

UV-INDUCED FLUORESCENCE IN THE FLOWERS OF CERTAIN PYGMY AND TUBEROUS *DROSERA* AND IN THE TRAPS OF *DROSERA BARRETTIURUM*

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Keywords: flower biology, anther fluorescence, pollen mimicry, prey attraction, sundews

Received: 29 November 2025

<https://doi.org/10.55360/cpn551.af129>

Abstract: Two phenomena connected to UV-induced visible autofluorescence in *Drosera* are reported here: 1) bright blue UV fluorescence of anthers of certain Australian pygmy and tuberous *Drosera* (*D. sections Bryastrum* and *Ergaleium*), likely connected to the attraction of crepuscular pollinators; 2) bright blue UV fluorescence of the yellow, potato crisp-like modified tentacles of *D. barrettiurum* (*D. section Arachnopus*), likely connected to prey attraction and probably serving as anther/pollen mimicry to attract (crepuscular or nocturnal) pollen-feeding insects.

Introduction

UV guides are contrasting patterns between UV-absorbing (UV-dark) and UV-reflecting (UV-bright) surfaces often seen in flowers. These have long been documented in carnivorous plant traps, including genera such as *Brocchinia*, *Dionaea*, *Drosophyllum*, *Heliophora*, and *Nepenthes* (Joel *et al.* 1985; Juniper *et al.* 1989). UV guides can only be perceived by animals with UV receptors, such as most pollinating insects and birds. Bees, for example, distinguish UV-dark and UV-bright as distinct colors (Kevan *et al.* 2001; Lunau *et al.* 2025), whereas humans require special photography to visualize them. This contrasts with UV-induced visible fluorescence (UVIVF), also called UV autofluorescence, the emission of visible light under UV radiation. UV autofluorescence in carnivorous plant traps appears to be rare. It has been observed mainly in pitcher plants—particularly in some *Nepenthes* species (often along the peristome), likely due to nectar secretions (Kurup *et al.* 2013; Hartmeyer *et al.* 2013), as well as *Sarracenia* (Kurup *et al.* 2013; Hartmeyer *et al.* 2013; Yearsley 2022), and *Heliophora* (Golos 2020). UV autofluorescence is also known from floral nectar in several non-carnivorous plants (Thorp *et al.* 1975; Kevan 1976; Zenchyzen *et al.* 2024). To date, UV-induced visible fluorescence has not been documented in the traps of any sticky carnivorous plant. Some species of *Drosera* have UV-autofluorescent anthers (see below; first publicly noted by Gibson 2018), similar to other angiosperms (Mori *et al.* 2018, 2023), but this relates to pollination, not prey attraction. Golos (2020) stated that, in addition to *Dionaea*, *Nepenthes*, *Sarracenia*, and *Brocchinia*, “UV-induced blue fluorescence has previously been reported from [...] certain *Drosera* [...]”. However, none of the cited references provide evidence for blue UV autofluorescence in *Drosera*—only in the other genera mentioned. In fact, Kurup *et al.* (2013), and Hartmeyer *et al.* (2013) emphasize that no UV fluorescence was detected in any *Drosera*, *Pinguicula*, and *Utricularia* traps studied, apart from red chlorophyll emissions at 366 nm, which are ubiquitous in

green plants (Lagorio *et al.* 2015). Hartmeyer *et al.* (2013) did note bright white reflectance in the dense white petiole indument of *D. ordensis* and in the stipules of pygmy *Drosera*. These white-translucent, papery stipules appear bright under UV light due to specular reflection of the visible light part produced by most UV torches, typically caused by smooth epidermal surfaces or bright, white hairs. This strongly contrasts with the red chlorophyll under UV light (pers. obs.). However, UV-induced blue autofluorescence has not been reported in the traps of any *Drosera* or other sticky carnivorous plant.

It is important to note that UVIVF images do not mirror the vision of bees or other UV-perceiving insects (Kevan *et al.* 2001; Lunau *et al.* 2025). These images display UV-induced autofluorescence emitted in the visible range, which can be perceived by both insects and humans, but they exclude the UV portion of the spectrum—seen by most insects—and include red wavelengths, which are invisible to bees and many other insects (Lunau *et al.* 2025).

