Important Butterfly and Moth Areas – Netherlands

Technical report

De Vlinderstichting

Butterfly CONSERVATION EUROPE

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Keywords

Butterflies, Moths, Lepidoptera, Areas, Key Biodiversity

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Contents

Chapter 1 / Introduction

New international conservation strategies such as the post-2020 global biodiversity network from the UN Convention on Biological Diversity (CBD, https://www.cbd.int) or the new European biodiversity strategy (https://environment.ec.europa.eu/strategy/biodiversity-strategy-2030_en) are aiming to improve the situation of biodiversity by 2030. Still, in the context of developing conservation actions, insects are rarely considered (Chowdhury *et al.*, 2023). Evidence of the global decline of insects has grown in recent years (Hallmann *et al.*, 2017; Wagner, 2020; Warren *et al.*, 2021). The main factors of their decline are habitat destruction, agricultural intensification, pesticide use, and climate change; however, other pressures such as nitrification or land abandonment can also pose a significant threat to them (Nijssen *et al.*, 2017; Wagner, 2020). Moreover, insects provide essential services for the well-functioning of ecosystems such as pollination, biological control, and diverse cultural services, but are also involved in disservices such as crop damage or the spread of diseases. Among insects, butterflies and moths, are one of the best-studied groups as they are easy to identify, popular among the public, and sensitive to environmental changes. These characteristics, make butterflies and moths ideal bioindicators to guide conservation actions for insects (Sevilleja *et al.*, 2020; van Swaay *et al.*, 2020).

For the conservation of butterflies and moths, as well as to help policymakers in selecting areas with a high insect biodiversity, it is essential to identify and prioritize areas where efforts should be concentrated to preserve butterfly and moth's populations and avoid their decline (Chowdhury *et al.*, 2023). In the past, such areas were identified only for butterflies on a European scale using expert knowledge (van Swaay & Warren, 2003, 2006). However, with the increasing amount of data gathered by volunteers, monitoring schemes and scientists, a data-driven assessment supported by expert knowledge, is more suitable to openly select important areas for butterflies and moths based on evidence provided by data. In the Netherlands, similar data-driven assessments have been done recently for birds (van Vreeswijk *et al.*, 2019) and for plants (Sparrius *et al.*, 2019), but not yet for any insect. This technical report builds upon these previous assessments, providing the first assessment of Important Butterfly and Moth Areas (IBMAs) for the Netherlands.

***Speyeria aglaja* is one of the most endangered butterflies in the Netherlands**

Here we define IBMAs as sites of international significance for the conservation of butterflies and moths which should be large enough to safeguard a viable population of a species, but at the same time, should be small enough to be conserved in their entirety. To identify IBMAs, Butterfly Conservation Europe and partners developed a set of robust and standardized criteria based on observational data, which might be applied to any region in the world.

Chapter 2 / Methods

Criteria

The criteria for selecting an Important Butterfly and Moth Area (IBMA) can be found below (Table 1). These criteria are based on the global criteria for Important Plant Areas (IPA) (Darbyshire *et al.*, 2017), however, not all criteria were applicable to butterfly and moth species so some adjustments were required.
The criteria are divided into two main criteria A) threatened species, and B) species richness, with several sub-criteria for both. A site can be identified as IBMA if it applies to one criterion or more. For the A-criterion on threatened species it is advised to follow the most recent and relevant IUCN Red List for the specific spatial scale at which IBMA's are selected. If such a Red List is outdated, or new information has become available, other relevant publications such as scientific articles for single species can be used to establish regionally threatened species. For example, if IBMA's are selected at the European scale, it is suggested to use the European Red List (van Swaay *et al.*, 2010) which will be updated in 2023. For this overview of the IBMA for the Netherlands, we used the Dutch Red List (van Swaay, 2019).

Heterogenous landscapes with calcareous grasslands and woodlands, such as the one in Sint Pietersberg & Jekerdal, are ideal to have a high number of both butterfly and moth's species

Table 1 Criteria to select Important Butterfly and Moth Areas (IBMA's). Preferably the criteria are applied using data, but in case this is not available, expert judgement can be used.

A. Threatened species		
A(i)	Site* contains one or more globally threatened species	Site known, thought or inferred to contain >=1% of the global population AND/OR >=10% of the national population OR the 5 "best sites" for that species nationally, whichever is most appropriate
A(ii)	Site contains one or more regionally threatened species	Site known, thought or inferred to contain >=10% of the national population, OR the 5 "best sites" for that species nationally, whichever is most appropriate
A(iii)	Site contains one or more highly restricted endemic species that are potentially threatened	Site known, thought or inferred to contain >=1% of the global population AND/OR >=10% of the national population, OR the 5 "best sites" for that species nationally, whichever is most appropriate
A(iv)	Site contains one or more range-restricted endemic species that are potentially threatened	Site known, thought or inferred to contain >=1% of the global population AND/OR >=10% of the national population, OR the 5 "best sites" for that species nationally, whichever is most appropriate
B. Species richness		
B(i)	Site contains a high number of species within a defined habitat	For each habitat type: up to 10% of the national resource can be selected within the whole national Important Butterfly and Moth Area network OR the 5 "best sites" nationally, whichever is the most appropriate
B(ii)	Site contains a high number of species of high conservation importance	Site known to contain >=3% of the selected national list of species of conservation importance OR the 15 richest sites nationally, whichever is most appropriate
B(iii)	Site contains an exceptional number of species	Site known to contain >=40% of the selected national list of all species OR the 15 richest sites nationally, whichever is most appropriate

* IBMAs sites have international significance for the conservation of butterflies and moths and should be large enough to safeguard a viable population of a species, but at the same time, should be small enough to be conserved in their entirety.

The criteria are now discussed in more detail to clarify their usage. The term *regionally* in the A(ii) criterion can apply to a specific region within a country (e.g. a province) but also to a whole country, therefore, regionally could also mean nationally. For example, in the case of the Netherlands, we used A(ii) as the criterion to select IBMA's at the national scale. In the case that the "5 best sites" threshold is used to apply a criterion, it is advised to select those sites based on other parameters such as species richness in the site or expert knowledge (e.g., several species of conservation importance in a certain area). The difference between A(iii) and A(iv) is the size of the species range, the different criterion allows for detailed analysis in case of such information: A "Highly Restricted Endemic species" is defined as a species with a total range of <100 km^2. A "Range Restricted Endemic species" is defined as a species with a total range of <5000 km^2 but >100 km2. The term "species of high conservation importance" refers to species that require a high conservation effort such as those species listed in the European Habitats Directive or under risk of extinction defined by the International Union for the Conservation of Nature (IUCN) Red List (i.e., near threatened, vulnerable, endangered, critically endangered, or regionally extinct).

Data

For the analysis we used the data from the National Database Flora and Fauna, which has been collected from many sources, such as online recording portals (telmee.nl, waarneming.nl), monitoring data from the Network Ecological Monitoring (NEM) and data from nature management organisations as Staatsbosbeheer and Natuurmonumenten. All data has been validated following standard protocols (https://www.ndff.nl/overdendff/validatie/). We understood globally threatened species as those mentioned as threatened on the European Red List (van Swaay *et al.*, 2010), regional threatened species as those metioned as threatened on the Dutch Red List (van Swaay, 2019), and species of high conservation importance as those mentioned on the Annexes II or IV of the Habitats Directive (https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:01992L0043-20130701).

Monitoring data together with opportunistic observations provide a strong source of information for the conservation of butterflies and moths

Selection process

For the selection, we used data for the last 10 years and included only species that are considered native in the Netherlands (i.e., migrants were excluded). By definition, IBMAs should be large enough to safeguard a viable population of butterflies and moths but also should be small enough to be conserved in their entirety, therefore, these areas should have recognizable boundaries for conservation authorities. To obtain such areas, we first aggregated the high-resolution recording data and applied the IBMA-criteria (Fig. 1). The data was aggregated at a hectare resolution for all criteria except for criteria B(iii) for which data was aggregated at a kilometer resolution to obtain meaningful species richness values in the area. Moreover, because many species lack information on their populations, we calculated the proportion of hectares occupied within a squared kilometer for the A(i) and A(ii) criterion and selected locations with >=10% of hectares occupied.
The aggregation process provided a set of points at a hectare (or kilometer) resolution that applied to one or more IBMA's criteria. However, many of these points were single points far from others. Therefore, to identify large areas that could be considered IBMA, we spatially grouped these points (Fig. 1) using an algorithm called DBSCAN (density-based spatial clustering of applications with noise) with the R-package *dbscan* version 1.1.5 (Hahsler *et al.*, 2019). DBSCAN clusters points based on a defined radius around the points and a minimum number of points reachable within the radius distance. For butterflies, we used a radius of 1000m and a minimum number of points of five to create a cluster. For moths, we used a radius of 2000m and a minimum number of points of five to create a cluster. After we obtained these groups of points, we defined the boundaries of the areas by using polygons from ©OpenStreetMap (https://www.openstreetmap.org/copyright). We intersected the groups of points with the polygons from ©OpenStreetMap (Fig. 1) obtained with the R-package *osmextract* version 0.4.1.9000 (Gilardi & Lovelace, 2022).
Finally, to identify all the IBMA's criteria within the polygons, we intersected the polygons with all the individual points that applied to the IBMA criteria (Fig. 1). All analyses were done in R version 4.0.2 (R Core Team & R Development Core Team, 2020). The scripts used to define the IBMA's can be found at the end of this report.

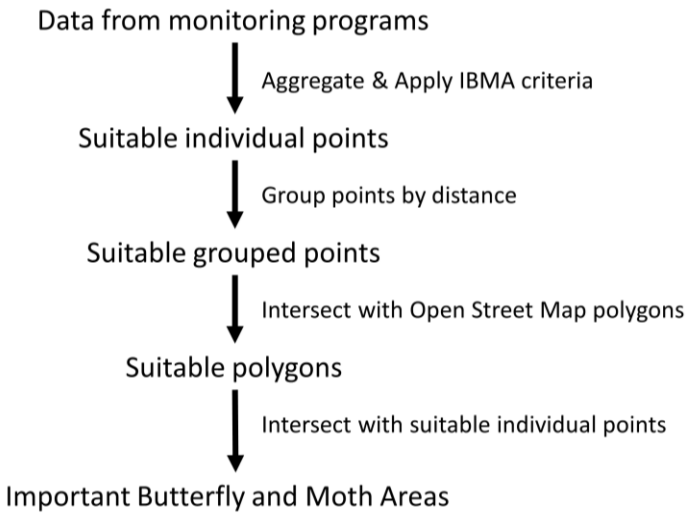


Figure 1 Steps for the selection of Important Butterfly and Moth Areas

Results

Overview

In total we identified 38 Important Butterfly and Moth Areas, for which 6 corresponded only for butterflies, 10 for moths and 22 were important for both groups (Fig. 2). The average area of the IBMAs is 1,510 hectares, with a minimum of 3 hectares for Sellingen and a maximum of 10,204 hectares for Biesbosch. Of the 38 IBMA, 33 (i.e., 87% of all IBMA in the Netherlands) fall within the Natura 2000 network, which provides the best protection for biodiversity in Europe. For every IBMA, we include a map showing their boundaries and location within the Netherlands, a list of qualifying criteria, and a list of the IUCN Red List species that has occurred in the area at least 10 times in the last 10 years. For butterfly species which have closed populations, we also include their population number within IBMA expressed as the percentage of the total population area. Finally, the individual IBMA are reported below but can also be explored online through the web: https://ibma.vlinderstichting.nl

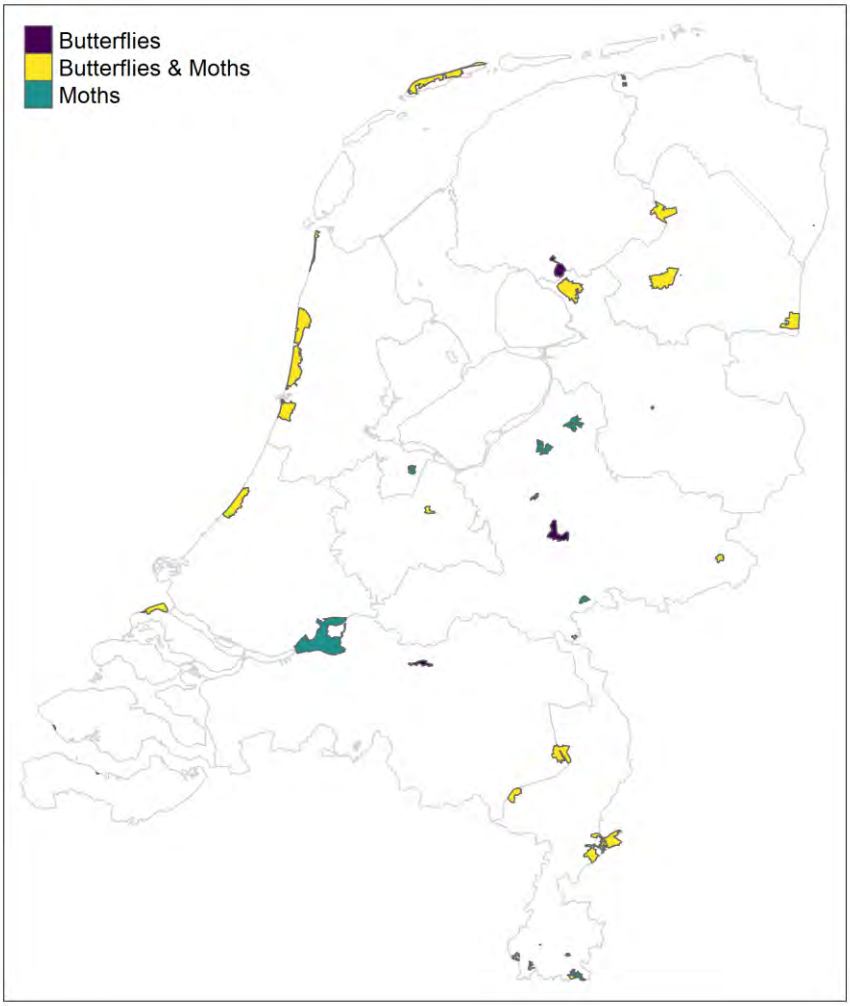
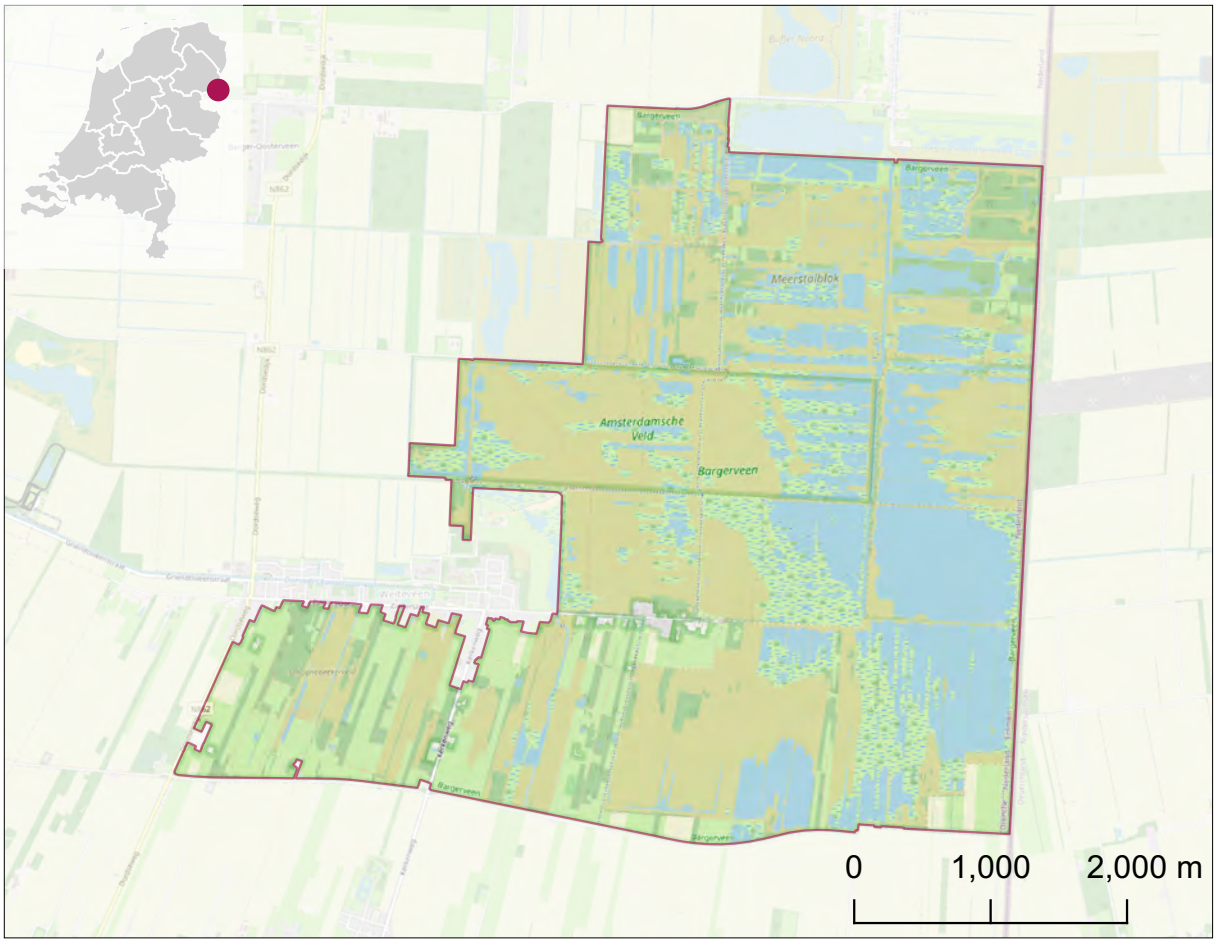


Figure 2 Important Butterfly and Moth Areas for the Netherlands, colored by the taxonomic group (s) for which they are important.



1 - Bargerveen

ILA Criteria: Biii (Butterflies); Bii (Moths)

- Bii: Site contains a high number of species of high conservation importance
- Biii: Site contains an exceptional number of species

Area: 2092 ha

Description:

Bargerveen is the last remnant of the former Bourtanger marsh, the original size of which is estimated to be between 1,600 and 3,000 km2. The Bargerveen consists of three parts: in the north the Meerstalblok, in the middle the Amsterdamsche Veld and in the south the Schoonebeekerveld. The management aimes at re-establishing living raised moors where possible. Living raised bog means that peat formation takes place through the growth of peat moss (Sphagnum), creating a mosaic of ridges and rifts. For butterflies the most important habitats are the grasslands along the edge of the peat bog as well as the moist heathlands. All butterflies of peat bog already have vanished in the past.

1 - Bargerveen

Endangered species seen in the last 10 years at least 10 times

- Butterflies: *Lycaena tityrus (VU); Plebejus argus (VU); Pyrgus malvae (EN); Pyronia tithonus (NT)*

- Moths: *Acronicta auricoma (VU); Ammoconia caecimacula (CR); Amphipoea oculea (EN); Bena bicolorana (VU); Ceramica pisi (VU); Cerastis rubricosa (VU); Charanyca ferruginea (VU); Clostera anachoreta (EN); Clostera pigra (EN); Coenobia rufa (VU); Cosmorhoe ocellata (VU); Cyclophora albipunctata (VU); Deilephila porcellus (VU); Deltote uncula (EN); Diacrisia sannio (VU); Diarsia brunnea (VU); Drymonia ruficornis (VU); Electrophaes corylata (VU); Ennomos alniaria (VU); Ennomos erosaria (EN); Eulithis testata (VU); Eupithecia icterata (EN); Eupithecia linariata (VU); Eupithecia nanata (VU); Eupithecia satyrata (EN); Eupithecia subumbrata (EN); Eupithecia succenturiata (VU); Falcaria lacertinaria (VU); Gastropacha quercifolia (EN); Gluphisia crenata (VU); Gortyna flavago (VU); Hada plebeja (VU); Helotropha leucostigma (VU); Hydrelia flammeolaria (VU); Hydria undulata (VU); Idaea muricata (VU); Lacanobia w-latinum (VU); Lasiocampa trifolii (VU); Laspeyria flexula (EN); Lycophotia porphyrea (VU); Malacosoma neustria (VU); Meganola albula (VU); Mythimna pudorina (VU); Nola aerugula (VU); Nola cucullatella (EN); Nonagria typhae (VU); Ochropacha duplaris (VU); Orthosia gracilis (VU); Parastichtis suspecta (VU); Pelurga comitata (VU); Perconia strigillaria (VU); Plusia putnami (EN); Pterapherapteryx sexalata (EN); Pyrrhia umbra (VU); Saturnia pavonia (VU); Stauropus fagi (VU); Tethea or (VU); Tetheella fluctuosa (VU); Tholera cespitis (EN); Tholera decimalis (VU); Trichiura crataegi (VU); Xanthia icteritia (VU); Xestia baja (VU)*

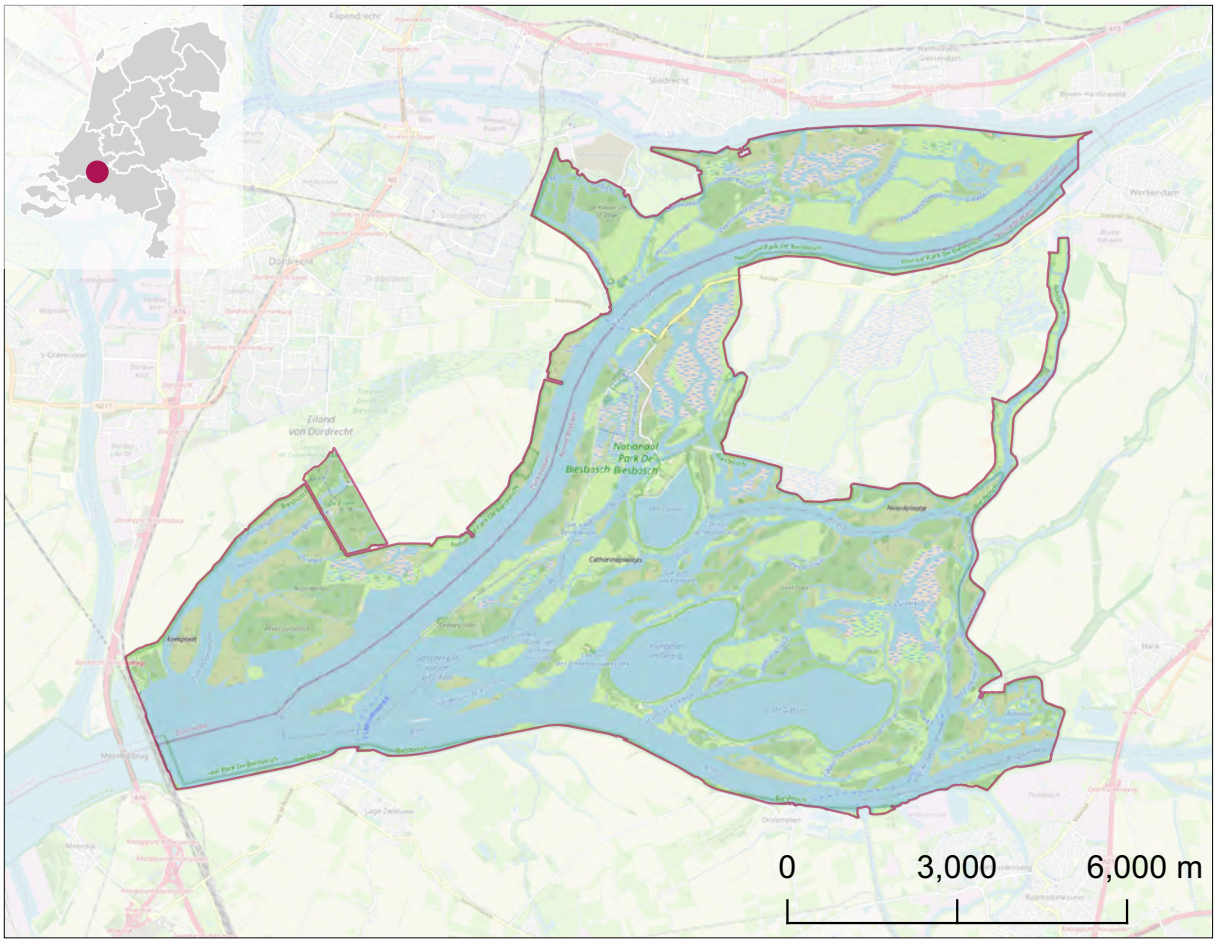
Endangered species not seen in the last 10 years at least 10 times

- Butterflies: *Thymelicus sylvestris (EN)*

- Moths: *Achlya flavicornis (VU); Acronicta aceris (VU); Acronicta psi (VU); Agrochola helvola (EN); Amphipoea lucens (CR); Apamea scolopacina (VU); Biston strataria (VU); Deltote deceptoria (VU); Diarsia mendica (VU); Epirrhoe tristata (VU); Eupithecia tripunctaria (VU); Eupithecia virgaureata (VU); Furcula bifida (EN); Globia sparganii (VU); Idaea emarginata (VU); Lacanobia thalassina (VU); Leucoma salicis (VU); Lobophora halterata (EN); Noctua orbona (VU); Orthosia opima (CR); Parascotia fuliginaria (VU); Trichopteryx carpinata (VU)*

Population (%) of butterfly species inside IBMA for the period 1990-2020

Callophrys rubi (1-10%); Lycaena tityrus (1-10%); Plebejus argus (1-10%); Pyrgus malvae (11-20%); Thymelicus sylvestris (1-10%)



2 - Biesbosch

ILA Criteria: Aii,Bii,Biii (Moths)

- Aii: Site contains one or more regionally threatened species
- Bii: Site contains a high number of species of high conservation importance
- Biii: Site contains an exceptional number of species

Area: 10204 ha

Description:

Biesbosch is the largest freshwater tidal area in Europe. As a result, you will find many willow floodplain forests and creeks, varied with rough grasslands and wetlands

2 - Biesbosch

Endangered species seen in the last 10 years at least 10 times

- Butterflies: No species

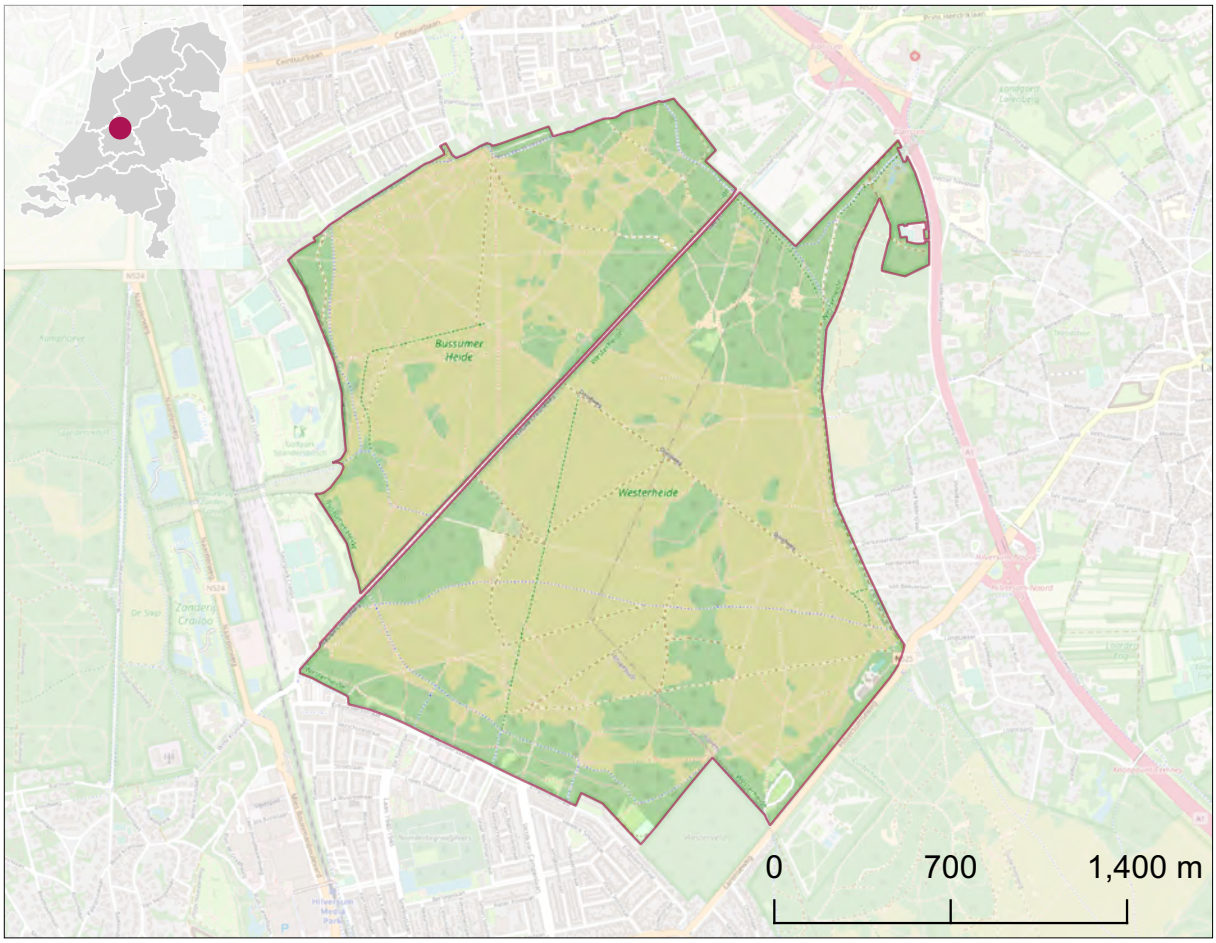
- Moths: *Abrostola tripartita (VU); Acronicta psi (VU); Apamea scolopacina (VU); Apamea unanimis (VU); Archanara dissoluta (EN); Biston strataria (VU); Cerastis leucographa (CR); Cerura vinula (VU); Chilodes maritima (VU); Clostera anachoreta (EN); Cosmia affinis (VU); Cosmia pyralina (VU); Cosmorhoe ocellata (VU); Ennomos alniaria (VU); Epirrhoe rivata (VU); Euchoeca nebulata (VU); Eulithis mellinata (VU); Eupithecia assimilata (VU); Eupithecia haworthiata (EN); Eupithecia subfuscata (VU); Eupithecia tenuiata (VU); Eupithecia tripunctaria (VU); Eupithecia virgaureata (VU); Gagitodes sagittata (CR); Globia sparganii (VU); Gluphisia crenata (VU); Gortyna flavago (VU); Graphiphora augur (EN); Hada plebeja (VU); Hecatera bicolorata (VU); Helotropha leucostigma (VU); Hepialus humuli (VU); Ipimorpha retusa (EN); Ipimorpha subtusa (VU); Lamprotes c-aureum (EN); Laspeyria flexula (EN); Lenisa geminipuncta (VU); Leucania obsoleta (VU); Leucoma salicis (VU); Lobophora halterata (EN); Lycia hirtaria (EN); Meganola albula (VU); Mythimna straminea (VU); Nonagria typhae (VU); Notodonta tritophus (VU); Orthonama vittata (VU); Orthosia populeti (VU); Parastichtis suspecta (VU); Pharmacis lupulina (VU); Philereme transversata (EN); Pterapherapteryx sexalata (EN); Scotopteryx chenopodiata (VU); Sesia apiformis (VU); Simyra albovenosa (VU); Spilosoma urticae (VU); Trichopteryx carpinata (VU)*

Endangered species not seen in the last 10 years at least 10 times

- Butterflies: No species

- Moths: *Acronicta tridens (VU); Caradrina clavipalpis (VU); Eupithecia valerianata (VU); Nola confusalis (VU); Ochropacha duplaris (VU); Parascotia fuliginaria (VU); Sideridis rivularis (VU); Thalpophila matura (VU); Watsonalla cultraria (VU)*

Biesbosch is the largest freshwater tidal area in Northwestern Europe and essential for the biodiversity of moths, like the endangered *Lamprotes c-aureum*



3 - Bussumer Heide & Westerheide

ILA Criteria: Aii,Bii (Moths)

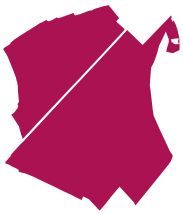
- Aii: Site contains one or more regionally threatened species
- Bii: Site contains a high number of species of high conservation importance

Area: 507 ha

Description:

Bussumer Heide & Westerheide is a structured heathland which contains a large number of moth species.

