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INVESTIGATIONS ON ECOLOGY AND DISTRIBUTION OF *SENECIO INAEQUIDENS* DC. (ASTERACEAE) IN TUSCANY (ITALY)

Abstract - A. Misuri, G. Ferretti, L. Lazzaro, M. Mugnai, D. Viciani, *Investigations on ecology and distribution of* Senecio inaequidens *DC. (Asteraceae) in Tuscany (Italy).*

We investigated the distribution of the alien species *Senecio inaequidens* in Tuscany. We verified occurrence and extent of its populations, investigating sites with ecological conditions suitable for it. In particular, we surveyed a large portion of Tuscany's railways, which proved to be effective dispersion corridors, due to the bio-ecological characteristics of *S. inaequidens*. Data collected in the field were georeferenced in GIS environment, allowing to produce a map of the current distribution of this species and an estimation of its current population size. The distribution of *S. inaequidens* in Tuscany can be generally considered to date not alarming, since the plant spreads mainly in secondary anthropogenic environments, particularly along railways and roadsides. However, the current extent of *S. inaequidens* in Tuscany is considerably larger, compared to past bibliographical reports, and thanks to our survey its status changed from naturalized to invasive. Moreover, four sites are reported as hosting large populations with risk of further spreading, for which monitoring programs are recommended.

Key words - alien invasive species, Compositae, South African ragwort, Tuscany, Italy

Riassunto- A. Misuri, G. Ferretti, L. Lazzaro, M. Mugnai, D. Viciani, *Ricerche su ecologia e distribuzione di* Senecio inaequidens *DC. in Toscana*.

In questo lavoro è stata studiata la distribuzione in Toscana della specie aliena *Senecio inaequidens*. Abbiamo verificato la presenza e l'estensione della diffusione di questa pianta, studiando e visitando i siti in cui sono presenti le condizioni ecologiche per la sua sopravvivenza. In particolare, abbiamo seguito gran parte delle linee ferroviarie, che si sono rivelate efficaci corridoi di dispersione di *S. inaequidens*, a causa delle sue caratteristiche bioecologiche. A partire dai dati raccolti sul campo, attraverso la georeferenziazione in ambiente GIS, è stata realizzata una mappa che mostra la sua distribuzione attuale e fornisce una stima delle dimensioni delle diverse popolazioni. A seguito dell'analisi dei dati, possiamo affermare che in generale, ad oggi, la distribuzione di *S. inaequidens* in Toscana non è allarmante, poiché la pianta si diffonde principalmente in ambienti antropogenici secondari, in particolare lungo le linee della rete ferroviaria e stradale. Tuttavia, *S. inaequidens* ha ampiamente aumentato la sua diffusione nel territorio toscano rispetto alle segnalazioni disponibili in letteratura, tanto che grazie a questa indagine il suo status di specie aliena è stato cambiato da naturalizzato a invasivo anche per la Toscana. Inoltre, si segnalano quattro siti con popolazioni consistenti ed a rischio di espansione, per i quali sarebbe opportuno prevedere programmi di monitoraggio.

Parole chiave - specie esotiche invasive, Compositae, senecione sudafricano, Toscana

Introduction

Biological invasions, due to intentional or accidental introduction of species in areas outside their native range, are a global and constantly increasing threat to biodiversity. In fact, invasive alien species are able to go beyond the limits of their natural dispersal mechanisms and overcome biogeographic barriers due to causes directly or indirectly linked to human activities (Richardson & Pyšek, 2006; Blackburn *et al*., 2014; Seebens *et al*., 2017). An invasive alien species has ecological and adaptive characteristics that allow it to stabilize and then proliferate, such as a low specialization and a high reproductive rate (Hansen & Clevenger, 2005). It is widely acknowledged that biological invasions are today an important component of human-induced global environmental change (Vitousek *et al*., 1997; Parmesan & Yohe, 2003) and a serious threat to native species and biodiversity (Weber, 2003; DAISIE, 2009; Bellard *et al*., 2016). As result, they lead to the alteration of ecosystem function (Vilà *et al*., 2011, 2015; Pyšek *et al*., 2012; Viciani *et al*., 2020; Lazzaro *et al*., 2020), economic losses and relative control costs (Scalera, 2010).

It is estimated that there are already over 12,000 alien species present in Europe, of which around 10-15% are invasive and that their number increased by 76% since 1970 and is still growing nowadays (Sundseth, 2014).

In Italy, according to Galasso *et al.* (2018), 791 non-native naturalized plants are recorded, among them 570 are considered as naturalized solely, while 221 as invasive in at least one region. *Senecio inaequidens* DC. (Asteraceae) is one of these latter species with the fastest expansion rate in many regions. In Tuscany, however, before the results of the present study, Galasso *et al.* (2018) considered it only as naturalized. Literature data were scarce both because of a probable sporadic diffusion until a few years ago and of the lack of focused investigations. The aim of this study is to define the current distribution of *S. inaequidens* in Tuscany, verifying its occurrence in sites where it was histori-

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cally recorded and in other ones that are ecologically suitable for the species spreading.

Materials and methods

Study species

Senecio inaequidens is a species of the family Asteraceae native to South Africa, where it can be found up to an altitude of 2,850 m (Hilliard, 1977; Werner *et al*., 1991; Meusel & Jäger, 1992). In the mid-twentieth century it was accidentally introduced to Europe, probably through seeds present in raw wool lots. The first record dates back to 1889 in Hannover, Germany (Brennenstuhl, 1995). Currently in Europe *S. inaequidens* is mainly distributed in urban areas, primarily located along the railways (Lachmuth *et al*., 2010). However, some populations established in natural habitats such as grasslands (Ernst, 1998; Banfi & Galasso, 2010) or mountain pastures (Sposimo *et al*., 2015). In Italy it has been cultivated since the late nineteenth century in some Botanical Gardens such as that of Florence (Banfi & Galasso, 2010). It was found for the first time in 1947 in the area of Lessini Mounts, near Verona (Carrara Pantano & Tosco, 1959; EPPO, 2006) where, according to Carrara Pantano & Tosco (1959), the seeds arrived through the packaging from South Africa, destined to the American troops stationed in Veneto, in the final stages of the Second World War or in the immediate post-war period. Currently it is present throughout the national territory (Galasso *et al*., 2018) and it is considered invasive, as mentioned above, in almost all regions.

It is a perennial herbaceous species (Banfi & Galasso, 2010; Curtaz *et al*., 2011) with entomophilous pollination, relying mostly on generalist insects. Generally, each individual produces from 80 to 100 flower-heads (GISD, 2015) and up to 600 in some cases (Giunti *et al*., 2014) producing 30,000 seeds per year (Banfi & Galasso, 2010). It has a long lasting flowering period, from April until late January, with a protandrous strategy (Heger & Böhmer, 2006), as well as many members of Asteraceae (Simpson, 2010). Furthermore, recent studies suggest its self-incompatibility (Lafuma & Maurice, 2007; Lachmuth *et al*., 2017).

Senecio inaequidens has a wide ecological tolerance that allows it to grow rapidly and to colonize very different environments along a wide altitude range. Usually it grows in disturbed and anthropogenic environments such as fields, pastures, vineyards and ruderal places, but it is often found in natural areas too, such as abandoned fields, rocky slopes and riverbanks (never in dense and shady woods). The communication routes such as roads, railways, paths and road embankments are undoubtedly the most suitable habitats for the establishment and spreading of *S. inaequidens*, which exploits the turbulence phenomena and the air currents, due to passing transport, for the dispersion of seeds (Blanchet *et al*., 2015). Indeed, the main vector for its diffusion is wind, but also animals, especially those with fur. Finally, it can be spread accidentally through soil movements, building materials and agricultural machinery.

