Spigelia gentianoides
Gentian pinkroot

5-Year Status Review:
Summary and Evaluation

Spigelia gentianoides in Three Rivers State Park, Florida. *Photos by Vivian Negrón-Ortiz*

U.S. Fish and Wildlife Service

Southeast Region

Florida Ecological Services

Panama City, Florida

August 2023

GENERAL INFORMATION

Current Classification: Endangered

Lead Field Office: Dr. Vivian Negrón-Ortiz, Florida Ecological Services, Panama City, FL, vivian_negronortiz@fws.gov

Reviewers:

Alabama Ecological Services Field Office: no comments received.

Lead Regional Office: Southeast Region, Carrie Straight, (404) 679-7226

Date of original listing: November 26, 1990 (55 FR 49046)

Methodology used to complete the review: In accordance with section 4(c)(2) of the Endangered Species Act of 1973, as amended (Act), the purpose of a status review is to assess each threatened species or endangered species to determine whether its status has changed and if it should be classified differently or removed from the Lists of Threatened and Endangered Wildlife and Plants (50 CFR 424.11). The U.S. Fish and Wildlife Service (Service) evaluated the biology, habitat, and threats of the *Spigelia gentianoides* (Gentian pinkroot) to inform this status review.

We announced initiation of this review in the Federal Register on May 13, 2022 (87 FR 29364). We received no public comments during the 60-day open comment period; however, key stakeholders were contacted while the review was being written, and various documents and communications were received. This review was accomplished using information obtained from the 5-yr reviews of 2009 and 2018, unpublished field survey results, reports of current research projects, peer reviewed scientific publications, unpublished field observations by Service, State and other experienced biologists, and personal communications.

FR Notice citation announcing the species is under active review: 87 FR 29364 (May 13, 2022): Endangered and threatened wildlife and plants: 5-Year Status Review of 35 Southeastern Species.

Species' Recovery Priority Number at start of review (48 FR 43098)

2. This ranking is based on a high threat due to habitat destruction, a high recovery potential, and its status as a species.

Review History

Previous 5-year reviews on January 21, 2009 and September 21, 2018 both recommended no change in status (Service 2009, 2018).

REVIEW ANALYSIS

Listed Entity

Taxonomy and nomenclature

Spigelia gentianoides Chapman ex A. de Candolle is a small, perennial herbaceous plant of about 10-30 cm long and belongs to the Loganiaceae. Gentian pinkroot was first collected in north Florida by Alvan Wentworth Chapman in 1837, probably from the west side of the Apalachicola River, in either Jackson or Calhoun counties. At the time the Recovery Plan was issued, the species was comprised of two varieties (variety *gentianoides* and variety *alabamensis*) (Gould 1996). Morphological and molecular studies reassessed the appropriate ranks of these varieties and elevated variety *alabamensis* to species, *S. alabamensis* (K.R. Gould) K.G. Matthews & Weakley (Weakley et al. 2011; Service 2018). Although we accept this change, we will continue to assess *S. alabamensis* in this review until its conservation status is determined.

Distinct Population Segment (DPS) (61 FR 4722).

The Act defines species as including any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate wildlife. This definition limits listing of a DPS to only vertebrate species. Because the species under review is a not a vertebrate, the DPS policy does not apply.

Recovery Criteria

Recovery Plan

Recovery plans are not regulatory documents and intended to provide guidance to the Service, States, and other partners on methods of minimizing threats to listed species and on criteria that may be used to determine when recovery is achieved. If the recovery criteria defined in the plan are still valid, meeting recovery criteria can indicate that the species no longer requires protections under the Act. However, when recommending whether a listed species should be delisted, the Service must apply the factors in section 4(a) of the Act (84 FR 45020).

The Recovery Plan was written and approved on 24 January 2012 and amended on November 7, 2019. The amended Recovery Plan lists three delisting criteria:

1. Existing core populations [Apalachee Wildlife Management Area (Apalachee WMA), TNC Spigelia Preserve (Spigelia Preserve), Three Rivers State Recreational Area (Three Rivers SRA), Rock Hill TNC Preserve (Rock Hill Preserve), and Geneva State Forest (Geneva SF)] are restored and properly managed, and monitoring demonstrates that the populations are stable or increasing over multiple 4 prescribed burn cycles, evidenced by a type of natural recruitment and/or multiple size classes (addresses Factors A, D, and E).

