

# Campsites as unexpected hotspots for the unintentional introduction and subsequent naturalization of alien plants in Belgium and the Netherlands

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## Key words

alien flora  
vascular plants  
campsites  
naturalization  
Belgium  
Netherlands

**Abstract** – Between 2015 and 2019 field work was carried out in campsites in Belgium and the Netherlands. These proved to harbor an extraordinary rich flora, consisting of (mostly) alien species and (very) rare native species that probably also were introduced, at least for the most part. These species were all introduced inadvertently by tourists, their seeds and/or fruits being attached to tent floors, car mats, shoes and clothing, car tires, etc. Although a number of the species had never been recorded before in the study area, several of them are clearly naturalized and are even relatively widespread. This applies at least to species such as *Poa infirma*, *Soliva sessilis*, and *Trifolium suffocatum*. Other interesting records include several Mediterranean Gnaphalieae (*Bombycilaena erecta*, *Filago congesta*, *F. gaditana*, *F. pygmaea*), various legumes of the genera *Medicago* and *Trifolium* (e.g. *Medicago littoralis*, *M. rigidula*, *Trifolium nigrescens*), *Parentucellia latifolia*, etc. Mechanisms for the introduction and spread for these species, their preferred habitat, local distribution and frequency, degree of naturalization, and recognition are commented upon. Most of the interesting species are also illustrated and a few distribution maps and a phytosociological relevé are also presented. The survival rates of these southern species are discussed. As a result of a changing climate their chances for a future local naturalization and spread seem realistic. To our knowledge, a similar large-scale study has never been conducted before.

**Samenvatting** – Tussen 2015 en 2019 werd veldwerk uitgevoerd op campings in België en Nederland. Deze bleken een buitengewoon rijke flora te herbergen, bestaande uit grotendeels uitheemse soorten maar ook nogal wat zeldzame inheemse soorten. Deze planten werden mogelijk allemaal onopzettelijk aangevoerd door toeristen. Met caravans, campers en tenten belanden zaden en/of vruchten uit het zuiden van Europa op standplaatsen van campings, gehecht aan tentzeilen, automatten, kleding, schoenen en autobanden. Hoewel een aantal van de soorten nog nooit eerder in het studiegebied waren waargenomen, is een deel daarvan duidelijk ingeburgerd en zelfs relatief wijdverspreid. Dit geldt minstens voor soorten zoals *Poa infirma*, *Soliva sessilis* en *Trifolium suffocatum*. Voor *Crassula tillaea* was het voorkomen op campings al eerder bekend, maar heeft het onderzoek bijgedragen een nauwkeuriger beeld van de verspreiding te verkrijgen. Andere interessante vondsten betreffen onder andere verschillende mediterrane Gnaphalieae (*Bombycilaena erecta*, *Filago congesta*, *F. gaditana*, *F. pygmaea*), verschillende taxa uit de Fabaceae, waaronder *Medicago* en *Trifolium* (bijvoorbeeld *Medicago littoralis*, *M. rigidula*, *Trifolium nigrescens*) en uit de Orobanchaceae, bijvoorbeeld *Parentucellia latifolia*.

Mechanismen voor de introductie en verspreiding van deze soorten, hun voorkeurs habitat, lokale verspreiding en frequentie, inburgeringsgraad en herkenning worden in dit artikel besproken. De meeste interessante soorten worden geïllustreerd aan de hand van foto's en enkele verspreidingskaarten. Tevens is er een vegetatieopname opgenomen. De overlevingskansen van deze zuidelijke soorten worden besproken. Als gevolg van een veranderend klimaat lijkt hun kans op een toekomstige lokale inburgering en verdere verspreiding realistisch.

Bij ons weten werd nooit eerder een vergelijkbaar grootschalig onderzoek uitgevoerd. Met dit artikel hopen we andere floristen aan te zetten tot meer onderzoek op campingterreinen binnen Europa. Temeer omdat in sommige gevallen campings een 'stepping stone' blijken te zijn voor de verdere verspreiding van deze soorten, hetgeen kan leiden tot een lokale inburgering.

In de onderzoeksperiode zijn door de auteurs meer dan 200 campings onderzocht, een groot aantal daarvan meerdere keren. Het delen van kennis op social media, het verschijnen van enkele artikelen op de website 'Nature Today' in 2017 en 2018 en een presentatie over dit onderwerp hebben ertoe bijgedragen dat ook andere floristen geïnteresseerd geraakten en hielpen om de verspreiding van sommige soorten beter in kaart te brengen. Hieruit blijkt dat vooral campings langs de kust meer soorten herbergen. Naast een milder klimaat met gemiddeld zachtere winters speelt de enorme stroom aan toeristen die hier jaarlijks bivakkeren een grote rol. De kans dat vreemde zaden, die zijn meegelift vanuit het buitenland, hier terecht komen is daardoor verhoudingsgewijs veel groter dan op campings in het binnenland. De binnenlandse campings worden minder frequent bezocht door buitenlandse

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## Samenvatting (vervolg)

toeristen en veelal trekken deze campings meer toeristen uit de directe omgeving aan. Ook blijken campings die gevestigd zijn op een zandige bodem doorgaans meer soorten te herbergen dan campings gelegen op zwaardere bodemtypen zoals klei. Dit geldt echter niet voor elke soort. *Poa infirma* komt bijvoorbeeld in veel grotere aantallen voor op campings die zijn gelegen op een zwaardere bodem. In de loop van het toeristenseizoen ontstaan, door lichtgebrek bij bezetting van standplaatsen en verdichting door betreding, open of kale plekken in de grasmat. Bij gebrek aan competitie ontwikkelt zich een ideale kiemsituatie voor vele voornamelijk zuidelijke soorten, die deels in het najaar al ontkiemen. Maar ook in het vroege voorjaar blijken zulke plaatsen nog vrij kaal te zijn en een uitstekend kiembed te vormen. Door het ontbreken van vegetatie blijken zulke locaties ook nog eens extra warmte te absorberen, wat gunstig uitpakt voor de zuidelijke soorten. Het blijkt dat vooral planten overleven die onder de maaihoogte blijven of tegen het intensief maaien bestand zijn, zoals veel rozetvormers. Het selecteert zich zelf. Veel mediterrane soorten bloeien relatief vroeg en zetten zaad vooraleer het toeristenseizoen op gang komt. Eenmaal aanwezig kunnen sommige soorten vanuit deze standplaatsen zich makkelijk verder op de camping verspreiden of op termijn zelfs daarbuiten.

Al in de winterperiode werden campings bezocht om een aantal soorten op de kaart te zetten, vooral soorten die op dat moment al gemakkelijk te herkennen zijn. Planten die niet direct herkend werden, werden vaak thuis verder opgekweekt tot aan de vruchtzetting. Hierdoor is er veel kennis opgedaan over vegetatieve kenmerken die zelden zijn beschreven in Flora's. Zo blijkt bij verschillende soorten uit het genus *Trifolium* enige variatie te bestaan in het bladpatroon. Binnen *T. glomeratum* en *T. tomentosum* kunnen de tekeningen op de bovenzijde van het blad sterk op elkaar lijken. Ook in de tekening op de bovenzijde van het blad bij *T. suffocatum* (mits aanwezig) en *T. ornithopodioides* zitten minieme verschillen. Het blijkt dat de nervatuur van het blad van eerst genoemde sprekender is en er meer bovenop ligt dan bij laatst genoemde. Deze vegetatieve kenmerken zijn goed bruikbaar in het veld voordat bloei aanwezig is. Ook binnen *Medicago littoralis* zit variatie. Zowel de bladgrootte, het al dan niet aanwezig zijn van vlekken op de bovenzijde van het blad en de mate van beharing kunnen binnen deze soort sterk verschillen. En bij *M. polymorpha* kunnen net zoals bij *M. arabica* donkere vlekjes op het blad voorkomen, een kenmerk dat zelden of nooit in de literatuur vermeld wordt.

Van een aantal soorten durven we te stellen dat ze zijn ingeburgerd, althans minstens lokaal. Eén van de meest prominente soorten op campings is ongetwijfeld *Poa infirma*, die vaak met duizenden op de standplaatsen voorkomt. We verwachten binnen een aantal jaren een nog nauwkeuriger beeld van de verspreiding te verkrijgen. De verwachting is dat ook meer binnenlandse campings waarschijnlijk dit gras binnen hun terreinen hebben staan. De eerste vondsten buiten de camping zijn ook al vastgesteld. Dat maakt verdere inburgering mogelijk. Een zelfde wijze van verspreiding geldt voor *Soliva sessilis*, toch ook één van de meest typerende soorten op campings. Ook van deze soort verwachten we dat hij over niet al te lange tijd buiten de camping gevonden zal worden, gezien deze soort in meerdere gevallen met duizenden tegelijk enorme clusters kan vormen waarbij andere soorten makkelijk verdrongen worden. Met de scherpe naald aan het eind van het nootje blijft deze makkelijk hangen aan kleding, schoeisel of zelfs autobanden waardoor verdere verspreiding kan worden bewerkstelligd.

Doordat het onderzoek op campings een periode van meerdere jaren bestrijkt en vele soorten jaar na jaar op dezelfde campings werden teruggevonden, kunnen we zeggen dat een deel van deze planten hier blijvend gevestigd zijn. Milde winters zullen een belangrijke factor zijn voor een aantal soorten om te kunnen overleven en/of vroegtijdig te kunnen bloeien. Sommige soorten zijn al eens in het verleden gevonden maar hebben eerder geen kans gehad zich permanent te vestigen. Mogelijk zal het veranderende klimaat deze soorten nu gunstig gezind zijn. Dat de meeste campings privéterreinen zijn en daardoor zelden worden bezocht door floristen en veel soorten bovendien al eind mei de vruchtzetting hebben afgerond, zal er toe hebben bijgedragen dat dit fenomeen niet eerder is opgemerkt. Of deze trend zich zal doorzetten is de vraag, gezien steeds meer campings transformeren naar chalet- of huisjesparken. Hierdoor zal mogelijk de aanvoer van vreemde zaden verminderen.

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## INTRODUCTION

Alien plants are introduced in various ways. Well known examples of unintentional introductions are, for instance, weedy species that are introduced as contaminants in cereals (so-called grain aliens) or pasture species that are introduced in sheep wool (so-called wool aliens). Likewise, the nursery trade is also responsible for the introduction and spread of weed species. Other sources may be bark or timber, granite, coal, sand, etc. but these vectors are obviously of a lesser importance in Belgium and the Netherlands than cereals these days or wool in the past.

In the spring of 2015, a new peculiar vector for the introduction of alien plants was met with along the Belgian coast. Entirely coincidental, one of us (BM) found in a campsite in De Panne the very rare native species *Filago pyramidata*. On closer inspection in the next days and weeks it turned out that several other interesting thermophilous, psammophilous species from southern Europe were found in this campsite, as well as in other campsites in the

area, some apparently never recorded before in Belgium. All these species – often with spiny, hooked or bristled fruits and / or with tiny seeds – were apparently introduced inadvertently by tourists returning from southern Europe, adhered to their car mats, tents, and other camping equipment. Upon arrival in the campsite area people unload their supplies and clean their car mats, thus 'sowing' numerous seeds and fruits that were brought unintentionally from the south. Most of the alien plants were found on the bare, disturbed substrate of seasonal pitches. Even in early spring, these pitches are usually devoid of any vegetation and they have proven to be a highly favorable germinating site (Fig. 1, 2, 3). As a result of the intensive use, the lawn grass is suffocated and a bare soil remains that is suitable for pioneer species completing their cycle before campers arrive (i.e. before May). The lack of competition from mainly lawn grasses not only contributes to the chance of success in the germination of these southern species, but also allows these species to expand locally. Rosette-forming and low-growing species in particular seem to have a high chance of success, also because they grow out of reach



Fig. 1. Botanists at work in a campsite in Castricum (NL), May 2019. Photo: S. Gonggrijp.

of the lawn mowers which enable them to flower and set fruit without difficulties. Especially in coastal areas, both in Belgium and the Netherlands, the climate is more temperate, with on average milder winters and slightly cooler summers. The milder winters in particular could have a favorable effect on newcomers from the Mediterranean regions. Many campsites, even in open countryside, are surrounded by hedgerows (Fig. 2). Within the shelter of these, the seasonal pitches heat up faster. The lack of vegetation also means that these spots possibly retain the stored heat for a longer time. In addition, many camper pitches and parking lots often have a gritty substrate such as pebbles, gravel or grass tiles. These artificial substrates also retain heat for a longer time, from which many southern species may benefit. All these specific circumstances turned out to be particularly favorable for southern, thermophilous species. Also, many of the species are winter annuals that germinate in autumn and benefit from mild winters where the aboveground parts do not freeze prematurely.

It soon became clear that this introduction vector is more important than initially thought. Numerous alien species seem to have arrived in western Europe this way and many of them look perfectly naturalized (at least locally). For a number of species campsites can even be an excellent stepping stone to attain a foothold outside the site. The expectation is that several species in a near future will spread from the campsites.

This encouraged us to inventory more campsites, caravan parks and similar habitats in a more systematic way, at first in coastal but soon also in potentially interesting inland areas in Belgium. In 2016, we also started identical inventories in the Netherlands. A first, preliminary account with records from a

few localities visited in Belgium in 2015 was already published (Verloove 2016). An overview of records from the Province of Zeeland in the Netherlands was also presented before (Gonggrijp 2018). In the present paper an overview of all our observations is presented. It also aims at encouraging botanists to inspect similar places – elsewhere in western Europe and beyond – in search for these alien plants. Although circumstances are perhaps more favorable in the climatologically milder coastal areas, several of the species here concerned have also been found in inland campsites.

