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A survey for the Sandhill Rustic *Luperina nickerlii gueneei* on Newborough Warren National Nature Reserve in 2016

ID Wallace, B Wallace & MC Wallace

NRW Evidence Report No. 202

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1. Crynodeb Gweithredol

Cafodd cyfanswm o 149 o Wladwr y Twyni *Luperina nickerlii gueneei* aeddfed eu cofnodi yn Nhywyn Niwbwrch rhwng 29 Awst a 2 Medi 2016. Roedd hyn yn cynnwys 121 aeddfed ar forfeydd heli ac ymyl y twyni ym Mhenllyn Pysgod a Braich Abermenai, a 28 aeddfed ar Dwyni a Morfeydd Heli Cefni. Mae'r niferoedd yn awgrymu bod poblogaethau sylweddol ar y ddau safle hyn. Maent wedi goroesi stormydd gaeaf 2013–14 a oedd wedi erydu ardaloedd eang o dwyni blaen Tywyn Niwbwrch, ac maent wedi ymateb i gynefin Marchwellt Tywyn sy'n datblygu yn dilyn digwyddiad. Mae'r cyfrifiad llawn yn gwrthgyferbynnu'n gryf â'r arolwg diwethaf yn 2010 a oedd wedi cofnodi 12 aeddfed yn unig. Fodd bynnag, mae poblogaethau sy'n wynebu'r môr o flaen Coedwig Niwbwrch yn Ro Bach a Thraeth Llanddwyn, ac yng Ngwddw Llanddwyn ar Ynys Llanddwyn, lle y cofnodwyd niferoedd bach o'r gwyfyn yn 2010, fel pe baent wedi diflannu, yn ôl pob golwg.

Rydym yn argymhell bod ardaloedd sy'n addas ar gyfer bridio yn cael eu mapio wrth iddynt ddatblygu, er mwyn pennu eu cyrhaeddiad, a bod poblogaethau Gwladwyr y Twyni yn cael eu monitro yn rheolaidd, yn dibynnu ar amllder stormydd gaeaf difrifol.

2. Executive Summary

A total of 149 adults of the Sandhill Rustic *Luperina nickerlii gueneei* was recorded on Newborough Warren between 29th August and 2nd September 2016. This included 121 adults on saltmarsh and dune edge at Penllyn Pysgod and Braich Abermenai, and 28 adults on Cefni Dunes & saltmarsh. Numbers indicate robust populations at these two sites. They have survived the 2013-14 winter storms which eroded large areas of the fore dunes on Newborough Warren and may have responded to developing Sand Couch habitat following the event. The total count contrasts sharply with the previous survey in 2010 which recorded just twelve adults. However, seaward-facing populations in front of Newborough Forest at Ro Bach and Traeth Llanddwyn, and at Gwddw Llanddwyn on Ynys Llanddwyn, where the moth was recorded in small numbers in 2010, seem to have been lost.

It is suggested that areas of suitable breeding habitat are mapped as they develop to determine their extent, and that the Sandhill Rustic population is monitored at regular intervals, depending upon the frequency of severe winter storms.

3. Introduction

3.1 Background information

The Sandhill Rustic *Luperina nickerlii* occurs as small, disjunct colonies around the English and Welsh coast which are considered to be separate subspecies. *Luperina nickerlii gueneei* is associated with coastal dunes in north Wales, the Wirral and south Lancashire where larvae feed on the rhizomes of Sand Couch *Elytrigia juncea* growing in pioneer dune habitats in the fore dunes, on shingle ridges and in transition zones between saltmarsh and dune. These are dynamic habitats which are prone to periodic losses and gains from coastal erosion and accretion. Severe winter storms can destroy significant areas of breeding habitat but such losses are typically offset by the development of new areas of habitat as new ridges and areas of embryo dune are created. In Wales, the moth has been recorded from Gronant Dunes & Talacre Warren, Kinmel Dunes, Morfa Conwy, Morfa Deganwy (last seen in 1926) and Newborough Warren. The larger populations at Newborough Warren and Gronant Dunes & Talacre Warren survived the 2013-14 winter storms but numbers will have been reduced in the short term at least.

