tussen Duin & Dijk

Connection and defragmentation

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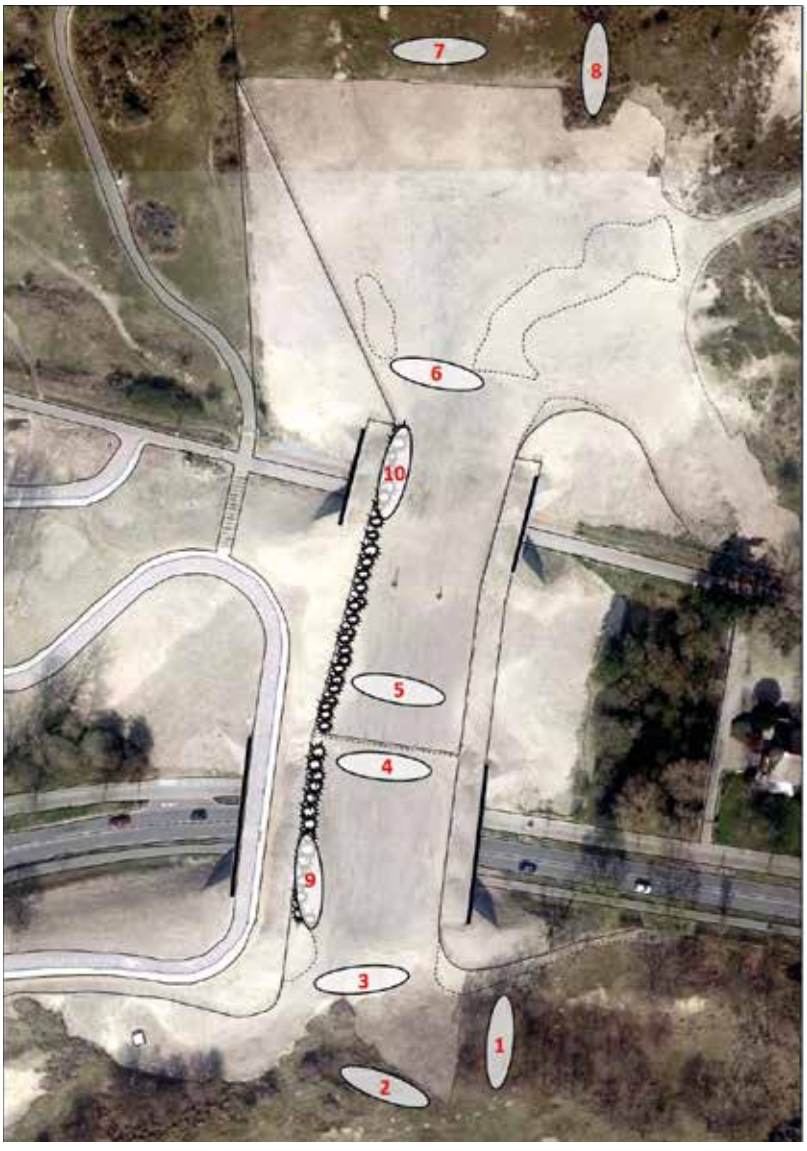
Ecoducts,

vital to soil fauna

The tree-stumps on the Zandpoort, February 2016. Photo: M. Boeken.

Figure 1. Location of the ecoducts within Zuid-Kennemerland national park.

Since 2014, researchers have been studying the use of wildlife crossings or ecoducts within the Zuid-Kennemerland National Park. From 2015, these efforts have included a study of the use of ecoducts by ground beetles and other soil fauna. What has happened since and what are the first results?



