# An assessment of the effects on forest birds of fenitrothion and phosphamidon sprayed, respectively, as larvicide and adulticide against spruce budworm

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The alarming advancement of the spruce budworm, (Choristoneura fumiferana) in New Brunswick has lead to the development of new methods aimed at controlling this menace of the forests. In the spring of 1974, Forest Protection Limited (FPL) ear marked a 2,000,000 acre block in northern New Brunswick to be sprayed partially with a 3 oz/acre application of fenitrothion to act as a larvicide, followed by a complete double application of phosphamidon at 1 oz/acre to act as a budworm adulticide. The Canadian Wildlife Service (CWS) and Chemical Control Research Institute (CCRI) worked together to evaluate the effect of these chemical applications on the song birds of the area. This report is concerned with the CWS aspect of the study.

## Location

The study areas were located in the Sevogle area, Northumberland County, New Brunswick. Three census routes (see Figure 1) were measured and marked, one in each of three of the designated spray blocks. The first route, 197, was situated in Block 197 beginning 1 mile from the Heath Steel Mines Road (Miners' Road) and continuing for 1.5 miles. The habitat was mixed forest consisting of spruce, fir maple, aspen, cedar, and birch. The dbh of the spruce and fir trees was between 3 to 9 inches and fir was the regenerating species. The second route, 195, was located in Block 195 on Urquharts Road starting 1.5 miles north of the junction of Urquharts and Miners' Road. This route was also 1.5 miles in length and consisted of two types of habitat. The first was a mixed forest consisting of spruce, fir and aspen with an occasional white pine and maple. Regeneration was limited to spruce and fir. The second habitat

was a coniferous forest of black spruce. The dbh of the spruce trees in both habitats was between 3 and 6 inches. The third route, measuring one mile in length, was in Block 193 on an unnamed road off the east side of the Chaplin Island Road north of the point where Hill Top Road and Highway 30 intersect. This route contained a young hardwood section of beech and maple with an occasional fir and spruce, which gave way to a mixed habitat of beech, maple, fir and spruce. Aspen replaced the beech in the eastern section of the plot. The dbh of the hardwoods was generally small, 1-6 inches, and the mixed forest, the dbh of the fir and spruce was usually between 3 and 6 inches. Fir was the regenerating species in this habitat. A fourth census route, acting as a control, was situated on Hill Top Road beginning 1.9 miles west of the junction of Hill Top and Chaplin Island Road. This route was also one mile in length through a mixed forest of fir, spruce, aspen, and scattered maple and birch. The dbh of the threes ranged from 3 to 6 inches and fir was the regenerating species.

It should be mentioned that FPL did not maintain similar block patterns for the fenitrothion and phosphamidon sprays. However, to avoid confusion, I retained the original names of the census routes with one exception. The name of the control route was changed from control to route 13 because it was within Block 13 of the phosphamidon spray zone (as was route 193), and of course, could not be considered a control. Examination of FPL's pointer maps showed the location of route 197 to be almost completely with Block 12. However, it was possible that the last quarter mile of the west end was in Block 11. A similar situation

existed with route 195 which appeared to be in Block 12. However, possibly, the last quarter mile on the north end was located in Block 11.

Procedure and Methods

The census routes were marked with flagging tape at each end and at quarter mile intervals which were measured off using the odometer on a Suzuki 125 cc trail bike.

The strip census method was employed to measure the avian population along the routes. Songs, if distinctly heard, were counted with a tally counter and subtotals were recorded at each quarter mile. Individual birds were recorded on Census Data Sheets 1974 if they were seen or heard at right angles to me as I walked the routes. A brief account of weather conditions were recorded on the Data Sheets and the time required for each census was recorded using a wrist watch. Total numbers of birds and songs, time, songs/minute, birds/minute, and total species were tabulated. The routes were in most cases, censused on alternate days with routes 197 and 195 done on one day and the control route (route 13) and 193 done on the next.

Spray cards were placed along the census routes shortly before the application of fenitrothion in an attempt to determine the coverage received by the areas. The cards were placed along the routes in open areas and were collected 2 to 3 hours after spraying had been completed. Cards were not set out for the phosphamidon applications as it was a colorless solution.

Searching for sick birds was carried out from 2 to 4 days after an area had been sprayed. It was done primarily along road sides and areas along the borders to two plots where spray overlapping may have occurred. It was done with as much noise as possible so as to cause any sick bird to move thus catching my eye. Any sick bird captured was killed by suffocation. The stomach and its contents were removed and placed in small vials of 10% formalin and the bird was then wrapped in aluminum foil, labeled, and frozen.

