

SOCHAN HARVEST PROGRAM

2022 ANNUAL REPORT

GRSM-2019-SCI-2073: Impacts of Traditional Cherokee Harvesting Techniques
on Sochan (*Rudbeckia laciniata*) Populations in GRSM, TN.

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BACKGROUND

Harvesting of sochan (*Rudbeckia laciniata*) (fig. 1) for traditional purposes in Great Smoky Mountains National Park (GRSM) (fig. 2) by members of the Eastern Band of Cherokee Indians (EBCI) continued for its fourth consecutive season in 2022. This program, which offers the EBCI a way to continue their relationship with cultural use plants, is authorized under the 2016 National Park Service (NPS) rule, *Gathering of Certain Plants or Plant Parts by Federally Recognized Indian Tribes for Traditional Purposes* (36 CFR 2.6).



Figure 1. Early spring sochan basal rosette.

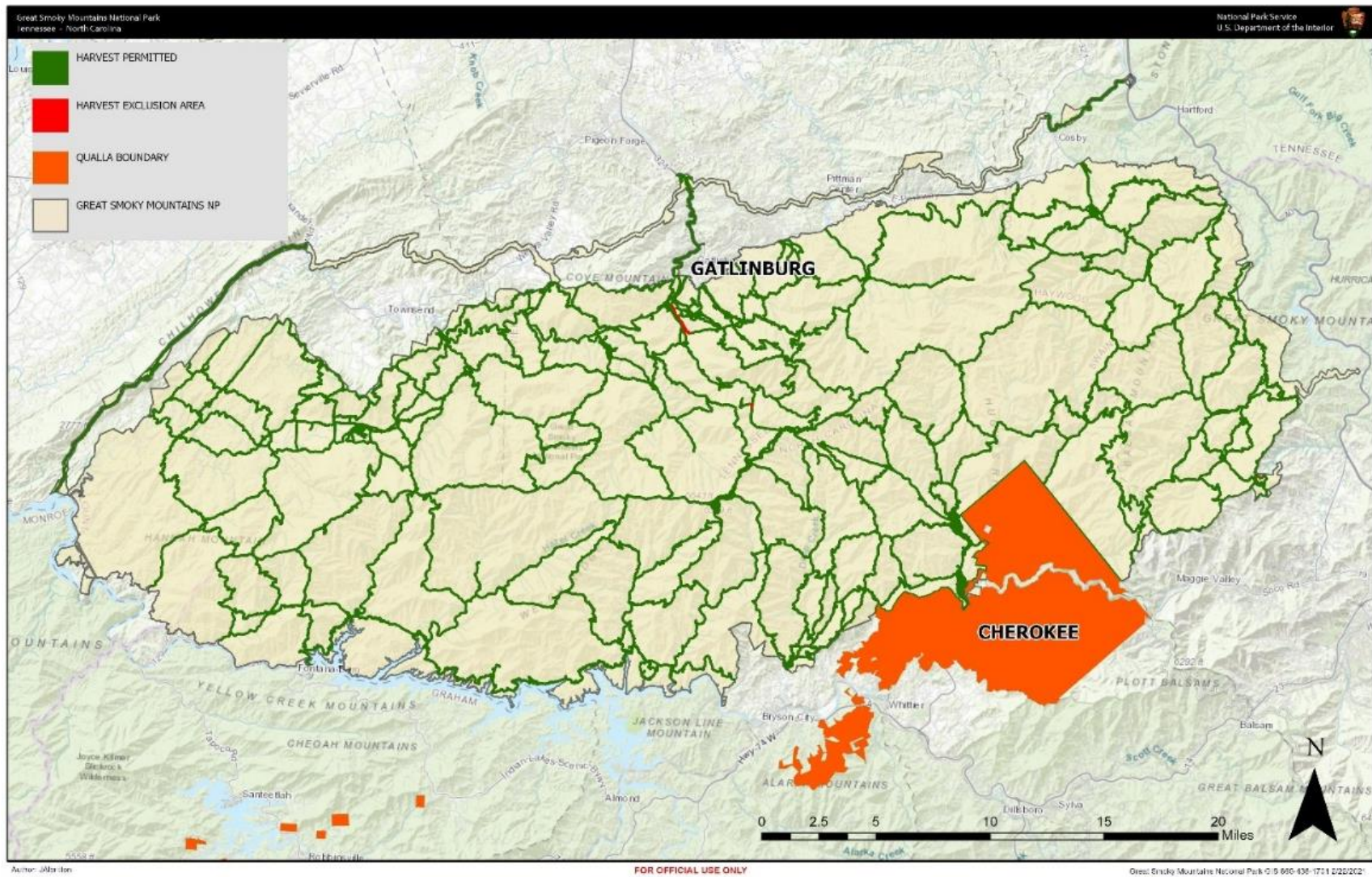


Figure 2. Map showing the designated harvest areas (green), the GRSM boundary (tan/grey), and the Qualla boundary (orange). Designated harvest areas are defined as any area within 328 ft. of official park trails, roads, or along the GRSM/Qualla boundary.