A detailed search for the moth at Newborough Warren was undertaken by the authors in 2010, with twelve adults found at eight locations (Figure 1 & Table 1; Wallace, 2011). Some of these sites will have been lost to the 2013-14 winter storms which resulted in the loss of up to 15-20m of frontal dunes in places (Duigan *et al.*, 2014). However, the moth is known to have survived this event, with an adult recorded at one location in Penllyn Pysgod in September 2014 (Sims, 2014).

Table 1. Past records of Sandhill Rustic *Luperina nickerlii* from Newborough Warren.

Grid Reference	Sample Date	Abundance	Recorder
SH46	1976		Hugh Michaelis
SH401630	1977		Hugh Michaelis
SH3965	27.08.1978	many	J.R. Langmaid; D.J.L. Agassiz; Barry Goater
SH424622	03.09.1979		D.H. Sterling
SH4264	29.08.1983		Barry Goater; Bernard Skinner
SH436618	03.09.1993	several adults	Brenda & Ian Wallace
SH392658	05.09.1993	1 beaten in daytime	Brenda & Ian Wallace
SH434618	31.08.1999	6 males + 6 females	Mike Hammett; Nigel Brown
SH42496216	24.08.2010	1 male	Brenda, Ian & Matthew Wallace
SH4262	24.08.2010	1 male	Brenda, Ian & Matthew Wallace
SH43396198	24.08.2010	1 female	Brenda, Ian & Matthew Wallace
SH39076593	26.08.2010	1 male	Brenda, Ian & Matthew Wallace
SH39076336	27.08.2010	1 male	Brenda, Ian & Matthew Wallace
SH39476363	27.08.2010	1 female	Brenda, Ian & Matthew Wallace
SH39776360	27.08.2010	4 adults	Brenda, Ian & Matthew Wallace
SH40706322	27.08.2010	2 adults	Brenda, Ian & Matthew Wallace
SH4214762562	22.08.2013	2 adults	Ian Sims
SH4230462443	22.08.2013	1 adult	Ian Sims
SH42386238	22.08.2013	2 adults	Ian Sims
SH4207562303	06.09.2014	1 adult	Ian Sims

