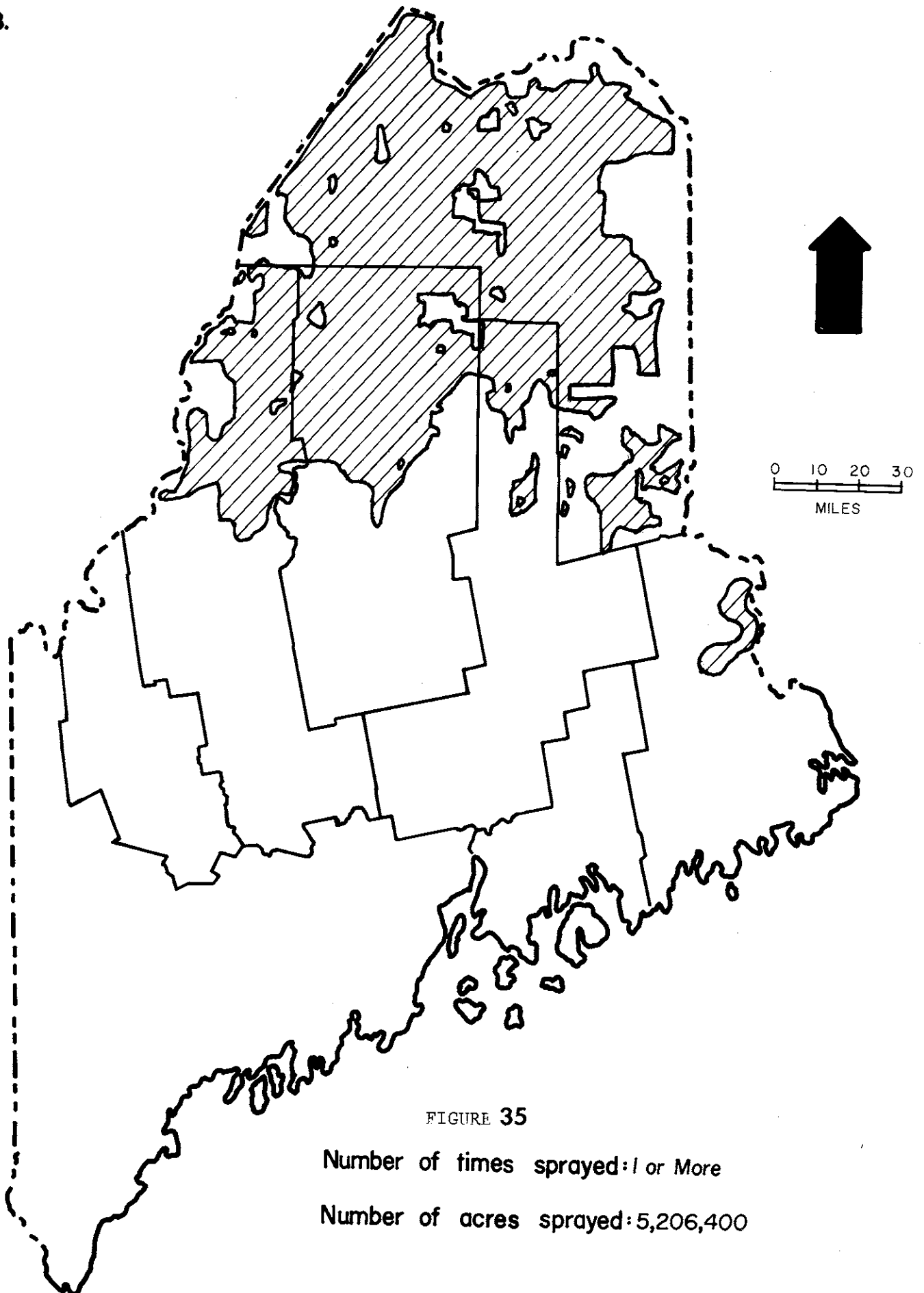


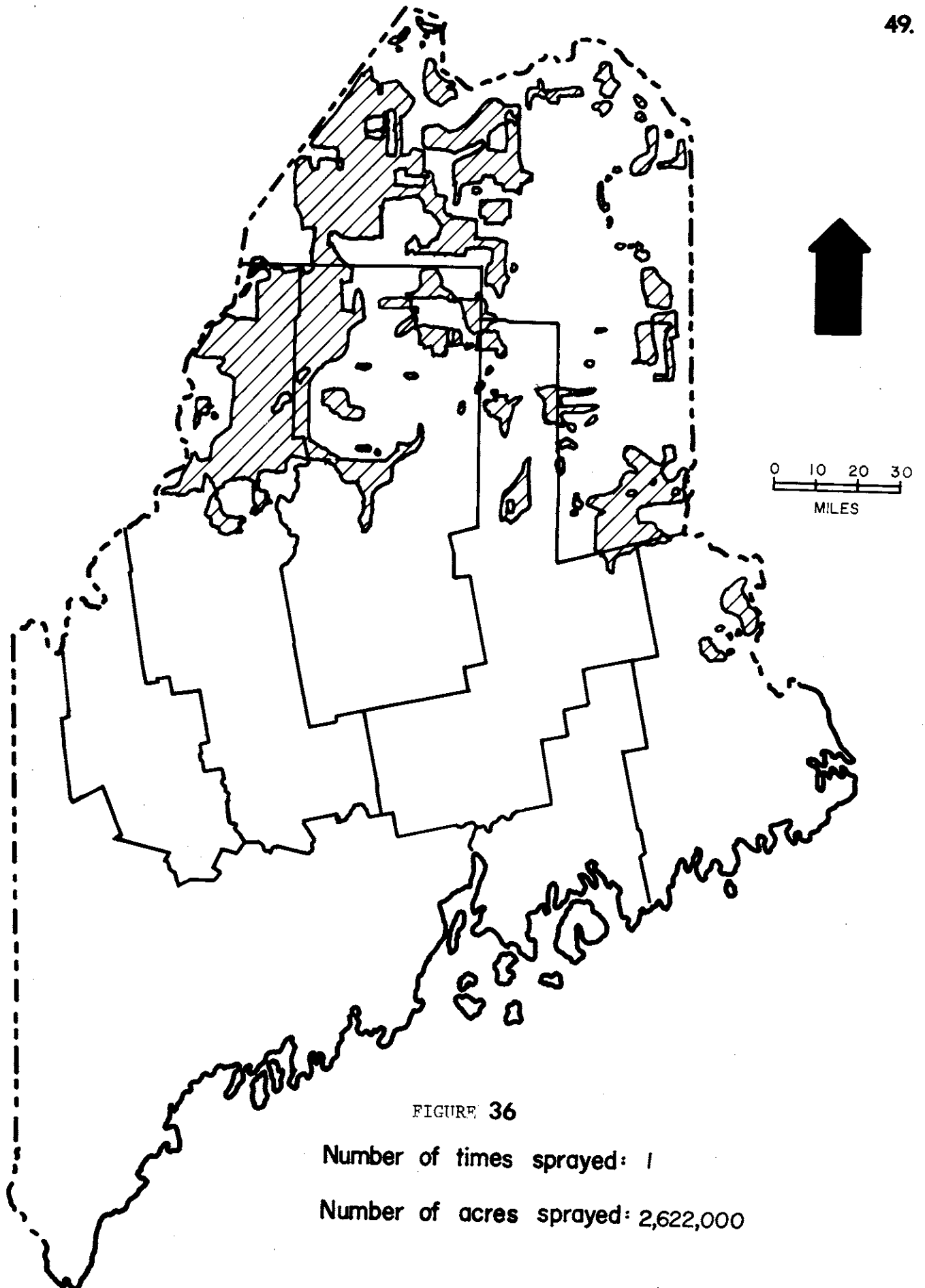
IV. SPRAYING HISTORY

TABLE 2.

MAINE SPRUCE BUDWORM SPRAY AREAS 1954-1976

Number Of Times Sprayed	Number Of Acres Sprayed
Sprayed Once	2,621,700 Acres
Sprayed Twice	1,561,700 Acres
Sprayed Three Times	564,000 Acres
Sprayed Four Times	280,400 Acres
Sprayed Five Times	145,400 Acres
Sprayed Six Times	26,800 Acres
Sprayed Seven Times	6,400 Acres
TOTAL NUMBER OF ACRES SPRAYED BETWEEN 1954-1976	5,206,400 Acres





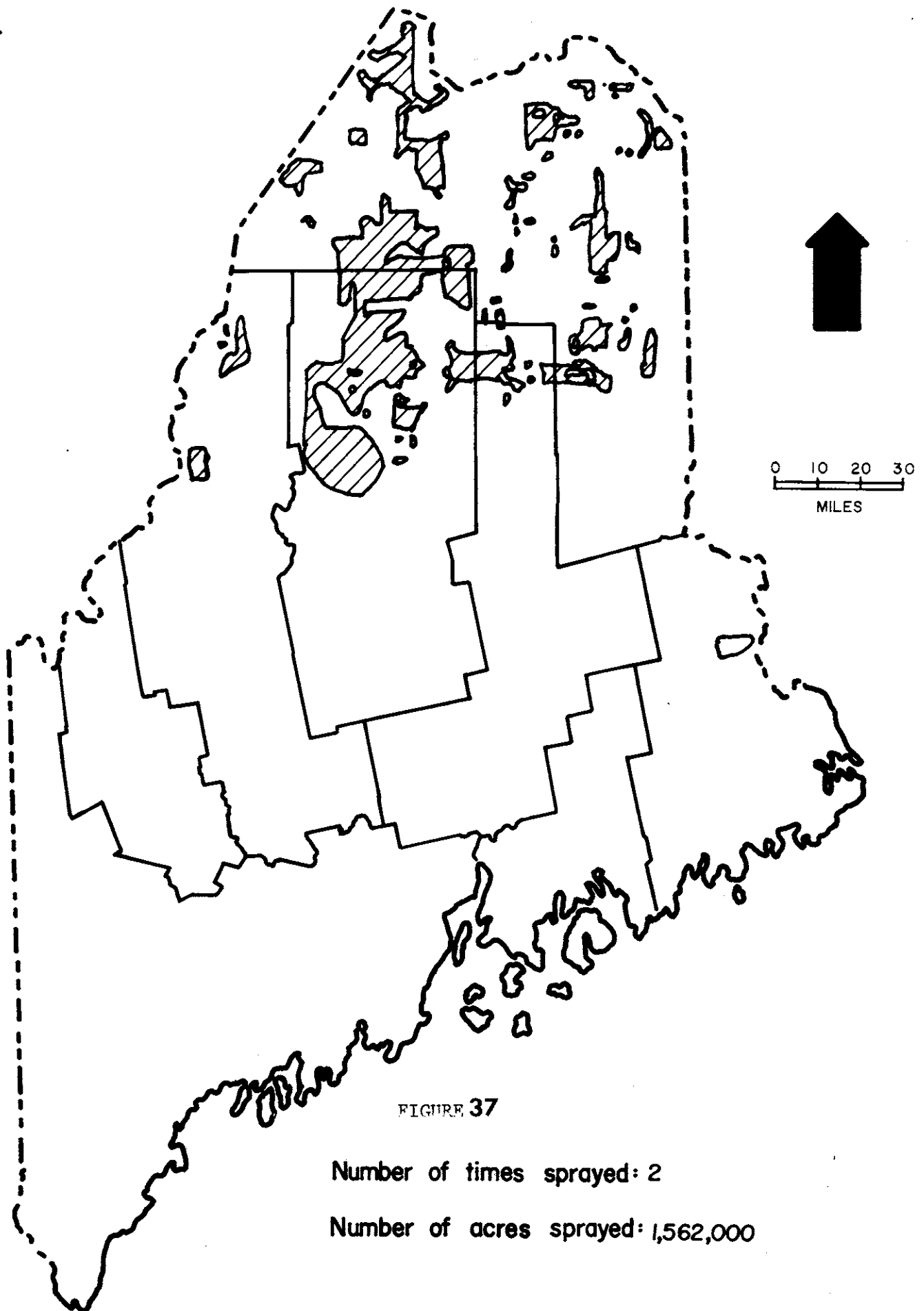
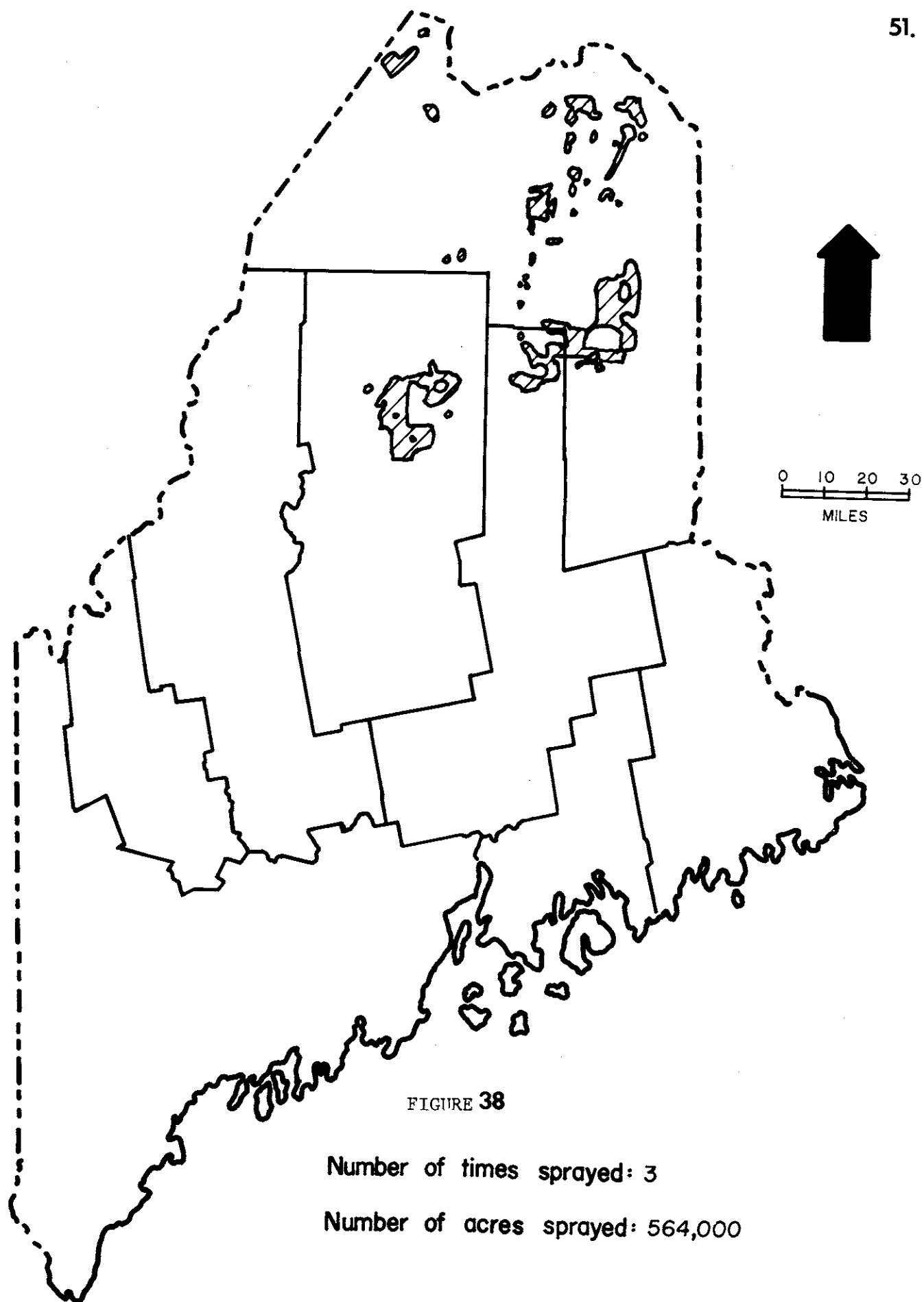
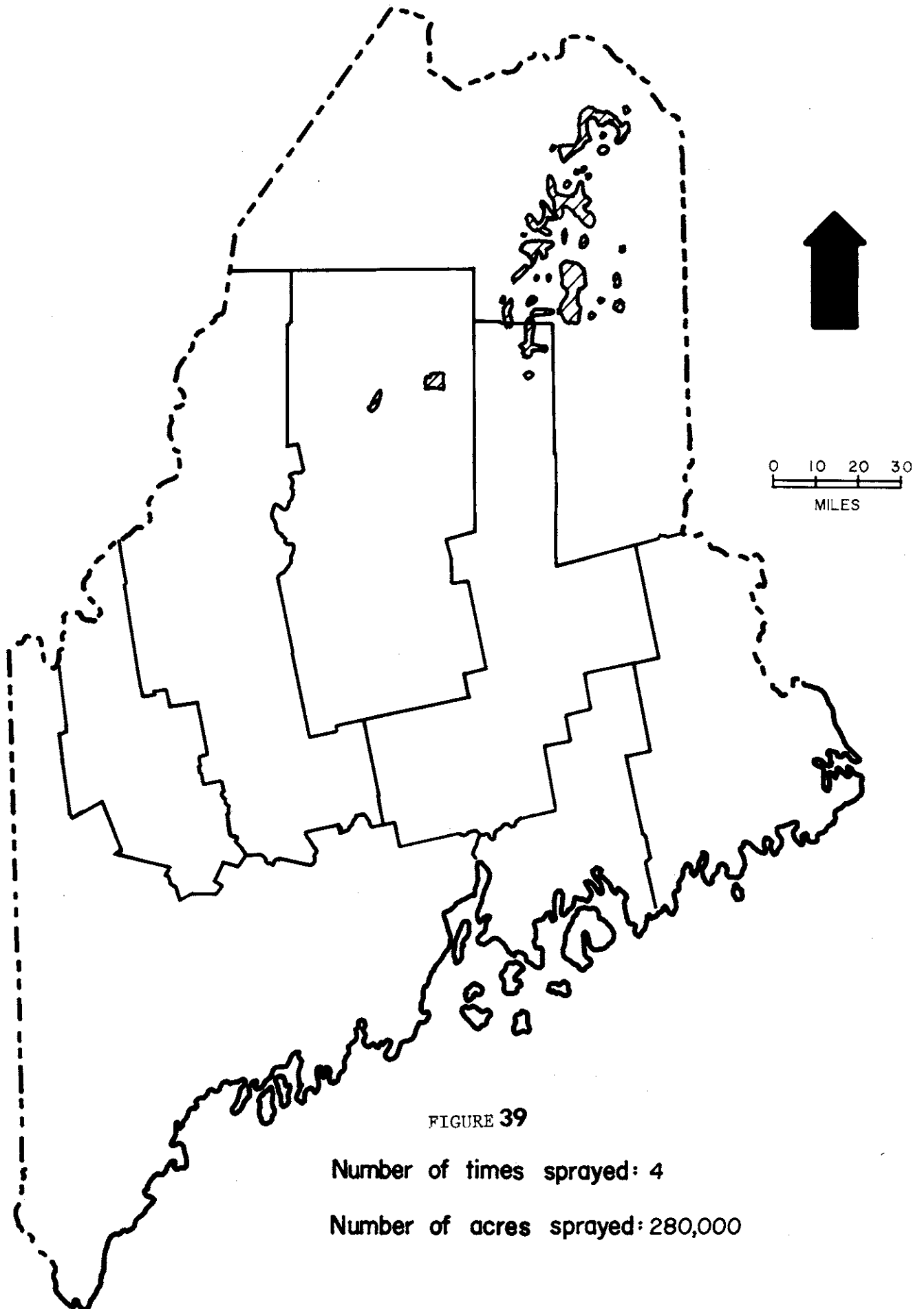


