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**Households' Experiences with the Red Imported Fire Ant in
South Carolina***

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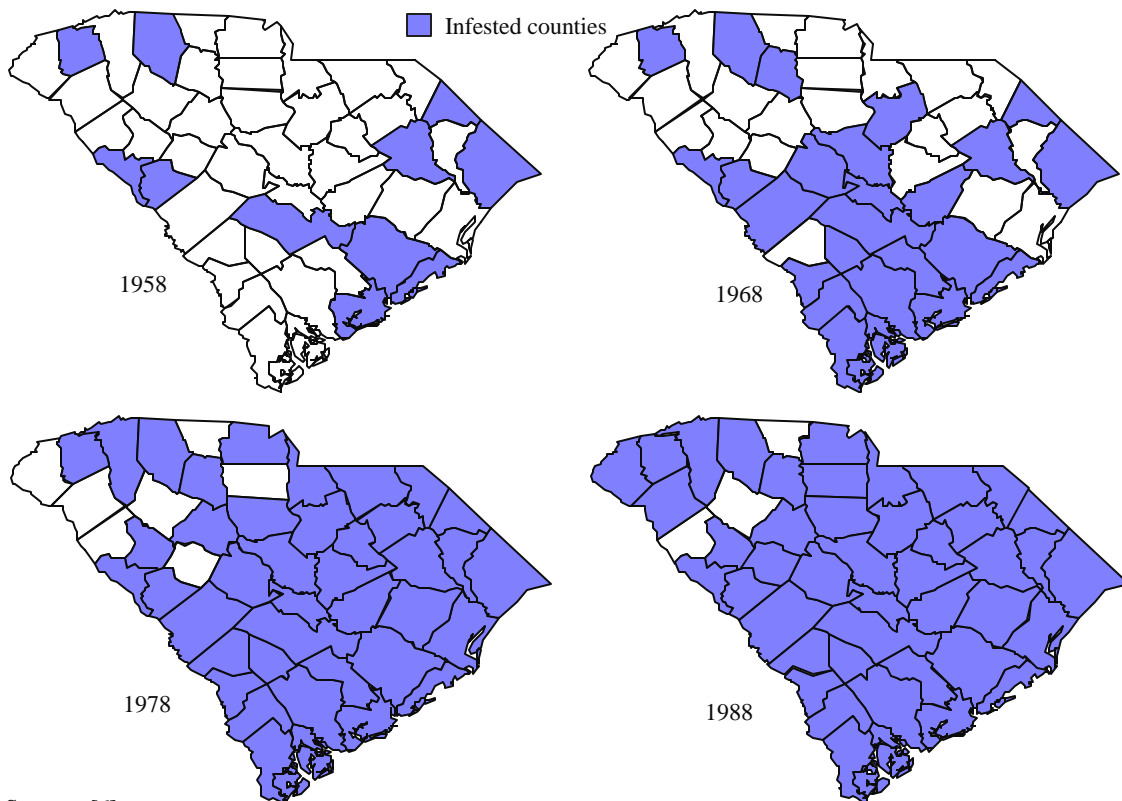
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Introduction

The red imported fire ant (*Solenopsis invicta*), abbreviated as RIFA hereafter, is believed to have been brought by accident to Mobile, Alabama in the 1930s via ship ballast from South America. The RIFA was first reported in Charleston and Orangeburg Counties in South Carolina in 1952 [7].¹ The RIFA had spread to ten SC counties by 1958 and to all but three counties in the state by 1988 (Figure 1). The RIFA is now reported in all of SC's 46 counties.

Figure 1. South Carolina counties with RIFA infestations



Source: [6]

The RIFA has had adverse impacts on the environments it has infested. In natural environments, the young of ground-nesting insects, reptiles, birds, and mammals are subject to RIFA predation. In agriculture, the RIFA damages crops and livestock. The RIFA poses a health threat to humans, as it is aggressive and has a venomous sting. Based on a survey of SC physicians, Caldwell et al. [2] estimated 660,000 cases of RIFA stings in the state in 1998, a rate of

¹ Numbers in brackets refer to the sources listed in the **References** section.

3.8 per 10,000 population. Of these, an estimated 33,000 sought medical treatment and there were two reported deaths. To avoid RIFA stings, people in infested areas may have to forgo outdoor leisure activities (e.g., gardening and playing in the yard). The RIFA also causes property damage. Tunneling activity by the RIFA can undermine the foundations of hardscape (e.g., sidewalks and driveways) and buildings. The RIFA readily infests electrical devices (e.g., water pumps and kitchen appliances) and can damage those devices. Households and businesses incur costs in treating and preventing RIFA infestations and in repairing RIFA damage.

