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Inventory and mapping of red-listed vascular flora in Hernani municipality (Gipuzkoa, Basque Country).

Mehatxu egoeran dauden landareen inbentarioa eta kartografia Hernani udalerrian (Gipuzkoa, Euskal Autonomia Erkidegoa).

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Abstract

A total of 119 new chorological reports are given for 7 red-listed species, namely, *Dryopteris aemula*, *Hymenophyllum tunbrigense*, *Prunus lusitanica*, *Soldanella villosa*, *Stegnogramma pozoi*, *Vandenboschia speciosa*, and *Veratrum album*. Comments on their ecology and local distribution maps are provided. The number of subpopulations of *S. villosa* (52) and *T. speciosum* (38) found is remarkable. In several streams, the gametophyte phase of *T. speciosum*, rarely reported in the Iberian Peninsula, exceeds the sporophyte generation in number of individuals, which probably has important conservation and genetic diversity implications. It is proposed that the Urumea Site of Communitary Interest be extended to cover the streams that discharge into it, or alternatively, threatened plant microreserves be established at the Apaizeta, Azketa and Kartola streams.

• **Key words:** Threatened flora, *Pterydophyta*, conservation, management, Natural Park.

Laburpena

Guztira, zerrenda gorrian dauden zazpi landareren 119 aipu korologiko ematen dira: *Dryopteris aemula* (Aiton) Kuntze, *Hymenophyllum tunbrigense* (L.) Sm., *Prunus lusitanica* L., *Soldanella villosa* Darracq ex Labarrère, *Stegnogramma pozoi* (Lag.) K. Iwats., *Vandenboschia speciosa* (Willd.) G. Kunkel., eta *Veratrum album* L.; baita euren kartografia herri mailako

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eskalan eta euren ekologiari buruzko aipamenak. Aipagarria da, bestalde, aurkituriko *S. villosa* eta *V. speciosa*-ren azpipopulazio kopuru altua, 52 eta 38koa, hurrenez hurren. Erreka batzuetan *V. speciosa* gametofito faseak topatu dira –Iberiar Penintsulan oso gutxitan aipatua– esporofito faseak baino indibiduo gehiagorekin, horrek *V. speciosa*-ren kontserbazioan eta dibertsitate genetikoan dituen inplikazio garrantzitsuekin. Ondorio bezala, Urumea Interes Bereziko Gunea izendatzea proposatzen dugu, barne har ditzan bertara isurtzen duten erreka eta bailara txikiak ere; edota, bestela, Apaizeta, Azketa eta Kartola erreketan landare mehatxatuen mikroerreserbak ezartzea.

• **GAKO-HITZAK:** Flora mehatxatua, Pterydophyta, kontserbazioa, kudeaketa, Parke Naturala.

RESUMEN

Se dan 119 citas corológicas de 7 especies amenazadas: *Dryopteris aemula*, *Hymenophyllum tunbrigense*, *Prunus lusitanica*, *Soldanella villosa*, *Stegnogramma pozoi*, *Vandenboschia speciosa* y *Veratrum album*. Se aportan comentarios ecológicos y mapas de distribución. El número de subpoblaciones de *S. villosa* (52) y *T. speciosum* (38) halladas es remarcable. En diversas regatas se ha encontrado la fase gametofítica de *T. speciosum*, raramente citada en la Península Ibérica, que además excede en número de individuos a la fase esporofítica, lo cual tiene importantes implicaciones en cuanto a la diversidad genética y consercación de *V. speciosa*. Proponemos que el lugar de interés comunitario Urumea sea extendido para englobar también las regatas que fluyen al Urumea, o alternativamente, que se establezcan microreservas de plantas amenazadas en las regatas de Apaizeta, Azketa y Kartola.

• **PALABRAS CLAVE:** Flora amenazada, *Pterydophyta*, conservación, gestión, Parque Natural.

INTRODUCTION

The flora of Hernani municipality remains relatively poorly studied. Contrastingly, the neighbouring Aiako Harria Natural Park and Leitzaran valley have been visited more often by botanists, and focused inventories have been made (Allorge & Allorge, 1941; Aseginolaza *et al.,* 1985; Catalán & Aizpuru, 1985; Arbelaitz *et al.,* 2002). Due to its geographical proximity, and similar ecological conditions, Hernani also hosts some of the red-listed species (Spanish and Basque). A few records of red-listed species have been reported in the last few decades in Hernani, including *Hymenophyllum tunbrigense* (L.) Sm., *Dryopteris aemula* (Aiton) O. Kunze and *Trichomanes speciosum* Willd. (Aseginolaza *et al.,* 1985; Aizpuru *et al.,* 1990; Arbelaitz *et al.,* 2002). However, a number of remote and potentially interesting areas of Hernani have rarely, if ever, been visited by botanists. This led us to the conclusion that further popu-

lations of red-listed species might be present, and/or that additional red-listed species might be found.

A project inventory of red-listed vascular flora in Hernani, mapping every subpopulation, was carried out from 2007 to 2009. The main purpose was to provide management and protection measures, to ensure the conservation of these populations. Additionally, the inventory and mapping of new populations and subpopulations of red-listed species is of paramount importance on a broader scale, for assessment of population trends, threats, and the conservation status of the species (Bañares *et al.,* 2008, 2010; Moreno, 2008) in a wider geographical context.

Thus, this paper provides new chorological records of species, resulting from the project cited above. Several red-listed species are reported, which are included either in the 2008 Red List of Spanish Vascular Flora (Moreno 2008, referred to as SRL below), or in the Red List of Vascular plants (Aizpuru *et al.,* 2010, referred to as BRL below), including the updated version (Department of Environment, TERRITORY Planning, Agriculture and Fishery 2011) or protected under the Bern Convention, or by the Communitary Habitat Directive. This information contributes to greater knowledge of their distribution, conservation state, and assessment of their red-listed status. Furthermore, comments are provided concerning their ecology and biology in the territory.

Materials and methods

Study area

Hernani municipality is situated in the north-eastern part of Gipuzkoa (Basque Country), in the eastern corner of the Bay of Biscay (Fig. 1). Hernani covers an area of 42 km^2, and has an elongated and narrow shape. The nearest point to the sea, 5 km inland, is in the north of the municipality, and the area borders Navarre province to the south. The Urumea river flows north-westwards across the municipality, and all the streams in Hernani discharge into it (Fig. 2). It is a mountainous area, with the highest peaks being found in the southern part of the municipality (Zaburu 780 m, Azketa-Antxista 834 m). Two areas of the municipality are protected, namely the Urumea Ibaia/Río Urumea Site of Communitary Interest (ES2120015), plus a small part (385 ha) that is included in the Aiako Harria Natural Park (also S.C.I., ES2120016).

The climate is oceanic, with a constant, warm temperature averaging 13.9 °C. This value has been taken from the average of the coldest month, 6.1 °C, and that of the warmest one, 21.6 °C. Precipitation is high (1430 mm/year) and there is no dry period longer than two months. Within Hernani, the precipitation shows a marked gradient, with up to 2000 mm yearly being recorded in the eastern part (IDOM 2004).

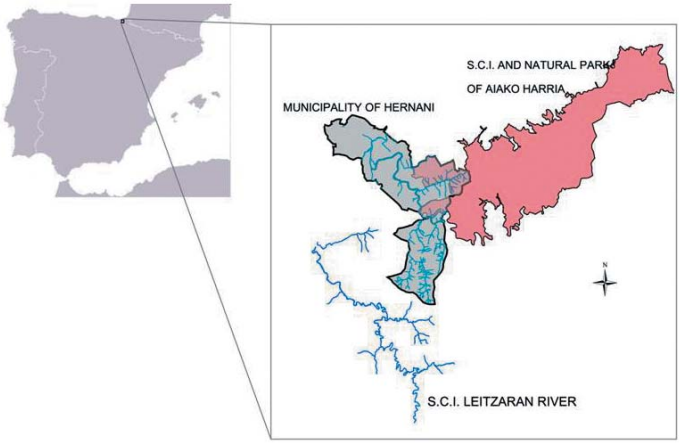

Fig. 1.- The location of Hernani municipality in the northern central area of the Iberian Peninsula and relative to the Sites of Communitary Interest, the Leitzaran River and the Aiako Harria Natural Park.

