

# Creole Pearly-eye Butterfly Monitoring near Jamestown in the Colonial National Historical Park

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Creole Pearly-eye (male). Photo by Ken Lorenzen



Creole Pearly-eye wing tip details. Photo by Ken Lorenzen



Pearly-eye caterpillar feeding evidence. Photo by Ken Lorenzen

## INTRODUCTION

Pearly-eyes belong to a group of butterflies known as satyrs (Lepidoptera: Nymphalidae). There are approximately 2,000 species of satyrs found world-wide, including almost 50 species in the United States (US) and Canada. Fifteen species of satyrs are found on the east coast, three of which are sibling species called pearly-eyes: the Northern Pearly-eye (*Lethe anthedon*), the Southern Pearly-eye (*Lethe portlandia*), and the Creole Pearly-eye (*Lethe creola*). These three satyrs are categorized as woodland satyrs because they prefer the dark interiors of forests and tend to remain close to the ground.

The Creole Pearly-eye is found in the southeastern US, ranging from parts of southern Virginia down to the Georgia-Florida border and west through parts of Kentucky, Tennessee, Indiana, Illinois, Arkansas, Missouri, Oklahoma, Mississippi, Alabama, Louisiana, and Texas.

The species is uncommon to rare throughout its range, and where populations do occur, they tend to be very localized – most likely due to host plant loss from habitat fragmentation, degradation, or total destruction. In Virginia, BAMONA (2018) has records for sightings of this butterfly in 10 southern counties and independent cities: Chesapeake, Dinwiddie Co., Greenville Co., Isle of Wight Co., Norfolk, Prince George Co., Pulaski Co., Suffolk, Surry Co., and Virginia Beach. According to NatureServe (2018), the Global Conservation Status ranking for this species is G3G4, indicating that the species has a low to moderate risk of extinction.

Adult Creole Pearly-eyes fly from mid-April to mid-September in some parts of their range, with up to three broods per year. According to Opler & Krizek (1984), there are two broods in Virginia: early June to early July and mid-August to mid-September. Adults do not nectar on flowers, instead obtaining nutrients from sap, moist soil, dung, carrion, and decaying organic matter. Wagner (2005) and Opler & Krizek (1984) state that Creole Pearly-eye caterpillars feed only on Switch Cane (*Arundinaria tecta*), a member of the grass family (Poaceae). The species overwinters in the caterpillar stage.

This butterfly inhabits dense, moist or wet bottomland forests, canebrakes, and the dense vegetation bordering swamps, as well as dense cove forests in the southern Appalachian Mountains. Males are reported to be most active during late afternoons or on cloudy days (BAMONA, 2018; Cech & Tudor, 2005; Opler & Krizek, 1984), often perching head down on tree trunks to await females. Males also have been reported straying to more open woodlands while females remain in the shady undergrowth (Opler & Krizek, 1984).

When comparing the three species of pearly-eye butterflies, male Creole Pearly-eyes are easily distinguished by their somewhat elongated forewings, which give the wings a “pointed” appearance. Another distinguishing character is that although the ventral forewing of all three species has a dark postmedian line inside the row of eyespots, only the Creole Pearly-eye has a raised bump, or “knuckle” feature (like the knuckle of a fist) in that line. This knuckle feature appears to always align with the topmost eyespot between forewing veins M1 and M2. Creole Pearly-eyes usually have five ventral forewing eyespots versus four typically found on Northerns and Southerns, but the number of eyespots is not diagnostic.

The antennal clubs of Creole Pearly-eye butterflies are typically black with orange tips, but the clubs can be completely black. Northern Pearly-eyes always have black antennal clubs with orange tips. Since the forewings of female Creole Pearly-eyes are not as elongated and the knuckle feature can be less pronounced, a female Creole Pearly-eye with orange-tipped antennal clubs can be difficult to separate from a Northern Pearly-eye of either sex. Southern Pearly-eyes have completely orange antennal clubs, so they are easily distinguished from Creoles and Northerns.

