Habitat Regulations Executive Committee

Monitoring Petalwort at Dawlish Warren – conservation assessment and prognosis: Appendix A

CONSERVATION ASSESSMENT AND PROGNOSIS FOR PETALWORT (*PETALOPHYLLUM RALFSII*) AT DAWLISH WARREN

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by
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1 INTRODUCTION

In 2012 populations of Petalwort (*Petalophyllum ralfsii*) at Dawlish Warren were surveyed to develop a baseline for monitoring population trends and the condition of the metapopulation (Lansdown 2012). Since this survey, the decision was taken to stop maintaining sea defences to the main part of the dune system and a wall was constructed immediately east of the visitor centre to maintain protection of this area. Between 2012 and 2019, under licence from Natural England, a number of *P. ralfsii* thalli were transplanted from Greenland Lake Slack to hollows in the area to the west of the visitor centre, including one which had previously been scraped to lower levels with the aim of making it more suitable for *P. ralfsii*.

This report presents the results of a survey to repeat data collection carried out in 2012 and assess the condition of the metapopulation following construction of the wall. Additional aims of this survey were to assess the success of attempts to translocate *P. ralfsii* to scrapes to the west of the visitor centre and to try to predict the consequences of sea incursion to Greenland Lake Slack.

The method employed in 2019 was identical to that employed in 2012 but was informed by mapping of potentially suitable habitat (Lansdown 2012) enabling more specific targeting of low-lying areas or hollows potentially representing suitable habitat for *P. ralfsii*. However, hollows were not as well-defined and easily recognised as implied by Figure 1.1 (see Chapter 2). Each hollow within Greenland Lake Slack was inspected thoroughly on hands and knees, with small plants confirmed using a x8 hand-lens. The sex of fertile plants was noted once per gender per hollow, to indicate fertility of the population. Hollows were numbered using the same numbering system as presented by Lansdown (2012) and reproduced here as Figure 1.1.

Acknowledgements

I am grateful to Phil Chambers, Steve Ayres and their colleagues for their help with background information, as well as with organising and carrying out the survey.

