

Changes in the biotope of the wart-biter (*Decticus verrucivorus* (L.)) in the Netherlands and Denmark (Orthoptera: Tettigoniidae)

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Samenvatting

Decticus verrucivorus heeft het moeilijk in deze regio: in Nederland is de soort vrijwel uitgestorven, België telt 5 "populaties", noord-Duitsland (Bremen en Niedersachsen) 41 en Engeland 4. Alleen in de kustgebieden van noordwest-Denemarken komt de soort nog talrijk voor.

De sprinkhaan, waarbij het rondlopen over afstanden van tientallen meters per dag een grote rol speelt bij het akoestisch rivaliteitsgedrag van de mannetjes, is hoofdzakelijk te vinden in semi-aride vegetaties met een vrij schaars plantendek. Behalve enkele verspreid staande hogere kruiden, die dienst kunnen doen als sjirppost en bescherming tegen predatie en de hete middagzon van de latere larvale stadia, moeten kale plekken of die, welke voorzien zijn van zeer kort gras, deel uitmaken van de habitat in verband met de eiafzetting.

Voor de embryonale ontwikkeling in het ei mag het niet te droog zijn. Vermoedelijk daarom bevinden plaatsen waar de soort voorkomt resp. - kwam zich dikwijls in de buurt van water, van bijvoorbeeld heidevennen, waar de wijfjes hun eieren afzetten langs het ven, terwijl de arena van de mannetjes zich kan uitstrekken over het aangrenzende droge gebied.

In voorgaande eeuwen bevorderde de mens het ontstaan van pionier- en overgangsplantengemeenschappen in de duinen en in heidegebieden, onder meer door het in stand houden van kudden grazers. In Nederland waren schapen in combinatie met het potstalsysteem het meest algemeen. In deze eeuw, en vooral na de tweede wereldoorlog, werd dit traditionele landgebruik beëindigd met fenomenen als ruilverkaveling, grondwaterverlaging en bebossing van stuivend zand met dennenplantages. Het halfnatuurlijke ongeperceleerde landschap met zijn vele kleine overgangen van het *limes divergens*-type maakte plaats voor een artificieel geperceleerde landinrichting met scherpe *limes convergens* overgangen. In de uitgedroogde natuurgebieden, die als snippers in de uniforme cultuursteppe lagen, bestond het beheer na het verdwijnen der schaapskudden vanaf de jaren '60 op de meeste plaatsen uit niets doen. Hierdoor breidden de vergrassing door o.a. *Deschampsia flexuosa* en verbossing door *Prunus serotina* zich uit en verarmde het gehele systeem. In de duinen leidde deze conserveringspolitiek tot het ontstaan van uniforme *Ammophila arenaria* vegetaties met veel "standing dead" materiaal, waardoor o.a. schrale *Corynephorion*- en Lichenenvegetaties hier thans nagenoeg verdwenen zijn.

In Nederland is men begonnen met de restauratie van deze inmiddels "historische" heide- en duinvegetaties door middel van begrazings- en gecontroleerde verstuiwingsprojecten, echter helaas zonder Wrattenbijters.

In Denemarken is de degradatie vanwege het "beheer" van niets doen in door de Staat aangekochte reservaten nog in volle gang. Aangezien de beheerders in noordelijk Jutland geen op het behoud van de Wrattenbijter gericht beheer willen voeren, zal deze vegetatie verarming voorlopig nog wel doorgaan. De Wrattenbijter, thans nog in flinke aantallen - maar dikwijls in kleine, geïsoleerde populaties - aanwezig, zal ook hier stellig binnen enkele decennia zeldzaam worden.

Résumé

Decticus verrucivorus ne se porte pas bien en Europe occidentale: aux Pays-Bas l'espèce a presque disparue, en la Belgique on compte 5 populations, dans le nord de l'Allemagne (Bremen et Niedersachsen) il y en a 41 et en Angleterre 4. L'espèce n'est abondante que dans les régions côtières du Danemark.