1. Irudia - Hernaniko udalerriaren kokapena Iberiar Penintsulako ipar erdialdean, eta Interes Komunitario gune birekiko, hots, Leitzaran ibaia eta Aiako Harria Parke Naturalarekiko.

With regard to the lithology, slate and grey are the predominant rocks in eastern Hernani, forming steep and narrow valleys. Downstream, dark grey marls are also present, and in the western part of the study area, where the valleys are more shallow, alluvial deposits, sandy limestone and marls form a mosaic in the hilly landscape (Sanz-Azkue *et al.* 2007).

The climax vegetation of Hernani (Loidi *et al.* 2011) mainly consists of acidophilous oak forests (*Hyperico pulchri Quercetum roboris* [Br.-Bl. 1967] Rivas-Martínez, Báscones, T.E. Díaz, Fernández-González & Loidi 1991), and acidophilous beech forests (*Saxifrago hirsutae Fagetum sylvaticae* Br.-Bl. 1967 em. Rivas-Martínez, Báscones, T.E. Díaz, Fernández-González & Loidi 1991) above 400-500 m a.s.l., with riparious alder forests along the streams and rivers (*Hyperico androsaemi Alnetum glutinosae* [Br.-Bl. 1967] Rivas-Martínez in Loidi 1983). However, the municipality has been densely populated and the landscape has been modified for many years, in such a way that grasslands, shrub communities, and exotic tree plantations are now important components of the landscape. The remaining stands of climax vegetation are scattered and have undergone intensive charcoal-making activity prior to the first third of the twentieth century.

Sampling methodology

We prospected part of the Urumea river, and particularly the streams that discharge into it, for red-listed plants. The coordinates of each subpopulation

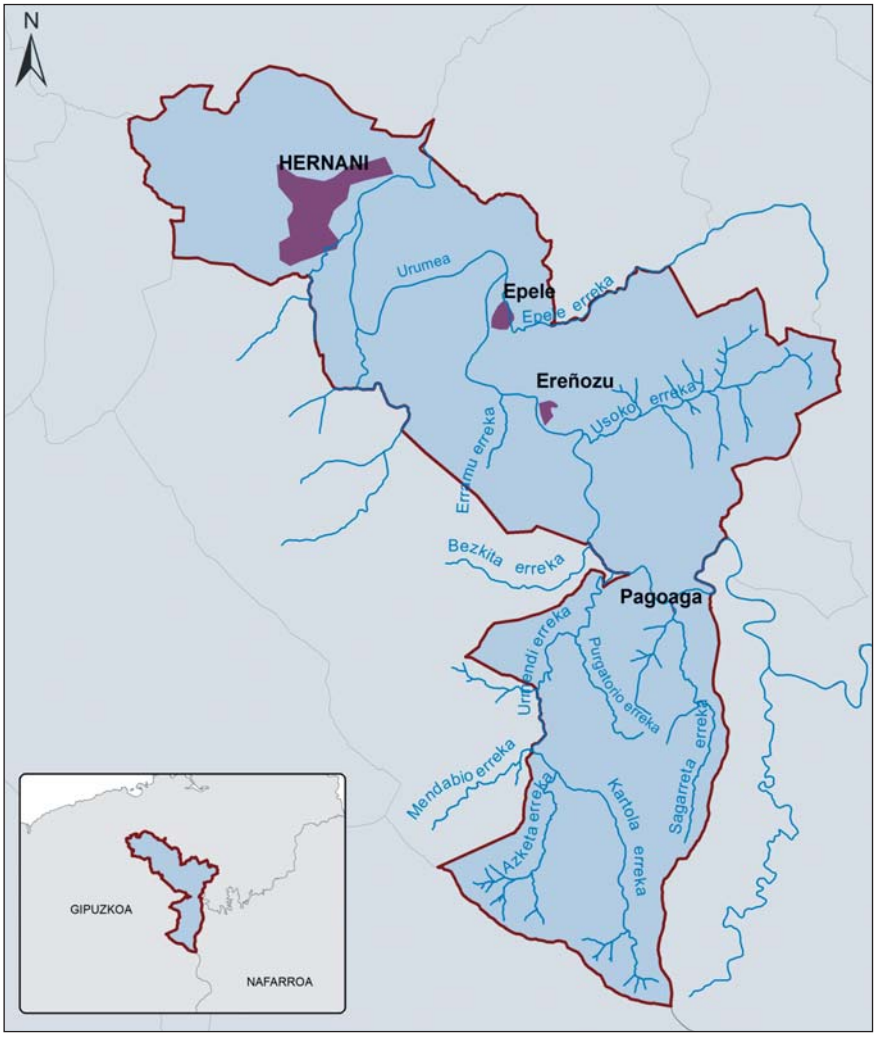

Fig. 2.- Map of the Hernani municipality showing the main streams that discharge into the Urumea river.
2. Irudia - Hernaniko udalerria eta Urumea ibaiera emaria daramaten erreka nagusien izenenak erakusten dituen mapa.

found were obtained with the aid of a Garmin Etrex Vista SUMMIT GPS. When the accuracy of the coordinates was insufficient, coordinates were obtained using SIGPAC (http://sigpac.mapa.es/fega/visor/). Coordinates are given in ED50 geodetic datum. Distribution maps were created using gvSIG software (http://www.gvsig.com/). Material from all the subpopulations we located was collected and deposited in the ARAN herbarium (Holmgren *et al*., 1990).

Fig. 3.- Threatened plants targeted in this study.
a) *Dryopteris aemula*, ARAN 69280.
b) *Hymenophyllum tunbrigense*, ARAN 69627.
c) *Prunus lusitanica*, ARAN 69621.
d) *Soldanella villosa*, ARAN 69156.
e) *Stegnogramma pozoi*, ARAN 69628.
f) *Veratrum album*, ARAN 69268.

3. Irudia - Lan honetan aurkitutako landare mehatxatuak.
a) *Dryopteris aemula*, ARAN 69280.
b) *Hymenophy-llum tunbrigense*, ARAN 69627.
c) *Prunus lusitanica*, ARAN 69621.
d) *Soldanella villosa*, ARAN 69156.
e) *Stegnogramma pozoi*, ARAN 69628.
f) *Veratrum album*, ARAN 69268.

Results

Chorologic reports by species

Dryopteris aemula (Aiton) Kuntze (Fig. 3a)

Material examined: ESP. GIPUZKOA (SS): Hernani, Azketa erreka, 30TWN8682, 334 m, very abundant along the watercourse, slope in the shade, 19-04-2009, *I. Sanz* & *I. Olariaga*, ARAN 69280. Hernani, Kartola erreka, 30TWN8781, 600 m, slope along the stream, in the shade, 4-04-2009, *I. Sanz* & *I. Olariaga*, ARAN 69269. Hernani, Ursaltueta erreka, 30TWN8582, 386 m, earthy slope near the watercourse, 10-07-2009, *I. Sanz* & *I. Olariaga*, ARAN 69279.