## Background

On August 15, 2016, in preparation for a US National Park Service (NPS) BioBlitz to be held in the Colonial National Historical Park, a survey was conducted by volunteers from the Historic Rivers Chapter of Virginia Master Naturalists (HRCVMN) and the Coastal Virginia Wildlife Observatory (CVWO) to assess butterfly activity and identify butterfly species observed at various NPS locations along the Colonial National Historical Parkway (Parkway) between Yorktown and Jamestown. In an area of the park near Jamestown, 12 Northern Pearly-eyes and a single Creole Pearly-eye were observed in the forest. This was the first known sighting of a Creole Pearly-eye in James City County and appears to be a northern extension of the range for this species on the Atlantic seaboard.

The following year, HRCVMN and CVWO volunteers requested permission from the NPS to do a follow-up survey in the same area near Jamestown where pearly-eye butterflies were observed in 2016. Permission was granted and the survey was conducted on August 9, 2017. No pearly-eye butterflies were observed at that location, so the survey team continued their search in other parts of the property where they used binoculars and cameras to identify two Creole and three Northern Pearly-eye butterflies.

Observing Creole Pearly-eyes during surveys conducted in two consecutive years suggested there might be an undiscovered breeding population of this rare butterfly in this area near Jamestown. This possibility provided the stimulus for us to submit a proposal to the NPS to conduct a more in-depth study in 2018. Our objectives were to search the area to: 1) locate host plants (Switch Cane) and if found, routinely examine leaves for evidence of Creole Pearly-eye caterpillar feeding; 2) determine if there are other locations on the property where Creole Pearly-eye butterflies can be observed; 3) determine the number and timing of Creole Pearly-eye broods; 4) compile a list of all butterfly species observed and the number

of individuals of each species observed; 5) compile a list of plants and trees in the area; and 6) make recommendations to the NPS about property management that will benefit and protect both Creole Pearly-eyes and their host plant. To accompany our proposal, we created a map outlining the area we wished to survey and identified the two locations where Creole Pearly-eyes were observed in 2016 and 2017, designated Site 1 and Site 2, respectively.

## METHODS

The search for Switch Cane was conducted by individuals or small groups traveling by foot, first exploring areas near Sites 1 and 2 where Creole Pearly-eyes were observed previously, then expanding the search to other parts of this area near Jamestown.

To document the number and timing of Creole Pearly-eye broods in the area, we conducted one butterfly survey per week from April 18 to July 31, and two or more surveys per week from August 5 through October 17. The 6-month time period encompassed the early June to early July and mid-August to mid-September flight times for Creole Pearly-eye broods in Virginia reported by Opler & Krizek (1984), and allowed for variation in the appearance of broods. Our surveys initially concentrated on the forest around and between Sites 1 and 2.

Butterfly surveys were conducted by individuals or small groups traveling by foot, using binoculars and cameras to help identify butterflies not easily recognized by sight. In the case of pearly-eye butterflies, we attempted to photograph every individual sighted because the close similarity in appearance of pearly-eye species often makes them difficult, if not impossible, to identify visually. This allowed us to study and compare images at a later time to confirm the species of each pearly-eye butterfly photographed, and eliminate duplicates of any individuals photographed more than once during a survey.

We recorded various kinds of information every time we conducted a survey, including: start and stop times, number of observers, general weather conditions, every butterfly species sighted, the number of individuals of each butterfly species sighted, and specific locations where pearly-eye butterflies were sighted. To avoid re-counting the same individuals while conducting surveys, we counted butterflies only as we moved forward through an area. If we had to retrace our steps, only butterflies not sighted during our first walk-through were counted along the repeated section.

All information recorded during each survey was organized and entered into a database for future analysis. At the end of the project a separate list of plants and trees was compiled, with particular scrutiny given to those locations where Creole Pearly-eye butterflies were observed. Surveys were conducted with care to minimize disturbance to the butterflies, habitat, and other wildlife.

## RESULTS

We began our search for Switch Cane in April. Thinking we would find cane close to the locations where Creole Pearly-eye butterflies were observed in 2016 and 2017, we began our search around Sites 1 and 2. Finding none, we gradually expanded our search area until we located two stands of cane on April 23.