The program runs on an annual basis and follows the below timeline:

- Jan/Feb: Joint EBCI/GRSM workshops held in Cherokee for interested EBCI members. Members are educated on program specifics, and permits are assigned.
- Mar 1 – May 31: Sochan harvest season. EBCI permittees report harvest locations to GRSM staff. GRSM staff conduct harvest site monitoring. Research sites are harvested by an appointed EBCI member.
- June: Joint EBCI/GRSM meeting to discuss harvest season
- Aug/Sept: Harvest monitoring by GRSM staff for collection of summer data
- Sept/Oct: Data entry, analysis, and report writing by GRSM staff
- Oct/Nov: Joint EBCI/GRSM meeting to discuss the upcoming harvest season

SOCHAN IN GRSM

Sochan is common throughout the park. It most often occurs in open floodplain areas at lower elevations, and adjacent to streams and in wetland seeps in the mid to high elevations.

Since the start of the harvest program in 2019, GRSM staff has collected over 625 sochan observations park-wide with Garmin GPS (fig. 3). A sochan observation is defined as any sochan patch that is at least 10m x 5m in area. These observations inform staff as to the extent of sochan populations throughout the park and help to advise on ideal harvest locations during annual workshops between NPS staff and EBCI members.

These data have also been used to develop a sochan habitat distribution model (Fig. 4) utilizing MaxEnt software (Phillips et al. 2006). In this application, MaxEnt utilizes sochan presence (observation) data and a set of environmental predictors (e.g., rainfall, topography, soil moisture, vegetation type, etc.) to estimate probability of sochan occurrence across the GRSM landscape. The most recent model indicates that over 7500 acres of GRSM habitat is suitable for sochan (i.e., habitat with conditions with 50% or greater probability of supporting sochan). Collection of sochan observations and refinement of the model will continue on an as-needed basis.

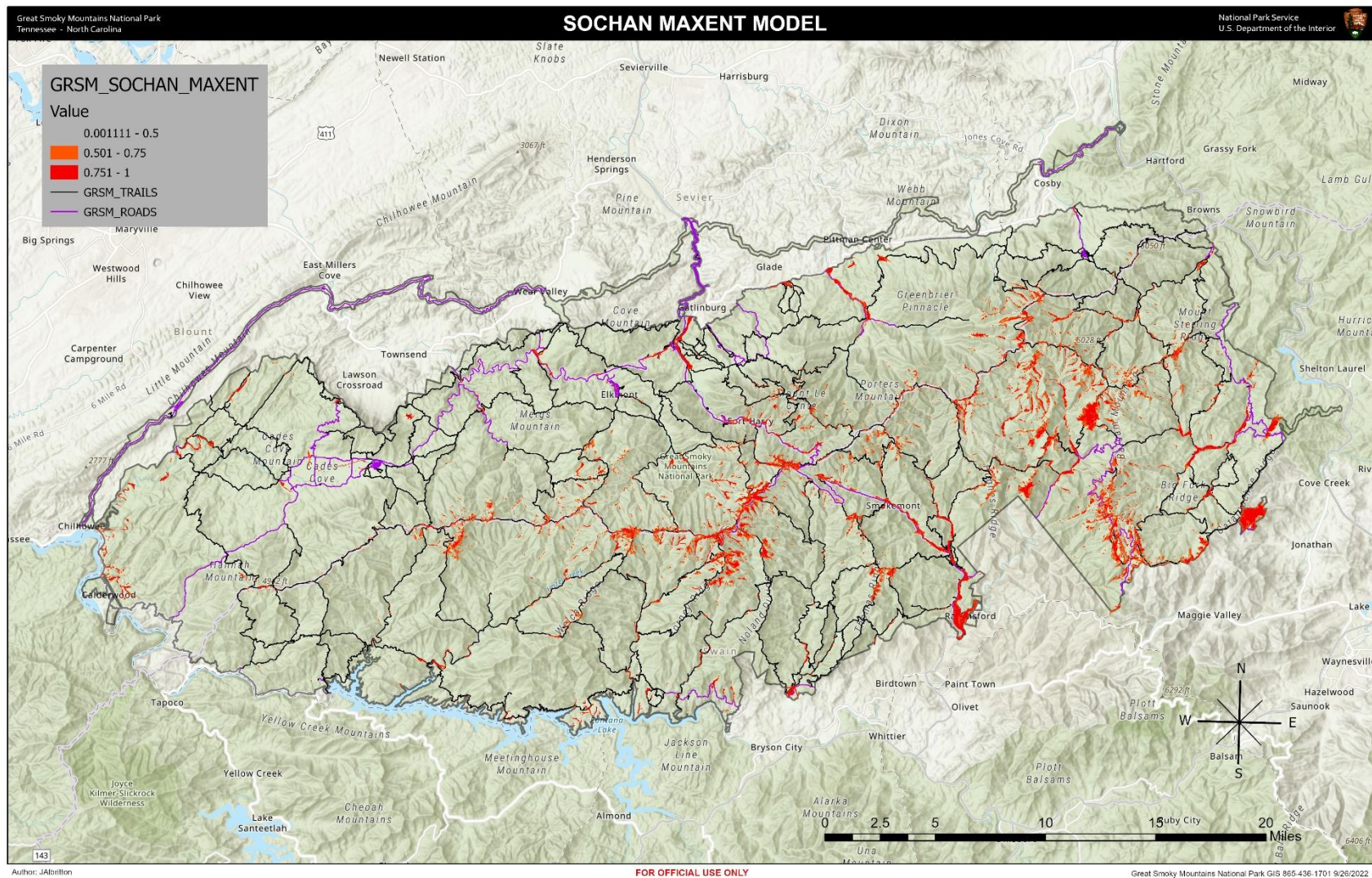


Figure 4. Map showing the most recent results of the sochan habitat distribution model. Areas in orange and red have conditions with 50% or greater probability of supporting sochan. Areas with <50% probability of supporting sochan are omitted from this map.

