

Annual weedy species of *Erigeron* in the northern Iberian Peninsula: a reviewDiego Liendo<sup>1</sup> , Itziar García-Mijangos<sup>1</sup> , Idoia Biurrún<sup>1</sup>  & Juan Antonio Campos<sup>1</sup> 

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**Abstract.** A revision of the alien *Erigeron* species formerly included in *Conyza* found in the northern Iberian Peninsula is presented. A close examination of numerous specimens collected by the authors as well as voucher specimens preserved at several herbaria has helped to clarify several aspects regarding this group. Four species have been recognised in the study area: *Erigeron canadensis* (= *Conyza canadensis*), *E. bonariensis* (= *C. bonariensis*), *E. sumatrensis* (= *C. sumatrensis*) and *E. floribundus* (= *C. floribunda*, including *C. bilbaoana*). They occupy anthropogenic habitats, such as road edges, abandoned fields, crops and waste ground, as well as natural and semi-natural communities, such as nitrophilous river bar communities and ruderal communities on coastal dunes subjected to substantial levels of anthropogenic disturbance. *Erigeron sumatrensis* and *E. floribundus* emerge as the two most frequent taxa. *Erigeron canadensis*, regarded in the past as the most widespread species of the group, is almost absent from the study area, especially from the Atlantic watershed. Furthermore, an important number of specimens previously identified as *E. bonariensis* do actually correspond to *E. sumatrensis*. No hybrids have been found. A detailed identification key highlighting the main features that help to separate the four *Erigeron* species is presented. Finally, as *E. floribundus* is the most controversial species in the group and the last to arrive, we include a study of its expansion across western Europe, where it has become a frequent alien especially along the Atlantic regions in the last century.

**Keywords:** Alien species; *Conyza*; distribution; *Erigeron*; *Erigeron floribundus*; identification key; Western Europe.

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## Introduction

*Erigeron* L. (*Asteraceae*) is a taxonomically complex genus which comprises at least 400 annual, biennial and perennial species, mostly in temperate regions (Nesom, 2006). This genus and the genus *Conyza* Less. have been traditionally considered as two separate but closely related genera [e.g. Stace 2010 in the 3<sup>rd</sup> edition of the *New flora of the British Isles* and Benedí *et al.* (2019) in *Flora Iberica*], although their distinction has long been problematic (Nesom, 1990, 1994). However, it has been shown that *Conyza* is polyphyletic and nested within *Erigeron* (Noyes, 2000) and, thus, some authors merge *Conyza* into a widely delimited genus *Erigeron*. This wide concept of *Erigeron* that includes species formerly included in *Conyza* is commonly accepted [e.g. Greuter (2003) in the Euro+Med treatment of *Astereae*, Tison & de Foucault (2014) in *Flora Gallica* and Stace (2019) in the 4<sup>th</sup> edition of the *New Flora of the British Isles*].

Forty-five species of *Erigeron* are present in Europe and the Mediterranean basin according to Euro+Med PlantBase (Euro+Med, 2006-2020). They include a number of taxa formerly included in *Conyza* that have been introduced in the last decades and centuries into Europe and the Mediterranean basin (Euro+Med, 2006-2020), where they occur mainly in disturbed habitats,

such as wasteland, abandoned fields, cultivated ground, roadsides or railways, although they can also be found in natural and semi-natural habitats such as sand dunes or grasslands (Thébaud & Abbott, 1995; Mundell, 2001; Campos *et al.*, 2004; Campos, 2010). Among these, the most widespread ones are *E. canadensis* (= *C. canadensis*), *E. bonariensis* (= *C. bonariensis*), *E. sumatrensis* (= *C. sumatrensis*) and *E. floribundus* (*C. floribunda*, including *C. bilbaoana*) (Mundell, 2016; see Table 1 for authorities). Additionally, despite *Erigeron* invasive species having very low hybridogenic activity (Galkina & Vinogradona, 2020), hybrids between *E. canadensis* and *E. bonariensis* (Wurzell, 1994; Mundell, 2016) and between native *E. acris* and *E. canadensis*, as well as between *E. sumatrensis* and *E. floribundus* have been reported from the UK and Ireland (Stace *et al.*; 2015; Mundell, 2016). It is also worth mentioning several hybrids described at the beginning of the 20<sup>th</sup> century in the NE Iberian Peninsula by Frère Sennen, such as those between *E. canadensis* and *Conyza ambigua* (= *C. x flahaultiana*), *E. canadensis* and *C. naudini* (*C. x rouyana*), *C. naudini* and *C. ambigua* (*C. x daveauana*), *C. naudini* and *E. coronopifolium* (*E. x mixtum*) and *E. coronopifolium* and *C. ambigua* (*E. x barcinonense*) (Sennen 1908, 1917).