Following the discovery of Switch Cane, we expanded our survey area to include both stands of cane plus the forest adjacent to and between the two stands. We expanded our survey area again on August 30 to include two previously unexplored sections of the area. The larger territory to explore meant that surveys required additional time to complete, which coupled with the limited number and availability of observers, prevented us from expanding the scope of our surveys any further.

## Caterpillar Feeding Evidence

According to BAMONA (2018), Creole Pearly-eye caterpillars feed at night and spend the day hiding at the base of cane plants. Ogard & Bright (2010) state that pearly-eye “caterpillars often feed at night.” The Alabama Butterfly Atlas (2018) states that Creole Pearly-eye caterpillars chew a “squared notch into cane leaves, which is typical of the satyrs.” Ogard & Bright (2010) state that most satyr caterpillars “chew distinctive squared-off indentations into host leaves, creating deeper, more extensive notches as they grow.” Neither source provided an image of this apparently characteristic pattern, but we did find cane leaves with distinct, squared indentations that we believe are the result of pearly-eye caterpillar feeding. We did not find any pearly-eye caterpillars on cane leaves or hidden at the base of cane plants during any of our surveys, but we did not commit a lot of time to searching for them.

We also found other feeding patterns typical of those produced by grasshoppers and katydids (rough-edged, scalloped-out holes within leaves or on the edges of leaves), and several instances where cane leaves had been rolled lengthwise and bound together by strands of silk. The latter type of feeding behavior is commonly caused by aptly-named leaf-rolling caterpillars (aka leafrollers), the majority of which are the larvae of butterflies and moths. In a few of the rolled leaves we opened we found caterpillars of the Dun Skipper (*Euphyes vestris*); in other leaves we found small caterpillars tentatively identified as *Crocidophora pustuliferalis*, a species of Crambid snout moth (Lepidoptera: Crambidae).

## Butterfly Surveys

We conducted a total of 35 butterfly surveys between April 18 and October 17. No surveys were conducted during the weeks of May 13-19 and July 22-28 due to inclement weather and the unavailability of observers. The number of observers participating in each survey ranged from one to four and the average time spent per survey was 1.9 hours (range = 45 minutes to 3.5 hours). For the entire project, observers collectively spent 134.7 hours conducting surveys.

Between April 18 and July 31, we conducted one butterfly survey each week depending on the availability of observers and the weather conditions. During our first survey we sighted just two butterflies (one individual each of two different species). We observed a slow rise in numbers each week through May 23 when we sighted 8 species and 16 individuals. On June 1, the numbers dropped slightly to 6 species and 13 individuals, and from June 8 through July 15 we sighted 5 or fewer species and 10 or fewer individuals. During our July 31 survey those numbers more than doubled to 12 species and 25 individuals. The increase in butterfly numbers, combined with the anticipated appearance of the second brood of Creole Pearly-eyes in mid-August, motivated us to begin conducting surveys at least twice per week, depending on the availability of observers and the weather conditions. The additional surveys created more opportunities for observing Creoles during the limited time we anticipated the second brood would be flying (approximately four to six weeks). If, from the beginning of this project, we had been conducting surveys in the larger area established on August 30, we may not have missed the first brood of Creole Pearly-eyes that we anticipated would be flying in June.

We did not set a specific time of day for conducting surveys, allowing observers to begin according to their availability and the weather. Some surveys began as early as 10:00 AM while other surveys began as late as 4:00 PM. Most surveys were conducted during the early to mid-afternoon, with an average start time of 1:30 PM and an average end time of 3:30 PM. Except as noted above, weather conditions were generally good when we conducted surveys, with clear to partly cloudy skies, calm or light and variable winds, and temperatures averaging 86.3°F (range = 70° to 93°F). Humidity was not measured.

The number of species sighted during a single survey ranged from 1 to 19. The highest number of species sighted during a one-month period was 28 in September. The highest number of butterfly sightings during a one-month period was 364, also in September. Over the course of the entire project, the total number of butterfly sightings was 874 and the total number of butterfly species sighted was 43.

