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Morphometric recognition of *Hordeum murinum* L. subspecies in Slovenia

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Abstract:

Jogan, N.: Morphometric recognition of *Hordeum murinum* L. subspecies in Slovenia. *Biologica Nyssana*, 8 (1), September 2017: 23-30.

Morphometric analysis of Slovenian material belonging to *Hordeum murinum* ssp. *leporinum* and type subspecies confirmed some of already reported distinguishing characters, but majority of them were not measured precisely before. After revision of herbarium material based on results, about 9% of sheets are still somehow »intermediate«, *H. murinum* ssp. *leporinum* is more common in Submediterranean part with some scattered populations in continental Slovenia and the type subspecies occur all over Slovenia in lowland ruderal places. Detailed determination key is provided based on results.

Key words: *Hordeum murinum*, subspecies delimitation, Slovenia

Apstrakt:

Jogan, N.: Morfometrijsko razpoznavanje podvrsta *Hordeum murinum* L. u Sloveniji. *Biologica Nyssana*, 8 (1), Septembar 2017: 23-30.

Morfometrijske analize materijala vrste *Hordeum murinum* sa područja Slovenije potvrdile su prisutnost dve podvrste: *H. murinum* ssp. *leporinum* i tipske podvrste. Potvrđeni su neki već ranije upotrebljeni karakteri za razlikovanje i pored toga preciznije su obrađeni neki od karaktera, koje su prethodni autori pretežno navodili samo deskriptivno. Između ostalog, revizija herbarijumskog materijala je jedan od rezultata, koji potvrđuje veliku prisutnost *H. murinum* ssp. *leporinum* u obalnom submediteranskom području Slovenije sa nekoliko lokalnih populacija i u unutrašnjosti, a tipska podvrsta se javlja po čitavoj Sloveniji na ruderalnim mestima u nizijama. Oko 9% materijala nije identifikovano. . Prikazan je ključ za determinaciju pomenute dve podvrste.

Ključne reči: *Hordeum murinum*, razdvajanje podvrsta, Slovenija

Introduction

Grasses themselves are often neglected even by serious field botanists, particularly so when they are part of ruderal vegetation. This is also the case of *Hordeum murinum* complex, which is probably one

of the best studied groups in the genus, however, the taxonomic delimitation of subordinated taxa has always been controversial (Nevski, 1941; Cudrado et al., 2013). In Central and SE Europe, *Hordeum murinum* complex represents a taxonomically interesting polyploid group with 4

taxa recognized at the level of subspecies (or sometimes species). Two of them are rare in the mentioned territory, *H. murinum* ssp. *glaucum* (Steud.) Tzvelev confined to the warmest areas of Southern Europe (e.g. Greece, Cyprus, S Italy, Spain) and a peculiar *H. murinum* ssp. *setariurum* H. Scholz & Raus known only from few localities in N Greece and S Macedonia (Scholz & Raus, 1997; Jogan, 2005). *Hordeum murinum* ssp. *leporinum* (Link) Arcang. and the type subspecies are reported in much wider area with "*leporinum*" being more thermophilous and particularly common in Mediterranean Europe and the type subspecies widespread but with overlapping range reaching as far South as Peloponnese and N Aegean (Strid, 2016). There are three ploidy levels recognized in the group, diploids ($2n=14$), tetraploids ($2n=28$) and hexaploids ($2n=42$) but the taxonomic delimitation is not congruent with ploidy levels so at least two different ploidy levels are reported for each subspecies, e.g. mostly $2n=28$ but also $2n=42$ or $2n=14$ for both widespread subspecies (Cvelev, 1976; Kankapaa et al., 1996; Tison & Foucault, 2014; Cuadrado & al., 2013). There is no completely reliable morphological characteristic that distinguishes the recognized subspecies, so several authors refer to the "*murinum* complex" (Cuadrado & al., 2013). Despite several studies evolution of the polyploid *H. murinum* complex is still not well understood (ibid.) and we can still agree with Nevski (1941), that *H. leporinum* is an ancestor of *H. murinum* s. str., whose spread towards North had been connected to man made ruderalization.

In the territory of Slovenia (and also neighbouring countries) only the two widespread subspecies are reported, namely *H. murinum* ssp. *murinum* (further **Hmm**) and *H. murinum* ssp. *leporinum* (**Hml**). In the past, their distribution had been simply recognized as allopatric: Hml reported only for the coastal Submediterranean region of Slovenia and Hmm as being excluded from that region and scattered in all other parts (Martinčič, 1984). But some field records blurred that picture with Hml records in the continental Slovenia and also Hmm recorded in some localities in the coast (Jogan & al., 1999; Jogan, 2007). Using determination keys it is not always easy to distinguish the two subspecies so our aim was to test the usefulness of morphometric characters for delimitation.