3 - Bussumer Heide & Westerheide



Endangered species seen in the last 10 years at least 10 times

- Butterflies: No species

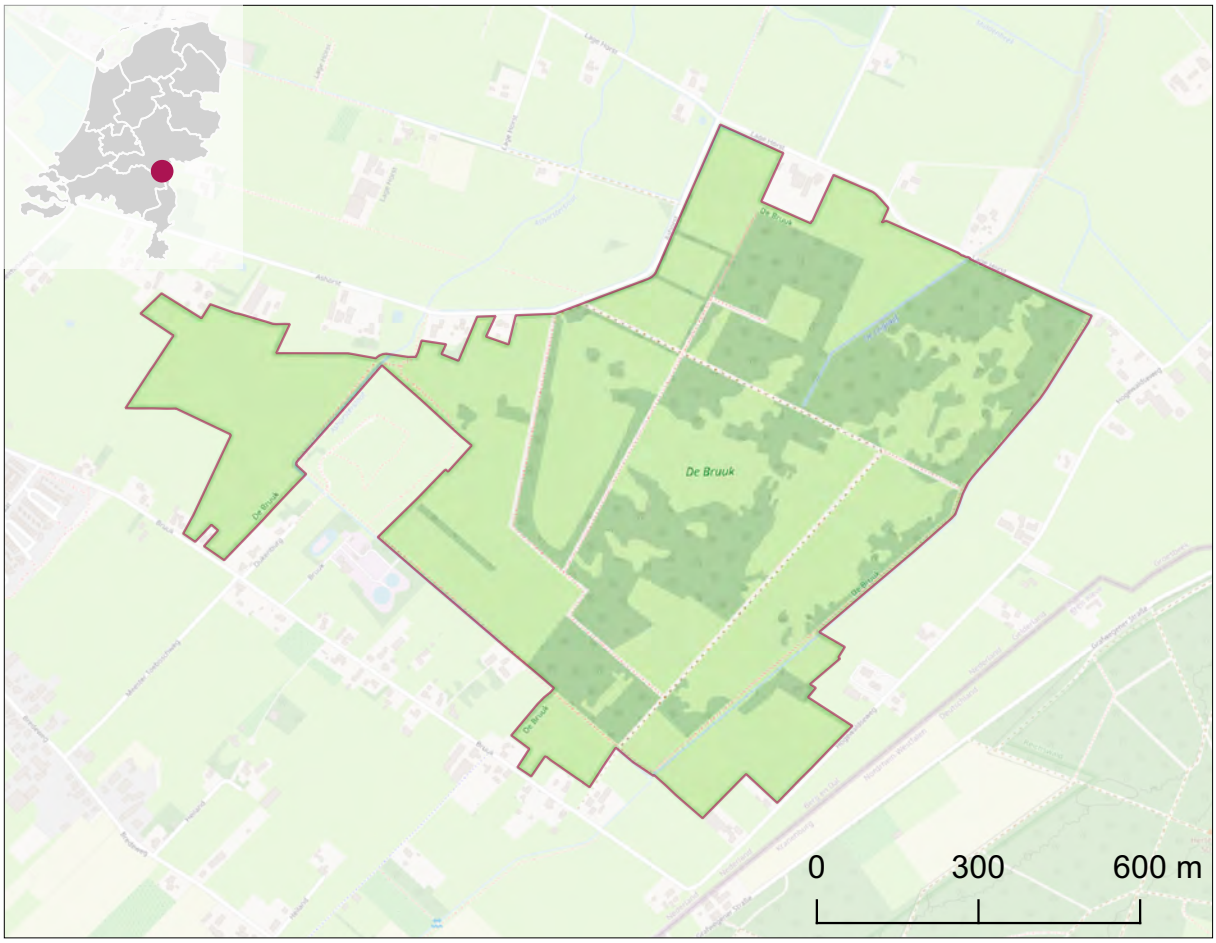
- Moths: *Alsophila aceraria (CR); Calamia tridens (VU); Eupithecia nanata (VU); Lasiocampa trifolii (VU); Lycophotia porphyrea (VU); Perconia strigillaria (VU); Saturnia pavonia (VU)*

Endangered species not seen in the last 10 years at least 10 times

- Butterflies: No species

- Moths: *Archiearis parthenias (VU)*

Three vulnarable species from this area are *Calamia tridens* (top-left), *Lasiocampa trifolii* (top-right) and *Saturnia pavonia* (bottom)



4 - De Bruuk

ILA Criteria: Aii,Bii,Biii (Butterflies); Bii (Moths)

- Aii: Site contains one or more regionally threatened species
- Bii: Site contains a high number of species of high conservation importance
- Biii: Site contains an exceptional number of species

Area: 99 ha

Description:

De Bruuk is a wet area at the lowest part of the 'Bekken van Groesbeek' and characterised by the alternation between wet grasslands, thickets, hedgerows and swamp forests. For butterflies the most important habitats are the fen meadows, flowerrich wet grasslands, often also popular for their orchids.

4 - De Bruuk

Endangered species seen in the last 10 years at least 10 times

- Butterflies: *Aricia agestis (NT); Boloria selene (EN); Issoria lathonia (VU); Nymphalis polychloros (VU); Pyrgus malvae (EN); Pyronia tithonus (NT)*

- Moths*: Deltote uncula (EN); Eulithis testata (VU); Miltochrista miniata (VU); Pterapherapteryx sexalata (EN)*

Endangered species not seen in the last 10 years at least 10 times

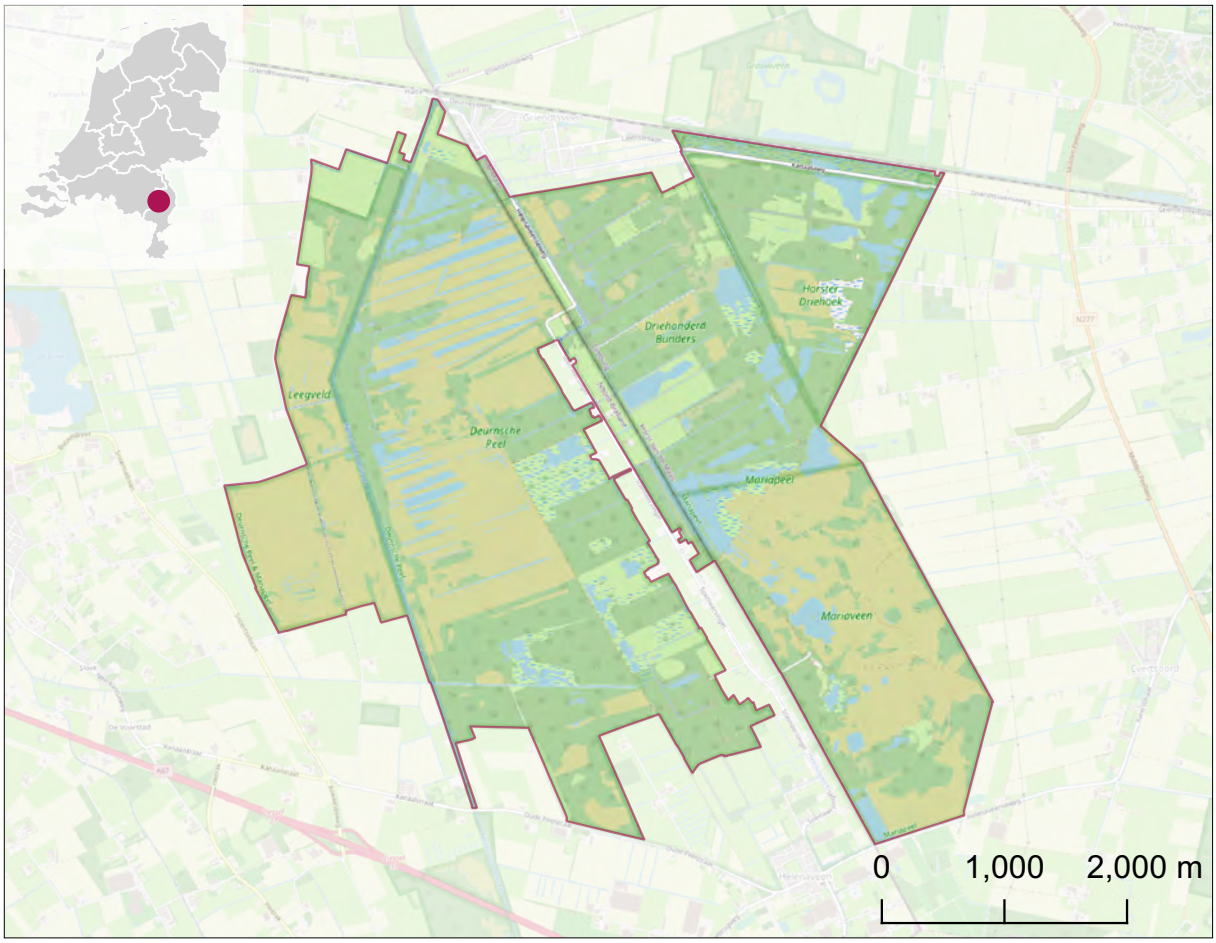
- Butterflies: No species

- Moths: No species

Population (%) of butterfly species inside IBMA

Apatura iris (1-10%); Boloria selene (1-10%); Issoria lathonia (1-10%); Pyrgus malvae (1-10%)

De Bruuk has a mix of habitats that allow visitors to observe endangered butterflies such as *Boloria selene*



5 - Deurnsche Peel & Mariapeel

ILA Criteria: Biii (Butterflies); Aii,Bii (Moths)

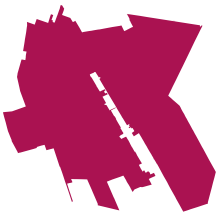
- Aii: Site contains one or more regionally threatened species
- Bii: Site contains a high number of species of high conservation importance
- Biii: Site contains an exceptional number of species

Area: 2310 ha

Description:

One of the remaining parts of the former large peatbogs in the Peel-region, now mainly consisting of wet woodlands, moist heathlands and small peatbogs.

5 - Deurnsche Peel & Mariapeel



Endangered species seen in the last 10 years at least 10 times

- Butterflies: *Heteropterus morpheus (VU); Plebejus argus (VU); Pyronia tithonus (NT)*

- Moths: *Achlya flavicornis (VU); Aethalura punctulata (EN); Archiearis parthenias (VU); Biston strataria (VU); Charanyca ferruginea (VU); Coenobia rufa (VU); Cyclophora albipunctata (VU); Diarsia mendica (VU); Electrophaes corylata (VU); Enargia paleacea (EN); Endromis versicolora (EN); Ennomos alniaria (VU); Eulithis testata (VU); Eupithecia tenuiata (VU); Falcaria lacertinaria (VU); Furcula bicuspis (EN); Gastropacha quercifolia (EN); Gluphisia crenata (VU); Hydrelia flammeolaria (VU); Hydria undulata (VU); Idaea emarginata (VU); Idaea muricata (VU); Idaea straminata (VU); Laspeyria flexula (EN); Leucania obsoleta (VU); Lycophotia porphyrea (VU); Mythimna pudorina (VU); Nola aerugula (VU); Ochropacha duplaris (VU); Paracolax tristalis (VU); Petrophora chlorosata (VU); Plusia putnami (EN); Pterapherapteryx sexalata (EN); Saturnia pavonia (VU); Simyra albovenosa (VU); Tethea or (VU); Tetheella fluctuosa (VU); Trichopteryx carpinata (VU)*

Endangered species not seen in the last 10 years at least 10 times

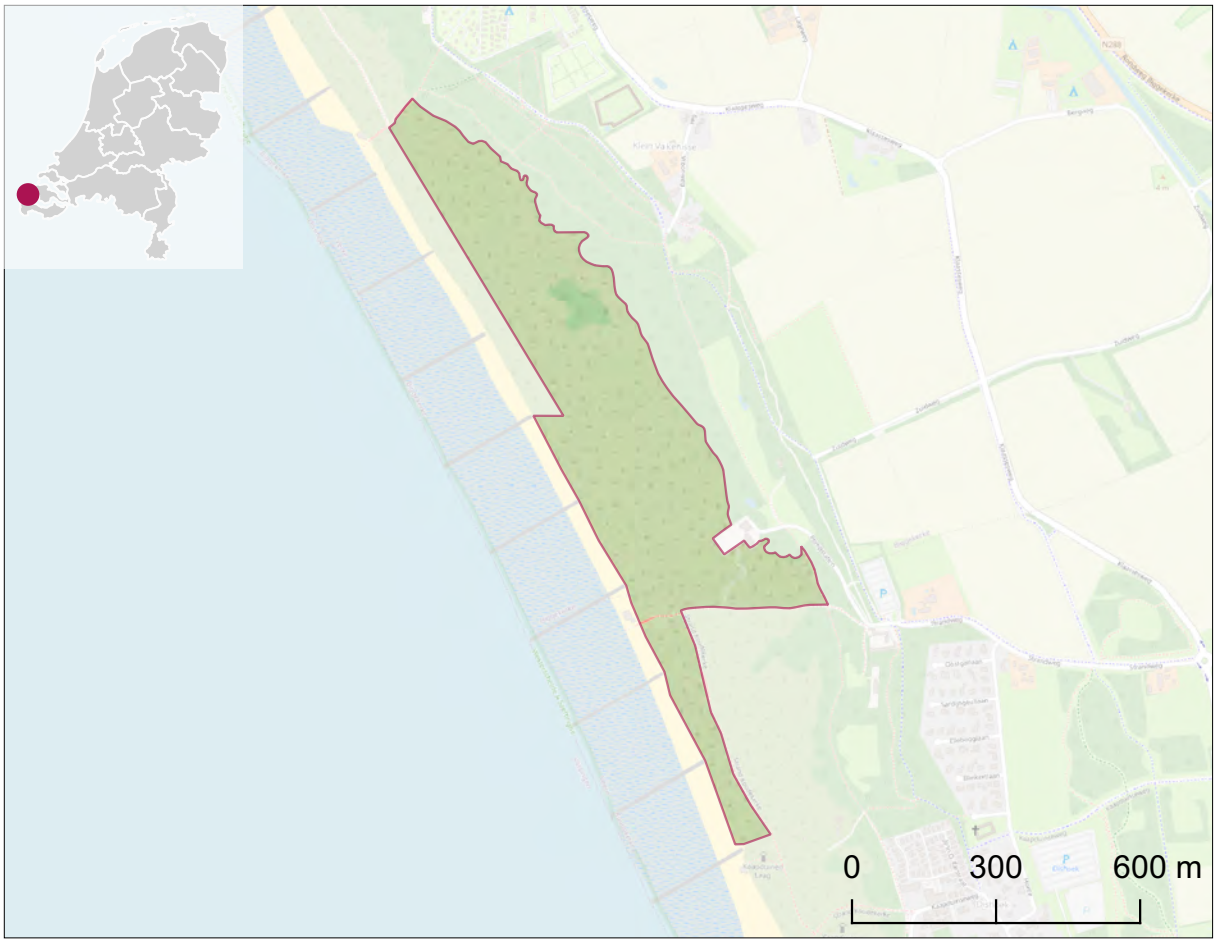
- Butterflies: No species

- Moths: *Leucodonta bicoloria (EN); Parastichtis suspecta (VU)*

Population (%) of butterfly species inside IBMA

Callophrys rubi (1-10%); Carterocephalus palaemon (1-10%); Heteropterus morpheus (41-50%); Plebejus argus (1-10%)

Heteropterus morpheus **is one of the most abundant, but also vulnerable species, that can be found at Deurnsche Peel & Mariapeel**



6 - Dishoek

ILA Criteria: Aii,Bii (Moths)

- Aii: Site contains one or more regionally threatened species
- Bii: Site contains a high number of species of high conservation importance

Area: 32 ha

Description:

Dishoek has a variation of dunes and forest in one of the sunniest and mildest places of the Netherlands.

6 - Dishoek

Endangered species seen in the last 10 years at least 10 times

- Butterflies: No species

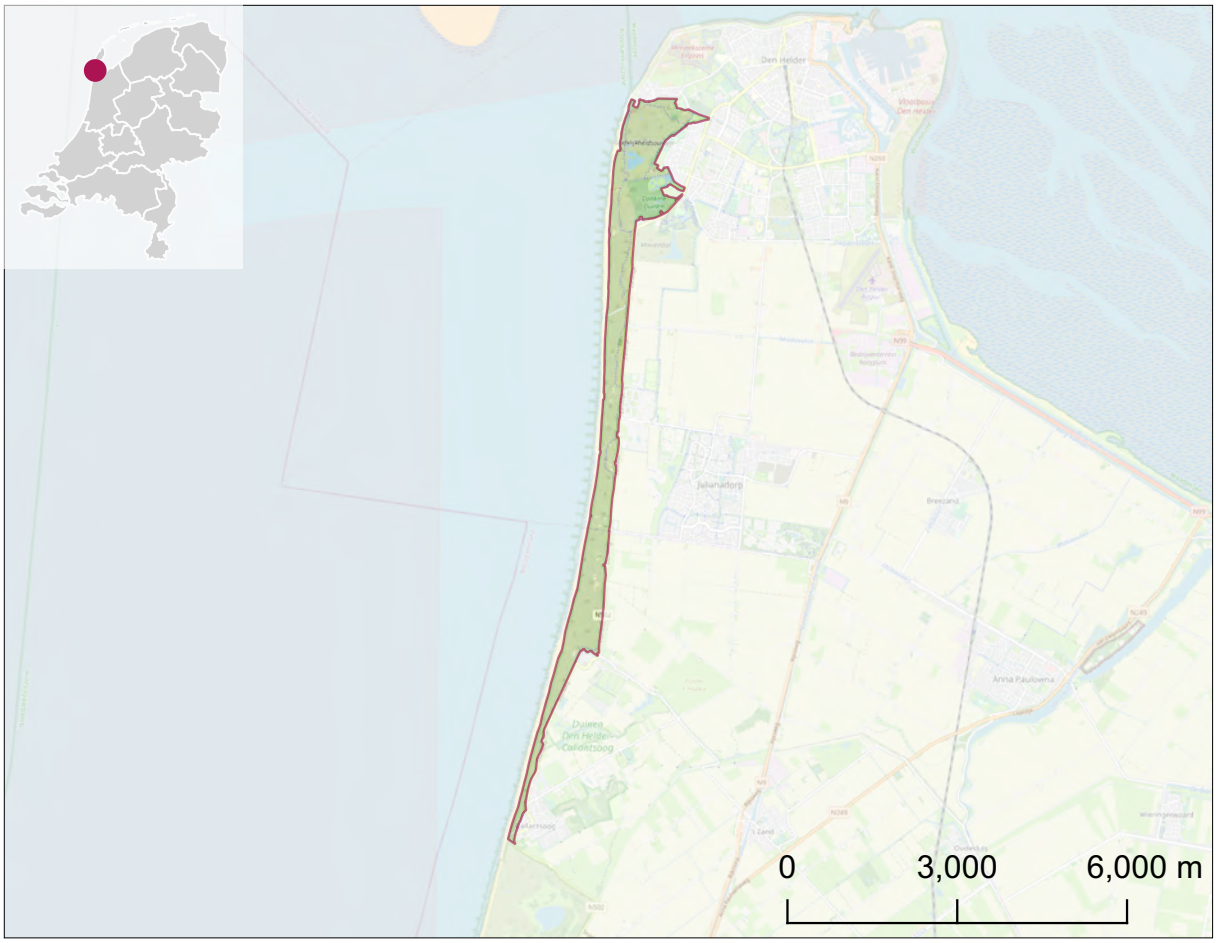
- Moths: *Agrotis ripae (VU); Agrotis vestigialis (VU); Charanyca ferruginea (VU); Coscinia cribraria (EN); Cosmorhoe ocellata (VU); Deilephila porcellus (VU); Eilema pygmaeola (EN); Epirrhoe galiata (CR); Euxoa tritici (VU); Malacosoma neustria (VU); Mythimna litoralis (EN); Nola aerugula (VU); Nola cucullatella (EN); Philereme transversata (EN)*

Endangered species not seen in the last 10 years at least 10 times

- Butterflies: No species

- Moths: No species

The two vulnerable species *Coscinia cribraria* (left) and *Mythimna litoralis* (right) occur in this area. The latter is living in the pioneer vegetation of the dunes



7 - Duinen Den Helder-Callantsoog

ILA Criteria: Biii (Butterflies); Bii (Moths)

- Bii: Site contains a high number of species of high conservation importance
- Biii: Site contains an exceptional number of species

Area: 569 ha

Description:

A relatively narrow strip of dunes with a mixture of wet and dry habitats.

7 - Duinen Den Helder-Callantsoog

Endangered species seen in the last 10 years at least 10 times

- Butterflies: *Speyeria aglaja (CR); Argynnis niobe (EN); Aricia agestis (NT); Hesperia comma (EN); Hipparchia semele (VU); Issoria lathonia (VU)*

- Moths: *Aethalura punctulata (EN); Agrotis vestigialis (VU); Biston strataria (VU); Cerura vinula (VU); Coscinia cribraria (EN); Deilephila porcellus (VU); Euchoeca nebulata (VU); Eupithecia nanata (VU); Eupithecia tenuiata (VU); Hydrelia flammeolaria (VU); Hyles gallii (EN); Lasiocampa trifolii (VU); Lycophotia porphyrea (VU); Mythimna litoralis (EN); Nola aerugula (VU); Nola confusalis (VU); Ochropacha duplaris (VU); Panolis flammea (VU); Perizoma flavofasciata (VU); Thalpophila matura (VU)*

Endangered species not seen in the last 10 years at least 10 times

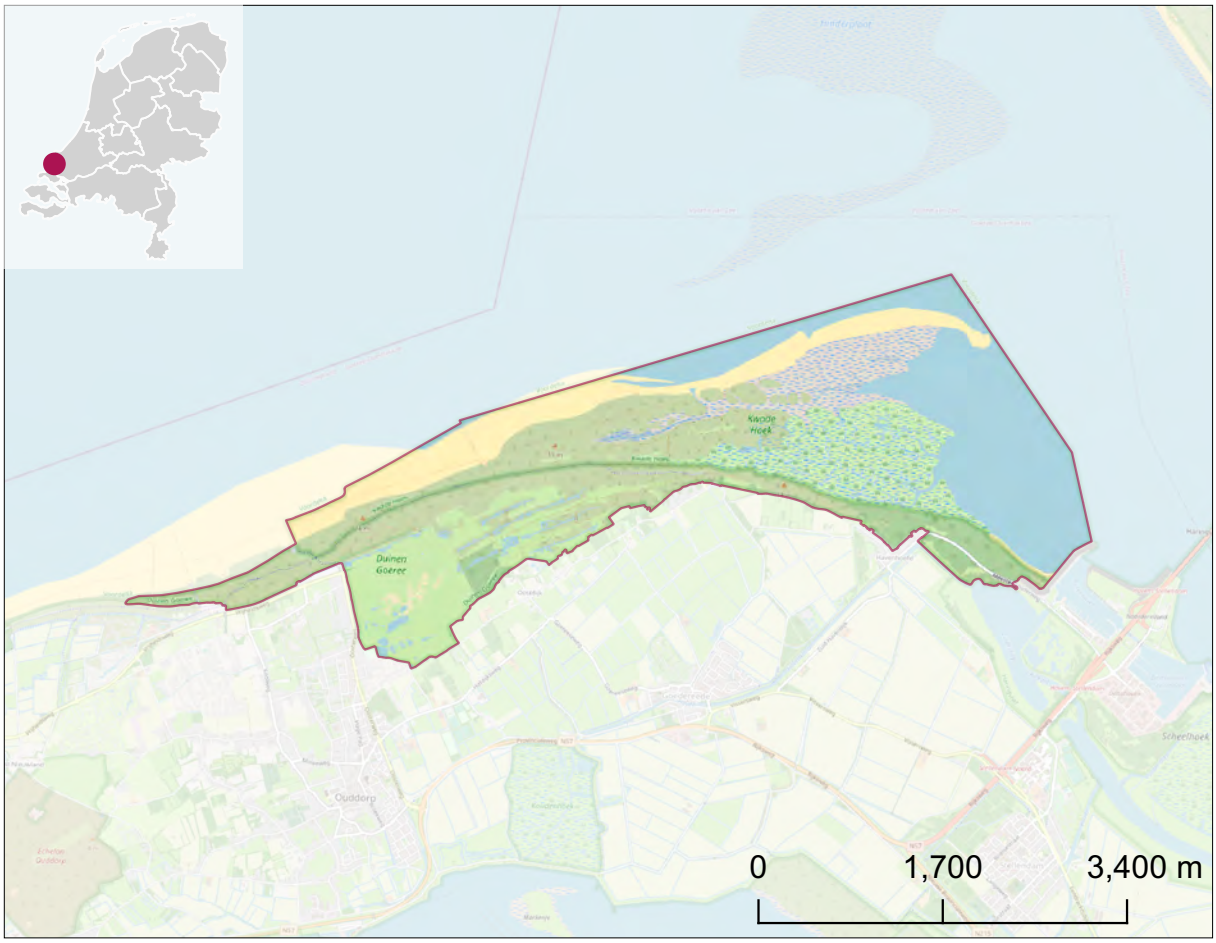
- Butterflies: No species

- Moths: *Amphipoea oculea (EN); Cilix glaucata (EN); Eilema pygmaeola (EN); Ennomos alniaria (VU); Leucoma salicis (VU)*

Population (%) of butterfly species inside IBMA

Argynnis niobe (1-10%); Callophrys rubi (1-10%); Hesperia comma (1-10%); Hipparchia semele (1-10%); Issoria lathonia (1-10%)

The endangered moth *Aethalura punctulata* can be found around birch in this area



8 - Duinen Goeree & Kwade Hoek

ILA Criteria: Biii (Butterflies); Bii (Moths)

- Bii: Site contains a high number of species of high conservation importance
- Biii: Site contains an exceptional number of species

Area: 1235 ha

Description:

The area includes a tidal area directly next to the North Sea. There is a transition from salt marshes to dune valleys and scrubs. There are both calcareous rich and poor areas which provide a great variety of vegetation.

8 - Duinen Goeree & Kwade Hoek

Endangered species seen in the last 10 years at least 10 times

- Butterflies: *Aricia agestis (NT); Hipparchia semele (VU); Issoria lathonia (VU); Pyronia tithonus (NT)*

- Moths: *Abrostola tripartita (VU); Agrotis vestigialis (VU); Cosmorhoe ocellata (VU); Cucullia asteris (EN); Deilephila porcellus (VU); Eupithecia linariata (VU); Globia sparganii (VU); Gluphisia crenata (VU); Graphiphora augur (EN); Laspeyria flexula (EN); Malacosoma neustria (VU); Philereme transversata (EN); Thalpophila matura (VU)*

Endangered species not seen in the last 10 years at least 10 times

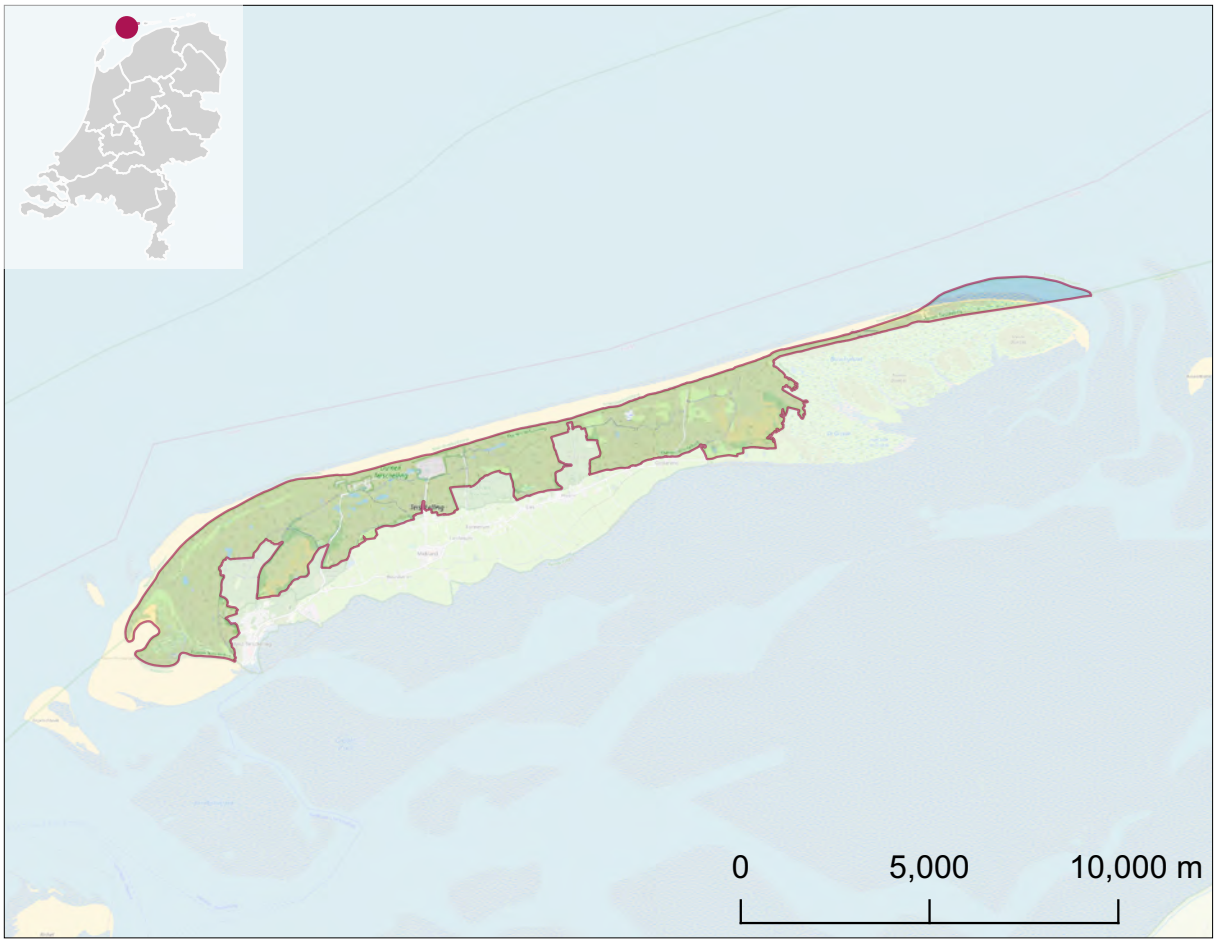
- Butterflies: No species

- Moths: *Cybosia mesomella (VU); Saturnia pavonia (VU); Xestia sexstrigata (EN)*

Population (%) of butterfly species inside IBMA

Hipparchia semele (1-10%)

The mix of salt marshes, dunes and shrubs, makes of Duinen Goeree & Kwade Hoek a very rich area for butterflies and moths



9 - Duinen Terschelling

ILA Criteria: Bii,Biii (Butterflies); Aii,Bii (Moths)

- Aii: Site contains one or more regionally threatened species
- Bii: Site contains a high number of species of high conservation importance
- Biii: Site contains an exceptional number of species

Area: 3642 ha

Description:

Terschelling is the second largest of the Dutch Wadden islands, after Texel. The dunes represent a mixture of wet dune valleys, as well as dry gray dunes and woodlands.