A considerable amount of time was spent searching for nests in much the same manner employed to locate sick birds. Records of dates visited, and the number of eggs and/or young were recorded on nest record cards for each nest found.

A total of 14 birds were captured alive using mist nets and were maintained in cages measuring 19 x 9.5 x 13 inches in size. The cages were placed along route 193 at eighth of a mile intervals shortly before both the phosphamidon applications and were collected 5 to 7 hours after spraying had been completed. Daily observations were made on the birds from the day of the first capture until July 24, seven days after they had been subjected to the second phosphamidon application at which time they were released.

## Discussion

### Fenitrothion Larvicide Program

Pre-spray censuses for the fenitrothion larvicide program were begun on May 21. It was evident from the first day that the avian population was considerably lower than expected. This was the result of not only a late, but a very cold spring which delayed the arrival of

the birds, especially warblers, and led to the starvation in some areas, of some of the insectivores which did arrive early in the season. This problem, coupled with a change in the position of route 195, lead to the decision to make official use of censuses commencing no earlier than May 28. Records of censuses prior to May 28 if required, may be found on the Census Data Sheets.

Although this change in routine allowed an extra seven days for the expected influx of birds to arrive, it was not possible to determine the avian population in any of the plots prior to the first application of fenitrothion on the morning of June 5 because the population did not level off. May 31 marked the date at which warblers, flycatchers, and thrushes began to arrive in any number. An influx of warblers on June 2 occurred corresponding with warmer weather and continued daily climaxing with the arrival of most of the Tennessee Warblers on June 5. Figures 2 and 3 show figuratively this build up in population. Consequently, new birds were arriving daily from the first pre-spray census up to the first fenitrothion application on June 5.

Plot 193 was the first one in the study area to be sprayed. It was sprayed on the morning of June 5 and from an approximate altitude of 75 feet designated by FPL for the larviciding spray. Unfortunately, conditions were considerably less than ideal as high winds existed at the time. The spray cards which had been placed in open areas along the first quarter mile of the west end of the route showed no deposit when examined. It was consequently assumed that little, if any fenitrothion had settled to the ground in the area.

The morning of June 6 produced very low census results compared to the last pre-spray census (see Figure 3) done on June 4. Unfortunately, the control route which usually was done on the same day as route 193 and could have provided a comparison of an unsprayed area, was not censused June 6 in order that spray cards could be placed along routes 197 and 195 which were scheduled to be sprayed. However, because of the low level of activity on route 193, a song count was done on the first quarter mile (east end) of the control route at 0900 hours. The result, even considering the count was made 3.5 hours later than usual for that location, was very poor with only 172 songs counted and one wood thrush contributed a large number of the songs. Examination of Census Data Sheets showed that song counts for the same quarter mile in the four most recent censuses leading up to June 6 had been 119, 199, 281, and 385 which suggests that the poor song count on route 193 was the result of the high winds experienced that day and not a result of any fenitrothion which may have fallen in the area.

Due to spray cards once again having to be placed along routes 197 and 195 on June 7 (weather conditions were unfavorable June 6), followed by the censusing of these routes on June 8, it was June 9 before a second post-spray census was taken on the control and 193 routes. As Figure 3 indicates, high results were obtained on both routes with route 193 producing the highest songs and birds/minute of all previous censuses. The low figures recorded on route 193 on June 11, six days after the spray, and too great a time for an effect of the fenitrothion, may be again attributed to high winds as examination of the results of the control route indicates.

Post-spray censuses were discontinued after the morning of June 11 on the control and 193 routes. The reason for this was that it was felt that very little, if any, fenitrothion had settled in the area and no signs of an effect had been observed. Also, it was believed that a fenitrothion effect had manifested itself on routes 197 and 195 and it was decided that time would be more wisely spent devoting more work to these plots.

Plots 197 and 195 were both sprayed on the morning of June 7. Deposits on the spray cards placed in open areas along both routes indicated that both areas had received good coverage. The cards were collected and taken to Ottawa by Mr. Dave Ray from whom further information regarding analysis of the cards by CCRI may be obtained.

Examination of Figure 2 illustrates that on June 8, the morning after the plot was sprayed and the first post-spray census, a drop in activity occurred on route 197 even though weather conditions were very good. A further drop in activity was recorded on June 10. Because the activity level was considerably lower on this day than what might be expected, a census of the first quarter mile (west end) of the control route was done to see if similar conditions existed there. Although the control census was done late in the morning (0956-1008) the results (see Figure 3) compared favorably with those of route 197 suggesting that generally, the activity level for the day was low.