L'espèce peut être observée principalement dans des végétations semi-arides à faible couverture, où les mâles se promènent sur des distances de plusieurs dizaines de mètres, comportement important dans le rituel acoustique de rivalité. L'habitat doit également être parsemé de hautes herbes, fournissant un poste de chant et une couverture pour les juvéniles contre les prédateurs et contre le soleil. Les endroits nus où les pelouses rases servent de lieu de déposition des oeufs. Les oeufs ne se développent pas sans un minimum d'humidité, ce qui peut expliquer le fait que beaucoup de sites actuels ou disparus sont adjacents à des eaux libres. Les femelles déposent les oeufs près des eaux, tandis que les arènes des mâles sont situées dans les environs plus secs.

Pendant des siècles, les pratiques agricoles, dont le paturage extensif, favorisaient les végétations pionnières, ainsi que les végétations de transition dans les dunes et les landes. Aux Pays-Bas les troupeaux de moutons étaient omniprésents dans un système de paturage saisonnier. Ces pratiques ont été abandonnées à partir du début de ce siècle et principalement après la deuxième guerre mondiale. S'y sont ajoutés les phénomènes de remembrement, de drainage et de forestation des dunes. Le paysage non encore lotis, contenant beaucoup de transitions graduelles, a été remplacé par un paysage parcellaire à transitions brusques. Les sites naturels asséchés disséminés dans le paysage ont été laissés à l'abandon depuis les années 60. Ceci a eu comme conséquence l'invasion par *Deschampsia flexuosa* et *Prunus serotina*, diminuant la diversité du système. Dans les régions côtières les végétations uniformes à *Ammophila* ont remplacées celles à *Corynephorion* et à lichenes.

Aux Pays-bas, la restauration des végétations "historiques" des landes et dunes a débuté moyennant des projets de paturage et de soumettre à l'action des vents des sables mobiles, mais sans que *Decticus* soit encore présent.

Au Danemark, l'évolution des réserves acquis par l'Etat, continue à se développer dans le sens de l'abandon. Les autorités du

Jutland septentrional ne semblent pas être favorables à des propositions pour un changement de la gestion des sites contenant *Decticus*. Tel était également le cas dans la réserve naturelle au Gooi, ce qui a eu comme conséquence un appauvrissement de la végétation. Il est à craindre que la population encore abondante du Dectique en Jutland se raréfiera dans les décennies à venir.

Summary

Decticus verrucivorus has become rare in northwestern Europe. In Holland it is almost extinct now, but in Thy, a backward region in northern Denmark, the most important populations of the region occur. Causes of the decrease are new agricultural methods since the 1960's, plantations of Pine woods on former heath and blowing sand areas and the "management" of organisations for nature conservancy. In previous centuries human activities in dune and heath areas stimulated pioneer and transient plant communities. E.g. man cropped Heath, Marram Grass and wood from areas which have a status as nature reserve now. Herds of cattle cut off the vegetation for hundreds of years. After the acquisition of those semi-natural vegetations, being results of "low energy" agriculture, the management policy of the State and of organisations for nature conservancy consisted of doing nothing, generally from the 1960's onwards. Consequently succession of the vegetation took place during decennia, so that heath areas were overgrown with the grass *Deschampsia flexuosa* and the American tree *Prunus serotina*, while the dunes became covered with a uniform Marram Grass (*Ammophila arenaria*) and Crowberry (*Empetrum nigrum*) vegetation. Especially in The Netherlands these effects were intensified by lowering of the ground water levels, in some cases up to several metres, in combination with increased N-depositions. In The Netherlands projects of grazing management and controlled moving of the dunes have started. In Denmark, where the impoverishment of the system not yet has gone on so far, at the moment one is not inclined to take such measures. In the article photos and descriptions of a variety of habitats of *D.v.* with their Orthoptera faunas are given.

