



Southern African Lepidoptera Conservation Assessment (SALCA)

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Silvia Mecenero¹, David A. Edge², and Hermann S. Staude³

¹ 4 Haarlem Street, Somerset West, 7130, South Africa. Email: silviakirkman@gmail.com

² P O Box 2586, Knysna, 6570, South Africa. Email: orachrysops@gmail.com

³ P O Box 398, Magaliesburg, 1791, South Africa. Email: hermann@busmark.co.za

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Abstract: A new conservation project initiated by the Lepidopterists' Society of Africa is described, with details of the scope of the project and the methodologies to be employed. The project is part of the National Biodiversity Assessment being conducted by the South African National Biodiversity Institute for completion in 2017.

Keywords: Biodiversity assessment, Lepidoptera, SABCA, IUCN, distribution database, conservation assessment, Red Listing

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INTRODUCTION

Butterflies and moths, or 'buttermoths' (a common name for all Lepidoptera, now widely used by members of the Lepidopterists' Society of Africa – LepSoc) belong to one of the most diverse order of insects, Lepidoptera, with butterflies being the most popular of all insect groups (New, 2014). Although moths form over 90% of Lepidoptera fauna, they have been largely over-looked in conservation studies (New, 2014). Lepidoptera are highly diverse (8 497 described species in southern Africa, Vári *et al.*, 2002) and they have highly specialised larval host requirements (Kroon, 1999). This therefore impacts on a significant proportion of plant species in all terrestrial ecosystems that support plant life. Probably one of the major reasons why alien invasive plants are so rampant in new environments is because the Lepidoptera species that keep them in check in their natural habitats were not introduced with them. Furthermore Lepidoptera are important pollinators, especially for fruit trees and they are also meaningful indicators of ecosystem health. It is therefore imperative that they are monitored and conserved.

LepSoc, since being founded in 1983, has played an extremely important role in conserving southern African butterflies (Edge & Mecenero, 2015). The conservation of Lepidoptera in the region was advanced by the thorough conservation assessments of butterflies in the region, conducted during the Southern African Butterfly Conservation Assessment (SABCA) project with LepSoc being one of the three lead institutions (Mecenero *et al.*, 2013). LepSoc

subsequently initiated the Custodians of Rare and Endangered Lepidoptera (COREL) programme to ensure the conservation of threatened Lepidoptera in southern Africa (Edge, 2011).

The outcomes of SABCA fed into the South African National Biodiversity Institute's (SANBI) National Biodiversity Assessment (NBA), which is key to SANBI's mandate to monitor and report regularly on the state of South Africa's biodiversity (Driver *et al.*, 2011). SANBI has been tasked by the South African Department of Environmental Affairs (DEA) to conduct a new National Biodiversity Assessment for South Africa which is due early 2018. Subsequent to a SANBI workshop comprising biodiversity experts in various fields from both the public and private (NGO) sector, including representatives of LepSoc, it was agreed that the Lepidoptera would be included in the next NBA.

To this end, the Southern African Lepidoptera Conservation Assessment (SALCA) project was launched in October 2015. SALCA would include the re-evaluation of all butterfly taxa which were assessed during SABCA (which only included the lepidopteran families Hesperidae, Nymphalidae, Papilionidae, Pieridae and Lycaenidae – hereinafter referred to as the "SABCA taxa") and new conservation assessments for Lepidoptera not included in the SABCA project. It was decided to include all Lepidoptera in the new assessment in order to best reflect the conservation status for the order as a whole, notwithstanding the additional challenges that this strategy poses, necessitating the development of new methodology and procedures. The alpha-taxonomy for many of the lesser known Lepidoptera groups is still very much under-explored with many new species still awaiting descriptions and the available location data are few for certain groups. However, there are moth experts available for many groups in the region; there is a good distribution database available, comprising over 120 000 geo-referenced records to use as a base; a book series on the moths of South Africa is currently in

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progress; there is an active amateur Lepidoptera society in the region, LepSoc; nocturnal Lepidoptera are easy to survey; and some species have great public appeal.

This overview therefore outlines the aims, objectives, structure and methodologies of SALCA.