Management related to this criterion is ongoing.

Management and monitoring. Fire management practices, i.e., winter burns, implemented by The Nature Conservancy (TNC) on their properties (Calhoun and Washington counties) and reduced soil disturbance practices, have resulted in a slight increase of *S. gentianoides* on Rock Hill Preserve. Currently, it is unknown the plant status at the Spigelia Preserve, but the last survey only found five plants, suggesting a 17% decline. The unit in Geneva SF has been burned every 3 years (R. Metzler, Alabama Forestry Commission, 06/16/2023, pers. comm.). A summer burn is scheduled for July/August 2023 (as the weather allows), followed by a site visit a month post-fire to determine how plants respond to fire (Ray Metzler, Alabama Forestry Commission, 06/16/2023, pers. comm). Growing season prescribed burns were implemented at the Three Rivers SRA and Apalachee WMA (2-year fire return interval) for several years. See Table 1 for estimated plant counts.

2. At least five (5) new populations are discovered or established within the historic range of the species on lands protected by a conservation mechanism. These populations should exhibit stable or increasing trends over multiple prescribed burn cycles, evidenced by a type of natural recruitment and/or multiple size-classes (addresses Factors A and E).

Spigelia gentianoides inventories are continuing since the listing of the species in 1990. At the time the species was listed, only three populations from Florida were known. Since then, additional populations have been found in Florida, two new sites were noted in 2013 (FNAI 2017), two sites are extirpated, and new findings have extended the species range into Alabama (Fig. 1). Inventories in 2018 failed to find new sites with *S. gentianoides* plants at 35 locations in southeast Alabama (Service 2018). No other inventories on potential suitable habitats have been done since 2018; therefore, *this criterion has not been met*.

3. Threats to *S. gentianoides* and its habitat (e.g., exotic species, site disturbance, urban development, hurricanes) have been managed and reduced to ensure the persistence of *S. gentianoides* into the foreseeable future (addresses Factors A, D, and E).

This criterion is ongoing and has not been met. Quantifying the impacts of threats on *S. gentianoides* populations is necessary to understand the persistence of populations and ability of this species to recover to pre-disturbance levels of abundance. Data is currently being collected to address threats and site disturbances due to hurricane and salvage logging post-hurricane [FNAI 2021, FNAI 2023, (pers. comm.)]. See ***Factor analysis A & E*** *for details on threats.*

Biology and Habitat Summary

The previous 5-year reviews (Service 2009, 2018) and the 2019 amended Recovery Plan provide details on the life history and biology, i.e., propagation and ex-situ collection (Service 2019), that will not be repeated here (Service 2012, 2018, https://ecos.fws.gov/ecp/species/4583).

Spigelia gentianoides is a perennial herbaceous plant of about 10-30 cm long. Recent studies by Shotts (2021) indicate that *S. gentianoides* at Geneva SF can reproduce in the absence of

pollinators. The study also confirms the presence of secondary pollen presentation (pollen was observed in the short bristles of the style), a system that promotes xenogamy (fertilization of a flower by pollen not from the parent plant) or autogamy (self-fertilization). Regarding pollination, visitors were scarce and *Bombus* spp. visited flowers on rare occasions. Insect visits were observed between noon and 7 p.m., and when they occurred, the insects could have carried out some level of pollen transfer by being attracted by the floral reward (nectar).

Spigelia gentianoides can be found growing as a solitary individual or in small clumps in predominately well drained upland pinelands where it is a component of a fire-maintained longleaf pine-wiregrass ecosystem, in areas where limestone outcrops and calcareous soils are widespread, and in soils somewhat dry but rich in humus. It is also found in pine-oak-hickory woods (upland mixed woodland) at Apalachee WMA.

Currently, it is restricted to seven extant locations within four counties west of the Apalachicola River: Calhoun, Jackson, and Washington counties in Florida, and Geneva County in Alabama (Fig. 1, Table 1). As of 2018, these sites supported about 3,900 plants. The species was originally recorded from nine locations, but two are considered extirpated (Fig. 1, Service 2012). Of the seven extant locations, two new were noted in 2013 (FNAI 2017). The extant locations are located on both public and private lands in fire-dependent longleaf pine-wiregrass and pine-oak-hickory ecosystems.