HARVEST PROGRAM - OVERVIEW

Program participation has increased each harvest season since its inception in 2019. In 2022, all 36 harvest permits were issued, and 33 harvests were conducted for a total of 22 harvest bags collected (figs. 5 & 6). The number of permits used (13) increased over any other year of the program but was still low compared to the total number of permits issued.

Harvesting was more spread out throughout the park relative to previous harvest seasons (fig. 7), though still was concentrated in easy-access areas (e.g., adjacent to roads, trails and parking lots).

In general, harvesting occurred in 5 primary areas (listed in order from most to least frequent):

- 1) Smokemont Front Country Campground and Riding Stables
- 2) Clingmans Dome-Newfound Gap-Upper Hwy 441
- 3) Straight Fork Road
- 4) Oconaluftee Visitors Center-Job Corps-Lower Hwy 441
- 5) Deep Creek Front Country Campground and surrounding area

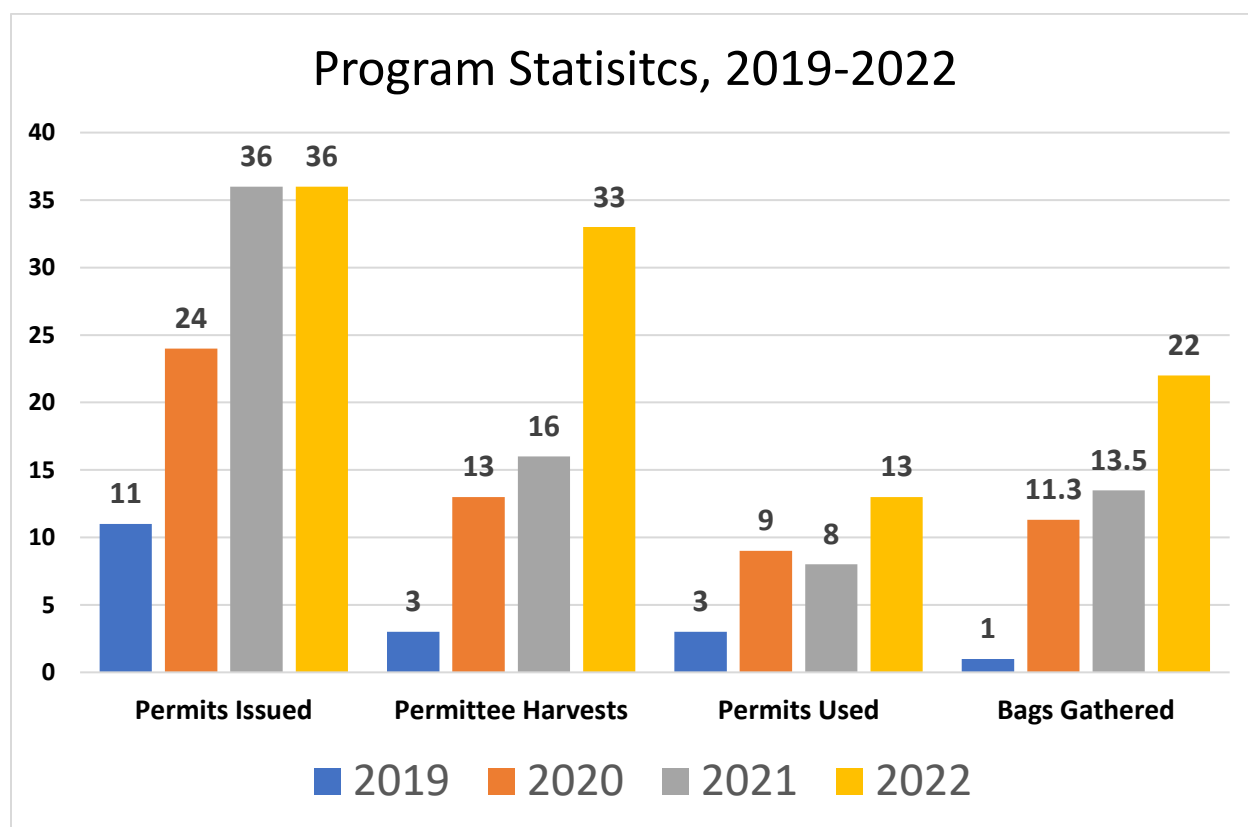


Figure 5. An overview of program statistics from 2019 to 2022.



Figure 6. Sochan harvest bags.

