

Short Communication

USE OF GIS AND MICROHABITAT PREDICTORS FOR POSSIBLE SITE OCCUPANCY OF THE HEIDELBERG OPAL BUTTERFLY (*CHRYSORITIS AUREUS*) WITHIN GAUTENG PROVINCE, SOUTH AFRICA

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ABSTRACT

The Heidelberg Opal butterfly (*Chrysoritis aureus*) is currently classified as endangered with a total of nine known localities in Gauteng. Recent work on the fine scale habitat requirements of *C. aureus* provided the opportunity to expand the search for additional suitable habitats for this species in the Gauteng Province, using GIS and current distribution databases. A topographical base map and overlays of food plant (*Clutia pulchella*), host cocktail ant (*Crematogaster liengmei*) distributions and geology (Ventersdorp Supergroup) were used to determine possible additional sites suitable for *C. aureus*. Eight potentially suitable sites were identified. Four of these sites were transformed by mining activities and thus excluded. One of the four remaining sites was deemed suitable for *C. aureus* as both the food plant (*C. pulchella*) and the host ant (*C. liengmei*) were present. *C. aureus* was not recorded at any of the other sites surveyed probably due to season of site visits (winter).

Key words: *Chrysoritis aureus*, habitat, *Clutia pulchella*, *Crematogaster liengmei*.

INTRODUCTION

South Africa has a large diversity of butterflies with a total of 657 different species including 60 threatened and 420 endemic species. The genus *Chrysoritis* consists of 30 different species, and has the highest conservation concern (Edge and Mecenero 2015).

The Heidelberg Opal butterfly (*Chrysoritis aureus*) was first discovered by C.R. Barret and F. Coetzee on the 25th of December 1959 near the town of Heidelberg in Gauteng (Terblanche *et al.* 2003). This species is currently listed as endangered (Mecenero *et al.* 2013).

Species of the genus *Chrysoritis* have unique feeding characteristics and are habitat specialists with many being myrmecophilous (species which have symbiotic relationship with ants) (Edge and Mecenero, 2015). According to Terblanche *et al.* (2003) ant-associated butterfly species are those with the highest threat status in South Africa.

C. aureus has a strong relationship with the food plant *Clutia pulchella* which serves as both food plant and host for the larvae. The butterfly also has a symbiotic relationship with the ant *Crematogaster liengmei* as the larvae of the butterfly are tended to by the ant (Terblanche *et al.* 2003). Both host plant and ant species need to be present to complete *C. aureus*'s lifecycle (Deysel 2016 and Deysel *et al.* 2017).

The current known habitats of *C. aureus* are situated on Witwatersrand or Ventersdorp geological

systems in Gauteng (Henning *et al.* 2009). The objective of this study was to identify additional suitable habitats for the endangered *C. aureus* in Gauteng using GIS and current distribution databases.

METHODS AND RESULTS

This study followed Pfab (2001) research methodology of site suitability for rare and endangered plants in the Magaliesberg. Using GIS overlays and Deysel (2016) and Deysel *et al.* (2017) habitat characteristics of *C. aureus*, "type habitats" were generated for both the Ventersdorp and Witwatersrand geological systems.

A typification of the nine current areas of occurrence of *C. aureus* within the Ventersdorp and Witwatersrand Supergroups were done using both abiotic and biotic characteristics recorded by Deysel (2016) and Deysel *et al.* (2017) (Table 1).

A base map was generated using topographical layers (1: 50 000) on ArcGis® Explorer and GIS distribution layers for the base geology (Ventersdorp and Witwatersrand systems), *Clutia pulchella* (the food plant) and *Crematogaster liengmei* (the cocktail ant) (Figure 1). Areas of intersection of all the above, specifically in areas which occurred at altitudes of between 1650 m and 1800 m above mean sea level and having south facing midslopes (Figure 2) identified on the base map.

A total of eight sites met the requirements of the habitat descriptors (Table 1). Further investigation, using satellite images, excluded sites 3; 4; 5 and 8 due to

complete anthropogenic transformation. Sites 3, 4, and 8 were identified as mine tailings dumps and Site 5 was identified as a landfill.

In field assessment of sites 1, 2, 6 and 7 took place in August 2016. At each of these sites, type habitat descriptors were used to ascertain suitability of the site

in terms of surface rock cover and type, slope and the mean height and cover of both dwarf shrubs and shrubs. Afterwards the area where searched for the presence or absence of the food plant *C. pulchella*, the cocktail ant *C. lingmei* and *C. aureus* (Table 2).

Table 1. Typification of abiotic and biotic components of the Witwatersrand and the Ventersdorp geological systems where *C. aureus* currently occurs.

