



Vegetation
survey of
**Horoka Tomamu
Montane Forest,**
Hokkaido, Japan,
2016 / 2018

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December 2018

(revised August 2019)

A survey carried out for

**Horoka Tomamu Montane
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conservation project**
www.horoka.org

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HOROKA TOMAMU VEGETATION SURVEY 2016/2018 - SUMMARY

Horoka Tomamu Montane Forest is a 50.5 hectare wooded mountain in central-southern Hokkaido, Japan, at latitude 43.100687° N and longitude 142.513781° E. It has an altitudinal range of 500-662 metres above sea level. A river runs along the western margin. The site lies within a larger area of forested mountains.

The fieldwork for this vegetation survey was carried out by Ben Averis, a British botanist on 12 days between 7th and 13th September 2016 and 11th to 18th October 2018. The aim was to map and describe the plant communities, in order to gain a better understanding of the habitats and to provide a basis for future site management.

The tree/shrub canopy and ground vegetation communities were classified separately. Sample quadrats were recorded in eight representative locations. At each of these locations, tree/shrub canopy species were recorded in a single 20 m x 20 m quadrat, within five 2 m x 2 m ground vegetation quadrats were recorded. Additional notes were made about the vegetation types found through the site generally (including some types that were not sampled with quadrats). Boundaries between vegetation types were mapped onto a large scale base map of the site. A list was made of all plant species found during the survey, including an indication of the approximate quantity of each species.

Nine tree/shrub canopy types (C1 to C9) and seven ground vegetation types (G1 to G7) were identified. For the purpose of mapping, areas were labelled with their canopy and ground layer combinations (e.g. C4/G1). Complex small-scale mosaics of two or more ground vegetation types beneath a single canopy type are common here and were labelled with percentage estimates (e.g. C2 / G1 70% G2 30%).

Totals of 161 vascular plant species and 113 bryophyte (moss and liverwort) species were recorded in this survey. These totals can be broken down as follows: 4 coniferous trees, 29 broadleaf trees, 5 broadleaf shrubs, 4 broadleaf sub-shrubs, 3 climbers, 3 clubmosses, 1 horsetail, 20 ferns, 1 dwarf bamboo, 13 other grasses, 6 sedges, 3 rushes, 69 herbs, 81 mosses and 32 liverworts. 19 lichens were recorded too, mostly to species level. Almost all of these species, including all bryophytes and lichens, are considered to be native to this area. Additional previous records include one broadleaf shrub, one grass and 18 herbs not found here by me; this gives a grand total of 181 vascular plant species recorded here.

The tree canopy is mostly of a species-rich broadleaved type with a very sparse scatter of conifers, but locally conifers are more common and in other places the canopy is dominated by *Betula ermanii* or *B. platyphylla* and, very locally, by mixtures of *Alnus hirsuta* and *Salix* spp. The ground vegetation is mostly species-poor and dominated by *Sasa senanensis*, but some places, especially steep banks and wetter ground, have more species-rich assemblages of herbs, grasses, sedges, ferns, mosses and liverworts.

Horoka Tomamu appears to be a good example of the native montane forest of this part of Japan, with the characteristic high richness in tree species, a good total number of ground flora species (even though most of the ground vegetation is species-poor because of the dominance of *Sasa*) and at least a moderate diversity of epiphytic bryophytes and lichens. The great abundance of dwarf bamboo is one of the main floristic differences between east Asian temperate forests and their counterparts in eastern North America; although these two regions are geographically far apart, they have broadly similar climates and share many forest plant species. Many plant species found in this survey are also native to Britain, where the climate is very different with cooler summers and much milder winters and where the species-richness of native forest tree canopies is much lower than at Horoka Tomamu.

This report describes the survey methods and results, presents an interpretation of the results in a discussion section and has appendices containing quadrat data, species lists, photographs (50 photos, showing landscape and habitat views) and maps (including the vegetation map of the site).

