Monitoring Life+ project Amsterdamse Waterleidingduinen

Source for Nature

Vervolgmonitoring en analyse, situatie 2015/2016

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Summary

Framework

During 2012 - 2016, Waternet carried out a dune restoration project entitled 'Source for Nature' in the Amsterdam Dunes (AD). In addition to a grant from the EU's LIFE+ programme, the province of North Holland also contributed financially to the project. The restoration concerned the priority habitat type 'Fixed dunes with herbaceous vegetation (grey dunes)' (H2130), and the habitat types 'Dunes with *Hippophae rhamnoides*' (H2160) and 'Humid dune slacks' (H2190). These habitats have diminished in size and quality principally through the processes of acidification and eutrophication caused by nitrogen deposition as well as through the explosive growth of black cherry (*Prunus serotina*). The land in the adjacent Haarlemmermeer has previously been drained. This along with water abstraction in the AD and sand extraction in the inner dunes has meant that the area has become much drier. In the last several decades however, Waternet has made changes to the catchment of the southern part of the AD that have helped with increasing the height of the water table. Acidification, eutrophication and desiccation followed by waterlogging encouraged the widespread growth of tall grasses, such as wood small-reed (*Calamagrostis epigejos*).

Within the Source for Nature project different restoration measures were implemented depending on the degree to which the dunes were vegetated. In areas with little grass encroachment, mowing was carried out and the cuttings removed (about 67 ha). If the area was heavily overgrown, the vegetation as well as the top layer of the soil was removed (about 34 ha). Mowing and top soil removal were both used in overgrown dune grasslands and dune valleys. Most thickets of black cherry and areas of mixed sea buckthorn and black cherry were cleared (almost 170 ha) and in some areas top soil was also removed (over 64 ha). Single black cherries were usually removed in a way that preserved the surrounding vegetation. In addition, pines (*Pinus nigra*; 4 ha) and poplars (*Populus* spp.; 2 ha) were also locally cleared, blow outs created (>2 ha) and dune-slack pools dredged (2 ha). In this report the restoration measures are evaluated.

Method

Waternet commissioned Bureau Waardenburg to record the vegetation as part of the Source for Nature project for the AD. Surveys were undertaken in the year prior to the start of restoration (baseline) and in the one to three years following restoration measures. Vegetation and simple abiotic parameters were recorded in small vegetation relevés of 2 by 2 metres. The location of these plots was recorded using a dGPS (10 cm accuracy) so that the survey could be repeated in exactly the same location (permanent plots). The initial situation was recorded in the period 2012 - 2014 (Inberg *et al.* 2015). Well-developed areas of grey dunes, dunes with *Hippophae rhamnoides* and humid dune slacks were also surveyed (target situation). The highest effort was in locations where management measures were to be undertaken, particularly in initially overgrown areas. Vegetation relevés were repeated in 2015 -

2016, following the restoration measures. A total of approximately 950 relevés were made.

During the vegetation surveys, species composition, the depth of the humus layer and the decalcification depth were also determined along with an estimate of the coverage of different vegetation layers. To assess the success of the management measures a comparison between the baseline situation (T0) and the new situation (T1) was made alongside that of the target situation. During the analysis, a Mann-Whitney U-test was used to determine whether there were significant differences in the recorded variables. This analysis was performed for the various sub-areas and habitat types. Attention was given to changes in soil, vegetation structure and species composition. Species were divided into ecological groups indicative of dune grasslands (habitat type H2130A and H2130B), dune slacks (habitat type H2190B and H2130C), dune scrub (habitat type H2160) and dune-slack pools (habitat type H2190A). Coverage and number of species was determined for each species-group, as well as for species indicative of grass encroached vegetation and other unwanted species such as black cherry. Multivariate analysis was used to analyse the data at the habitat level.

Results

In general, the time between restoration measures and the T1 surveys was too short in which to properly assess the success of the restoration measures, especially in the case of top soil removal. Nevertheless, the abiotic conditions, vegetation structure and abundance of both the target and unwanted species give an indication of the direction in which the vegetation is developing (see table 1).

Table 1: Overview of LIFE+ restoration management in various habitat types of the Amsterdam Dunes and the prognosis regarding recovery. Green = positive, light green = moderately positive, orange = moderately negative and red = negative.

Habitat type / **Area**	**H2130A**	**H2130B**	**H2160**	**H2190B/ H2130C**	**H2190B***	**H2190A**
Tonneblink	+					
Pollenberg	+					
Groot Zwarteveld		+/-		-/+		
Haasvelderduinen-Boeveld	+		-	+/-		
Middenduinen Central		+	+/-			
Haasveld	+	+/-		+/-		+
Middenduinen North		+	-			
Vinkenveld	+	+				
Oosterduinrel					+	
Schapenwei					+/-	
Pools						+

* *including wet alkaline grasslands*

The restoration of calcareous grey dunes (H2130A) was initiated through mowing, the removal of top soil and sand deposition in the dune grasslands in the areas of

Tonneblink, Pollenberg, Vinkenveld and Haasvelderduinen-Boeveld. The removal of pine forest in the area of Haasveld also enables the recovery of dune grassland. Abiotic conditions are generally favourable as calcium is present in the upper soil layer. Especially tall grasses were removed together with the top soil but remained after mowing only, meaning that grazing is required to prevent further development. At the same time however, the high grazing pressure from fallow deer hinders the recovery of calcareous dunes. Carrying out these restoration measures in a mosaic in Tonneblink, Pollenberg, Vinkenveld will lead to a phased recovery, which also has benefits for small animals such as butterflies.

