

Statement

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LepSoc Africa

Current waves of a butterfly migration over southern Africa

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People in Southern Africa have reacted in social media to the annual migration of butterflies across southern Africa, especially such as never before. This is such a good sign because it shows that people make an effort to get into touch with their indigenous wildlife heritage. After most welcome rains in parts of southern Africa the butterflies responded in spectacular way in January 2020. A migration event with *Belenois aurota* (Pioneer Caper White/ Brown-veined White) the main proponent, was a bit later than normal.

There are a number of migrations and dispersal events of butterflies all across Africa. The migration of mainly white butterflies over Gauteng and other provinces of the central interior of South Africa is part of what has recently been dubbed the Kgalagadi Butterfly Migration which originates in the Northern Karoo and Kalahari. The butterflies of this Kgalagadi Butterfly Migration fly northeast (or approximately northeast), and distinctly so, during the main migration events.

People are intrigued by this phenomenon and with that also come a few myths, some of which need some busting early on. For starters there is no migration that starts in the southwestern Cape, runs along the coast, then runs inland and ends up full scale in Madagascar.

Another myth is that these butterflies result in pest damage in croplands or rangelands (grasses). The caterpillars of these butterflies that take part in this migration feed mostly on indigenous plants of the Caper family (such as *Boscia*, the Shepherd's tree). The caterpillars of these migrating butterflies are not part of any crop or rangeland damage, whatsoever.

There are still more questions than answers. The extent of the migrations and the existence of various different regional migrations in Africa need a lot of research. Some of these

migrations are dispersal events whereas others certainly have the necessary features to be called a migration.

Members of the Lepidopterists Society of Africa and other wildlife enthusiasts take part in several ways in gaining knowledge on these migrations. These include taking part in the Great Little White Butterfly Migration and LepiMAP of the Animal Demography Unit in collaboration with the South African Biodiversity Institute and the Lepidopterists' Society of Africa. An effort is made to understand the migrations in different regions. These migrations differ for example from Tanzania to the southeastern Karoo and in KwaZulu Natal. The late Torben Larsen, who was also a member of LepSoc Africa, reported spectacular migrations through Botswana in the past.

The main proponent of the current migrations of butterflies across southern Africa is the *Belenois aurota* (Pioneer Caper White/ Brown-veined White/ Pioneer). The name Pioneer Caper White is used in the current edition of the popular butterfly guide by Steve Woodhall (also member of LepSoc Africa and former president of LepSoc Africa) which should be on the shelves soon. This name Pioneer Caper White is suggested to build the bridge between all the different names for *Belenois aurota* that exist from South Africa to India (the butterfly ranges from South Africa all across Africa to India).

As part of a PhD (Stellenbosch University) by Reinier Terblanche (also LepSoc member) and as part of the Tswalu Kalahari Butterfly Research project initiated in 2013 by the Tswalu Foundation a specific effort has been made to gain insight to the migration *Belenois aurota* (Brown-veined White/ Pioneer Caper White). This project evolved into looking at all the butterfly species that take part in a recognizable migration originating from the southwestern and western parts of southern Africa (in South African terms this comprises the northern Karoo and Kalahari). There are several other butterfly species that also regularly take part in the migration.

At the 10th Oppenheimer Research Conference in 2019 the term Kgalagadi Butterfly Migration was introduced to refer to that part of the migration that originate in the northern Karoo and southern Kalahari and spread across the western and central interior of southern Africa (including Namibia, Botswana, Zimbabwe and parts of South Africa). One of the first priorities during this project at Tswalu Kalahari Reserve was to confirm and find more detail about the life history of *Belenois aurota* especially with a focus on what is happening *in the wild*. Tswalu Kalahari Reserve was more ideal than anticipated to study these enigmatic butterflies and the

research also led to a much broader perspective to the migrations of butterflies from the Kalahari.

Some of the findings so far:

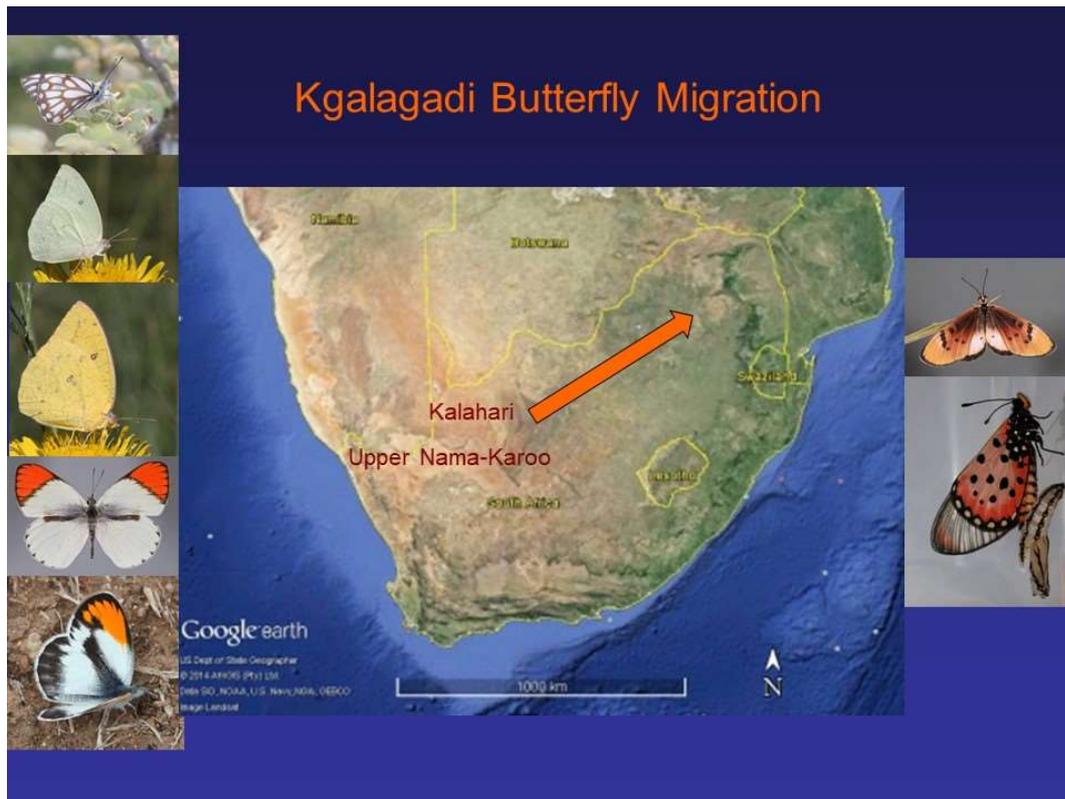
- It emerged that there is a Kgalagadi Butterfly Migration that consists of a number of butterfly species that distinctly, especially in times of the migration, most often fly towards the northeast. Observations of flights in other directions have been recorded but more data is needed to interpret that. Note the main direction of flight of the migrants in other parts of South Africa (example southeastern Karoo) and surely in other parts of Africa are different.
- The two main proponents of the Kalagadi Butterfly Migration are *Belenois aurota*, the Pioneer Caper White (or Brown-veined White) butterfly and *Catopsilia florella*, the African Migrant.
- The concept of source areas that sustain these one-way migrations, was established through the present research. The main host-plant species of the caterpillars that sustain millions of butterflies in the migration at the Kalahari Bushveld Bioregions and parts of the Upper Karoo, for each of *Belenois aurota* and *Catopsilia florella* occur in patches which were then coined by this research to be migration source areas (Terblanche, R.F., 6th Oppenheimer Research Conference, 2015).
- The main larval host-plant species that sustain *Belenois aurota*, the Brown-veined White butterfly from the Kalahari Bushveld and Upper Karoo is *Boscia albitrunca*, the Shepherd's Tree. For *Catopsilia florella*, the African Migrant it was discovered that the main host-plant species that sustain its migration and abundance in the Kalahari is *Senna italica* subsp. *arachoides*. It is interesting that further northeast in subtropical South Africa there are a number of host-plant species that are used by *Belenois aurota* and *Catopsilia florella* while in the Kalahari there is one species available to use as host-plant for the caterpillars. These host-plant species in the Kalahari, are very abundant at places. While the specific host-plant species of these two migrants were noted before, this context of source areas and specific host-plants per region that sustain these enormous populations have not been realised before this research, in particular in the case of host-plant *Senna italica* that sustains the migration of *Catopsilia florella* from the Kalahari (Terblanche, R.F. 6th Oppenheimer Research Conference, 2015).
- Life history and behaviour of *Belenois aurota* were studied by focusing on the early stages (larvae and pupae) at *Boscia albitrunca* trees. GPS-marked *Boscia albitrunca* trees were surveyed with each visit to Tswalu Kalahari Reserve so that an idea of the life history and aspects of the population dynamics of *Belenois aurota* could be acquired. Ad hoc records and observations of phenology of *Boscia albitrunca* and *Belenois aurota* on *Boscia albitrunca* at Tswalu Kalahari Reserve and beyond in the larger region were also made with GPS coordinates to augment the data from more regular surveyed trees at Tswalu Kalahari. A number of interesting findings were made:
- It was discovered that there is also a green morph of the pupae of *Belenois aurota* which occurs mainly in spring and early summer. The pupae of *Belenois aurota* are