Senecio inaequidens dangerousness is linked to the presence in all parts of the plant of pyrrolizidine alkaloids (PAs), molecules that can cause poisoning by ingestion in animals and humans (Scherber *et al*., 2003; Giunti *et al*., 2014). Livestock feeding naturally on pastures and invaded habitats tend not to graze the fresh plant because of the bitter taste of alkaloids. However, this tendency is minimized when the plants dry out and the unpleasant taste is lost, thus increasing the risk of ingestion of contaminated hay. The risk for humans is not only direct, due to physical contact with the plant (for example in plants and flowers picking for domestic use) but also indirect, since the PAs are not metabolized by the animals and may contaminate any derived food product (e.g.,honey, milk, eggs and meat). Pyrrolizidine alkaloids molecules, therefore, identified in food and feed, have raised a strong concern in Europe for human health. Although, currently, the European Union has not approved and defined limit values for PAs in food, the European Food Safety Authority (EFSA) has confirmed that some of these are potential genotoxic carcinogens (EFSA, 2011) and numerous studies focused on the effect and risk on human and animal health (EFSA, 2007, 2017; Mulder *et al*. 2015). There is no doubt, therefore, that the knowledge of its distribution is important not only from the ecological point of view, but also for the human health one.

Investigation methods

Our investigation started with the acquisition of all literature concerning *S. inaequidens* reports in Tuscany (Soldano, 1980; Biagioli *et al*., 2002; Gestri, 2009; Pierini *et al*. 2009; Marchetti, 2010, 2011; Selvi, 2010; Peruzzi *et al*., 2014). The field work took into account the survey of sites where the species occurrence had been reported historically and thus sites potentially ecologically suitable for the plant. In particular, we visited railways considering their ecological importance as favourable environments for the species (Lachmuth *et al*., 2010). Accordingly, we carried out extensive surveys (between November 2018 and October 2019) visiting both the bibliographical sites and numerous new locations, primarily train stations and the roadside of the main road routes traveled. The total number of sites examined is 172. Using both GPSs and smartphones, we were able to create a georeferenced photographical documentation of *S. inaequidens* individuals' locations.

In addition to the presence/absence data of the species in surveyed sites, we also indicated a semi-quantitative estimation of population sizes, according to the following categories based on number of individuals:
- Small: 1-5 individuals
- Medium: 6-20 individuals
- Large: 21-50 individuals
- Very large: more than 50 individuals

This estimation, even if approximated, gives an idea of the size of the populations examined, and can consequently provide an insight of the potential ecological impacts exerted by the plants in these sites.
The geographic data processing and the drawing of the distribution maps have been performed in a GIS environment (QGIS version 2.18.15 'Las Palmas' and ArcGis).

Results and discussion

Among the 172 sites we surveyed, *S. inaequidens* was found in 72 locations, of which 60 resulted to be new occurrence reports. Detailed information concerning geographical and population data for each surveyed site, together with georeferenced coordinates and bibliographical or herbarium references, are reported in a comprehensive table in Appendix (Tab. 1). The results of our investigations are summarized in two maps. The first one (Fig. 1) shows the distribution at present date; it includes new reports and bibliographic or herbarium sites verified and confirmed by us; also the sites that correspond to historical reports of the plant but in which we could not find *S. inaequidens* anymore are showed. Moreover, the distribution map reports also an estimation of population sizes (small, medium, large, very large) within the sites (Fig. 1), highlighting where the highest numbers of individuals occur and how such largest populations are spatially correlated.
The second map (Fig. 2) shows all the results (positive or negative) for all the surveyed sites, in order to make the extent of the sampling effort more visible, and to display in a clearer way the collected data.
The plant was found mainly along railway lines, as it was expected. Only in a few cases, it was recorded outside railways areas: some localities in Garfagnana, upper Versilia, in the provinces of Carrara, Livorno and Siena, in Mugello Valley and in Mt. Morello near Florence (Tab. 1). Only in the latter site, an isolated individual of *S. inaequidens* was found in a quite natural environment, far from urban centres or roadsides. This site is located in wood's edge, along the path that leads to the locality Poggio al Giro. On the contrary, in most of the investigated sites the populations are in disturbed and anthropogenic environments, especially along railway lines, as already reported in the literature. Almost all the occurrence sites found, in fact, are closely connected to the transport network that connects an urban centre with the neighbouring one. In fact, many authors agree that the extensive development of transportation networks plays a major role in both exotic species introduction and their subsequent invasions (Trombulak & Frissell, 2000; Von der Lippe & Kowarik, 2008; Wilson *et al*., 2009). Some studies have also highlighted the role of vehicles in transferring organisms, seeds, eggs and other propagules in urban areas (Von der Lippe & Kowarik, 2008). Furthermore, Bangert & Huntly (2010) showed that railways may act more as a corridor for exotic species than as a direct source of disturbance for native species.
As far as our investigation is concerned, it can be noted that in some railway stations the absence of the plant was recorded despite its presence in the previous and following ones (i.e. railway line from Florence to Pisa). *Vice-versa* a presence of the plant was observed between two railway stations where it is absent (i.e. the railway line that goes from Empoli to Siena). In some cases, we hypothesized that this lack of continuity in the species occurrence, may be due to physical barriers built between two railway stations, such as tunnels or bridges. These structures may prevent or limit seed dispersal. In other cases, we hypothesized that the plant did not have enough time to spread yet. Moreover, we underline that when periodical railways maintenance and cleaning carried out to remove weeds by means of herbicide may play some role in limiting the spread of *S. inaequidens* too.
From Fig. 1, we can note that the railway lines most affected by *S. inaequidens* invasion are almost all the principal ones. In the surveyed area, interesting cases are: the line that goes from Florence SMN to Pisa Centrale, the line that connects Florence with Prato, the line that connects Pisa Centrale with Massa Centrale, the line that goes from Prato to Emilia-Romagna and the line that from Prato leads to Pistoia. It is quite evident from the maps (Figs 1-2) that a railway line with a high traffic density and a high number of trains is more easily invaded by *S. inaequidens.*
As to soil preferences, it is difficult to give an exhaustive answer in the context of the study area. In Tuscany, the plant mainly occupies railways embankments, consisting in limestone, granitic or basaltic stones, or is located along road edges and walls. Because of its biology, this species prefers ruderal environments with more or less incoherent and stony soils (as can be the railway ballast), but it is difficult to attribute this preference solely to the type of geological substrate (calcareous or not). It is more reasonable that its soil preference is connected to the degree of cementation of the rock and to the fact that these types of environments emerge precisely in a context that favours plant dispersal.

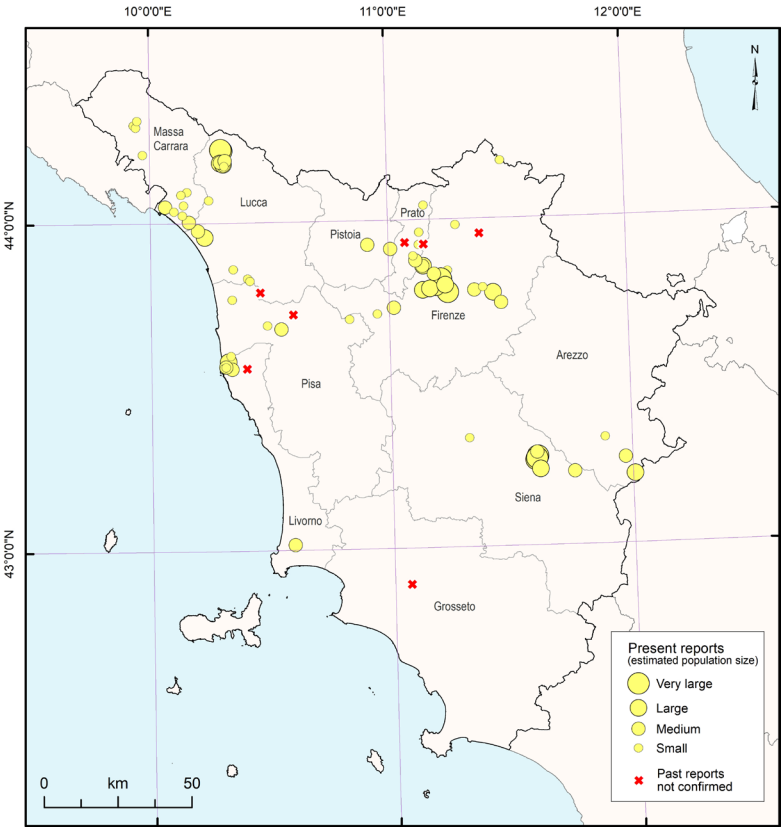

Figure 1. Map of current distribution and estimated population sizes of *Senecio inaequidens* in Tuscany. Estimated population sizes: small (1-5 individuals), medium (6-20 individuals), large (21-50 individuals), very large (more than 50 individuals).

