

Monitoring of rare or threatened
plant species in the Bystrinsky
cluster, Nature park „Vulkani
Kamchatki“

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1. Introduction

Like many remote regions, the Kamchatka peninsula on the eastern fringe of Russia including the vegetation of the Bystrinsky cluster (Быстринский кластер, BC), part of the Nature Park „Vulkani Kamchatki“ (природный парк «Вулкани Камчатки») has insufficiently been investigated up to now. This lack of knowledge may partly be due to its location, its late discovery by Russians in the 17th century, but also to the entry controls carried out until the end of the past century (KRESTOV *et al.* 2008; EICHHORN 2010). Especially knowledge about rare and endangered plants has to be further enforced to ensure the protection of the park's diverse landscapes. In the context of for example gold deposits and mining activities on the borders of the Bystrinsky cluster, this knowledge is one of the protection measures of the borders and the territory of the BC (KISS 2011).

I will in the following paper refrain from giving a general introduction into the Bystrinsky cluster's territory and its geographic, geological and climatic features, since this can be looked up in various other publications, and is of no real relevance here (e.g. MANAGEMENT PLAN OF NATURE PARK „BYSTRINSKY“ 2003; v. HESSBERG 2006; KUNKEL 2006; KRESTOV *et al.* 2008; EICHHORN 2010).

The “ecological monitoring program for the especially protected natural areas on Kamchatka” (СТИШОВ 2007) gives an example of how rare and endangered plants should be monitored. During my stay in the Bystrinsky cluster, I discovered and monitored populations of *Rhodiola rosea*, *Cypripedium yatabeanum* and *Lobaria pulmonaria*. This paper describes the results of this monitoring activities and gives general advice how further monitoring of plant species could be carried out on the territory of the BC.

2. Plant species concerned

2.1 red book species

Of the 623 vascular plant species occurring on the park territory in 2009, 24 species are included in the Red Data Book Kamchatka, of which 5 species are included in the Red Data Book Russia (Красная Книга Камчатки 2007; Красная книга России 2009; Чернягина и Ябуков 2009, Нестерова 2010). The following list contains species that should be considered in the monitoring activities of botanists and inspectors during the flowering season. The status of red-book species is given through the short-cuts CR (critically endangered), EN (endangered) or VU (vulnerable) behind the name. The letters behind the red-book status indicate locations where this species has already been detected, and are explained in the short-cuts section at the end of this paper. This list of plants contained in the Red Data Book is an extract from Чернягина и Ябуков 2009 and Нестерова 2010. Species annotated “*” are listed in the Red Data Book Kamchatka, species annotated “**” are listed in the Red Data Book Russia.

division Polypodiophyta

Ophioglossaceae

1. ***Ophioglossum thermale* Kom. EN
Upper hot Apapelsky springs (Верхнеаппапельск горяч источники). First proved in 2010 on the territory of the BC by Нестерова 2010.
2. ***Ophioglossum vulgatum* L. var. *alaskanum* (E. Britt.) C. Chr. – Southern adderstongue.
(*Ophioglossum alascamun* E. Britt.). VU. O.
Warm spots in Oksinsky and Apapelsky hot springs (Оксинско-Аппапельски источники).
Under the canopy of *Filipendula camtschatica* surrounding the exit site of thermal waters.

Athyriaceae

3. **Diplazium sibiricum* (Turcz. ex G. Kunze) Kurata – EN. Э.
On rocky taluses on south-eastern and southern slopes, up to 840 m a.s.l. Often occurs in forests, may be abundant.

Division Magnoliophyta

Poaceae

4. **Achnatherum confusum* (Litv.) Tzvel. – (Stipa confusa Litv.). **EN**. Г, Э.
Rocks, rocky slopes, talus edges. Sporadically in forests – common in some places.

Liliaceae

5. **Lilium pensylvanicum* Ker-Gavl. – **Siberian Lily**. **VU**. (А), Э, Ап, (Ков).
Herb meadows, grassy slopes in the forest, up to 800 m a.s.l. Rare.

