Marsh Fritillary Habitat Condition Survey of the St Davids Peninsula

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Abstract

Since the mid-1950s, there has been a reduction in grazing on the marshy grassland habitat across the common land on the St Davids peninsula. With much of this common land designated as a Special Area of Conservation (SAC) and/or Site of Special Scientific Interest (SSSI), the change in management has driven wide ranging impacts on the features and associated species of these sites: the local extinction of the marsh fritillary butterfly in 2013 is likely to have been one of them. Through undertaking a survey of the habitat across the St Davids peninsula, we found that 106 hectares (ha) is currently in suitable condition for marsh fritillary butterflies, be it 'Good Condition' (8.6 ha), 'Suitable Overgrazed' (1.2 ha), 'Suitable Undergrazed' (53.8 ha) or 'Suitable Sparse' (42.4 ha). Marsh fritillary metapopulations require between 80-142 ha of suitable habitat to survive in the long term so, with this 106 ha of suitable habitat across a 495 ha area of surveyed land, there is a high probability that the area could once again support a long term marsh fritillary metapopulation. In addition, action on the ground, such as local projects that are improving habitat management across the SACs and private land, and increasing the load of devil's-bit scabious (*Succisa pratensis*) in these suitable habitat areas through plug planting and prevention of scrub encroachment, will increase the area of habitat available. The patches of suitable habitat are a good size and well connected, and thus improving the habitat quality will hopefully see the SAC/SSSI habitats and features restored to a large degree in the near future.

Introduction

The marsh fritillary (*Euphydryas aurinia*) is one of the UK's most vulnerable butterfly species. Once widespread across the UK, the marsh fritillary is now restricted to the southwest with a decrease in abundance of 64 % since 2005 (Fox *et al*., 2015). It is a UK Biodiversity Action Plan (BAP) Priority Species and listed under Annex II of the EU Habitats and Species Directive.

Marsh fritillaries can be found on a wide variety of habitats including heathland and fens, but are most often associated with marshy grassland (or Rhos pasture) where purple moor-grass (*Molinia caerulea*) occurs. The best habitats are lightly grazed grassland where devil's-bit scabious (*Succisa pratensis* – henceforth *Succisa*), the larval food plant of marsh fritillaries is abundant. The height of vegetation is also important with a preference of 12 to 25 cm (Fowles, 2003) in order to provide sufficient shelter for larvae, whilst also leaving *Succisa* leaves accessible for egg laying.

Throughout June and July, adult females lay eggs on the underside of *Succisa* leaves. They tend to show preference for larger leaves amongst tussocks in order to reduce the need for movement to a neighbouring host plant (Pschera & Warren, 2018). After hatching, larvae live in clusters in a protective larval web and consume the leaves of *Succisa*. They then overwinter in thicker webs amongst dense tussocks before emerging in February. Pupation occurs in April, then adults usually emerge from late May. Mostly the dispersal range is limited to 2 km, but those emerging later in the season may travel greater distances as a mechanism to create new colonies (Zimmerman *et al*., 2011).

Marsh fritillaries exist in metapopulations made up of discrete colonies that undergo regular extinctions and recolonisations. A 50 hectare (ha) area of suitable habitat is required to support a marsh fritillary metapopulation in the short-term, but 100 ha will be necessary for long-term survival (Fowles & Smith, 2006). However, the result of metapopulation modelling by Bulman *et al*. (2007) suggests that a minimum area of 80-142 ha of suitable habitat is needed for survival after 100 years. Marsh fritillary butterflies are also vulnerable to barriers which can prevent movement between populations.

Marsh fritillaries were last recorded on the St Davids peninsula in 2013 across areas of the North-west Pembrokeshire Commons Special Area of Conservation (SAC) (Appendix 1). However, it is believed that the area of suitable habitat on these commons was not sufficient to maintain a population long-term and they are now believed to be locally extinct. This was most likely due to lack of grazing, leading to scrub encroachment and reduction of good condition and/or suitable condition habitat (Pembrokeshire Biodiversity Partnership, 2016). The Pembrokeshire Biodiversity Partnership Species Action Plan for marsh fritillary acknowledges the loss and fragmentation of habitat as a key threat to the species. They recommend land management changes that will increase the suitable habitat through re-establishing suitable grazing regimes (Pembrokeshire Biodiversity Partnership, 2017).

The aim of this survey was to assess the suitability of habitat around the St Davids peninsula for its potential to support a marsh fritillary metapopulation.

