

# The vegetation of the habitat of the Brenton blue butterfly, *Orachrysops niobe* (Trimen), in the Western Cape, South Africa

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THE BRENTON BLUE BUTTERFLY IS KNOWN only from a small population in one hectare of asteraceous coastal fynbos at Brenton-on-Sea. This fynbos is characterized by a great diversity of shrubs, herbs and graminoids, with a successional gradient to thicket where *Pterocelastrus tricuspidatus* is dominant. The eggs of the butterfly are laid on the lower side of the leaves of *Indigofera erecta*, on which the larvae feed. Fifteen 1-m<sup>2</sup> quadrats containing plants of *Indigofera erecta* with and without eggs of the butterfly were distinguished and sampled separately from 15 1-m<sup>2</sup> quadrats containing plants of *Indigofera erecta* without eggs. No marked differences in total vegetation, shrub or herb cover between the sites with and without eggs were observed. There was a difference in abundance of the fern *Pteridium aquilinum*, with over 30% cover at sites with no eggs and only about 6% at sites with eggs present. This could reflect the absence of other plants where the ferns had such dense cover.

## Introduction

The Brenton blue butterfly, *Orachrysops niobe* (Trimen), is known only from a 1-ha plot at Brenton-on-Sea, near Knysna, Western Cape province.<sup>1</sup> The habitat of the butterfly is surrounded by new housing development and is also within an area which is planned for further development. It is therefore important to obtain information on the status of this species and its habitat to ensure its survival. The objectives of the study reported here were to: collate and synthesize floristic information on the vegetation of the site at Brenton-on-Sea, and other potential areas where the butterfly may occur; investigate the vegetation quantitatively and describe the dynamics of the vegetation; and identify reasons for the selection of the site by the butterfly as its habitat.

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## Study area

Three localities were investigated, namely, Brenton Extension 1 (where the only known colony of *O. niobe* exists), Nature's Valley (where *O. niobe* was found in the past but is now locally extinct), and Goukamma Nature Reserve (Fig. 1). The last was included because of the similarity of the vegetation composition in this reserve to the two other sites. Other similarities exist as discussed below, making Goukamma Nature Reserve a potential site for the relocation of the butterfly.

Brenton Extension 1 is situated on the seaward-facing slopes between the western head of the Knysna estuary and the Buffelsbaai headland (Figs 1 and 2). These slopes are fairly steep and approach an altitude of 200 m above sea level. Nature's Valley is east of Plettenberg Bay at the mouth of the Grootrivier. The river and its tributaries run through a series of deep gorges opening to the ocean. The study site at Nature's Valley is situated on an ancient dune system running parallel to the coast and consisting of sediments very similar in nature to the Brenton site. Goukamma Nature Reserve at Sedgfield forms part of the dune and lake complex of this area. It stretches from Groenvlei in the west to beyond the Goukamma River in the east and borders on Buffelsbaai. The reserve borders on the ocean and ranges in altitude from 0 to 200 m above sea level.

All three localities are fairly steep, sea-facing slopes and are likely to be affected by marine processes. It is known that salt-laden air and direct salt spray can affect vegetation growth markedly.<sup>2</sup> Local climatic conditions are ameliorated also by this proximity to the shore-line.

## Methods

The field work at Brenton-on-Sea and Nature's Valley was undertaken in December 1996. We sampled the habitat of the butterfly at Brenton, surrounding areas burnt in the summer of 1995/96, and

locations which show various stages of disturbance and succession. Data were also available from studies on Goukamma Nature Reserve.<sup>3</sup> Relevés (5 × 5 m) were sampled and Braun Blanquet cover/abundance and site characteristics recorded. These data were analysed using TWINSPAN to classify the sites and reciprocal averaging to show their relationships.<sup>4</sup>

