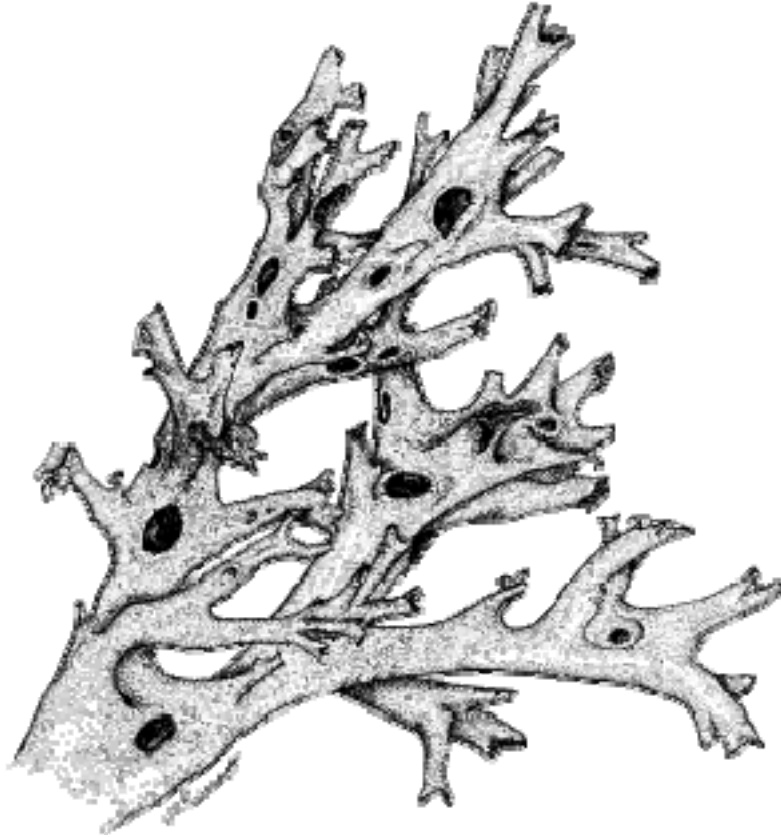


Potential Historic Distribution  
of *Cladonia perforata* in Escambia County FL  
to include Santa Rosa, Okaloosa and Walton counties



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## **Objective–**

This paper intends to ‘prove or disprove’ whether the listed endangered species of reindeer lichen known as *Cladonia perforata* currently inhabits sections of viable habitat in areas thrice recently disturbed by storms and whether it has been able to colonize new sites as yet undocumented.

Historically confusion arose because of original samples from 1945 and 1952 being marked as having been found in ‘Escambia’, yet *Cladonia perforata* has not ever been rediscovered or documented in the Florida panhandle outside of Okaloosa County. **[Fall 2010 Update: Those already familiar with Escambia *C. Perforata* labeling mystery are directed to the ‘Update’ section at the end of this paper. Research by the author, following presentation of this paper, has since cleared up this past confusion. TM]** The purpose of this project is to attempt to demonstrate -through attempted discovery of current undocumented populations- whether or not it is likely *Cladonia perforata* is or ever was in evidence on appropriate habitat in Escambia County. For good measure, other nearby coastal property determined by FNAI (Florida Natural Areas Inventory) to be potentially suitable habitat will be researched as well within a reasonable distance. These areas are to include Escambia County from the Ft Pickens and Gulf Island National Seashore properties in Escambia as well as protected dunes of Pensacola Beach, UWF property (east of Portofino development) on Santa Rosa Island, Opal Beach, and Navarre Beach Park, all in Santa Rosa county, Beasley Park and Henderson Beach State Park in Okaloosa county and Topsail Hill Preserve State Park in Walton County FL. The author readily points to other known populations of *C. perforata* which exist –notably in the protected areas of Eglin AFB- on the Florida peninsula, but stipulates that for the purposes of this project, the survey of distribution is herein limited to feasible –yet as yet unknown- locations of the so-named

Okaloosa population. It is believed that at a time of lower sea level previously, the population in Okaloosa likely would have been contiguous with the peninsular population. Okaloosa's *Cladonia perforata* is likely a relic population which survived a time when much more of Florida was under water. The Suwannee Channel-created Gulf Trough flowed through Florida, Georgia and into the Carolinas (Bryan 2008) separating what is modern south Florida from the panhandle. This seems the most likely reason Holocene habitat of Okaloosa *C. perforata* being removed from the main population in central Florida. (Mahar)

### ***Introduction***

*C. perforata* is endemic to Florida and has specialized hollow branches (called podetia) its uneven branching of 0.125 inch thickness forming a compressed cluster 1.5 to 2.5 inches across with *perforations* (hence the name) 0.04-0.06 inches wide. This is not to be confused with the similar, and more prolific *C. leporina* which is finer and with red fruiting parts.