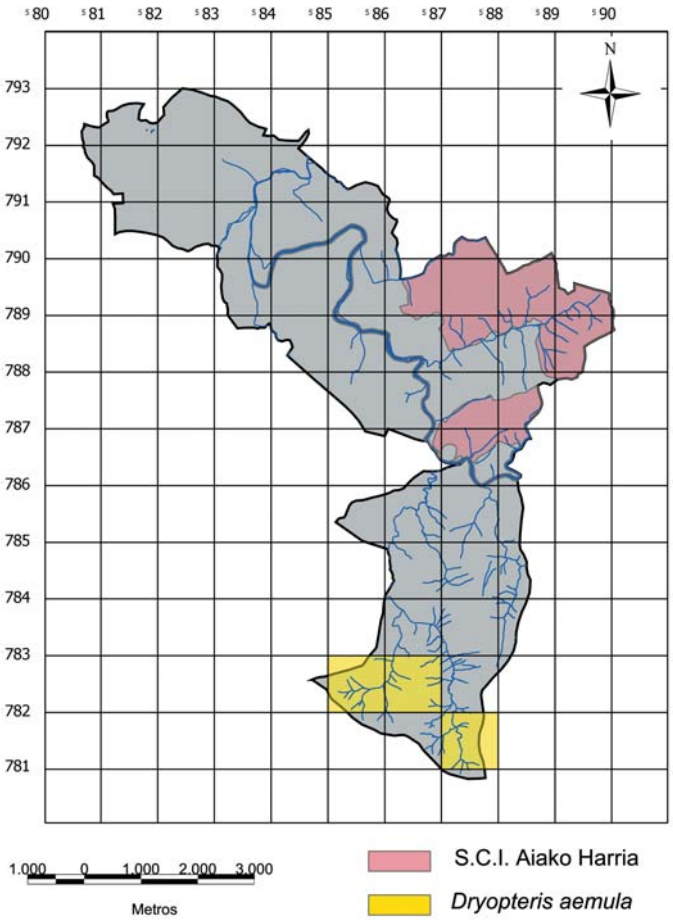

Fig. 4.- Map displaying the new subpopulations of *D. aemula* found in Hernani municipality. The 1x1 km² grids where it is present are marked in yellow.

4. Irudia - Hernanin aurkituriko *D. aemula* subpopulazioak kokatzen direneko 1x1 km² koadrikulak adierazten dituen mapa, horiz.

Notes: A paleotropical fern included in the SRL under the Vulnerable (D2) category, and Nearly Threatened in the BRL. In spite of being widespread but uncommon along the Cantabric coast (Castroviejo *et al*., 1986), it has been considered as a very rare species by several authors (Aseginolaza *et al.,* 1985; Aizpuru *et al.,* 1999). In Hernani, *D. aemula* has been found along the streams found in three steep valleys, forming very abundant populations (Fig. 4). We have been unable to find the plant in Pagoaga erreka, where Aseginolaza *et al*. (1985) previously reported it, despite visiting the area several times.

Hymenophyllum tunbrigense (L.) Sm. (Fig. 3b).

Material examined: ESP. GIPUZKOA (SS): Hernani, Apaizeta erreka, 30TWN8888, 290 m, earthy slope near the stream, 30-12-2009*, I. Sanz* & *I. Olariaga*, ARAN 69639; 30TWN8888, 311 m, siliceous rocks near the watercourse, 17-07-2009*, I. Sanz* & *I. Olariaga*, ARAN 69187; 30TWN8888, 333 m, siliceous rocks near the watercourse, *I. Sanz* & *I. Olariaga*, ARAN 69186. Hernani, Azketa erreka, 30TWN8683, 229 m, small cliff along the stream, close to a waterfall, 17-01-2010*, I. Sanz* & *I. Goñi*, ARAN 69623; 30TWN8682, 334 m, large siliceous rocks near the watercourse, 19-04-2009*, I. Sanz* & *I. Olariaga*, ARAN 69183; 30TWN8682, 334 m, large siliceous rocks near the watercourse, 19-04-2009*, I. Sanz* & *I. Olariaga*, ARAN 69185; 30TWN8682, 337 m, large siliceous rocks near the watercourse, 19-04-2009*, I. Sanz* & *I. Olariaga*, ARAN 69184. Hernani, Izeneder erreka, 30TWN8988, 424 m, on two rocks 2 m from the stream, 30-12-2009*, I. Sanz* & *I. Olariaga*, ARAN 69634. Hernani, Kartola erreka, 30TWN8683, 219 m, shaded cliff near the watercourse, 14-03-2009*, I. Sanz* & *I. Olariaga*, ARAN 69627; 30TWN8684, 158 m, siliceous rocks near the watercourse, 14-03-2009*, I. Sanz* & *I. Olariaga*, ARAN 69182. Hernani, Sagarreta erreka, 30TWN8847, 210 m, *Pinus radiata* afforestation, on a large siliceous rock, 28-03-2009*, I. Sanz* & *I. Olariaga*, ARAN 69181.

Notes: This fern is also included as Vulnerable (B2, D2) in the SRL and BRL. A few records are known in the Basque Country, where the plant seems to be very localized and uncommon. In Hernani, 11 new subpopulations of *H. tunbrigense* have been found during this study (Fig. 5), which are distributed over 6 different km^2 grids. Previous to this work, *H. tunbrigense* was only known in 12 of the km^2 grids within the entire Basque Country (Aizpuru *et al.,* 2010). In Hernani, *H. tunbrigense* preferably inhabits large, siliceous rocks close to streams, occurring in the vertical and strongly shaded rock faces. The populations in Hernani are highly isolated from each other, and composed of very few individuals, with the exception of Azketa erreka and Apaizetako erreka. *Hymenophyllum tunbrigense* was previously collected on one occasion in Hernani, in 1982 (ARAN 315191, viewed), when it was found growing in a deep creep close to the top of Oindi mountain. This seems to represent its highest elevation in the Iberian Peninsula (Castroviejo *et al*. 1986, 500 m). In spite of

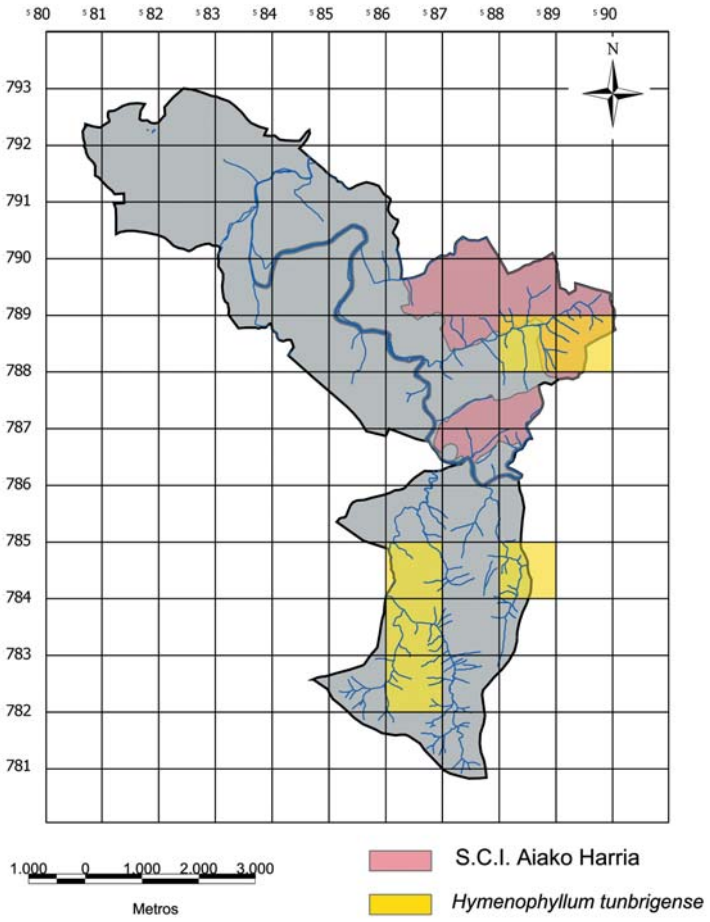

Fig. 5.- Map displaying the new subpopulations of *H. tunbringense* found in Hernani municipality. The 1x1 km^2 grids where it is present are marked in yellow.

5. Irudia - Hernanin aurkituriko *H. tunbringense* subpopulazio berriak dauden 1x1 km^2 koadrikulak horiz adierazten dituen mapa.

the collector's (Xabier Lizaur, pers. com.) precise indications of its location, we were unable to find it again.

Prunus lusitanica L. (Fig. 3c)

Material examined: ESP. GIPUZKOA (SS): Hernani, Apaizeta erreka, 30TWN8888, 211 m, near a stream on siliceous bedrock, 17-07-2009, *I. Sanz* & *I. Olariaga*, ARAN 69273. Hernani, Erramuerreka, 30TWN8588, 221 m, scattered along a stream for approximately 75 m, 7-02-2010, *I. Sanz*, ARAN 69621.