As previously noted, the variant of *S. gentianoides* found in northern Alabama is now considered a full species. It is known to occur only in dolostone glades in Bibb County, Alabama with an estimated number of element occurrences of 6-20 in about 2,000-8,000 sq mi (NatureServe 2023). Of the 17 glades where the species occurs, several are protected by the Nature Conservancy (Service 2012). According to a recent study, *S. alabamensis* has two flowering peaks, early May and mid-June, and would not set seed in the absence of floral visitors Shotts (2021).

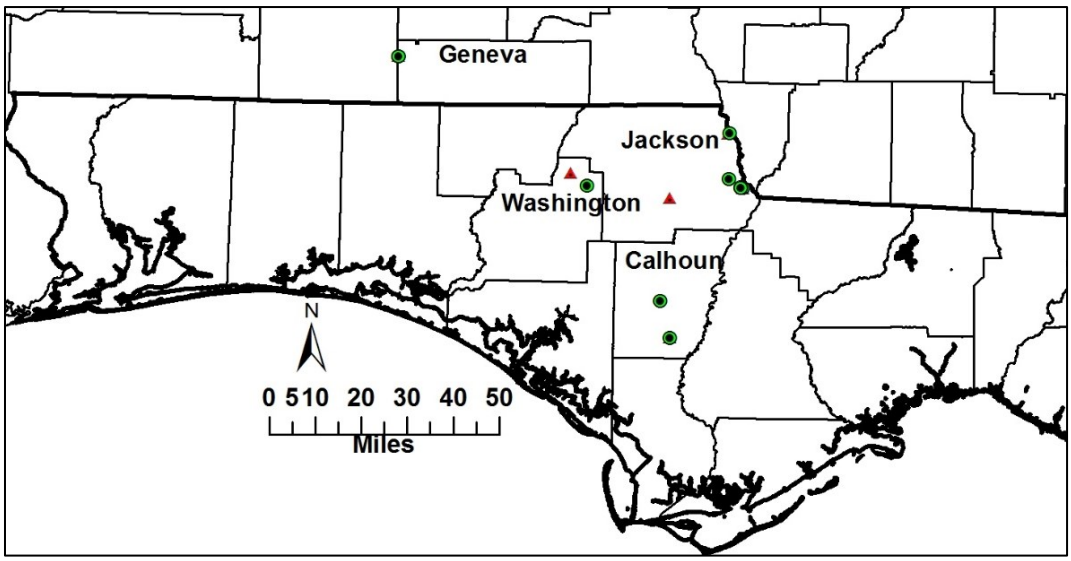

Fig. 1. Location of extirpated (triangle) and extant (circle) *S. gentianoides* populations in western Florida and extreme southern Alabama.

Table 1. *Spigelia gentianoides* locations and estimated number of plants from 2005 to 2023.

County / State	Location	2005-2011	2013-2018	2021	2023
Calhoun / FL	TNC Spigelia Preserve	32	30	5	0
Calhoun / FL	CR 4*		3	unknown	unknown
Jackson / FL	Anglin Tract**	3	unknown	3	3
Jackson / FL	Three Rivers SRA	< 400/600-800	~379	611	386
Jackson / FL	Apalachee WMA	1,746	1,895	2,875	2,094
Washington / FL	Rock Hill Preserve*		384	792	1,869
Geneva / AL	Geneva SF***	400	~1,200/ 500	^137	200-300
Bibb / AL†	Bibb County Glades	~3,600	over 1,000		2,500 - 10,000

* Sites documented in 2013.
** Plants have been surveyed since 2004 (G Anglin, 06/16/2023, pers. comm.).
*** A summer burn in July/August 2023 or as the weather allows is scheduled for that unit (R. Metzler, Alabama Forestry Commission, 06/16/2023, pers. comm.).
^ 2019 subset counts based on pollination studies by Shotts (2021):
† The population in Bibb County is currently considered a separate species, *S. alabamensis*. The 2018 counts correspond to two glades (Shotts 2021) and the estimated number of plants for 2023 was accessed from NatureServe (https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.131502/Spigelia_gentianoides).