● *Figure 2. Location of the ten series of traps on and around Ecoduct Zandpoort.*

● Panagaeus bipustulatus. *Photo: M. Boeken.*

Pitfall traps

The first study into animals' use of the ecoducts in the Zuid-Kennemerland National Park was initiated in 2014 (Van der Spek *et al.*, 2017; figure 1). In March 2015, a second project studying the use of the then 1-year-old Zandpoort ecoduct by ground beetles and other soil fauna went underway. According to what is now considered a standardised method, to this aim, five pitfall traps with a diameter of 8.5 cm are dug into the soil across a more or less homogeneous environment and equipped with a roof to prevent the rain and wind from entering.
The traps are positioned in a straight line at 5 m intervals, which should more or less even out any terrain variation. The containers are lined with a layer of formalin (4%) designed to kill and preserve the trapped animals quickly. The addition of some washing-up liquid will break the surface tension and prevent the animals from escaping. This makes this method not very animal-friendly, but, between animals eating the bait and escaping, 'dry' traps provide only anecdotal evidence. Furthermore, with this method, the traps would have to be emptied at least once every week, while traps with the fluid only need to be emptied every two (or three) weeks. In order to prevent vertebrates from getting caught in them as well, the traps are also covered with pieces of chicken wire, which keeps larger animals (e.g. adult toads, mice, lizards) from falling into the fluid and climbing out again.

Sample sites

In order to get a good overview of the original species composition and abundance, the decision was made to place a series of traps on both sides of Ecoduct Zandpoort, in non-degraded woodland or thickets (series 1 and 8) as well as in exposed dune grassland (series 2 and 7; figure 2). Additional series were dug in on both access routes (series 3 and 6) and on the ecoduct proper (series 4 and 5). From 2016, additional series were placed in the so-called 'stobbenwal' structures (with wood and tree roots) that had been created at that time (series 9 and 10). At the request of the Province of Noord-Holland and PWN, from the end of April, yet more series of traps were positioned around the sites of the future ecoducts of ▶

● Philoscia muscorum.
Photo: Bert Pijs.

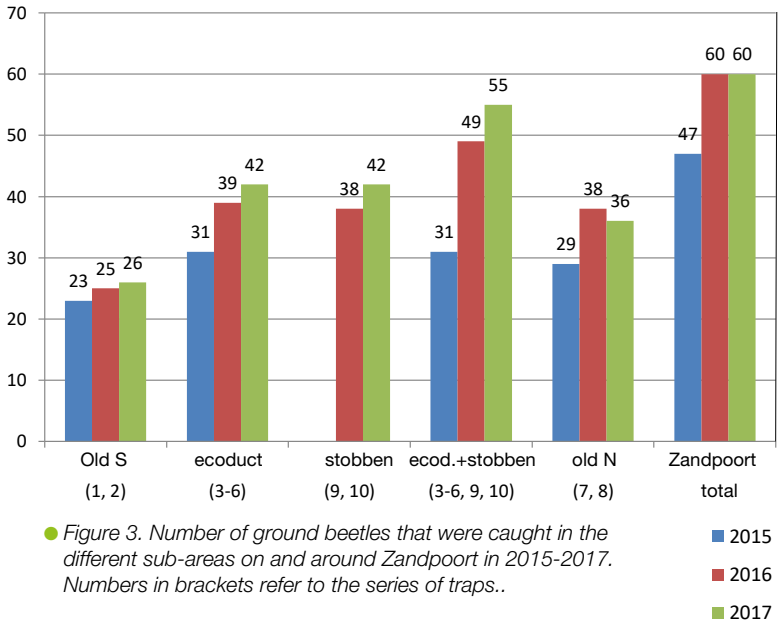
Duinpoort and Zeepoort. Similarly to the Zandpoort situation, here too on either side, a series of traps was put in woodland or thicket and an additional one in dune grassland. In 2017, the series around the Zeepoort were doubled to get a better sense of the initial situation, and, once it became possible (in early July), five series were placed on the new ecoduct: three in the bare soil and two in 'stobbenwallen'. Every two weeks, all the traps were emptied and the captured animals for each series collected and identified.

Ground beetles and more

The focus initially was on the ground beetles that were caught. But of course many more animals ended up in the traps, and it would be a shame to throw these away unseen. Many of these other species can also provide information on the impact and use of the ecoducts. That is why all woodlice (*Isopoda*) have also been identified and counted, as were centipedes (*Chilopoda*), millipedes (*Diplopoda*), harvestmen (*Opiliones*), wolf spiders (*Lycosidae*), ants (*Formicidae*), cockroaches (*Blattodea*) and other groups of invertebrates. Additionally, as several experts were interested in material, for instance rove beetles (*Staphylinidae*), snout beetles (*Curculionidae*) and wasps (*Hymenoptera*, a number of varieties) were collected as well. A large amount of data has been collected in this way over the last couple of years.