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Table 1. Synonyms for the different *Erigeron* (formerly *Conyza*) species identified in the northern Iberian Peninsula. Nomenclature followed indicated in bold.

<b><i>Erigeron canadensis</i> L.</b>	<b><i>Erigeron bonariensis</i> L.</b>
<i>Conyza canadensis</i> (L.) Cronq.	<i>Conyza bonariensis</i> (L.) Cronq.
	<i>E. crispus</i> Pourr.
	<i>E. linifolius</i> Willd.
	<i>C. ambigua</i> DC.
<b><i>Erigeron sumatrensis</i> Retz.</b>	<b><i>Erigeron floribundus</i> (Kunth) Schultz-Bip.</b>
<i>Conyza sumatrensis</i> (Retz.) E. Walker	<i>E. bilbaoanus</i> (J. Rémy) Cabrera
<i>E. naudini</i> (Bonnet) Humbert	<i>Conyza bilbaoana</i> J. Rémy
<i>E. daveauanus</i> (Sennen) Greuter	<i>C. floribunda</i> Kunth
<i>C. floribunda</i> ‘auct.’	<i>C. floribunda</i> Kunth var. <i>floribunda</i>
<i>C. floribunda</i> Kunth var. <i>subleiotheca</i> (Cuatrec.) J.B. Marshall.	<i>C. sumatrensis</i> var. <i>leiotheca</i> (S.F. Blake) Pruski & G. Sancho
<i>C. albida</i> Willd. ex Sprengel	
<i>C. erigeroides</i> DC.	

*Erigeron canadensis* is thought to be native to North America (Cronquist, 1976) and was introduced into Europe at the beginning of the 17<sup>th</sup> century (Marshall & McClintock, 1972; Prieur-Richard *et al.*, 2000). It is a highly successful invader which is now widely spread across the globe. Regarding *E. bonariensis*, this species is native to South America and it was first recorded in Europe in the 18<sup>th</sup> century (Prieur-Richard *et al.*, 2000), where it has naturalised especially across the Mediterranean basin and Atlantic regions of SW Europe (Milović, 2004) given its more thermophilous requirements (Wurzell, 1988, 1994; Zambrano-Navea, 2013). However, it can also occur, with lower abundance, in northern countries such as the UK (Wurzell, 1988; Rand, 2008), Belgium (Verloove & Boulet, 2001; Verloove, 2006) or Norway (Gederaas *et al.*, 2012). With respect to *E. sumatrensis*, this species is native to South America as well, although it was first named from Sumatra where it is an alien (McClintock & Marshall, 1988; Mundell, 2001). It was introduced into Europe, namely France, during the 19<sup>th</sup> century (Thébaud *et al.*, 1996). At the beginning of the 20<sup>th</sup> century it was already expanding across France, Spain and Portugal (Milović, 2004) and in 1984 it was recorded for the first time in Great Britain (Wurzell, 1988), though it had already been reported from the Channel Islands in 1961 (Jee, 1962; Stace & Crawley, 2015). As Milović (2004) pointed out, this species has been widely confused with *E. bonariensis* as a result of their morphological and ecological resemblance and the lack of an appropriate literature (see for example comments in Wurzell, 1988, 1994). According to Thébaud & Abbott (1995), *E. sumatrensis*, along with *E. canadensis*, is probably among the most widespread species found throughout the world. Finally, *E. floribundus* arrived in SW Europe at the beginning of the 20<sup>th</sup> century and has been spreading since then. However, Verloove & Sánchez Gullón (2008) mentioned that this species has been surprisingly overlooked in Spain by some authors such as Campos & Herrera (1997) and Sanz-Elorza *et al.* (2004), with just a few references from northern regions (Aedo *et al.*, 2001; Verloove & Sánchez Gullón, 2008).