A survey conducted between 1983 and 1985 by Lemke and Kissam [5] gathered information on households' experiences with the RIFA in SC. The respondents were visitors to booths providing RIFA-related information at public gatherings in SC. The results of that survey might not reflect current RIFA problems in the state for several reasons. First, the survey was conducted about 15 years ago, and the RIFA has since spread throughout the state. Second, about 60% of the survey respondents were from three counties (Horry, Lexington, and Richland). The RIFA experiences of these respondents might not reflect the experiences of individuals in other parts of the state. Finally, individuals with RIFA-related problems would have been more likely to visit the information booths than individuals without those problems, so the results of the survey might overstate the extent of RIFA problems for the general population.

To learn more about the current impacts of the RIFA, a random sample of SC households was contacted via telephone between November 1998 and January 1999 using Clemson University's Computer-Assisted Telephone Interview Laboratory, Department of Sociology. The survey relied on an instrument developed for a study of households' experiences with the RIFA in Texas [4]. The authors modified the instrument to meet the goals of the current research.

Out of 861 household representatives contacted, 809 (94%) agreed to participate in the survey. Participants were asked about their experiences with the RIFA and the expenses that they incurred in RIFA control and remediation. To the authors' knowledge, this is the first state-wide survey based on random sampling techniques to determine households' experiences with the RIFA in SC or in any other state.² This report summarizes the survey results.

² Several previous studies have surveyed households in other states regarding their experiences with the RIFA, but the sampling procedures used in those studies limit the extent to which the survey results can be generalized. Diffie et al. [3] surveyed individuals visiting a RIFA information booth at an agricultural exposition in Georgia. As discussed earlier, individuals with RIFA problems would be more likely to visit a RIFA booth than individuals without RIFA problems. Thompson and Jones [8] and Thompson et al. [9] surveyed households in three counties in southern Arkansas, using Cooperative Extension Service mailing lists. Whether the households included in the Arkansas survey constitute a random sample is unknown. The

The Respondents

At least two residents from each county in South Carolina took part in the survey. Charleston County had the largest number of respondents with 60, followed by Greenville and Richland Counties with 56 respondents each. As discussed in more detail below, the spatial distribution of the sampled households corresponds to the spatial distribution of the state's households. Selected characteristics of the respondent households follow:

- 61.1% of the respondents were female,
- 46.7% of the respondents indicated the head of the household was male,
- 68.7% of the respondents classified themselves as married,
- the mean age of the household heads was 53.3 years (standard error = SE = 0.6 years).
- the mean number of household members was 2.8 (SE = 0.1 members),
- 81.3% of the respondents classified themselves as white, 17.2% as black, and 1.5% as another race,
- 18.0% of the respondents reported an annual household income of less than \$20,000, 44.9% reported an annual household income between \$20,000 and \$50,000, and 37.1% reported an annual household income greater than \$50,000,
- the highest level of educational attainment of the household heads was: high school diploma or less, 35.1%; some college or technical school, 19.2%; college or technical school diploma, 32.8%, and graduate or professional degree, 12.8%,
- 67.8% of the respondents said they were native South Carolinians,
- 84.8% of the respondent households owned their residences,
- 91.9% of the respondents lived in detached dwellings (houses or mobile homes), 3.4% lived in apartment buildings, and 3.4% lived in townhouses or condominiums, and
- 6.1% of the respondent households had no residential lots, 18.0% had residential lots of less than $\frac{1}{2}$ acre, 37.2% had residential lots between $\frac{1}{2}$ and 1 acre, and 38.7% had residential lots larger than 1 acre.

Based on data for the SC population from the 1990 Census [10], middle and high income, white and married households who live in their own homes are over-represented in the sample. On average, the heads of the respondent households are older than household heads in the SC population, and they have a higher level of educational attainment than adults in the population.

households may have been on the mailing lists because of their contacts with extension personnel concerning RIFA problems .

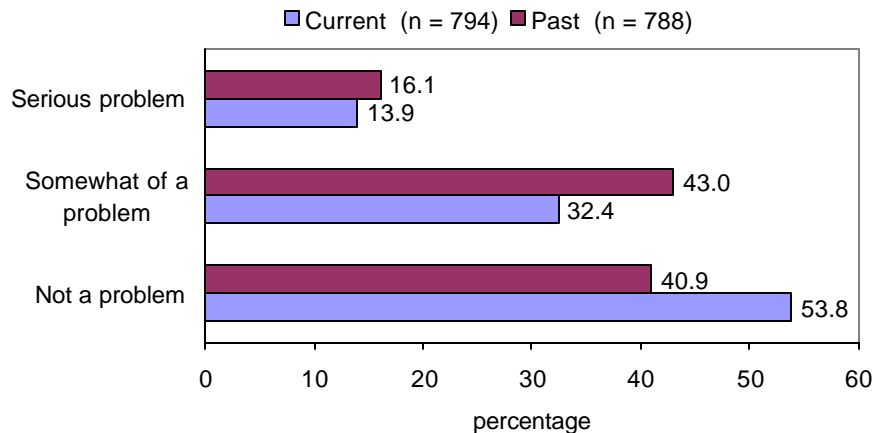
The characteristics of the sample households are typical for telephone survey research. Women are more likely to answer the phone at home and are more likely to agree to participate in surveys than are men. Whites tend to be more comfortable than other races in participating in telephone survey research. Also, participation rates for telephone surveys tend to be higher for individuals with higher levels of education and income [1].