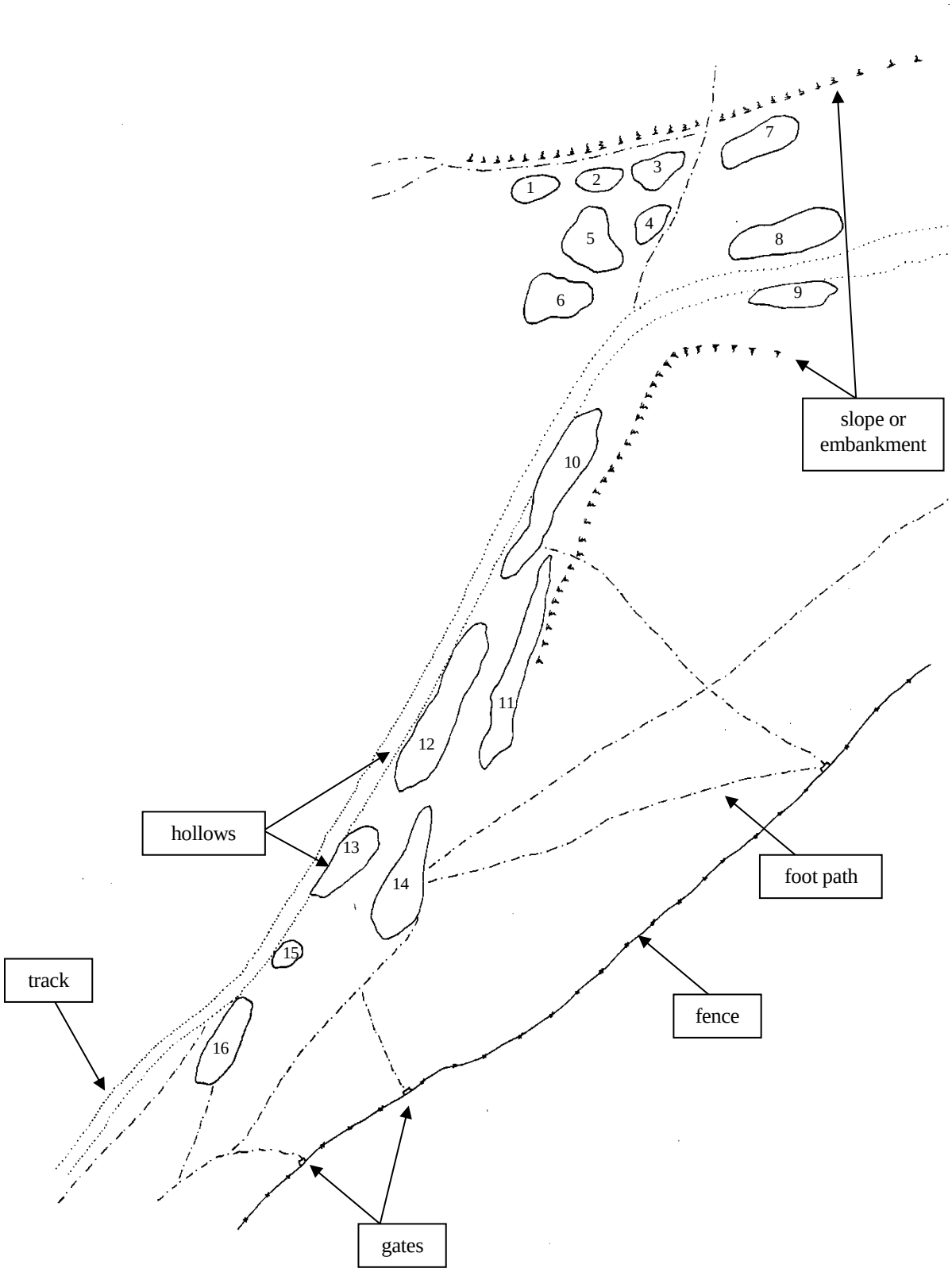

Figure 3.3 Distribution of hollows in Greenland Lake Slack with preliminary numbering system

2. RESULTS

In 2019, populations of *P. ralfsii* were found in Greenland Lake Slack in seven hollows, with a total of 1301 thalli counted (Table 2.1), although hollow No. 9 (which had supported 300-400 thalli in 2012) was not surveyed because it was inundated due to heavy rain the night before. Both sexes were recorded in three hollows and female plants only in another two. Including an estimate of up to 400 thalli in hollow No. 9, the total population of *P. ralfsii* in Greenland Lake Slack in 2019 is estimated to be 1300-1700 thalli. Populations were scattered throughout the slack in areas where they had been recorded by previous surveys (Lansdown 2012), however there had been changes in the occurrence of thalli in different hollows, with some hollows such as No. 16 no longer supporting plants but others such as Nos. 4/5 supporting a large number of thalli where none had been found in 2012. In 2012 hollow No. 16 was maintained along the line of a path through a stand of reeds. In 2019, the path had moved slightly and no longer created conditions suitable for *P. ralfsii*.

Table 2.1 Number of thalli recorded in each hollow in Greenland Lake Slack in 2012 and 2019

Hollow No.	2012	2019	Notes
1	0	0	These hollows very shallow and dry, probably not suitable
2	0	0	
3	0	0	
4	0	106	Not feasible to distinguish between these two hollows
5	0		
6	0	3	
7	0	0	Hollow very shallow, dry, probably not suitable
8	400-500	11	Dominated by sparse *Carex panicea*
9	300-400	present	Inundated, not surveyed
10	400	1063	
11	0	0	
12	50-100	90 + 17	Difficult to relocate boundaries of these two hollows
13	100-150		
14	<10	11	
15	0	0	
16	<10	not found	path no longer used
Total No. thalli	**1270-1570**	**1301**	
No. populations	**7**	**7**	

Comparison of the results of counts from previous years, although not directly replicated, suggests that when surveys were considered reliable (1999, 2003, 2012, 2019 - Table 2.2), the number of thalli recorded fell between 2003 and 2012 and has since remained stable. The overall distribution of thalli has remained fairly consistent (Table 2.1) with much local variation, although there appears to be a trend for the shallower hollows to become less suitable as they become overwhelmingly dominated by grass and sedges. Comparison of the maps of thallus distribution (Figs. 2.1-2.3) suggest that in spite of being perennial, *P. ralfsii* is quite mobile.