The paucity of references for this species in Spain may reflect the treatment of the genus in regional floras of this country. Aizpuru *et al.* (1999) did not include *E. floribundus* (either as *C. bilbaoana* or *C. floribunda*) in their illustrated keys to the flora of the Basque Country and neighbouring territories, given that it was not known to be present in the territory covered by the flora. In the same way, Bolòs & Vigo (1996) neither took *E. floribundus* into account in their flora of Catalonia and neighbouring regions, but did consider another species named *Conyza blakei* (Cabrera) Cabrera. However, Laínz (2002) stated that the description of *C. blakei* given in the Catalan flora did not match the description on the flora of Buenos Aires province (Cabrera, 1963-1970) and that accordingly *C. blakei* sensu Bolòs & Vigo (1996) was in fact *C. bilbaoana* (= *E. floribundus*) (González-Martínez, 2015). In any case, genuine *C. blakei* is present in SW France (Tison & de Foucault, 2014), and it might also be scattered across northeast Spain (Bolòs & Vigo, 1996). Its present (or future) occurrence in the Basque Country and neighbouring territories cannot be ruled out (F. Verloove, pers. comm.). Additionally, and adding more to this confusion, *Flora iberica*, which constitutes the reference work for vascular plants of the Iberian Peninsula and the Balearic Islands, has recently released a volume covering part of the *Compositae* family (Benedí *et al.*, 2019) in which *Conyza* and *Erigeron* are treated as two separate genera and, more importantly, where *Conyza canadensis* and *C. bonariensis* are accepted as the only alien *Conyza* species present in this territory (Morales, 2019).

Hence, in the Iberian Peninsula important doubts have long existed regarding the identification of numerous annual weedy *Erigeron* specimens, especially those glabrescent plants that did not match the well-known *E. canadensis*. Therefore, in the present work we have examined specimens collected in the northern Iberian Peninsula in order to (1) determine which species of annual weedy *Erigeron* are currently present; (2) develop a detailed identification key highlighting the main features that help to separate the different annual weedy *Erigeron* species distinguished in the study

area; and (3) estimate which species are more frequent. Additionally, we present a study of the expansion of *E. floribundus* in western Europe as this is the most controversial taxon of the group.

## Methods

The study area for the present work corresponds to the regions of Cantabria, Basque Country, Navarre and neighbouring territories in northern Spain. This area is drained by two watersheds separated by the Cantabrian Mountain Range: Atlantic on the north, with streams flowing into the Bay of Biscay, and Mediterranean on the south, with streams flowing into the Ebro River (Figure 1). Within this area, the vast majority of the

specimens were collected between Cantabria in the west and northern Navarre in the east. Initially, we focused on specimens collected by the authors and other members of the Flora and Vegetation Research Group of the University of the Basque Country (UPV/EHU) along with voucher specimens preserved at the BIO herbarium of the same institution. Subsequently, in order to study as many *Erigeron* specimens from the study area as possible, we also examined voucher specimens sent on loan by the following herbaria: ARAN (Arantzadi Society of Sciences), SEST (Natural Sciences Society of Sestao) and VIT (Natural History Museum of Álava). These herbaria also contained voucher specimens from SW France (Atlantic Pyrenees department) that were also examined (Appendix S1). A total of 261 voucher specimens were studied.

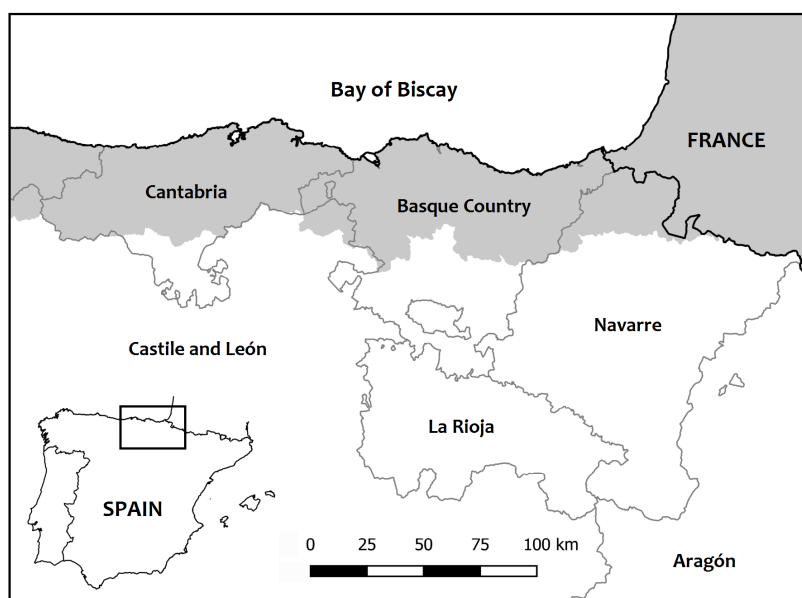


Figure 1. Study area showing the Atlantic (grey) and the Mediterranean watersheds (white).