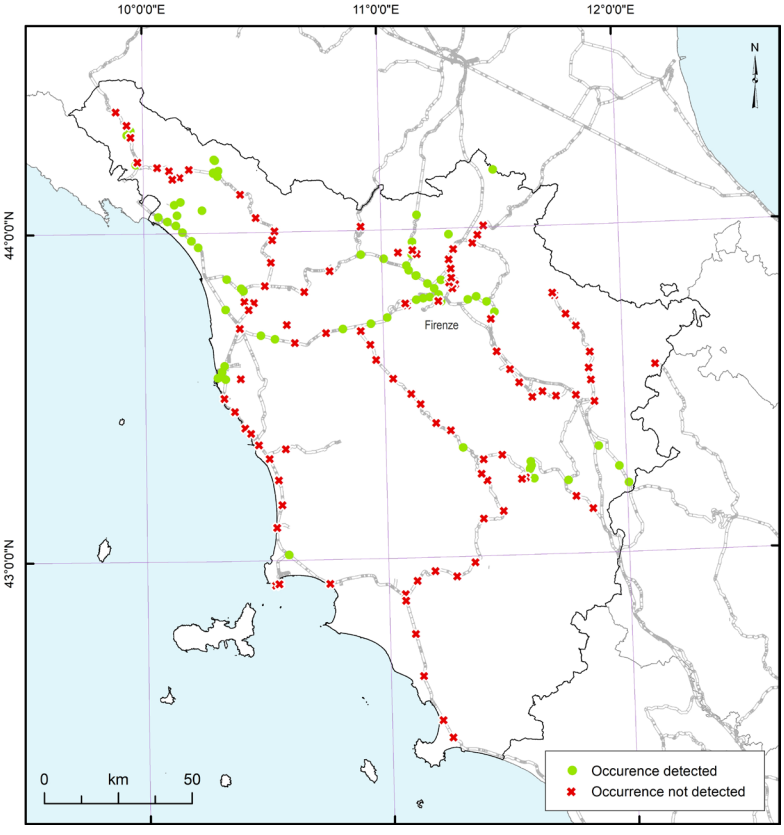

Figure 2. Map of all the investigated sites, showing occurrences and absences detected of *Senecio inaequidens* in Tuscany. The gray track corresponds to the railway network. The marks that are outside of it correspond to sites located along the roadside. For more detailed information, see Tab. 1.

The maximum altitude where we found *S. inaequidens* is 916 m a.s.l., in the village of Arni, in upper Versilia. As regards the bioclimatic preference of the species, even in this case, the breadth of its tolerance range does not allow us to indicate one in particular. Comparing its distribution with Tuscan bioclimates (GISD, 2015), it can be noted that the species grows both in Mediterranean and Temperate macrobioclimates.

Finally, it is important to highlight the cases of Sillano, in Garfagnana and of the hills between Rapolano Terme and Asciano, in the Siena province (Figs 1-2, Tab. 1). The roadside of the final section of the provincial road 14 leading to the town of Sillano, a few bends before the town entrance, is largely occupied by *S. inaequidens*. In the village we also found it widespread on stonewalls. On the contrary, in the Siena province it is present in great abundance along the provincial road 26, going towards Asciano. These two locations should have a priority in the perspective of a future containment plan, as both sites are largely invaded by *S. inaequidens*. Indeed, even if they are not part of the railway network, they are surrounded by cultivated and abandoned fields or open meadows, i.e. semi-natural environments threatened by a possible spread of the species.

Conclusions

The data we acquired so far for the Tuscany region have shown that this species, not so widespread in the past, has largely increased its diffusion in the Tuscan territory. Consequently, our distribution data have been used to change its alien status from naturalized to invasive also for Tuscany (Galasso *et al*., 2019). It is important, therefore, to implement a monitor plan, at least in some sites, in order not to let that the documented reality would turn into a possible threat to the diversity of spontaneous species. In the four most affected sites by the invasion of *S. inaequidens* (Sillano, near Rapolano Terme, Florence Castello and Florence SMN railway stations), in addition to periodic monitoring, it would probably be appropriate to intervene also with focused containment actions, if the plant starts spreading in more natural and semi-natural environments.

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References

Banfi E., Galasso G. (a cura di), 2010. *La flora esotica lombarda*. Museo di Storia Naturale di Milano, Milano.

Bangert R., Huntly N., 2010. The distribution of native and exotic plants in a naturally fragmented sagebrush-steppe landscape. *Biological Invasions* 12(6): 1627-1640.

Bellard C., Cassey P., Blackburn T.M., 2016. Alien species as a driver of recent extinctions. *Biology Letters* 12(2): 20150623.

Biagioli M., Gestri G., Acciai B., Messina A., 2002. *Fiori sulla pietra. Flora vascolare illustrata delle ofioliti e delle altre terre del Monteferrato in Toscana*. Ed. Gramma, Perugia.

Blackburn T.M., Essl F., Evans T., Hulme P.E., Jeschke J.M., Kühn I., Kumschick S., Marková Z., Mrugała A., Nentwig W., Pergl J., Pyšek P., Rabitsch W., Ricciardi A., Richardson D.M., Sendek A., Vilà M., Wilson J.R., Winter M., Genovesi P., Bacher S., Pergl J., 2014. A unified classification of alien species based on the magnitude of their environmental impacts. *PLoS biology* 12(5): e1001850.

Blanchet E., Penone C., Maurel N., Billot C., Rivallan R., Risterucci A., Maurice S., Justy F., Machon N., Noël F., 2015. Multivariate analysis of polyploid data reveals the role of railways in the spread of the invasive South African Ragwort (*Senecio inaequidens*). *Conservation Genetics* 16(3): 523-533.

Brennenstuhl G., 1995. *Senecio inaequidens* DC. bei Salzwedel-neu für Sachsen-Anhalt. *Floristische Rundbriefe* 29(2): 181-183.

Carrara Pantano A., Tosco U., 1959. Una nuova avventizia per la flora italiana: *Senecio reclinatus* L. f. di origine sud-africana, nella campagna veronese. *Memorie del Museo Civico di Storia Naturale di Verona* 7: 151-157.

Curtaz A., Talichet M., Barni E., Bassignana M., Masante D., Pauthenet Y., Siniscalco C., 2011. *Specie esotiche invasive e dannose nei prati di montagna. Caratteristiche, diffusione e metodi di lotta*. Institut Agricole Régional, Aosta.

DAISIE, 2009. *Handbook of Alien Species in Europe*. Springer. Dordrecht, The Netherlands.

EFSA (European Food Safety Authority), 2007. Opinion of the Scientific Panel on Contaminants in the Food Chain on a request from the European Commission related to Pyrrolizidine Alkaloids as undesirable substances in Animal Feeds. *EFSA Journal* 5(5): 447.