The habitat of the Brenton blue butterfly (Fig. 3) was studied within the fynbos to determine the insect's plant preferences. The butterfly lays its eggs on the underside of leaves of *Indigofera erecta* Thunb., the Brenton blue butterfly weed. The specimens of *I. erecta* on which eggs had been laid were marked with flags by D. Britton and L. Silberbauer (pers. comm.) and vegetation at each of these localities was sampled with 1-m<sup>2</sup> quadrats. Fifteen samples were taken where *I. erecta* was present with eggs and 15 quadrats were sampled where the plant was without eggs. Density, percentage cover, total cover and cover of dead or decaying *I. erecta* were recorded. The data were analysed for percentage frequency, mean density and mean percentage cover for each species and an importance value of each species was calculated.<sup>5</sup> Density data for the 30 quadrats were used in an ordination analysis by reciprocal averaging to show the relationship between samples and species.<sup>4</sup>

## Plant communities

A floristic comparison of the vegetation of the study sites with neighbouring floras indicated that the dune fynbos of the Brenton and Nature's Valley sites is more similar to each other than to dune fynbos at Goukamma Nature Reserve or on the slopes between Buffelsbaai and Brenton. In addition, *I. erecta* has not been observed at either Goukamma Nature Reserve or Buffelsbaai. A more careful search for this *Indigofera* species may be necessary to establish its distribution within the vegetation types.

A mosaic of dune thicket and fynbos is the dominant sea-facing vegetation along this coastal region (Fig. 3). The dune thicket occurs on calcareous coastal dunes where annual rainfall exceeds 450 mm, conditions which are favourable at the localities studied. The fynbos may be described as typical mountain fynbos, which at some places is found fairly close to the coast.

Two main communities were identified at the Brenton Extension 1 study site, coastal fynbos and dune thicket. These occurred as a mosaic and resulted in a