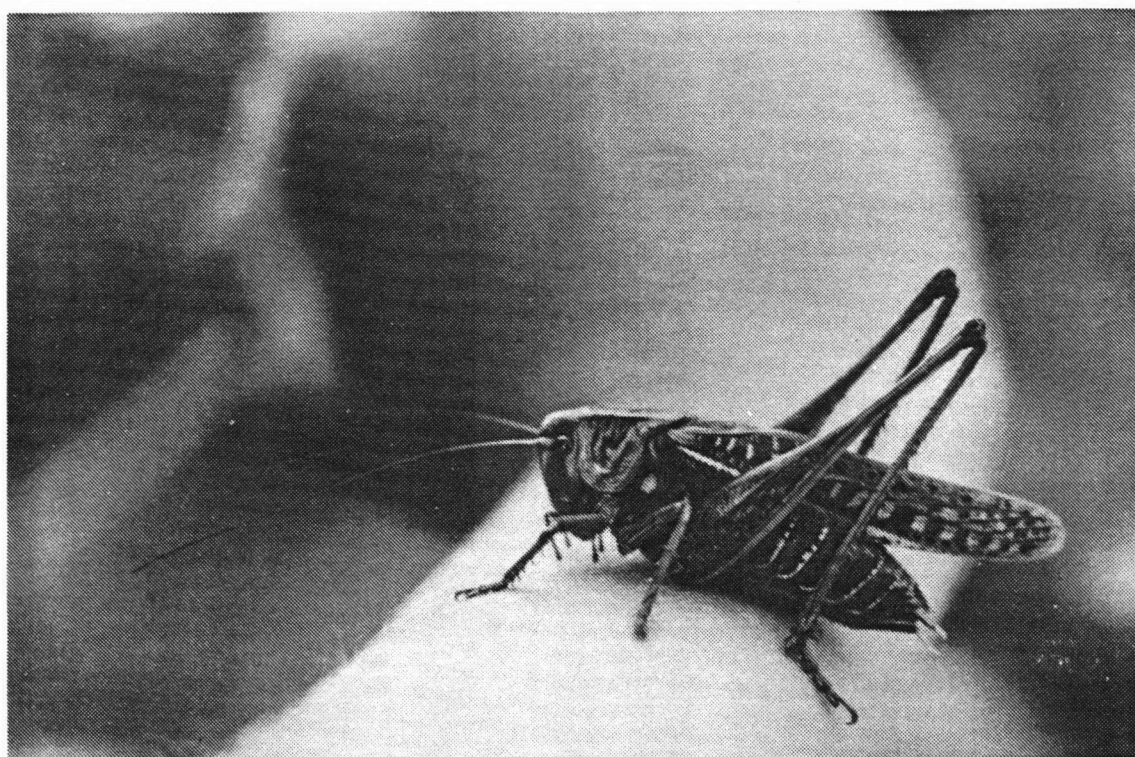


Photo 1: *Decticus verrucivorus*, ♂. A for Denmark very rare colour form: dark brown-grey with streaks of clear dark green Hjardemål Klit, Thy, northern Denmark (Jylland), 26.VII.1995. (x 1.8)

1. Introduction

In the second half of this century *Decticus verrucivorus* (L.), the magnificent wart-biter, the "gorilla" among the bushcrickets, has become very rare in the Netherlands. During the last two decades this decline has continued, the species being nearly extinct now (Tienstra, 1993 and pers. comm.). In neighbouring countries the situation is not much better: Belgium has 5 very small "populations" (Decleer & Devriese, 1992; Gossesries & Jacob, 1995), northern Germany (Bremen und

Niedersachsen) 41 (was 67 in the period 1981 - 1985, Grein, 1990) and England has 4, two of which in a single 10 x 10 km square (Cherrill, 1994). In the summer of 1995 I counted more than 2000 chirping males of the species on the Thy peninsula in northern Denmark, but in this country on the whole the wart-biter is also declining (Cherrill, 1994).

The causes for this overall decline in the region are thought to be a) a break with the age-old agricultural tradition of keeping cattle herds in semi-natural landsca-



Photo 2: Former corn field on dune sand, fallow land for three years, with mainly grasses (i.e. *Agrostis* spp.) and *Trifolium arvense*. Hjärdemål Klit, 24.VII.1995. Habitat of *Decticus verrucivorus*, *Chorthippus brunneus* and *Omocestus viridulus*.

pes, replaced by the reclamation of these for agricultural purposes, and b) the splitting up of biotopes, leaving an artificial landscape divided into lots. Mismanagement by nature conservation organisations has led to a further impoverishment of the few remaining biotopes.