9 - Duinen Terschelling

Endangered species seen in the last 10 years at least 10 times

- Butterflies: *Speyeria aglaja (CR); Argynnis niobe (EN); Aricia agestis (NT); Boloria selene (EN); Hesperia comma (EN); Hipparchia semele (VU); Issoria lathonia (VU)*

- Moths: *Acronicta auricoma (VU); Actebia praecox (CR); Agrotis vestigialis (VU); Amphipoea oculea (EN); Cerura vinula (VU); Cilix glaucata (EN); Clostera pigra (EN); Coscinia cribraria (EN); Cosmorhoe ocellata (VU); Cybosia mesomella (VU); Cyclophora albipunctata (VU); Deilephila porcellus (VU); Deltote uncula (EN); Diarsia mendica (VU); Eilema pygmaeola (EN); Ennomos alniaria (VU); Eulithis testata (VU); Eupithecia icterata (EN); Eupithecia linariata (VU); Eupithecia nanata (VU); Eupithecia succenturiata (VU); Euxoa cursoria (EN); Euxoa tritici (VU); Falcaria lacertinaria (VU); Gortyna flavago (VU); Hyles gallii (EN); Idaea emarginata (VU); Idaea straminata (VU); Lasiocampa trifolii (VU); Lycophotia porphyrea (VU); Malacosoma neustria (VU); Mythimna litoralis (EN); Mythimna straminea (VU); Noctua orbona (VU); Nola aerugula (VU); Notodonta tritophus (VU); Paracolax tristalis (VU); Photedes extrema (EN); Phytometra viridaria (CR); Pseudoterpna pruinata (CR); Rhodostrophia vibicaria (EN); Scotopteryx luridata (CR); Selidosema brunnearia (EN); Sideridis reticulata (EN); Tetheella fluctuosa (VU); Thalpophila matura (VU); Tholera decimalis (VU); Xestia baja (VU)*

Endangered species not seen in the last 10 years at least 10 times

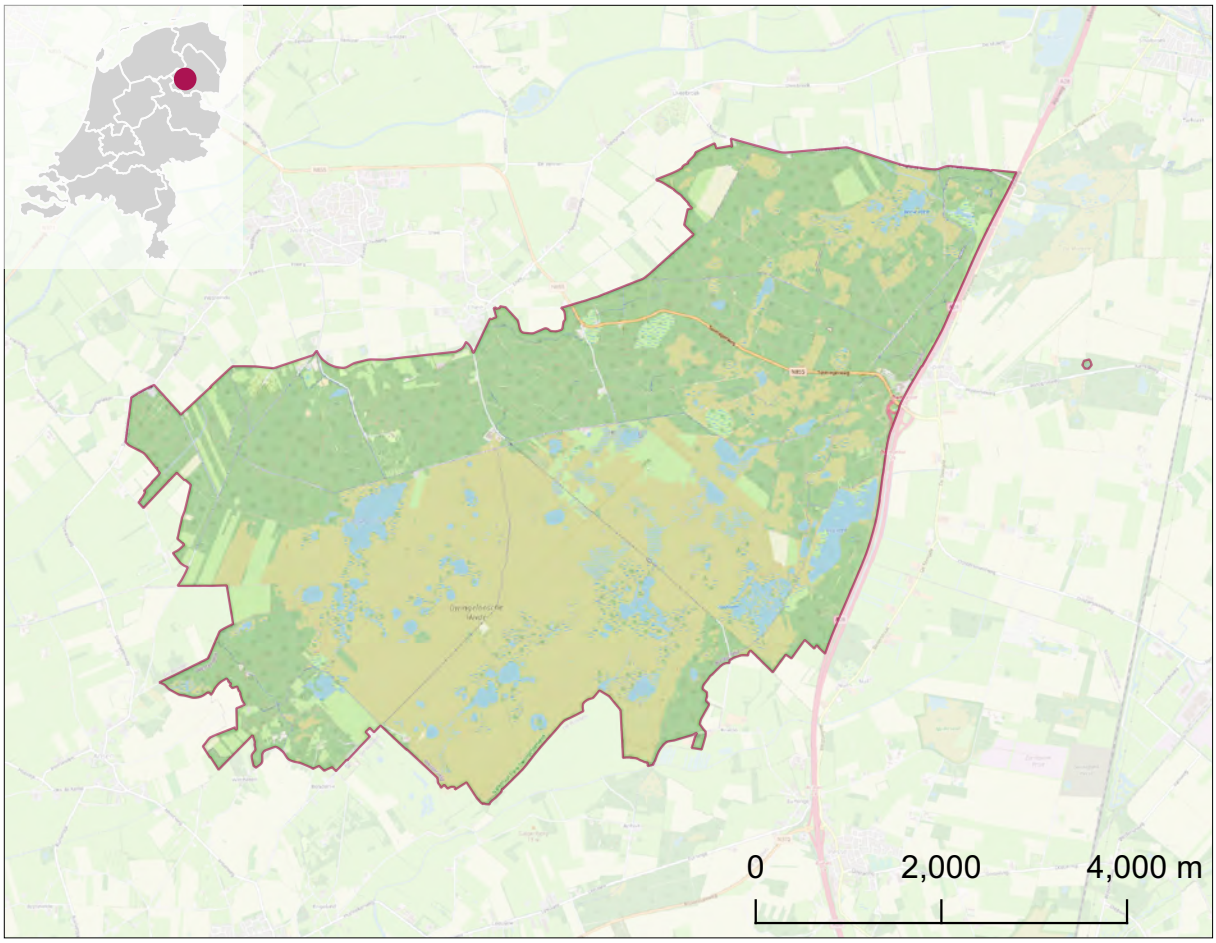
- Butterflies: No species

- Moths: *Euchoeca nebulata (VU); Orthosia gracilis (VU)*

Population (%) of butterfly species inside IBMA

Speyeria aglaja (1-10%); Argynnis niobe (11-20%); Boloria selene (21-30%); Callophrys rubi (1-10%); Hesperia comma (1-10%); Hipparchia semele (1-10%); Issoria lathonia (1-10%)

The combination of wet and dry dunes in Terschelling is essential for many threatened butterfly and moth species



10 - Dwingelderveld

ILA Criteria: Aii,Bii,Biii (Butterflies); Aii,Bii,Biii (Moths)

- Aii: Site contains one or more regionally threatened species
- Bii: Site contains a high number of species of high conservation importance
- Biii: Site contains an exceptional number of species

Area: 3767 ha

Description:

Dwingelderveld consists of large wet heathlands and peatbogs surrounded by woodlands. Many of these used to hold populations of characteristic peat butterflies, but now only a few sites hold small populations.

10 - Dwingelderveld

Endangered species seen in the last 10 years at least 10 times

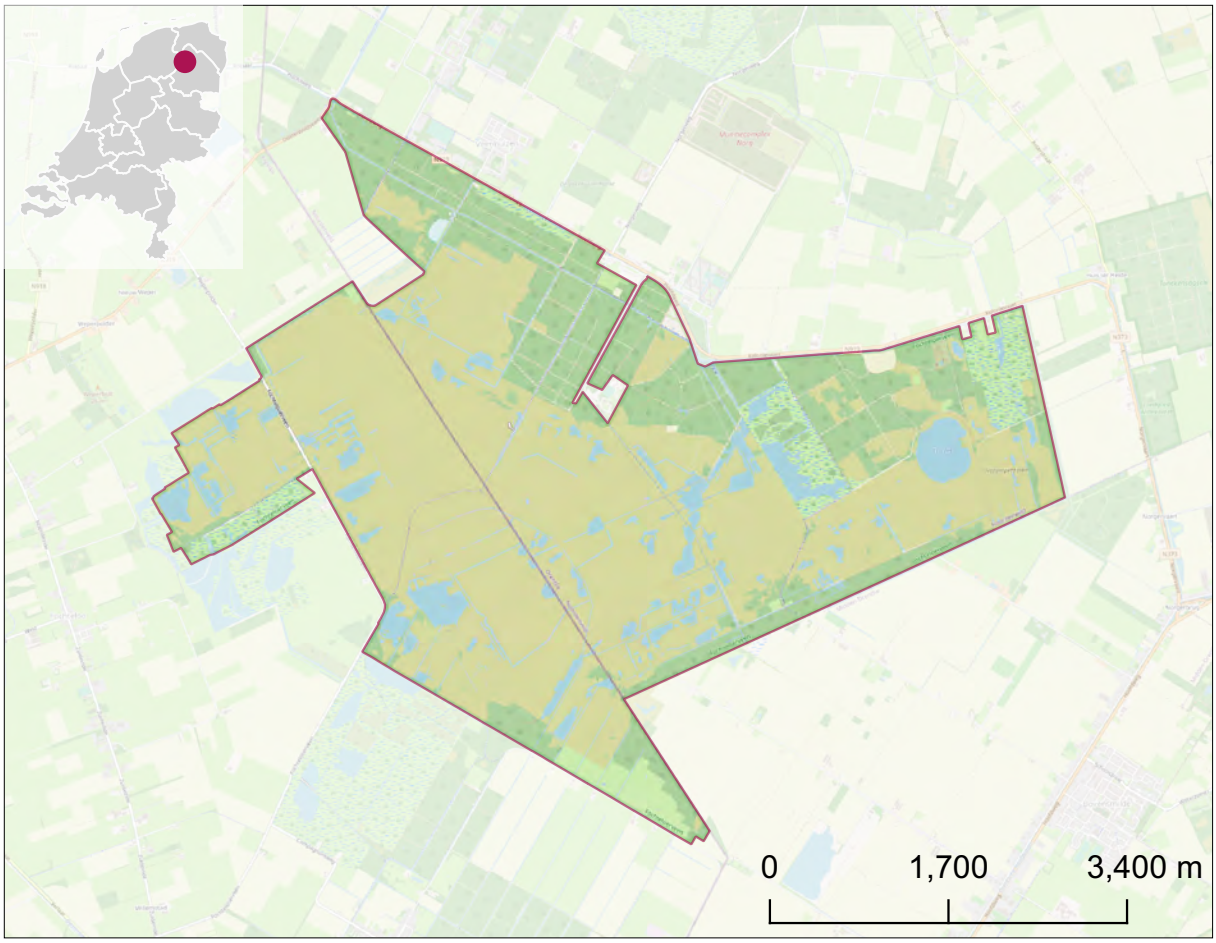
- Butterflies: *Agriades optilete (CR); Boloria aquilonaris (CR); Hesperia comma (EN); Lycaena tityrus (VU); Nymphalis polychloros (VU); Phengaris alcon (EN); Plebejus argus (VU); Pyrgus malvae (EN); Pyronia tithonus (NT)*
- Moths: *Achlya flavicornis (VU); Acronicta aceris (VU); Acronicta auricoma (VU); Acronicta psi (VU); Aethalura punctulata (EN); Agrotis vestigialis (VU); Archiearis parthenias (VU); Arctornis l-nigrum (CR); Biston strataria (VU); Calamia tridens (VU); Cepphis advenaria (VU); Ceramica pisi (VU); Cerastis rubricosa (VU); Charanyca ferruginea (VU); Coenobia rufa (VU); Cosmorhoe ocellata (VU); Cybosia mesomella (VU); Cyclophora albipunctata (VU); Deilephila porcellus (VU); Deltote deceptoria (VU); Deltote uncula (EN); Diacrisia sannio (VU); Diarsia brunnea (VU); Diloba caeruleocephala (EN); Drymonia dodonaea (EN); Drymonia ruficornis (VU); Electrophaes corylata (VU); Ennomos alniaria (VU); Ennomos erosaria (EN); Epirrhoe tristata (VU); Eulithis testata (VU); Eupithecia exiguata (CR); Eupithecia indigata (EN); Eupithecia nanata (VU); Eupithecia pusillata (EN); Eupithecia satyrata (EN); Eupithecia subumbrata (EN); Eupithecia tantillaria (VU); Eupithecia tenuiata (VU); Eupithecia virgaureata (VU); Falcaria lacertinaria (VU); Furcula bicuspis (EN); Gastropacha quercifolia (EN); Gluphisia crenata (VU); Hada plebeja (VU); Harpyia milhauseri (VU); Hydrelia flammeolaria (VU); Idaea emarginata (VU); Idaea muricata (VU); Idaea straminata (VU); Jodis putata (VU); Lacanobia thalassina (VU); Lacanobia w-latinum (VU); Lasiocampa trifolii (VU); Laspeyria flexula (EN); Lobophora halterata (EN); Lycia hirtaria (EN); Lycophotia porphyrea (VU); Lymantria monacha (VU); Malacosoma neustria (VU); Meganola albula (VU); Miltochrista miniata (VU); Mythimna pudorina (VU); Nola aerugula (VU); Nola confusalis (VU); Nola cucullatella (EN); Odontopera bidentata (VU); Odontosia carmelita (CR); Pachetra sagittigera (EN); Panolis flammea (VU); Parascotia fuliginaria (VU); Parastichtis suspecta (VU); Pechipogo strigilata (VU); Perconia strigillaria (VU); Peribatodes secundaria (VU); Perizoma flavofasciata (VU); Plusia putnami (EN); Polia nebulosa (EN); Pterapherapteryx sexalata (EN); Saturnia pavonia (VU); Stauropus fagi (VU); Tethea or (VU); Tetheella fluctuosa (VU); Tholera cespitis (EN); Tholera decimalis (VU); Trichopteryx carpinata (VU); Watsonalla cultraria (VU); Xestia baja (VU); Xestia sexstrigata (EN)*

Endangered species not seen in the last 10 years at least 10 times

- Butterflies: *Coenonympha tullia (CR); Hipparchia semele (VU); Satyrium ilicis (EN)*
- Moths: *Agrochola helvola (EN); Clostera pigra (EN); Eupithecia tripunctaria (VU); Hydria undulata (VU); Leucodonta bicoloria (EN); Leucoma salicis (VU); Macaria signaria (EN); Ochropacha duplaris (VU); Pelurga comitata (VU); Sideridis reticulata (EN); Tiliacea aurago (VU)*

Population (%) of butterfly species inside IBMA

Agriades optilete (91-100%); Boloria aquilonaris (81-90%); Callophrys rubi (1-10%); Hesperia comma (1-10%); Lycaena tyrus (1-10%); Phengaris alcon (11-20%); Plebejus argus (1-10%); Pyrgus malvae (1-10%)



11 - Fochteloërveen

ILA Criteria: Aii,Bii,Biii (Butterflies); Bii (Moths)

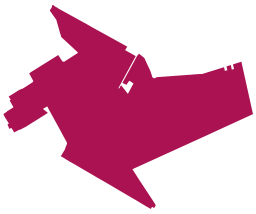
- Aii: Site contains one or more regionally threatened species
- Bii: Site contains a high number of species of high conservation importance
- Biii: Site contains an exceptional number of species

Area: 2618 ha

Description:

Fochteloërveen is one of the largest remaining peat bogs in the Netherlands. A lot of work has been carried out here to keep the water inside the nature reserve. It is home to the largest population of *Coenonympha tullia*.

11 - Fochteloërveen



Endangered species seen in the last 10 years at least 10 times

- Butterflies: Coenonympha tullia (CR); Plebejus argus (VU); Pyronia tithonus (NT)

- Moths*: Cerura vinula (VU); Cyclophora albipunctata (VU); Diacrisia sannio (VU); Eulithis testata (VU); Falcaria lacertinaria (VU); Gastropacha quercifolia (EN); Idaea muricata (VU); Lycophotia porphyrea (VU); Malacosoma neustria (VU); Miltochrista miniata (VU); Nola aerugula (VU); Saturnia pavonia (VU)*

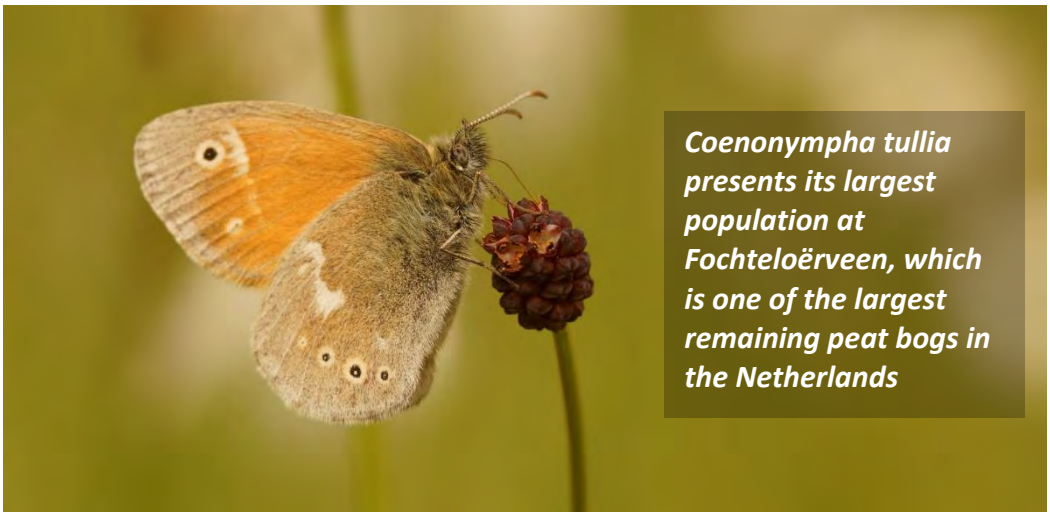
Endangered species not seen in the last 10 years at least 10 times

- Butterflies: No species

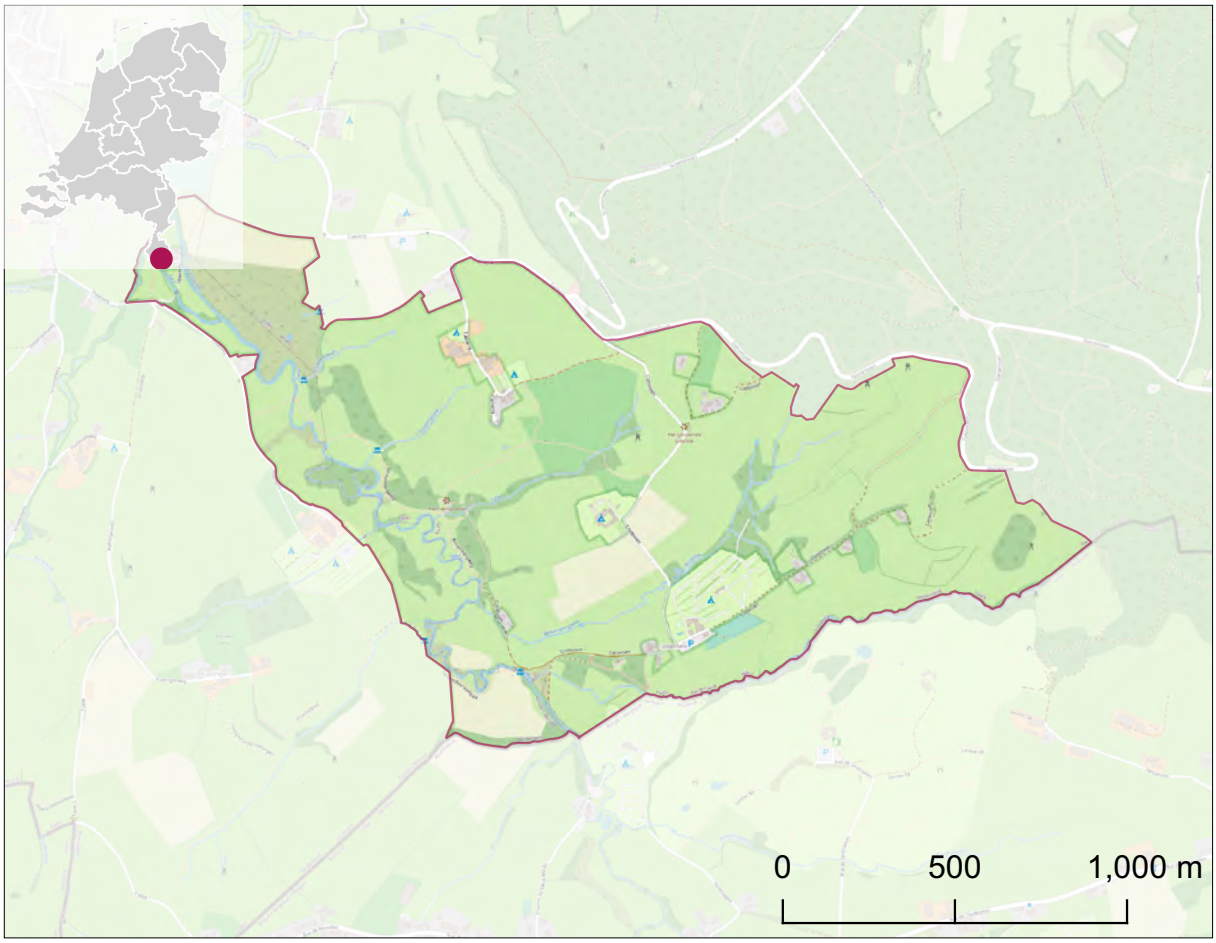
- Moths: Cucullia scrophulariae (EN); Eupithecia nanata (VU); Lasiocampa trifolii (VU)

Population (%) of butterfly species inside IBMA

Callophrys rubi (1-10%); Coenonympha tullia (71-80%); Plebejus argus (1-10%)



Coenonympha tullia presents its largest population at Fochteloërveen, which is one of the largest remaining peat bogs in the Netherlands



12 - Geuldal

ILA Criteria: Aii,Bii,Biii (Butterflies); Bii (Moths)

- Aii: Site contains one or more regionally threatened species
- Bii: Site contains a high number of species of high conservation importance
- Biii: Site contains an exceptional number of species

Area: 212 ha

Description:

A mixture of grasslands and woodland along the small Geul-river.

12 - Geuldal

Endangered species seen in the last 10 years at least 10 times

- Butterflies: *Aricia agestis (NT); Cyaniris semiargus (CR); Nymphalis polychloros (VU); Thecla betulae (EN); Thymelicus sylvestris (EN)*

- Moths: *Asthena albulata (EN); Cilix glaucata (EN); Ennomos alniaria (VU); Ennomos fuscantaria (EN); Laspeyria flexula (EN); Miltochrista miniata (VU); Selenia lunularia (EN); Sesia apiformis (VU)*

Endangered species not seen in the last 10 years at least 10 times

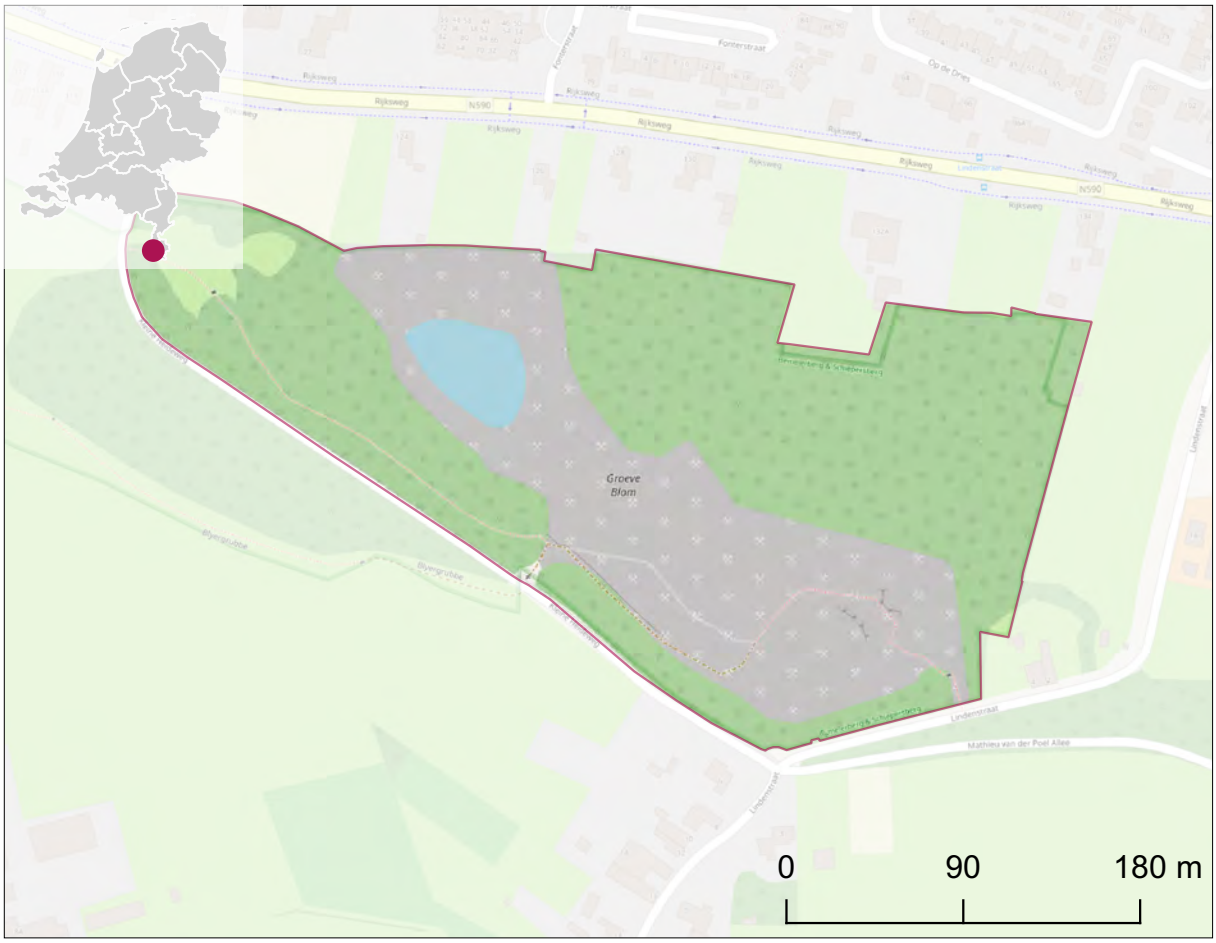
- Butterflies: No species

- Moths: *Ennomos alniaria (VU)*

Population (%) of butterfly species inside IBMA

Argynnis paphia (1-10%); Cyaniris semiargus (31-40%); Thecla betulae (1-10%); Thymelicus sylvestris (1-10%)

The Geul-river gives name to this area that presents a mixture of grasslands and woodlands giving habitat to an exceptional number of butterflies and moths



13 - Groeve Blom

ILA Criteria: Aii,Bii (Butterflies); Aii,Bii (Moths)

- Aii: Site contains one or more regionally threatened species
- Bii: Site contains a high number of species of high conservation importance

Area: 8 ha

Description:

A small area in a former quarry now offering a speciesricht calcareous grassland.

13 - Groeve Blom

Endangered species seen in the last 10 years at least 10 times

- Butterflies: *Aricia agestis (NT); Carcharodus alceae (NT); Cupido minimus (RE); Cyaniris semiargus (CR); Erynnis tages (CR); Leptidea sinapis (EN); Melitaea cinxia (CR); Thymelicus sylvestris (EN)*

- Moths: *Scotopteryx chenopodiata (VU)*

Endangered species not seen in the last 10 years at least 10 times

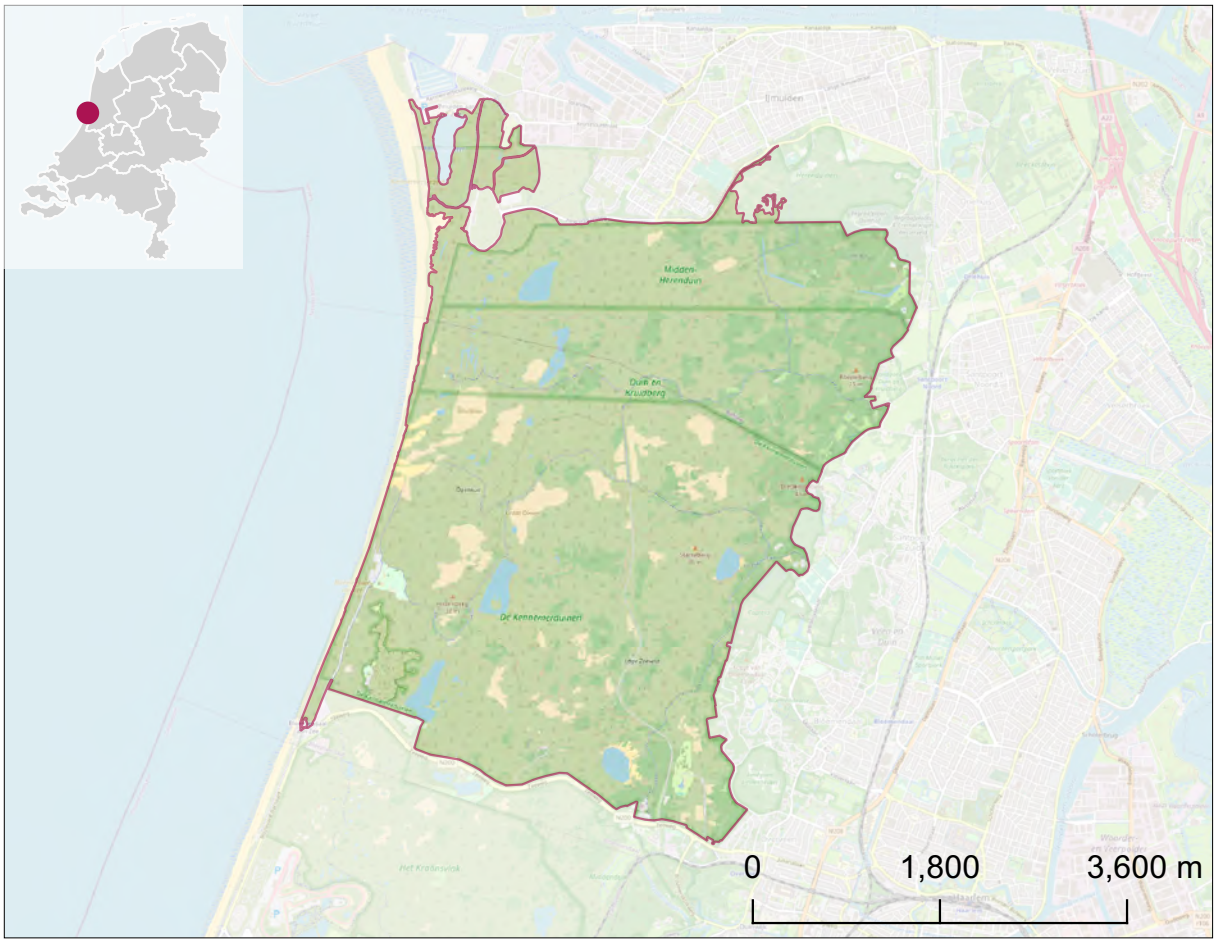
- Butterflies: *Nymphalis polychloros (VU)*

- Moths: No species

Population (%) of butterfly species inside IBMA

Argynnis paphia (1-10%); Carcharodus alceae (1-10%); Cupido minimus (1-10%); Cyaniris semiargus (1-10%); Erynnis tages (21-30%); Issoria lathonia (1-10%); Lep dea sinapis (31-40%); Melitaea cinxia (51-60%); Thymelicus sylvestris (1-10%)

***Melitaea cinxia* is a famous butterfly in ecological studies which has a large population at Groeve Blom**



14 - Kennemerland-Zuid

ILA Criteria: Bii,Biii (Butterflies); Aii,Bii,Biii (Moths)

- Aii: Site contains one or more regionally threatened species
- Bii: Site contains a high number of species of high conservation importance
- Biii: Site contains an exceptional number of species

Area: 2297 ha

Description:

A large and wide area with coastal dunes and woodland.