In European floristic works approach in delimitation of the studied two taxa is slightly diverse, either taxa are recognized as independent species (Nevski, 1941; Pignatti, 1983; Martinčič, 1984; Lambinon & al., 1992;

Jogan, 2007) or mostly as subspecies (Amaral Franco & Rocha Afonso, 1998; Bolos & Vigo, 2001; Cincović & Kojić, 1976; Ciocirlan, 1990; Conert, 2000; Csiky, 2009; Cuadrado & al., 2013; Fischer & al., 2008; Ilijanić & Topić, 2000; Lauber & Wagner, 1998; Poldini & al., 2002; Stohr, 2002; Tison & Foucault, 2014). Both were mentioned in countries with at least some submediterranean influence, but in Central and W Europe Hml mostly as only casual plant of ruderal sites (Conert, 2000; Lambinon & al., 1992).

Determination keys are mostly using 1-3 characters for delimitation between Hmm and Hml, only some up to 5 characters (Nevski, 1941; Bolos & Vigo, 2001; Jogan, 2007; Lauber & Wagner, 1998). In majority of keys difference in spikelet (and awn) length between central and lateral spikelets of triple is mentioned and quite often also differences in shape of both glumes of lateral spikelet. Often the only mentioned distinguishing measure is length of central spikelet's "stalk". This stalk is a peculiar characteristic in some *Hordeum* species and is developed above glumes and below lemma, so in fact this is a prolonged internode of spikelet axis. Reported gap of this measurement between the subspecies is between 0.6 and 1 mm, in Hmm central spikelet stalk is shorter and in Hml longer, mostly with no overlapping reported (Nevski, 1941; Amaral Franco & Rocha Afonso, 1998; Bolos & Vigo, 2001; Ciocirlan, 1990; Fischer & al., 2008; Jogan, 2007; Stohr, 2002; Tison & Foucault, 2014). In practice it is often not so easy to use this character. Other distinguishing characters used in some of the determination keys were: inflorescence width (Bolos & Vigo, 2001; Lauber & Wagner, 1998) and colour (Lauber & Wagner, 1998; Tison & Foucault, 2014), lateral lemma width (Nevski, 1941; Jogan, 2007) and hairiness (Cvelev, 1976; Jogan, 2014).

Material and methods

Herbarium material available in herbarium LJU (University of Ljubljana, Biotechnical Faculty) and personal herbarium collection of the author (HSNJ, Hortus siccus N. Jogan) enriched by some more systematic sampling for *H. murinum* have been taken as the main source for selection of representative sample of well preserved specimens, together 86 sheets served as operational taxonomic units (OTUs).

In each selected herbarium sheet one well preserved and complete plant served as an OTU and all the measurements taken on that plant. In the measuring phase, one inflorescence was broken apart

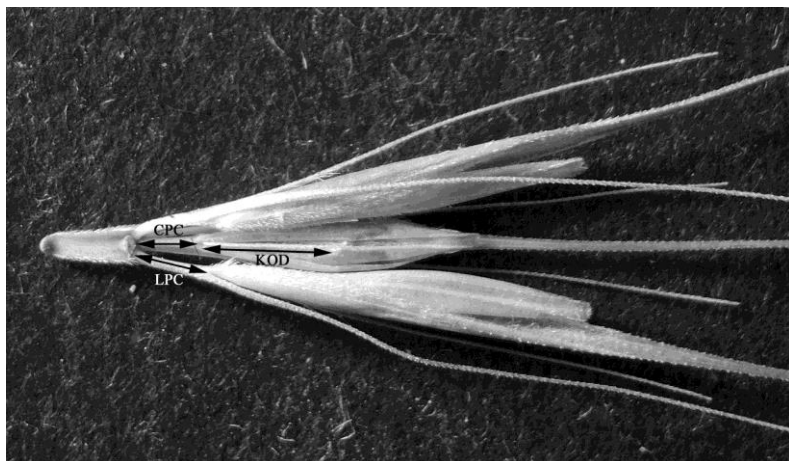


Fig. 1. Three of the mentioned characters that are specific for *Hordeum* spikelet triple: CPC (length of central "stalk"), LPC (length of lateral "stalk") and KOD (length of central spikelet axis prolongation)

so that all spikelet measurements were done on the triple of spikelets from the central part of inflorescence. Remaining spikes are enclosed in herbarium capsulae attached to the sheet. Macroscopic measurements were done by a ruler and all smaller parts measured under stereo microscope Euromex at 20x magnification and with an ocular measuring scale divided to 1/20 mm.