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1 INTRODUCTION

The purpose of this survey was to map and describe the plant communities of Horoka Tomamu Montane Forest, a nature reserve in Hokkaido, Japan. This information is needed to provide an account and understanding of the habitats and vegetation present and to help to inform future management of the site. Horoka Tomamu Montane Forest is a 50.5 hectare mountain, named Maruyama, situated in central-southern Hokkaido at latitude 43.100687° N and longitude 142.513781° E (see Maps 1-3 in Appendix 4). It rises from 500 metres above sea level at its base to 662 metres on the summit. It is owned by Simon and Masumi Holledge and is designated as a forest reserve. It is almost entirely covered in forest and lies within a much larger mountain forest landscape. Neighbouring mountains within 1-4 km rise to over 800 m, the highest being Mount Shamansha (1062 m), 3.6 km to the north. The nearest centres of human population are the town of Minami-Furano (5 km to the NNE) and the villages of Kami-Tomamu (8 km to the ESE) and Shimukappu (9.6 km to the SW) (all distances measured directly and not by road); access is from the south, along a 5 km track leading off the 136 Shimukappu-Tomamu road. People have lived in this area in the past, but the reserve and adjacent area have been uninhabited for several decades (www.horoka.org).

In *The 3rd National Survey on the Natural Environment (Vegetation)* (Environment Agency, undated) this site is mapped almost entirely as ‘*Picea yezoensis*, *Abies sachalinensis*, *Quercus mongolica* var. *grosseserrata*, *Tilia japonica*, *Acer mono* forest’. Small areas in the south are mapped as ‘Cultivated meadow’. Land to the east is mapped as ‘*Abies sachalinensis* plantation’ and land to the west, across the river, is mapped as a mixture of ‘*Acer mono* var. *glabrum*-*Tilia japonica* community’ and ‘*Abies sachalinensis* forest’. The bedrock here is described as pre-Cretaceous diabase (dolerite), diabasic tuff and chert (www.horoka.org). The climate is described as humid continental (type Dfb, with warm summers and cold winters) according to the Köppen-Geiger classification, with snow lying on the ground from November/December to April/May (www.horoka.org). Forest fires are an occasional feature in this part of Japan; for example in the late 1950s or early 1960s there was a forest fire on the southern slopes at Horoka Tomamu (www.horoka.org). There are no domestic grazing stock here but the site is lightly grazed by Sika deer *Cervus nippon yezoensis*. Also present are other mammals including brown bear *Ursus arctos yezoensis* and sable *Martes zibellina*, and many birds, bats, fish and herpetofauna (www.horoka.org).

Before this vegetation survey took place the only botanical information available for this site was a list of 95 vascular plant species, dating from 2011 or earlier; there were no records of bryophyte species. Botanical nomenclature in this report follows that of currently accepted names given on *The Plant List* website: <http://www.theplantlist.org> but noting that for three species (*Ilex rugosa*, *Rhododendron pentandrum* (= *Menziesia pentandra*) and *Viburnum furcatum*) their names are classed on that website as ‘unresolved’.

2 METHODS

I carried out the fieldwork for this survey on six days in the period 7th to 13th September 2016 and six days in the period 11th to 18th October 2018. During the fieldwork I was accompanied at all times by my daughter Elen Averis, and, for part of the time, by Simon and Masumi Maruo Holledge, and, on 7th September 2016, Dr Yasuo Konno, a botanist, from Obihiro.

Physical access within the site is limited by the extensive dense cover of dwarf bamboo *Sasa senanensis*. However, some paths about 1 m to 3 m wide have been cut through the *Sasa* (see Map 4 in Appendix 4) and one can also walk the length of the road along the SE edge of the site and, when water levels permit, the length of river along the western edge of the site. All of these access routes were utilized during the surveys in 2016 and 2018. Additional off-path routes were taken in 2016 and 2018, mainly to look at gullies (five on the western side and one on the eastern side).