Genetics, genetic variation, or trends in genetic variation

Genetic studies were conducted by Hershberger et al. (2015) and summarized in Service (2018). There has been no new information related to the genetics of the species since the last 5-year review (Service 2018).

Threats (Five-Factor Analysis) Summary

The status of a species is determined from an assessment of factors specified in section 4 (a)(1) of the Act. For threats or Five-Factor Analysis of *S. alabamensis* see Service (2018). The summary of current threats to *S. gentianoides* is below.

A. Present or threatened destruction, modification or curtailment of its habitat or range: Conversion of much of the upland forest land in the four counties to pulpwood plantations (clearcutting, mechanical site preparation, and pine plantations) has possibly extirpated other populations. Clearcutting and/or selective thinning are of concern since typical silviculture operations often result in soil disturbance and compaction. In particular, site preparation practices resulting in soil disturbance, change in canopy cover from tree harvest, and change in fire frequency and seasonality are of concern. Land conversion coupled with disruption of pre-historical and historical fire regimes of the longleaf pine-wiregrass ecosystem is responsible for the rapid decline of the ecosystem where *S. gentianoides* is found. Several studies have shown that frequent prescribed fire regimes are important for maintenance of longleaf pine-wiregrass ecosystem (Hiers et al. 2007). Prescribed burnings at 3 – 5 yr intervals seem to maintain optimal

S. gentianoides populations. However, areas at Apalachee WMA are on a 2-year fire rotation where the largest population of *S. gentianoides* appears to be stable. Geneva SF will also be implementing a 2-year fire rotation starting in 2024 (R. Metzler, Alabama Forestry Commission, 06/16/2023, pers. comm.) followed by plant surveys. It is unknown, however, 1) if frequent fires are detrimental to recruitment, and 2) the implications of fire seasonality to *S. gentianoides* survival.

Habitats converted to pine plantation and managed without fire have created a shaded canopy. In addition, pine plantation management induces severe soil disturbance. According to Kral (1983), *S. gentianoides* would not survive the mechanical site preparation used in pine monoculture. This observation seems accurate due to the fragile nature of these plants, but the population located at the Spigelia Preserve seems to have survived, at least over the short term, after cutting and planting. Nevertheless, the population exhibited a decline immediately after the last timber harvest. Similarly, the population on the Aglin Tract in Jackson Co. emerged in a former pine plantation, which is land that is currently managed for listed species under cooperative agreement with the State of Florida to manage the property.

Urban development also threatens *S. gentianoides*. Conversion of much of forest land to residential development has possibly extirpated many populations. More than a third of Florida's land is projected to be developed by 2070 along with a growth of about 33.7 million residents– almost 15 million more people than in 2010. The future scenario for the Panhandle predicts that it will be the least developed region of the state[1].

Catastrophic events, such as hurricanes, can cause habitat loss and fragmentation with unknown consequences to rare ecosystems and species (Henry et al. 2019). The impacts caused by hurricanes can't be minimized, but the time between a natural disturbance and logging seems to have important management implications as Leverkus et al. (2020) demonstrated that delaying logging post-hurricane can minimize the negative ecological effect of this practice. Post 2018 Hurricane Michael (HM) surveys and monitoring can provide some preliminary trends (FNAI 2021; C. Eckel, H. Rosner-Katz, A. Jenkins, FNAI, 06/26/2023, pers. comm.) on how *S. gentianoides* respond to salvage logging post-hurricane. To note is that multiple years of data are necessary to demonstrate accurate patterns and trends and how resilient are *S. gentianoides* populations since HM affected gentian pinkroot locations from minor to catastrophic (FNAI 2021).

- 2021-2023 preliminary data from 24 permanent plots established in Apalachee WMA, Rock Hill Preserve, Spigelia Preserve, and Three Rivers SRA suggest that
    - locations that did not receive salvage logging have a trend toward increasing, while those that did receive salvage logging have decreased in plant numbers (C. Eckel, H. Rosner-Katz, A. Jenkins, FNAI, 06/26/2023); therefore, the percent change in the number of plants appears to be associated with the severity of logging (Tables 1 & 2).
    - Rock Hill Preserve was burned before both 2021 and 2023 monitoring events, so the increased in numbers could be explained by a positive respond of plants to fire.

