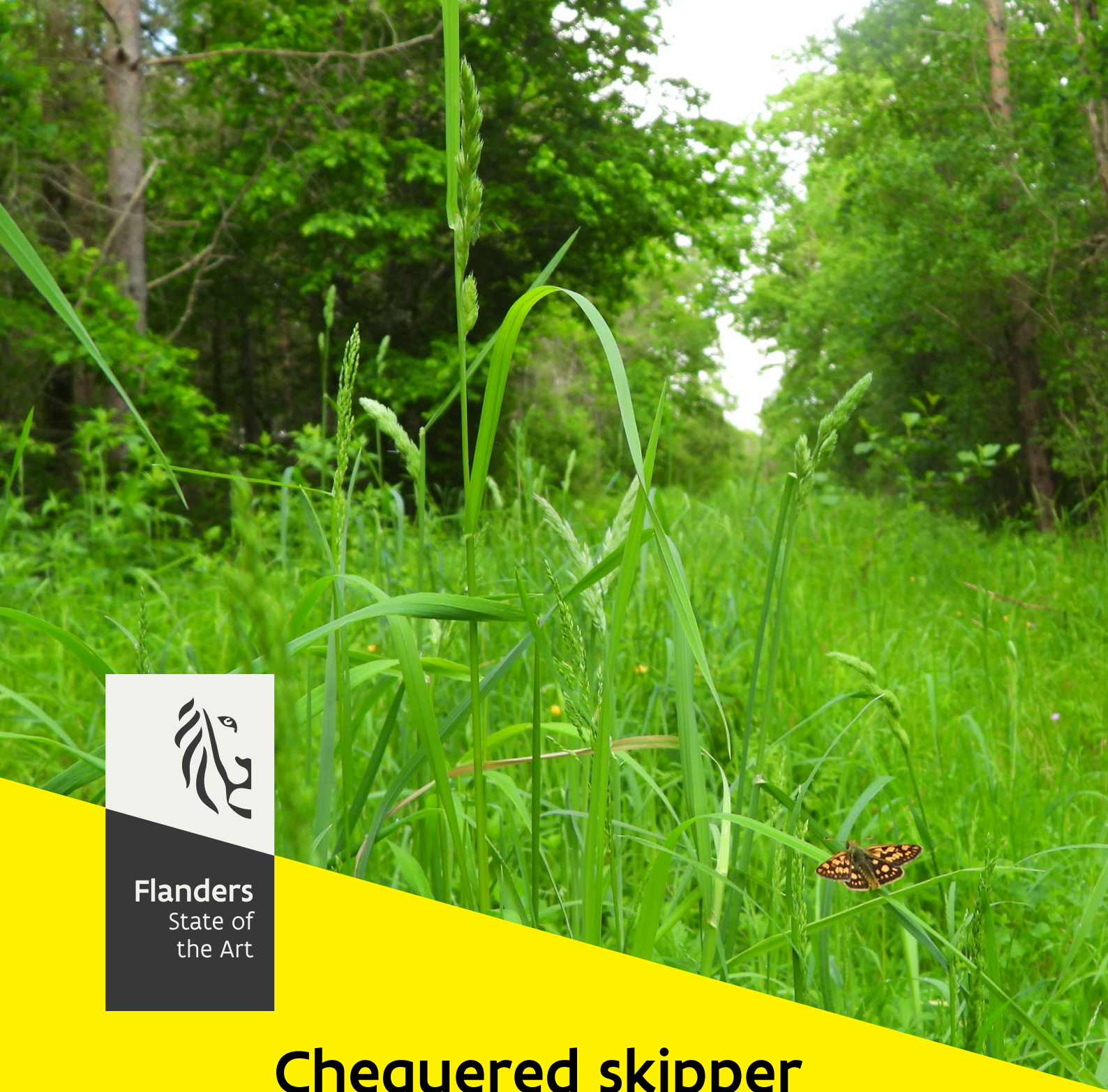

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Chequered skipper captive breeding

How-to' guide for captive breeding Chequered skippers in England

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INBO.be

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Photo 1 Chequered Skippers in the Rockingham landscape in England (Photo: Liam Creedon).

Abstract

This report provides a comprehensive protocol for the captive breeding of the Chequered Skipper (*Carterocephalus palaemon*), developed to support the species' reintroduction in England after its extinction in 1976. Recently, the Chequered Skipper has been successfully bred in captivity in Belgium using populations sourced from southern Belgium (Fagne and Famenne regions). This guide outlines all stages of the breeding process—from adult collection, transport and environmental control to caterpillar care, hibernation and release methods. Emphasis is placed on maintaining near-natural temperature, humidity and photoperiod conditions to replicate the butterfly's ecological requirements. Detailed practical recommendations are provided for host plant selection and maintenance, disease prevention and behavioral monitoring. The report demonstrates that the Chequered Skipper is a relatively straightforward species to rear under appropriate conditions and identifies key factors influencing breeding success, such as plant quality, cage design and microclimate stability. Lessons learned from the project offer guidance for future reintroduction and conservation efforts of the species in similar temperate regions.

Samenvatting

Dit rapport biedt een uitgebreid protocol voor het kweken van het Bont dikkopje (*Carterocephalus palaemon*) in gevangenschap, ontwikkeld ter ondersteuning van de herintroductie van de soort in Engeland na het uitsterven in 1976. Het Bont dikkopje werd recent met succes gekweekt in gevangenschap in België met exemplaren uit populaties in Zuid-België (de regio's Fagne en Famenne). Deze handleiding beschrijft alle fasen van het kweekproces – van de verzameling van volwassen vrouwtjes, het transport en de omgevingscontrole tot larvenverzorging, overwintering en uitzettingsmethoden. Er wordt sterk de nadruk gelegd op het behoud van natuurlijke temperatuur-, vochtigheids- en lichtomstandigheden om de ecologische vereisten van de vlinder te benaderen. Dit rapport biedt bovendien praktische aanbevelingen voor de keuze en verzorging van waardplanten, ziektepreventie en gedragsobservaties. Het rapport toont aan dat het Bont dikkopje relatief eenvoudig te kweken is onder geschikte omstandigheden en benadrukt sleutelfactoren die het kweekresultaat beïnvloeden zoals plantkwaliteit, kooiontwerp en microklimaatstabiliteit. De opgedane ervaring biedt waardevolle richtlijnen voor toekomstige herintroductie- en instandhoudingsprojecten van de soort in vergelijkbare gematigde regio's.

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Photo 2 Catching Chequered Skippers in Durbuy, south Belgium (Photo: Daan Van Eenaeme).

1 Introduction

The Chequered Skipper was once present in de Midlands and Lincolnshire in England but went extinct in 1976, mostly due to habitat loss and changes in woodland management (Wildman 2023). The population in Scotland, however, is still present thanks to local conservation efforts (Ravenscroft 1995; Ravenscroft & Warren 1996).

A first attempt to reintroduce the species in England was carried out in the 1990s (Ravenscroft & Warren 1996). Chequered Skipper eggs and adults were collected from northern France (Spincourt, Rafour, Villecloye, Chantemelle and Fôret de Lachalade and Haute Chevauchee areas of the Fôret d'Argonne), which was selected as the main source population for the reintroduction (Moore & Pullin 1997; Warren 1995). Captive breeding was attempted using captured adults and eggs, but this reintroduction attempt was unsuccessful due to low stock quality of both translocated adult and captively reared eggs. Many adults were released in unmated or poor condition and eggs had been subjected to laboratory-based host plant and humidity experiments to synchronise emergence with wild Chequered Skippers. Weather conditions were poor in both main release years and high-quality habitat was limited (Wildman 2023).

In the 2010s, a second attempt to reintroduce Chequered Skipper in England was developed by Butterfly Conservation. The Rockingham Forest landscape of Northamptonshire and Cambridgeshire was chosen as a reintroduction site given it was the last stronghold of the species in England (Wildman et al. 2022). This reintroduction project was part of the Back from the Brink project. Details about the number of individuals translocated and/or restocked during the different reintroduction years can be found in Bourn et al. (2025). This reintroduction resulted in the establishment of two native English populations, but follow-up is needed to ensure its long-term sustainability. The present report and breeding project is part of this effort.