Project aims and objectives

The aim of SALCA is to re-evaluate the conservation assessments and Red Listings for all butterfly taxa in southern Africa (South Africa, Lesotho and Swaziland – hereafter referred to as the atlas region), and to conduct new conservation assessments for any new butterfly taxa and selected moth taxa in the region, so as to a) monitor which of our Lepidoptera taxa are under greatest threat of extinction and trends therein, b) identify threats and conservation actions required, and c) contribute to South Africa's next National Biodiversity Assessment which will assess the status of South Africa's biodiversity and identify priorities for conservation action. The objectives of SALCA are to:

- a) Decide, in consultation with lepidopterists, which Lepidoptera taxa are to be included.
- b) Resolve taxonomic issues where possible.
- c) Consolidate and verify relevant taxon distribution data to establish an up-to-date database for the conservation assessments.
- d) Conduct prioritised field surveys.
- e) Assign assessments to taxon authors with relevant expertise.
- f) Conduct conservation assessments for all selected taxa selected.
- g) Identify no-go areas for development.
- h) Describe the known threats to Lepidoptera biodiversity.
- i) Identify hotspots and endangered ecosystems for threatened Lepidoptera.
- j) Assess the change in threat status over time (Red List Index) for the SABCA taxa.
- k) Assess the protection level (proportion of locations already in protected areas) for the threatened taxa including trends over time for the SABCA taxa.
- l) Describe and evaluate responses to pressures on Lepidoptera biodiversity, including the expansion of protected areas and development/implementation of management plans.
- m) Identify the benefits of conserving Lepidoptera biodiversity.
- n) Produce an end-product of the conservation assessments that is accessible to end-users.
- o) Define data sharing conditions.
- p) Publicise the project.

Organisation of SALCA

The lead institutions of SALCA are the Brenton Blue Trust (BBT) and LepSoc. Limited funding is being provided by various private donors, managed via the BBT. The time scale of the project is October 2015 – December 2017. The project team includes a project director (D.A. Edge), a project manager (S. Mecenero), IT managers (B.H. Coetzer and A.J. Coetzer), provincial leaders (Gauteng and North West: J.C.H. Dobson; Limpopo and Mpumalanga: A.J. Coetzer; Free State: R.F. Terblanche; KwaZulu-Natal: K.N.A.

Cockburn; Western Cape: A.S. Morton; Eastern Cape: E.L. Pringle; Northern Cape: G.A. Henning; and Southern Cape: D.A. Edge) and taxon authors comprising members of LepSoc (in the process of being allocated).

METHODOLOGY

a) Determine which taxa to include in SALCA

Butterflies

Mecenero *et al.* (2013) defined the taxa of conservation concern (TCC) as those Red Listed as threatened (Critically Endangered – CR; Endangered – EN and Vulnerable – VU), Near Threatened (NT), Data Deficient (DD), Rare (R) and Extremely Rare (ExR), totalling 151 taxa. These taxa will be focussed on during SALCA, including the Extinct (EX) taxa and any Least Concern (LC) taxa whose distribution has declined to the extent that they would now qualify as TCC. In this regard, the LC taxa will be screened by following the quick initial evaluation process used during SABCA (see Table 2.1 in Mecenero *et al.*, 2013) as well as comparing distribution maps for records from SABCA and those added after the SABCA deadline to highlight taxa with major distribution changes. Taxa where a demonstrable genuine decline in distribution or population size has been observed will be highlighted, even if these are not yet in a NT or threatened category. This exercise will be carried out by the relevant database and taxon authors. All remaining LC taxa will undergo a rapid re-assessment.

Additionally, the original SABCA taxa will be expanded to include any butterfly taxa newly described or recorded in the atlas region, including: *Cassionympha perissinottoi* sp. nov. (Pringle, 2013); *Chrysoritis lyndseyae* stat. rev. (Heath, 2011); *Lepidochrysops frederikae* sp. nov. (Henning & Ball, 2013); *Neptis serena* (Pringle, 2011) (new record for South Africa); *Teniorhinus harona* (Coetzer, 2014) (new record for South Africa).

