Conservation of rare plants in natural areas in Penza region

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Abstract. 200 rare species are included in the second edition of the Red Book of Penza Region. Information on the distribution of species in existing and planned protected areas should be clarified in the preparation of the next edition of the Red Book. Herbarium materials and literary information were used to clarify the information. 148 rare species of vascular plants (74% of them are listed in the Red Book of Penza region) are currently protected by the modern system of specially protected natural territories of Penza region. Populations of 13 of the 22 species listed in the Red Book of the Russian Federation are currently not known, two species are subject to exclusion due to incorrect identification. There are 86 protected species of vascular plants (43%) on the territory of the State Nature Reserve «Privolzhskaya lesostep». 114 species are protected (57%) only on the territory of natural monuments. 57 species do not have territorial protection in the region. Only 34 of them are known to have a population known to scientists. These species need priority protection measures. The existing system of protected areas needs significant optimization.

1. Introduction

1709 species of vascular plants have been identified at the present stage of floristic research in the flora of Penza region [1], of which 200 species are listed in the Red Book of Penza Region [2]. The species are distributed very unevenly across the territory of Penza region. The reason for this is the border position between the forest-steppe and steppe natural zones.

Penza region is located at the junction of two large geomorphological formations: the western slopes of the Volga upland (most of them) and the plains of the Oka-Don lowland (a small north-eastern part). Its territory belongs to the basins of two major rivers: the Volga and the Don and belongs to different landscapes [3-6].

Penza Region also has a very uneven distribution of natural areas, which, unfortunately, do not reflect the existing landscape diversity of this territory [7]. The existing system of protected areas in Penza region needs significant optimization.

Information about the measures of conservation of rare species in protected areas, given in the Red Book of Penza region, is currently not relevant. The reasons for this are: 1) incomplete analysis of the available herbarium and literature data, 2) the appearance of new results of repeated field studies in recent years, 3) the formation of new and the elimination of some old protected areas after the second edition of the Red Book. The identification of the degree of territorial protection of the regional Red Book species should precede the next (third) edition of the Red Book of Penza Region.
2. Materials and Methods
The authors conducted long-term floristic and phytocenotic studies in the territories of protected areas of Penza region. In addition, a critical analysis of literary sources and herbarium specimens available in herbarium collections has been carried out (Herbarium of the Botanical Institute named after V L Komarov (LE); Herbarium named after D P Syreyschikov of Moscow State University named after M V Lomonosov (MW); Herbarium named after I I Sprygin of Penza State University (PKM); Herbarium of the Institute of Ecology of the Volga Basin of the Russian Academy of Sciences (PVB); Herbarium of the State Nature Reserve «Privolzhskaya lesostep» (Herbarium of the Reserve). The source of information is indicated for each new finding. Reference is given to herbarium materials (year and acronym of herbarium storage). In the absence of herbarium samples, the first document on organization process of protected areas, which are on the website of the organization «Center for Specially Protected and Other Natural Territories and Water Areas of Penza Region» [8].

The names of the protected areas where rare species are found are underlined. If the protected status of a protected area is currently removed, the word (liquidated) is indicated after the name of the protected area.

For the first time, the findings of rare species made near the boundaries of protected areas were noted. This information can serve as a basis for expanding the area of existing protected areas in the future.

Data of distribution of species on the territory of five clusters of the State Nature Reserve «Privolzhskaya lesostep» are given according to [9]. Designation accepted in the text: *- view of the Red Book of the Russian Federation [11]. The nomenclature and volumes of taxa are mainly standardized by Plants of the World Online (http://powo.science.kew.org/).

3. Results

Clade Lycopodiophyta
Lycopodiaceae
1. Huperzia selago (L.) Bernh. ex Schrank et Mart.: natural monument «Sosnovoborskiy bor-chernichnik» (2005 – PKM).
2. Diphasiastrum complanatum (L.) Holub: State Nature Reserve «Privolzhskaya lesostep» (Borok, Verhovya Sury); natural monuments «Dvorikovskiy vodno-lesnoy kompleks» (PKM), «Zasurskiy bor-chernichnik» (?), «Sosnovoborskiy bor-chernichnik» [8].
3. Lycopodium annotinum L.: State Nature Reserve «Privolzhskaya lesostep» (Verhovya Sury); natural monuments «Dvorikovskiy vodno-lesnoy kompleks» [12], «Klyukvennoe boloto» [8], «Lomovskie mohovye bolota», «Nikonovskiy bor» (1968 – PKM), «Svetlopolyanskie mohovye bolota», «Sosnovoborskiy bor-chernichnik» [8].
4. Lycopodium clavatum L.: State Nature Reserve «Privolzhskaya lesostep» (Verhovya Sury); natural monuments «Dvorikovskiy vodno-lesnoy kompleks» [12], «Zarosl mozhzhevelnika» [8], «Ivanryssinskiy landshaftnyy kompleks» [8], «Kachimskoe mohovoe boloto» (2003 – PKM), «Klyukvennoe boloto» [8], «Lomovskie mohovye bolota», «Naskaftymskie bolota» [8], «Nikonovskiy bor», «Ozero Bolshoe Mohovo», «Svetlopolyanskie mohovye bolota», «Sosnovoborskiy bor-chernichnik» (2003 – PKM). The species was previously protected on the territory of the natural monument «Ozero Maloe Mohovo» (Protected areas have not existed since 14.07.2000).
5. Lycopodiella inundata (L.) Holub: natural monument «Ilminskoe klyukvennoe boloto».

Clade Polypodiophyta
Botrychiaceae
6. Botrychium lunaria (L.) Sw.: State Nature Reserve «Privolzhskaya lesostep» (Verhovya Sury, Kuncherovskaya lesostep); natural monuments «Dvorikovskiy vodno-lesnoy kompleks» [12], «Ivanryssinskiy landshaftnyy kompleks».
7. **Botrychium multifidum** (S. G. Gmel.) Rupr.: State Nature Reserve «Privolzhskaya lesostep» (Borok, Verhovya Sury).