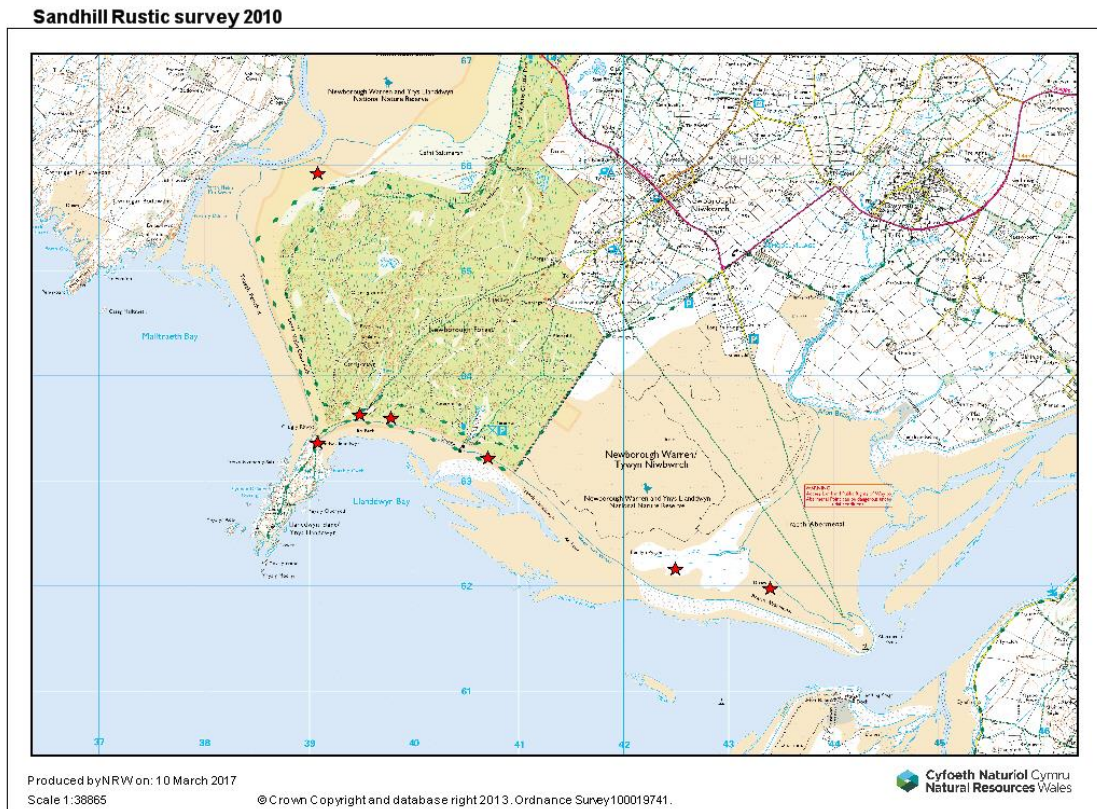


Figure 1: The distribution of Sandhill Rustic on Newborough Warren in 2010 (Wallace, 2011). Twelve moths were recorded from seven widely dispersed sites.

3.2. Objectives

Whilst the Sandhill Rustic was known to have survived the winter storms at Newborough Warren on account of the 2014 record from Penllyn Pysgod, it was clearly desirable to survey the dune system to determine its current status and distribution.

4. Methods

Following daytime reconnaissance visits, searches for Sandhill Rustic were undertaken from 29th August to 2nd September 2016. Adults were located by torch-light as they rested up on vegetation, principally on the larval foodplant Sand Couch, from about 9.30pm until midnight. This is the standard method for surveying this species and was devised by Adrian Spalding (Spalding, 2015). Brenda, Ian and Matthew Wallace undertook the survey and were assisted on the Cefni Dunes by Mike Howe. A visit to Morfa Dinlle was made on 3rd September 2016.

Grid references were obtained using a Garmin *etrex 10*.

5. Results

A total of 149 Sandhill Rustic adults was recorded from two core areas (Figure 2) – 121 moths in the Penllyn Pygod & Braich Abermenai area (Figure 3) and 28 moths on Cefni Dunes & saltmarsh (Figure 4). No moths were found in former south-west facing fore-dune sites (see Figure 1). The site at Traeth Llanddwyn had completely disappeared but at Ro Bach re-generation was starting from remains of rhizomes. It should be noted that Kevin Peace recorded two adults at a light trap in front of Newborough Forest at Ro Bach on 15th August 2016 (see Figure 2).

The habitat on the east side of Ynys Llanddwyn seemed little altered from its 2010 appearance. No moths were found then or in 2016, although high tides isolating the island prevented a good survey there in 2010. A list of all 2016 records is given in Table 2.

Searches at Porth Cwyfan and Porth Terfyn near Aberffraw, and near Fort Belan on Morfa Dinlle failed to locate the moth.