14 - Kennemerland-Zuid

Endangered species seen in the last 10 years at least 10 times

- Butterflies: *Argynnis niobe (EN); Aricia agestis (NT); Hipparchia semele (VU); Issoria lathonia (VU); Nymphalis polychloros (VU); Pyrgus malvae (EN); Satyrium ilicis (EN)*

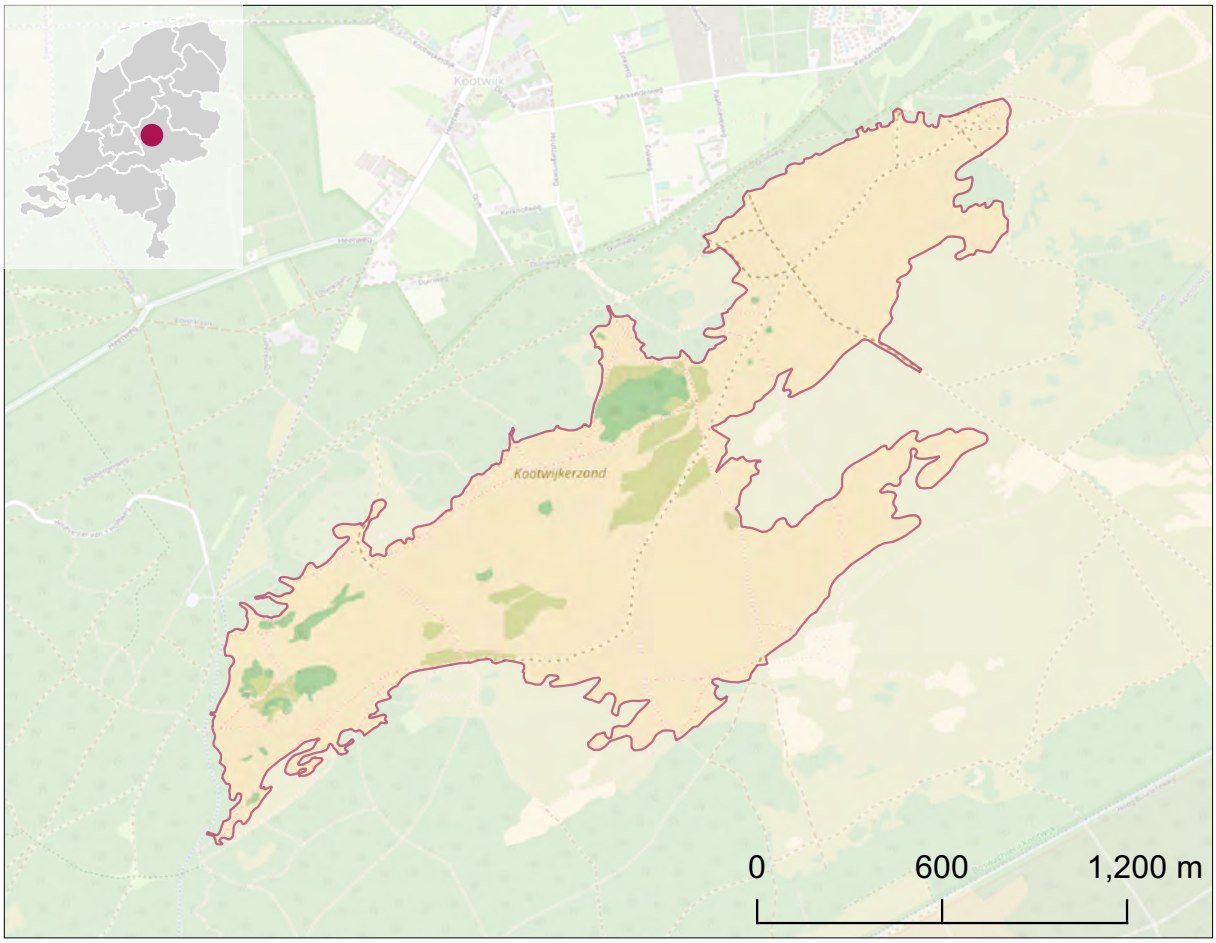
- Moths: *Achlya flavicornis (VU); Acronicta auricoma (VU); Acronicta psi (VU); Agrochola helvola (EN); Agrotis cinerea (CR); Agrotis ripae (VU); Agrotis vestigialis (VU); Ammoconia caecimacula (CR); Amphipoea oculea (EN); Apamea sublustris (EN); Biston strataria (VU); Calophasia lunula (EN); Cerastis rubricosa (VU); Cerura vinula (VU); Charanyca ferruginea (VU); Chilodes maritima (VU); Cilix glaucata (EN); Cleorodes lichenaria (CR); Clostera pigra (EN); Coscinia cribraria (EN); Cosmia affinis (VU); Cosmorhoe ocellata (VU); Cybosia mesomella (VU); Cyclophora porata (EN); Deilephila porcellus (VU); Diacrisia sannio (VU); Diloba caeruleocephala (EN); Earophila badiata (EN); Eilema pygmaeola (EN); Ennomos alniaria (VU); Eulithis testata (VU); Eupithecia assimilata (VU); Eupithecia icterata (EN); Eupithecia indigata (EN); Eupithecia innotata (EN); Eupithecia linariata (VU); Eupithecia plumbeolata (CR); Eupithecia subfuscata (VU); Eupithecia subumbrata (EN); Eupithecia succenturiata (VU); Eupithecia tenuiata (VU); Eupithecia tripunctaria (VU); Euxoa cursoria (EN); Euxoa tritici (VU); Gluphisia crenata (VU); Gortyna flavago (VU); Harpyia milhauseri (VU); Heliothis viriplaca (VU); Hepialus humuli (VU); Horisme vitalbata (EN); Hyles gallii (EN); Idaea emarginata (VU); Idaea muricata (VU); Idaea straminata (VU); Ipimorpha subtusa (VU); Lacanobia contigua (EN); Lasiocampa trifolii (VU); Laspeyria flexula (EN); Leucania obsoleta (VU); Leucoma salicis (VU); Litoligia literosa (VU); Lobophora halterata (EN); Longalatedes elymi (VU); Lycia hirtaria (EN); Meganola albula (VU); Miltochrista miniata (VU); Mythimna litoralis (EN); Mythimna pudorina (VU); Nola aerugula (VU); Nola confusalis (VU); Nola cucullatella (EN); Notodonta tritophus (VU); Odontopera bidentata (VU); Orthosia gracilis (VU); Panolis flammea (VU); Pareulype berberata (EN); Pelurga comitata (VU); Pennithera firmata (VU); Perizoma flavofasciata (VU); Philereme transversata (EN); Photedes extrema (EN); Photedes fluxa (EN); Phytometra viridaria (CR); Polia nebulosa (EN); Polymixis lichenea (EN); Rhodostrophia vibicaria (EN); Scopula marginepunctata (VU); Scopula nigropunctata (EN); Sideridis reticulata (EN); Sideridis turbida (EN); Tethea or (VU); Thalpophila matura (VU); Tholera cespitis (EN); Tholera decimalis (VU); Trichopteryx carpinata (VU); Watsonalla cultraria (VU); Xestia baja (VU)*

Endangered species not seen in the last 10 years at least 10 times

- Butterflies: No species
- Moths: *Apamea anceps (EN); Epirrhoe rivata (VU); Eulithis mellinata (VU)*

Population (%) of butterfly species inside IBMA

Argynnis niobe (21-30%); Argynnis paphia (41-50%); Hipparchia semele (1-10%); Issoria lathonia (11-20%); Pyrgus malvae (21-30%); Satyrium ilicis (11-20%)



15 - Kootwijkerzand

ILA Criteria: Aii,Bii (Butterflies)

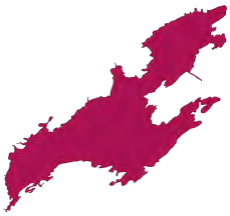
- Aii: Site contains one or more regionally threatened species
- Bii: Site contains a high number of species of high conservation importance

Area: 205 ha

Description:

Kootwijkerzand is one of the largest drift sand areas in the Netherlands. Because of the drift there is an extreme microclimate in the pioneer vegetation, alternated with an open heathland.

15 - Kootwijkerzand



Endangered species seen in the last 10 years at least 10 times

- Butterflies: *Hesperia comma (EN); Hipparchia semele (VU); Hipparchia statilinus (CR)*

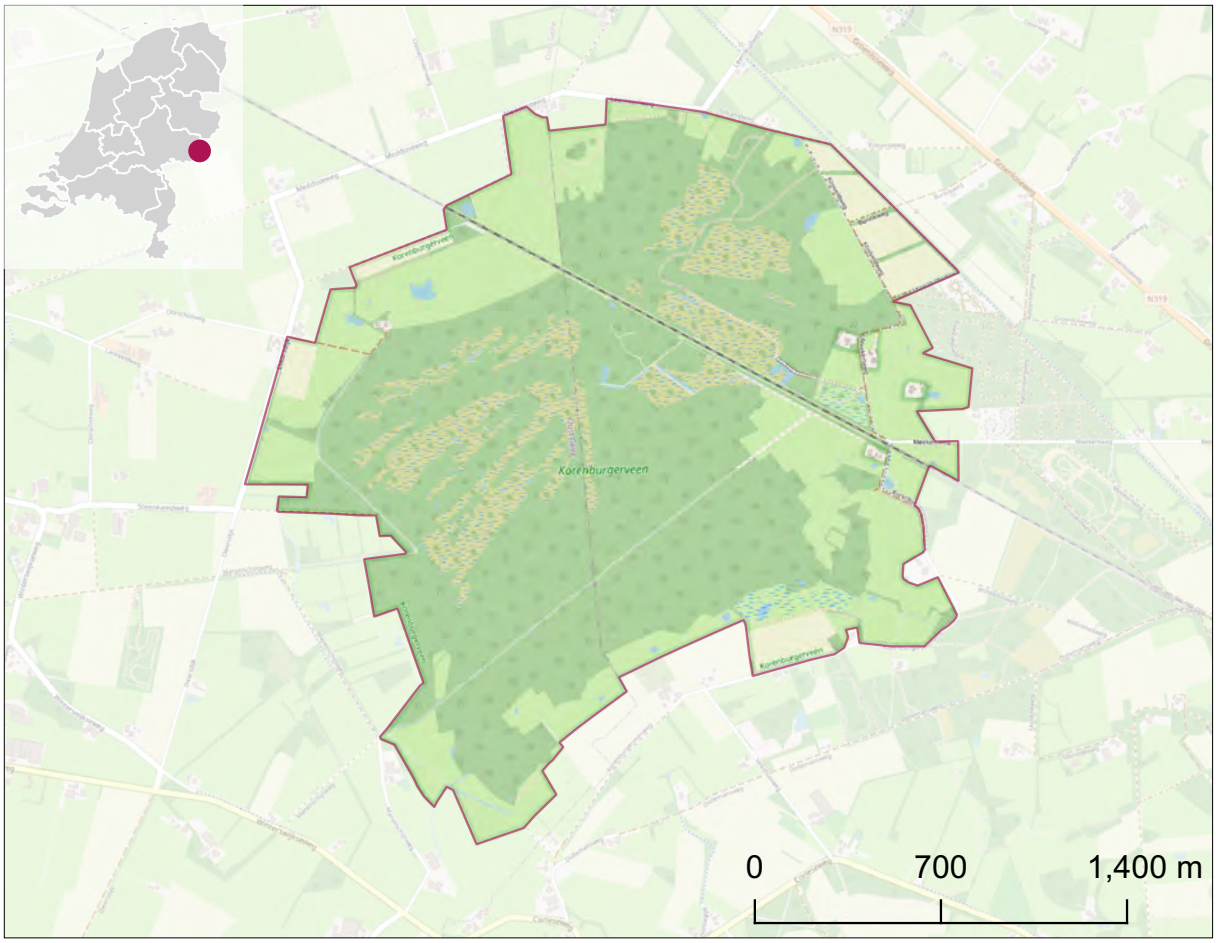
- Moths: No species

Endangered species not seen in the last 10 years at least 10 times

- Butterflies: Lycaena tityrus (VU)
- Moths: No species

Population (%) of butterfly species inside IBMA

Hesperia comma (1-10%); Hipparchia semele (21-30%); Hipparchia statilinus (91-100%); Lycaena tyrus (1-10%)



16 - Korenburgerveen

ILA Criteria: Biii (Butterflies); Aii,Bii (Moths)

- Aii: Site contains one or more regionally threatened species
- Bii: Site contains a high number of species of high conservation importance
- Biii: Site contains an exceptional number of species

Area: 461 ha

Description:

Korenburgerveen, near Winterswijk, is a unique raised moor area in the Netherlands. There are fens, moist fen meadows, swamp forest and moist heath.

16 - Korenburgerveen

Endangered species seen in the last 10 years at least 10 times

- Butterflies: *Aricia agestis (NT); Issoria lathonia (VU); Limenitis camilla (VU); Nymphalis polychloros (VU); Plebejus argus (VU); Thymelicus sylvestris (EN)*

- Moths: *Aethalura punctulata (EN); Archiearis parthenias (VU); Deltote uncula (EN); Diacrisia sannio (VU); Ennomos erosaria (EN); Eulithis testata (VU); Falcaria lacertinaria (VU); Idaea muricata (VU); Lycophotia porphyrea (VU); Miltochrista miniata (VU); Nola aerugula (VU); Pterapherapteryx sexalata (EN)*

Endangered species not seen in the last 10 years at least 10 times

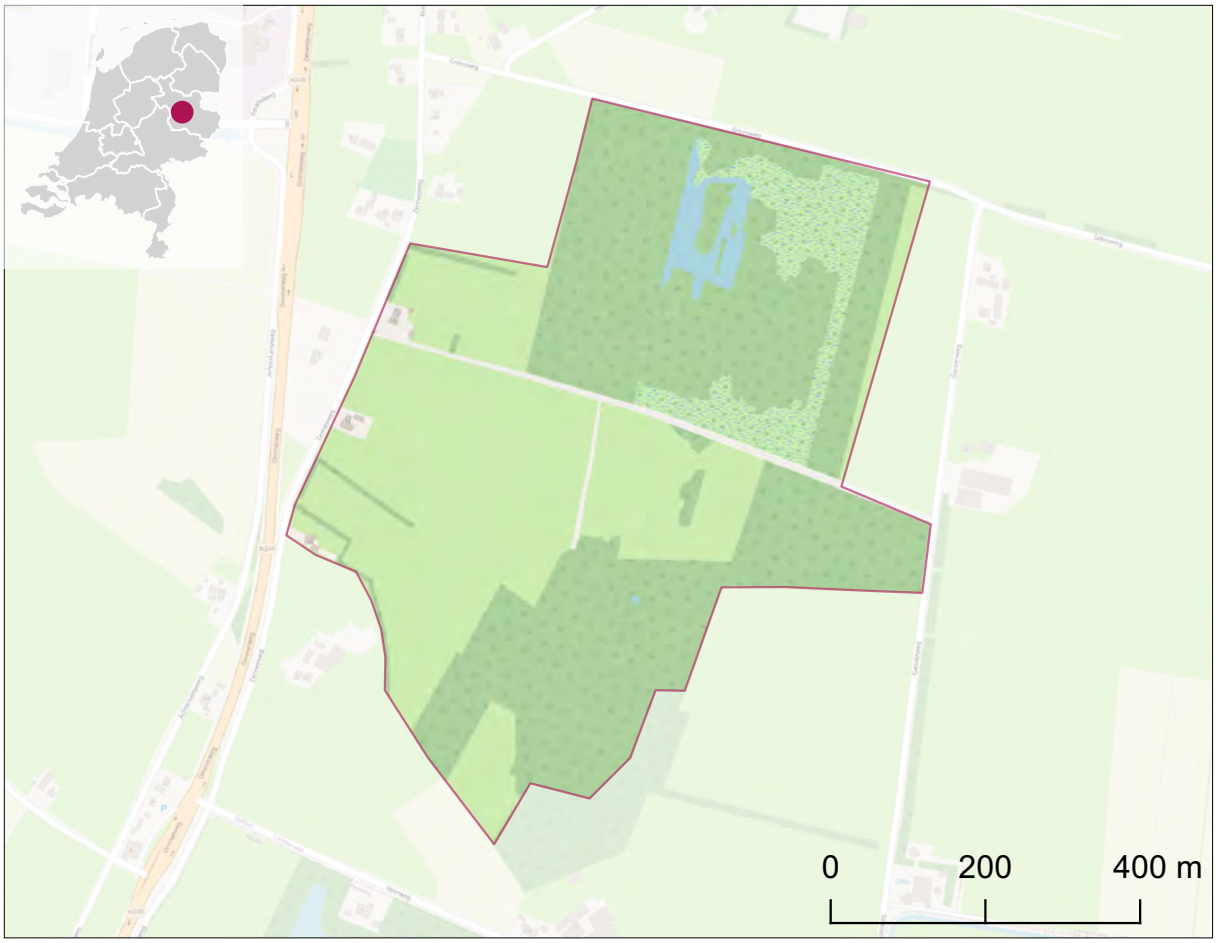
- Butterflies: *Boloria selene (EN)*

- Moths: *Cyclophora albipunctata (VU); Cyclophora pendularia (CR); Diarsia mendica (VU); Drymonia ruficornis (VU); Electrophaes corylata (VU); Ennomos alniaria (VU); Euchoeca nebulata (VU); Globia sparganii (VU); Ipimorpha retusa (EN); Mesoleuca albicillata (VU); Orthonama vittata (VU); Tethea or (VU); Trichiura crataegi (VU)*

Population (%) of butterfly species inside IBMA

Apatura iris (1-10%); Boloria selene (1-10%); Callophrys rubi (1-10%); Carterocephalus palaemon (1-10%); Issoria lathonia (1-10%); Limenitis camilla (1-10%); Plebejus argus (1-10%); Thymelicus sylvestris (1-10%)

An overview of the Korenburgerveen's peat bog, which is the habitat of many specialist *Lepidoptera* species.



17 - Luttebergerven

ILA Criteria: Bi,Biii (Butterflies)

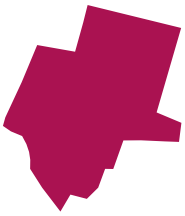
- Bi: Site contains a high number of species within a defined habitat
- Biii: Site contains an exceptional number of species

Area: 47 ha

Description:

This is one of the largest remaining areas of fen meadows in the Netherlands. It is unique in its combination of butterfly species, once often widespread and common, but now this combination can only still be found at this place.

17 - Luttebergerven



Endangered species seen in the last 10 years at least 10 times

- Butterflies: *Aricia agestis (NT); Boloria selene (EN); Phengaris alcon (EN); Pyrgus malvae (EN)*

- Moths: No species

Endangered species not seen in the last 10 years at least 10 times

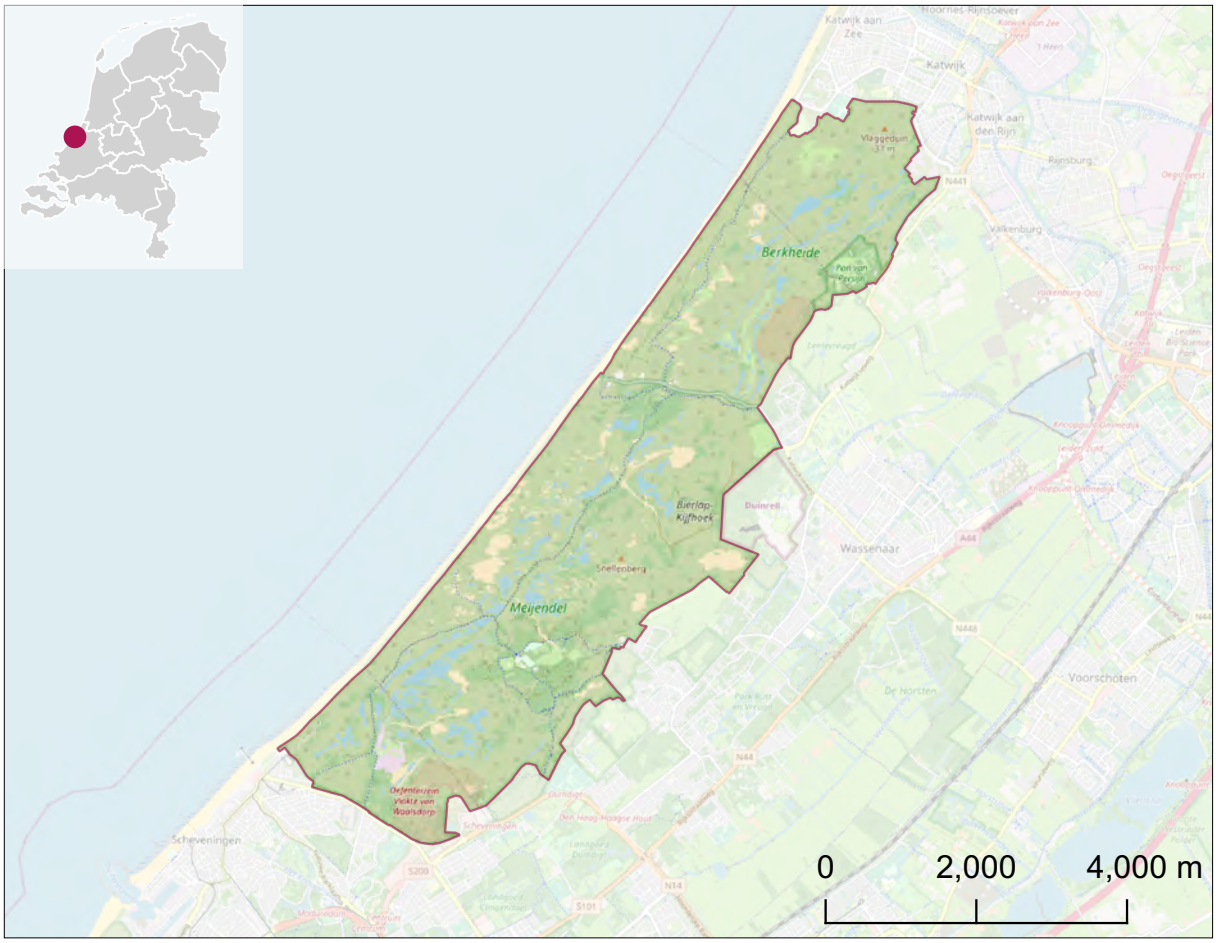
- Butterflies: *Thymelicus sylvestris (EN)*

- Moths: No species

Population (%) of butterfly species inside IBMA

Boloria selene (1-10%); Callophrys rubi (1-10%); Phengaris alcon (1-10%); Pyrgus malvae (1-10%)

The combination of *Phengaris alcon* (top-left), *Boloria selene* (top-rigth) and *Pyrgus malvae* (bottom) makes of Luttebergerven a unique area for butterflies



18 - Meijendel & Berkheide

ILA Criteria: Biii (Butterflies); Aii,Bii (Moths)

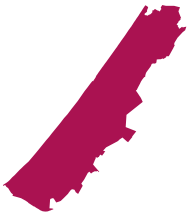
- Aii: Site contains one or more regionally threatened species
- Bii: Site contains a high number of species of high conservation importance
- Biii: Site contains an exceptional number of species

Area: 2681 ha

Description:

A varied and extensive, calcareous, coastal dune landscape with differences in relief throughout the area. In terms of habitat, it is also varied between dune valleys, grasslands and forest

18 - Meijendel & Berkheide

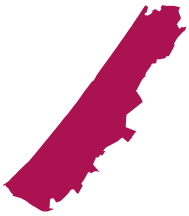


Endangered species seen in the last 10 years at least 10 times

- Butterflies: *Aricia agestis (NT); Hipparchia semele (VU); Issoria lathonia (VU); Nymphalis polychloros (VU); Pyronia tithonus (NT)*

- Moths: *Achlya flavicornis (VU); Acronicta aceris (VU); Acronicta auricoma (VU); Acronicta psi (VU); Actebia praecox (CR); Actinotia polyodon (VU); Agrochola helvola (EN); Agrotis cinerea (CR); Agrotis ripae (VU); Agrotis vestigialis (VU); Ammoconia caecimacula (CR); Amphipoea oculea (EN); Apamea anceps (EN); Apamea sublustris (EN); Apeira syringaria (VU); Aporophyla lutulenta (CR); Autographa jota (EN); Biston strataria (VU); Calophasia lunula (EN); Cerastis rubricosa (VU); Cerura vinula (VU); Charanyca ferruginea (VU); Cilix glaucata (EN); Clostera pigra (EN); Coenobia rufa (VU); Coscinia cribraria (EN); Cosmia affinis (VU); Cosmia pyralina (VU); Cosmorhoe ocellata (VU); Cucullia absinthii (EN); Cucullia chamomillae (EN); Cybosia mesomella (VU); Deilephila porcellus (VU); Diarsia brunnea (VU); Diarsia mendica (VU); Diloba caeruleocephala (EN); Earophila badiata (EN); Eilema pygmaeola (EN); Electrophaes corylata (VU); Ennomos alniaria (VU); Euchoeca nebulata (VU); Eulithis mellinata (VU); Eupithecia assimilata (VU); Eupithecia haworthiata (EN); Eupithecia innotata (EN); Eupithecia linariata (VU); Eupithecia subfuscata (VU); Eupithecia subumbrata (EN); Eupithecia tantillaria (VU); Eupithecia tenuiata (VU); Eupithecia tripunctaria (VU); Eupithecia virgaureata (VU); Euxoa cursoria (EN); Euxoa tritici (VU); Gluphisia crenata (VU); Gortyna flavago (VU); Harpyia milhauseri (VU); Hecatera bicolorata (VU); Heliothis viriplaca (VU); Hemistola chrysoprasaria (EN); Hepialus humuli (VU); Horisme vitalbata (EN); Hydria cervinalis (EN); Hyles gallii (EN); Idaea emarginata (VU); Idaea muricata (VU); Idaea straminata (VU); Ipimorpha subtusa (VU); Lacanobia contigua (EN); Lacanobia thalassina (VU); Lasiocampa trifolii (VU); Laspeyria flexula (EN); Lenisa geminipuncta (VU); Leucania obsoleta (VU); Leucoma salicis (VU); Litoligia literosa (VU); Lobophora halterata (EN); Longalatedes elymi (VU); Lycia hirtaria (EN); Macaria wauaria (VU); Meganola albula (VU); Miltochrista miniata (VU); Mythimna litoralis (EN); Mythimna pudorina (VU); Mythimna straminea (VU); Nola aerugula (VU); Nola confusalis (VU); Nola cucullatella (EN); Notodonta tritophus (VU); Ochropacha duplaris (VU); Panolis flammea (VU); Paranthrene tabaniformis (EN); Perizoma flavofasciata (VU); Philereme transversata (EN); Photedes extrema (EN); Photedes fluxa (EN); Phytometra viridaria (CR); Polia bombycina (CR); Polia nebulosa (EN); Rhodostrophia vibicaria (EN); Scopula marginepunctata (VU); Selenia lunularia (EN); Sesia apiformis (VU); Sideridis reticulata (EN); Sideridis turbida (EN); Tethea or (VU); Thalpophila matura (VU); Tholera cespitis (EN); Tholera decimalis (VU); Tiliacea aurago (VU); Trichopteryx carpinata (VU); Watsonalla cultraria (VU); Xanthorhoe quadrifasiata (EN); Xestia baja (VU); Zanclognatha lunalis (CR)*

Endangered species not seen in the last 10 years at least 10 times



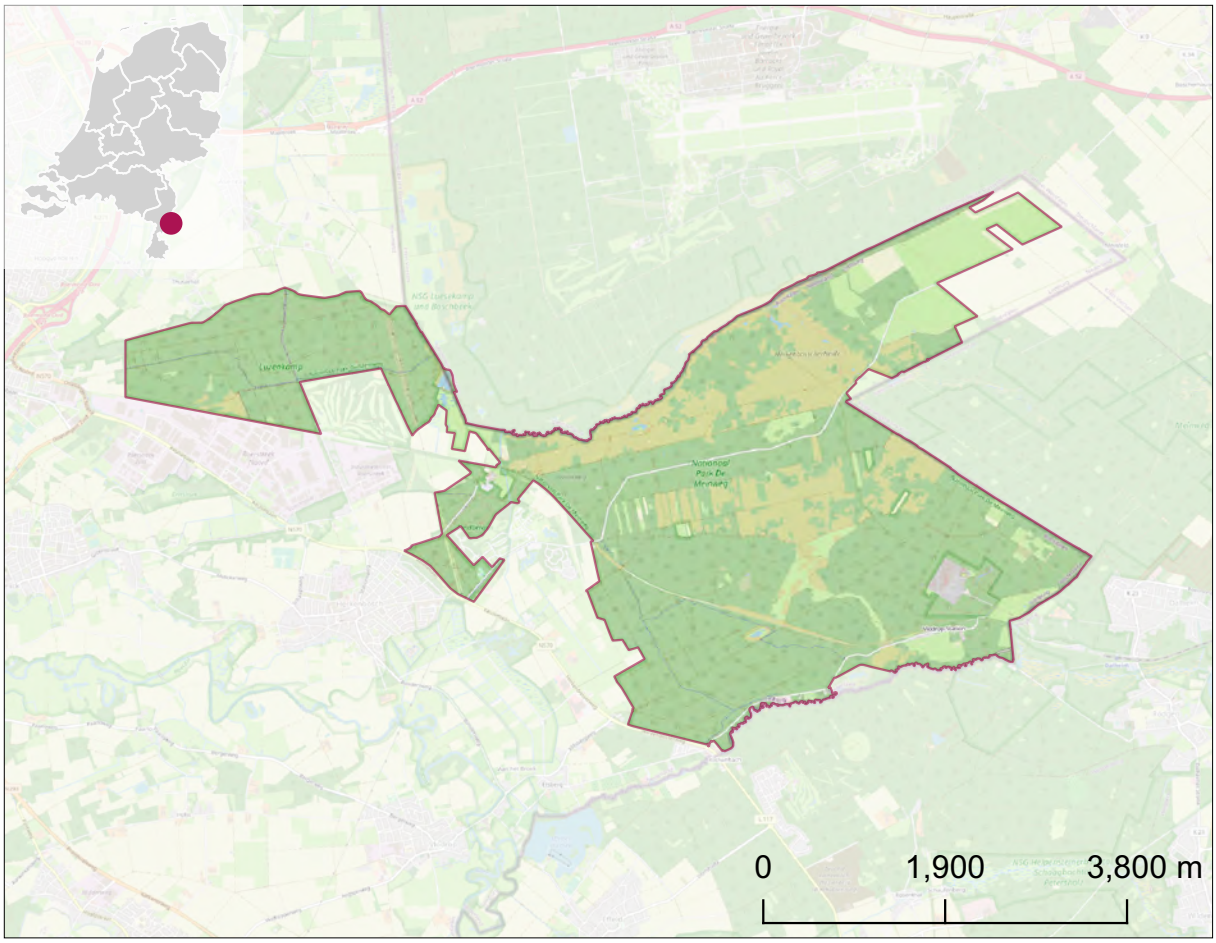
- Butterflies: No species

- Moths: *Abrostola tripartita (VU); Epirrhoe rivata (VU); Pareulype berberata (EN)*

Population (%) of butterfly species inside IBMA

Argynnis paphia (1-10%); Hipparchia semele (1-10%); Issoria lathonia (1-10%)

The coastal dunes of Meijendel & Berkheide provide habitat for a large number of butterflies and moths thanks to their mix of forest, grasslands and shrubs



19 - Meinweg

ILA Criteria: Biii (Butterflies); Aii,Bii,Biii (Moths)

- Aii: Site contains one or more regionally threatened species
- Bii: Site contains a high number of species of high conservation importance
- Biii: Site contains an exceptional number of species

Area: 2146 ha

Description:

Meinweg is located next to the German border and has a varying landscape from dry heathlands to swampy forests with a stream.