I classified and mapped the vegetation on the basis of floristic variation observed during the fieldwork. My experience of recognizing plant communities of the British National Vegetation Classification (NVC) (Rodwell 1991-2000) over the last 30 years helped with the process of recognizing floristic variation here, even though this is a different landscape with so many different plant species. For the purpose of classifying the vegetation at this site I found it helpful to classify the tree/shrub canopy and the ground vegetation separately. I described a total of nine tree/shrub canopy types (coded C1 through to C9) and seven ground vegetation types (G1 to G7), so I was able to map forest vegetation using the appropriate combination of canopy and ground vegetation codes. Some areas have complex mosaics of two or more ground vegetation types and were therefore mapped as such, with an estimated percentage cover value given for each type.

For fieldwork I used a base map provided by Simon and Masumi Holledge onto which I had previously superimposed boundaries of glades as seen in aerial photography. This information helped for navigating through the site and for drawing vegetation boundaries. The final vegetation map was also drawn up onto a base map supplied by Simon and Masumi Holledge.

In 2016 I recorded samples of vegetation at eight locations (coded A-H) chosen as representative examples of the main forest vegetation types seen at this site. At each of these locations, tree/shrub canopy species were recorded in a single quadrat measuring 20 m x 20 m (re-shaped to a longer, narrow area of 400 m² at location E to fit the narrow riverside zone of sampled habitat there), and within this 400m² area I recorded a set of five 2 m x 2 m quadrats in ground vegetation. For each quadrat I recorded the altitude (in metres above sea-level), slope aspect (N, NE, E etc.), approximate slope gradient (in degrees), the percentage cover of bare ground (in ground vegetation quadrats only), the average vegetation height (in metres for the canopy layer and centimetres for the ground layer), and, in

ground vegetation quadrats, and the approximate quantity of the aerial parts of each plant species using the DOMIN scale:

1 = <4% cover (few individuals)	5 = 11-25% cover	9 = 76-90% cover
2 = <4% cover (several individuals)	6 = 26-33% cover	10 = 91-100% cover
3 = <4% cover (many individuals)	7 = 34-50% cover	
4 = 4-10% cover	8 = 51-75% cover	

Locations A-H are indicated on the vegetation map. Photographs were taken to show the appearance of the vegetation (including a photo of the location of each 2 m x 2 m ground vegetation quadrat at locations E, F, G and H, where the ground vegetation was relatively species-rich or heterogeneous, or not overwhelmingly dominated by dwarf bamboo). Photographs were also taken of additional vegetation types that were not sampled by quadrats.

I made a list of all plant species found during the course of this survey, noting the approximate quantity of each species within the site on a simple 4-point scale (1 = rare; 2 = occasional; 3 = frequent; 4 = abundant). As with any survey, this cannot be considered a complete list of all species present, especially as the main focus here was the description and mapping of vegetation types rather than species recording. Further search is likely to reveal additional species. However, the current list (including vascular plant species recorded here before 2016 but not seen in my survey) gives a meaningful indication of the nature of the flora here.

The survey in 2016 was my first visit to the far east, so I encountered many plant species here that were totally new to me. This presented a considerable challenge with regard to the identification and naming of plant species, but I was fortunate to have the loan, from Dr Yasuo Konno, of some identification books on Japanese vascular plants during the time of my stay in 2016. Dr Konno was also with me during the first day of survey fieldwork, when he gave me much help with the identification of several species. I made collections of bryophytes and posted these back to Scotland (in 2016 and 2018) so that I could examine them with the microscope back at home. I have been able to use a copy of the 5-volume *Illustrated Moss Flora of Japan* by Noguchi (1987-1994) for the mosses. One of the sedges is referred to here as *Carex* sp. because the nature of the material I found was insufficient for more specific determination (and, rather reassuringly for me, when this material was subsequently examined by two other Japanese botanists they too could not identify it to species level). Among the bryophytes, almost all records were made to species level but two were pairs of similar-looking species and one was to genus level. I did not attempt any survey of lichens because I am not an expert lichenologist, but I did identify and record some lichens growing on trees.

3 RESULTS

The vegetation types found in this survey are described below. The eight canopy/shrub layer types C1-C9 are described first, followed by descriptions of the seven ground vegetation types G1-G7. These descriptions include cross-referencing notes on the associations between canopy (C) and ground (G) types.