Orchidaceae

6. ***Cypripedium macranthon* Sw. – **Large-flowered Cypripedium**. **VU**. О.
In stonebirch and larch forests around the hot springs of Оху (ключы Окси). Rare in forests.
7. ***Cypripedium yatabeanum* Makino – **Spotted Lady's Slipper**. **VU**. (А), Э.
Stonebirch forests, subalpine meadows on southern slopes sheltered from the wind, up to 800 m a.s.l. Rare in forests, but in some places (under the canopy of birch trees) occurs fairly often.
8. **Epipactis papillosa* Franch. et Savat. **VU**. Ап.
Alder vegetation in flood plains, in outflow areas of hot springs. Rare in forests.
9. ***Epipogium aphyllum* (Fr. Schmidt) Sw. – **Ghost orchid**. **EN**. (Ков).
Larch and mixed forests in the basin of the river Kovavli (р. Ковавли). Rare in forests.

Polygonaceae

10. **Acetosella aureostigmatica* (Kom.) Tzvel. – **VU**. Ап.
In the village Anavgai (п. Анавгай), in anthropogenically altered sites near the bore holes of thermal water. Abundant.

Ceratophyllaceae

11. **Ceratophyllum demersum* L. – **Rigid hornwort**. **EN**. Ап. village of Anavgai.
In cold small lakes with inflow of thermal water. Very abundant.

Paraveraceae

12. **Papaver anjuicum* Tolm. **EN**. Э.
South-western slope of the Kosirevka mountain range (Козыревский хребет), at an altitude of 1400 m a.s.l. On damp and rocky slopes. Very rare.

Brassicaceae

13. **Arabidopsis bursifolia* (DC.) Botsch. **EN**. Г, Э, Ап.
Rocks, southern and south-western slopes with few herbs, and clayey slopes. Sporadically in forests, up to 600 m. a.s.l.

14. **Draba alpina* L. – **Alpine Draba**. EN. БА.

Moist rocky and mossy cliffs on the upper part of the Anaun volcano (). Quite often in the alpine region, around 1700-1750 m a.s.l.

15. **Draba stenopetala* Trautv. – **Anadyr Draba**. EN. Э.

Crassulaceae

16. ***Rhodiola rosea* L. – **Golden Root**. EN. (А), КЗ, Э, Д, БА, О.

On silty gravel deposits, rocky outcrops and eroded slopes on the banks of rivers and brooks, on the margins of screes, on stony, grassy and tundra slopes. Quite often in the alpine forest belt, up to 1370 m a.s.l. In places of joint growth of *R. rosea* and *R. integrifolia*, hybrids occur (female specimen of these hybrids can possess red and yellow flowers in their inflorescence).

Saxifragaceae

17. **Chrysosplenium wrightii* Franch. et Savat. – **Wright's Golden Saxifrage**. VU. Д.

Moist red volcanic screes on eastern slopes. Rare in the alpine belt, around 1610 m a.s.l.

Fabaceae

18. **Astragalus inopinatus* Boriss. CR. Ap.

On rocks of the river Bystraya (р. Быстрая), near the mouth of the river Kabalan (р. Кабалан). Rare in forests.

Apiaceae – Carrot family

19. **Phlojodicarpus villosus* (Turcz. ex Fisch. et C A. Mey.) Ledeb. EN. Ap.

Rocky slopes and screes. Rare.

Ericaceae

20. **Orthilia obtusata* (Turcz.) Hara – **Sidebells Wintergreen**. EN. II.

Sphagnum bog on the mountain pass of the Chempura mountain (г. Чемпура).

Gentianaceae

21. **Gentiana prostrata* Haenke – **Pigmy gentian**. EN. О.

Overgrown screes on the mountain pass of the Chempura mountain (river Anavgai bassin) (р. Анавгай). Rare in the alpine belt, around 1185 m a.s.l.

Asteraceae

22. **Bidens kamtschatica* Vass. EN. Ap, п. Анавгай,

Anavgai hot springs, on the overwettered banks of lakes out of slightly heated thermal waters. Rare. Third known location of this for Kamchatka endemic species (after the Uson Caldera and the valley of geyers).