Cystopteridaceae

8. **Gymnocarpium dryopteris** (L.) Newman: State Nature Reserve «Privolzhskaya lesostep» (Verhovya Sury); natural monuments «Arbekovskij les» (1906 – PKM), «Klyukvennoe boloto» [8].

Ophioglossaceae

9. **Ophioglossum vulgatum** L.: natural monuments «Dvorikovskij vodno-lesnoj kompleks» [12], «Zarechenskij monument «Urochishche Cherdak».

Salviniaeae

10. **Salvinia natans** (L.) All.: natural monuments «Ozernyj kompleks Lugovoj» [8], «Ozero Kuvakarki» [8], «Ozero Chapchor», «Pojmennaya dubrava».

Thelypteridaceae

11. **Phegopteris connectilis** (Michx.) Watt: State Nature Reserve «Privolzhskaya lesostep» (Verhovya Sury); natural monument «Arbekovskij les» (1906 – PKM).

Clade Pinophyta

Cupressaceae

12. **Juniperus communis** L.: State Nature Reserve «Privolzhskaya lesostep» (Verhovya Sury); natural monuments «Bolshevyasskij les» [13], «Dvorikovskij vodno-lesnoj kompleks» [12]; «Zarosl mozhzhvelelnik». The species was previously protected on the territory of the natural monument «Klyuchevskoj bor» (protected areas existed in 1991–2008).

Ephedraceae

13. **Ephedra distachya** L.: natural monuments «Ardymskij shihan», «Olshanske sklony».

Clade Magnoliophyta

Alliaceae

14. **Allium flavescens** Besser: State Nature Reserve «Privolzhskaya lesostep» (Kuncherovskaya lesostep); natural monuments «Ivanovskaya step» [8], «Karzhimantskie sklony», «Krasnyj Mar» [14], «Solonzovaya step» [8], «Step Bolshoj Endovy» [15], «Urochische Podgornoe», «Urochische Cherdak» [16], but later the growth was not confirmed [17]. «Shuro-Siran».

15. **Allium lineare** L. [**A. strictum** auct. non Schrad.]: State Nature Reserve «Privolzhskaya lesostep» (Kuncherovskaya lesostep); natural monument «Shuro-Siran» [18].

16. **Allium podolicum** (Asch. et Graebn.) Blocki ex Raciborski et Szafir [**A. paniculatum** auct. non L.]: State Nature Reserve «Privolzhskaya lesostep» (Poperechenskaya step, Ostrovkovskaya lesostep); natural monuments «Ivanovskaya step», «Kajarsovskij solonez» (2018 – Herbarium of the Reserve), «Krasnyj Mar» (2018 – Herbarium of the Reserve).

17. **Allium scorodoprasum** L.: State Nature Reserve «Privolzhskaya lesostep» (Borok), natural monument «Urochische Cherdak» (figure 1).

– **Allium sphaerocephalon** L.: the species is apparently erroneously given for natural monuments «Belogorskaya step» and «Shuro-Siran».

Apiaceae

18. **Aulacospermum multifidum** (Sm.) Meinsh.: State Nature Reserve «Privolzhskaya lesostep» (Kuncherovskaya lesostep).
19. **Bupleurum aureum** Fisch. ex Hoffm.: State Nature Reserve «Privolzhskaya lesostep» (Verhovaya Sury).

20. **Bupleurum falcatum** L.: natural monument «Urochishche Cherdak».

21. **Siliaum silius** (L.) Schinz et Thell.: State Nature Reserve «Privolzhskaya lesostep» (Kuncherovskaya lesostep); natural monuments «Danilovskaya soloncovaya polyana», «Kajzarovskij solonez» (2018 – Herbarium of the Reserve), «Solonzovaya step», «Urochishche Podgornoe».

22. **Vincetoxicum rossicum** (Kleopow) Barbar.: State Nature Reserve «Privolzhskaya lesostep» (Ostrovcovskaya lesostep); natural monument «Zubrilovskij park» [19].

**Asclepiadaceae**

23. **Aster amellus** L. s. l.: State Nature Reserve «Privolzhskaya lesostep» (Poporechenksaya step, Kuncherovskaya lesostep, Ostrovskovskaya lesostep); natural monuments «Belogorskaya step», «Elanskie stepi», «Ivanovskaya step», «Step Bolshoj Endovy», «Subbotinskie sklyony», «Urochishche Cherdak», «Shuro-Siran» [18].

24. **Galatella angustissima** (Tausch) Novopokr.: State Nature Reserve «Privolzhskaya lesostep» (Kuncherovskaya lesostep); natural monuments «Ardymskij shihan», «Krasnyj Mar», «Olsanskie sklyony», «Shuro-Siran» [18].

25. **Galatella hispida** (L.) Rchb. f.: State Nature Reserve «Privolzhskaya lesostep» (Poporechenksaya step, Kuncherovskaya lesostep, Ostrovskovskaya lesostep); natural monuments «Danilovskaya soloncovaya polyana», «Ivanovskaya step» [8], «Urochishche Cherdak», «Kajzarovskij solonez» (2018 – Herbarium of the Reserve).

26. **Galatella rossica** Novopokr.: State Nature Reserve «Privolzhskaya lesostep» (Poporechenksaya step, Ostrovskovskaya lesostep); natural monuments «Danilovskaya soloncovaya polyana», «Urochishche Podgornoe».

27. **Galatella villosa** (L.) Rchb. f.: State Nature Reserve «Privolzhskaya lesostep» (Poporechenksaya step, Kuncherovskaya lesostep, Ostrovskovskaya lesostep); natural monuments «Ardymskij shihan», «Elanskie stepi», «Ivanovskaya step», «Solonzovaya step», «Step Bolshoj Endovy», «Urochishche Podgornoe», «Shuro-Siran».

28. **Gelasia ensifolia** (M. Bieb.) Zaika, Sukhor. et N. Kilián [Scorzonera ensifolia M. Bieb.]: State Nature Reserve «Privolzhskaya lesostep» (Kuncherovskaya lesostep); natural monuments «Step Bolshoj Endovy», «Shuro-Siran» [18].