Although not widely so, campsites were already known to often harbor an interesting non-native flora but there seem to be no previous studies that thoroughly investigated the issue (for some, very fragmented information, see e.g. Chagneau 2019, Rivière 1993, Vivant 1983, Woodhead & Clement 1997). Also outside of Europe, tourists, especially those residing in campsites, are a reputed introduction vector for alien plants and new potential weeds will continue to arrive as visitation and tourism increases, which is a worldwide trend (Drost & Junak 2009, Keighery 1995).

## MATERIALS AND METHODS

Field work was conducted by the authors in campsites and caravan parks (to a lesser extent also in similar ‘habitats’ such as transit areas for mobile homes) between 2015 and 2019, in Belgium as well as in the Netherlands. In total, 238 campsites were inventoried (167 in the Netherlands and 71 in Belgium), many of them on several occasions. Fig. 4 gives an overview of the geographical distribution of all visited campsites, including



Fig. 2. Typical campsite habitat (Koksijde, BE), June 2016. Photo: F. Verloove.



Fig. 3. The vegetation in campsites is often dominated by non-native species. In this lawn, *Soliva sessilis* Ruiz & Pav. and *Trifolium glomeratum* L. are the dominant species. Koksijde (BE), June 2016. Photo: F. Verloove.

those that did not yield interesting species. The main focus was on campsites located on light soils such as sand because these offered better conditions for the potential establishment of southern weeds. In Belgium these were located in the Provinces of West-Flanders (33 harbored at least one interesting species, mostly near the coast), East-Flanders (7), Antwerp (12) and Limburg (8). None were visited in the climatologically less favorable southeastern part of the country (Wallonia) where winters tend to be much colder. In the Netherlands an even higher amount of campsites harbored at least one interesting species, resulting in the following numbers per province: 59 in Noord-Holland (incl. Texel), 35 in Zeeland, 25 in Zuid-Holland, 15 in Friesland (incl. Ameland and Terschelling), 7 in Gelderland, 7 in Brabant, 6 in Flevoland, 4 in Utrecht, and 4 in Limburg. As a rule, only campsites with a continuous influx of visitors that are returning from the south were inspected (holiday parks with exclusively fixed accommodation units are unsuitable, for obvious reasons).

For all of the interesting species and for many others as well herbarium vouchers were collected and these were deposited in the herbaria of Naturalis Biodiversity Center (L) in the Netherlands and/or of Meise Botanic Garden (BR) in Belgium (herbarium acronyms according to [Thiers 2019+](#)). Sometimes, plants were dug out and further cultivated *ex situ*, in order to obtain better material, including both flower and fruit characters, for a more accurate identification ([Fig. 5](#)). Given the probable origin of most of the species, they were usually identified using recent

Floras from France and the Iberian Peninsula ([Castroviejo 1986-onwards](#), [Tison & de Foucault 2014](#)). The nomenclature follows the [Euro+Med Plantbase](#), except for *Filago gaditana* where [Andrés-Sánchez et al. \(2019\)](#) is followed.

The results of our field work are outlined below. The first and major part refers to the clearly alien species. All species are arranged in alphabetical order, first according to families, then species. Each species name is preceded by a symbol that indicates its frequency:

- found in a single campsite in Belgium or the Netherlands
- found in 2–5 campsites in Belgium and/or the Netherlands
- found in 6–10 campsites in Belgium and/or the Netherlands
- found in 11–20 campsites in Belgium and/or the Netherlands
- found in at least 21 campsites in Belgium and/or the Netherlands

Thereafter, the estimated degree of naturalization **in the campsites** (for some taxa, the status of naturalization within campsites may be different from the status outside these specific areas)

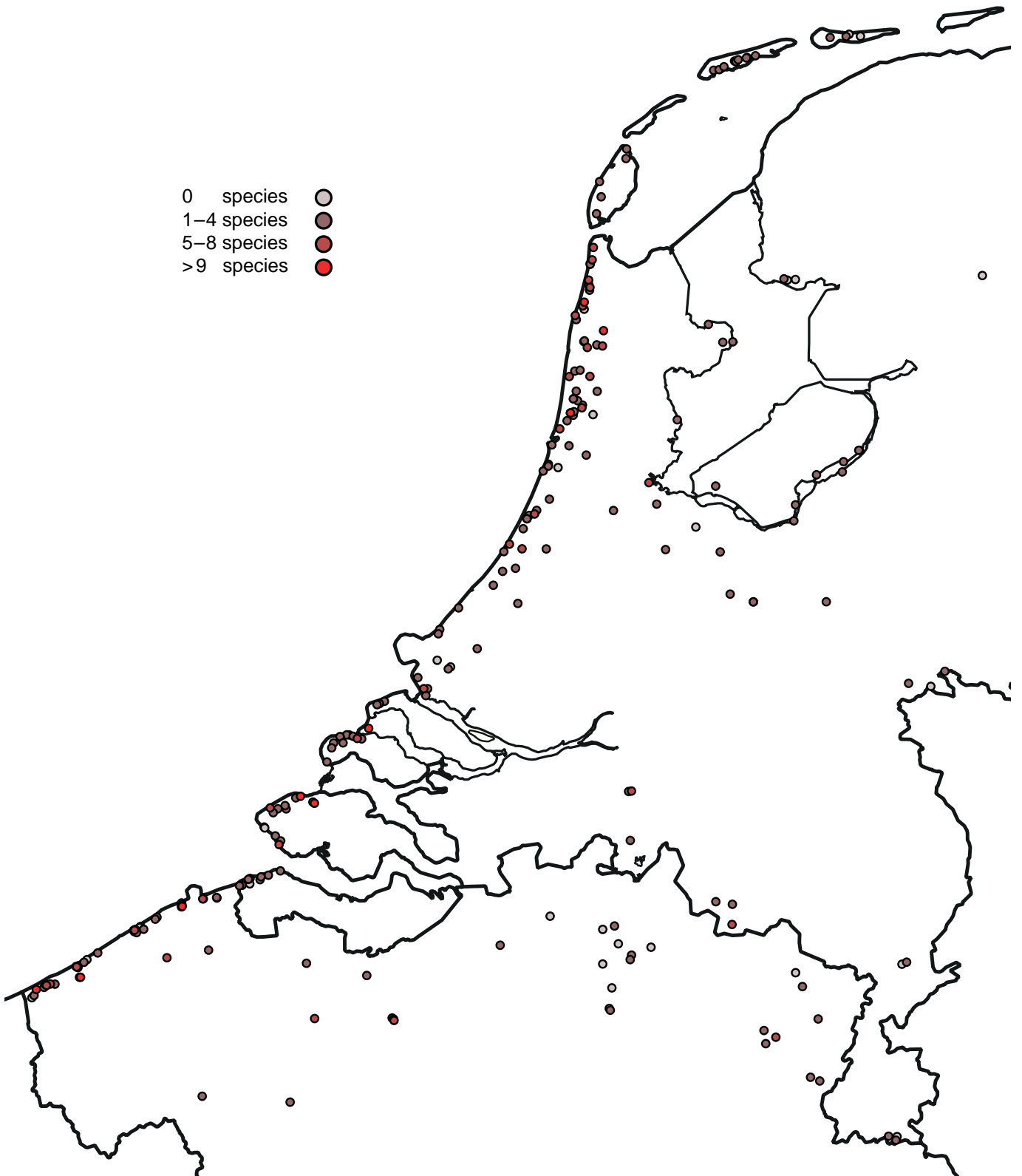


Fig. 4. Geographical distribution of all campsites visited in Belgium and the Netherlands with an indication of their diversity of alien plants. All species from the main part of this paper were taken into consideration, as well as *Crassula tillaea* Lest.-Garl. Map: B. Odé.

is provided (casual vs. naturalized, abbreviated as: casBE for casual in Belgium, natNL for naturalized in the Netherlands, etc.). This is not always easy to assess and is mostly based on our repeated observations in the course of the years of our study. Species that entirely cover seasonal pitches are believed to have been present for several years already. As we indicate in

the discussion below, the adventitious flora in campsites is quite stable: the same species are seen again and again, whereas additional, newly introduced species are not brought in every year. Most species have undoubtedly been growing there for years without ever having been noticed before. Finally, the species area of origin is specified, and if relevant also secondary



Fig. 5. Several species were grown to maturity ex situ, in order to obtain flowering and fruiting material for a more accurate identification. Photo: S. Gonggrijp.



Fig. 6. *Bombycilaena erecta* (L.) Smoljan. in Sint Maartenszee (NL), May 2019. Photo: S. Gonggrijp.



Fig. 7. *Bombycilaena erecta* (L.) Smoljan. in Sint Maartenszee (NL), May 2019. Photo: J.-J. Spaargaren.

distribution areas. Most of these species are illustrated and details about their occurrence in the study area, including distribution maps for the most widespread species, are presented. Since all campsites are private areas that cannot be entered without permission, no names of campsites are given. In the second, shorter part of the paper an alphabetical list is presented with rare native species that have been recorded during our field work. Some of these are among the most characteristic campsite plants, e.g. *Crassula tillaea*.

## RESULTS

### APIACEAE

- *Oenanthe pimpinelloides* L.

casBE

Mediterranean-Atlantic area.

*Oenanthe pimpinelloides* is a very rare species in the study area whose residence status has long been unclear (Ronse 2005, Westhoff & van der Meijden 2000). It is now generally considered to be non-native, in Belgium as well as in the Netherlands. At present, it is probably best known as a noxious lawn weed in the Botanic Garden in Meise, Belgium (Ronse 2005).

In a campsite in Brugge in Belgium, a single individual of this species was observed in 2017. Its fruits have long and stiff persistent styles and are therefore easily transported via clothes or footwear (Ronse 2005).

### ASTERACEAE

- *Bombycilaena erecta* (L.) Smoljan. — Fig. 6 & 7

cas?NL

Mediterranean area.

This species has never been recorded with certainty before in Belgium or the Netherlands<sup>1</sup>. In 2019, two populations were found in a single campsite in Sint Maartenszee (the Netherlands), about 450 m apart. In one of them at least 100 individuals were counted, whereas in the other only 3 individuals were observed. In the first population, the species seems to be at least temporarily established.

*Bombycilaena erecta* was first recognized as young, non-flowering rosettes. The leaves were widest above middle, but the plants were more slender than those of the *Filago* species that we found during our fieldwork.

- *Cotula australis* (Sieber ex Spreng.) Hook. f. — Fig. 8 & 9

natBE / natNL

Australia and New Zealand. Widely naturalized elsewhere in the world.

1. *Bombycilaena erecta* (L.) Smoljan. was included in a checklist of vascular plants in Belgium and the Netherlands (van der Meijden & Vanhecke 1986), but it is unknown on what basis. No herbarium specimens from these two countries could be traced in BR or L.





Fig. 8. *Cotula australis* (Sieber ex Spreng.) Hook. f. in Houthalen (BE), May 2019. The species regularly grows in dense, nearly monospecific mats. The typical campsite alien *Crassula tillaea* is also discernible. Photo: R. Barendse.



Fig. 9. *Cotula australis* (Sieber ex Spreng.) Hook. f. in Vrouwenpolder (NL), April 2019. Detail of flower heads. Photo: S. Gonggrijp.

In Belgium, *Cotula australis* formerly was a characteristic but fairly rare wool alien in the Vesdre valley near Verviers, and was observed at least between 1893 and 1921 (Verloove 2006). In 2015 it was found again as an urban weed in the city of Brussels. From 2016 onwards it was found in several campsites, mostly but not exclusively at the Belgian coast (e.g. Blankenberge, De Haan, De Panne, Lombardsijde, Nieuwpoort, Wenduine, Westende). It was also observed in scattered inland localities (e.g. Antwerpen-Linkeroever, Houthalen-Helchteren). In some localities it is very common and obviously naturalized.

In the Netherlands, *Cotula australis* has been found as an urban weed since 2008, when it was first observed in Alkmaar (Denters 2014). Since then the species has increased significantly and is now found in numerous cities throughout the country. In 2017, *C. australis* was first found in a campsite and at present it is known from c. 30 campsites, most (but not all) of them located in coastal areas. In some localities the species is very common and obviously naturalized.

Outside of Europe, for instance in North America (Drost & Junak 2009), the occurrence of the species has also been associated with tourists and campsites.

*Cotula australis* is easily recognized. The plants grow to about 10 cm high, the leaves are finely divided, and the slender stalks of the flower heads are longer than the leaves. The plants are, however, often tiny and lax and thus easily overlooked. Furthermore, the species flowers very early – it has been observed in flower during all winter months – and rapidly dies back during spring, depending on weather conditions.

- ***Crepis bursifolia* L. — Fig. 10**

casNL

Italy. Naturalized and increasing elsewhere in the Mediterranean area (and beyond).

*Crepis bursifolia* had not been recorded before in the Netherlands, whereas in Belgium it was recorded only once: a single individual was seen growing in cracks of pavement in the city of Menen in 2016, but it disappeared the next year. In 2019, a single non-flowering rosette of *C. bursifolia* was observed in a campsite in Vrouwenpolder in the Netherlands. It was grown to maturity ex situ.

Although initially restricted to a relatively small area in southern Italy, *Crepis bursifolia* is a fast spreading weed, for instance in France (Tison & de Foucault 2014). It is also fast spreading in California in the United States (Bogler 2006).