Table 2.2 Results of all available counts and estimates of thallus numbers at Dawlish Warren

Date	V.C. Slack	Greenland Lake Slack	Notes
4 April 1997	Few thalli	No information	Brief search following discovery of species new to site, not a survey
15-16 May 1997	76 thalli counted	3 thalli found	Probably too late in the spring
12 Dec. 1999	>1000 estimated; 387 counted on ca. 25% of area	1,000-10,000 estimated; 428 thalli counted on ca. 15% of area	Survey under good conditions
12 October 2001	ca. 200 thalli	ca. 250 thalli	Survey probably inadequate
15-17 April 2003	ca. 600 thalli	ca. 2500 thalli	Slacks flooded in January to March 2003
2-3 Feb. 2012	1 thallus found	ca. 1250-1600 thalli	3 dry winters prior to survey
4-5 April 2019	no thalli found	ca. 1301 thalli found	slack No. 9 inundated, not surveyed

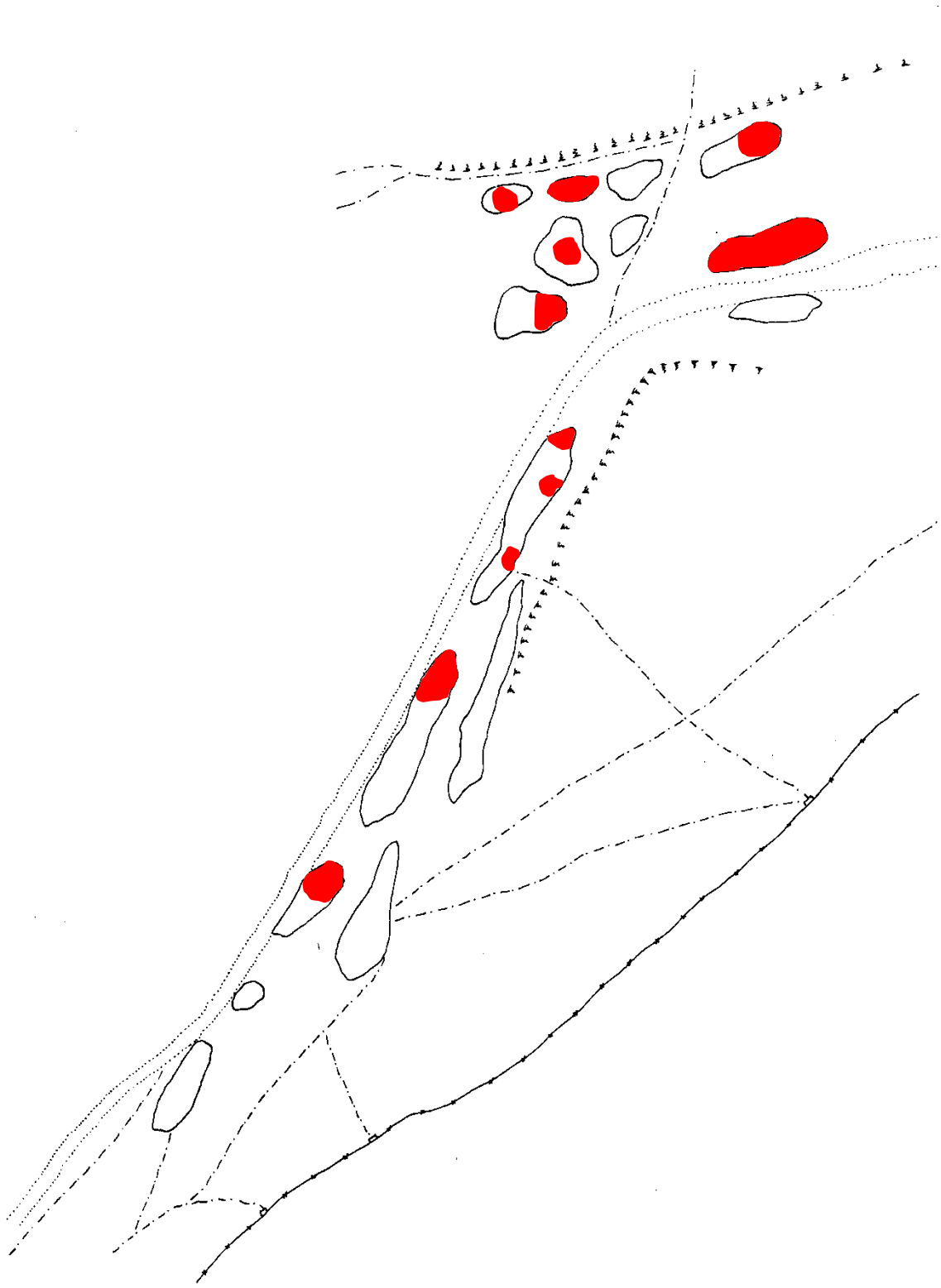

Figure 2.1 Distribution of *P. ralfsii* in Greenland Lake Slack in 2003 (interpreted from Holyoak 2003)