33 species of lichen occur in Florida...Of the eight species of reindeer lichens found most often in Florida scrub, *C. perforata* is the most uncommon member of the scrub-lichen community by reason of its exclusive habitat and unusually disconnected distribution and overall global rarity, This author previously researched locations of *C. Perforata* on Eglin property with Jackson Guard verifying current/historic distribution of a portion of the population believed inadvertently not recorded on a recent map. This sparked the author's interest in expanding the search outside the known management boundaries of Eglin proper. This search shall be limited to coastal sand pine scrub of the subtype: rosemary. This will be the first search of the western end of Santa Rosa Island that this author is aware of, following Hurricane Ivan.

## ***History***

George Llano, an airman in the US Army Air Force (as it was then known) stationed at Eglin Field in WWII and a budding lichenologist not yet famous, was the first to ever collect *Cladonia perforata* apparently growing in the sand dunes of what is now Eglin Air Force Base's Santa Rosa Island property. In doing so he marked his samples as being from "Santa Rosa Island Escambia". These samples from 1945 were examined by Alexander Evans in 1952 who named them *C. perforata*. (Buckley and Hendrickson 1988). The lichen was not collected again until found by a researcher in Highlands County, central Florida in 1968. Little else was heard from this lichen again until lichenologists tried to find this rare combination of an algae and a fungus growing on Santa Rosa Island in Escambia –and couldn't.

In 1988, the Florida Natural Areas Inventory launched a search in the panhandle for the lost *C. perforata*. It wasn't easy. Evans had also collected on the panhandle. Maddeningly his labels from 1948 and 1953 also read "Escambia County" forcing a search of half of the 48-mile-long barrier island. The searchers scoured the designated area, finding no trace of *C. perforata*. It would seem implausible that professional lichenologists on three occasions would consistently note the incorrect location on their samples, especially when within sight of Eglin's main runway.

While FNAI searchers failed to locate *C. perforata* in 1988, it was found in 1989 by botanists Dr Gerould S Wilhelm and Dr James R Burkhalter, some miles east nearly to Destin.

Two dramatically different search results in two sequential years demonstrates the importance of searching only the particular habitat utilized by *C perforata* as well as correctly documenting the location of the original find correctly.

While samples were labeled as Escambia, holotypes (these fix a name to a taxon) on file were identified as “common on sand dunes of Santa Rosa Island FL Eglin Field 1945” Confusion ensued as to the original location of the *initial* find. George Llano revisited the area in the 1950’s to try to solve the mystery and the site he selected as being the original location was under the pavement of a liquor store. This did not help matters in as much the site chosen was neither in Escambia County nor was it on Eglin Air Force Base property. By 1986 this local (originally documented) population was believed destroyed.

Prior to it’s rediscovery on Santa Rosa Island, it was later found in a mosaic of patches at several other Florida locales from Port St Lucie on the Atlantic, to Sarasota on the Gulf of Mexico to the New Wales Ridge gunning north and south between the two from just south of Orlando.

### ***Location***

This researcher plans to seek out *Cladonia perforata*, after personal communication with researcher Dr Rebecca Yahr (now of the Royal Botanic Garden Edinburg) who suggested possible types of habitat based upon her previous work on Santa Rosa Island. The planned search area covers the Florida panhandle coast from longitude -87.29W near Ft Pickens in Escambia County to -86.29W near Santa Rosa Beach in Walton County ranging from between 30.31N and 30.37N latitude and limiting the search predominantly to rosemary balds and immediately surrounding disturbed areas. This represents an area just bordering on the subtropical with average January temperatures of 44-56F and July averaging 74-86F with annual (fully humid) precipitation along the coast of 65 inches. The search will be limited to seasonally flooded areas otherwise visibly populated with knolls of rosemary scrub.