Mowing, top soil removal and the cutting of black cherry, poplar and pines was applied in the overgrown acid grey dunes (H2130B) in the areas Groot Zwarteveld, Haasveld, Middenduinen Central, Middenduinen North, and Vinkenveld. Target species increased and tall grasses decreased in cover (improving habitat quality) following the cutting of black cherries, pines and poplars. They are however still there, as is the risk that they can take over again. Grazing in the middle dunes would maintain the levels of tall grass species and this is best achieved with cattle and sheep, which have a preference for this sort of vegetation. The first target species were noted after additional top soil removal and it is expected that this area will develop into acid grey dunes.

Sea buckthorn thickets (*Hippophae rhamnoides*; H2160) have strongly suffered from the invasion of black cherry. In Haasvelderduinen-Boeveld, Middenduinen Central and Middenduinen North, sea buckthorn did not return after black cherry and sea buckthorn were cut only. This was due to the reduced vitality of sea buckthorn and the scale to which black cherry was present. In Middenduinen Central sea buckthorn was able to return after additional removal of the top soil. In Middenduinen North however, the re-growth of sea buckthorn after top soil removal was much less successful, because of the poorer baseline situation and the higher grazing pressure by fallow deer. Sustainable recovery of sea buckthorn will only be able if the number of fallow deer decreases.

In humid dune slacks (H2190B and H2130C) with tall grass and shrub encroachment in Groot Zwarteveld, Haasveld and Haasvelderduinen-Boeveld, top soil removal was used as the main restoration measure. This was either shallow or deep depending on the degree of vegetation growth. Various target species of calcareous dune slacks returned to Groot Zwarteveld in the following years, as did many species that are indicative of acidic conditions suggesting that the lack of calcareous seepage could have noticeable consequences. In Haasvelderduinen-Boeveld and Haasveld, top soil removal led to a sharp decline in scrub species and signalled the start of the restoration process, although some of the valleys remain too dry (Haasvelderduinen-Boeveld). In addition, the establishment of many typical dune slack species is hampered by the absence of well-developed remnant populations in the immediate vicinity.

Restoration management was also carried out along the inner edge of the dunes at Oosterduinrel and Schapenwei. Here, the vegetation included species from calcareous dune slacks (H2190B), but also species of wet alkaline grasslands. Ditch banks and grasslands were redeveloped in both of these areas through the removal of the top soil, thereby increasing the influence of seepage with calcareous ground water. Restoration of the vegetation is now under strong pressure from grazing of fallow deer in Oosterduinrel. It is expected that the planned reduction in grazing pressure will aid the recovery of the vegetation. The lack of grazing by fallow deer in Schapenwei has helped the re-establishment of target species, but that has also been accompanied by a return of common rush (*Juncus effusus*). It is not yet clear whether the recovery of the target vegetation will continue as this would require a substantial increase in the seepage with calcareous ground water and, in the short term, mowing to prevent the return of more dominant species.

In the central part of the AD (Middenduinen North, Groot Zwarteveld and Haasveld), silted and overgrown pools (H2190A) were dredged and excavated, and trees removed to reduce shading along their banks. In the short term this has resulted in the establishment of stoneworts (*Characea*). Animals have responded positively with the return of amphibians (e.g. natterjack toad) and dragonflies (e.g. yellow-spotted whiteface).

Conclusion

A long-term prognosis for vegetation development can be given based on the amount of work undertaken and the results of the monitoring (see table 2). This includes both an increase in the area and in the quality of habitats.

Table 2: Prognosis of the areas of habitat restoration LIFE+ in the Amsterdam Dunes (increase in area and improved quality).

Habitat type	**Area (ha)**
Fixed dunes with herbaceous vegetation (calcareous - H2130A)	46
Fixed dunes with herbaceous vegetation (acid - H2130B)	205
Dunes with *Hippophae rhamnoides* (H2160)	17
Calcareous dune slacks (H2190B incl. H2130C)	24
Wet alkaline grasslands (incl. H2190B target species)	1
Dune-slack pools (H2190A)	2

Broadly speaking, it can be concluded that the restoration management undertaken in the LIFE+ ‘Source for Nature’ project in the AD led to the restoration of several habitat types, especially ‘Fixed coastal dunes with herbaceous vegetation’ (H2130A and H2130B). Calcareous humid dune slacks, including slightly decalcified moist dune grasslands (H2190B incl. H2130C), and pools (H2190A) also benefited but to a lesser extent. The restoration of sea buckthorn (H2160) was difficult in certain areas.