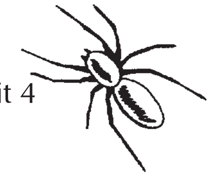


Activity #3

Controlling the Argentine Ant

● ● ● **Class Period One** *Argentine Ant Control Efforts*

Materials & Setup

- Argentine ant range acetates (master, pp. 48-59)
- Overhead projector and screen

For each student

- Student Page "Designing a Control Strategy That Works: Questions From the Discussion" (pp. 60-64)

Instructions

1) Ask students to review what they learned during the last activity about where and how quickly Argentine ant populations are spreading within Haleakalā National Park. Have students from the team that worked on that topic provide a quick synopsis.
2) Using Teacher Background "The Spread of Argentine Ants in Haleakalā National Park and Recent Efforts at Control" (pp. 40-43), lead a class discussion on recent efforts to control the spread of Argentine ants in Haleakalā National Park. Use the acetates to illustrate key points.
3) Assign the Student Page "Designing a Control Strategy that Works: Questions from the Discussion" as homework.

● ● ● **Class Period Two** *Effectiveness of Control Efforts*

Instructions

1) With the entire class, discuss students' determinations about the effectiveness of the ant control experiment. Review their calculations and talk about factors that might make the results questionable.
2) Ask students to discuss the idea that current control efforts may be simply buying time during which alternative methods of *eradication* may be developed and tested.
3) Review the entire unit, discussing student questions and ideas.

Journal Ideas

- What can you do to prevent the spread of Argentine ants within Haleakalā National Park?
- What kind of educational program would be effective at helping park visitors learn about Argentine ants and how to stop their spread?

Assessment Tools

- Student Page "Designing a Control Strategy that Works: Questions from the Discussion" (teacher version, pp. 44-47)
- Participation in class discussion
- Journal entries

Teacher Background

Designing and Implementing an Argentine Ant Control Program

Because there are native ants in most natural areas around the world, few attempts have been made to control ants for conservation purposes. Researchers and resource managers in Haleakalā National Park face quite a challenge designing a control program for the Argentine ant. There is, however, a huge industry built around the control of ants in urban and agricultural situations and ongoing research about the effectiveness of various pesticides. Still, the number of ant control products is limited because the U.S. Environmental Protection Agency (EPA) has a strict registration process for pesticides. The EPA must separately register each product (which is a combination of an attractive bait and the toxicant or poison that actually kills the ants).

Recently, a toxicant called hydramethylnon has gained EPA approval for a variety of uses and has been found to be relatively effective against ants and much safer than many of its predecessors. Hydramethylnon was used in the late 1980s to eradicate the little fire ant (*Wasmannia auropunctata)* from Santa Fe Island in the Galapagos. So researchers began looking at options for using this pesticide against Argentine ants in the park. Here is how the control program evolved:

Step #1: Conduct a Bait Preference Test

Because the park's infested area is large and most of it is inaccessible by foot, spreading the bait by helicopter is the most feasible approach to broad-scale treatment. This dispersal method requires using a solid, pelletized bait. So researchers conducted a year-long test to determine which baits the ants preferred.

Step #2: Test the Combination of Bait and Toxicant on Small Plots

The most attractive bait was protein-based. So researchers did these tests during the summer when ant populations rise and bait retrieval is highest. During the summer, the ants' need for protein is the greatest.

Most ant-control strategies involve prolonged access to toxic bait. But the hydramethylnon formulated in the bait breaks down in the sunlight in only a few days. Researchers knew that spreading the toxic bait by helicopter over large areas would be an expensive proposition, unlikely to happen more than once a year. So they decided to test the effect of a single broadcast treatment of toxic bait, hoping for eradication, even though it seemed like a long shot.

This test application did not achieve eradication. But it did result in a 97 percent reduction in the numbers of foraging ants.

Step #3: Refine Approach to Focus on Control

Based on their test results, researchers decided that eradication would not be attainable but that controlling the spread of the populations would be possible. They hypothesized that applying the toxic bait along the borders of the ants' range would limit the population's expansion into new territory.

Step #4: Test the Control Hypothesis

In this study, planned for the summer of 1996, they would measure the effect of treating the population borders. They chose two study sites, one in each of the two ant populations.

[See Acetate Figure 5: 1996 Aerial Treatment Plots, p. 52. If you want to review the location of the ant populations and their direction of expansion, see Acetate Figures 1-4, pp. 48-52.]

The plot in the upper population was located at the "crater" floor along the border expanding into the summit basin (the "crater plot"). It was a large plot, covering over 20 hectares. The location and size of this plot were chosen because researchers and resource managers wanted to:

- Try to halt the rapid spread into the "crater" and keep the ants away from a campground located less than 500 meters (1640 feet) from the ant boundary,
- Determine whether a deeper plot is more effective than a narrower plot, and
- Test the future possibility of treating large areas.

Six monitoring sites plus a control site were used to track the reduction and recovery of ants in the "crater" plot. Monitoring sites along the border in both the treated and untreated areas were used to measure the rate of expansion. [See Acetate Figure 6: Upper Population Plot, p. 53.]

The lower population plot (the "frontcountry plot") was also located along an expanding border but was much smaller. It measured 260 meters (853 feet) long and only 120 meters (394 feet) deep. The design of this plot was chosen because:

- Researchers wanted to see if a narrow border treatment would be sufficient to stop movement, and
- It represents a small section of what would potentially be a 120-meter-wide swath encompassing all expanding ant boundaries.

Monitoring transects with bait stations every ten meters (33 feet) were established in the treated plot and in adjacent, untreated shrubland. These were used to measure rates of reinvasion in the treated plot, as well as rates of territory expansion. [See Acetate Figure 7: Lower Population Plot, p. 54.]

In August 1996, the toxic bait was dispersed in these two plots by a helicopter and a bait hopper. The bait hopper was designed and built especially for this purpose.

[See Acetate Figure 8: Post-Treatment Results for the Lower Population Plot and Upper Population Plot, p. 55.]

Study Results

- Ant numbers in both plots dropped off soon after treatment.

- By November, the numbers in the upper plot had jumped back up to 50 percent of their pretreatment levels. As the winter months set in, population levels dropped off (as they do naturally—see the control figures in Figure 8 for comparison). In the upper plot, population levels began recovering from this seasonal trend in June and July of 1997.

- In the lower plot, there was very little recovery by November, and by July (10 1/2 months after treatment), the ant numbers had recovered to only 21 percent of their pretreatment levels.

The Conclusions?

- The smaller, narrower frontcountry plot was more effective in suppressing recovery than the large "crater" plot. Researchers believe this is primarily due to the fact that it is easier for the helicopter pilot to cover narrower areas more thoroughly with the toxic bait.

- There was no expansion of the ants' territory after treatment in either of the plots, while the borders in the untreated control areas expanded significantly.

Stop Right Here!

Students will analyze what happened as a result of this treatment as part of their homework assignment. Use the remainder of the information on this sheet as background for the Class Period Two class discussion.

- The lower population expanded, on average, only one meter (three feet) beyond its pre-treatment range. This expansion is only about 3.5 percent of the mean expansion rate for previous years.

- Expansion on the western portion of the upper population was similar and was only about 4.5 percent that of previous years.

Step #5: Treat All Expanding Borders

Based on these results, researchers decided to treat all expanding borders of both populations in a 120-meter-wide (394-foot-wide) swath to determine if this control strategy would work on a larger scale. In August of 1997, they treated the entire upper population border and the southwest edge of the lower population border.