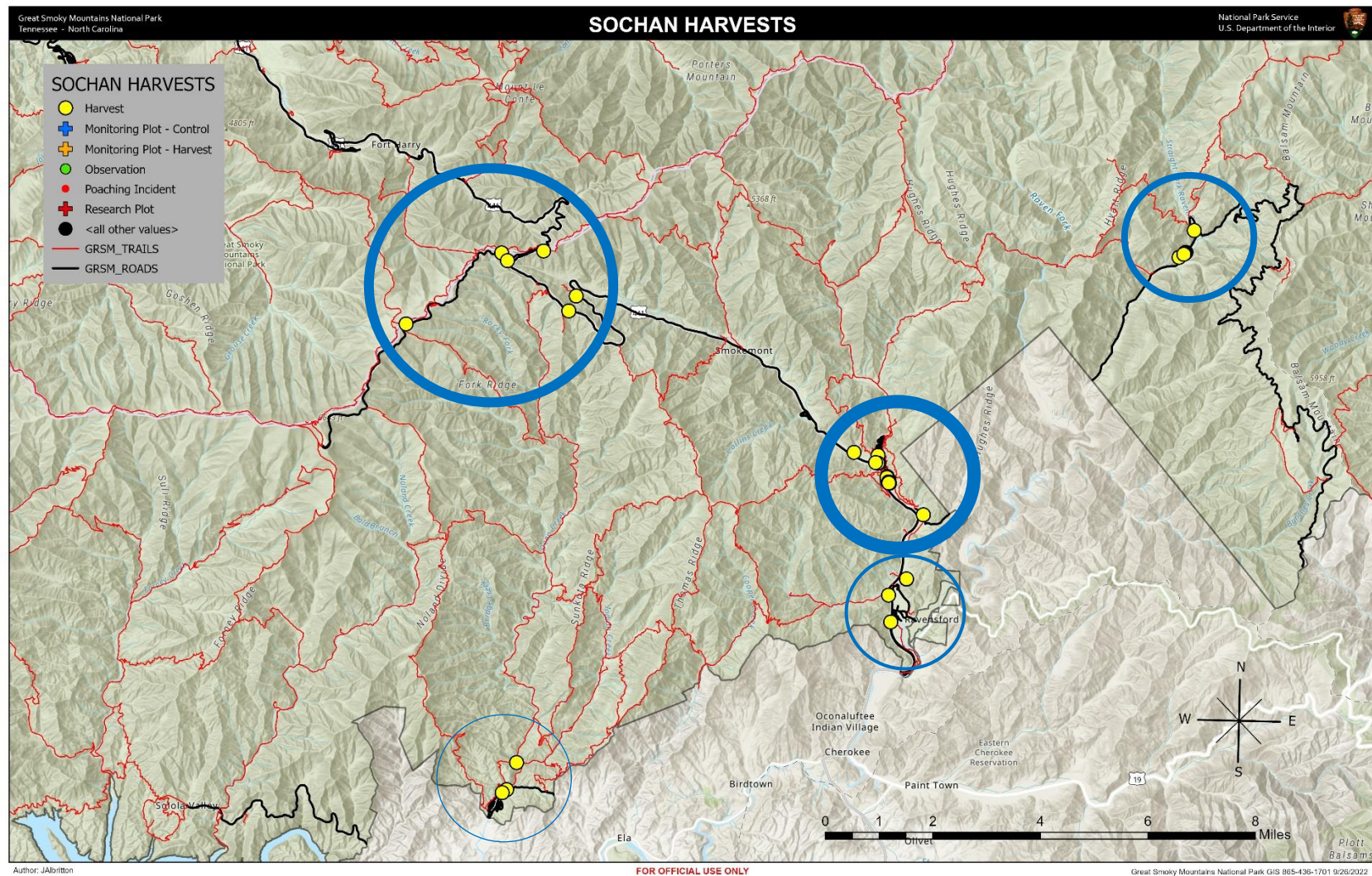


Figure 7. 2022 Sochan harvests (yellow markers). The thickness of the blue line indicates relative number of harvests compared to other locations.

SOCHAN HARVEST MONITORING

SPRING MONITORING:

All harvests are reported to the EBCI natural resources management staff, preferably within 1 week of the harvest, utilizing either an online or paper report form (fig. 8). Additionally, harvesters set out blue pin flags marked with their permit number at harvest sites to make relocation easier (fig. 9). These reports are then turned over to GRSM staff. Site checks are then performed by GRSM staff on all reported locations. All locations are geolocated with Garmin GPS, and a subsample of harvested plants is checked for compliance with harvest quantity standards and traditional harvest techniques outlined in the special use permit.

REPORT A SOCHAN HARVEST

Use this form to record information for each harvesting trip. Please fill out the form as completely as possible. If there were multiple harvest locations, a separate form should be submitted for each location. Thank you!



- Permit #: _____
- Which Community Club are you from? _____
- Gathering Date (Month/Day/Year; e.g., 12/17/2018): _____
- Time of Day (E.g., 1:00 PM): _____
- Number of Individuals that participated in gathering: _____
- GPS Coordinates (if possible) for Harvest Location:
Latitude (UTM Northing): _____; Longitude (UTM Easting): _____
Location Description: _____

- Did you take a photo of the harvest location with a smartphone? YES | NO
If yes, email the photo and your permit # to cherokee.naturalresources@gmail.com
- Additional Comments: _____

- Number of collection bags collected: ☐ ¼ ☐ ½ ☐ ¾ ☐ 1 ☐ 1¼ ☐ 1½ ☐ 1¾ ☐ 2
- Time spent harvesting: Hours _____
- Do you plan to return to the same location to harvest this year? YES | NO

Figure 8. Sochan harvest report form



Figure 9. A blue pin flag left out by an EBCI harvester.

SUMMER MONITORING:

GRSM staff uses a series of monitoring plots to assess harvest impacts to sochan populations. Plots can be divided into 1 of 3 categories: harvest monitoring, research, and control (tables 1 and 2).