therefore polymorphic, though in broad terms it could be described as dimorphic (two main forms with different colour and patterns). Polymorphism (or dimorphism in broad terms) in pupae of *Belenois* is functional. Early in the wet season, normally spring and early summer depending on rains the pupae are green. In the late summer or early autumn depending on rains and being associated with “stripping of *Boscia*”, pupae are of the chalk-and-charcoal form in the southern Kalahari. “Stripping of *Boscia*” means that foliage on many of the branches are completely devoured and effectively removed by a visibly high concentration of larvae that has built up during the wet season. These numerous larvae that removed the foliage from the branches most often pupate on the branches and twigs where leaves have been removed (sometimes some of the larvae pupate on bushes nearby). An explanation for the polymorphism of *Belenois aurota* pupae could be that the green morph of the early summer is cryptic among foliage whereas the chalk-and-charcoal morph is more cryptic on the bare whitish grey branches and twigs that have been stripped from leaves. One could also consider that when the pupae are more visible because the foliage is gone the whitish and blackish patterns serve, if these pupae are then noted by predators, as warning colouration (aposematism). All these life history traits observed in the field once again confirm the importance of observing life history and behaviour *in the wild*.

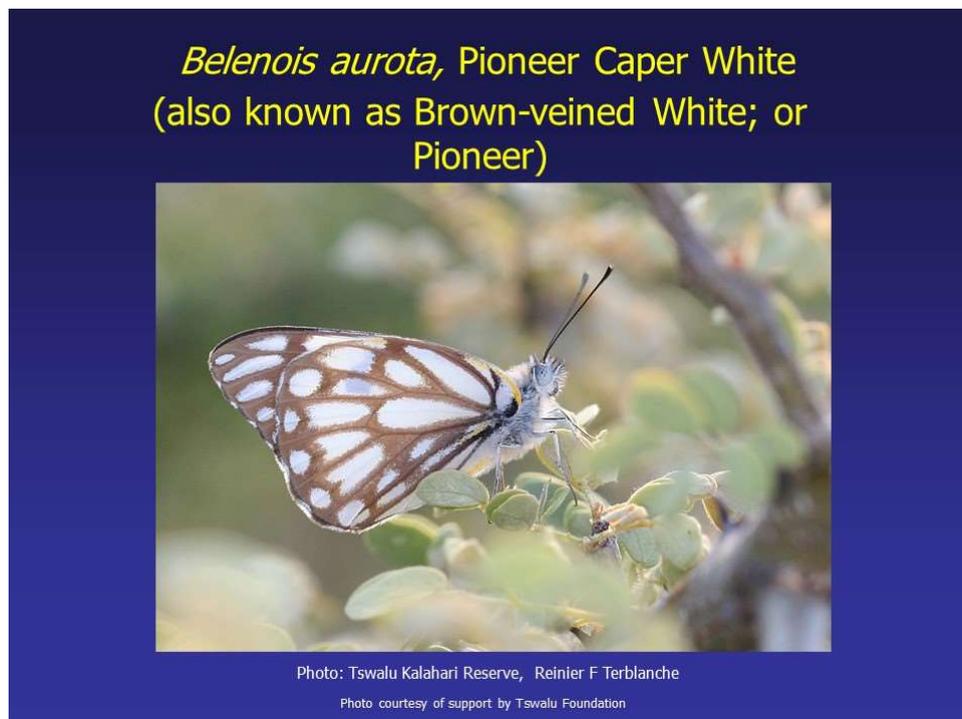
- Another interesting phenomenon is that “flocking of butterflies” is encountered when the many chalk-and-charcoal pupae eclose for the adults to emerge in mid-late summer or early autumn depending on rainfall history and the presence or absence of parasitoids (small wasps that lay their eggs inside the early stages of the butterfly). A few hundred of these butterflies may be observed in *Boscia albitrunca* trees that are over 3 m tall. The dynamics of the flocking is studied in more detail at the moment.
- Significant amounts of *Belenois aurota* pupae were killed by parasitoides during one season and added as an important factor that influences the migration of *Belenois aurota*. This could have resulted in *Pinacopteryx eriphia* (Zebra White) being dominant in the migration such as found in counts that were conducted by R.F. Terblanche in Botswana on the way to Zimbabwe in one year. A better understanding of the patterns of parasitoid infestation with the aid of regular counts is needed.
- Another interesting observation of *Belenois aurota* behaviour in the field is that while the larvae are dependent on *Boscia albitrunca*, the Shepherd’s Tree, for their survival in the Kalahari, the adult butterflies prefer flowers of other plant species as nectar sources. For example, *Belenois aurota* would visit flowerheads of *Vachellia hebeclada* (Candle-pod Thorn) for nectar while avoiding the flowers of a *Boscia albitrunca* tree next to the thorn tree. This has been observed in particular north of the Dedebeben Research Station at Tswalu Kalahari where a number *Vachellia hebeclada* trees occur among *Boscia albitrunca* trees. All these observations add insight to the field ecology of not only *Belenois aurota*, but also the keystone tree species *Boscia albitrunca* (Terblanche, unpublished data for PhD in prep).
- Currently a lot of investigations take place including an analysis of soils beneath *Boscia albitrunca*, an inventory of nectar sources used by the adult butterflies, a description of the polymorphic pupae from Tswalu Kalahari Reserve to Lephallale and so forth.