29. **Jacobaea erucifolia** (L.) G. Gaertn., B. Mey. et Scherb. [Senecio erucifolius L.]: State Nature Reserve «Privolzhskaya lesostep» (Poporechenksaya step, Ostrovskovskaya lesostep); natural monuments «Danilovskaya soloncovaya polyana», «Kajzarovskij solonez» (2018 – Herbarium of the Reserve), «Komarovskij rezervat golovchati Litvinova», «Krasnyj Mar» (2018 – Herbarium of the Reserve), «Solonzovaya step».

30. **Jacobaea fluviatilis** (Wallr.) E. Wiebe [Senecio fluviatilis Wallr.]: State Nature Reserve «Privolzhskaya lesostep» (Verhovaya Sury); natural monument «Lomovskie mohovye bolota».

31. **Jacobaea kirghisia** (DC.) E. Wiebe [Senecio paucifolius S.G. Gmel.]: natural monuments «Kajzarovskij solonez» (2018 – Herbarium of the Reserve).

32. **Jacobaea schwetziowii** (Korsch.) Tatanov et Vajukov [Senecio schwetziowii Korsch.]: natural monuments «Belogorskaya step», near the natural monuments «Ramzajskij rezervat golovchati Litvinova» (PKM), «Urochishche Cherdak».

33. **Pentanema germanicum** (L.) D. Gut. Larr., Santos-Vicente, Anderb., E. Rico et M.M. Mart. Or. [Inula germanica L.]: State Nature Reserve «Privolzhskaya lesostep» (Ostrovcovskaya lesostep ?); natural monuments «Belogorskaya step», «Shuro-Siran».

34. **Pseudopodospermum tauricum** (M. Bieb.) Vajukov et Saksonov [Scorzonera taurica M. Bieb.]: State Nature Reserve «Privolzhskaya lesostep» (Kuncherovskaya lesostep); natural monuments «Step Bolshoj Endovy», «Elanskie stepi», «Shuro-Siran» [18].
35. *Rhaponticoides ruthenica* (Lam.) M.V. Agab. et Greuter [*Centaurea ruthenica* Lam.]: natural monument «Urochishche Cherdak».

36. *Scorzonera parviflora* Jacq.: natural monument «Kajsarovskij solonez» (2019 – Herbarium of the Reserve).

37. *Tripolium pannonicus* (Jacd.) Dobrocz.: natural monument «Kajsarovskij solonez» (2019 – Herbarium of the Reserve).

Boraginaceae

38. *Onosma volgensis* Dobrocz. [*O. simplicissima* auct. non L.]: natural monument «Urochishche Cherdak».

Brassicaceae

39. *Dentaria quinquefolia* M. Bieb. [*D. arenarius* auct. non L.]: State Nature Reserve «Privolzhskaya lesostep» (Kuncherovskaya lesostep); natural monuments «Arbekovskij les», «Kuvshinovskij les».

40. *Syrenia montana* (Pall.) Klokov: State Nature Reserve «Privolzhskaya lesostep» (Kuncherovskaya lesostep),«Kajsarovskij solonez» (2019 – Herbarium of the Reserve).

Campanulaceae

41. *Adenophora lilifolia* (L.) A. DC.: State Nature Reserve «Privolzhskaya lesostep» (Verhovya Sury, Popereschenskaya step, Kuncherovskaya lesostep, Ostrovkovskaya lesostep); natural monuments «Dvorikovskij vodno-lesnoj kompleks» [12], «Ramzajskaya dubrava», «Urochishche Cherdak».

Caryophyllaceae

42. *Dianthus volgicus* Juz. [*D. arenarius* auct. non L.]: State Nature Reserve «Privolzhskaya lesostep» (Kuncherovskaya lesostep, the indication for the «Verhovya Sury» section is incorrect); natural monuments «Dvorikovskij vodno-lesnoj kompleks» [12], «Ozernyj ekokompleks Lugovoj», «Nikonovskij bor», «Tri gory», «Shuro-Siran».

43. *Gypsophila volgensis* Krasnova [*G. altissima* auct. non L.]: natural monuments «Belogorskaya step», «Elanskie stepi», «Olshanskie sklony», «Urochishche Cherdak».

44. *Lychnis chalcedonica* L.: State Nature Reserve «Privolzhskaya lesostep» (Ostrovkovskaya lesostep); natural monuments «Zolotarevskij bor», «Kichkilejskij sosnyak s dubom», «Pojmennaya dubrava».

45. *Minuartia setacea* (Thuill.) Hayek: State Nature Reserve «Privolzhskaya lesostep» (Kuncherovskaya lesostep).

46. *Otites sibirica* (L.) Raf. [*Silene sibirica* (L.) Pers.]: natural monuments «Ardymskij shihan», «Belogorskaya step», «Olshanskie sklony», «Step Bolshoj Endovy».

− *Silene steppica* Kleopow [*S. multiflora* auct. non (Ehrh.) Pers.]: the species is included in the Red Book of Penza region [10] according to mistakenly determined samples; it is subject to exclusion from the lists.

Chenopodiaceae

47. *Krascheninnikovia ceratoides* (L.) Gueldenst.: natural monuments «Ardymskij shihan», «Belogorskaya step», «Olshanskie sklony», «Solonzovaya step», «Step Bolshoj Endovy».

Crassulaceae

48. *Jovibarba sobolifera* (Sims) Opiz: near the natural monument «Dvorikovskij vodno-lesnoj kompleks» [12].

Cyperaceae

49. *Carex arnellii* Christ: «Zasurskij bor-chernichnik». «Kichkilejskij sosnyak s dubom».
50. Carex appropinquata Schumach.: natural monument «Dvorikovskij vodno-lesnoj kompleks» (PKM).

51. Carex bohemica Schreb.: near the natural monuments «Lomovskie mohovye bolota» (PKM).

52. Carex hartmanii Cajander: State Nature Reserve «Privolzhskaya lesostep» (Verhovya Sury); natural monuments «Dvorikovskij vodno-lesnoj kompleks» (PKM); «Zarechenskij les», «Naskaftymskoe pushicevoe boloto», «Nikolskoe boloto» (2005 – PKM), «Ozero Borovoe» (?)[8].