Even in the absence of ripe achenes, the species is easily identified based on its leafless stems, dense basal rosettes consisting of glabrous, lyrate leaves with dentate lateral lobes and relatively large terminal lobes. When in flower, the small number of inner involucre bracts (usually less than 10) and the erect, relatively few flower buds on slender peduncles are characteristic additional helpful features for the identification of plants of *Crepis bursifolia*.



Fig.10. *Crepis bursifolia* L. in Vrouwenpolder (NL), April 2019. Rosette leaves. Photo: S. Gonggrijp.

- ***Crepis foetida* L. subsp. *rhoeadifolia*** (M. Bieb.) Čelak.  
casNL  
Eastern Europe and West Asia.

*Crepis foetida* subsp. *foetida* is supposedly native in Belgium and possibly also in Zuid-Limburg in the Netherlands (Lambinon & Verloove 2012, van der Meijden 2005). Its subsp. *rhoeadifolia*, however, is a recent newcomer in western Europe. In Belgium, this subspecies was brought in via railway infrastructure in port areas and it also appeared after the remodeling of coal mining spoil heaps in the Kempen (Verloove 2008). At present the subspecies is naturalized and fast spreading in the Antwerp port area and in the aforementioned coal basin. In the Netherlands,

on the other hand, it was recorded only once, when a single plant was found in 2019 in a campsite in Sint Maartenszee. However, the subspecies might have been overlooked.

Plants of subsp. *rhoeadifolia* are usually taller than those of subsp. *foetida*. The involucre bracts of subsp. *rhoeadifolia* are eglandular and bristly hairy with the outer bracts usually longer than  $\frac{1}{2}$  the length of the inner ones.

●● ***Crepis sancta*** (L.) Bornm. — Fig. 11

casBE / casNL

Eastern Mediterranean area.

In Belgium, *Crepis sancta* was first recorded in 1948 in Lasne-Chapelle along a tramline. Soon afterwards, in 1951, it was seen in Kinkempois and subsequently in rather numerous additional localities (see Lawalrée 1954 for an overview). It locally persisted for some time but eventually disappeared. Most records were made near railway tracks, in road verges or on coal mining spoil heaps. At present, a small colony with a declining number of individuals persists in a railway yard in Boom since 2016. In the Netherlands, *C. sancta* was first recorded near a grain mill in Wormerveer in 1924. In the early 1960s it was seen on two occasions along the River Meuse (van Oostroom & Reichgelt 1966a) but, like in Belgium, the species never managed to naturalize.

*Crepis sancta* was found in two campsites in 2019, one in Belgium (Berlare), with only a single individual, and one in the Netherlands (Kamperland). In the latter it was found in two pitches with 7 and 10 individuals respectively. Interestingly, an individual of this species was also found in the surrounding coastal dunes, possibly a first attempt to a further local dispersal.

This species is easily recognized and rather aberrant among the other representatives of the genus (it was formerly accommodated in a separate genus, *Lagoseris* M. Bieb.). All of its leaves are basal and the receptacle is covered with long hairs. Also, involucre bracts have a broad conspicuous pale margin.

●● ***Filago congesta*** DC. — Fig. 12 & 13

casBE / casNL

Western Mediterranean area.

*Filago congesta* had never been recorded in Belgium and the Netherlands before 2019. In that year it was discovered in three campsites in the Netherlands, in the Provinces of Zeeland and Zuid-Holland (Schotsman-Zuid, Rockanje, and Vrouwenpolder). In the latter locality seven individuals were counted, whereas in the other two only single individuals were observed. In Belgium two individuals of *F. congesta* were found in a campsite in Berlare, also in 2019. On closer examination, it turned out that at least one previous record of a single individual of *F. pyramidata*, from a campsite in De Panne in 2016, probably also belonged to *F. congesta*.

*Filago congesta* is much reminiscent of native *F. pyramidata* and both were probably initially intermingled. These species share a clearly pyramidal involucre that is distinctly 5-angled. Both are easily separated in fruit: in *F. congesta* the central flowers have achenes without pappus hairs (exceptionally with 3–5 pappus hairs that are early deciduous), whereas in *F. pyramidata* the central flowers have a persistent pappus that consists of c. 10–20 hairs (Andrés-Sánchez et al. 2019).

● ***Filago gaditana*** (Pau) Andrés-Sánchez & Galbany (syn.: *Evax pygmaea* (L.) Brot. var. *gaditana* Pau; *Filago pygmaea* L. subsp. *ramosissima* (Mariz) R. Fern. & I. Nogueira) — Fig. 14 & 15

casNL

Western Mediterranean area.

*Filago gaditana* was initially described from Morocco (Pau 1924) and is also known as a native species from the Iberian

Peninsula (Andrés-Sánchez et al. 2019). It had never been recorded before in Belgium or the Netherlands. It was reported by Vivant (1983) from a campsite in southwestern France (sub *Evax pygmaea* var. *ramosissima*); it is now naturalized in this area (Tison & de Foucault 2014). In 2019 three individuals of this species were discovered in one campsite in Sint Maartenszee in the Netherlands.

*Filago gaditana* closely resembles *F. pygmaea* and both are sometimes considered conspecific (or the former reduced to infrataxon of the latter). Recent taxonomic studies (Andrés-Sánchez et al. 2019, Tison & de Foucault 2014), however, tend to accept both as distinct species. *Filago gaditana* is distinguished for its involucre bracts with distinctly undulate margins, its longer, procumbent lateral branches and paler smaller achenes being 0.7–1 mm long (vs. 1.2–1.4 mm in *F. pygmaea*).

● ***Filago pygmaea*** L. (syn.: *Evax pygmaea* (L.) Brot.) — Fig. 16 & 17

casNL

Mediterranean area.

In 2019 four individuals of this species were discovered in one campsite in Amsterdam in the Netherlands.

*Filago pygmaea* is naturalized in France in the extreme southwest (Biarritz area). Recently it was found for the first time further north along the Atlantic coast in La Baule-Escoublac (Loire-Atlantique) (Chagneau 2019). All records are from campsites.

This species is closely related to the preceding species, but it is readily separated due to its involucre bracts with plane margins (see also there for their separation).

● ***Hedypnois rhagadioloides*** (L.) F.W. Schmidt (incl.: *H. cretica* (L.) Dum. Cours.) — Fig. 18

casNL

Mediterranean area.

This species is unknown from Belgium (Verloove 2006) and in the Netherlands it was only recorded twice before in the 1930s, as a grain and wool alien (Kloos 1932, 1939). In 2019 a single individual was found in the Netherlands in a campsite in Kamperland.

*Hedypnois rhagadioloides* is native in the Mediterranean part of France (incl. Corsica), but has naturalized on the Atlantic coast, where it was already reported by Vivant (1980), and soon spread further north. In many instances its presence there has been associated with campsites (e.g. Guillévic et al. 1990, Chagneau in Le Bail 2007, Terrisse 1994) from where it expands to surrounding suitable habitats. Now it is completely naturalized on the Atlantic coast of France.

In identical circumstances it is also known to occur outside of Europe, for instance in North America (Drost & Junak 2009).



Fig. 11. *Crepis sancta* (L.) Bornm. in Kamperland (NL), April 2019. Photo: S. Gonggrijp.



Fig. 12. *Filago congesta* DC. in Berlare (BE), May 2019. Photo: F. Verloove.



Fig. 13. *Filago congesta* DC. in Vrouwenpolder (NL), April 2019. Photo: S. Gonggrijp.



Fig. 14. *Filago gaditana* (Pau) Andrés-Sánchez & Galbany in Sint Maartenszee (NL), March 2019. Photo: S. Gonggrijp.



Fig. 15. *Filago gaditana* (Pau) Andrés-Sánchez & Galbany in Sint Maartenszee (NL), April 2019. In this species, the involucre bracts have clearly wavy margins. Photo: S. Gonggrijp.

●●●● *Soliva sessilis* Ruiz & Pav. (incl. *S. pterosperma* (Juss.) Less.; syn.: *Cotula sessilis* Ruiz & Pav.) Stace) — Fig. 3, 19, 20 & 21

natBE / natNL

South America. Widely naturalized elsewhere in the world.

Between 1887 and 1904, *Soliva sessilis* was recorded as a characteristic but rather rare wool alien in the Vesdre valley near Verviers in Belgium (Verloove 2006). It had not been recorded before from the Netherlands. The species first naturalized in southern Europe. The first French records were from the Landes and Pyrénées-Atlantiques departments in the extreme southwest of the country and date back to the early 1980s (Vivant 1983). *Soliva sessilis* was soon observed further north along the Atlantic coast and now occurs up to the Pays de la Loire region (comm. D. Chagneau, May 2019). About 20 years ago it was reported from the British Isles, where it was found in a caravan park (Woodhead & Clement 1997) and later also in cricket fields (Hounsome 2013, Woodhead 2013). The species' presence in similar habitats elsewhere in western Europe was thus expected and, indeed, since 2016 it has been found on numerous occasions, at first in coastal areas in Belgium (e.g. Blankenberge, Bredene, De Panne, Nieuwpoort, Wenduine, etc.), subsequently also in inland campsites (e.g. Gent, Houthalen-Helchteren Jabbeke, etc.). In some of these places, *S. sessilis* forms nearly monospecific mats with thousands of individuals; it either must have been introduced some time ago already or it reproduces very fast. In the Netherlands, it is even more common and it is undoubtedly



Fig. 16. *Filago pygmaea* L. in Amsterdam (NL), March 2019. Photo: S. Gonggrijp.



Fig. 17. *Filago pygmaea* L. in Amsterdam (NL), March 2019. The margins of the involucre bracts are flat. Photo: S. Gonggrijp.





Fig. 18. *Hedypnois rhagadioloides* (L.) F.W. Schmidt in Kamperland (NL), April 2019. The thickened peduncle is quite characteristic. Photo: S. Gonggrijp.

one of the most typical campsite aliens. It was first found in 2016 in Cadzand and now occurs in 77 grid cells of 1 km<sup>2</sup> across the country, mostly in coastal areas in the Provinces of Zeeland and Noord-Holland, but several populations are found in the northern and easternmost parts of the country, incl. the Wadden Sea Islands and Zuid-Limburg. In both countries, *S. sessilis* is clearly naturalized and a further expansion, away from the campsites, is predictable.

The sharp spine on top of the achene, which is in fact a persistent style, can pierce foot wear – in particular soft-soled shoes commonly worn around the beach and when camping – and car tires. The achene readily clings to tent floors, bags, doorstep carpets, and other fabric surfaces and is thus transported over long distances. Achenes may also be dispersed in the fur of pets. Once established, the plant forms dense carpets that suppress most other lawn species and can out-compete rare species (Castro 2006). It is considered one of the most hated turf weeds in New Zealand, because it can make bare-foot walking very painful (Harrington 2009). The plants are low-growing and, like many other campsite aliens, escape the blades of most mowers. Campsites are a favorite habitat for the establishment and further spread of the species. In British Columbia, Canada, the most common location for finding *S. sessilis* is in areas where tenting and recreational vehicle use are prevalent (Polster 2007). The presence of this species in campsites is very unfavorable, which can also be deduced from comments provided by Tripadvisor, e.g. a review for a campsite in Queensland, Australia: “... understand it is dry in this part of the country however in a camping area where you put a tent up, to have Bindi-eyes (*Soliva pterosperma*) in this area is unforgivable. Did not stay here on return journey because of that reason ...” (Tripadvisor, review of May 2014).

Achene bodies in all plant material checked have wings that are markedly sinuate to incised, a characteristic feature of *Soliva*

*pterosperma*, whereas in *S. sessilis* s.str. wings are entire (Cabrera 1949). However, on a worldwide scale these two species apparently seem to intergrade and are now considered to be conspecific (e.g. Webb 1986, Espinar 1997, Watson 2006, Hurrell 2013) with the latter name having nomenclatural priority.

Some molecular phylogenetic studies suggest to include *Soliva* in a broadly circumscribed genus *Cotula* (Himmelreich et al. 2012). The combination that reflects this inclusion was recently established by Stace in Rich et al. (2019).

#### CARYOPHYLLACEAE

##### ●● *Paronychia argentea* Lam. — Fig. 22

casBE / casNL

Mediterranean area.

This species was never formally reported before from Belgium (Verloove 2006) although the species apparently has persisted for some time on the grounds of an abandoned freight railway yard in Brugge (comm. A. Zwaenepoel). In the Netherlands, *Paronychia argentea* was observed a few times in the past two decades, first in Utrecht (2005), then in Bergen op Zoom (2016) and Brouwersdam (2019), mostly (but not exclusively) occurring in urban habitats ([waarneming.nl](http://waarneming.nl)).

In 2016, a single, richly branched individual was observed in a campsite in Antwerpen-Linkeroever in Belgium (confirmed in 2017, but possibly gone in 2018). In 2019, another individual



Fig. 19. *Soliva sessilis* Ruiz & Pav. in Houthalen (BE), May 2019. Photo: F. Verloove.



Fig. 20. *Soliva sessilis* Ruiz & Pav. in Houthalen (BE), May 2019. This species ultimately forms mats in which the lawn grass is completely replaced. Photo: R. Barendse.

was found in a campsite in De Panne near the coast (A. Jacobs on [waarnemingen.be](http://waarnemingen.be)). In the Netherlands, the species was found in similar circumstances in Vrouwenpolder in 2019.

