# NEW AND RARE (INSUFFICIENTLY KNOWN) BEETLE SPECIES FOUND IN THE LITTER OF CONIFEROUS AND MIXED FORESTS IN LITHUANIA

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## Introduction

Forests cover 20598 square kilometres and occupy 33.1 % of Lithuanian territory. Of these, coniferous woods make up 58.8%, soft leafy forests 35.8%, whereas the hard ones make up 4.5% of all forests. About 85% of forests are natural (Lithuanian Forest Statistics, 2010). The Scotch pine (*Pinus sylvestris*) and Norway spruce (*Picea abies*) are the most common species of trees in Lithuanian coniferous forests (Lithuanian Forest Statistics, 2010).

In theory, 90% of the biomass produced by a forest returns to the soil. Bacteria and fungi break down the leaves and dead wood into nutrients that can be taken up again by plants to make new leaves and wood. The forest litter is a natural habitat for numerous beetles' species. Some of them live there as predators or are directly involved in the processes of decomposition of organic residues, while others spend their larval or pupal stage or period of hibernation. Different trees depending of the dominant tree species contain different shapes of herbaceous plants and mosses communities, litter structure and decomposition, which is directly related to the residents of the animal, including beetles species diversity and distribution (Wiezik *et al*., 2007). The ground and rove beetles being typical forest litter dwellers widely use for bioindications of various succesional processes in the forest ecosystems (Monsevičius, 1986; Gedminas & Žiogas, 2001; Zdzioch, 2003; Smoleński *et al*., 2004; Skłodowski & Garbalińska 2007; Schwerk & Szyszko 2007). Despite that the knowledge on beetles, especially on the small ones, living or hibernating in the forest litter is still poor. Only rove beetles (Staphylinidae s.str.) living in the litter of some types of Lithuanian forests have been dissertated before (Monsevičius, 1986, 1988). There are also a few published works related to investigations of surface dwelling beetle species in Lithuanian pine forests and bogs (Žiogas & Gedminas, 1994; Lynikienė, 2006; Žiogas & Vaičikauskas, 2007a, 2007b; Dapkus & Tamutis, 2008).

The aim of this study was to discover the species composition of rare beetle species both living and hibernating in the litter of different mature forests, as well as pine, spruce and larch plantations.

## Material and methods

Study ***area and site characteristics***. Research was carried out at the different forests located in Kaunas, Kazlų Rūda, Prienai, Jurbarkas and Neringa provinces* from October to April in 2010 – 2011 (Table 1.). The chosen forests differed between each other by age, predominant species of trees in the stand as well as site classes and canopy closures.

Different litter composition was detected in each forest site as well. The basic criteria of investigated sites are provided (Table 2). Site classes have been estimated following the scale given by Vaičys and Labanauskas (1968): Na - normal humidity, very poor fertility soils; Nb - normal humidity, poor fertility soils; Nc – normal humidity, fertile soils. Geobotanical characteristic have been made following the scale given by Braun-Blanquet (1964): + - solitary individuals, 1 – individuals covering less than 20% of area, 2 - – individuals covering 20–25 % of area, 3 - individuals covering 25–50% of area, 4 - individuals covering 50–75 % of area, 5 - individuals covering more than 75 % of area. Stand age, basal area and canopy closure are given according the data of forest inventory data (http://www.amvmt.lt/).

Table 1. The information on localities of research areas

| Forest names (site codes) | Provinces* | Coordinates |
|---|---|---|
| Braziūkai (PC) | Kaunas | 54°53'54"N; 23°29'43"E |
| Braziūkai (PVM) | Kazlų Rūda | 54°54'27"N; 23°28'32"E |
| Braziūkai (LC) | Kazlų Rūda | 54°53'30"N; 23°28'31"E |
| Braziūkai (PO) | Kazlų Rūda | 54°54'03"N; 23°28'40"E |
| Viliūšiai (SC), | Kazlų Rūda | 54°54'32"N; 23°25'58"E |
| Liepgiriai (MMF) | Jurbarkas | 55°04'50"N; 23°24'06"E |
| Degsnė (MLF) | Prienai | 54°34'08"N; 23°54'29"E |
| Lapės (PMS) | Neringa | 55°36'29"N; 21°06'47"E |
| Lapės (CPF) | Neringa | 55°36'37"N; 21°07'14"E |

*The name "provinces" herein include all kinds of administrative units used in Lithuania since 2000 (municipalities, district municipalities and town municipalities).