Findings

RIFA Problems

Of the individuals surveyed, only 10.3% indicated they had never heard of the RIFA and only 16.4% stated they had never seen the RIFA. The respondents were asked whether the RIFA was a current problem in their residences or yards and whether the RIFA had been a problem in those areas in the past. Among those responding, 46.3% indicated that the RIFA was currently either a serious problem or somewhat of a problem, and 59.1% indicated that the RIFA had been either a serious problem or somewhat of a problem in the past (Figure 2). The percentage of respondents perceiving the RIFA to be a serious problem is much lower in this survey than in the Lemke and Kissam [5] survey, where 87% of the respondents indicated the RIFA was a serious problem on their property.

Figure 2. Experiences with the RIFA in residences and yards



Respondents who indicated that the RIFA was either a current or previous problem were asked to indicate the time(s) of the year when they had RIFA problems; the average number of RIFA mounds in their yards; the RIFA problem areas of their residences and yards; and which activities in their yards, if any, had to be curtailed due to the RIFA. The respondents indicated the RIFA problems were more prevalent in the spring and summer months than in the fall and winter months (Figure 3). A majority of respondents (52.6%) with RIFA problems had six or

more mounds in their yards, and 5.3% of the respondents had more than 30 mounds (Figure 4). The major RIFA problem areas identified by the respondents (Figure 5) were landscapes, play areas for children, gardens, and hardscapes. About 33% of the respondents with RIFA problems indicated that their families' outdoor activities had been restricted due to the RIFA. Children playing in the yard was the outdoor activity most frequently reported as restricted (Figure 6).

Figure 3. Time of year the RIFA is a problem (n = 513)

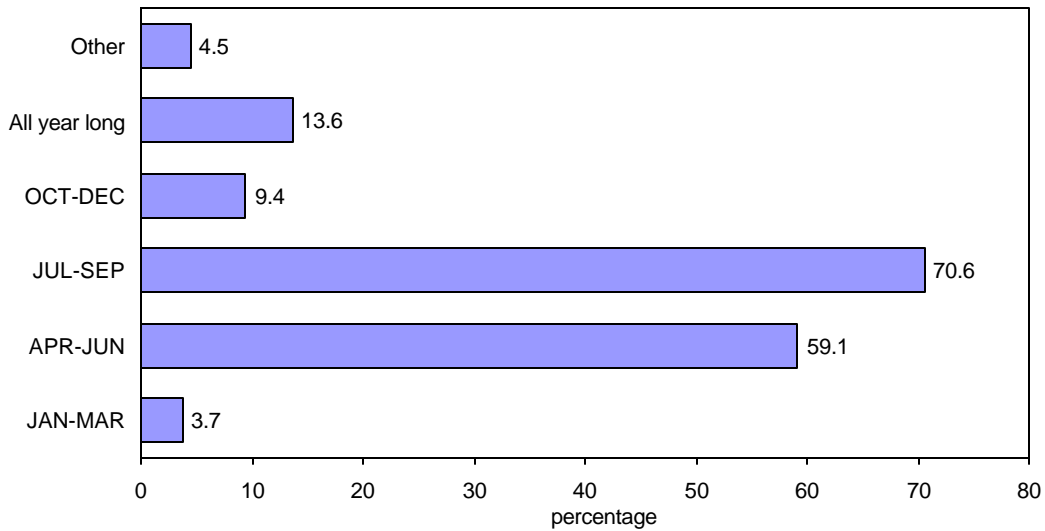


Figure 4. Average number of RIFA mounds in yards (n = 474)

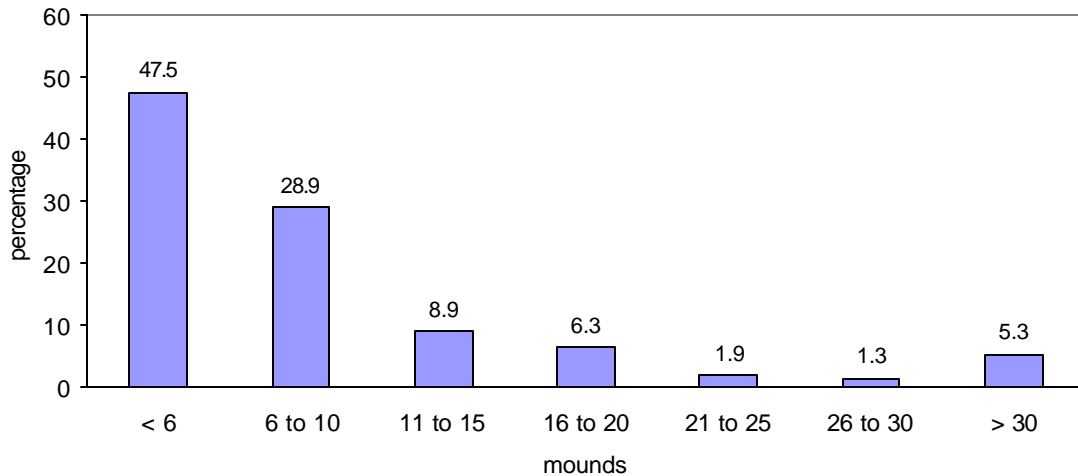


Figure 5. RIFA problem areas (n = 809)