All the distinguishing characters used in above mentioned literature were measured (one measurement per each character per OTU) and in addition to them about as big number of other potentially useful characters as follows:

VSN: total plant height (dm), CPP: palea length of central spikelet (cm), CR: length of central lemma's awn (cm), CPC: length of central "stalk" (mm), CKP: width of central lemma (mm), ANT: length of ripe anther (mm), LPP: palea length of lateral spikelet (cm), LR: length of lateral lemma's awn (cm), LPC: length of lateral "stalk" (mm), LKP: width of lateral lemma (mm), DPP: central palea hairy (Y/N), Dstr: margin of outer lateral spikelet glume ciliate (Y/N), Dnot: margin of inner lateral spikelet glume ciliate (Y/N), KOD: length of central spikelet axis prolongation (mm), KOS: width of central spikelet axis prolongation (mm), KOB: axis prolongation yellow (Y/N). Palea lengths were taken as equal to lemma lengths, so the lemma's awn lengths were measured from the palea tip to the end of awn. Some peculiar character measurements are shown in **Fig. 1**.

Input matrix of 86 OTUs with 12 measured characters were used for all subsequent analyses starting with simple univariate statistics and further on different multivariate approaches (using PAST 1.74, http://palaeo-electronica.org/2001_1/past/) to

recognize taxonomic structure. A priori formed groups of 2 taxa (Hm and Hml) were slightly modified after results of numerical analyses so at the end a small "transitional" group of OTUs with unclear taxonomic position had been recognized as the third entity. After removing that group from analyses, the taxonomic structure is much more clear-cut, but in the field we have to be aware of such populations.

Studied material is listed in Supplementum with locality, MTB grid code (Niklfield, 1971), author, date, herbarium acronym and accession number.

Results and discussion

Majority of OTUs was determined using the mentioned determination keys but some of them (9%) remain at the level of *H. murinum* s. lat. Those were temporarily excluded from the data matrix for first univariate statistical analyses. From all measured characters, some that showed a potential usefulness for distinguishing studied taxa are represented by box plots in **Fig. 2**. Usefulness of already reported distinguishing characters has mostly been confirmed for following characters: central stalk length (**Fig. 2a**), central awn length (**Fig. 2b**), lateral awn length (**Fig. 2c**), lateral palea length (**Fig. 2d**), lateral lemma width (**Fig. 2e**) and plant height (**Fig. 2f**). Several of them are reported in determination keys without measurements, only describing their relative length.

Some of the recorded attribute characters were more randomly distributed among studied taxa and results are not presented here because of limited usability for distinguishing taxa.

Several conducted multivariate analyses helped us to recognize the most useful distinguishing characters and also to recognize the overall taxonomic structure. With exclusion of mentioned small group of «intermediates» separation of two clusters representing both subspecies was clear with only slight overlapping as shown in **Fig. 3**. Obviously delimitation of subspecies will remain uneasy in some populations.

Interesting results turned to be comparison of total lengths of spikelets (**Fig. 4**), quite often roughly mentioned as »lateral awn exceeding central awn« or »... not exceeding ...«. Total lengths were calculated from 3 measurements for each spikelet (CPC+CPP+CR and LPC+LPP+LR respectively). Indeed in Hm central awn is mostly slightly