PLOT TYPE	SAMPLE SIZE (N)	PLOT TYPE DESCRIPTION
Harvest Monitoring	5	Monitoring sites that are harvested by permitted members of the EBCI.
Research	2	Monitoring sites that are harvested by specific members of the EBCI Natural Resources Department. These locations are off-limits to harvesting by permitted members of the EBCI.
Control	6	Monitoring sites that are off-limits to harvesting.

Table 1. Sochan harvest monitoring plot types, 2022 sample size (N), and plot type descriptions.

As the program has progressed plots have been added (table 2). Several plots now have 3 years of data and 2 research plots have 4 years of data. It should be noted that there are 3 plots (not listed below in table 2) that are now retired: 1 plot at Collins Creek that was originally a harvest monitoring plot which has received only very limited harvesting and was therefore not considered representative of a harvest site and 2 plots at Purchase Knob that were mistakenly mowed in early summer 2022 during routine GRSM maintenance activities. Because baseline data exists for both these locations, these plots will be resampled in 2023 to assess impacts of mowing. Additionally, not listed below in table 2, a research plot was added in 2022 in the Flat Creek area. Baseline (pre-harvest) data was collected and harvesting will begin in 2023. We also had 1 harvest monitoring plot that experienced significant roadside cutting in half the plot in early August 2022 prior to summer monitoring. The data from this plot were omitted from 2022 analysis. This plot will also be considered for resampling in 2023 to assess the impacts of mowing.

PLOT LOCATION NAME	ELEVATION	PLOT TYPE	SAMPLE DATE 2019	SAMPLE DATE 2020	SAMPLE DATE 2021	SAMPLE DATE 2022
RL_20190807_0930_C	4956	Control	8/7/2019	8/7/2020	8/5/2021	8/4/2022
RL_20200603_1400_C	3857	Control		8/10/2020	8/3/2021	8/9/2022
RL_20200729_0900_C	4032	Control		7/29/2020	8/5/2021	8/18/2022
RL_20200824_1115_C	3034	Control		8/27/2020	8/26/2021	8/22/2022
RL_20210812_1000_C	>6000	Control			8/12/2021	8/8/2022
RL_20200915_1000_C	2172	Control		9/15/2020	8/30/2021	8/16/2022
RL_20190502_0950_HM	3029	Harvest Monitoring	8/27/2019	8/24/2020	8/26/2021	8/22/2022
RL_20200512_1015_HM	2170	Harvest Monitoring		8/19/2020	8/16/2021	8/15/2022
RL_20200831_1300_HM	2173	Harvest Monitoring		9/2/2020	8/30/2021	8/16/2022
RL_20210617_0848_HM	>6000	Harvest Monitoring			8/12/2021	8/8/2022
RL_20220502_1000_HM	2170	Harvest Monitoring				8/15/2022
RL_20190418_1440_R	1625	Research	8/29/2019	8/26/2020	8/24/2021	8/25/2022
RL_20190423_1300_R	3858	Research	8/13/2019	8/12/2020	8/10/2021	8/11/2022

Table 2. Sochan monitoring plots with elevation, plot type, and sample (monitoring) history.

All plots are sampled using a m² quad-based restricted random sampling design, where quads are located along a series of randomly located transects fixed to a baseline that spans the length of a sochan population. The following metrics (table 3) are collected in the summer at each plot. Select members of the EBCI conducted a mix of whole-leaf and turkey-foot harvesting using traditional EBCI techniques at the 2 research plots (fig. 10). This is the 4th consecutive year that harvesting has occurred at the research plots (fig. 10).

SUMMER DATA METRICS COLLECTED IN EACH PLOT	
METRIC	SAMPLING LEVEL
Sochan Stem Abundance	Quadrat
Sochan Stem Height	Quadrat
Sochan Stem Fertility	Quadrat
Number of Flowers per Stem	Quadrat
Canopy Density	Transect
Human and Natural Disturbances	Quadrat and Plot
Landscape Photographs (Fig 13)	Plot

Table 3. Metrics collected during summer sampling at each plot



Figure 10. An EBCI member harvesting with his kids at a sochan research plot in GRSM in 2022.

RESULTS & DISCUSSION

SPRING MONITORING

Thirty-two of the thirty-three harvests were compliant with program harvest standards. One permit holder harvested *Xanthorrhiza simplicissima* (yellowroot), though this was a case of plant misidentification. This harvester was educated on sochan identification.

When this project began, a primary concern was the impacts of trampling on sochan and surrounding habitat, especially from large harvest groups (though group size is limited to 6). To-date, no trampling or other negative impacts to surrounding habitat have been documented.

SUMMER MONITORING

We've been studying the impacts of traditional EBCI harvest techniques on sochan populations since 2019 (table 4). Due to small sample size, 2019 harvest and control plots were omitted from this analysis. Overall, harvesting seems to have positively impacted sochan populations (table 4, Figures 11-14). Based on an analysis of variance (ANOVA) test, the effect of treatment type (harvest/research vs control) was not significant ($p > 0.05$) on any of the data metrics collected from 2019-2022.

In 2022, harvest monitoring plots had a range of 65 – 318 stems (mean 195) per plot across sampled quads. The 2 research plots had similar stem counts for sampled quads: 67 and 223 (mean 145). After 3–4 years of harvesting, mean stem density / m^2 has increased across harvest (from 3.7 to 5.3 stems/ m^2) and research plots (from 1.7 to 7.7 stems/ m^2), while control (non-harvested) plots have remained relatively stable (from 4.5 to 5.2 stems/ m^2) (table 4, fig. 11). Research and harvest monitoring plots have also experienced positive changes with regards to fertility and total flowers per stem, while stem height has remained relative constant (table 4, figs 12-14). Comparatively, data from control plots has remained stable or trended down (table 4, figs 12-14) during the same time period.