Angiosperm flowers exhibit two distinct UV-related features: UV guide marks, which are well studied and occur in many plant families, showing UV contrast within floral organs (e.g., petal marks) or between them; and blue fluorescence induced by UV radiation, observed across various families of flowering plants as well. This fluorescence has been detected in floral nectar—an uncommon trait documented in 41 plant species from 19 families (Thorp *et al.* 1975; Zenchyzen *et al.* 2024)—as well as in anthers and pollen (Mori *et al.* 2018, 2023). UV fluorescence of pollen is thought to aid pollination or protect pollen grains and their DNA from harmful UV radiation (Mori *et al.* 2018).

Materials and methods

UV-induced visible fluorescence (UVIVF) was detected by illuminating plants with UV light in the dark and photographing them in the visible spectrum (Yearsley 2022). For this study, a UV flashlight (Convoy S2+, Convoy Electronics Co., Hong Kong) with a Nichia 276A LED emitting at 365 nm was used. Plants were grown under greenhouse conditions by the author, from seed obtained from a commercial source (the late Allen Lowrie), permitted wild-collection for research purposes at Theda Station (collection licence FT61000860 to Thilo Krueger), or from seeds and plants acquired through horticultural trade among CP growers. Photographs of overall habit and flowers were taken with a digital camera (Panasonic, Japan) under normal daylight conditions and with the UV torch in complete darkness (either at night in the greenhouse, or for diurnal *Drosera* flowers, in a fully darkened indoor room). Macro photographs were taken using a microscope (Zeiss, Germany) with a mounted digital camera (Sony, Japan) and stacking photography software (Helicon Focus, Ukraine), under: a) bidirectional microscope illumination (dual gooseneck lights), b) unidirectional illumination by the mounted UV flashlight in complete darkness, and c) both light sources combined. Experiments were conducted in April 2018 and February 2022 (*Drosera* flowers) and in January and April 2022 (*D. barrettiorum*). Flower closure time was recorded under natural light conditions in the greenhouse in southern Germany and noted when the petals began fading and closing over the ovary.

Results

The results for UV-induced visible fluorescence in *Drosera* flowers are summarized in Table 1 and Fig. 1; fluorescence in the leaves of *Drosera barrettiorum* is shown in Figs. 2 and 3. Gibson

(2018) documented anther fluorescence for *D. paleacea* and *D. enodes*, but detected none in flowers of *D. zigzagia*, *D. binata*, and *D. × badgingarra* (*D. allantostigma* × *D. omissa*).

Table 1. *Drosera* species tested for UV fluorescence of anthers and pollen, and for anthesis duration and flower closure time of individual flowers. Species are arranged by the strength of the visible fluorescence: +++ = very strong; ++ = strong; + = weak, limited to the anther dehiscence lines; – = species tested negatively (no UV autofluorescence detected).

Species	UV-induced visible fluorescence of anthers	Anthesis duration [days]	Approx. flower closure [hour]
<i>D. sect. Bryastrum</i>			
<i>D. enodes</i>	+++	1	22:00 (10 pm)
<i>D. micrantha</i>	+++	1	21:00 (9 pm)
<i>D. paleacea</i>	+++	1	21:00 (9 pm)
<i>D. trichocaulis</i>	+++	1.5	05:00 (5 am)
<i>D. verrucata</i>	+++	3	open all night
<i>D. scorpioides</i>	++	1	21:00 (9 pm)
<i>D. stelliflora</i>	++		18:00 (6 pm)
<i>D. citrina</i>	+	1	17:00 (5 pm)
<i>D. eneabba</i>	+	1	18:00 (6 pm)
<i>D. walyunga</i>	+	1	17:00 (5 pm)
<i>D. albonotata</i>	–	1	15:00 (3 pm)
<i>D. callistos</i>	–	1	16:00 (4 pm)
<i>D. leucoblata</i>	–	1	15:00 (3 pm)
<i>D. manni</i>	–	1	18:00 (6 pm)
<i>D. sect. Ergaleium</i>			
<i>D. gracilis</i>	–	1	16:00 (4 pm)
<i>D. rupicola</i>	+	up to 5	open all night
<i>D. zigzagia</i>	+	1	18:00 (6 pm)
<i>D. sect. Lasiocephala</i>			
<i>D. lanata</i>	–	1	16:00 (4 pm)
<i>D. petiolaris</i>	–	1	16:00 (4 pm)
<i>D. sect. Arachnopus</i>			
<i>D. barrettiorum</i>	–	1	17:00 (5 pm)
<i>D. indica</i>	–	1	15:00 (3 pm)
<i>D. sect. Drosera</i>			
<i>D. admirabilis</i>	–	1	17:00 (5 pm)
<i>D. capensis</i>	–	1	16:00 (4 pm)

