Hunting and Exposure: Estimating Risk and Future Use at Nuclear Production Sites*

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Introduction

Decisions concerning the reuse and remediation of contaminated nuclear production sites should be based upon realistic and supportable assumptions of use and risk. We argue that specific rather than generic criteria are needed to make informed decisions, and it illustrates, using one site as an example, that basic land use information can provide crucial data about the risk assessment and reuse decision process.

In recent years, a major planning issue for the government[1] and for some regional and local planners,[2] has been the identification of future uses for U.S. Department of Energy (DOE) sites and facilities. Since 1994, twenty DOE sites have been involved in the Future Use Project, a project designed to reconfigure DOE activities and land

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1 DOE Office of Environmental Management, **Forging the Missing Link: A Resource Document for Identifying Future Use Options** (1994); DOE Savannah River Operations Office, **Savannah River Site Future Use Project Report** (1996); National Research Council, **Improving the Environment: An Evaluation of DOE's Environmental Management Program** (1995).

2 *See e.g.*, Christopher J. Noah, *Environmental Ethics and the Future Use of Weapons Facilities,* **Fed. Facilities Envtl. J.** 349 (1994); Jurgen Brauer, *U.S. Military Nuclear Materials Production Sites: Do They Attract or Repel Jobs?,* 2,1 **Med. and Global Survival** 35 (1995); Ann Markusen et al., *Coming in from the Cold: The Future of Los Alamos and Sandia National Laboratories,* Working Paper No. 91, Center for Urban Policy Research, Rutgers University (1995).

holdings.[3] Through a formal planning process involving the public, fifteen of those twenty sites have developed recommendations for future land use. Although many factors generally influence the remediation and future use of DOE sites, land suitability and public opinion will likely play increasingly significant roles in determining future use scenarios.

Risk assessment concerning site contamination is an important element of the DOE's decision process regarding the future use and remediation of production sites. This is especially important for uses such as recreation which may involve large segments of the population. Consequently, consideration of local preferences and practices will be necessary in developing realistic exposure scenarios for accurate risk assessment.[4]

This research concentrates on the recreational use at one DOE site. Specifically, it focuses on the hunting and fishing that took place at the Crackerneck portion of the Savannah River Site in South Carolina during the 1995-96 hunting season.

Recreational Use at Savannah River Site

DOE's Savannah River Site (SRS) occupies 310 square miles adjoining the Savannah River in midwestern South Carolina (Figure 1). Recreational uses, including more opportunities for hunting, were included in the future use plans proposed by the Citizen Advisory Board[5] and the Land Use Technical Committee of Westinghouse Savannah River[6] (WSRC). DOE acknowledged this future use as a public preference.[7]

One segment of the southwestern riverfront portion of SRS has had a sporadic history of public use. This site, officially named the Crackerneck Wildlife Management Area but locally known as

3 *See* DOE (1994), *supra* note 1.

4 For example, 1.4 million South Carolina residents 16 years old and older engage in wildlife-related recreational activities according to the U.S. Fish and Wildlife Service's 1991 National Survey of Hunting, Fishing and Wildlife Associated Recreation (1993).

