



## Distribution and preliminary assessment of a rare fungus *Hemileccinum depilatum* (Boletales, Basidiomycota) in Ukraine

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**Abstract.** *Hemileccinum depilatum* (Boletales, Basidiomycota) is currently known from Western and Central Europe, the Mediterranean, the Balkan Peninsula, and Asia (Azerbaijan and Turkey). The fungus is rare throughout its range and is included in the Red Lists in several European countries. In Ukraine, the species is known since 2006. Formerly, *H. depilatum* was found on the South Coast of Crimea, in the Mountain Crimea, Western Forest-Steppe and the Carpathians. The species was recorded only in five localities in three regions of Ukraine: Khmelnytsky, Transcarpathian, and the Autonomous Republic of Crimea. Over the recent years, the fungus has been also reported from the following five regions: Cherkasy, Ivano-Frankivsk, Kyiv, Lviv, and Ternopil. Thus, by now the total number of the species localities increased from 5 to 14. However, the number of records grows due to additional data recently provided from field observations by amateur mycologists, rather than it can be considered as a result of an increasing population trend of the fungus. Undoubtedly, *H. depilatum* is a rarely occurring species in Ukraine and is to be protected. A preliminary assessment of the species at the national level using the IUCN criteria and categories is provided. Today, the main threat to its existence is collection of the fruit bodies by local population. Therefore, it is proposed to continue searching for new localities of the fungus and to protect those sites at least at the regional level, as well as to provide public outreach, primarily through social networks, which nowadays bring together tens of thousands of amateur mycologists in Ukraine.

**Keywords:** Boletaceae, Boletus, fungal conservation, IUCN, *Hemileccinum impolitum*, *Leccinum*, rare fungus, *Xerocomus*

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**Реферат.** *Hemileccinum depilatum* (Boletales, Basidiomycota) трапляється у Західній та Центральній Європі, Середземномор'ї, на Балканському півострові, а також в Азії (Азербайджан і Туреччина). Скрізь він є рідкісним, у ряді країн Європи внесений до природоохоронних списків. В Україні він відомий з 2006 р. Гриб знаходили на Південному березі Криму, у Гірському Криму, Західному Лісостепу та Карпатах. До цього дослідження в Україні було відомо лише п'ять його місцезнаходжень, розташованих в Автономній Республіці Крим, Закарпатській і Хмельницькій областях. Упродовж останніх років грибок був зареєстрований ще у п'яти областях – Івано-Франківській, Київській, Львівській, Тернопільській і Черкаській, а кількість відомих локалітетів виду зросла з 5 до 14. Однак це збільшення пов'язане насамперед з широким залученням до пошуків даного виду мікологів-аматорів, а не є наслідком тенденції до збільшення чисельності гриба. Отже, *H. depilatum* є рідкісним в Україні видом і потребує охорони. Здійснено попередню оцінку виду на національному рівні із застосуванням критеріїв та категорій МСОП. На сьогодні головною загрозою для його існування є збір плодівих тіл населенням. Тому пропонується продовжувати пошук нових місцезнаходжень цього рідкісного гриба, брати їх під охорону хоча б на регіональному рівні, а також здійснювати роз'яснювальну роботу з населенням, насамперед через соціальні мережі, які на сьогодні об'єднують в Україні десятки тисяч мікологів-аматорів.

**Ключові слова:** Boletaceae, Boletus, *Hemileccinum impolitum*, *Leccinum*, *Xerocomus*, МСОП, охорона грибів, рідкісний грибок