Further discussion about the vegetation is given in section 4 of this report. The quadrat data are in Appendix 1. The plant species list made for the site as a whole is in Appendix 2. Photographs of the main habitat types are in Appendix 3. The vegetation map, which shows vegetation codes and boundaries and the locations where quadrat samples were recorded, is Map 4 in Appendix 4.

Descriptions of tree/shrub canopy types (C1-C9)

These nine types can be placed into four broader groups: A = mountain slope forest of mixed broadleaves with scattered conifers; B = birch-dominated mountain slope forest; C = alder/willow-dominated forest on wetter, flatter low ground; D = conifer plantation.

Group A: mountain slope forest of mixed broadleaves with scattered conifers (C1-3); coloured green in Map 4 in Appendix 4

These three types all have much in common in terms of their species composition, differing mainly in the relative cover of broadleaves and conifers.

C1 Species-rich mixed broadleaf canopy (see photographs 1-3 and 7-12; two 400m² samples at locations A and B)

This is a species-rich and varied canopy of mainly *Acer pictum*, *Quercus mongolica*, *Tilia japonica*, *Ulmus davidiana*, *U. laciniata*, *Betula ermanii*, *B. maximowicziana*, *Fraxinus mandshurica*, *Phellodendron amurense* (= *P. sachalinense*) and *Alnus hirsuta*. There are also smaller amounts of *Acer japonicum*, *A. caudatum*, *A. palmatum*, *Sorbus commixta*, *S. alnifolia*, *Betula platyphylla*, *Kalopanax septemlobus*, *Chengiopanax sciadophylloides*, *Magnolia obovata*, *Prunus maximowiczii*, *P. ssiori*, *Populus tremula*, *Euonymus hamiltonianus*, *E. macropterus* and *Salix caprea*, and the shrubs *Hydrangea paniculata* and *Viburnum furcatum* and *Rhododendron pentandrum*. These broadleaves make up at least 90% of the canopy cover. There is also a sparse scatter of the conifers *Abies sachalinensis* and *Picea yezoensis* making up less than 10% of the canopy cover.

The species-rich nature of this tree/shrub canopy is shown by the totals of 11 and 15 species in the two 400m² samples recorded in this survey.

This is the most widespread and extensive type of tree/shrub canopy at this site, where it was found to be associated with ground vegetation type G1 (pure *Sasa* swards).

C2 Species-rich mixed broadleaves with c. 20% conifers (see photographs 13 and 14; 400m² sample at location D)

This resembles the C1 type described above but with the broadleaved element making up about 80% of the canopy cover (>90% in C1) and the conifers *Abies sachalinensis* and *Picea yezoensis* making up the remaining c. 20%.

This canopy type occurs in the north of the site, on level to moderately sloping ground. It is associated with ground vegetation types G1 (more or less pure *Sasa* swards) and G2 (*Sasa* with sparse associated flora).

C3 Species-rich mixed broadleaves with c. 40% conifers (see photographs 15 and 16; three 400m² samples at locations E, F and H)

This resembles the C1 type described above but with the broadleaved element making up about 60% of the canopy cover (>90% in C1) and the conifers *Abies sachalinensis* and *Picea yezoensis* (and a very little *Taxus cuspidata*) making up the remaining c. 40%. It occurs on moderate to steep slopes in the north-western part of the site, where the cool northerly slope aspect probably favours the growth of the conifers.

This canopy type is associated with a mixture of ground vegetation types G1 (more or less pure *Sasa* swards), G2 (*Sasa* with sparse associated flora), G3 (species-rich banks) and G5 (*Sasa* with wetland herbs and sedges).

This area appears to be the most shaded, sheltered and humid part of the site, and it was here that the richest epiphytic floras of bryophytes and lichens were seen on the tree trunks. These epiphytic floras include a good range of mosses as well as several liverworts (with epiphytic *Cololejeunea macounii*, *Metzgeria* spp., *Porella* spp. and *Frullania* spp. suggesting an influence of humid conditions) and lichens including *Lobaria* spp., *Sticta* spp., *Heterodermia* spp. and *Menegazzia* spp. (some of these being 'old forest' lichen species/genera in Britain and perhaps also in Japan, and some also being pollution-sensitive and therefore good indicators of clean air).