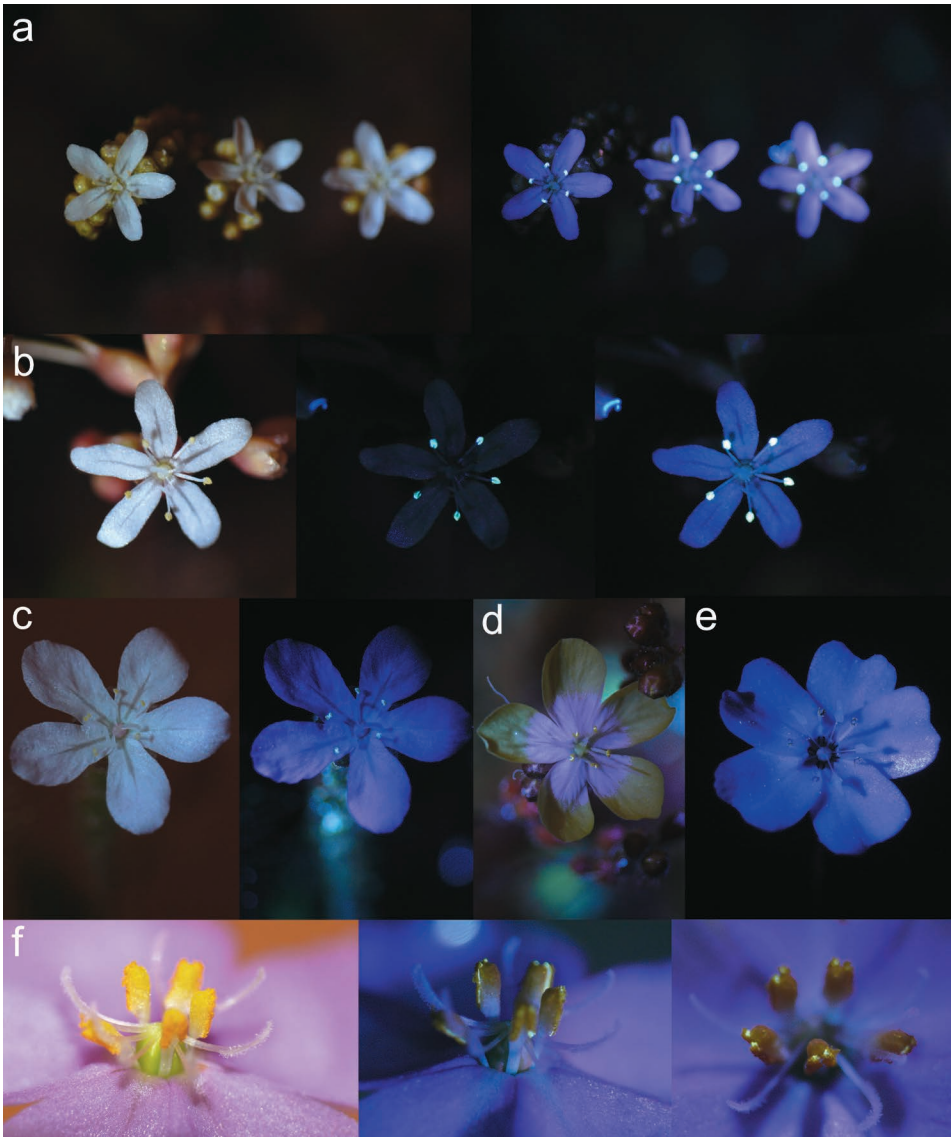


Figure 1. UV-induced visible fluorescence in *Drosera* anthers. Strong fluorescence: (a) *Drosera micrantha*. Left: ambient light; right: UV light. (b) *D. enodes*. Left: ambient light; middle: diffused UV light; right: focused UV light. (c) *D. scorpioides*. Left: ambient light; right: UV light. Note the reflection of the woolly scape hair. (d) Weak fluorescence of *D. citrina* anthers under UV light. (e) No fluorescence of *D. mannii* under UV light (the fluorescent pollen sticking to the petals on the left is not from *Drosera* but airborne pollen of a non-CP species). (f) Weakly fluorescent margins of the anther thecae in *D. barrettiorum*. Left: ambient light; middle and right: under UV light.

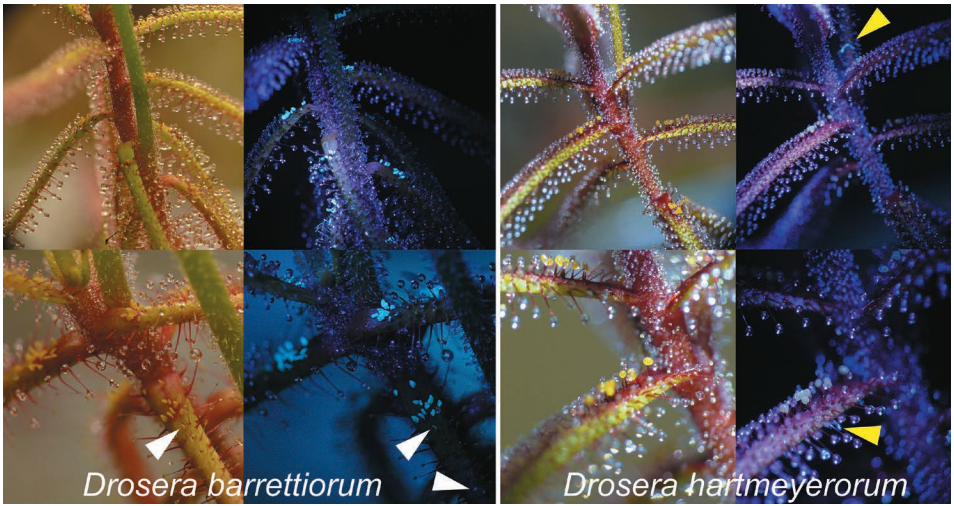


Figure 2. UV-induced visible fluorescence of the potato crisp-like modified tentacles of *Drosera barrettiorum*. Left: plant under natural light; right: the same under UV light. White arrows indicate the smaller potato crisp tentacles among the carnivorous tentacles, which are easier to spot under UV light. For comparison, in the two right columns: no UV-induced fluorescence is visible in the homologous yet morphologically different yellow, moriform tentacles of *D. hartmeyerorum*. Left: natural light; right: UV light. The yellow arrows mark a cotton fiber adhering to the plant, showing bright UV autofluorescence.

Discussion

UV-induced fluorescence in *Drosera* anthers seems to be related to crepuscular bloom.

Anther UV fluorescence in *Drosera* appears strongly linked to flowers that open during crepuscular or nocturnal periods (Table 1). Additionally, all these pygmy *Drosera* species with late-closing flowers have uniformly white or very pale pink petals and emit floral fragrance (pers. obs.), suggesting a possible connection to attracting crepuscular or night-active pollinators. UV fluorescence of anthers and pollen is generally considered to serve flower-pollinator communication (Mori *et al.* 2018). However, experimental evidence that pollinators prefer UV-fluorescent flowers over non-fluorescent ones under natural conditions is still lacking (Kevan *et al.* 2001; Lunau *et al.* 2025). During the day, fluorescence emitted by UV-autofluorescent floral organs in intense sunlight may not be perceived by insects because of overwhelming reflected light. For this reason, some authors consider its role in pollinator signalling negligible (Kevan 1976; Iriel & Lagorio 2010; Lagorio *et al.* 2015). However, UV-induced fluorescence is thought to play a more important role under low-light conditions, providing an additional visual cue for crepuscular and nocturnal animals, including pollinators (Kurup *et al.* 2013; Mori *et al.* 2018; Zenchyzen *et al.* 2024).