In France, where *Paronychia argentea* is native in the Mediterranean area, the species was able to naturalize on the Atlantic coast in the past decades (Hérault 1977, Tison & de Foucault 2014, Vivant 1983). In recent years, it is progressively spreading northwards and has now reached Brittany, where it has been

observed in and near campsites (Guillévic et al. 1990, Rivière 1993, Terrisse 1994, Zanré 2014). The species was first confined to campsites, but soon spread to other suitable habitats, for instance open pinewoods (Vivant 1983). In some places it has become so common that it can be considered a threat to native vegetations (Chagneau 2019).

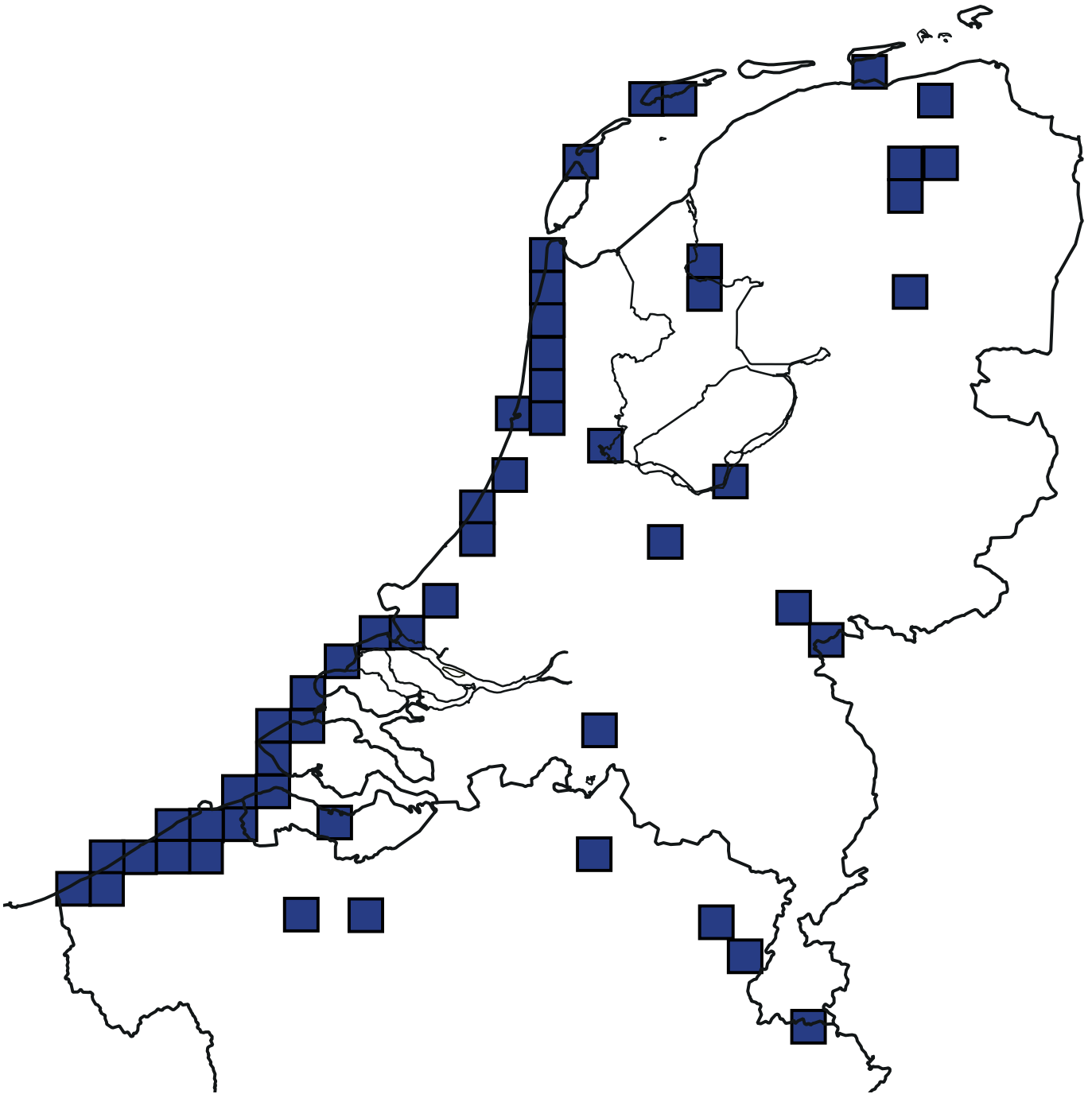


Fig. 21. Current distribution of *Soliva sessilis* Ruiz & Pav. in Belgium and the Netherlands. This species occurs in an almost uninterrupted area along the North Sea coast with some scattered inland localities. At present, it is exclusively found in campsites.

●●●● *Polycarpon tetraphyllum* (L.) L.

natBE / natNL

Mediterranean-Atlantic area.

This species is already known since the first half of the 19<sup>th</sup> century as an alien in Belgium and the Netherlands (Verloove 2006). Early records were at least in part associated with the wool processing industry (Visé 1942, 1958) and merely ephemeral. Since the 1990s, however, *Polycarpon tetraphyllum* managed to naturalize in the study area, especially in urban habitats (cracks in pavement, foot of walls). It now has become a characteristic urban weed, especially in the larger cities (de Graaf 1996, Denters 2004, Lawalrée 2000, Verloove 2002). The species is

also frequently introduced in plant containers with imported olive trees (Hoste et al. 2009).

During our field studies, *Polycarpon tetraphyllum* was found on numerous occasions in Belgium as well as the Netherlands. The species often occurs in large numbers and is locally sometimes forming almost monospecific stands; it is obviously naturalized in many campsites, both in coastal and inland localities. In the Netherlands, it has also been recorded in the northernmost provinces (Province of Friesland).

*Polycarpon tetraphyllum* has also been associated with campsites in Australia (Lohr & Keighery 2014) and in North America (Drost & Junak 2009).



Fig. 22. *Paronychia argentea* Lam. in Antwerpen-Linkeroever (BE), May 2017. Photo: F. Verloove.

- ***Spergularia bocconei*** (Scheele) Asch. & Graebn.  
casBE  
Mediterranean-Atlantic area.

This species had never been recorded before in Belgium (Verloove 2006). It was observed in several pitches in a campsite in Bredene in 2016. The original pitch was subsequently destroyed, but the species was recorded in another pitch on the same campsite in 2017.

In similar circumstances, *Spergularia bocconei* is also known from the Atlantic coast in France (Chagneau & Dalibard 2007) and the British Isles, for instance in car parks (Online Atlas of the British and Irish Flora). Outside of Europe, for instance in North America (Drost & Junak 2009), the species has also been associated with tourists and campsites.

*Spergularia bocconei* closely resembles native *S. rubra* (L.) J. Presl & C. Presl, the latter also being a fairly characteristic campsite weed. The former is immediately noticeable by the usually much paler petals, being very pale pink to almost white. On closer examination, the stipules of *S. bocconei* are generally broadly triangular or even deltoid and those of *S. rubra* are narrower and long-acuminate. The ripe seeds of *S. bocconei* are also paler and smaller, being dull grayish-brown and most of them are less than 0.5 mm across. The seeds of *S. rubra* are dark brown to black and most of them more than 0.5 mm across.

#### FABACEAE

- ***Medicago littoralis*** Rohde ex Loisel. — Fig. 23 & 24  
casBE / natNL  
Mediterranean area.

In their revision of *Medicago* in Belgium and the Netherlands, van Ooststroom & Reichgelt (1958) only included a single and doubtful record from Belgium for *M. littoralis* (a non-flowering individual growing near Koksijde). There are indeed no confirmed records from Belgium (Verloove 2006) and this also applies to the Netherlands.

In Belgium, a few plants of this species were seen in 2015 in a campsite in De Panne and the presence of *Medicago littoralis* was subsequently confirmed in 2016. In the Netherlands, *M. littoralis* was more often observed, for the first time in 2017. It was recorded in Dishoek and Braakman in the Province of Zeeland, and in Castricum, Egmond aan Zee, Wijk aan Zee and Zandvoort in the Province of Noord-Holland. All these campsites are located in (near-)coastal areas. However, the species was also found inland, in Luyksgestel in the Province of Noord Brabant. In most instances, *M. littoralis* was seen in small numbers, but in Zandvoort at least 150 individuals were counted; at least in this locality it appears to be locally naturalized.



Fig. 23. *Medicago littoralis* Rohde ex Loisel. in Wijk aan Zee (NL), May 2019. Photo: S. Gonggrijp.

There are similar records of *Medicago littoralis* from campsites in coastal areas in northwestern France (Departement Pas-de-Calais: Le Touquet; [Coulot & Rabaute 2013](#)).

The spiny fruits of *Medicago* easily adhere to clothing, door mats, tents, etc. Several other species of the genus have also been recorded in campsites, viz. *M. polymorpha*, *M. rigidula*, *M. truncatula*, as well as the native species *M. arabica* (L.) Huds. and *M. minima* (L.) L.

*Medicago littoralis* proved to be a fairly variable species, especially with respect to leaf size, the presence or absence of spots on the upper leaf surface, and the degree of hairiness.

●●●● ***Medicago polymorpha* L.** — [Fig. 25](#)

natBE / natNL

Mediterranean-Atlantic area.

*Medicago polymorpha* is a rather frequent and long-known alien in both Belgium and the Netherlands ([van Ooststroom & Reichgelt 1958](#), [Verloove 2006](#)) where it has been introduced mainly with wool and cereals. It has long-persisting seeds and can (re-)germinate from a persisting seed bank many decades after its initial introduction. For that reason it is often seen on demolition sites (e.g. [Verloove & Heyneman 2012](#)) and records on the banks of the River Meuse can also refer to former wool aliens.

This species was seen on numerous occasions in campsites, in Belgium as well as in the Netherlands. In Belgium, all records are



Fig. 24. An immature fruit of *Medicago littoralis* Rohde ex Loisel. in Zandvoort (NL), March 2019. Photo: S. Gonggrijp.

from coastal areas whereas in the Netherlands the species was also found twice in inland campsites (in Amsterdam and Luyksgestel).



Fig. 25. *Medicago polymorpha* L. in Oostkapelle (NL), May 2017. Photo: S. Gonggrijp.

The species is usually found in relatively low numbers of plants (up to a few dozens), but in Ellemeet in the Province of Zeeland, Netherlands, at least 500 individuals were observed. In this campsite and a few others the species can be considered naturalized.

*Medicago polymorpha* is a very variable species. However, despite its variability, it is easily distinguished from the three other alien species of this genus: its fruits are thin-walled (the coils are easily pulled apart, without risk of injuries) and its upper leaf surface is glabrous. *Medicago polymorpha* may have – like *M. arabica* – dark spots on the upper leaf surface, a feature that is rarely mentioned in literature.

- ***Medicago rigidula* (L.) All. — Fig. 26**

casNL

Mediterranean area.

*Medicago rigidula* was formerly recorded as a rare alien in Belgium, where it was mostly associated with the wool processing industry. It was not known from the Netherlands (van Ooststroom & Reichgelt 1958, Verloove 2006).

In 2019, a single individual of this species was recorded in a campsite in Brouwersdam (Zuid-Holland) in the Netherlands.



Fig. 26. An immature fruit of *Medicago rigidula* (L.) All., Brouwersdam (NL), May 2019. Photo: S. Gonggrijp.

*Medicago rigidula* is easily separated from the other representatives of the genus, especially because of its glandular hairy fruits.

The entire plant is hairy. The peduncle is clearly aristate. The fruits are c. 6 mm across and disc-shaped with about 4 to 5 turns that are rounded (not keeled) on the back. The fruits are predominantly set with glandular hairs, but also have quite a few simple hairs. The fruits of *M. littoralis* are always glabrous, whereas those of *M. truncatula* are slightly hairy but lack glands and have a clear lateral groove.

●● *Medicago truncatula* Gaertn. — Fig. 27

casBE

Mediterranean area.

*Medicago truncatula* is a regularly occurring but ephemeral alien in both Belgium and the Netherlands (van Ooststroom & Reichgelt 1958, Verloove 2006), where it has been introduced mainly with wool and cereals.

During our fieldwork, the species was found in three campsites in coastal areas in Belgium (Blankenberge, De Panne, and Nieuwpoort). At least in De Panne, the species was seen in several consecutive year and is present with more than ten individuals.

*Medicago truncatula* shares the thick-walled pods and hairy upper leaf surfaces with *M. littoralis* and *M. rigidula*. It is easily separated from these species based on its slightly hairy immature fruits that lack glands.

●● *Trifolium glomeratum* L. — Fig. 3 & 28

nat?BE / nat?NL

Mediterranean-Atlantic area.

*Trifolium glomeratum* has regularly been recorded before in Belgium and the Netherlands, mostly based on introductions with cereals and wool (e.g. Kloos 1952, Verloove 2006).

The species was found in two campsites in Belgium and two in the Netherlands, all along the North Sea coast. The species often occurs in relatively large numbers (50 or more individuals; at least 1,000 in Castricum in the Netherlands) and is seen every year again in the same localities. It is uncertain, however, if this species is genuinely naturalized locally.

In western Europe this species is native to coastal areas in the British Isles. It is tempting to assume that the recent records along the nearby Belgian and Dutch coast might as well be the result of a natural range extension, for instance because of a changing climate. However, natural populations in the British Isles seem to be declining lately (Stace 2010).