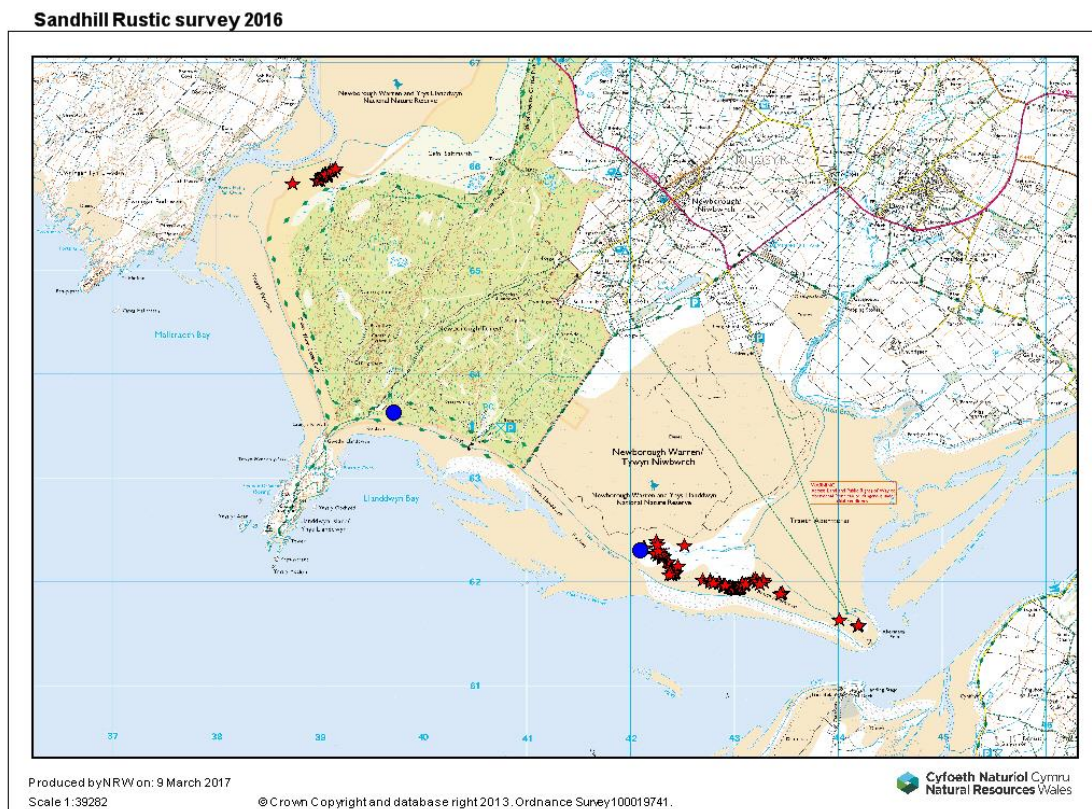


Figure 2: The distribution of Sandhill Rustic on Newborough Warren in 2016. Red stars = 2016 records, blue circles = Kevin Peace light trap record from the edge of Newborough Forest at Ro Bach in August 2016, and Ian Sims light trap record from Penllyn Pysgod in September 2014.

Sandhill Rustic survey 2016



Figure 3: The distribution of Sandhill Rustic at Penllyn Pysgod and Braich Abermenai on Newborough Warren in 2016. Red stars = 2016 records, blue circle = Ian Sims light trap record in September 2014.

Sandhill Rustic survey 2016



Figure 4: The distribution of Sandhill Rustic on Cefni Dunes & saltmarsh, Newborough Warren in 2016.

Table 2. Records of Sandhill Rustic from Newborough Warren in 2016. Includes a light trap record made by Kevin Peace. Records in blue = Cefni Dunes & Saltings, black = Penllyn Pysgod & Braich Abermenai.