In 1991, responding to the new finds of *Cladonia perforata* both on the peninsula and in the panhandle, the Florida Natural Areas Inventory (the FNAI is administered by Florida State University with funding from the Florida Dept. of Environmental Protection as well as Florida Fish and Wildlife) surveyed 110+ sites throughout Florida's interior and coasts to determine the status of this extremely rare lichen.

Of those, only a dozen sites were located with a population of *C. perforata*. three Eglin Air Force Base sites in Okaloosa County, (two of which were decimated by Hurricane Opal) and several other more recently discovered south Florida locations. There are currently 30 sites for *C. perforata* known including four disconnected areas. These include the Atlantic coastal region around Port St Lucie, the Gulf Coast region around Sarasota, the New Wales Ridge in the center of the Peninsula and the farthest region, supporting the only remaining North Florida sites, is defined as being the section of Santa Rosa Island in Okaloosa County. This is approximately 400 miles northwest of the nearest population. FNAI deems there to be suitable habitat elsewhere along the northern gulf coast. This search (and others likely to follow) will determine whether *C. perforata* has arrived and colonized suitable habitat or recolonized areas it existed in previously without being discovered. In current viable habitat where *C. perforata* 'should' occur, it has been documented on only 8% of possible locations (according to research from Archbold Biological Station) and has not been documented further than 0.497 miles from the nearest population. Generally individuals are within 150ft of the nearest member of the population. This raises the question of dispersal among the four known areas, especially the far removed sites in Okaloosa.

Central Florida's Lake Wales Ridge supports the bulk of the known sites for *C. perforata*. However the Eglin site on Santa Rosa Island supports a large and relatively undisturbed

population, now protected by fencing and signs at an elevation sufficient enough to protect it from storm wash-over and this particular location is an area where this reindeer lichen is most abundant. Many other sites include only scattered individuals making population estimates problematic. The Santa Rosa Island site however also includes large mats of this species both mixed with *C. Leporina* but also made entirely of *C. perforata*. The success of this location should be a good predictor for habitat for other successful *C. perforata* populations, presupposing a viable means of dispersal is present.

The type locality, (meaning original area of the find) which was reported from Escambia County on the west of Santa Rosa Island, was likely reported in error according to Wilhelm and Burkhalter (1990), who rediscovered *C. perforata* on the eastern end of the island in 1989. There was a small wildfire on the island “by the seawall in 1993” reported anecdotally by an Eglin old timer but it is not known if any unidentified populations of *C. perforata* were lost. The disturbance by fire, rare on the island would have created opportunities for this lichen to colonize though it may have also erased some lichen in the process. Fire is important to the lichen at elevations too high for routine flooding though it is slow to recolonize fire disturbed locales (Yahr 2005). Sadly, some sections of the 1989 find were subsequently destroyed by Hurricane Opal in 1995.

Such a mistake in indentifying the location of a –then- never before recorded lichen sample, to be made by a lichenologist who would later be world famous for his globe trotting lichen studies seems implausible considering the Eglin AFB location located on the island is within direct sight of the Eglin Main runway and the original researcher was a military man based there. Part of the reason for this search is the certainty this author has that the original searcher George Llano knew where he was, or certainly should have.

The western part of the island has scrub which would be suitable habitat for *C. perforata* but has apparently not been surveyed in twenty plus years. This project will search the island locating viable habitat and then searching those particular areas for *C.perforata* to determine whether ‘Escambia’ was ever a correct location label or alternatively whether the lichen has succeeded in colonizing here in the intervening years.

In as much as *C. perforata* is little understood, nor is much known about natural dispersal outside of being physically displaced (kicked by an animal or blown by the wind). It is readily pointed out here that finding a new population or rediscovering one found previously would cause just as many questions to be asked as it would answer. It is not within the scope of this simple project to determine how events could transpire, such things will be left to the botanists and biologists, rather this author attempts to determine whether it was originally in Escambia or whether it could or has colonized undocumented locations on Santa Rosa Island.