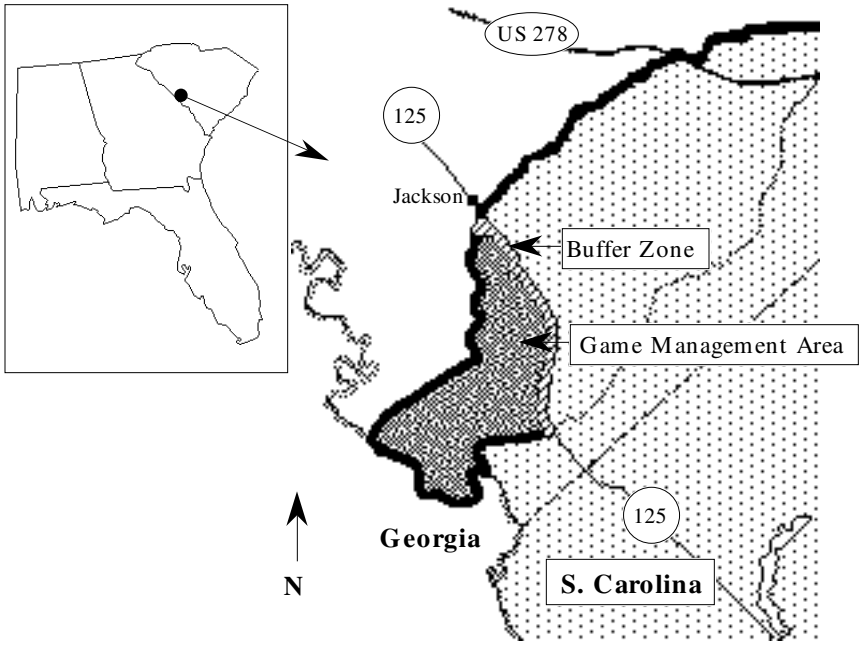
5 Citizen Advisory Board of the Savannah River Site Future Use Project (CAB-SRS), *Vision: Future Land Use-SRS,* in DOE (1996), *supra* note 1.

6 Westinghouse Savannah River Company (WSRC), *SRS's Land Use Technical Committee's Future Use Report,* in DOE (1996), *supra* note 1.

7 *See* DOE (1996), *supra* note 1.

Crackerneck, was originally condemned for use as part of the SRS buffer area. A lawsuit in the early 1970s resulted in the site being opened for public recreational use under the management of the U.S. Department of Agriculture Forest Service (USFS) and the South Carolina Department of Natural Resources (SCDNR).

Figure 1
Location of Study Area



For about ten years, the site was accessible year round for various recreational uses, including camping and hunting. However, in the fall of 1984, the DOE repossessed the Crackerneck area out of concern for terrorist attacks. Specifically, the DOE eliminated general public use and access, limited hunting and fishing to specific times and required users to obtain special DOE permits. In 1995, after a decade of restricted use, the DOE responded to increased public demand and pressure by the SCDNR and agreed to enlarge Crackerneck and expand access on a trial basis. For the 1995-96 season, the Crackerneck hunting area was doubled to more than 10,000 acres and DOE permit requirements were rescinded. Although hunters and anglers still needed state permits, public users could enter the site freely.

Public hunts are allowed under DOE Order 4300.1C, which states that "all installations having suitable land and water areas will have programs for the harvesting of fish and wildlife by the public." On Crackerneck, the common practice is "still" hunting, i.e. hunters stay in an advantageous spot waiting for the deer, or other prey, to approach. On other SRS sections, controlled hunts using dogs are conducted fourteen to eighteen days each year by Westinghouse Savannah River Company (WSRC), which manages the site for DOE. The controlled hunts are conducted specifically to manage deer and feral hog populations. Only dog owners, handlers and hunters who pay a $50 fee, who maintain an active status on the management list and who are subsequently chosen by computer drawing, are permitted to participate in these hunts. Population management, not recreation, is the primary focus of these harvests.[8] This research, however, focuses exclusively on the hunter/fisher-initiated activity on Crackerneck, since access there is more likely to approximate a user demand situation than the hunts that are management controlled.

Hypotheses

The DOE has suggested a fourteen day recreational exposure assumption.[9] We test the null hypothesis that there is no difference between actual recreational use of SRS and the fourteen day recreational exposure advanced by DOE. We expected that the Crackerneck area would be used primarily by local hunters since the site is remote from major population centers as well as from comparable public game management areas in the coastal plain. Data taken from a survey of hunters in South Carolina[10] indicates that sportsmen average more than 40 days per year hunting, making it reasonable to suspect that some hunters that go to Crackerneck on a regular basis might be surpassing the DOE fourteen day exposure assumption.

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8 *See* WSRC, *supra* note 6.

9 DOE, **Charting the Course: The Future Use Report DOE/EM-0283** (1996).

10 Joanna Burger et al., *Risk Perception, Federal Spending and the Savannah River Site: Attitudes of Hunters and Fishermen,* 17 **Risk Anal.** 313 (1997).