It is possible that the high results recorded on route 197 on June 5, the last pre-spray census, were the result of an influx of Tennessee Warblers, some of which were only migrating through the area. On June 3,

6 Tennessee Warblers were recorded on route 197. Twenty-four were recorded on June 5. As this species is one which is very loud and at times sings almost continually, it is conceivable that such an influx could result in a higher activity level.

It is also possible that the drop in activity recorded on the first post-spray census on the morning of June 8 was a result of some of the Tennessee Warblers leaving the area. Eighteen were recorded on June 8, six less than on June 5, representing a loss of 25% of the number recorded on the last pre-spray census. The migrating of these six birds to another area, again considering their vociferous nature, could account for at least part of the drop in the activity level. This does not mean however, that the possibility of the drop being a result of a fenitrothion effect is ruled out.

Activity levels for the pre- and post-spray censuses on route 195 were similar to those on route 197. As can be seen from examining Figure 2, activity levels were increasing daily until the first post-spray census when a considerable drop occurred. Examination of the Census Data sheets showed that on June 5, an increase from 9 (recorded on June 3) to 16 Tennessee Warblers occurred as well as an increase in the number of Cape May Warblers from 7 to 11. Once again, it is conceivable that the arrival of these birds may have been the cause of the high statistics recorded on June 5. Although the number of Tennessee Warblers did not decline significantly to explain the drop in activity level on June 8, (only one less) the difference in the number of Cape May Warblers (the number fell from 11 to 3) may have contributed to some extent.

It is of interest to note that route 195 did not experience a continued drop in activity on June 10 as did route 197 as results were approximately equal from the first post-spray count until the last. The activity level however, did not climb back up to the level achieved as early as June 3 so it is possible that this is evidence of a minor effect of fenitrothion.

Searching for sick birds resulted in the finding of four birds effected by the fenitrothion. On June 7, I observed what appeared to be a sick Myrtle Warbler at the half-way point of route 195. The bird was first observed on the ground near the road and I was able to approach within 10-15 feet of it before it fluttered with a chimney swift type action landing 1 foot off the ground in a small fir. It squatted on a branch but seemed alert exhibiting head movements as if searching for insects. When approached, it fluttered to another tree and landed 10-15 feet above the ground. It continued to flutter from one tree to another until it was lost from sight.

A sick Tennessee Warbler was found the same day on route 195 approximately one half of a mile from the south end of the route. It was unable to fly and jumped and flapped its wings in an effort to elude me. I captured it, killed it by suffocation and removed the stomach and its contents, placing them in a small vial of 10% formalin. Both the bird which was wrapped in aluminum foil and frozen, and the vial was labeled NG-74-1.

On the morning of June 8, a sick Magnolia Warbler was located on route 197. It was first observed squatting on the ground attempting to catch insects but unable to fly. It attempted to hop away from me and hide but I captured it and killed it by suffocation. The stomach and contents were removed and the bird was wrapped and frozen in aluminum foil. Both the bird and stomach contents were labeled NG-74-2.

The fourth bird was a Bay Breasted Warbler found on route 197 by Dave Ray. The bird fell out of a tree and was incapable of flight. It jumped and fluttered its wings to escape but was killed, frozen, and labeled NG-74-3.

Phosphamidon Adulticide Program

Although censusing was done in the last two weeks in June, it was decided that censuses taken only from July 1 until the spray dates would be used as pre-spray censuses. The reason for this decision was that the avian activity level began to drop off at the beginning of July and continued to do so almost on a daily basis leading up to and after the phosphamidon applications. It was my feeling that the high figures recorded during the last two weeks in June were not relevant in trying to evaluate any kind of effect which the phosphamidon may have produced as they did not reflect the population level in the days just prior to the spray applications.

Examination of Figures 4 and 5 illustrate how the numbers of birds and songs began to drop off slightly leading up to the spray date. It is important to realize that the figures do not illustrate how quickly activity was decreasing as they do not bring into account the

breakdown of what I call the "noise factor". In an area where the population is lower than what the environment may accommodate, high figures (e.g. birds and songs) may be recorded because distant songs may be heard. If the population and activity level is sufficient, then it is possible with the use of distant songs, some of which may be contributed by continuous singers, to record for example, an average of 20 songs/minute. However, this same location in the peak of the breeding season with a larger population will still produce the same or slightly higher results because the more distant birds will not be heard over the birds singing in the close proximity of the observer. In other words, it is only the birds in the same vicinity as the observer who are recorded and not the more distant ones. The population is now larger, but the figures do not reveal this fact.