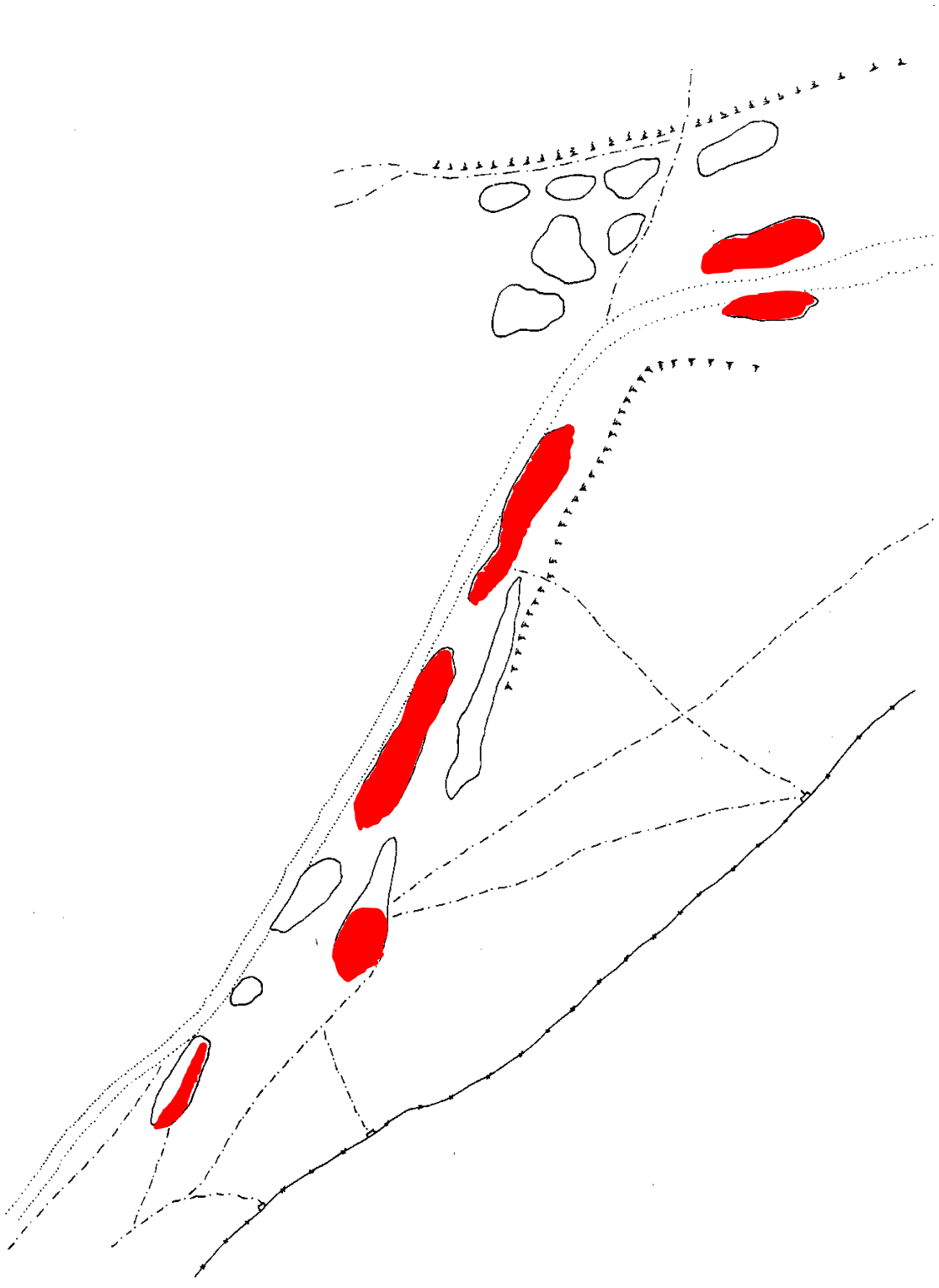

Figure 2.2 Distribution of *P. ralfsii* in Greenland Lake Slack in 2012 (from Lansdown 2012)