Here, we describe our experiences of a Chequered Skipper captive breeding project in Belgium giving details about how and when to catch individuals for breeding purposes, how to treat adult butterflies, eggs, caterpillars and pupae and what facilities are needed.

2 The Chequered Skipper *Carterocephalus palaemon*

2.1 Distribution

2.1.1 Global distribution

The Chequered Skipper has a Holarctic distribution: it occurs from Northern America in the west to Kamtsjatka (Russia) in the east (Figure 1).

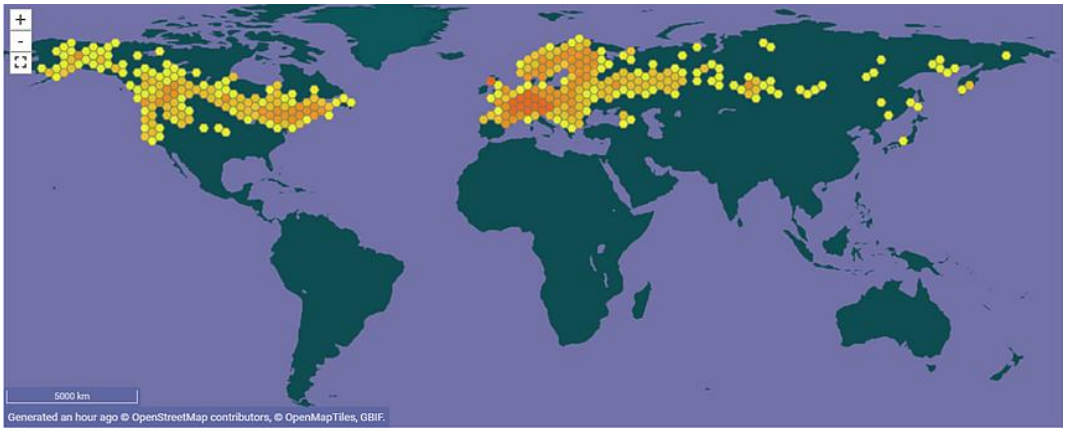

Figure 1 The global distribution of the Chequered Skipper (source: GBIF).

2.1.2 European distribution

In Europe, the Chequered Skipper occurs from Scotland and the Picos de Europa in the west and ranges east to the European part of Russia and from the Pyrenees and northern Greece to northern Scandinavia (Figure 2).

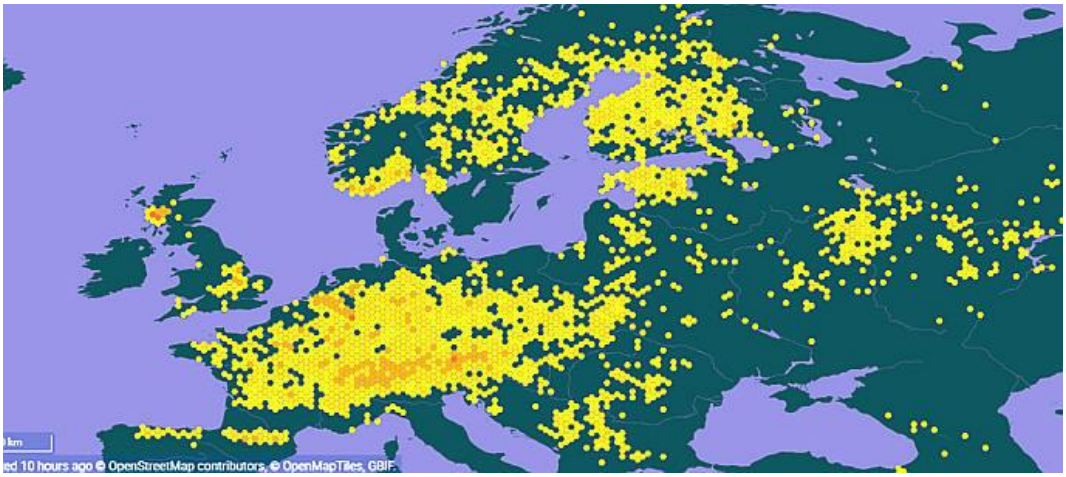

Figure 2 The European distribution of the Chequered Skipper. The records in England are all historical ones (source: GBIF).

2.2 Ecology

2.2.1 Habitat

In north-west Europe, the Chequered Skipper is a species of wide, but sheltered clearings in humid woodlands (Figure 3). In northern Belgium, however, it also occurs in sheltered dry heathlands (Bink 1992; Eeles 2019; Figure 4).

Figure 3 Typical biotopes of the Chequered Skipper in south Belgium (Photo: Daan van Eenaeme).

Figure 4 Typical habitat in north Belgium (Photo: Daan Van Eenaeme).

2.2.2 Host plants

Chequered Skippers use a wide variety of broad-leaved grasses such as Heath false brome (*Brachypodium pinnatum*), False-brome (*Brachypodium sylvaticum*), Purple small-reed (*Calamagrostis canescens*; Figure 5), Meadow fescue (*Festuca pratensis*) and Purple moor grass (*Molinia caerulea*) (Asher et al. 2001; Bink 1992; Bos et al. 2006; Eeles 2019; Emmet & Heath 1989; Moore 2004; Moore & Pullin 1997; Ravenscroft 1994a; Ravenscroft 1994c; Tax 1989).

Figure 5 Caterpillar on Purple small-reed (*Calamagrostis canescens*) in Beauraing, south Belgium (Photo: Daan Van Eenaeme).

2.2.3 Nectar plants

The nectar plants most often used by Chequered Skippers are Ragged Robin (*Lychnis flos-cuculi*), Bugle (*Ajuga reptans*), Bush vetch (*Vicia sepia*) Carthusian pink (*Dianthus carthusianorum*), Ground ivy (*Glecoma hederacea*), Creeping buttercup (*Ranunculus repens*), Marsh thistle (*Cirsium palustre*) and Greater stitchwort (*Stellaria holostea*) (Figure 6; Ebert & Rennwald 1993;Tax 1989; Eeles 2016).

Figure 6 Chequered Skipper habitat with Bugle (*Ajuga reptans*) and Bush vetch (*Vicia sepium*) in Romedenne, south Belgium (Photo: Daan Van Eenaeme).

2.2.4 Phenology

The adult Chequered Skipper flight period peaks between mid-May and mid-June. Eggs can be found in June. Caterpillars emerge in mid-June, hibernate from October to April, and pupate in the beginning of April after which adults emerge by mid-May (Eeles 2016; Eeles 2019; Figure 7).

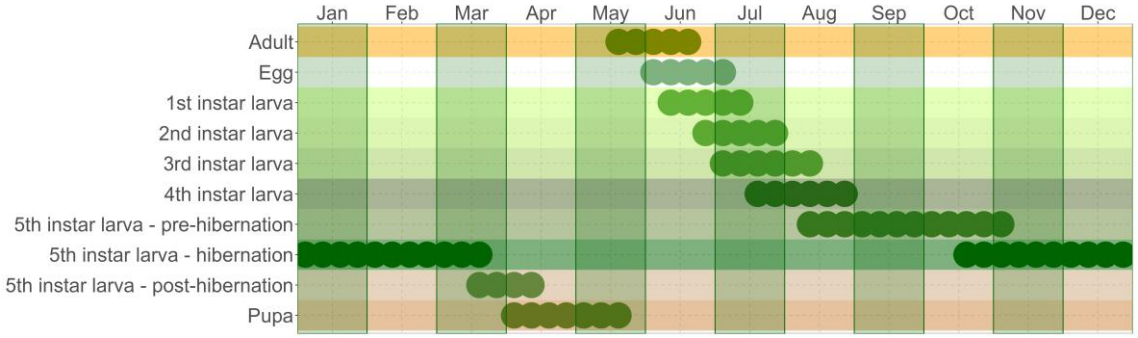

Figure 7 Phenology of the different life stages during the captive breeding in Belgium.