Methods

A desk study looking at past records of marsh fritillary sightings was undertaken to identify land that should be surveyed. Survey effort was concentrated within the functional landscape (2 km) of either historic marsh fritillary records, or good condition habitat identified by Beynon & Kerr (2021) (Appendix 2,3).

There are numerous, historical marsh fritillary records on both the North-west Pembrokeshire Commons/Comins Gogledd Orllewin Sir Benfro and the St Davids/Ty Ddwei SACs. As the North-west Pembrokeshire Commons SAC is designated for wet habitats, such as transition mire, and much of the area is classed as marshy grassland in the vegetation features map (Countryside Council for Wales, 2008a), the whole of this SAC was selected for survey. With much of the St Davids SAC consisting of dry coastal habitat (Countryside Council for Wales, 2008b), the marsh fritillary records were used to target the survey effort. Private land within the survey area was identified as being potentially suitable if it appeared to be marshy grassland when viewed on satellite maps.

A total of 495 ha of land were selected for surveying with a mixture of common land and private land (Figure 1). Permissions were sought with private landowners of marshy grassland habitat surrounding the core SAC land and only those where permission was granted have been included in this report.

A training day, led by ecologist Jon Hudson, was undertaken on the 15th September 2021 on Dowrog Common to ensure there was continuity between different surveyors. Following training, all land was walked and visual assessments of the selected land were carried out. As surveyors walked the land, annotations were made on printed maps to record the habitat conditions. The habitat condition categorised based on the suitability for marsh fritillaries (Fowles, 2005 and amended as per Fowles & Smith, 2006). The different habitat types were classified as one of six different categories based on the abundance of *Succisa*, the vegetation height, and the percentage scrub cover (Table 1). Surveying took place from 2021 to 2023 during the September-October period. After October, the *Succisa* was no longer flowering and identification became challenging.

Table 1. Criteria for marsh fritillary habitat suitability, taken from Fowles (2005).

Code	**Classification**	**Definition**
GC	Good Condition	Abundant *Succisa*, vegetation height 12-25 cm, scrub cover less than 5 %.
SU	Suitable Undergrazed	Frequent or occasional *Succisa*, vegetation height above 25 cm.
SO	Suitable Overgrazed	Frequent *Succisa*, vegetation height below 12 cm.
SS	Suitable Sparse	Occasional *Succisa*, vegetation height below 25 cm.
PR	Potential Rank	Rare *Succisa*, vegetation height above 25 cm.
NS	Not Suitable	No *Succisa* present.

The maps were then digitised using QGIS software (version 2.32.3). By placing a 1 km and 2 km buffer around the Good Condition habitat the core and functional landscape was highlighted.