EFSA (European Food Safety Authority), 2011. Scientific Opinion on Pyrrolizinine alkaloids in food and feed. *EFSA Journal* 9(11): 2406.

EFSA (European Food Safety Authority), 2017. Risks for human health related to the presence of pyrrolizidine alkaloids in honey, tea, herbal infusions and food supplements. *EFSA journal* 15(7): e04098.

EPPO (European and Mediterranean Plant Protection Organization), 2006. EPPO data sheet on Invasive Plants. *Senecio inaequidens*. Web version 2006-02-01 - doc 05-11836. Available from: https://gd.eppo.int/taxon/SENIQ/documents [accessed March 1, 2019]

Ernst W.H.O., 1998. Invasion, dispersal and ecology of the South African neophyte *Senecio inaequidens* in the Netherlands: from wool alien to railway and road alien. *Acta Botanica Neerlandica* 47(1): 131-151.

Galasso G., Conti F., Peruzzi L., Ardenghi N.M.G., Banfi E., Celesti-Grapow L., Albano A., Alessandrini A., Bacchetta G., Ballelli S., Bandini Mazzanti M., Barberis G., Bernardo L., Blasi C., Bouvet D., Bovio M., Cecchi L., Del Guacchio E., Domina G., Fascetti S., Gallo L., Gubellini L., Guiggi A., Iamonico D., Iberite M., Jimenéz-Mejías P., Lattanzi E., Marchetti D., Martinetto E., Masin R.R., Medagli P., Passalacqua N.G., Peccenini S., Pennesi R., Pierini B., Podda L., Poldini L., Prosser F., Raimondo F.M., Roma-Marzio F., Rosati L., Santangelo A., Scoppola A., Scortegagna S., Selvaggi A., Selvi F., Soldano A., Stinca A., Wagensommer R.P., Wilhalm T., Bartolucci F., 2018. An updated checklist of the vascular flora alien to Italy. *Plant Biosystems* 152(3): 556-592.

Galasso G., Domina G., Andreatta S., Angiolini C., Ardenghi N.M.G., Aristarchi C., Arnoul M., Azzella M.M., Bacchetta G., Bartolucci F., Bodino S., Bommartini G., Bonari G., Buono S., Buono V., Caldarella O., Calvia G., Corti E., D'Antraccoli M., De Luca R., De Mattia F., Di Natale S., Di Turi A., Esposito A., Ferretti G., Fiaschi T., Fogu M.C., Forte L., Frigerio J., Gubellini L., Guzzetti L., Hofmann N., Laface V.L.A., Laghetti G., Lallai A., La Rosa A., Lazzaro L., Lodetti S., Lonati M., Luchino F., Magrini S., Mainetti A., Marignani M., Maruca G., Medagli P., Mei G., Menini F., Mezzasalma V., Misuri A., Mossini S., Mugnai M., Musarella C.M., Nota G., Olivieri N., Padula A., Pascale M., Pasquini F., Peruzzi L., Picella G., Pinzani L., Pirani S., Pittarello M., Podda L., Enri S.R., Rifici C.D., Roma-Marzio F., Romano R., Rosati L., Scafidi F., Scarici E., Scarici M., Spampinato G., Stinca A., Wagensommer R.P., Zanoni G., Nepi C., 2019. Notulae to the Italian alien vascular flora: 8. *Italian Botanist* 8: 63-93.

Gestri G., 2009. Flora vascolare dei Monti della Calvana (Prato, Toscana). *Informatore Botanico Italiano* 41(1): 77-123.

GISD (Global Invasive Species Database), 2015. Species profile: *Senecio inaequidens*. Available from: http://www.iucngisd.org/gisd/species.php?sc=1458 [accessed October 20, 2016]

Giunti M., Ferretti G., Lazzaro L., Foggi B., Lombardo L., Castelli G., 2014. *Azione per il contenimento di* Senecio inaequidens*. Pianta esotica in rapida espansione in ambienti di interesse conservazionistico ed economico. Relazione tecnica finale*. NEMO, Nature Environment Management Operators, Firenze.

Hansen M.J., Clevenger A.P., 2005. The influence of disturbance and habitat on the presence of non-native plant species along transport corridors. *Biological Conservation* 125(2): 249-256.

Heger T., Böhmer H.J., 2006. NOBANIS (European Network on Invasive Alien Species) – Invasive Alien Species Fact Sheet – *Senecio inaequidens*. Available from: www.nobanis.org [accessed March 1, 2019]

Hilliard O.M., 1977. *Compositae in Natal*. University of Natal Press, Pietermaritzburg.

Lachmuth S., Durka W., Schurr F.M., 2010. The making of a rapid plant invader: genetic diversity and differentiation in the native and invaded range of *Senecio inaequidens*. *Molecular Ecology* 19(18): 3952-3967.

Lachmuth S., Henrichmann C., Horn J., Pagel J., Schurr F.M., 2017. Neighbourhood effects on plant reproduction: An experimental-analytical framework and its application to the invasive *Senecio inaequidens*. *Journal of Ecology* 106(2): 761-773.

Lafuma L., Maurice S., 2007. Increase in mate availability without loss of self-incompatibility in the invasive species *Senecio inaequidens* (Asteraceae). *Oikos* 116(2): 201-208.

Lazzaro L., Bolpagni R., Buffa G., Gentili R., Lonati M., Stinca A., Acosta ATR., Adorni M., Aleffi M., Allegrezza M., Angiolini C., Assini S., Bagella S., Bonari G., Bovio M., Bracco F., Brundu G., Caccianiga M., Carnevali L., Di Cecco V., Ceschin S., Ciaschetti G., Cogoni A., Foggi B., Frattaroli A.R., Genovesi P., Gigante D., Lucchese F., Mainetti A., Mariotti M., Minissale P., Paura B., Pellizzari M., Perrino EV., Pirone G., Poggio L., Poldini L., Poponessi S., Prisco I., Prosser F., Puglisi M., Rosati L., Selvaggi A., Sottovia L., Spampinato G., Stanisci A., Venanzoni R., Viciani D., Vidali M., Villani M., Lastrucci L., 2020. Impact of invasive alien plants on native plant communities and Natura 2000 habitats: State of the art, gap analysis and perspectives in Italy. *Journal of Environmental Management* 274: 111140 (13 pp.). DOI: 10.1016/j.jenvman.2020.111140

Marchetti D., 2010. Note floristiche Tosco-Liguri-Emiliane VII. Dati su alcune fanerogame interessanti raccolte nell'Appennino Lucchese (Toscana). *Annali del Museo Civico di Rovereto, sezione Archeologia, Storia e Scienze naturali* 25 (2009): 127-139.

Marchetti D., 2011. Note floristiche Tosco-Liguri-Emiliane. VIII. Fanerogame nuove o rare per la regione apuana (Liguria-Toscana) e note critiche. *Annali del Museo Civico di Rovereto, sezione Archeologia, Storia e Scienze naturali* 26 (2010): 191-268.

Marchetti D., 2020. Note floristiche tosco-liguri-emiliane. XIII. Fanerogame osservate o raccolte in Lunigiana (MS, Toscana). Parte seconda. *Annali del Museo Civico di Rovereto, sezione Architettura, Storia e Scienze Naturali* 35 (2019): 63-106.

Meusel H., Jäger E. (Hrsg.), 1992. *Vergleichende Chorologie der zentraleuropäischen Flora*, vol. 3. Gustav Fischer Verlag, Jena.

Mulder P.P., Sánchez P.L., These A., Preiss-Weigert A., Castellari M., 2015. Occurrence of pyrrolizidine alkaloids in food. *EFSA Supporting Publications* 12(8): 859E.