2.3 Red List status in north-west Europe

The Chequered Skipper is considered Vulnerable in Flanders (north Belgium; Maes et al. 2021) and in Wallonia (south Belgium; Rodts 2025), Near Threatened in Luxemburg (Cantú-Salazar et al. 2024) and of Least Concern in the Netherlands (van Swaay 2019) and France (UICN France et al. 2012). The butterfly is also classified as Least Concern in the UK (Fox et al. 2022) owing to the health of the Scottish population, although it would be Critically Endangered if assessed in England. In the most recent European Red List of butterflies, the species was assessed as Near Threatened (van Swaay et al. 2025).

Photo 3 A territorial male Chequered Skipper in Vodelée, south Belgium (Photo: Dirk Maes).

3 Collection and initial handling

3.1 Permits

Before collecting takes place, make sure that all permits are dealt with. Since Chequered Skippers are not legally protected in Wallonia, we were allowed to catch them, but only outside protected areas. No permission was given by the Walloon authorities to capture individuals inside nature reserves.

3.2 Collection sites

Prior to the reintroduction of the Chequered Skipper, source populations or regions needed to be identified. To do so, we first collected information on the known distribution of the species in NW-Europe (the Netherlands and Belgium) and in Scotland. Subsequently, we used species distribution modelling to determine which potential source region resulted in the highest suitability when projected to the reintroduction site (Maes et al. 2019; Halford et al. 2024). Two regions in the Walloon area in south Belgium were selected as most suitable source regions: Fagne and Famenne, west and east of the river Meuse, respectively (Figure 8).

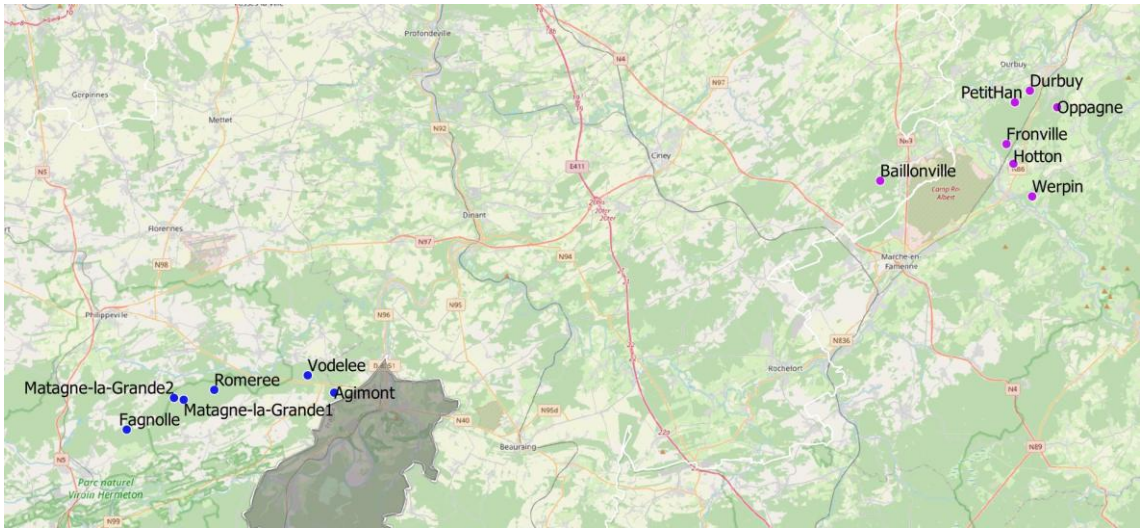

Figure 8 Location of the potential collection sites in Wallonia (south Belgium): the Fagne sites are shown in blue and the Famenne sites in purple.

3.2.1 Fagne

Adult females from the Fagne region, caught for rearing, mainly came from the two Matagne-la-Grande sites (Figure 9; Figure 10). In 2022, 2023 and 2024, two, one and three females, respectively, were caught in the Fagne region for captive breeding.

Figure 9 Potential collection sites in the Fagne region.


Figure 10 Biotope of the Chequered Skipper in Matagne-la-Grande, south Belgium (Photo: Dirk Maes).

3.2.2 Famenne

Adult females from the Famenne region, caught for rearing, mainly came from Durbuy (Figure 11; Figure 12). In both 2022 and 2024, two females were caught in Famenne for captive breeding.

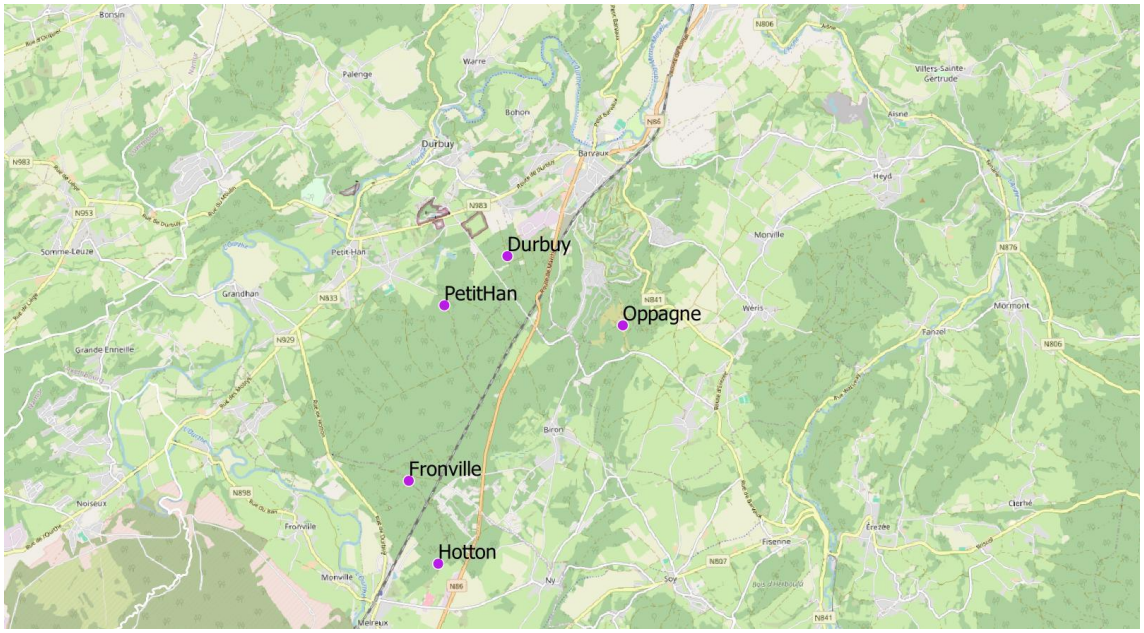

Figure 11 Potential collection sites in the Famenne region.


Figure 12 Biotope of the Chequered Skipper in Durbuy, south Belgium (Photo: Dirk Maes).

3.3 Collection stage

Captive breeding should begin with wild-caught females. Most, if not all females will have mated shortly after eclosion and carry fertile eggs. It is important to collect at the beginning of the flight season when females are still carrying most of their eggs. Females start flying about one week after the first males emerge. In order to be able to capture enough females, it is advisable to only collect females when enough individuals are on the wing (i.e. about 1-1.5 weeks after the first observation of females).

3.4 Collection method

Netting is the most appropriate method to capture Chequered Skippers (Figure 13).

Figure 13 Netting is the best way to capture Chequered Skippers (Photo: Dirk Maes (left), Ive Van Krunkelsven (right)).

To differentiate males from females in the field, the underside of the antennae can be used as a distinguishing feature (Figure 14; Figure 15): in males the underside of the antenna is entirely yellow, while in females they are partly brown. Females also have a broader abdomen compared to male Chequered Skippers.