53. Carex limosa L.: State Nature Reserve «Privolzhskaya lesostep» (Verhovya Sury); natural monuments «Ilminskoe klyukvennoe boloto», «Kachimskoe mohovye boloto», «Klyukvennoe boloto», «Naskaftymskoe pushicevое boloto» «Nikolskое boloto». For «Zasurskij bor-chernichnik» [8] specified incorrectly.

54. Carex remota L.: natural monuments «Arbekovskij les», «Zarechenskij les» (2017 – Herbarium of the Reserve).

55. Carex sylvatica Huds.: natural monument «Zarechenskij les».

56. Carex tomentosa L.: natural monument «Zarechenskij les».

57. Eriophorum gracile W. D. J. Koch: natural monuments «Lomovskie mohovye bolota», «Ozero Bolshoe Mohovoe», «Nikolskoe boloto», «Klyukvennoe boloto». For natural monuments «Ilminskoe boloto» [8], «Naskaftymskoe pushicevое boloto» [8], «Pestrovskoe torfyanoe boloto» [8] it is indicated on the basis of incorrectly determined herbarium samples.

58. Eriophorum latifolium Hoppe: natural monuments «Dvorikovskij vodno-lesnoj kompleks» (PKM). For natural monuments «Ivanysinskij landshaftnyj kompleks» [8], «Lomovskie mohovye bolota» [8], «Sosnovoborskij bor-chernichnik» [8] it is indicated on the basis of incorrectly determined herbarium samples.

59. Rhynchospora alba (L.) Vahl.: State Nature Reserve «Privolzhskaya lesostep» (Verhovya Sury) (2016 – Herbarium of the Reserve); natural monument «Klyukvennoe boloto».

Dipsacaceae

60. Cephalaria nitrinovii Bobrov: natural monuments «Komarovskij rezervat golovchatki Litvinova», «Ramzajskij rezervat golovchatki Litvinova».

Droseraceae

61. Drosera anglica Huds.: natural monuments «Lomovskie mohovye bolota»; in natural monuments «Klyukvennoe boloto» and «Nikolskoe mohovoe boloto» the growth is not confirmed by modern studies.

62. Drosera rotundifolia L.: State Nature Reserve «Privolzhskaya lesostep» (Verhovya Sury); natural monuments «Ivanysinskij landshaftnyj kompleks» [8], «Ilminskoe boloto», «Kachimskoe boloto», «Klyukvennoe boloto», «Lomovskie mohovye bolota», «Nikolskoe mohovoe boloto», «Ozero Bolshoe Mohovoe», «Pestrovskoe torfyanoe boloto» [8], «Svetlopolyanskie mohovye bolota».

Ericaceae

63. Andromeda polifolia L.: natural monument «Kachimskoe boloto».

64. Chamaedaphne calyculata (L.) Moench: natural monuments «Klyukvennoe boloto», «Lomovskie mohovye bolota», «Ozero Bolshoe Mohovoe».

65. Ledum palustre L.: natural monuments «Lomovskie mohovye bolota»; apparently disappeared in natural monuments «Klyukvennoe boloto» and «Pestrovskoe torfyanoe boloto».

66. Oxycoccus palustris Pers.: State Nature Reserve «Privolzhskaya lesostep» (Verhovya Sury); natural monuments «Ilminskoe klyukvennoe boloto», «Kachimskoe boloto», «Klyukvennoe boloto», «Lomovskie mohovye bolota», «Nikolskoe mohovoe boloto».

67. Vaccinium uliginosum L.: natural monument «Lomovskie mohovye bolota».
Fabaceae
68. *Astragalus asper* Jacq.: natural monument «Step Bolshoj Endovy».
69. *Astragalus austriacus* Jacq.: State Nature Reserve «Privolzhskaya lesostep» (Ostrovцовская lesostep); natural monuments «Ivanovskaya step», «Step Bolshoj Endovy».
70. *Astragalus onobrychis* L.: natural monuments «Ardymskij shihan», «Ivanovskaya step», «Olshanskie sklony».
71. *Astragalus varius* S. G. Gmel.: State Nature Reserve «Privolzhskaya lesostep» (Kuncherovskaya lesostep); natural monuments «Ardymskij shihan», «Elanskie stepi», «Shuro-Siran».
72. *Lupinus spryginii* (Belyaeva et Sipliv.) Knjaz. [L. albus auct. non Link]: State Nature Reserve «Privolzhskaya lesostep» (Verhovya Sury); natural monuments «Subbotinskie sklony» (figure 3).

Gentianaceae
73. *Gentiana cruciata* L.: State Nature Reserve «Privolzhskaya lesostep» (Poperechenskaya step, Kurcherovskaya lesostep, Ostrovцовская lesostep); natural monuments «Belogorsкая step» [8], «Ivanovskaya step», «Olshanskie sklony», «Step Bolshoj Endovy».
74. *Gentiana pneumonanthe* L.: State Nature Reserve «Privolzhskaya lesostep» (Verhovya Sury, Poperechenskaya step, Kurcherovskaya lesostep, Ostrovцовская lesostep); natural monuments «Nikonovskij bor» [22], «Ozero Bolshoe Mohovoe» [23], «Ramzajskaya dubrava» [8].

Hyacinthaceae
75. *Scilla siberica* Haw.: natural monuments «Les po reke Serdobe», «Urochishche Podgornoe», «Zubrilovskij park», «Morozovskij dendrarij», «Kuvshinovskij les» [22]; apparently, the «Shuro-Siran» is specified incorrectly for natural monuments, since the species was not found during special searches.