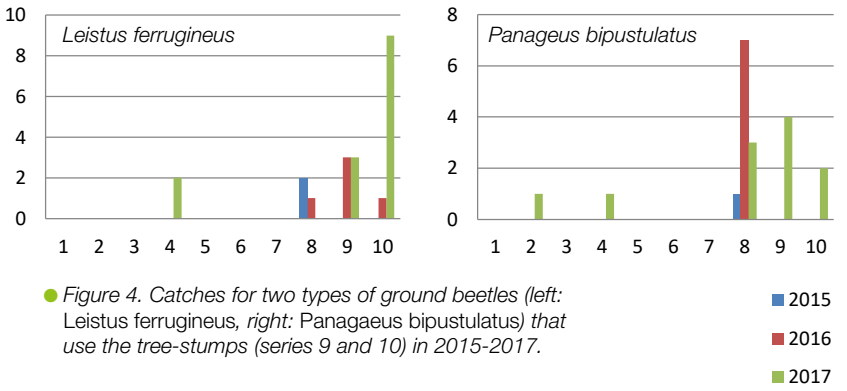
Expectations

In this article we will focus mainly on the developments on the Zandpoort ecoduct, with the data from the baseline studies around Duinpoort and Zeepoort being used to assess the variation in results on both sides of the ecoduct. The data from the other series of traps also serve to give an impression of whether certain species are found quite generally or only occur locally.



● *Figure 3. Number of ground beetles that were caught in the different sub-areas on and around Zandpoort in 2015-2017. Numbers in brackets refer to the series of traps..*

On a new sand body such as the sand forming the base of the ecoduct, the first animals that are expected to appear are beetles (*Coleoptera*) and of course especially the strong flyers among the species. Among these may be species without a clear preference for any type of terrain, but also species that live on open sand specifically. Non-flying species are usually more bound to a particular biotope and would be expected to appear once more vegetation has sprung up. A wildlife crossing is therefore mostly of use to the latter. To more sensitive animals like arthropods (*Arthropoda*) with all their senses, a strip of tarmac with a completely different temperature, humidity level and smell may easily become an insurmountable obstacle. In a fragmented area such as the Zuid-Kennemerland dunes, populations of slowly spreading species may easily face extinction if no recolonisation can take place. These dunes feature some species that are very rare in the rest of the Netherlands. It is therefore important for any ecoduct to become an integral part of the dune ecosystem and feature



● *Figure 4. Catches for two types of ground beetles (left:* Leistus ferrugineus*, right:* Panagaeus bipustulatus*) that use the tree-stumps (series 9 and 10) in 2015-2017.*