[1] http://1000friendsofflorida.org/florida2070/wp-content/uploads/2016/09/florida2070summaryfinal.pdf

- Spigelia Preserve had 5 plants in 2021 and were not relocated in 2023. This site was burned in 2020 and scraped over in 2021. Impacts to this site possibly account for the decline in plant number (Table 1), but it might also show a time lag in habitat regeneration or recovery.

Table 2. *Spigelia gentianoides* response to Hurricane Michael (HM) damage and salvage logging (SL) (FNAI 2021).

Location	HM damage	Salvage logging	Plant changes
Apalachee WMA	severe	No or low intensity around plants	Increase
Rock Hill Preserve	minimal	no	Increase
Spigelia Preserve	heavy	Y	Decrease
Three Rivers SRA	severe	Y	Decrease

B. Overutilization for commercial, recreational, scientific, or educational purposes:
There is no evidence of overexploitation of *Spigelia gentianoides*. However, other species within the genus have been exploited for their medicinal and/or poisonous properties (Rogers 1986). We have no evidence for *S. gentianoides* that Factor B is a threat at this time.

C. Disease or predation:
Neither diseases nor predation are currently known to be major threats to *S. gentianoides* or *S. alabamensis*. However, minor herbivore damage was noted at Three Rivers SRA and Geneva SF (Service 2018) populations.

D. Inadequacy of existing regulatory mechanisms:
The Endangered Species Act (Act) of 1973, as amended prohibits the removal of federally listed threatened and endangered plants or the malicious damage of such plants on areas under federal jurisdiction, or the destruction of endangered plants on non-federal areas in violation of state law or regulations or in the course of any violation of a state criminal trespass law. However, the Act does not provide protection for plants on non-federal lands unless it is in violation of state law. Overall, the regulatory mechanisms are not sufficient to protect the species from the threats identified in this review.

Florida. *S. gentianoides* is listed as endangered under the Preservation of Native Plant Flora of Florida Act (PNPFF Act) (Rule: 5B-40.0055, Section 581.185-187, Florida Statutes; https://www.flrules.org/gateway/RuleNo.asp?ID=5B-40.0055). The PNPFF Act addresses the protection of endangered, threatened, or "commercially exploited" plants (http://www.sfrc.ufl.edu/Extension/florida_forestry_information/planning_and_assistance/threatened_and_endangered_species.html). The removal of protected plants from a property, whether for transplant, sale, or any other purpose, requires both the written permission of the landowner and a permit from the Florida Department of Agriculture and Consumer Services.

Alabama. Alabama State Constitution provided the necessary authority to add plants to Alabama's section 6 cooperative agreement. Department of Conservation and Natural Resources has a policy to protect, conserve and increase the wildlife of the state [Ala. Code 9-2-2 (1)], but provides little direction as to how this is to be accomplished. While the state's Natural Heritage Program maintains lists of non-game species considered endangered, threatened, of special

concern or poorly known, it does not apply penalties for taking listed species or for altering their habitats. The Nongame Wildlife Program, which was started in 1984, helps administer endangered and threatened species projects on federally and state-listed species, and issues scientific collecting permits to enable a wide range of projects and collect the data for fishes, amphibians, reptiles, birds, and mammals (http://www.outdooralabama.com/wildlife/nongame-wildlife-program).

e. Other natural or manmade factors affecting its continued existence:
Non-native plants. Currently, non-indigenous plants within or near extant populations of *S. gentianoides* do not pose a threat. However, *Lygodium japonicum* (Thunb. ex Murr.) Sw. (Japanese climbing fern) and *Lonicera japonica* Thunb. (Japanese honeysuckle) have been found in the vicinity of *S. gentianoides,* and both are becoming problematic in areas of the Southeast.

Synthesis

Spigelia gentianoides small herbaceous plant found in fire-dependent ecosystems that has a very narrow distribution in addition to a low population density. It is currently restricted to four counties and seven populations in the panhandle of Florida and to the north into Alabama. In these locations, the plant's numbers range from three to about 2,000 individuals. Surveys indicate that the species declined at Spigelia Preserve and increased at Apalachee WMA and Rock Hill Preserve. The plant status remains unknown at Calhoun CR 4. A previous variety of *S. gentianoides* found in Bibb County, Alabama has been elevated to a full species, namely *S. alabamensis*. This species is found in 17 Ketona Glade locations in the county and has included thousands of plants, however, no recent inventory has been conducted.

