Feasibility study on reintroduction of Marsh Fritillary *Euphydryas aurinia* to Danish SACs

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Contents

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Introduction

Reintroduction has been used as a tool in conservation management of butterfly populations in Western Europe (e.g. The Netherland, Great Britain) and is planned for another rare Danish Butterfly, the Large Blue, as part of a LIFE-project.

This report is part of the LIFE project ASPEA – Action for sustaining the population of *Euphydryas aurinia*. Action A6. The main question is the feasibility of reintroducing of the *Euphydryas aurinia* in two SACs where it is presumed to be extinct.

Status in Europe and Denmark

Marsh Fritillary *Euphydryas aurinia* is declining in Denmark and surrounding Member States (e.g. Sweden, Finland and Great Britain). Already it is extinct in Belgium and The Netherlands.

Since the end of the1980´es the species has only been found in the northern part of Denmark. Outside northern Jutland it disappeared during the 1980´es: in 1982 in southern Denmark (probably due to sheep overgrazing), in 1983 and 1987 it disappeared from two localities in central Jutland (Stoltze 1996).

The last record from the former county 'Viborg Amt' was in 1998. After year 2000 the species has only been recorded in the former county 'Nordjyllands Amt'. In 2006/2007 it is known to occur at some 5-20 localities depending on how localities are defined.

1998: 4 areas known
- Lundby Hede, FX127
- Råbjerg Mose, 'Granly' FX342
- Napstjert Mose, FX342
- Tolshave Mose, FX342

In 2000, the species was re-discovered at:
- Råbjerg Mose, road side, FX 342
- Skrædderengen, FX123 – apparently extinct again in 2004
- Strandby, FX 113
- Napstjert Engen / Videslet, FX342

And as a new record:
- Hjeds Kær, not Natura2000

In 2001, it was discovered or re-discovered at:
- Jennet Gunger, at border of FX342

In 2004, it was discovered or re-discovered at:
- Tranum Millitary Area, FX274 – known from 1970

Råsig Mose, south of Tolshave, FX342
Overklitten Sø, outside Natura 2000
Tranum Klitplantage, road side outside Natura 2000

In 2005, it was discovered or re-discovered at:
Randborg, FX442
Milrimvej, FX342 – known *c*. 1994
Cottages Area East of Napstjert, outside Natura2000

In 2006, it was discovered or re-discovered at:
Lodskovvad Mile, FX005 – last record 1973 or maybe 1974
Sortkær Hede, FX342
Jerup Hede, FX 342 – last seen in 1993

In 2007, it was discovered or re-discovered at:
Jerup Strand, outside Natura 2000

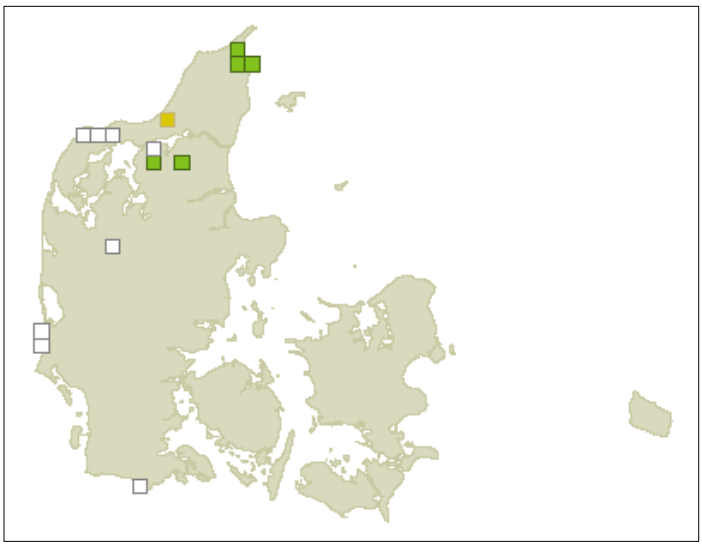


Fig 1. Distribution of *Euphydryas aurinia* in Denmark, 2004 and 2005.
Open squares are monitored without records, Green squares are with records in the national monitoring programme NOVANA and orange area records outside NOVANA (Søgaard et al. 2005).