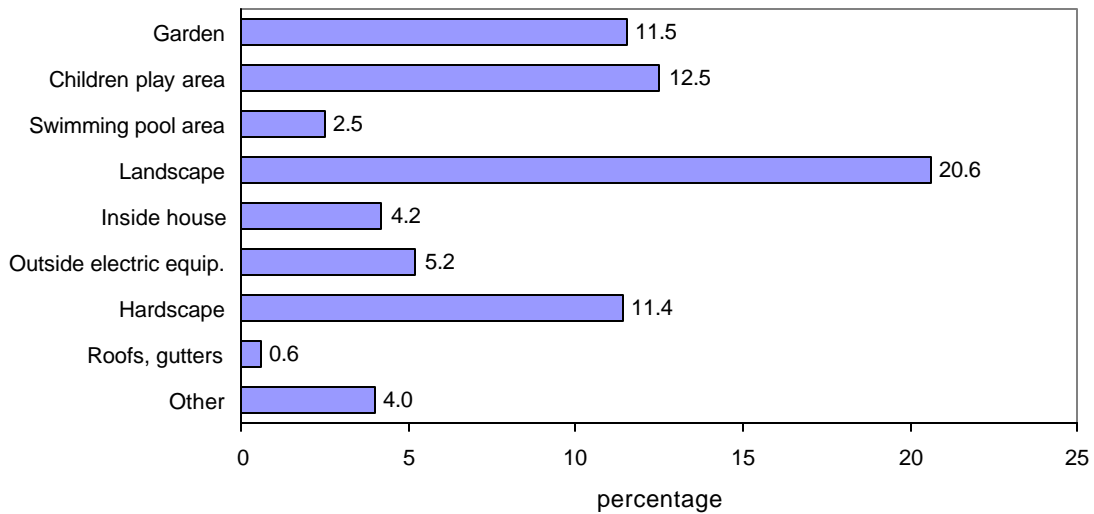
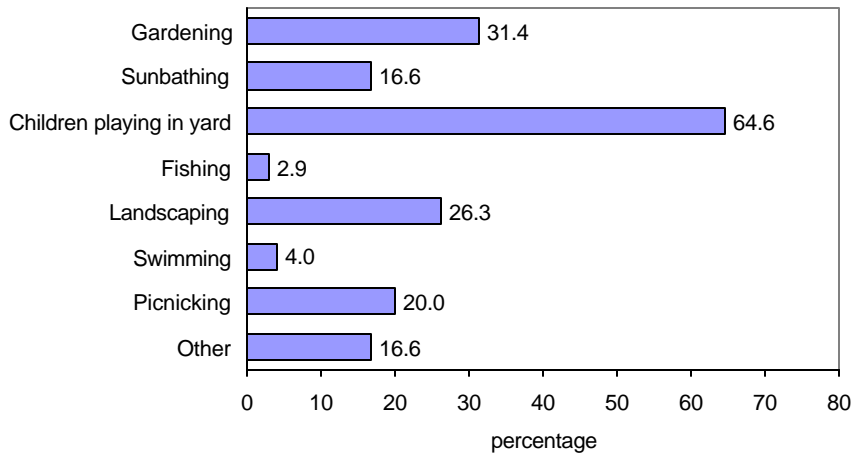


Figure 6. Activities restricted due to the RIFA (n = 175)



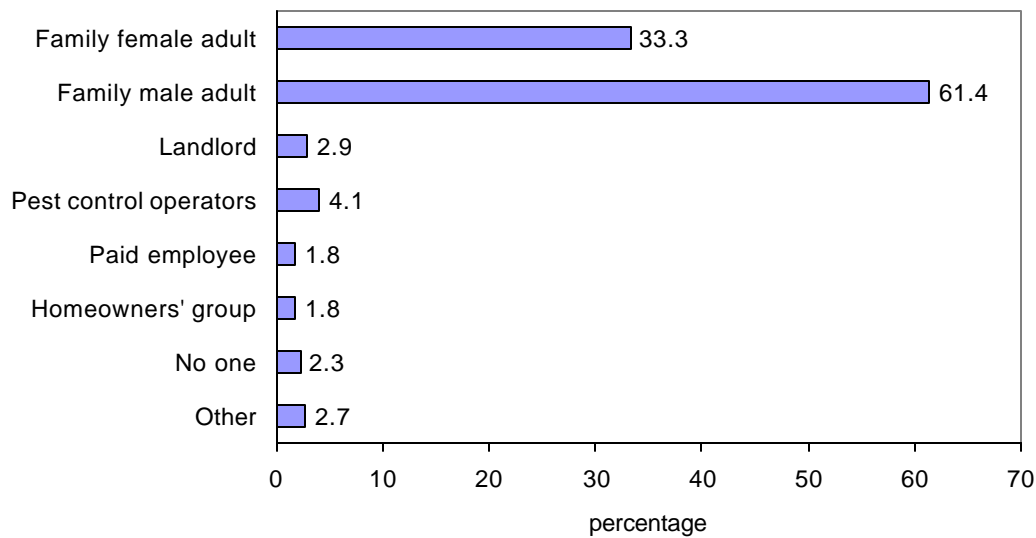
Thirty-seven respondents (4.6% of the total sample) indicated that children in their households had required medical attention due to RIFA stings, and 46 respondents (5.8% of the total sample) reported that adults in their households had required medical attention due to those stings. Twenty-two respondents (2.7% of the total sample) had pets that required veterinary attention due to RIFA stings.