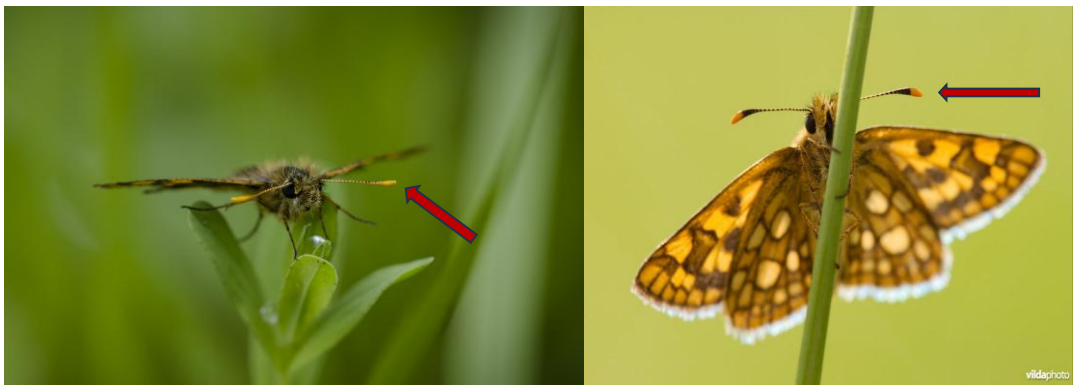

Figure 14 Difference between male (left) and female (right) Chequered Skippers. In males, the underside of the tip of the antenna is completely yellow, while they are partly brown in females (Photos: Ive Van Krunkelsven (left) & Jeroen Mentens – VildaPhoto (right)).

Figure 15 Mating of Chequered Skippers in the field, female on top, male at bottom (note the larger abdomen and mixed brown-yellow colour of the underside of the antenna in the female (Photo: Daan Van Eenaeme).

3.5 Transportation to the captive breeding site

Female Chequered Skippers are transported to the captive breeding site in cool boxes (at 10-15°C) on the day of capture. Each Chequered Skipper was individually placed in a pot of 2 cm diameter and a height of 5 cm with perforated lids (Figure 16).

Figure 16 Transportation of the captured Chequered Skippers to the reintroduction site oin England (Photo: Dirk Maes).

3.6 Nectar provisioning

Upon arrival at the captive breeding site, captured adult females are put in small breeding cages with one host plant (in this case False-brome). Preferably, the host plant should touch the top of the breeding cage to make it easier for the female to locate. Bugle (*Ajuga reptans*) and Ragged Robin (*Silene flos-cuculi*) from the grounds of the aquatic research centre in Linkebeek are used as natural nectar sources, but other nectar plants can be used as well (see 2.2.3). Since it is not known if and how much nectar these natural plants contain, it is advisable to provide sweet honey water as a supplementary sugar source (1 tea spoon honey, 100 ml boiling water). This honey water is drenched in a paper tissue. To make sure that females drink enough to take up sufficient sugar, they can be set manually on the tissue containing the honey water (Figure 17).

Figure 17 Breeding cage for adult females with flower nectar sources (e.g. Ragged Robin, Buttercup, Red clover; left) and honey water (right; Photos: Daan Van Eenaeme).

Photo 4 Wing-clipping Chequered Skippers for genetic research (Photo: Ive Van Krunkelsven).

4 Captive breeding facilities

4.1 Captive breeding setup

4.1.1 Captive breeding location

The captive breeding site in Belgium is located at the aquatic rearing station of the Research Centre for Aquatic Fauna situated at Dwersbos 28 in Linkebeek (https://www.vlaanderen.be/inbo/over-ons/onderzoekscentrum-voor-aquatische-fauna-linkbeek/). The site is surrounded by a lot of ponds, resulting in a buffered microclimate with cooler summer temperatures (Figure 18).

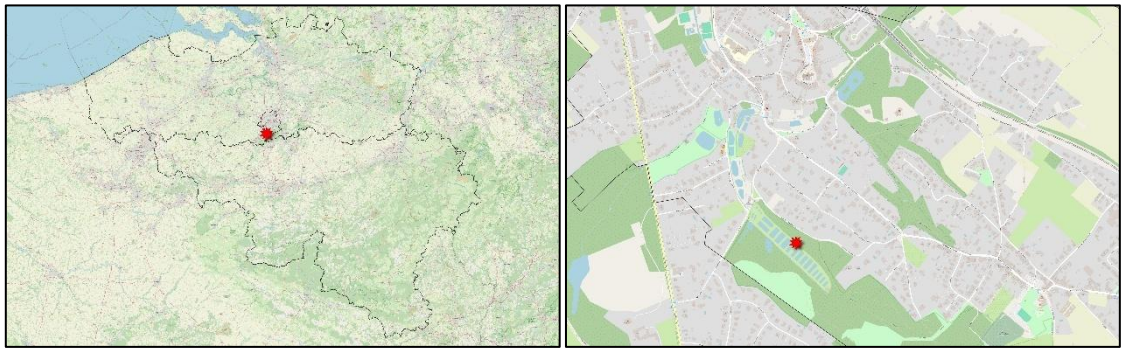

Figure 18 Location of Linkebeek in Belgium (red star, left) and detailed location of the breeding facility (right).

The breeding cages with the females are kept at a height of 1 meter in a sheltered poly tunnel in which water basins for rearing fish and amphibians are also present (Figure 19). This setup results in a relatively high air humidity. The sheltered poly tunnel protects the breeding cages from strong winds and heavy rainfall. The sheltered poly tunnel is located at the north side of a small valley and receives sun during morning, mid-day and evening, leading to slightly higher temperatures in the tunnel than the surrounding areas. Drafts are mostly avoided by closing the tunnel in windy conditions.

Figure 19 Sheltered poly tunnel in which the breeding cages are kept for both adults and caterpillars (Photo: Petra Vijncke).

4.1.2 Cage dimensions and materials

Adult females are individually kept in breeding cages of 30 cm x 30 cm x 30 cm (https://www.vermandel.com/product/entomologie-producten/diversen-entomologie/kweekmateriaal/kweekkooi-30x30x30cm/; Figure 20). These cages are deliberately small to increase the encounter rate of females with the host plant. Once the caterpillars emerge from the eggs, the host plants are transferred to larger breeding cages of 35 cm x 35 cm x 60 cm (https://www.vermandel.com/product/entomologie-producten/diversen-entomologie/kweekmateriaal/kweekkooi-35x35x60cm/; Figure 20). This allows the leaves of the host plant to hang down without touching the floor of the cage, which is the preferred situation for young caterpillars.

Figure 20 Breeding cages in which adult females are kept for egg-laying (right) and breeding cages for caterpillars (left; Photo: Daan Van Eenaeme).

4.1.3 Environmental controls

The conditions in which both captive egg-laying females and caterpillars are kept in breeding cages that maximally mimic natural temperatures and humidity.

4.1.3.1 Temperature

As females are kept in breeding cages in a sheltered poly tunnel, they are exposed to slightly higher temperatures than those outside the poly tunnel. This is beneficial for egg-laying.

Eggs laid on the host plants remain in the sheltered poly tunnel unless the temperature is above 40°C. In very sunny and warm weather, a carton is put on top of the breeding cage to avoid overheating. When many eggs are laid in the same breeding cage on the same host plant, it is advisable to spread them over multiple breeding cages in the egg stage to avoid possible cannibalism among caterpillars later.

Caterpillars are kept in more or less the same conditions as the eggs, but direct sunlight should be avoided in autumn and winter to prevent overheating. Conditions must remain sufficiently moist and humid to prevent desiccation. In spring, host plants with caterpillars are placed in direct sunlight to activate the caterpillars following the hibernation period (Figure 21). They bask

in the sun to warm up and, prior to pupation, start looking for a place on the host plant or on the breeding cage to pupate (Figure 22). Pupae are kept in the sheltered poly tunnel at more or less natural temperatures.

Figure 21 Caterpillar basking in the sun before pupation (Photo: Daan Van Eenaeme).

Figure 22 Pupae on the side of the breeding cage (Photo: Petra Vijncke).

4.1.3.2 Humidity

Breeding cages are kept at a height of 1 meter in the sheltered poly tunnel where water basins for rearing amphibians and fish are also present, resulting in a relatively high air humidity.

4.1.3.3 Light regime

All stages experience normal day-night photoperiods as they are kept in a sheltered, but open poly tunnel.

4.1.3.4 Ventilation

The sheltered poly tunnel in which all stages are kept is open and is well-ventilated.