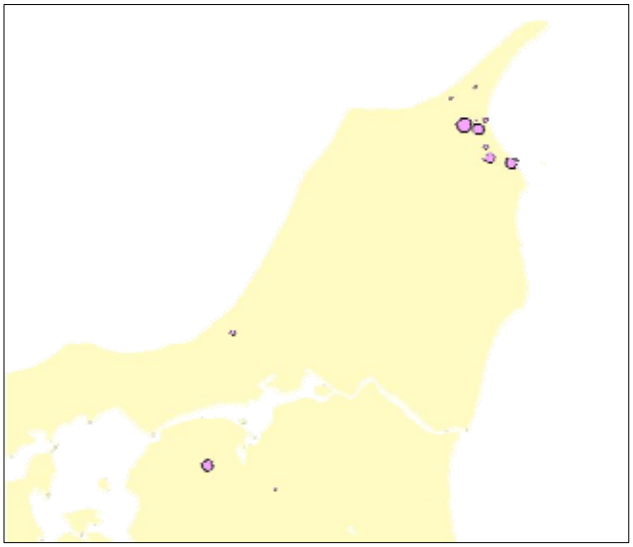


Fig 2. Distribution of Euphydryas aurinia, 2006. Dot size indicating size of population in 2006.

Danish management history of *Euphydryas aurinia*

1991: Government: Full species protection.
1998: National Environmental Research Institute (NERI): alarming only 3-4 populations left.
1999: The Danish Society for Nature Conservation (DN): special protection of the area Tolshave
1999: County of North Jutland (NJA): Lundby Hede – management
2000: Danish Forest and Nature Agency (SNS): consulting report, status and actions suggestions
2000: SNS: National Action Plan. (Skov- og Naturstyrelsen 2000)
2001: NJA: Tolshave - management
2001: NERI & NJA: pilot project on monitoring
2002: NJA: agri-environmental schemes target at Marsh Fritillary, information initiative with folder and website.
2004: National monitoring programme of water and nature (NOVANA): monitoring every 2. year
2005-2007: LIFE-projektet ASPEA

Study areas

In two SACs in the area of the former County of North Jutland *Euphydryas aurinia* is targeted. However, there are no records for app. 15 years. Marsh Fritillary is probably extinct in two SACs. In the area DK00FX115 the species was last seen in 1992, and in DK00FX120, is was last recorded in 1990.

DK00FX115. Kærsgård Strand, Vandplasken og Liver Å

This site is situated at the west coast South of Hirtshals town.

The species was last recorded in 1992 along a fence in a dune slack. As far back in time as in 1976 it was recorded to be numerous in 'Tornby Klit' (Knudsen 1981) – probably the northern part of the SAC, sub area D.

The area is well visited by entomologists due to a fine population of other butterflies e.g. *Aricia artaxerxes* - a species only found in Denmark at Jutland´s Northwest edge. The local naturalists often send their records to a local website and information is frequently shared among the naturalists. Their possible observations have been seeked for this study, but no new records have appeared. Also the field survey performed for this study did not record the species. It is there for believed to be locally extinct.

Taking the reports from the landowner and local naturalists into consideration, it is clear that changes have taken place: shrubbery is increasing, mainly *Hippophaë rhamnoides*, *Rosa rugosa* and *Salix repens*. In the northwest corner of the fenced and grazed area there used to be open vegetation; now there is dense shrubbery. Outside the fenced area, the herbal vegetation is getting more dense, e.g. Wood Small-reed *Calamagrostis epigeios* is occupying still larger areas. The landowner reported that the area many years ago was grazed by horses. A theory is, that a suitable number of horses grazing the area might be better for the *Euphydryas aurinia* since horses – as opposed to cattle - do not eat the larvae food plant *Succia pratensis*.

Just south of this area, a large cottage area has developed since the mid 1980´es. It is possible that unknown populations of *Euphydryas aurinia* thereby disappeared and as a consequence the possibility of maintaining a metapopulation structure. The hydrology might have changed, also north of the cottage area.

The dense sward outside of the fenced and grazed area is probably a consequence of an increasingly higher level of deposition of airborne nitrogen. Probably the most significant source to this deposition is loss from farming activities. Locally, traffic relating to cottage and beach areas might also be factor. Ship traffic, on the other hand, is not considered a factor since it does not occur close to the coast. Contribution from fire stoves in the cottages cannot be excluded as a factor of some significance.

Within the large fenced area in the southern part of the site, including the lake Vandplasken, is found probably the highest number of red listed and other rare plant species in Denmark; at least one species of moss is only found here. Among the targeted species we find large populations of the orchid *Liparis loeseli* and snail *Vertigo gyerii*. As a consequence, management actions have to be carried out very carefully.

Four potential sub areas have been examined as potential habitats of *Euphydryas aurinia*. The over all conclusion is, however, that only a small area is suitable. The map shows the sub areas, and the photos below give an idea of the area. Compare with the field notes in appendix I.