23. **Taraxacum albescens* Dahlst. EN. Ky.
Rocky slopes and screes. Rare in the alpine belt.
24. **Taraxacum neokamtschaticum* Worosch. VU. (A), Ap, (Крю).
Eroded slag-clayey slopes. Rare in the alpine belt, around 1140-1360 m a.s.l.

2.2 species included in the monitoring plan

Seven of the 11 species that the general monitoring plan previews to be monitored are included in the Red Data Book Kamchata, and have been listed above:

1. *Cypripedium macranthon* Sw.
2. *Neottia asiatica* Ohwi
3. *Epipactis papillosa* Franch. et Savat.
4. *Lilium pensylvanicum* Ker-Gavl.
5. *Rhodiola rosea* L.
6. *Ophioglossum vulgatum* L. var. *alaskanum* (E. Britt.) C. Chr.
7. *Achnatherum confusum* (Litv.) Tzvel.

Four more species should be included in monitoring activities:

8. *Draba cana* Rydb.
9. *Hypericum gebleri* Ledeb.
10. *Eleocharis quinqueflora* (F.X. Hartm.) O. Schwartz.
11. *Nymphaea tetragona* Georgi

3. methods

Every time I detected a vascular species needed to be monitored, I noted the phenopase (l - leaves, fl - flowering, fr - fruiting), the number of individuals flowering, the number of leaves without flowers, the number of tussocks (for *R. rosea*), and the viability, if possible. However, for example for plants only seen from the back of a horse while riding, it was not possible to note any information but taking the GPS coordinates.

The number of flowering plants was divided into 9 categories:

0: no information on number available

1: 1-5 individuals

2: 6-10 individuals

3: 11-15 individuals

4: 16-20 individuals

5: 21-25 individuals

6: 26-30 individuals

7: 31-40 individuals

8: >40 individuals

The viability should be expressed through the following symbols:

oo very weak, not reproducing, germinated „accidentally“

o weakened, miserable state

Ø weakened, damages can be seen

• normal

•• very robust

Even though the main focus during my stay on Kamchatka was on vascular plants, one lichen species from the Red Data Book Kamchatka could be detected. Mosses were collected on many spots, but since they have not been determined until now, it is not known whether this collection as well contains rare or endangered species.

For every species, a database and a digital map were created in the folder „endangered plants“. How to use these maps, how to add data to these maps and how the database included in these folders is to be cared for is in detail written down in the text-document „read-me“ contained in the same „endangered plants“-folder. GPS-coordinates and information on number, vitality and habitat can be found in this digital database in the same folder.

4. results from the year 2011

In the year 2011, *Rhodiola rosea* and *Cypripedium yatabeanum* were monitored on the territory of the BC. These two species had already been found on the park territory in previous years on various locations (Чернягина и Ябуков 2009 and Нестерова 2010). They may not be especially rare, but since *R. rosea*, as a valuable medicine plant in traditional medicine, is susceptible to collection, its population status, especially around settlements, should be monitored. *C. yatabeanum*, present in quite high number on the territory of the Bystrinsky cluster, needs to be monitored and especially protected as a species from the Red Book Russia (Нестерова 2010).

Previous locations of *R. rosea*:



Figure 1: *Rhodiola rosea* in the beginning of flowering

Around the (abandoned) settlement of Viun (п. Вьюн) along the upper course of the river Kopelio (р. Копылье), one of the sources of the river Icha (р. Ича); around the hot springs of the Kosirevka river valley (р. Козыревка), in the Bystraya river valley (р. Быстрая) near the village of Ezzo (as well as in the Uksitschan river valley (р. Уксичан) and its surrounding plateau-like watersheds), around the Anaun volcano (г. Анаун), along the upper course of the river Anavgai (р. Анавгай) in the vicinity of the Оху, the Арапельский and the Орпалькинский hot springs (ключи Окси, Апапельский и Опалькинский) (Чернягина и Ябуков 2009).