Grid Reference	Abundance	Date	Recorder	Notes
SH3872665839	1 ad	31.08.2016	ID, B & M Wallace	
SH3895765875	1 ad	31.08.2016	ID, B & M Wallace	
SH3897065872	1 ad	31.08.2016	ID, B & M Wallace	
SH3899065872	1 ad	31.08.2016	ID, B & M Wallace	
SH3900965924	1 ad	31.08.2016	ID, B & M Wallace	
SH3900365904	1 ad	31.08.2016	ID, B & M Wallace	
SH3900365904	1 ad	31.08.2016	ID, B & M Wallace	
SH3901165918	1 ad	31.08.2016	ID, B & M Wallace	
SH3902365917	1 ad	31.08.2016	ID, B & M Wallace	
SH3903365931	1 ad	31.08.2016	ID, B & M Wallace	
SH3903365931	1 ad	31.08.2016	ID, B & M Wallace	
SH3903065937	1 ad	31.08.2016	ID, B & M Wallace	
SH3905165919	1 ad	31.08.2016	ID, B & M Wallace	
SH3905165919	1 ad	31.08.2016	ID, B & M Wallace	
SH3905165919	1 ad	31.08.2016	ID, B & M Wallace	
SH3905165919	1 ad	31.08.2016	ID, B & M Wallace	
SH3905765914	1 ad	31.08.2016	ID, B & M Wallace	
SH3905765914	1 ad	31.08.2016	ID, B & M Wallace	
SH3907065918	1 ad	31.08.2016	ID, B & M Wallace	
SH3906265937	1 ad	31.08.2016	ID, B & M Wallace	
SH3904965937	1 ad	31.08.2016	ID, B & M Wallace	
SH3908665963	1 ad	31.08.2016	ID, B & M Wallace	
SH3910565964	1 ad	31.08.2016	ID, B & M Wallace	
SH3910965969	1 ad	31.08.2016	ID, B & M Wallace	
SH3911365957	1 ad	31.08.2016	ID, B & M Wallace	
SH3910965968	1 ad	31.08.2016	ID, B & M Wallace	
SH3913865993	1 ad	31.08.2016	ID, B & M Wallace	
SH3914165985	1 ad	31.08.2016	ID, B & M Wallace	
SH4242262088	1 ad	02.09.2016	ID, B & M Wallace	
SH4240962077	1 ad	02.09.2016	ID, B & M Wallace	
SH4239462088	1 ad	02.09.2016	ID, B & M Wallace	
SH4237862124	1 ad	02.09.2016	ID, B & M Wallace	
SH4239162072	1 ad	02.09.2016	ID, B & M Wallace	
SH4237762070	1 ad	02.09.2016	ID, B & M Wallace	
SH4236462073	1 ad	02.09.2016	ID, B & M Wallace	
SH4237862145	1 ad	02.09.2016	ID, B & M Wallace	
SH4244162153	1 ad	02.09.2016	ID, B & M Wallace	
SH4235162195	1 ad	02.09.2016	ID, B & M Wallace	
SH4233862190	1 ad	02.09.2016	ID, B & M Wallace	
SH4230362249	1 ad	02.09.2016	ID, B & M Wallace	
SH4229462235	1 ad	02.09.2016	ID, B & M Wallace	
SH4229162223	2 ad	02.09.2016	ID, B & M Wallace	pr in cop
SH4229162245	1 ad	02.09.2016	ID, B & M Wallace	
SH4228462261	2 ad	02.09.2016	ID, B & M Wallace	pr in cop
SH4227062274	1 ad	02.09.2016	ID, B & M Wallace	
SH4224662253	1 ad	02.09.2016	ID, B & M Wallace	
SH4226162269	1 ad	02.09.2016	ID, B & M Wallace	
SH4226962264	2 ad	02.09.2016	ID, B & M Wallace	pr in cop
SH4222162277	1 ad	02.09.2016	ID, B & M Wallace	
SH4226062297	2 ad	02.09.2016	ID, B & M Wallace	pr in cop
SH4226062297	2 ad	02.09.2016	ID, B & M Wallace	pr in cop