*Trifolium glomeratum* is easily distinguished: all of its glomerules are sessile (terminal as well as axillary), a feature which in the study area is only shared with *T. suffocatum*. Compared with the latter, the flowers of *T. glomeratum* are bluish-purple or pink (vs. whitish) and inflorescences are scattered along stems (vs. mostly congested at the base of the stem).



Fig. 27. *Medicago truncatula* Gaertn. in Nieuwpoort (BE), May 2017. Photo: F. Verloove.



Fig. 28. *Trifolium glomeratum* L. in Castricum (NL), April 2019. The pinkish flowers are arranged in dense sessile clusters (glomerules). Photo: S. Gonggrijp.

●●●● *Trifolium nigrescens* Viv. — Fig. 29 & 30

casBE / casNL

Mediterranean area.

*Trifolium nigrescens* was never reliably recorded before in Belgium, but in the Netherlands it was formerly recorded on two occasions: first in 1938 near a grain storage in Erp (three herbarium specimens preserved in L) and subsequently in 1974 in Apeldoorn (Mennema & van Ooststroom 1975). A previous claim from Belgium, as grain alien in 1999 (Verloove 2006), was incorrect and turned out to be ascribable to the similar-looking *T. michelianum* Savi. The latter is sometimes introduced with rapeseed from Australia, where it is a naturalized weed of agricultural fields.

In Belgium, a small population of *Trifolium nigrescens* with c. 16 individuals was detected in 2016 in De Panne and its presence was subsequently confirmed. Since then the species was also found in campsites in Berlare, Koksijde, Oostduinkerke, and Westerlo. In the Netherlands, *T. nigrescens* was first observed in 2017 in Sint Maartenszee and subsequently found in three other campsites in Noord-Holland, two in Zuid-Holland, one in Zeeland, and one in Brabant. In Belgium as well as in the Netherlands the presence of this species was regularly confirmed and at least in some campsites it is persisting. However, the species is usually seen in small numbers and, at least for now, considered ephemeral.

Similar records of *Trifolium nigrescens* are available from the Atlantic coast in France. The species is well-established there and is possibly overlooked in campsites from where it spreads to



Fig. 29. *Trifolium nigrescens* Viv. in Koksijde (BE), June 2016. Flower color can range from creamy white to pale pink. Photo: F. Verloove.





Fig. 30. *Trifolium nigrescens* Viv. in Koksijde (BE), June 2016. Photo: F. Verloove.

surrounding suitable habitats (mostly sandy roadsides in coastal areas; [Chagneau 2019](#), [Coulot & Rabaute 2015](#)). With its long-pedicellate, bracteate white flowers, *Trifolium nigrescens*

resembles *T. repens* L. *Trifolium nigrescens* is, however, clearly an annual species.



Fig. 31. *Trifolium resupinatum* L. in Aagtdorp (NL), May 2017. Photo: S. Gonggrijp.



Fig. 32. *Trifolium resupinatum* L. in Oostkapelle (NL), May 2017. Flower heads with overblown flowers with distinctly swollen calyxes. Photo: S. Gonggrijp.

●●●● *Trifolium resupinatum* L. — Fig. 31 & 32

nat?BE / nat?NL

Mediterranean-Atlantic area.

*Trifolium resupinatum* is a rather regular but normally ephemeral alien, which is usually associated with wool and grain importation (Verloove 2006). In recent years, *Trifolium resupinatum* is also sown as a forage crop, either in pure stands or in association with cereal crops, grasses, etc. It is increasingly seen as an escape from such fields. It is also a regular contamination in commercial birdseed mixtures.

This species has been recorded from numerous campsites, both in Belgium and the Netherlands. It occurs in coastal as well as inland localities. Sometimes it is found in relatively large numbers (100 or more individuals), but this usually applies to a limited number of pitches, often a single one. Most of the time it is found with rather few individuals and although it doubtlessly is a characteristic and widespread campsite alien, it is uncertain whether or not *Trifolium resupinatum* is genuinely naturalized in the study area.

All plants seen in campsites are identical in morphology. They have relatively small flower heads which are c. 10–15 mm across, a typical feature of var. *resupinatum*. Plants grown as a forage crop have larger heads, up to 25 mm across, and belong to var. *majus* Boiss. (syn.: *T. suaveolens* Willd.). The nominal variety has been recorded before in campsites, for instance in France (Coulot & Rabaute 2014).

●●●● *Trifolium suffocatum* L. — Fig. 33 & 34

natBE / natNL

Mediterranean-Atlantic area.

*Trifolium suffocatum* had never been recorded before in Belgium and the Netherlands. A small population was first discovered in 2015 in a campsite in De Panne. In fact, *T. suffocatum* turned out to be very common in this campsite as was seen in the next years. At least 8–9 subpopulations were counted, some with more than 100 individuals. In identical circumstances the species was also found in two campsites in Koksijde in 2016 and in Oostduinkerke in 2017. In Koksijde, the species locally forms monospecific mats that consist of 1,000 or more individuals. Also in 2016, scattered individuals were observed in an inland campsite in Gent (not confirmed there subsequently). In the Netherlands, *T. suffocatum*

was first noticed in 2017 in Callantssoog. Since then, it has been observed in at least 20 campsites, 12 of them in the Province of Noord-Holland (including one locality in coastal dunes with approximately between 50,000 and 100,000 individuals) and four in the Province of Zeeland (in one site with more than 10,000 individuals). On several occasions *T. suffocatum* was already seen outside of campsites, for instance on carparks (Schotsman, Callantssoog). In the latter locality, it was even observed in abundance (more than 500 individuals) in a nature site close to the campsite from where it most likely 'escaped'.

In coastal areas of northwestern France (Département Pas-de-Calais: Le Touquet, Calais), similar records from campsites were already known since the 1990s (Coulot & Rabaute 2013). Also elsewhere in the world the species has been found as a weed of (disturbed) lawns. Styer & Morgan (2013) reported the first record of the species in North America as an established weed in lawns in a golf court.

*Trifolium suffocatum* turned out to be one of the most typical campsite aliens. It is clearly naturalized, but only in coastal and near-coastal areas. The species has very inconspicuous flowers and easily passes unnoticed. It is a tiny, prostrate annual with +/- all inflorescences sessile and congested at the base of the plant. Corollas are whitish and c. 3–4 mm long, and shorter than the calyx. In the vegetative phase, this species often much resembles *T. ornithopodioides*, especially with respect to leaf venation. However, leaf venation of *T. suffocatum* is more pronounced, i.e. the veins are raised above the surface.

●●● *Trifolium tomentosum* L. — Fig. 35

natBE(?) / natNL

Mediterranean area.

*Trifolium tomentosum* is a very rare alien that is usually associated with wool importation (Verloove 2006). In Belgium, a population with several dozens of plants was found on nearly bare sand in De Panne in 2015 and confirmed in the intervening years. The species was also seen in Oostduinkerke. In the Netherlands, *T. tomentosum* is known from five campsites and at least in one, in Castricum, it is very common (approximately 1,000 individuals).

Similar records of *Trifolium tomentosum* are available from the Atlantic coast in France, where it is well-established and spreading, for instance in Loire-Atlantique, Morbihan, and



Fig. 33. *Trifolium suffocatum* L. in De Panne (BE), June 2019. Photo: R. Barendse.

Vendée (Bousquet et al. 2018, Chagneau 2019, Coulot & Raubate 2015). Many records are from or near campsites.

*Trifolium tomentosum* mostly resembles native *T. fragiferum* L. and the latter is also sometimes observed in campsites. *Trifolium tomentosum* is, however, an annual species. It may also resemble *T. resupinatum*, but the inflorescences of *T. tomentosum* are usually (sub-)sessile (peduncle shorter than the subtending leaf) and the two upper calyx teeth are indistinct and largely obscured by the woolly hairs of the flower head.

#### GERANIACEAE

#### ●●●● *Erodium moschatum* (L.) L'Hérit. — Fig. 36

nat(?)BE / nat(?)NL

Mediterranean area.

*Erodium moschatum* was formerly a rather frequent but ephemeral alien, both in Belgium and the Netherlands (Bruggeman 1964, Verloove 2006). Most records were either associated with the wool processing industry or cereals. In recent years,

*E. moschatum* is increasingly seen in western Europe, often without obvious vector of introduction. In some instances, the species easily survives and seems to be naturalizing locally. It is an archaeophyte in the British Isles, especially in coastal areas (Stace 2010), and has progressively spread along the Atlantic coast in France up to the northernmost departments (Lambinon & Verloove 2012). The recent naturalization attempts in the area under study may therefore result from a changing climate.

In the past years, *Erodium moschatum* was observed in rather numerous campsites, especially in the Netherlands. While in Belgium all findings are located along the North Sea coast (Blankenberge, Bredene, and Nieuwpoort), the species has also been found in several inland localities in the Netherlands. Its presence was regularly confirmed, year after year, but in most instances the species occurs in limited numbers, at most a couple of dozens. Although *E. moschatum* seems to naturalize locally in the study area, it is unclear whether this also applies to the campsites in which it was found lately. In some localities, for instance in Den Helder, it was seen in two consecutive years and with increasing numbers.

This species is known to be a nuisance in lawns: its stems are closely appressed to the soil and therefore 'missed' by lawn mowers (Terrisse 1994).

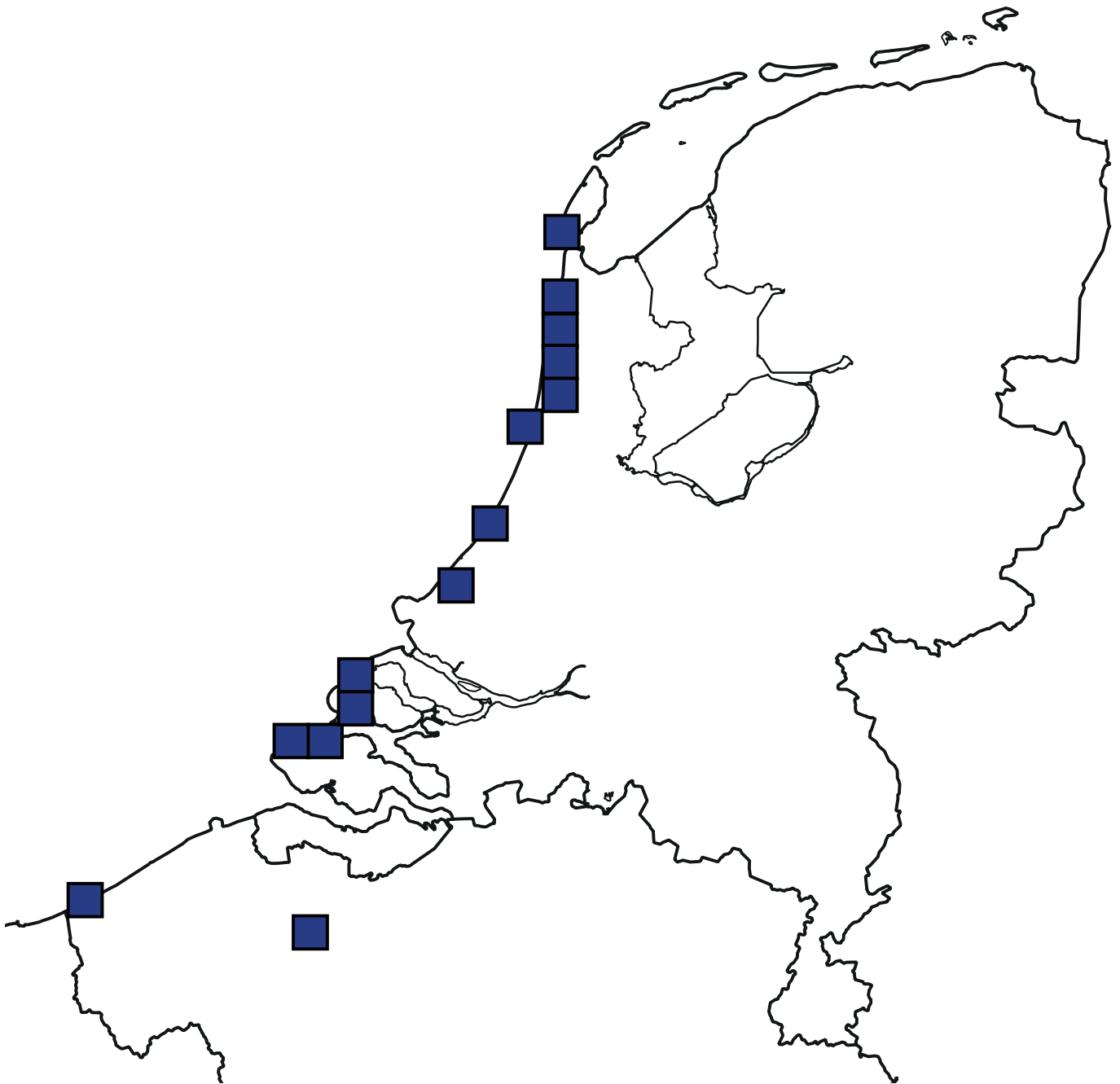


Fig. 34. Current distribution of *Trifolium suffocatum* L. in Belgium and the Netherlands. This species had never been recorded before in the Low Countries and is now found in relatively numerous localities along the North Sea coast with only a single inland locality in Belgium.

*Erodium moschatum* is easily distinguished. Compared with native taxa of the genus its leaves are clearly pinnate and the apical pit of the mericarp is covered in sessile glands.

OROBANCHACEAE

●● *Parentucellia latifolia* (L.) Caruel — Fig. 37

nat(?)BE

Mediterranean-Atlantic area.