Notes: *Prunus lusitanica* is a species of great biogeographic interest that is included in the SRL as Vulnerable (B2). In the Basque Country, it is categorized as at Critical Extinction Risk in the BRL, as well as in the last updated version produced in 2011. There are very few records of this species in the northern central area of the Iberian Peninsula (Beltrán, 2006); in the Basque Country it is known in only 5 of the km^2 grids (Aizpuru *et al.,* 2010), and it has been recorded only once in Gipuzkoa (Lizaur & Terés, 1995). We found *P. lusitanica* at two sites in Hernani (Fig. 6), occurring on siliceous bedrock, alongside streams in narrow valleys, at a relatively low elevation. This habitat conforms to the ecological requirements described for this species in the northern area of the

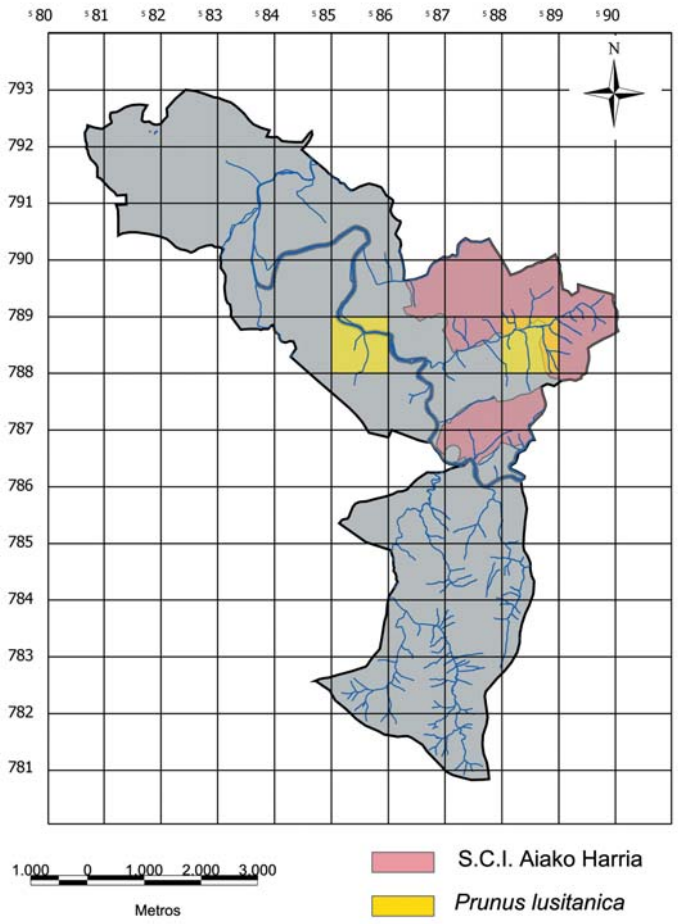

Fig. 6.- Map displaying the new subpopulations of *P. lusitanica* found in Hernani municipality. The 1x1 km^2 grids where it is present are marked in yellow.

6. Irudia - Hernanin aurkituriko P. lusitanica subpopulazio berriak dauden 1x1 km^2 koadrikulak horiz adierazten dituen mapa.

Iberian Peninsula (Beltrán, 2006). The subpopulation of Erramuerreka erreka encompasses three reproductive individuals, and the one in Apaizeta four non-reproductive plants (Ihobe 2011).

Soldanella villosa Darracq ex Labarrère (Fig. 3d)

Material examined: ESP. GIPUZKOA (SS): Hernani, Apaizeta erreka, 30TWN8888, 272 m, on both sides of a waterfall, on siliceous bedrock, 30-12-2009, *I. Sanz* & *I. Olariaga*, ARAN 69631; 30TWN8888, 311 m, on both sides of a waterfall, on siliceous bedrock, 30-12-2009, *I. Sanz* & *I. Olariaga*, ARAN 69638; 30TWN8888, 333 m, slope near the stream, 30-12-2009, *I. Sanz* & *I. Olariaga*, ARAN 69630; 30TWN8888, 339 m, slope near the stream, 30-12-2009, *I. Sanz* & *I. Olariaga*, ARAN 69637; 30TWN8888, 298 m, wet place in the shade, near a waterfall, 17-07-2009, *I. Sanz* & *I. Olariaga*, ARAN 69180; 30TWN8683, 275 m, near a pipe that crosses the track, on a slope, 19-04-2009, *I. Sanz* & *I. Olariaga*, ARAN 69179. Hernani, Azketa erreka, 30TWN8683, 247 m, near a waterfall in a wet area, 8-03-2009, *I. Sanz* & *I. Olariaga*, ARAN 69285; 30TWN8683, 288 m, under a large rock, dripping, near the watercourse, 19-04-2009, *I. Sanz* & *I. Olariaga*, ARAN 69178; 30TWN8683, 238 m, spring that comes from a cliff, close to a waterfall, 8-03-2009, *I. Sanz* & *I. Olariaga*, ARAN 69290; 30TWN8682, 319 m, siliceous rock near the waterfall, 19-04-2009, *I. Sanz* & *I. Olariaga*, ARAN 69175; 30TWN8682, 335 m, siliceous rock near the watercourse, 8-03-2009, *I. Sanz* & *I. Olariaga*, ARAN 69293; 30TWN8683, 298 m, siliceous rock near the watercourse, dripping, 19-04-2009, *I. Sanz* & *I. Olariaga*, ARAN 69177; 30TWN8682, 314 m, siliceous rock near the watercourse, 19-04-2009, *I. Sanz* & *I. Olariaga*, ARAN 69176; 30TWN8582, 511 m, close to a track, in a small waterfall, 26-05-2010, *I. Sanz* & *I. Olariaga*, ARAN 69815; 30TWN8682, 582 m, on both sides of a waterfall, 26-05-2010, *I. Sanz* & *I. Olariaga*, ARAN 69816. Hernani, close to Antxista, spring located in the upper part of Santodomingo stream, 30TWN8681, 693 m, slope near a track, near a little spring, 13-04-2009, *I. Sanz* & *I. Olariaga*, ARAN 69138. Hernani, Izeneder erreka, 30TWN8989, 365 m, on both sides of a waterfall, 30-12-2009, *I. Sanz* & *I. Olariaga*, ARAN 69636; 30TWN8988, 413 m, near a small waterfall, 30-12-2009, *I. Sanz* & *I. Olariaga*, ARAN 69635; 30TWN8988, 426 m, near a waterfall, 30-12-2009, *I. Sanz* & *I. Olariaga*, ARAN 69633. Hernani, Kartola erreka, 30TWN8781, 439 m, on a small siliceous cliff, in an afforested area, 4-04-2009, *I. Sanz* & *I. Olariaga*, ARAN 69163; 30TWN8782, 382 m, small river bank, partly covered with sediment, 4-04-2009, *I. Sanz* & *I. Olariaga*, ARAN 69170; 30TWN8782, 332 m, spring coming from the ground, with dense plant cover, 14-03-2009, *I. Sanz* & *I. Olariaga*, ARAN 69173; 30TWN8683, 184 m, spring on the slope of the stream, 14-03-2009, *I. Sanz* & *I. Olariaga*, ARAN 69174; 30TWN8782, 365 m, large spring close to the main watercourse, 4-04-2009, *I. Sanz* & *I. Olariaga*, ARAN 69172; 30TWN8781, 654 m, abundant colonies