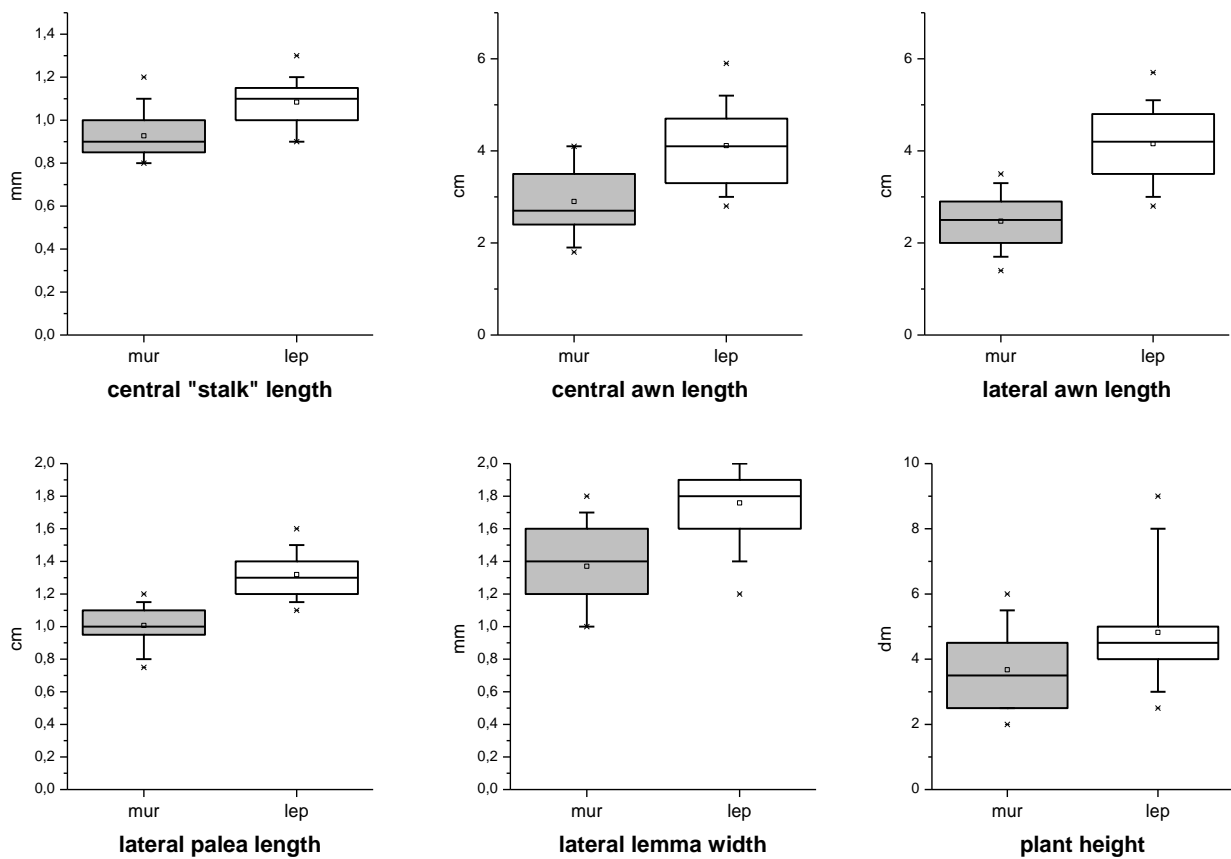


Fig. 2. Box plots of some of the useful distinguishing characters. Box comprising 2nd and 3rd quartile, whiskers 1st and 4th quartile, some outliers marked with *, Hmm on the left (grey), Hml on the right (white). a) central stalk length; b) central awn length; c) lateral awn length; d) lateral palea length; e) lateral lemma width; f) plant height

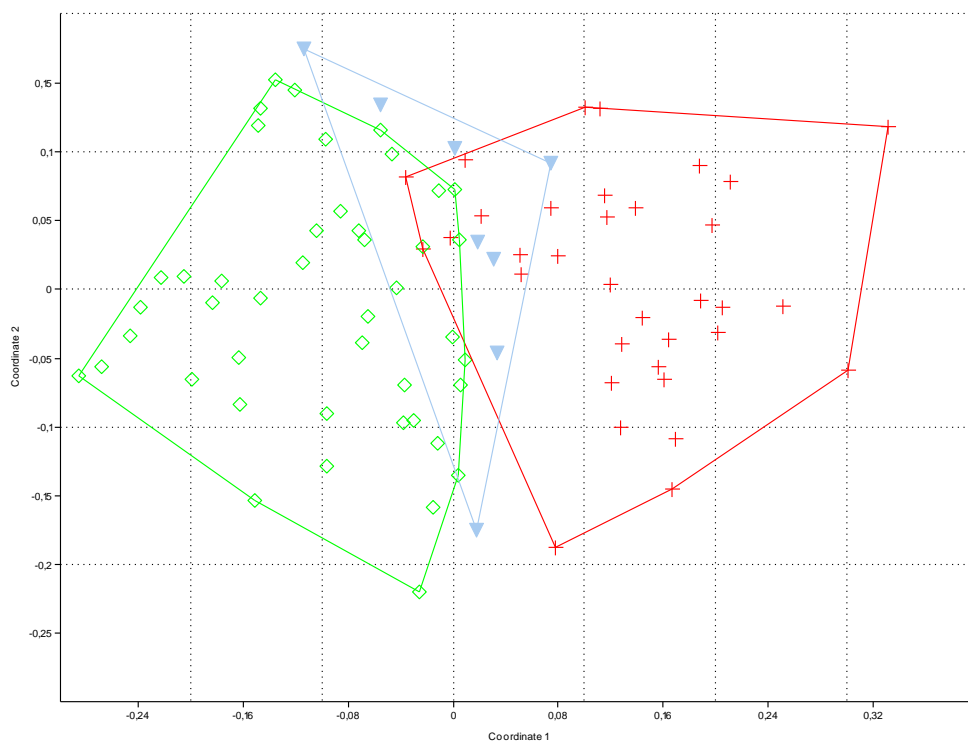


Fig. 3. Results of PCA. Input data matrix with 12 characters and 86 OTU grouped in Hml (red crosses), Hml (red crosses), Hml (red crosses) and intermediate group (blue triangles)