2. Quality of the vegetation in relation to the behaviour of *Decticus verrucivorus*

According to own observations the biotope of *D. verrucivorus* not only consists of the arid habitats in which the adult chirping males so often can be found, but also of places with bare sand or very low tufted vegetation for egg deposition (Cherrill et al., 1991) and sites with a variety of higher herbs for the growing up of the older larvae (Cherrill & Brown, 1992). Without grazing management the latter can easily develop into more "ruderal" and dense vegetation, possibly leading to the extinction of the population. Because the adult males of this ground-living species as part of their sexual rivalry behaviour walk distances of up to a hundred metres a day while chirping (own obs.), wart-biter males can be observed pushing themselves through grassy vegetation (Tienstra, 1994; photo 2). For this purpose they seem

to have - in comparison with other Decticinae, e.g. *Decticus albifrons* - relatively short fore and mid legs. During the "push" they keep their long hind legs nearly stretched. This pushing behaviour is not possible in habitats with too dense a vegetation consisting of high herbs, nor in vegetations with a predominance of specific species of grasses, e.g. *Deschampsia flexuosa* (photo 3), where locomotion is impeded (Tienstra, 1992). I observed wart-biter males, which became entangled desperately in the rigid flowering stems of this grass. In 24 hours all of four observed males had moved less than 1 m from a mark (own obs. of the last wart-biters in the Gooi area in 1988).

From a height of 20–25 cm the sound transfer of *D.v.* is at its best (Keuper et al., 1986), so the best habitat for the arena of the rivaling males has to contain tussocks of this height or some taller plants at regular distances that can be climbed as chirping posts. The male takes such a post for 5–10 minutes and then moves on during 1–2 minutes to a next one. The females, too, will climb posts of c. 20 cm high, probably to be able to hear the males better (Tienstra, 1995). For this purpose the *Genisto anglicae-Callunetum*, the grazed dry heath, is very suitable (photo 4). Due to the

absence of grasses, the microclimate is warm in such a vegetation type. An analogous situation to this anthropogenic habitat are mediterranean habitats rich in Orthoptera with scarce vegetation consisting of small herbs, a low coverage of grasses, many Ericaceae and a lot of warmth radiation.

3 Humidity of the biotope

In Denmark as well as in The Netherlands male wart-biters can or could be found in dry habitats in heath and dune areas in the conditions described in the previous paragraph. Female wart-biters often stay at the edge of this habitat, in more humid vegetations, where egg deposition can take place. Ingrisch (1986) demonstrated with *in vitro* experiments, that there was a delay in the first diapause and strong survival reduction of final diapausing eggs at humidity rates of 50 and 30 %. A humidity rate of 75 % was correlated to shortest hatching times and highest survival rates. This means, that this percentage of humidity for the developing eggs is preferable, but not essential.

Humidity may be one of the parameters that account for the different population sizes on a site in consequent years. Haes et al. (1990) demonstrated that both summer sunshine hours and spring rainfall had a strong positive effect on numbers of *D.v.* two years later (the

Sussex chalk grassland, 1969 - 1987: in northern Europe the eggs of *D.v.* have a "standard" diapause of two years). They suggest that the adult population size is determined more by the total number of eggs laid two years previously than by variation in subsequent egg and nymphal survival.

Schatral et al. (1985) give a picture of a "damp meadow" at the border of the Faulensee (Germany) being a site of *D.v.* (a further description of the habitat is lacking). One of the Gooi localities was also situated along a fenn (photo 5). Especially the females could be found along the small lake. Possibly the humid conditions for embryonic development in the eggs were more favourable here: in this locality the largest population of the region was found. Preference of females for localities near water is also suggested by the Horsehair Worm, *Gordius dectici*, which is a parasite of bushcrickets, especially the wart-biter (Grzimek, 1971). The worm deposits its eggs in open water. To accomplish this, the host moves to the water urged by an impulse not yet known. In the water the abdomen of the insect is cracked and the worm leaves the host.