[See Acetate Figure 9: Population Border Areas Treated During 1997, p. 56.]

They monitored expansion of the ant population at 84 stations along the treated borders. [See Acetate Figure 10: Lower Population Monitoring Sites, p. 57, and Figure 11: Upper Population Monitoring Sites, p. 58.]

Treatment Results

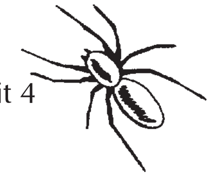
- The mean rate of expansion at these stations one year after treatment was considerably lower than mean rates of expansion calculated from distribution data for previous years. [Acetate Table 1: Comparison of Pre- and Post-Treatment Boundary Expansion, p. 59, shows the difference. Students will have calculated some of these figures in their homework assignment.]

Different Kinds of Research

Here is a little twist that you may want to go into with students. It helps illustrate the difference between experimental and applied research.

During quarterly monitoring of the 84 stations after the aerial treatment, researchers were able to identify areas where the treatment was not working (perhaps due to pilot error or unknown ecological factors). In those small trouble spots, researchers applied the toxic bait again by hand. So, in reality, the method that worked to slow the spread of the ants was aerial treatment of a 120-meter-wide border coupled with periodic hand treatment of small areas.

If this were a purely experimental study, researchers would not have changed the parameters of the study by reapplying toxic bait by hand. However, since the ultimate goal is to achieve a resource management objective (controlling the spread of Argentine ants), the researchers could make adjustments as they went along.



- Expansion on the eastern portion of the upper population was greatest but still only about 25 percent of the 81 meters/year (266 feet/year) calculated for the 1993-1997 time period.

Given these results, researchers and resource managers plan to use the border treatment strategy each year to slow the spread of ants in the park. Their ultimate goal is still to eradicate the Argentine ant in the park. Slowing their spread is a way to buy some time to investigate and develop different approaches to eradication.

Sources

Krushelnycky, P. D., et al, *A Thirty Year Record of Argentine Ant Range Expansion in Haleakala National Park, Maui, Hawaii*, U.S. Geological Survey, Biological Resources Division, Makawao, Hawaiʻi, in preparation.

Loope, Lloyd L., Arthur C. Medeiros, and F. R. Cole, in *Proceedings of the Conference on Science in the National Parks, 1986, Volume 5: Management of Exotic Species in Natural Communities*, L. K. Thomas, Jr., (ed.), The U.S. National Park Service and The George Wright Society, 1988.

VanGelder, Ellen, Personal communication, February and March 2000.

Teacher Version

Designing a Control Strategy That Works: Questions From the Discussion

Based on the class discussion and the information provided below, answer the following questions:

1) Discuss the importance of each of the following characteristics of the Argentine ant to the design of a strategy to control or eradicate the ant:

    a) Argentine ant queens are unable to fly. They mate in the nest where they were born, and if they are leaving to establish a new nest of their own, they walk a short distance away. So Argentine ant populations expand slowly outward. Most other ant species have winged queens that may fly a long distances away from their birth nests to establish a new nest of their own.

    With Argentine ants, it is possible to treat the boundaries of the population to keep it from spreading further. This is because of the “budding” process through which the population expands slowly outward. A new, noncontiguous population will only be established if people transport the ants to a new place.

    b) Like most other ant species, the Argentine ant shares food through “trophallaxis.” In this process, worker ants pass regurgitated food to other workers, the brood (larvae and pupae), and the queens. Highly attractive food gets passed quickly throughout the nest.

    In designing a control program aimed at eradicating ants, it is important that the workers pass on the toxicant to other ants, especially the queen, so the whole colony is poisoned and cannot repopulate itself. Since workers are the first to eat the food (then pass it on to others through trophallaxis) the toxicant needs to be slow acting so workers have a chance to pass it on before they die. Combining a slow-acting toxicant with a highly attractive bait is a key to success.

c) The Argentine ant forms large "unicolonies" in which it is difficult to distinguish among nests. In the park, each of the two ant populations is essentially one big colony. The Argentine ants from one nest do not defend their territory against Argentine ants from another nest. In fact, worker ants move readily from nest to nest, helping out wherever they are needed.

There is no way to control the Argentine ant population one nest at a time.

2) In the summer of 1996, researchers conducted a study in which they measured the effect of treating segments of the ant population borders with toxic bait. One of the two study areas they chose was located on the "crater" floor, on the rapidly expanding eastern edge of the ant population. One reason the researchers cited for choosing this site was that they wanted to keep the ants away from the Hōlua campground and cabin, less than 500 meters (1640 feet) away from the boundary of the ant population.

Drawing on what you have learned about the characteristics of Argentine ants, explain why researchers would be concerned about keeping the ants away from the campground and cabin area.

The main point here is that Argentine ants disperse over long distances only through human contact. If the ants spread to the campground and cabin area, which are both heavily used by people, there is a much greater likelihood that ants will be transported to uninfested areas within or outside of the "crater."

3) In August 1997, a helicopter was used to apply toxic bait to the expanding border areas of both Argentine ant populations. The entire upper population border was treated, as well as the southwest edge of the lower population border. Researchers monitored the expansion of the ant population at 84 stations along these borders.

They divided the upper study area and monitoring stations into two portions because they have different historic rates of expansion:

- The “frontcountry” or western part, where the historic rate of expansion is slower.
- The “crater” or eastern part, where the population has historically spread more rapidly.

One year after the treatment, researchers gathered the data contained in Table #1: August 1998 Ant Border Monitoring Results, August 1997-August 1998 (Student Page 5, p. 64). Use the data provided to answer the following questions, writing the formulas and each step of your calculations in the spaces below the questions. Round to the nearest one-tenth:

Mean boundary expansion = Total expansion (T)/Number of stations recording data (n)

a) What is the mean boundary expansion for the lower population?

MBE = T/n
MBE = 38/37
MBE = 1.0 m/yr

b) What is the mean boundary expansion for the frontcountry segment of the upper population?

MBE = T/n
MBE = 23/21
MBE = 1.1 m/yr

c) What is the mean boundary expansion for the “crater” segment of the upper population?

MBE = T/n
MBE = 482/23 (although there are 26 stations, 3 had no data)
MBE = 21.0 m/yr

d) What is the mean boundary expansion for the entire upper population?

MBE = T/n
MBE = 505/44
MBE = 11.5 m/yr

4) Fill in the table below, using the results of your calculations. Then answer the question that follows.

	Mean boundary expansion one year after treatment (m/yr)		**Mean boundary expansion in previous years (m/yr)***
Lower population	__1.0___	(n = __37__)	29 (1982-97 data)
Upper population	__11.5__	(n = __44__)	
Frontcountry segment	__1.1___	(n = __21__)	24 (1993-97 data)
"Crater" segment	__21.0__	(n = __23__)	81 (1993-97 data)

Question

Based on the data in the table above, would you say that the effort to control the spread of the Argentine ant is working or not working? Explain your reasoning.