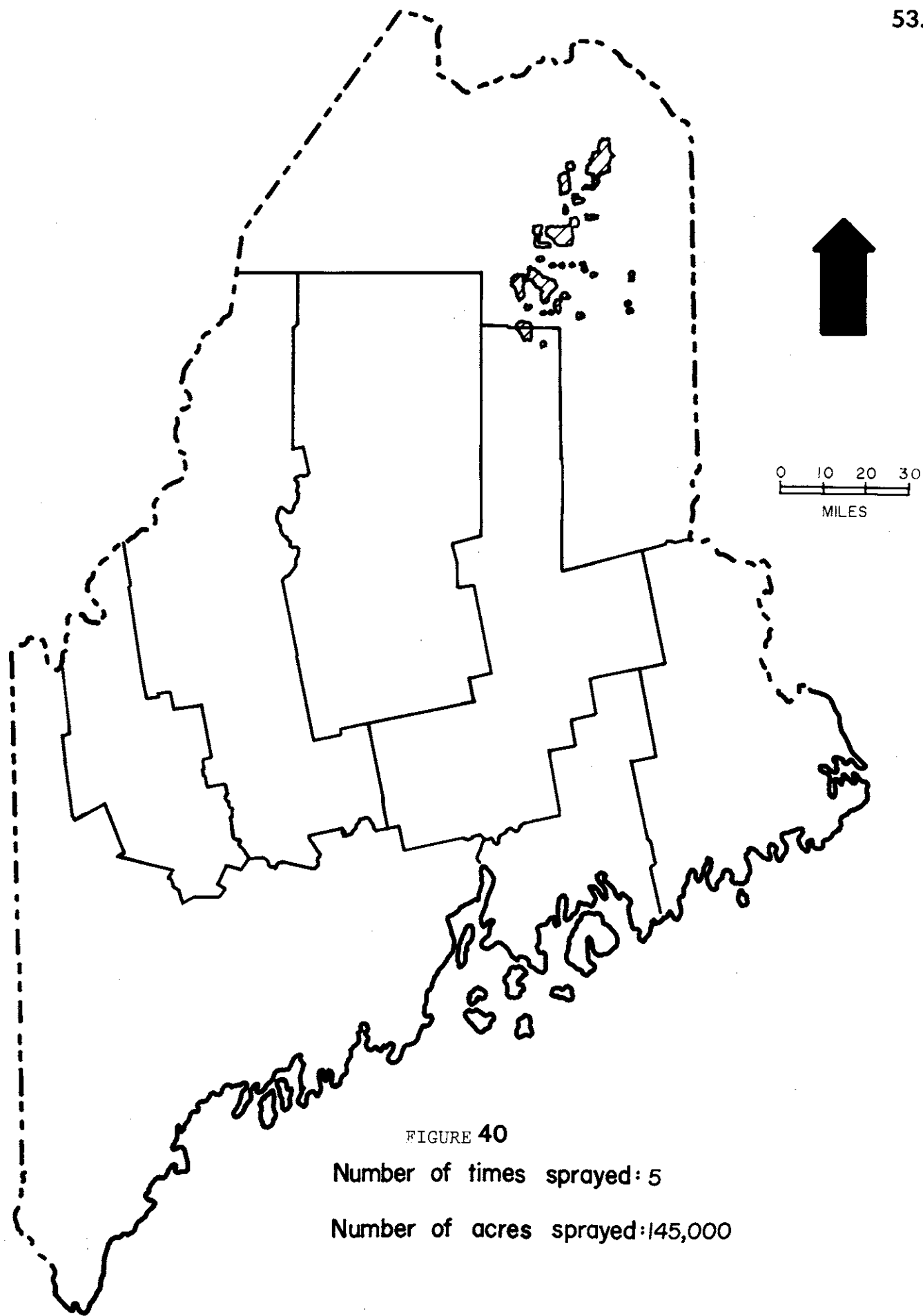
FIGURE 37

Number of times sprayed: 2

Number of acres sprayed: 1,562,000







54.

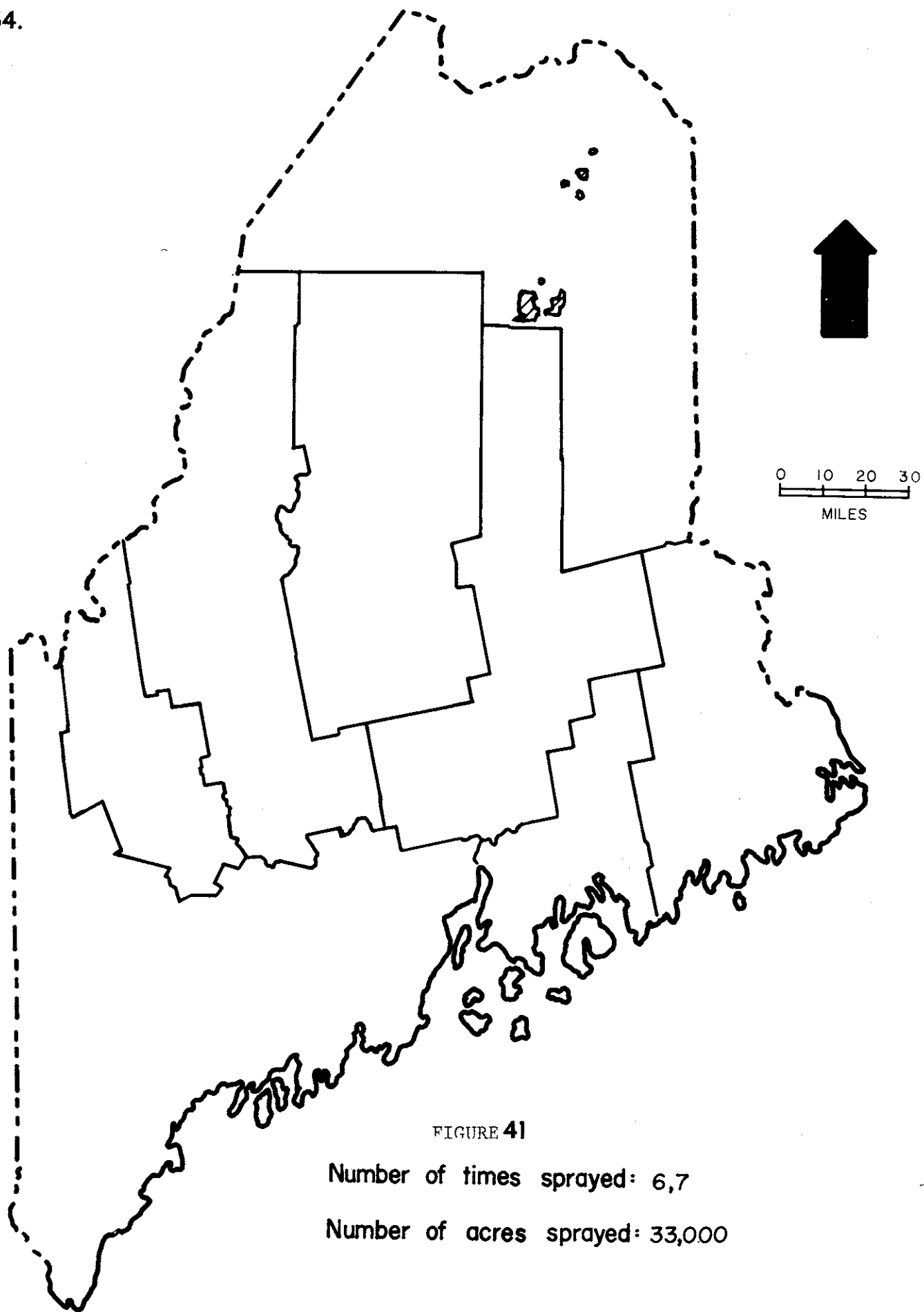


FIGURE 41

Number of times sprayed: 6,7

Number of acres sprayed: 33,000

TABLE 3

SUMMARY OF AERIAL SPRAYING FOR SPRUCE BUDWORM CONTROL IN MAINE

YEAR	INSECTICIDE	ACRES TREATED
1954	DDT	21,000
1958	DDT	302,000
1960	DDT	217,000
1961	DDT	53,000
1963	DDT	479,000
1964	DDT	58,100
1967	DDT	92,162
1970	fenitrothion (Accothion ^R)	210,000
1972	mexacarbate (Zectran ^R)	500,000
1973	mexacarbate (Zectran ^R)	470,000
1974	mexacarbate (Zectran ^R)	430,000
1975	carbaryl (Sevin ^R)	496,445
1975	fenitrothion (Sumithion ^R)	1,499,260
1975	mexacarbate (Zectran ^R)	238,000
1976	carbaryl (Sevin ^R)	3,460,000
1976	trichlorfon (Dylox ^R)	40,000
1977	carbaryl (Sevin ^R)	808,000
1977	trichlorfon (Dylox ^R)	55,000
1977	acephate (Orthene ^R)	58,000

MAINE SPRUCE BUDWORM SUPPRESSION PROJECTS

1954, 1958, 1960, 1961

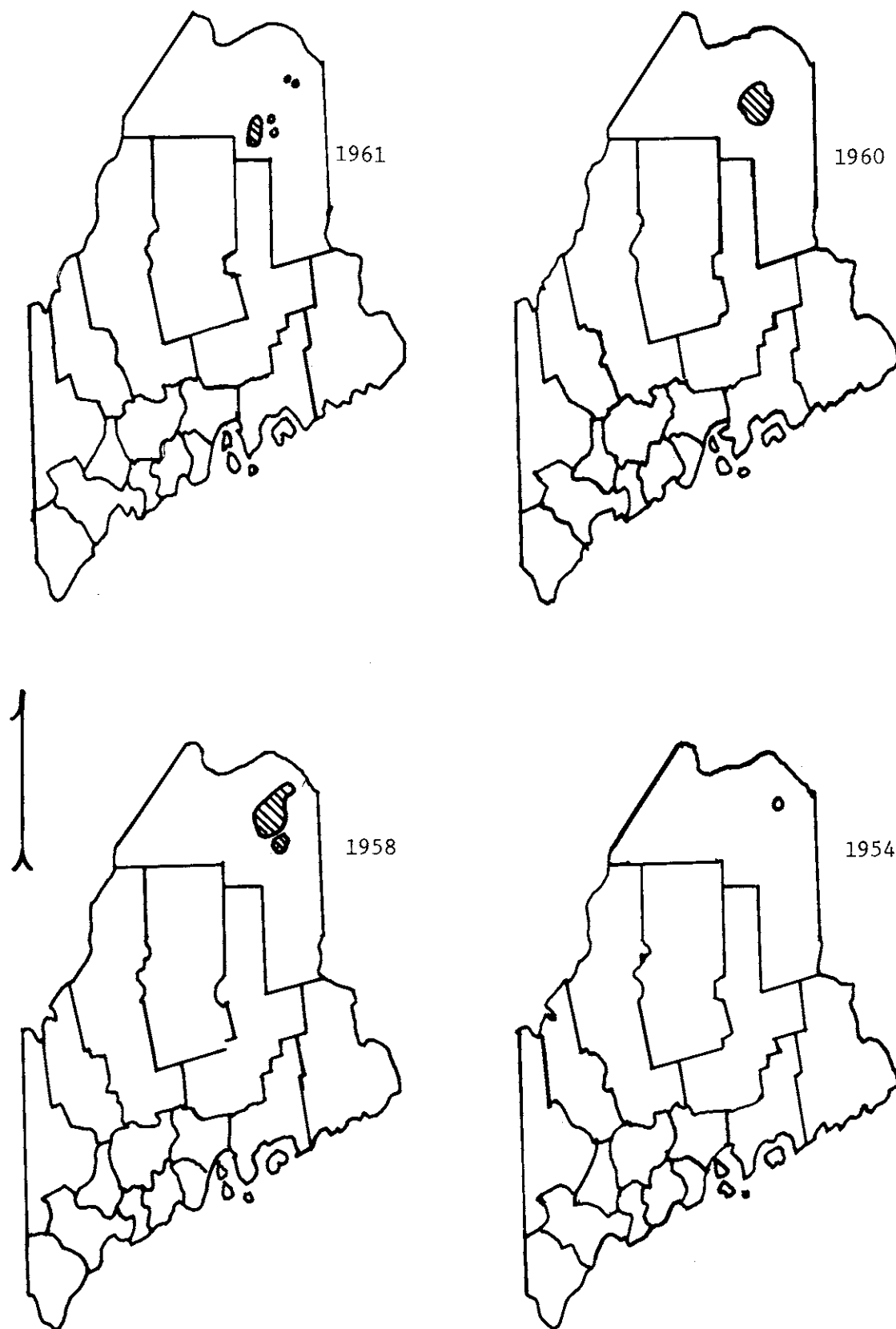
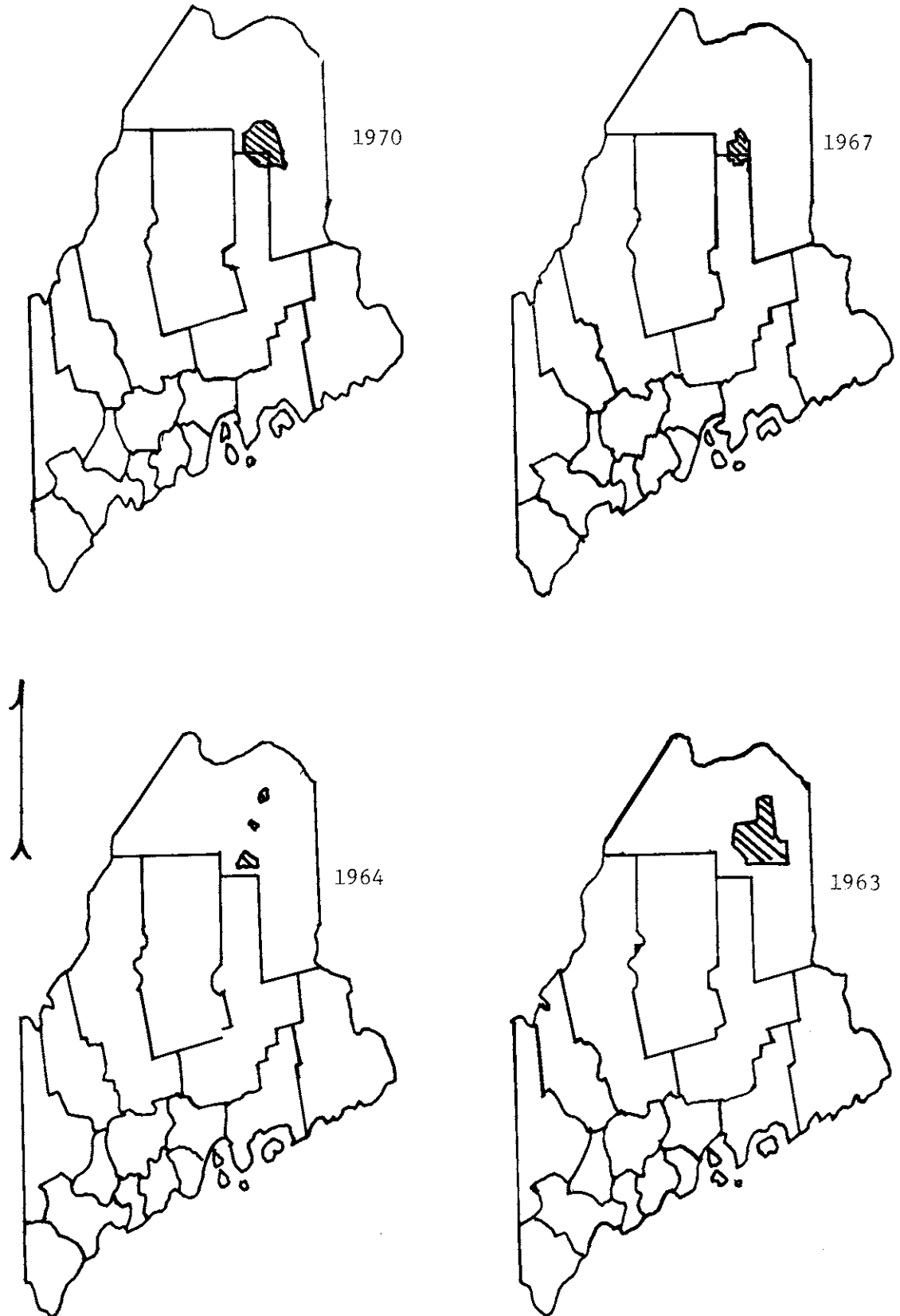