Previous locations of *C. yatabeanum*:



Figure 2: *Cypripedium yatabeanum* in full flower in the middle of June, near lake Galiamaki

Around the (abandoned) settlement of Viun along the upper course of the river Kopelio, one of the sources of the river Icha as well as in the Bystraya river valley near the village of Ezzo (as well as in the Uksitschan river valley and its surrounding plateau-like watersheds) (ЧЕРНЯГИНА И ЯБУКОВ 2009). НЕСТЕРОВА 2010 found a population of *C. yatabeanum* around lake Galiamaki.

In 2011, the first individuals of *R. rosea* were found in the central part of the BC, south-west from the village of Ezzo, in a region where they had not been previously described. One population was detected along the upper course of the river Oemtevlan (р. Оемтевлан), on the wet meadows longing this river, in summer probably growing to high-herb meadows.

Further south, I found *R. rosea* along one of the tributaries of the Bystraya Chairiusovka (Быстрая Хайрюзовка), namely along the small river Ivolga (р. Иволга). Along another tributary of the Bystraya Chairiusovka, the small river Chuikov (р. Чуйков), this species was as well detected. During this time however, no notes on individual number or vitality were made (Figure 3).

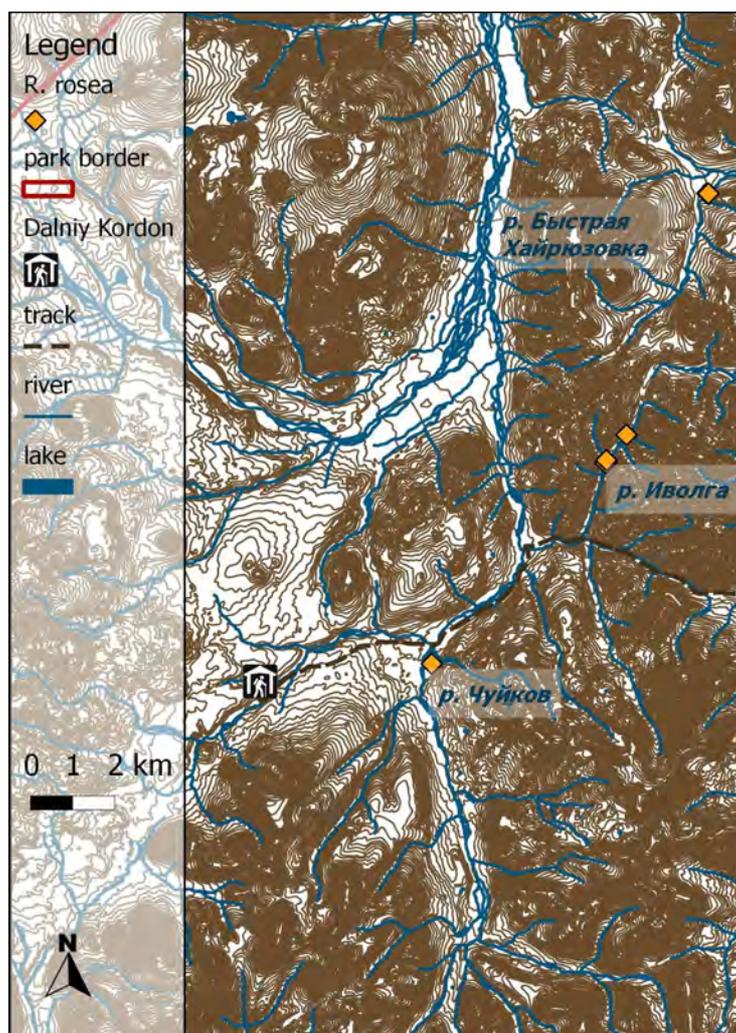


Figure 3: *R. rosea* found on the migration way with the reindeer-herders

In July, three weeks were spent around the lake Galiamaiki (о. Галямаки) in the eastern part of the BC territory. We made our way there riding on horses, therefore only short notes of plant populations could be made on the way. *R. rosea* was found along the banks of the river Irakan (р. Иракан) and along the Praviy Ebiev (р. Прав. Ебев), one of the tributaries of the Irakan flowing into the Bystraya. Furthermore, a population of this plant species was found on the mountain pass leading to the valley of the river Galiamaiki (р. Галямаки) (Figure 4).