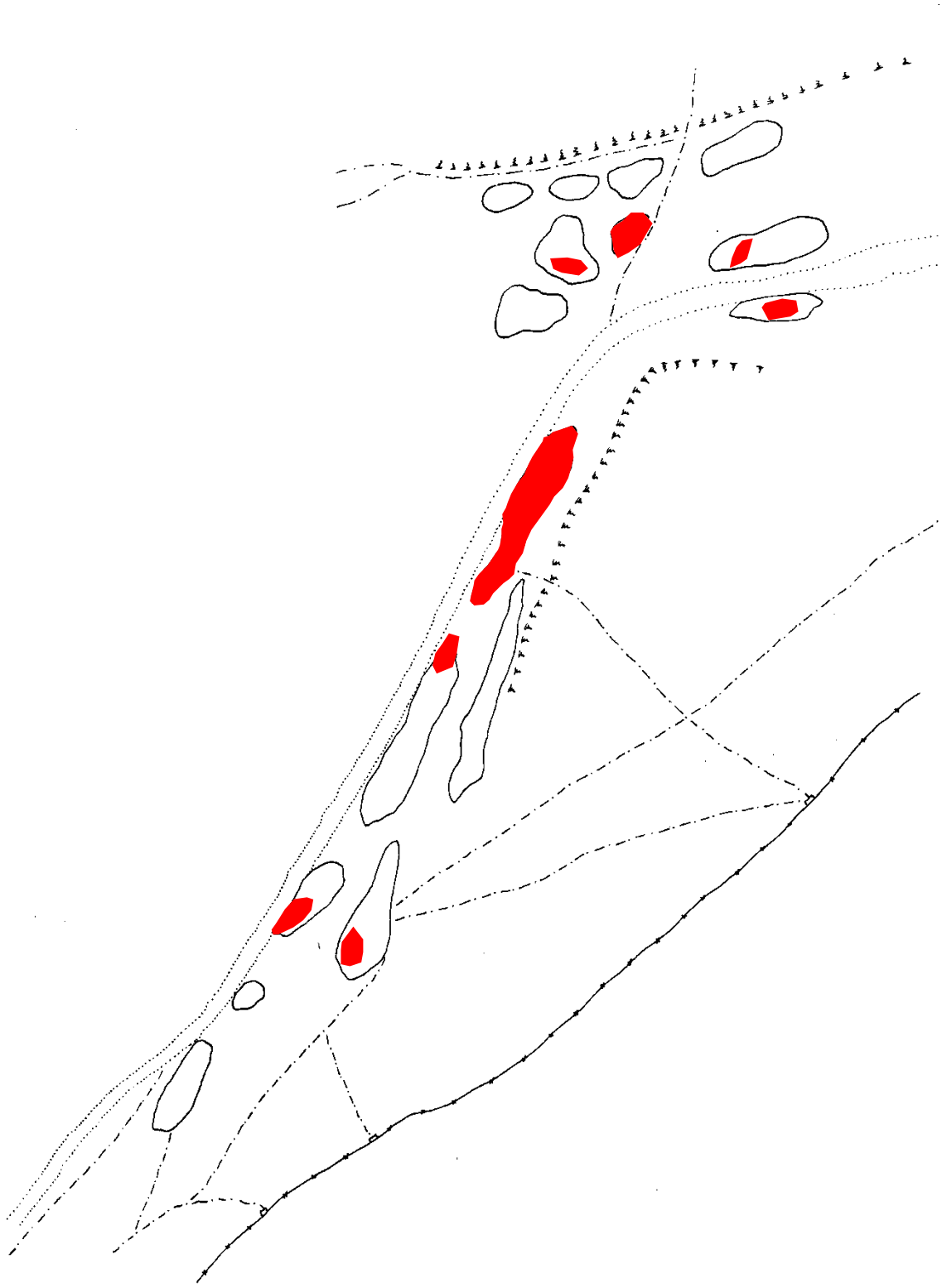

Figure 2.3 Distribution of *P. ralfsii* in Greenland Lake Slack in 2019

Despite intensive searches, no thalli were found in either the slacks where plants had been introduced to the west of the visitor centre or in the Visitor Centre Slack. This suggests that transplanting was unsuccessful and that the Visitor Centre Slack population may now be extinct.