Park researchers and resource managers believe the answer is yes, the control effort is working. Students may support their answer in many ways; perhaps the most obvious is to compare the rates of spread pre- and post-treatment. Here are some points of comparison:

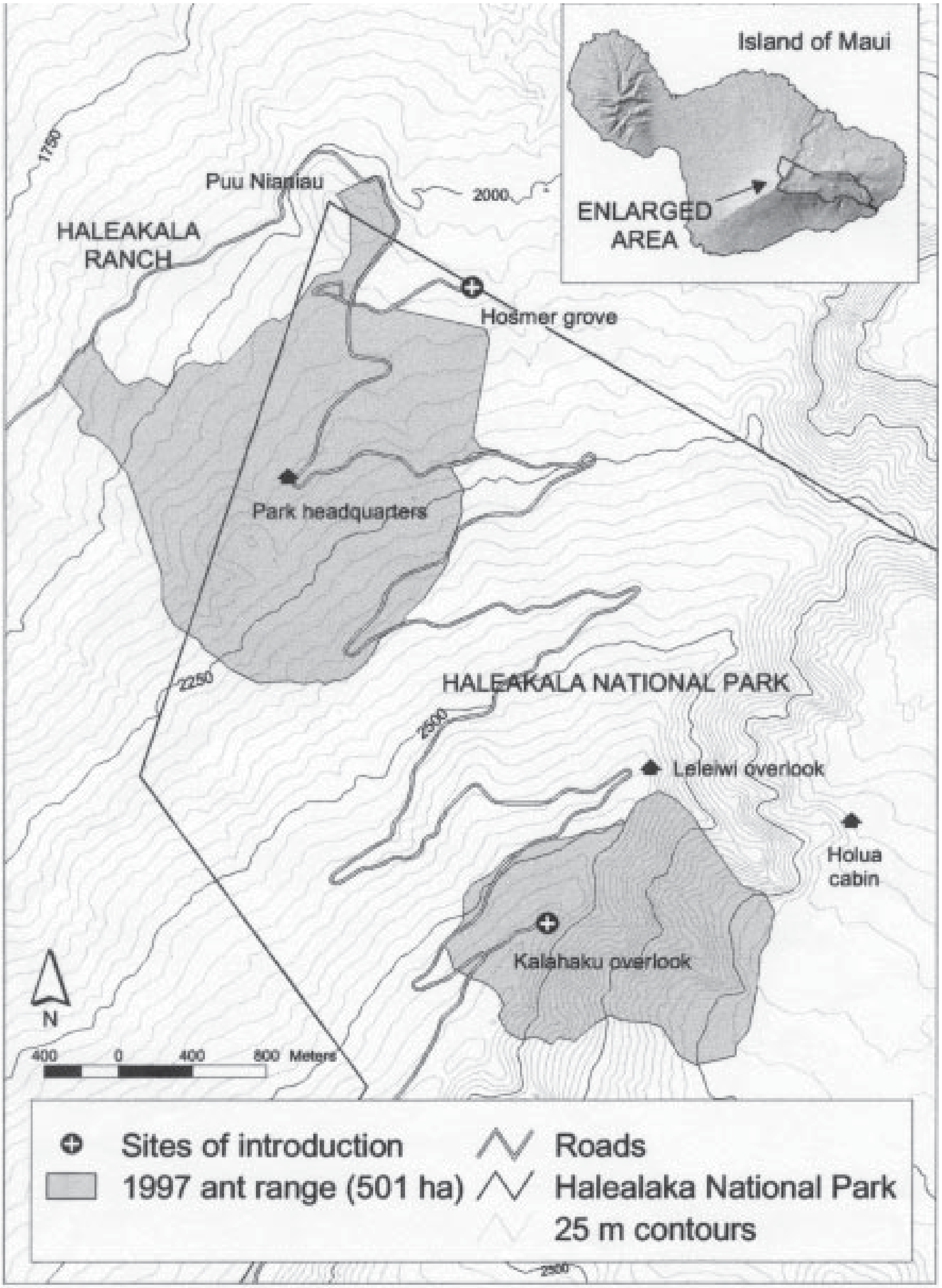
• The mean rate of expansion at these stations one year after treatment was considerably lower than mean rates of expansion calculated from distribution data for previous years. [Acetate Table 1: Comparison of Pre- and Post- Treatment Boundary Expansion shows the difference. Students will have calculated some of these figures in their homework assignment.]

• The lower population expanded, on average, only one meter beyond its pretreatment range. This expansion is only about 3.5 percent of the mean expansion rate for previous years.

• Expansion on the western portion of the upper population was similar, and was only about 4.5 percent that of previous years.

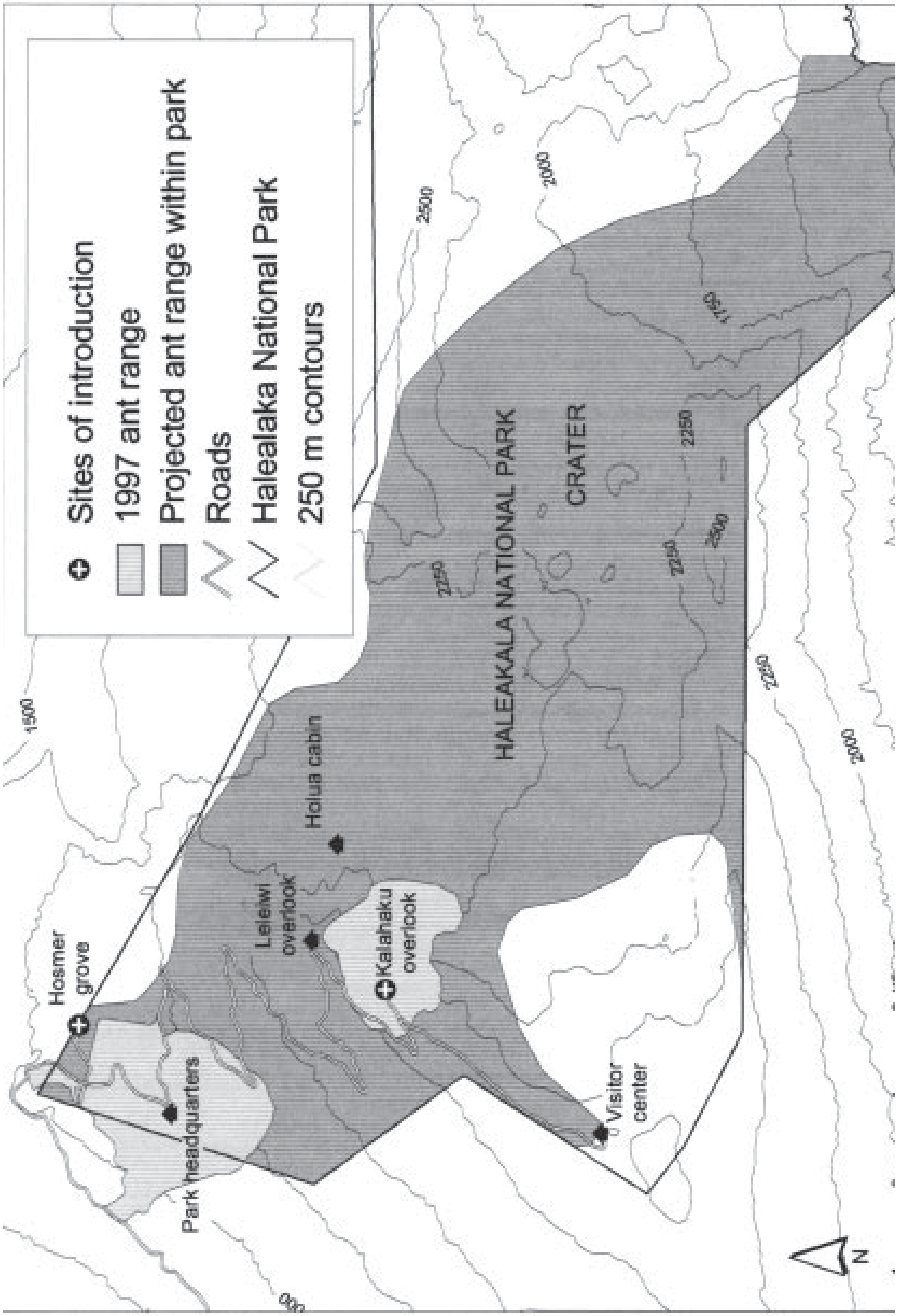
• Expansion on the eastern portion of the upper population was greatest, but still only about 25 percent of the 81 meters/year calculated for the 1993-1997 time period.