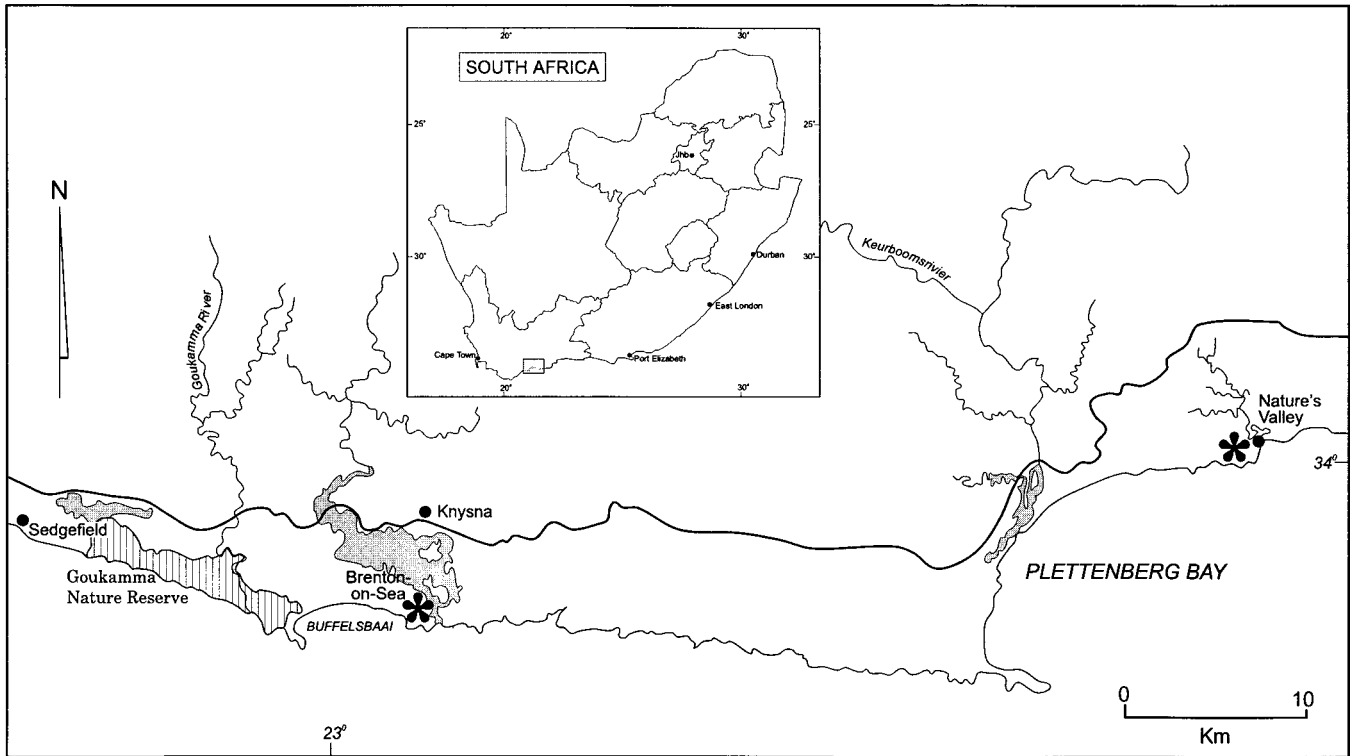


Fig. 1. Map of the southern Cape, showing the study site localities.

local complexity of structure which was difficult to map (Table 1).

Coastal Fynbos is a variable community characterized by bracken fern (*Pteridium aquilinum*), *Indigofera erecta* (Brenton blue butterfly weed), *Leucadendron salignum*, *Rhynchosia capensis* and about ten other species which did not occur consistently. Many of these are members of the Asteraceae family, hence the term asteraceous coastal fynbos. The fynbos community (No. 2, Table 1) identified as the possible habitat of the butterfly, had a higher species richness, with *Bobartia aphylla*, *Myrica quercifolia*, *Oxalis* species, and *Watsonia pillansii* present. A second fynbos community was characterized by the presence of *Indigofera verrucosa* and *Lightfootia fasciculata*. A number of species were common to both communities, but generally absent from the dune thicket.

Disturbed fynbos communities were identified as burnt areas (samples 2 and 8) and those cleared of woody species (samples 3 and 4). The burnt areas had higher species richness and floristically matched the butterfly-favoured fynbos areas, whereas the cleared areas were species poor and contained mostly pioneer plant species. *Indigofera erecta* occurred in burnt areas, but not after bush clearing.

Dune thicket occurred as clumps within the fynbos at the Brenton Extension 1 site dominated by *Pterocelastrus tricuspidatus* and various other woody species. Many

of these woody species occur within the fynbos as seedlings or a single individuals and can be considered as pioneer species in the transition of fynbos to thicket. *Indigofera erecta* and other herbaceous species do not occur under closed thicket.

#### Habitat conditions at egg-laying sites

From analysis of the microhabitat where the female lays eggs, we determined that there is possibly a critical complement of species which is attractive to the female butterfly as well as an opti-

imum percentage cover of shrubs, herbs and bracken. Table 2 details all of the plant species found within the sites with and without eggs. *Indigofera erecta* was always present because this was the indicator plant where the quadrats were located. Although each *I. erecta* specimen was examined for the presence of eggs, some could have been overlooked or could have the right potential qualities for eggs but were not used by the female butterflies. Note that the first ten plant species have a high importance value (>7) in the



Fig. 2. Brenton-on-Sea, near Knysna above Buffelsbaai, site of the only known population of the Brenton blue butterfly, *Orachrysops niobe*.

sub-set of quadrats with eggs on the food plant. By comparison, the great abundance and high importance value of *Pteridium aquilinum* and the shrub or small tree *Pterocelastrus tricuspidatus* in the set without eggs, means that some of the first 10 species have a much lower importance value (<6). It is likely that some of these species are necessary in a habitat for the butterfly to lay eggs.

It may appear that the relatively high percentage of shrubs, trees and ferns has a major influence on the site chosen (Table 2). However, this is not necessarily true as the ordination of samples and species shows. The relationships between the quadrats with and without eggs are shown in Fig. 5. There is an almost complete separation of the samples without eggs from those with eggs. A fairly tight cluster of samples with eggs may indicate that the female needs a complement of species as a suitable micro-habitat to lay eggs. One exception is quadrat 1, which was a disturbed and open habitat, and separated from the more typical set of micro-habitats on axis 1 (Fig. 4).