Iridaceae
76. *Gladiolus tenuis* M. Bieb. [G. apterus Klokov.; G. imbiricatus auct. non L.]: State Nature Reserve «Privolzhskaya lesostep» (Poperechenskaya step, Ostrovцовская lesostep, Kurcherovskaya lesostep); natural monuments «Kuvshinovskij les», «Step Bolshoj Endovy».
77. *Iris aphylla* L.: State Nature Reserve «Privolzhskaya lesostep» (Borok, Poperechenskaya step, Kurcherovskaya lesostep, Ostrovцовская lesostep); natural monuments «Elanskie stepi», «Ivanovskaya step» [8], «Karzhimantskie sklony», «Krasnyj Mar» (personal message of the authors – 2018), «Ramzajskaya dubrava», Subbotinskie sklony, «Urochishche Podgornoe», «Shuro-Siran».
78. *Iris halophila* Pall.: natural monuments «Danilovskaya solonzovaya polyana», «Kajzarovskij solonez» (personal message of the authors – 2019).
79. *Iris sibirica* L.: natural monument «Ramzajskaya dubrava».

Lamiaceae
80. *Galeobdolon luteum* Huds.: natural monument «Zubrilovskij park» (2020 – PKM).
81. *Prunella grandiflora* (L.) Scholler: State Nature Reserve «Privolzhskaya lesostep» (Poperechenskaya step, Kurcherovskaya lesostep); natural monuments «Karzhimantskie sklony», «Subbotinskie sklony», «Urochishche Cherdak».
82. *Salvia verticillata* L.: State Nature Reserve «Privolzhskaya lesostep» (Kurcherovskaya lesostep) (Herbarium of the Reserve); natural monuments «Solonzovaya step», «Subbotinskie sklony», «Urochishche Cherdak».
83. *Salvia nutans* L.: State Nature Reserve «Privolzhskaya lesostep» (Ostrovцовская lesostep) (personal message of A N Dobrolyubov – 2018).
84. *Thymus pallasianus* Heinr. Braun: State Nature Reserve «Privolzhskaya lesostep» (Kurcherovskaya lesostep).
Lentibulariaceae

85. *Utricularia minor* L.: State Nature Reserve «Privolzhskaya lesostep» (Verhovya Sury, Kuncherovskaya lesostep); natural monuments «Klyukvennoe boloto», «Lomovskie mohovye bolota», «Ozero Bolshoe Mohovo», «Svetlopolskies mohovye bolota». There are no herbarium materials for the two locations: «Ivanysinskij landshaftnyj kompleks» [8], «Ozero Borovoe» [8].

Liliaceae

86. *Gagea granulosa* Turcz.: State Nature Reserve «Privolzhskaya lesostep» (Kuncherovskaya lesostep); natural monument «Solonzovaya step» (PKM).

87. *Gagea rubra* (Besser) Schult. et Schult. f.: State Nature Reserve «Privolzhskaya lesostep» (Kuncherovskaya lesostep, Ostrovovskaya lesostep); natural monuments «Ardymskij shihan», «Krasnyj Mar» (2018 – Herbarium of the Reserve), «Olshanskie sklony», Urochishche Podgornoe».

88. *Fritillaria ruthenica* Wikstr.: State Nature Reserve «Privolzhskaya lesostep» (Poperechenskaya step, Ostrovovskaya lesostep, Kuncherovskaya lesostep); natural monuments «Zubrilovskij park» (1969 – PKM), «Les po reke Serdobe», «Urochishche Lysaya gora», «Shuro-Siran».

89. *Fritillaria meleagroides* Patrin ex Schult. et Schult. f.: natural monument «Urochishche Podgornoe».

90. *Lilium pilosiusculum* (Freyn) Misch. [L. martagon auct. non L.]: State Nature Reserve «Privolzhskaya lesostep» (Verhovya Sury, Kuncherovskaya lesostep); near the natural monument «Dvorikovskij vodno-lesnoj kompleks» [12], natural monuments «Issinskaya dubrava» [24], «Kardavskij les» [8], «Ramzajskaya dubrava», «Urochishche Cherdak».

91. *Tulipa quercetorum* Klokov et Zoz [T. biebersteiniana auct. non Schult. et Schult. f.]: natural monuments «Zubrilovskij park» (1969 – PKM), «Les po reke Serdobe», «Pojmennaya dubrava» (personal observations of the authors – 2019), «Prisurskaya dubrava», «Urochishche Podgornoe».

Limoniaceae

92. *Limonium donetziicum* Klokov [L. tomentellum auct. non (Boiss.) Kuntze]: natural monument «Kajšarovskij solonez» (2018 – Herbarium of the Reserve).

Linaceae

93. *Linum flavum* L.: State Nature Reserve «Privolzhskaya lesostep» (Poperechenskaya step, Kuncherovskaya lesostep, Ostrovovskaya lesostep); natural monuments «Belogorskaya step», Karzhamantskie sklony» [8], «Solonzovaya step», «Step Bolshoj Endovy», «Subbotinskie sklony» [25], «Urochishche Cherdak».

Onagraceae

94. *Circaea alpina* L.: State Nature Reserve «Privolzhskaya lesostep» (Verhovya Sury); natural monument «Kardavskij les».

95. *Circaea quadriradiata* (Maxim.) Franch. et Sav. [C. lutetiana auct. non L.]: natural monument «Kichkilejskij sosnyak s dubom».

Orchidaceae

96. *Cephalanthera longifolia* (Huds.) Frisch.: natural monument «Dvorikovskij vodno-lesnoj kompleks» (PKM) (figure 2).