Parmesan C., Yohe G., 2003. A globally coherent fingerprint of climate change impacts across natural systems. *Nature* 421(6918): 37.

Peruzzi L., Viciani D., Angiolini C., Astuti G., Banfi E., Brandani S., Bonari G., Cambria S., Cannucci S., Castagnini P., D'antraccoli M., De Giorgi P., Di Natale S., Ferretti G., Fiaschi T., Gonnelli V., Gottschlich G., Lastrucci L., Lazzaro L., Misuri A., Mugnai M., Pierini B., Pinzani L., Roma-Marzio F., Sani A., Selvi F., Spinelli A., Bedini G., 2019. Contributi per una flora vascolare di Toscana. XI (664-738). *Atti della Società Toscana di Scienze Naturali, Memorie, Serie B* 126: 35-46.

Peruzzi L., Viciani D., Bedini G. (a cura di), 2014. Contributi per una flora vascolare di Toscana. V (247-319). *Atti della Società Toscana di Scienze Naturali, Memorie, Serie B* 120: 35-44.

Peruzzi L., Viciani D., Bedini G. (a cura di), 2015. Contributi per una flora vascolare di Toscana. VI (320-356). *Atti della Società Toscana di Scienze Naturali, Memorie, Serie B* 121: 29-35.

Pierini B., Garbari F., Peruzzi L., 2009. Flora vascolare del Monte Pisano (Toscana nord-occidentale). *Informatore Botanico Italiano* 41(2): 147-213.

Pierini B., Peruzzi L., 2014. Prodromo della flora vascolare della Provincia di Lucca (Toscana nord-occidentale). *Informatore Botanico Italiano* 46(1): 1-499.

PYŠEK P., JAROŠÍK V., HULME P.E., PERGL J., HEJDA M., SCHAFFNER U., VILÀ M., 2012. A global assessment of invasive plant impacts on resident species, communities and ecosystems: the interaction of impact measures, invading species' traits and environment. *Global Change Biology* 18(5): 1725-1737.

RICHARDSON D.M., PYŠEK P., 2006. Plant invasions: merging the concepts of species invasiveness and community invasibility. *Progress in physical geography* 30(3): 409-431.

SCALERA R., 2010. How much is Europe spending on invasive alien species? *Biological Invasions* 12(1): 173-177.

SCHERBER C., CRAWLEY M.J., POREMBSKI S., 2003. The effects of herbivory and competition on the invasive alien plant *Senecio inaequidens* (Asteraceae). *Diversity and Distributions* 9(6): 415-426.

SEEBENS H., BLACKBURN T.M., DYER E.E., GENOVESI P., HULME P.E., JESCHKE J.M., PAGAD, S., PYSEK P., WINTER M., ARIANOUTSOU M., BACHER S., BLASIUS B., BRUNDU G., CAPINHA C., CELESTI-GRAPOW L., DAWSON W., DULLINGER S., FUENTES N., JAEGER H., KARTESZ J., KENIS M., KREFT H., KUEHN I., LENZNER B., LIEBHOLD A., MOSENA A., MOSER D., NISHINO M, PEARMAN D., PERGL J., RABITSCH W., ROJAS-SANDOVAL J., ROQUES A., RORKE S., ROSSINELLI S., ROY H.E., SCALERA R., SCHINDLER S., STAJEROVA K., TOKARSKA-GUZIK B., VAN KLEUNEN M., WALKER K., WEIGELT P., YAMANAKA T., ESSL F., BACHER S., 2017. No saturation in the accumulation of alien species worldwide. *Nature communications* 8: 14435.

SELVI F., 2010. A critical checklist of the vascular flora of Tuscan Maremma (Grosseto province, Italy). *Flora Mediterranea* 20: 47-139.

SIMPSON M.G., 2010. *Plant systematics.* II ed. Elsevier Academic press, London.

SOLDANO A., 1980. Segnalazione di nuove specie esotiche nella flora della provincia di Massa-Carrara. Dinamicità del contingente floristico di importazione della zona. *Annuario 1978-79, Biblioteca Civica di Massa*: 223-235.

SPOSIMO P., TINTI D., FERRETTI G., LAZZARO L., FOGGI B., GIUNTI M., 2015. *Senecio inaequidens: una nuova criticità per la conservazione delle praterie.* Pp. 42-46. Conference Paper: Management and Conservation of Dry Grasslands in Natura 2000 Sites. The LIFE+ RI.CO.PR.I. project and comparison with other similar LIFE+ experiences, Rome, March 26th-27th, 2015.

SUNDSETH K., 2014. *Invasive alien species: a European response.* European Commission DG Environment Units B, 2. Luxembourg: Publications Office of the European Union.

THIERS B., 2019. *Index Herbariorum: A global directory of public herbaria and associated staff.* New York: Botanical Garden's Virtual Herbarium. Available from: http://sweetgum.nybg.org/science/ih/ [accessed December 15, 2019]

TROMBULAK S.C., FRISSELL C.A., 2000. Review of ecological effects of roads on terrestrial and aquatic communities. *Conservation biology* 14(1): 18-30.

VICIANI D., VIDALI M., GIGANTE D., BOLPAGNI R., VILLANI M., ACOSTA A.T.R., ADORNI M., ALEFFI M., ALLEGREZZA M., ANGIOLINI C., ASSINI S., BAGELLA S., BONARI G., BOVIO M., BRACCO F., BRUNDU G., BUFFA G., CACCIANIGA M., CARNEVALI L., CESCHIN S., CIASCHETTI G., COGONI A., DI CECCO V., FOGGI B., FRATTAROLI A.R., GENOVESI P., GENTILI R., LAZZARO L., LONATI M., LUCCHESE F., MAINETTI A., MARIOTTI M., MINISSALE P., PAURA B., PELLIZZARI M., PERRINO E.V., PIRONE G., POGGIO L., POLDINI L., POPONESSI S., PRISCO I., PROSSER F., PUGLISI M., ROSATI L., SELVAGGI A., SOTTOVIA L., SPAMPINATO G., STANISCI A., STINCA A., VENANZONI R., LASTRUCCI L., 2020. A first checklist of the alien-dominated vegetation in Italy. *Plant Sociology* 57(1): 29-54.

VILÀ M., ESPINAR J.L., HEJDA M., HULME P.E., JAROŠÍK V., MARON J.L., PERGL J., SCHAFFNER U., SUN Y., PYŠEK P., 2011. Ecological impacts of invasive alien plants: a meta-analysis of their effects on species, communities and ecosystems. *Ecology letters* 14(7): 702-708.

VILÀ M., ROHR R.P., ESPINAR J.L., HULME P.E., PERGL J., LE ROUX J.J., SCHAFFNER U., PYŠEK P., 2015. Explaining the variation in impacts of non-native plants on local-scale species richness: the role of phylogenetic relatedness. *Global Ecology and Biogeography* 24(2): 139-146.

VITOUSEK P.M., D'ANTONIO C.M., LOOPE L.L., REJMANEK M., WESTBROOKS R., 1997. Introduced species: a significant component of human-caused global change. *New Zealand Journal of Ecology* 21(1): 1-16.

VON DER LIPPE M., KOWARIK I., 2008. Do cities export biodiversity? Traffic as dispersal vector across urban-rural gradients. *Diversity and Distributions* 14(1): 18-25.

WEBER E., 2003. *Invasive plant species of the world: a reference guide to environmental weeds.* CAB International Publ., Wallingford.

WERNER D.J., ROCKENBACH T., HÖLSCHER M.L., 1991. Herkunft, Ausbreitung, Vergesellschaftung und Ökologie von *Senecio inaequidens* DC. unter besonderer Berücksichtigung des Köln-Aachener Raumes. *Tuexenia* 11: 73-107.