- The next steps would be phylogeographic studies, marking and tracking of specimens and the implementation of counting methods that have now been tested for years, to be used by many people.

In summary from the work by the Tswalu Kalahari Butterfly Research project: The term Kgalagadi Butterfly Migration was introduced to indicate several butterfly migration “waves” which originate annually at the Kalahari- and northern Karoo bioregions during summer. At least ten butterfly species consistently take part in the Kgalagadi Butterfly Migration. The main proponents of this migration are *Belenois aurota* (Pioneer; Brown-veined White) and *Catopsilia florella* (African Migrant). Qualitative and quantitative aspects of host-plants, early stages and adults of the migrant butterfly species are researched at present. Places such as Tswalu Kalahari Reserve has been confirmed to be an important source area for the Kgalagadi Butterfly Migration. A practical framework for conservation of the Kgalagadi Butterfly Migration, will be submitted to a suitable journal soon.



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Brown-veined White (*Belenois aurota*) at Tswalu Kalahari Reserve.
Photo courtesy of support by the Tswalu Foundation.



Main host plant of caterpillars of Brown-veined White *Belenois aurota* in the Kalahari Bushveld Bioregions and Upper Karoo Bioregion is *Boscia albitrunca* Shepherd's Tree (CAPPARACEAE)

Photo: Shepherd's Tree at Tswalu Kalahari Reserve, Reinier Terblanche

Photo courtesy of Tswalu Foundation

Shepherd's tree, with its remarkably deep root system (the deepest root system published for any tree on earth, 68 m, is that of the *Boscia albitrunca*, the Shepherd's tree) is the main host plant that sustain Brown-veined White butterfly migrations. These findings of the main host-plant species that sustain the migration, led to the introduction of the term "source areas for migrations" during the Tswalu Kalahari Butterfly Research project. Photo courtesy of the Tswalu Foundation.

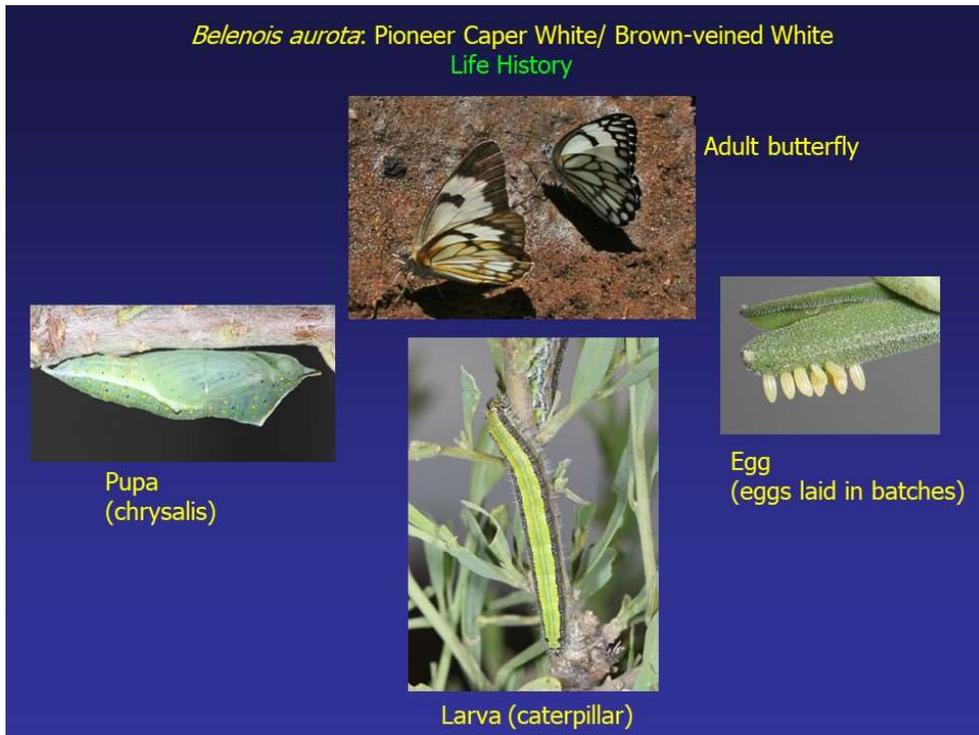
Belenois aurota (Pioneer Caper White, Brown-veined White) moments before adult will emerge from pupa