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*Hemileccinum* Šutara is one of the smallest genera of the *Boletaceae* (*Boletales*, *Basidiomycota*) currently comprising five species (<http://www.indexfungorum.org/names/Names.asp>). The genus was described by J. Šutara (2008) to include two species then placed in *Xerocomus* Quél., as *H. depilatum* (Redeuilh) Šutara and *H. impolitum* (Fr.) Šutara. Formerly they were regarded by different authors as belonging to three genera, *Boletus* L., *Leccinum* Gray, and already mentioned *Xerocomus*. However, the two species were transferred to *Hemileccinum*, once it was noticed that anatomical structure of the peripheral stipe layers in both species is of the leccinoid type (i.e. corresponding to that of *Leccinum*) (Bertault, 1980; Šutara, 2008). Therefore these species could be referred neither to *Boletus*, nor to *Xerocomus*. This conclusion was supported by molecular phylogenetic analyses; moreover, studies on phylogenetic relationships have demonstrated that both species are also rather distant from *Leccinum* (Binder, Besl, 2000; Bakker, Noordeloos, 2005). Thus, a new genus was proposed based on distinct morphology and phylogenetic data. Morphologically, the genus appears similar to *Leccinum*, but its species differ in having the yellow hymenophore, unchanging in color context, iodoform odor, and violet macrochemical reaction of the pileus surface with NH<sub>3</sub> vapour (Šutara, 2008). Furthermore, multigenous analysis of highly informative genetic markers showed a distinct phylogenetic lineage and clearly supported *Hemileccinum* as a separate genus (Wu et al., 2014).

Subsequently, based on molecular phylogenetic evidence and morphological data (Halling et al., 2015; Wu et al., 2016), other two species, the Southeast Asian *Boletus indecorus* Masee [*Corneroboletus indecorus* (Masee) N.K. Zeng & Zhu L. Yang] and the North American *B. subglabripes* Peck, were transferred to *Hemileccinum*; in addition, a new species, *H. rugosum* G. Wu & Zhu L. Yang, was described from south-western China. Thus of the currently known five species of *Hemileccinum*, only two are native to Europe, *H. depilatum* and *H. impolitum*. The latter is quite widespread, while *H. depilatum* is a rarely occurring species. It has been reported from Western and Central Europe, the Mediterranean, the Balkans (<http://e-codb.bas.bg/rdb/bg/vol1/Boldepil.html>) and Asia (Azerbaijan and Turkey) (Doğan et al., 2012; Mustafabayli, Aghayeva, 2019). Due to its rarity, the species was included in the Red Lists of fungi in several European countries. In Bulgaria, *H. depilatum* is red-listed as Endangered (EN B2ab(iii)) (Gyosheva et al.,

2006; Assyov, Denchev, 2015). In the fungal *Red List of the Czech Republic* it is categorized as Vulnerable (Holec, Beran, 2006; Šutara et al., 2009), in the *Red List of Fungi for Great Britain* – as Data Deficient (Ainsworth et al., 2013). In Poland, only two records of *H. depilatum* are known and the species is included into the "*List of Rare and Endangered Species of Fungi*" ("*Rejestr gatunków grzybów chronionych i zagrożonych*" (GREJ), [https://www.grzyby.pl/gatunki/Boletus\\_depilatus.htm#GREJ](https://www.grzyby.pl/gatunki/Boletus_depilatus.htm#GREJ)).

In Ukraine, until recently only one species of this genus was known, *H. impolitum*, a quite widespread mushroom commonly gathered in forests by local population. It has been recorded in Central Polissya, West, Right Bank and Left Bank Forest-Steppe, Left Bank Grass-Meadow and Grass Steppe, as well as Crimea (Zerova et al., 1979; Akulov, Prydiuk, 2007; Sarkina, 2018). The second species, *H. depilatum*, was found for the first time in Ukraine by I.S. Sarkina (2014a, b) in 2006 in Mys Martian Nature Reserve (South Coast of Crimea). The second and third finds of the fungus in 2008 were reported by the first author from Western Forest-Steppe (Heluta, 2012). After that, *H. depilatum* was recorded in the Mountain Crimea (Sarkina, 2014b) and the Carpathians (Berkela, Pokynchereda, 2015; Gleb, 2016). In 2016, a single fruit body collected in Central Polissya was brought by amateurs to the M.G. Kholodny Institute of Botany, NAS of Ukraine, for identification. Since recently, more observation data on the occurrence of this species have been provided through "Fungi of Ukraine", a social network group (<https://www.facebook.com/groups/Hryby.Ukrayiny/?ref=bookmarks>). Consequently, distribution area of the fungus in the country was expanded to include the Right Bank Forest-Steppe, as well as several new localities were added to the earlier reported regions mentioned above.