Of the five most often sighted butterfly species, the Least Skipper (*Ancycloxypha numitor*) ranked first with 252 total sightings. At a distant second was the Summer Azure (*Celastrina neglecta*), with 85 total sightings, followed by the Eastern Tailed Blue (*Cupido comyntas*) at third, with 67 total sightings. At fourth and fifth were Northern Pearly-eyes (*Lethe anthedon*) and Appalachian Browns (*Satyrodes appalachia*), with 55 and 50 total sightings, respectively.

Our first Creole Pearly-eye butterfly sighting of 2018 occurred on August 16 at Site 2, and over the next six weeks we observed Creoles a total of 17 times during 11 surveys. Our last sighting occurred on September 29 at Site 3. Four sightings occurred at or near Site 2, and 13 sightings were clustered in the forest approximately 300 yards west of Site 2, a location we later designated as Site 3. No Creole Pearly-eye butterflies were observed anywhere else in the in this area during any of our surveys.

Most of the pearly-eye butterflies we encountered on clear or partly cloudy days were concealed in the Stiltgrass, taking flight only when we approached within a few yards of their hiding places. The butterflies usually re-settled quickly in the Stiltgrass or on a tree trunk or branch within several yards of their previous perch. We conducted two surveys under mostly to completely cloudy conditions, but contrary to reports that pearly-eyes are active on cloudy days (Belth, 2013; Cech & Tudor, 2005; Opler & Krizek, 1984), we did not observe any active flight. Instead, the pearly-eyes we encountered took flight only at the moment we almost walked into them, rather than several yards before we reached their hiding places. But clear, cloudy, or in between, we observed no pearly-eye flight activity except for the butterflies provoked into flight by our approach.

Every time we encountered a pearly-eye butterfly, we remained still and watched until it reached a new perch, at which time we moved slowly to a position where we could photograph the butterfly. However, some butterflies flew up to 10 yards or more before landing and in several cases, we lost sight of them before a species identification could be made or a photograph could be taken. Fortunately, we successfully photographed 102 pearly-eye butterflies out of 112 sightings. Five of the butterflies we photographed could not be identified to species due to a lack of visible characters in the images. Of the remaining 97 pearly-eye sightings we photographed and identified to species, careful examination of the images allowed us to determine that 24 individuals (18 Northernns and 6 Creoles) had been photographed more than once during a survey. Thus, the total number of individual pearly-eye butterflies we sighted during this project was 73 (55 Northern, 17 Creole, 1 Southern).

The Southern Pearly-eye (*Lethe portlandia*), together with six Northern Pearly-eyes and three Creole Pearly-eyes, was observed as we moved through the forest around Site 3. As with our 2016 discovery of a single Creole Pearly-eye at Site 1, we believed this was the first known sighting of a Southern

Pearly-eye in James City County and a northern extension of the range for Southerns. We were not completely surprised by the discovery because Creoles and Southerns have very similar ranges, often occur together in similar habitats, and both use Switch Cane as a caterpillar host plant (Alabama Butterfly Atlas, 2018; Cech & Tudor, 2005; Glassberg, 1999).

However, while preparing this document we became aware of an unpublished report by Chazal & Van Alstine (2002), listing plant and animal species recorded from the Jamestown Island area. Their lists were compiled from various sources, including field observations by staff from the Virginia Department of Conservation and Recreation, Division of Natural Heritage (DCR-DNH), and the Biota of Virginia (BOVA) database. [*BOVA is a joint project of the Virginia Department of Game and Inland Fisheries (VDGIF) and Virginia Polytechnic Institute and State University*]. Since both Southern Pearly-eye and Creole Pearly-eye butterflies were listed in BOVA, both were included in the report. The authors caution readers that “the resolution of [BOVA] data is not precise” and if BOVA “is the only database purporting the occurrence of a species within the search area .... its presence ... should not be assumed.” Field observations by DCR-DNH staff listed the Southern Pearly-eye, but there was no field observation of a Creole Pearly-eye by DCR-DNH staff. Thus, per the report’s guidelines, the Creole Pearly-eye BOVA listing can be disregarded.