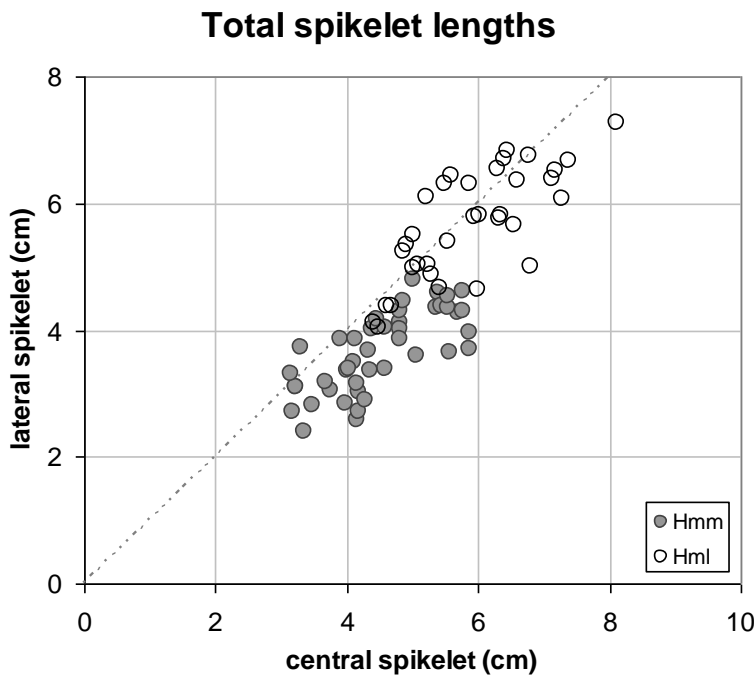


Fig. 4. Comparison of total spikelet lengths of central vs. lateral spikelet of triple. Hmm represented with grey, Hml with empty symbols. Equal lengths at dashed diagonale, longer central spikelet below

exceeding the laterals, but in Hml where it is often stated, that laterel awns are exceeding central one, situation is more diverse with only about half of OTU having laterel awns reaching or exceeding the central one. But mostly dimensions of spikelets are distinctly bigger than in Hmm, so probably better distinguishing character for quick orientation in the field would be: total length of spikelets 3-5 cm vs. 5-7 cm in Hmm and Hml respectively. In fact all the average measured values of Hmm and Hml differ mostly 20-35%, an interesting situation that is often observed in polyploids when compared to ancestral diploids, but in discussed group both subspecies are predominantly tetraploid so interpretation must be different.

Our results can be compiled in a determination key which use much more characters than the others mentioned above and some of the measurements are now more precisely measured. But of course we have to bear in mind that Slovenia is a tiny territory where distribution range of both discussed taxa overlap and so populations far from studied area can be slightly different.

Statistics of the useful distinguishing characters are presented as minimum and maximum (in brackets) and an interval between 1st and 3rd quartile.

1 Total spikelet lengths (including awns) (2.5) 3.5-4.6 (5.9) cm, central spikelet of a triple with

»stalk« (0.3) 0.6-1 (1.4) mm long, palea (0.8) 0.85-1 (1.2) cm long and lemma's awn (1.8) 2.4-3.5 (4) cm long, lateral spikelets with lemma's awn (1.4) 2-3 (3.5) cm long, palea (0.75) 0.9-1.1 (1.2) cm long and lemma (1) 1.2-1.6 (1.8) mm wide. Anthers (0.6) 0.7-1 (1.4) mm, plant (20) 25-45 (60) cm

.....*H. murinum* ssp. *murinum*

1* Total spikelet lengths (including awns) (4) 5-6.5 (8) cm, central spikelet of a triple with »stalk« (0.5) 0.9-1.2 (1.5) mm long, palea (0.9) 1-1.15 (1.3) cm long and lemma's awn (2.8) 3.4-4.7 (5.9) cm long, lateral spikelets with lemma's awn (2.8) 3.5-4.8 (5.7) cm long, palea (1.1) 1.2-1.4 (1.6) cm long and lemma (1.2) 1.6-1.9 (2.1) mm wide. Anthers (0.7) 0.9-1.3 (1.6) mm, plant (25) 40-50 (90) cm