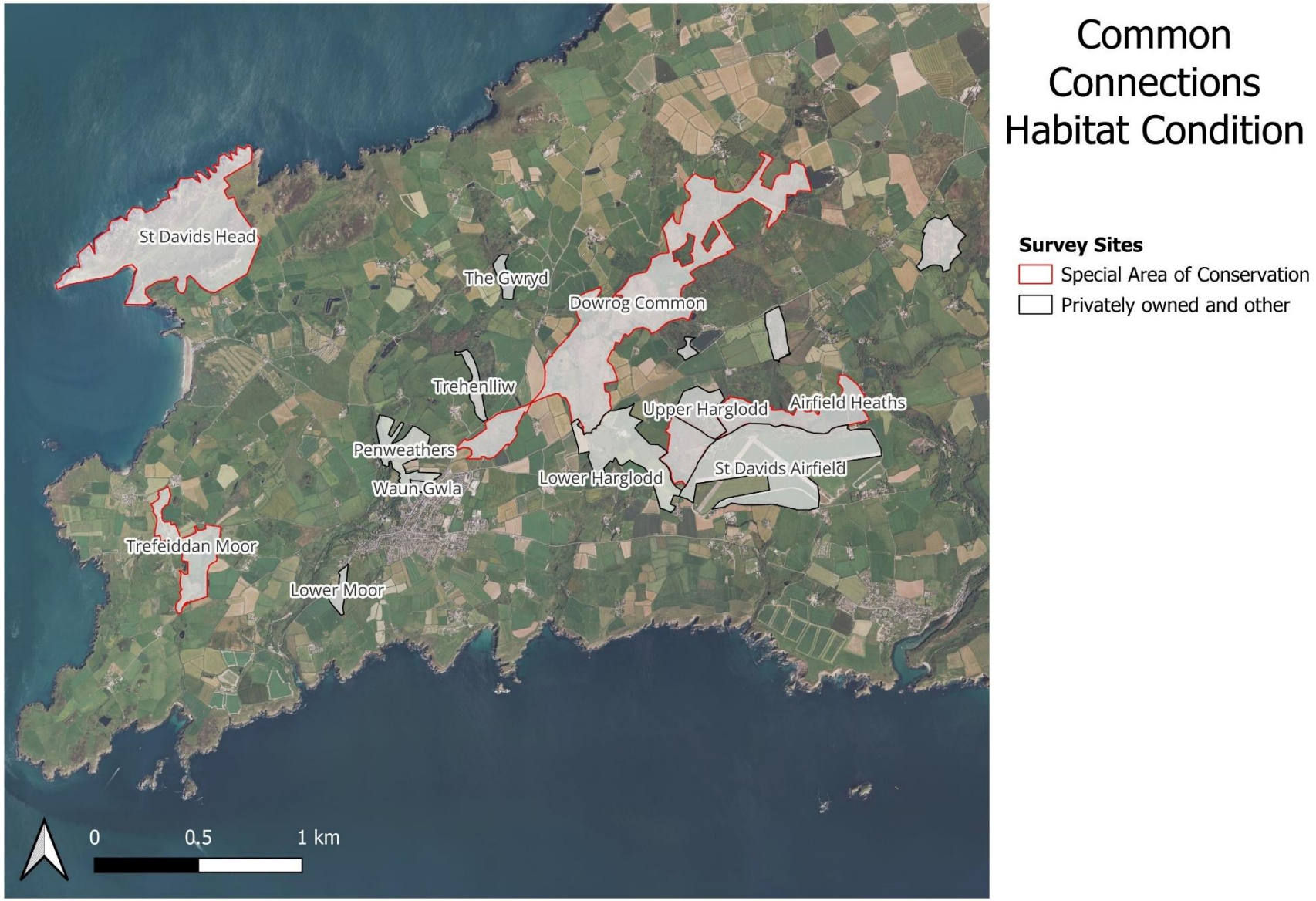


Figure 1: Sites selected where habitat has the potential to be suitable for marsh fritillaries

Results

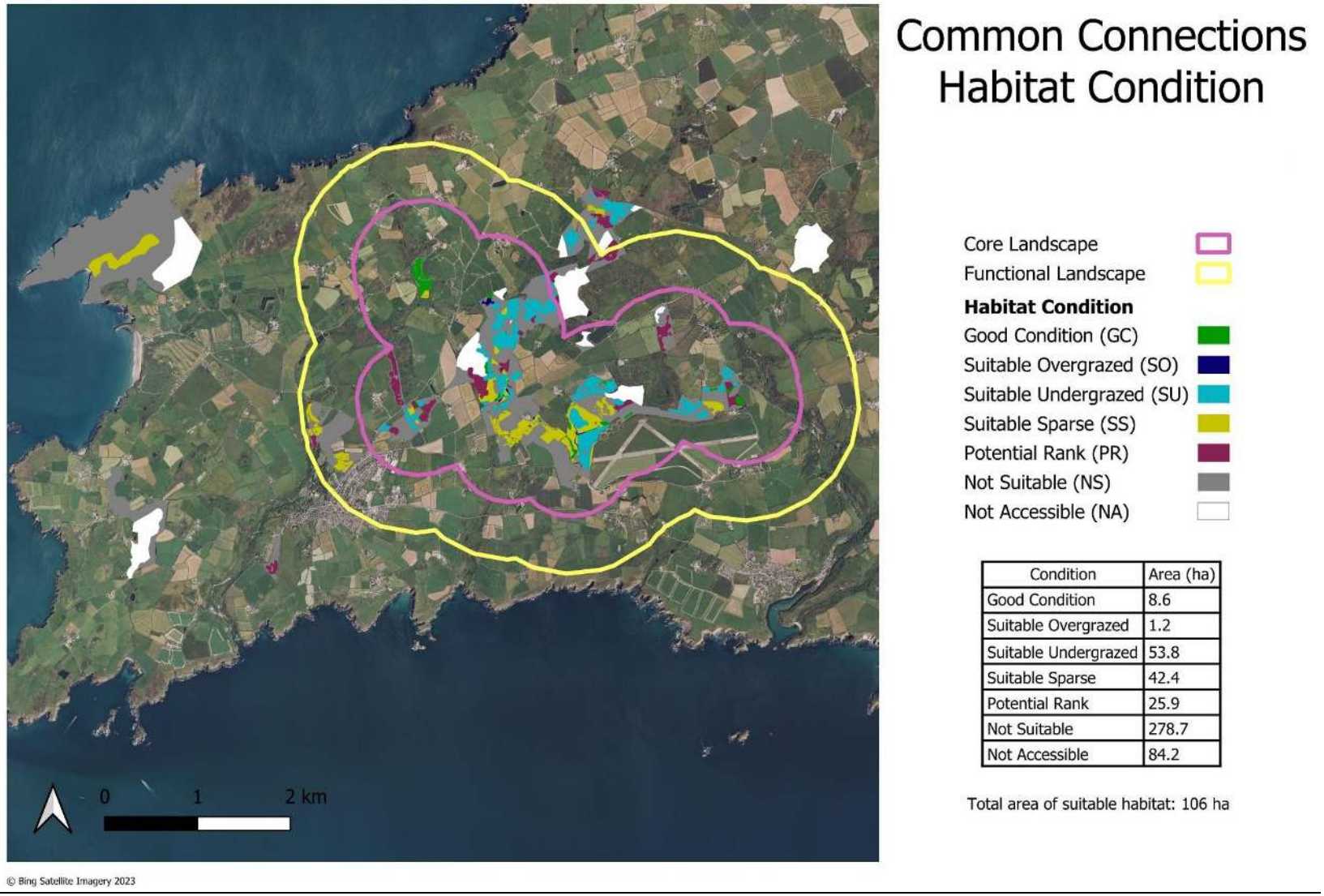
Of the 410 ha that were accessible for surveying, 106 ha were in good or suitable condition (Figure 3; Table 2). This meets the required 100 ha necessary for long-term survival as suggested by Fowles and Smith (2006). Of the good and suitable condition habitat, approximately 61 % was found on areas of the Pembrokeshire Commons SAC (Dowrog Common, St Davids Airfield, Waun Fawr).