Here we provide a description and illustrations of *H. depilatum* (Fig. 1), followed by a list of all currently known localities in Ukraine and a distribution map (Fig. 2).

***Hemileccinum depilatum* (Redeuilh) Šutara**, Czech Mycol. 60(1): 55. 2008. – *Bas.*: *Boletus depilatus* Redeuilh, Bull. Soc. Mycol. France 101(4): 389. 1986 [1985]. – *Syn.*: *Leccinum depilatum* (Redeuilh) Šutara, Česká Mykol. 43(1): 4. 1989. – *Xerocomus depilatus* (Redeuilh) Manfr. Binder & Besl, Micologia 2000 (Trento): 85. 2000.

Pileus 4–10(–15) cm wide, hemisphaerical, later convex, plano-convex to flattened cushion-shaped,

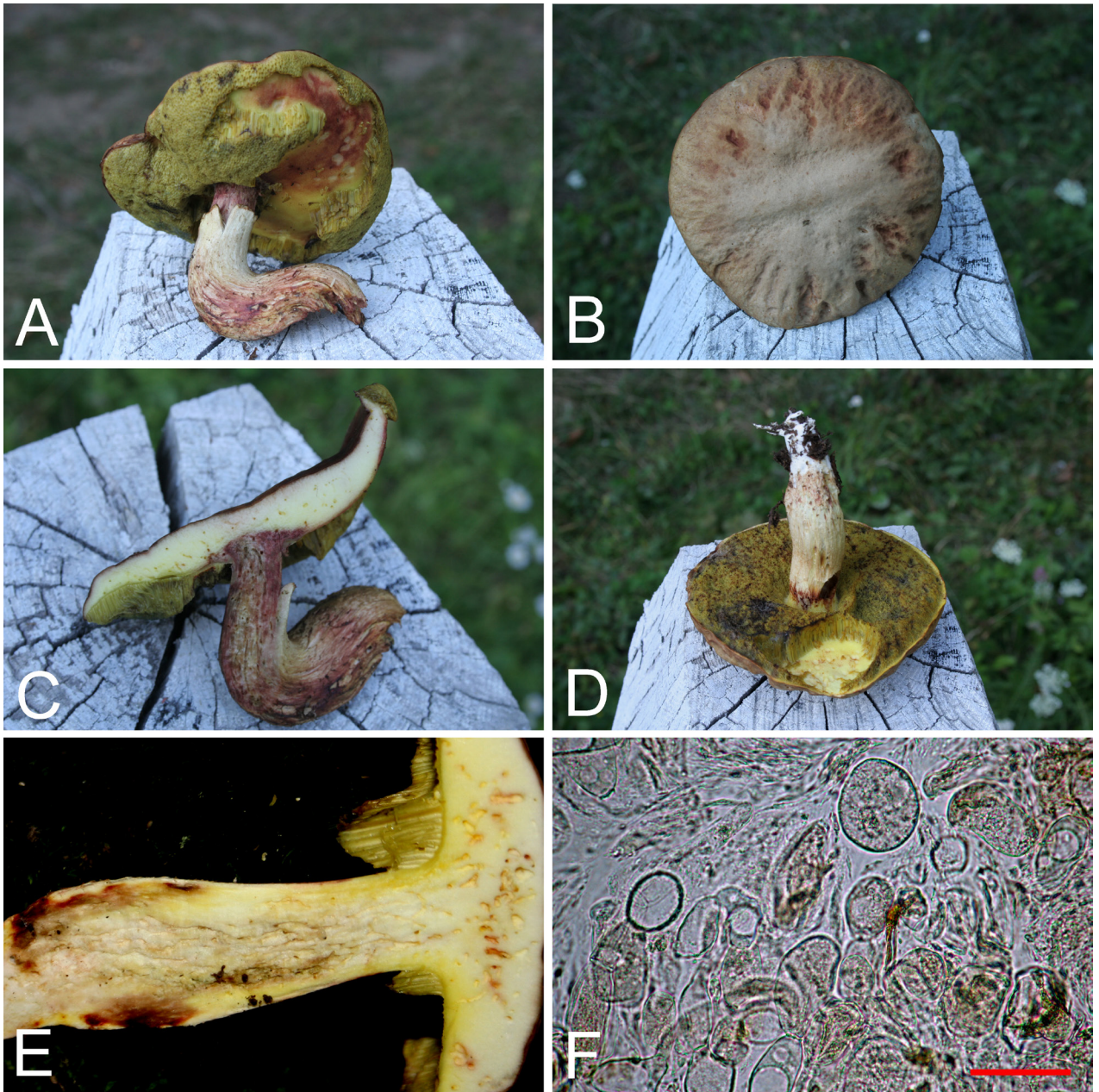


Fig. 1. Fruit bodies of *Hemileccinum depilatum* collected in Khmelnytsky Region (A–E); pileus pseudoepithelium composed of ellipsoid to subglobose cells (F). Bar: 50  $\mu$ m