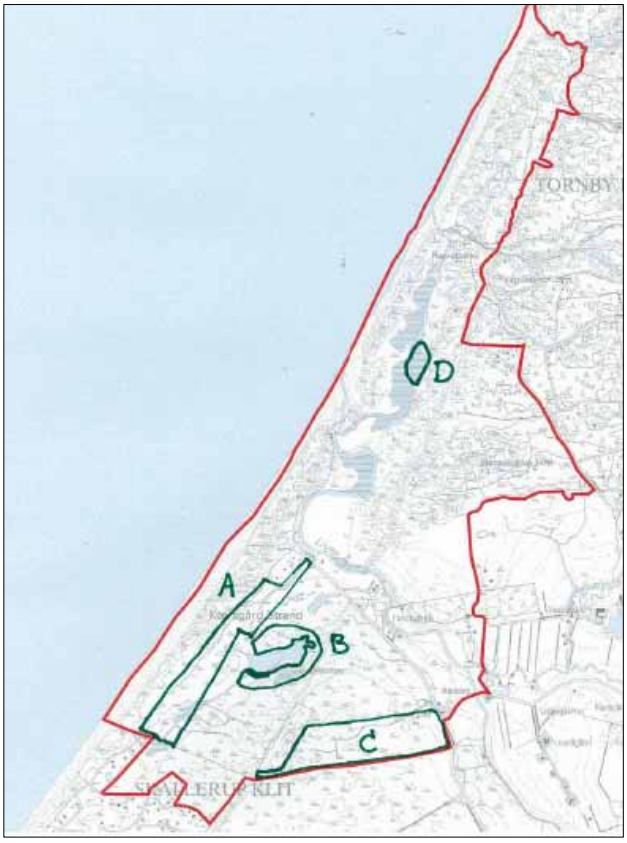


Fig. 3. Map of DK00FX115 with sub areas.


Fig. 4 . The fence west of Vandplasken. Note the difference in height of vegetation. Sub area 115 A


Fig. 5. Viper's grass *Scorzonera humilis*, almost overgrown by Sea-Buckthorn *Hippophaë rhamnoides*. Sub area 115 A.

Fig. 6. Small plants of Devil's Bit Scabious in low herbal vegetation bit half covers by Creeping Willow *Salix repens*. Sub area 115 B.

Fig. 7. Devil's Bit Scabious in tall grasses. Sub area 115 D.

DK00FX120. Store Vildmose

This site partly consists of an old raised bog. The bog is highly influenced by drainage and has degraded in most parts. Between the bog areas and the river Ryå is found the largest area in Denmark of old meadow that is still mowed. The meadow hosts a fine population of the Corncrake *Crex crex*.

The last records from the area were in 1990 or 1991. The entomologist responsible for this record was contacted before visiting the area.

Six potential sub areas have been examined. The butterfly was, however, not found. The over all conclusion is that there is no suitable habitats in the site. Lack of management might be the reason for extinction. Also fragmentation or too few areas to maintain the metapopulation structure could be explanations. The nearest by area known to host a population of *Euphydryas aurinia* is about 20 km away. Potential areas as well as areas formerly known as habitats for the species are situated in between.

The map shows the sub areas, and the photos give an idea of the area. Compare with the field notes in appendix I.

Parts of the huge meadow still mowed might be mowed too late for *Euphydryas aurinia*. But that is probably just right – or even too early – for the Corncrake.