***Sampling of beetles***

Five samples of litter have been taken from 0,25 $m^2$ in each site in the limits of 100 m2. The samples of litter have been placed in the plastic bags which have been stored in the refrigerator in the temperature 1–5$^0$C till sampling of beetles. The beetles have been sampled in the laboratory using the white ground plate (0,25 $m^2$), hand glass and exhauster. The material was placed in the cruets with ethanol. A stereomicroscope Motic SMZ – 168 and identification guides were used for the identification of the specimen to species level.

The classification of the order Coleoptera follows Bouchard *et al*., (2011), the genera and species names follow the Catalogue of Lithuanian beetles (Tamutis *et al*., 2011).

The collected material is deposited in the collections of the Kaunas T. Ivanauskas Zoological Museum (Kaunas, Lithuania).

**Results**

During the current study of beetles of the leaf litter of coniferous and mixed forest in Lithuania, 42 species, which are rare, insufficiently known and sporadically distributed in our country, were detected (the list includes species that are considered as rare or very rare by S. Pileckis and V. Monsevičius (1995, 1997) and species, which were reported later and are known only from a few localities in Lithuania). Four species - *Meotica exilis* (Knoch, 1806), *Dacrila fallax* (Kraatz, 1856), *Orthoperus nigrescens* Stephens, 1829, and *Orchestes fagi* (Linnaeus, 1758) are recorded from Lithuania for the first time

(in the list they are marked with an asterisk *).

Table 2. Characteristics of investigated forest sites: PVM – mature pine forest (*Pinetum vaccinio myrtillosa*); MMF – mature mixed forest; PC – thick pine culture; PMS – thick *Pinus mugo* stand; CPF – coastal pine forest; LC – thick larch culture; SP – thick spruce culture; MLF – mature larch forest; PO – mature coniferous forest (*Piceetum oxalidosum*)

| **Stands** | PVM | MMF | PC | PMS | CPF | LC | MLF | SC | PO |
|---|---|---|---|---|---|---|---|---|---|
| **Site class** | Nb | Nc | Nb | Na | Na | Nb | Nc | Nc | Nc |
| **Stand age** | 100 | 80 | 30 | 60 | 30 | 23 | 150 | 23 | 100 |
| **Stand basal area** | 0.7 | 1 | 0.8 | 0.3 | 0.5 | 0.7 | 1.1 | 0,7 | 0.6 |
| **Canopy closure** | 0.5 | 0,9 | 1 | 1 | 0.8 | 1 | 0.9 | 1 | 0.9 |
| **Litter composition(%)** | | | | | | | | | |
| Leaves | 0 | 70 | 2 | 0 | 0 | 6 | 6 | 0 | 1 |
| Needles | 7 | 10 | 80 | 7 | 6 | 80 | 76 | 85 | 82 |
| Twigs | 5 | 7 | 8 | 8 | 4 | 8 | 7 | 5 | 5 |
| Cones | 2 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 2 |
| Moses | 83 | 0 | 0 | 80 | 83 | 0 | 0 | 0 | 0 |
| Grass residues | 0 | 0 | 0 | 0 | 1 | 0 | 3 | 0 | 0 |
| Humified mort mass | 3 | 10 | 7 | 3 | 3 | 4 | 5 | 7 | 10 |
| **Shrub layer** | | | | | | | | | |
| *Sorbus aucuparia* L. | + | - | + | - | - | 1 | + | - | 1 |
| *Frangula alnus* Mill. | - | - | + | - | - | 1 | + | - | 1 |
| *Betula pendula* Roth. | + | - | - | - | - | + | - | - | - |
| *Betula pubescens* Ehrh. | + | - | - | - | - | - | - | - | - |
| *Picea abies* (L.) | + | - | - | - | - | + | + | - | + |
| *Acer platanoides* L. | - | + | + | - | - | - | + | - | - |
| *Quercus robur* L. | + | - | + | - | - | + | - | - | - |
| *Fagus sylvatica* | - | + | - | - | - | - | - | - | - |
| *Juniperus commnis* L. | + | - | - | - | + | - | - | - | - |
| *Lonicera xylostelum* L. | - | + | - | - | - | - | - | - | - |
| *Salix caprea* L. | - | - | - | - | - | - | - | - | + |
| **Tree 2nd layer** | | | | | | | | | |
| *Betula pendula* Roth. | 1 | - | - | - | - | 1 | - | - | 1 |
| *Picea abies* (L.) | 1 | - | 1 | - | - | 1 | - | - | 3 |
| *Pinus sylvestris* L. | 1 | 1 | 2 | - | 2 | + | - | - | - |
| *Quercus robur* L. | + | - | + | - | - | 1 | - | - | + |
| *Fagus sylvatica* | - | 1 | - | - | - | - | - | - | - |
| *Tilia cordata* Mill. | - | - | - | - | - | - | 3 | - | - |
| **Tree 1st layer** | | | | | | | | | |
| *Larix decidua* Mill. | - | - | - | - | - | 5 | 5 | - | - |
| *Fagus sylvatica* | - | 4 | - | - | - | - | - | - | - |
| *Picea abies* (L.) | - | 3 | 1 | - | - | + | - | 5 | 4 |
| *Pinus mugo* | - | - | - | 5 | - | - | - | - | - |
| *Pinus sylvestris* L. | 4 | - | 5 | - | 5 | 1 | - | - | 2 |