Photo 5 Biotope of the Chequered Skipper in Fagnolle, south Belgium (Photo: Dirk Maes).

5 Host plant provisioning

5.1 Host plant species used for caterpillars

False-brome (*Brachypodium sylvaticum*), Wood small-reed (*Calamagrostis epigejos*), Cock's-foot (*Dactylis glomerata*) and Giant fescue (*Festuca gigantea*) were used as host plants. These were collected in the wild from the vicinity of the breeding location in Linkebeek and are typically 40-50 cm high, have a ground diameter of 10-15 cm and are in efflorescence. They are potted and put in larger breeding cages (60 cm high) after egg-laying has taken place. In our breeding cages, caterpillars seem to prefer leaves that hang downwards to build their shelter on (Figure 23). False-brome is a slow-grower and takes a lot of time to regenerate after it is cut down, while Cock's-foot regenerates faster.

Figure 23 Shelter at the end of a leaf from where the first instar caterpillar feeds on the host plant (Photo: Daan Van Eenaeme).

5.2 Predator checking

Before potting host plants and offering them to caterpillars, it is essential to ensure the complete removal of potential predators (e.g. ants, snails, spiders) from the foliage, roots and surrounding soil. To verify the absence of such organisms, plants can be gently shaken and the roots immersed in water to dislodge or eliminate any hidden predators. If a substantial number of ants emerge from the soil, the plant should be discarded. Additionally, host plants infested with

aphids should be avoided, as aphid presence can negatively impact plant health and nutritional quality.

5.3 Host plant treatments

5.3.1 Watering

Plants are watered regularly to avoid desiccation. It is best to put a plastic holder underneath the potted plant so that the plant always has water available. However, ensure that caterpillars cannot fall into the water in the plastic holder.

5.3.2 Frequency of replacement and amount of host plants given

Host plants are replaced when a large number of leaves are eaten. If it is possible to keep only one caterpillar per breeding cage and a large host plant in optimal condition, one host plant could be sufficient for the whole breeding period. August and September are the months in which the caterpillars eat the most and when host plants might have to be replaced by fresh specimens. When multiple caterpillars are housed in the same breeding cage and caterpillars eat a lot of the leaves (especially in August and September), additional host plants need to be supplied.

Photo 6 Biotope of the Chequered Skipper in Matagne, south Belgium (Photo: Dirk Maes).

6 Captive breeding protocol

6.1 Detailed life stage management

6.1.1 Egg care

6.1.1.1 Substrate

Eggs are laid on the plant and are left as such. The egg stage lasts about 10 (Frohawk 1892a; Frohawk 1892b) to 15 days (Ravenscroft 1992), depending on the temperature. Prior to hatching, the black head of the first instar caterpillars become visible through the eggshell (Figure 24). Females live for 10-12 days after being placed in the breeding cages. In one instance, a female lived for 18 days.

Figure 24 Chequered Skipper eggs ready to hatch on False-brome (*Brachypodium sylvaticum*) in captive breeding (Photo: Daan Van Eenaeme).

6.1.1.2 Humidity

See 4.1.3.2

6.1.1.3 Mortality rates and causes

No mortality has been observed in the egg stage.

6.1.2 Larval breeding

In total, there are five caterpillar instars (Eeles 2016). In 2022, the length of the caterpillars was recorded on two occasions. Caterpillars from Fagne were significantly larger than the ones from Famenne, both on 15 July (average size 12.1 mm in Fagne and 9.8 mm in Famenne) and on 1 September (average size 19.6 mm in Fagne and 17.2 mm in Famenne; Figure 25).

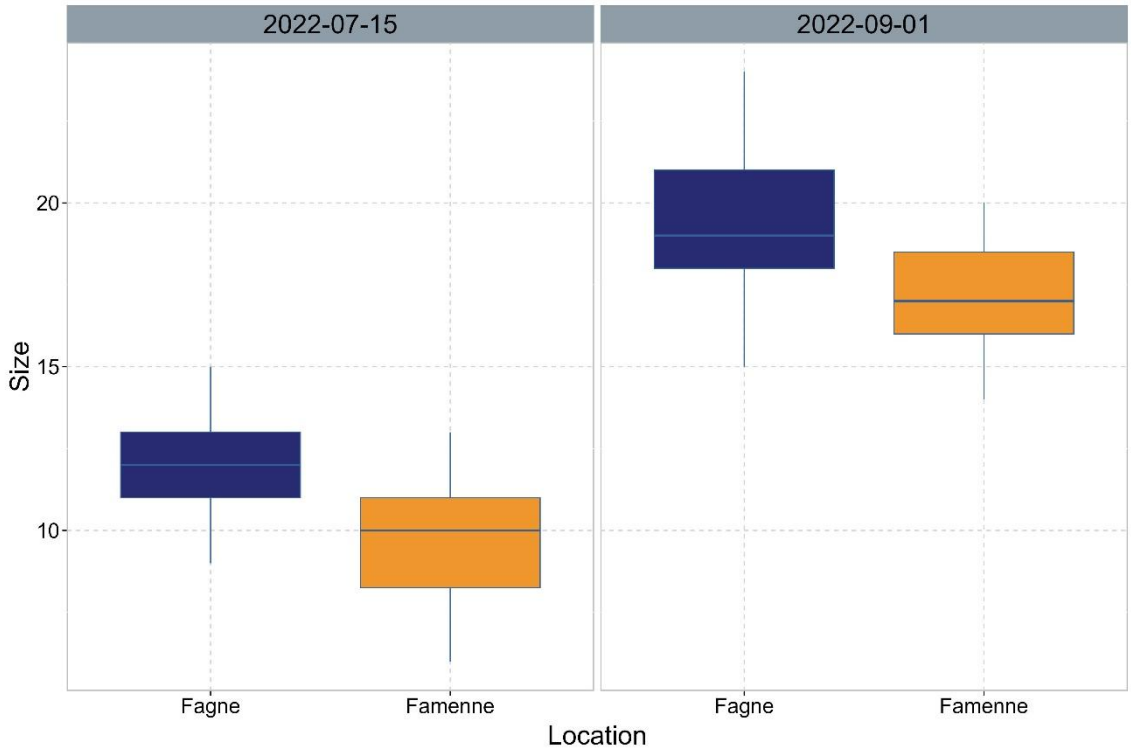

Figure 25 Mean size of caterpillars on 15 July 2022 and on 1 September 2022 from the Fagne and the Famenne locations.

6.1.2.1 First instar

The first caterpillars start hatching at the beginning of June (Figure 26). The first instar caterpillars are only a couple of millimetres long. This stage lasts approximately 15 days (Frohawk 1892a; Frohawk 1892b).

Figure 26 First instar caterpillars of Chequered Skippers in captive breeding (Photo: Daan Van Eenaeme).

The caterpillar builds a tubelike shelter at the end of the leaves using silk, probably to avoid predation during the day (Figure 23).

6.1.2.2 Second instar

The second instar caterpillar is about 6 mm long (Figure 27).This stage lasts between 9-16 days (Eeles 2016; Frohawk 1892a; Frohawk 1892b).

Figure 27 Second instar caterpillar in captive breeding with typical feeding markings on the leaves (Photo: Daan Van Eenaeme).

6.1.2.3 Third instar

Third instar caterpillars are about 10 mm long (Figure 28). This stage lasts 10-13 days (Eeles 2016; Frohawk 1892a; Frohawk 1892b).

Figure 28 Third instar caterpillar (Photo: Daan Van Eenaeme).

6.1.2.4 Fourth instar

The fourth instar caterpillars are about 15 mm long (Figure 29). This stage lasts about 20 days (Eeles 2016; Frohawk 1892a; Frohawk 1892b).

Figure 29 Fourth instar caterpillar (Photo: Daan Van Eenaeme).

6.1.2.5 Fifth instar

Fifth instar caterpillars are pale green at first. The colour of the head eventually changes from black to light green (Figure 30). By this point, the caterpillar is around 24 mm long (Eeles 2016; Frohawk 1892a; Frohawk 1892b). In October, the caterpillars prepare for hibernation. By the following March (i.e. after hibernation), they have turned pale brown and are perfectly camouflaged in the dead grass leaves (Figure 30).