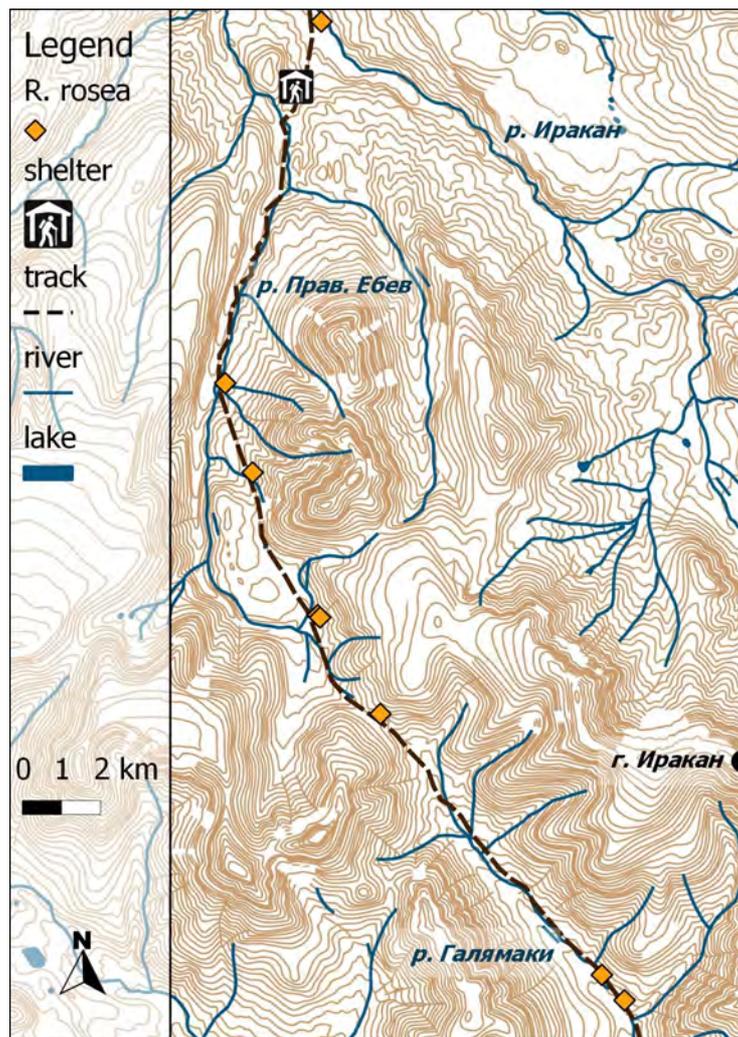


Figure 4: *R. rosea* found on the way to lake Galiamaki

Since time was most intensively spent along the eastern border of the lake Galiamaki, the biggest population of this plant species was discovered here. In these places, *R. rosea* was always growing on rather moist meadows, sometimes on high-herb meadows, sometimes on rather low wet tundra-like meadows bordering the lake. Furthermore, the plant was found on two spots near lake Mielkoe (о. Мелкое), lying south-west of lake Galiamaki (Figure 5).