Moths

The precise methodology that will be used for these fauna is not entirely clear at this stage, due to the lack of any literature in this regard since such a project has never been attempted before.

It is tentatively envisaged that the following approach will be employed to determine which taxa to include in SALCA, with the proviso that the methodology could be adapted if it proves to be necessary:

- From the moth distribution database (~120 000 distribution records), the endemics will be extracted. Any near-endemics will also be extracted.
- From these, any taxa with unstable alpha-taxonomy will be removed.
- Taxa with a restricted distribution will be highlighted.
- Experts will be approached for their input on the final list, and whether any taxa have been missed. Further refining criteria may be added to filter out the taxa even more (e.g. the detectability of a taxon,

the number of distribution records available for a taxon, the ease of identification of a taxon, availability of experts for a particular taxon).

- The initial evaluation process used during SABCA (Mecenero *et al.*, 2013) may also be applied here to try and highlight the special taxa.

The above approach reduces bias as no group is excluded up front. Groups with insufficient data will automatically exclude themselves. The bias would be toward those groups that have been given attention historically, but this simply means that possibly threatened taxa in poorly worked groups could not be detected. The majority of location data were indiscriminately collected, hence reducing geographic and taxonomic bias. It would be preferable to select all taxa within a taxonomic group (e.g. within a subfamily or tribe) that mainly qualify with the above criteria. However, individual qualifying taxa may be selected from groups where exceptional information warrants this. The above approach would yield the following:

- Identification of widespread taxa not of immediate conservation concern (the majority).
- Identification of narrow endemics (important to help identify unique habitats).
- A list of taxa that could possibly be threatened, for further individual analysis.

Additionally, South Africa's Department of Environmental Affairs has initiated a Shale Gas Exploration Strategic Environmental Assessment (SGE SEA), which aims to improve biodiversity data for the fracking region in the Karoo (for more details see <http://seasgd.csir.co.za/>). An initial analysis by Staude & Coetzer (2015) has identified 1 109 moth taxa occurring in this region, of which 117 are presumed endemic, based on the current moth distribution database in LepiAfrica (a Closed Corporation launched in 2002 and represented by a group of lepidopterists from LepSoc to accumulate foundational data and information on Lepidoptera, including distributional data, and place it in the database Lepidops). The project has been active ever since and location data are included). The time frame for the SEA project is very tight and thus inadequate to conduct a proper assessment of the important moth taxa falling within this region. It would be imperative to at least include these 117 endemic taxa as part of the selected SALCA moth taxa, as well as the near endemics. The remaining 992 taxa should be screened for inclusion, in case any may potentially be threatened.

b) Resolving taxonomic uncertainties

The following five butterfly taxa were assessed as being Data Deficient due to taxonomic uncertainty during SABCA (Mecenero *et al.*, 2013): *Aloeides pallida littoralis*, *Chrysoritis thysbe mithras*, *Crudaria wykehami*, *Lepidochrysois penningtoni* and *Pseudonympha swanepoeli*. Research into the taxonomic status of these taxa has been ongoing since the end of SABCA, mainly using modern DNA analysis techniques, and the taxon authors will keep

themselves appraised of progress during SALCA. Where possible, the taxonomic uncertainty will be resolved so as to upgrade the taxon into an appropriate Red List category. Any taxonomic uncertainties with other Lepidoptera taxa will also be identified.

c) Updating and verifying the distribution database

Data consolidation

All relevant data additional to the SABCA database will be consolidated to create a comprehensive and up-to-date SALCA distribution database, with one section for butterfly and another for moth taxa. The butterfly section will include the original SABCA data, which had a deadline of 20 July 2012 (Mecenero *et al.*, 2013). For butterflies, new data since 20 July 2012 will be added and for moths all existing data will be added. New butterfly and moth data will be obtained from: data in Lepidops (LepSoc) (Coetzer, 2008); citizen science data where observation records have been correctly identified, from the online virtual museum for Lepidoptera, LepiMap (Animal Demography Unit - ADU; see <http://vmus.adu.org.za/>) and the online site for collecting biodiversity observations, iSpot (SANBI; see <http://ispot.org.za/>); data collected during field surveys; and any important outstanding collections that may possibly be digitised if funding is obtained specifically for this.