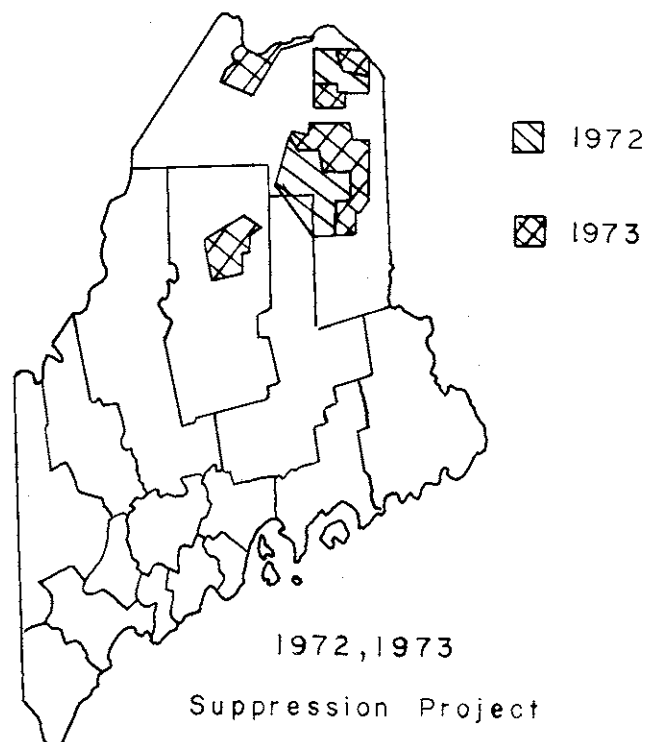
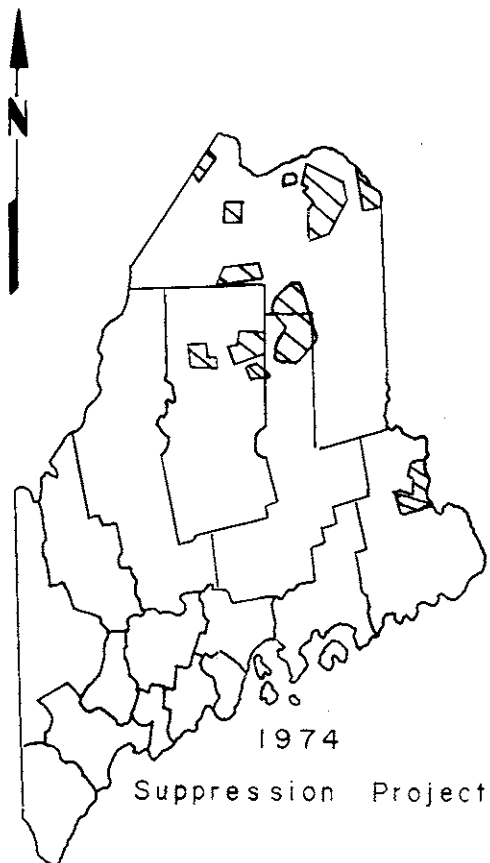
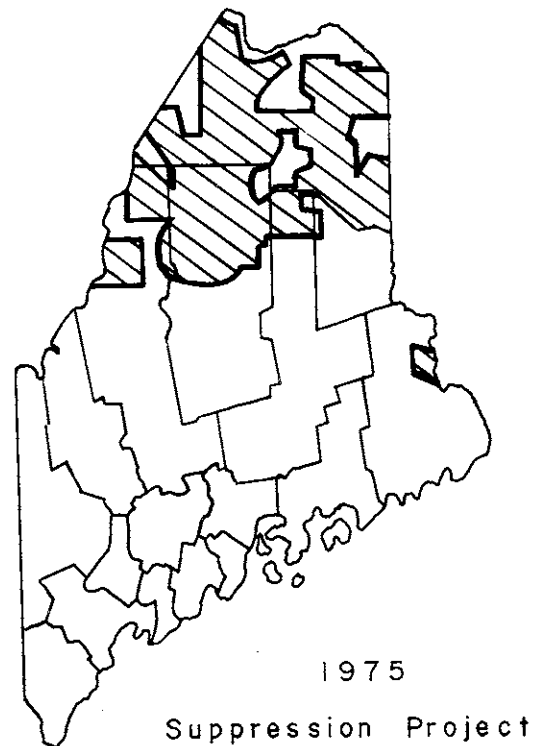
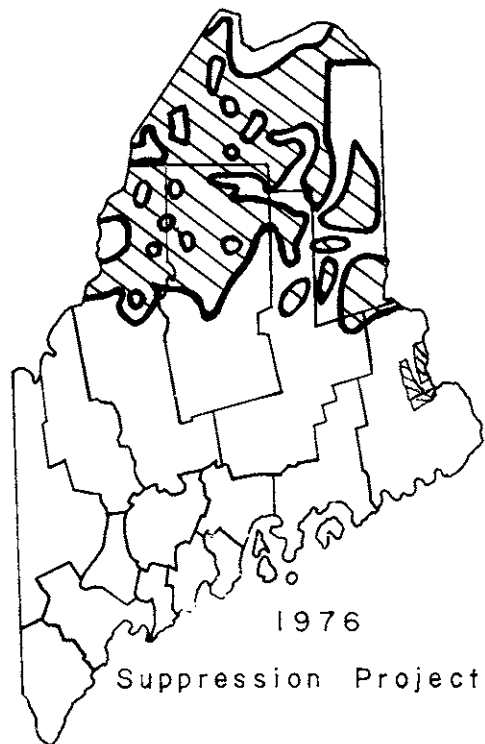
FIGURE 43

MAINE SPRUCE BUDWORM SUPPRESSION PROJECTS

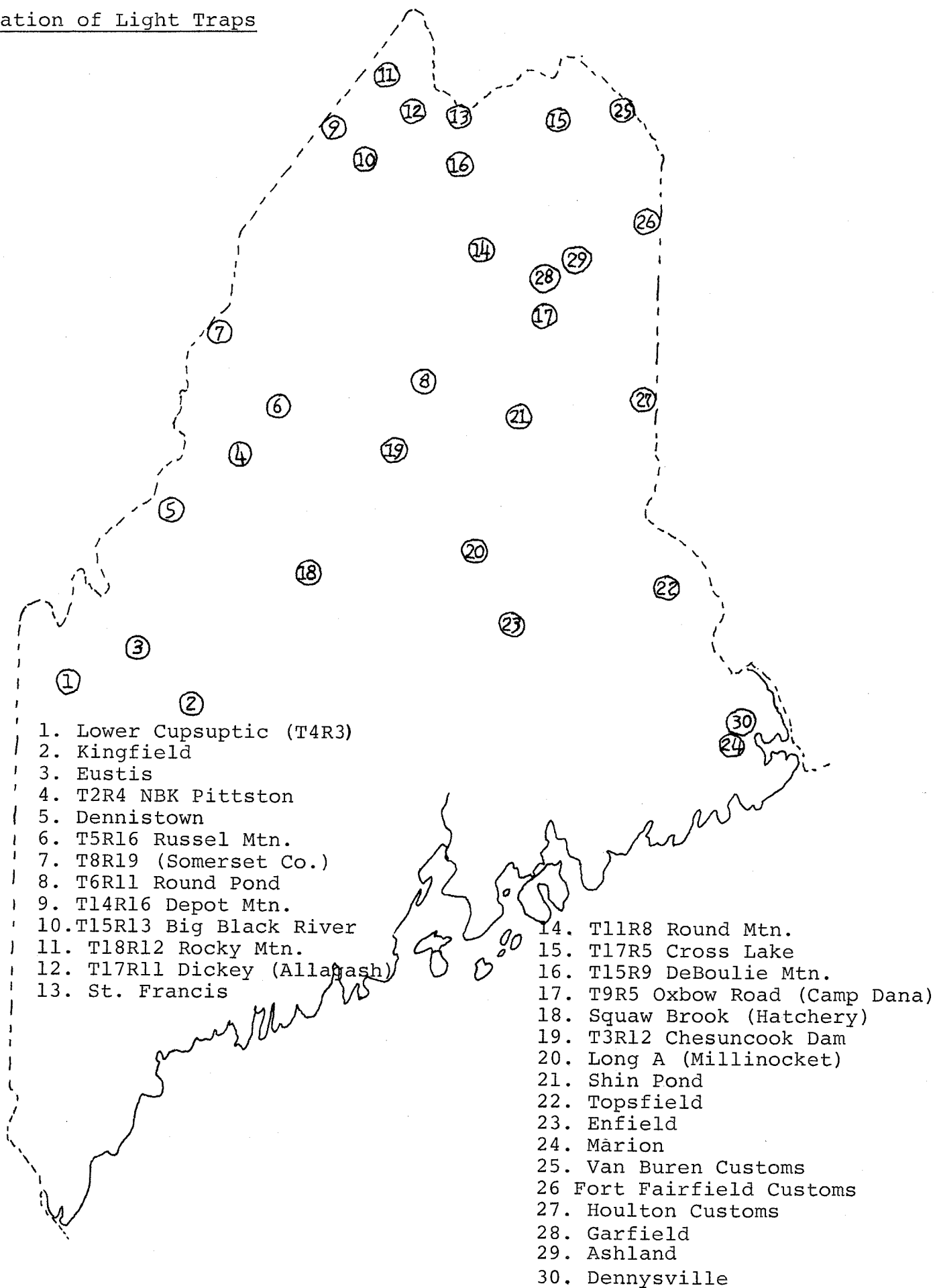
1963, 1964, 1967, 1970



Maine Spruce Budworm Suppression Projects 1972-1976



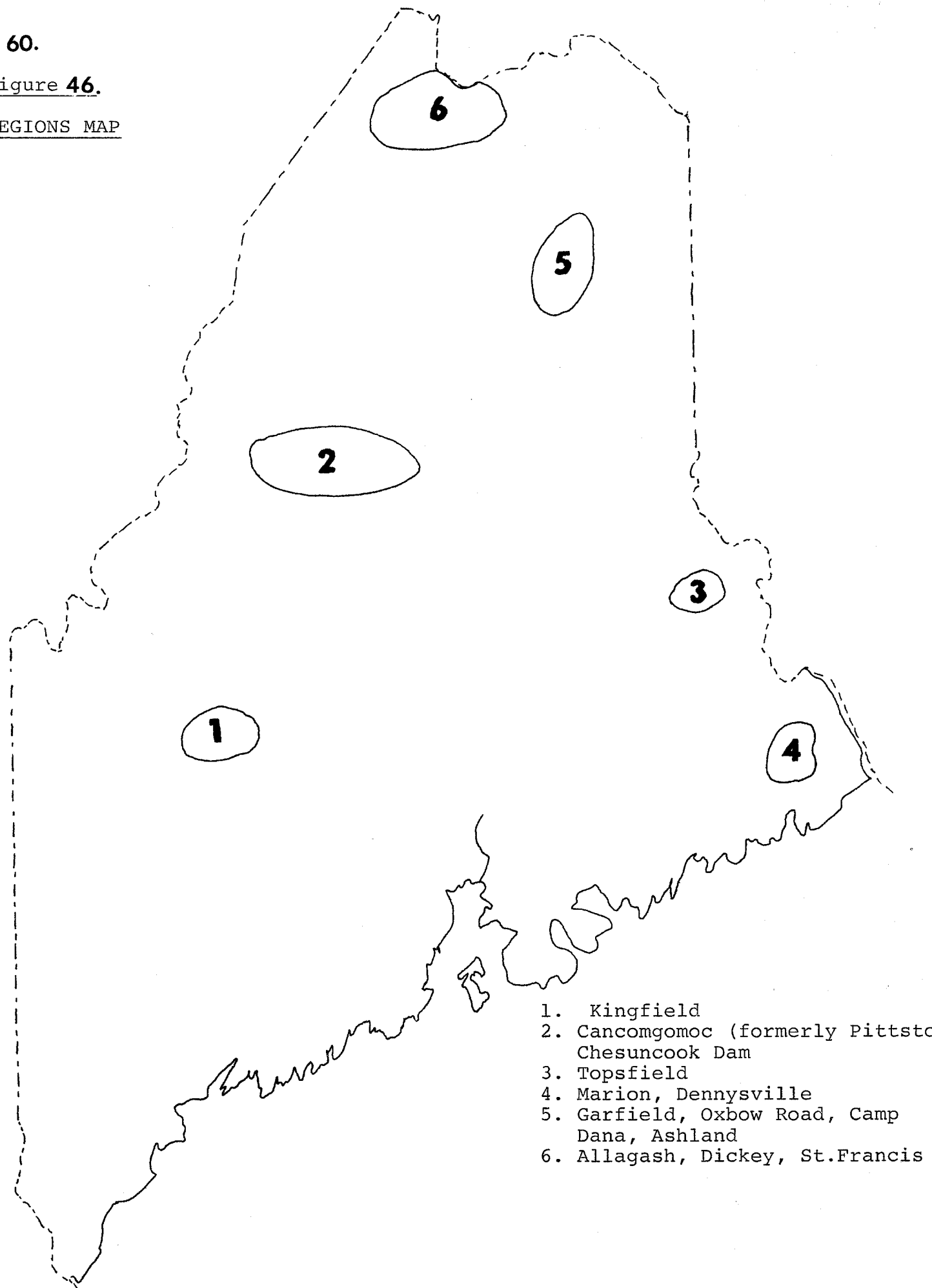
**V. MOTH FLIGHT
DATA
1961-1976**

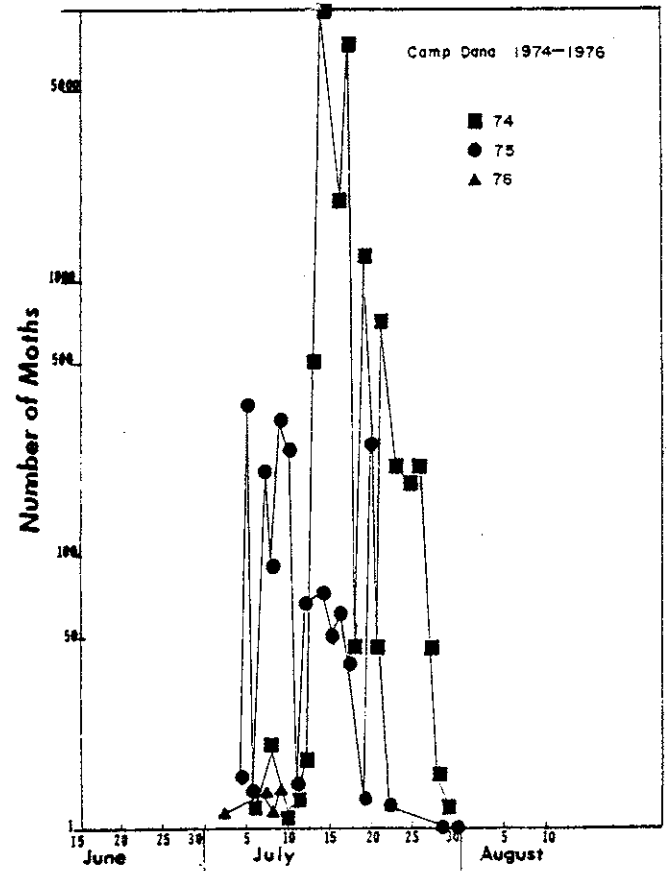
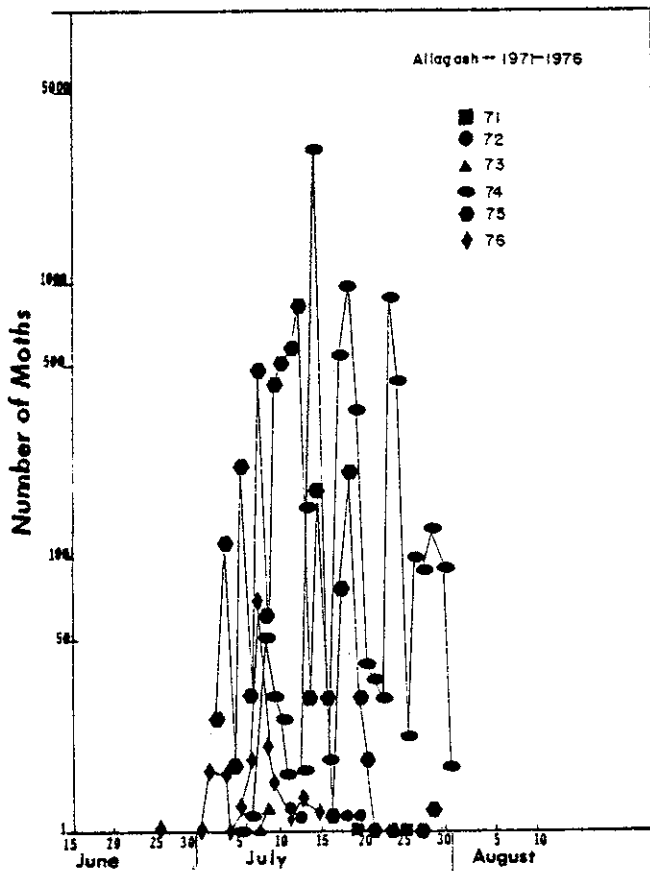
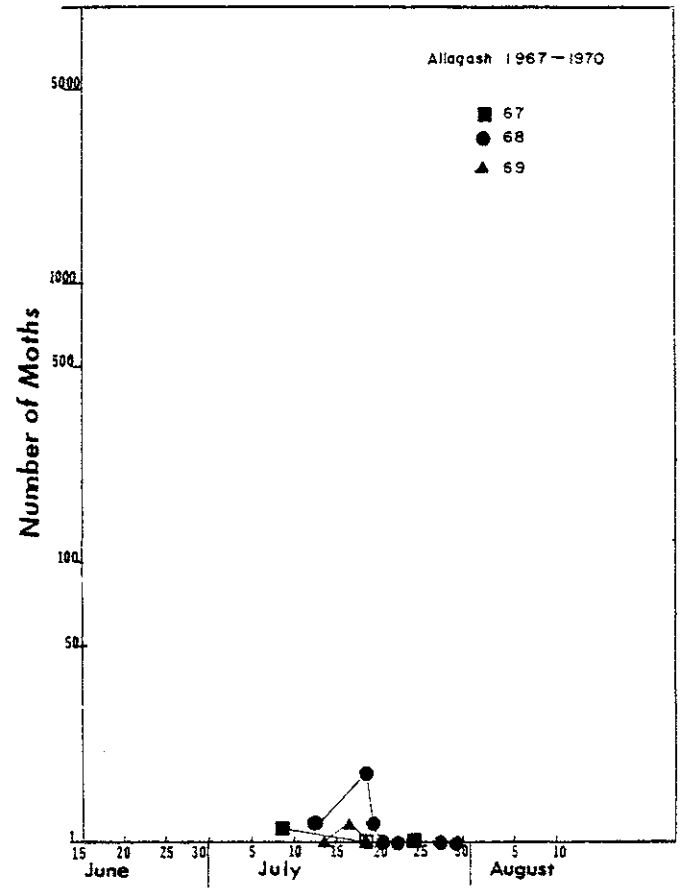
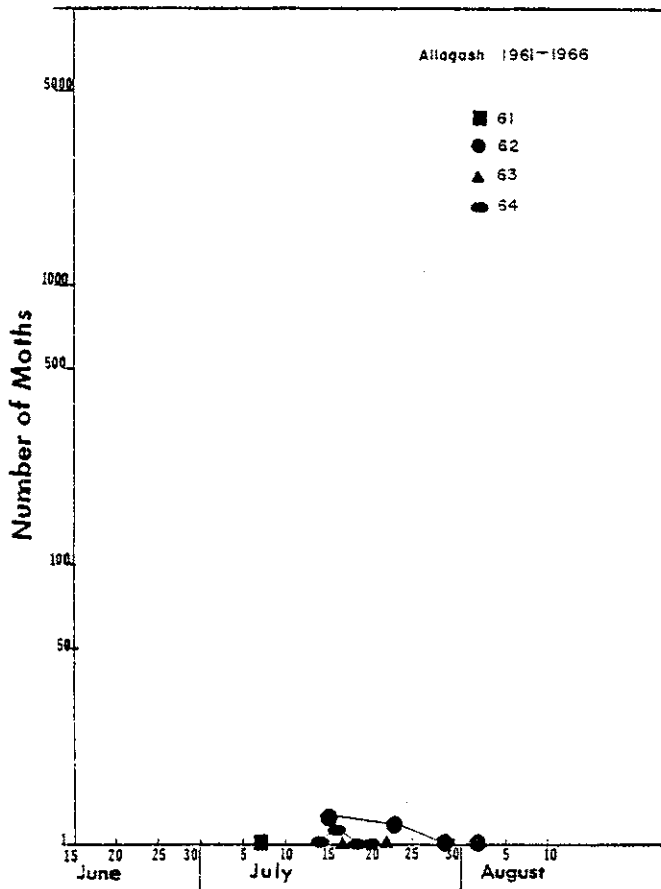
Location of Light Traps