Harvesting has been concentrated between early April and early May, during the time when sochan rosettes are fairly robust with many basal leaves, but in the majority of cases are still lacking an upright stem. EBCI harvest patterns seem to prefer this stage, though some harvesters will harvest cauline leaves. The primary difference between harvest patterns at research and harvest monitoring sites is the total number of harvests per site per year and total harvest quantities. Research plots are harvested 1 – 2 times per year with a range of 0.25 – 1 collection bags (fig. 6) taken during each harvest, while harvesting at harvest monitoring plots is more random with a greater range of harvest quantities (0.25 – 2 bags, fig. 6) and a greater range of harvests per year. Some sites have received multiple harvests (>10) in a single season, while others have received only 1-2 harvests over the course of the study.

Treatment	Year	Mean Stem Density / m ²	Mean flowers per stem / m ²	Mean Stem Height / m ²	**Stem Fertility / m ²
Control	2020	4.5	3.3	91	0.57
Control	2021	6.1	2.4	94	0.64
Control	2022	5.2	2.1	83	0.60
Harvest	2020	3.7	5.3	114	0.60
Harvest	2021	4.1	4.4	121	0.61
Harvest	2022	5.3	5.6	112	0.75
Research	2019	1.7	0.5	66	0.20
Research	2020	4.4	0.9	79	0.36
Research	2021	2.4	0.9	84	0.35
Research	2022	7.7	0.9	71	0.45

Table 4. Data metrics from 2019-2022 for all control, harvest, and research sites. Stem fertility is calculated as a ratio of fertile stems to all stems.

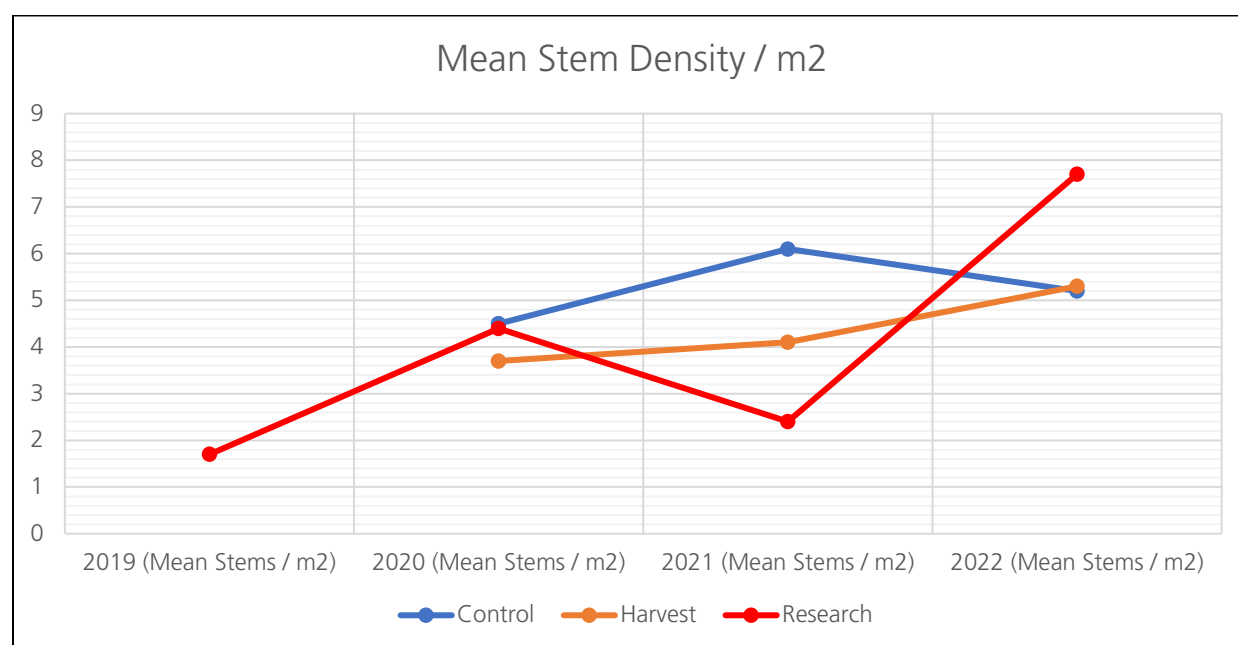


Figure 11. Sochan stem density per m² across all harvest monitoring, research, and control plots across all sample years (2019-2022). The dots are all data points.

