The effectiveness of deterrent measures to minimize disturbance impacts to breeding European nightjar at an upland wind farm site in South Wales, UK

Mike P. Shewring[1]* & Jim O. Vafidis[2]

[1] *Natural Power Consultants, Y Lanfa, Aberystwyth, Ceredigion, SY23 1AS, UK*
[2] *University of the West of England, Coldharbour Lane, Bristol, BS16 1QY, UK*

SUMMARY

The Pen y Cymoedd windfarm in South Wales, UK, is set in an upland area currently dominated by coniferous forestry with a varied age structure resulting from standard forestry management practices. The site supports an important population of European nightjar *Caprimulgus europaeus.* The activities associated with wind farm construction have the potential to damage and disturb nightjar nests during the breeding season whilst long term operation has the potential for collision mortality. To mitigate for potential impacts during construction, we implemented measures to allow nest avoidance including the identification and demarcation of active nest sites. Due to the difficulty in locating nightjar nests and the potential for false negative results, additional measures were deployed at 17 turbine locations to deter nightjars from establishing nesting territories. Deterrent measures involved regular removal of vegetation on the construction areas. We tested the effectiveness of the deterrent measures by comparing levels of male nightjar territorial display activity in treated and untreated locations over one breeding season. Territorial behaviour was recorded using standard nightjar presence-absence survey methods. We found no significant difference between levels of territorial display activity in treated and untreated areas. This suggests that the deterrent measures utilised at Pen y Cymoedd in 2016 were ineffective in deterring male nightjar display activity during windfarm construction.

BACKGROUND

The European nightjar *Caprimulgus europaeus* is a crepuscular and nocturnal bird that breeds across most of Europe and temperate Asia. Nightjar is a cryptic species with low levels of daytime activity. Nightjars typically breed in upland heathland, although in Wales they are almost exclusively associated with commercial forestry plantation (Conway *et al*. 2007). Renewable energy policy (e.g. Welsh Assembly Government (2005)) encourages the development of large wind-power schemes at commercial forestry sites throughout Wales. There is concern that the installation of these developments have the potential to impact on important nightjar populations through damage to and disturbance of nest sites during the breeding season, as well during the operational phase through direct mortality (collision) and disturbance. Appropriate mitigation is therefore required to minimise the impacts on nightjars during construction activities and as part of the consent measures for the Pen y Cymoedd windfarm scheme, a new windfarm development in South Wales. The developer was required to incorporate a number of measures to minimize risks to this species. This typically involves monitoring active nests in order to avoid disturbance and damage during turbine installation and infrastructure works (Shewring & Carrington *et al.* 2015). Since the landscape in which nightjars breed is often extensive, such monitoring requires intensive survey effort, which may result in nest sites being missed. One potential way to minimize the likelihood of damaging undiscovered nests is to incorporate deterrent measures that discourage nightjars from establishing nest sites in construction zones. Deterrent measures are often used to reduce human-wildlife conflicts in development, agriculture and residential areas (e.g. Brough & Bridgman 1980, Werner *et al.* 2005, Andrew *et al.* 2007).

In this article, we describe the effectiveness of a deterrent measure for nightjars used at the Pen y Cymoedd windfarm site in South Wales during the 2016 breeding season. The wind farm is a 76 turbine scheme (developed by Vattenfall Wind Power Ltd) located on an upland plateau between Aberdare and Resolven in South Wales, UK, (approximate centre SN906021). The site is in excess of 15 km^2 and is managed by Natural Resources Wales (formerly Forestry Commission) on behalf of the Welsh Government as upland rotation conifer plantation. The site is dominated by Sitka spruce *Picea sitchensis* crops of varied age interspersed with significant areas of unplanted and remnant blanket bog, wet modified bog, and unimproved acid grassland. This mosaic of clear-fell, young crop and heathland provides suitable nesting habitat for nightjars across large areas of the site. Given that localised forest clearance is associated with the wind farm development, suitable habitat is located at each turbine. This creates the potential for conflict during construction works, which could potentially impact both the nightjar populations and construction programme and budget. A search for existing evidence of such interventions in the *Conservation Evidence* database (Sutherland *et al.* 2017) showed one study (Burgess *et al*. 1990) that found that clearing areas of heathland increase the nightjar numbers.