WILSON J.R.U., DORMONT E.E., PRENTIS P.J., LOWE A.J., RICHARDSON D.M., 2009. Something in the way you move: dispersal pathways affect invasion success. *Trends in ecology & evolution* 24(3): 136-144.

(ms. pres. 24 gennaio 2020; ult. bozze 15 dicembre 2020)

Appendix

Table 1. Detailed geographical, reference and population data for each surveyed site. Herbarium acronyms are in accordance with Thiers (2019), plus the unofficial HBioFI for the Herbarium of the Department of Biology, University of Florence, a herbarium not yet indexed by "Index Herbariorum" (Thiers, 2019), and some personal herbaria, indicated with the name of the owner. Estimated population sizes: small (1-5 individuals), medium (6-20 individuals), large (21-50 individuals), very large (more than 50 individuals).

Province - Municipality	**Site name (FS= Railway Station)**	**Occurrence check: 1 = detected; 0 = not detected**	**Herbarium specimen data (Herbarium acronym, Collectors, Date)**
AR - AREZZO	Arezzo FS	0	
AR - AREZZO	Giovi FS	0	
AR - AREZZO	Indicatore FS	0	
AR - BIBBIENA	Bibbiena FS	0	
AR - BUCINE	Bucine FS	0	
AR - CAPOLONA	Capolona FS	0	
AR - CASTIGLION FIORENTINO	Castiglion Fiorentino, Ex Zuccherificio	1	HDipBio (*Lastrucci, Mereu* 8/9/2010)
AR - CORTONA	Camucia-Cortona FS	1	
AR - CORTONA	Terontola-Cortona FS	1	FI (*Ferretti, Mugnai, Di Natale* 9/10/2018)
AR - LATERINA	Ponticino FS	0	
AR - MONTEVARCHI	Montevarchi FS	0	
AR - PERGINE VALDARNO	Laterina FS	0	
AR - POPPI	Poppi FS	0	
AR - PRATOVECCHIO	Pratovecchio FS	0	
AR - SAN GIOVANNI VALDARNO	San Giovanni Valdarno FS	0	
AR - SANSEPOLCRO	Sansepolcro FS	0	
AR - STIA	Stia FS	0	
AR - SUBBIANO	Calbenzano FS	0	
FI - BARBERINO DI MUGELLO	Bilancino, SR65 della Futa	1	
FI - BARBERINO VAL D'ELSA	Barberino Val d'Elsa FS	0	
FI - BORGO SAN LORENZO	Borgo San Lorenzo FS	0	FIAF (*Signorini* 10/10/1994)
FI - BORGO SAN LORENZO	Panicaglia FS	0	
FI - BORGO SAN LORENZO	Ronta FS	0	
FI - CALENZANO	Il Rosi, via di Fibbiana	1	
FI - CALENZANO	Il Rosi, via Pratese	1	
FI - CAMPI BISENZIO	S. Donnino Badia FS	1	
FI - CASTELFIORENTINO	Castelfiorentino FS	0	
FI - CERTALDO	Certaldo FS	0	
FI - EMPOLI	Empoli FS	1	
FI - EMPOLI	Granaiolo FS	0	
FI - EMPOLI	Ponte a Elsa FS	0	
FI - FIESOLE	Compiobbi FS	1	
FI - FIESOLE	Fiesole-Caldine FS	0	
FI - FIESOLE	Pian del Mugnone FS	0	
FI - FIGLINE VALDARNO	Figline FS	0	
FI - FIRENZE	Firenze Cascine FS	1	
FI - FIRENZE	Firenze Castello FS	1	HDipBio (*Ferretti* 4/8/2012)
FI - FIRENZE	Firenze Le Piagge FS	1	
FI - FIRENZE	Firenze Rifredi FS	1	
FI - FIRENZE	Firenze SMN	1	

Bibliographical references	Checking date	Coordinates WGS84		Estimated population sizes
		Lat N	Long E	
	07/12/2018	43.461339	11.875571	
	09/11/2018	43.526967	11.864398	
	07/12/2018	43.482342	11.799486	
	07/12/2018	43.693390	11.809737	
	07/12/2018	43.480378	11.617628	
	07/12/2018	43.563731	11.856908	
	08/09/2010	43.324350	11.888063	small
	17/01/2019	43.261632	11.971164	medium
Peruzzi *et al*., 2019	09/10/2018	43.210556	12.007778	large
	07/12/2018	43.481604	11.716471	
	07/12/2018	43.525400	11.564266	
	07/12/2018	43.496415	11.660584	
	07/12/2018	43.730351	11.767817	
	07/12/2018	43.787810	11.722951	
	07/12/2018	43.566408	11.527602	
	26/10/2018	43.569910	12.134742	
	07/12/2018	43.795432	11.714445	
	07/12/2018	43.612365	11.863935	
	16/10/2018	43.982345	11.285067	small
	17/01/2019	43.499343	11.111233	
	16/10/2018	43.954379	11.384748	
	08/11/2018	43.978611	11.407368	
	08/11/2018	44.006412	11.433042	
	11/12/2018	43.859398	11.145510	large
	11/12/2018	43.858629	11.143000	medium
	08/12/2018	43.785538	11.142546	large
	17/01/2019	43.605423	10.968057	
	17/01/2019	43.547124	11.037723	
	20/12/2018	43.715926	10.949246	small
	17/01/2019	43.652247	10.945232	
	20/12/2018	43.694388	10.906015	
	07/12/2018	43.782523	11.358706	medium
	08/11/2018	43.830444	11.307616	
	08/11/2018	43.818124	11.295449	
	07/12/2018	43.621848	11.473505	
	17/11/2018	43.792317	11.199775	large
	13/10/2019	43.818660	11.219220	very large
	17/11/2018	43.789679	11.172216	large
	03/12/2018	43.799361	11.236939	large
	03/12/2018	43.777752	11.246810	very large

Province - Municipality	Site name (FS= Railway Station)	Occurrence check: 1 = detected; 0 = not detected	Herbarium specimen data (Herbarium acronym, Collectors, Date)
FI - FIRENZE	Firenze Leopolda FS	0	
FI - FIRENZUOLA	Castiglioncello di Firenzuola	1	PI (*Roma-Marzio et al*. 17/05/2019)
FI - LASTRA A SIGNA	Lastra a Signa FS	0	
FI - MONTELUPO FIORENTINO	Montelupo-Capraia FS	1	
FI - PELAGO	Sant' Ellero FS	1	
FI - PONTASSIEVE	Pontassieve FS	1	
FI - PONTASSIEVE	Sieci FS	1	
FI - RIGNANO SULL'ARNO	Rignano FS	0	
FI - SAN PIERO A SIEVE	Campomigliaio FS	0	
FI - SESTO FIORENTINO	M. Morello	1	HDipBio (*Signorini* 21/1/2018)
FI - SESTO FIORENTINO	Sesto F.no FS	1	
FI - SESTO FIORENTINO	Montorsoli FS	0	
FI - SIGNA	Signa FS	0	
FI - VAGLIA	Ex sanatorio Banti	0	
FI - VAGLIA	Fontebuona FS	0	
FI - VAGLIA	Vaglia FS	0	
GR - CIVITELLA PAGANICO	Civitella Paganico FS	0	
GR - CIVITELLA PAGANICO	Monte Antico FS	0	
GR - FOLLONICA	Follonica FS	0	
GR - GROSSETO	Braccagni-Giuncarico, Madonnino	0	Herb SELVI (*Selvi* 28/10/1999)
GR - GROSSETO	Alberese Scalo FS	0	
GR - GROSSETO	Grosseto FS	0	
GR - GROSSETO	Montepescali FS	0	
GR - ORBETELLO	Albinia FS	0	
GR - ORBETELLO	Orbetello Scalo FS	0	
GR - ROCCASTRADA	Roccastrada FS	0	
GR - ROCCASTRADA	Sticciano FS	0	
LI - BIBBONA	Bolgheri FS	0	
LI - CAMPIGLIA MARITTIMA	Campiglia Marittima FS	1	FI (*Ferretti, Mugnai, Misuri* 15/01/2019)
LI - CASTAGNETO CARDUCCI	Castagneto Carducci FS	0	
LI - CECINA	Cecina FS	0	
LI - LIVORNO	Livorno Centrale FS	1	
LI - LIVORNO	Livorno, Porto industriale	1	
LI - LIVORNO	Livorno, via Andrea de Pazzi	1	
LI - LIVORNO	Livorno, via Guido Donegani	1	
LI - LIVORNO	Livorno, via Leonardo da Vinci	1	
LI - LIVORNO	Livorno, Poggio Corbolone	0	
LI - LIVORNO	Antignano FS	0	
LI - LIVORNO	Quercianella-Sonnino FS	0	
LI - PIOMBINO	Piombino FS	0	
LI - PIOMBINO	Piombino Marittima FS	0	
LI - ROSIGNANO MARITTIMO	Castiglioncello FS	0	
LI - ROSIGNANO MARITTIMO	Rosignano FS	0	
LI - ROSIGNANO MARITTIMO	Vada FS	0	
LI - SAN VINCENZO	San Vincenzo FS	0	