RIFA Control

The respondents who indicated that they had RIFA problems (either currently or in the past) were asked a series of questions about their efforts to control the RIFA. An adult male

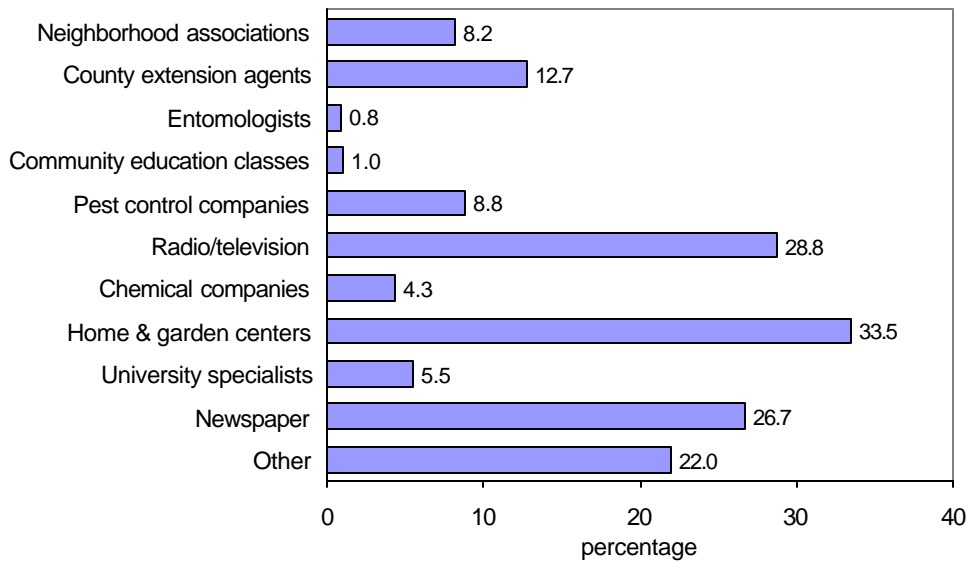
family member was identified by a majority of the respondents as the person generally responsible for RIFA control (Figure 7). The mean time spent by household members in controlling the RIFA and repairing RIFA damage was 7.99 hours per year (SE = 1.23 hours per year). Less than 5% of the respondent households relied on professional pest control companies for RIFA control responsibilities.

Figure 7. Person(s) responsible for RIFA control (n = 513)



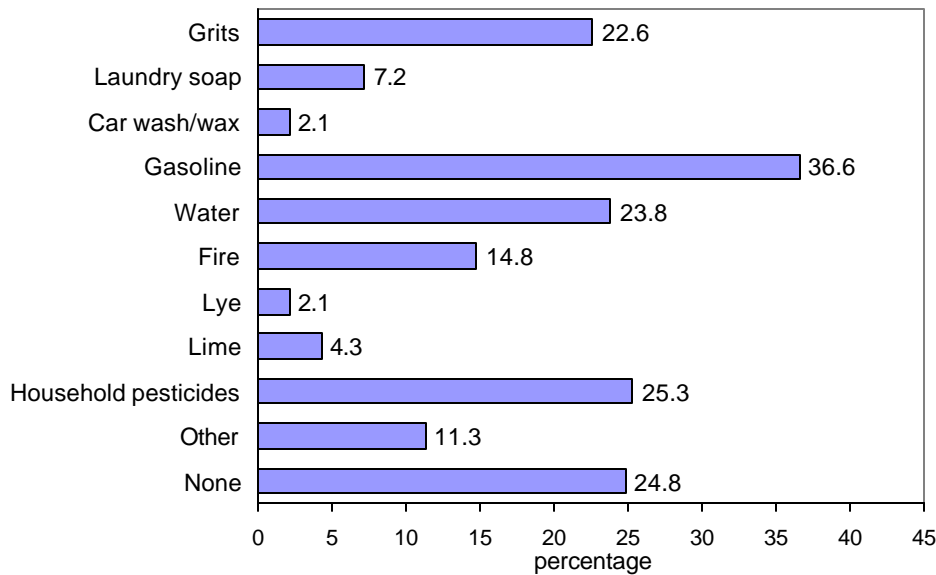
Home and garden centers, radio and television, and newspapers were identified as the leading sources of RIFA information (Figure 8). Fewer than 20% of the respondents identified county extension agents and university specialists as information sources. However, county extension and university personnel provide much of the RIFA information conveyed by television, radio, and newspapers.