Some authors argue that floral UV fluorescence is not necessarily connected to flower-pollinator communication. Instead, they suggest it serves as UV protection for anthers, pollen, and the DNA

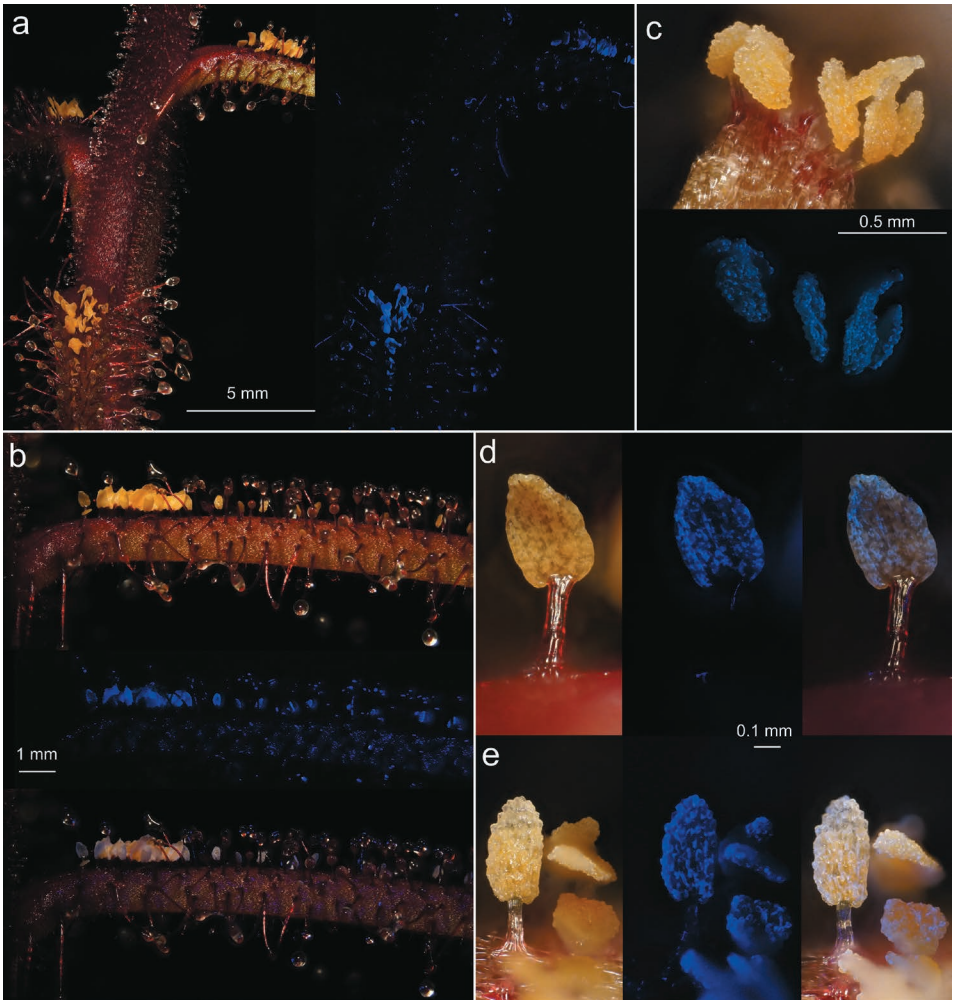


Figure 3. Close-ups of the leaf base, lamina, and the potato crisp-like tentacles of *Drosera barrettiorum*. (a) Stem and leaf bases. Left: under natural light spectrum; right: under UV light. Note that the stem indument and the tentacles are not UV-autofluorescent, but their glistening mucilage merely reflects the light of the UV torch. In contrast, the potato crisp tentacles at the leaf base show autofluorescence. (b) Leaf base. Top: natural light; middle: UV light only; bottom: UV light and natural light combined. Note the smaller potato crisp tentacles along the entire lamina. The blue shine of the mucilage is a mere reflection, not autofluorescence. (c) Group of potato crisp tentacles at the leaf base. Top: ambient light; bottom: UV light. (d) and (e) A single potato crisp tentacle at high magnification. Left: natural light; middle: UV light; right: UV light and natural light combined. (a, b, d): Plant from near Theda Station. (c, e): Plant from Dillie Gorge. Scale bars indicated.