**Discussion**

The effects disturbance due to of urbanization butterfly communities have rarely

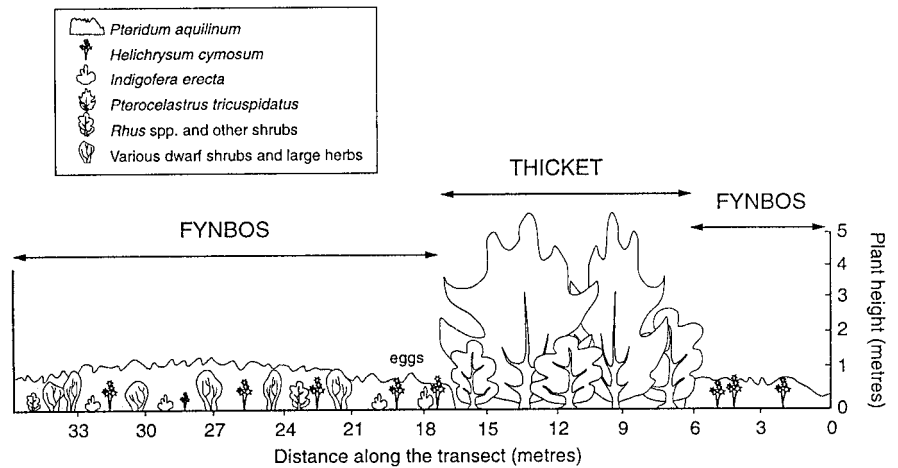


Fig. 3. Profile diagram of the Brenton blue butterfly habitats at Brenton-on-Sea.

been investigated.<sup>6</sup> In an examination of butterfly diversity along an urban gradient at six sites near Palo Alto, California, Blair and Launer<sup>6</sup> found that species diversity was highest at intermediate levels of disturbance, whereas abundance decreased from natural to urban areas. Thus disturbance of the habitat is not necessarily detrimental to butterfly habitats, as we have found in this case. Increased urban development, however, could lead to loss of species as was the

case at Nature's Valley for *O. niobe*, which disappeared there in the 1980s (J. Ball, pers. comm.).

Dune thicket is dominated by bird-dispersed plant species and is not fire-prone. It is associated with deep, relatively fertile soils in fire-protected sites at low altitudes and with a higher proportion of summer rather than winter rain.<sup>7</sup> Asteraceous and grassy fynbos occurs where there is a high proportion of summer rainfall on finer textured and more

Table 1. Abbreviated two-way table of classified samples and the diagnostic species of the plant communities studied at Brenton Extension 1 (samples 1–8) and Nature's Valley samples (9 and 10).

Relevé number:	Fynbos community 1			Fynbos community 2			Thicket community			
	9	10	1	2	7	8	3	5	6	4
<b>Fynbos community — 1 species</b>										
<i>Indigofera verrucosa</i>		+	+							
<i>Lightfootia fasciculata</i>	+	+	1							1
<b>Fynbos community — 2 species</b>										
<i>Bobartia aphylla</i>				1	+	1				
<i>Myrica quercifolia</i>				1	1					
<i>Oxalis</i> sp.				+	+	+				
<i>Watsonia pillansii</i>				+	+	3				
<b>General fynbos species</b>										
<i>Pteridium aquilinum</i>		1	3	3	3	3				+
<i>Indigofera erecta</i>	+	+	+	+	+	+				
<i>Leucadendron salignum</i>	+	+		+	+	+				
<i>Metalasia muricata</i>	2b	2a			+	+				
<i>Rhynchosia capensis</i>	+	+	+		1			+		
<i>Cullumia decurens</i>			1		+	+				
<i>Pelargonium capitatum</i>			1	+	+					
<b>Fynbos to thicket transitional species</b>										
<i>Rhus glauca</i>					+		1	2b	2a	
<i>Cineraria</i> sp.					+	+	3	+		
<i>Stoebe plumosa</i>					+	+	+			
<i>Helichrysum cymosum</i>					+		2b	2a		
<i>Helichrysum petiolare</i>					+	+	2b			
<i>Senecio purpurea</i>					1		1	+		
<i>Pterocelastrus tricuspidatus</i>		+			1			+	4	
<i>Chironia baccifera</i>					+		+	2b		
<b>General species for all communities</b>										
<i>Chrysanthemoides monilifera</i>					+		1	3		1
<i>Isolepis cernua</i>				+			+	+		2a
<i>Tetralia cuspidata</i>		1			+		1			
<i>Ficinia ramosissima</i>	1				3			+		
<i>Dichisma ciliatum</i>				2a						+

A number of general species have been excluded. Numbers and letters in the table represent the Braun-Blanquet scale of cover abundance, namely + = present; 1 = 1–5% cover, etc. Key to localities: 1, Coastal fynbos with thicket invasion; 2, burnt area above township; 3, cleared thicket; 4, pioneer plants on cleared areas; 5, thicket; 6, thicket/bushclump; 7, coastal fynbos — top of hill; 8, burnt area above township; 9 and 10, coastal fynbos.