.....*H. murinum* ssp. *leporinum*

And finally here is the updated distribution map of the studied taxa in Slovenia (**Fig. 5**). With light grey dots not only "intermediate" OTUs were represented but also other reported occurrences of *H. murinum* complex (cf. Jogan et al., 2001) for which no herbarium material had been available so it is better to recognize them on that taxonomic level. Obviously the group is represented only in lowland Slovenia mostly below 300 m a.s.l., only few scattered localities can reach up to 600 m a.s.l. along the main highways. In the extreme SW part along the Adriatic coast and in Vipava valley Hml is the common taxon, but also some populations of Hmm can be found. In central and E Slovenia Hmm is present in majority of sampling sites, but there are also some records of Hml populations.

As it has been expected that both studied taxa are mostly tetraploids, possible hybridization could not be excluded as a cause for "intermediate" populations, but detailed study of those "intermediate" OTUs was beyond our scope. It is important to stress that in the discussed territory both studied taxa are sympatric with slightly bigger frequency of Hml populations in the SW coastal part of Slovenia and Hmm present in all lowland parts of the country. In interpreting »intermediates« also a hypothesis of Nevski (1941), that Hml is an ancestral relative of Hmm can be roughly taken into consideration, but it seems that the evolution of the »murinum complex« had been more complicated (Cuadrado & al., 2013)

Distribution pattern matches quite well pattern in adjacent Friuli-Venezia Giulia (NE Italy,

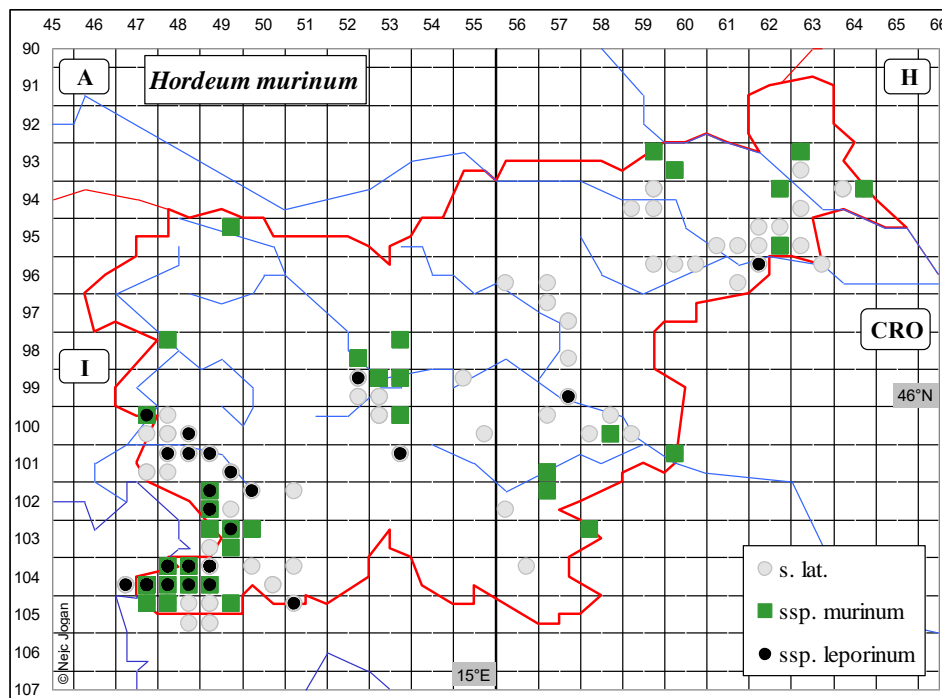


Fig. 5. Distribution of discussed taxa in Slovenia: green squares Hmm, black dots Hml, only revised records presented, grey circles: *H. murinum* s. lat. partly as a result of revision, mostly based on literature and unpublished field records

Poldini 2002) but maybe also in mentioned region Hml can be expected with some local populations further from the coast. In Croatia situation is similar, Hml reported in the coastal region with only one locality in continental part and Hmm scattered (Nikolić, 2015): In continental adjacent countries, Austria and Hungary, Hml occurrence is very local to ephemeral (Csiky, 2009; Fischer et al., 2008).

In the future presence of Hml in continental Slovenia is to be studied in detail as it would not be possible to exclude the probability of mostly ephemeral occurrence of this taxon in extremely dry ruderal places as e.g. along the railways or in abandoned gravel sites in bigger cities where "urban heat island" phenomenon can impact local mesoclimatic conditions. On the other hand it would be interesting to study populations of Hmm in the coastal part of Slovenia. At least the impression after the sampling is that Hmm is more linked to shadowy, slightly wet ruderal places whereas Hml is common in very dry ruderal communities.