The best biotope for the wart-biter I ever saw, with several hundreds of chirping males and females/larvae on one site, the Bulbjerg in northern Denmark, has an always humid soil (beach sand on limestone). The



Photo 3: *Deschampsia flexuosa* vegetation on a former *Calluna vulgaris* field, Hjärdemål Klit, VIII.1995. No Orthoptera fauna.



Photo 4: *Genisto anglicae-Callunetum*, the dry grazed heath vegetation predominant on the Zuiderheide, Gooi, The Netherlands, 1964. In the distance, 30 m lower, lie the humid "green" places where egg deposition and larval development took place. Males often wandered from these places to the front of this photo (a distance of 1.6 km). Orthoptera fauna: *Decticus verrucivorus*, *Chorthippus brunneus*, *C. biguttulus*, *C. mollis*, *Myrmeleotettix maculatus*, *Oedipoda caerulescens* and *Gryllus campestris*.

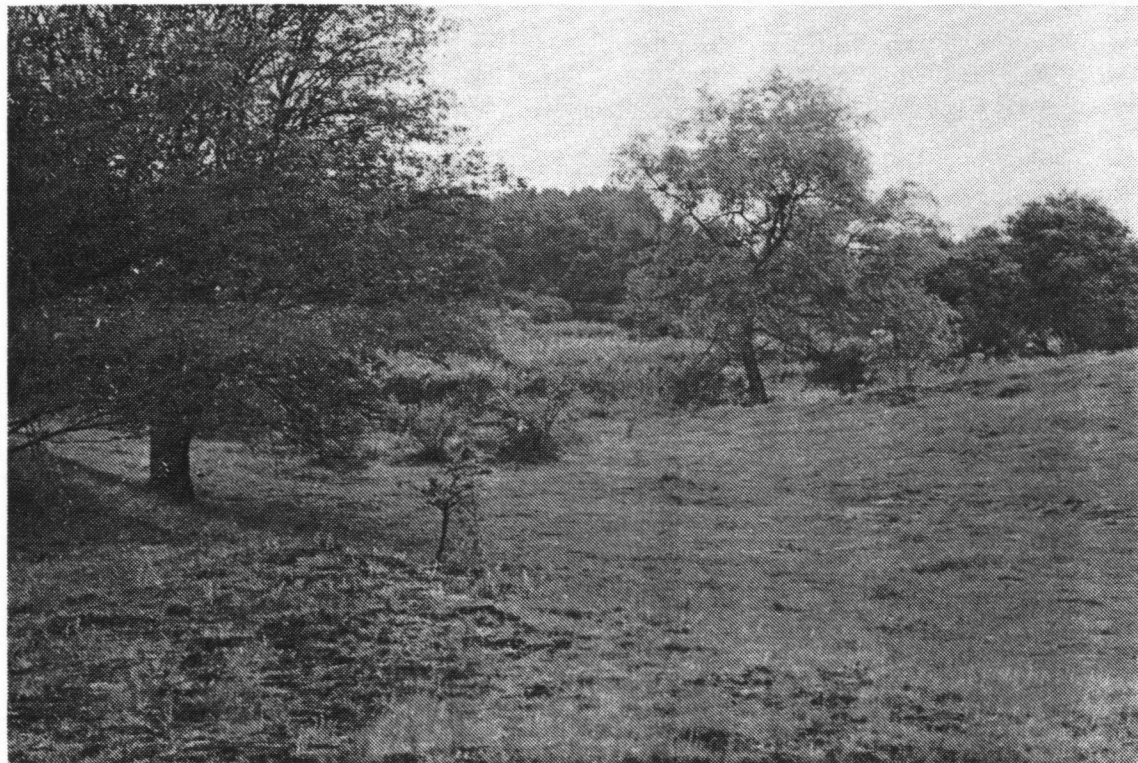


Photo 5: Laarder Waschmeer, Gooi, 2.IX.1988. The humid "green" breeding place of photo 4, now consisting of a cow-grazed grassy vegetation of i.e. *Calluna vulgaris*, *Festuca ovina*, *F. rubra*, *Deschampsia flexuosa* and the Lichen *Cladonia portentosa*. In the gully *Agrostis* spp. and *Molinia coerulea*. Along the fen eutrophic weeds and shade by several shrubs. Orthoptera after restoration: *Tettigonia viridissima*, *Meconema thalassinum*, *Leptophyes punctatissima*, *Metrioptera brachyptera*, *Nemobius sylvestris*, *Chorthippus albomarginatus*, *C. brunneus*, *C. biguttulus*, *C. mollis*, *Omocestus viridulus*, *Myrmeleotettix maculatus*, *Stenobothrus stigmaticus*, *Tetrix undulata*; disappeared: *Decticus verrucivorus*, *Gryllus campestris*, *Oedipoda caerulescens*.

highest population densities can be found here just along the coast (photo 6). The sea reaches the foot of this locality and in the stormy 1993 summer males were chirping while salt water drops were thrown upon them! Unfortunately in 1995 this site was rather completely eroded by intensified tourist recreation.

Drought may be the restricting factor for high population densities in the Dutch National Park "Hoge Veluwe", where only small numbers (6, 15 singing males, in 1995 none) have been observed (photo 8).

4. Extinction and recolonisation

In the previous paragraphs I tried to demonstrate that the wart-biter needs habitats consisting of pioneer and transient plant communities, while the amount of humidity also is rather critical. The requirements of the species thus can be characterized as opportunistic. Without grazing management on a site, the population could become extinct while a neighbouring one some (several) hundreds of metres away, might be in more favourable biotope conditions and survive. In a semi-natural, not-parcelled landscape, with periodic grazing, recolonisation of such a site may take place, the more so because of wandering males reaching