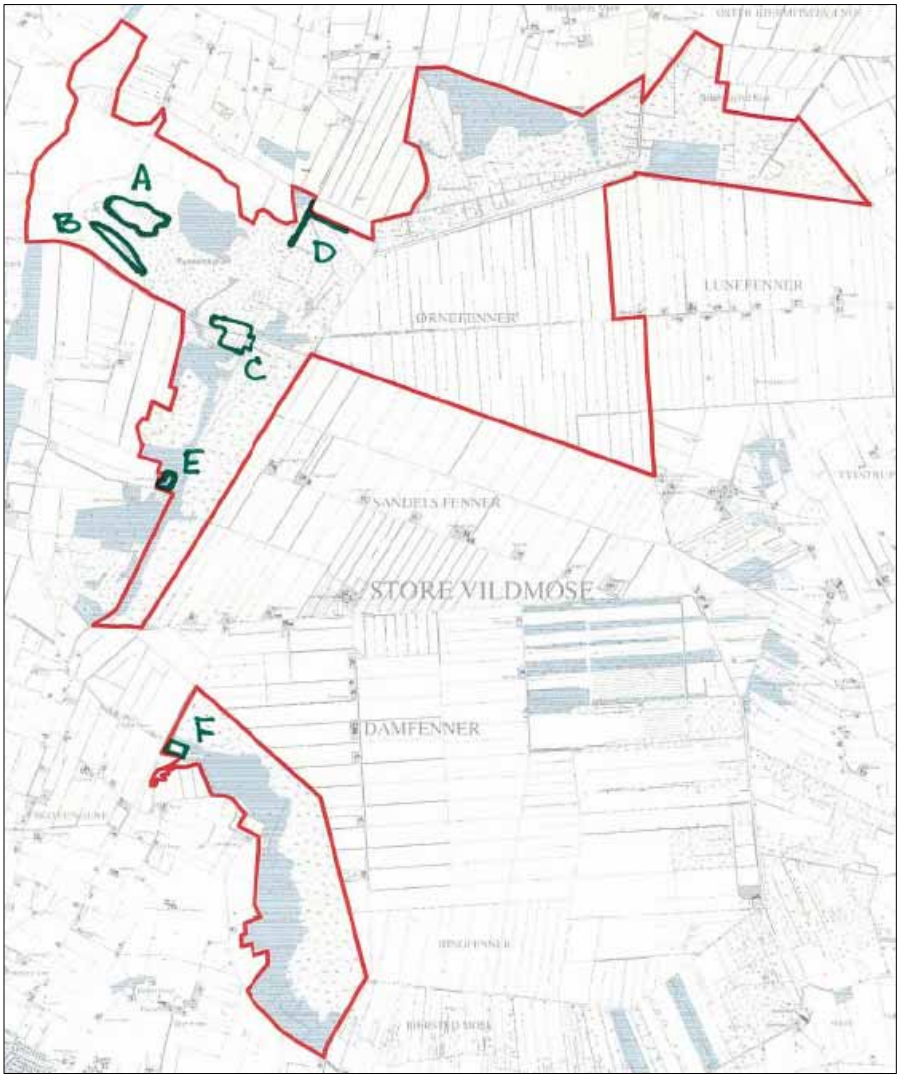


Fig. 8. Map of DK00FX120 with sub areas


Fig. 9. Old hay meadow north of Ryssengrave, Store Vildmose. Sub area 120 A.


Fig. 10. Succia pratensis at mowed area. Sub area 120 A.

Fig. 11. Devil's Bit Scabious at the edge between a parking lot and dense willow scrub. Sub area 120 C

Fig. 12. Edges between bog area and hay meadow. Sub area 120 D.

New records in other SACs

In the project period of the ASPEA LIFE-project there were some new records or re-records in two Natura 2000 sites where the species was not targeted. They are not the result of a direct survey for the species, but just accidental findings whilst doing other work in the field.

The sites are:

DK00FX005, Råbjerg Mile og Hulsig Hede, recorded by The County of Northern Jutland 2005. This could be a possible re-colonisation from one of the two largest, and most expanding populations situated app. 7 km to the South. Last known record in this area was in 1973.

DK00FX274, Ejstrup Klit og Egvands Bakker, recorded by a local birdwatcher in 2004.
This is probably an over seen population in a military area closed to the public. In 2005 and 2006, 3 to 4 populations (or subpopulations) were found outside the military area - and outside the SAC, though on state forest land.

Other SACs with potential occurrence of *Euphydryas aurinia*

SACs with *Euphydryas aurinia* as a target

Euphydryas aurinia was recently extinct in SACs where it was targeted.

DK00FX123, Nibe Bredning, Halkær Ådal and Ulvedybet.
DK00EX129, Vullum Sø (old Viborg Amt, not part of ASPEA
DK00FX025, Vangså Hede (old Viborg Amt, not part of ASPEA)

The last records FX129 were in 1998 (Bech *et al* 1998) 4-6 individuals were seen at Juni 4th.
Last record in FX123 is between 2000 and 2003 (data from the county)

Other SACs that have hosted the species

The following SACs have hosted the species in the last 15-20 years. Possibly, populations have been overseen:

DK00FX114 Uggerby Klitplantage, Uggerby Å's udløb - 1993
DK00FX117 Åsted Ådal
DK00FX121 Svinkløv Plantage og Grønne Strand – 1991
DK00EY124 Løgstør Bredning, Vejlerne og Bulbjerg
DK00FX219 Lien med Underlien

And maybe others sites in northern Thy (not part of ASPEA)

Natural re-colonisation

It has been a bit of a tradition in Danish conservation management that *Euphydryas aurina* does not fly long distances and that it has low ability of colonizing new areas. A mobility study of Danish *Euphydryas aurinia* (Nielsen 1993) with marked individuals recorded only short flying distances of an average of 200 meters. A 500 meter-distance has been used as a potential maximum range in e.g. projects related to agri-environmental schemes.

In well monitored sites in Great Britain, however, colonisations have been recorded at much longer distances. Three sites were colonised within 5 km of known colonies, three within 5-20 km, and one maybe as far away as 40 km. In Scotland, adults may be extremely widespread in years of abundance (Barnett & Warren 1995). Joyce & Pullin (2003) use 20 km as the suspected colonisation distance for *Euphydryas aurinia*. This long-distance spreading seems to occur in years of high numbers of adults as well as warm weather.

The two SACs of this study are situated 20 and 25 km away from areas known to host healthy populations of *Euphydryas aurinia*. In both cases the species was in the early 1990´es recorded from areas closer to the SACs. The possibility of a future natural re-colonisation can not be eliminated.