Conclusion

As a result we can confirm, that both previously mentioned subspecies of *H. murinum* are present in Slovenia, there are more useful distinguishing characters than reported before but still it is not always easy to recognize the subspecies. *Hordeum*

murinum ssp. *murinum* is present all-over Slovenian lowland and *H. murinum* ssp. *leporinum* predominantly in the coastal region, but with some scattered populations also inland. Ecological preferences in the areas where both co-occur remained to be studied.

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Supplemental data: Specimina visa:

Hordeum murinum ssp. *leporinum*

Sežana (10249/3), leg. R. Justin, 16.3.1905, LJU 10130753 (17315); Strunjan (10447/4), leg. T. Wraber, 21.7.1972, LJU 10130751 (33548); Koper (10448/3), leg. T. Wraber, 19.5.1973, LJU 10130750 (24142); Biljenski griči (10148/1), leg. G. Seljak, 22.5.1987, LJU 10130766 (120321); Prade (10448/4), leg. B. Mozetič, 5.5.1989, LJU 10130785

(121541); Sežana-Vrhovlje (10249/3), leg. V. Debevec, 10.6.1989, LJU 10130784 (121095); Dane pri Sežani (10249/3), leg. M. Frelih, 10.6.1989, LJU 10130786 (121751); Piran, Mogoron (10447/3), leg. G. Planinc, 9.5.1993, LJU 10130772 (124994); Osp (10449/1), leg. N. Dolenc, 16.4.1994, LJU 10130743 (59976); Strunjan (10447/4), leg. S. Toth, 24.4.1994, LJU 10130748 (59992); Škocjan (10448/3), leg. A. Zajko, 18.6.1994, LJU 10130747 (60006); Koper, Norbedi (10448/2), leg. B. Toškan, 20.6.1994, LJU 10130749 (60051); Sežana, Kopriva (10249/1), leg.

M. Vrabc, 20.5.1995, LJU 10130757; Avber pri Sežani (10249/1), leg. M. Pegan Žvokelj, 22.5.1995, LJU 10130774 (126998); Lozice (10250/1), leg. M. Žvanut, 15.6.1995, LJU 10130759; Brkini, Sv. Pavel (10551/1), leg. N. Jogan, 29.7.1996, LJU 10130760; Vrtovin, Šateji (10048/4), leg. U. Jelenc, 25.5.1997, LJU 10130768 (127748); Dane (10249/3), leg. M. Šebart, 31.5.1997, LJU 10130767 (127788); Turjak (10153/2), leg. P. Presetnik, 26.6.1997, LJU 10130770 (127743); Panovec, strelišče (10047/2), leg. N. Jogan, 19.7.1997, LJU 10130761 (63481); Vel. Žablje (10149/1), leg. K. Vodopivec, 19.6.1999, LJU 10130763 (63403); Haloze, Borl (9662/1), leg. N. Jogan, 12.7.2002, LJU 10143040; Sp. Škofije (10448/2), leg. P. Glasnović, 2.5.2003, LJU 10134768; Sp. Škofije, Bonifika (10448/2), leg. P. Glasnović, 8.5.2004, LJU 10134770; Bertoki (10448/2), leg. P. Glasnović, 15.5.2004, LJU 10134769; Ankarani (10448/1), leg. P. Glasnović, 20.5.2005, LJU 10134771; (9957/4), leg. N. Jogan, HSNJ L1028; (9952/2), leg. N. Jogan, HSNJ L993; (10447/4), leg. N. Jogan, HSNJ P1134; (10449/3), leg. N. Jogan, HSNJ P1277; (10449/1), leg. N. Jogan, HSNJ P1293; (10148/2), leg. N. Jogan, HSNJ P1296; (10447/4), leg. N. Jogan, HSNJ P1350; (10447/4), leg. N. Jogan, HSNJ P1379; (10448/1), leg. N. Jogan, HSNJ P1423; (10448/1), leg. N. Jogan, HSNJ P1424; (10449/1), leg. N. Jogan, HSNJ P1459; (10447/4), leg. N. Jogan, HSNJ P1505; (10447/4), leg. N. Jogan, HSNJ P1623; (10447/4), leg. N. Jogan, HSNJ P1633; (10447/4), leg. N. Jogan, HSNJ P1763; (10149/4), leg. N. Jogan, HSNJ P562; (10349/2), leg. N. Jogan, HSNJ P578; (10448/1), leg. N. Jogan, HSNJ P879;