Environmental characteristic		Witwatersrand Geological System	Ventersdorp Geological System
Terrain Units		Scarp and midslope	Midslopes
Aspect		South facing	South facing
Altitude (above mean sea level) (m)	Range	1 601 - 1 791	1 653 - 1 784
	Mean	1695.5	1 718
Gradient / slope (°)	Range	8 – 28	12 - 20
	Mean	18	16
Surface rock cover (%)	Range	46 – 60	31 -45
	Mean	53	38
Rock type		Boulders	Large rocks
Soil type		Mispah	Glenrosa
Soil depth (mm)	Range	30 – 280	70 - 320
	Mean	155	195
Soil texture		Sandy	Clay/loam
Clay percentage (%)		< 10	20 - 40
Temperature (°C)	Range	21.2 - 26.8	21.2 - 26.8
	Mean	24	24
Mean canopy cover (all plants) (%)	Range	28 – 60	23 -51
	Mean	44	37
Species richness		27 -61 species	56 - 68 species
Dominant dwarf shrubs		1. <i>Lopholaena coriifolia</i>	1. <i>Athrixia elata</i>
		2. <i>Searsia magalismontana</i> subsp. <i>coddii</i>	2. <i>Gymnosporia buxifolia</i>
Mean canopy cover dwarf shrubs (%)	Range	1 – 12	2 - 6
	Mean	6.5	4
Dwarf shrub height (mm)	Range	166 – 258	550 - 960
	Mean	212	755
Dominant forbs		1. <i>Pearsonia sessilifolia</i> subsp. <i>sessilifolia</i>	1. <i>Berkheya setifera</i>
		2. <i>Gerbera piliselloides</i>	2. <i>Hilliardiella aristata</i>
		3. <i>Tetraselago wilmsii</i>	
Mean canopy cover forbs (%)	Range	1 – 6	8 - 16
	Mean	3.5	12
Dominant graminoids/grasses		1. <i>Loudetia simplex</i>	1. <i>Cymbopogon pospischilii</i>
		2. <i>Cymbopogon nardus</i>	2. <i>Themeda triandra</i>
		3. <i>Aristida diffusa</i> subsp. <i>burkei</i>	3. <i>Hyparrhenia hirta</i>
		4. <i>Aristida transvaalensis</i>	4. <i>Setaria nigrirostris</i>
		5. <i>Sporobolus pectinatus</i>	
		6. <i>Schizachyrium sanguineum</i>	
		7. <i>Andropogon schirensis</i>	
		8. <i>Themeda triandra</i>	
Mean canopy cover graminoids/grasses (%)	Range	23 – 57	30 - 75
	Mean	40	52.5
Graminoid/grass height (mm)	Range	300 - 2 500	300 - 1 700
	Mean	1 400	1 000
Phytomass (kg/ha)		2 362	2 117
<i>Clutia pulchella</i> average height (mm)		462	331