the area. Sperm competition probably plays a role (Tienstra, 1993a, 1995) and normally provides for the genetic enrichment of separated populations (Tienstra 1994, 1995). Also the females can often be found in very dry, bare vegetations, hundreds of metres away from the "green" breeding places (own obs.). The survival (Cherrill, pers. comm.) of diapausing eggs in the soil with too low humidity for up to 8 years forms an important element of the ecology of the species.

5. Changes of the landscape and the future of *D. verrucivorus* in the two countries

After the second world war, and especially in the 1960's, in The Netherlands as well as in Denmark, many heath and blowing sand areas were acquired by the State and by nature conservation organisations. From this moment on, in many cases the (over-) grazing management, which had kept heath fields and blowing sand areas in pioneer plant communities' condition, suddenly ceased. As the age of a *Calluna vulgaris* plant is about 40 years, and no more germination of this species could take place because of the dense vegetation, by 1990 the former biotopes fit for *D.v.* had been

replaced by grassfields (*Deschampsia flexuosa*: heath areas in Holland and Denmark), uniform Crowberry vegetations (*Empetrum nigrum*: dunes in Denmark) or vegetations consisting of monotonous Marram Grass (*Ammophila arenaria*: dunes in both countries). In these vegetations wart-biters cannot display their rivalry behaviour which include walking, the bare places for egg deposition are absent and warmth radiation has become insufficient. On top of this disaster, in both countries the plantation of pine forests to fix the blowing sand has occurred. The exotic *Prunus serotina*, nowadays in Holland called "wood pest", was planted in large numbers as "fire wall" and "soil improver". Since it has overgrown thousands of acres in the Netherlands, where it has replaced the natural vegetation completely, it is now fought against. In the Gooi area the heath is disposed of this shrubby tree every five years. In Denmark it is still planted nowadays (!). Because of these plantations, populations of the wart-biter were, if not yet totally wiped out, impeded to get contact with each other. In the fixed parcelled landscape of today the opportunistic surviving strategy of this species is no longer appropriate.

Finally I mention the lowering of the ground water level as a consequence of agricultural demands, which especially in Holland has taken extravagant forms, so that woods are dying and fens are drying up. A lowering of the ground water level with several metres surely must be disastrous for *D.v.*, because of the extreme delay of the first diapause (Ingrisch, 1986). On top of this has come the high N-deposition in both countries, which has stimulated overgrowing of heath areas by grass and ruderal herbs.