Group B: birch-dominated forest (C4 and C5); coloured yellow in Map 4 in Appendix 4

Betula ermanii is dominant in C4 and *B. platyphylla* dominant in C5. The birches are accompanied by a sparser growth of other species found in C1-C3.

C4 *Betula ermanii*-dominated canopy (see photographs 17 and 18; 400m² sample at location C)

Betula ermanii is dominant here, making up at least 90% of the canopy cover. Other broadleaves occur at a low (<10%) cover: mainly *Acer pictum*, *Quercus mongolica*, *Tilia japonica*, *Ulmus davidiana*, *U. laciniata*, *Fraxinus mandshurica*, *Phellodendron amurense* (= *P. sachalinense*), *Alnus hirsuta*, *Betula platyphylla* and *Magnolia obovata*. The conifers *Abies sachalinensis* and *Picea yezoensis* are very thinly scattered at <1% cover.

This type of canopy occupies a large area on the eastern slopes of the site, where it is associated with ground vegetation type G1 (more or less pure *Sasa* swards).

C5 *Betula platyphylla*-dominated canopy (see photographs 19 and 20)

Betula platyphylla is the dominant tree species here, making up about 90% of the canopy cover. Other tree species seen here, at a low (<10%) cover, are *B. ermanii*, *Acer pictum*, *Quercus mongolica*, *Ulmus davidiana*, *Alnus hirsuta*, and (<1% cover) the conifers *Abies sachalinensis*, *Picea yezoensis* and *P. glehnii*.

This type of canopy occupies a narrow zone along the lower south-eastern edge of the site, on level to gently sloping ground and with ground vegetation type G1 (more or less pure *Sasa* swards).

Group C: *Alnus-Salix* woodland on flatter, wetter low ground (C6-C8); coloured orange/red/pink in Map 4 in Appendix 4

These three types have *Alnus hirsuta* and *Salix* species accompanied by varying amounts of other broadleaves.

C6 *Alnus hirsuta* - *Betula* spp. - *Acer pictum* canopy (see photographs 21 and 22; 400m² sample at location G)

In this type *Alnus hirsuta* makes up at least 50% of the canopy cover. The canopy also includes *Acer pictum*, *Betula ermanii*, *B. platyphylla* and *Salix rorida*.

This type of canopy was found in this survey only once, in a small area near the river at the NW site margin where it is associated with ground vegetation type G4 (grass-dominated swards).

C7 *Alnus hirsuta* - *Salix* spp. canopy (see photographs 23 and 24)

This consists mainly of *Alnus hirsuta*, *Salix udensis*, *S. caprea* and *Ulmus davidiana*, with smaller amounts of *S. schwerinii*, *S. rorida*, *Acer pictum*, *Fraxinus mandshurica*, *Betula ermanii*, *Quercus mongolica*, *Populus suaveolens*, *P. tremula* and *Abies sachalinensis*.

This type of canopy was found on damp, more or less level lower ground along the western and southern edges of the site, where it is associated with ground vegetation type G1 (more or less pure *Sasa* swards).

C8 *Alnus hirsuta* - *Fraxinus mandshurica* - *Betula platyphylla* canopy (see photographs 25 and 26)

This is an open canopy of *Alnus hirsuta*, *Fraxinus mandshurica* and *Betula platyphylla*, with a little *Ulmus davidiana*. It was found once in this survey - on low, level, wet ground at the SE edge of the site, where the ground vegetation is of the G6 type (*Phragmites* swards).

Group D: conifer plantation (C9); coloured purple in Map 4 in Appendix 4

C9 *Abies sachalinensis* plantation (see photograph 27)

The canopy here consists mainly of planted *Abies sachalinensis*. There is also a very sparse scatter of broadleaves including *Betula ermanii*, *Quercus mongolica* and *Phellodendron amurense* (= *P. sachalinense*). This canopy type occurs in a small area on an E-facing slope at the NE edge of the site, where it is associated with ground vegetation types G1 (more or less pure *Sasa*) and G7 (*Sasa*-herb-fern-bryophyte assemblage).