To characterise morphologically the different annual weedy *Erigeron* species found in the study area, the following vegetative and reproductive traits were measured: leaf length, leaf width, stem hairs length, capitula length and width, number of tubular and ligulate florets per capitulum, number of lobes per tubular floret, and ligule length of ligulate florets. Additionally, the original descriptions of the taxa involved were consulted.

Distribution maps for the northern Iberian Peninsula based on the examined specimens are presented. For this purpose, bibliographical references were not considered since we cannot confirm whether the identification fit the criteria included in the aforementioned key. Information on the examined specimens regarding province, locality, 1x1 km UTM grid square (ED50 datum), site description, elevation, date and authors of collection and registration code in the corresponding herbarium is shown in Appendix S1.

Finally, a map showing the distribution and earliest records of *E. floribundus* in western Europe was created in order to analyse its geographical expansion in this territory. For this purpose, bibliographical references and own unpublished data were used along with occurrences

provided by the following electronic resources: Global Biodiversity Information Facility (GBIF, worldwide; <https://www.gbif.org>), Inventaire National du Patrimoine Naturel (INPN, France; <https://inpn.mnhn.fr>), National Biodiversity Network Atlas (NBN Atlas, UK; <https://records.nbnatlas.org>), the Botanical Society of Britain and Ireland (BSBI, UK and Ireland; <https://bsbi.org/maps>) and the Plant Information System of Spain (ANTHOS, <https://www.anthos.es>). These results are presented in 50 x 50 km grid cells.

## Results and Discussion

### Annual weedy *Erigeron* species in the northern Iberian Peninsula and identification key for their distinction

Four annual weedy *Erigeron* species formerly included in *Conyza* have been identified in the northern Iberian Peninsula: *E. canadensis*, *E. bonariensis*, *E. sumatrensis* and *E. floribundus* (Figure 2; see Table 1 for synonyms). This result is in line with what has been reported from



other European countries (e.g. Mundell, 2016; Verloove, 2019). However, as already commented above, *Flora Iberica* only considers *E. canadensis* (sub *Conyza canadensis*) and *E. bonariensis* (sub *Conyza bonariensis*) to be present in the Iberian Peninsula, in line with the treatment of *Conyza* in *Flora Europaea* (Cronquist, 1976). Our findings, though, clearly overcome this outdated genus outline, in agreement with the trends

observed in the last decades across Europe, where some additional *Conyza* species have been recognized and accepted (Verloove, 2006; Rand, 2008; Mundell, 2016), sometimes with a varying nomenclature. Of these, *C. sumatrensis* and *C. floribunda* (many times as *C. bilbaoana*) are clearly amongst the most widespread ones and have been erroneously included in *Flora iberica* within *C. bonariensis* (Morales, 2019).



Figure 2. Capitula of *Erigeron* species: a, *E. canadensis*, with very conspicuous ligules; b, *E. bonariensis*, with red-tipped involucre bracts; c, *E. floribundus*, with glabrous involucre bracts; d, *E. sumatrensis*, with hairy involucre bracts.

With respect to *C. sumatrensis*, according to Morales (2019), this species could not be recognised in the territory covered by *Flora iberica* on the basis of the diagnostic characteristics included in the literature consulted by the author. Additionally, Morales (2019) also argues that the great morphological variability of *C. bonariensis* implies that a number of taxa have been described and that some forms of this species had been identified as *C. sumatrensis*. In our opinion, though, they are clearly distinct taxa that can be distinguished on the basis of both morphological features, such as plant height and robustness, width of stem leaves, inflorescence shape, capitula width, number of tubular florets per capitulum and colour of the apex of the involucre bracts (see key below), and genetic features (Thébaud & Abbott, 1995; Galkina & Vinogradova, 2020). In the same way,

regarding *C. floribunda*, this species can be also clearly distinguished from *C. bonariensis* both morphologically (e.g. stem and leaves hairiness, inflorescence shape, number of tubular florets per capitulum, capitula width and involucre bracts hairiness) and genetically (Thébaud & Abbott, 1995).