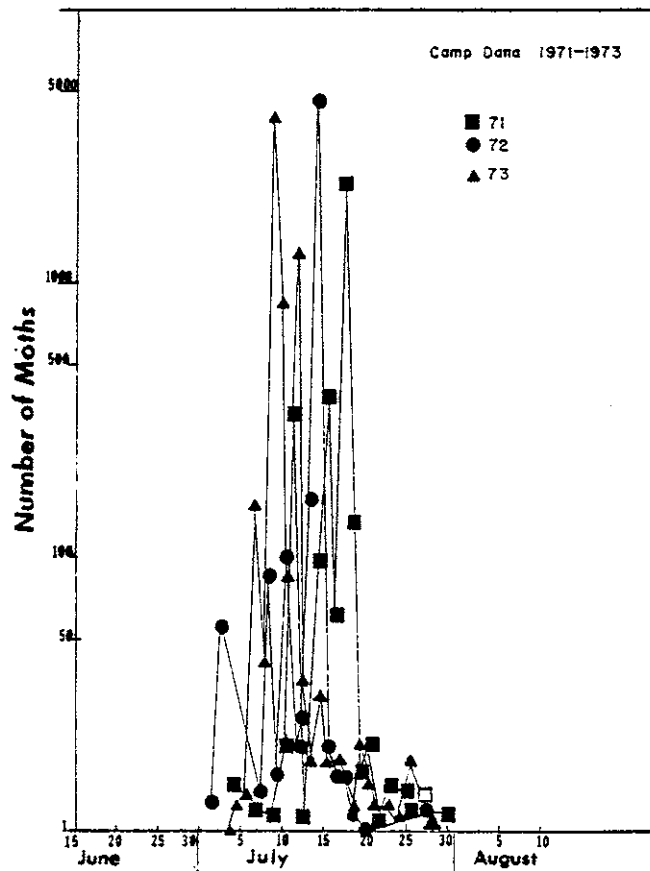
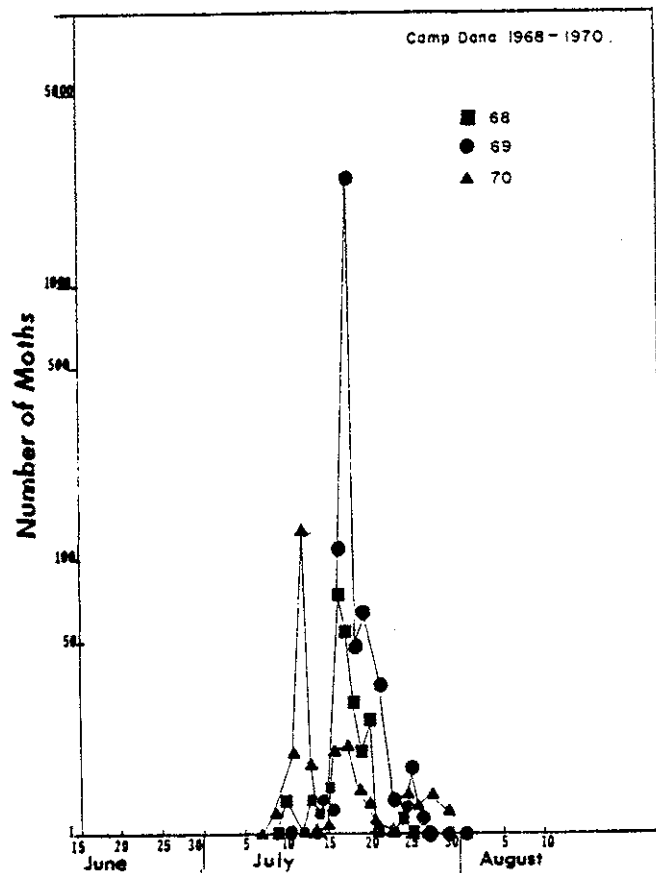
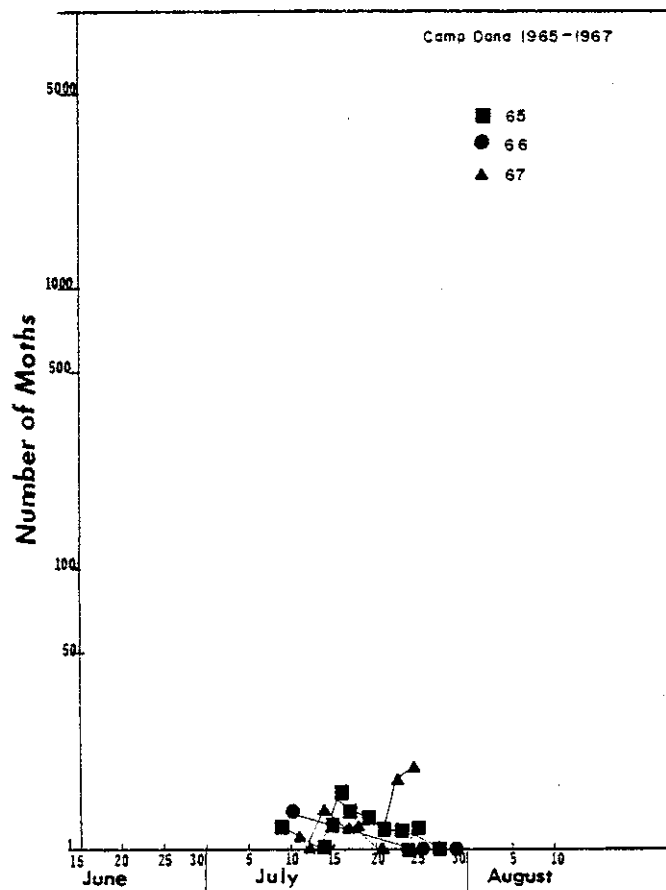
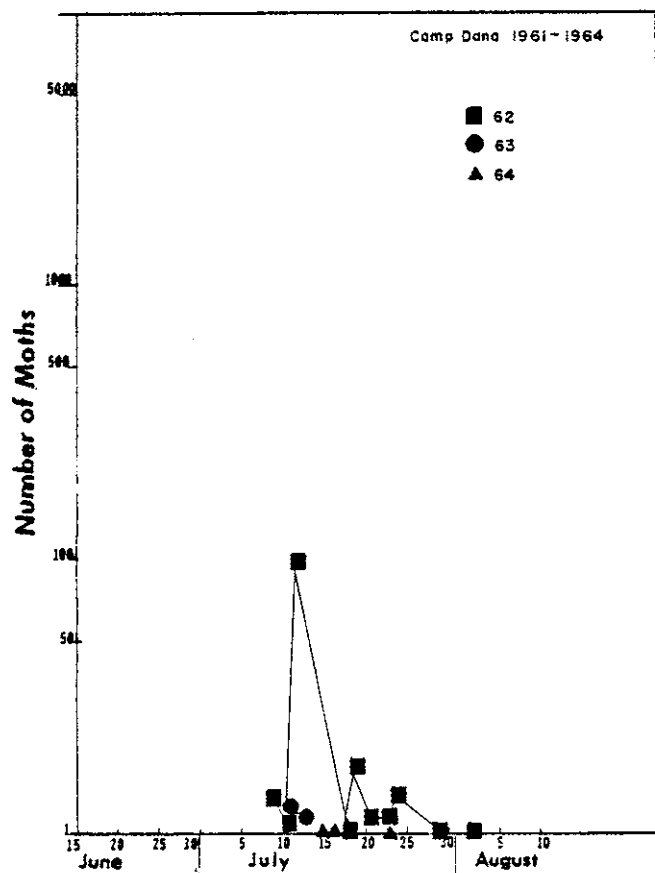
60.

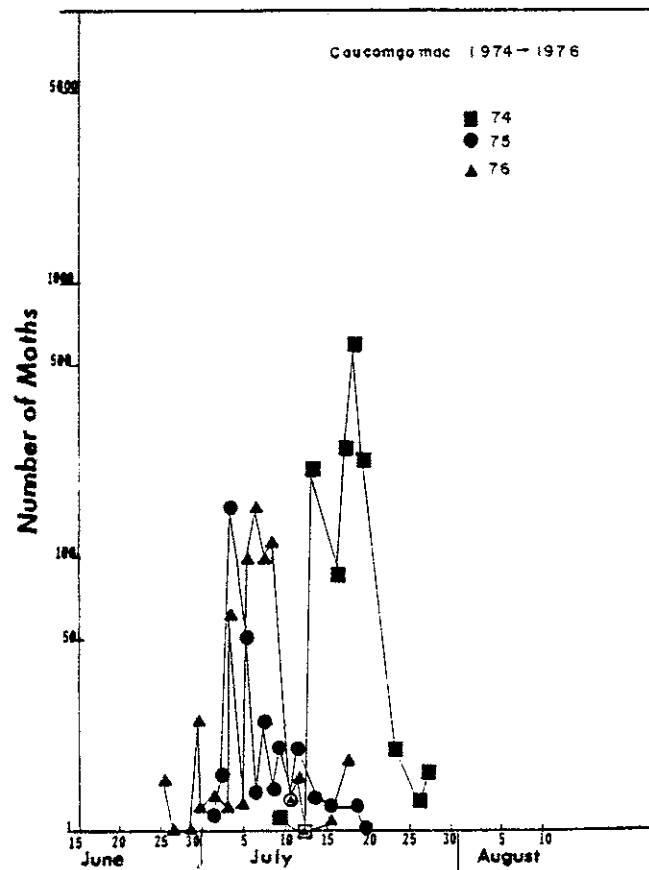
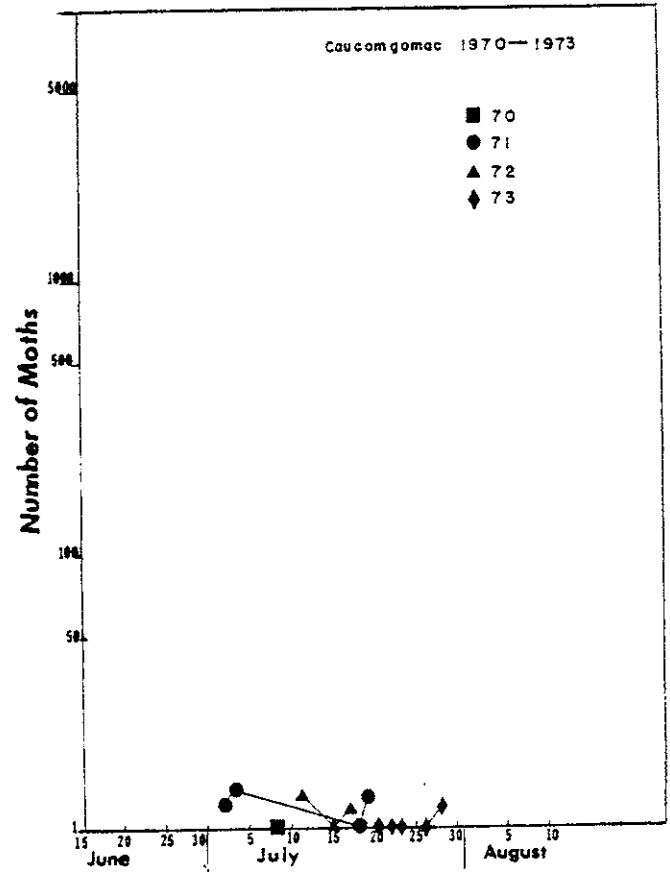
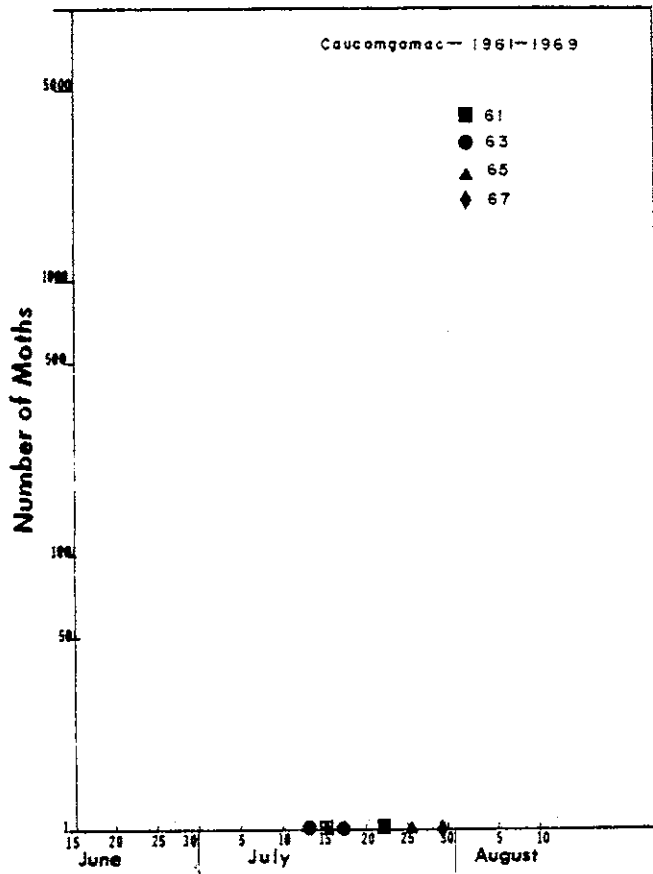
Figure 46.