Methods

The Crackerneck area is accessible through one entry gate off Brown Road between Jackson, South Carolina, and SRS (Figure 1). Users wishing to enter the considerable expanse of swamp on Crackerneck may do so by boat from the Savannah River after first registering at the entry gate. Although unlimited access, long hunting seasons and liberal regulations can confound quantification of public use on wildlife management areas,[11] the Crackerneck site offered a model situation for preliminary assessment of public user habits precisely because of its limited access and season.

The site was open only on Fridays, Saturdays, and Thanksgiving Day from 4:30 am to 7:30 pm from October 27 through December 30, 1995, and from 4:30 am to 1:00 pm during January, 1996. Entry information was obtained from gate sign-in sheets for 29 (21 full days, eight half days) of the 30 days the site was open; the sheets from one of the half-day hunts were unavailable. The SCDNR sign-in sheets included name, county of residence, vehicle license number, emergency phone number, point of entry (river or gate), boat registration number, time(s) in and out, and harvest information. This data was entered into a spreadsheet format and analyzed with SPSS-PC statistical software. Additional variables such as total time of each visit, the number of persons per group, and the distance travelled (estimated from the site gate to the centroid of each county of origin along primary access roads) were derived from the initial data. By sorting and consolidating visit information, the data set provided a basis for analyzing both visits and individual users. Because the 14-day exposure scenarios suggested by DOE do not specify an hourly equivalent of a recreational day, the number of visits and the number of days for individual users are used interchangeably in this analysis.

Results

Use Characteristics

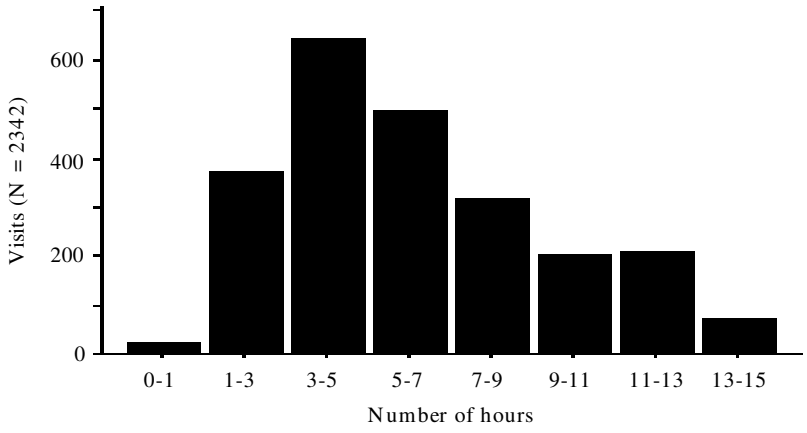
Between October 27, 1995 and January 27, 1996, more than 2,300 visits were made to Crackerneck. Slightly more than 80% of the visits

[11] Robert Gooding, et al., *Use of Capture-recapture Techniques to Estimate Public Use on the Clarks Hill WMA,* 45 **Proc. Ann. Conf. Southeast Ass'n Fish & Wildlife Agencies** 189 (1991).

originated from within 25 miles of the gate and 12% originated from distances between 25 and 75 miles away. The remaining 8% of visits were initiated from distances over 75 miles, with a majority of those distances exceeding 100 miles. Though the vast majority of user visits originated from Aiken County, nearly 200 visits originated from a distance greater than 75 miles. Consequently, because it appears that many people are willing to travel these extended distances, Crackerneck may have some regional significance in addition to its value as a local resource.

Visitors to Crackerneck spent a total of 14,500 hours on site. Although visits ranged from 20 minutes to nearly fifteen hours, the average lasted just over six hours (Figure 2). Not surprisingly, duration generally increased with distance travelled to the site. A comparison of mean visit hours for visitors grouped by origin — local (within 25 miles), intermediate (25 to 75 miles) and distant (beyond 75 miles) — reveals a statistically significant difference of about an hour between each group (Anova $F=47.7$, $p<.01$, $df=2$). The mean visit time is approximately 6 hours for local visits, 7 hours for intermediate distance travel and 8 hours for those originating more than 75 miles away.