Figure 2.4 Hollow No. 10, with sticks marking the location of thalli and yellow lines to highlight solitary thalli and groups of thalli

Figure 2.5 Hollow No. 12 with Hollow No. 10 behind

Thalli occurred in different parts of hollows, depending on a variety of factors. Thus, in hollow No. 10, the lowest levels of the hollow were dominated by bare ground with scattered bryophytes and tufts of grasses of sedges, with a broad fringe of mosses around the sides and then vascular plant-dominated sward on higher ground (Figure 2.4). In hollow No. 10 *P. ralfsii* occurred mainly within the fringe of mosses. While in hollows such as 5, 6 and 14 (Fig. 25), *P. ralfsii* occurred in areas with only patchy vascular plants in the lowest parts of the hollow.

It appears likely that this difference in the distribution of thalli may be at least partly related to the height of the hollow above the groundwater table. If correct, then it would appear likely that groundwater-table helps to suppress vascular vegetation, the higher the hollow is above the maximum groundwater level, the less able *P. ralfsii* is to compete against vascular plants. As the groundwater table drops relative to ground level within Greenland Lake Slack, fewer areas remain suitable for *P. ralfsii*. If correct, then this has significant implications for any attempt to create suitable habitat for *P. ralfsii* in the area around the visitor centre.

The other important factor shown by these images (Figs. 2.4-2.5) is that the distribution of *P. ralfsii* in hollows is very patchy. For this reason, it is not realistic to count the number of thalli in a small part of a hollow, extrapolating up to derive an estimate of the total population within the hollow (c.f. Anon 1999).

3 DISCUSSION

3.1 Survey method

This is the first survey carried out after development of the baseline in 2012 and as such represents the first opportunity there has been to test the condition assessment method proposed (Lansdown 2012). Precise comparison between data collected in 2019 and previous surveys appears to be impossible because it is not possible to be certain that all thalli are found, as some may be very small or obscured by dense vegetation, as well as because of the difficulty in precisely re-locating the boundaries of specific hollows.

It is very difficult to have confidence in counts of thalli, partly for the reasons outlined above and partly because not all thalli are visible at the surface at any given time (Holyoak 2003). In spite of this it is clear that mapping the distribution of thalli in relation to the sketch map of hollows, combined with counting thalli, provides an indication of changes in the size of the population, as well as differences in distribution. Simple interpretation of the data (Table 3.1) suggests that there has been a decline in the population since 2003, including a reduction in the area occupied, both as the number populations (applying the definition from Lansdown 2012) and the area over which thalli occur. This is probably due to successional change within Greenland Lake Slack, possibly linked to a lowering of the water table, as the hollows in which it was not found are now too dry and densely vegetated with vascular plants for *P. ralfsii*.

Year	Number of hollows with thalli	Estimated total population
2003	9	2500
2012	7	1270-1570
2019	7	1300-1700

The main constraints on use of counts of thalli are:

- It is time-consuming, taking approximately two days to cover the 16 hollows identified in Greenland Lake Slack, as well as the Visitor Centre Slack and hollows around the Visitor Centre.
- It is vulnerable to short-term changes in the weather, such as the impracticality of surveying hollow number 9 due to heavy rain during the previous night which left standing water in the hollow through which it was impossible to see the thalli. Equally, extended periods of dry weather can make it almost impossible to find thalli.
- It is difficult to divide up the hollows in a way which ensures no (or limited) duplication but comprehensive coverage of suitable habitat.
- It can be deeply unpleasant, surveying for two days on hands and knees.

It also proved difficult for the wardens to conduct monitoring, not least because of potential confusion with other liverwort species.

It would be highly desirable to find an alternative method of assessing the conservation condition of the populations and metapopulation of *P. ralfsii* at Dawlish. However, at present there is no obvious way of doing this which would provide an indication of the conservation condition of the metapopulation.

3.2 Condition assessment

Survey in 2019 has enabled a test of the efficacy of the method proposed in 2012. It is clear a) that for the foreseeable future it is not practical to assume that surveys can be carried out each year or b) that the most effective method of assessing the conservation value of the entire metapopulation at Dawlish must include a count of the number of thalli. The assessment process proposed by Lansdown (2012) is presented below with consideration of its merits.