Today’s patchy mosaic of *C. perforata* distribution, seen in the fragmented scrubland on high white sand ridges of central Florida as well as the higher dunes of Santa Rosa island may reflect all or may reflect only a part of the historic range of this particular endangered lichen. All the more reason to conduct a further search of the appropriate habitat especially considering the potential for colonization of disturbed sands following multiple hurricanes followed by years of calm (preceding 2010).

Researchers (Hilsenbeck and Muller 1991) observed it is “difficult to count such a small and inconspicuous organism.” Indeed, of all the government agencies owning land with known *C. perforata* populations, only the DOD’s Eglin AFB has an active monitoring program in place. The specific conditions of *C. perforata* microhabitats do require further investigation and today can be generally described as having these three associated plant species in succession: sand

pine (*Pinus clausa*), which dominates the tree-layer (although the actual canopy may be sparse or missing entirely), scrub oaks (*Quercus myrtifolia*, *Q. geminata*), which are clumped and scattered throughout, and Florida rosemary (*Ceratiola ericoides*), which dominates the shrub layer. *Cladonia perforata* typically occurs in open patches of sand between groupings of rosemary (or at its base) and in areas with sparse or no herbaceous cover. Of these, rosemary is the most important and *C. perforata* will not be likely to occur far from populations of such. This has been demonstrated across the Archbold Biological Station where populations also abound and for this reason only the mosaic of patches known as Rosemary Balds will be searched for this project..

Why Rosemary? Though this is not yet entirely known, since lichen is a combination of individuals from both the Algal and Fungal kingdoms, it is likely that one or the other element requires a biological or chemical component found only with this particular rosemary. Further study is required to determine the actual requirements of this particular reindeer lichen.

The importance of *Ceratiola ericoides*, which itself is listed as threatened, is that it harbors other endangered species in its same habitat *which don't exist where it is absent*. This includes not only this project's subject lichen but also the sand skink *Plestiodon reynoldsi* of interior Florida. Researchers acknowledge that Sand Skinks are difficult to detect and might be found in suitable habitat if searched for sufficiently. *Plestiodon* has never been documented in the Florida panhandle.

*C. perforata* occurs at relatively higher elevations than surrounding areas, on excessively well drained, nutrient-poor, acidic (5-6%), white sands of the most xeric (driest) micro sites even within rosemary scrub. This sand is of the Newhan Series and is thermic, uncoated Typic

Quartzsaments, meaning general quartz sands with an annual soil temperature of 59-72F and slopes ranging from 2-30% (Pizzolato pers comm. 2010).

The Okaloosa County sites of *C. perforata* are on continuous white sand coastal scrub dominated by rosemary and also downslope into areas of gallberry (*Illex glabra*) swales.

How *C. perforata* got to the island originally is unknown as neither spore-producing structures nor soredia are known from this particular lichen and it is believed only to reproduce clonally. Insofar as we know, the main form of reproduction is by way of simple vegetative fragmentation. The biological and ecological aspects of this species are little known other than its being limited to a very specific xeric habitat with a disturbance regime. It can occur in monospecific mats or in mixed-species mats with *Cladonia leporina*, forming tangled mixed-species clumps. It is found on white sand coastal dunes but not on upland sand hills composed of darker minerals. It can however persist in dense sand pine scrub on a mat of dry needles awaiting a future disturbance as witnessed by Rebecca Yahr (then of the Archbold Biological Station now of the Royal Botanical Gardens Edinburgh UK) in 1995 while working on Eglin AFB. In this scrub, roughly 30% of the bare sand persists for more than 25 years allowing ample opportunity for lichen to colonize.

Further research found however that *C. perforata* trends downward in dominance in sites that have not burned in more than 20 years likely due to increased amounts of ground litter accreting which would lead to a loss of direct contact with *C. perforata*'s preferred dry ground.

While habitat loss is the most critical element in protecting lichens, it should be noted that *C. perforata* requires disturbance. So ironically the very disturbance which harms it, allows it to thrive in newly exposed areas. It will recolonize burned or flooded areas as soon as it is relocated there naturally and though it will be harmed initially, say by an off road vehicle, others

parts of the population will be likely to move into the newly disturbed tracks left behind in the white sand. Likewise, wash over, such as from hurricanes will clear large areas for *C perforata* to colonize over time as the redeveloping beach reforms itself. This time frame is in years and requires first grasses, dunes and then rosemary before *C perforata* would colonize. Lastly, the most likely means of dispersal seems to be physical relocation by means of feet or wind. It should be noted the very feet which could trample it, could also relocate it, allowing colonization.