SH4226062298	1 ad	02.09.2016	ID, B & M Wallace	
SH4224062389	2 ad	02.09.2016	ID, B & M Wallace	pr in cop
SH4224462360	1 ad	02.09.2016	ID, B & M Wallace	
SH4224462360	1 ad	02.09.2016	ID, B & M Wallace	
SH4224462360	1 ad	02.09.2016	ID, B & M Wallace	
SH4224462360	1 ad	02.09.2016	ID, B & M Wallace	
SH4224462363	1 ad	02.09.2016	ID, B & M Wallace	
SH4250362347	1 ad	02.09.2016	ID, B & M Wallace	
SH4211662333	1 ad	02.09.2016	ID, B & M Wallace	
SH4210862327	1 ad	02.09.2016	ID, B & M Wallace	
SH4268362022	1 ad	29.08.2016	ID, B & M Wallace	
SH4275562018	1 ad	29.08.2016	ID, B & M Wallace	
SH4275862015	1 ad	29.08.2016	ID, B & M Wallace	
SH4275161998	1 ad	29.08.2016	ID, B & M Wallace	freshly emerged
SH4275061997	1 ad	29.08.2016	ID, B & M Wallace	freshly emerged
SH4275061997	1 ad	29.08.2016	ID, B & M Wallace	
SH4275361996	1 ad	29.08.2016	ID, B & M Wallace	
SH4275361996	1 ad	29.08.2016	ID, B & M Wallace	
SH4279061985	1 ad	29.08.2016	ID, B & M Wallace	
SH4283861989	1 ad	29.08.2016	ID, B & M Wallace	
SH4284461987	1 ad	29.08.2016	ID, B & M Wallace	flying
SH4284061982	1 ad	29.08.2016	ID, B & M Wallace	
SH4284361983	1 ad	29.08.2016	ID, B & M Wallace	
SH4288461968	2 ad	29.08.2016	ID, B & M Wallace	pr in cop
SH4288461968	1 ad	29.08.2016	ID, B & M Wallace	
SH4288561966	1 ad	29.08.2016	ID, B & M Wallace	
SH4288561959	1 ad	29.08.2016	ID, B & M Wallace	
SH4288561959	1 ad	29.08.2016	ID, B & M Wallace	
SH4288561959	1 ad	29.08.2016	ID, B & M Wallace	
SH4288261958	1 ad	29.08.2016	ID, B & M Wallace	
SH4288061954	1 ad	29.08.2016	ID, B & M Wallace	
SH4289061964	1 ad	29.08.2016	ID, B & M Wallace	
SH4289061964	1 ad	29.08.2016	ID, B & M Wallace	
SH4289061964	1 ad	29.08.2016	ID, B & M Wallace	
SH4289061964	1 ad	29.08.2016	ID, B & M Wallace	
SH4289061964	1 ad	29.08.2016	ID, B & M Wallace	
SH4289661965	1 ad	29.08.2016	ID, B & M Wallace	
SH4293261949	1 ad	29.08.2016	ID, B & M Wallace	
SH4294061948	1 ad	29.08.2016	ID, B & M Wallace	crippled
SH4294561945	1 ad	29.08.2016	ID, B & M Wallace	
SH4294861945	1 ad	29.08.2016	ID, B & M Wallace	crippled
SH4295161946	1 ad	29.08.2016	ID, B & M Wallace	
SH4296961942	1 ad	29.08.2016	ID, B & M Wallace	
SH4296361935	1 ad	29.08.2016	ID, B & M Wallace	
SH4296361935	1 ad	29.08.2016	ID, B & M Wallace	
SH4297461934	1 ad	29.08.2016	ID, B & M Wallace	freshly emerged
SH4295961931	1 ad	29.08.2016	ID, B & M Wallace	
SH4295961931	1 ad	29.08.2016	ID, B & M Wallace	
SH4295961931	1 ad	29.08.2016	ID, B & M Wallace	
SH4297961939	1 ad	29.08.2016	ID, B & M Wallace	freshly emerged
SH4297961939	1 ad	29.08.2016	ID, B & M Wallace	
SH4299061936	1 ad	29.08.2016	ID, B & M Wallace	freshly emerged
SH4299061936	1 ad	29.08.2016	ID, B & M Wallace	
SH4300561934	1 ad	29.08.2016	ID, B & M Wallace	
SH4300561934	1 ad	29.08.2016	ID, B & M Wallace	

SH4300561934	1 ad	29.08.2016	ID, B & M Wallace	
SH4300561934	1 ad	29.08.2016	ID, B & M Wallace	
SH4300461928	1 ad	29.08.2016	ID, B & M Wallace	
SH4300461928	1 ad	29.08.2016	ID, B & M Wallace	
SH4299161924	1 ad	29.08.2016	ID, B & M Wallace	
SH4301161934	1 ad	29.08.2016	ID, B & M Wallace	
SH4302361933	1 ad	29.08.2016	ID, B & M Wallace	
SH4302661937	1 ad	29.08.2016	ID, B & M Wallace	
SH4302261946	1 ad	29.08.2016	ID, B & M Wallace	
SH4303161932	1 ad	29.08.2016	ID, B & M Wallace	
SH4302261956	1 ad	29.08.2016	ID, B & M Wallace	
SH4302261956	1 ad	29.08.2016	ID, B & M Wallace	
SH4303861934	1 ad	29.08.2016	ID, B & M Wallace	
SH4304461937	1 ad	29.08.2016	ID, B & M Wallace	
SH4305761943	2 ad	29.08.2016	ID, B & M Wallace	pr in cop
SH4308661966	1 ad	29.08.2016	ID, B & M Wallace	
SH4305761974	1 ad	29.08.2016	ID, B & M Wallace	
SH4309761972	1 ad	29.08.2016	ID, B & M Wallace	
SH4306761985	1 ad	29.08.2016	ID, B & M Wallace	
SH4306761985	1 ad	29.08.2016	ID, B & M Wallace	
SH4306761985	1 ad	29.08.2016	ID, B & M Wallace	
SH4309961972	1 ad	29.08.2016	ID, B & M Wallace	
SH4317162015	1 ad	29.08.2016	ID, B & M Wallace	
SH4318762033	1 ad	29.08.2016	ID, B & M Wallace	
SH4320061994	1 ad	29.08.2016	ID, B & M Wallace	
SH4321062012	1 ad	29.08.2016	ID, B & M Wallace	
SH4326162017	1 ad	29.08.2016	ID, B & M Wallace	
SH4327062002	1 ad	29.08.2016	ID, B & M Wallace	
SH4323761979	1 ad	29.08.2016	ID, B & M Wallace	
SH4344461880	1 ad	29.08.2016	ID, B & M Wallace	
SH4345261890	1 ad	29.08.2016	ID, B & M Wallace	
SH4343061886	1 ad	29.08.2016	ID, B & M Wallace	crippled
SH4400461633	1 ad	29.08.2016	ID, B & M Wallace	
SH4418361572	1 ad	29.08.2016	ID, B & M Wallace	
SH4419061577	1 ad	29.08.2016	ID, B & M Wallace	flying
SH397637	2 ad	15.8.2016	Kevin Peace	2 ad