Figure 2
Visit Duration 1995–96



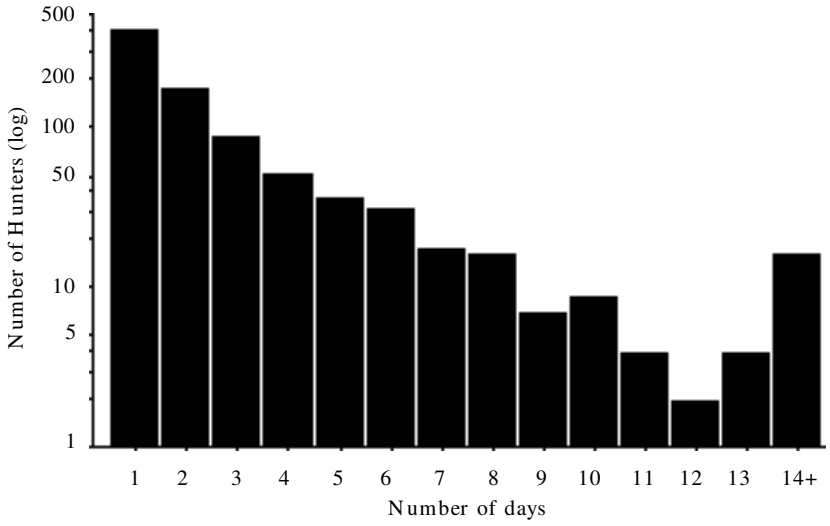
Except for traditional Thanksgiving Thursday, Crackerneck is open only on select Fridays and Saturdays. The number of visits on each of these two days is nearly equal, with Saturdays being slightly more popular. The site averaged nearly 121 visitors per day on full days,

reaching a maximum of 181 visitors at one point. Half days averaged 22 visitors per day and reached a maximum of 40 visitors in one day.

User Characteristics

The duration of an individual's expected exposure is an important statistic in risk assessment. Since the DOE uses an estimate of 14 days per recreational user,[12] it was especially important to assess the actual number of days on site for each hunter. When the 2,342 entries to Crackerneck in this data set were consolidated and analyzed, it was determined that about 855 individuals used the site during 1995-96. Because it is possible that individuals could be counted more than once, the actual number of users is likely to be slightly lower.[13] The estimate of 855 individuals, and all averages derived from that figure, should be considered conservative for exposure estimates.

Figure 3
Days per Hunter 1995–96



Distance of residence from the site affects the number of days a visitor uses Crackerneck. As expected, local users had a higher mean (3.13 days, $p<.05$) than those travelling longer distances (1.8 and 1.7 days for the middle and longer range distances). While users averaged

12 *See* DOE (1996) *supra* note 9.

13 Errors might result from the illegibility of the sign-in sheets or from inconsistencies in the name used on the sign-in sheets, e.g. using "Billy" on one occasion and "William" on another.

2.7 days or visits per person, the range varied from a low of one to a high of 23 days per individual. The most common use is one or two trips per person; nearly 68% of users came only once or twice while 20% used the site three to five days per season. There is a wide distribution of cumulative hours ranging from 20 minutes to more than 100 hours with 51 visitors each having over 48 hours on site.

One hundred five people (12%) visited Crackerneck more than six of the 29 days and sixteen people (2%) used it fourteen or more days (Figure 3). This small group averaged sixteen days or 122 hours potential exposure time per person. Since DOE uses fourteen days in its conservative risk assessment modelling, it is important to note that a small group of users meet or exceed the DOE assumption even though the site is open very limited hours and days for hunting season.

Discussion

We offer the first analysis of the current user-instigated recreational use of the Savannah River Site. Current use assessment is crucial to plan for future use as anticipated in all future use documents for SRS[14] and other DOE facilities. Moreover, this paper should be considered a critical part of realistic scenarios in exposure assessment for risk evaluation.[15] We suggest three important issues for consideration in SRS and DOE future use assessment: current recreational use, potential recreational use and validity of the current exposure assumption.