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Vremski Britof (10350/1), leg. R. Justin, 30.6.1905, LJU 10130752 (17314); Gornje Ležeče (10350/1), leg. R. Justin, 2.7.1905, LJU 10130746 (17313); Ljubljana (9953/1), leg. R. Justin, 30.5.1918, LJU 10130745 (17310); Šmarna gora (9852/4), leg. R. Justin, 6.7.1936, LJU 10130744 (17308); Ljubljana, Ilirska cesta (9953/1), leg. B. Turk, 15.9.1985, LJU 10130739; Ljubljana, Bežigrad (9953/1), leg. N. Jogan, 24.5.1988, LJU 10130756; Solkan (10047/2), leg. L. Merljak, 16.6.1989, LJU 10130783 (121108); Novo Mesto (10257/1), leg. D. Kovačec, 10.6.1993, LJU 10130778 (125060); Lendava, Sv. Trojica (9464/2), leg. N. Jogan, 12.7.1994, LJU 10130755; Preserje pri Domžalah (9853/2), leg. T. Bačič,

1.6.1995, LJU 10130776 (126581); Belveder-Ronek (10447/4), leg. J. France, 17.7.1995, LJU 10130775 (126532); Ormož (9562/4), leg. N. Herga, 8.6.1996, LJU 10130782 (127498); Pobegi (10448/4), leg. K. Sedmak, 17.6.1996, LJU 10130780 (127448); Sežana (10249/3), leg. B. Tavčar, 18.6.1996, LJU 10130781 (127524); Vel. Badin (10549/2), leg. N. Jogan, 11.5.1997, LJU 10130769; Ormož, ž. p. (9562/4), leg. N. Jogan, 29.7.1997, LJU 10130758; Grosuplje (10053/2), leg. D. Simonič, 18.5.1998, LJU 10130762 (54571); Metlika, Radovica (10358/1), leg. B. Frajman, 1.8.2001, LJU 10130864; Valdoltra (10448/1), leg. P. Glasnović, 21.4.2003, LJU 10134767; Izola (10447/4), leg. U. & W. Starmuhler, 24.4.2006, LJU 10135027; Portorož (10447/4), leg. V. Mikolaš & al., 15.5.2010, LJU 10142708; Dovje (9549/2), leg. V. Plemel, 4. 8. 1873, LJU 10130740; (9848/1), leg. N. Jogan, HSNJ A910; (9852/4), leg. N. Jogan, HSNJ L1033; (9953/1), leg. N. Jogan, HSNJ L1035; (9953/1), leg. N. Jogan, HSNJ L818; (9953/2), leg. N. Jogan, HSNJ L867; (10349/1), leg. N. Jogan, HSNJ P1241; (10249/1), leg. N. Jogan, HSNJ P1266; (10547/2), leg. N. Jogan, HSNJ P1346; (10449/3), leg. N. Jogan, HSNJ P1385; (10448/2), leg. N. Jogan, HSNJ P1408; (10447/4), leg. N. Jogan, HSNJ P1477; (10448/3), leg. N. Jogan, HSNJ P1630; (10349/4), leg. N. Jogan, HSNJ P1820; (10548/1), leg. N. Jogan, HSNJ P27; (10349/2), leg. N. Jogan, HSNJ P571; (9363/1), leg. N. Jogan, HSNJ Š769; (9462/2), leg. N. Jogan, HSNJ Š902; (9359/2), leg. N. Jogan, HSNJ Š917; (9360/3), leg. N. Jogan;

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Celje (9757/4), leg. A. Knap, 7.8.1938, LJU 10130741; Žalec (9757/1), leg. S. Grobelnik, 14.6.1993, LJU 10130777 (125058); Ljubljana, BS3 (9953/1), leg. H. Krečič, 19.6.1994, LJU 10130742 (60076); Lendava, železnica (9464/2), leg. N. Jogan, 12.7.1994, LJU 10130754; Dane-Šmarje (10249/3), leg. A. Lisjak, 30.6.1995, LJU 10130779 (126939); Hrvatinski hrib (10448/2), leg. K. Marc, 25.7.1996, LJU 10130773 (127831); Ig-Pod Strahom (10053/1), leg. J. Zajc, 26.6.1997, LJU 10130764 (63775); Zg. Hrušica (9953/3), leg. M. Kučec, 31.7.1997, LJU 10130771 (127911); Tolmin (9848/1), leg. Š. Glišovič, 22.5.1999, LJU 10130765 (63422); (10547/2), leg. N. Jogan, HSNJ P1345;