97. *Cephalanthera rubra* (L.) Rich.: State Nature Reserve «Privolzhskaya lesostep» (Verhovya Sury); natural monuments «Zarechenskij les», «Inzenskij massiv».
98. **Corallorhiza trifida** Chatel.: natural monument «Dvorikovskij vodonosnoj kompleks» (PKM).  
99. *Cyripedium calceolus* L.: natural monuments «Zarechneskij les», «Issinskaya dubava» (PKM).  
100. **Dactylorhiza maculata** (L.) Soo: State Nature Reserve «Privolzhskaya lesostep» (Verhovya Sury). A check of the indications is required, because the species was previously mixed with the ubiquitous *D. fuchsii* (Druce) Soo: «Zasurskij bor-chernichnik» [8], «Inzenskij massiv» [25], «Naskaftyskoe pushiceve boloto» [8], «Sosnovoborskij bor-chernichnik» [8].  
101. **Dactylorhiza incarnata** (L.) Soo: natural monuments «Dvorikovskij vodonosnoj kompleks» (PKM), «Zarechneskij les».  
102. *Epipogium aphyllum* (F. W. Schmidt) Sw.: State Nature Reserve «Privolzhskaya lesostep» (Verhovya Sury).  
103. **Gymnadenia conopsea** (L.) R. Br.: State Nature Reserve «Privolzhskaya lesostep» (Verhovya Sury); natural monuments «Dvorikovskij vodonosnoj kompleks» [12], «Zarechneskij les».  
104. **Listera ovata** (L.) R. Br.: natural monuments «Dvorikovskij vodonosnoj kompleks» (PKM), «Zarechneskij les», «Ivanysinskij landschaftnyj kompleks».  
105. *Neottianthe cucullata* (L.) Schltr.: State Nature Reserve «Privolzhskaya lesostep» (Verhovya Sury).  
106. *Orchis militaris* L.: natural monument «Zarechneskij les».

**Oxalidaceae**

107. **Oxalis acetosella** L.: near the natural monument «Sosnovoborskij bor-chernichnik» (PKM).  

**Plantaginaceae**

108. **Plantago maxima** Juss. ex Jacq.: natural monument «Danilovskaya solonzovaya polyanam»; близ natural monuments «Krasnyj Mar» (2018 – Herbarium of the Reserve).

**Poaceae**

109. **Heliotrichon desertorum** (Less.) Nevski: State Nature Reserve «Privolzhskaya lesostep» (Poperechenskaya step, Kuncherovskaya lesostep, Ostrovkovskaya lesostep).  
110. **Melica transsilvanica** Schur: natural monuments «Shuro-Sirans», «Ivanovskaya step», «Krasnyj Mar» (2018 – Herbarium of the Reserve), «Urochishche Lysaya gora», «Subbotinski sklyony» [9, 16, 25], «Pojemnaya dubava» [personal message of Ivanov A I].  
111. **Schoenoclacca festucacea** (Willd.) Link.: natural monument «Urochishche Podgornoe».  
112. **Stipa boryshenica** Klokov ex Prokudin [S. anomala auct. non P. A. Smirn.]: State Nature Reserve «Privolzhskaya lesostep» (Kuncherovskaya lesostep); natural monument «Shuro-Sirans» [18].  
113. *Stipa dasyphylla* (Lindem.) Trautv.: State Nature Reserve «Privolzhskaya lesostep» (Poperechenskaya step, Kuncherovskaya lesostep, Ostrovkovskaya lesostep); natural monuments «Urochishche Podgornoe», «Shuro-Sirans» [18].  
114. *Stipa pennata* L.: State Nature Reserve «Privolzhskaya lesostep» (Borok, Poperechenskaya step, Kuncherovskaya lesostep, Ostrovkovskaya lesostep); natural monuments «Ardymskij shihan» [8], «Belogorskaya step» [26], «Dvorikovskij vodonosnoj kompleks» [12], «Elanskije stepi» [26], «Ivanovskaya step» [26], «Kajarskovskij solonez» (personal message of the authors – 2018), «Karzhamtanskije sklyony» [26], «Krasnyj Mar» [26], «Nikityanskije gory» [8], «Nikonovskij bor» [22], «Olsanskije sklyony» (PKM), «Ramjaizkaja dubava» [27], «Tri gory» [8], «Urochishche Podgornoe» [28], «Urochishche Cherdak» [16], «Step Bolshoj Endovy» [29], «Subbotinski sklyony» [16, 30].  
115. **Stipa praecapillata** Alechin [S. sareptana auct. non A. K. Becker]: State Nature Reserve «Privolzhskaya lesostep» (Poperechenskaya step).
116. *Stipa pulcherrima* K. Koch: State Nature Reserve «Privolzhskaya lesostep» (Poperechenskaya step, Ostrovcovskaya lesostep).

117. *Stipa tirsia* Steven: State Nature Reserve «Privolzhskaya lesostep» (Poperechenskaya step, Kuncherovskaya lesostep, Ostrovcovskaya lesostep); natural monuments «Ärdymskij shihan», «Elanskie stepi», «Ivanovskaya step» [8], «Krasnyj Mar» (personal message of the authors – 2020), «Urochishche Cherdak», «Solonzovaya step» [8], «Urochishche Podgornoe» [28], «Step Bolshoj Endovy» [29], «Shuro-Siran» [18].

118. *Stipa zalesskij* Wilensky: State Nature Reserve «Privolzhskaya lesostep» (Poperechenskaya step, Ostrovcovskaya lesostep).

Polygalaceae

119. *Polygala sibirica* L.: natural monument «Urochishche Cherdak».

Pyrolaceae

120. *Monesis uniflora* (L.) A. Gray.: State Nature Reserve «Privolzhskaya lesostep» (Verhovya Sury) (2018 – Herbarium of the Reserve); «Dvorikovskij vodno-lesnoj kompleks» (PKM).

Ranunculaceae

121. *Adonanthus vernalis* (L.) Spach [Adonis vernalis L.]: State Nature Reserve «Privolzhskaya lesostep» (Borok, Poperechenskaya step, Kuncherovskaya lesostep, Ostrovcovskaya lesostep); natural monuments «Ärdymskij shihan», «Belogorsky step», «Elanskie stepi», «Ivanovskaya step» [8], «Karzhimantskie sklony», «Krasnyj Mar», «Olshanskie sklony», «Urochishche Lysaya gora», «Shuro-Siran», «Urochishche Podgornoe», «Subbotinskie sklony», «Solonzovaya step», «Step Bolshoj Endovy», «Urochishche Cherdak», «Shuro-Siran» [18].

122. *Adonanthus volgensis* (Steven ex DC.) Chrtek et Slaviková [Adonis volgensis Steven ex DC.]: State Nature Reserve «Privolzhskaya lesostep» (Ostrovcovskaya lesostep).