First, while public access to the recreational area at SRS is limited to 21 full days and nine half days, it is apparent that current use of the site within this small window of opportunity is substantial. Forty hunters per acre has been used as an optimal use density for recreational planning at SRS.[16] On the busiest day at Crackerneck in 1995, less than 75% of this capacity was reached. This suggests that there is additional capacity at the Crackerneck site that could be used to meet regional demand for hunting. Indeed there are more than 200 square

[14] *See* DOE (1996), *supra* note 1; CAB-SRS, *supra* note 5; WSRC, *supra* note 6.

[15] *See* DOE (1996), *supra* note 1; CAB-SRS, *supra* note 5; WSRC, *supra* note 6.

[16] Elizabeth LeMaster, U.S. Fish and Wildlife Service, SRS field office. Personal communication (May 1996) (on-file with author).

miles of currently undeveloped land similar to the Crackerneck site within the buffer area of SRS that might be suitable for a variety of recreational uses.

Second, although more than 80% of the users live near SRS, some users come from distances of greater than 75 miles to hunt, fish or simply enjoy the natural beauty of the site. Trip distance influences both length of the visit (positively) and number of visits (negatively). Local users visit the site more frequently and for shorter time periods than do users who have to travel significant distances to get to the site. The long-distance traveler requires greater support services and spends more money per trip than local recreational users.[17] Current use levels suggest that there is opportunity to expand site use, and an expansion could mean a positive economic impact to the region.

An expansion of recreational opportunities would obviously change the use profile, and possibly the user profile, of Crackerneck and SRS. For example, increasing the number of days the site is available for hunting and fishing could result in an increase in the number of days a specific individual uses the site, as well as an increase in the total number of users. Results from interviews with hunters and others in South Carolina suggest that there is demand for recreational use at the site, and some individuals have indicated a willingness to pay for access to more of the site.[18]

Increasing the range of recreational opportunities to include camping, hiking or other activities as suggested by the Citizen Advisory Board[19] could also change the use profile by expanding the user base from mostly hunters and anglers to a more varied group. This would require using the site in non-hunting as well as hunting season. Although the demand for these more passive recreational forms has not yet been determined, they should be considered in future risk assessments as potential uses.

Third, a small group of local users hunt Crackerneck both with regularity and endurance. During the 1995-96 season, sixteen individuals met or exceeded the DOE assumptions for recreational

17 Clemson Univ. Extension Wildlife Program, **Economic Impact of Hunting on Rural Communities: Jasper and McCormick Counties in South Carolina** (1992).

18 *See* Burger et al., *supra* note 10.

19 *See* CAB-SRS, *supra* note 5.

exposure even under the severely limited access imposed at the site. Although this accounts for only 2% of current recreational users, the number of people included in this category can be expected to increase with extensions of recreational use at Crackerneck. While the average number of days per visit (or exposure) is slightly less than three and falls well within the fourteen days suggested by DOE, we have shown that there is a non-hypothetical, real range of reasonable maximum exposure that exceeds the fourteen day scenario. Future assessments of risk to recreational users should take this into account.

An expansion of recreational opportunities, would probably change the use profile, and possibly the user profile, of Crackerneck and SRS. For example, increasing the number of days the site is available for hunting and fishing could result in an increase in the number of days a specific individual uses the site, as well as an increase in the total number of users. Increasing the range of recreational opportunities to include camping, hiking or other activities as suggested by the Citizen Advisory Board[20] could also change the use profile by expanding the user base from mostly hunters and anglers to a more varied group using the site in non-hunting as well as hunting season.

It is apparent that the use of a fourteen day exposure assumption for recreational use[21] at this DOE site should not be automatic as it may be unrealistic in light of local hunting practices on Crackerneck. Where land use information is available, it should be used to create realistic and supportable exposure assumptions for current and potential site use. If the future use process is to be successful, it must continue to re-examine assumptions and consider local practices as well as local preferences in assessing risk and assigning future use.



20 *See* CAB-SRS, *supra* note 5.

21 *See* DOE (1996) *supra* note 1.