The main threat to both *S. gentianoides* and *S. alabamensis* is habitat loss and modification. Conversion of much of the historical forest land to commercial pine plantations has possibly extirpated many populations. More than a third of Florida's land is projected to be developed by 2070 along with a growth of almost 15 million more people than in 2010; therefore, development pressures in the Florida panhandle are severe even though it's to be the least developed region of the state. Although some populations of *S. alabamensis* are protected by TNC ownership, properties under private ownership are still at risk of habitat loss and modification. Additionally, lack of habitat management (e.g., fire, removal of shrubs) reduces species abundance. One of the seven populations of *S. gentianoides* occurs on a private property where the landowner has a cooperative agreement with the State of Florida to manage his property. Populations on private property are potentially threatened by future development for home-sites, agriculture, logging of associated hardwoods, recreational facilities, or other purposes.

Spigelia gentianoides continues to meet the definition of an endangered species due to threats like habitat destruction or modification due to development, the plant's present narrow distribution, disturbances such as hurricanes, and its general low population numbers. Because some of the *S. gentianoides* populations have less than 30 individuals, any impact to existing populations could cause extirpation of these populations.

RECOMMENDATIONS FOR FUTURE ACTIVITIES

1. Establish protection and management agreements with landowners.

2. Conduct surveys/inventories on each known population. For each extant population, the following data should be collected once a year: the total number of individuals, number of flowering vs. non-flowering plants, presence of visitors to the flowers, and whether seedling recruitment is occurring.
3. Conduct a long-term study using populations distributed throughout the species' historical range for 10 years to document both distribution and abundance changes.

   Observations of flowering and fruiting are important and should be integrated with variables such as plant size and seedling data. Since gentian pinkroot occurs in fire prone habitats, the effect of this disturbance (including winter vs. growing season prescribed fire, fire frequency, intensity, duration, and timing) on survival and fecundity should be also monitored. Such studies should be conducted on large populations. Plants should be monitored several times during a 12-month cycle (e.g., flowering and fruiting seasons) the first year, then annually or biannually over an extended number of years.

4. Investigate if there is a soil seed bank persistence of seeds throughout the species' geographic range.
5. Conduct germination studies and investigate whether seedling recruitment is occurring.
6. Monitoring and managing for invasive species,

   Frequent inventories or surveys of the Florida populations for invasive plant species should be established, which will help with the early detection and eradication of small patches of exotic invasive plants within the sites. This is an ongoing action for the Three Rivers SRA population conducted by the Park staff.

7. Conduct surveys/inventories on potentially new sites in Northern Florida and other suitable habitats. This action can include the use of aerial photographs and species distribution models to determine potential sites, with subsequent field inventory of the site using a consistent, statistically valid, repeatable inventory method. If new populations are discovered, protection should be sought.
8. Reintroduce plants within the historic range, specifically in the sites where the plants have been extirpated.
9. Determine the long-term impacts of hurricanes and salvage logging on *S. gentianoides* populations.
10. Assess impacts of a reduced fire interval (2-year compared to longer 3- to 5-year interval) on populations of *S. gentianoides* including seed bank, seed germination, and recruitment. Specifically, to assess populations at Apalachee WMA and Geneva SF.

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RESULTS / SIGNATURES

U.S. Fish and Wildlife Service
Status Review of Gentian Pinkroot (*Spigelia gentianoides*)

Status Recommendation:

On the basis of this review, we recommend the following status for this species. A 5-year review presents a recommendation of the species status. Any change to the status requires a separate rulemaking process that includes public review and comment, as defined in the Act.

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist:
    ____ *The species is extinct*
    ____ *The species does not meet the definition of an endangered or threatened species*
    ____ *The listed entity does not meet the statutory definition of a species*
_X_ No change needed

Note: A detailed assessment of both *S. gentianoides* and *S. alabamensis* would be beneficial in the future.

FIELD OFFICE APPROVAL:

Acting for:
Division Manager, Florida Ecological Services Field Office, U.S. Fish and Wildlife Service

Approve WILLIAM BROOKS Digitally signed by WILLIAM BROOKS Date: 2023.08.29 09:34:58 -04'00'