Bibliographical references	Checking date	Coordinates WGS84		Estimated population sizes
		Lat N	Long E	
	17/11/2018	43.780373	11.234532	
SBI Gruppo Flor. Sist. Evoluz. 2019, pers. com.	17/05/2019	44,175010	11,480480	small
	08/12/2018	43,769504	11,102530	
	20/12/2018	43,733189	11,018889	medium
	07/12/2018	43,742111	11,469628	medium
	07/12/2018	43,774052	11,437505	large
	07/12/2018	43,790889	11,394617	small
	07/12/2018	43,721264	11,453187	
	08/11/2018	43,937076	11,303296	
	04/07/2019	43,843994	11,247942	small
	09/10/2018	43,833878	11,191130	medium
	08/11/2018	43,835835	11,283074	
	08/12/2018	43,775510	11,095815	
	08/11/2018	43,850541	11,291895	
	08/11/2018	43,877903	11,290467	
	08/11/2018	43,906390	11,283230	
	23/11/2019	42,940150	11,283160	
	23/11/2019	42,981210	11,359890	
	15/01/2019	42,926597	10,755769	
Selvi, 2010	15/10/2019	42,890086	11,067960	
	17/11/2018	42,639994	11,134403	
	17/11/2018	42,768134	11,105865	
	23/11/2019	42,869520	11,069060	
	17/11/2018	42,503927	11,210841	
	17/11/2018	42,450548	11,249163	
	23/11/2019	42,957610	11,192940	
	23/11/2019	42,929340	11,118590	
	15/01/2019	43,244663	10,550544	
Peruzzi *et a*l., 2019	15/01/2019	43,016558	10,587671	medium
	15/01/2019	43,168744	10,563772	
	15/01/2019	43,310311	10,514157	
	15/01/2019	43,554166	10,336419	medium
Lazzeri 2019, pers. com.	08/01/2019	43,558125	10,303139	small
Lazzeri 2019, pers. com.	28/09/2019	43,560810	10,310660	small
	15/01/2019	43,561424	10,310933	medium
Lazzeri 2011, pers. com.	15/01/2019	43,577239	10,321661	large
Lazzeri 2011, pers. com.	15/01/2019	43,555010	10,399482	
	04/01/2019	43,495450	10,329190	
	04/01/2019	43,454943	10,372598	
	15/01/2019	42,924850	10,530958	
	15/01/2019	42,928512	10,545185	
	04/01/2019	43,404594	10,414354	
	04/01/2019	43,387903	10,438042	
	04/01/2019	43,352667	10,470181	
	15/01/2019	43,100363	10,539839	

Province - Municipality	Site name (FS= Railway Station)	Occurrence check: 1 = detected; 0 = not detected	Herbarium specimen data (Herbarium acronym, Collectors, Date)
LU - ALTOPASCIO	Altopascio FS	0	
LU - BAGNI DI LUCCA	Bagni Di Lucca FS	0	
LU - BARGA	Fornaci Di Barga FS	0	
LU - BORGO A MOZZANO	Borgo a Mozzano FS	0	
LU - CAMPORGIANO	Petrognano SR445 (ponte)	1	
LU - CASTELNUOVO DI GARFAGNANA	Castelnuovo Di Garfagnana FS	0	
LU - LUCCA	Nozzano FS	1	
LU - LUCCA	M. Cotrozzi (ex cave)	0	PI (*Peruzzi, Dolci* 9/4/2014)
LU - LUCCA	Lucca FS	0	
LU - LUCCA	Ponte a Moriano FS	0	
LU - MASSAROSA	Massarosa Bozzano FS	1	
LU - MINUCCIANO	Minucciano.Pieve.Casola FS	0	
LU - PIAZZA AL SERCHIO	Petrognano SR445	1	
LU - PIAZZA AL SERCHIO	Piazza Al Serchio FS	1	
LU - PIAZZA AL SERCHIO	Piazza al Serchio, via Roma	1	
LU - PIAZZA AL SERCHIO	San Donnino	1	HDipBio (*Marchetti* 15/9/2015)
LU - PIAZZA AL SERCHIO	SRT 445 radd	1	
LU - PIETRASANTA	Pietrasanta FS	1	
LU - SAN ROMANO IN GARFAGNANA	Orzaglia	1	
LU - SERAVEZZA	Seravezza-Querceta FS	1	
LU - SILLANO	Sillano SP 14	1	
LU - SILLANO	Sillano, centro	1	
LU - STAZZEMA	Arni	1	HDipBio (*Ferretti, Misuri, Romano* 18/10/2019)
MS - AULLA	Aulla, centro	1	
MS - AULLA	Aulla Lunigiana FS	0	
MS - CARRARA	Carrara-Avenza FS	1	
MS - CARRARA	Colonnata, via dei Canaloni, cave Pizzagallo	1	
MS - CARRARA	Pontidi Vara, via Miseglia Fantiscritti	1	
MS - FILATTIERA	Filattiera FS	0	
MS - FIVIZZANO	Equi Terme FS	0	
MS - FIVIZZANO	Fivizzano-Rometta-Soliera FS	0	
MS - FIVIZZANO	Gragnola FS	0	
MS - FIVIZZANO	Monzone FS	0	
MS - MASSA	Bergiola Maggiore	1	Aulla (*Marchetti*, 7/10/1981)
MS - MASSA	Codupino	1	Aulla (*Marchetti*, 19/5/1981)
MS - MASSA	Massa Centro FS	1	
MS - MONTIGNOSO	Montignoso FS	1	FI (*Ferretti, Lazzaro, Mugnai,* 23/10/2018)
MS - MULAZZO	Groppoli di Mulazzo	1	
MS - PONTREMOLI	Pontremoli FS	0	
MS - VILLAFRANCA IN LUNIGIANA	Pontemagra, lungo il fiume Magra	1	Aulla (*Marchetti*, 26/10/1983)
MS - VILLAFRANCA IN LUNIGIANA	Pradaccio	1	
MS - VILLAFRANCA IN LUNIGIANA	Villafranca-Bagnone FS	0	
PI - BUTI	M. Pisano-Vicopisano	0	