Summarising, we are in disagreement with *Flora iberica* over the approach on *Conyza* and we propose that at least four species of *Conyza* can be found in the northern Iberian Peninsula (*C. canadensis*, *C. bonariensis*, *C. sumatrensis* and *C. floribunda*). This implies that *C. sumatrensis* and *C. floribunda* should be regarded as separate taxa that can be clearly distinguished from *C. bonariensis*. Furthermore, these *Conyza* species should be included within *Erigeron* (Greuter, 2003; Stace, 2019; Verloove, 2019).

In our study area, the four annual weedy *Erigeron* species behave like short-lived species (annual or biennial) that flourish and fructify between late summer and autumn and produce overwintering rosettes that renew growth in spring (Campos, 2010; Hipkin *et al.*, 2012). They occur mainly in anthropogenic habitats, such as road edges, abandoned fields, crops and waste ground, where they can become abundant in nitrophilous megaphorb communities on disturbed soils of the *Dauco-Melilotion* (Loidi & Navarro, 1988), *Chenopodium muralis* (Carretero, 1994), *Cynancho-Convolvulion sepium* and *Sisymbrium officinalis* phytosociological alliances, among others (Campos, 2010; Campos *et al.*, 2013). Additionally, they can invade natural and semi-natural communities, such as nitrophilous river bar communities of the *Bidention tripartitae* alliance, especially *E. sumatrensis* and *E. floribundus* (Liendo *et al.*, 2015, 2016) and ruderal *Dauco-Melilotion* communities on coastal dunes subjected to substantial levels of anthropogenic disturbance, especially *E. sumatrensis*, *E. bonariensis* and *E. floribundus* (Herrera & Campos, 2010). Phytosociological nomenclature follows Mucina *et al.* (2016).

Below we provide an identification key for mature individuals of these alien *Erigeron* species based on own observations and measurements made by the authors in a number of *Erigeron* specimens and previous works (Campos, 2010). It is worth highlighting the differences in the inner involucre bracts between *E. floribundus* and *E. canadensis*, which have not been pointed out in previous keys (but see Mundell, 2001). We consider that this feature could allow a quick and robust separation of these taxa.

1. Leaves glabrous or nearly glabrous with scattered hairs along the underside midrib, margins ciliate (ciliae often 1 mm long). Capitula ca. 2-3 mm wide at anthesis. Involucre bracts glabrous or nearly glabrous. Tubular florets 4-5 lobed. Inflorescence columnar or rhomboid.....2  
 1' Leaves pubescent. Leaf margins densely appressed-pubescent, hardly ciliate towards the base. Capitula with parallel sides, ca. 5-10 mm wide at anthesis. Involucre bracts softly pubescent. Tubular florets 5-lobed. Inflorescence pyramidal or subcorymbose.....3  
 2. Inner involucre bracts 3-3.5 (3.8) mm long x 0.3-0.4 (0.5) mm wide. Inner tubular florets mostly 4-lobed, not becoming wider towards the apex, ca. 12-15 (20) per capitulum. Ligules always present, > 0.7 mm long, white, distinctly exceeding involucre. Inflorescence narrowly cylindrical or columnar, much longer than wide. Middle and lower stem leaves entire or softly toothed. Plant annual, yellowish-green, stem not hirsute with hairs < 1.2 mm long..... *E. canadensis*  
 2' Inner involucre bracts 3.5-4.1 (4.5) mm long x 0.6-0.7 (0.8) mm wide. Inner tubular florets mostly 5-lobed, becoming wider towards the apex, ca. 4-6 (8) per capitulum. Ligules absent or rudimentary, < 0.4

mm long, not exceeding involucre. Inflorescence much broader, sometimes rhomboid, only slightly longer than wide. Middle and lower stem leaves deeply lobed, lobes > 1.5 mm long. Plant mostly biennial, dull greyish-green, stem densely hirsute with hairs usually > 1.8 mm long .....*E. floribundus*  
 3. Robust plant, up to ca. 30- 200 cm tall. Inflorescence grey-pubescent, not glandular, broad and profusely ramified, pyramidal or rhomboid, side branches not overtopping the main axis. Apex of involucre bracts not purplish. Tubular florets, ca. 7-10 per capitulum. Middle stem leaves narrowly lanceolate, usually toothed, ca. 5-20 mm wide, side veins conspicuous. Capitula ca. (4) 5-7 mm wide at anthesis .....*E. sumatrensis*  
 3' Plant hardly exceeding 60 cm. Inflorescence branches less numerous with side branches overtopping the main axis. Apex of involucre bracts often purplish. Tubular florets, ca. 13-16 per capitulum. Stem leaves sublinear, entire or minutely toothed, less than 4 mm wide. Capitula ca. 6-10 mm wide at anthesis..... *E. bonariensis*