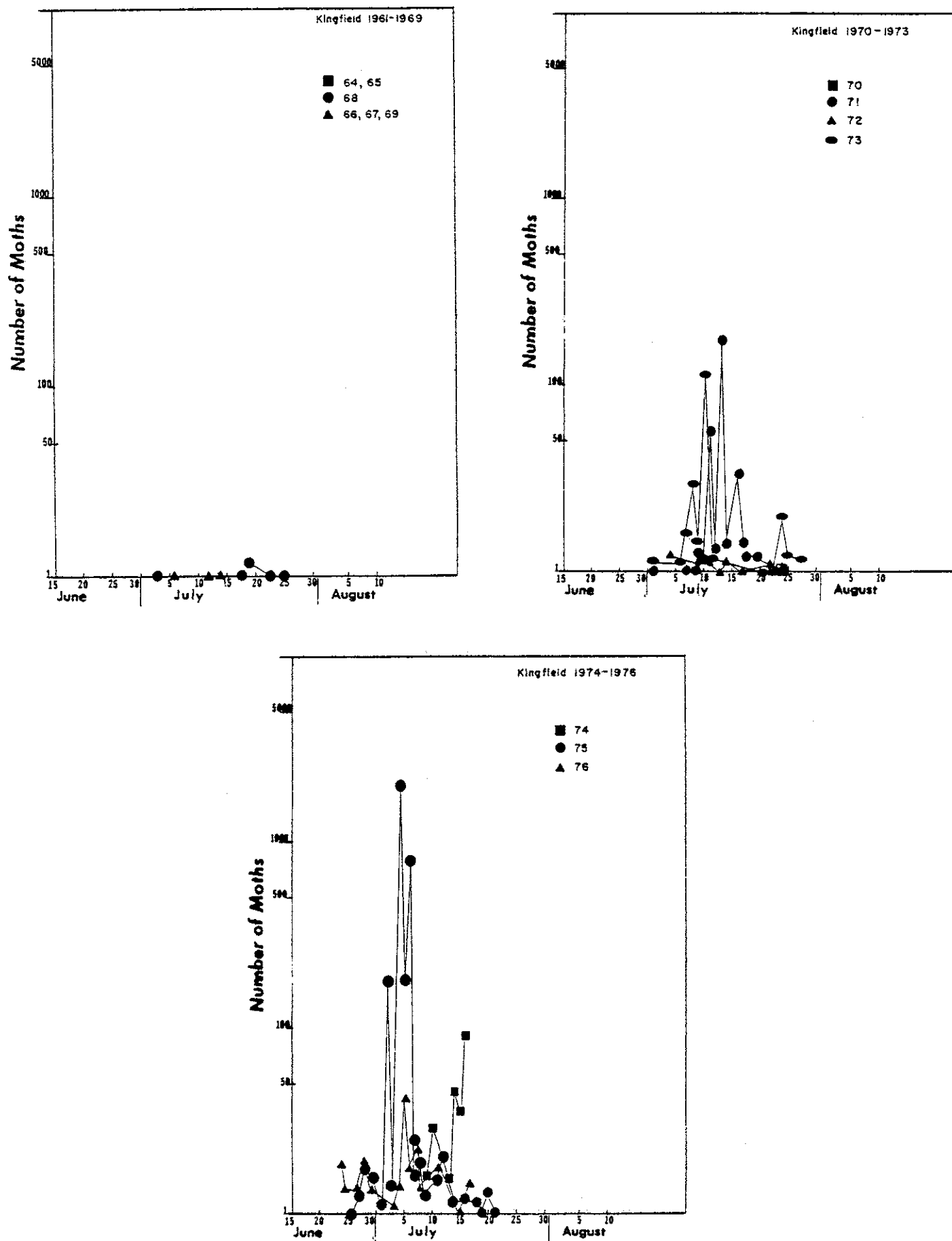
REGIONS MAP











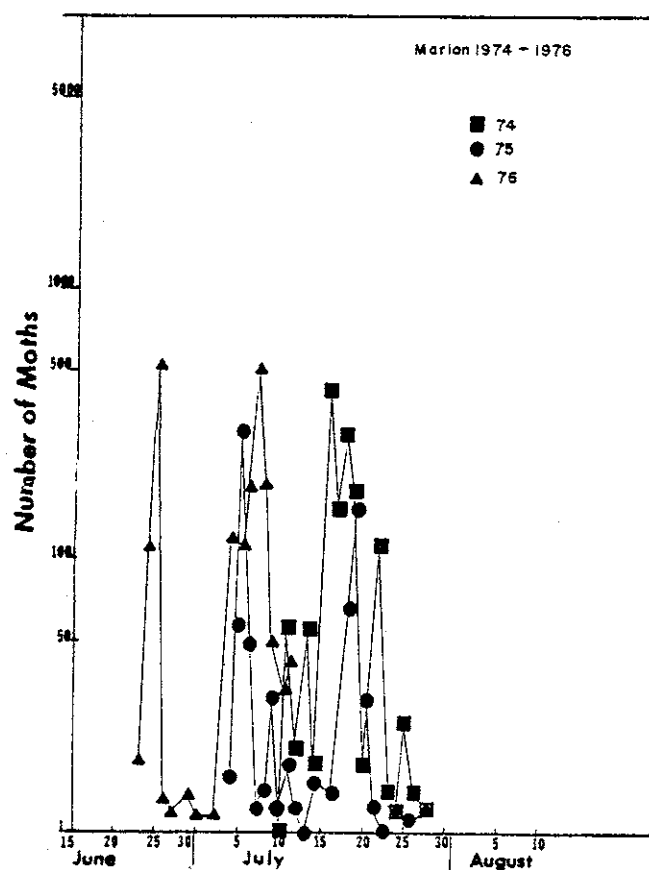
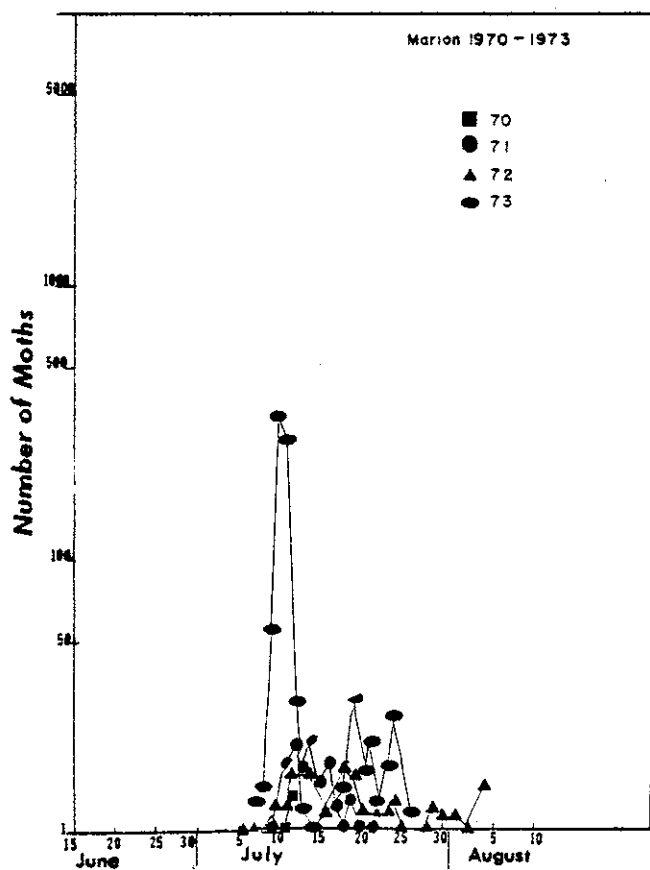
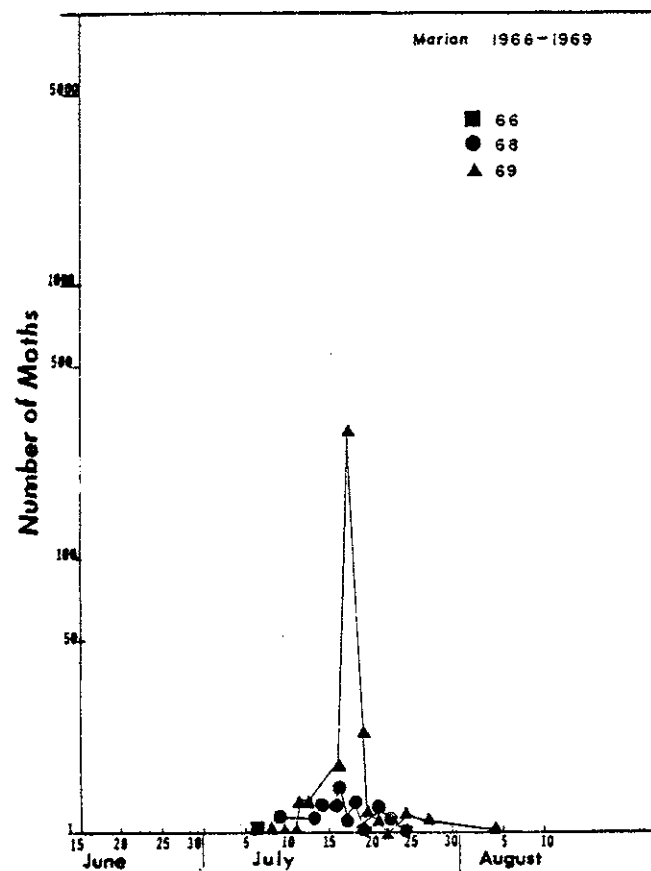
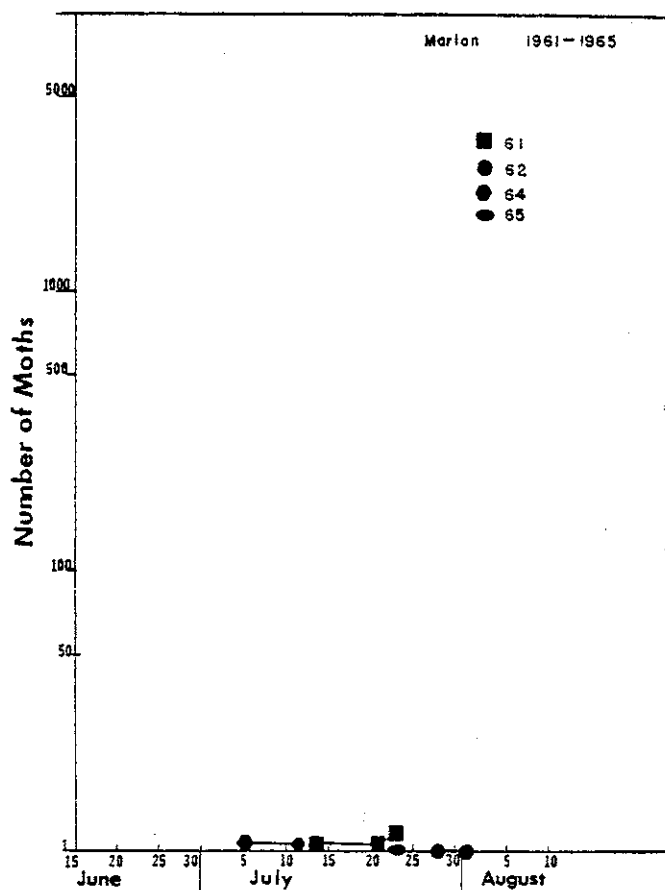


FIGURE 52

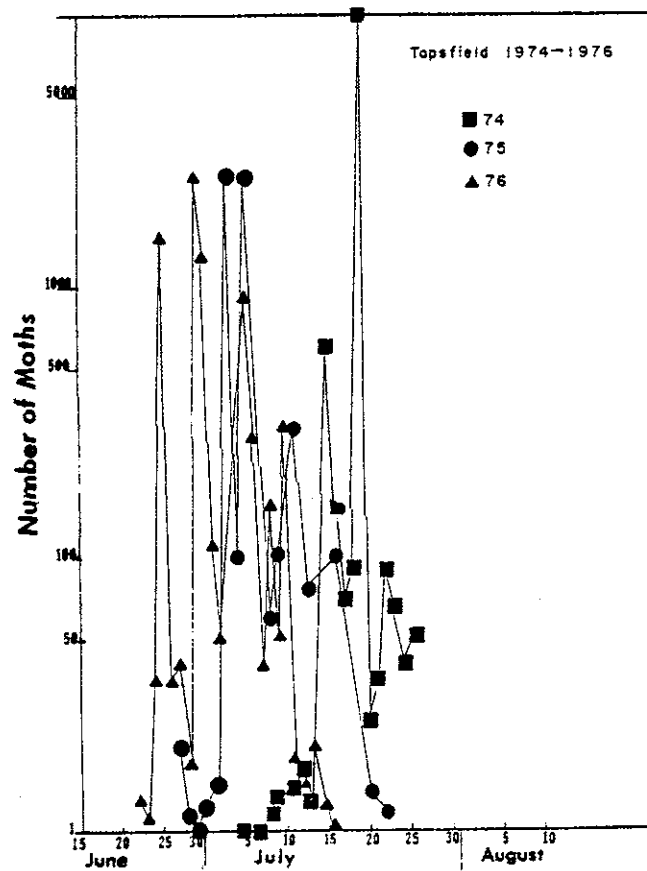
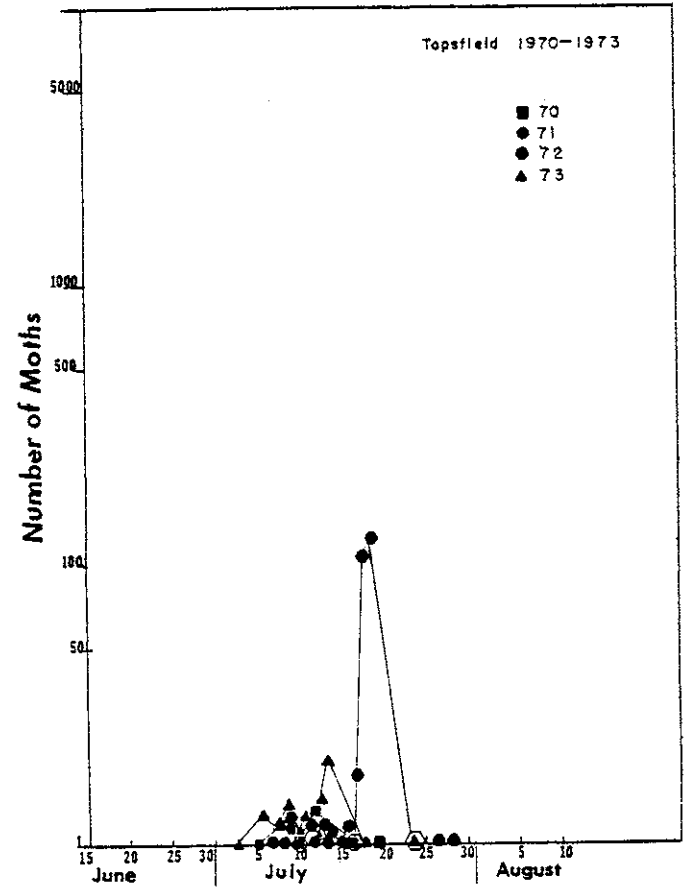
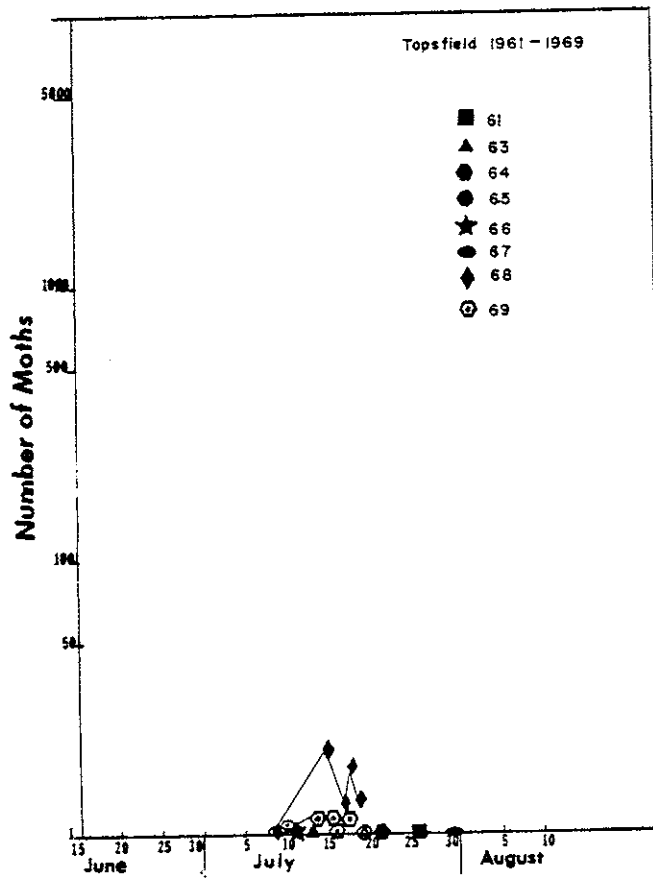


TABLE 4.--SUMMARY OF THE NUMBER OF SPRUCE BUDWORM MOTHS
COLLECTED AT LIGHT TRAPS IN VARIOUS LOCATIONS, DURING JULY OF 1961.

Light Trap Location	Dates of Collection*																											
	7	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	29	: AUGUST							
----- Number of Spruce Budworm Moths -----																												
Lower Cupstic						2									1													2
Dennistown																												1
T15 R16 -																												1
Russell Mountain											1																	2
T15 R13 -																												1
Big Black River																												1
T18 R12 -											1	2																4
Rocky Mountain																												3
T17 R11 -							1								1													4
Dickey																												1
St. Francis	1														1	2												1
T11 R8 -								1																				1
Round Mountain																												3
T17 R5 -																												1
Gross Lake, Guerett							3	79	8		2	8			3		8		2									119
T15 R9																												10
DeBoulie Mountain							9	1																				594
T9 R5	1	3	1	120	184	38	10	7	22	23	52	77	19	19	12	6												3
Greenville									2						1													2
Chesuncook Dam							1							1														1
Millinocket																												1
Topsfield																												1
Enfield						4		3				1		1														9
Dennysville						1							1	2														4
TOTAL	1	1	9	1	6	122	198	122	19	9	27	32	53	83	26	21	21	8	2	1	1							763

*For example, July 7 means the night of July 6-7.

TABLE 6.--SUMMARY OF THE NUMBER OF SPRUCE BUDWORM MOTHS
COLLECTED AT LIGHT TRAPS IN VARIOUS LOCATIONS, DURING JULY OF 1963.

LIGHT TRAP LOCATION	Dates of Collection*																													
	JULY																													
	2	7	8	9	11	12	13	14	15	16	17	18	19	20	21	22	23	25	26	27	29									
Lower Cupsuptic T4R3						1				3																		3		
Tim Pond T2H4																											1			
Eustie																														
Pittston T2R4NBKP							1				1																2			
Dennistown							1			1																	3			
T5R16WELS Russell Mtn.									1											1							6			
T8R19										2										2							2			
T13R12 Round Pond Mtn.																														
T15R13 Big Black River																														
T8R13 Tramway																														
T8R12 Rocky Mtn.																														
T17R11 Dickey											1																2			
St. Francis	1										1	1	1		1	1											2			
T11R8 Round Mtn																											1			
T17R5 Cross Lake																											1			
T15R9 DeBoulie Mtn.							1	25	7	1										1	1	1					38			
T9R5							1	15	2		2		2		1					7	2	1					40			
Greenville, Fish Hatchery																											5			
T3R12 Chesuncook Dam																														
Long A (Millinocket)																											1			
Mount Chase Shin Pond																											2			
Topsfield																														
Enfield																											4			
Dennysville																											16			
TOTAL	1	3	3	1	9	4	18	34	11	2	9	3	5	1	2	3	4	8	7	4	1						133			
*For example, July 9, means the night of July 8-9.																														

*For example, July 9, means the night of July 8-9.

TABLE 7.--SUMMARY OF THE NUMBER OF SPRUCE BUDWORM MOTHS
COLLECTED AT LIGHT TRAPS IN VARIOUS LOCATIONS, DURING JULY OF 1964.

LIGHT TRAP LOCATION	Dates of Collection*																												
	JULY																												
	5	6	7	8	9	11	12	13	14	15	16	17	18	19	20	21	22	23	24	29									
Lower Cupstutio T4R3																													1
Kingfield																													
Eustis																													
Pittston T2R4 NBKP																													
Dennistown			1																										
T5R16 WELS Russell Mtn.																													
T6R19 (St. Cyprien)									1		1																		
T13R12 Round Pond Mt.																													
T15R13 Big Black River									1																				
T8R13 Tramway																													
T16R12 Rocky Mtn.						1					2			5															
T17R11 Dickey									1		2			1		2													
St. Francis											1																		
T11R8 Round Mtn.																													
T17R5 Cross Lake																													
T15R9 DeBoulie Mtn.					2									1	3														
T9R5, Orbow Road				1							5	7		1	1														
Greenville, Fish Hatchery																													
T3R12 Chesuncok Dan																													
Long A (Millinocket)																													
Mount Chase, Shin Pond																													
Topfield																													
Enfield																													
Dennysville																													
Wyman T4R3																													
TOTAL	3	3	3	5	5	3	3	13	14	14	38	13	7	9	12	2	2	2	1	1	1								154

*For example, July 9 means the night of July 8-9

TABLE 8.--SUMMARY OF THE NUMBER OF SPRUCE BUDWORM MOTHS
COLLECTED AT LIGHT TRAPS IN VARIOUS LOCATIONS, DURING JULY AND AUGUST OF 1965.