ACTION

The measure intended to deter breeding nightjars in turbine areas and the adjacent 200 m involved removal of all ground vegetation above 10 cm using industrial brush-cutters. These works involved increased human presence associated with three operatives present within the defined 200 m radius of each turbine area for approximately 3-4 hours on each visit. The work was completed on a rolling basis with fortnightly clearance

* To whom correspondence should be addressed: mikes@naturalpower.com

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around each turbine location between 1 May and 31 August 2016. These measures were undertaken at 17 of the 76 turbine locations on the site.

These 17 sites were chosen based on construction programme requirements and the perceived risk to the programme from conflict with nesting nightjars at each location. The other 59 turbine locations were not subject to any ongoing vegetation clearance. All 76 locations supported habitat suitable for nesting nightjars, with clear-fell in close proximity around each turbine location and/or coniferous forestry between 0 and 12 years old in the wider area. Both habitats are utilised by nightjars as a nesting resource (Jenks *et al.* 2014). No suitable data were available showing numbers of nightjars around each turbine prior to construction for comparison.

Nightjar activity monitoring: Presence-absence surveys were completed using listening surveys following the methods described by Gilbert *et al.* (1998). This involved visiting a suitable nesting area twice in June-July between dusk and 1 h after dusk or between 1 h before dawn and dawn to listen for nightjar territorial display activity such as male 'churring'. All 76 turbine locations were visited at least twice. Standard nightjar survey methods generally involve the use of a walked transect through the area of interest. However, given the point style locations of interest at Pen y Cymoedd this was modified to a stationary listening survey at each turbine location for a minimum of 20 minutes. Low amplitude tape luring (to stimulate any resident birds but minimise the potential for drawing in individuals from surrounding habitat patches) was also used (for up to 10 minutes) if no territorial display activity was noted within the 20 minute observation window. Surveys were completed at all turbine locations in 2016 and the results used to target subsequent nightjar capture and nest finding efforts. Insufficient numbers of nest sites were confirmed in 2016 to allow a meaningful assessment of the effectiveness of deterrent measures on nesting behaviour and we therefore tested the effectiveness of deterrent measures on levels of male territorial display behaviour as a proxy for nesting.

CONSEQUENCES

Around the 17 turbines where deterrent measures were deployed, male display activity was noted in seven separate locations, representing 41% of the treated turbine areas (Table 1). These displays were observed on eight of the 14 survey visits to the positively identified locations. No nests were confirmed within these locations. Around the 59 untreated turbine areas, male display activity was noted in 14 separate locations; 23% of untreated turbine areas. A single nest site was confirmed within 200 m of a turbine location. There was no significant effect of deterrent treatment on the occurrence of male display activity compared to untreated sites (X^2= 0.555, d.f. = 1, P = 0.45).

DISCUSSION

This study showed that the regular removal of ground vegetation within a 200 m radius of wind turbines under construction had no significant effect on observed levels of male nightjar display activity. This suggests deterrent measures

Table 1. Number of sites with male nightjar territorial activity, with and without deterrents.

Display Activity (Yes/No)	Nightjar activity results where deterrents were deployed[1]		Nightjar activity results where **no** deterrents were deployed[2]	
	%	Number	%	Number
Yes	41	7	23	14
No	59	10	77	45

[1] N = 17 locations in total
[2] N = 59 locations in total

involving vegetation removal and potential human disturbance associated with these works at the level of effort deployed here are not cost-effective in displacing nightjar territorial behaviour from areas.

Deterrent measures as deployed at a greater frequency may be more successful than those described here. However, there is no appropriate evidence base to support this and given the results of our works we would suggest this avenue is probably not cost effective to explore further.

As such we would suggest that where activities are proposed with the potential to disturb, damage or destroy nightjar nests, or where there is a high risk of operational mortality, future measures to minimise such potential human wildlife conflict should explore alternative potential deterrent measures. These should have suitable consideration of the species ecology (i.e. cryptic species that tends to sit 'tight' on nests to avoid notice) and focus on long-term landscape-scale increased habitat provision and improved habitat quality to ensure the long term viability of populations.

The findings of this study provide the first evidence of the low cost-effectiveness of nesting deterrent measures during construction. This can be used to inform appropriate nesting nightjar conservation interventions to reduce human-wildlife conflict.

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