Regarding glabrescent taxa, *E. canadensis* was previously thought to be much more common than *E. floribundus* across the study area. As a matter of fact, it was listed among the 50 most frequent alien species in the Basque Country across a wide range of habitats, being *E. floribundus* absent from this list (Campos *et al.*, 2013). However, a close examination of numerous glabrescent specimens pointed out that almost half of the voucher specimens previously identified as *E. canadensis* were in fact *E. floribundus* (Table 2), many of them from the Atlantic watershed. This suggests that *E. floribundus* is actually the species that is widely spread across this region (Figure 3), which is in accordance with previous research suggesting that *C. bilbaoana* (= *E. floribundus*) is probably the commonest representative of the genus in SW France and that it has been surprisingly overlooked in Spain (Verloove & Sánchez Gullón, 2008). Additionally, and according to several voucher specimens examined, *E. floribundus* would have been present in inland and coastal localities of the study area since at least the early 1980s. *E. canadensis*, on the other hand, would be almost absent from the Atlantic watershed since only a few specimens collected in the 80s and 90s in the Basque Country and SW France, respectively, were confirmed as such. This misidentification has also been reported from another oceanic territory such as New Zealand, where true *Conyza canadensis* (= *E. canadensis*) is a rare plant and it is the widespread *C. bilbaoana* (= *E. floribundus*) which is known there as 'Canadian fleabane' due to an early identification error (Kent, 1991; Stanley, 1996; Mundell, 2001). In the words of Kent (1991), in New Zealand *C. canadensis* would be 'part of a complex, the true species being rare, and the most widespread being the South American *C. bilbaoana*'.



Table 2. Correspondence (number of voucher specimens) between the original identification of the annual weedy *Erigeron* specimens used in the present study and the new adscription based on the identification key proposed. In bold cases where the original identification did not match with the new adscription for a high number of voucher specimens.

Original identification	New adscription			
	<i>E. canadensis</i>	<i>E. floribundus</i>	<i>E. sumatrensis</i>	<i>E. bonariensis</i>
<i>Conyza canadensis</i>	30	<b>29</b>	5	--
<i>Conyza bilbaoana</i>	--	31	--	--
<i>Conyza sumatrensis</i>	--	--	91	--
<i>Conyza bonariensis</i>	--	2	<b>47</b>	13
<i>Conyza albida</i> x <i>bonariensis</i>	--	1	1	--
<i>Conyza albida</i> x <i>canadensis</i>	1	4	--	--
<i>Conyza</i> sp.	2	2	2	--

With respect to the pubescent taxa, our examination revealed that a significant number of specimens previously identified as *E. bonariensis* were in fact *E. sumatrensis* (Table 2). A possible explanation for this is that, as previously mentioned, the regional key in Aizpuru *et al.* (1999) does not include *E. sumatrensis* and considers *E. bonariensis* as the only pubescent taxon of the genus. This regional key does include *Conyza albida* (a synonym for *E. sumatrensis*), but the description matches partly that of *E. floribundus*. This, along with the great amount of *E. sumatrensis* recently recorded in the study area (Figure 3), suggests that this species is much more frequent than *E. bonariensis*, which is in accordance with previous works (e.g. Campos, 2010).

No hybrids have been found among the specimens that have been examined in the framework of the present study.

### Expansion of *Erigeron floribundus* in western Europe

*Erigeron floribundus* is the most controversial taxon in the group of *Erigeron* species formerly included in *Conyza*. As previously discussed, its resemblance to other similar species, especially *E. canadensis*, caused that it was usually overlooked in many regions and

countries. Figure 4 shows the distribution and expansion of *E. floribundus* in western Europe in the last century.

According to the Global Biodiversity Information Facility (GBIF) and the French *Inventaire National du Patrimoine Naturel* (INPN), *E. floribundus* was first recorded in the early 20<sup>th</sup> century in Marseille (1903) and nearby Toulon (1912) in southeast France, which would constitute the first records for this species in Europe (Figure 4). However, caution should be taken since several records originally identified as *Erigeron naudini*, a synonym for *E. sumatrensis* (Wurzell, 1988), reported from the first half of the 20<sup>th</sup> century in southeast France, have been included in GBIF as *E. floribundus*. Although it is found in central and south-eastern France, especially in the Occitanie region, its main distribution range in this country encompasses the Atlantic regions, where it can achieve high abundances. In southwest France it is known since the early 1960s from Anglet (Aedo *et al.*, 2001) and the Gironde estuary (INPN) in the Nouvelle-Aquitaine region. In Brittany and Pays de la Loire regions, where this species is widely spread and abundant, the earliest records are from the 1980s according to the INPN. This species has also reached Normandy and Hauts-de-France in northern France, where it was reported for the first time in the mid and late 2000s.