scattered in springs and waterfalls, 3-05-2009, *I. Sanz* & *I. Olariaga*, ARAN 69160; 30TWN8781, 616 m, small and continuously scattered colonies, close to waterfalls, 3-05-2009, *I. Sanz* & *I. Olariaga*, ARAN 69158; 30TWN8780, 686 m, small and continuously scattered colonies along the watercourse, 3-05-2009, *I. Sanz* & *I. Olariaga*, ARAN 69159; 30TWN8781, 415 m, cliff near a small waterfall, 4-04-2009, *I. Sanz* & *I. Olariaga*, ARAN 69165; 30TWN8781, 415 m, high cliff close to the stream, in a spring, 4-04-2009, *I. Sanz* & *I. Olariaga*, ARAN 69166; 30TWN8781, 435 m, siliceous and dripping cliff, near the stream, 4-04-2009, *I. Sanz* & *I. Olariaga*, ARAN 69164; 30TWN8782, 370 m, attached to a coarse piece of wood at the edge of the watercourse, 4-04-2009, *I. Sanz* & *I. Olariaga*, ARAN 69171; 30TWN8781, 407 m, at the edge of the watercourse, 4-04-2009, *I. Sanz* & *I. Olariaga*, ARAN 69168; 30TWN8781, 544 m, scattered plants between waterfalls, on the slopes along the stream, 3-05-2009, *I. Sanz* & *I. Olariaga*, ARAN 69162; 30TWN8781, 411 m, slope close to a waterfall, attached to a log, 4-04-2009, *I. Sanz* & *I. Olariaga*, ARAN 69167; 30TWN8782, 348 m, slope near a track, 14-03-2009, *I. Sanz* & *I. Olariaga*, ARAN 69294; 30TWN8782, 383 m, slope near the stream, 4-04-2009, *I. Sanz* & *I. Olariaga*, ARAN 69169; 30TWN8781, 620 m, opened area, near a track, in a spring, 3-05-2009, *I. Sanz* & *I. Olariaga*, ARAN 69161. Hernani, Sagarreta erreka, 30TWN8883, 436 m, on one side of a small waterfall, under *Chamaecyparis lawsoniana*, 04-06-2010, *I. Sanz*, ARAN 69748; 30TWN8882, 531 m, spring of the main watercourse, 04-06-2010, *I. Sanz*, ARAN 69749. Hernani, Santodomingo erreka, 30TWN8681, 677 m, wet cliff near the watercourse, close to a waterfall, 13-04-2009, *I. Sanz* & *I. Olariaga*, ARAN 69135; 30TWN8681, 727 m, *Larix* afforestation, along a small stream, 13-04-2009, *I. Sanz* & *I. Olariaga*, ARAN 69137; 30TWN8681, 590 m, near a waterfall, 13-04-2009, *I. Sanz* & *I. Olariaga*, ARAN 69156; 30TWN8681, 661 m, spring close to the stream, under a pollard beech, 13-04-2009, *I. Sanz* & *I. Olariaga*, ARAN 69139; 30TWN8781, 714 m, slow flowing spring, under alder stand, 13-04-2009, *I. Sanz* & *I. Olariaga*, ARAN 69134; 30TWN8681, 619 m, slow flowing stream, 13-04-2009, *I. Sanz* & *I. Olariaga*, ARAN 69155; 30TWN8681, 726 m, spring in alder stand, 13-04-2009, *I. Sanz* & *I. Olariaga*, ARAN 69136; 587038 4781576, 524 m, small colonies along the watercourse, 3-05-2009, *I. Sanz* & *I. Olariaga*, ARAN 69133; 30TWN8781, 482 m, wet cliff near a waterfall, 13-04-2009, *I. Sanz* & *I. Olariaga*, ARAN 69157; 586873 4781579, 618 m, waterfall and spring, 13-04-2009, *I. Sanz* & *I. Olariaga*, ARAN 69140. Hernani, Saratsain erreka, 30TWN8587, 382 m, in a spring, near a track, 30-12-2009, *I. Sanz* & *I. Olariaga*, ARAN 69632. Hernani, Usoko erreka, 30TWN8888, 135 m, wet slope near the watercourse, 17-07-2009, *I. Sanz* & *I. Olariaga*, ARAN 69131. Hernani, Ursaltueta erreka, 30TWN8582, 386 m, spring coming out of the ground, 19-04-2009, *I. Sanz* & *I. Olariaga*, ARAN 69132.

Notes: *Soldanella villosa* is categorized as Vulnerable in the BRL and SRL (D2). It is a Cantabric endemism that is found in the northern central part of the

Iberian Peninsula (Castroviejo *et al.,* 1990). The new records at Hernani complete a gap in the distribution area of this species (Fig. 7), since it is already known in the neighbouring Aiako Harria and the Leitzaran valley (Aseginolaza *et al.,* 1985). In Hernani, *S. villosa* has been found in the southern part of the municipality, showing high habitat plasticity and mostly occurring near small waterfalls and streams, on wet slopes etc. However, the most important colonies are found in still water springs (Santodomingo erreka, Azketa) where *S. villosa* thrives, covering large areas. From the total number of subpopulations

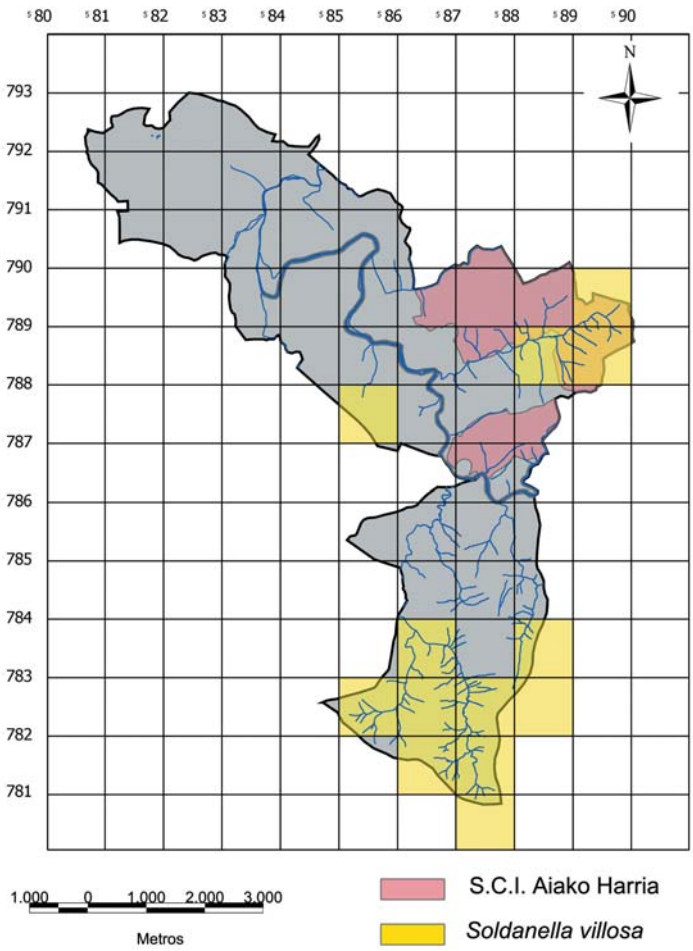

Fig. 7.- Map displaying the new subpopulations of *S. villosa* found in Hernani municipality. The 1x1 km^2 grids where it is present are marked in yellow.

7. Irudia.- Hernanin aurkituriko *S. villosa* subpopulazio berriak dauden 1x1 km^2 koadrikulak horiz adierazten dituen mapa.

found within Hernani (52), the abundance of *S. villosa* would appear to be similar, or even higher than, that reported in the Aiako Harria Natural Park (Arbelaitz *et al.,* 2002), which is in the central zone of the species distribution area. Furthermore, *S. villosa* has been found in 13 new km^2 grids in Hernani, a significative amount considering that this species has previously been reported in only 29 of the km^2 grids throughout the whole of the Basque Country (AIZPURU *et al.,* 2010).