Table 2. Habitat condition.

Classification	**Area (ha)**
Good Condition	8.6
Suitable Undergrazed	53.8
Suitable Overgrazed	1.2
Suitable Sparse	42.4
Potential Rank	25.9
Not Suitable	278.7
Not Accessible	84.2

There were 8.6 ha of Good Condition habitat surveyed, 66 % of which was found on SAC sites. However, the densest area of good condition habitat was found on private land, just over 0.5 km from the SAC at the Gwryd where 4 ha (73 %) of the site was considered Good Condition. Suitable Undergrazed, Suitable Overgrazed and Suitable Sparse categories amounted to a total area of 97.5 ha (Figure 2). Much of this occurred on the SACs where Suitable Undergrazed land dominated. There were 25.9 ha of Potential Rank habitat recorded.

Figure 2: Top left: Suitable Undergrazed habitat in the foreground and Potential Rank habitat to the rear; top right: Suitable Sparse habitat; bottom left: Suitable Overgrazed habitat and bottom right: Good Condition habitat



Condition	Area (ha)
Good Condition	8.6
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Potential Rank	25.9
Not Suitable	278.7
Not Accessible	84.2

Total area of suitable habitat: 106 ha

Figure 3: Suitability of the habitat to sustain a marsh fritillary population across the St Davids peninsula. The core- and functional landscapes are based upon a 1 km distance (core landscape) and 2 km distance (functional landscape) from Good Condition habitat

Of the land that was surveyed, 278.7 ha were classified as Not Suitable (Figure 4). This mostly consisted of dense gorse and heather scrub where no *Succisa* was present. There was also scrub encroachment in some areas with dense bracken and bramble, as well as willow scrub, fen and reedbed and areas affected by agricultural run-off. If there was no *Succisa* present at all, the area was categorised as Not Suitable, even if the vegetation type and height appeared like it would be suitable for *Succisa*. There is a possibility that small amounts of *Succisa* amongst these habitat were unobserved, leading to a probable overestimation of unsuitable habitat.

Figure 4: An example of habitat classed as Not Suitable

84.2 ha of identified land for surveying were not accessible. This was largely due to dense scrub blocking access into fields. It is likely that these inaccessible sites are unmanaged and therefore not suitable marsh fritillary habitat.

In total there was 106.1 ha of habitat that can be considered suitable to host a marsh fritillary metapopulation.

Discussion

Fowles and Smith (2006) state that to give a 95 % chance of long-term marsh fritillary survival, an area needs 100 ha of suitable habitat which must cover 6.25 % of the total land area. Our surveys recorded 106.1 ha, equating to 21 % of the surveyed land area which meets and exceeds the necessary habitat requirements. This suitable habitat also appears well connected, in large part due to the position of Lower Harglodd farm between the North-west Pembrokeshire Commons SAC, Dowrog Common and the St Davids Airfield Heaths (Figure 5). This connectivity increases the size of the habitat patches which are also vital for marsh fritillary survival (Fowles and Smith, 2006).