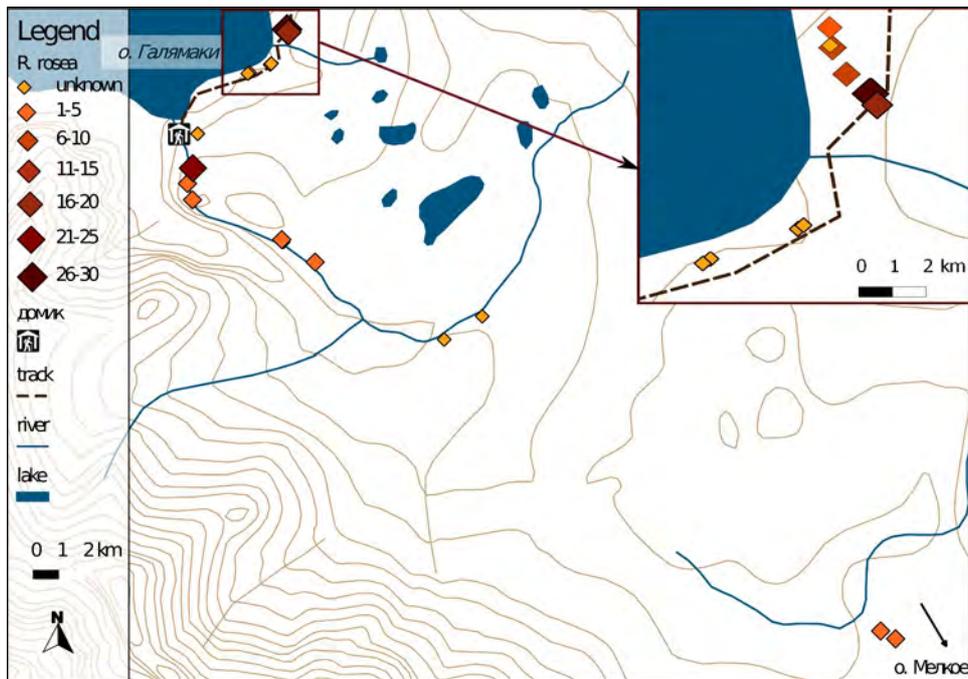


Figure 5: *R. rosea* found on the eastern shore of lake Galiamaki

Around the Ketachansky Kordon (Кордон Кетачанский) at the Southern border of the BC, *R. rosea* was as well found on a location between the first and the second Ketachan river (р. Кетачан 1-й and 2-й) (Figure 8).

C. yatabeanum was found in a single population in the small river valley at the south-western border of lake Galiamaki. This population grows higher up in the valley, on a tundra-like meadow on the slope along the horse track leading away from lake Galiamaki (Figure 6).



Figure 6: *C. yatabeanum* population around lake Galiamaki



Figure 7: meadow with dwarf-shrubs and *C. yatabeanum* near lake Galiamaki

Lobaria pulmonaria, a lichen contained in the Red Data Book Kamchatka was discovered in the region of the Ketachanskiy Kordon on two different locations. The first population was found south of the first Ketachan river. It was growing on the stems of old and big poplars (*Populus suaveolens*), and could be detected on 2 trees around this place. The second population was detected on the way from the Ketachanskiy Kordon to the spawning place of salmon about 3 km further north of the Ketachanskiy Kordon. Here, *L. pulmonaria* was growing on the stems of old willows (*Salix spec.*), and could be spotted on many trees around this location (Figure 8).