Reintroduction of butterflies

Butterfly species have been introduced or reintroduced in other places of the world. It had happened either as part of an action plan, or more or less accidentally.

Re-introduction of Marsh Fritillary

Re-introduction or just introduction and other releases of Marsh Fritillary has been carried out in Great Britain more often than any other butterfly (Barnett & Warren 1995)

On of the more recent projects, in one of the more isolated occurrence area is:

2007 Cumbria, Great Brittain, 20.000 larvae breed and released (http://www.butterfly-conservation.org/news/article.php?id=49)

Reintroduction of other butterfly species in Western Europe

Butterflies have been translocated or reintroduced in some parts of Europe where they were extinct.

Large Blue *Maculinea arion*
1990 The Netherlands, 70 imago from Poland
2000 North Cornwall, Great Britain, 10 females, 2 males and < 300 larvae raised in captivity released
Total of reintroduction in 6 or 8 sites in Great Britain,

Dusky Large Blue (possible: *Maculinea nausithous*)
1990 Moerputten reserve, Netherland – 86 imago from Poland

Small Pearl-bordered Fritillary *Clossiana selene*
1993 Meije Reserve, Netherland - 79 imago released
2001 Ilperveld reserve, Netherland – 20 imago released

Results of Dutch reintroductions

At the internet some results of the Dutch projects have been published (http://www.mnp.nl/mnc/i-en-1060.html). As examples these results are shown below.

Trend in large blues

"*In 1990, about 20 years after they had gone extinct in the Netherlands, 86 large blues and 70 dusky large blues from Poland were released in the Moerputten reserve (south of 's Hertogenbosch). Both these species live on damp infertile to lightly fertilised grassland, and their host plant is the greater burnet. In their larval stage they are parasites of certain ant species, so therefore they are dependent not only on the great burnet but also on the presence of these host ants.*
There is now only one Dutch population of the large blue. Numbers fluctuate greatly from year to year. There are three small populations of dusky large blue; after increasing sharply, this species has been declining for several consecutive years and is thus once again at risk of going extinct in the Netherlands. One of the reasons for the decline is that the vegetation of its habitat is becoming rank, and grazing animals are preventing the host ants from increasing. In addition, inappropriate mowing is making much of the habitat of the dusky large blue unsuitable."

Trend in the small pearl-bordered fritillary

"*The small pearl-bordered fritillary used to be common in the Netherlands. It frequents damp, nutrient-poor grassland and marshes with flower-rich reed areas, where its host plant (the marsh violet) and nectar plants grow. The species has disappeared from many areas because of drainage, land reclamation and the intensification of farming.*
In 1993 the small pearl-bordered fritillary was reintroduced in the nutrient-poor grasslands of the Meije reserve (Zuid-Holland), after careful management had brought about an increase in the

marsh violet and nectar plants. In total, 79 butterflies were released, in two phases. The population increased sharply, especially in the first few years. It increased again in 2001.

In 2001 20 specimens of the small pearl-bordered fritillary were released in the Ilperveld reserve…."

Reintroductions in Denmark

Reintroductions of butterflies have not been a part of nature conservation in Denmark. But as part of a LIFE project with dry grassland restoration at the island of Møn it is planned to reintroduce Large Blue to an area where the species was last found in 1976. The last known Danish population of the Large Blue is some where else at the same island.

Habitat directive and reintroduction

Article 22 in The Habitats Directive states, that Member States shall "*study the desirability of re-introducing species in Annex IV that are native to their territory where this might contribute to their conservation, provided that an investigation, also taking into account experience in other Member States or elsewhere, has established that such re-introduction contributes effectively to re-establishing these species at a favourable conservation status and that it takes place only after proper consultation of the public concerned…*"

Euphydryas aurinia is not at annex IV, only at annex II. Therefore reintroduction is just one conservation tool among others that can be used to reach favorable conservation status.

Genetic aspects of reintroduction of *Euphydryas aurinia*.

In 2004 larvae form 5 populations were collected and the genetics investigated as part of Peter Sigaard´s Master Thesis at University of Aarhus. One of the populations, Hjeds Kær, is not part of the ASPEA project, since it is not a natura2000 site. Sigaard also did a morphological study of 429 pinned and dried specimens found in national museums. Of the 429 specimens, 234 were collected in Northern Jutland (56 females and 188 males).

This study asked Sigaard for a recommendation, and he made a report, se appendix II.

The morphological analysis showed changes towards smaller and perhaps more slender wings, which can reduce dispersal ability. There can be at least three explanations: habitat quality, habitat structure and inbreeding. All three factors probably play a role. Sigaard finds that habitat quality may be the most important.