*Parentucellia latifolia* had never been recorded before in Belgium. It was discovered in 2016 in De Panne and Nieuwpoort and in

2017 also in Lembeke. In the first locality, *Parentucellia latifolia* grows in a small population with c. 35 individuals; there, it is possibly more or less established or tends to become so. In the other localities, only single individuals were observed. It has been noticed elsewhere that populations of *P. latifolia* may heavily fluctuate from one year to another, possibly depending on climatic conditions during winter (Terrisse 1994).

*Parentucellia latifolia* is progressively spreading northwards along the Atlantic coast in France. It has now reached Le Havre in the Department Seine-Maritime. Its spread has been associated with campsites (e.g. Edouin 1989, Terrisse 1994). According to Guillévic et al. (1990), this species has spread a lot in Morbihan, especially in campsites where it is observed to be very prolific.

This species is tiny and, despite its purplish corollas, rather inconspicuous. It may easily pass unnoticed.



Fig. 35. *Trifolium tomentosum* L. in Castricum (NL), March 2019. Photo: S. Gonggrijp.



Fig. 36. *Erodium moschatum* (L.) L'Hérit. in Nieuwpoort (BE), May 2016. Photo: B. Mortier.



Fig. 37. *Parentucellia latifolia* (L.) Caruel in De Panne (BE), May 2018. Photo: B. Mortier.

## PLANTAGINACEAE

- ***Plantago lagopus* L.** — Fig. 38

casNL

Mediterranean area.

*Plantago lagopus* is a regular but ephemeral alien, both in Belgium and the Netherlands. Most of its occurrences were associated with cereals (Kimstra-Sinnema 1965, Verloove 2006). During our field work a single individual of this species was observed in a campsite in Vrouwenpolder in Zeeland in the Netherlands in 2019.

At a first glance, this species looks like native *Plantago lanceolata* L. However, its bracts and sepals are densely villous and it is usually an annual.



Fig. 38. *Plantago lagopus* L. in Vrouwenpolder (NL), April 2019. Photo: S. Gonggrijp.



Fig. 39. *Rumex pulcher* L. in Berlare (BE), May 2017. The panduriform leaves are typical of this species. Photo: F. Verloove.

#### POLYGONACEAE

##### ●● *Rumex pulcher* L. — Fig. 39

casBE / casNL

Mediterranean-Atlantic area. Commonly naturalized elsewhere in the world, often as a weed, for instance in America and Australia.

*Rumex pulcher* is a rare and ephemeral alien in Belgium and is mostly associated with wool and cereals (Verloove 2003, 2006). In similar circumstances it is also known from the Netherlands (e.g. Danser 1924).

In Belgium, a single individual was seen in an inland campsite in Berlare in 2017 (not confirmed in 2019). In the Netherlands, *Rumex pulcher* was first observed in a campsite in 2018 in Zeist (Utrecht), also in the interior of the country. There, the species



Fig. 40. *Ranunculus muricatus* L. in Zutendaal (BE), May 2017. Photo: R. Barendse.

seems to be more or less established (35–50 individuals). In the same year it was also observed in a coastal campsite in Den Helder, Province of Noord-Holland. In this locality five individuals were counted in 2019. In 2018 it was also seen in Julianadorp aan Zee and in 2019 in Wijk aan Zee, both also located in Noord-Holland.

*Rumex pulcher* is a very variable species. [Rechinger \(1932\)](#) recognized five subspecies. Alien plants seen in western Europe often belong to subsp. *woodsii* (De Not.) Arcang. (syn.: subsp. *divaricatus* (L.) Arcang.) ([Verloove 2003](#)). This subspecies is characterized by its arcuate-divaricate fruiting branches and broadly ovate fruiting valves with several very short rather irregular marginal teeth. Most of the plants seen in campsites were immature and difficult to assign accurately to one of the subspecies. The plants seen in Wijk aan Zee, however, were grown to maturity *ex situ* and are clearly aberrant. Their leaf shape is not panduriform, but oval and small with a long leaf stalk. Fruiting valves have 5 to 6 strong teeth on either margin, some of them being 3–4 mm long. These features are typical of subsp. *raulinii* (Boiss.) Rech. f. from the eastern Mediterranean area ([Raycheva et al. 2007](#)), but which is sometimes also seen elsewhere as an alien (e.g. [Karlsson 2000](#)).

#### RANUNCULACEAE

##### ●●●● *Ranunculus muricatus* L. — Fig. 40

casBE / natNL

Mediterranean area.

*Ranunculus muricatus* is a very rare alien in Belgium and is mostly associated with cereals ([Verloove 2006](#)). In Belgium a small population with scattered individuals was found in a campsite in Nieuwpoort in 2016. The same year it was also seen in Heist-aan-Zee and in 2017 in Bredene, all in coastal areas. Also in 2017, the species was observed in an inland campsite in Zutendaal. In all these cases, *R. muricatus* was found with at most 5–10 individuals and is considered casual. In the Netherlands, this species was more often recorded. All



Fig. 41. *Ranunculus parviflorus* L. in De Panne (BE), May 2017. Photo: R. Barendse.

but one (from Amsterdam) are from coastal campsites, six in the Province of Noord-Holland, five in Province of Zuid-Holland, and two in Province of Zeeland. In Noordwijkerhout, in Zuid-Holland, a population with about 350 individuals was noticed. At least in this locality, *R. muricatus* looks more or less naturalized.

This species has achenes with a distinct beak of c. 2–3 mm long. The face of the achene is covered with tough spines. It cannot be mistaken for any of the native or other alien species found in the study area.

##### ●●●● *Ranunculus parviflorus* L. — Fig. 41

natBE / natNL

Mediterranean-Atlantic area.

*Ranunculus parviflorus* is a very rare alien in Belgium. It is best known from De Panne where it is naturalized as a lawn weed in a cemetery near the coast, at least since the 1950s. It is an occasional (lawn) weed elsewhere, for instance in the Botanic Garden in Meise ([Ronse 2011](#)). In Belgium, this species was observed in rather numerous campsites since 2015 (e.g. Blankenberge, Bredene, De Haan, Heist-aan-Zee, Nieuwpoort, Wenduine). Most campsites are located in coastal areas, but the species has also been observed in inland localities (Gent, Houthalen-Helchteren). It is a fairly characteristic campsite alien. In most localities the species was seen with dozens of individuals and it is clearly naturalized. The same applies to the Netherlands, although there the species seems to be restricted





Fig. 42. *Galium murale* (L.) All. in Heule (BE) in May 2018. Photo: F. Verloove.

to coastal areas. Most localities are found in the Province of Zeeland, but it was also seen further north in the Provinces of Noord-Holland and Zuid-Holland. Its largest population is located in Kamperland, where approximately 500 individuals were counted.

*Ranunculus parviflorus* is rather inconspicuous and easily overlooked. Like native *R. sardous* Crantz, *R. parviflorus* has reflexed sepals, but it is a much smaller annual with tiny flowers that are at most 8 mm across and with petals hardly longer than sepals. Also, its receptacle is glabrous, not hairy.

#### RUBIACEAE

##### ●●●● *Galium murale* (L.) All. — Fig. 42

natBE / natNL

Mediterranean area.

*Galium murale* was recorded once at the beginning of the 20<sup>th</sup> century in Belgium (Verloove 2006). In recent times it is increasingly observed in urban habitats (e.g. Antwerpen, Brugge, Gent, Liège, etc.) and the species is also regularly found in plant containers originating from the Mediterranean area (Hoste et al. 2009).

In the Netherlands it was recorded once on an unloading quay in the port of Amsterdam in 1965 (Adema 1974). Like in Belgium, it was recently able to naturalize locally in urban habitats (Denters 2015).

In 2016, *Galium murale* was discovered in campsites in Blankenberge, Heist-aan-Zee, Koksijde, and Nieuwpoort. In the first locality, the species occurs with many hundreds of individuals and is obviously naturalized. All records are from coastal campsites. The species was also observed in two inland gypsy and traveller caravan sites (Eeklo, Heule). In the Netherlands, the species is found in a comparable number of localities, mostly in the Province of Noord-Holland. Most populations are found in (near-)coastal areas. However, the species is also present in at least three campsites in Amsterdam.

*Galium murale* is a tiny, inconspicuous species that is easily overlooked. With its cylindrical mericarps, yellowish green corollas in few-flowered inflorescences, and leaves with backward-directed prickles, it cannot be confused with any of the other representatives of the genus in the study area, native as well as introduced ones.

## SOLANACEAE

- ***Solanum chenopodioides*** Lam.

casNL

South America. Widely naturalized elsewhere, including in the Mediterranean area.

*Solanum chenopodioides* was formerly rarely recorded as an ephemeral alien, in Belgium as well as in the Netherlands (van Ooststroom & Reichgelt 1966c, Verloove 2006). Since 1995 it is persisting and recently spreading along railway tracks in the port area in Ghent. Since 2013 it is known from identical habitats in the port area in Antwerp. It is locally naturalized now. Similar behavior has been observed recently in some localities in the Netherlands as well (waarneming.nl).

In 2019 a few individuals were found in a campsite in Amsterdam.

*Solanum chenopodioides* belongs to the *S. nigrum* group and may have been overlooked. It is, however, a perennial and often taller than *S. nigrum* and more or less shrublike. Its fruiting peduncle is sharply deflexed, the inflorescence is an umbelate cyme (versus a raceme) and its berries are purplish-black. Stem and leaves of *S. chenopodioides* have an indumentum of dense, appressed hairs, especially on young parts, which are very different from the sparser, patent, often glandular hairs of *S. nigrum*.

## POACEAE

- ***Aegilops triuncialis*** L. — Fig. 43

casNL

Mediterranean area.

*Aegilops triuncialis* was formerly a rather regular but ephemeral alien, both in Belgium and the Netherlands (Jansen 1951, Verloove 2006).

In 2019, a single individual was observed in a campsite in Kamperland in the Province of Zeeland, the Netherlands.

In recent years only one other species of this genus is sometimes observed in the study area, *Aegilops cylindrica* Host., usually as a grain alien. Compared with the latter, *A. triuncialis* has spikelets with longer and more patent awns, which are more than 15 mm long.

- ***Poa infirma*** Kunth — Fig. 44, 45 & 46

natBE / natNL

Mediterranean-Atlantic area.

*Poa infirma* had never been recorded before in Belgium and the Netherlands. It was at first discovered in Belgium in 2016, when it was found in several coastal campsites (e.g. Blankenberge, Bredene, Nieuwpoort, Wenduine). As a result of its very early flowering it had doubtlessly widely been overlooked elsewhere. Subsequently, it was also seen in several inland campsites (e.g. in Antwerpen-Linkeroever, Gent, Houthalen-Helchteren, Jabbeke). In most places, the species occurs with numerous individuals (often 1000s occurring in a monospecific vegetation) and it is obviously naturalized, at least locally. It is one of

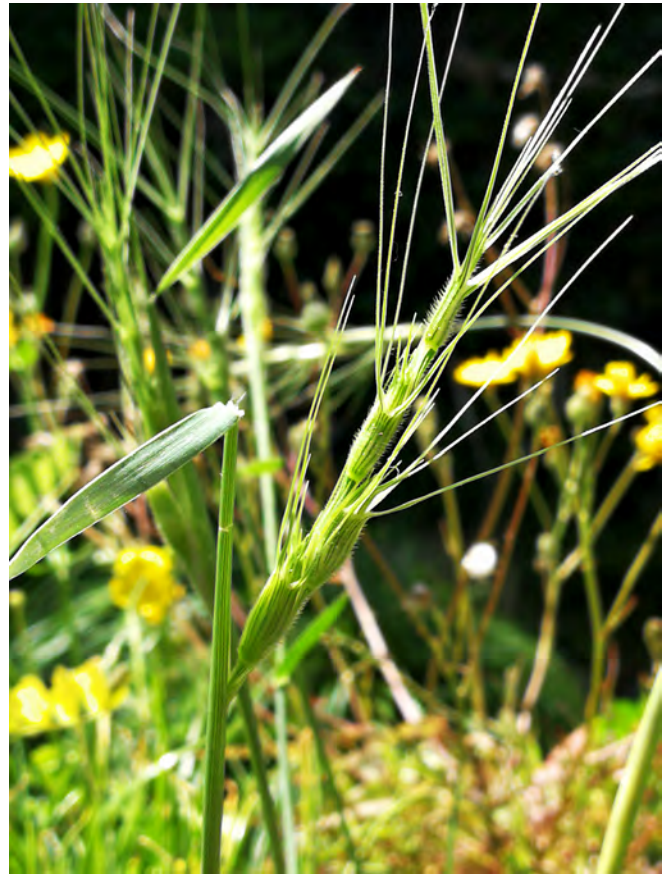


Fig. 43. *Aegilops triuncialis* L. in Kamperland (NL), May 2019. Photo: S. Gonggrijp.



Fig. 44. *Poa infirma* Kunth in Blankenberge (BE), May 2017. Photo: R. Barendse.