123. *Anemone sylvestris* L.: State Nature Reserve «Privolzhskaya lesostep» (Poperechenskaya step, Kuncherovskaya lesostep, Ostrovcovskaya lesostep); natural monuments «Urochishche Lysaya gora», «Shuro-Siran» (Herbarium of the Reserve).

124. *Anemonoides altaica* (C.A. Mey.) Holub: natural monument «Arbekovskij les»: the view probably disappeared, as it is not detected by special searches.

125. *Clematis recta* L.: near the natural monument «Krasnyj Mar».

126. *Delphinium cuneatum* Steven ex DC. s. l.: State Nature Reserve «Privolzhskaya lesostep» (Poperechenskaya step, Kuncherovskaya lesostep, Ostrovcovskaya lesostep); natural monuments «Urochishche Lysaya gora», «Urochishche Cherdak», «Step Bolshoj Endovy» (PKM).

127. *Pulsatilla patens* (L.) Mill.: State Nature Reserve «Privolzhskaya lesostep» (Verhovya Sury, Poperechenskaya step, Kuncherovskaya lesostep, Ostrovcovskaya lesostep); natural monuments «Bolshevyasskij les», «Dvorikovskij vodno-lesnoin kompleks» [12], «Zolotarevskij bor», «Ivanovskij les» (personal message of the authors – 2018), «Sosnovoborskij bor-chernichnik» [8], «Subbotinskie sklony» [25], «Tri góry», «Shuro-Siran» [18].

128. *Ranunculus polyphyllus* Waldst. et Kit. ex Willd.: State Nature Reserve «Privolzhskaya lesostep» (security zone of Ostrovcovskaya lesostep) (2019 – Herbarium of the Reserve); natural monument «Urochishche Podgornoe».

129. *Ranunculus pedatus* Waldst. et Kit.: State Nature Reserve «Privolzhskaya lesostep» (Ostrovcovskaya lesostep) (PKM); natural monuments «Urochishche Podgornoe», «Urochishche Shugaj».

Rosaceae

130. *Amygdalus nana* L.: State Nature Reserve «Privolzhskaya lesostep» (Poperechenskaya step, Kuncherovskaya lesostep, Ostrovcovskaya lesostep); natural monuments «Belogorsky step» [8].
Elanskie stepi [8], «Ivanovskaya step» [Центр..., 2020], «Karzhimantskie sklony» [8], «Krasnyj Mar» [8], «Solonzovaya step» [8], «Urochishe Podgorne» (PKM), «Shuro-Siran» [18].

131. *Cotoneaster laxiflorus* J. Jacq. ex Lindl. [C. melanocarpus Fisch. ex. Blytt]: natural monuments «Ivanovskaya step», «Nikityanskie gory» [8], «Ozernyi ekokompleks Lugovoj» [8], «Subbotinskie sklony», «Urochishe Lysaya gora».

132. *Potentilla alba* L.: State Nature Reserve «Privolzhskaya lesostep» (Verhovya Sury, Poperechenskaya step, Kuncherovskaya lesostep, Ostrovcovskaya lesostep); natural monuments «Karzhimantskie sklony» [8], «Ramzajskaya dubrava» и «Subbotinskie sklony», «Urochishe Cherdak» [16].

133. *Spiraea crenata* L. [incl. *S. litvinovii* Dobrocz.]: State Nature Reserve «Privolzhskaya lesostep» (Poperechenskaya step, Kuncherovskaya lesostep, Ostrovcovskaya lesostep); natural monuments «Ardymskij shihan», «Belogorskaya step», «Elanskie stepi», «Ivanovskaya step» [8], «Karzhimantskie sklony», «Krasnyj Mar», «Olshanskie sklony», «Solonzovaya step», «Subbotinskie sklony», «Shuro-Siran», «Urochishe Lysaya gora».

134. *Spiraea hypericifolia* L.: State Nature Reserve «Privolzhskaya lesostep» (Ostrovcovskaya lesostep) (2017 – MW); natural monument «Subbotinskie sklony».

**Salicaceae**

135. *Salix lapponum* L.: State Nature Reserve «Privolzhskaya lesostep» (Verhovya Sury ?); natural monuments «Kachimske boloto», «Klyukvennoe boloto», «Lomovskie mohovye bolota», «Nashaftymskoe boloto», «Nikolske boloto», «Ozero Bolshoe Mohovoe».

136. *Salix myrtilloides* L.: natural monuments «Kachimske boloto» [8], «Lomovskie mohovye bolota», «Svetlopolyanskie bolota» (?).

137. *Salix rosmarinifolia* L.: State Nature Reserve «Privolzhskaya lesostep» (Verhovya Sury); natural monuments «Krasnyj Mar» (Herbarium of the Reserve), «Lomovskie mohovye bolota», «Svetlopolyanskie bolota», «Ozero Bolshoe Mohovoe».

**Scheuchzeriaceae**

138. *Scheuchzeria palustris* L.: natural monuments «Ilinskoe klyukvennoe boloto», «Lomovskie mohovye bolota», «Nashaftymskoe boloto» (PKM), «Nikolske boloto», «Chibirlejskoe klyukvennoe boloto».

**Scrophulariaceae**

139. *Digitalis grandiflora* Mill.: natural monument «Urochishche Cherdak».

140. *Gratiola officinalis* L.: State Nature Reserve «Privolzhskaya lesostep» (Verhovya Sury).

141. *Pedicularis dasystachys* Schrenk: natural monuments «Kajzarovskiy solonez» (2018 – Herbarium of the Reserve), «Urochishe Podgorne».

142. *Pedicularis sceptrum-carolinum* L.: natural monument «Dvorikovskij vodo-lesnoj kompleks» (Herbarium of the Reserve).

**Sparganiaceae**

143. *Sparganium natans* L. [S. minimum Wallr.]: State Nature Reserve «Privolzhskaya lesostep» (Verhovya Sury, Kuncherovskaya lesostep); natural monuments «Zasurskij bor-chernichnik», «Kachimske boloto» (2018 – Herbarium of the Reserve), «Nikolske boloto», «Ozero Bolshoe Mohovoe», «Svetlopolyanskie mohovye bolota».