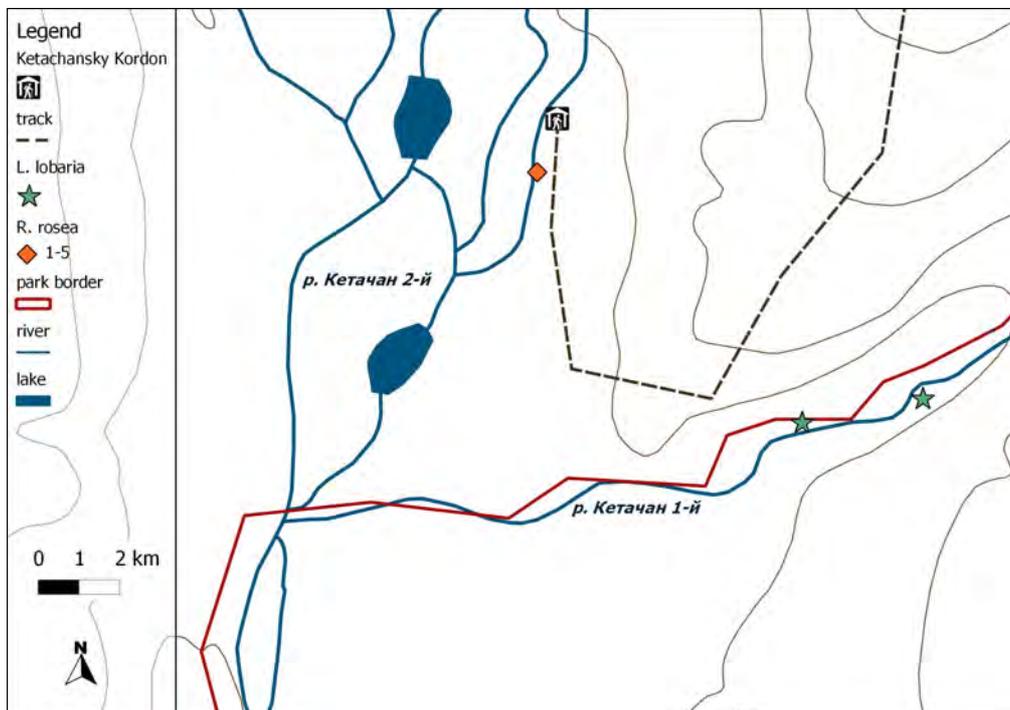


Figure 8: *L. pulmonaria* in the region of the Ketachan rivers



Figure 10: *Lobaria pulmonaria* on the stem of an old poplar (*Populus suaveolens*) near the first Ketachan river.

6. conclusions

This document provides the first set of data which can be used for the establishment of a database of rare and endangered plant species on the territory of the Bystrinsky Cluster (Nature park Vulkani Kamchatki). This database should be renewed and continued every year.

In order to monitor the populations of rare plants on the territory of the BC, regular monitoring activities have to be carried out. This work can, but must not only be done by botanists. Some of the 27 vascular plant species of the Red Data Book Kamchatka and the monitoring plan are easily recognizable, and every interested inspector and tourist can help filling the database with valuable information. However, thoughtful information is necessary especially for tourists, not to encourage them to collect rare plants as interesting souvenirs. Every information on the location of rare plants brought in by tourists must be verified by an inspector or other person knowing the plant species of concern before being included in the database. This monitoring activity can be called „by the way“, since tourists, inspector and botanists monitor the populations of rare plants „on their way“, and the observations have a casual and a accidental character, but is nevertheless an important way to collect data.

Besides this way of monitoring, the establishment of permanent plots where certain populations should be monitored every year is advisable. This has not been done until now, and the critical question is how to choose the plots to be monitored. It would be advisable to establish a few easily reachable permanent research spots, and guarantee their regular monitoring. One approach is to focus on very sensitive spots such as thermal and/or hot springs, which could especially be threatened by recreation activities or construction plans, on spots around settlements that could be threatened by collecting activities (e.g. for *Rhodiola rosea*), on places highly frequented by tourists, on places which are of general interest on a nature conservation and ecosystem protection point of view, like for example the region of the Ketachansky spawning place (нерестилище у Кетачанского кордона), and on the border regions of the cluster territory, to survey the ongoing mining activities.

In 2010, extensive work has been carried out on diverse hot springs on the territory of the BC, even identifying the first proof of *Ophioglossum thermale*, a species present in the Red Data Book Kamchatka, for the first time on the territory of the BC (НЕСТЕРОВА 2010). Unfortunately, these data seem not be yet available to the park management, or to botanists working for the park. Since hot springs nevertheless form a very special and, on a worldwide scale, rare habitat, these data would be an important part of the database. Furthermore, hot springs are easily susceptible to recreation activities. For this reason, the park management should pay attention to accurately protect these unique places and their vegetation. This could be done by for example inviting botanists in regular intervals, allowing them to visit these spots, and in return use their data for protection measures. The known thermal hot springs on the park territory (e.g. Oksinsko-Apapelski springs) which can easily be reached in summer should therefore be one of the first permanent monitoring spots on the BC territory. If no botanists can be found working for the park, this important task can of course also be fulfilled by an inspector.

I advise to search for the presence of *R. rosea* at a walking distance from the Esso settlement, and to check the population size and vitality once a year by an inspector. The population around lake Galiamaki can be monitored together with the *C. yatabeanum* population, when driving or riding to there. Since every summer at least one inspector is present at the Ketachansky Kordon, monitoring the *R. rosea* population there may not be difficult, and be one more argument for the special protection of this area in future times.