19 – Meinweg

Endangered species seen in the last 10 years at least 10 times

- Butterflies: *Aricia agestis (NT); Issoria lathonia (VU); Limenitis camilla (VU); Nymphalis polychloros (VU); Pyronia tithonus (NT); Thymelicus sylvestris (EN)*

- Moths: *Achlya flavicornis (VU); Acronicta auricoma (VU); Actinotia polyodon (VU); Aethalura punctulata (EN); Agrotis vestigialis (VU); Amphipoea oculea (EN); Archiearis parthenias (VU); Bena bicolorana (VU); Biston strataria (VU); Calamia tridens (VU); Callopistria juventina (RE); Ceramica pisi (VU); Cerastis rubricosa (VU); Charanyca ferruginea (VU); Clostera pigra (EN); Cosmorhoe ocellata (VU); Cucullia scrophulariae (EN); Cybosia mesomella (VU); Cyclophora albipunctata (VU); Deilephila porcellus (VU); Diarsia brunnea (VU); Diarsia mendica (VU); Drymonia dodonaea (EN); Drymonia ruficornis (VU); Enargia paleacea (EN); Endromis versicolora (EN); Epirrhoe tristata (VU); Euchoeca nebulata (VU); Eupithecia icterata (EN); Eupithecia indigata (EN); Eupithecia linariata (VU); Eupithecia nanata (VU); Eupithecia subfuscata (VU); Eupithecia tantillaria (VU); Eupithecia virgaureata (VU); Euxoa tritici (VU); Falcaria lacertinaria (VU); Furcula bicuspis (EN); Gluphisia crenata (VU); Harpyia milhauseri (VU); Hydrelia flammeolaria (VU); Idaea emarginata (VU); Idaea muricata (VU); Idaea straminata (VU); Lasiocampa trifolii (VU); Laspeyria flexula (EN); Leucodonta bicoloria (EN); Lycia hirtaria (EN); Lycophotia porphyrea (VU); Lymantria monacha (VU); Malacosoma neustria (VU); Meganola albula (VU); Miltochrista miniata (VU); Mythimna pudorina (VU); Nola aerugula (VU); Nola confusalis (VU); Nola cucullatella (EN); Ochropacha duplaris (VU); Odontopera bidentata (VU); Pachetra sagittigera (EN); Panolis flammea (VU); Paracolax tristalis (VU); Parascotia fuliginaria (VU); Parastichtis suspecta (VU); Pennithera firmata (VU); Perconia strigillaria (VU); Peribatodes secundaria (VU); Petrophora chlorosata (VU); Photedes fluxa (EN); Plagodis pulveraria (EN); Polia nebulosa (EN); Pseudoterpna pruinata (CR); Saturnia pavonia (VU); Scopula nigropunctata (EN); Stauropus fagi (VU); Synanthedon vespiformis (EN); Tethea or (VU); Tetheella fluctuosa (VU); Tholera decimalis (VU); Trichopteryx carpinata (VU); Watsonalla cultraria (VU); Xanthia icteritia (VU); Xestia baja (VU); Xestia sexstrigata (EN)*

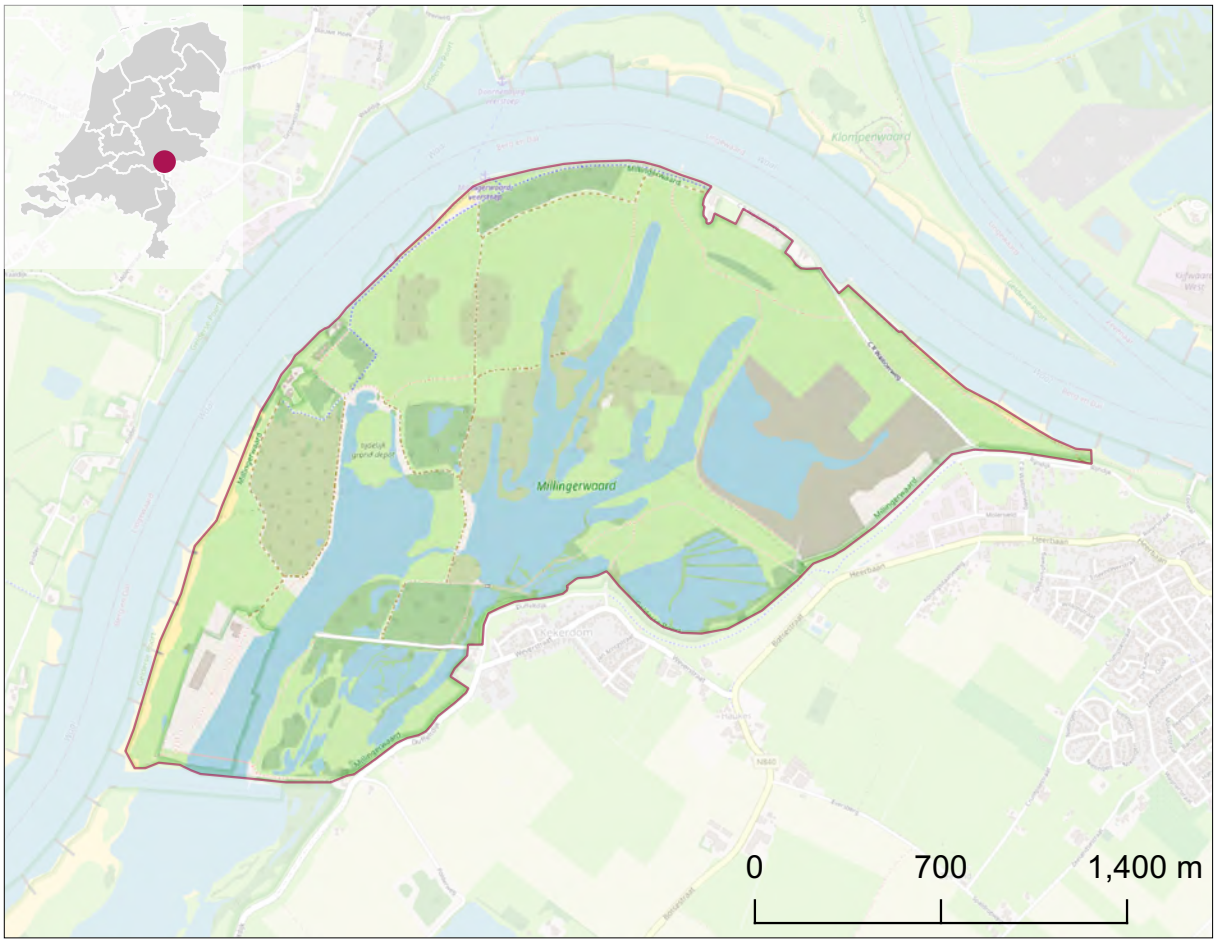
Endangered species not seen in the last 10 years at least 10 times

- Butterflies: *Hipparchia semele (VU); Satyrium ilicis (EN)*

- Moths: *Electrophaes corylata (VU); Eulithis testata (VU); Lacanobia thalassina (VU); Lithophane lamda (CR); Mythimna straminea (VU); Pterapherapteryx sexalata (EN); Thera britannica (VU)*

Population (%) of butterfly species inside IBMA

Callophrys rubi (1-10%); Issoria lathonia (1-10%); Thymelicus sylvestris (11-20%)



20 - Millingerwaard

ILA Criteria: Aii,Bii (Moths)

- Aii: Site contains one or more regionally threatened species
- Bii: Site contains a high number of species of high conservation importance

Area: 424 ha

Description:

Millingerwaard is a unique floodplain system with riparian forests, marshes, herb-rich grasslands, ponds and river dunes. Wild horses and cattle roam freely through the area.

20 – Millingerwaard

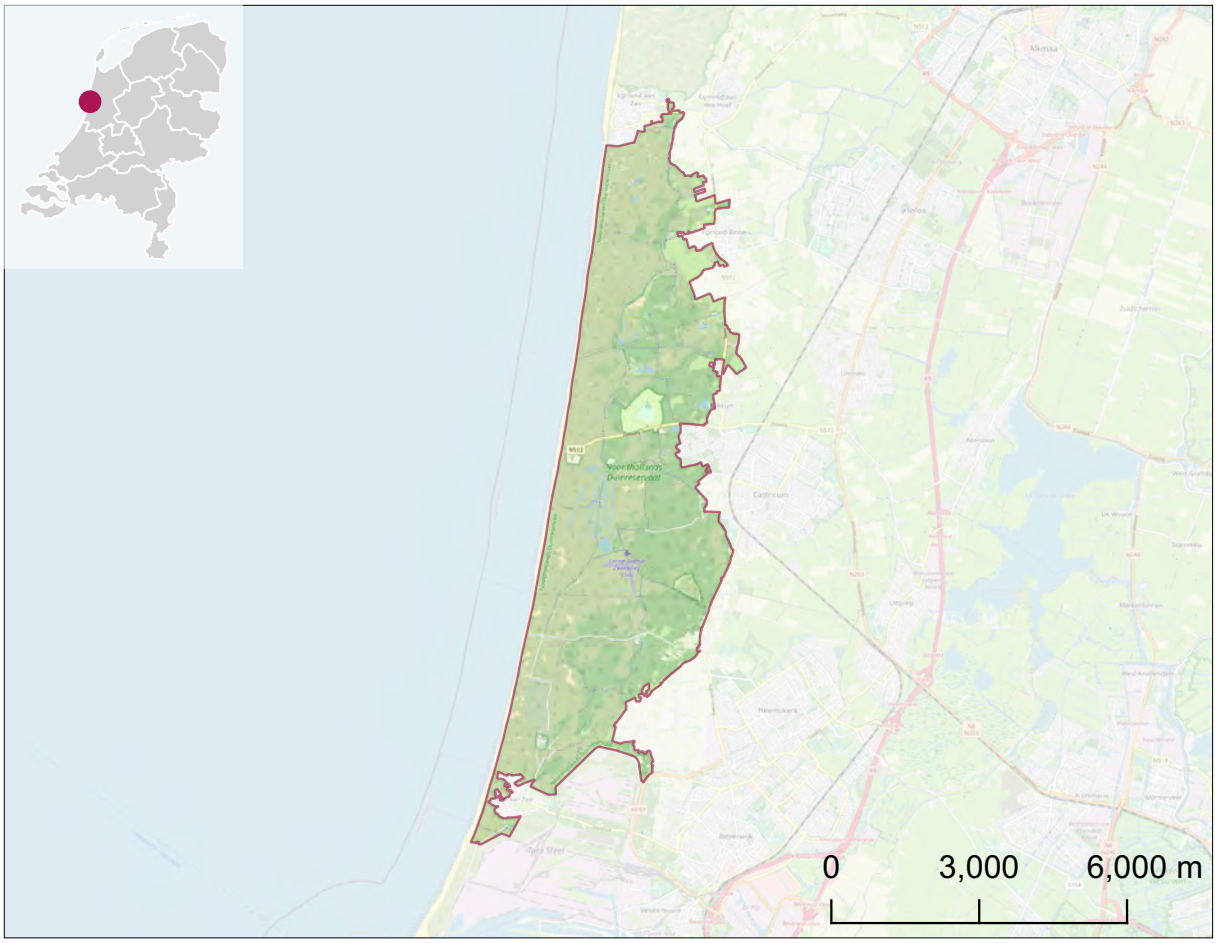
Endangered species seen in the last 10 years at least 10 times

- Butterflies: No species
- Moths: *Agrotis ripae (VU); Apamea scolopacina (VU); Chamaesphecia empiformis (CR); Charanyca ferruginea (VU); Cilix glaucata (EN); Cosmia pyralina (VU); Cosmorhoe ocellata (VU); Cucullia scrophulariae (EN); Deilephila porcellus (VU); Epirrhoe rivata (VU); Eupithecia haworthiata (EN); Eupithecia succenturiata (VU); Eupithecia tripunctaria (VU); Eupithecia virgaureata (VU); Euxoa tritici (VU); Gluphisia crenata (VU); Ipimorpha retusa (EN); Ipimorpha subtusa (VU); Laspeyria flexula (EN); Orthosia gracilis (VU); Perizoma flavofasciata (VU); Photedes fluxa (EN); Scopula nigropunctata (EN); Spilosoma urticae (VU)*

Endangered species not seen in the last 10 years at least 10 times

- Butterflies: No species
- Moths: *Eupithecia tenuiata (VU); Gortyna flavago (VU); Pterapherapteryx sexalata (EN)*

The mix of riparian forests, marshes, herb-rich grasslands, ponds and river dunes makes of Millingerwaard an ideal place for moths but also for other insects such as dragonflies



21 - Noordhollands Duinreservaat

ILA Criteria: Biii (Butterflies); Aii,Bii,Biii (Moths)

- Aii: Site contains one or more regionally threatened species
- Bii: Site contains a high number of species of high conservation importance
- Biii: Site contains an exceptional number of species

Area: 3708 ha

Description:

The Noordhollands Duinreservaat is a 20 kilometer long dune area to reclaim drinking water. In order to obtain good drinking water, the entire area is designed as a nature reserve with a wide variety of landscape, from pioneer vegetation to calcareous gray dunes and forests. This wide variety of vegetation result in a high moth diversity and many butterflies.

21 - Noordhollands Duinreservaat

Endangered species seen in the last 10 years at least 10 times

- Butterflies: *Argynnis niobe (EN); Aricia agestis (NT); Hesperia comma (EN); Hipparchia semele (VU); Issoria lathonia (VU); Nymphalis polychloros (VU); Satyrium ilicis (EN)*

- Moths: *Abrostola tripartita (VU); Achlya flavicornis (VU); Acronicta aceris (VU); Acronicta auricoma (VU); Acronicta psi (VU); Actebia praecox (CR); Actinotia polyodon (VU); Agrochola helvola (EN); Agrotis ripae (VU); Agrotis vestigialis (VU); Ammoconia caecimacula (CR); Amphipoea oculea (EN); Amphipyra tragopoginis (EN); Apamea anceps (EN); Apamea sublustris (EN); Apamea unanimis (VU); Apeira syringaria (VU); Aporophyla lutulenta (CR); Autographa jota (EN); Autographa pulchrina (EN); Biston strataria (VU); Calophasia lunula (EN); Cepphis advenaria (VU); Cerastis rubricosa (VU); Cerura vinula (VU); Charanyca ferruginea (VU); Chilodes maritima (VU); Cilix glaucata (EN); Cleorodes lichenaria (CR); Clostera pigra (EN); Coscinia cribraria (EN); Cosmia affinis (VU); Cosmorhoe ocellata (VU); Cucullia absinthii (EN); Cybosia mesomella (VU); Cyclophora albipunctata (VU); Cyclophora porata (EN); Deilephila porcellus (VU); Diacrisia sannio (VU); Diarsia brunnea (VU); Diarsia mendica (VU); Diloba caeruleocephala (EN); Drymonia ruficornis (VU); Earophila badiata (EN); Eilema pygmaeola (EN); Electrophaes corylata (VU); Ennomos alniaria (VU); Eulithis mellinata (VU); Eulithis testata (VU); Eupithecia assimilata (VU); Eupithecia icterata (EN); Eupithecia indigata (EN); Eupithecia innotata (EN); Eupithecia linariata (VU); Eupithecia plumbeolata (CR); Eupithecia subfuscata (VU); Eupithecia subumbrata (EN); Eupithecia tantillaria (VU); Eupithecia tenuiata (VU); Eupithecia tripunctaria (VU); Eupithecia virgaureata (VU); Euxoa cursoria (EN); Euxoa tritici (VU); Falcaria lacertinaria (VU); Gluphisia crenata (VU); Gortyna flavago (VU); Harpyia milhauseri (VU); Hecatera bicolorata (VU); Heliothis viriplaca (VU); Hepialus humuli (VU); Hydria cervinalis (EN); Hyles gallii (EN); Idaea emarginata (VU); Idaea muricata (VU); Idaea straminata (VU); Ipimorpha retusa (EN); Ipimorpha subtusa (VU); Lacanobia contigua (EN); Lacanobia thalassina (VU); Lasiocampa trifolii (VU); Laspeyria flexula (EN); Lenisa geminipuncta (VU); Leucoma salicis (VU); Litoligia literosa (VU); Lobophora halterata (EN); Longalatedes elymi (VU); Meganola albula (VU); Miltochrista miniata (VU); Mythimna conigera (EN); Mythimna litoralis (EN); Mythimna pudorina (VU); Mythimna straminea (VU); Nola aerugula (VU); Nola confusalis (VU); Nola cucullatella (EN); Nonagria typhae (VU); Notodonta tritophus (VU); Ochropacha duplaris (VU); Odontopera bidentata (VU); Orthosia gracilis (VU); Orthosia populeti (VU); Panolis flammea (VU); Paranthrene tabaniformis (EN); Parascotia fuliginaria (VU); Pareulype berberata (EN); Pelurga comitata (VU); Pennithera firmata (VU); Perizoma flavofasciata (VU); Philereme transversata (EN); Photedes extrema (EN); Photedes fluxa (EN); Phytometra viridaria (CR); Polia nebulosa (EN); Polymixis lichenea (EN); Rhodostrophia vibicaria (EN); Scopula marginepunctata (VU); Scopula nigropunctata (EN); Selidosema brunnearia (EN); Sesia apiformis (VU); Sideridis reticulata (EN); Sideridis turbida (EN); Stauropus fagi (VU); Tethea or (VU); Thalpophila matura (VU); Tholera cespitis (EN); Tholera decimalis (VU); Tiliacea aurago (VU); Trichopteryx carpinata (VU); Watsonalla cultraria (VU); Xanthia icteritia (VU); Xanthorhoe quadrifasiata (EN); Xestia baja (VU); Xestia sexstrigata (EN); Xylena vetusta (CR)*

Endangered species not seen in the last 10 years at least 10 times

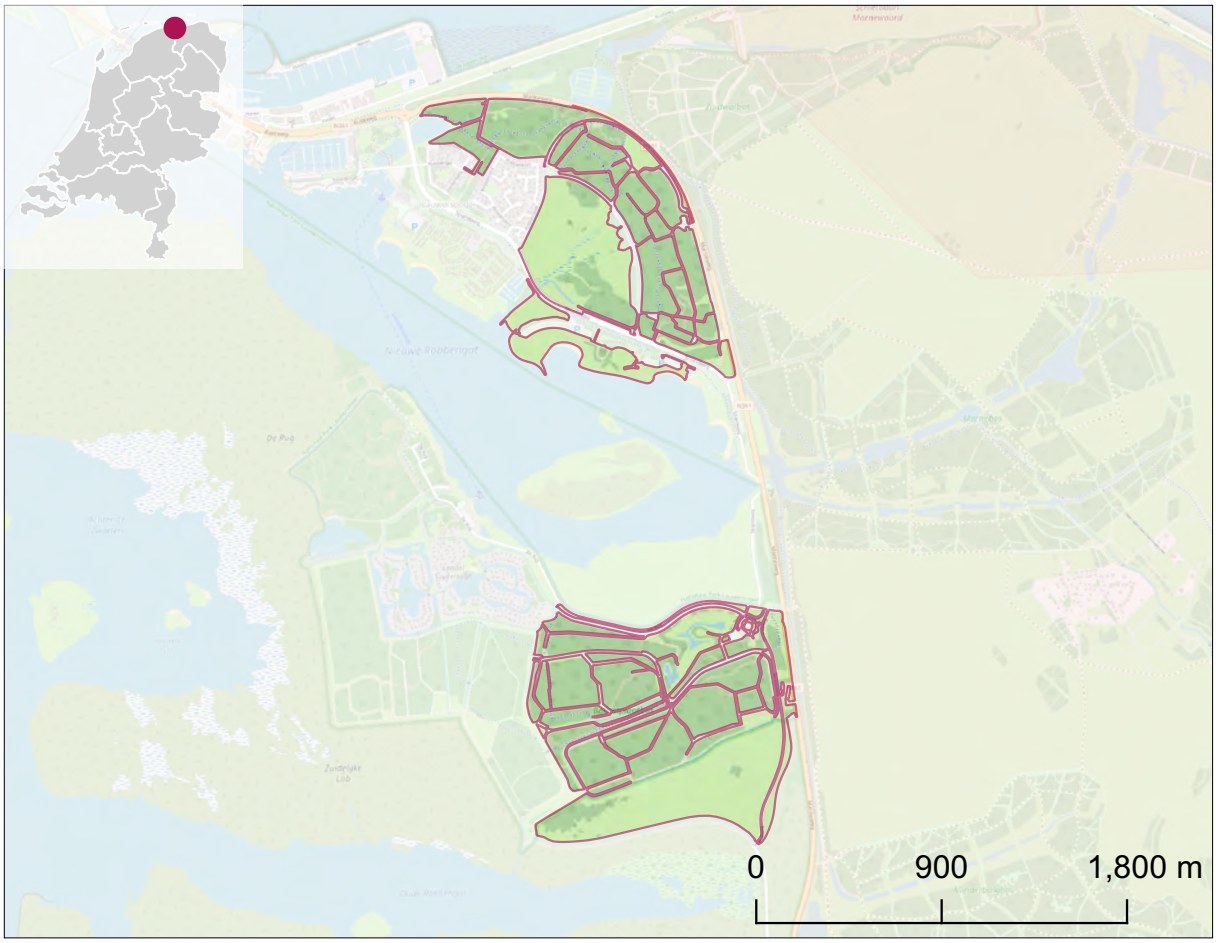
- Butterflies: *Thymelicus sylvestris (EN)*

- Moths: *Agrotis cinerea (CR); Archiearis parthenias (VU); Epirrhoe rivata (VU); Euxoa nigricans (EN); Globia sparganii (VU); Leucania obsoleta (VU); Scotopteryx chenopodiata (VU)*

Population (%) of butterfly species inside IBMA

Argynnis niobe (21-30%); Argynnis paphia (1-10%); Hesperia comma (11-20%); Hipparchia semele (1-10%); Issoria lathonia (1-10%); Satyrium ilicis (11-20%)

The large dune area of the nature reserve in Noordhollands Duinreservaat have a wide variety of habitats which result in a very high diversity of both butterflies and moths



22 - North eastern Lauwersmeer

ILA Criteria: Aii,Bii (Moths)

- Aii: Site contains one or more regionally threatened species
- Bii: Site contains a high number of species of high conservation importance

Area: 203 ha

Description:

Wet grassland area with many orchids. It is in a former estuary, after the building of a dam slowly changing to a vegetation based on sweet water.

22 - North eastern Lauwersmeer

Endangered species seen in the last 10 years at least 10 times

- Butterflies: No species

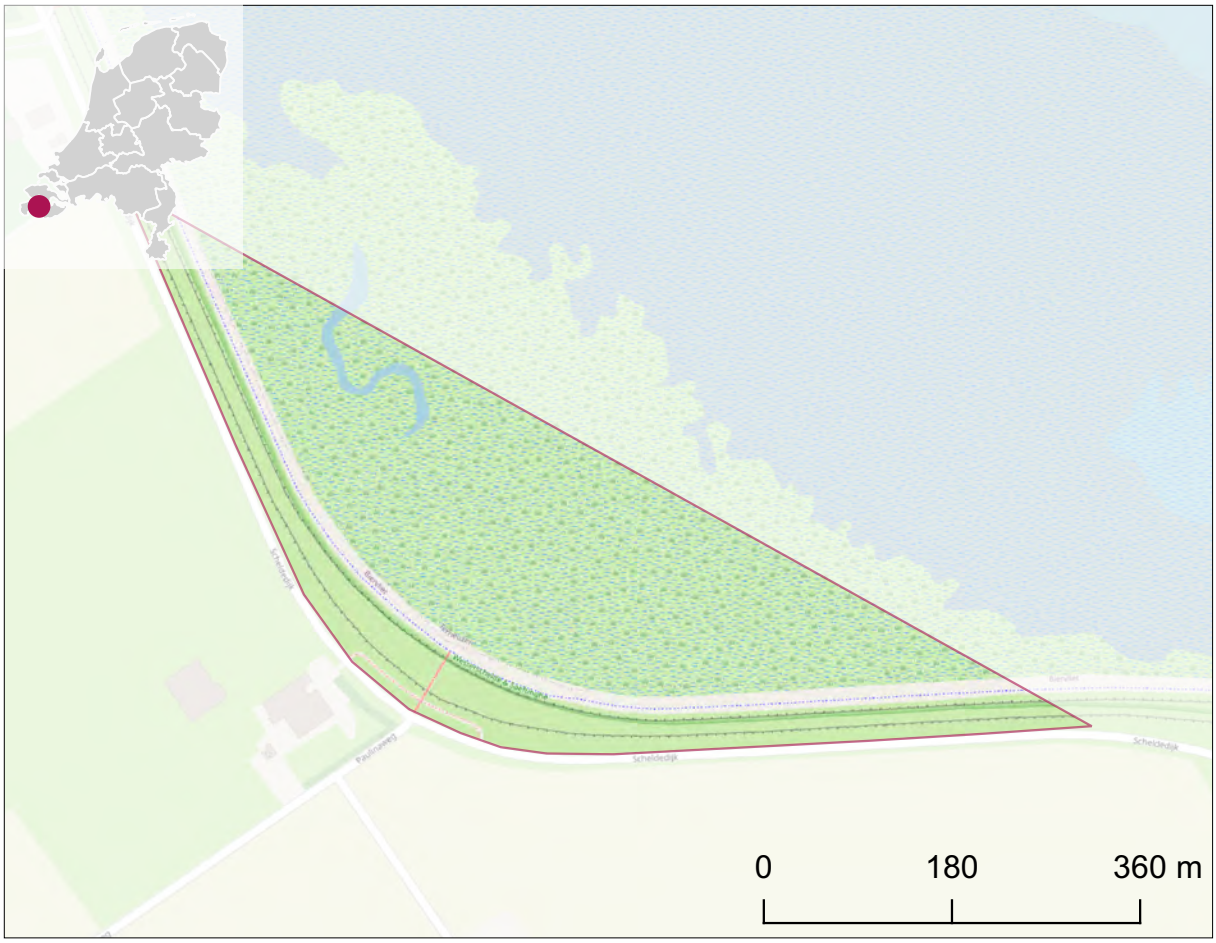
- Moths: *Acronicta aceris (VU); Agrotis vestigialis (VU); Amphipoea fucosa (VU); Anaplectoides prasina (EN); Archanara dissoluta (EN); Cerura vinula (VU); Charanyca ferruginea (VU); Chilodes maritima (VU); Cilix glaucata (EN); Clostera pigra (EN); Cyclophora albipunctata (VU); Diarsia brunnea (VU); Diarsia mendica (VU); Ennomos alniaria (VU); Euchoeca nebulata (VU); Eulithis testata (VU); Eupithecia exiguata (CR); Eupithecia innotata (EN); Eupithecia subfuscata (VU); Eupithecia tantillaria (VU); Eupithecia tenuiata (VU); Eupithecia tripunctaria (VU); Falcaria lacertinaria (VU); Furcula bifida (EN); Gluphisia crenata (VU); Gortyna flavago (VU); Hada plebeja (VU); Hecatera bicolorata (VU); Hepialus humuli (VU); Hydrelia flammeolaria (VU); Hydria undulata (VU); Idaea emarginata (VU); Ipimorpha subtusa (VU); Lacanobia w-latinum (VU); Laspeyria flexula (EN); Leucania obsoleta (VU); Leucoma salicis (VU); Lobophora halterata (EN); Macaria signaria (EN); Malacosoma neustria (VU); Meganola albula (VU); Mythimna straminea (VU); Nola aerugula (VU); Nola confusalis (VU); Notodonta tritophus (VU); Ochropacha duplaris (VU); Odontopera bidentata (VU); Perizoma flavofasciata (VU); Photedes extrema (EN); Photedes fluxa (EN); Pyrrhia umbra (VU); Stauropus fagi (VU); Tethea or (VU); Tetheella fluctuosa (VU); Thalpophila matura (VU); Xanthia icteritia (VU)*

Endangered species not seen in the last 10 years at least 10 times

- Butterflies: No species

- Moths: *Aethalura punctulata (EN); Epirrhoe rivata (VU); Helotropha leucostigma (VU); Ipimorpha retusa (EN); Lymantria monacha (VU); Orthonama vittata (VU); Parastichtis suspecta (VU); Senta flammea (EN); Simyra albovenosa (VU); Xestia sexstrigata (EN)*

***Clostera pigra* is one of the many moth species which can be found in the Nord-East of the Lauwersmeer area**



23 - Paulinaschor

ILA Criteria: Aii,Bii (Moths)

- Aii: Site contains one or more regionally threatened species
- Bii: Site contains a high number of species of high conservation importance

Area: 19 ha

Description:

Paulinaschor is a salt marsh with mud flats and associated flora. In order to protect the inland, there is an herb-rich dike along with Malva and Dipsacus.