A concerted effort by LepSoc members, in collaboration with Ditsong Museum of Natural History staff, will be made to digitise and geo-reference location records for important moth taxa in their collection, earmarked for possible SALCA assessment, in that collection.

The consolidated database will conform to Darwin Core database standards (Wieczorek *et al.*, 2012) and will include, at least, the following fields: Family, Subfamily, Genus, Species, Subspecies, Collector (Observer), Date (day, month, year), Country, Province, Town, Locality description, Latitude (S) and Longitude (E) coordinates (degrees, minutes, seconds). Additionally, the level of accuracy of the coordinates will be documented, as guided by SANBI.

Data verification

In order to verify records, species distribution maps will be produced based on the updated and completed database. Outlier records (records out of the range for a taxon) will be flagged during review by the relevant taxon authors. These flagged records will be investigated and corrected, if necessary, to cover the following possible errors in the database:

- Misidentification of specimen(s). For older records the previously prevailing taxonomy may have differed from currently accepted taxonomy. In the case of subspecies or fairly similar taxa a wrong identification may have been made by the collector or observer. The originator of the record will be contacted and clarification obtained, if necessary by inspection of the specimen(s).
- Incorrect or inaccurate coordinates resulting from

poor label data or inaccurate data capture. Particularly for the threatened taxa (CR, EN and VU) accurate coordinates are essential because these taxa tend to be confined to very small areas.

Flagged records that cannot be corrected will be removed from the assessments. The deadline for the database to be consolidated and verified is 31 March 2017. No new data will be accepted into the SALCA database thereafter, so as to ensure that the conservation assessments can be completed on time for SANBI's review.

d) Prioritising taxa and areas to be targeted for ongoing field surveys

Field surveys will be conducted by members of LepSoc during the time period of SALCA. Provincial leaders, mainly with experience from SABCA, have been appointed for each province or region. They will be responsible for ensuring that all the data collected since SABCA ended is obtained and submitted to the SALCA database, that the necessary new surveys are done (with the necessary permits, where required), and for submitting new records to SALCA by the database deadline of 31 March 2017. The surveys will be prioritised by taxa and area, as described below.

Prioritisation of field surveys by taxa

For butterflies, the field surveys will target the following taxa:

- Extinct taxa: In view of LepSoc's success in finding new localities for CR taxa (e.g. Garvie *et al.*, 2014; Bazin & Edge, 2015; Coetzer, 2015; Lawrence, 2015), searches will continue for the taxa assessed as Extinct during SABCA, led by the appointed COREL custodians for each taxon.
- Data Deficient (due to insufficient distribution information - DDD): Focused searches for butterfly taxa assessed as DDD due to lack of information during SABCA will be carried out to try and upgrade them from a DDD status to an appropriate Red List category, possibly using GIS modelling and led by the taxon custodians.
- CR, EN, VU, NT, R and ExR taxa: For butterfly taxa assessed in one of these categories during SABCA, searches will be conducted for those with less than three localities, possibly using GIS modelling and led by the taxon custodians or taxon authors.
- LC taxa and non-SABCA taxa: Following the screening of LC taxa that were not assessed as TCC during SABCA but which now have been observed to show genuine decline in distribution or population size, field surveys for these taxa will be conducted provided that these taxa are highlighted prior to the commencement of the field surveys.

Field surveys for non-SABCA taxa may be prioritised similarly.

Prioritisation of field surveys by area

Quarter degree grid squares (QDGS's) that have been under-surveyed for butterflies have been identified and prioritised by Engelbrecht & Robertson (submitted; see also Engelbrecht, 2015), using the SABCA database.