A. If at least ten thalli, including sexually active plants are found in a population at least once in five years, then that population can be considered to be in favourable condition.

In 2019 more than ten thalli were found in six of seven populations (see Table 3.1) and five of these populations included sexually active plants. Thus, five populations meet this criterion and could be considered to be in good condition. There is no way of knowing whether this may be a valid measure of the condition of populations.

B. If 50% of each hollow has more than 50% higher plant cover, then the hollow may be considered to be in unfavourable condition for *P. ralfsii*.

Higher plant cover was not recorded in the field in 2019, but all hollows included more than 50% cover of higher plants over much of their area. The important difference was that in those hollows supporting large populations of *P. ralfsii*, the cover was either patchy, there was available bare ground or there were extensive patches of mosses through which *P. ralfsii* could grow and these were the areas in which thalli were found. There is therefore a need to replace this measure with a measure of the representation of bare ground in hollows.

C. If more than 90% of populations comprising the Greenland Lake Slack metapopulation are in favourable condition and at least three different populations include "hotspots" with at least 50 thalli, then the overall metapopulation may be considered to be in favourable condition.

Whilst not based on records over five years, application of this criterion to available data (Table 3.1) suggests that it may not be useful. For example, there is no evidence for a decline in the condition of the metapopulation between 2019 and 2012 but the measure would indicate a failure.

Table 3.1 Condition assessment based on data from two surveys

	Assessment year	Reference year	%	condition
2012 : 2003	7	9	78	fail
2019 : 2012	6	7	86	fail
2019 : 2012	6	9	67	fail

It is clear that the second two indicators would benefit from modification to represent the specific micro-habitat tolerances of *P. ralfsii*. It would also be useful to add a measure of distribution, as well as an indicator of total population. An alternative protocol, applicable to collected every five years could be:

If five or more hollows support P. ralfsii and the total number of thalli recorded exceeds 1,000, including male and female individuals, then the metapopulation may be considered to be in favourable condition.

It is important to recognise that there is no information available on inter-annual variation in the number of thalli produced by a single plant or in the number of plants a population. To derive an informed assessment of the condition of individual populations or the metapopulation as a whole, there would be a need to collect detailed autecological information, as well as monitoring groundwater levels.

3.3 Prognosis

3.3.1 Translocation and habitat creation

The failure of attempts to establish *P. ralfsii* in areas to the west of the Visitor Centre means that if the Greenland Lake Slack metapopulation continuous to decline, there is no reliable way of ensuring the survival of *P. ralfsii* at Dawlish. However, it is known that work which resulted in excavation of sand from part of Greenland Lake Slack in the past led to colonisation by *P. ralfsii*. It is therefore clearly possible to increase the population by scraping or removing substrate. The only way to identify a reliable method by which populations could established to the west of the Visitor Centre is by experimental work on existing populations.

If the organisations responsible for the management of Dawlish Warren are committed to conservation of *P. ralfsii*, *Cheilothela chloropus* and *Ophioglossum azoricum* to mitigate the likely impact if sea incursion to

Greenland Lake Slack, then they need to actively support on experimental work to try to ensure the future of these three species in areas which will remain after relaxation of the sea defences. This work must include experimental translocation, combined with habitat management. Recognising that the entire population of P. ralfsii (and other species) is likely to be lost, there should be no constraint on potential for experimental manipulation of populations within Greenland Lake Slack.

3.3.2 Relaxation of sea defences

Remote imagery presented by Lansdown (2012) shows that if, as a result of relaxation of sea defences, the morphology of Greenland Lake Slack returns to a structure similar to that which occurred in 1945, all populations of *P. ralfsii* currently present in Greenland Lake Slack, as well as populations of other notable species such as rabbit moss (*Cheilothela chloropus*) and small adder's-tongue (*Ophioglossum azoricum*) would be lost. Most could actually be lost as a result of a single sea incursion event. Thus, the prognosis for *P. ralfsii* at Dawlish is very poor without an extensive and imaginative translocation programme.