23 - Paulinaschor

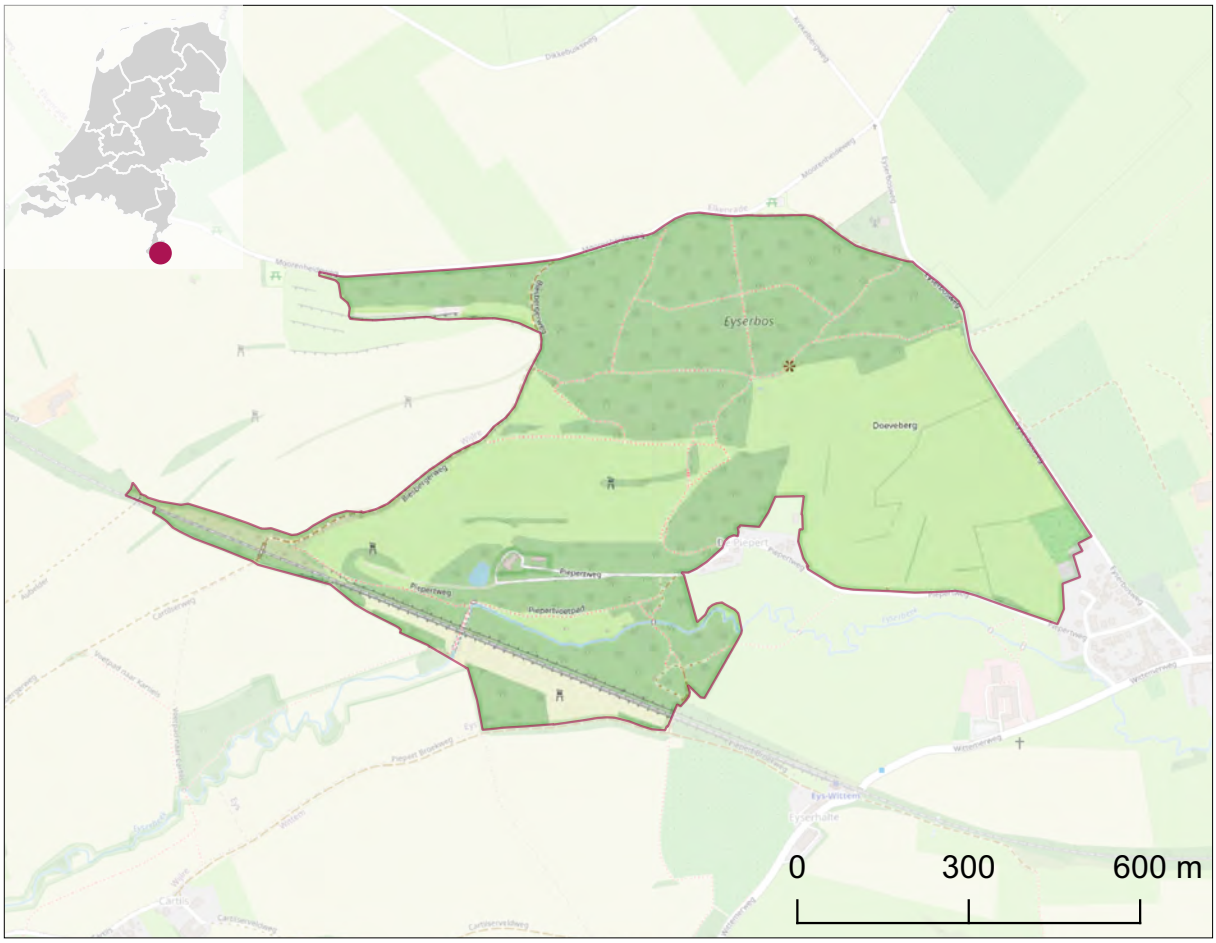
Endangered species seen in the last 10 years at least 10 times

- Butterflies: No species
- Moths: *Eremobia ochroleuca (RE)*

Endangered species not seen in the last 10 years at least 10 times

- Butterflies: No species
- Moths: No species

The very threatened moth species *Eremobia ochroleuca* has been observed several times in Paulinaschor



24 - Piepert

ILA Criteria: Aii,Bii,Biii (Butterflies); Aii,Bii (Moths)

- Aii: Site contains one or more regionally threatened species
- Bii: Site contains a high number of species of high conservation importance
- Biii: Site contains an exceptional number of species

Area: 75 ha

Description:

This area consists of dry flowerricht grasslands, small calcareous grasslands, a rough wet area as well as a nice open woodland, making it one of the best sites for butterflies in the South of Limburg.

24 - Piepert

Endangered species seen in the last 10 years at least 10 times

- Butterflies: *Aricia agestis (NT); Carcharodus alceae (NT); Cyaniris semiargus (CR); Erynnis tages (CR); Issoria lathonia (VU); Leptidea sinapis (EN); Melitaea cinxia (CR); Pyronia tithonus (NT); Thecla betulae (EN); Thymelicus sylvestris (EN)*

- Moths: *Cucullia scrophulariae (EN); Cyclophora annularia (CR); Ennomos fuscantaria (EN); Eupithecia haworthiata (EN); Eupithecia tripunctaria (VU); Eupithecia venosata (EN); Eupithecia virgaureata (VU); Hadena perplexa (CR); Hemistola chrysoprasaria (EN); Horisme vitalbata (EN); Laspeyria flexula (EN); Lygephila pastinum (CR); Miltochrista miniata (VU); Perizoma flavofasciata (VU); Scopula nigropunctata (EN); Scotopteryx chenopodiata (VU); Sideridis rivularis (VU); Triphosa dubitata (CR); Watsonalla cultraria (VU)*

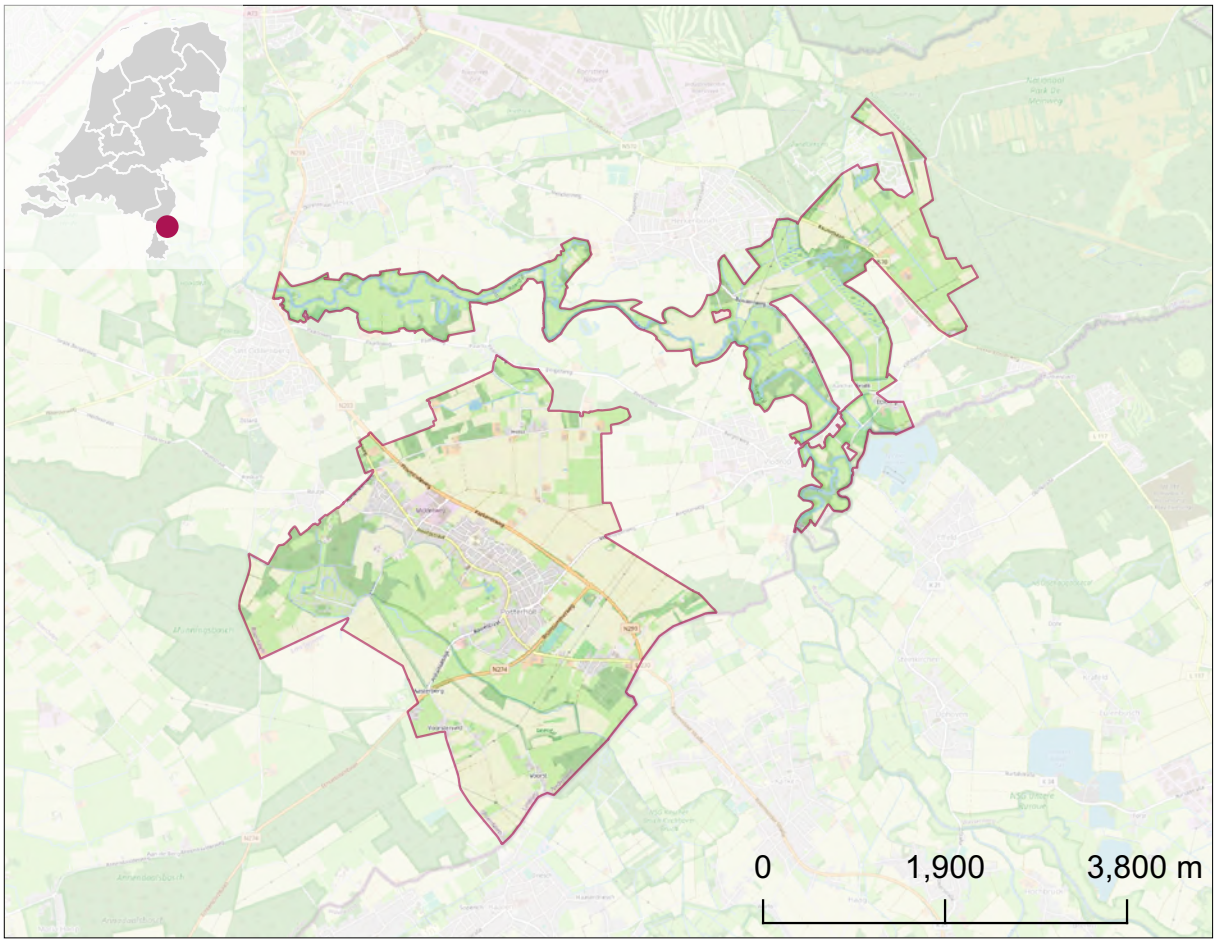
Endangered species not seen in the last 10 years at least 10 times

- Butterflies: Speyeria aglaja (CR)

- Moths: *Cosmorhoe ocellata (VU)*

Population (%) of butterfly species inside IBMA

Apatura iris (1-10%); Argynnis paphia (1-10%); Carcharodus alceae (1-10%); Cyaniris semiargus (1-10%); Erynnis tages (11-20%); Issoria lathonia (1-10%); Leptidea sinapis (1-10%); Thecla betulae (1-10%); Thymelicus sylvestris (1-10%)



25 - Roerdal & Posterholt

ILA Criteria: Aii,Bii,Biii (Butterflies); Aii,Bii (Moths)

- Aii: Site contains one or more regionally threatened species
- Bii: Site contains a high number of species of high conservation importance
- Biii: Site contains an exceptional number of species

Area: 1822 ha

Description:

Wet grasslands and road verges offering room to one of the most threatened Dutch butterflies.

25 - Roerdal & Posterholt

Endangered species seen in the last 10 years at least 10 times

- Butterflies: *Aricia agestis (NT); Issoria lathonia (VU); Limenitis camilla (VU); Nymphalis polychloros (VU); Phengaris nausithous (CR); Pyronia tithonus (NT); Thymelicus sylvestris (EN)*

- Moths: *Miltochrista miniata (VU); Sesia apiformis (VU)*

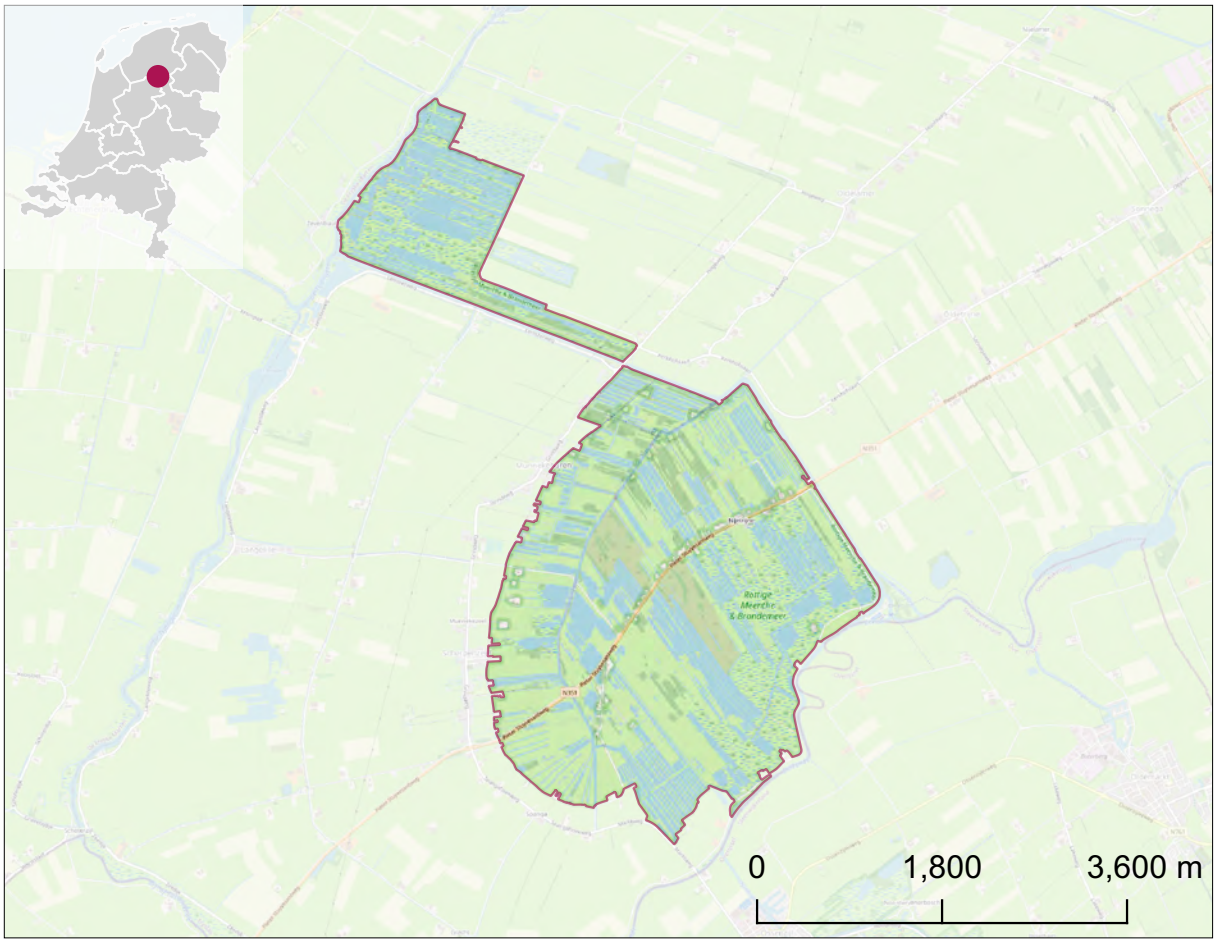
Endangered species not seen in the last 10 years at least 10 times

- Butterflies: No species

- Moths: *Biston strataria (VU); Caradrina clavipalpis (VU); Idaea straminata (VU); Laspeyria flexula (EN); Tiliacea aurago (VU)*

Population (%) of butterfly species inside IBMA

Callophrys rubi (1-10%); Issoria lathonia (1-10%); Limenitis camilla (1-10%); Phengaris nausithous (91-100%); Thymelicus sylvestris (11-20%)



26 - Rottige Meenthe & Brandemeer

ILA Criteria: Ai,Bii (Butterflies)

- Ai: Site contains one or more globally threatened species
- Bii: Site contains a high number of species of high conservation importance

Area: 1366 ha

Description:

Wetlands consisting of humid grasslands, reed and wet woodlands, and an important population of the Dutch subspecies of *Lycaena dispar*.

26 - Rottige Meenthe & Brandemeer

Endangered species seen in the last 10 years at least 10 times

- Butterflies: *Boloria selene (EN); Lycaena dispar (CR); Pyronia tithonus (NT)*
- Moths: No species

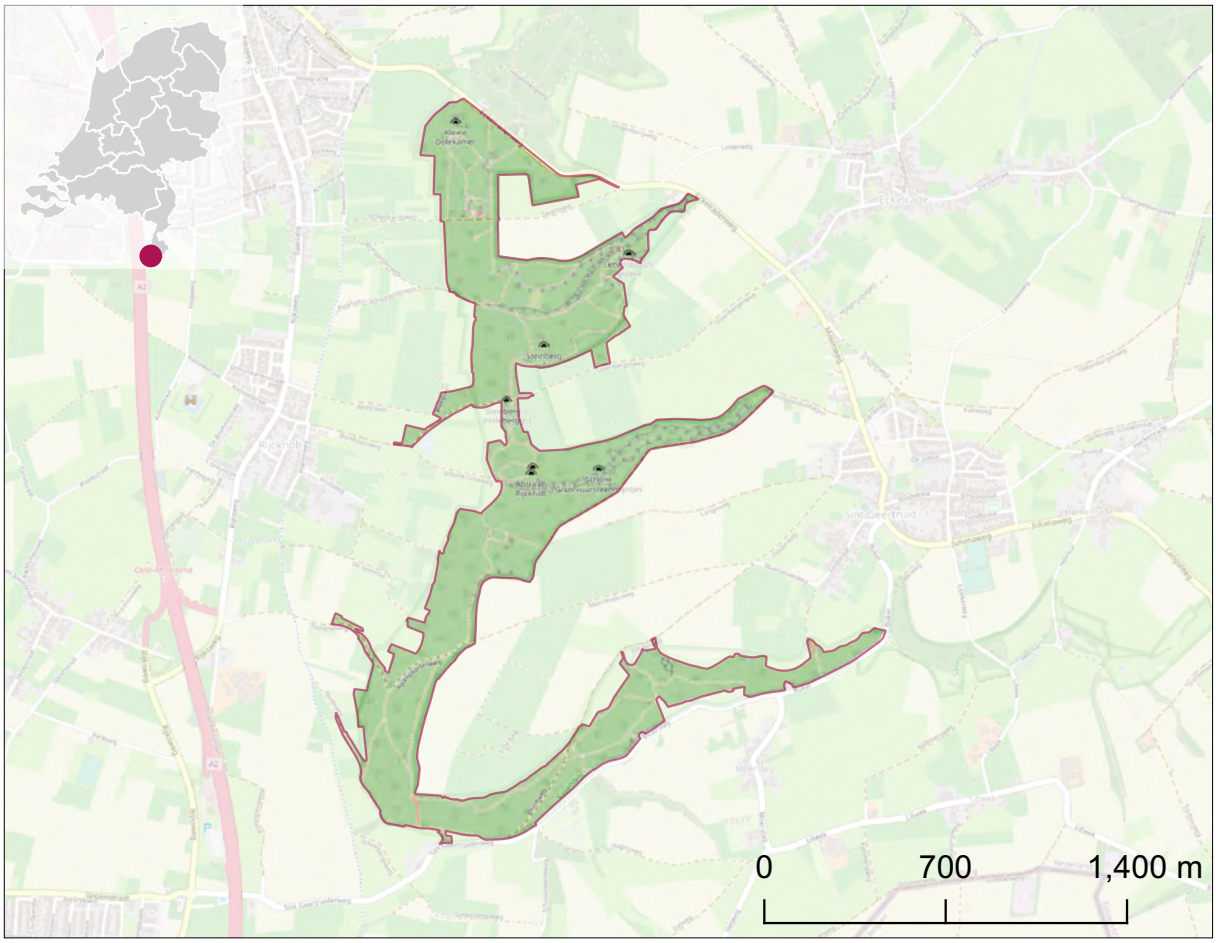
Endangered species not seen in the last 10 years at least 10 times

- Butterflies: No species
- Moths: No species

Population (%) of butterfly species inside IBMA

Boloria selene (1-10%); Lycaena dispar (11-20%)

This area is one of the two sites where the subspecies *Lycaena dispar batava* can be found in the world



27 - Savelsbos

ILA Criteria: Aii,Bii (Moths)

- Aii: Site contains one or more regionally threatened species
- Bii: Site contains a high number of species of high conservation importance

Area: 130 ha

Description:

A calcareous woodland on a steep hillside. It used to be very open coppiced woodland, but has slowly changed into a high forest. It is probably the warmest south exposed woodland in the Netherlands.

27 - Savelsbos

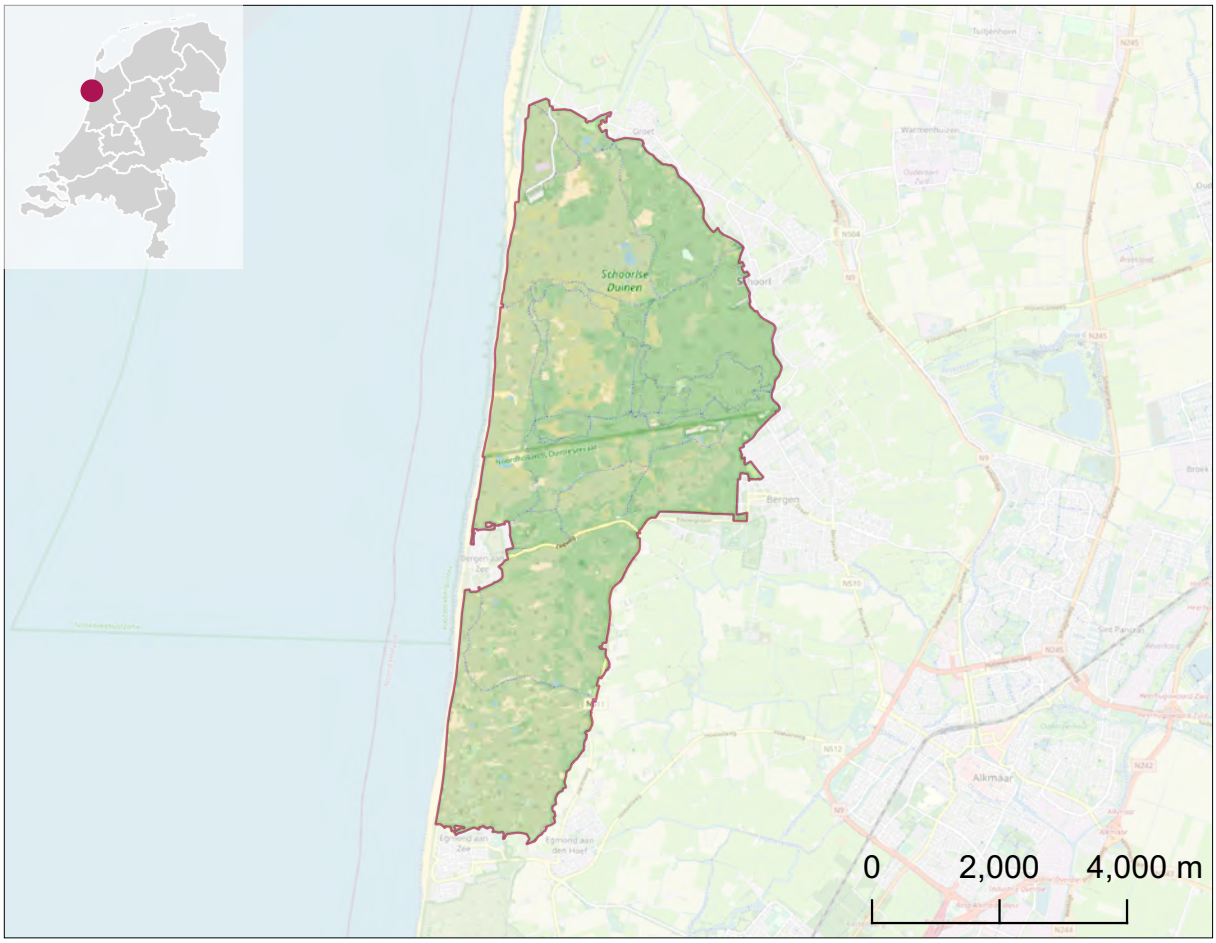
Endangered species seen in the last 10 years at least 10 times

- Butterflies: No species
- Moths: *Asthena albulata (EN); Hydrelia flammeolaria (VU); Miltochrista miniata (VU)*

Endangered species not seen in the last 10 years at least 10 times

- Butterflies: No species
- Moths: No species

Asthena albulata **(left) and** ***Miltochrista miniata*** **(right) are only two of the many species that should occur in this area, but more research is needed to get a better understanding of the whole moth fauna**



28 - Schoorlse Duinen

ILA Criteria: Biii (Butterflies); Aii,Bii (Moths)

- Aii: Site contains one or more regionally threatened species
- Bii: Site contains a high number of species of high conservation importance
- Biii: Site contains an exceptional number of species

Area: 3322 ha

Description:

A large and wide area with coastal dunes and woodland. It has important and large populations of *Satyrium ilicis*, *Argynnis niobe* and *Hesperia comma*.

28 - Schoorlse Duinen

Endangered species seen in the last 10 years at least 10 times

- Butterflies: *Argynnis niobe (EN); Aricia agestis (NT); Hesperia comma (EN); Hipparchia semele (VU); Issoria lathonia (VU); Nymphalis polychloros (VU); Satyrium ilicis (EN)*

- Moths: *Achlya flavicornis (VU); Acronicta aceris (VU); Acronicta auricoma (VU); Acronicta psi (VU); Aethalura punctulata (EN); Agrochola helvola (EN); Agrotis vestigialis (VU); Ammoconia caecimacula (CR); Amphipoea oculea (EN); Apamea anceps (EN); Apamea sublustris (EN); Aporophyla lutulenta (CR); Archiearis parthenias (VU); Autographa jota (EN); Biston strataria (VU); Calophasia lunula (EN); Cerastis rubricosa (VU); Cerura vinula (VU); Charanyca ferruginea (VU); Cilix glaucata (EN); Clostera pigra (EN); Coscinia cribraria (EN); Cosmorhoe ocellata (VU); Cucullia absinthii (EN); Cybosia mesomella (VU); Cyclophora albipunctata (VU); Cyclophora porata (EN); Deilephila porcellus (VU); Diacrisia sannio (VU); Diarsia brunnea (VU); Diarsia mendica (VU); Diloba caeruleocephala (EN); Drymonia ruficornis (VU); Earophila badiata (EN); Eilema pygmaeola (EN); Electrophaes corylata (VU); Ennomos alniaria (VU); Eulithis testata (VU); Eupithecia icterata (EN); Eupithecia indigata (EN); Eupithecia innotata (EN); Eupithecia linariata (VU); Eupithecia nanata (VU); Eupithecia subfuscata (VU); Eupithecia tenuiata (VU); Eupithecia virgaureata (VU); Euxoa cursoria (EN); Euxoa tritici (VU); Falcaria lacertinaria (VU); Gluphisia crenata (VU); Gortyna flavago (VU); Harpyia milhauseri (VU); Heliothis viriplaca (VU); Hydrelia flammeolaria (VU); Hydria cervinalis (EN); Hyles gallii (EN); Idaea emarginata (VU); Idaea muricata (VU); Idaea straminata (VU); Idaea sylvestraria (EN); Lacanobia contigua (EN); Lasiocampa trifolii (VU); Laspeyria flexula (EN); Leucoma salicis (VU); Lithophane semibrunnea (EN); Litoligia literosa (VU); Lobophora halterata (EN); Lycia hirtaria (EN); Lycophotia porphyrea (VU); Lymantria monacha (VU); Meganola albula (VU); Miltochrista miniata (VU); Mythimna litoralis (EN); Mythimna pudorina (VU); Mythimna straminea (VU); Noctua orbona (VU); Nola aerugula (VU); Nola confusalis (VU); Nola cucullatella (EN); Notodonta tritophus (VU); Ochropacha duplaris (VU); Odontopera bidentata (VU); Orthosia gracilis (VU); Panolis flammea (VU); Paracolax tristalis (VU); Paranthrene tabaniformis (EN); Pareulype berberata (EN); Pechipogo strigilata (VU); Pennithera firmata (VU); Perizoma flavofasciata (VU); Photedes extrema (EN); Photedes fluxa (EN); Phytometra viridaria (CR); Polia nebulosa (EN); Polymixis lichenea (EN); Rhodostrophia vibicaria (EN); Scopula marginepunctata (VU); Selidosema brunnearia (EN); Sideridis reticulata (EN); Sideridis turbida (EN); Stauropus fagi (VU); Tethea or (VU); Thalpophila matura (VU); Tholera cespitis (EN); Tholera decimalis (VU); Tiliacea aurago (VU); Trichopteryx carpinata (VU); Watsonalla cultraria (VU); Xestia baja (VU)*

Endangered species not seen in the last 10 years at least 10 times

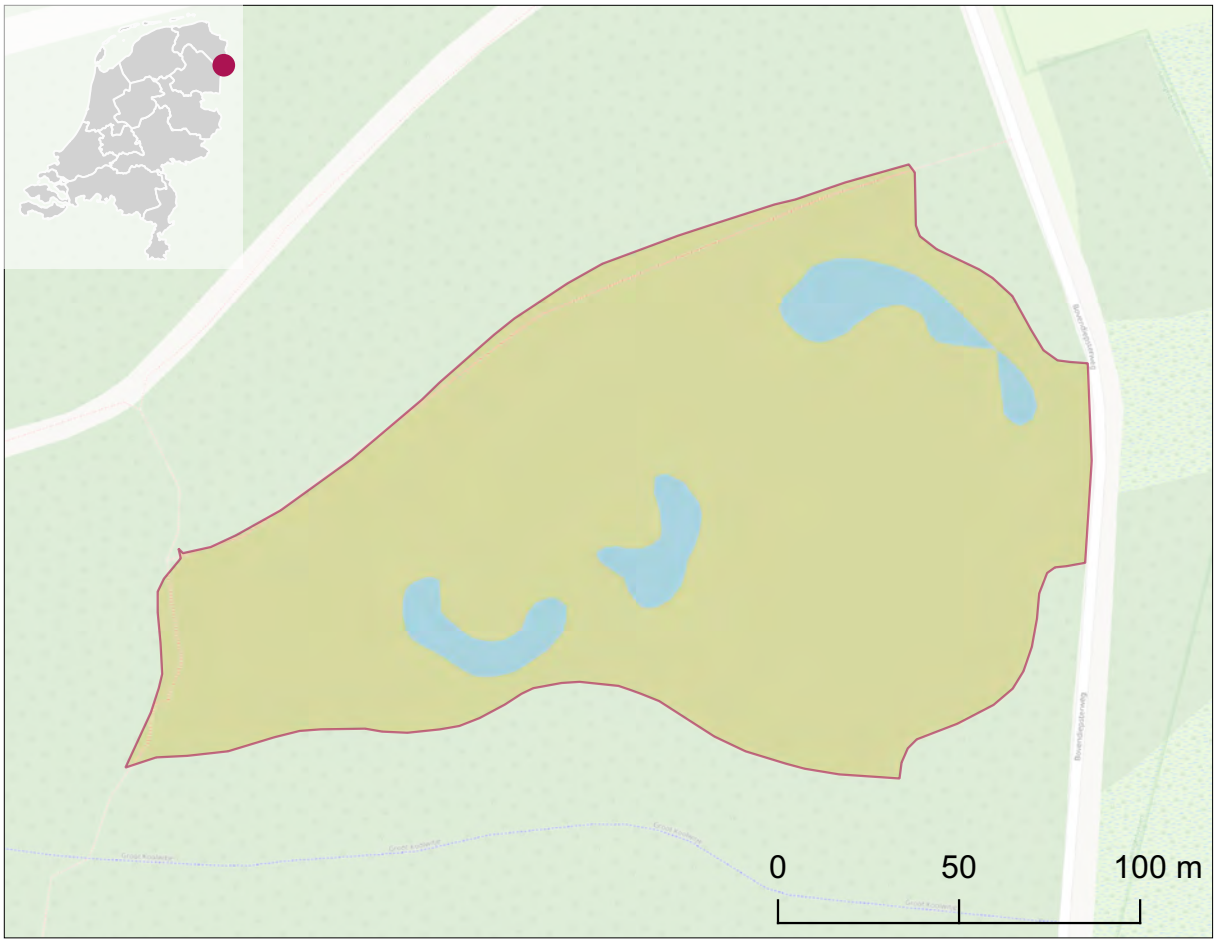
- Butterflies: No species

- Moths: *Actebia praecox (CR); Cosmia affinis (VU); Eupithecia tantillaria (VU); Eupithecia tripunctaria (VU); Longalatedes elymi (VU); Synanthedon myopaeformis (EN)*

Population (%) of butterfly species inside IBMA

Argynnis niobe (21-30%); Argynnis paphia (1-10%); Hesperia comma (11-20%); Hipparchia semele (1-10%); Issoria lathonia (1-10%); Satyrium ilicis (41-50%)

The coastal dunes of Schoorlse Duinen give habitat to many endangered butterflies such as the small *Satyrium ilicis*



29 - Sellingen

ILA Criteria: Aii,Bii (Butterflies)