Field surveys for SALCA will be prioritised according to the identified under-surveyed areas. For the moths, considering the SALCA time constraints as well as the great amount of work required for the moth assessments, there will not be time to undergo formal field surveys. However, if any surveys are undertaken, the data will be included.

e) Allocation of taxon authors

During SABCA, lepidopterist experts from LepSoc were allocated as authors for each taxon (Mecenero *et al.*, 2013). This list of taxon authors has been reviewed and revised to include more lepidopterists, including taxon authors for the new non-SABCA taxa, and to redistribute the workload so that no individual has a disproportionate amount of work to do. The criteria for selecting taxon authors were: having a close knowledge of the taxonomy and ecology of the taxon; being based in or close to the places where the taxon occurs; having been the taxon author during SABCA; having been the describer of the new taxon, or the first to record it in southern Africa; having studied and published on the ecology, distribution and conservation of a species recently as part of formal studies at a university or other appropriate research institution.

f) Conducting the conservation assessments

Conservation assessments, including Red Listing, will be carried out for all taxa selected for SALCA, following the IUCN Red listing procedure (IUCN, 2014). Butterfly taxa already assessed during SABCA will undergo a re-assessment during SALCA, with focus on the TCC, as well as any other LC taxa subsequently presumed to be TCC. For new non-SABCA taxa included in SALCA, new assessments will be carried out for each taxon. The assessments will be conducted by the appointed taxon authors and checked by the project manager, prior to submission to SANBI for final verification. For those assessors who were involved with the SABCA assessments and are thus already familiar with the process, they will be referred to the IUCN online Red List training course as a refresher (see www.iucnredlist.org/technical-documents/red-list-training/online-training). For those few assessors who have not conducted assessments yet, extra guidance and assistance will be provided to them. All assessment data will be captured using standardised data standards and requirements for Red Listing, as guided by the IUCN (IUCN, 2013). The assessments will be finalised during the final year of the project (2017) and submitted to SANBI's Threatened Species Programme for review no later than 30 September 2017. Based on SANBI's feedback, revisions to the assessments will be completed by mid-December 2017 for inclusion in the NBA.

g) Listing and mapping no-go areas for development

The DEA, together with SANBI, is investigating ways to bolster legislation to prevent future developments to proceed in areas where highly threatened biodiversity exists. To this end, a regional Alliance for Zero Extinction (AZE) is being considered, which will give

even further protection to such sites (see www.zeroextinction.org for more details on this concept). Consequently the occurrence of taxa in the CR and EN categories that have only two or less locations needs to be accurately mapped and the details submitted to SANBI for incorporation into the regional AZE. The methods to be employed when mapping these sites will follow SANBI guidelines.

h) Revising threats to southern African butterfly biodiversity

During the assessments, the threats to the SALCA taxa will be revised and updated by the taxon authors. Upon completion, the section on threats in Mecenero *et al.* (2013) will be reviewed and updated to reflect any change in the threats to Lepidoptera biodiversity.

i) Identifying biodiversity hotspots and endangered ecosystems

The vegetation types and hotspots identified during SABCA will be reviewed to include current knowledge and all SALCA taxa. Biodiversity hotspots will include identifying those areas containing the highest number of threatened, TCC and endemic taxa (Mecenero *et al.*, 2013). The vegetation types containing threatened taxa will be identified and prioritised according to how many threatened taxa they contain (Mecenero *et al.*, 2013). The number of TCC and endemics in these vegetation types will also be determined. Together, the biodiversity hotspots and priority vegetation types will be investigated and, in consultation with the botanical experts, put together a combined case for their declaration as Critical Biodiversity Areas.

j) Calculating the Red List Index

The Red List Index (RLI) can only be calculated for the SABCA taxa that have undergone a previous assessment. The RLI will be calculated using the following formula (IUCN, 2009):

$$\text{Red List Index at time } t: RLI_t = 1 - \frac{\sum_s W_{c(t,s)}}{W_{EX} \cdot N}$$

where $W_{c(t,s)}$ at time t and for species/taxon s is the weighting allocated to each Red List category c given in IUCN (2009), W_{EX} is the extinction weight (see IUCN, 2009) and N is the number of taxa in the group assessed (excluding EX and DD taxa).