We are fortunate that roughly half of the existing populations of *C. perforata* currently inhabit land dedicated to conservation. The Okaloosa County site, the existence of which resulted in this study, occurs on a beach/dune habitat restricted to such vehicular and foot traffic though it was formerly open to the public. The threat of such a disturbance resulted in Eglin AFB fencing off the singular remaining publically accessible site.

Two previously recorded Okaloosa County sites on island property of Eglin AFB supported small populations of *C. perforata* but were believed destroyed with Hurricane Opal's arrival in October 1995 when large areas of Santa Rosa Island were either washed clean of all terrestrial lichens or were simply flooded with salt water from the gulf. Estimates are that >50% of the potential habitat of *C. perforata* on the east end of the island was unfavorably affected by the storm, and ~70% of the lone surviving population did not survive (Teague 2000). The area was then further degraded –at least temporarily, since disturbance is a requirement of this lichen- by Hurricane Ivan in September 2004 and only 10 months later by Hurricane Dennis in July 2005. [It is worth noting here that the USGS reported Hurricane Ivan generated an 89 foot high storm wave -in the gulf- considered to be the highest and most intense ever registered. A small amount of reindeer lichen, reintroduced by Rebecca Yahr and others, did survive Ivan.

Throughout its distribution, *C. perforata* is considered rare. In regularly over-washed or otherwise flooded systems, high dry sand balds with rosemary may serve as refuge from the wet conditions which do not favor *C. perforata* survival. It should be noted that these higher dryer spots would allow it a launch pad for distribution as it awaits a proper wind. Therefore there refuge spots provide a ready source for recolonizing disturbed areas which could allow a local population to recover after an otherwise devastating event. This is most important since while other lichen may disperse through spores, *C. perforata* cannot. Wind is seen as the singular most frequent element in dispersal of either vegetative parts or entire individuals to new micro-sites for colonization.

In the late 1980's, a researcher collected data on the occurrence of vascular plants and ground lichens .He found that larger less isolated patches tended to be more herbaceous and predicted that these patches are suitable for *C. perforata*, but are not occupied merely because the plants have not arrived and colonized. A similar observation would later be made by this author.

With Air Force support, researchers Rebecca Yahr and Paula DePriest started a series of small-scale experimental reintroductions of the lichen to endeavor to learn the best colonization protocols. The Air Force and U.S. Fish and Wildlife Service considers this reintroduction project important in the long range recovery of *Cladonia perforata* in northwest Florida and the lichen survives to this day. Initially believed difficult to do, eventually Yahr's research demonstrated no difference in success in introducing *C. perforata* to either inhabited or uninhabited sites. Apparently, it is successful whenever the correct habitat is available, and all it requires is transport to the habitat. This shows that rosemary scrub is likely a constantly shifting mosaic of patches wherein the players all enter and exit the stage (Yahr 2001).

Five years after Hurricane Opal, remnants of the original larger population of *Cladonia perforata* were reported to be doing well. The same holds true today just over 5 years following Hurricane Ivan as this researcher recently witnessed.

***Methods and techniques:***

A remote aerial survey of known and suspected habitats for rosemary clusters were used for this project as well as was utilization of the FNAI biodiversity matrix to locate particular sites likely to hold all the species required for *C. perforata* to be present including sand pine, Florida rosemary, *C. perforata* and gallberry. Maps, photos, and a FL DEP State Park Research permit in hand (and a US National Park applied for) all suspected viable habitat of Santa Rosa Island and adjacent Moreno Point was checked on foot. Due to the extreme rarity of this lichen, if any of the endangered lichen found, the permit required that it not even be handled only that its location be recorded. There were no collections made. Photographs were made to aid in determining exact location searched.

It was expected there were further sites outside the protected area which may have not been documented. Again this survey only covered the Florida panhandle counties of Escambia, Santa Rosa, Okaloosa and Walton. This will be further be limited to Holocene age white sand deposits based on potential habitat type and availability, further searches into and along Bay, Gulf and Franklin counties to the east are advised as they are not believed to have been inundated by the Suwannee Channel from the Gulf to the Atlantic discussed elsewhere in this paper and therefore may have viable habitat.