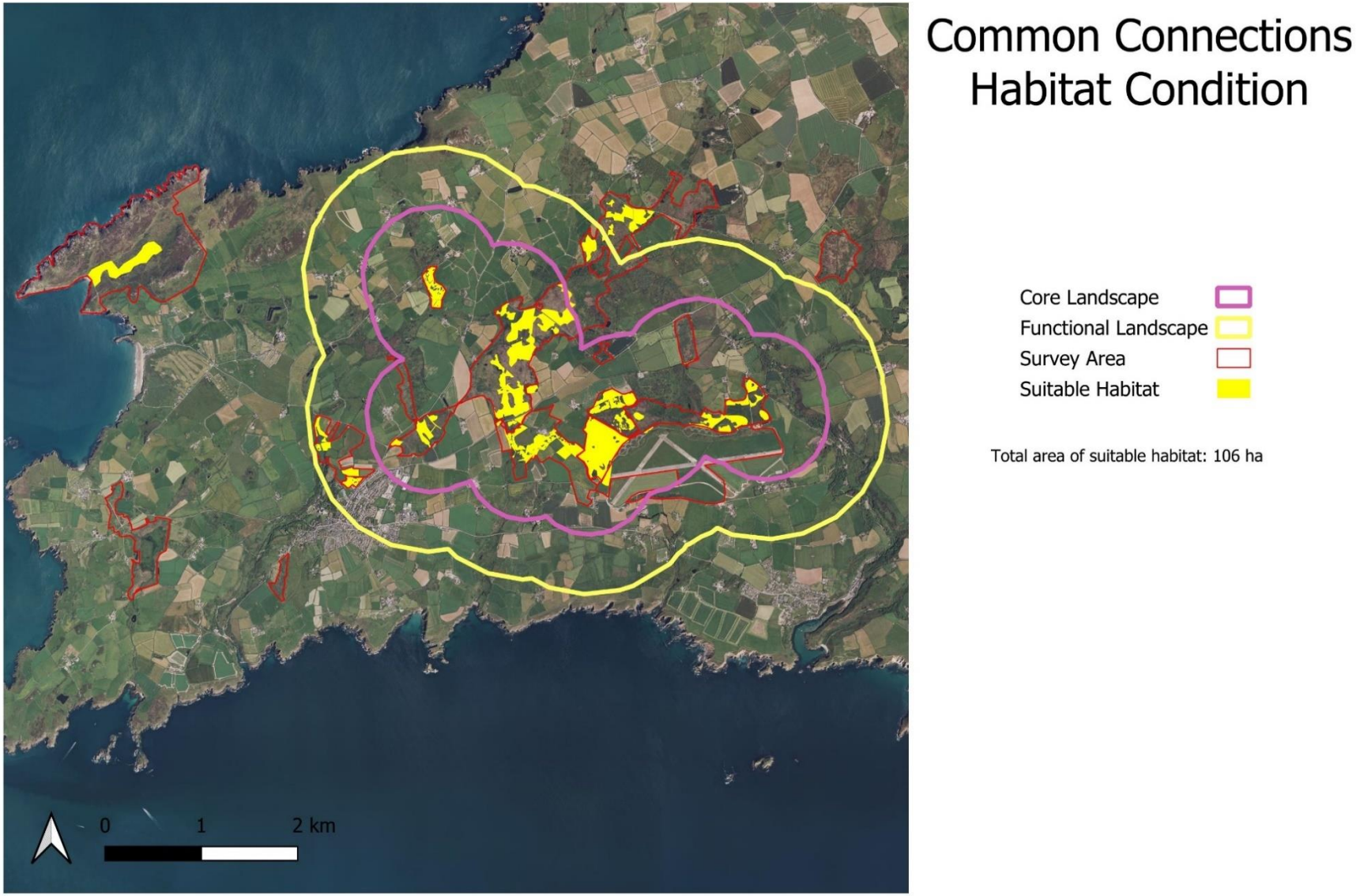

Figure 5: Habitat suitable for the marsh fritillary butterfly within the core and functional landscape areas based on the patches of Good Condition habitat

Most of the suitable condition habitat was Suitable Undergrazed (39.8 ha), with the vegetation height being above the 12-25 cm that is favourable for the marsh fritillary. The last recorded sighting of a marsh fritillary in St Davids was on Dowrog Common in an area that currently corresponds to Suitable Undergrazed habitat. Many of the areas that were surveyed showed little sign of management which also meant there was a considerable amount of Potential Rank habitat. As it currently stands, the southernmost area of Dowrog Common is grazed by ponies providing areas of Suitable Sparse habitat as well as small areas of Good Condition. However, much of this area was still Suitable Undergrazed. A small area at the north end of the common is grazed by cattle which was the only area of Suitable Overgrazed habitat. In addition, around St Davids Head there were grazing ponies which created Suitable Sparse habitat.