Descriptions of ground vegetation types (G1-G7)

Types G1 and G2 are very similar to each other in being dominated by *Sasa senanensis*. G3 is noticeably more species-rich, with much less *Sasa*. G4 is distinct in being dominated by grasses. G5 has *Sasa* combined with a wetland element, and G6 (another wet type) is distinct in being dominated by *Phragmites*. G7 (in the plantation) is floristically related to G2 and G3 but with less *Sasa* than G2 and lower species richness than G3.

G1 More or less pure *Sasa senanensis* swards (see photographs 7, 8, 15-20, 23, 24 and 28; fifteen 4m² quadrat samples at locations A, B and C)

This vegetation consists almost entirely of tall, dense swards of *Sasa senanensis*. The dwarf bamboo is about 120-160 cm tall and is overwhelmingly dominant, with few or no accompanying plants. A few very thinly scattered plants of *Hydrangea petiolaris*, *Achlys japonica*, *Astilbe odontophylla* and *Leucothoe grayana* were found in this vegetation in this survey. The ground surface itself is mainly soil/humus and leaf litter of *S. senanensis*. No mosses were found on the ground in the quadrat samples of this vegetation, though very small quantities of species such as *Brachythecium* sp. were seen more widely within G1; many of the trees here support at least some growth of epiphytic bryophytes and lichens; epiphytic species here include the mosses *Anomodon minor*, *Boulaya mittenii*, *Dicranum flagellare*, *Homalothecium laevisetum*, *Raiiella fujisana* and *Trachycystis flagellaris*.

This is the most extensive type of ground vegetation at this site, where it is found mainly on well-drained slopes but also locally on flatter ground. It was found in this survey beneath all canopy types except C8, and is also the type of vegetation occupying the open glades.

This type of ground vegetation was sampled by a total of fifteen 4m² quadrats at locations F, G and H.

G2 *Sasa senanensis* with sparse associated flora (see photographs 13 and 14; five 4m² quadrat samples at location D)

This resembles the G1 vegetation described above, but although *Sasa senanensis* is again strongly dominant it is not quite as dense as in G1, so there is space here and there for a sparse, discontinuous and species-poor assemblage of scatter of other species including *Hydrangea petiolaris*, *Pachysandra terminalis*, *Ilex rugosa* and a very little *Astilbe odontophylla*, *Dryopteris expansa*, *Lycopodium dendroideum*, *Huperzia serrata*, the mosses *Rhynchostegium pallidifolium*, *Thuidium delicatulum* and *Myuroclada maximowiczii*, and seedlings of *Acer pictum*, *Sorbus commixta*, *Tilia japonica* and *Viburnum furcatum*. Epiphytic bryophytes and lichens are fairly common, forming assemblages similar to those on trees in G1 vegetation and including at least one population of the lichen *Lobaria pulmonaria*. This vegetation is floristically intermediate between types G1 and G3.

This vegetation occupies well-drained level to sloping ground in the northern part of the site, occurring in mosaics with the G1 pure *Sasa* swards (and locally with the G3 richer assemblages) beneath canopy types C2 and C3 (i.e. beneath mixtures of broadleaves and conifers).

G3 Species-rich herb-sedge-fern-bryophyte banks (see photographs 31-36; ten 4m² quadrat samples at locations E and F)

This is a species-rich and varied assemblage of plants. *Sasa senanensis* is generally sparse, leaving plenty of space for many smaller plant species including the creeper/climber *Hydrangea petiolaris*, the herbs *Achlys japonica*, *Pachysandra terminalis*, *Aconitum sachalinense ssp. yezoense*, *Oxalis acetosella*, *Galium kamtschaticum*, *G. trifloriforme*, *Maianthemum dilatatum*, *Aruncus dioicus*, *Rubus pseudojaponicus*, *Sanicula chinensis*, *Solidago virgaurea*, *Thalictrum sachalinense*, *Viola selkirkii*, *Cirsium kamtschaticum*, *Circaea alpina* and *Epilobium amurense*, the grass *Calamagrostis hakonensis*, sedges *Carex* spp., the ferns *Phegopteris connectilis*, *Dennstaedtia wilfordii*, *Deparia pycnosora*, *Dryopteris crassirhizoma*, *D. expansa*, *Athyrium vidalii*, *Gymnocarpium robertianum*, *Leptorumohra miqueliana*, *Polystichum braunii*, *P. tripterum*, *Adiantum myriosorum* and *Hymenophyllum wrightii*, the clubmoss *Huperzia serrata*, the mosses *Atrichum undulatum*, *Aulacomnium heterostichum*, *Thuidium delicatulum*, *T. tamariscinum*, *Fissidens dubius*, *Bryhnia novae-angliae*,