6. Discussion

The total of 149 adults of Sandhill Rustic on Newborough Warren in 2016 is in stark contrast with the twelve adults recorded in 2010, and indicates that the population has not only survived the 2013-14 winter storms but has been able to respond to any suitable conditions created subsequently. The storms may have rejuvenated some of the site, possibly by dumping sand, which may have been washed from the Braich Abermenai dunes. In 2016, all the adults were recorded from two core areas, at Penllyn Pysgod & Braich Abermenai and Cefni Dunes & saltmarsh. In 2010, the species was more widespread with adults recorded in front of the forest at Ro Bach and Traeth Llanddwyn, and at Gwddw Llanddwyn. Suitable habitat has been lost at Traeth Llanddwyn, but the rejuvenating habitat at Ro Bach has the potential to support the moth in the near future. The record of two adults at a light trap in August 2016 at Ro Bach suggests that a small breeding population may have been overlooked here. Alternatively, the moths may have dispersed from Penllyn Pysgod or

Cefni Dunes. It is possible that Sandhill Rustic is present on Ynys Llanddwyyn but not on the wing during the survey visit. However, the area of habitat is quite isolated as neighbouring fore-dune habitat has gone. Whilst the amount of habitat required to support a population is not known, it may currently be too small.

The 2010 and 2016 surveys are not directly comparable as the calendar dates are not the same and in 2010 spring tides covered a lot of habitat or made it inaccessible. However, the increase from three adult moths in 2010 to 121 in 2016 at Penllyn Pysgod & Braich Abermenai suggest that the population size has increased markedly. The variation in counts at Cefni Dunes & saltmarsh has to be treated with more caution. The singleton adult recorded here in 2010 was during a daytime visit and no night-time search was undertaken. A count of 28 adults here in 2016 indicates a robust population.

The Cefni site is currently being eroded quite rapidly by the meandering of the main channel. The end point of this erosion is not known but it may be that new habitat will develop, possibly across the estuary, as channels tend to shift to and fro over quite a long time period.

Searching for new sites was not part of the survey, but small areas of promising habitat were seen at Porth Cwyfan and Porth Terfyn near Aberffraw, and near Fort Belan on Morfa Dinlle. These are not thought to be big enough to support a viable population but might lead to occasional occupancy following colonisation by a vagrant, gravid female.

7. Conclusions & Recommendations

Newborough Warren currently supports a robust population of the Sandhill Rustic which appears to have responded well to any suitable habitat creation following the 2013-14 winter storms. Small populations recorded in 2010 at Traeth Llanddwyyn and Ro Bach may have been lost but rejuvenating Sand Couch habitat at Ro Bach and existing habitat at Gwddw Llanddwyyn should have the potential to support the moth in the near future.

Ideally, areas of suitable breeding habitat should be mapped as they develop to provide a measure of the resource, and searches for adult moths should be undertaken at regular intervals, perhaps every five years depending upon the severity of intervening winter storms and habitat loss.

8. Acknowledgements

We are grateful to Mike Howe for commissioning the survey. The Senior Reserves Manager Graham Williams of Natural Resources Wales and Dick Loxton of Mynydd Llandegai facilitated access.