The genetic part showed that the two large populations situated app 2 kilometres from each others in Råbjerg Mose and Napstjert Mose, have a good genetic variation and some exchanges of genes. The population in Strandby has probably suffered from some isolation. Lundby Hede still has good variation. Only the population not included in ASPEA, Hjeds Kær, suffered from genetic drift.

"*Future management is … recommended to increase gene flow between remaining population in order to reduce generic drift and inbreeding while habitats are restored in order to increase carrying capacity*."(Sigaard 2007). Sigaard also recommends for reintroduction purposes that specimens should not be taken from areas where genetic variation is low. If reintroduction is used as many specimens of both sexes should be realeased.

Joyce & Pullin (2003) made a genetic study in Great Britain and concluded: "*that effective conservation of species must seek to provide networks of suitable habitats for groups of subpopulations, rather than maintaining habitats for isolated populations*."

Discussion of reintroduction

When discussing reintroduction it is very important to distinguish between different types of releases of individuals (see eg. Andrén & Nilsen 1995). IUCN had a statement in 1987 defining:

Introduction: Release outside native range

Re-introduction: Intentional release in parts of native range from which a species disappeared in historical time by human activities. (The definition used in this study).

Re-stocking: Release in native range to build up the number.

Conclusion

The two SACs in this study do not provide fully sustainable habitats for reintroducing and maintaining a population of *Euphydryas aurinia*. A re-introduction programme to both areas would take quite a restoration of the habitats. The populations will be isolated from other populations.

If suitable habitats were restored and maintained in these areas, the distance to vital populations would probably allow for natural re-colonisation to occur. Especially the site FX120 where the distance to the known populations around Tranum Klitplantage is 20 km.

Establishing of step stone habitats with a distance no longer than 5 kilometre between them might be necessary to secure genetic input to a population. Otherwise releases have to occur more than once.

Larvae is easy to breed. It is likely that volunteers can do the collection and breeding. However, a project suitable for a permission from *the full species protection* must include various follow-ups to secure that the released individuals are not just lost. It would probably be necessary with a quite intensive monitoring of reintroduced populations – both by numbers, habitat parameters and genetics. Otherwise the money spend will be wasted.

The conclusion is that re-introduction of *Euphydryas aurinia* to the two SACs FX00DK115 and DK00FX120 can not be recommended.

References

Andrén, C. & Nilsen, G., 1995. Translocation of amphibians and reptiles. – Memorand Soc. Fauna Flora Fennica 71(3-4): 84-87.

Barnett, L.K. & Warren, M.S., 1995. Species Action Plan, Marsh Fritillary *Eurodryas aurinia*. Butterfly Conservation. http://www.butterfly-conservation.org/species/action_plans/marsh_fritillary/mf_action_plan.pdf

Bech, K., Christensen, E., Fibirger, M., Helsing, F., Jensen, L., Knudsen, K., Madsen, A. & Møller, H.E., 1998. Fund af Storsommerfugle i Danmark 1998. Tillæg til Lepidoptera bind VII nr. 7.

Eliasson, C. U., 2005. Faktablad: Euphydryas aurinia – väddnätfjäril. ArtDatabanken, SLU.

Joyce, D.A. & Pullin, A.S., 2003. Conservation implications of the distribution of genetic diversity at different cale: a case study using the marsh fritillary butterfly (Euphydryas aurinia), Biological Conservation 114: 453-461

Knudsen, K., 1981. Status over Nordjyllands storsommerfugle 1970-1979.

Kjærgård, J.K., 1993. Fund af Hedepletvinge i Thy. – Naturnyt 22(2): 50-51.

Nielsen, P., 1993. Vurdering af bestandsstørrelse og mobilitet af hedepletvinge (Euphydryas aurinia) på De himmerlandske Heder, samt studier over artens biologi. – Odense Universitet, Biologisk Institut.

Sigaard, P., 2006. Reintroduktion af Hedepletvinge (Euphydryas aurinia) – Anbefalinger baseret på en genetisk undersøgelse af bestande i Danmark. Afdeling for Genetik og Økologi, Biologisk Institut, Aarhus Universitet

Sigaard, P., 2007. Habitat degradation and fragmentation – genetic consequences exemplified by *Euphydryas aurinia*. – Master Thesis at Ecology and Genetics, Department of Biological Sciences, University of Aarhus.

Skov- og Naturstyrelsen, 2000. Handlingsplan for bevaring af den truede sommerfugl Hedepletvinge *Euphydryas aurinia*. Miljø- og Energiministeriet, Skov- og Naturstyrelsen.

Stoltze, M., 1996. Danske Dagsommerfugle. Gyldendal.

Stoltze, M., 1998. Overvågning af dagsommerfugle i Danmark. Notat 16. februar 1998. Miljø- og Energiministeriet, Danmarks Miljøundersøgelser.