Figure 1: Argentine Ant Populations in Haleakalā National Park, 1997



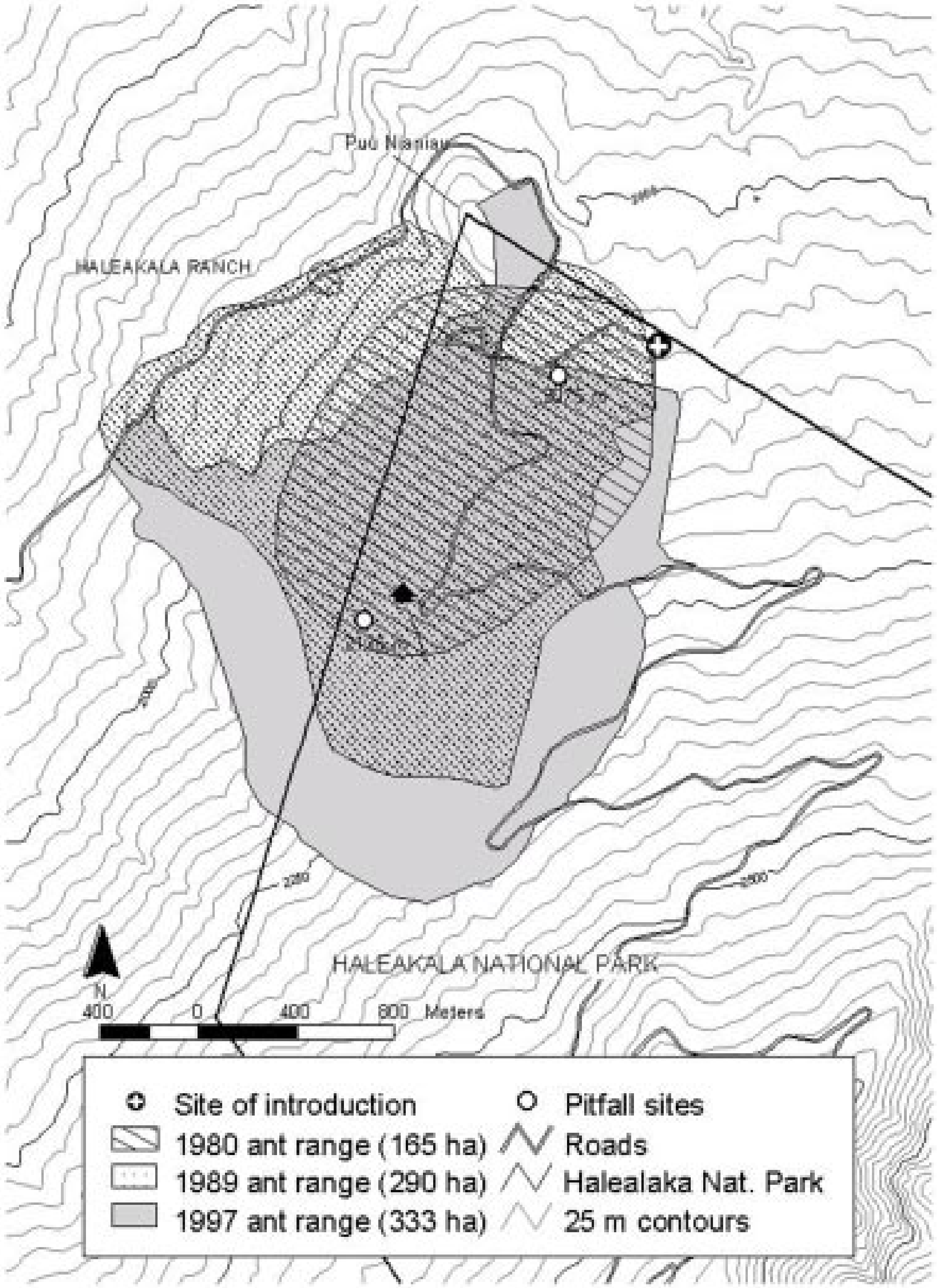
Map: Krushelnycky, Paul, S. Joe, Lloyd Loope, and Arthur Medieros, unpublished data.

Figure 2: Potential Range of the Argentine Ant in Haleakalā National Park



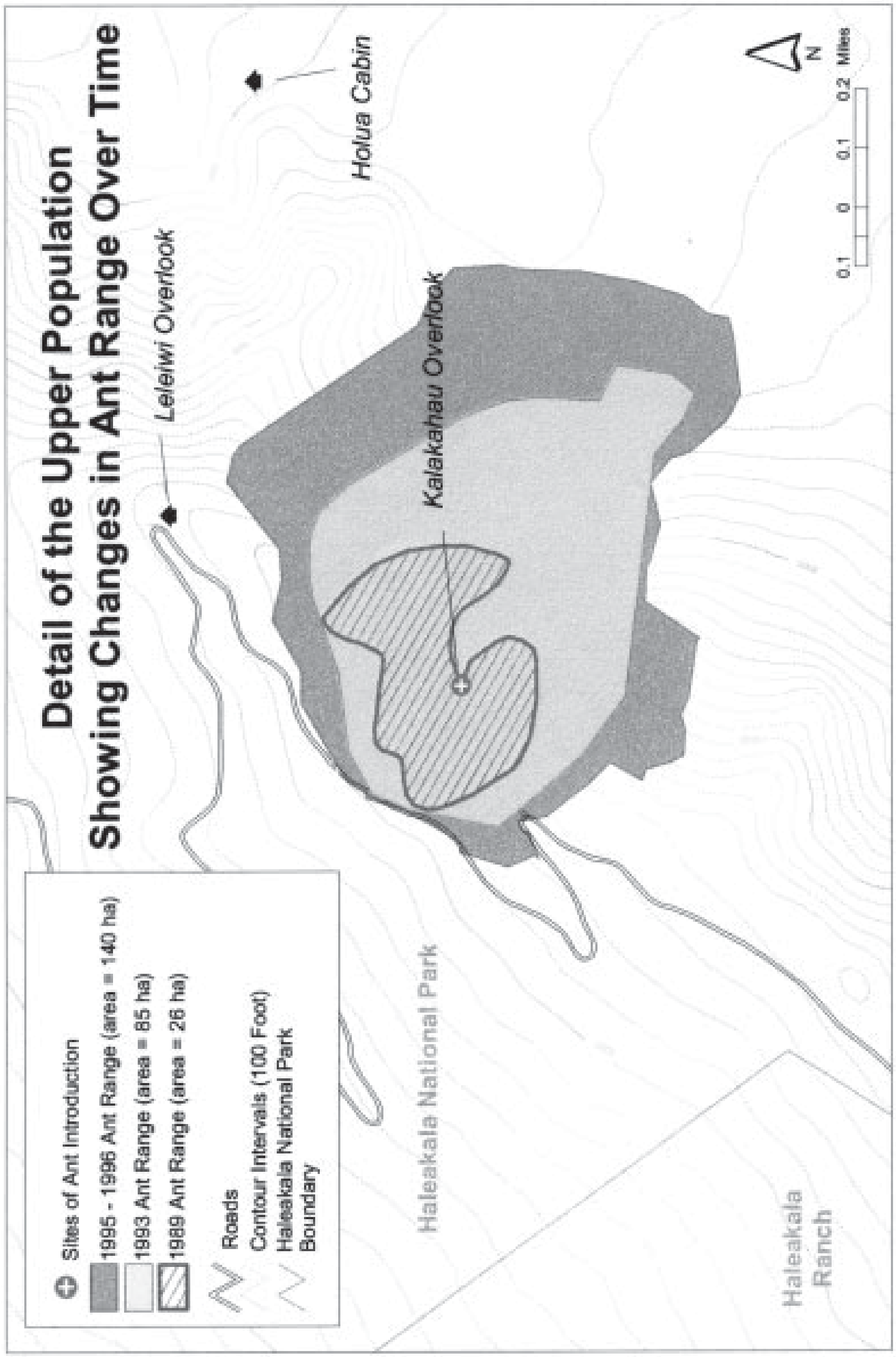
Map: Krushelnycky, Paul, S. Joe, Lloyd Loope, and Arthur Medieros, unpublished data.