● Masoreus wetterhallii. *Photo: Udo Schmidt.*

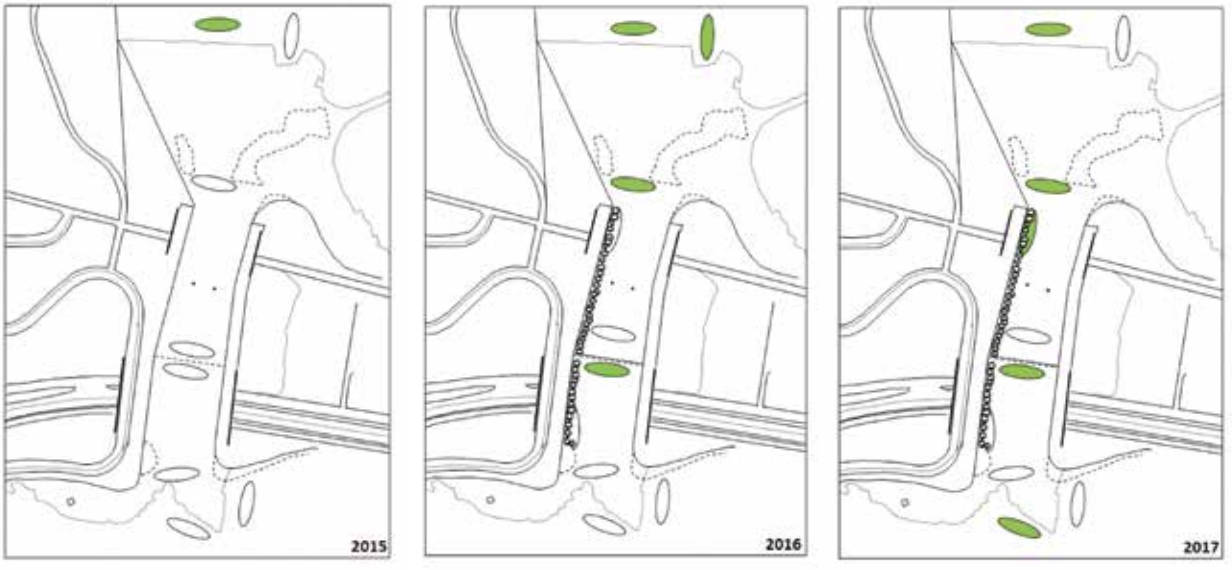
the same variety of biotopes (open sand, dune grassland, thickets). Only that will allow the species that would take several generations to cross the ecoduct (some smaller ground beetle species (*Carabidae*) only travel 50 m per generation!) to find food and the conditions they need to reproduce.

Results

In the past three years, 70 species of ground beetles were caught on and around Zandpoort (figure 3). The pitfall traps around the two other ecoducts caught an additional nine species in this same period. This is a large variety of species, taking into account the dry and relatively barren terrain. In comparison: in the whole Amsterdam Water Supply Dunes area, about half of the more than 300 Dutch species were caught in the period between 1974 and 2005 (Baeyens *et al.*, 2007), and these included a large number of species that are only found in humid surroundings. In 2015, more than a year after completion of the ecoduct, the number of species caught on the ecoduct was already significantly higher than what was caught in the surrounding area. This is mainly due to the fact that on both sides of the ecoduct, the traps were not placed on open sand. A large number of species is restricted to this kind of open sandy habitat; in addition, beetles can walk much faster on sparsely vegetated sandy terrain, so they have a greater chance of ending up in a trap. Not surprisingly, many of the beetles caught on the ecoduct were flying, sand-loving species, such as the northern dune tiger beetle (*Cicindela hybrida*). Still, nearly a third of the number would have to have walked over to the ecoduct: species without wings or functional flight muscles. The following year, the number of species on the ecoduct grew considerably, in particular due to the 'stobbenwal' (photo p.18). In 2016 and 2017, various non-flying species were caught in the stobbenwal that had not been found on the ecoduct before. A nice example ▶

Some species do not need the tree-stumps in their advance over the bridge.

● *Figure 5. Catches for* Masoreus wetterhallii *on and around Zandpoort in 2015-2017.*



Oniscus asellus. *Photo: Bert Pijs.*

Pitfall trap with formalin and chicken wire to prevent vertebrate bycatch. Photo: M. Boeken.

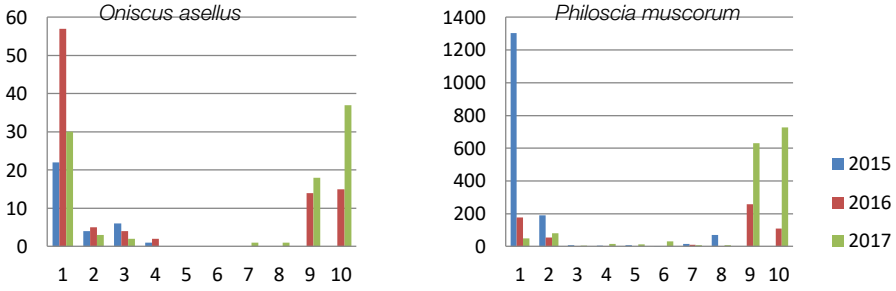


Figure 6. Catches for two types of woodlice (left: common woodlouse, right: common striped woodlouse) that use the tree-stumps (series 9 and 10) in 2015-2017.