The *C. yatabeanum* population around lake Galiamaki can easily be monitored if ever going or driving to lake Galiamaki in summer, because the track down to the lake leads along the population site.

Since *L. pulmonaria* is generally described as an indicator species for unspoiled air and environments, the occurrence of this species around the Ketachansky Kordon indicates its importance as a location yet relatively untouched by civilization. This reinforces the need for special protection of this area, thus assuring the further existence of a relatively intact ecosystem and the co-occurrence of many important animal species (salmon, brown bear), the persistence of such sensitive habitats as the springs of the Ketachansky river, and the untouched habitats surrounding this place. During the summer months, an inspector is always present at the Kordon, and it would be easy to assure the yearly monitoring of this species' population development.

To allow the inspectors of the BC to carry out monitoring activities, a handout containing the plant species to be monitored with pictures and important features to recognize these species will be given to every inspector. This leaflet will as well include GPS coordinates of the locations of *R. rosea*, *C. yatabeanum* and *L. pulmonaria* populations dealt with in this paper, so that yearly monitoring can be done.

short-cuts

- (A) – around the (abandoned) settlement of Viun along the upper course of the river Kopolio (р. Копылье), one of the sources of the river Icha (р. Ича). Collection В.В. Якубова (Гришин, Якубов, 1993).
- Кз – around the hot springs of the Kosirevka river valley (р. Козыревка). Collection О.А. Чернягиной.
- Г – Valley of the Bustraya (р. Быстрая) near the Gorgachan mountain pass (перевал Горгачан).
- (Ков) – Kovavli river valley. Сборы О.А. Чернягиной, В.В. Якубова.
- Э – Bustraya river valley near the village of Ezzo (as well as Uksitschan river valley and its surrounding plateau-like watersheds). Collection Т.И. Нечаевой, Н.С. Пробатовой, А.Е. Кожевникова и М.Ю. Горшкова (Кожевников, 1981а; Кожевников, 1981б; Кожевников, Горшков, 1984), А.П. Хохрякова и А.Н. Беркутенко (Хохряков, Беркутенко, 1981), О.А. Чернягиной, В.В. Якубова. , Д– Срединный Камчатский хребет в окр. г. Дыгерен-Олегенде. Сборы Т.И. Нечаевой, Н.С. Пробатовой, А.Е. Кожевникова и М.Ю. Горшкова, О.А. Чернягиной, В.В. Якубова.

- Д** – Sredinny Kamchatsky mountain range (Срединный Камчатский хребет) around Dygeren-Olengende mountain (г. Дыгерен-Олегенде). Collection Т.И. Нечаевой, Н.С. Пробатовой, А.Е. Кожевникова и М.Ю. Горшкова, О.А. Чернягиной, В.В. Якубова.
- ВА** – around the Anaun volcano. Collection П.Т. Новограбленова (Новограбленов, 1932), Р. Малеза (Hulten, 1926–1930), В.В. Якубова.
- О** – upper course of the river Anavgai (р. Анавгай) in the vicinity of the Оху, the Arapelskiy and the Opalkinskiy hot springs (ключи Окси, Апапельских и Опалькинских). Collection П.Т. Новограбленова, Р. Малеза (Hulten, 1926–1930), О.А. Чернягиной (Кириченко, Чернягина, 2004)
- П** – Mountain pass across the Sredinniy mountain range near Kreruk mountain (г. Крерук) from the Anavgai river valley (р. Анавгай) to the Kamchatka river valley (р. Камчатка). Collection П.Т. Новограбленова (Новограбленов, 1932), О.А. Чернягиной (Кириченко, Чернягина, 2004).
- Ку** – Upper course of the Kulkiev (р. Кулкев), around the Kubalykich peak (сопка Кубалыкич).
- (Крю)** – Kriuki mountain range (хребет Крюки), in the (Усть-Камчатский р-н). Collection А.Е. Кожевникова и М.Ю. Горшкова (Кожевников, 1981, Кожевников, Горшков, 1984).

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