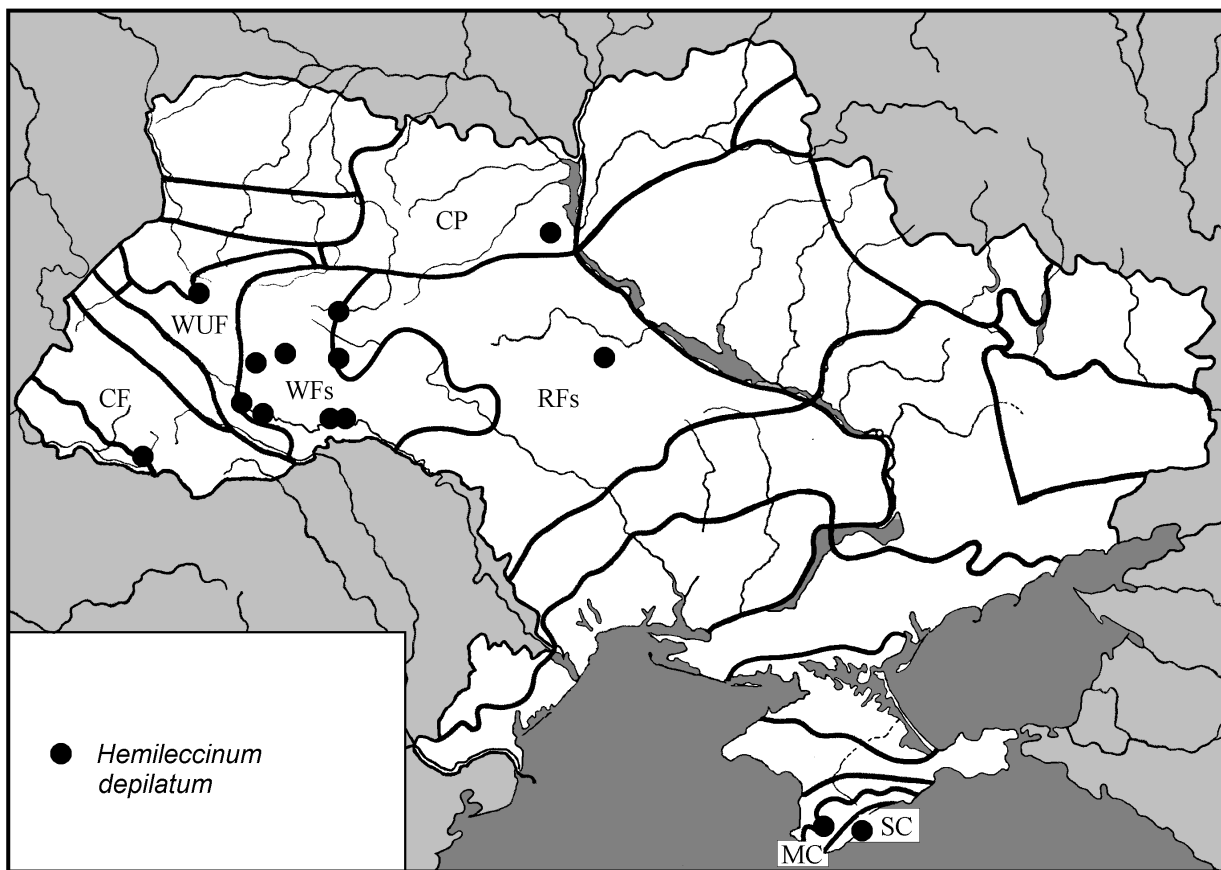


Fig. 2. Distribution of *Hemileccinum depilatum* in Ukraine (CF – Carpathian Forests, CP – Central Polissya, MC – Mountain Crimea, RFs – Right Bank Forest-Steppe, SC – Southern Crimea, WFs – Western Forest-Steppe, WUF – Western Ukrainian Forests)

surface uneven, slightly wrinkled or pitted, mostly glabrous, but at early stages finely tomentose in pits and at pileus margin, later completely glabrous, at first yellow-brown, then chestnut-brown, fading to ochre or tinged to flesh color (Fig. 1, A–D). Pileipellis non-separable. In young fruit bodies pileipellis is composed of two layers, the upper soft trichoderm consisting of loosely intertwined filamentous hyphae and the lower layer formed by dense somewhat saddle-shaped hyphae. Soon after, as the upper layer starts to disappear, the lower one becomes a pseudoepithelium composed of ellipsoid to subglobose cells (Fig. 1, F). Hymenophore near stipe apex slightly depressed, sometimes almost free. Tubes up to (10–)15–20 mm long, deep yellow when young, olive-yellow with age. Pores minute, 0.5–1 mm in diameter, rounded, concolorous with the tubes, unchanging when bruised. Stipe 6–15 × 2.5–4(–4.5) cm, relatively fleshy, elongate clavate or

elongate subfusoid, tapering, occasionally spindle-shaped toward base, often distinctly curved, covered with scabrosities as in *Leccinum*, but less conspicuous, light-colored and not darkening, later partly collapsing; stipe surface light-yellow or whitish, in old fruit bodies sometimes with brownish to burgundy spots or reddish band. Stipe base covered with white or whitish, occasionally yellow-olive to brownish tangled basal tomentum. Partial veil and annulus absent. Context of stipe and pileus whitish, light-yellow, often more deep yellow above tubes and under stipe surface, at stipe base or all over the stipe in old fruit bodies sometimes with brown or brown-red spots (Fig. 1, E), or completely red-brown (Fig. 1, C), color unchanging when cut, odor unpleasant resembling iodoform, particularly in the lower part of the stipe, taste mild.

Macrochemical reactions. Pileus surface:  $\text{NH}_4\text{OH}$  – violet.

Spore print olive-brown. Spores (10–)12–14(–17) × 4.5–6(–7) μm, fusoid-ellipsoid, smooth.

Deciduous forests, predominantly under hornbeam, on alkaline soils. Solitary, very rare. July–August. Edible mushroom of low quality due to unpleasant odor.