Figure 3: Spread of the Lower Population (1997 range projected)



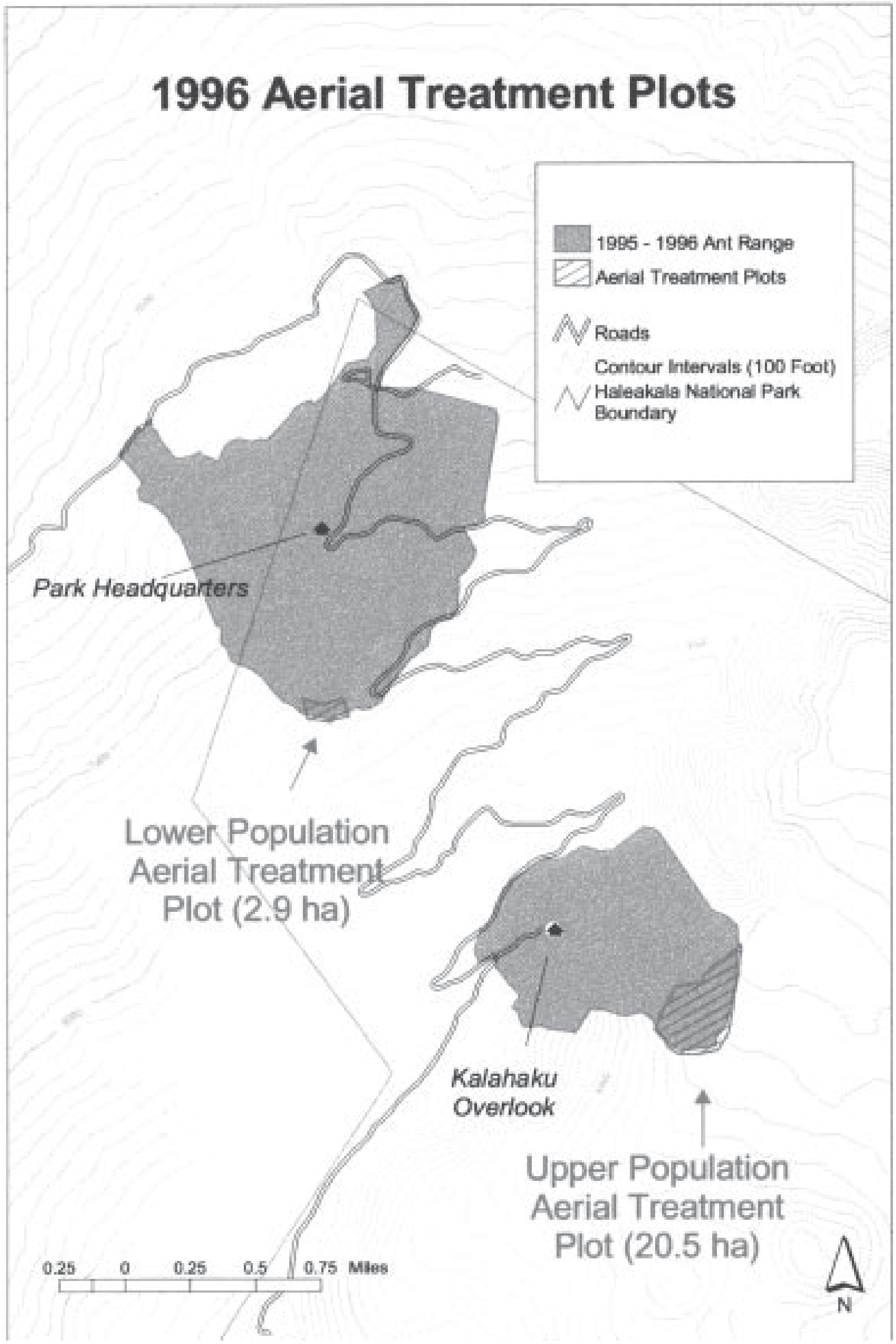
Map: Krushelnycky, Paul, S. Joe, Lloyd Loope, and Arthur Medieros, unpublished data.

Figure 4: Spread of the Upper Population



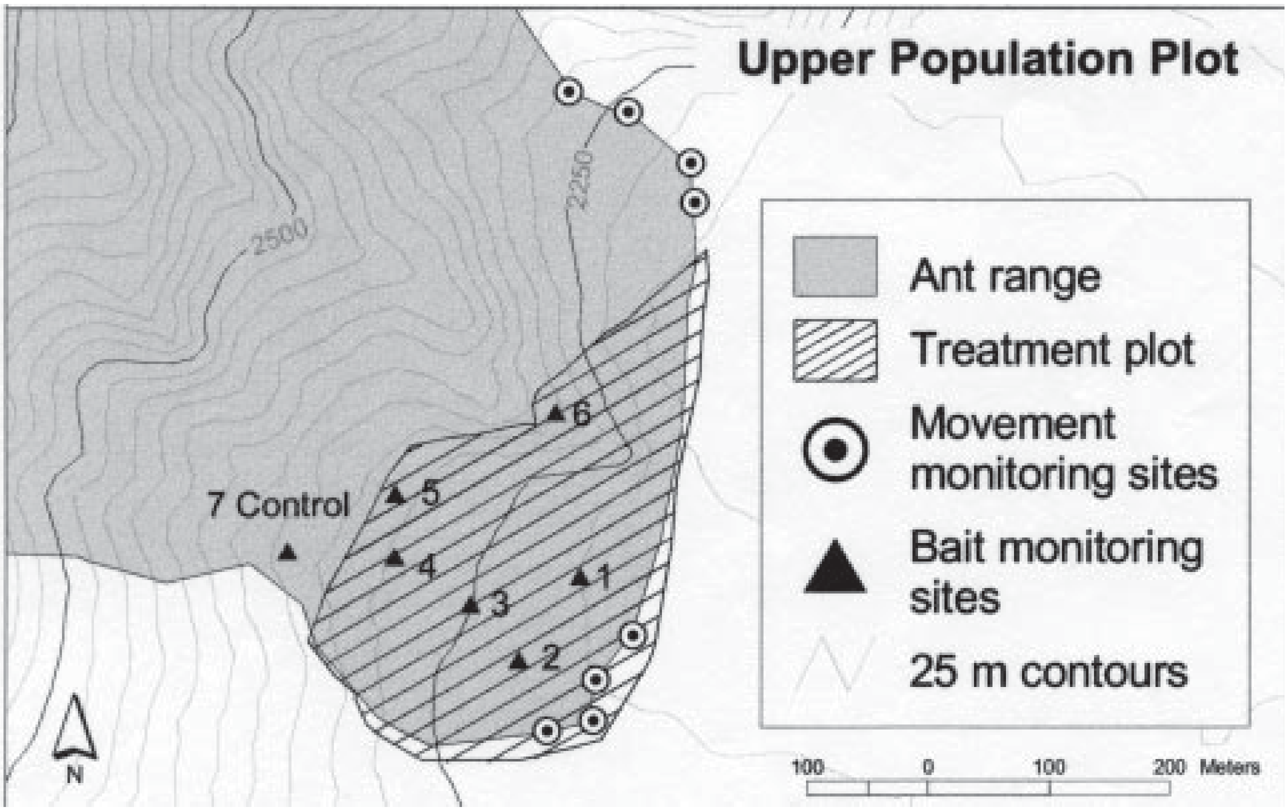
Map: Krushelnycky, Paul, S. Joe, Lloyd Loope, and Arthur Medieros, unpublished data.