LIGHT TRAP LOCATION	Dates of Collection *																											
	JULY																											
	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	AUGUST		1	2	3	4	5
Lower Cuscutic T4R3																												
Kingfield																												
Eustis																												
T2R4 NBKP Pittston																												
Dennistown																												
T5R16 WELS Russell Mtn.																												
T3R19 (St. Cyprien)																												
T6R13 Tramway																												
T12R12 Round Pond Mtn.																												
T15R13 Big Black River																												
T16R12 Rocky Mtn.																												
T17R11 Dickey																												
St. Francis																												
T11R8 Round Mtn.																												
T17R5 Cross Lake																												
T15R9 DeBoulie Mtn.																												
T9R5 Oxbow Road																												
Greenville, Fish Hatchery																												
T3R12 Chesuncook Dam																												
Long A (Millinocket)																												
Mount Chase, Shin Pond																												
Topsfield																												
Enfield																												
Marion																												
Vanceboro																												
TOTALS	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
* For example, July 10 means the night of July 9-10																												

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TABLE 9.--SUMMARY OF THE NUMBER OF SPRUCE BUDWORM MOTHS
COLLECTED AT LIGHT TRAPS IN VARIOUS LOCATIONS, DURING JULY OF 1966.

LIGHT TRAP LOCATION	Dates of Collection *																															
	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	25	26	29	31										
Kingfield					1																											1
Lower Cupsuptic T4R3								1																								1
Eustis																																
T2R4NBKP-Pittston																																
Dennistown											1					1																2
T5R16 Russell Mtn.																																
T8R19 (Somerset County)																																
T8R13-Tramway																																
T13R12-Round Pond Mtn.																																
T15R13-Big Black River																																
T18R12 Rocky Mtn.																																
T17R11 Dickey																																
St. Francis																																
T11R8 Round Mtn.																																
T17R5 Cross Lake																																
T15R9 DeBoullie Mtn.																																
Fort Kent Customs																																
Madawaska																																
Fort Fairfield																																
Houlton																																
T9R5 Oxbow Rd																																
Squaw Brook (Fish Hatchery)																																
T3R12 Chesuncook Dam																																
Long A (Millinocket)																																
Shin Pond																																
Topsfield																																
Enfield																																
Marion																																
Vanceboro																																
TOTAL	1	3	3	4	2	1	0	12	4	5					2	3	4	4	4	1	1	1										51

* For example, July 10 means the night of July 9-10.

TABLE 10.--SUMMARY OF THE NUMBER OF SPRUCE BUDWORM MOTHS
COLLECTED AT LIGHT TRAPS IN VARIOUS LOCATIONS, DURING JULY AND AUGUST OF 1967.

	Dates of Collection*																															AUGUST TOTAL
	JULY																															
	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	Total
1. Lower Capsuptic(T4R3)																																
2. Kingfield						1																										13
3. Eustis				2	1																											1
4. T2R4MBKP Pittston								1																								3
5. Dennistown				4																		1										2
6. Wyman									1																							6
7. T5R16 Russell Mtn.																																
8. T8R19 (Somerset Co.)																																
9. T8R13 Tramway																																
10. T13R12 Round Pond Mtn.																																
11. T15R13 Big Black River				1																												1
12. T18R12 Rocky Mtn.																																
13. T17R11 Dickey				2														1														1
14. St. Francis													1					1														4
15. T11R8 Round Mtn.																																
16. T17R5 Cross Lake				1																												1
17. T15R9 DeBoulie Mtn.				1																												1
18. T10R11 Clear Lake Mtn.								4				5	4	1		3	4															26
19. Fort Kent Customs																																
20. Madawaska Customs																																
21. Van Buren Customs																																
22. Fort Fairfield Customs																																
23. Houlton Customs																																
24. T9R5 Ashby Road				4	3		1	3	12	6		5	1	3		3	1	4		1												44
25. Squaw Brook(Hatchery)												1																				4
26. T3R12 Chesuncook Dam																																1
27. Long A (Millinocket)																																
28. Shin Pond																																
29. Topsfield				2																												
30. Enfield				1																												
31. Marion																																
32. Vanceboro																																
TOTALS	1	2	11	11	1	5	3	9	16	6	5	12	4	4	4	7	5	4	1	1	1	1	5	1	1	1	1	1	1	1	120	

* For example, July 10 means the night of July 9-10.

TABLE 11.--SUMMARY OF THE NUMBER OF SPRUCE HUDWORM MOTHS
COLLECTED AT LIGHT TRAPS IN VARIOUS LOCATIONS, DURING JULY AND AUGUST OF 1968.

LIGHT TRAP	JULY							DATES OF COLLECTIONS*																AUGUST								
	2	3	4	5	6	7	8	9	10	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	4	TOTAL
1	3	6	4	11	1	3	1	1						5		4	3	2	2	3	2		1	1	1				1		55	
2		1											2	2?		1?	3?				1		1								11	
3													1	2?		4	1			1											9	
4																															0	
5				1	5	3							1	4		5			1												20	
6																															0	
7							4							2		2	2						1?								11	
8													1	2		1						1									5	
9													1	1	1	1															3	
10																															0	
11														4	1	3		1													9	
12										2						16	2	1	1		1		1	1	1	2	1	1			24	
13																		2?	1												8	
14													1	2	3	2	3	1	1												13	
15																	65	21	7	1		1			1						96	
16							1		1	1		2	12	3	9	27															73	
17							1	1	6	1	6	3	9	76	52	28	17	24	1	1	2	1	11	1	3	2			1		228	
18													1	1	7	1	4														14	
19						2	1			3	1		1	1	1	2															11	
20												5	4	18	12	17	2	1													95	
21	1	31	1	3										5	2	3			3												13	
22																															49	
23							1						21			4	17	6													166	
24					1	1	1	6		2	2		2	20	62	32	11	6	7	3	3	3	1	1				2			35	
25																			5	2											0	
26																															0	
27																															0	
TOTALS:	4	38	5	15	5	4	18	4	10	7	12	15	64	152	154	219	91	46	23	9	8	7	17	4	4	5	2	1	1	3	1	948

*For example, July 10 means the night of July 9-10

TABLE 12.--SUMMARY OF THE NUMBER OF SPRUCE BUDWORM MOTHS
COLLECTED AT LIGHT TRAPS IN VARIOUS LOCATIONS, DURING JULY AND AUGUST OF 1969.

DATES OF COLLECTIONS																																--AUGUST--				TOTAL
-- JULY --																																				
TRAP	5	6	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5					
1. Lower Cupstptic																															37					
2. Kingfield											2		13	22																	1					
3. Eustis	1						1					9	1				1														15					
4. Pittston T2R4																															0					
5. Dennistown											2	9	2	6	2	6	2	3				2									37					
6. Caucomgomac																															0					
7. Somerset Co. T8R19												1																			0					
8. Squaw Brook										3	33																				*13					
9. Depot Mt. T14R16																															51					
10. Chimenticook T16R13																															6					
11. Rocky Mt. T18R12																															0					
12. Dickey T17R11												3																			17					
13. St. Francis												3																			6					
14. Round Pond T6R11																															3					
15. Round Mt. T11R8																															35					
16. Cross Lake T17R5																															0					
17. DeBoullie T15R9																															17					
18. Oxbo T9R5																															6					
19. Fort Kent Customs- 20. Madawaska Customs- 21. Van Buren Customs- 22. Fort Fairfield Customs																															3					
23. Boulton Customs																															19					
24. Chesuncook Dam																															568					
25. Long A																															28					
26. Shin Pond																															9					
27. Topsfield																															100					
28. Enfield																															355					
29. Marion																															10					
30. Vanceboro Customs																															8					
31. Vassalboro																															344					
32. Georgetown-June 16(1)																															37					
33. Brunswick																																				
TOTALS	1	2	1	2	18	39	12	9	70	232	213	2958	558	234	48	114	53	11	14	21	25	9	2	4	5	14	15	15	6	6	7	5415				
*Somerset August 6 & 7 (1), 11 & 12 (1), 12 & 13 (2)																																				

*Somerset August 6 & 7 (1), 11 & 12 (1), 12 & 13 (2)

TABLE 13.--SUMMARY OF THE NUMBER OF SPRUCE BUDWORM MOTHS
COLLECTED AT LIGHT TRAPS IN VARIOUS LOCATIONS, DURING JULY AND AUGUST OF 1970.

TRAP	DATES OF COLLECTIONS																															TOTAL
	-- JULY --															-- AUG. --																
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	0		
1. Lower Cupsuptic																															0	
2. Kingfield																						1									1	
3. Eustis						1	1	1	2			3				1			1	1											11	
4. Pittston T2R4						1	1					1	2					1						1							7	
5. Dennistown						12	8	24	37	9	2	22	13			1	5			2	4	8	6	6							164	
6. Caucomgomac						1																									1	
7. T8R19 Somerset Co.						2		1	1			1	1		1							3	1								13	
8. Squaw Brook						1	2	5	1	6		1	1		1				1	1	1				1						22	
9. Depot Mt. T14R16						1			1		1	4			1																9	
10. Chimenticook T16R13						1					2	2	4		1																16	
11. Rocky Mountain T18R12								5			3	3			1							1									10	
12. Dickey T17R11																															0	
13. St. Francis						3			4	1		3		2		1	2	6	1													24
14. Round Pond T6R11						2	6	3	8		12		8	2		1	2		2	3	4	1	4									63
15. Round Mt. T11R8											1																					4
16. Cross Lake T17R5						2	1	16	9	87	40	25	23	20	2	2	1	3	1	1	1	4	1									239
17. DeBoulie T15R9						2	1	15			7		3	4	5		1		2	1	3	1	1	2								48
18. Oxbow T9R5						1	4		24	138	15	1	2	16	19	20	8	6	2		1	7	4	6	7							285
19. Houlton Customs						3	1			2			1																			0
20. Chesuncook Dam						1	1	1	1	6	4	13	7		2		2		1	2		1										9
21. Long A																																42
22. Shin Pond												2																				2
23. Topsfield						1	1	3	3		1	6		1		1																17
24. Enfield						9	3	5	13	15	8	10	3	3	2	4	3		2			1										81
25. Marion											1	1	6																			8
26. Vanceboro Customs																																0
TOTAL	2	1	22	19	45	50	101	307	104	25	52	74	64	31	22	13	5	20	6	10	20	12	21	18	13	8	7	2	2	2	1076	

TABLE 14.--SUMMARY OF THE NUMBER OF SPRUCE BUDMORN MYTHS
COLLECTED AT LIGHT TRAPS IN VARIOUS LOCATIONS, DURING JULY AND AUGUST OF 1971.

TRAP	DATES OF COLLECTIONS																															AUGUST	TOTAL	
	1	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2			3
1. Cuspuptic(Rangeley)	3								6	6	5	7	3	2	3	25	14				4	1	4		3		1							73
2. Kingfield	1				1	1	4	3	56	6	17	7	3	33	8	3																		298
3. Eustis					1	3	1	5	1	1	1	1	2	4																			20	
4. Pittston Farm'									5	7	3	61	10			16	10	9			1		1										123	
5. Dennistown					6	20	62	117	47	194	23	141	167	69	53	23	8	29	107	47	5	14	3											1135
6. Caucomgomac									5				1		3																		9	
7. T8R19(Somerset Co.)				3				4	6	1		17	1	1	49	2	1	3	6		6	12				2		1						115
8. Squaw Brook				1		7	2	12	52	2	1	43	2	5	39	2	2	1																171
9. Depo E Mt.(T14R16)									1				2		2	2	3			24						1	1							34
10. Chimenticook(T16R13)												4	7		2	2	2	4			1	11			5									36
11. Rocky Mtn.												23	1		12			13			1	3			5	1								59
12. Allagash(T17R11)																		1					1											2
13. St. Francis									2	1			3	6	2	6	6	31		19	26		33	72			3	25	20	1				257
14. Round Pond Telos(T6R11)				2	5	4		8	17	5	2	13	9	6	22	16	16	58	4	1	14	3	1	2										212
15. Round Mtn.(T11R8)												1				9		1	2															15
16. Cross Lake				9	86	35	111	151	122	1604	112	4	1044	966	1407	1352	671	4000	365	57	660	404	886	54	158	67	10	13						14356
17. DeBoulie				5				1		1	1				65	5	21	17	3	21	11	19	30	13	4	1								218
18. Camp Dana (Oxbow)				8		4	2	13	18	357	2	96	363	40	1327	130	12	21	2		8	7	4	5										2421
19. Fort Kent Customs																																		0
20. Madawaska Customs														4																				0
21. Van Buren Customs																																		4
22. Fort Fairfield Customs																																		0
23. Houlton Customs				1											1	1																		3
24. Chesuncook Dam							1		2	1	7	13		1	6	1	3																	35
25. Long A							4		3	17	17	11	165	4	23	7	5	9	3			1		1										270
26. Shin Pond																				1														1
27. Topsfield																																		9
28. Enfield				7	2	6	17	34	23	88	36	131	114	29	52	38	48	8	4															637
29. Marion						1			1	14	15	12	19	8	14	3	1	5	1	1			1											96
30. Vanceboro Customs																																		0
31. Vassalboro				5			1	3	34	1																								44
TOTAL	4	8	20	25	100	77	197	342	859	1745	457	764	1514	1307	3156	1694	837	4189	380	89	794	549	1011	169	199	75	20	39	20	1	8	2	2	20653

TABLE 15.--SUMMARY OF THE NUMBER OF SPRUCE BUDMORM MOTHS
COLLECTED AT LIGHT TRAPS IN VARIOUS LOCATIONS, DURING JULY AND AUGUST OF 1972.

TRAP	DATES OF COLLECTIONS																															TOTAL					
	JULY																																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31		AUGUST	1	2	3	4
1. Lower Cupsuptic	1												1			1		3		2	1	2															12
2. Kingfield		1						2			2			2		25	17	10	5	2	1	4		1													12
3. Eustis												6	17	22		13	12	20	7	21	3															110	
4. Pittston Farm(T2R4)								2			7	8	2	13		100	122	60	34	93	54	57	2	5	3	3						1					96
5. Dennistown Plt.							1	2	3	13	20	12	147	83																						819	
6. Caucomgomac(T7R15)	4	6																1	5																	16	
7. Chesuncook Dam(T3R12)							2	2		1	3	1	8	21		2	9	2																		51	
8. Squaw Brook(T2R6)							2			3	3	1	22	12		26	12	5	1	5																92	
9. Depot Mt.(T14R16)											1																										1
10. Chimenticook Stream(T16R13)																																					0
11. Rocky Mtn.(T18R12)																																					29
12. Allagash(T17R11)																																					9
13. St. Francis							1																														375
14. T8R19 (Somerset Co.)													2	1		12	110	28	45	12	29	34	27	19	9	30	2	5	7	2						64	
15. DeBoulie Mtn.(T15R9)											1	2	11	3	14		1	1	24			6														202	
16. Gross Lake (T17R5)												1	22	34	55	4	16	6	15	43	2	1	2													2625	
17. Round Mtn.(T11R8)							2	7	4	18	26	352	89	228	888	322	245	34	31	233	24	28	23	3	1	11	26	4	9	8	1	7	1			188	
18. Camp Dana(T9R5)	5	56								133			4	34		1	1	1	1	4	3															5024	
19. Round Pond Telos(T6R11)							7	85	12	94	20	24	160	4500+	21	14	16	2	2	1																5612	
20. Shin Pond (Mt. Chase Plt.)							3	7	12	11	5	10	9	8	10	11	9	7	12	1																143	
21. Long A. Twp.(TAR8&R9)	1									1			1			1	2	2	5	8															23		
22. Enfield	4	7						2	3				4	1	2	4	3	2	1	1	2	3														46	
23. Topsfield								1	3	1	1	3	3	1		1	12	107	132																	268	
24. Marion							1	1	1	3	3	11		11	8	2	13	10	2	2	2	4	1													94	
C1. Ft. Kent Customs																																					0
C2. Madawaska Customs																																					4
C3. Van Buren Customs																																					0
C4. Fort Fairfield Customs																																					44
TOTAL	5	9	63	8	20	20	33	108	75	298	568	184	718	10687	758	577	320	304	442	208184	120	53	26	54	32	16	18	15	5	5	135	8				15,959	

TABLE 16.--SUMMARY OF THE NUMBER OF SPRUCE BUDMORM MOTHS
COLLECTED AT LIGHT TRAPS IN VARIOUS LOCATIONS, DURING JULY AND AUGUST OF 1973.

TRAP	DATES OF COLLECTIONS																															AUG. TOTAL		
	1	2	3	4	5	6	7	JULY	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	
1. Lower Cupscupctic	2	1					20	14			4																							41
2. Kingfield	2	2		2	2	2	12	29	9	114	3										1			2	20	5	4							209
3. Eustis	4	1				2	22	39		13	12	24			6	20																		143
4. Pittston Farm							49	8	9	1			28	1				2						2	1			8						109
5. Dennistown																		10	10	55	5	21	12					2	3	6			217	
6. Caucomgomac (T7R15)							2			8	64									1	1	1												7
7. Chesuncook Dam (T3R12)						25	32	24	253	13	228	7	7	2	3						1	1												88
8. Squaw Brook (T2R6)					3	5	13		36	4	9	2	2	17	6		1	1						6	54	13		3						672
9. T15R15																				1	1	1												100
10. Chimenticook Stream (16R13)					1	4	18											3																27
11. Rocky Mtn. T18R12)				10	25	1	1	16		3					1	1												1	2	2	1			64
12. Allagash (T17R11)							1	3																										4
13. St. Francis	4	4	8	51	108	22	12	33	33	17	112	70	86	59	112	118	52	1		3	4							1	1					879
14. Somerset Co. (T8R19)					2	78	71	71	532	2	210	5	1	6				4	3				5		3	1								923
15. DeBoulie Mt. (T15R9)					106			17	16	18		18	19	41	15	42	58	14	25	12			1	25	13	1	9	1	1					455
16. Cross Lake (T17R5) (Black Light)					1177	470	136	1368	4500+	585+	1000+	285	70	800+	65+	110+	70+	6	8	55	65	30	2	20	160	30	4	13						11,030
17. Round Mt. (T11R8)				1	51	1	9	8	13	34	67	4	2					2	1		4	2	13		5	2	1							220
18. Camp Dana (T9R5) (Oxbow)				1	5	156	40	4212	820	81	1098	32	13	26	17	17		2	23	10	3	3	2	2	14	4	2							6,589
19. Round Pond Telos (T6R11)				66	429	137	413	847	29	83	271	13	10				31																	2,300
20. Shin Pond (Mt. Chase Plt.)							675+	3000+	61	73	85	9	1	1	1	1	1	1	8	3	7	2	2	5	13	13	15	5	3					3,784
21. Long A. Twp. (Millinocket)						1		1	61	73	85	9	1	1	1	1	1	1	8	3	7	2	2	5	13	13	15	5	3					310
22. Enfield							1	4			10																							18
23. Topsfield						5		3	5	2	4	2	8	17			1											1						50
24. Marion							5	8	53	324	266	26	3	1	1		6	31	11	24	2	13	27	8	2									811

*19 Extra Telos Camp (Operated 1 night only - July 10 ----- 10,000)

10,000

C1 Fort Kent Customs
C2 Madawaska "
C3 Van Buren
C4 Fort Fairfield Customs
C5 Houlton Customs

0
0
0
0
19

TOTAL 12 3 85 505 1372 927 1548 9692 6369 11,401 3451 468 253 963 269 281 177 126146 88 134 83 46 87 36211845 37 18 1 1 1 39,069

TABLE 17.---SUMMARY OF THE NUMBER OF SPRUCE BUDWORM MOTHS
COLLECTED AT LIGHT TRAPS IN VARIOUS LOCATIONS, DURING JULY AND AUGUST OF 1974.