**List of species**

CARABIDAE

***Leistus rufomarginatus* (Duftschmid, 1812).**

Viliūšiai f., 02 10 2011, 1 spec., in spruce culture.

***Amara brunnea* (Gyllenhal, 1810)**

Braziūkai f., 15 10 2010, 2 spec., in mature coniferous forest (*Piceetum oxalidosum*).

***Agonum gracile* Sturm, 1824**

Lapės f., 06 10 2010 (1 spec., in coastal pine forest).

***Agonum micans* Nikolai 1822.**

Lapės f., 05 10 2011 (1 spec., in coastal pine forest).

***Badister collaris* Motschulsky, 1844.**

Lapės f., 06 10 2010 (1 spec., in thick *Pinus mugo* stand).

***Harpalus luteicornis* (Duftschmid, 1812).**

Braziūkai f., 15 10 2010 (1 spec., in larch culture).

HYDROPHILIDAE

***Cercyon tristis* (Illiger, 1801).**

Lapės f., 06 10 2010 (1 spec., in coastal pine forest).

LEIODIDAE

***Agathidium seminulum* (Linnaeus, 1778)**

Liepgiriai f., 31 03 2011 (1 spec., in mature mixed forest).

STAPHYLINIDAE

***Bibloplectus ambiguus* (Reichenbach, 1816)**

Lapės f., 06 10 2010 (5 spec., in coastal pine forest).

***Brachygluta sinuata* (Aubé, 1833)**

Braziūkai f., 17 04 2011 (1 spec., in mature pine forest *Pinetum vaccinio myrtillosa*)

**Note.** This species is distributed in western Palaearctic region, widely known in Europe. Till now actual faunal data on this species from Lithuania have been absent, although it have been noted for Lithuania by A. Smetana & C. Besuchet (2004). Some authors treated this species name as a subspecies of *B. haematica* (Reichenbach, 1816) (Besuchet, 1974; Lundberg & Gustafsson, 1995, Telnov, 2004; Silfverberg, 2004).

***Bryaxis puncticollis* (Denny, 1825)**

Braziūkai f., 11 11 2010 (1 spec., in pinus culture); Braziūkai f., 02 10 2011 (1 spec., in spruce culture); Braziūkai f., 17 04 2011 (2 spec., in mature pine forest *Pinetum vaccinio myrtillosa*); Degsnė f., 05 04 2011 (3 spec., in mature larch stand); Liepgiriai f., 31 03 2011 (2 spec., mature mixed forest).

***Pselaphus heisei* Herbst, 1792**

Braziūkai f., 17 04 2011 (4 spec., in mature pine forest *Pinetum vaccinio myrtillosa*).

***Mycetoporus clavicornis* (Stephens, 1832)**

Lapės f., 06 10 2010 (12 spec., in coastal pine forest); Lapės f., 06 10 2010 (9 spec., in thick *Pinus mugo* stand).