### **Results/Research:**

With these words from *C. Perforata* expert Rebecca Yahr to myself in mind: “it occurs strictly on white sands. Especially with other lichens and *Ceratiola* (FL rosemary). It does creep down to swales in Okaloosa, but I suspect only in between large disturbances of long periodicity.” (Yahr, personal communication to Mahar) I began a search of Santa Rosa Island and the mainland state parks of Henderson Beach and Topsail.

**January 14** Search through eastern Topsail dunefield enshrouded in fog. Large populations of lichens were located between No Name Lake and Campbell Lake, but none were *C. perforata*

**January 28** Eglin/Santa Rosa Island *Cladonia perforata* survey to verify coordinates and verify location of a previous population not documented on most recent map. Successfully located *C. Perforata*.

**February-19** Search through western Henderson beach public area nature trail. Found large quantity of *C. leporina*, but no *C. perforata*.

**February-24** Search through western Topsail. The area was disturbed by prescribed fire to the north, and rain events which had opened Morris Lake to the gulf on the south. Again, lichens were found along with the rosemary, but no *C. perforata* was in evidence.

**April-8** Search of Santa Rosa Island starting with Navarre (formerly State) Park, Opal Beach area of Gulf Islands National Seashore, UWF property east of Portofino development, protected dunes of Pensacola Beach, Gulf Island’s National Seashore Ft Pickens area including the Fort itself as well as Advanced Redoubt, and several other ‘high and dry’ areas. More East on Santa Rosa Island, I also checked Beasley Park and the Gulf Island National Seashore’s Okaloosa District which border’s Eglin property. In none of these varied locations was *C. perforata*

located though the lichen it frequently forms multi-species mats with *C. leporina* was found in abundance.

### ***Conclusion.***

It was determined, after exhaustive searching in the many locations mentioned, that at the present time, it is not possible to discern whether or not *Cladonia perforata* indeed existed in Escambia as so claimed by Eglin Field's George Llano in 1945. Whereas the island has been over washed many times recently, leaving only the higher elevations as likely habitat for this endangered lichen, and whereas all such elevations this searcher could identify were personally searched resulting in finds of the appropriate pine and rosemary-bald habitat but not ever including *C. perforata*, it is not possible to state with any degree of certainty that it the lichen originally existed in Escambia. It remains implausible that multiple researchers could be wrong as to which county they were in upon making their finds. It should be noted that there was not as much Florida rosemary found as expected, and this being the key factor in the suitability of habitat for *C. perforata*, obviously played a mayor role in the lack of success in finding the lichen.

It is further duly noted that the Florida rosemary that was found was at a lower elevation than this researcher had been lead to expect based on the current scientific literature. This seems likely to have been caused by alteration of the habitat by storms. The highest/driest dunes tended to be devoid of rosemary altogether, which resulted in a lack of lichen, as were the dune swales. The areas with the greatest rosemary populations were, as one might expect those within Ft Pickens and Topsail parks, these being the largest tracts of land and best preserved. These were also the furthest from the known *C. perforata* sites.

Based upon this search by foot, between January and April 2010, this author can say only that the endangered lichen *C. perforata* currently protected by Eglin AFB and found only within the confines of it's lands, 'may' have been found in Escambia as originally noted. But there is currently no evidence of its existence elsewhere outside of those areas upon Santa Rosa Island specifically located in Okaloosa.

***Update Fall 2010***

Further historic map research indicates:  
during the original *C. Perforata* discovery in 1945,  
**George Llano was indeed standing in Escambia County**  
at the tip of Santa Rosa Island,  
Though he was within site of Eglin Field  
across Choctawhatchee Bay.

It was not until after the war in 1946,  
When Okaloosa County received deed to three miles of beachfront  
previously belonging to the War Department, National Park Service and  
Escambia County, that the maps changed.

Based upon this finding, Llano is proven to have correctly identified his  
original location as Escambia County and there is no reason to expect  
discovery of *C. Perforata* within modern Escambia County's Santa Rosa  
Island boundary further west.

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