Figure 30 Fifth instar caterpillar prior to hibernation (left) and after hibernation (right; Photos: Daan Van Eenaeme).

6.1.2.6 Feeding frequency

Caterpillars usually feed at night and shelter in their tube at the end of a leaf during the day.

6.1.2.7 Cleaning regime

When host plants are replaced or whenever a high number of droppings are present in the cages, droppings need to be removed from the bottom of the breeding cage to prevent mould from growing.

6.1.2.8 Densities per cage

A maximum of 3–4 caterpillars are typically maintained per breeding cage on a high-quality host plant, with an absolute upper limit of 15 caterpillars per individual plant.

6.1.3 Hibernation method for diapausing caterpillars

Prior to hibernation, sufficient grass leaves must be available to allow the construction of a hibernation shelter. If all leaves are consumed, the caterpillars are unable to form a hibernaculum. In such cases, additional host plants should be provided in the breeding cages. These do not necessarily need to be fresh and green, as their coloration does not need to match that of the caterpillars (Figure 31).

Figure 31 Chequered Skipper caterpillar in its hibernaculum (Photo: Daan Van Eenaeme).

6.1.3.1 Temperature

See 4.1.3. Hibernating caterpillars remain in the sheltered poly tunnels as long as temperatures remain above 0°C. In freezing temperatures, they are placed in a sheltered indoor location at a stable temperatures of 5°C to avoid desiccation. This indoor location is equipped with a heather that automatically switches on when temperatures fall below 5°C.

6.1.3.2 Duration

Hibernation lasts from the beginning of October to the beginning of March (cf. Eeles 2016; Frohawk 1892a; Frohawk 1892b).

6.1.3.3 Mortality rates and causes

During the caterpillar stage, about 20% die, mostly during hibernation, with possible reasons being low host plant quality, parasitoids and/or dessication.

6.1.4 Pupation

Pupation occurs on the leaves of the host plants or on the side of the breeding cage (Figure 32). No interventions are needed. The pupal stage lasts about 3-4 weeks, sometimes extending to 40 days (Eeles 2016; Frohawk 1892a; Frohawk 1892b).

Figure 32 Pupa on a host plant in a breeding cage (Photo: Daan Van Eenaeme).

Just before eclosion, the pupa turns almost entirely black and the colours of the wings become visible (Figure 33).

Figure 33 Pupae turn almost entirely black just before eclosion (Photo: Daan Van Eenaeme).

6.1.4.1 Mortality rates and causes

During the pupal stage, mortality rates are very low (about 5%). In 2023, however, a parasitoid fly *Sturmia bella* emerged from 2-3 pupae.

6.1.5 Adult emergence and maintenance

Adult emergence in captivity starts at the end of April. Adults are then fed with nectar from wild collected flowers and/or artificial sugar solution (1 teaspoon of honey/100 ml water; Figure 17).

6.1.5.1 Mortality rates and causes

The adult mortality rate is very low, since they are kept in closed breeding cages in the same conditions as females captured in the wild the year before. When spiders are able to enter the breeding cages, they are capable of predating the adult butterflies.

7 Health and disease management

7.1 Observed diseases, parasites or fungal infections

Detailed descriptions of disease risk management and pre and post-release health surveillance (Figure 34) are given in Jaffe & Sainsbury (2017), Donald & Sainsbury (2018a), Donald & Sainsbury (2018b), Jaffe & Sansbury (2018) and Shadbolt & Sansbury (2020).

Figure 34 Post release check at the reintroduction site by veterinarians of the Zoological Society of London (Photos: Katie Callaghan).

The parasitic fly *Sturmia bella* was found in some pupae during captive breeding in 2023 (Figure 35). This parasitic fly is most often found in Nymphalidae species, such as Small tortoiseshell (*Aglais urticae*).

Recently a new species of parasitoid wasp, *Cotesia carterocephali*, was described from a single gregarious brood from a post-hibernation final instar Chequered Skipper larva reared in Scotland and described by Mark Shaw (Shaw 2022; Figure 35). This parasitoid was not observed during Chequered Skipper breeding in Belgium.

Figure 35 The parasitic fly *Sturmia bella* emerged from pupae during captive breeding in 2023 (left, Photo: Wikimedia Commons) and *Cotesia carterocephali*, a newly described parasitoid wasp of Chequered Skippers from Scotland (right, Photo: Marc Shaw).

7.2 Measures to prevent or manage pathogens

Ensure that breeding cages are securely closed to prevent access by predators such as ants or spiders. Good air circulation (in sheltered but open poly tunnels) can be important to prevent pathogens.

Photo 7 Sites with Chequered Skippers are also interesting for other rare species, such as this Wood Tiger (*Parasemia plantaginis*; Photo: Dirk Maes).

8 Behavioural observations

8.1 Egg laying

By using relatively small breeding cages, in which host plants can touch the roof of the cage, captured females can find the host plant more easily because they usually fly towards the light in the upper part of the breeding cage.

8.2 Larval feeding

Chequered Skipper caterpillars usually feed at night. Most leaves are consumed in August and September, before hibernation.

8.3 Hibernation

Hibernation takes place in a hibernaculum, i.e. the end of a leaf on the host plant that is spun together.

8.4 Adult flight & mating

When females are kept in breeding cages for egg-laying, they should be prevented from flying excessively in the breeding cages in order to minimise energy loss. In our breeding cages, about 40% of the volume is taken up by the host plant.

Making Chequered Skippers mate in captivity is difficult since they have a particular courtship behaviour involving free and high flights (Ravenscroft 1994b). In nature, males defend a territory from which they inspect/attack all other flying insects. When a female flies by, it is chased by the male in an upward flight, a situation that is hard to imitate in captivity. Individuals bred in captivity can be released at reintroduction sites as newly captured females are required to start the next breeding cycle.

9 Timing and duration

The phenology of captive bred Chequered Skippers is very similar to that of the wild butterfly (cf. Eeles 2016; Frohawk 1892a; Frohawk 1892b; Figure 7). Exposure to relatively natural conditions during the breeding process (i.e. similar host plants and nectar sources, natural day-night rhythm and seasonal temperature variations) results in a relatively high success rate for breeding Chequered Skippers.

Photo 8 Daan Van Eenaeme photographing a wing-clipped Chequered Skipper (Photo: Dirk Maes).

10 Release method and follow-up

10.1 Release method and stage

Chequered Skippers are best released at reintroduction sites as soon as possible after eclosion to avoid egg-laying occurring in the cages. It is advisable to place the butterflies in a large tent the evening before release to cool them down and remove it the following morning (Figure 36). In cooler conditions, before the butterflies become active, they will be vulnerable to predation and should be monitored to prevent this.

Here, we used adult butterflies as the reintroduction life stage, but releasing captive-bred caterpillars could also be tested (cf. Polley et al. 2025).

Figure 36 Typical cage in which Chequered Skippers should be kept in overnight at reintroduction sites (Photo: Katie Callaghan).

10.2 Follow-up

10.2.1 Genetic follow-up

A genetic study should be carried out prior to reintroduction to analyse the most suitable Chequered Skipper source populations (Maes et al. 2019) and the structure of these populations together with their *Wolbachia* hosts (Halford et al. 2025). Once adult Chequered Skippers are released at reintroduction sites, it is essential to conduct genetic monitoring to assess genetic compatibility among populations. This can be achieved by collecting wing clips (taking a small part of the hind wings and keeping it in 96% ethanol for further genetic analyses; Figure 37) from both reintroduced individuals and their offspring in the following year. Such analyses allow the detection of genetic admixture between reintroduced individuals, providing valuable insights into the suitability of source populations used for captive breeding. Moreover, the results can inform whether mixing individuals from genetically distinct source regions is advisable for maintaining or enhancing genetic diversity within the reintroduced populations (Joyce & Pullin 2004), but also if individuals from different source populations are compatible based on their *Wolbachia* strains (Halford et al. 2025).