Søgaard, B., Pihl, S. og Wind, P. 2006: Arter 2004-2005. NOVANA. Danmarks Miljøundersøgelser. 248 s. – Faglig rapport fra DMU nr. 582. http://www.dmu.dk/Udgivelser/Faglige+rapporter/

Appendix I. Field notes.

See map of sub areas in chapter “Study areas”.

DK00FX115, Kærsgård Strand, Vandplasken and Liver Å.

Sub area	**115 A**	Along and west of fence.		
Visited		Date		20060824
Euphydryas aurinia		Numbers of larval web		0
		Numbers of imago		-
Succia pratensis		Frequency		Occasional
		Size		Medium
		Sun exposing		Low
Flowers, nectar plants		Frequency		Scattered
Surrounding vegetation		Height	Herbal layer	50 cm, but variable
			Scrubs	Dense, 1 m
Management		Grazing husbandry		No
		Grazing intensity		-
		Mowing		No
Changes over time		Interview		No
		Ortho photo analysis		
Other notes		Some 20 larvae web of *Melitaea cinxia*		
Suitability to *E. aurinia*		Conclusion		Less suitable

Sub area	**115 B**	Inside the fence around Vandplasken , below old sea line		
Visited		Date		20060824
Euphydryas aurinia		Numbers of larval web		0
		Numbers of imago		-
Succia pratensis		Frequency		Frequent
		Size		Small
		Sun exposing		Full at many plants
Flowers, nectar plants		Frequency		Frequent
Surrounding vegetation		Height	Herbal layer	5-10 cm
			Scrubs	1 m
Management		Grazing husbandry		Beef cattle
		Grazing intensity		Medium
		Mowing		No
Changes over time		Interview		Changes from Horses to cattle, shrubbery increasing
		Ortho photo analysis		

Other notes		
Suitability to *E. aurinia*	Conclusion	Not suitable

Sub area	**115 C**	Above old sea line, inside the fence	
Visited		Date	20060825
Euphydryas aurinia		Numbers of larval web	0
		Numbers of imago	-
Succia pratensis		Frequency	Abundant
		Size	Small
		Sun exposing	Both full and half
Flowers, nectar plants		Frequency	Probably frequent
Surrounding vegetation		Height – Herbal layer	10 cm
		Height – Scrubs	Often > 1 m
Management		Grazing husbandry	Beef Cattle
		Grazing intensity	Medium to high
		Mowing	No
Changes over time		Interview	Yes, same fence as 115 A
		Ortho photo analysis	
Other notes			
Suitability to *E. aurinia*		Conclusion	Maybe suitable for small population

Sub area	**115 D**	North of the River Liver Å, West of Hønsebakkerne	
Visited		Date	20060607 + 20060824
Euphydryas aurinia		Numbers of larval web	None
		Numbers of imago	None
Succia pratensis		Frequency	Frequent
		Size	Medium
		Sun exposing	Shaded by grasses
Flowers, nectar plants		Frequency	Frequent
Surrounding vegetation		Height – Herbal layer	40 cm
		Height – Scrubs	Few
Management		Grazing husbandry	Beef cattle and sheep
		Grazing intensity	Low
		Mowing	No
Changes over time		Interview	No interview
		Ortho photo analysis	More dense vegetation
Other notes			
Suitability to *E. aurinia*		Conclusion	Not suitable

DK00FX120. Store Vildmose

Sub area	**120A**	Stavad Enge North of Ryssengrave		
Visited		Date		20060821
Euphydryas aurinia		Numbers of larval web		0
		Numbers of imago		-
Succia pratensis		Frequency		Frequent
		Size		Medium
		Sun exposing		Full at time of visit, but maybe to late mowing
Flowers, nectar plants		Frequency		Probably frequent
Surrounding vegetation		Height	Herbal layer	5 -10 cm
			Scrubs	No
Management		Grazing husbandry		No
		Grazing intensity		-
		Mowing		Yes
Changes over time		Interview		No, but well known old mowing area.
		Ortho photo analysis		
Other notes				
Suitability to *E. aurinia*		Conclusion		Less suitable

Sub area	**120 B**			
Visited		Date		20060821
Euphydryas aurinia		Numbers of larval web		0
		Numbers of imago		-
Succia pratensis		Frequency		Occasional
		Size		Medium
		Sun exposing		Full
Flowers, nectar plants		Frequency		Unknown
Surrounding vegetation		Height	Herbal layer	10-20 cm
			Scrubs	No
Management		Grazing husbandry		No
		Grazing intensity		-
		Mowing		Yes
Changes over time		Interview		No
		Ortho photo analysis		
Other notes				
Suitability to *E. aurinia*		Conclusion		Not suitable