Stegnogramma pozoi (Lag.) K. Iwats. (Fig. 3e)

Material examined: ESP. GIPUZKOA (SS): Hernani, Azketa erreka, 30TWN8682, 344 m, shaded cliff, under a spring, 19-04-2009*, I. Sanz* & *I. Olariaga*, ARAN 69277. Hernani, Epele erreka, 30TWN8789, 97 m, slope close to the stream, 17-01-2010*, I. Sanz*, ARAN 69628; 587141 4790058, 59 m, small slope near the stream, 17-01-2010*, I. Sanz*, ARAN 69629. Hernani, Erramuerreka, 30TWN8588, 20 m, on a slope between waterfalls, 06-04-2010*, I. Sanz*, ARAN 69624. Hernani, Kartola erreka, 30TWN8683, 170 m, small spring, near the main watercourse, 14-03-2009*, I. Sanz* & *I. Olariaga*, ARAN 69275. Hernani, Purgatorio erreka, 30TWN8684, 190 m, shaded cliff near a waterfall, 25-07-2009*, I. Sanz* & *I. Olariaga*, ARAN 69276. Hernani, Urmendi erreka, 30TWN8685, 80 m, small slope near the track, 17-01-2010*, I. Sanz* & *I. Goñi*, ARAN 69625.

Notes: Some additional, new localities of this biogeographically interesting fern are provided. It seems to be widespread in suitable habitats within the Basque Country (Aseginolaza *et al.,* 1985). Although it is neither in the BRL nor the SRL, in the neighbouring Navarre it is considered to be sensitive to habitat degradation (Anonymous, 1997), and the species is strictly protected in France (OLIVIER *et al.,* 1995).

Vandenboschia speciosa (Willd.) G. Kunkel.[1]

≡ *Trichomanes speciosum* Willd.

Material examined: ESP. GIPUZKOA (SS): Hernani, Apaizeta erreka, 588747 4788528, 316 m, under two rocks, near a waterfall, in the shade, 17-07-2009*, I. Sanz* & *I. Olariaga*, ARAN 69130; 588817 4788436, 211 m, earthy slope near the waterfall, 17-07-2009*, I. Sanz* & *I. Olariaga*, ARAN 69129, [fertile]. Hernani, Azketa erreka, 30TWN8682, 344 m, close to waterfall, under two rocks, 19-04-2009*, I. Sanz* & *I. Olariaga*, ARAN 69122, [fertile]; 30TWN8682, 336 m, close to the stream in the shade in a small cave, 19-04-2009*, I. Sanz* & *I. Olariaga*, ARAN 69124, [fertile]; 30TWN8682, 321 m, near the main watercourse, in a spring, 19-04-2009*, I. Sanz* & *I. Olariaga*, ARAN 69126; 30TWN8683, 278 m, under two rocks lying near a waterfall, in the shade, 19-04-2009*, I. Sanz* & *I. Olariaga*,

[1] The cited materials consist of sporophytes, unless otherwise indicated. The material with sporangia is referred to as fertile.

ARAN 69127, [fertile]; 30TWN8682, 338 m, near a waterfall, water splashed, 19-04-2009, *I. Sanz* & *I. Olariaga*, ARAN 69123; 30TWN8683, 247 m, slope near a track and the watercourse, 8-03-2009, *I. Sanz* & *I. Olariaga*, ARAN 69292; 30TWN8683, 276 m, earthy slope, near the pipe that crosses the track, 19-04-2009, *I. Sanz* & *I. Olariaga*, ARAN 69128, [fertile]; 30TWN8682, 321 m, shaded slope at the edge of the watercourse, 19-04-2009, *I. Sanz* & *I. Olariaga*, ARAN 69125; 30TWN8683, 235 m, earthy slope near a waterfall, 8-03-2009, *I. Sanz* & *I. Olariaga*, ARAN 69286; 30TWN8682, 334 m, spring in a vertical cliff, together with *Soldanella villosa*, 8-03-2009, *I. Sanz* & *I. Olariaga*, ARAN 69289. Hernani, Branketa erreka, 30TWN8889, 248 m, close to the watercourse, in shaded cliff, and on top of a stone, 25-07-2009, *I. Sanz* & *I. Olariaga*, ARAN 69149 [with gametophyte]; 30TWN8889, 249 m, siliceous cliff near the watercourse, 25-07-2009, *I. Sanz* & *I. Olariaga*, ARAN 69121, [fertile]. Hernani, Erramuerreka, 30TWN8588, 221 m, vertical cliff near a waterfall, 26-04-2009, *I. Sanz* & *I. Olariaga*, ARAN 69148. Hernani, Usoko erreka, 30TWN8989, 181 m, underneath a stone situated under a waterfall, 17-07-2009, *I. Sanz* & *I. Olariaga*, ARAN 69282; 30TWN8989, 163 m, slope near the river, 17-07-2009, *I. Sanz* & *I. Olariaga*, ARAN 69281, [fertile]. Hernani, Kartola erreka, 30TWN8781, 459 m, close to the watercourse, in a small cave covered by two large stones, 4-04-2009, *I. Sanz* & *I. Olariaga*, ARAN 69144; 30TWN8781, 444 m, water splashed location, near a waterfall, 4-04-2009, *I. Sanz* & *I. Olariaga*, ARAN 69145; 30TWN8783, 270 m, small creep near the watercourse, shaded 14-03-2009, *I. Sanz* & *I. Olariaga*, ARAN 69147; 30TWN8683, 206 m, small hole in a rock, amongst the roots of a pollard oak, 17-01-2010, *I. Sanz*, ARAN 69626; 30TWN8782, 300 m, siliceous vertical cliff, mossy, 14-03-2009, *I. Sanz* & *I. Olariaga*, ARAN 69146. Hernani, Larrakaitz erreka, 30TWN8887, 81 m, near a small waterfall, in a wet area, 19-06-2009, *I. Sanz* & *I. Olariaga*, ARAN 69256; 30TWN8887, 78 m, near a small waterfall, in the shade, covered with vegetation, 19-06-2009, *I. Sanz* & *I. Olariaga*, ARAN 69258, [data gaizki dago]; 30TWN8887, 82 m, near a small waterfall, in the shade, covered with vegetation, 19-06-2009, *I. Sanz* & *I. Olariaga*, ARAN 69259; 30TWN8788, 78 m, dry cliff near the watercourse, 19-06-2009, *I. Sanz* & *I. Olariaga*, ARAN 69143, [fertile]; 30TWN8788, 32 m, small stream, in a waterfall, in the shade in a wet area, 19-06-2009, *I. Sanz* & *I. Olariaga*, ARAN 69142; 30TWN8888, 152 m, cliff near a waterfall, in a rather insolated area, 19-06-2009, *I. Sanz* & *I. Olariaga*, ARAN 69141. Hernani, Lizarregi erreka, 30TWN8888, 273 m, near a waterfall, on a rock, 30-12-2009, *I. Sanz* & *I. Olariaga*, ARAN 69498, [fertile]. Hernani, Purgatorio erreka, 30TWN8684, 190 m, at the edge of a waterfall, 25-07-2009, *I. Sanz* & *I. Olariaga*, ARAN 69264, [fertile]; 30TWN8684, 210 m, at the edge of a waterfall, 25-07-2009, *I. Sanz* & *I. Olariaga*, ARAN 69265. Hernani, Sagarreta erreka, 30TWN8885, 190 m, on both sides of a waterfall, somewhat splashed by the water, 28-03-2009, *I. Sanz* & *I. Olariaga*, ARAN 69260; 30TWN8785, 170 m, at the edge of a waterfall, on a rock, 28-03-2009, *I. Sanz* & *I. Olariaga*, ARAN 69257; 30TWN8883, 309 m, cliff near the waterfall, in the shade, 28-03-2009,

I. Sanz & *I. Olariaga*, ARAN 69262; 30TWN8884, 270 m, on a cliff in the shade, 28-03-2009*, I. Sanz* & *I. Olariaga*, ARAN 69261. Hernani, Saratsain erreka, 30TWN8687, 41 m, in the watercourse, in the shade, 13-06-2009*, I. Sanz* & *I. Olariaga*, ARAN 69287. Hernani, Urmendi erreka, 30TWN8684, 127 m, near the watercourse, shaded cliff, 6-06-2009*, I. Sanz* & *I. Olariaga*, ARAN 69284; 30TWN8684, 142 m, spring near the watercourse, 6-06-2009*, I. Sanz* & *I. Olariaga*, ARAN 69283, [fertile].