Bibliographical references	Checking date	Coordinates WGS84		Estimated population sizes
		Lat N	Long E	
	23/10/2018	43,817354	10,672522	
	19/12/2018	44,003450	10,551640	
	19/12/2018	44,045392	10,473307	
	19/12/2018	43,977215	10,541304	
	19/12/2018	44,172961	10,314059	small
	19/12/2018	44,116494	10,409243	
	20/12/2018	43,829952	10,407170	small
Peruzzi *et al.*, 2015	29/01/2019	43,786331	10,459506	
	23/10/2018	43,837119	10,506708	
	19/12/2018	43,908368	10,534276	
	20/12/2018	43,858718	10,346619	small
	19/12/2018	44,194236	10,193853	
	19/12/2018	44,176400	10,312632	medium
	19/12/2018	44,182692	10,296696	large
	22/10/2018	44,185000	10,297364	medium
Pierini & Peruzzi, 2014	19/12/2018	44,180560	10,309556	large
	19/12/2018	44,178098	10,310230	large
	23/10/2018	43,956593	10,228814	large
Giunti 2019, pers. com.	06/10/2019	44,189940	10,317620	medium
	23/10/2018	43,976984	10,200478	medium
	19/12/2018	44,220470	10,303881	very large
Marchetti, 2010	19/12/2018	44,223676	10,300287	very large
Marchetti, 2011	18/10/2019	44,069689	10,247257	small
Marchetti, 2020	18/10/2019	44,210170	9,970266	small
	19/12/2018	44,218790	9,976881	
	19/12/2018	44,051176	10,062854	medium
Sani A. 2017, pers. com.	30/05/2017	44,095797	10,156197	small
Sani A. 2017, pers. com.	30/05/2017	44,087564	10,130100	small
	19/12/2018	44,331363	9,933370	
	19/12/2018	44,170308	10,153640	
	19/12/2018	44,201664	10,059430	
	19/12/2018	44,191068	10,109247	
	19/12/2018	44,165638	10,123815	
	07/10/1981	44,055720	10,140990	small
	19/05/1981	44,036940	10,100330	small
	23/10/2018	44,024486	10,135468	small
Peruzzi *et al.*, 2019	23/10/2018	44,003979	10,163198	medium
Marchetti, 2020	18/10/2019	44,300745	9,932941	small
	19/12/2018	44,371995	9,887394	
Marchetti, 2020	18/10/2019	44,293254	9,942824	small
Marchetti, 2020	18/10/2019	44,313888	9,948430	small
	19/12/2018	44,294409	9,948327	
Pierini *et al.*, 2009	19/01/2019	43,717897	10,596401	

Province - Municipality	Site name (FS= Railway Station)	Occurrence check: 1 = detected; 0 = not detected	Herbarium specimen data (Herbarium acronym, Collectors, Date)
PI - CASCINA	Cascina FS	1	
PI - CASCINA	Navacchio FS	1	
PI - MONTOPOLI IN VAL D'ARNO	S.Romano-S.Croce FS	0	
PI - PISA	Canale scolmatore, Bosco dell'Ulivo	1	
PI - PISA	Pisa Centrale FS	0	
PI - PONTEDERA	Pontedera FS	0	
PI - RIPARBELLA	Riparbella FS	0	
PI - SAN GIULIANO TERME	Ripafratta FS	1	
PI - SAN GIULIANO TERME	Rigoli FS	0	
PI - SAN GIULIANO TERME	S. Giuliano Terme FS	0	
PI - SAN MINIATO	San Miniato-Fucecchio FS	1	
PI - VECCHIANO	Migliarino, via Aurelia	1	
PO - MONTEMURLO	Monteferrato	0	
PO - PRATO	Ponte Datini	1	
PO - PRATO	Prato Centrale FS	1	
PO - VAIANO	Vaiano FS	1	
PO - VAIANO	Vaiano, La Foresta	1	
PO - VAIANO	M. Calvana	0	CSN (*Gestri* 12/11/2012)
PO - VAIANO	La Briglia	0	
PO - VERNIO	Vernio FS	1	
PT - MONTALE	Montale FS	1	
PT - MONTECATINI TERME	Montecatini T.me FS	0	
PT - PISTOIA	Pistoia FS	1	FI (*Ferretti* 6/8/2012)
PT - PISTOIA	Castagno FS	0	
SI - ASCIANO	Arbia FS	0	
SI - ASCIANO	Asciano FS	0	
SI - ASCIANO	Asciano M. Oliveto M. FS	0	
SI - ASCIANO	Castelnuovo Berardenga FS	0	
SI - BUONCONVENTO	Buonconvento FS	0	
SI - MONTEPULCIANO	Montepulciano FS	0	
SI - MONTERIGGIONI	Badesse FS	0	
SI - MONTERIGGIONI	Castellina In Chianti FS	0	
SI - MONTERONI D'ARBIA	Monteroni d'Arbia FS	0	
SI - MONTERONI D'ARBIA	Ponte a Tressa FS	0	
SI - MURLO	Murlo FS	0	
SI - POGGIBONSI	Poggibonsi FS	0	
SI - RAPOLANO TERME	Rapolano Terme FS	1	
SI - RAPOLANO TERME	SP 26	1	
SI - RAPOLANO TERME	SP 26	1	
SI - RAPOLANO TERME	SP 26	1	
SI - RAPOLANO TERME	SP 438	1	
SI - SIENA	Siena FS	1	
SI - SINALUNGA	Sinalunga, SP 13	1	FI, HDipBio (*Ferretti, Mugnai, Di Natale* 9/10/2018)
SI - TORRITA DI SIENA	Torrita Di Siena FS	0	

Bibliographical references	Checking date	Coordinates WGS84		Estimated population sizes
		Lat N	Long E	
	20/12/2018	43,674538	10,545240	medium
	20/12/2018	43,685988	10,486790	small
	20/12/2018	43,690516	10,760219	
Lazzeri 2018, pers. com.	15/01/2019	43,594646	10,332229	small
	20/12/2018	43,708426	10,398482	
	20/12/2018	43,662106	10,628725	
	15/01/2019	43,339463	10,582193	
	23/10/2018	43,822575	10,416076	small
	20/12/2018	43,789684	10,419673	
	20/12/2018	43,764879	10,436848	
	20/12/2018	43,701309	10,831725	small
	22/06/2018	43,766003	10,340305	small
Biagioli *et al.*, 2002	11/12/2018	43,930648	11,070076	
	11/12/2018	43,890101	11,104643	small
	13/10/2019	43,875639	11,113661	medium
	16/10/2018	43,961557	11,130990	small
	11/12/2018	43,924017	11,128236	small
Gestri, 2009	11/12/2018	43,924986	11,148959	
	16/10/2018	43,936895	11,131711	
	16/10/2018	44,043640	11,152383	small
	03/12/2018	43,912436	11,009389	medium
	23/10/2018	43,879231	10,780782	
Peruzzi *et al.*, 2014	13/10/2019	43,926642	10,913579	medium
	30/09/2018	44,012341	10,915429	
	17/01/2019	43,294363	11,406229	
	17/01/2019	43,235325	11,579148	
	17/01/2019	43,231731	11,563485	
	17/01/2019	43,306847	11,484912	
	23/11/2019	43,135370	11,483560	
	17/01/2019	43,135376	11,856307	
	17/01/2019	43,385605	11,272982	
	17/01/2019	43,408718	11,212233	
	23/11/2019	43,230060	11,419580	
	23/11/2019	43,250850	11,396230	
	23/11/2019	43,113950	11,400400	
	17/01/2019	43,468091	11,149415	
	17/01/2019	43,283293	11,602507	medium
	17/01/2019	43,260716	11,598177	very large
	17/01/2019	43,271153	11,604958	very large
	17/01/2019	43,265143	11,601798	very large
	17/01/2019	43,231878	11,614871	large
	17/01/2019	43,331800	11,322643	small
Peruzzi *et al.*, 2019	09/10/2018	43,222809	11,757544	medium
	17/01/2019	43,174138	11,787584	

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