Sub area	**120 C**			
Visited		Date		20060821
Euphydryas aurinia		Numbers of larval web		0
		Numbers of imago		-
Succia pratensis		Frequency		Occasional
		Size		Large
		Sun exposing		Half
Flowers, nectar plants		Frequency		Unknown
Surrounding vegetation		Height	Herbal layer	Variable
			Scrubs	-
Management		Grazing husbandry		No
		Grazing intensity		-
		Mowing		At parking lot
Changes over time		Interview		No
		Ortho photo analysis		
Other notes				
Suitability to *E. aurinia*		Conclusion		Not suitable

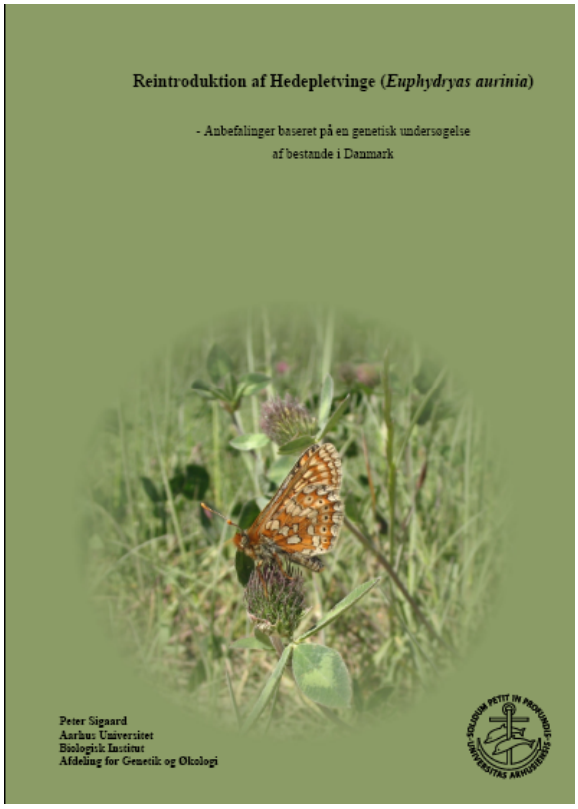
Sub area	**120 D**	Roadside at Tagmarksvej and meadow NE of Ryssengrave		
Visited		Date		20060821
Euphydryas aurinia		Numbers of larval web		0
		Numbers of imago		-
Succia pratensis		Frequency		Occasional
		Size		Medium
		Sun exposing		Half
Flowers, nectar plants		Frequency		Probably enough
Surrounding vegetation		Height	Herbal layer	High at roadside,
			Scrubs	
Management		Grazing husbandry		No
		Grazing intensity		-
		Mowing		At meadow, not every year
Changes over time		Interview		No
		Ortho photo analysis		
Other notes		One web of *Melitaea cinxia*		
Suitability to *E. aurinia*		Conclusion		Not suitable

Sub area	120 **E**	North East of Sandels Bjerg		
Visited		Date		20070821
Euphydryas aurinia		Numbers of larval web		0
		Numbers of imago		-
Succia pratensis		Frequency		Rare
		Size		Small
		Sun exposing		Full
Flowers, nectar plants		Frequency		Probably high
Surrounding vegetation		Height	Herbal layer	10-20 cm
			Scrubs	No
Management		Grazing husbandry		No
		Grazing intensity		-
		Mowing		No
Changes over time		Interview		No
		Ortho photo analysis		
Other notes				
Suitability to *E. aurinia*		Conclusion		Not suitable

Sub area	**120 F**	Meadow near “Trædestenene” [The step stones]		
Visited		Date		20060821
Euphydryas aurinia		Numbers of larval web		0
		Numbers of imago		-
Succia pratensis		Frequency		Rare
		Size		Medium
		Sun exposing		In shade
Flowers, nectar plants		Frequency		Unknown
Surrounding vegetation		Height	Herbal layer	50 cm
			Scrubs	Some
Management		Grazing husbandry		No
		Grazing intensity		-
		Mowing		No / occasionally?
Changes over time		Interview		No
		Ortho photo analysis		
Other notes				
Suitability to *E. aurinia*		Conclusion		Not suitable

Appendix II. Recommendations based on genetic research.

Reintroduktion af Hedepletvinge (*Euphydryas aurinia*) – Anbefalinger baseret på en genetisk undersøgelse af bestande i Danmark. [Reintroduction of Marsh Fritillary (*Euphydryas aurinia*) – recommendations based on genetic research on Danish populations]. **By Peter Sigaard.**



Written on request of the former Country of North Jutland for use in this study.

Also an appendix in, and partly summary in Danish of the Master Thesis:

Sigaard, P., 2007. Habitat degradation and fragmentation – genetic consequences exemplified by *Euphydryas aurinia*. – Ecology and Genetics, Department of Biological Sciences, University of Aarhus.