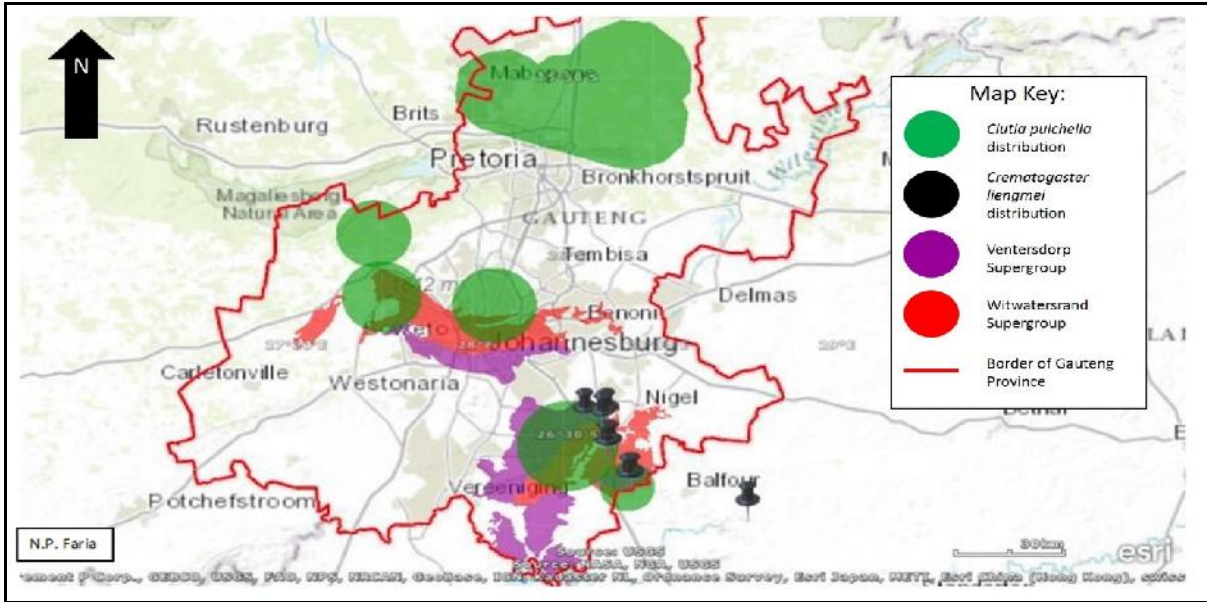


Figure 1. Combined distribution map indicating intersecting areas of the geological systems, the food plant and the cocktail ant (Esri 2016).



Figure 2. Eight possible sites of occupation of *C. aureus* according to altitude and aspect (Esri 2016).

Table 2. Results obtained during the site visits conducted in October 2016.

	Site 1	Site 2	Site 6	Site 7
Co-ordinates	26° 10' 00" S 28° 07' 24" E	26° 11' 10" S 28° 03' 47" E	26° 03' 30" S 27° 47' 51" E	26° 03' 11" S 27° 46' 16" E
Altitude (above sea level) (m)	1 650	1 728	1 683	1 695
Terrain Units	South facing	South facing	South facing	South facing
Aspect	Moderate	Steep	Steep	Moderate
Slope	Midslope	Midslope	Midslope	Midslope
Surface rock cover (%)	50	70	70	50
Rock type	Boulders	Boulders	Large rocks	Large rocks
Canopy cover (%)	30	20	25	25

	1. <i>Clutia pulchella</i> 2. <i>Acacia mearnsii</i> (Alien invader plant)	1. <i>Clutia pulchella</i> 2. <i>Vachellia karoo</i> 3. <i>Buddleja saligna</i>	1. <i>Protea caffra</i>	1. <i>Protea caffra</i>
Dominant shrubs				2. <i>Acacia mearnsii</i> (Alien invader plant)
Mean cover of shrubs (%)	15	25	10	10
Mean height of shrubs (mm)	1 700	1 500	1 500	1 500
	1. <i>Sporoboluspyramidalis</i>	1. <i>Sporoboluspyramidalis</i>	1. <i>Cymbopogonpospischilii</i>	1. <i>Cymbopogonpospischilii</i>
Dominant graminoids/grasses	2. <i>Hyparrheniahirta</i> 3. <i>Panicum maximum</i>	2. <i>Hyparrheniahirta</i>	2. <i>Hyparrheniahirta</i>	2. <i>Hyparrheniahirta</i>
Mean cover of graminoids/grasses (%)	35	10	10	10
Mean height of graminoids/grasses (mm)	250	250	150	100
Was <i>Clutia pulchella</i> present?	Yes	Yes	Yes	Yes
Was <i>Crematogaster liengmei</i> present?	Yes	No	No	No
Was the Heidelberg Opal butterfly observed?	No	No	No	No
Additional information	Area recently burnt and <i>Crematogaster liengmei</i> found on food plant (<i>Clutia pulchella</i>)	Area recently burnt	Area recently burnt	Area recently burnt

DISCUSSION

Site 1 was found to be the most promising site for *C. aureus* to occur as both the food plant (*C. pulchella*) and host ant (*C. liengmei*) were observed. All four sites however conformed well to the habitat descriptors. The food plant *C. pulchella* was present at all four sites, but the cocktail ant (*C. liengmei*) was not observed at Sites 2, 6 and 7. Adult individuals or larval evidence of *C. aureus* was also not observed at any of the four sites, probably as a result of the timing of the survey. Roos and Henning, (1999) state that the butterfly emerges in early October, December and February. Due to time constraints experienced by the first author to hand this work in by September to comply for the requirements of her qualification, visits to the sites could only be undertaken in August. This is a definite shortcoming of this study and the sites ideally need to be revisited during the periods identified by Roos and Henning (1999) above.

The habitat typification and method used in this study could be applied to identify other possible sites of occupancy of the *C. aureus*, since the distribution of this butterfly includes parts of the adjacent Mpumalanga Province.

This study re-emphasizes the need and immense utilitarian value of undertaking and completing more autecological research on threatened species after Deysel

(2016) and Deysel *et al.* (2017). By making use of modern technology such as GIS and satellite imagery linked to good empirical data collected in the field, the identification and conservation of crucial habitats for endangered and non-threatened biota alike are possible. The fact that half of the additional suitable habitats identified in this study have already been destroyed as potential habitat by *C. aureus* is testament to our lack of detailed autecological knowledge of many species.

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