As for the DCR-DNH field observation of a Southern Pearly-eye, based on methods described in the report, no specimen was collected and no photograph was taken (*i.e.*, the observation was visual only). But as we have learned from our own project, pearly-eye species are very similar in appearance and a visual identification is not necessarily a positive identification. Without a specimen or photograph to refer to, and no indication of what characters were used by DCR-DNH staff to verify the Southern Pearly-eye sighting, we consider the validity of the observation to be suspect. Additionally, VDGIF reported through its Virginia Fish and Wildlife Information Service (VFWIS) database that Southern and Creole Pearly-eye butterflies were *not* confirmed for the Jamestown Island area. A current search of the VFWIS (2018) database, which includes BOVA data, lists no pearly-eye species for James City County. Therefore, we conclude that our August 15, 2016 sighting of a Creole Pearly-eye and our September 4, 2018 sighting of a Southern Pearly-eye are the first known *confirmed* sightings of these two species in James City County.

Nevertheless, observing all three pearly-eye species at the same time and place apparently marked a rare event. Porter (2016) reported finding all three pearly-eye species in the Tallassee Forest in Athens-Clarke County, Georgia and commented: “The presence of three virtually indistinguishable, but genetically distinct, species at the same time and in the same place is almost unheard of outside the tropics.” Pyle (2010) reported finding all three pearly-eye species at the same time on a farm in southern Illinois, and Cech & Tudor (2005) mentioned that all three pearly-eye species can be found together in parts of Arkansas. By using the BAMONA (2018) Regional Species Checklist generator and selecting random counties within states where the ranges of the three pearly-eye species overlap, we identified 28 counties in 10 states where sightings of all three species have been reported. However, this does not mean that all three species were sighted at the same time and place in any of those counties.

After finding the two stands of Switch Cane, we anticipated being able to observe Creole Pearly-eye butterflies on or near one or both stands, but none were ever sighted at either location. Instead, Creoles were observed only at Sites 2 and 3, well away from both stands of cane. According to Butterflies of Massachusetts (2018), “Northern Pearly-eyes are often more active at twilight” with “courtship [taking] place at dusk.” Tveten & Tveten (1996) state that Southern Pearly-eyes “fly late in the day and are active until dusk, with courtship occurring at nightfall.” This is likely true for Creoles as well, as indicated by

Belth (2013) who states that Creoles are most active at dusk and dawn. Based on these comments and our own observations, it appears that adult Creole Pearly-eyes congregate away from their host plants late in the day for the purpose of mating, then females return to the cane at dusk (or possibly at dawn the next day) to oviposit.

This behavior may explain the absence of adult Creoles on or near the cane during the times we conducted our surveys, as well as the presence of adult Creoles only in two fairly specific locations in the area. Many sources report that Creoles and Southerns occur together (e.g., Alabama Butterfly Atlas, 2018; Cech & Tudor, 2005; Glassberg, 1999), so there may be a natural predilection, perhaps even involving a pheromonal component, for comingling when pearly-eye species occupy the same habitat. This also may explain why two-thirds (36 out of 55) of our Northern Pearly-eye sightings occurred at or near Site 3, but further study of this interesting phenomenon is necessary.

Northern Pearly-eyes use a variety of woodland grasses (Family Poaceae) as host plants [e.g., Bearded Shorthusk (*Brachyelytrum erectum*), Orchard Grass (*Dactylis glomerata*), White Cutgrass (*Leersia virginica*)], but we did not try to identify all grasses in the area. According to the Digital Atlas of Virginia Flora (2018), the three examples given do occur in James City County, and Chazal & Van Alstine (2002) list Orchard Grass and White Cutgrass as present in the Jamestown Island area. NABA-NJ (2018) and the Maryland Biodiversity Project (2018) indicate that Northern Pearly-eyes in New Jersey and Maryland have adapted to using Japanese Stiltgrass (*Microstegium vimineum*), an invasive non-native grass, as a host plant. If Northern Pearly-eyes in this area also have adapted to using Stiltgrass as a host plant, this may explain the widespread distribution of Northern sightings. However, further study of the relationship between pearly-eye butterflies and Japanese Stiltgrass is needed.