Photo: Tswalu Kalahari Reserve, Reinier Terblanche

Photo courtesy of support by Tswalu Foundation

Pupa of *Belenois aurota* (Pioneer Caper White/ Brown-veined White) with wing patterns visible just before adult butterfly will emerge.



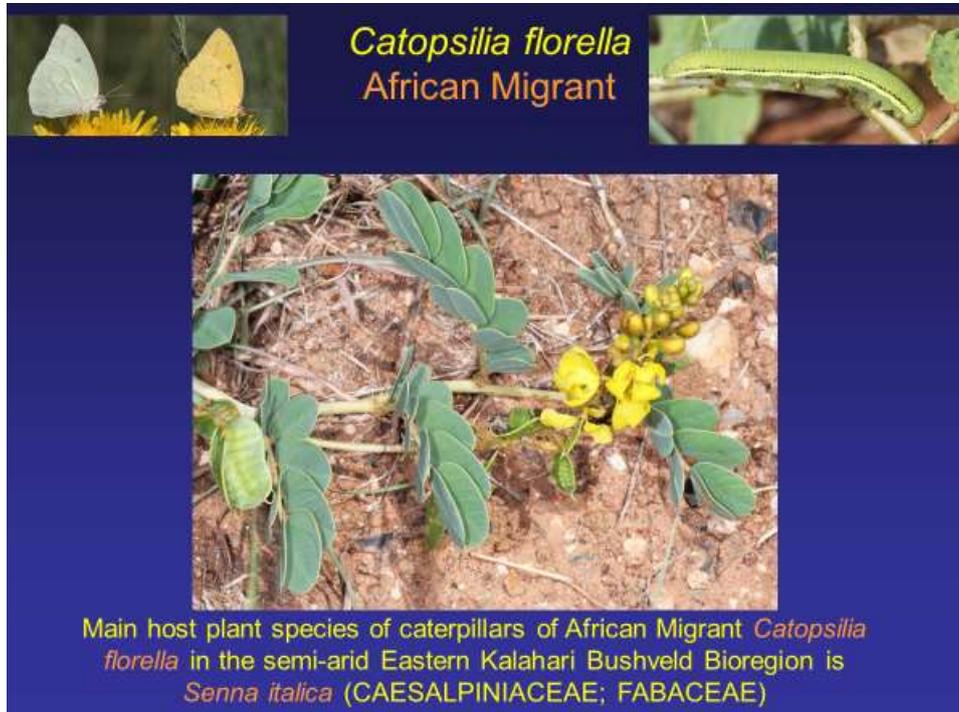
Brief outline of life history of *Belenois aurota* (Pioneer Caper White/ Brown-veined White).



Before the onset of mass migrations of Brown-veined White butterflies, many Shepherd's trees are stripped from their leaves. During these times following the stripping of leaves of the trees, the normal green pupae are replaced by masses of "chalk-and-charcoal" pupae stacked "head-to-tail" on the branches.



Male (white with bluish green tint), female autumn form (yellow) and larva of *Catopsilia florella* (African Migrant).



During the Tswalu Kalahari Butterfly Research project it was discovered that the migration of African Migrants, *Catopsilia florella* (part of the Kalahari Butterfly Migration) depends source areas of the main host-plant species of the larvae, *Senna italica* (an indigenous legume).

* All photos courtesy of support of the Tswalu Foundation.

** Unpublished PhD; RF Terblanche (Stellenbosch University; In Prep.