In the phosphamidon pre-spray censuses, the noise factor was not a problem. Consequently, distant songs were heard and recorded which belied the fact that the activity levels on all plots was dropping off quickly.

Census routes 193 and 13 (formerly the control for the fenitrothion program) which were in Block 13 were the first routes in the study area to receive a phosphamidon application all of which were done from an altitude of 300 feet. The date of the spray was July 13 and weather conditions at the time of application were very good. The second application to Block 13 took place on July 17, again under very good weather conditions. Both were morning sprays.

Examination of Figure 5 illustrates that only on July 14, the first census after the first application, and July 20, 3 days after the second application did the results drop below what might have been expected considering the seasonal drop off in activity. However, high winds were experienced on both of these days during the censuses which would explain the low results. There was no significant change in numbers of any of the warbler species following either of the two applications on both plots.

Block 12, containing the majority (if not all) of route 197 and probably all of route 195 received its first application on the morning of July 14. Unfortunately, weather conditions were poor with winds of at least 15 mph occurring at the time of the spray. Block 11 which may have contained the eastwestern quarter mile of route 197 was sprayed the morning of July 16 under favorable weather conditions. The second application to both Blocks 11 and 12 was done on the morning of July 21 under favorable weather conditions.

As was the case with routes 193 and 13, no effect of the phosphamidon applications was observed on routes 197 and 195. Figure 4 indicates that considering again the seasonal drop off, at no time after either spray on both plots did the activity level dip below what might have been expected. The only alarming change in status of a species following a spray occurred with the Tennessee Warblers on route 195 which fell from a total of 12 to 5 after the first application. However, on two occasions in the pre-spray censuses on route 197, numbers of the same species dropped from 11 to 4 on consecutive censuses on two occasions suggesting that the drop on route 195 may have had nothing to do with the spray.

Considerable searching was done following each of the phosphamidon applications. Most of the searching on routes 197 and 195 were restricted to the areas where overlapping may have occurred along the boundaries of Blocks 11 and 12. On occasion, searching was carried into Block 11 as well. Both routes 13 and 193 were searched as well with special care given to route 193 which was subjected to an overspray on the first application. This in effect, is a second application over the same area to empty the loads from the planes which for one reason or another, had not been completed after the whole block had been sprayed once. At no time was a sick bird observed by myself or any of the contractors or staff by CCRI on any of the areas under study.

Eight cages containing a total of three species of birds (see Figure 6) were placed at an eighth of a mile intervals along route 193 to study the effect of the phosphamidon on individual birds. The cages were placed in open areas so that none of the birds would benefit from vegetative protection and therefore would be in direct contact with the spray in the air and also through their food on the bottom of the cages. No unusual behaviour by any of the birds was observed after either the first or second application. However, on the day of release, 7 days after the second spray of July 21, the male purple finch from cage #1 was found squatting and breathing heavily on the bottom of the cage. This was believed to be a result of the manner in which the finches battered themselves against the sides of the cage (all three had poorly conditioned plumage the day of release) but as a precaution, the bird was suffocated, wrapped in aluminum foil, labeled NG-74-4 and frozen for analysis.

In an effort to observe the effect of phosphamidon on active nests, a total of 13 nests were found and visited on at least two occasions. A record of all the nests and visits to them may be found in Figure 7. Frequent visits were not made as it was feared that this would cause the adults to desert the nest.

Due to the lateness in the season at the time of completion of the spraying and the depredation of at least 3 of the nests, only 4 nests, numbers 3, 11, 12, and 13 were active through the spraying operation. Two of these nests, numbers 3 and 11 had young fledglings in the nest at the time of both applications. A check of the nests on July 26 showed that both nests were empty and the assumption was made that the young had fledged as the nest had not been harmed in any way. The remaining two nests, numbers 12 and 13, each contained 3 eggs on the final pre-spray visit. On the post-spray visit, nest 13 still had 3 eggs which were being incubated. All that may be deduced from this is that only one, if in fact any, of the parents had been killed by the spray. Considering the apparent success of the fledglings from nests 3 and 11 and the lack of any sick birds found through searching, this is highly unlikely. The eggs in nest 12 had hatched by the time a post-spray visit was made and judging from their stage of development, it was not likely that they had hatched prior to the final application. Their vitality however, indicated that for the few days they had been alive, they had not ingested a lethal amount of phosphamidon as a result of consuming contaminated insects.