**Table 2.** Percentage frequency, mean density and cover and importance value of plants in 1-m<sup>2</sup> quadrats with and without eggs of the Brenton blue butterfly.

Species	Quadrats with eggs on food plant					Quadrats without eggs on food plant				
	Frequency (%)	Mean density (Plants m <sup>-2</sup> )	Mean cover (%)	Importance value	Rank	Frequency (%)	Mean density (Plants m <sup>-2</sup> )	Mean cover (%)	Importance value	Rank
<i>Indigofera erecta</i>	100	4.0	2.2	22.9	4	100	5.8	4.67	28.1	3
<i>Tetralia cuspidata</i>	93	3.27	10.27	30.7	2	53	1.67	1.73	10.8	7
<i>Ficinia ramosissima</i>	87	7.33	12.8	44.3	1	60	7.93	13.07	38.7	2
<i>Helichrysum cymosum</i>	67	1.87	6.73	19.9	60	2.13	1.67	12.5	6	
<i>Isolepis cernua</i>	53	5.2	6.6	27.4	3	73	2.6	7.47	21.2	4
<i>Pteridium aquilinum</i>	47	1.4	7.6	17.9	6	100	6.87	33.4	62.8	1
<i>Rhynchosia capensis</i>	47	1.6	1.2	10.2	8	20	0.6	0.47	3.8	18
<i>Erica speciosa</i>	47	0.8	7.0	15.5	7	33	0.6	2.53	7.4	8
<i>Hypericum aethiopicum</i>	40	0.93	0.67	7.1	10	–	–	–	–	
<i>Peucedamum capense</i>	40	1.00	0.93	7.6	9	20	0.4	0.33	3.1	21
<i>Metalasia muricata</i>	27	0.27	1.8	5.6	12	–	–	–	–	
<i>Anthospermum aethiopicum</i>	27	0.53	0.4	4.4	16	7	0.2	0.27	1.4	3
<i>Leucadendron salignum</i>	27	0.33	1.93	5.9	11	13	0.13	0.4	2.0	27
<i>Asparagus densiflorus</i>	27	0.53	0.87	5.0	14	7	0.13	0.67	1.7	32
<i>Helichrysum foetidum</i>	13	0.13	0.13	1.7	30	13	1.07	0.2	3.9	15
<i>Erica copiosa</i>	20	0.26	1.93	5.1	14	–	–	–	–	
<i>Rhus crenata</i>	20	0.33	0.73	3.7	20	7	0.07	0.07	0.9	40
<i>Rhus lucida</i>	20	0.33	0.33	3.2	22	27	0.53	0.4	4.2	14
<i>Hypoxis villosa</i>	20	0.33	0.2	3.0	24	7	0.13	0.13	1.1	37
<i>Myrsine africana</i>	20	0.4	1.27	4.6	15	13	0.13	0.2	1.8	31
<i>Lightfootia</i> sp.	13	0.33	1.73	4.3	17	13	0.47	1.2	3.6	19
<i>Centella asiatica</i>	13	0.4	0.13	2.5	27	–	–	–	–	
<i>Cullumia decurrens</i>	13	0.33	1.2	3.6	21	20	0.27	0.6	3.2	22
<i>Cineraria</i> sp.	13	0.13	0.13	1.7	30	13	0.87	0.33	3.6	20
<i>Diospyros dichrophylla</i>	13	0.13	0.13	1.7	30	20	0.2	0.33	2.7	23
<i>Stoebe plumosa</i>	13	0.13	3.0	5.4	13	–	–	–	–	
<i>Pterocelastrus tricuspidatus</i>	13	0.13	0.2	1.8	29	33	0.4	11.4	16.8	5
<i>Lobelia neglecta</i>	7	0.07	0.07	0.9	37	27	1.2	1.13	6.6	9
<i>Dichisma ciliatum</i> subsp. <i>erinoides</i>	13	0.4	0.2	2.5	26	33	0.47	0.33	4.6	12
<i>Senecio purpureas</i>	–	–	–	–	–	27	0.4	0.33	3.9	17
<i>Imperata cylindrica</i>	–	–	–	–	–	27	0.73	0.33	4.6	11
<i>Ehrharta villosa</i>	–	–	–	–	–	20	1.53	0.33	5.8	10
Mean % total cover			75.5					79.9		
Mean % dead & detritus cover			18.5					25.1		
Mean % total cover			75.5					79.9		
Mean % dead & detritus cover			18.5					25.1		
Mean % cover shrubs			18.9					16.7		
Mean % cover herbs			18.6					14.7		
Mean % cover graminoids			36.7					24.4		
Mean % cover ferns			6.4					33.5		