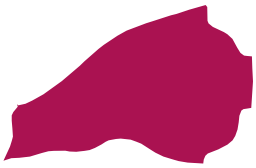
- Aii: Site contains one or more regionally threatened species
- Bii: Site contains a high number of species of high conservation importance

Area: 3 ha

Description:

A small peat bog surrounded by woodland, one of the last site for the threatened *Agriades optilete.*

29 - Sellingen



Endangered species seen in the last 10 years at least 10 times

- Butterflies: *Agriades optilete (CR)*
- Moths: No species

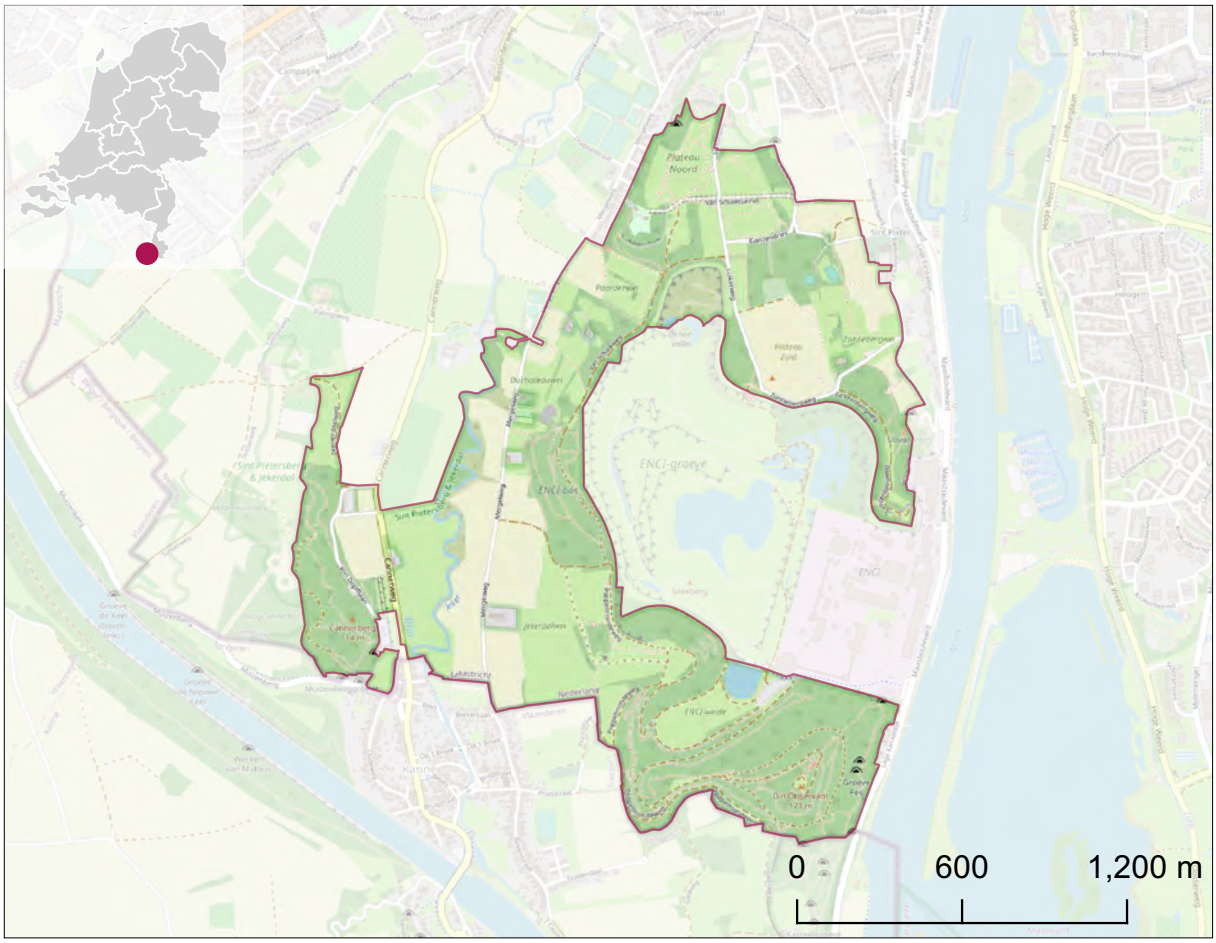
Endangered species not seen in the last 10 years at least 10 times

- Butterflies: No species
- Moths: No species

Population (%) of butterfly species inside IBMA

Agriades optilete (1-10%); Callophrys rubi (1-10%); Lycaena tityrus (1-10%)

Sellingen is a nice small peat bog where to find the critically endangered butterfly *Agriades optilete*



30 - Sint Pietersberg & Jekerdal

ILA Criteria: Aii,Bii,Biii (Butterflies); Aii,Bii,Biii (Moths)

- Aii: Site contains one or more regionally threatened species
- Bii: Site contains a high number of species of high conservation importance
- Biii: Site contains an exceptional number of species

Area: 258 ha

Description:

This is one of the southernmost and warmest places of the Netherlands, and also a place where chalk reaches the surface. The area is a mixture of dry grasslands and woodlands, with a deep quarry in the middle. Mining has stopped and the area will be added to the nature reserve. The area has some of the best calcareous grasslands in the Netherlands and is also famous for its first arrivals from species from the south expaning north because of climate warming.

30 - Sint Pietersberg & Jekerdal

Endangered species seen in the last 10 years at least 10 times

- Butterflies: *Aricia agestis (NT); Carcharodus alceae (NT); Cupido minimus (RE); Cyaniris semiargus (CR); Erynnis tages (CR); Issoria lathonia (VU); Leptidea sinapis (EN); Melitaea cinxia (CR); Nymphalis polychloros (VU); Pyronia tithonus (NT); Thecla betulae (EN); Thymelicus sylvestris (EN)*

- Moths: *Abrostola tripartita (VU); Achlya flavicornis (VU); Acronicta aceris (VU); Acronicta psi (VU); Actinotia polyodon (VU); Apamea scolopacina (VU); Archiearis parthenias (VU); Asthena albulata (EN); Bena bicolorana (VU); Biston strataria (VU); Calophasia lunula (EN); Caradrina clavipalpis (VU); Catephia alchymista (RE); Catocala promissa (RE); Charissa obscurata (CR); Cilix glaucata (EN); Cosmia affinis (VU); Cosmia pyralina (VU); Cosmorhoe ocellata (VU); Cucullia scrophulariae (EN); Cyclophora annularia (CR); Deilephila porcellus (VU); Diarsia brunnea (VU); Drymonia ruficornis (VU); Enargia paleacea (EN); Ennomos fuscantaria (EN); Euchoeca nebulata (VU); Eupithecia haworthiata (EN); Eupithecia linariata (VU); Eupithecia subfuscata (VU); Eupithecia tantillaria (VU); Eupithecia tripunctaria (VU); Eupithecia venosata (EN); Eupithecia virgaureata (VU); Falcaria lacertinaria (VU); Furcula bifida (EN); Gluphisia crenata (VU); Harpyia milhauseri (VU); Hecatera bicolorata (VU); Hemistola chrysoprasaria (EN); Horisme vitalbata (EN); Hydrelia flammeolaria (VU); Hydria undulata (VU); Idaea straminata (VU); Ipimorpha subtusa (VU); Lacanobia w-latinum (VU); Laspeyria flexula (EN); Lobophora halterata (EN); Lycia hirtaria (EN); Lycophotia porphyrea (VU); Lymantria monacha (VU); Macaria wauaria (VU); Meganola albula (VU); Miltochrista miniata (VU); Nola confusalis (VU); Nonagria typhae (VU); Notodonta tritophus (VU); Ochropacha duplaris (VU); Oligia versicolor (VU); Parastichtis suspecta (VU); Petrophora chlorosata (VU); Pharmacis lupulina (VU); Philereme transversata (EN); Polia nebulosa (EN); Pyrrhia umbra (VU); Scopula marginepunctata (VU); Scopula nigropunctata (EN); Scotopteryx chenopodiata (VU); Selenia lunularia (EN); Sesia apiformis (VU); Stauropus fagi (VU); Synanthedon myopaeformis (EN); Tethea or (VU); Tiliacea aurago (VU); Trichopteryx carpinata (VU); Watsonalla cultraria (VU); Xanthia icteritia (VU)*

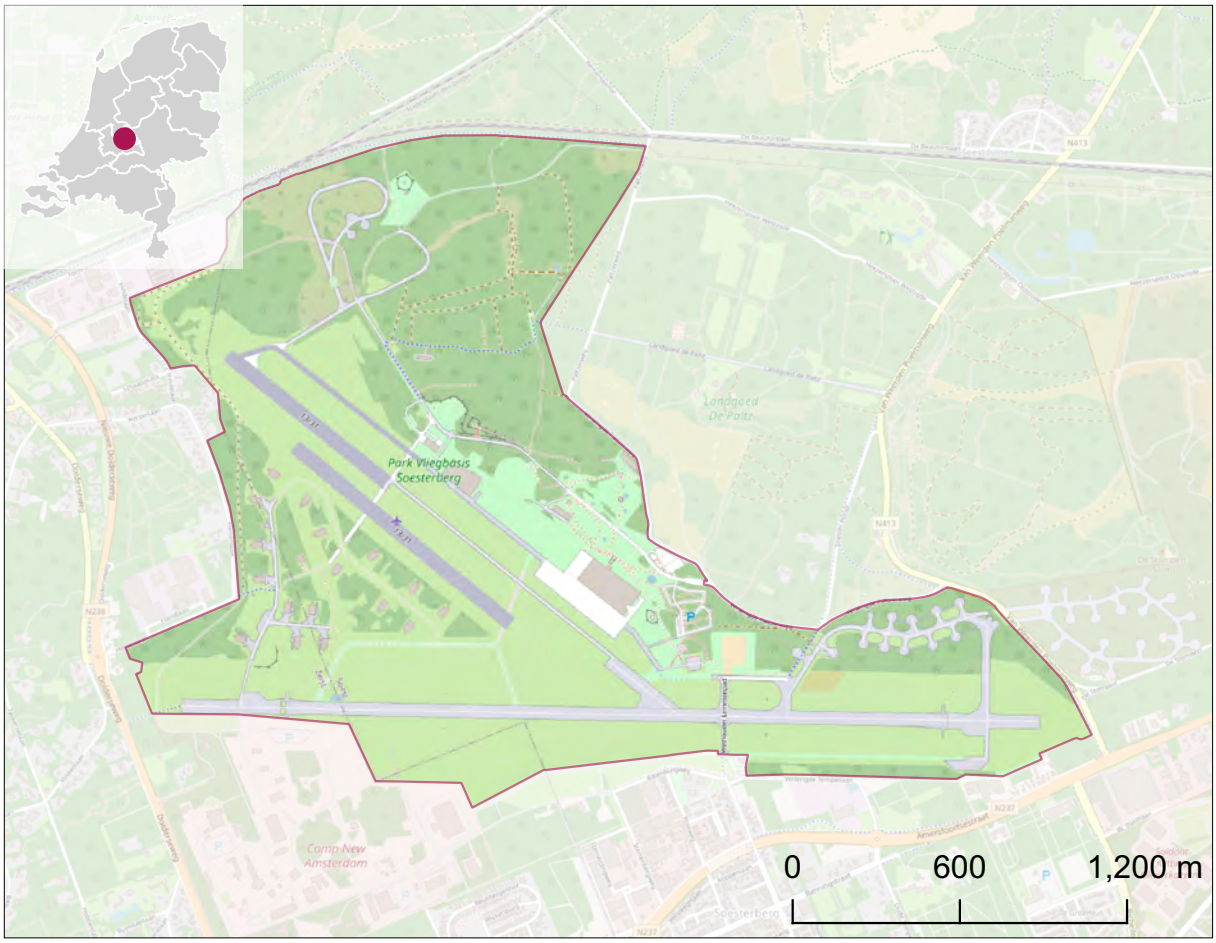
Endangered species not seen in the last 10 years at least 10 times

- Butterflies: *Aporia crataegi (RE)*

- Moths: *Eupithecia icterata (EN); Synanthedon vespiformis (EN); Triphosa dubitata (CR)*

Population (%) of butterfly species inside IBMA

Apatura iris (1-10%); Argynnis paphia (1-10%); Callophrys rubi (1-10%); Carcharodus alceae (51-60%); Cupido minimus (61-70%); Cyaniris semiargus (11-20%); Erynnis tages (51-60%); Issoria lathonia (1-10%); Leptidea sinapis (41-50%); Melitaea cinxia (31-40%); Satyrium w-album (1-10%); Thecla betulae (1-10%); Thymelicus sylvestris (1-10%)



31 - Soesterberg

ILA Criteria: Biii (Butterflies); Bii (Moths)

- Bii: Site contains a high number of species of high conservation importance
- Biii: Site contains an exceptional number of species

Area: 413 ha

Description:

Soesterberg is a former airbase located at one of the highest parts of the Utrechtse heuvelrug. For a long time the dry grasslands along the former runway have been mown to prevent birds from breeding there. As a result these grasslands are now full of flowers and give habitat to many butterflies and moths.

31 - Soesterberg

Endangered species seen in the last 10 years at least 10 times

- Butterflies: *Aricia agestis (NT); Hesperia comma (EN); Hipparchia semele (VU); Issoria lathonia (VU); Plebejus argus (VU); Thymelicus sylvestris (EN)*

- Moths: *Actinotia polyodon (VU); Agrotis vestigialis (VU); Amphipoea oculea (EN); Calamia tridens (VU); Charanyca ferruginea (VU); Cyclophora albipunctata (VU); Drymonia ruficornis (VU); Eupithecia icterata (EN); Eupithecia nanata (VU); Eupithecia tantillaria (VU); Falcaria lacertinaria (VU); Hada plebeja (VU); Idaea emarginata (VU); Idaea straminata (VU); Lacanobia w-latinum (VU); Laspeyria flexula (EN); Lycophotia porphyrea (VU); Miltochrista miniata (VU); Noctua orbona (VU); Paracolax tristalis (VU); Parastichtis suspecta (VU); Peribatodes secundaria (VU); Saturnia pavonia (VU); Stauropus fagi (VU); Tetheella fluctuosa (VU); Thalpophila matura (VU); Tholera decimalis (VU); Watsonalla cultraria (VU)*

Endangered species not seen in the last 10 years at least 10 times

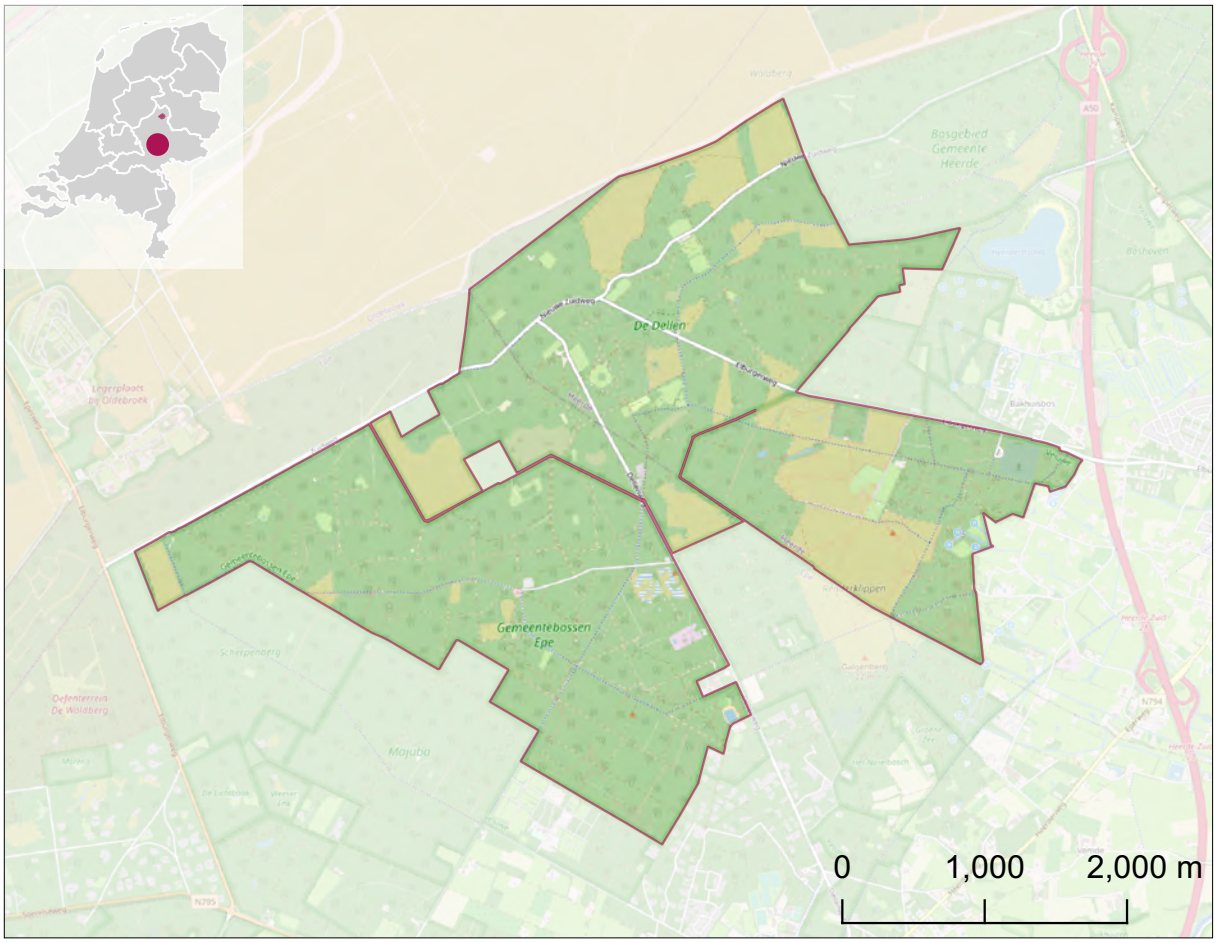
- Butterflies: No species

- Moths: *Cucullia scrophulariae (EN); Deilephila porcellus (VU)*

Population (%) of butterfly species inside IBMA

Callophrys rubi (1-10%); Hesperia comma (1-10%); Hipparchia semele (1-10%); Plebejus argus (1-10%); Thymelicus sylvestris (11-20%)

The flower rich grasslands of the former airbase of Soesterberg give habitat for a large number of butterflies and moths



32 - Veluwe - Epe/Heerde

ILA Criteria: Aii,Bii (Moths)

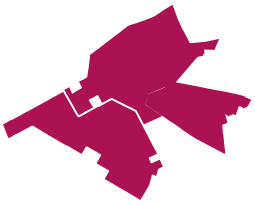
- Bii: Site contains a high number of species of high conservation importance
- Biii: Site contains an exceptional number of species

Area: 1365 ha

Description:

Varied landscape with heath of differend ages, deciduous and coniferous forest

32 - Veluwe - Epen/Heerde



Endangered species seen in the last 10 years at least 10 times

- Butterflies: No species

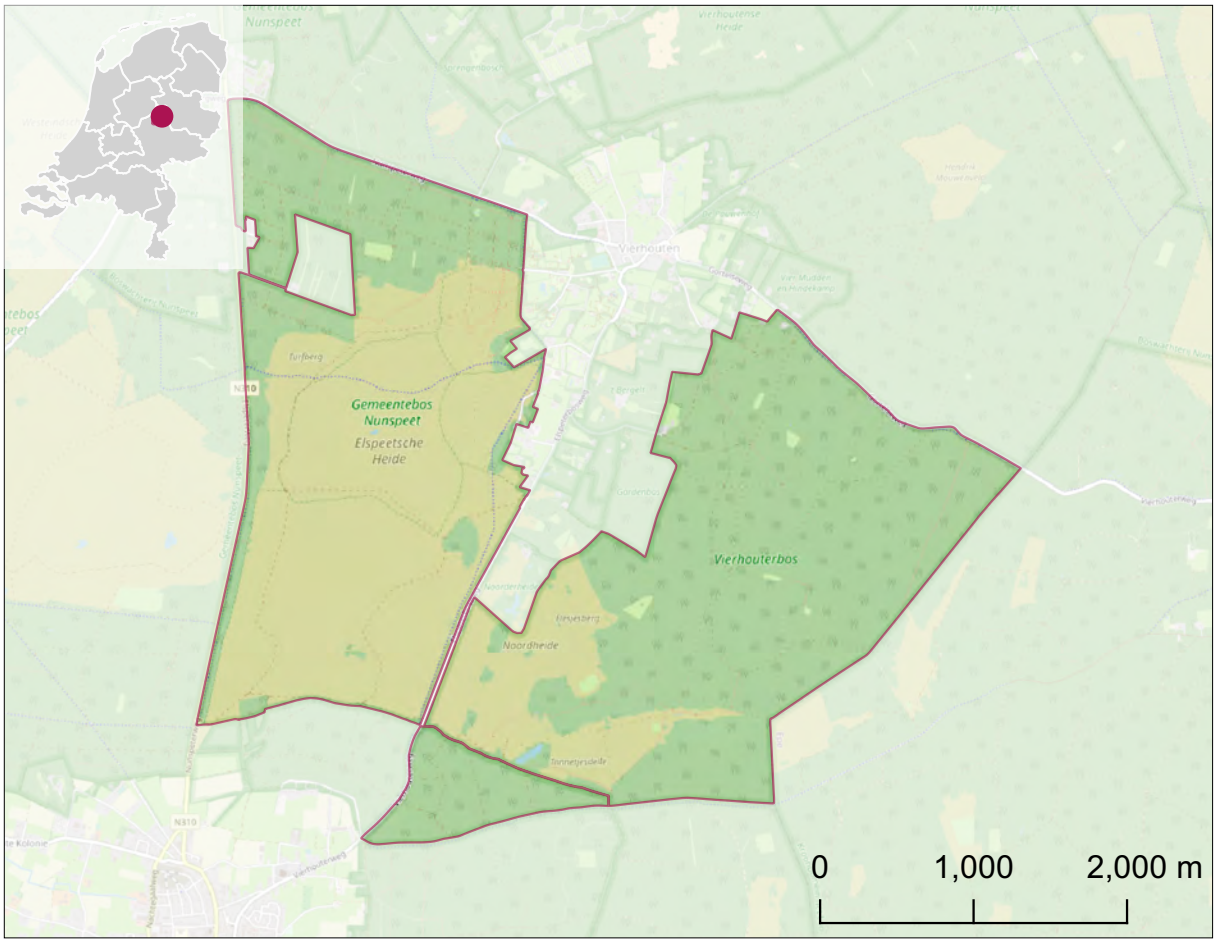
- Moths: *Achlya flavicornis (VU); Acronicta auricoma (VU); Biston strataria (VU); Cepphis advenaria (VU); Charanyca ferruginea (VU); Cybosia mesomella (VU); Cyclophora albipunctata (VU); Diacrisia sannio (VU); Diarsia brunnea (VU); Drymonia ruficornis (VU); Eulithis populata (EN); Eupithecia nanata (VU); Eupithecia tantillaria (VU); Falcaria lacertinaria (VU); Idaea straminata (VU); Lasiocampa trifolii (VU); Lycia hirtaria (EN); Lycophotia porphyrea (VU); Miltochrista miniata (VU); Odontopera bidentata (VU); Panolis flammea (VU); Paracolax tristalis (VU); Perconia strigillaria (VU); Peribatodes secundaria (VU); Perizoma flavofasciata (VU); Saturnia pavonia (VU); Stauropus fagi (VU); Tetheella fluctuosa (VU); Thera britannica (VU); Watsonalla cultraria (VU)*

Endangered species not seen in the last 10 years at least 10 times

- Butterflies: No species

- Moths: *Tholera decimalis (VU)*

***Lycia hirtaria* is one of the early flying moths that can be found around Epen and Heerde**



33 - Veluwe - Vierhouten

ILA Criteria: Aii,Bii (Moths)

- Aii: Site contains one or more regionally threatened species
- Bii: Site contains a high number of species of high conservation importance

Area: 1283 ha

Description:

Varied landscape with heath, deciduous and coniferous forest

33 - Veluwe - Vierhouten

Endangered species seen in the last 10 years at least 10 times

- Butterflies: No species

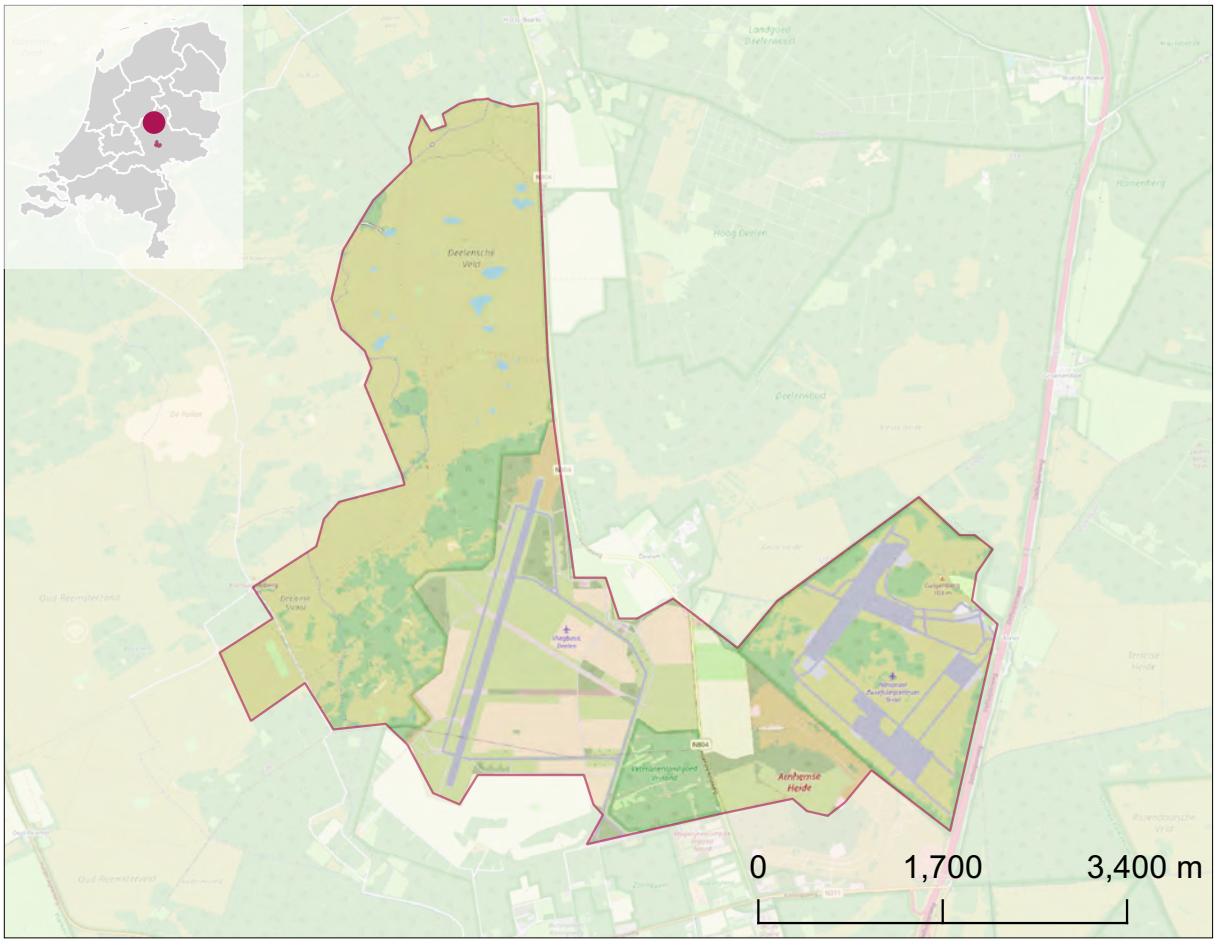
- Moths: *Acronicta auricoma (VU); Aporophyla lueneburgensis (RE); Diarsia brunnea (VU); Eupithecia nanata (VU); Falcaria lacertinaria (VU); Idaea straminata (VU); Jodis putata (VU); Lasiocampa trifolii (VU); Lycophotia porphyrea (VU); Miltochrista miniata (VU); Mniotype satura (EN); Noctua orbona (VU); Nola aerugula (VU); Paracolax tristalis (VU); Peribatodes secundaria (VU); Saturnia pavonia (VU); Watsonalla cultraria (VU); Xestia baja (VU); Xylena solidaginis (VU)*

Endangered species not seen in the last 10 years at least 10 times

- Butterflies: No species

- Moths: *Diacrisia sannio (VU); Stauropus fagi (VU)*

The endangered *Mniotype satura* only occur at the Veluwe area, including Vierhouten



34 - Veluwe - Zuid

ILA Criteria: Bii,Biii (Butterflies)

- Aii: Site contains one or more regionally threatened species
- Bii: Site contains a high number of species of high conservation importance

Area: 2030 ha

Description:

This area is a mixture of wet heathland, dry open forest and large dry grasslands. For the characteristic butterflies the combination of all these habitats forms the basis, they could not do without each other. For some species this area is the most important occurrence in the Netherlands.