Conclusions

The observation of a total of three sick birds on two of the three fenitrothion plots is evidence that under the conditions of application to plots 197 and 195, a dosage of 3 oz/acre of fenitrothion can produce a deleterious effect on the avian population. It was however, a minor effect as statistics obtained from pre- and post-spray censuses on routes 197 and 195 could not conclusively prove that a fenitrothion effect occurred.

The lack of deposit marks on the spray cards placed on route 193 is testimony to the fact that spraying under windy conditions is unsuccessful in terms of the spray droplets reaching ground level.

The results obtained from pre- and post-spray censuses on four phosphamidon routes and the fact that at no time was a sick bird observed following an application indicates that under the conditions of application during the study, a 2 x 1 oz/acre application of phosphamidon at least 4 days apart does not have an injurious effect on the avian population. Observations also concluded that applications of this dosage and conditions does not prove detrimental to seed eating birds exposed to direct contact with the spray. It was also concluded that applications of this dosage and conditions do not have an injurious effect on the hatching and fledgling success of robins or Swainson's thrushes.

Figure 1. Location of Fenitrothion and Phosphamidon Census Routes.

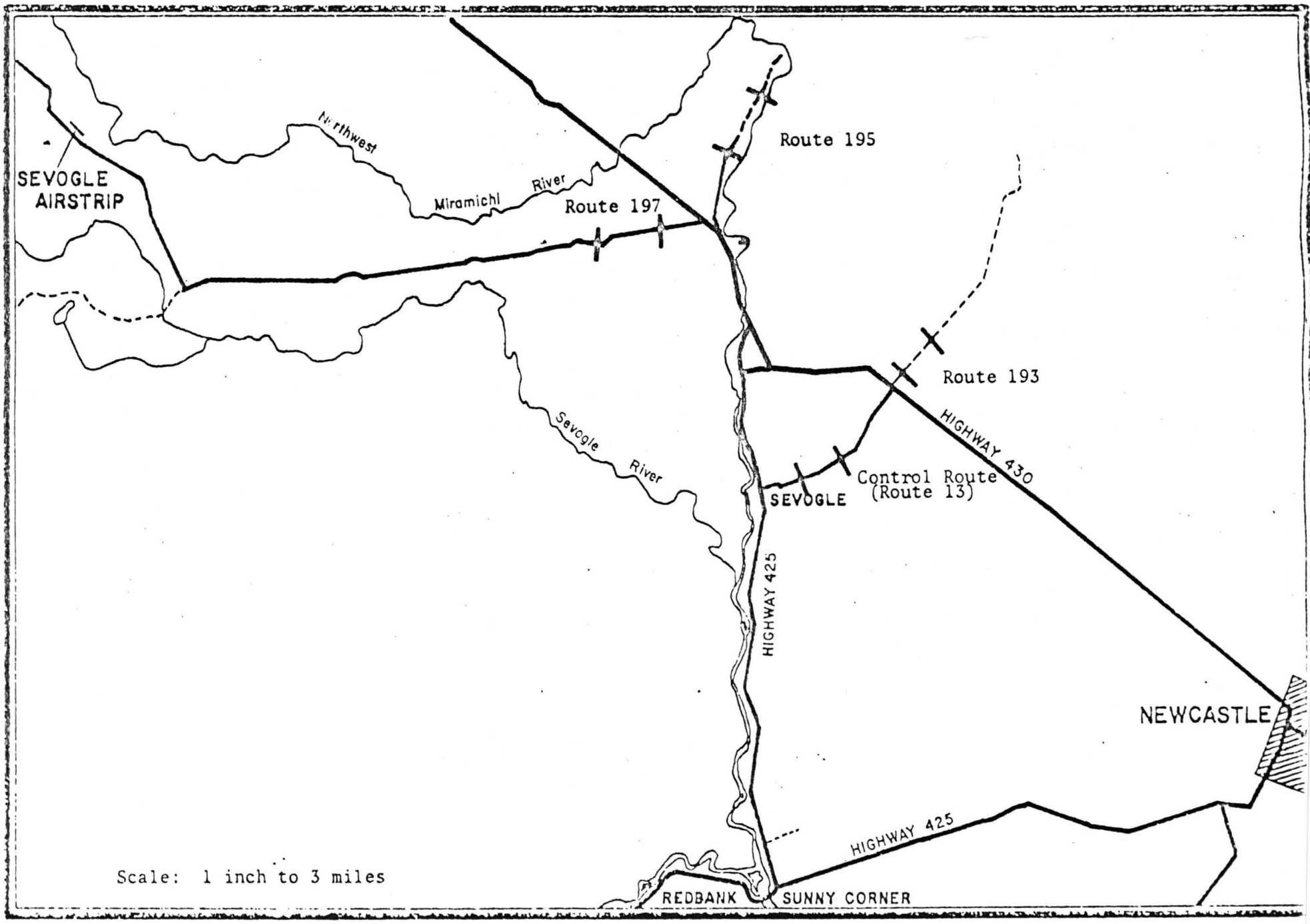

Figure 2. Pre- and Post-Spray Fenitrothion Census Data of Routes 197 and 195.

| Date | Total Birds | Total Songs | Time | Songs/ Minute | Birds/ Minute | Total Species | Weather |
|---|---|---|---|---|---|---|---|
| Route 197 | | | | | | | |
| May 28 | 87 | 537 | 90 | 5.97 | 0.97 | 22 | Good |
| 30 | 111 | 866 | 91 | 9.52 | 1.22 | 29 | Excellent |
| June 1 | 83 | 708 | 88 | 8.05 | 0.94 | 23 | Heavy Rain |
| 3 | 171 | 1777 | 96 | 18.51 | 1.78 | 39 | Excellent |
| 5 | 187 | 1960 | 90 | 21.78 | 2.08 | 39 | Cloudy |
| 7 | | Plot Sprayed | | | | | |