Brachythecium sp., *Rhynchostegium pallidifolium*, *Plagiothecium neckeroideum*, *P. nemorale*, *Loeskeobryum cavifolium*, *Bartramia pomiformis*, *Pogonatum contortum*, *P. spinulosum*, *Saelania glaucescens*, *Anoetangium aestivum*, *Amphidium* sp. and *Homalia trichomanoides*, and the liverworts *Conocephalum japonicum*, *C. salebrosum*, *Metzgeria conjugata*, *Plagiochila ovalifolia*, *Moerckia erimona* and *Pellia* sp..

Seedlings of *Abies sachalinensis*, *Acer japonicum*, *A. pictum*, *Fraxinus mandshurica*, *Ulmus davidiana* and *U. laciniata* are also common.

The vegetation height is mostly between 15 and 35 cm. Unvegetated soil and leaf litter occupies between 15% and 70% of the ground surface.

Epiphytic bryophytes and lichens are abundant and varied, and include the mosses *Boulaya mittenii*, *Hypnum pallescens*, *Trachycystis flagellaris*, *Neckera* spp., *Sanionia uncinata*, *Raiiella fujisana* and *Ulota* spp., the liverworts *Frullania* spp., *Porella* spp., *Cololejeunea macounii*, *Metzgeria furcata*, *M. consanguinea* and *Radula complanata*, and lichens including *Lobaria pulmonaria*, *L. quercizans*, *L. fuscotomentosa*, *Sticta fuliginosa*, *S. nylanderiana/wrightii*, *Heterodermia* species, *Menegazzia subsimilis*, *M. terebrata*, *Pseudocyphellaria crocata*, *Peltigera collina*, *Cetrelia chicitae*, *Parmelia praesquarrosa* and *Caloplaca flavorubescens*.

Decaying wood on the ground also supports abundant bryophyte growth including the mosses *Rhynchostegium pallidifolium*, *Brachythecium* sp., *Dicranum scoparium*, *Callicladium haldanianum*, *Loeskeobryum cavifolium*, *Bryonoguchia molkenboeri* and *Rhizomnium striatulum*, and the liverworts *Calypogeia japonica*, *C. neesiana*, *Bazzania denudata*, *Lophocolea bidentata*, *L. heterophylla*, *Lepidozia reptans* and *Riccardia palmata*.

This vegetation occupies parts of the steep, well-drained and very locally rocky N-NW-facing banks to the SE of the river along the NW edge of the site. It occurs here beneath canopy type C3 (c. 60% mixed broadleaves / c. 40% conifers). It also occurs in very small extent along parts of the edges of the stream gullies on the western and eastern slopes of the mountain.

This is the most species-rich ground assemblage found in this survey. The species-richness is evidently related to the reduced cover of *Sasa senanensis*, leaving enough space for smaller plants to grow without being smothered by the dwarf bamboo and its leaf litter. Some amount of ground instability on steep banks might also periodically produce new areas of bare soil with potential for colonisation by a wide range of vascular plant and bryophyte species. Additionally, the richness in bryophytes here is probably helped by the shade, shelter and humidity on these steep N-NW-facing banks.