34 – Veluwe - Zuid

Endangered species seen in the last 10 years at least 10 times

- Butterflies: *Argynnis aglaja (CR); Aricia agestis (NT); Hesperia comma (EN); Hipparchia semele (VU); Issoria lathonia (VU); Lycaena tityrus (VU); Melitaea athalia (CR); Nymphalis polychloros (VU); Phengaris alcon (EN); Plebejus argus (VU); Pyrgus malvae (EN); Thecla betulae (EN); Thymelicus sylvestris (EN)*

- Moths: No species

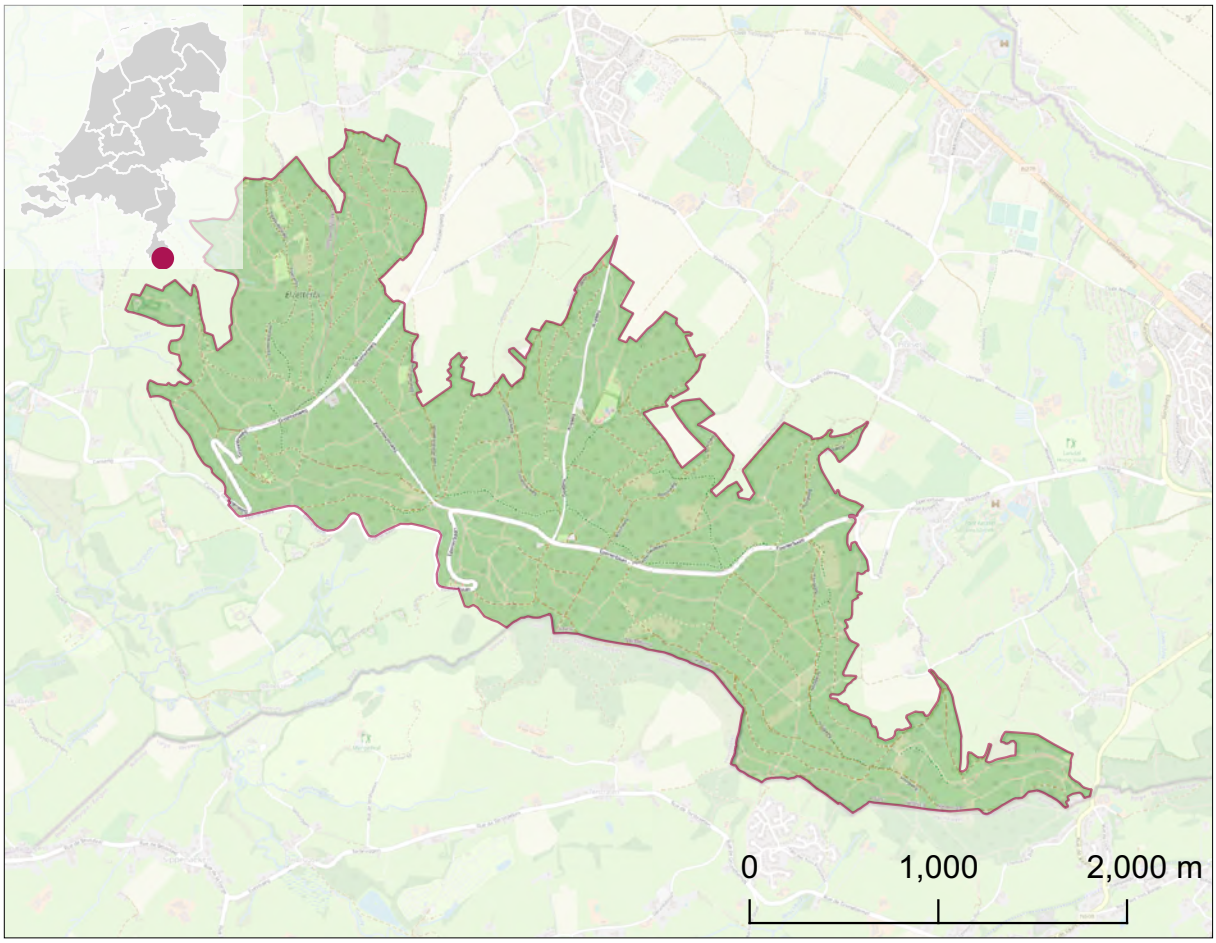
Endangered species not seen in the last 10 years at least 10 times

- Butterflies: *Argynnis niobe (EN); Coenonympha arcania (RE); Hipparchia statilinus (CR)*
- Moths: No species

Population (%) of butterfly species inside IBMA

Argynnis aglaja (51-60%); Argynnis paphia (1-10%); Callophrys rubi (11-20%); Hesperia comma (21-30%); Hipparchia semele (21-30%); Issoria lathonia (1-10%); Lycaena tyrus (31-40%); Melitaea athalia (21-30%); Phengaris alcon (1-10%); Plebejus argus (1-10%); Pyrgus malvae (11-20%); Thecla betulae (1-10%); Thymelicus sylvestris (11-20%)

***Melitaea athalia* has a large population in Veluwe Zuid**



35 - Vijlenerbos

ILA Criteria: Aii,Bii,Biii (Moths)

- Aii: Site contains one or more regionally threatened species
- Bii: Site contains a high number of species of high conservation importance
- Biii: Site contains an exceptional number of species

Area: 611 ha

Description:

Probably the highest and one of the coolest woodlands in the Netherlands, directly to the Belgian border, and with a fauna influenced by the Ardennes directly to the south.

35 - Vijlenerbos

Endangered species seen in the last 10 years at least 10 times

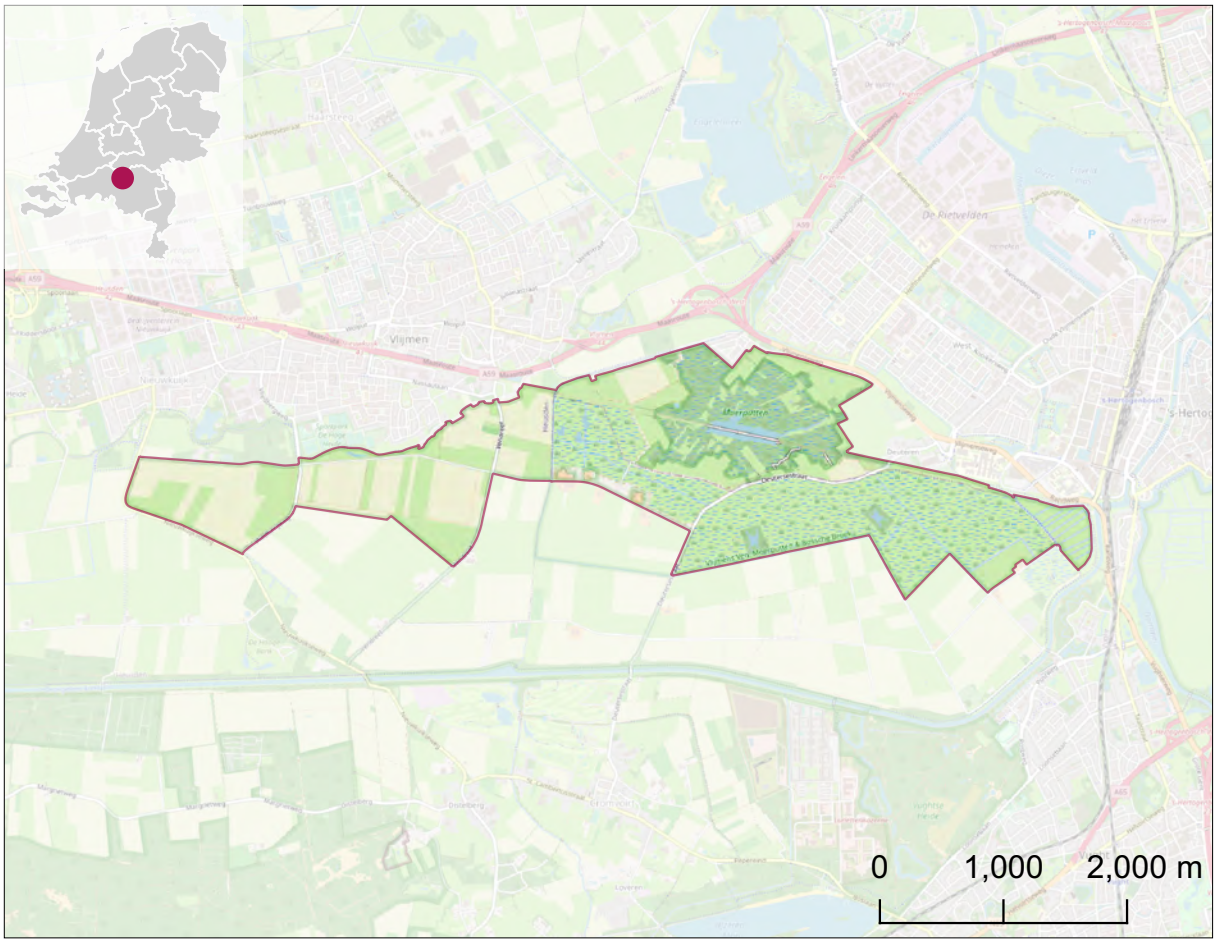
- Butterflies: No species

- Moths: *Abrostola tripartita (VU); Achlya flavicornis (VU); Acronicta aceris (VU); Anaplectoides prasina (EN); Apamea scolopacina (VU); Archiearis parthenias (VU); Asthena albulata (EN); Autographa pulchrina (EN); Biston strataria (VU); Cepphis advenaria (VU); Cosmia pyralina (VU); Cucullia scrophulariae (EN); Cyclophora albipunctata (VU); Diarsia brunnea (VU); Diarsia mendica (VU); Diloba caeruleocephala (EN); Drymonia ruficornis (VU); Electrophaes corylata (VU); Enargia paleacea (EN); Ennomos alniaria (VU); Ennomos fuscantaria (EN); Ennomos quercinaria (VU); Epirrita christyi (CR); Eupithecia haworthiata (EN); Eupithecia lariciata (EN); Eupithecia subfuscata (VU); Eupithecia tantillaria (VU); Eupithecia tenuiata (VU); Eupithecia tripunctaria (VU); Eupithecia virgaureata (VU); Falcaria lacertinaria (VU); Harpyia milhauseri (VU); Hydrelia flammeolaria (VU); Hydria undulata (VU); Lacanobia thalassina (VU); Laspeyria flexula (EN); Leucodonta bicoloria (EN); Lobophora halterata (EN); Lycia hirtaria (EN); Lymantria monacha (VU); Macaria wauaria (VU); Meganola albula (VU); Mesoleuca albicillata (VU); Miltochrista miniata (VU); Nola confusalis (VU); Ochropacha duplaris (VU); Odontopera bidentata (VU); Oligia versicolor (VU); Panolis flammea (VU); Pasiphila debiliata (EN); Peribatodes secundaria (VU); Perizoma flavofasciata (VU); Petrophora chlorosata (VU); Polia nebulosa (EN); Scopula nigropunctata (EN); Selenia lunularia (EN); Stauropus fagi (VU); Tetheella fluctuosa (VU); Tiliacea aurago (VU); Trichopteryx carpinata (VU); Watsonalla cultraria (VU); Xanthorhoe quadrifasiata (EN)*

Endangered species not seen in the last 10 years at least 10 times

- Butterflies: No species

- Moths: *Acronicta psi (VU); Acronicta tridens (VU); Aleucis distinctata (CR); Autographa jota (EN); Cosmorhoe ocellata (VU); Eulithis populata (EN); Eupithecia lanceata (CR); Eupithecia nanata (VU); Hemistola chrysoprasaria (EN); Mesotype didymata (EN); Thera britannica (VU)*



36 - Vlijmens Ven & Moerputten

ILA Criteria: Aii,Bii,Biii (Butterflies)

- Aii: Site contains one or more regionally threatened species
- Bii: Site contains a high number of species of high conservation importance
- Biii: Site contains an exceptional number of species

Area: 684 ha

Description:

An area with wet grassland, including some fine fen meadows, and wet woodlands. Recently the area has been extended and new grasslands have been created to offer new habitat for *Phengaris teleius*.

36 - Vlijmens Ven & Moerputten

Endangered species seen in the last 10 years at least 10 times

- Butterflies: *Aricia agestis (NT); Boloria selene (EN); Issoria lathonia (VU); Phengaris teleius (CR); Pyronia tithonus (NT)*

- Moths: No species

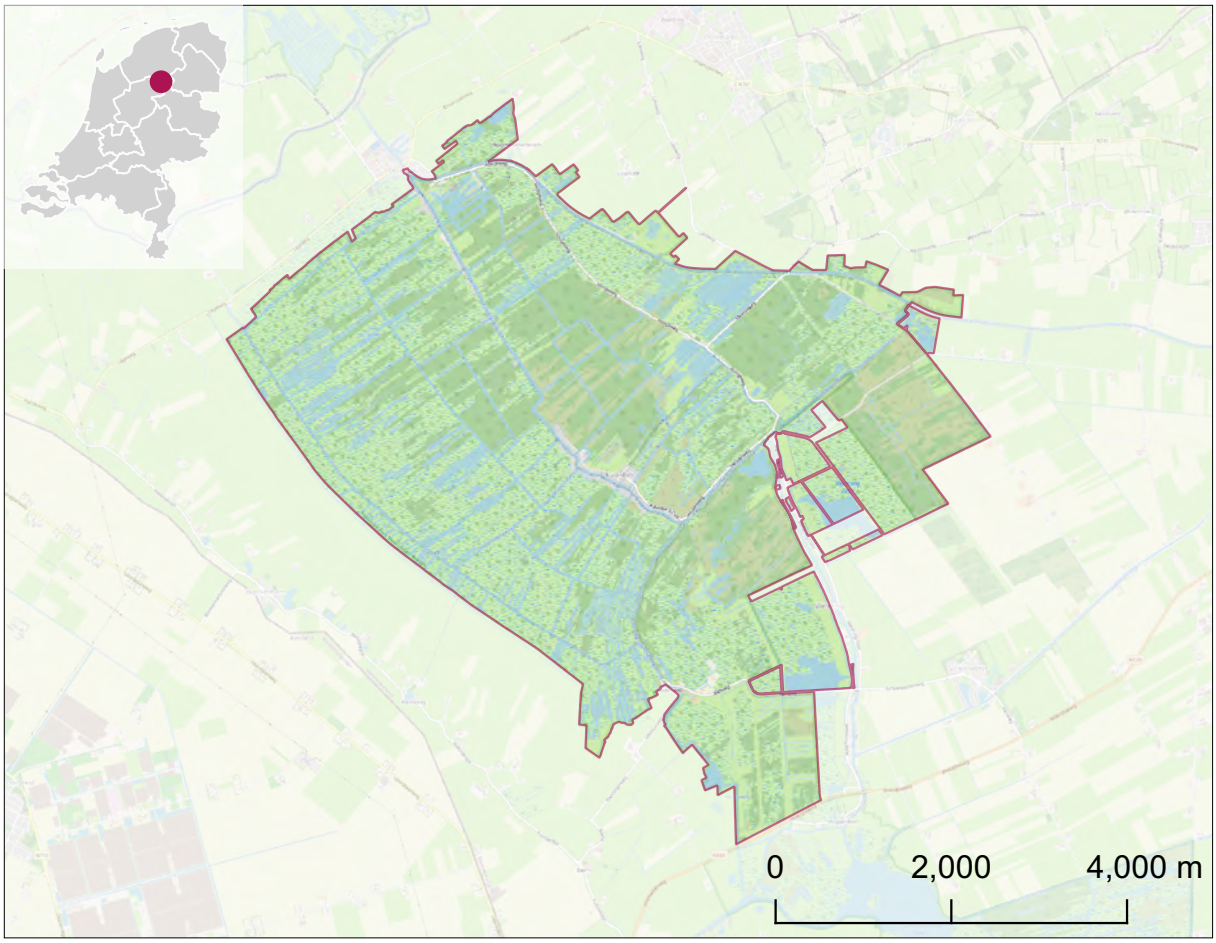
Endangered species not seen in the last 10 years at least 10 times

- Butterflies: *Phengaris nausithous (CR); Thymelicus sylvestris (EN)*

- Moths: No species

Population (%) of butterfly species inside IBMA
Issoria lathonia (1-10%); Phengaris teleius (91-100%)

Moerputten is home to the largest population of the endangered *Phengaris teleius in the Netherlands*



37 - Weerribben

ILA Criteria: Ai,Bii,Biii (Butterflies); Bii (Moths)

- Ai: Site contains one or more globally threatened species
- Bii: Site contains a high number of species of high conservation importance
- Biii: Site contains an exceptional number of species

Area: 3549 ha

Description:

The Weerribben is one of the largest wetlands in Northwest Europe. Thanks to human hands cutting peat and reed, a unique landscape was created, full of lakes, waterways, reedlands, marsh forests and bogs. The area has the largest population of the Dutch subspecies of *Lycaena dispar*, but also hosts many endangered other butterflies and dragonflies.

37 - Weerribben

Endangered species seen in the last 10 years at least 10 times

- Butterflies: *Boloria selene (EN); Lycaena dispar (CR); Nymphalis polychloros (VU); Pyronia tithonus (NT)*

- Moths: *Aethalura punctulata (EN); Apamea unanimis (VU); Autographa jota (EN); Cucullia chamomillae (EN); Cyclophora albipunctata (VU); Deltote uncula (EN); Electrophaes corylata (VU); Endromis versicolora (EN); Euchoeca nebulata (VU); Eulithis testata (VU); Falcaria lacertinaria (VU); Furcula bicuspis (EN); Gagitodes sagittata (CR); Gastropacha quercifolia (EN); Globia sparganii (VU); Helotropha leucostigma (VU); Hydrelia flammeolaria (VU); Idaea emarginata (VU); Ipimorpha retusa (EN); Lacanobia splendens (EN); Leucoma salicis (VU); Malacosoma neustria (VU); Miltochrista miniata (VU); Mythimna straminea (VU); Ochropacha duplaris (VU); Orthosia gracilis (VU); Petrophora chlorosata (VU); Pterapherapteryx sexalata (EN); Simyra albovenosa (VU); Tetheella fluctuosa (VU); Trichiura crataegi (VU)*

Endangered species not seen in the last 10 years at least 10 times

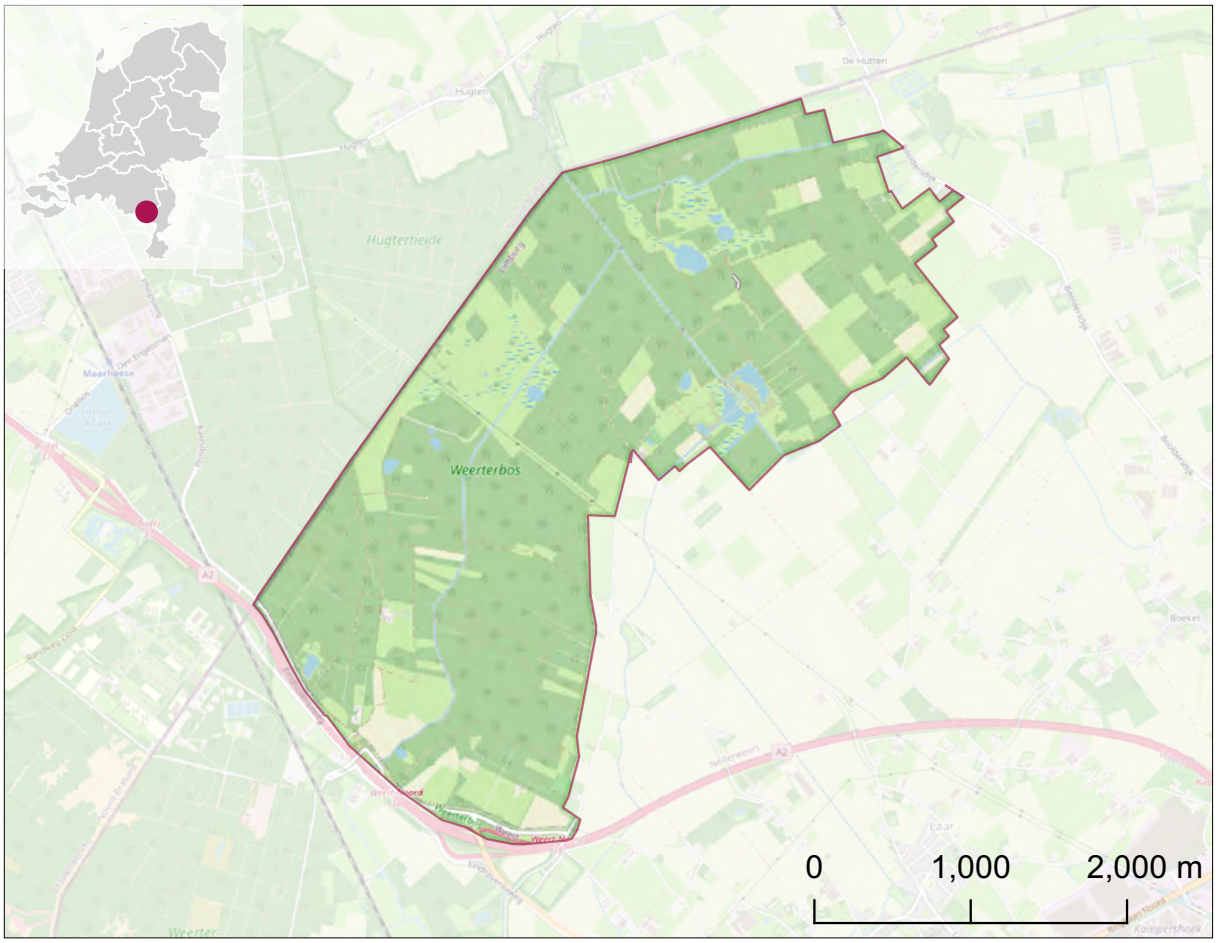
- Butterflies: No species

- Moths: *Archiearis parthenias (VU); Ennomos alniaria (VU); Gortyna flavago (VU); Hydria undulata (VU); Orthonama vittata (VU); Tethea or (VU)*

Population (%) of butterfly species inside IBMA

Apatura iris (11-20%); Boloria selene (11-20%); Callophrys rubi (1-10%); Lycaena dispar (61-70%)

Wererribben is one of the most important areas for *Gagitodes sagittata*, which can be found as larvae on the host plant *Thalictrum flavum* in August and September



38 - Weerterbos

ILA Criteria: Bii,Biii (Butterflies); Bii (Moths)

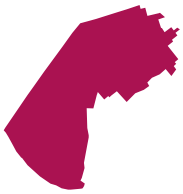
- Bii: Site contains a high number of species of high conservation importance
- Biii: Site contains an exceptional number of species

Area: 994 ha

Description:

Dry and moist forests, fens, moist grasslands and small heaths form the Weerterbos. For butterflies this is one of the places where you can see all characteristic woodland species.

38 - Weerterbos



Endangered species seen in the last 10 years at least 10 times

- Butterflies*: Heteropterus morpheus (VU); Issoria lathonia (VU); Limenitis camilla (VU); Nymphalis polychloros (VU); Pyronia tithonus (NT)*

- Moths*: Archiearis parthenias (VU); Cucullia scrophulariae (EN); Miltochrista miniata (VU)*

Endangered species not seen in the last 10 years at least 10 times

- Butterflies: *Thymelicus sylvestris (EN)*

- Moths: No species

Population (%) of butterfly species inside IBMA

Apatura iris (1-10%); Argynnis paphia (1-10%); Callophrys rubi (1-10%); Carterocephalus palaemon (1-10%); Heteropterus morpheus (11-20%); Limenitis camilla (1-10%)

The forests of Weerterbos are an ideal place to observe woodland species such as *Apatura iris*

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Annexe I / R codes

Apply IBMA criteria, example for butterflies

```
library(data.table)
library(raster)
library(sf)
library(tidyverse)
library(mapview)
library(tmap)

# Read ndff data
ndff <- readRDS("./NDFF_dagvl.rds")

# Read native butterflies data
native <- read.csv("./Dutch_native_butterflies.csv", sep = ";")

native <- native[native$srt_Scientific_name != "Nymphalis antiopa",] # Remove antiopa because is migrant now

# Read RedList butterflies data
redlist <- read.csv("./RL_2019_lijst.csv", sep = ",")


# Parameters to subset the data
today <- Sys.Date()
thisyear <- year(today)
numyears <- 9
scalekm <- 1000 #1000x1000km = 1km2
scaleha <- 100 #100mx100m = 1ha

# Prepare data
ndff <- as.data.table(ndff)
ndff1 <- ndff[ndff$loc_schaal < 150, ] # Subset for a high precision coordinate
ndff1 <- ndff1[ndff1$jaar >= (thisyear-numyears) & ndff1$jaar <= thisyear, ] # subset for the last 10 years observations
ndff1 <- ndff1[ndff1$aantal > 0, ] # subset for counts larger than 0
ndff1 <- ndff1[ndff1$soort_nl %in% native$soort_nl, ] # select only native species (no migrants)

# Join information of IUCN Red list and habitat directive
ndff1 <- ndff1 %>%
  left_join(redlist, by = "soort_nl") %>%
  left_join(native, by = "soort_nl")

# Convert x and y in hectare
ndff1$xha <- scaleha*(floor(ndff1$x/scaleha)) + (scaleha/2)
ndff1$yha <- scaleha*(floor(ndff1$y/scaleha)) + (scaleha/2)
```

```
ndff1$xkm <- scalekm*(floor(ndff1$x/scalekm)) + (scalekm/2)
ndff1$ykm <- scalekm*(floor(ndff1$y/scalekm)) + (scalekm/2)

head(ndff1)

# Create a unique ID for each xy
ndff1$xyidha <- stringr::str_c(ndff1$xha, "_", ndff1$yha)
ndff1$xyidkm <- stringr::str_c(ndff1$xkm, "_", ndff1$ykm)

# A(i) Select species globally threatened ####
ai <-  ndff1[ndff1$soort_nl %in% "grote vuurvlinder", ] # select only native species (no migrants)

# Make spatial points
ai_butpoints <- st_as_sf(ai, coords = c("xha", "yha"), crs="EPSG:28992" )
ai_butpoints$Criteria <- "Ai"

# A(ii) Select places with RedList endangered species ####
endsp <- redlist[redlist$IUCNcat %in% c("NT","VU", "EN", "CR", "RE"),] # Get list of endangered sp

ndff1_endsp <- ndff1[ndff1$soort_nl %in% endsp$soort_nl, ] # select endangered species
ndff1_endsp <- ndff1_endsp[order(ndff1_endsp$srt_Scientific_name),]

# Per species and km2 count the number of occupied ha and select the ones with >10% occupied
aii <- ndff1_endsp %>%
 group_by(soort_nl, xyidkm) %>%
 mutate(ha_per_km2 = length(unique(xyidha))) %>% # Calculate number ha per km2 per species
 ungroup() %>%
 group_by(soort_nl) %>% # Per species calculate the number of ha and the proportion of occupied
ha
 mutate(totalha = length(unique(xyidha)),
      propha = (ha_per_km2/totalha)*100) %>%
 filter(propha >= 10) %>% # Select only locations where >10% of km2 are occupied
 distinct(xyidkm, .keep_all = TRUE) # Keep only distinct locations

aii_butpoints <- st_as_sf(aii, coords = c("xha", "yha"), crs="EPSG:28992" )
aii_butpoints$Criteria <- "Aii"


# B(ii) Select habitat directive species OR endangered species with a high number of other
endangered species ####
habitatdir <- native[native$HD %in% "ja" ,]
bii <-  ndff1[ndff1$soort_nl %in% habitatdir$soort_nl, ] # select only native species (no migrants)

# Make spatial points
biihab_butpoints <- st_as_sf(bii, coords = c("xha", "yha"), crs="EPSG:28992" )
biihab_butpoints$Criteria <- "Bii_hab"
```

```
# Calculate number of unique endangered species per location with data table preserving species names
ndff1_endsploc2 <- ndff1_endsp[,":="(NumEndanSp = length(unique(soort_nl))), by=list(xkm,ykm, xyidkm)]

# Get locations for each endangered species where there is maximum counts and other endangered species
bii2 <- ndff1_endsploc2 %>%
  dplyr::group_by(soort_nl) %>%
  slice_max(NumEndanSp, n = 15) %>% # First: select 15 best places based on other endangered sp
  slice_max(aantal, n = 15) # Second: select 15 best places based on counts


biiend_butpoints <- st_as_sf(bii2, coords = c("xha", "yha"), crs="EPSG:28992")
biiend_butpoints$Criteria <- "Bii_endtop15"

# B(iii) Places with high number of species ####
# Calculate number of unique species per location with data.table
ndff1_nsp <- ndff1[ , .(numsp = length(unique(soort_nl))), by = list(xkm,ykm, xyidkm)]

# Select a threshold
uniqsp <- length(unique(ndff1$soort_nl))
spthreshold <- round(uniqsp*0.40,0) # 40% threshold = 25sp

# Filter sites with less species than the threshold
biii <- ndff1_nsp[ndff1_nsp$numsp >= spthreshold,]

# Make spatial points
biii_butpoints <- st_as_sf(biii, coords = c("xkm", "ykm"), crs="EPSG:28992")
biii_butpoints <- biii_butpoints[order(-biii_butpoints$numsp),]
biii_butpoints$Criteria <- "Biii"

# tmap
numsp_map <-tm_shape(ndff_nsp_butpoints, name = "PointsSpecies") +
  tm_dots(col = "numsp", title = "# Species")+
  tm_shape(ndff_nsp_raster, name = "RasterSpecies", raster.downsample = FALSE) +
  tm_raster(title = "# Species") +
  tm_layout(title = paste("Threshold (35%): >=", spthreshold, "species"))

tmap_save(numsp_map, "./Results/numspecies_threshold_map.html")

# Check map ####
mapview(ai_butpoints, col.regions = "darkorange")+
  mapview(aii_butpoints, col.regions = "black")+
  mapview(biihab_butpoints, col.regions = "blue") +
  mapview(biiend_butpoints, col.regions = "lightblue") +
  mapview(biii_butpoints, col.regions = "green")
```

```
st_write(ai_butpoints, "./Results/ai_butterpoints.gpkg", append=FALSE)
st_write(aii_butpoints, "./Results/aii_butterpoints.gpkg", append=FALSE)
st_write(biihab_butpoints, "./Results/biihab_butterpoints.gpkg", append=FALSE)
st_write(biiend_butpoints, "./Results/biiend_butterpoints.gpkg", append=FALSE)
st_write(biii_butpoints, "./Results/biii_butterpoints.gpkg", append=FALSE)
```

Create groups of points, example for butterflies

```
library(data.table)
library(raster)
library(sf)
library(tidyverse)
library(mapview)
library(tmap)
library(dbscan)

# Read data ####
# Read all points for butterflies
ai_butpoints <- st_read("./Results/ai_butterpoints.gpkg")
aii_butpoints <- st_read("./Results/aii_butterpoints.gpkg")
biihab_butpoints <- st_read("./Results/biihab_butterpoints.gpkg")
biiend_butpoints <- st_read("./Results/biiend_butterpoints.gpkg")
biii_butpoints <- st_read("./Results/biii_butterpoints.gpkg")

# Join all criteria ####
# Butterflies
ai_butpoints2 <- ai_butpoints %>%
  st_jitter(factor = 0.0001) %>%
  mutate(Group = "Butterflies") %>%
  select(Group, Criteria, xyidkm, xyidha, geom) %>%
  distinct(geom, .keep_all = TRUE)

aii_butpoints2 <- aii_butpoints %>%
  st_jitter(factor = 0.0001) %>%
  mutate(Group = "Butterflies") %>%
  select(Group, Criteria, xyidkm, xyidha, geom) %>%
  distinct(geom, .keep_all = TRUE)

biihab_butpoints2 <- biihab_butpoints %>%
  st_jitter(factor = 0.0001) %>%
  mutate(Group = "Butterflies") %>%
  select(Group, Criteria, xyidkm, xyidha, geom) %>%
  distinct(geom, .keep_all = TRUE)

biiend_butpoints2 <- biiend_butpoints %>%
  st_jitter(factor = 0.0001) %>%
  mutate(Group = "Butterflies") %>%
  select(Group, Criteria, xyidkm, xyidha, geom) %>%
```

```
 distinct(geom, .keep_all = TRUE)

biii_butpoints2 <- biii_butpoints %>%
 st_jitter(factor = 0.0001) %>%
 mutate(Group = "Butterflies",
       xyidha = NA) %>%
 select(Group, Criteria, xyidkm, xyidha, geom) %>%
 distinct(geom, .keep_all = TRUE)

butpoints <- rbind(ai_butpoints2, aii_butpoints2, biihab_butpoints2, biiend_butpoints2,
biii_butpoints2)
butpoints <- butpoints %>%
 distinct(geom, .keep_all = T)

# Make groups ####
# Butterflies
butpointscoord <- st_coordinates(butpoints) # Get the coordinates
butpoints <- cbind(butpoints, butpointscoord)# Get the coordinates

butpointsdf <- as.data.frame(butpoints)
cl <- dbscan(butpointsdf[, c("X", "Y")], eps=1000, minPts=5)
cl <- do.call(cbind.data.frame, cl)
butpoints2 <- cbind(butpoints, cl)
butpoints_gr <- butpoints2 %>% dplyr::filter(cluster > 0)
```

Download Open Street Map data, example for leisure areas for the Netherlands

```
library(osmextract)
library(sf)

# Leisure areas
leisureNL <- oe_get(place = "Netherlands",
          layer = "multipolygons",
          quiet = FALSE,
          vectortranslate_options = c(
           "-select", "osm_id, leisure",
           "-where", "leisure IS NOT NULL"
          )
)
```