**Thymelaeaceae**

144. *Daphne mezereum* L.: State Nature Reserve «Privolzhskaya lesostep» (Verhovya Sury); natural monuments «Bolshevyasskij les» [13], «Dvorikovskij vodo-lesnoj kompleks» [12], «Zarechenskij les», «Zolotarevskij sosnovyj bor», «Inzenskij massiv», «Issinskaya dubrava» [24], «Subbotinskie sklony» [30].
Trapaceae
145. **Trapa natans** L. s. l.: natural monument «Ozero Chapchor».

Valerianaceae
146. **Valeriana spryginii** P. A. Smirn. [V. rossica auct. non P. A. Smirn.]: State Nature Reserve «Privolzhskaya lesostep» (Poperechenskaya step, Kuncherovskaya lesostep, Ostrovcovskaya lesostep), natural monument «Belogorskaya step» [8].

Violaceae
147. **Viola stangina** Kit. ex Schult. [V. persicifolia Roth]: State Nature Reserve «Privolzhskaya lesostep» (Verhovya Sury, Kuncherovskaya lesostep); natural monuments «Belokamenskij park» (PKM), «Kaisarovskij solonez» (2019 – Herbarium of the Reserve). «Krasnyj Mar» (Herbarium of the Reserve).

148. **Viola tanaitica** Grosset: natural monument «Urochishche Cherdak».

**4. Discussion**

200 species of vascular plants are listed in the Red Book of Penza region [2]. 148 protected species of vascular plants (74 %) were registered in the protected areas of Penza region. Accordingly, 52 species are not protected in any protected area.

147 new data was added by us. Most of them, 75 % of them, are the result of more careful consideration of existing publications, herbarium materials, and data from repeated field surveys of protected areas. 25 % of the new information falls on the natural monuments created after the publication of the current Red Book [2] («Dvorikovskij vodno-lesnoj kompleks» – 21 species, «Pojmennaya dubrava» – 3 species, «Kaisarovskij solonets» – 11 species).

Five indications from the Red Book [2] relating to *Diphasiastrum complanatum*, *Pentanema germanicum*, *Carex hartmaniorum*, *Salix myrtilloides*, *Sa. lapponum* have been rejected, as there is no herbarium confirmation for them. *Allium sphaerocephalon* was mistakenly cited for the natural monument «Shuro-Siran» plant list, and *Silene steppicola* should be excluded from the plant lists of Penza region due to an error in the definition of herbarium samples.

22 species included in the Red Book of the Russian Federation [11] are found in Penza region. 13 of these species are found within the protected areas: *Cephalaria litvinovii*, *Cephalanthera rubra*, *Cephalanthera longifolia*, *Cypripedium calceolus*, *Epipogium aphyllum*, *Fritillaria rutenica*, *Iris aphylla*, *Neottianthe cucullata*, *Orchis militaris*, *Stipa dasyphylla*, *Stipa pennata*, *Stipa pulcherrima*, *Stipa zalesskii*. Only a single population of the recently discovered species *Cotoneaster integerrimus* Medik. ([C. alaunicus] Golist.) has no territorial protection.

Populations of six species of the Red Book of the Russian Federation [11] (*Iris pumila*, *Liparis loeselii*, *Neotinea ustulata*, *Orchis morio*, *Astragalus tanaiticus*, *Hedysarum grandiflorum*) in Penza region are currently unknown. The existing data is very old and out of date. The references to *Carex umbrosa*, *Dactylorhiza baltica*, appear to be erroneous. These species should be excluded from the list of flora of Penza region.

86 species (43 %) grow on the territory of the reserve «Privolzhskaya lesostep». 114 species (67 %) are protected only on the territory of natural monuments. Of course, the state nature reserve provides the most reliable protection and the ability to monitor populations. There are not all types of habitats in the reserve «Privolzhskaya lesostep». As a result of which many stenotope species were left without territorial protection. In this regard, the improvement of the network of protected areas is very important for the conservation of the region's biodiversity.
Figure 1. *Allium scorodoprasum* L.

Figure 2. *Cephalanthera longifolia* (Huds.) Frisch.

Figure 3. *Lupinaster spryginii* (Belyaeva et Sipliv.) Knjaz.
47 (24%) species are found only in one protected area (13 species in the reserve «Privolzhskaya lesostep», and 34 species in 16 natural monuments). The diversity of the gene pool is necessary for the reliable conservation of rare species.

List of species 52 (26 %) not found in any protected area has been compiled. Four species are recommended for exclusion from the [2] due to erroneous indications (Carex umbrosa, Dactylorhiza longifolia, D. baltica, Ranunculus polyrhizos, Silene steppicola).

Very poor and outdated information is available on 14 species. However, the chances of finding them are there.

Specific data on actual populations of the remaining 34 species are available. Many halophytes, species on the borders of their areals, and stenotopic species are not protected in the network of protected areas in the region. The number of protected areas in poorly explored areas is extremely insufficient.

The combination of species that have absolutely no territorial protection (52 species) and species that are protected in only one protected area (57 species) gives the figure of 107 species. That is, more than half of the Red Book of Penza Region [2] needs to improve the strategy of their conservation, which primarily means the need to transform the network of protected areas of various ranks.

5. Conclusion
148 (74%) of the 200 species of vascular plants of the Red Book of Penza region are protected in the regional network of protected areas. Among them there are 13 species from list in the Red Book of the Russian Federation [11]. Only one species of the Red Book of the Russian Federation has no territorial protection, although its real population is known to scientists.

47 (24%) species are protected only in one protected area. 52 (26 %) species are not represented at all in protected areas. Thus, about half of the species of the [2] need to improve their territorial protection.

The existing system of protected areas needs to increase the total area, ensure a more uniform distribution of protected areas across the territory of the region, strengthen the landscape representativeness and representation of phytocenotic diversity.

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