would be *Leistus ferrugineus*. In 2015, this species was only found in a sea buckthorn (*Hippophae rhamnoides*) thicket on the northern side of the ecoduct, and in 2016 it was encountered in the stobbenwal as well. In 2017, it was no longer found in the buckthorn thicket, whereas in the stobbenwal it was present in relatively large numbers, and also out on the ecoduct itself, in the traps closest to the section that then sported the densest vegetation. A similar development shows the spread of the striking *Panagaeus bipustulatus* (figure 4).

Some species do not need the stobbenwal in their advance over the ecoduct. *Masoreus wetterhallii*, another non-flying species measuring about 5 mm that frequents dune grassland with open spaces, was found on the ecoduct before it was caught in the stobbenwal (figure 5). The distribution found in consecutive years would seem to suggest that several species are crossing the ecoduct from the same side. This does not have to be the case: they could also have come from the other side. To further investigate this, population genetic research would be useful (see Oostermeijer *et al.*, 2018, elsewhere in this issue).

There were also some surprising finds. For example, in 2016, several individuals of the species *Dyschirius angustatus* were found at different sites on the ecoduct. This (strong-flying) species had not been seen in all of the western Netherlands, and is caught so rarely that its ecology is still little known (Turin, 2000). This beetle was found on the ecoduct again in 2017. Another 2017 find that was at least as rare was *Harpalus serripes,* caught both on and around the Zandpoort as well as the recently completed Zeepoort, with a kind of dry sandy soil, which in this century had only been caught in a few places in the dunes of Noord-Holland (Texel and around Egmond). Zuid-Kennemerland was a well-known site for this species in the last century, but it had not been found in the much-studied AWD within the 1974-2005 period (Baeyens *et al.*, 2007). And although this sizeable beetle sports wings, there is some doubt as to whether it can actually fly (Turin, 2000).

Other groups

What makes ground beetles such valuable ecological indicators is for instance the great range of species and their widely differing habitat preferences. But more groups are useful when it comes to investigating how dune connections are used and what the impact of their layout is. Litter eaters such as woodlice will not pop up on a barren ecoduct en masse, and the seven species that were found in this study are certainly no rarities. But the presence of the stobbenwal does give a clear impression of the ways in

● *Series of traps on the Zandpoort. Photo: M. Boeken*

which such a structure can create new opportunities, and for instance connect populations, as we have seen here (figure 6).
Predators such as harvestmen also exemplify the effects of the stobbenwal. In addition to some of the larger species that are resistant to dehydration, the dunes harbour quite a few smaller species that tend to keep to the shade. Actually, most of the fourteen species that were counted prevailed in the denser thickets: an average of ten. In the dune grassland there were significantly fewer (three to five), and on the ecoduct itself usually only two or three species are found, while in the stobbenwal six to eight were found in 2017.

Conclusions

The dunes of Zuid-Kennemerland, in addition to typical dune species, harbour a great many other species that do not or hardly occur elsewhere in the country. This region is explicitly mentioned in the literature, for example, with regard to unique varieties of *Harpalus xanthopus winkleri*, a ground beetle, *Lithobius subtilis*, a small centipede, and *Vertigo substriata*, a whorl snail. All these species occur in areas adjacent to or even already on the ecoducts themselves.
For stenotopic species (which only tolerate a narrow range of environmental conditions) in the dunes, of which this article features only a limited number of examples, ecoducts therefore appear to have a function, and such connections between fragmented habitats can be of vital importance.
The results of the first three years of research show that the Zandpoort ecoduct is already being used by a large number of species, which started only shortly after its construction. This also includes species for whom roads and railway tracks are a major obstacle. The same was observed in the first few months after completion of the Zeepoort. The stobbenwal features also appear to have an important function, as a magnet and in guiding species towards the ecoduct. The study will be continued over the following years.

Acknowledgements

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Annual reports for this study can be accessed on www.pwn.nl.

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