It should be noted that the method used to classify habitat for marsh fritillaries is somewhat subjective, depending on the individual surveyor, the access across sites, the timing of grazing/cutting management during the year of the survey and the effect of the weather conditions. Therefore, the data presented here should be used as an indication of the area of habitat available rather than an absolute figure. Some habitats that consisted of an intricate mosaic of Suitable Sparse, Good Condition, Suitable Overgrazed and Suitable Undergrazed habitat at the Gwryd, Waun Fachelich and Upper Harglodd were categorised as Suitable Sparse and re-surveying is recommended if a finer scale habitat map is required in the future. For example, where rides had been cut or grazed through dense, but short, areas of heather at Waun Fachelich, abundant *Succisa* plants were uncovered and so we felt that it was incorrect to map this habitat as Unsuitable/Potential Rank. Good Condition land at the Gwryd (which is pony-grazed from ~September/October – April/May) consisted of well-established, dense, but short, patches of *Succisa* on relatively dry patches of ground with no *Molinia* tussocks among them. Following Fowles (2005), these patches would have been mapped as Overspill Grassland due to the lack of *Molinia*. In some years, the vegetation height of these patches remains below 10 cm due to the growing conditions of the year, where they would be classified as Suitable Overgrazed. Taller *Succisa* plants, with larger leaves suitable for egg laying, bordered areas of scrub and were found in wetter areas of the site, where *Molinia* was more abundant. However, using the methods outlined here, these mosaic habitats fell into the Good Condition category at the time of surveying.

Succisa presence point data has also been collected along the coastal path between St Davids Head and Aber-pwll, as well as on the Lower Treginnis and Aber-mawr coastal path (see Beynon & Kerr, 2021 and additional unpublished data held by The Bug Farm). Data held includes area estimates of suitable condition habitat, and the number of *Succisa* plants within the area. While these discrete records have not been included in the habitat calculations in this report, these are an excellent indicator of other potential survey sites for future work and suggest that there are greater amounts of suitable quality habitat within the peninsula than we have demonstrated here.

Many of the areas of common land around the St Davids peninsula will require an increase in management to bring suitable habitat to good condition, or to bring unsuitable or potential rank habitat to suitable condition. Cattle are the most appropriate grazers to create a tussocky mosaic habitat that provides shelter for marsh fritillary larvae. Ponies can be selective in where they graze and may leave large areas untouched, whereas sheep are prone to overgrazing. Some areas of common land that have not been managed recently may require active scrub clearance before grazing can occur. Mowing may be necessary to create

pathways for grazers, and in some areas where bracken is dense, rolling or burning may be appropriate (Pembrokeshire Biodiversity Partnership, 2017).

Since 2020 there has been significant marshy grassland habitat creation and management on private land at Lower Harglodd, Penweathers and the Gwryd (as part of a Sustainable Management Scheme Project (The Bug Farm, 2021), a Local Places for Nature project (The Bug Farm, 2022) and a Nature Networks Fund project (The Bug Farm, 2023). This work has included large-scale plug planting with *Succisa* and improved grazing and cutting management. Additional private land will also be managed on other farms across the peninsula as part of a second Nature Networks Fund project, with additional plug planting of *Succisa* across private land. As such, the condition of good and suitable condition habitat on private land will improve over the coming years.

There is also likely to be improvement in the habitat condition on the North-west Pembrokeshire Commons SAC in the near future, due to the afore-mentioned projects, additional nature recovery action on the ground and a Natural Resources Wales (NRW) LIFEQuake project. Over the course of this five-year project, NRW will be investing in improving land management in areas of peatland, quaking bog and the surrounding wetlands, with the North-west Pembrokeshire Commons SAC as one of the key project sites. The fencing, mowing, scraping and community engagement works will enable the return of appropriate grazing regimes with the aim to return the wetland features to good condition again (NRW, 2023). This project will drive the increase of Good Condition habitat with the restoration of appropriate grazing once farmers can safely put their cattle onto the commons. Good Condition habitat patches which are so vital for the marsh fritillary metapopulations (Fowles and Smith, 2006), should then expand, increasing the availability of this habitat in the near future.

