On the Distribution and Ecology of Ceratopteris in Surinam

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In his preliminary revision of the genus *Ceratopteris* Benedict (1909) distinguished four species: *C. thalictroides* (L.) Brongn., *C. pteridoides* (Hook.) Hieron., *C. deltoidea* Benedict, and *C. lockhartii* (Hook. & Grev.) Kunze. Two more names were said to deserve further investigation: *C. cornuta* (Palisot) LePrieur and

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C. gaudichaudii Brongn. Since then the first four have not been in dispute, *C. cornuta* has become generally recognized, and *C. gaudichaudii* has remained doubtful (Fosberg, 1958).

Most of the species of *Ceratopteris* are widely distributed. *Ceratopteris thalictroides* occurs in tropical Asia, Australia, and America (Benedict, 1909; Morton, 1967). *Ceratopteris pteridoides* is known from tropical America, subtropical South America, and continental tropical and subtropical eastern Asia (De Vol, 1957). *Ceratopteris deltoidea* is now known only from Florida, Central America, Jamaica, Porto Rico, Guyana, and Surinam. It has probably disappeared from Louisiana (Benedict, 1909; De Vol, 1956). *Ceratopteris lockhartii* is known from Trinidad, Guyana, and French Guiana (Benedict, 1909), *C. cornuta* from tropical and subtropical Africa, and *C. gaudichaudii* from Guam.

Three of the species have been collected in Surinam, and will be discussed in detail. *Ceratopteris lockhartii*, which has not been reported since Benedict (1909), is to be expected, and has been found in Guyana and in French Guiana. The following notes on the distribution and ecology of *Ceratopteris* in Surinam are based on literature, herbarium specimens at Utrecht, and on personal observations made from 1964 to 1966.

Ceratopteris thalictroides occurs generally in the swamps of the coastal area. Lindeman (1953, Table I col. 2 & 3 and p. 120) presented two vegetation records from the Nickerie district, with *C. thalictroides* erroneously cited as *C. deltoidea*. This vegetation, occurring in 10–20 cm of oligohalinic water (wet season) over a layer of 10 cm of peat on clay, is dominated by *Eleocharis mutata* or *Cyperus articulatus* with the *Eleocharis* as co-dominant species.

During the severe dry season of 1964, large areas of swamp forest in the Perika River area burned, and even thick layers of the peat soil were destroyed by the fire. *Ceratopteris thalictroides* penetrated into the newly formed open water from the shallow ditches traversing this area. Both in the ditches and in the new habitat it occurs now in 20–60 cm of water during the rainy season, whereas in the dry season there may be hardly any water or even no surface water with just a soaked substrate.

The main vegetation types in which *C. thalictroides* occurs are (1) floating patches of *Salvinia auriculata* or *Utricularia* sp., (2) floating mats dominated by *Jussiaea leptocarpa*, and (3) vegetation rooted in shallow water, principally of *Calathea comosa*. In all cases the ferns float or are rooted, but in none can they drift freely, because either the water is too shallow, the locality is too sheltered, or they are confined by a dense growth of other plants. Other records from northern Surinam agree with the above data.

Outside of Surinam the species has been observed mainly rooting in mud or floating in shallow water (Benedict, 1909; Backer and Posthumus, 1939, p. 252; Copeland, 1958, pp. 164-165; Fosberg, 1958).

Ceratopteris pteridoides is also one of the common species of wet habitats in northern Surinam. Lindeman (1953, Table I col. 19 and p. 121) described a swamp vegetation from the Nickerie district with *Leersia hexandra* as the main species growing in 20–30 cm of oligohalinic water during the wet season.

Another series of observations made in 1964–66 is also available concerning the behavior of this fern in the area of the artificial Brokopondo Lake in central Surinam (van Donselaar, 1968). In a stagnant branch of the small Soekroewatra Creek, *C. pteridoides* rooted in the mud, primarily with a blue-flowered member of the Scrophulariaceae tentatively identified as a species of *Bacopa*, and also with *Panicum repens*, *Jussiaea affinis*, *Nymphaea* sp., and *Lemna valdiviana*. When the dam in the Surinam River was closed on February 1, 1964, and the lake began to form (Leentvaar, 1966a[2], 1966b; van der Heide, 1967), this vegetation was lifted by the rising water, and after a while only those species that could float, *C. pteridoides* and *Lemna valdiviana*, survived. From this and several other nuclei *C. pteridoides* began to spread over the expanding lake. The success of *C. pteridoides* varied greatly and unpredictably, but in general the populations were densest

[2] Leentvaar reported *C. thalictroides* in the lake and published (1966b) a map showing its distribution at the end of 1964, but his data actually apply to *C. pteridoides*.

where the trees still retained their leaves and offered some shade (the shallow lake basin had not been cleared beforehand). At its maximum in April, 1966, *C. pteridoides* colonized 17,000 hectares (42,000 acres). Its distribution appeared to be influenced greatly by the prevailing easterly to south-easterly winds. By December, 1966, the quantity of *C. pteridoides* appeared to have diminished considerably; only scattered patches were observed. Possibly control of the Water-hyacinth, *Eichhornia crassipes*, the most abundant plant in the lake, affected the *Ceratopteris* because in many places it offered shelter. Another factor may have been the increased light intensity as more and more inundated trees shed their leaves. Data after December, 1966, are not available.

Other records from Surinam all refer to specimens occurring in permanently inundated places. Whether the plants thrive with other aquatics (e.g., *Eichhornia crassipes, Salvinia auriculata*), or with marsh plants, or alone, there is always an ample supply of stagnant or even flowing water.

Reports of this species from Florida (St. John and St. John, 1935; Correll, 1938, p. 48; Darling, 1961) and from Panama (Woodson, 1946) seem to agree with the above observations (see also Benedict, 1909).

Ceratopteris deltoidea has been collected in Surinam four times. The first collection was from open water in a swamp in the Coronie District, northern Surinam, the second from the Paloemeu River, southern Surinam, the third from a former bed of Gran (also called Marowijne) Creek in the Brokopondo Lake area of central Surinam (van Donselaar, 1968), and the fourth from the Surinam River a little south of Brokopondo Lake. Because this species has been reported only from the southern United States, some of the Caribbean islands, and the coastal area of Demerara, Guyana (Benedict, 1909; De Vol, 1956), it seems likely that the Paloemeu River station in Southern Surinam is the southernmost yet known.

At the time that about ten floating specimens of *C. deltoidea* were found in the branch of Gran Creek, the expanding lake had reached the area. Therefore, it is not possible to present reliable data on the original habitat. Compared to *C. pteridoides*, the

present species increased only moderately. Within a period of one and a half years it spread only a few kilometers from its original station.

According to Benedict (1909) and Safford (1912), *C. deltoidea* is found in ditches in Porto Rico and in Demerara. In Jamaica it was formerly found in "a clear flowing stream, a foot or two in depth . . . mostly in the quieter reaches near the shore, but sometimes well out in the current. The plant does not float except possibly in its juvenile stages of growth." (Benedict, 1909). Proctor recently collected the species floating along the River Mapi in Jamaica.

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