9. References

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10. Appendix 1. Site photographs.



Figure 5: The low sandflat with sand couch grass and the encroaching channel at the south west end of the Cefni saltmarsh, looking west on 28th August 2016.



Figure 6: An area of young sand couch grass abutting saltmarsh vegetation at the southwest end of the Cefni saltmarsh, being examined by Brenda and Matthew Wallace on 28th August 2016.



Figure 7: Older sand couch grass at the south western end of the Cefni Saltmarsh looking east on 28th August 2016.



Figure 8: Dunes being cut back by the meandering channel of the Afon Cefni looking east at mid-tide on 28th August 2016.



Figure 9: Looking west towards Penllyn Pysgod from Abermenai with the dunes of Braich Abermenai on the left. There seems no significant difference in habitat between the upper view taken on 29th August 2016 and lower in August 2010.





Figure 10: Sand couch grass backing Braich Abermenai dunes on 29th August 2016. Note the two drift lines indicating that the habitat is inundated by spring tides.



Figure 11: A deposit of fine silt may be left by the sea when it covers the sand couch grass, as here at Penllyn Pysgod on 29th August 2016.



Figure 12: An area at the back of Braich Abermenai where sand couch grass and sea purslane grow together and in patches. There appears to be generally more sand in the view of 29th August 2016.





Figure 13: Sand couch grass colonising a new sand mound behind Braich Abermenai on 29th August 2016.



Figure 14: Tall sand couch grass at the back of Braich Abermenai on 29th August 2016.



Figure 15: An extensive area of sand couch grass amongst salt marsh vegetation on a dead flat area behind Braich Abermenai on 29th August 2016.



Figure 16: Sand couch grass dominating a low mound of sand in Penllyn Pysgod on 29th August 2016.



Figure 17: The east end of Penllyn Pysgod photographed on 29th August 2016 and nearby in August 2010 showing very little change in habitat.





Figure 18: This picture of low sand mounds amongst saltmarsh in Penllyn Pysgod on 29th August 2016 seems to show the same proportions of different habitats as in August 2010.





Figure 19: Water movement has kept the area of sand around this mound open in Penllyn Psygod on 29th August 2016.



Figure 20: The fringe of sand couch grass can be narrow if the backing dune is steep. The two drift lines seen in Figure 10 photo are also clear in this view. Braich Abermenai on 29th August 2016.



Figure 21: Seaward face of Traeth Llanddwyn on 31st August 2016 showing no fore dune.



Figure 22: The fore dune has been less damaged the nearer you get to Llanddwyn Island and the grass seems poised to re-establish a fore dune from remaining rhizomes. The rear parts of the fore dune seem to have been unaffected but the rhizomes may be too deep to support caterpillars. Photographed on 31st August 2016.



Figure 23: Seaward facing area at Ro Bach looking east on 31st August 2016. A few straggly rhizomes of sand couch grass remain, but the fore dune photographed in August 2010 which supported Sandhill Rustics has gone and the dune edge is generally much steeper.





Figure 24: New growth can be seen in this lower view of the west end of Ro Bach on 31st August 2016.



Figure 25: One of the 121 Sandhill Rustic moths seen between Abermenai Point and Penllyn Pysgod in 2016 by the authors.



Figure 26: There is no evidence of damage to the sand couch grass at Porth y Cwch on Llanddwyn Island, when comparing August 2010 with August 2016.





Figure 27: Surveyors Matthew and Brenda Wallace bleakly contemplate the small fringe of sand couch grass behind the fore dune near Fort Belan on 3rd September 2016.



Figure 28: Sandhill Rustic surveyors Brenda and Matthew Wallace limber up before a hard evening's mothing on 29th August 2016.

11. Data Archive Appendix

The data archive contains:

- [A] The final report in Microsoft Word and Adobe PDF formats.
- [B] Species records, which are held on the NRW Recorder 6 database.

Metadata for this project is publicly accessible through Natural Resources Wales' Library Catalogue <http://libcat.naturalresources.wales> or <http://catllyfr.cyfoethnaturiol.cymru> by searching 'Dataset Titles'. The metadata is held as record no. 118345.



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