Figure 8. Sources of information about the RIFA (n = 513)



Among respondents who had RIFA problems, more than 75% had tried one or more "home remedies" in their attempts to control the RIFA (Figure 9). More than one third of the respondents had used gasoline on RIFA mounds, a practice that is potentially damaging to the environment. Whether the widespread use of these home remedies is due to the cost of recommended control practices and/or perceptions that the recommended control practices are not effective is not known.

Figure 9. Home remedies tried by respondents (n = 513)



RIFA-Related Expenses

The respondents were asked to list the cash expenses they incur in an average year for RIFA control and remediation. The expenditures were grouped into the following categories:

- treatment expenses including materials (e.g., insecticide mound treatments, baits, and home remedies), equipment (e.g., sprayers, spreaders, and injection equipment), supplies (protective clothing, gloves, and repellent sprays), and professional services (e.g., lawn maintenance and pest control companies), TREAT;
- repair expenses for electrical equipment (e.g., well pumps, appliances, air conditioners, and televisions), ELECT;
- other repair expenses (e.g., gardens, landscape, sidewalks, driveways, roofs, and gutters), OTHER;
- medical treatment expenses, MED; and
- veterinary treatment expenses for household pets, VET.

Some survey respondents indicated that they had incurred cash expenses in RIFA control and remediation, but were not able to estimate dollar expense amounts. To provide a conservative estimate of RIFA-related cash expenses, the missing cash expense amounts were set to zero. The RIFA-related expenses were calculated for each household using the formula

$$\text{EXPENSE}_i = \text{TREAT}_i + \text{REPAIR}_i + \text{OTHER}_i + \text{MED}_i + \text{VET}_i,$$

where i indexes households.

Table 1 summarizes the RIFA-related expenses by region of the state (Figure 10). As mentioned earlier, there is a close correspondence between the regional distribution of the sample households and the estimated regional distribution of households for 1996 from the 1990 Census [10]. The North West region is the only region in the state in which fewer than 50% of the sampled households had expenses associated with RIFA control and remediation. The RIFA has spread throughout the North West region only in the past few years, so these results are not surprising. Among the other regions, the West Central had the highest percentage of sampled households reporting cash expenses (71.2%) due to the RIFA. Statewide, 51.9% (SE = 1.8%) of the sampled households reported cash expenses and/or household time for RIFA control and remediation.

The mean RIFA-related expenditures among households reporting such expenditures do not differ significantly across the five regions in a statistical sense.³ For each region, the mean of treatment expenses was higher and the mean of veterinary expenses was lower than the means of the other cash expense categories. The second highest mean cash expense was for medical care in the West Central and Central regions; for electrical repairs in the Eastern region, and for other repairs in the North West, North Central and Southern regions. The ordering of mean cash expenses from highest to lowest for the state is treatment expense, other repair expense, medical expense, electrical repair expense, and veterinary expense. Statewide, treatment expenses accounted for more than 50% of RIFA-related cash expenses by the respondent households (Figure 11).

Figure 10. South Carolina regions



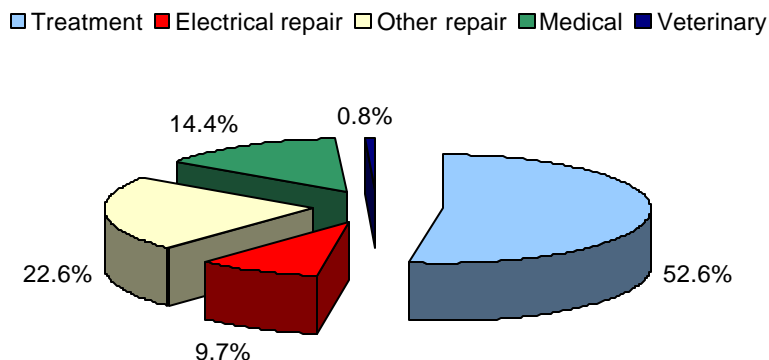
³ The calculated F-statistic for the null hypothesis that the mean expenditures are equal across the five regions is 0.45 (p-value = 0.82).