Notes: A species which is included as Vulnerable (B1, D2) in the SRL and the updated BRL of 2011. This paleotropical fern has been cited in a few localities

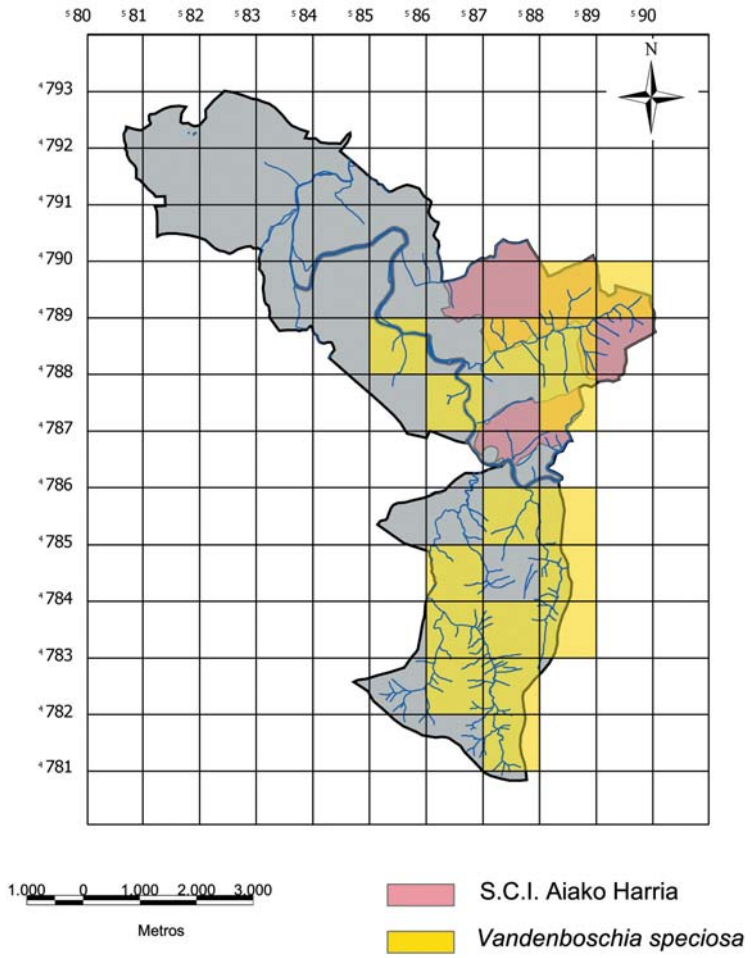

Fig. 8.- Map displaying the new subpopulations of *V. speciosa* found in Hernani municipality. The 1x1 km^2 grids where it is present are marked in yellow.

8. Irudia.- Hernanin aurkituriko *V. speciosa* subpopulazio berriak dauden 1x1 km^2 koadrikulak horiz adierazten dituen mapa.

within Gipuzkoa (Catalán & Aizpuru, 1985; Lizaur & Terés, 1995; Aizpuru *et al.,* 2005). It has also been reported at two localities in Hernani (Aizpuru *et al.,* 1990; ARBELAITZ *et al.,* 2002), which we have confirmed during our study. We also found 38 new sporophyte subpopulations of *V. speciosa* within Hernani (Fig. 8), distributed in 17 of the km² grids (15 of which were new sites). This contrasts with previous recordings in only 27 grids across the whole of the Basque Country. This high number is remarkable, considering the scarceness of the species in the neighbouring Aiako Harria Natural Park and the Leitzaran Valley, and in the Iberian Peninsula in general (Arbelaitz *et al.* 2002).

V. speciosa is one of the few ferns (the only one in Europe) in which the two generations of its life cycle (gametophyte and sporophyte) are perennial and can live independently. The gametophyte can reproduce asexually by producing vegetative propagules, resulting in populations which do not contain the sporophyte (Rumsey *et al.,* 1998, 1999). Solely gametophytes are known in many areas of north and central Europe (Vogel *et al.*, 1993; Rumsey *et al.,* 1998; Turo_ová, 2005), where, conversely, the sporophyte is unknown. To our knowledge, the gametophyte phase has very rarely been reported in the Iberian Peninsula, only in Cádiz (Pérez Latorre *et al.,* 2005), Biscay and Cantabria (J. Garmendia, pers. comm.), and the northern part of Navarre (Oreja 2008). It has also been reported a few times in the French Basque Country (Loriot, 2005). Fieldwork during this study showed that the gametophyte generation (Fig. 9),

Fig. 9.- In-situ photograph of *V. speciosa* (ARAN 69149), showing the sporophyte and gametophyte generations. The arrow and broken circle indicate a gametophyte patch.

9. Irudia.- In-situ ateratako *V. speciosa* (ARAN 69149) argazkia, esporofito eta gametofito belaunaldiak erakutsiaz. Geziak eta marradun borobilak gametofitoa darakus.

previously overlooked, is not only present but widespread within suitable habitats in Hernani. Fieldwork in collaboration with the research team of Dr. Víctor Suárez (University of Granada), revealed that in some streams most individuals of the *V. speciosa* populations correspond to the gametophyte generation. The gametophyte individuals exceeded the sporophytes in the Apaizeta (14 gametophytes, 2 sporophytes) and Branketa streams (16, 2), whilst numbers were more or less equal in other streams, such as Azketa (19 gametophytes, 18 sporophytes), Larrakaitz (8, 6) and Usoko (6, 6). This variation may be due to the differing habitat requirements of the gametophyte and sporophyte generations (Makgomol & Sheffield, 2001; Kingston & Hayes, 2005) and changes in habitat availability from stream to stream.

It has been noted that the sporophyte generation seldom possesses sporangia in the Iberian Peninsula (Castroviejo *et al.,* 1986), at least in the herbarium material, as Aizpuru *et al.* (1999) also claimed for the Basque Country. In Hernani, at least 11 of the 48 colonies discovered were fertile.

Veratrum album L. (Fig. 3f)

Material examined: ESP. GIPUZKOA (SS): Hernani, between Antxista and Unamuno peaks, 30TWN8681, 763 m, peat bog with *Sphagnum* and *Polytrichum commune*, at edge of *Larix kaempferi* plantation, 4-04-2009*, I. Sanz* & *I. Olariaga*, ARAN 69270. Hernani, Santodomingo erreka, 30TWN8681, 726 m, spring coming out of the ground, in an alder stand, together with *Soldanella villosa*, 13-04-2009*, I. Sanz* & *I. Olariaga*, ARAN 69274; 30TWN8781, 714 m, shaded spring in *Alnus glutinosa* and *Salix atrocinerea* stand, stony, 4-04-2009*, I. Sanz* & *I. Olariaga*, ARAN 69268.

Notes: *Veratrum album* is considered as a species of Special Interest in the BRL, its populations being highly isolated and containing few individuals (Uribe-Echebarria & Campos, 2006). In spite of having been cited in a few localities in Gipuzkoa (Aseginolaza *et al.,* 1985; Catalán & Aizpuru, 1985; Aizpuru *et al.,* 2004), this species was unknown in the Adarra-Mandoegi chain. The three new sites we found (Fig. 10) are at springs located in the montane stage. The subpopulation where ARAN 69268 was collected is of particular importance since it contains ca. 25 individuals.