TRAP	DATES OF COLLECTIONS																															AUG.
	JULY																															
	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	2	TOTAL
1. Warren							15	180	35	233	10	44	35	89			366	40	11								3	4			0	1057
2. Lower Cupsuptic								10	28																							216
3. Kingfield								2	15	37	3	13	39	118	102	469	275	605														1678
4. Dennistown Plt.																																
5. Milton Twp.								1	10	4	94	6	5	21	47	53	120	5	66	320	156	3	1	10	20	6	3	13	11			976
6. Pittston Farm T2R4																	17	203	64		4	8			3	1	5	38	10	2		792
7. Caucongmac T7R15								3									85	241	605	225		27			6	13						1416
8. Chesuncook T3R12																																3495
9. Big Squaw R2R6																																6181
10. St. Pamphile T15R15																																1791
11. Allagash T17R11																																7449
12. T8R19 (Somerset Co.)																																3866
13. DeBoullie Mtn. T15R9																																14871
14. Clayton Lake T11R14																																276
15. Portage Lake																																32267
16. Round Mt. T11R5																																2159
17. Camp Dana T9R5																																27396
18. Hay Lake T6R8																																105
19. Long A. Millinocket																																6404
20. Enfield																																15128
21. Topsfield																																11319
22. Marion																																1383
23. Blue Hill																																1234
24. Passadumkeag																																17325
TOTAL	18	2	5	2	19	93	192	258	608	174	525	2252	52985	4889	12140	17455	7834	38938	2330	4789	3374	3680	2349	990	925	832	547	319	133	20		158,784

TABLE 18.--SUMMARY OF THE NUMBER OF SPRUCE BUDMORM MOTHS
COLLECTED AT LIGHT TRAPS IN VARIOUS LOCATIONS, DURING JULY AND AUGUST OF 1975.

DATE		JUNE							JULY							AUGUST							TOTAL	
Location	25	26	27	28	29	30	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. Portland																								
2. North Bridgton	2			6	10	17																		
3. Kingfield	1	4		14	12		2	170	8	1600	175	800	13	15	6	1	13	24			3			2
4. Lower Cupsuptic				7	48	850	11	1500t	9	225	125t	246	205		8		87		18	2	25			2
5. Milton Twp.				2	1	2		128	2150	84	207	43	1242	34	2700		1080	858		4	126	1		69
6. Pittston Farm																								
7. Caucongonac							3	12	132		42	7	25	8	23	5	18	30	6	3	8			4
8. Chesuncook Dam	10			2	20		14	9000t	68	10	3	28	7	150	20	12	150	91	26	48	5			10
9. Squaw Brook	6	8		3	103			4000t	170	1500	1350	150	350	300t	300	300	150	54	148	31	34			7
10. Moose River				6	146	33	20	273	840	76	220	1250		44	495	450	550	800	34	175	56			200
11. Allagash							25	109		14	21030	470		58	421	127	110	32						
12. Estcourt																								
13. Deboulie Mtn.																								
14. Hay Lake																								
15. Portage																								
16. Round Mtn.																								
17. Garfield																								
18. Clayton Lake																								
19. Blue Hill				32	4		1	3	2	300t	22	9	20	14	3		8	7	65	70	50	40		
20. Long A.	1	15		10	181	320	450t	700t	1900	2500t	2000	4000t	3300t	700	1200		520	1500t	220	425t				
21. Marion																								
22. Topsfield				2	1	3	8	8	11	53	295	40	4	7	27	4	150t	300t	5	1	75t	9		63
23. Greenbush	4	12		30	215	29	41	78	500	43	450	325	180	150	204	110	18	32						1
JULY																								
Location	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7				
1. Portland																								
2. North Bridgton																								
3. Kingfield																								
4. Lower Cupsuptic																								
5. Milton Twp.																								
6. Pittston Farm																								
7. Caucongonac																								
8. Chesuncook Dam																								
9. Squaw Brook																								
10. Moose River																								
11. Allagash																								
12. Estcourt																								
13. Deboulie Mtn																								
14. Hay Lake																								
15. Portage																								
16. Round Mtn.																								
17. Garfield																								
18. Clayton Lake																								
19. Blue Hill																								
20. Long A.																								
21. Marion																								
22. Topsfield																								
23. Greenbush																								
AUGUST																								
Location	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7				
1. Portland																								
2. North Bridgton																								
3. Kingfield																								
4. Lower Cupsuptic																								
5. Milton Twp.																								
6. Pittston Farm																								
7. Caucongonac																								
8. Chesuncook Dam																								
9. Squaw Brook																								
10. Moose River																								
11. Allagash																								
12. Estcourt																								
13. Deboulie Mtn																								
14. Hay Lake																								
15. Portage																								
16. Round Mtn.																								
17. Garfield																								
18. Clayton Lake																								
19. Blue Hill																								
20. Long A.																								
21. Marion																								
22. Topsfield																								
23. Greenbush																								
TOTAL																								
20																								
140																								
2871																								
3368																								
436																								
14,694																								
291																								
9388																								
8612																								
3674																								
3772																								
402																								
25,125																								
2277																								
4893																								
2207																								
1734																								
36156																								
495																								
20,089																								
772																								
6017																								
241																								
119,871																								

TABLE 19.--SUMMARY OF THE NUMBER OF SPRUCE EUDORM MOTHS
COLLECTED AT LIGHT TRAPS IN VARIOUS LOCATIONS, DURING JUNE AND JULY OF 1976.

Location	DATE							JUNE							JULY							TOTAL											
	22	23	24	25	26	27	28	29	30	1	2	3	4	5	6	7	8	9	10	11	12		13	14	15	16	17	18	19	20	21	22	23
1. Gray							1			2						1				1						3							8
2. Union				79	21	4	1	15	1	1		4	1					1			1	2											131
3. Milton			5	4	43	7	14	1	2	10	6	2	3		14	12	13	4	4		7												151
4. Kingfield			16	6	6	16	7	6		6	2	8	41	13	25	6		14					1	7									174
5. Moose River	1	6	33	22	2	9	526	100	47	85	139	60	350	550	260	550	205	8	122	142	24	4	9	9									3263
6. Chesuncook									1		7			1	25	88		2	2	1	1	1											129
7. Caucomgomac				11	1	1	1	25	3	6	3	58	2	95	150	94	105	4	5	10	1	2			11								587
8. Long A.	15	2	15	45	1250+	230					93	57		1200+	650+1200+					30	12	7	18	17									4841
9. Blue Hill			4	4	1	4	5	4	1	3	3	1	1	10		5		1										2					49
10. Topsfield	5	2	37	1500+	33	37	15	2000+1250+	110	50		130	900	275	40	150	50	300	13	9	19	4	1										6930
11. Marion	16	105	500	5	3		6	2	2	14	115	108	175	485+	180	48	31	39	7	2	6	20	54										1923
12. Hay Lake	10							41	14	10					165	76	82	255								2	27	256	4	1	2		945
13. Garfield											2				6	3	7																18
14. Allagash			2				2	16	12	1	3	17	67	18	10		2	4	19		2	2											177
15. DeBouille						1								400+	2000+	34	25	157				46								5	31		2699
16. Clayton Lake							1	8					5	9	133	18					7	3	9	90									283
TOTAL	5	44	175	2154+	125	61	106	3836+	1649+	194	163	339	385	1504+	2838+	3861+	2447+430	589	458	203	78	29	103	98	104	2	27	258	4	6	33		22,308

**VI. AIRCRAFT
EMPLOYED**

Aircraft Employed

Spray aircraft have undergone considerable evolution since the 1950's. An early workhorse was the Stearman crop duster. This sturdy reliable biplane had to be used in great numbers on large projects due to its low load capacity -- one New Brunswick project employed almost 200 of them. Since the Stearman days, larger projects demanded the use of war surplus TBM and PV-2 aircraft with longer ranges and higher load capacities. In addition, helicopters were occasionally employed in sensitive areas. In the early and mid 1970's larger aircraft such as DC-6s and DC-7s, C-54s, and Constellations became available. The large projects then being planned suggested the use of these large planes with long ranges, high speeds, and high load capacity. Early field tests showed that the higher speeds and altitudes employed with 4-engine aircraft were no barrier to obtaining effective spray deposit. Today, 4-engine aircraft are as common on major budworm spray jobs as were Stearmans two decades ago. Aircraft used in Maine are shown below,

Traditionally, spray aircraft were visually guided in the blocks. Recently, electronic systems have become available which permit accurate guidance of 4-engine aircraft to spray blocks and over planned flight lines within spray blocks. These systems also provide accurate monitoring of actual flight performance, including spray system calibration.

Aircraft spraying systems have not advanced dramatically since the 1950's, but improvements in their calibration and employment have been made. Formulated insecticides were commonly delivered at active ingredient rates of 1 pound in a gallon volume per acre. Refined techniques now provide for rates less than 3/4 pound per acre, in finished spray volumes that are frequently less than one quart per acre. The spray cloud emitted is a fine aerosol with droplets within a specified size range. The spray cloud settles slowly and drifts through the foliage, thus providing full coverage. Although the behavior of spray clouds is not well understood, practical experience provides the necessary guidelines. In addition, computer spray drift models are becoming available which will aid project planners in more discriminating insecticide application.

Aircraft Employed on Maine Spruce
Budworm Suppression Projects, 1954-1977.

1954: (First year of budworm spraying)

6 Stearman

1 observer plane

Planes were contracted for through Barney W. Flieger of Forest Protection Limited of New Brunswick, a non profit corporation set up to handle aerial spray projects using cooperative government - industry funds.

1955: No spray project conducted.

1956: No spray project conducted.

1957: No spray project conducted.

1958:

8 TBM's

2 smaller Stearman Biplanes

Guidance - Five guide planes, responsible only to the Department of Forestry, were hired to check on the spraying. Each plane flew with a pair of spray planes. The spray planes were obtained through the Simsbury Flying Service of Simsbury, Connecticut.

1959: No spray project conducted.

1960:

6 TBM's

1 Stearman

Guidance - Three Cessna 180 Aircraft and inspection pilots were used for guidance purposes. Two of these were with the Department. Each plane flew with a pair of spray planes to check on proper spraying and flight courses. The spray planes were obtained through the Red River Aero Dusting Company Incorporated of Texarkana, Arkansas.

1961:

2 TBM's

1 Stearman 450

Two Cessna 180 Aircraft were used for inspection purposes. One was hired directly by the Maine Forest Service and the other was supplied by the U.S. Forest Service, Region 7. The spray planes was contracted through the Simsbury Flying Service of Simsbury, Connecticut.

1962: No spray project conducted.

1963:

10 TBM's

2 Stearman

Guidance - To better control the spray aircraft, a flag plane system was adopted, a method devised by Forest Protection Limited of New Brunswick, Canada. Seven Cessna 170 Aircraft and pilots were contracted for guidance purposes by the State through Bar Harbor Airways of Ellsworth, Maine. The spray planes were obtained from the Simsbury Flying Service of Simsbury, Connecticut.

1964:

2 TBM's

1 Stearman

Guidance - Separate arrangements were made for the other necessary planes and personel. Insecticide, plus some storage and loading equipment came from Forest Protection Limited of New Brunswick, Canada. The spray planes were contracted through the Richardson Aviation Company of Yakima, Washington.

1965: No spray project conducted.

1966: No spray project conducted.

1967:

3 TBM's

1 Helicopter

Guidance - Four Cessna 180 Aircraft and pilots were used to guide the spray planes and these were separately contracted for by the State. Four experienced navigators for these planes were obtained through Forest Protection Limited of Canada. The spray planes were provided by the Johnson Flying Service of Missoula, Montana.

86.

The helicopter, which was used in place of the Stearman for spraying irregular and marginal areas, was contracted by the State through Maine Helicopters Incorporated of Augusta, Maine.

1968: No spray project conducted.

1969: No spray project conducted.

1970:

3 TBM's

Guidance - Two Cessna 172 aircraft and pilots were used for guiding the spray planes and were contracted by the State from Bar Harbor Airways in Ellsworth, Maine. The spray planes themselves were provided by the Hillcrest Aircraft Company of Lewiston, Idaho.

1971: No spray project conducted.

1972:

11 PV-2's

3 TBM's

1 Helicopter

Guidance - Seven Cessna planes and pilots were used for spray plane alignment. These were contracted by the State through the Maine Aviation Corporation of Portland, Maine. Navigators were supplied by Forest Protection Limited of Canada. Spray planes were contracted through Aviation Specialties Incorporated of Mesa, Arizona. The helicopter was contracted by the State through the Northeast Helicopter Service of Bucksport, Maine.

1973:

10 PV-2's

6 TBM's

1 Helicopter

Guidance - Eight Cessna planes and pilots were contracted by the State through the Maine Aviation Corporation of Portland, Maine. Spray planes were obtained through the Hillcrest Aircraft Company of Lewiston, Idaho. The helicopter was obtained by the State through Maine Helicopters Incorporated of Augusta, Maine.

1974:

6 PV -2's

3 TBM's

1 Helicopter

Guidance - Spray planes were guided by a pair of Cessna planes flying above, each manned by an experienced navigator supplied by Forest Protection Limited of Canada. The seven Cessna planes and pilots were contracted by the State through the Maine Aviation Corporation of Portland, Maine. Spray planes were contracted through Globe Air Incorporated of Mesa, Arizona. The helicopter was contracted by the State through Northeast Helicopter Service of Old Town, Maine.

1975:

10 TBM's (plus one unproductive since it crashed on first take-off).

9 PV-2's

4 C-54's

2 Constellation

Guidance - 17 Cessna, 2 being the 310 type for roving Chief Pilot, one at each airport. These were contracted by the State through the Maine Aviation Corporation of Portland, Maine. Navigators were provided by the Forest Protection Limited of New Brunswick, Canada. Spray planes were supplied by the Hillcrest Aircraft Company and helicopters were contracted by the State through Northeast Helicopter Service Incorporated of Bucksport, Maine.

1976:

Pembroke Area (Washington County)

4 Bell 47 Helicopters

1 Cessna 210 Chase Plane

Millinocket

6 PV-2's

2 TBM's

Guidance System - 4 Cessna 210, 1 Control Cessna 310 (included a M.F.S. monitor).

Presque Isle

2 Constellation L - 749

12 C-54's

2 Ag. Cat type

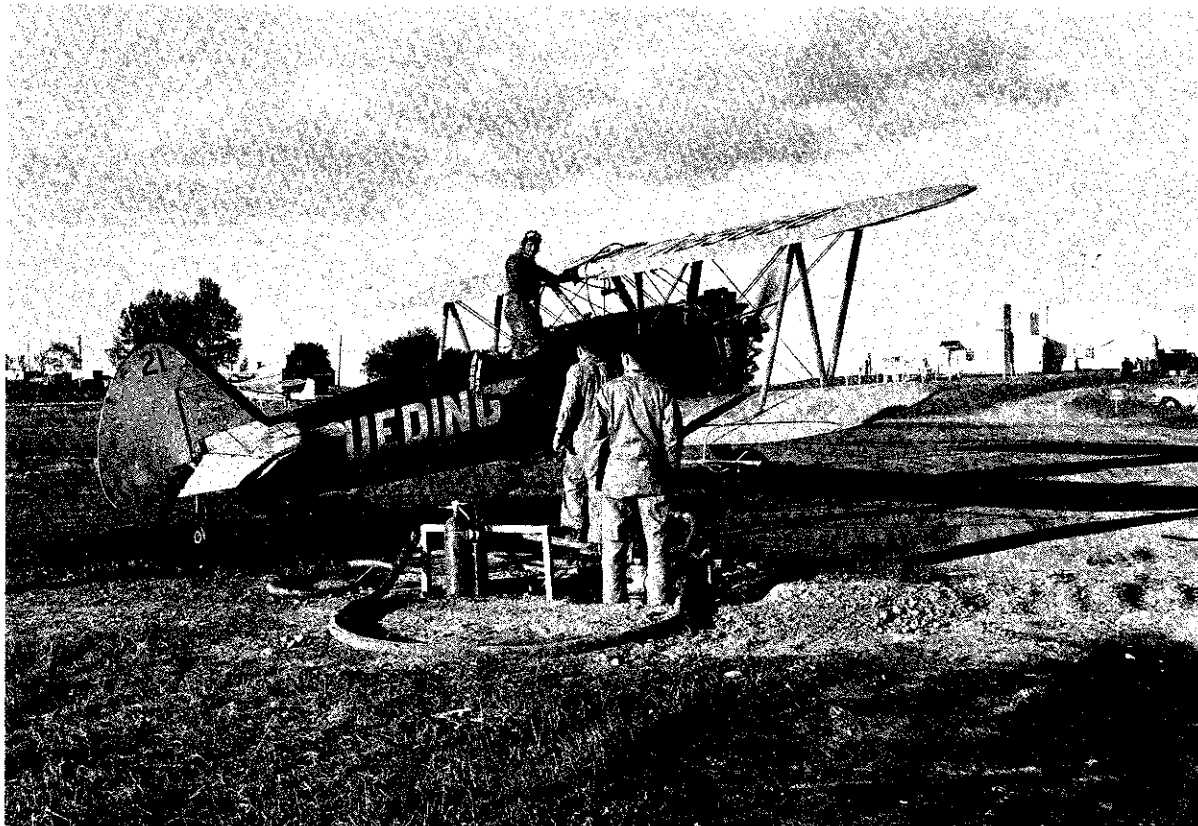
Guidance - 7 Litton - 51 systems, 3 Cessna 210 monitors and 1 Control Cessna 310 (included a MFS monitor).

1 Rescue Helicopter - Sikorsky (included Medic crew).

88.

Planes were contracted through Globe - Biegert Incorporated of Mesa, Arizona. Helicopter work was subcontracted by Globe - Biegert Incorporated to Northeast Helicopter Service and Maine Helicopters Incorporated.