inside, with autofluorescence being a mere side effect (Iriel & Lagario 2010; Lagario *et al.* 2015). This explanation seems unlikely for the *Drosera* species studied here, as all their heliophilous flowers are equally exposed to bright Australian sunlight and UV radiation during the day. Yet strong UV-induced visible fluorescence was detected only in those few species whose ephemeral flowers remain open during the afternoon and extend anthesis into dusk or even nighttime (Table 1). Species with strictly diurnal flowers showed no anther autofluorescence. In a few species, very weak whitish UV-induced fluorescence was visible along the dehiscence line of the theca or the connective of the anthers (Table 1). However, none displayed the bright UV-induced fluorescence of the entire anther seen in the positively tested species.

UV-induced visible fluorescence unique in *Drosera barrettiorum* traps—a possible pollen mimicry?

Anther and pollen mimicry is widely observed in flowers across many plant lineages (Lunau *et al.* 2024). This includes flowers of at least five species in the carnivorous plant genus *Pinguicula* (Fleischmann 2016). Mimicry of pollen, anthers, and stamens by sterile (non-pollen-containing) parts of the flower is considered the most widespread and speciose type of mimicry worldwide (Lunau *et al.* 2024). Plants employ this strategy either to distract herbivores, to divert pollinivorous pollinators from the real pollen load, or as an additional cue to attract pollinators (Lunau 2000, 2007; Lunau *et al.* 2024). However, pollen mimicry in carnivorous plant traps—or on plant leaves in general—is, to the author’s knowledge, documented here for the first time.

Drosera barrettiorum bears yellow “potato crisp-like” (term coined by Lowrie 2014) modified tentacles at the lamina base (Figs. 2, 4). A more scientific description of their shape would be “flat elliptic hyperbolic-paraboloid” (Krueger *et al.* 2023). Yet the term “potato crisp” (or “potato chip”) leaves little to add; it perfectly describes the shape and texture of these peculiar structures and is therefore adopted here. These yellow, potato crisp-like tentacles of *D. barrettiorum* show bright blue fluorescence under UV light. Their shape, size, coloration, and texture—combined with the UV-induced visible fluorescence—closely resemble anthers or floral pollen mimics of other plants. These structures in *D. barrettiorum* may function as pollen or anther mimics, most likely to attract pollen-collecting or pollinivorous insects.

In contrast, no UV autofluorescence was detected in the closely related *D. hartmeyerorum*, whose modified tentacles (“emergences”) strongly reflect in the yellow part of the visible spectrum (Hartmeyer & Hartmeyer 2010). Similarly, no UV fluorescence was found in the Y-shaped organs of *D. maanyaa-gooljoo* or *D. serpens* (see Krueger *et al.* 2023 for images of these organs). It was also absent in the peculiar sticky trichomes at the leaf base of *D. margaritacea*, in any other member of *D.* section *Arachnopus*, and in any *Drosera* species studied by the author (approximately 100 species from all subgenera and sections tested). Nothing can be said about the recently described *D. bracteosa*, which has emergences somewhat similar to those of *D. barrettiorum* (Krueger & Fleischmann 2025) and is also phylogenetically closely related to that species (Fleischmann *et al.*, unpublished data). However, *D. bracteosa* was available to the author only as herbarium material, not as living plants. Dried leaves of that species did not show any UV-induced fluorescence—although the same was true for dried, herborized leaves of *D. barrettiorum*. Hence, nothing can be said about the peculiar modified tentacles of *D. bracteosa* so far. UV-induced fluorescence appears to be limited to living tissue of the yellow potato crisp-like tentacle heads of *D. barrettiorum*. This may be connected to certain secondary metabolites that cause UV fluorescence (Donaldson 2020).



Figure 4. *Drosera barrettiorum* yellow potato crisp-like tentacle heads. Prince Regent River National Park, Kimberley, Western Australia.