**Distribution in Ukraine.** *Autonomous Republic of Crimea*, Bakhchisarai Region, Male Sadove village, 21.07.2013, N.O. Bagrikova (Sarkina, 2014b); Yalta City Council, Nikita Botanical Garden, Mys Martian Nature Reserve, 05.07.2006, I.S. Sarkina (Sarkina, 2014a, b). – *Cherkasy Region*, Lysianka District, Pochapyntsi village, 27.07.2017, V. Shulha. – *Ivano-Frankivsk Region*, Horodenka District, Daleshove village, 23.09.2017, A. Yemchuk. – *Kyiv Region*, Borodyanka District, near Klavdievo-Tarasove settlement, 04.08.2016, collected by amateurs. – *Khmelnysky Region*, Vinkivtsi town, 03.09.2019, N. Marysyk; Horodok district, Ivankivtsi village, 17.08.2019, V. Kydanchuk-Dronska; Kamianets-Podilskyi District, Kytaihorod village, 24.08.2008, V.P. Heluta; Lenivka village, 21.08.2008, V.P. Heluta, V.P. Hayova; Krasyliv District, Krasyliv town, 24.07, 20.08.2019, V. Kydanchuk-Dronska. – *Lviv Region*, Zolochiv District, Yaktoriv village, 16.08.2019, O. Stepko. – *Ternopil Region*, Zalishchyky town, 28.09.2015, L. Burdeina-Domarad; Chortkiv town, 16.07, 19.08.2019, S. Flekey. – *Transcarpathian Region*, Rakhiv District, Carpathian Biosphere Reserve, Kisvynske branch, 2015 (Berkela, Pokynchereda, 2015; Gleb, 2016).

*Hemileccinum depilatum* in its general appearance is quite similar to *H. impolitum* but differs in pitted, or hammered, pileus surface and microscopic structure of pileipellis. In *H. impolitum*, pileipellis hyphae are cylindrical and filamentous, with only a small number of terminal cells slightly broadened at the top. In *H. depilatum*, pileus surface undergoes conspicuous changes during its development. Initially, the pileipellis consists of two layers, the upper layer of loosely intervoven filamentous hyphae and the lower one with densely arranged hyphae. At this stage, the pileus surface appears finely tomentose. However, it becomes completely glabrous, as soon as the filamentous hyphae in the upper layer disappear. In the originally lower layer, gradually broadening hyphae become more or less inflated, so that the pileipellis eventually is composed of predominantly ellipsoid to subglobose cells. Thus the two species can be easily distinguished by this micromorphological character.

Hitherto, *H. depilatum* was recorded in Central Polissya, Western and Right Bank Forest-Steppe, Carpathian Forests, Mountain Crimea and Southern Crimea. According to administrative divisions in Ukraine, the species was reported from the Autonomous Republic of Crimea, Cherkasy, Ivano-Frankivsk, Kyiv, Khmelnytsky, Lviv, Ternopil and Transcarpathian regions. At present, in total 14 localities of the fungus are known in the country. However, the number of records increased due to additional data recently provided by amateur mycologists as a result of their field observations, rather than growing population trend of the fungus. Undoubtedly, *H. depilatum* is a rarely encountered species which is to be protected at the national level. It has been already recommended to include this species into the *Red Data Book of Ukraine* (Heluta, 2012). However, it is necessary to assess its conservation status nationally.

Nowadays, the red-listing system developed by the IUCN is widely internationally recognized (IUCN..., 2012). This system is based on assessing conservation status of all species against standard criteria applied to estimate extinction risk for the species and to assign it to one of the recommended categories (IUCN..., 2019). We have made a preliminary evaluation of the status of *H. depilatum* in Ukraine using the IUCN Red List categories and criteria, in accordance with special guidelines for fungal red-listing (Dahlberg, Mueller, 2011). This is a tentative assessment since the species was only recently recognized in the country (in 2006), therefore due to insufficient recording time for an ectomycorrhizal fungus, its population size cannot yet be estimated. However, based on the concept of functional individual (Dahlberg, Mueller, 2011) and current distribution of the fungus in the country, we can apply criterion D for its evaluation. The number of mature individuals in the known up to now 14 localities can be estimated as minimum 140, but maximum actual number of the localities can be increased in future, apparently not exceeding 100. Thus, for the time being the species is assessed as Vulnerable (VU) under criterion D1.

At present, the main threat for *H. depilatum* is collecting its fruit bodies by local population. Therefore for conservation purposes it is important to protect already known sites, at least at the regional/local level, and to continue searching for new localities of the fungus in appropriate habitats. It is also essential to raise public awareness and to engage local people, primarily through social networks connecting professional mycologists with tens of thousands of amateurs.

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