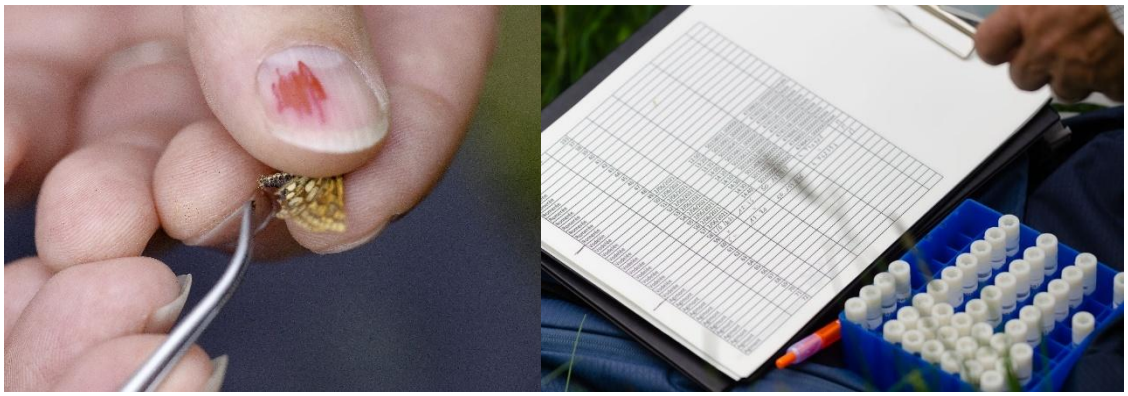

Figure 37 Wing-clipping a Chequered Skipper (left) and preservation of samples in alcohol for further genetic research (right, Photos: Ive Van Krunkelsven).

10.2.2 Mark-release-recapture study

Additionally, conducting a mark–release–recapture (MRR) study at the release sites, utilizing photographs submitted by citizen scientists, can provide valuable insights into population size, dispersal patterns and mobility of both reintroduced and native individuals (cf. Wildman et al. 2024).

11 Outcomes and lessons learned

11.1 Overall captive breeding success rates

The Chequered Skipper is relatively straightforward to rear under appropriate, near-natural conditions. Bink (1992) reported that a female Chequered Skipper can produce up to 100 eggs. Based on observations from our captive breeding program, it is feasible for a female to lay approximately 70 eggs, from which 40–50 adults may emerge under optimal conditions, i.e. in the absence of predators, parasitoids and pathogens. In an experiment conducted at the University of Liverpool, a total of 320 adults emerged from 26 females from both Famenne and Fagne (Laura Jimenez Burney, personal communication), corresponding to an average of 12–13 adults per female, with some Famenne-origin females producing up to approximately 16 adults each.

11.2 Applicability to other regions

The described protocol is applicable to regions with comparable climatic conditions, such as the United Kingdom. The suitability of the selected reintroduction sites in England was previously assessed and confirmed (Maes et al. 2019). In cooler climates, maintaining slightly elevated temperatures during breeding experiments may be beneficial to support successful development. However, these conditions should remain within the natural thermal range experienced by the species to avoid maladaptive effects.

11.3 Recommendations for improvement

11.3.1 Personnel

In an optimal scenario, the rearing process should be overseen by at least 0.5 full-time equivalent (FTE) personnel, dedicated to the continuous monitoring and management of breeding conditions using temperature and humidity data loggers. Such an approach would ensure the maintenance of host plants and nectar sources under optimal conditions, thereby maximizing the number of successfully reared individuals available for translocation or subsequent experimental work. Furthermore, the systematic collection of data across the different life stages of Chequered Skipper (e.g. number of eggs per female, caterpillar size and weight, growth rates) would substantially enhance understanding of the species' autecology and life-history parameters.

11.3.2 Genetics

If possible, it would be advisable to test whether individuals coming from different regions are compatible prior to captive breeding (IUCN/SSC 2013; Halford et al. 2025). This topic is studied by PhD student Laura Jimenez Burney at the University of Liverpool (*Endosymbionts as an overlooked threat for insect reintroductions*).

11.3.3 Mating in captivity

Including mating in captive Chequered Skippers is difficult. This is due to the territoriality of the males and courtship behaviour prior to mating, i.e. chasing the female in an upward flight (Eeles 2019). Attempts to force male and female Chequered Skippers to mate using a hand-pairing technique were unsuccessful during a captive breeding experiment at the University of Liverpool (Figure 38).

Figure 38 Attempt to make male and female Chequered Skippers made using a hand-pairing technique (Photos: Ilik Saccheri).

Using larger breeding cages to encourage mating (e.g. 2m x 2m x 2m) and releasing males and females in a large poly tunnel (Figure 39) to accommodate natural courtship behaviour did not result in any matings in captivity (personal communication, Laura Jimenez Burney). Building larger and higher poly tunnels in a natural setting (e.g. a large tent at one of the reintroduction sites) with sufficient nectar sources and host plants might make it possible to induce mating in (semi-)captivity. This needs to be tested during follow-up research, however.

Adults emerging in captivity need to be released as early as possible at reintroduction sites, in the hope that wild mating between individuals of different source regions will occur and result in fertile offspring.

Figure 39 Sheltered poly tunnel in which males and female Chequered Skippers were released in Liverpool to (unsuccessfully) induce mating (Photo: Ilik Saccheri).

Photo 9 Biotope of the Chequered Skipper in Werpin, south Belgium (Photo: Dirk Maes).

12 References

Asher J, Warren MS, Fox R, Harding P, Jeffcoate G & Jeffcoate S (2001) The millennium atlas of butterflies in Britain and Ireland. Oxford University Press, Oxford.

Bink FA (1992) Ecologische atlas van de dagvlinders van Noordwest-Europa. Schuyt & Co Uitgevers en Importeurs bv, Haarlem.

Bos F, Bosveld M, Groenendijk D, van Swaay CAM, Wynhoff I & De Vlinderstichting (2006) De dagvlinders van Nederland. Verspreiding en bescherming (Lepidoptera: Hesperioidea, Papilionoidea). Nederlandse Fauna 7. Nationaal Natuurhistorisch Museum N, Uitgeverij K & European Invertebrate Survey. Nationaal Natuurhistorisch Museum Naturalis; KNNV Uitgeverij; European Invertebrate Survey, Leiden.

Bourn NAD, O'Riordan S, Maes D, Goffart P, Shadbolt T, Hordley L, Sainsbury AW, Bulman C, Hoare D, Field R, Curson J, Wildman JP, Halford G, Jaffe J, Donald H, Van Eenaeme D & Ellis S (2025) The history, science and preliminary results from the reintroduction of the chequered skipper, *Carterocephalus palaemon* into Rockingham forest, England (vol 28, pg 1063, 2024). Journal of Insect Conservation 29 (2): 1. https://doi.org/10.1007/s10841-025-00661-z.

Cantú-Salazar L, Mestdagh X, L'Hoste L, Martin Y, Vray S & Titeux N (2024) Red List of the butterflies of Luxembourg. *In:* Butterflies of Luxembourg - Distribution, conservation and Red List. Mestdagh X, L'Hoste L & Cantú-Salazar L (editors). Ferrantia 90. Musée national d'histoire naturelle, Luxembourg. p. 41-57.

Donald H & Sainsbury A, W. (2018a) Disease Risk Management and Post-Release Health Surveillance Protocol for Chequered Skipper (*Carterocephalus palaemon*) Wild-To-Wild Translocations. England ZSoLaN. Zoological Society of London and Natural England, London.

Donald H & Sainsbury AW (2018b) Chequered Skipper (*Carterocephalus palaemon*) Wild-To-Wild Translocation from the Belgian Ardennes to Rockingham Forest, Northamptonshire, UK Disease Risk Management and Post-Release Health Surveillance Protocol. Institute of Zoology, Zoological Society of London, London.

Ebert G & Rennwald E (1993) Die Schmetterlinge Baden-Württembergs, Band 2, Tagfalter II. Verlag Eugen Ulmer, Stuttgart.