In contrast to *D. hartmeyerorum*, where the conspicuous yellow-headed modified tentacles occur only at the leaf base (Schlauer 2001; Lowrie 2014; Krueger *et al.* 2023), the modified tentacles of *D. barrettiorum* and the closely related *D. bracetosa* are found at the leaf base and, in much smaller size, along the carnivorous tentacles across the entire lamina (Krueger *et al.* 2023; Krueger & Fleischmann 2025). Modified tentacles among the “normal” carnivorous tentacles represent a pattern unique to these two species from *D.* section *Arachnopus* and are not paralleled in any other known *Drosera* species. From this positioning, it seems plausible that these modified yellow, potato crisp-like tentacles—which in *D. barrettiorum* emit bright blue light under UV radiation and are visually distinct from the sticky tentacles—play a role in prey attraction, luring prey into the surrounding sticky tentacles.

Perhaps *D. barrettiorum* and *D. hartmeyerorum* have adapted to different prey activity times. The modified tentacles of *D. barrettiorum* may attract more crepuscular insects, while those of *D. hartmeyerorum* attract more diurnal, visually oriented insects. Selective prey capture has been demonstrated to some degree in *D.* section *Arachnopus* (Krueger *et al.* 2020, 2022; Tagawa *et al.* 2024). It will be interesting to see whether DNA metabarcoding of *D. barrettiorum* traps (see Krueger *et al.* 2022 for methods) detects significantly more pollinivorous and/or crepuscular insects among the captured prey compared to other taxa from *D.* section *Arachnopus* that lack UV-fluorescent modified tentacles at their leaf bases.

Based on the author’s observations, *Drosera barrettiorum* is pollinated by pollen-feeding and pollen-collecting insects, such as small bees (Halictidae and Meliponini), chrysomelid beetles, and

syrrhids. Hence, there might be a potential pollinator-prey conflict if the modified yellow tentacles on the leaves act as pollen baits. However, such conflict is likely minimal because, first, the flowers of *D. barrettiorum* close in the late afternoon, separating diurnal pollinators from pollen-attracted crepuscular prey. Second, the anthers of *D. barrettiorum* show only slight UV-induced fluorescence (Fig. 1f), so “conditioned” pollinators foraging for pollen on the flowers would probably not be attracted to the anther mimics on the leaves at the same time.

Interestingly, the surface ultrastructure of the potato crisp-like tentacle heads differs slightly between the two accessions of *D. barrettiorum* studied. Plants from Dillie Gorge have a microstructure of collapsed, shallow papillae, giving their surface a bubble-like appearance (“prawn crackers” rather than “potato crisps”) (Figs. 3c, e). In contrast, those from near Theda Station have a branched, treelike 2D-surface pattern (Fig. 3d). If these structures truly represent anther or pollen mimics, local populations may have evolved slightly different surface patterns to best mimic pollen-providing plants in their area. This phenomenon is known from deceit flowers of other plants (e.g., orchids), which develop local variations to overcome pollinators learning and avoiding false structures. However, a learning effect in carnivorous plant prey is negligible compared to duped pollinators. It should be noted that the Dillie Gorge plants are much greener compared to other populations of *D. barrettiorum*. This difference persists even when plants are grown side by side under identical conditions (pers. obs.). In contrast, other populations are vividly red throughout.

The sources of the UV-induced fluorescence.

In several unrelated plant species, anther and pollen UV fluorescence is commonly caused by hydroxycinnamate derivatives (Mori *et al.* 2018). However, the cause of UV autofluorescence in the anthers of certain *Drosera* species remains unclear. Not all *Drosera* species have UV-fluorescent anthers. The author observed this trait in a handful of pygmy *Drosera* (*D.* sect. *Bryastrum*; Table 1) and, to a much lesser degree, in a few tuberous *Drosera* (*D.* section *Ergaleium*), but not in other closely or more distantly related species. Moreover, the strong UV-induced fluorescence occurs in the actual tissue of the anther thecae, not in the pollen tetrads (Fig. 1). Hence, in *Drosera*, the sporopollenin of the pollen exine does not act as the underlying UV-excited blue fluorophore, contrary to what Donaldson (2020) suggested for other plants. Thus, the underlying fluorophore responsible for UV fluorescence in the anthers of some *Drosera* flowers remains unknown. It does not appear to be linked to a specific anther color—although similar colors can result from chemically very different pigments. For example, some pygmy *Drosera* with white anthers (e.g., *D. stelliflora*) and others with yellow anthers (e.g., *D. micrantha*, *D. enodes*) commonly show strong UV-induced fluorescence (Fig. 1). On the other hand, other species with white or yellow anthers show no UV fluorescence at all (Fig. 1).