| 8 | 158 | 1620 | 91 | 17.80 | 1.74 | 34 | Very Good |
| 10 | 100 | 1140 | 79 | 14.43 | 1.27 | 28 | Cloudy |
| 12 | 149 | 1625 | 93 | 17.47 | 1.60 | 33 | Cloudy |
| 13 | 155 | 1482 | 91 | 16.29 | 1.70 | 44 | Cloudy |
| 14 | 160 | 1666 | 89 | 18.72 | 1.80 | 36 | Excellent |
| Route 195 | | | | | | | |
| May 28 | 88 | 389 | 69 | 5.64 | 1.28 | 25 | Cloudy |
| 30 | 104 | 758 | 75 | 10.11 | 1.39 | 28 | Excellent |
| June 1 | 107 | 877 | 86 | 10.20 | 1.24 | 30 | Rain |
| 3 | 167 | 1568 | 86 | 18.23 | 1.94 | 38 | Excellent |
| 5 | 136 | 1455 | 72 | 20.21 | 1.89 | 36 | Cloudy |
| 7 | | Plot Sprayed | | | | | |
| 8 | 132 | 1210 | 76 | 15.92 | 1.74 | 39 | Good |
| 10 | 123 | 970 | 60 | 16.17 | 2.05 | 27 | Cloudy |
| 12 | 124 | 1422 | 88 | 16.16 | 1.41 | 37 | Good |
| 13 | 114 | 1177 | 76 | 15.49 | 1.50 | 34 | Windy |
| 14 | 135 | 1279 | 78 | 16.40 | 1.73 | 34 | Excellent |

Figure 3. Pre- and Post-Spray Fenitrothion Census Data of Control and Route 193.

| Date | Total Birds | Total Songs | Time | Songs/ Minute | Birds/ Minute | Total Species | Weather |
|---|---|---|---|---|---|---|---|
| Control | | | | | | | |
| May 29 | 55 | 438 | 58 | 7.56 | 0.95 | 19 | Rain |
| 31 | 93 | 843 | 62 | 13.60 | 1.50 | 27 | Excellent |
| June 2 | 124 | 453 | 65 | 14.67 | 1.91 | 35 | Very Good |
| 4 | 143 | 1302 | 77 | 16.91 | 1.86 | 39 | Good |
| 6 | | 172* | Not Done | | | | |
| 9 | 156 | 1569 | 67 | 23.42 | 2.33 | 37 | Very Good |
| 10** | 21 | 160 | 12 | 13.33 | 1.75 | 15 | Cloudy |
| 11 | 137 | 1251 | 61 | 20.51 | 2.25 | 34 | Cloudy |
| Route 193 | | | | | | | |
| May 29 | 22 | 96 | 47 | 2.04 | 0.47 | 12 | Rain |
| 31 | 93 | 580 | 59 | 9.83 | 1.58 | 26 | Excellent |
| June 2 | 104 | 690 | 64 | 10.78 | 1.63 | 30 | Windy |
| 4 | 132 | 1153 | 64 | 18.02 | 2.06 | 34 | Very Good |
| 5 | | Plot Sprayed | | | | | |
| 6 | 102 | 486 | 51 | 9.53 | 2.00 | 29 | Windy |
| 9 | 126 | 1016 | 51 | 19.92 | 2.47 | 32 | Good |
| 11 | 68 | 499 | 53 | 9.42 | 1.28 | 27 | Windy |

* Song count done on first quarter mile.