Figure 5: 1996 Aerial Treatment Plots



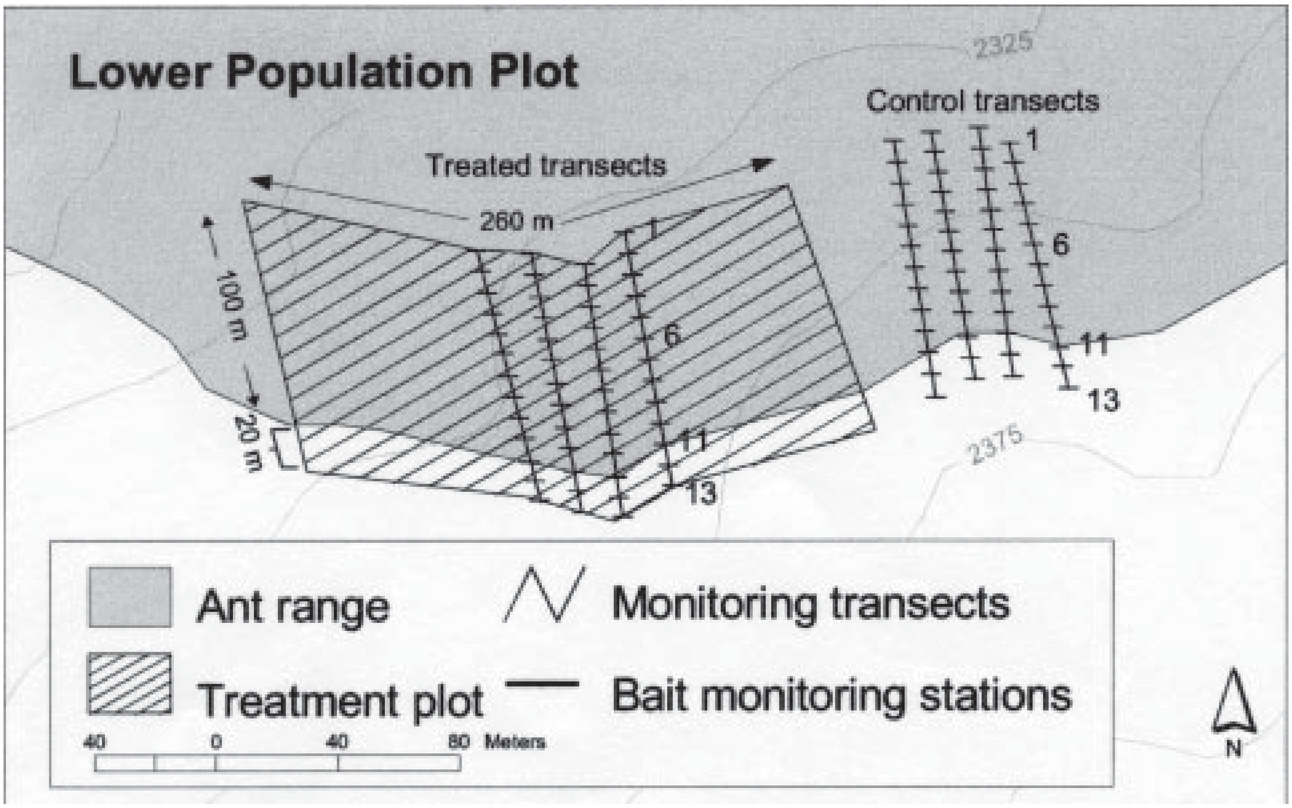
Map: Krushelnycky, Paul, S. Joe, Lloyd Loope, and Arthur Medieros, unpublished data.

Figure 6: Upper Population Plot



Map: Krushelnycky, Paul, S. Joe, Lloyd Loope, and Arthur Medieros, unpublished data.

Figure 7: Lower Population Plot



Map: Krushelnycky, Paul, S. Joe, Lloyd Loope, and Arthur Medieros, unpublished data.