The following species only occurred once or twice (+, quadrats with eggs on food plant):

*Ehrharta calycina* (+), *Muralia ericaefolia*, *Rhoicissus digitata*, *Crassula campestris* subsp. *campestris*, *Chironia melampyriifolia* (+), *Pelargonium capitatum* (+), *Crassula subulata* var. *fastigata* (+), *Cynodon dactylon* (+), *Pentaschistis heptamera* (+), *Indigofera verrucosa* (+), *Sporobolus africanus* (+), *Tarconanthus camphoratus* (+), *Agathosma capensis* (+), *Oxalis* sp (+), *Helichrysum petiolare* (+), *Felicia echinata* (+), *Knowltonia vesicatoria* subsp. *humilis* (+), *Ornithogalum graminoides* (+), *Clutia alaternoides* var. *alaternoides* (+), *Conyza canadense*, *Erica* sp. indet., *Grass* sp. indet., *Hibiscus trionum*, *Asteraceae* indet., *Cheilanthes viridis*, *Rubia petiolaris*, *Maytenus heterophylla*, *Struthiola hirsuta*, *Thamnochortus glaber*, *Kniphofia uvaria*.

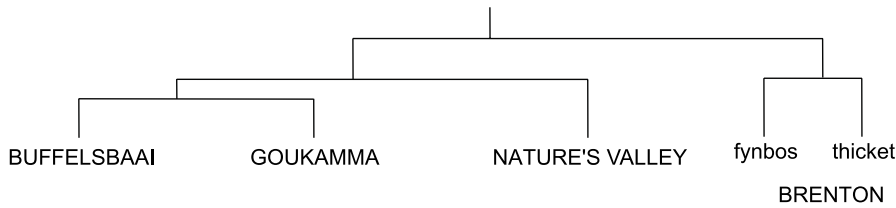


Fig. 4. Classification of the study sites with coastal fynbos. TWINSPLAN analysis of available floristic data.

fertile soils than for other fynbos types.<sup>7</sup> Since these factors favour both vegetation types, there is an interaction where the vegetation is in transition.

Whether fynbos is a successional stage towards thicket has been much debated, with evidence to support this view. Pierce<sup>8</sup> has shown that thicket seedlings become established from bird-dispersed propagules under emergent fynbos shrubs. Fire frequency in relation to rates of thicket development are thought to be the main determinants in the relative distributions of fynbos and thicket.<sup>9</sup> Under certain conditions moribund fynbos may become extensively invaded by woody species, thus affecting vegetation structure and diversity.<sup>3</sup>

The ideal fire frequency in coastal fynbos is between 20 and 30 years.<sup>11</sup> Thicket formation in the absence of fire for periods exceeding these limits may be responsible for incremental degradation of the fynbos habitat of the butterfly, as seems to have occurred at Brenton Extension 1. Over the years this could have led to a reduction in the butterfly population. Grundel *et al.* found that canopy cover had an influence on the habitat use of the Karner blue butterfly in oak woodlands of Illinois.<sup>11</sup>

Microhabitats for the Brenton blue butterfly

Although it was not possible to define the microhabitat and complement of

plant species required, our results (Table 2, Fig. 5) suggest that the butterfly selects *I. erecta* in a habitat with an open structure and a wide variety of the fynbos, to lay eggs. Furthermore, the density of the *I. erecta* is fairly similar in quadrats both with or without eggs, but the cover is higher in quadrats without eggs (Table 2). This suggests that an increased cover of leaves of *I. erecta* is required if there is a denser shrub or fern layer.