** Statistics based on result of figures obtained only from first quarter mile of route.

Figure 4. Pre- and Post-Spray Phosphamidon Census Data of Routes 197 and 195.

| Date | Total Birds | Total Songs | Time | Songs/ Minute | Birds/ Minute | Total Species | Weather |
|---|---|---|---|---|---|---|---|
| Route 197 | | | | | | | |
| July 1 | 124 | 1774 | 80 | 22.18 | 1.55 | 35 | Cloudy |
| 3 | 133 | 1841 | 84 | 21.92 | 1.58 | 29 | Cloudy |
| 5 | 124 | 1587 | 88 | 18.03 | 1.41 | 33 | Very Good |
| 8 | 126 | 1642 | 82 | 20.02 | 1.54 | 31 | Very Good |
| 12 | 107 | 1264 | 80 | 15.80 | 1.34 | 27 | Good |
| 14 | | Plot Sprayed | | | | | |
| 16 | 85 | 1311 | 81 | 16.19 | 1.05 | 24 | Good |
| 19 | 74 | 1025 | 78 | 13.14 | 0.95 | 25 | Windy |
| 21* | 81 | 1027 | 88 | 11.67 | 0.92 | 24 | Cloudy |
| 23 | 63 | 782 | 81 | 9.65 | 0.77 | 21 | Good |
| 25 | 54 | 699 | 72 | 9.71 | 0.75 | 21 | Very Good |
| 27 | 48 | 495 | 71 | 6.97 | 0.68 | 19 | Good |
| Route 195 | | | | | | | |
| July 1 | 96 | 1411 | 75** | 18.81 | 1.28 | 28 | Cloudy |
| 3 | 113 | 1727 | 77 | 22.43 | 1.47 | 27 | Cloudy |
| 5 | 115 | 1400 | 79 | 17.72 | 1.46 | 33 | Very Good |
| 8 | 137 | 1492 | 75 | 19.89 | 1.83 | 32 | Good |
| 12 | 112 | 1460 | 76 | 19.21 | 1.47 | 31 | Good |
| 14 | | Plot Sprayed | | | | | |
| 16 | 99 | 1286 | 68 | 18.91 | 1.46 | 30 | Very Good |
| 19 | 64 | 968 | 72 | 13.44 | 0.89 | 20 | Windy |
| 21 | | Plot Sprayed | | | | | |
| 23 | 62 | 930 | 70 | 13.29 | 0.89 | 21 | Good |
| 25 | 65 | 741 | 62 | 11.95 | 1.05 | 22 | Good |
| 27 | 63 | 675 | 65 | 10.38 | 0.97 | 24 | Good |

* Plot sprayed after census.

** Approximate.

Figure 5. Pre- and Post-Spray Phosphamidon Census Data of Routes 13 and 193.