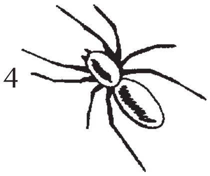
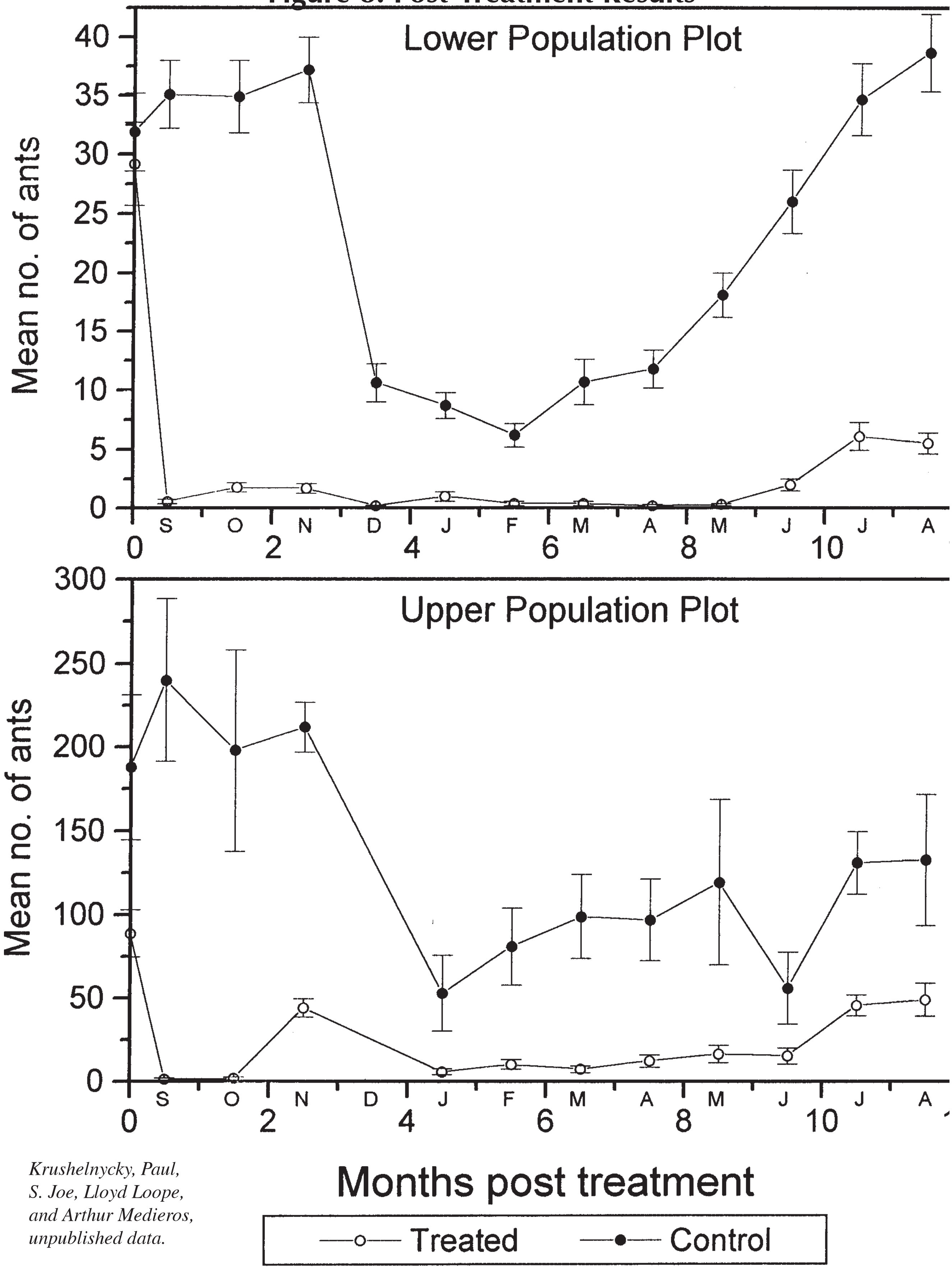
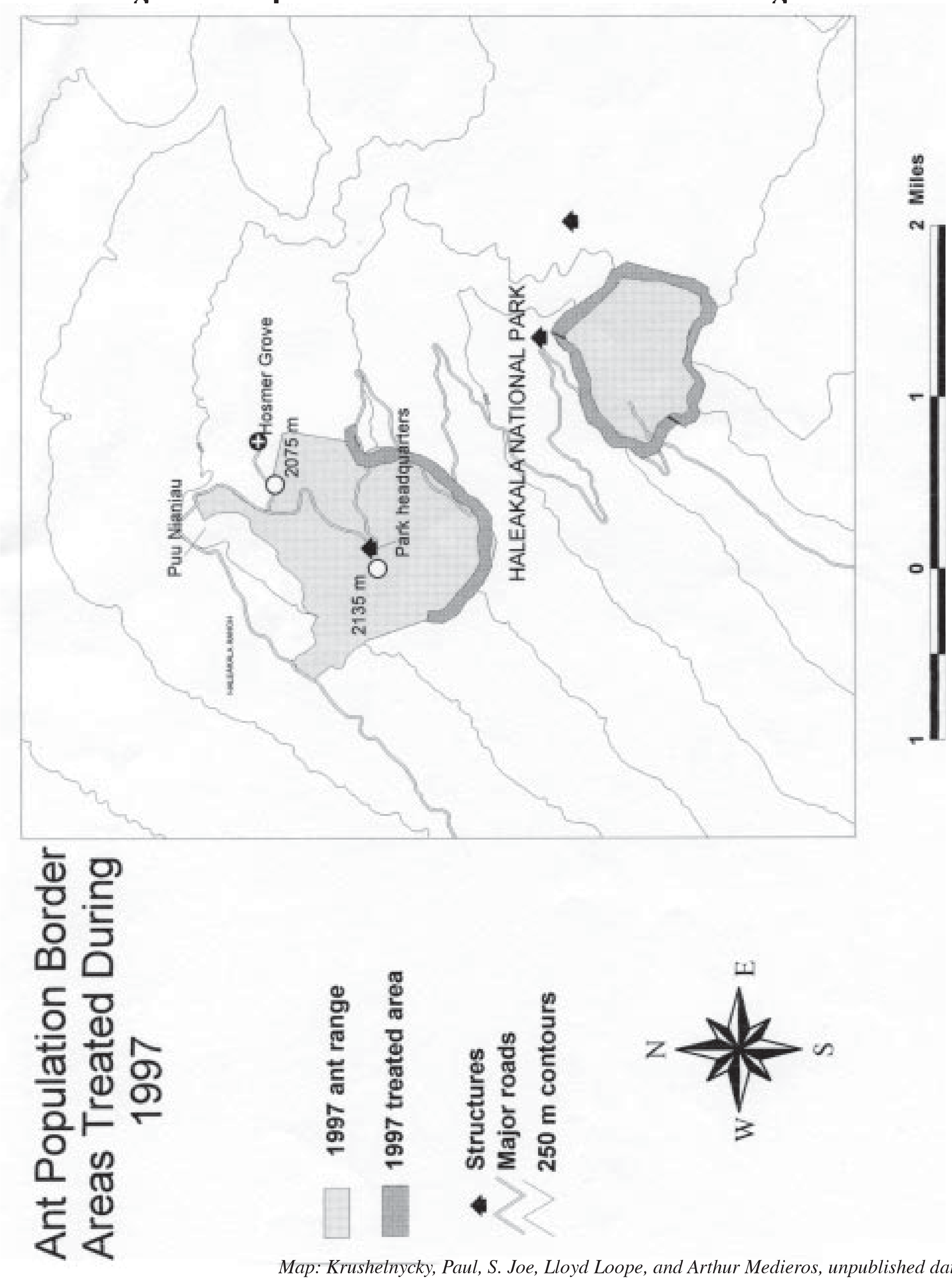