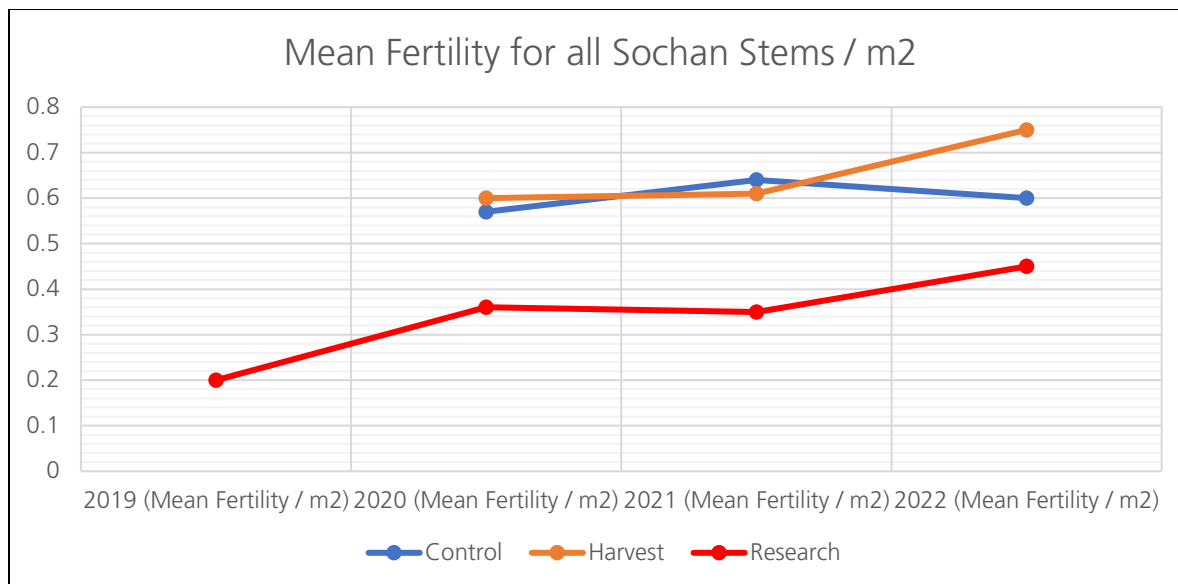


Figure 12. Mean fertility of all sochan stems per m² across all harvest monitoring, research, and control plots across all sample years (2019-2022). Mean fertility is calculated as a ratio of fertile stems to all stems. The dots are data points.

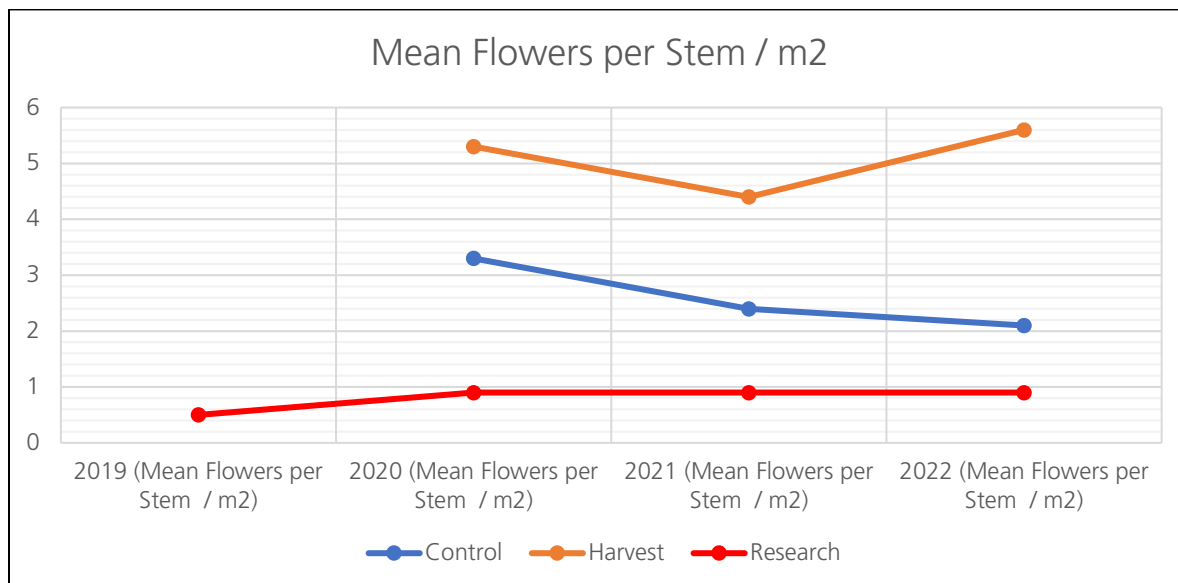


Figure 13. Mean flowers per stem per m² across all harvest monitoring, research, and control plots across all sample years (2019-2022). The dots are data points.