Fig. 45. *Poa infirma* Kunth in Chaam (NL), May 2019. This species is often dominant. Photo: S. Gonggrijp.

the most typical campsite aliens. A further spread, especially in coastal areas, is very likely. Meanwhile, the species has also been recorded in other habitats, for instance in cemeteries. In the Netherlands *P. infirma* is even more widespread and it must have been overlooked for quite some time. After that the species was identified in campsites from 2016 onwards, an observation from Westenschouwen in Zeeland of an unknown *Poa* species in 2008 turned out to be the first record of *P. infirma* in the Netherlands ([waarneming.nl](http://waarneming.nl)). Since then the species has been recorded in countless localities and at present it occurs in at least 179 grid cells of 1 km<sup>2</sup>! Moreover, *P. infirma* is not only very common in campsites, but also in ecologically similar habitats, i.e. open, sun-exposed places with gravelly or sandy substrates. The species is found in both coastal and inland sites and hardly decreases in abundance in the northernmost parts of the country.

*Poa infirma* closely resembles *P. annua* L. and both species may have been confused. The former is a very early-flowering species (January–April) and some populations may have disappeared before most botanists start recording plants so early in the season ([Takagi-Arigho 1994](#)). Its striking light green colour is characteristic; in addition the panicles are erect, lanceolate to ovate and often slightly to markedly one-sided. However, the only reliable character that separates both species is anther length, being 0.2–0.5 mm in *P. infirma* and 0.6–0.8(–1.3) mm in *P. annua*.

●● ***Rostraria cristata*** (L.) Tzvelev — [Fig. 47](#)

nat?BE / casNL

Mediterranean area.

In Belgium, *Rostraria cristata* is a rather frequent but ephemeral alien that is mostly associated with grain importation and wool

([Verloove 2006](#)). In recent years it is increasingly found in urban habitats ([Allemeersch 2006](#)). At least some records refer to plants introduced as weeds in plant containers imported from the Mediterranean area ([Hoste et al. 2009](#)). The species is mostly found on sidewalks, at the foot of walls, in cracks in pavement, but also on railway infrastructure. The same applies to the Netherlands, where it has become an even more characteristic urban weed ([Denters 2004](#), [Wetzels & Dijkhuis 2016](#)).

Taking into account the above, *Rostraria cristata* is a rather exceptional campsite alien. In Belgium, an apparently stable population was found in a campsite in De Panne in 2015. In the next years, its presence there was regularly confirmed (c. 350 individuals were counted in 2016). In 2016, the species was seen in a mobile home carpark in Nieuwpoort and in 2018 c. 20 individuals were found in a campsite in Koksijde. All these campsites are located along the Belgian coast. In the Netherlands, *R. cristata* was only found in a single campsite, in Tuitjenhorn (Schagen) in the Province of Noord-Holland, in 2017. Its presence there was subsequently confirmed in the same pitches in 2019.

●● ***Sporobolus indicus*** (L.) R.Br.

natNL

Pantropical. Naturalized in the Mediterranean area and progressively spreading further north.

*Sporobolus indicus* is a regular but usually casual alien, both in Belgium and the Netherlands. Formerly it was associated with the wool-processing industry, whereas recent records are mostly linked with grain importation ([Verloove 2006](#)). In recent years, this species is increasingly recorded in the study area, usually in urban and peri-urban environments, often without

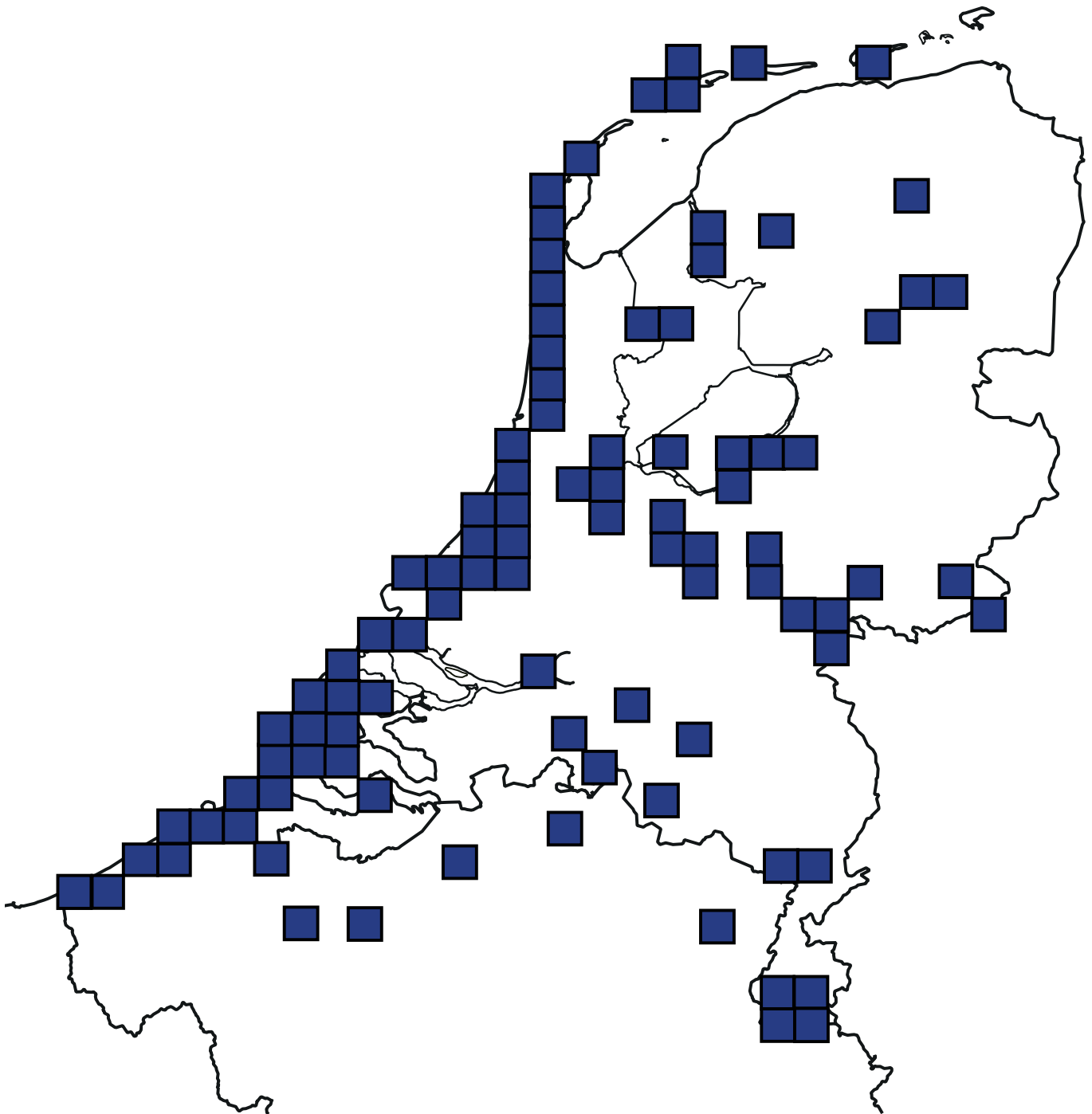


Fig. 46. Current distribution of *Poa infirma* Kunth in Belgium and the Netherlands. This species had never been recorded before but proved to be omnipresent in campsites throughout the study area. As soon as botanists were familiar with this species, it was also found in numerous localities in habitats other than campsites. The species was probably overlooked for quite a long time.

an obvious vector of introduction. The species is sometimes persisting for some years and these events are probably the first indications for a wider naturalization in a near future. In the past decades, the species has progressively expanded its secondary area in southwestern Europe northwards, reaching northwestern France. Therefore, the recent records in Belgium and the Netherlands might possibly result from more favorable climatic circumstances.

During our field study, *Sporobolus indicus* was found twice, but only in the Netherlands: in Den Helder (since 2017) and IJmuiden (2019), both in the Province of Noord-Holland. In both localities, the species occurs with c. 75 individuals and in the

first locality it is obviously increasing in number. In the latter it is confined to the carpark in front of the campsite.

*Sporobolus indicus* is a morphologically very characteristic species with very long inflorescences that somehow remind of a rat tail, hence its vernacular name rat's tail grass.



Fig. 47. *Rostraria cristata* (L.) Tzvelev in Koksijde (BE), May 2018. Photo: F. Verloove.

### CAMPSITES AS A REFUGIUM FOR ENDANGERED AND RARE NATIVE SPECIES?

During our field studies it became clear that campsites also harbor interesting, often rare native species, although it is often difficult to assess whether these species occur due to or in spite of camping activities; in other words, whether they were introduced there by campers or have colonized the campsites by natural means of dispersal. Some of the more interesting taxa are briefly discussed in alphabetical order below.

***Capsella rubella*** Reut. (Brassicaceae) — A rare, supposedly native species in some parts of Belgium (Auquier & Sérusiaux 1978, Lambinon & Verloove 2012) and thought to be absent from the Netherlands, at least by contemporary authors (van der Meijden 2005; but see, on the contrary, van Oostroom 1975). The species is not always easily separated from *Capsella bursa-pastoris* (L.) Medik. and is sometimes not recognized as a distinct species (e.g. Pujadás Salvá 1993). However, plants found in campsites are usually very typical and clearly belong to *C. rubella*. This species is very common in campsites, especially, but not exclusively, in coastal areas. In De Panne in Belgium, *C. rubella* is locally common in sandy roadsides, ruderalised sand dunes and similar habitats. It is not unlikely that it was

first introduced in campsites and subsequently spread to other suitable habitats.

In at least one campsite (in De Panne) *C. × gracilis* Gren. was also recorded, the sterile hybrid of the two aforementioned species (Verloove 2016).

***Crassula tillaea*** Lest.-Garl. (Crassulaceae) — This species had become extremely rare in Belgium and was only known from a single historical locality in Stambruges (Mer de Sable; Lambinon & Verloove 2012) where it is still present. In the Netherlands, it was also very rare, but it is recently slightly increasing, for instance in cemeteries and campsites (Kruijssen & Weeda 1992, van der Ham & Vreeken 2009). These authors emphasized that the species recently occurred in habitats and vegetation types that do not correspond with the known preferences of this species, suggesting that in many instances these records may refer to introductions. During our field study we have noticed that *Crassula tillaea* is one of the most characteristic campsite plants. There is hardly any campsite where it is lacking, especially those located in coastal areas. Moreover, it often occurs in almost monospecific stands with many 1000s of individuals. In several places, the species was also found just outside the campsite, but still in places clearly associated with the campsite (parking lots, bare sandy areas, etc.).

***Filago pyramidata*** L. (Asteraceae) — This species has become a very rare species in Belgium (Lambinon & Verloove 2012)

while it is extinct in the Netherlands (van der Meijden 2005). It has been recorded in a campsite in De Panne in 2015. Other records of similar plants from Nieuwpoort and Blankenberge refer to immature plants and may belong to either this or the similar *Filago congesta* Guss. ex DC. In all cases, *F. pyramidata* obviously is an introduction.

***Scleranthus annuus*** L. subsp. ***polycarpus*** (L.) Bonnier & Layens (Caryophyllaceae) — In Belgium, this taxon is rare in parts of Wallonia and very rare elsewhere (Lambinon & Verloove 2012) and the same applies to the Netherlands (Jansen & de Kleuver 1967, van der Meijden 2005, van Ooststroom & Reichgelt 1966b). We have found it in scattered campsites along the Belgian coast (De Panne, Koksijde, and Blankenberge) and in 10 campsites in coastal areas in the Netherlands. In some localities this taxon is quite abundant (with 100s or even 1000s of individuals) and obviously established. Since subsp. *polycarpus* was not known to occur in coastal areas in the study area, all occurrences most likely refer to introductions.

***Torilis arvensis*** (Huds.) Link. (Apiaceae) — This species is very rare in Belgium. Six individuals were observed in a campsite in Antwerpen-Linkeroever in 2018. The fruits with hooked spines easily adhere to clothing. However, the species has little chance to reproduce and naturalize in campsite habitats, because its inflorescences probably will not survive the mowing regime (unless it would germinate in less disturbed places, for instance below the hedgerows that separate the pitches).

***Trifolium micranthum*** Viv. (Fabaceae) — This species was long thought to be a rare or very rare species, both in Belgium and the Netherlands (van Ooststroom 1968, Lambinon & Verloove 2012, van der Meijden 2005). Van Landuyt et al. (2004) found out that the species was a characteristic weed of lawns in Flanders Fields war cemeteries in the surroundings of Ieper in Belgium. In comparable circumstances, *T. micranthum* was also regularly observed in campsites in Belgium and the Netherlands. These occurrences may refer to relics of natural populations or introductions. However, it was demonstrated that the species very easily spreads as a result of human-mediated long-distance dispersal (D'hondt et al. 2012).

***Trifolium ornithopodioides*** L. (Fabaceae) — A very rare species in the Netherlands with most occurrences in Zeeland and the Wadden Sea Islands (Hazebroek et al. 2001; van Ooststroom & Reichgelt 1965a, 1965b). There is one unpublished record from the Waasland port area in Belgium (comm. G. Spanoghe). *Trifolium ornithopodioides* was found in nine campsites in the Netherlands, five of them on the island of Terschelling. It was also seen in Katwijk aan Zee (100s of plants), Rijnsburg, Scharendijke (several places with dozens) and Kamperland. In the latter locality it occurs inside as well as just outside the campsite (c. 350 individuals). The status of this species probably is most problematic. At least Katwijk aan Zee falls outside the known native distribution range of the species due to the absence of historical records from this village. Other records are from areas where the species also occurs naturally, which could point at relics of natural populations. The fact that *T. ornithopodioides* was not seen at all in Belgian campsites seems to confirm this. However, we think that most of the records only by chance coincide with the species natural distribution range.