## Habitat

We conducted our final survey on October 17 and as we followed our route through the area looking for butterflies, we also compiled a list of the plants and trees we observed. To save time, not all grasses were included. Sweetgum (*Liquidambar styraciflua*) was the predominant tree and Japanese Stiltgrass was pervasive and the predominant undergrowth. Based geographic location and types of vegetation observed, Patterson (2008) classified the forested areas near Jamestown as “Coastal Plain Loblolly Pine – Oak Forest” and the surrounding wetlands as “Tidal Freshwater Marsh”. In their unpublished report, Chazal & Van Alstine (2002) categorized this area as “*Pinus taeda* – *Quercus* (*alba*, *falcata*, *stellata*) Forest the Alliance”, and the surrounding wetlands as “Tidal Oligohaline Marsh”.

When we compared vegetation at locations where Creole Pearly-eye butterflies were sighted, we found considerable differences in diversity. We noted 51 species at Site 1, 36 species at Site 2, and 17 species at Site 3, with only 14 species common to all three locations. While there were differences between all three sites, Site 3 differed the most because it had the lowest diversity of vegetation, it was the only site with Golden Bamboo (*Phyllostachys aurea*) growing nearby, and it lacked wetland plants and grasses. We do not know if any of these differences contributed to the presence of all three species of pearly-eye butterflies at that location.

## SUMMARY AND RECOMMENDATIONS

We successfully accomplished the following project objectives: we located two stands of Switch Cane and we found possible evidence of pearly-eye caterpillar feeding; we discovered a third location where Creole Pearly-eye butterflies were present (Site 3); we compiled a list of all butterfly species sighted and their numbers; and we compiled a list of plants and trees observed growing in the area.

Our only unanswered question is the number of Creole Pearly-eye broods observable in the area. We anticipated the appearance of a first brood sometime in early June (Opler & Krizek, 1984), but no Creoles were sighted until August 16, the approximate date a second brood was anticipated. Prior to August 30 our surveys did not cover as much territory, which may explain why we did not observe the anticipated first brood. Or, it may be that there is only one brood of Creoles in this area – the brood we observed flying between August 16 and September 29.

Based on our observations, we are confident that there is a breeding population of Creole Pearly-eyes in this area near Jamestown, but the low number of individuals sighted indicates the fragility of the population. For that reason, it is important for the National Park Service to protect the two stands of Switch Cane. No other actions should be taken in or around those two locations that might result in harm to the cane or the surrounding forest, especially if the hydrology of the area would be affected.

As yet we do not know why Creole Pearly-eye butterflies have been observed at only three very specific locations in this area. Having encountered all three species of pearly-eyes at Site 3, we do not know if this was a unique occurrence or if pearly-eyes have gathered in that location in previous years and will continue to do so in years to come. Thus, until the behavior of this butterfly is better understood, we recommend that all forested areas included in our 2018 study be protected from disturbance, especially around Sites 1, 2, and 3.

For the next phase of this project, we would like to: 1) expand the search for Switch Cane to nearby areas to determine if other stands of cane are present; 2) continue our efforts to document pearly-eye caterpillar feeding; 3) conduct a further search in the original area for grasses that are known host plants for Northern Pearly-eye caterpillars; 4) conduct butterfly surveys at least twice per week from early May through early October in a continuing effort to document the number and timing of Creole Pearly-eye broods in the original area; 5) continue to record specific locations where pearly-eye butterflies are observed; and 6) continue to record all butterfly species and their numbers sighted in this area. If additional observers can be recruited, we would like to expand our survey area to include the forest areas on both sides of the Parkway east of this area that we were unable to explore in 2018.

## **ACKNOWLEDGEMENTS**

We would like to thank the following organizations and individuals for their assistance with this project: the United States National Park Service, Colonial National Historical Park, and especially Dorothy Geyer, USNPS Natural Resource Specialist, for approving our research proposal and granting permission for us to access this NPS property near Jamestown; the James River Association, especially Emily Cope, Regional Outreach Coordinator; the Coastal Virginia Wildlife Observatory; the Historic Rivers Chapter of Virginia Master Naturalists, including Lester Lawrence who assisted with the initial search for Switch Cane; and Allen Belden, for reviewing this document, sharing his expertise, and providing valuable comments and guidance.

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