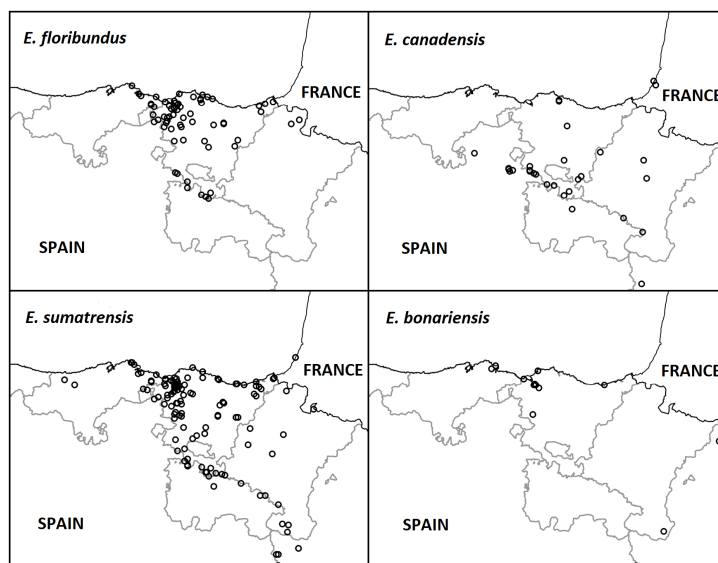


Figure 3. Known distribution of *Erigeron floribundus*, *E. canadensis*, *E. sumatrensis* and *E. bonariensis* in the study area based on the examined voucher specimens (see Appendix S1).

In Spain, *E. floribundus* has been present since at least the 1980s in the Bay of Biscay and the Ebro basin in the north of the country, although a 1963 citation without voucher specimen from Hondarribia near the French border (Aedo *et al.*, 2001) could mean that this species has been present in this territory since long before (Figure 4). It is especially abundant in the Bilbao metropolitan area. In the Galicia region (NW Spain) *E. floribundus* is known since 1966 (Aedo *et al.*, 2001), though most of the references for this region are much more recent. It has also been recorded from Extremadura and Andalusia regions in southwest Spain, where it has been present since at least 1993. In nearby Portugal, few references of *E. floribundus* are available so far. It was first recorded (as *Conyza bilbaoana*) in 2004 from Vila Nova de Gaia in the north-western part of the country and regarded as a new neophyte to the Portuguese flora (Alves & Aguiar, 2012). However, according to GBIF there are two references from 1970 in southeast Portugal near the south-western Spanish records, meaning that this species could have been present in Portugal and the south-western Iberian Peninsula since long before.

*Erigeron floribundus* has also reached the UK and Ireland where it has become a widespread alien in some areas. In the UK it was not recognised until 1994, when a population of a robust *Conyza* species collected in Southampton (S England) in 1992 and clearly different from *C. canadensis* was identified as *C. bilbaoana*

(Stanley, 1996). Subsequently, a record from 1977 in Essex (SE England) (Stace & Crawley, 2015) and a 1974 specimen from Flintshire in northern Wales (Hipkin *et al.*, 2012) were uncovered. It has also been found in Scotland, where it was first collected in Fochabers in 2005, and Northern Ireland where, according to the Botanical Society of Britain and Ireland (BSBI), it was first recorded from Belfast in the 2000s (Figure 4). *E. floribundus* is especially frequent in Greater London, southern England between Bournemouth and Portsmouth and southern Wales where, according to the National Biodiversity Network Atlas, it is known from Swansea since 2001. It has probably arrived in the UK from Brittany (Stace & Crawley, 2015). Similar to what has been described for the UK, *E. floribundus* was first recognised in Ireland in 1996 when a population found near New Ross (SE Ireland) in 1992 was identified as *Conyza bilbaoana* (Reynolds, 1997). However, specimens of this species had been previously collected in Dublin in 1984 and 1985, although they were not identified as such until 1996 (Reynolds, 1997; Mundell, 2016). Subsequently, it was found in other parts of the country, such as the south-western coast, where it is known from Tralee since 1995 (Reynolds, 1997) and the north-western coast, where it was first detected in the 2010s. According to BSBI, it is nowadays a frequent alien in the Dublin area and the south-eastern coast between Waterford and Wexford.