Conclusion

Overall, an area of 106.1 ha of suitable habitat was found, forming 21 % of the whole survey area. This meets the necessary land area to sustain a marsh fritillary population in the long-term. While half of this suitable habitat falls in the category of Suitable Undergrazed, there are land management changes currently being put in place by NRW which will allow the grazing to become more appropriate. This means we can expect to see an increase in the area of Good Condition habitat within the next decade, strengthening the core and functional landscapes that would support a marsh fritillary population should a reintroduction occur. However, even within the scope of the survey undertaken to inform this report, the patches of suitable habitat are well connected and largely fall within the current core landscape which means there is a strong potential that the habitat would be able to support a marsh fritillary metapopulation on the St Davids peninsula in the long term.

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sites, consolidating the maps and writing the final draft of the report. We would like to thank Louise Carey for assisting with surveying ~70 % of the sites, Grace Leach for assisting with the mapping and Hannah Kerr for reading over a copy of the report.

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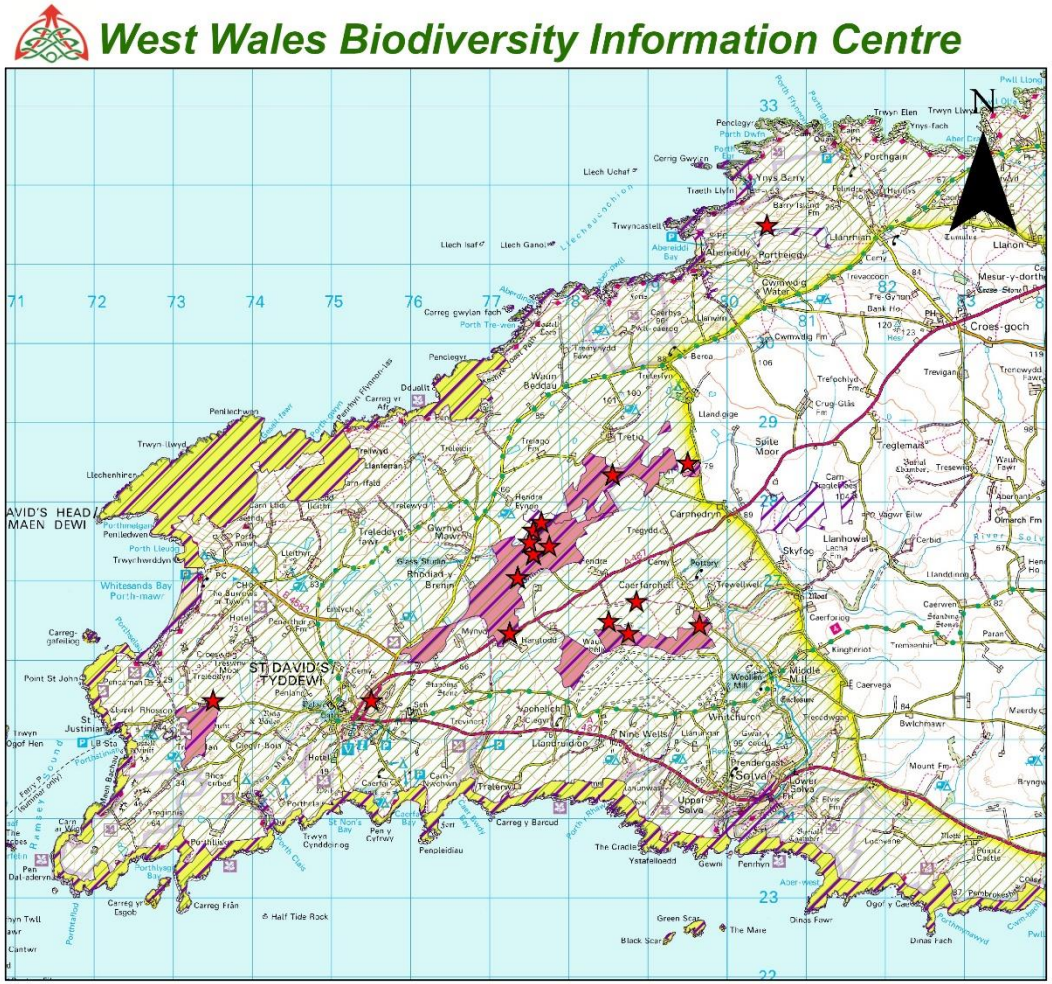
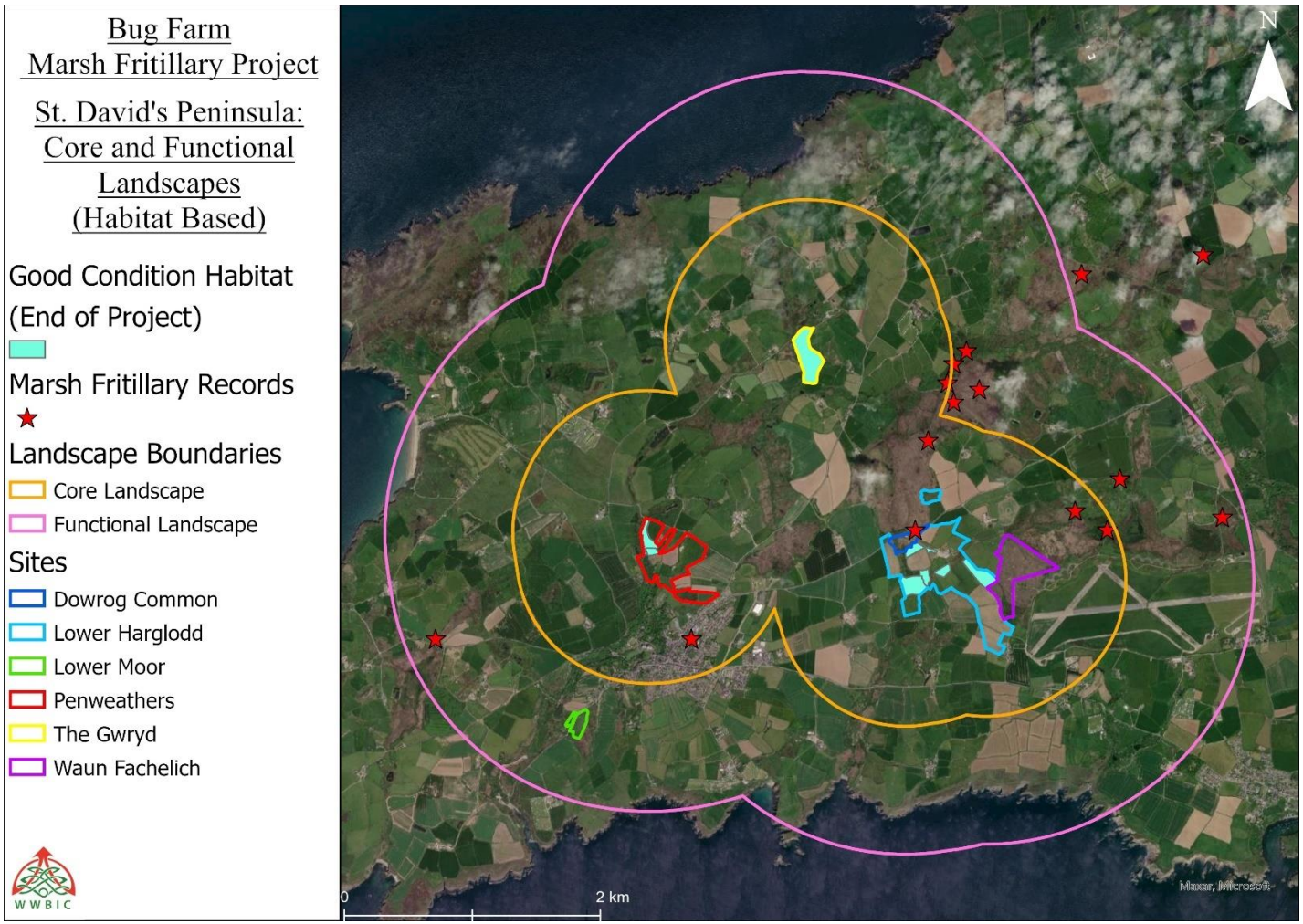
Appendices

Appendix 1: Historical marsh fritillary butterfly records across the St Davids peninsula.



Appendix 2: The functional habitat based upon historical marsh fritillary records (taken from Beynon & Kerr, 2021)

Appendix 3: The functional habitat based upon good condition habitat (taken from Beynon & Kerr, 2021)



*The methods used to classify marsh fritillary habitat by Beynon & Kerr (2021) differed slightly from this project, hence the different habitat conditions.