This study implies that in searching for the ideal habitat for the butterfly, the following plant species should be present: *Indigofera erecta*, *Ficina ramosissima*, *Tetraria cuspidata*, *Isolepis cernua*, *Helichrysum cymosum*, *Pteridium aquilinum*, *Erica speciosa*, *Peucedanum capensis*, *Rhynchosia capensis*, and *Hypericum aethiopicum*. Minor species such as other legumes may be important as food for the adult butterflies. Plant species richness may play a part in the selection of habitat. Some authors have found that species with a geographically restricted range occur in the most species-rich communities.<sup>12,13</sup> However, Lewis *et al.*<sup>14</sup> found on Grande Comore, off Madagascar, that endemic butterflies did not show this relationship. Phenology of the flowering species and the use of the plants by both adult and larval butterflies can also be an aspect requiring further study. Shapiro<sup>15</sup> found that temporal relationships of butterflies in oak woodlands of Pennsylvania was important.

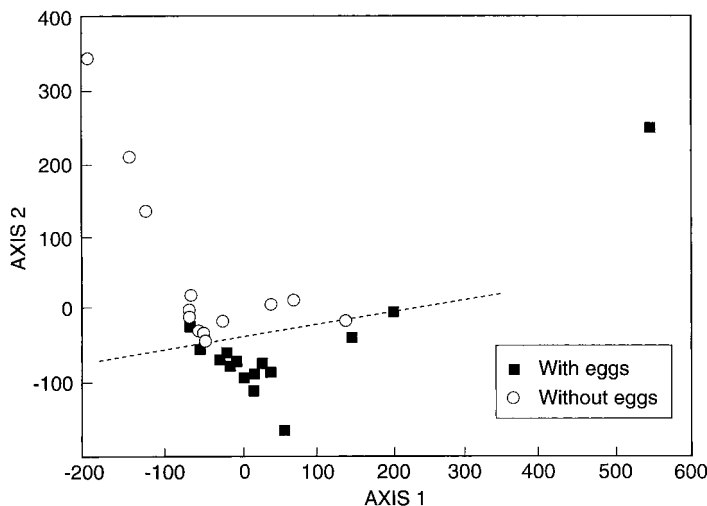


Fig. 5. Ordination of the 30-m<sup>2</sup> quadrats of the Brenton blue butterfly breeding habitat by reciprocal averaging.

The impact of housing on the habitat of the butterfly has also been investigated.<sup>1,16</sup> The proximity of houses could result in the extinction of the species. However, suggestions have been made regarding the artificial control of the dynamics of the vegetation in order to maintain a suitable microhabitat for the butterfly population.<sup>17</sup>

Management of the habitat

As a result of these and other studies, recommendations on the management of the Brenton blue butterfly and its habitat have been put forward.<sup>1</sup> No further housing development has been allowed within the butterfly's habitat in Brenton Extension 1. Vegetation management by reducing the ferns and shrubs, by selective burning, has been suggested. The burning programme that was introduced on the slope above the habitat site was not successful in attracting the butterfly, probably because the thicket is too dense there.

Suggestions for further studies include: the identification of similar patches of fynbos with like plant species and translocation of butterflies to these sites, ecological studies on the manipulation of the habitat so that it is favourable for the breeding of the butterfly, and more intensive studies of the requirements of the butterfly and its host plant. A revised management plan is being drafted by the Brenton blue butterfly management committee to obtain funding.