Yet I believe grazing management must be sufficient to get the biotope appropriate for *D.v.* again, as modest results in Holland demonstrate (photo 5). Though recently many heath areas in Holland have been restored by fenced grazing programs, so that for the eye biotopes look suitable for *D.v.*, this big bushcricket is now absent from almost all 32 formerly known localities. From the Drongelen Canal population, rediscovered in 1971, only three females could be traced in 1996 (photo 9, page. 9) on the only place that was more or less appropriate, the rest of the biotope was overgrown with Blackberries (*Rubus caesius*). If enough diapausing eggs are present in the soil, instant removal of the vegetation may restore this possibly last population of the species



Photo 6: Overview of the habitat of *Decticus verrucivorus* in the dunes on foot of the Bulbjerg, Thy, northern Jylland, 24.VII.1995. In front *Leymus arenarius*, in the back *Ammophila arenaria*, for details see photo 7. The vegetation is a climax for this site; it is maintained by salt wind and blowing sand. In this "complete" habitat larvae as well as adult wart-biters could be found in high densities. Orthoptera fauna: *Decticus verrucivorus*, *Chorthippus brunneus*, *C. biguttulus*, *C. albomarginatus*, *Omocestus viridulus*, *Myrmeleotettix maculatus*.



Photo 7: Detail of the middle of photo 6. The following plant species can be observed: *Ammophila arenaria*, *Galium verum* subsp. *maritimum*, *Geranium sanguineum*, *Pimpinella saxifraga*, *Achillea millefolium*, *Hieracium umbellatum*, *Rosa pimpinellifolia*, *Armeria maritima*, *Campanula rotundifolia* and *Festuca rubra* subsp. *arenaria*.

in The Netherlands. In coastal areas in northern Denmark *D.v.* is still occurring in many places. Yet here too splitting up of the biotope has taken place and is still going on. At the moment pine woods are still planted over large areas on former dune landscapes! Since the 1960's the Ministry of Ecology has acquired many dune and heath areas in the region. Since then apparently no other management has taken place than covering blowing sand with branches. In 1981 the magnificent 6000 acres' Hanstholm Reserve had many open sandy places with *Violo-Corynephorretum* and *Callunetum* vegetations (Tienstra, 1992). The "look" of this area was violet, caused by the flowering *Calluna* heath. In 1995 the overall vegetation colour had become green, caused by *Polypodio-Empetretum* vegetations - formerly covering only north exposed slopes but nowadays found all over the place - and open places had nearly disappeared. On

a state heath near Frøstrup the number of *Ophioglossum vulgatum* plants on a site had decreased from c. 150 in 1992 to 20 in 1995, and *Gentiana pneumonanthe* individuals from c. 50 in 1992 to 2 in 1995. A place with the rare *Botrychio-Polygaletum* plant association was completely overgrown with the grass *Deschampsia flexuosa* in 1995 (this plant association has been evaded in the Gooi area in the same manner). The Thy Statsskov distrikt authority proved to be not interested into proposals of controlled grazing and dune moving experiments. The same was the case in 1964 with the Gooi Nature Reserve organisation. It can be hoped that the responsible Danish authorities will take adequate measures in time. There will be no future for *D.v.* in both countries, unless existing and reintroduced populations will be kept under strict management conditions.



Photo 8: *Spergulo-Corynephorretum*, "Hoge Veluwe" N.P., The Netherlands, 21.VIII.1995. Habitat of the butterfly *Neohipparchia statilinus*, (Tree Grayling, NL: Kleine Heivlinder, FR: Faune), an astonishing dry and scant biotope for the wart-biter, which occurs close to this site although in small numbers. Orthoptera: *Chorthippus mollis*, *C. parallelus*, *Omocestus viridulus*, *Stenobothrus lineatus*, *Oedipoda caerulea*. Natural management by blowing sand and grazers, i.e. Mouflon and Red Deer. At a ½ km lies a Red deer meadow, possibly a breeding place for wart-biters.

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