| Date | Total Birds | Total Songs | Time | Songs/ Minute | Birds/ Minute | Total Species | Weather |
|---|---|---|---|---|---|---|---|
| Route 13 (formerly control) | | | | | | | |
| July 2 | 104 | 1129 | 54 | 20.91 | 1.93 | 32 | Very Good |
| 4 | 107 | 1282 | 62 | 20.68 | 1.73 | 33 | Very Good |
| 7 | 115 | 1149 | 55 | 20.89 | 2.09 | 34 | Cloudy |
| 9 | 104 | 992 | 55 | 18.04 | 1.89 | 31 | Cloudy |
| 13 | | Plot Sprayed | | | | | |
| 14 | 84 | 647 | 56 | 11.55 | 1.50 | 28 | Windy |
| 17 | | Plot Sprayed | | | | | |
| 18 | 81 | 922 | 56 | 16.46 | 1.45 | 30 | Good |
| 20 | 54 | 498 | 54 | 9.22 | 1.00 | 21 | Windy |
| 22 | 80 | 778 | 56 | 13.89 | 1.43 | 24 | Cloudy |
| 24 | 71 | 595 | 54* | 11.02 | 1.31 | 22 | Good |
| 26 | 52 | 529 | 51 | 10.37 | 1.02 | 17 | Good |
| 28 | 64 | 717 | 53 | 13.53 | 1.21 | 23 | Good |
| Route 193 | | | | | | | |
| July 2 | 87 | 1156 | 47 | 24.60 | 1.85 | 27 | Very Good |
| 4 | 85 | 1013 | 53 | 19.11 | 1.60 | 26 | Good |
| 7 | 79 | 850 | 46 | 18.48 | 1.72 | 26 | Cloudy |
| 9 | 95 | 799 | 41 | 19.49 | 2.32 | 23 | Rain |
| 13 | | Plot Sprayed | | | | | |
| 14 | 76 | 713 | 45 | 15.84 | 1.69 | 24 | Windy |
| 17 | | Plot Sprayed | | | | | |
| 18 | 57 | 520 | 49 | 10.61 | 1.16 | 24 | Good |
| 20 | 44 | 292 | 48 | 6.08 | 0.92 | 21 | Windy |
| 22 | 64 | 577 | 51 | 11.31 | 1.25 | 20 | Cloudy |
| 24 | 52 | 559 | 46 | 12.15 | 1.13 | 21 | Cloudy |
| 26 | 47 | 477 | 46 | 10.37 | 1.02 | 20 | Good |
| 28 | 40 | 206 | 48 | 4.29 | 0.83 | 20 | Very Good |

* Approximate.

Figure 6. Species, Numbers, and Sex of Caged Birds Exposed to Phosphamidon Applications.

| Cage Number | Species | Number and Sex |
|---|---|---|
| 1 | Purple Finch | 2 males, 1 female |
| 2 | Evening Grosbeak | 2 males |
| 3 | Evening Grosbeak | 1 male, 1 female |
| 4 | Evening Grosbeak | 1 male |
| 5 | Evening Grosbeak | 1 male, 1 female |
| 6 | Evening Grosbeak | 1 female |
| 7 | Cowbird | 1 (sex unknown) |
| 8 | Evening Grosbeak | 2 males |

Figure 7. Records of Nests within Phosphamidon Spray Zone.

| Nest Number | Species | Date | Location | Eggs | Young | Outcome |
|---|---|---|---|---|---|---|
| 1 | Magnolia Warbler | 24 June | Plot 195 | 0 | 4 | |
| | | 11 July | | 0 | 4 | |
| | | 26 July | | 0 | 0 | Fledged |
| 2 | Olive Backed Thrush | 27 June | Plot 195 | 0 | 3 | |
| | | 11 July | | 0 | 0 | Fledged |
| 3* | Olive Backed Thrush | 27 June | Plot 195 | 2 | 0 | |
| | | 11 July | | 1 | 3 | |
| | | 26 July | | 0 | 0 | Fledged |
| 4 | Olive Backed Thrush | 29 June | Plot 195 | 2 | 0 | |
| | | 11 July | | 2 | 1 | |
| | | 26 July | | 2 | 0 | Deserted |
| 5 | White Throated Sparrow | 26 June | Plot 193 | 4 | 0 | |
| | | 10 July | | 0 | 0 | Empty |
| 6 | White Throated Sparrow | 26 June | Plot 193 | 0 | 3 | |
| | | 10 July | | 0 | 0 | Predated |
| 7 | Olive Backed Thrush | 8 July | Plot 193 | 3 | 0 | |
| | | 26 July | | 0 | 0 | Predated |
| 8 | Olive Backed Thrush | 8 July | Plot 193 | 3 | 0 | |
| | | 26 July | | 0 | 0 | Fledged |
| 9 | White Throated Sparrow | 9 July | Plot 193 | 3 | 0 | |
| | | 26 July | | 1 | 0 | Unknown |
| 10 | White Throated Sparrow | 10 July | Plot 193 | 5 | 0 | |
| | | 26 July | | 0 | 0 | Predated |
| 11* | Robin | 12 July | Corner of | 1 | 2 | |
| | | 26 July | Urquhart's & Miner's Road | 0 | 0 | Fledged |
| 12* | Olive Backed Thrush | 15 July | Plot 193 | 3 | 0 | |
| | | 26 July | | 0 | 0 | Fledged |
| 13* | Olive Backed Thrush | 15 July | Plot 193 | 3 | 0 | |
| | | 26 July | | 3 | 0 | Unknown |

*Nest active and successful through two applications of 1 oz/acre of phosphamidon.