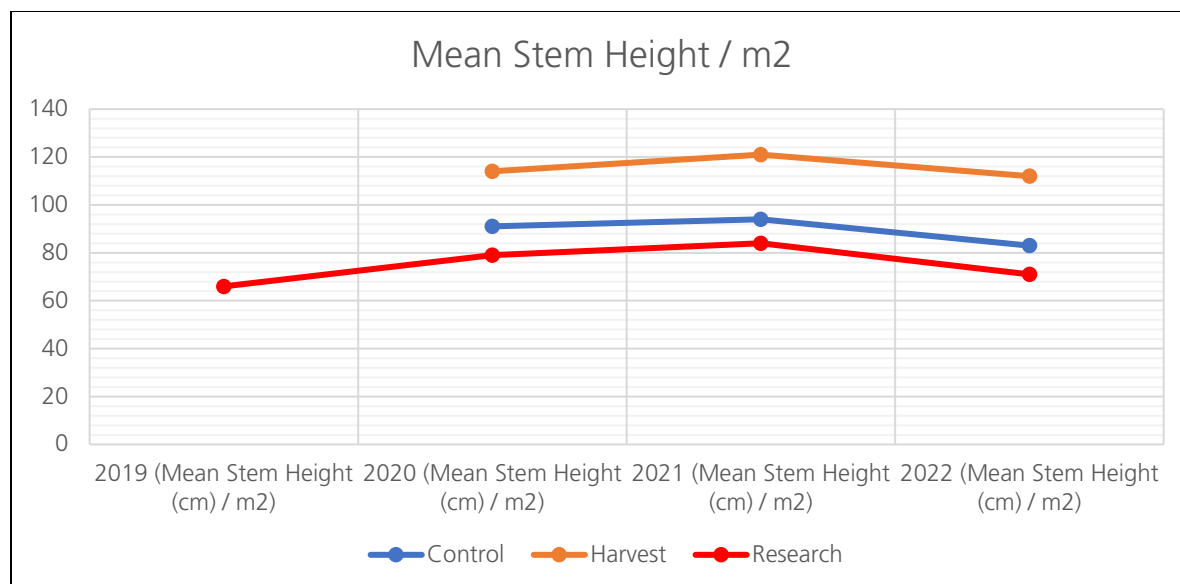


Figure 14. Mean stem height per m^2 across all harvest monitoring, research, and control plots across all sample years (2019-2022). The dots are data points.

Overall, it is possible that harvesting has led to an increase in stem density and fertility, and that 1-2 harvests annually is of the most benefit. It's unknown whether multiple (e.g. >5-10) harvests over multiple years or differing harvest intensities concentrated at any particular site would have a negative effect. The recently established research site at Flat Creek will help to answer these questions, as different sample quads will be harvested at different intensities and at different intervals. Other factors that may contribute include natural or invasive disturbance regimes and/or changes to canopy/subcanopy/shrub structure.

NATURAL AND HUMAN DISTURBANCES

Observations and data collection over the course of this project show that sochan populations across the park are prone to a variety of natural disturbance regimes. Common natural disturbances at floodplain sites are flood events and changes to canopy composition due to beaver impacts. Insect herbivory has been noted at several monitored populations, and casually observed at many locations. Elk pass through monitored populations that occur in the Oconaluftee area, though herbivory from elk or other wildlife has not been noted. Disturbance from exotic-invasives include a variety of invasive plants and hog disturbance. To this point in the project, hog disturbance has been minimal at all but 1 monitored location (plot RL_20190418_1440_R). The most common invasive plants include *Microstegium vimineum*, *Vinca* spp., *Lonicera japonica*, and *Rosa multiflora*. Human disturbances, though not attributable to EBCI harvesters, are primarily noted in the easy-access roadside monitored populations and include social and fisherman access trails.

The spread or incidental introduction of invasive plants in harvested areas is an additional concern. Quad level data collection on disturbances began in 2021. General observation data were collected

during the first two years of the project: 2019 and 2020. Table 4 shows qualitative data for invasive plants at 3 monitored harvest sites and 2 research sites. At 4 of these sites, percent cover of invasive plants and the percentage of sample quads with invasive plants present has either decreased or remained stable.

PLOT LOCATION NAME	PLOT TYPE	YEAR	SAMPLED 1x1m (m ²) QUADS	QUADS WITH INVASIVE PLANTS PRESENT	PERCENTAGE OF SAMPLED QUADS WITH INVASIVES PRESENT	MEAN % COVER OF INVASIVE PLANTS / m ²
RL_20200512_1015_HM	HARVEST MONITORING	2021	31	27	88	1-25%
		2022	31	19	61	1-25%
RL_20200831_1300_HM	HARVEST MONITORING	2021	47	17	36	1-25%
		2022	47	18	38	1-25%
RL_20190502_0950_HM	HARVEST MONITORING	2021	14	0	0	NA
		2022	14	0	0	NA
RL_20190418_1440_R	RESEARCH	2021	35	7	20	1-25%
		2022	35	29	83	1-25%
RL_20190423_1300_R	RESEARCH	2021	61	0	0	NA
		2022	61	0	0	NA

Table 5. Data on exotic invasive plants in 5 sochan monitoring plots

CONCLUSION

The sochan monitoring program continued for the 4th consecutive year. All 36 permits were filled, and the program experienced increases in participation, number of harvests and quantity of sochan harvested. The number of harvests in 2022 was more than the total from the previous 3 years combined. During workshops held for EBCI members interested in obtaining a permit during winter 2022, we stressed the importance of harvesting across a variety of locations and elevations and discussed the potential negative impacts of overharvest at any given location. 2022 harvesting was more spread out and harvesting in the floodplain across from smokemont riding stables was greatly reduced over 2020-2021 levels. Harvest reporting was adequate, which is on par with previous seasons.

Monitoring data indicate that sochan populations have shown a positive response to harvesting. From a management perspective, harvest quantities and techniques defined in the project guidelines appear sustainable, and 1-2 harvests per season appears to be of the most benefit. This however will likely depend on the quantity of harvest and perhaps the timing of harvest. More data is needed to discern if multiple harvests of large quantity (e.g., 5-10+, or overharvest) at one location across multiple seasons would have negative impacts to a population (e.g., reduced vigor, significantly reduced stem density).

LITERATURE CITED

Phillips, S. et al. 2006. Maximum entropy modeling of species geographic distributions. *Ecological Modeling*. 190: 231-259.