***Bryopachis crassicornis* (Mäklin, 1847)**

Liepgiriai f., 31 03 2011 (2 spec., in mature mixed forest).

***Sepedophilus testaceus* (Fabricius, 1793)**

Liepgiriai f., 31 03 2011 (2 spec., in mature mixed forest).

***Aleochara bipustulata* (Linnaeus, 1761)**

Degsnė f., 05 04 2011 (3 spec., in mature larch stand).

***Mniusa incrasata* (Mulsant & Rey, 1852)**

Braziūkai f., 15 10 2010 (4 exx, in mature coniferous forest (*Piceetum oxalidosum*)).

****Meotica exilis* (Knoch, 1806)**

Lapės f., 05 10 2011 (1 spec., in coastal pine forest).

**Notes**. Actually it is a common and widely distributed species in Europe (Burakowski *et al*., 1980; Silfverberg, 2010), known also in northern Africa, Kazakhstan and Siberia (Smetana, 2004), recently discovered in North America as well (Majka & Klimaszewski, 2008).

****Dacrila fallax* (Kraatz, 1856)**

Lapės f., 05 10 2011 (1 spec., in coastal pine forest).

**Notes.** This species is distributed in Palaearctic region, known in Sweden, Denmark, Estonia, and Latvia (Silfverberg, 2010), northwestern Belarus (Alexandrovich *et al*., 1996), northern Poland (Burakowski *et al*., 1980).

***Schistoglossa gemina* (Erichson, 1837)**

Lapės f., 06 10 2010 (1 spec., in thick *Pinus mugo* stand).

***Gyrophaena bihamata* Thomson, 1867**

Liepgiriai f., 31 03 2011 (2 spec., in mature mixed forest).

***Cephenium majus* Reitter, 1882**

Braziūkai f., 17 04 2011 (11 spec., in mature pine forest *Pinetum vaccinio myrtillosa*).

***Nevraphes elongatulus* (Müller & Kunze, 1822)**

Braziūkai f., 15 10 2010 (2 spec., in mature coniferous forest (*Piceetum oxalidosum*)); Viliūšiai f., 02 10 2011 (1 spec., in spruce culture); Liepgiriai f., 31 03 2011 (2 spec., in mature mixed forest).

***Stenichnus scutellaris* (Müller & Kunze, 1822)**

Braziūkai f., 15 10 2010 (1 spec., in mature coniferous forest (*Piceetum oxalidosum*)); Braziūkai f., 17 04 2011 (6 spec., in mature pine forest *Pinetum vaccinio myrtillosa*); Lapės f., 05 10 2011 (3 spec., in coastal pine forest); Viliūšiai f., 02 10 2011 (1 spec., in spruce culture).

***Stenus formicetorum* Mannerheim, 1843**

Braziūkai f., 15 10 2010 (1 spec., in mature coniferous forest (*Piceetum oxalidosum*)); Braziūkai f., 17 04 2011 (2 spec., in mature pine forest *Pinetum vaccinio myrtillosa*).

***Stenus impressus* Germar, 1824**

Braziūkai f., 11 11 2010 (1 spec., in pinus culture).

***Othius lapidicola* Mätrkel & Kiesenwetter, 1847**

Liepgiriai f., 31 03 2011 (1 spec., in mature mixed forest).

***Philonthus laevicollis* (Lacordaire, 1835)**

Degsnė f., 05 04 2011 (3 spec., in mature larch stand).

***Philonthus mannerheimi* Fauvel, 1868**

Braziūkai f., 17 04 2011 (1 spec., in mature pine forest *Pinetum vaccinio myrtillosa*); Degsnė f., 05 04 2011 (1 spec., in mature larch stand).

***Philonthus micanthoides* Benick & Lohse, 1956**
Lapės f., 06 10 2010 (1 spec., in coastal pine forest).
***Philonthus punctus* (Gravenhorst, 1802)**
Lapės f., 06 10 2010 (1 spec., in coastal pine forest).
***Philonthus umbraitilis* (Gravenhorst, 1802)**
Lapės f., 06 10 2010 (1 spec., in coastal pine forest).
***Quedius nigriceps* Kraatz, 1857**
Lapės f., 06 10 2010 (1 spec., in thick *Pinus mugo* stand).