Other plant compounds are also known to cause UV autofluorescence, such as flavonoids (Donaldson 2020). These could partly explain the bright blue fluorescence of the yellow, likely flavonoid-containing, modified tentacles of *D. barrettiorum*. However, this is not the only or even the most likely cause. First, not the entire yellow, potato crisp-like tentacle head emits UV fluorescence, and certainly not at the same intensity throughout. The main fluorescent regions appear to lie in the fine ultrastructure (see Figs. 3c, d). Second, the similarly bright yellow modified tentacle heads of the closely related *D. hartmeyerorum* show no UV autofluorescence (see Fig. 2), even though they perfectly reflect the yellow part of the visible light spectrum (Hartmeyer & Hartmeyer 2010).

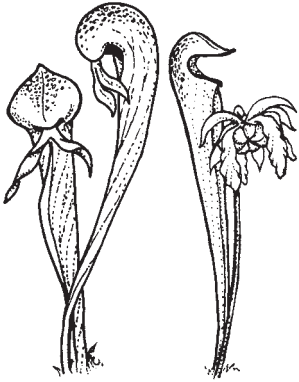
Acknowledgments: The staff of Theda Station, Kimberley, Australia, are thanked for their hospitality and support during fieldwork. Fieldwork by the author and Thilo Krueger in the Kimberley in 2022, including field studies on prey spectra of *D. barrettiorum* and *D. hartmeyerorum*, was funded by a research grant by the German CP society (G.F.P. e.V.). Thanks go to Robert Gibson for numerous fruitful discussions on *Drosera* floral biology, to Thilo Krueger for discussions regarding *Drosera* prey attraction, and to Michal Golos for sharing insights on UV fluorescence. Karl Herold, John Brittnacher, and Michal Golos provided helpful comments to the manuscript.

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CARNIVOROUS PLANT NEWSLETTER

Journal of the International
Carnivorous Plant Society
www.carnivorousplants.org

Volume 55, Number 1
March 2026



Front Cover: Praying Mantis consuming a tree frog while hanging out on a *Sarracenia leucophylla* 'Wilkerson's Red Rocket'. Photo by Michael Wang. Article on page 31.

Back Cover: *Drosera barrettiorum* (pink flowers) and *D. aurantiaca* (orange flowers) growing side by side along a creek at Prince Regent River National Park, Kimberley, Western Australia. Photo by Andreas Fleischmann. Article on page 15.

Carnivorous Plant Newsletter is dedicated to spreading knowledge and news related to carnivorous plants. Reader contributions are essential for this mission to be successful. Do not hesitate to contact the editors with information about your plants, conservation projects, field trips, or noteworthy events. Views expressed in this publication are those of the authors, not the editorial staff.

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Date of effective publication of the December 2025 issue of Carnivorous Plant Newsletter: 14 November 2025.

The ICPS is the International Cultivar Registration Authority (ICRA) for the names of cultivated carnivorous plants according to the International Code of Nomenclature for Cultivated Plants. Send relevant correspondence to the ICPS, Inc.

Carnivorous Plant Newsletter is published quarterly in March, June, September, and December by the ICPS, Inc., 2121 N. California Blvd., Suite 290, Walnut Creek, CA 94596, USA. Periodicals postage paid at Walnut Creek, CA and additional mailing offices. Postmaster: Send address changes to ICPS, Inc., 2121 N. California Blvd., Suite 290, Walnut Creek, CA 94596, USA. Printed by Sheridan, 810 E. 10th Street, Lawrence, KS 66044. Logo and masthead art: Paul Milauskas.
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