Table 1. Summary statistics for South Carolina household annual expenditures on RIFA control and remediation, by region.^a

Item	Region						Not Reported	State
	North West	North Central	West Central	Central	Southern	Eastern		
Percentage of households in the sample	26.1	10.3	7.3	18.5	14.2	21.8	1.9	100.0
Percentage of households in the state, 1996 (estimated) [10]	27.8	7.8	7.8	18.5	15.1	23.0	---	100.0
Percentage of sampled households with EXPENSE > \$0	28.9	59.0	71.2	62.7	57.4	60.9	20.0	51.9
Mean values (\$)								
for sampled households with EXPENSE > \$0								
TREAT	65.98	82.86	75.71	78.54	95.67	81.77	46.33	81.37
ELECT	4.79	16.82	6.31	7.12	8.71	48.29	0.00	15.02
OTHER	21.43	30.27	12.79	34.41	54.04	35.64	66.67	35.04
MED	20.84	9.80	29.29	40.55	21.81	4.83	0.00	22.22
VET	0.66	1.94	0.95	2.81	0.53	0.01	0.00	1.17
EXPENSE	113.69	141.67	125.05	163.44	180.76	170.54	113.00	154.83
for all sampled households								
TREAT	19.08	48.92	53.90	49.22	54.90	49.77	9.27	42.24
ELECT	1.39	9.93	4.49	4.46	5.00	29.39	0.00	7.80
OTHER	6.19	17.87	9.10	21.57	31.01	21.70	13.33	18.19
MED	6.02	5.78	20.85	25.41	12.52	2.94	0.00	11.54
VET	0.19	1.14	0.68	1.76	0.30	0.01	0.00	0.61
EXPENSE	32.87	83.64	89.02	102.42	103.73	103.81	22.60	80.37

^a Variables are defined as follows: TREAT is treatment cash expense, ELECT is electrical repair cash expense, OTHER is all other repair cash expense, MED is medical cash expense, VET is veterinary cash expense, and EXPENSE is total cash expense.

Figure 11. Percentage distribution of RIFA-related cash expenses



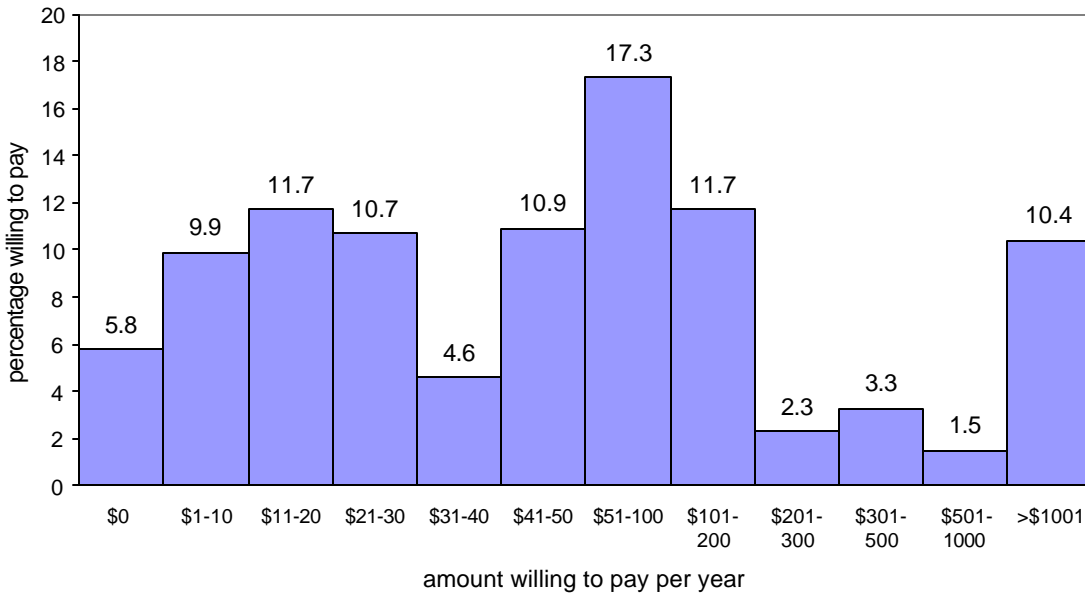
The mean of RIFA-related cash expenses for all of the households in the sample (n = 809) is \$80.37 per year (SE = \$8.69 per year). The lower and upper 95% confidence limits for the mean of RIFA-related expenditures for SC households are \$63.33 per year and \$97.43 per year, respectively.⁴ There were an estimated 1.376 million households in SC in 1996 [11]. With this number of households, the estimated cash expenditures by the state's households for RIFA control and remediation amount to \$110.59 million per year (\$80.37 per year per household times 1.376 million households). The lower and upper 95% confidence limits for statewide cash expenditures by households for RIFA control and remediation are \$87.14 million per year (\$63.33 per household per year times 1.376 million households) and \$134.06 million per year (\$97.43 per household per year times 1.376 million households), respectively.

Willingness to Pay for RIFA Control

Respondents were asked whether it was important to them to control the RIFA. Out of the total sample, 465 (57%) answered yes. These 465 respondents were then asked how much they would be willing to spend each year for RIFA control. The choices available to the respondents were \$0, \$1 to \$10, \$11 to \$20, \$21 to \$30, \$31 to \$40, \$41 to \$50, \$51 to \$100, \$101 to \$200, \$201 to \$300, \$301 to \$500, \$501 to \$1,000, and \$1,001 or a higher amount specified by the respondent. Out of the 465 respondents asked the question, 394 chose one of the payment categories (Figure 12). More of the respondents chose the \$51 to \$100 per year category than any other category. The median willingness to pay of the 394 respondents falls in the \$41 to \$50 category.