CRYPTOPHAGIDAE
***Micrambe abietis* (Paykull, 1798)**
Braziūkai f., 15 10 2010 (1 spec., in larch culture); Lapės f., 06 10 2010 (1 spec., in coastal pine forest); Braziūkai f., 15 10 2010 (1 spec., in mature coniferous forest (*Piceetum oxalidosum*)); Viliūšiai f., 02 10 2011 (14 spec., in spruce culture).
***Atomaria morio* Kolenati, 1846**
Braziūkai f., 17 04 2011 (1 spec., in mature pine forest *Pinetum vaccinio myrtillosa*).
***Atomaria nigripennis* (Kugellan, 1794)**
Lapės f., 21 09 2010 (1 spec., in coastal pine forest).

NITIDULIDAE
***Epuraea thoracica* Tournier, 1872**
Braziūkai f., 15 10 2010 (1 spec., in mature coniferous forest (*Piceetum oxalidosum*)).
***Meligethes denticulatus* (Heer, 1841)**
Braziūkai f., 15 10 2010 (1 spec., in mature coniferous forest (*Piceetum oxalidosum*)).

COCCINELLIDAE
***Scymnus abietis* (Paykull, 1798)**
Degsnė f., 05 04 2011 (9 spec., in mature larch stand).
***Calvia decemguttata* (Linnaeus, 1727)**
Degsnė f., 05 04 2011 (1 spec., in mature larch stand).
***Calvia quinquedecimguttata* (Fabricius, 1777)**
Braziūkai f., 17 04 2011 (1 spec., in mature pine forest *Pinetum vaccinio myrtillosa*).

CORYLOPHIDAE
****Orthoperus nigrescens* Stephens, 1829**
Viliūšiai f., 02 10 2011 (14 spec., in spruce culture).
**Notes:** It is distributed in Europe but is insufficiently known and rarely observed. Generally this species is found in the litter of deciduous forests (Bowestead, 1999), but we found it in exclusively coniferous stand.

LATRIDIIDAE
***Corticarina lambiana* (Sharp, 1910)**
Braziūkai f., 15 10 2010 (1 spec., in mature coniferous forest *Piceetum oxalidosum*).

BRENTIDAE

***Cyanapion spencii* (Kirby, 1808)**

Degsnė f., 05 04 2011 (2 spec., in mature larch stand).

CURCULIONIDAE

***Brachonyx pineti* (Paykull, 1792)**

Liepgiriai f., 31 03 2011 (1 spec., in mature mixed forest).

****Orchestes fagi* (Linnaeus, 1758)**

Liepgiriai f., 31 03 2011 (3 spec., in mature mixed stand).

**Notes:** This species is widely distributed in Palearctic region together with it's host plant *Fagus sylvatica*. Recently found in Canada (MacLellan, 2012).

## Discussion

The studies were carried out during the period unsuitable for vegetation, so species of beetles living constantly in the forest litter as well as only overwintering ones were registered. The latter species made up 7% of all species registered and they belonged to Nitidulidae, Coccinellidae, Brentidae ir Curculionidae families.

The other species were characteristic dwellers of forest litter associated to specific habitats.

Fourteen rare species of beetles were registered in pine forests of the Curonian Spit and they were not found in other study places in Lithuania. It is interesting to note that staphylinid *Mycetophotrus clavicornis* was quite numerous in pine forests of *Pinus sylvestris*, as well as in *Pinus mugo* stands. Therefore, it is known only from southern and eastern parts of continental Lithuania (Monsevičius, 1985).

Two species (*Meotica exilis* and *Dacrila falax*) were registered for the first time in Lithuania. The latter species was found in pine forest's litter as overwintering habitats as it lives along the coast of fresh waters Benick & Lohse, 1974; Burakowski *et al*., 1980).

The forest with admixture of *Fagus sylvatica* and *Pinus sylvestris* had quite unique composition of beetles too. Seven species were characteristic for this habitat. The litter of the habitat was composed of a big mass of decaying leaves and other organic material, so fungivorous and detritovorous species (e. g., *Agathidium seminulum*, *Bryopachis crassicornis*, *Sepedophilus testaceus*, *Gyrophaena bihamata*) prevailed. Monophagous species *Orchestes fagi* was registered in this habitat, and it was the first record in Lithuania. Larvae and adults of *O. fagi* feed on leaves of *Fagus sylvatica* so they are considered as pests in Europe (Bale & Luff, 1978; Bale, 1984). There were many leaves in the litter damaged by *O. fagi*, so it seems that the beetles of this species are numerous and could damage beech in Liepgiriai forest.