***Trifolium subterraneum*** L. (Fabaceae) — This species is very rare in both Belgium and the Netherlands (Lambinon & Verloove 2012, van der Meijden 2005). During our field study it was rather regularly recorded. Most records are from coastal areas in Belgium (Bredene, De Haan, De Panne, Nieuwpoort, Oostduinkerke, etc.), but it was also found in inland localities, for instance in Bocholt. In some localities

the species was very numerous. In the Netherlands, the species was found in nine campsites, five of these in the Province of Noord-Holland. Here again, it is unknown whether or not these are natural occurrences. In Belgium, *Trifolium subterraneum* is by far best known from coastal areas (Zwaenepoel 2006). In the Netherlands, the species must be an introduction in all campsites in the Province of Noord-Holland, since there is only a single, very old previous record from that province. The same applies to records from the Province of Zuid-Holland, where the species only occurs on the island of Goeree-Overflakkee, whereas localities in Zeeland partly refer to obvious introductions and partly to possibly indigenous populations.

Further native and less rare neophytic taxa that were regularly observed include: *Aphanes arvensis* L., *A. australis* Rydb. (a very common and omnipresent species in campsites), *Anisantha diandra* (Roth) Tutin ex Tzvelev, *Bromopsis erecta* (Huds.) Holub (a single locality), *Catapodium marinum* (L.) C.E. Hubb., *C. rigidum* (L.) C.E. Hubb., *Filago minima* (Sm.) Dumort., *Herniaria glabra* L., *H. hirsuta* L., *Hypochaeris glabra* L. (common in two campsites), *Medicago minima* (L.) L., *Mibora minima* (L.) Desv., *Myosurus minimus* L., *Poa bulbosa* L., *Scleranthus annuus* L. subsp. *annuus*, *Silene conica* L., *Sagina apetala* Ard., *Spergularia rubra* (L.) J. Presl & C. Presl, *Torilis nodosa* (L.) Gaertn., *Trifolium scabrum* L., *T. striatum* L., *Tuberaria guttata* (L.) Fourr. (a large population on the island of Texel), *Veronica polita* Fr., *Vulpia bromoides* (L.) Gray, and *V. membranacea* (L.) Dumort.

## DISCUSSION AND CONCLUSION

Five consecutive years of field work in numerous campsites and caravan parks (and similar habitats such as parking lots for campers) in Belgium and the Netherlands yielded an unexpectedly high number of alien plant species that must have been introduced as fruits or seeds from southern Europe attached to car mats, camping equipment (ground sheets, tent fabrics), shoes and clothing, car tires, etc. These fruits and seeds apparently find appropriate conditions to germinate in the more or less permanently disturbed lawns that are typical of campsites. Several of these alien species are apparently naturalized, especially – but clearly not exclusively! – in the climatologically favorable (near-) coastal areas that are located on fast heating soils that in many ways closely resemble those found in southern Europe. Species such as *Poa infirma*, *Soliva sessilis*, and *Trifolium suffocatum* had not been recorded before in the study area (or the second species merely as a very rare, ephemeral alien a very long time ago). Yet, they turned out to be among the most characteristic campsite weeds and are completely naturalized in numerous localities. Similarly, previously unrecorded species like *Trifolium nigrescens* or rare aliens like *Cotula australis*, *Erodium moschatum*, *Galium murale*, *Ranunculus muricatus*, *R. parviflorus* were also among the most typical campsite aliens. Also rare or even very rare native species have found a suitable secondary habitat in campsites. *Crassula tillaea*, for instance, has been observed in a large majority of the visited localities. A representative image of the vegetation usually observed in these habitats is presented in a phytosociological relevé from a campsite in Castricum, the Netherlands (Table 1). The fate of a couple of other southern species remains to be assessed; not previously reported species such as *Filago congesta*, *F. pygmaea*, *Parentucellia latifolia*, *Spergularia bocconeii*, and a few others might locally naturalize and spread in the coming years, like they recently have done along the Atlantic coast in western France.

Table 1. Phytosociological relevé from a campsite in Castricum, the Netherlands. Relevé: Adrie van Heerden (Plantensociologische Vereniging Nederland).

Table number	1	2	3	4
Relevé number	2	3	4	5
<b>Author (code)</b>	0353	0353	0353	0353
<b>Date (Year / Month / Day)</b>	20190516	20190516	20190516	20190516
<b>Year</b>	2019	2019	2019	2019
<b>Month</b>	05	05	05	05
<b>Day</b>	16	16	16	16
<b>X-coordinate (km) (× 1000)</b>	104821.000	104842.000	104672.000	108181.000
<b>Y-coordinate (km) (× 1000)</b>	505264.000	505309.000	505375.000	534952.000
<b>Plot length (m)</b>	1.50	1.20	1.00	1.20
<b>Plot width (m)</b>	1.00	1.20	1.50	1.20
<b>Plot surface (m<sup>2</sup>)</b>	1.50	1.44	1.50	1.44
<b>Inclination (degrees)</b>	0	0	0	0
<b>Total cover (%)</b>	70	50	60	40
<b>Cover of herb layer (%)</b>	65	50	60	40
<b>Cover of bryophyte layer (%)</b>	10	1	1	0
<b>Cover of litter (%)</b>	10	10	40	0
<b>Average height (high) herb layer (cm)</b>	5	5	20	8
<b>Average height (low) herb layer (cm)</b>	2	2	6	2
<b>Natura 2000 area</b>	0087	0087	0087	0087
<b>Associa_01</b>	14BA01	14BA01	14BA01	28AA03
<b>Norm_lh_01</b>	0.3	0.4	0.6	0.3
<b>Incompl_01</b>	0.3	0.5	0.4	0.2
<b>Weirdne_01</b>	0.3	0.4	0.7	0.4
<i>Agrostis capillaris</i>	+		+	+
<i>Aphanes australis</i>	2b	1	2m	1
<i>Bellis perennis</i>	2a			
<i>Capsella bursa-pastoris</i>	r	1		
<i>Cerastium semidecandrum</i>	+	r	+	
<i>Elytrigia repens</i>	1		2m	
<i>Festuca rubra</i>	2m		1	
<i>Geranium pusillum</i>	+	+	+	
<i>Hypochaeris radicata</i>	+			
<i>Lolium perenne</i>	1	1		+
<i>Poa annua</i>	2m		1	1
<i>Poa bulbosa</i>	+		+	

As a rule, we have noticed that during our fieldwork – which also included monitoring of several of the more interesting campsites – the weed flora is relatively stable. This means that the presence of the typical species is confirmed year after year, whereas the number of new introductions is surprisingly low. This seems to suggest that the majority of this characteristic weed flora was already introduced years ago, but completely passed unnoticed. Only the diminutive but – because of its bright colour – very striking *Crassula tillaea* had been observed before in campsites. Nearly all of the other campsite weeds are also low-growing, but are often rather unattractive and not as striking as the crassula. The Dutch in particular are since many years known to be fanatical campers and, as a consequence, are doubtlessly responsible for the inadvertent dispersal of seeds and fruits throughout Europe. This camping related dispersal phenomenon, therefore, probably occurred in Europe for already a long time. Moreover, campsites are private properties that are probably rarely visited by botanists. We did, however, notice that differences in phenology may have hampered the observation of occurrences. The germination and development of alien plants largely depends on climatological circumstances.

During mild winters, species like *Cotula australis* and *Galium murale* are able to flower and fruit throughout the year. *Poa infirma* can also develop very early in the season if weather conditions are favorable. However, when this is the case most plants are already gone by May, which means that the species largely remains unnoticed.

Although hard to prove, it is tempting to suggest that global warming has positively influenced the naturalization of at least some of these campsite weeds. Many of the species are native to warm-temperate areas, mostly the Mediterranean area, or they are naturalized there, after having been introduced there a long time ago from South America, Australia, etc. Many of the species have progressively extended their native or secondary distribution area into southwestern France in the past years or decades, some even reaching northwestern France, up to close to the Belgian frontiers. Perhaps none, however, ended up in Belgium or the Netherlands as a result of a natural colonization process, possibly encouraged by global warming. The fact, though, that these species are able to persist or even naturalize may, on the other hand, well be the result of a changing climate. Species like *Cotula australis*, *Erodium moschatum*,

(Table 1, continued)

Table number	1	2	3	4
Relevé number	2	3	4	5
<i>Scleranthus annuus</i>	1		r	
<i>Veronica arvensis</i>	1	1	1	
<i>Erodium cicutarium</i>	+		1	
<i>Brachythecium albicans</i>	2a	1		
<i>Kindbergia praelonga</i>	+			
<i>Trifolium suffocatum</i>	r			
<i>Trifolium glomeratum</i>	2a		1	
<i>Arenaria serpyllifolia</i>		2m	1	
<i>Juncus bufonius</i>		2b		2b
<i>Plantago coronopus</i>		3		
<i>Plantago major</i> subsp. <i>major</i>		+		r
<i>Ranunculus bulbosus</i>		r		
<i>Taraxacum</i> sectie <i>Erythrosperma</i>		1		
<i>Sagina micropetala</i>		1	+	
<i>Polycarpon tetraphyllum</i>		1	r	
<i>Soliva sessilis</i>		r		
<i>Anisantha sterilis</i>			r	
<i>Conyza canadensis</i>			r	
<i>Crassula tillaea</i>			1	2a
<i>Vulpia myuros</i>			2m	
<i>Festuca brevipila</i>			2a	
<i>Festuca filiformis</i>			1	
<i>Taraxacum</i> sectie <i>Ruderalia</i>			r	
<i>Hypnum cupressiforme</i> var. <i>cupressiforme</i>			1	
<i>Trifolium tomentosum</i>			2b	
<i>Cerastium glomeratum</i>				1
<i>Cerastium fontanum</i> subsp. <i>vulgare</i>				r
<i>Erophila verna</i>				+
<i>Montia minor</i>				+
<i>Poa pratensis</i>				+
<i>Poa trivialis</i>				1
<i>Sagina procumbens</i>				1
<i>Stellaria pallida</i>				r
<i>Trifolium repens</i>				+
<i>Rosa</i> species				r

*Polycarpon tetraphyllum*, *Rostraria cristata*, *Soliva sessilis* and several others were already repeatedly introduced a long time ago in the study area, but never managed to establish until (very) recently.

One might wonder what the importance is of these campsite weeds, since most of them are restricted – at least apparently – to a very characteristic, non-natural habitat (periodically disturbed lawns, moreover located in private properties). The importance seems three-fold. First of all, visitors of campsites unintentionally carry unexpectedly high amounts of seeds and fruits with them. As such, campsites are an unexpected and hardly known hotspot for the introduction of alien plants. In a recent past, plant containers with olive trees also proved to harbor a huge number of weed plants (Hoste et al. 2009). Secondly, we have noticed that some of the more widespread species, for instance *Poa infirma* and *Trifolium suffocatum*, already started to escape from the campsites, colonizing surrounding suitable habitats. These often include coastal sand dunes. In Castricum, the Netherlands, we noticed the spread of *Crassula tillaea* from a campsite over almost ten kilometers, both in a northerly and southerly direction, along various cycle tracks in the dune area.

The closer to the campsite, the higher the abundance of its occurrence. *Crassula tillaea* is also colonizing the islands of Texel and Ameland in a massive way, while only ten years ago this species was not found at all along the paths on Ameland (comm. Hinko Talsema). It is not unlikely that others of the aforementioned species will first naturalize inside campsites and subsequently spread beyond the campsite limits. In the past decades, several southern species have naturalized or suddenly appeared in coastal dunes in Belgium and the Netherlands, without an obvious vector of introduction or an indication of their origin. This applies to grasses such as *Anisantha diandra*, *Vulpia fasciculata* (Forssk.) Fritsch, *V. membranacea*, but also to, for example, *Tragopogon dubius* Scop. Although, of course, we cannot be sure, perhaps campsites may have also played a role in the introduction of these species in the study area. Finally, one of the more prevalent weeds discovered during our field work is undoubtedly *Soliva sessilis*, commonly known as Bindii weed, Bindii eye, lawn burweed, or carpet burweed. In many campsites, this species is very well established and often grows in almost monospecific mats, partly or even completely replacing the grass lawn. In some campsites, e.g. in Houthalen-Helchteren



(Belgium) and Kamperland (the Netherlands), this species occurs with thousands of individuals. With its spine-tipped achenes *S. sessilis* is a genuine nuisance that prevents people from walking barefoot, even to such an extent that interactive travel forums such as Tripadvisor refer to the species' presence in campsites. Given its abundance, there is little doubt that the species will also be transported to other suitable habitats, i.e. mainly lawns, away from the campsites. Illustrative in this respect is its occurrence at a swimming pool in Amsterdam, where neither tents nor caravans come, but that is rented by a nearby campsite. It is beyond doubt that the species was introduced there by campsite visitors by achenes adhered to their shoes or clothing.

It is obvious that campsites have played an important role in the introduction and subsequent naturalization of southern plant species in Belgium and the Netherlands. For a number of reasons, it is unclear whether or not this will remain the case. First of all, genuine backpacking and caravanning seems to be slightly decreasing lately. We have noticed that campsites increasingly invest in fixed chalets and mobile homes rather than in pitches for tents. This may considerably reduce the number of introduced seeds and fruits. Secondly, coastal campsites were formerly predominantly located as near as possible to the sea, i.e. inside the coastal dunes where southern species found ideal germination conditions. In Belgium, nearly all campsites disappeared from the dunes as a result of a decree on the protection of coastal dunes. They are now mostly located in the nearby polders, on nutrient-rich clayish soils that are much less favorable for the southern plant species.

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