The RLIs will be compared between the Red Listings of 2012 and 2017, for butterflies only. Comparisons may also be made with the RLI of 1989 using “back-casting” (Butchart *et al.*, 2007), i.e. look at the data then available and allocate each taxon in the 1989 Red List to a current category. In addition to the RLI, the increase or decrease in the higher ranks of extinction risk (CR and EN) will be noted.

k) Assessing protection levels

Protection levels (PLs) will be calculated for threatened and NT taxa, and comparisons between PLs will be made between 2012 and 2018, if feasible. The protection level (PL) is the proportion of the extent of occurrence (and possibly area of occupancy) that

occurs in protected areas, as well as the proportion of the probable “original” distribution that is in currently protected areas. The estimated PLs will be categorised as follows: well protected (>15 % of occupied range in protected area); moderately protected (5-15% of occupied range in protected area); poorly protected (1-5% of occupied range in protected area); not protected (0% of occupied range in protected area).

Distribution modelling may be necessary whereby smoothed probability of occurrence distributions are produced per taxon (Mecenero *et al.*, 2015). From this, the proportion of grid squares, at a particular resolution (e.g. 5 minute grid squares), containing probabilities of occurrence greater than a certain percentage (e.g. >95% or >99%) can be extracted and these grid squares then overlaid with a protected areas layer to determine what proportion fall within protected areas.

l) Describe responses to pressures on Lepidoptera biodiversity and assess effectiveness

The principle responses have been on the one hand legislative and initiated by government (e.g. DEA, 2015), and on the other hand LepSoc’s COREL programme (Edge, 2011), which includes habitat management measures such as alien eradication and appropriate fire management. The effectiveness of these measures will be assessed and reported on.

m) Describe and quantify in economic terms the benefits of conserving Lepidoptera biodiversity

All possible benefits accruing to society from the conservation of Lepidoptera biodiversity will be identified and the economic benefits, both current and in the future, described and quantified.

n) Conservation assessment product

The conservation assessments will be made accessible to end users (e.g. researchers, conservation managers, environmental impact assessors, researchers, etc.) through publication as a supplement to LepSoc’s journal *Metamorphosis*.

o) Data sharing conditions

According to the SABCA data sharing agreements, the SABCA database may be used by LepSoc and SANBI, both SABCA lead institutions together with the ADU, to further research and conservation efforts (Anon, 2007). Thus SALCA is permitted to use the SABCA distribution data. New, non-SABCA distribution data added to the SALCA database have the following conditions attached to their use: non-SABCA distribution data in the SALCA database may not be shared with any individual or organisation unless specific permission, in writing, has been obtained from the data owner(s). These data are for the sole use of the SALCA project. Project team members may not use the data for purposes other than for SALCA and may not share the data with others outside of the SALCA project team.

p) Publicising the project

The SALCA project will be publicised by LepSoc, via LepSoc's website, newsletter and email distribution list, as well as via its various social media pages on Facebook and pages of related Lepidoptera and invertebrate groups. Press releases will be sent annually to various media outlets (e.g. radio, newspaper, magazines).

q) Timescale and project deliverables

The SALCA project was launched in October 2015 and will continue until December 2017, at which time the conservation assessments need to be handed over to SANBI for inclusion in the NBA of 2018. The following are the SALCA project deliverables:

- Up-to-date and verified database.
- Conservation assessments, including Red Listing, in the form of a database.
- Conservation assessment end-user product
- Red List Index comparisons for butterflies.
- A list of no-go areas for development.
- An evaluation of (with some case studies): threats to Lepidoptera biodiversity; hotspots and endangered ecosystems for threatened Lepidoptera; protection level of threatened taxa; responses to pressures on Lepidoptera biodiversity; benefits of Lepidoptera biodiversity.

CONCLUSIONS

Lepidoptera contribute to important ecological processes and thus it is imperative that we monitor and conserve them. The recently launched SALCA project expands on the important butterfly conservation assessment research conducted during SABCA, to continue monitoring the state of the regions butterflies, and importantly to include all Lepidoptera. The outcomes of SALCA will feed into the National Biodiversity Assessment, which ultimately will feed into policy for the conservation of threatened biodiversity, determination of areas of high conservation value, and general land use policies.

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