General results

A total of 112 new subpopulations of threatened plants were discovered in this study. The number of subpopulations by stream and species is presented in Tab. 1. The Apaizeta, Azketa and Kartola streams stand out because of the high number of subpopulations that they harbour, corresponding to four, four and five threatened species respectively. In Tab. 2, we show the total number of 1x1 km^2 grids for each threatened plant considered here, in the Basque Country

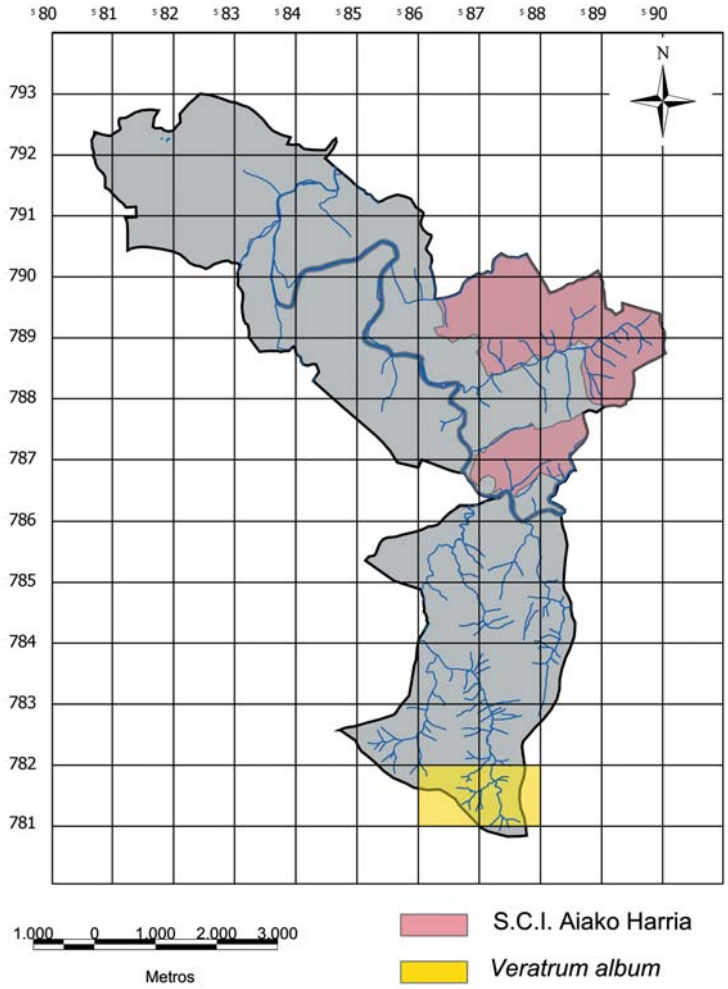

Fig. 10.- Map displaying the new subpopulations of *V. album* found in Hernani municipality. The 1x1 km² grids where it is present are marked in yellow.

10. Irudia.- Hernanin aurkituriko V. album subpopulazio berriak dauden 1x1 km² koadrikulak horiz adierazten dituen mapa.

as a whole, and also the proportion located in Hernani. Hernani hosts 33% of the km² grids within the Basque Country where *H. tubringense* is known, along with 31% of *S. villosa* and 37% of *V. speciosa*. Tab. 3 compares the number of subpopulations of threatened species known in the Aiako Harria Natural Park (S.C.I.), with the number of subpopulations from Hernani that are located within the protected area, and outside it. Most of the subpopulations of threatened plants found in Hernani are located outside protected areas.

Stream	*D. aemula*	*H. tunbrigense*	*P. lusitanica*	*S. villosa*	*V. speciosa*	*V. album*	*Total*
Erramuerreka	0	0	1	0	1	0	2
Saratsain	0	0	0	1	1	0	2
Purgatorio	0	0	0	0	2	0	2
Urmendi	0	0	0	1	2	0	3
Azketa	1*	4	0	9*	10	0	25
Ursaltueta	1	0	0	1*	0	0	2
Kartola	1	2	0	18*	5	1	27
Santodomingo	0	0	0	10*	0	2	12
Sagarreta	0	1	0	2	4	0	7
Larrakaitz	0	0	0	0	6	0	6
Lizarregi	0	0	0	0	1	0	1
Apaizeta	0	3	1	6*	2	0	12
Izeneder	0	1	0	3	0	0	4
Usoko	0	0	0	1	2	0	3
Branketa	0	0	0	0	2	0	2

Table 1.- Number of subpopulations of threatened plants by species in different streams across Hernani. The column total indicates the total number of subpopulations in each stream. Asterisks indicate the presence of subpopulations with remarkably abundant individuals.

1. Taula - Landare mehatxatu subpopulazio kopurua erreka bakoitzeko Hernaniko udalerrian, espeziez espezie. Azken zutabeak erreka bakoitzeko landare mehatxatu subpopulazio kopurua darakus. Asteriskoek indibiduo kopurua de la eta azpimarragarriak diren subpopulazioak adierazten dituzte.

	Basque Country	Hernani municipality	% of 1x1 km grids in Hernani
D. aemula	38	3	8
H. tunbrigense	18	6	33
P. lusitanica	7	2	29
S. villosa	42	13	31
T. speciosum	44	17	37
V. album	51	2	4

Table 2.- Number of 1x1 km^2 grids in which *D. aemula, H. tunbringense, P. lusitanica, S. villosa, V. speciosa* and *V. album* are found in the Basque Country and the Hernani municipality, along with the proportion of grids located in Hernani.

2. Taula - *Dryopteris aemula, H. tunbringense, P. lusitanica, S. villosa, V. speciosa and V. album* 1 x 1 km^2 karratu kopurua E.A.E.n eta Hernanin, eta Hernanin kokatuta dauden 1 x 1 km^2 karratu proportzioa.

	AIAKO HARRIA S.C.I.	HERNANI MUNICIPALITY	
		In Aiako Harria S.C.I.	Outside Aiako Harria S.C.I.
D. aemula	0	0	3
H. tunbrigense	7	2	4
P. lusitanica	1	1	1
S. villosa	24	3	10
T. speciosum	6	2	15
V. album	2	0	2

Table 3.- . Number of subpopulations of threatened plants known in the Aiako Harria S.C.I., together with the subpopulations within Hernani and either in or outside the Aiako Harria S.C.I.

3. Taula - Aiako Harria I.B.G.-an ezagutzen den landare mehatxatu subpopulazio kopurua, eta Hernanin aurkitutako subpopulazioen artean, zenbat diren Aiako Harria I.B.G. barruan eta zenbat kanpoan.

Discussion

Previous to this study, only three red-listed species had been cited in Hernani, at a total of four sites, namely *Hymenophyllum tunbrigense*, *Dryopteris aemula* and *Vandenboschia speciosa* (Aseginolaza *et al.,* 1985; Aizpuru *et al.,* 1990; ARBELAITZ *et al.,* 2002). This study has contributed not only to the mapping of new subpopulations of these species, but also to the discovery of *Prunus lusitanica*, *Soldanella villosa*, *Stegnogramma pozoi*, and *Veratrum album* in Hernani. This makes a total of six red-listed species, all of which are associated with stream and spring microhabitats. Four of these species are paleotropical ferns, which find a suitable habitat in the narrow and steep valleys that are characterized by special conditions of high humidity and constant temperature.

A total of 112 subpopulations of the six red-listed plant species have been precisely mapped as an outcome of this study, which is highly important from a conservational point of view. The abundance of subpopulations of *S. villosa* and *V. speciosa* is comparable, or even higher, than that reported in the Aiako Harria Natural Park (Arbelaitz *et al.* 2002). Considering the subpopulations from Hernani, most of the new reports are located outside the Aiako Harria. Thus, Hernani is likely to harbour some of the most important populations of certain species, such as *S. villosa* and *V. speciosa*, not only on a regional scale, but also in the wider Iberian context.

As mentioned above, a small part of Hernani municipality is included in the Aiako Harria Natural Park. Remarkably, a large proportion of the subpopulations have been found outside this area. Furthermore, all the species have at least one population outside the protected area, where intense forestry activities may represent a serious threat to some of them. The design and establish-

ment of special protection microreserves, similar to the microreserve network implemented in dune habitats in the Basque Country (García-Mijangos *et al.* 2011) and in the south-east of the Iberian Peninsula (Laguna *et al.*, 2004), could be a suitable solution for supporting the conservation of these populations in the future. As a result of this work, we propose that the Urumea S.C.I. be extended to all small valleys and to the streams that discharge into this river, in order to protect the subpopulations of threatened plants found here. Alternatively, if this first proposal is not achievable, the Azketa, Kartola and Apaizeta streams should be declared as threatened plant microreserves.

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