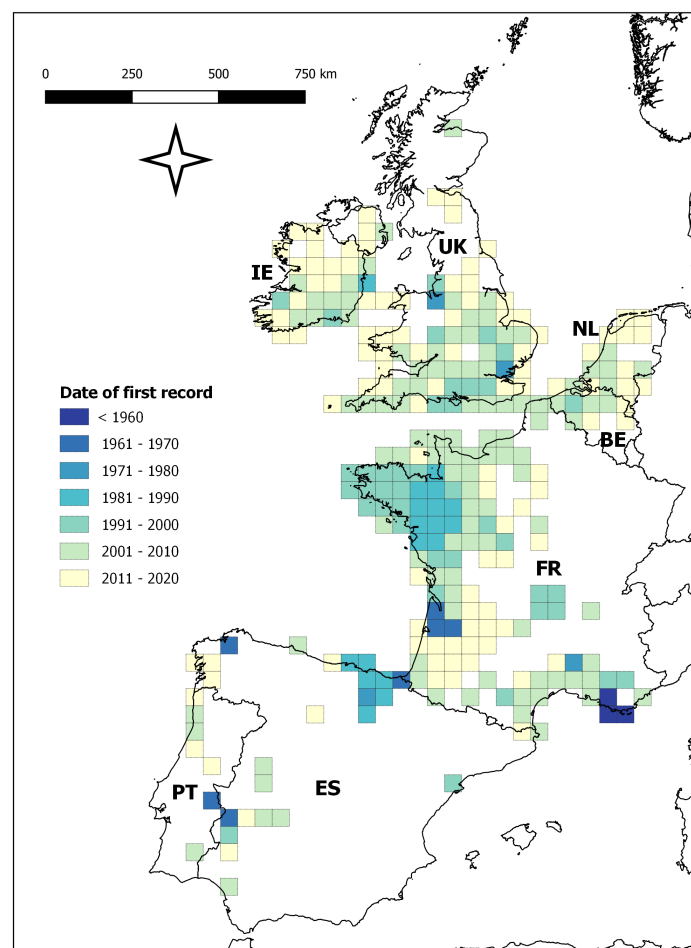


Figure 4. Dates of first records of *Erigeron floribundus* in western Europe. Information is provided in grid cells of 50 x 50 km. PT: Portugal, ES: Spain, FR: France, BE: Belgium, NL: The Netherlands, UK: United Kingdom, IE: Ireland.

Finally, *E. floribundus* has also been found in Belgium and the Netherlands. Regarding Belgium, it was first collected in 1999 in the Kortrijk area (Verloove, 2001). Subsequently, it has been found across the country, especially Flanders, with a concentration of records in the south of West-Flanders where the first populations were detected and having also spread to the rest of the region, except for the Polders and Kempen areas (F. Verloove, pers. comm.). It is also known from Brussels and, in recent years, it has been found in Wallonia, where it is still scarce. In relation to the Netherlands, it was first found in the early 2000s in Rotterdam and has since then been detected in other parts of the country (Figure 4). It is precisely in Rotterdam and surrounding areas where more records of *E. floribundus* are available.

## Conclusions

Four annual weedy species of *Erigeron* formerly included in *Conyza* have been identified in northern Spain: *E. canadensis*, *E. bonariensis*, *E. sumatrensis* and *E. floribundus*. All of them occur mainly in anthropogenic habitats, although they can also invade natural and semi-natural communities, such as nitrophilous river bar communities and ruderal communities on coastal dunes. *Erigeron floribundus* and *E. sumatrensis* are the most widespread taxa of this group in the northern Iberian Peninsula. *Erigeron canadensis*, regarded in the past as the most widespread taxon in this region, is almost absent nowadays, especially from the Atlantic watershed.

*Erigeron floribundus* has spread across western Europe in the last decades, especially along the Atlantic regions, although it can also be found in Mediterranean localities. The history of its expansion is discussed, from the initial (though uncertain) references from southeast France in the early 20<sup>th</sup> century to the most recent detections in Belgium and the Netherlands. The pattern of detection of *E. floribundus* in western Europe suggests that this species could have been introduced independently at different times in different locations.

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## Supplementary Material

- Appendix S1.** Voucher specimens of *Erigeron* included in the present work.