Figure 8: Post-Treatment Results



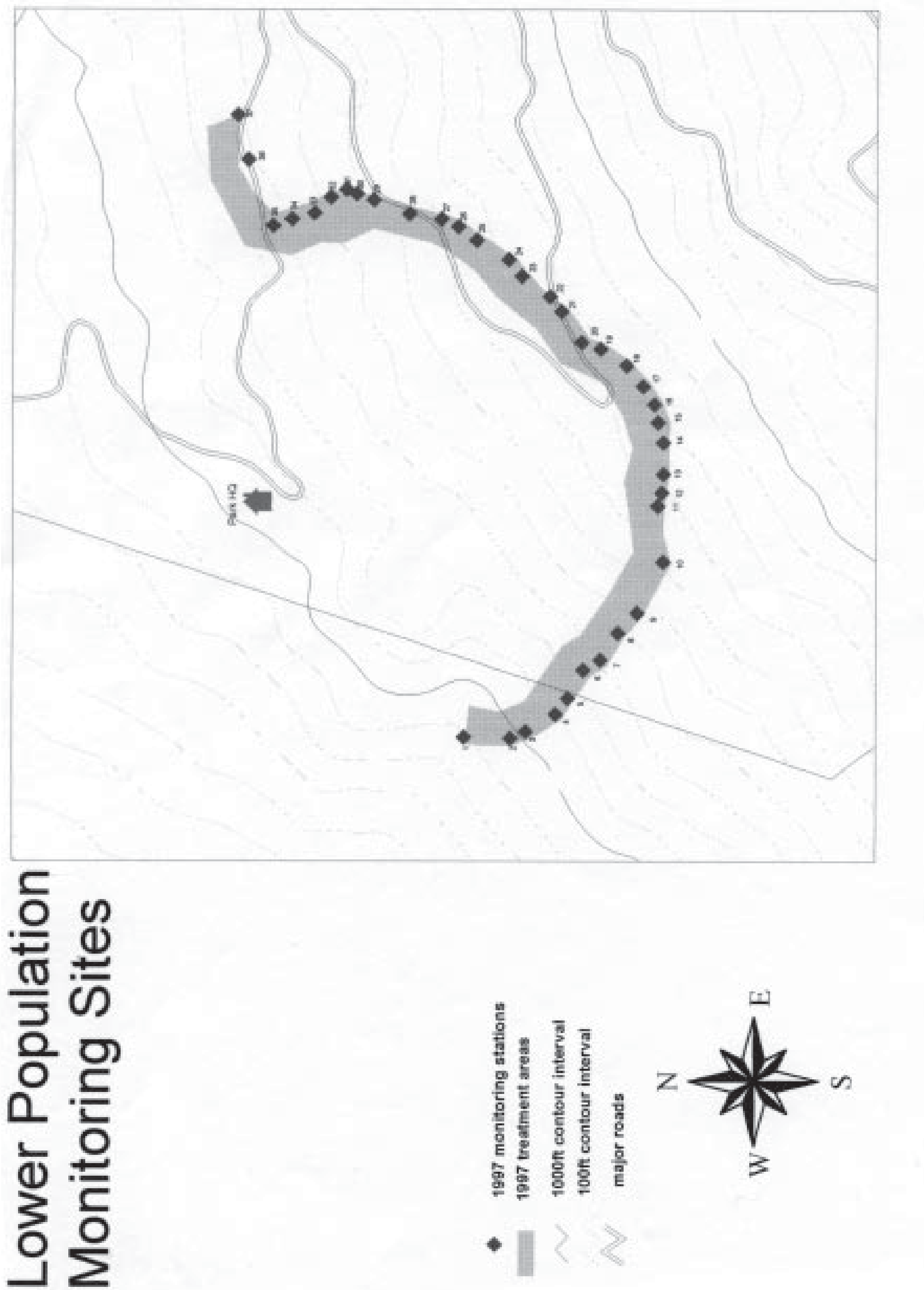
Krushelnycky, Paul, S. Joe, Lloyd Loope, and Arthur Medieros, unpublished data.

Figure 9: Population Border Areas Treated During 1997



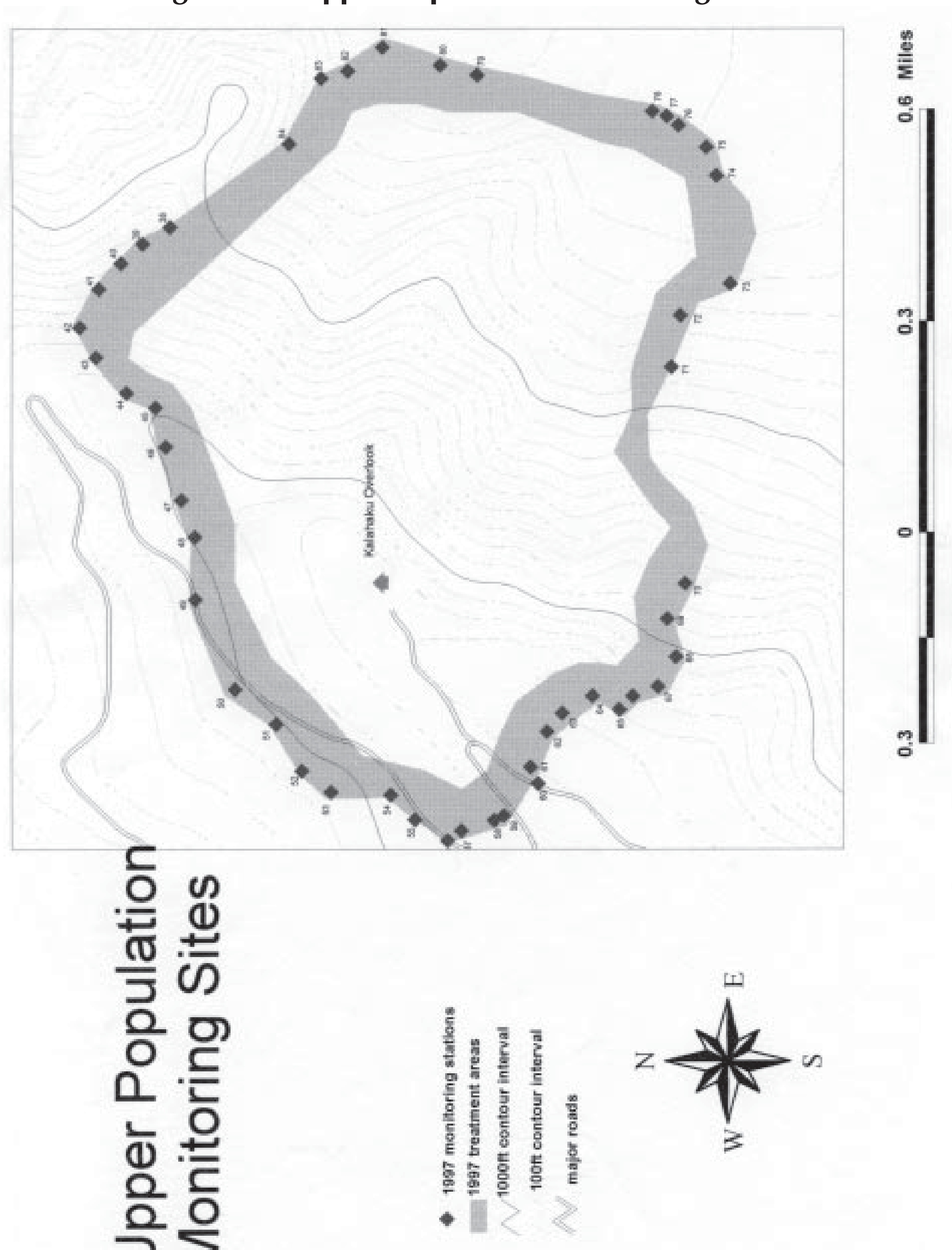
Map: Krushelnycky, Paul, S. Joe, Lloyd Loope, and Arthur Medieros, unpublished data.

Figure 10: Lower Population Monitoring Sites



Map: Krushelnycky, Paul, S. Joe, Lloyd Loope, and Arthur Medieros, unpublished data.

Figure 11: Upper Population Monitoring Sites



Map: Krushelnycky, Paul, S. Joe, Lloyd Loope, and Arthur Medieros, unpublished data.

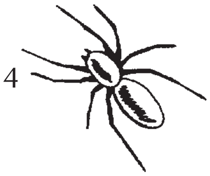


Table 1: Comparison of Pre- and Post-Treatment Boundary Expansion

	Mean boundary expansion one year after treatment (m/yr)		Mean boundary expansion in previous years (m/yr)
Lower population	__1.0___	(n = __37__)	29 (1982-97 data)
Upper population	__11.5__	(n = __44__)	
Frontcountry segment	__1.1___	(n = __21__)	24 (1993-97 data)
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Krushelnycky, Paul, S. Joe, Lloyd Loope, and Arthur Medieros, unpublished data.