Some species of beetles were characteristic for the pine forest *Pinetum vaccinio myrtillosa* as well. Staphylinids *Pselaphus heisei* and *Cephenium majus* were quite numerous in this type of habitat. Species of beetles associated with spruce stands were revealed as well, e.g. *Mniusa incrasata* (as a dweller of spruce stand this species was mentioned by Vidm. Monsevičius (1983)). *Leistus rufomarginatus* was registered in the spruce culture despote its preference to leafy forests.

Coccinellid *Scymnus abietis* was abundant in the mature larch forest, so it is possible to guess its relationships with pests of this kind of the trees. It is considered to be the predator of spruce bud scale (*Physokermes piceae* (Schrank)) (Draga *et al*., 2012).

Comparison of numbers of rare species of beetles reveals that mature forests have bigger variety of species than young stands (Fig. 1), so mature forests could be considered as reservoirs of biodiversity having unique assemblages of beetles. They are very important indicators for nature conservation and management of forests should be carried out in order to preserve at least minimal areas of such stands.

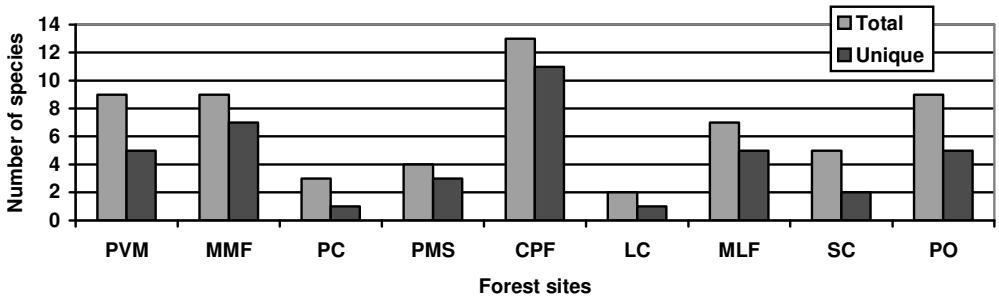


Fig. 1. The total and unique species number in investigated forest sites: PVM – mature pine forest (*Pinetum vaccinio myrtillosa*); MMF – mature mixed forest; PC – thick pine culture; PMS – thick *Pinus mugo* stand; CPF – coastal pine forest; LC – thick larch culture; SP – thick spruce culture; MLF – mature larch forest; PO – mature coniferous forest (*Piceetum oxalidosum*)

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**Naujos ir retos (mažai žinomos) vabalų rūšys aptiktos spygliuočių ir mišriuose miškuose Lietuvoje**

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Siekiant įvertinti įvairių spygliuočių ir mišrių miškų paklotės bioįvairovės parametrus, 2010–2011 metais ne vegetacijos metu (spalio – balandžio mėnesiais), buvo vykdyti tyrimai įvairiuose šalies miškuose. Tyrimai buvo atlikti naudojant paklotės mėginių metodą, kai iš pasirinktų barelių buvo paimami paklotės mėginiai (po 5 vnt.) nuo 0,25 $m^2$ paviršiaus ploto. Nariuotakojai iš mėginių buvo renkami naudojant baltą paletę ir ekshausterį. Šių tyrimų metu aptiktos 4 naujos ir 42 retos ar mažai žinomos Lietuvos faunai vabalų rūšys. Pirmą kartą Lietuvoje skelbiamos šios rūšys: *Meotica exilis* (Knoch, 1806), *Dacrila fallax* (Kraatz, 1856), *Orthoperus nigrescens* Stephens, 1829, *Orchestes fagi* (Linnaeus, 1758). Nustatyta, kad daugiausiai retų ir tik tam tikroms buveinėms būdingų (unikalių) rūšių aptikta brandžiuose medynuose. Straipsnyje pateikiamas šių rūšių sąrašas, diskutuojama kai kurių rūšių prieraišumo buveinėms bei brandžių medynų išsaugojimo svarbos bioįvairovės išsaugojimui klausimais.

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