3.3.3 Visitor numbers

In the absence of saline incursion, predicted increases in visitor pressure on Greenland Lake Slack could benefit *P. ralfsii* by increasing pressure on vascular plants and thereby maintaining bare habitat. As can be seen from the difference in hollow No. 16, in 2012 use of the path through the reeds maintained open ground enough for *P. ralfsii* to survive. The slight change in the route followed by walkers between 2012 and 2019 to avoid the wettest area meant not only that *P. ralfsii* had gone, but the hollow could no longer be recognised.

Saline incursion and any loss of the dune area beyond the new sea wall will inevitably result in greater human pressure on remaining dune habitats. The potential effects of this on species such as P. ralfsii are very difficult to predict. Clearly, if attempts to establish *P. ralfsii* (and in the absence of work to establish the other notable species apart from *Romulea columnae*) in areas protected by the new sea wall continue to be unsuccessful, the question is academic as the notable species will have been lost from the site. Heavy visitor pressure in the area around the Visitor Centre could compromise any further attempts to establish notable species in this area, unless visitor access is very carefully managed, however if access is minimised in the most vulnerable areas but open in less sensitive area, the result could serve to maintain habitat for these species which would otherwise be lost to succession. Thus, the potential effects of increased visitor pressure are more dependent upon management than numbers or seasonality.

3.4 Long-term conservation of *P. ralfsii* at Dawlish Warren

We still do not know enough about the ecology of *P. ralfsii* to be able to undertake conservation with any confidence of success. The predicted loss of the populations in Greenland Lake Slack presents an opportunity to carry out experimental management in a natural population. Possible methods which could be tested include:

- Extensive excavation of areas in the land around the visitor centre, taking levels down to those which currently support *P. ralfsii* in Greenland Lake Slack.
- Translocating individual plants of *P. ralfsii*, digging down to locate the parent plant of thalli on the surface.
- Propagating *P. ralfsii* using methods applied elsewhere to species such as Atrichum angustatum and Ceratodon conicus (Lansdown 2018) to enable extensive planting of very high numbers of plants into potentially suitable habitat.
- Transplantation of turves within Greenland Lake Slack to study colonisation patterns. Turves should be removed and introduced to potentially suitable habitat created through management, the holes created should be filled with bare sand from nearby areas to create a bare surface for colonisation. This may help to establish why previous translocation attempts have been unsuccessful.
- Transplantation of fertile plants of both sexes should also be tested to establish whether this may have a better chance of success.

Even if successful, transplanted populations are likely to be subject to much higher pressure from tourism. In particular if the area of the warren is reduced by the sea, then remaining areas are likely to be subject to much greater pressure and may be compromised because of this.

4. CONCLUSIONS

1. The population of *P. ralfsii* in the Visitor Centre Slack appears to have died out, following a long-term decline.

2. It appears likely that attempts to translocate *P. ralfsii* to establish populations in natural and artificial hollows west of the Visitor Centre have been unsuccessful.

3. The population of *P. ralfsii* in Greenland Lake Slack appears to have declined since 2003 in terms of total numbers of thalli, the number of hollows occupied and the distribution of thalli. This is probably at least partly due to successional changes in the dune system, probably involving a decline in the water table, as the hollows which no longer support *P. ralfsii* are too dry and heavily vegetated by vascular plants to be suitable.

4. Populations of *P. ralfsii* (as well as those of *Cheilotheila chloropus* and *Ophioglossum azoricum*) in Greenland Lake Slack are unlikely to survive if relaxation of sea defences results in the predicted saline incursion and changes to the topography of the site.

5. In the absence of sea incursion, increased visitor pressure could have a beneficial effect on populations of P. ralfsii in Greenland Lake Slack, increasing pressure on vascular plants (particularly sedges and grasses), thus maintaining open habitats suitable for *P. ralfsii*, however it could equally have a negative effect on all species through uncontrolled soil compaction or erosion, depending on the circumstances. For any effects to be beneficial, there will be a need for active control of access.

6. The potential effects of increased visitor pressure on notable species within the area around the visitor centre, in the event of saline incursion and changes to the topography of the point will depend on the effectiveness of attempts to translocate these species to the area and on management of visitor access. Low-level access is likely to benefit these species, supressing establishment of dense swards of aggressive grasses.

7. The predicted loss of *P. ralfsii* from Greenland Lake Slack presents an opportunity to undertake experimental work to identify methods by which existing populations can be expanded and new populations established

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