Conclusions

Studies on the present and past habitats of the Brenton blue butterfly at Brenton-on-Sea and Nature's Valley have shown that the butterflies may have very particular habitat requirements. They occur in mature dune fynbos, which we have called coastal fynbos. Although many of the early colonizers of the dune fynbos are present, such as the *Phyllica* species, *Metalasia muricata* and *Ehrharta villosa*, there are many more species of *Ericaceae* present, as well as *Proteaceae* and *Asteraceae*. The soils are more mature with a build-up of organic matter and there is an invasion of thicket species such as *Pterocelastrus tricuspidatus*, *Maytenus heterophylla* and *Rhus* species. Rainfall is high in these regions, at least during some periods of the year, with a high sedge (for example, *Isolepis cernua* and *Ficina ramosissima*) and graminoid cover. The butterfly appears to require a specific stage in the coastal fynbos vegetation for breeding sites and fire probably maintains this mosaic of vegetation types. However, the

vegetation is in a dynamic state, and should best be maintained with fire, burning at intervals of more than 10 years.

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## A bridge to first-year chemistry

**Chemistry – An Introduction for Southern African Students.** By Michael Clugston, Rosalind Flemming and Daphne Vogt. Pp. 616. Oxford University Press, Cape Town. R350.00. ISBN 0 19 578081 7.

This book is unique, as it is the only chemistry textbook specifically designed for southern African students at university. It is a modified version of *Advanced Chemistry* by Clugston and Flemming, an A-level school textbook in the United Kingdom. Daphne Vogt has incorporated material that will be of interest to students in our part of the world.

Most introductory chemistry textbooks currently prescribed are very similar to one another and often are not very suitable for local curricula. They tend to be designed for American universities and, consequently, hardly cover organic chemistry. This results in the necessity to prescribe two first-year chemistry texts, one general and the other organic. In many ways, the book by Clugston *et al.* breaks the mould. First, it is divided into the three traditional pillars of physical, inorganic, and organic chemistry. Another unique feature is that it deals with each topic mainly as a two-page spread. Where a topic requires more than two pages, it is dealt with as a series of spreads. This makes the book student-friendly, dealing with concepts in a crisp and to-the-point fashion. Matters of interest, or requiring further explanation or expansion are relegated to boxes. In these respects, the book is refreshing and novel. As one has come to expect for introductory books on chemistry, it is beautifully illustrated and its over-

all layout and presentation are pleasing to the eye. It is written in a style that maintains the reader's interest, while remaining easy to understand for the novice and, equally important, for students whose first language is not English. This is done without deviating from scientifically acceptable language.

The organic chemistry section is substantial and covers more ground than most general chemistry textbooks at this level. Its high standard of presentation is one of its strengths and sets it apart from competitive texts. It provides an introduction to structure and reactivity, surveys the functional groups and reactivities of the main classes of molecules, then goes on to deal with biological molecules and finishes with a discussion of spectroscopy and chromatography. The latter topics are seldom seen in a text at this level. The overall impression is of an interesting, dynamic and relevant science, with a reasonable balance between biological and industrial aspects of organic chemistry.

The inorganic section describes the periodic behaviour of the elements. The physical properties and reactivities of the *s*- and *p*-block elements are covered in considerable detail. The section concludes with an introduction to the transition metals. This part is well written and sufficiently comprehensive for the purposes of first-year chemistry.

Overall, the physical chemistry section

introduces the field well. The treatment of equilibrium, acid-base equilibria, kinetics, electrochemistry and thermochemistry is excellent. Having stated the positive, the treatment of physical chemistry has some weaknesses. Certain topics are covered superficially (such as the description of Lewis structures), while other topics are not covered at all (properties of solutions). Valence bond theory is relegated to a short description under organic chemistry, rather than being integrated into the physical chemistry section on bonding. In general, the treatment of atomic structure, bonding and thermodynamics is probably at a standard somewhat lower than that usually expected of first-year students in this country.

This book gives the impression of being a bridge between school and university level chemistry. In this role, it can play an extremely important function, especially for under-prepared students. Perhaps more examples relevant to southern Africa could have been included, as suggested by the title, although this is a minor criticism. Its coverage of organic chemistry will make it an attractive option as a first-year textbook, as will its price. Nonetheless, lecturers will probably need to provide supplementary material for aspects of physical chemistry. Whether it will actually replace existing first-year texts, or merely supplement them, will depend on the curricula of individual teaching institutions.

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