Eeles P (2016) A Study of the Life Cycle of the Chequered Skipper Butterfly *Carterocephalus palaemon* (Pallas). http://www.dispar.org/reference.php?id=119

Eeles P (2019) Life Cycles of British & Irish Butterflies. Pisces Publications, Berkshire.

Emmet AM & Heath J (1989) The moths and butterflies of Great-Brittain and Ireland Vol 7 (1): Hesperiidae - Nymphalidae. Harley Books, Colchester.

Fox R, Dennis EB, Brown AF & Curson J (2022) A revised Red List of British butterflies. Insect Conservation and Diversity 15 (5): 485-495. https://doi.org/10.1111/icad.12582.

Frohawk FW (1892a) Life-History of *Carterocephalus palaemon*. The Entomologist 25: 225-228.

Frohawk FW (1892b) Life-History of *Carterocephalus palaemon*. The Entomologist 25: 254-256.

Halford G, Bulman CR, Bourn N, Maes D, Harpke A & Hodgson JA (2024) Can species distribution models using remotely sensed variables inform reintroductions? Trialling methods with *Carterocephalus palaemon* the Chequered Skipper Butterfly. Journal of Insect Conservation 28 (5): 909-921. https://doi.org/10.1007/s10841-024-00555-6.

Halford G, Maes D, Yung CJ, Whiteford S, Bourn NAD, Bulman CR, Goffart P, Hodgson JA & Saccheri IJ (2025) Genomic Monitoring of a Reintroduced Butterfly Uncovers Contrasting Founder Lineage Survival. Evolutionary Applications 18 (2): e70074. https://doi.org/10.1111/eva.70074.

IUCN/SSC (2013) Guidelines for Reintroductions and Other Conservation Translocations. Version 1.0. IUCN. IUCN Species Survival Commission, Gland, Switzerland.

Jaffe J & Sainsbury AW (2017) Disease Risk Analysis for the Translocation of the Chequered Skipper (*Carterocephalus palaemon*) from the Belgium Ardennes to Rockingham Forest, Northamptonshire, UK. Zoology Io. Institute of Zoology, London.

Jaffe J & Sansbury AW (2018) Chequered Skipper (*Carterocephalus palaemon*) disease risk management and post-release health surveillance Report 2018-19. Zoological Society of London and Natural England, London.

Joyce DA & Pullin AS (2004) Using genetics to inform re-introduction strategies for the Chequered Skipper butterfly (*Carterocephalus palaemon*, Pallas) in England. Journal of Insect Conservation 8 (1): 69-74. https://doi.org/10.1023/b:jico.0000027510.59074.16.

Maes D, Ellis S, Goffart P, Cruickshanks KL, van Swaay CAM, Cors R, Herremans M, Swinnen KRR, Wils C, Verhulst S, De Bruyn L, Matthysen E, O'Riordan S, Hoare DJ & Bourn NAD (2019) The potential of species distribution modelling for reintroduction projects: the case study of the Chequered Skipper in England. Journal of Insect Conservation 23 (2): 419-431. https://doi.org/10.1007/s10841-019-00154-w.

Maes D, Herremans M, Vantieghem P, Veraghtert W, Jacobs I, Fajgenblat M & Van Dyck H (2021) IUCN Rode Lijst van de dagvlinders in Vlaanderen 2021. Rapporten van het Instituut voor Natuur- en Bosonderzoek 2021 (10). Instituut voor Natuur- en Bosonderzoek, Brussel. https://doi.org/10.21436/inbor.34052968.

Moore JL (2004) The ecology and re-introduction of the Chequered Skipper butterfly *Carterocephalus palaemon* in England. School of Biosciences, The University of Birmingham,, Birmingham.

Moore JL & Pullin AS (1997) The re-establishment of the Chequered Skipper Butterfly (*Carterocephalus palaemon*) in England. Birmingham University, Birmingham.

Polley M, Linton JE, Brewster A, MacKenzie AS, Keyghobadi N, Steiner J, Kerekes T & Norris DR (2025) Reintroduction of an Endangered Butterfly, the Mottled Duskywing (Erynnis martialis). Animal Conservation. https://doi.org/10.1111/acv.70038.

Ravenscroft NOM (1992) The Ecology and Conservation of the Chequered Skipper Butterfly *Carterocephalus palaemon* (Pallas). University of Abderdeen, Aberdeen.

Ravenscroft NOM (1994a) The ecology and conservation of the Chequered skipper butterfly Pallas in Scotland. II: Foodplant quality and population range. Journal of Applied Ecology 31: 623-630. https://doi.org/10.2307/2404153.

Ravenscroft NOM (1994b) Environmental influences on mate location in male Chequered skippers butterflies, *Carterocephalus palaemon* (Lepidoptera: Hesperiidae). Animal Behaviour 47: 1179-1187. http://dx.doi.org/10.1006/anbe.1994.1156.

Ravenscroft NOM (1994c) The feeding behaviour of *Carterocephalus palaemon* (Lepidoptera: Hesperiidae) caterpillars: does it avoid host defences or maximize nutrient intake? Ecological Entomology 19: 26-30. https://doi.org/10.1111/j.1365-2311.1994.tb00386.x.

Ravenscroft NOM (1995) The conservation of *Carterocephalus palaemon* in Scotland. *In:* Ecology and Conservation of Butterflies. Pullin AS (editor). Chapman & Hall, London. p. 165-179.

Ravenscroft NOM & Warren MS (1996) Species Action Plan. The Chequered Skipper *Carterocephalus palaemon*. Butterfly Conservation, Dorset.

Rodts J (2025) De slimste vlindergids – Alle 100 dagvlinders van de Benelux. Uitgeverij Houtekiet, Antwerpen.

Shadbolt T & Sansbury AW (2020) Chequered Skipper (*Carterocephalus palaemon*) disease risk management and post-release health surveillance Report 2019-20. Zoological Society of London and Natural England, London.

Shaw MR (2022) Rearings of four European Microgastrinae (Hymenoptera: Braconidae), three new to Britain including a new species of Cotesia Cameron, 1891. Entomologist's Gazette 73 (3): 165-175. https://doi.org/10.31184/G00138894.733.1853.

Tax M (1989) Atlas van de Nederlandse dagvlinders. Vereniging tot behoud van Natuurmonumenten in Nederland/De Vlinderstichting, 's Graveland/Wageningen.

UICN France, MNHN, OPIE & SEF (2012) La Liste rouge des espces menaces en France - Chapitre Papillons de jours de France métropolitaine. France U, MNHN, OPIE & SEF. UICN France, MNHN, OPIE & SEF, Paris.

van Swaay CAM (2019) Basisrapport Rode Lijst Dagvlinders 2019 volgens Nederlandse en IUCN-criteria. Rapport VS 2019.001. Vlinderstichting D. De Vlinderstichting, Wageningen.

van Swaay CAM, Warren MS, Ellis S, Clay J, Bellotto V, Allen DJ & Trottet A (2025) Measuring the pulse of European biodiversity using the Red List. European Red List of Butterflies. European Commission, Brussels, Belgium. https://doi.org/10.2779/935927.

Warren MS (1995) The Chequered Skipper returns to England. Butterfly Conservation News 60: 4-5.

Wildman JP (2023) The History, Ecology, and Reintroduction of the Chequered Skipper Butterfly *Carterocephalus palaemon* in England. PhD thesis. University of Northampton, Northampton.

Wildman JP, Ollerton J, Bourn NAD, Brereton TM, Moore JL & McCollin D (2022) The value of museum and other uncollated data in reconstructing the decline of the chequered skipper butterfly *Carterocephalus palaemon* (Pallas, 1771). Journal of Natural Science Collections 10: 31-44. https://natsca.org/article/2724.

Wildman JP, Ollerton J, Bourn NAD, O'Riordan S & McCollin D (2024) Using photographic mark-recapture to estimate population size, movement, and lifespan of a reintroduced butterfly. Biodiversity and Conservation 33 (6-7): 2011-2036. https://doi.org/10.1007/s10531-024-02837-6.

Photo 10 Chequered Skipper volunteer teams in Belgium.

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Photo 11 Female Chequered Skipper in south Belgium (Photo: Daan Van Eenaeme).

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