Of the 41 respondents who indicated they were willing to pay \$1,001 or more per year for RIFA control, only one listed a specific amount (\$1,200). The others were either unable to provide a specific dollar amount or said they would pay “whatever it takes.”

Figure 12. Frequency distribution of respondents' willingness to pay each year for RIFA control (n = 394)



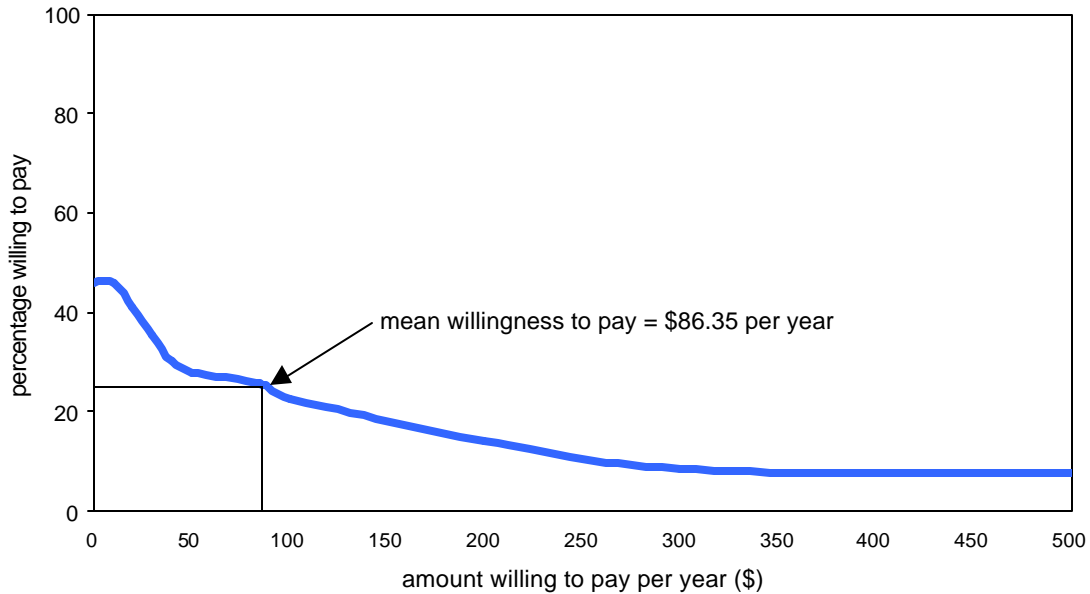
Assigning a \$0 willingness to pay for RIFA control to each of the 344 respondents who indicated that it was not important to them to control the RIFA and to each of the 71 respondents who indicated that RIFA control was important to them but did not choose a payment category, 46% of the respondents to the survey were willing to pay more than \$0 each year for RIFA control.⁵ Thus, the median willingness to pay for RIFA control is \$0 for the entire sample (Figure 13). Assigning a \$1,001 willingness to pay to respondents who indicated they were willing to pay \$1,001 or more per year but did not list a specific payment amount and the mid-ranges of the other willingness to pay categories, the mean willingness to pay for the entire sample (n = 809) is \$86.35

⁴ Other estimates of mean annual household expenditure on RIFA control and remediation are \$35.26 for Georgia [3] and \$87.10 for Arkansas [9].

⁵ This response is almost identical to the response to a similar question in the Lemke and Kissam [5] survey. They asked respondents whether they would be willing to pay more in property taxes for RIFA control, and 45% answered, “Yes.”

per year (SE = \$8.12 per year). This is \$5.98 higher than the mean of direct cash expenditures for RIFA control and remediation.⁶

Figure 13. Respondents' willingness to pay each year for RIFA control (n = 809)



The lower and upper 95% confidence limits for the mean willingness to pay for RIFA control by SC households are \$70.41 per year and \$102.29 per year, respectively. With an estimated 1.376 million households in SC in 1996 [11], the estimated willingness to pay for RIFA control by the state's households is \$118.82 million per year (\$86.35 per year per household times 1.376 million households). The lower and upper 95% confidence limits for statewide willingness to pay for RIFA control by households are \$96.88 million per year (\$70.41 per household per year times 1.376 million households) and \$140.75 million per year (\$102.29 per household per year times 1.376 million households), respectively.

Summary

The survey results show that the RIFA has adverse impacts on SC households. About 46% of the survey respondents indicated the RIFA was a problem in their residences and/or yards. The state's households spend an estimated total of approximately \$111 million per year for

⁶ Direct cash expenditures for RIFA control and remediation should provide a lower bound for willingness to pay for RIFA control. The direct cash expenditures do not reflect the value to households of outdoor activities that household members have to forgo in order to avoid the RIFA.

RIFA control and remediation, and would be willing to spend approximately \$119 million per year for RIFA control. Substantial benefits would accrue to SC households from research and extension programs that would be effective in controlling the RIFA.

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