**VII. AIRCRAFT PHOTO
ESSAY**



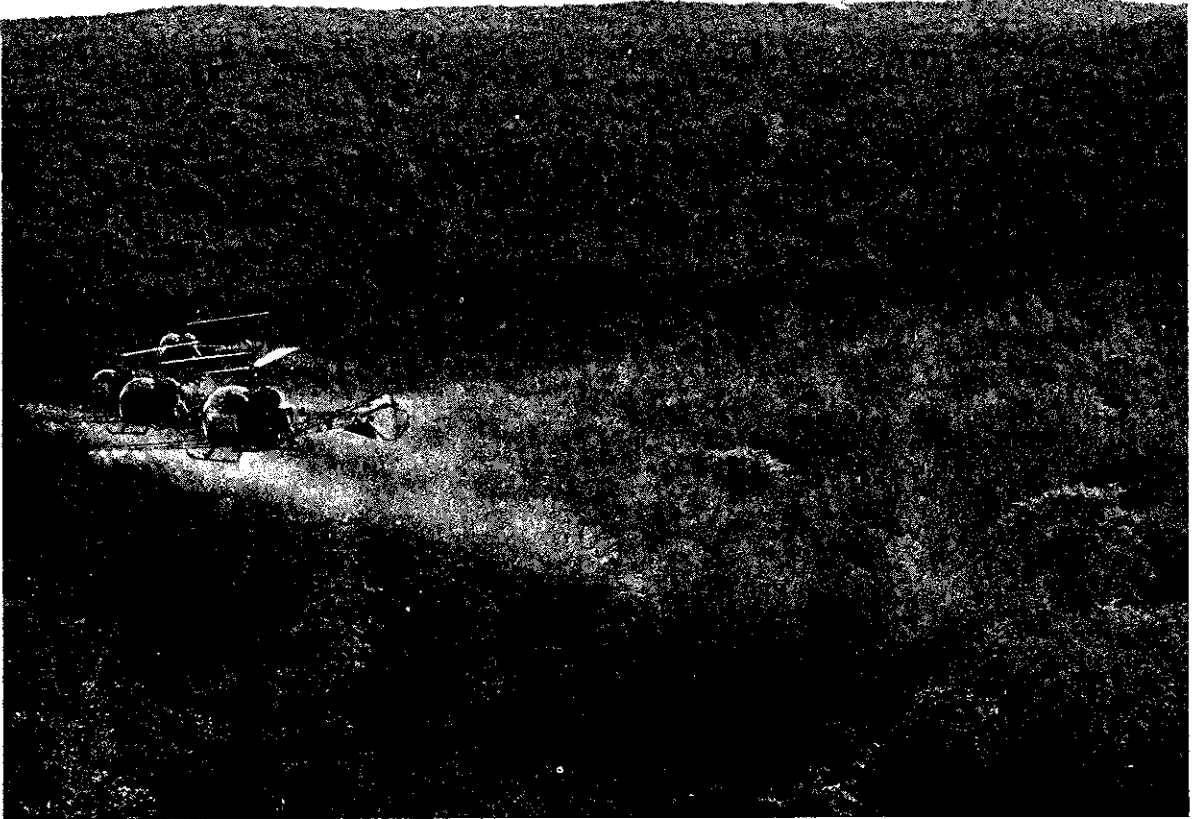
Stearman crop duster preparing for takeoff, 1950's.
Maine Forest Service photo.

Plate 2



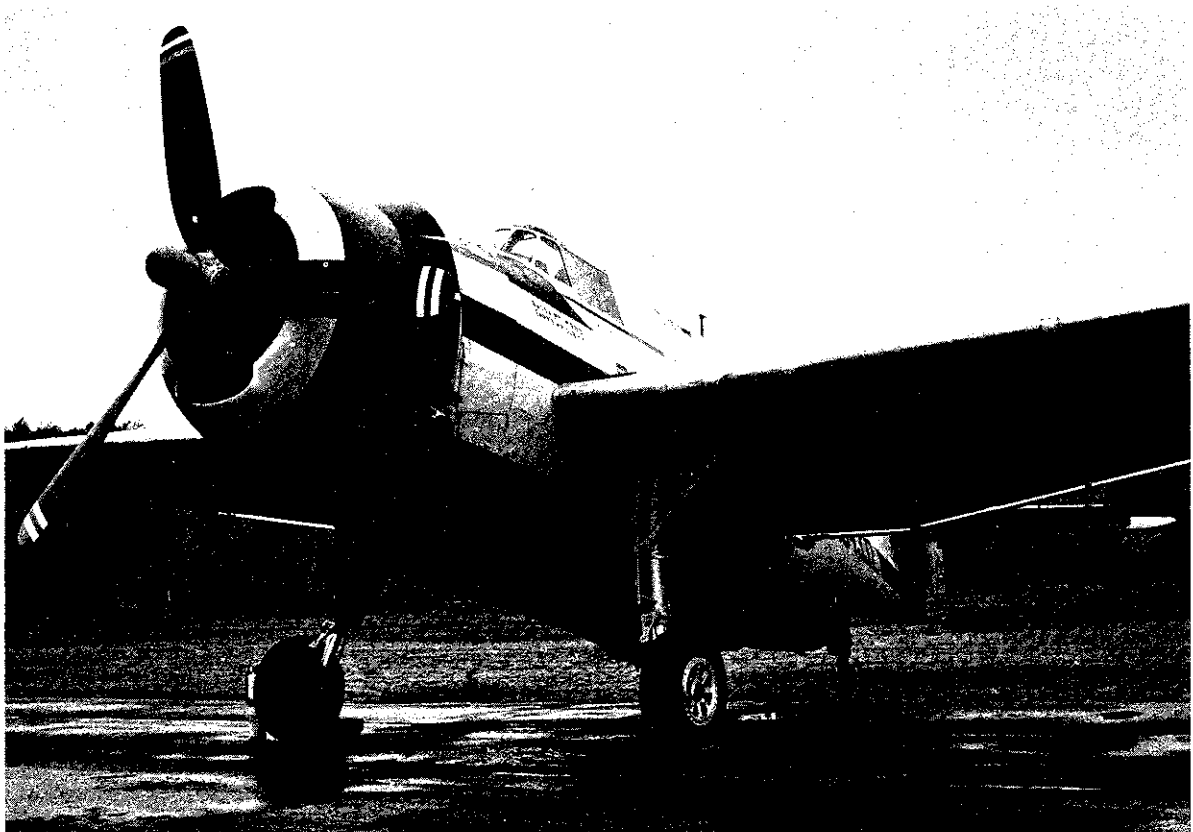
Stearman spraying, 1950's. Photo courtesy of Forest
Protection Limited, Fredericton, New Brunswick.

90.



Team of helicopters spraying near Lily Bay, 1977.
Jan Sassaman photo.

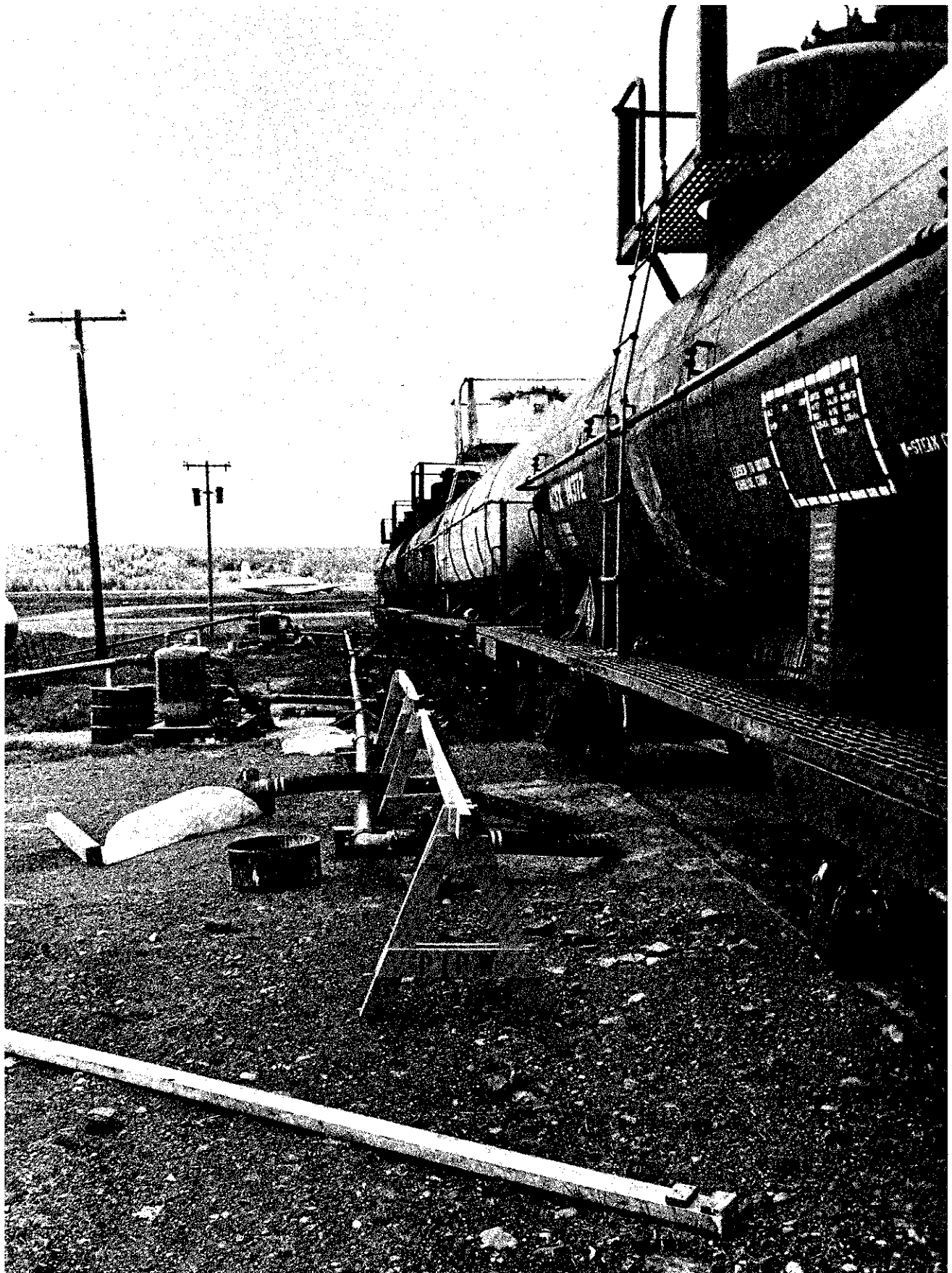
Plate 4



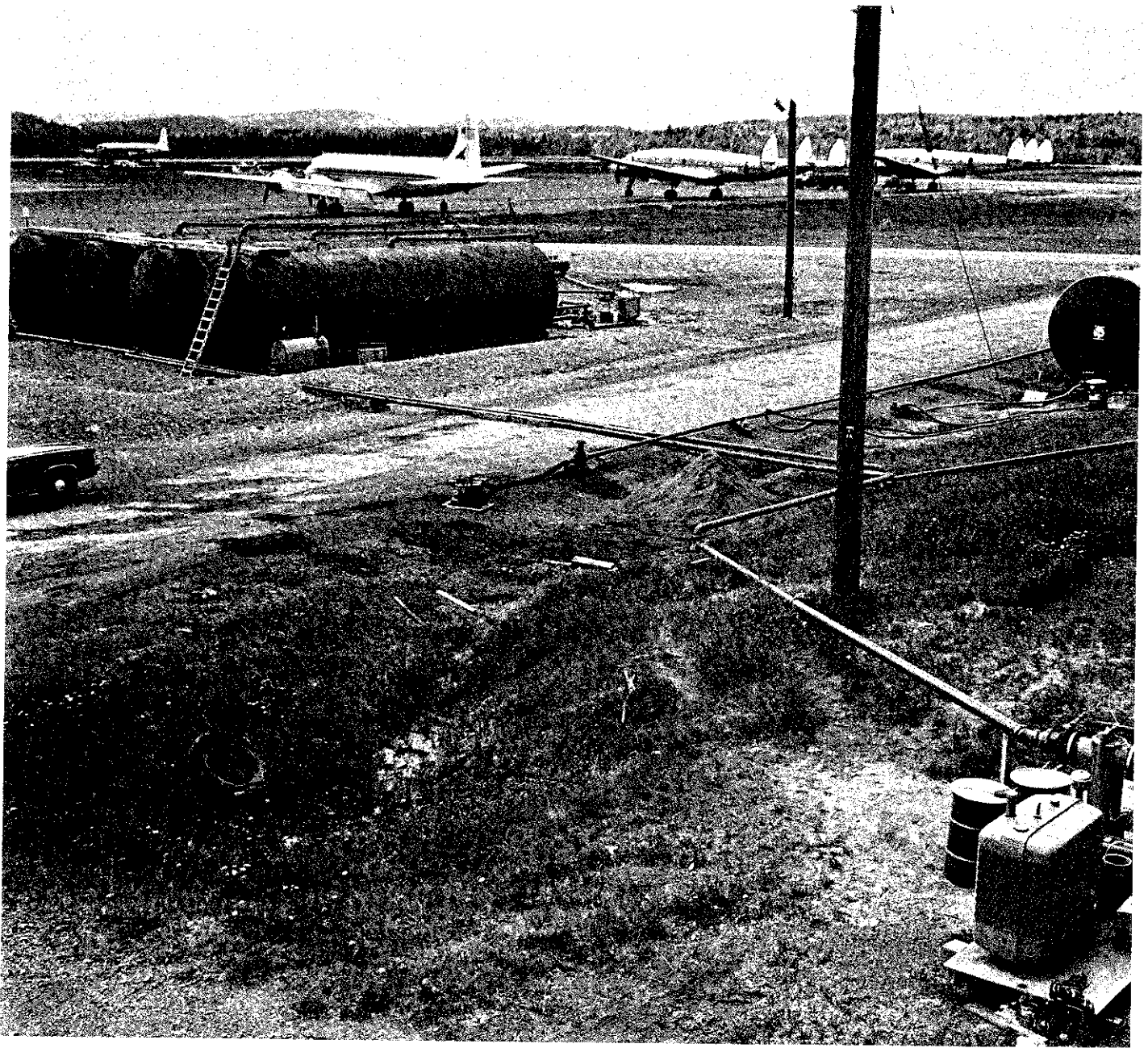
TBM parked at Millinocket, 1977. Christopher Ayres
photo.



PV-2 at Millinocket, 1977. Christopher Ayres photo.



Tank car delivery of Sevin-4-oil, Presque Isle, 1976.
Maine Forest Service photo.



Mixing and storage tanks, Presque Isle, 1976. C-54 and constellation spray aircraft provided by Globe-Biegert Aviation in background. Maine Forest Service photo.



Insecticide tanks in 4-engine spray aircraft, 1976.
Maine Forest Service photo.



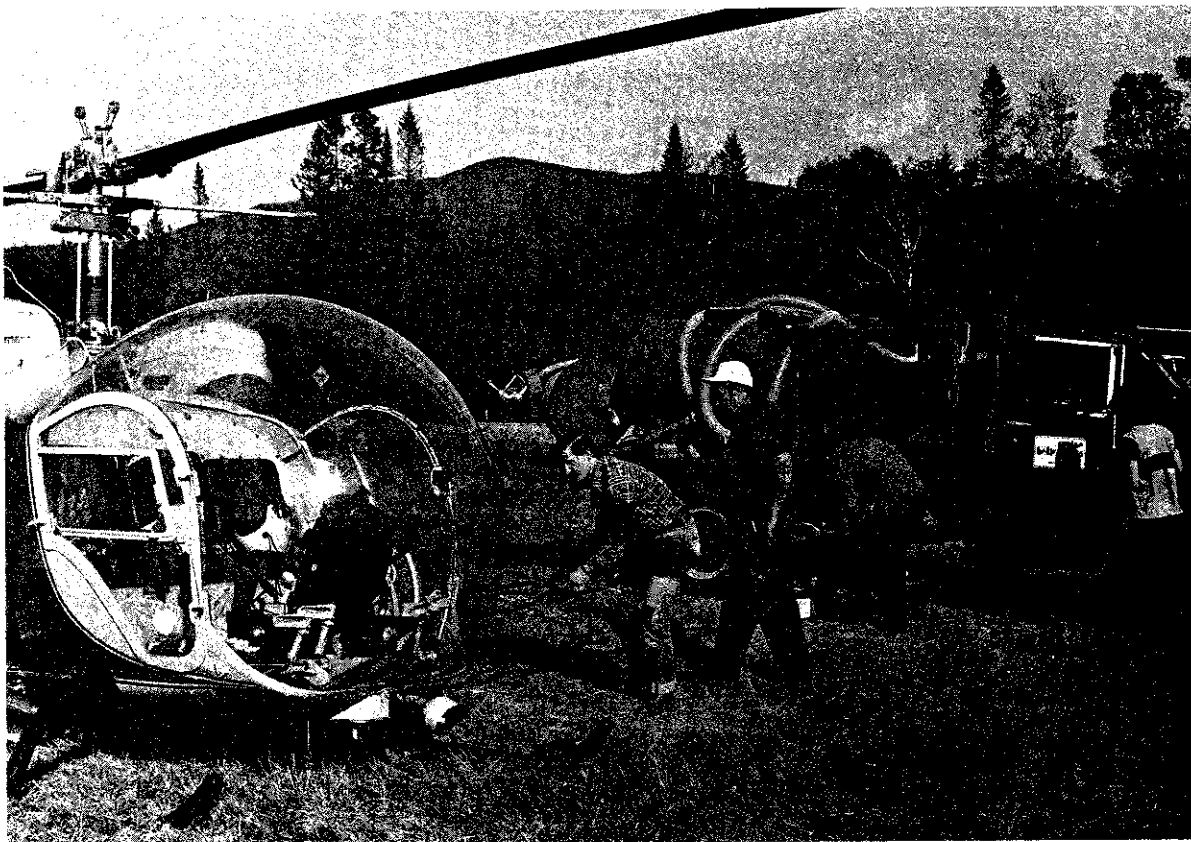
C-54 spray aircraft at Millinocket, 1977. Hillcrest Aircraft Company. Christopher Ayres photo.

Plate 10



Helicopter insecticide loading, Lily Bay Field, 1977. Jan Sassaman photo.

96.



Helicopter maintenance, 1977. Jan Sassaman photo.

Plate 12



Planning operations, Lily Bay Field, 1977. Jan Sassaman photo.

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