G4 *Brachypodium sylvaticum* - *Muhlenbergia huegelii* grass swards (see photographs 17 and 18; five 4m² quadrat samples at location G)

This is grass-dominated vegetation with abundant *Brachypodium sylvaticum* and *Muhlenbergia huegelii*, and smaller amounts of *Brylkinia caudata* and *Calamagrostis hakonensis*. These grasses are accompanied by a sparse growth of the herbs *Galium trifloriforme*, *Jacobaea cannabifolia*, *Cardamine scutata*, *Aquilegia buergeriana*, *Clinopodium micranthum* var. *sachalinense*, *Viola grypoceras* and *Petasites japonicus*, the sedge *Carex dispalata*, the sub-shrub *Rubus idaeus*, and very small amounts of the mosses *Pleuroziopsis ruthenica*, *Climacium dendroides* and *Thuidium delicatulum*. There are also a few seedlings of *Abies sachalinensis*, *Acer japonicum*, *A. pictum*, *Alnus hirsuta*, *Fraxinus mandshuriana*, *Prunus ssiori* and *Ulmus davidiana*.

The herbs are largely hidden among the taller grass swards, but *J. cannabifolia*, *A. buergeriana*, *P. japonica* and *R. idaeus* overtop the grasses.

This vegetation was found only once in this survey: on a small area of more or less level, well-drained but probably periodically inundated ground by the river at the western edge of the site. It occurs here beneath canopy type C6 (*Alnus hirsuta*, *Betula ermanii*, *B. platyphylla* and *Acer pictum*).

G5 *Sasa senanensis* with wetland herbs and sedges (see photographs 25, 26, 37 and 38; five 4m² quadrat samples at location H)

In this vegetation *Sasa senanensis* is common at varying densities and is accompanied by a mix of other species including *Carex dispalata*, *C. mollicula*, *Clinopodium micranthum* var. *sachalinense*, *Chrysosplenium kamtschaticum*, *Filipendula camschatica* (= *F. kamtschatica*), *Laportea bulbifera*, *Peracarpa carnosus*, *Pachysandra terminalis*, *Galium trifloriforme*, *Angelica sachalinensis*, *Cardamine scutata*, *Circaea alpina*, *Cirsium kamtschaticum*, *Impatiens noli-tangere*, *Jacobaea cannabifolia*, *Mimulus tenellus*, *Osmundastrum cinnamomeum*, *Cardiocrinum cordatum*, *Parasenecio hastatus*, *Petasites japonicus*, *Dryopteris crassirhizoma*, *D. expansa*, *Hydrangea petiolaris* and the moss *Thuidium delicatulum*.

Assemblages of bryophytes and lichens on trees and on fallen rotting wood are similar to those found to be associated with the G3 vegetation type (see above); epiphytic lichens here include *Lobaria pulmonaria* and *L. quercizans*.

This vegetation occupies damp to wet soils on level to sloping ground to the SE and E of the river along the NW edge of the site. It occurs here beneath canopy type C3 (c. 60% mixed broadleaves / c. 40% conifers). It is scattered and patchy within this NW marginal area of the site, and, as with G3, its total extent is only small.

With species such as *Carex dispalata*, *C. mollicula*, *Chrysosplenium kamtschaticum* and *Filipendula camschatica* (= *F. kamtschatica*) the species

composition of this ground vegetation reflects the damp to wet conditions and in this way is in clear contrast to the G1, G2 and G3 vegetation on adjacent drier ground.

G6 *Phragmites australis* swards (see photographs 25 and 26)

This type of ground vegetation is very distinctive in that it consists mainly of a tall (150-200 cm), dense sward of *Phragmites australis*. The reed is here accompanied by a sparser growth of *Artemisia montana*, *Jacobaea cannabifolia*, *Carex utriculata*, *Sasa senanensis* and *Angelica sachalinensis*. This vegetation occupies a small area of wet, level ground at the SE edge of the site, where it is associated with canopy type C8 (*Alnus hirsuta* - *Fraxinus mandshurica* - *Betula platyphylla*).

G7 *Sasa*-herb-fern-bryophyte assemblage in conifer plantation (see photograph 27)

This vegetation has a patchy, discontinuous cover of plants including *Hydrangea petiolaris*, *Pachysandra terminalis*, *Achlys japonica*, *Rubus idaeus*, *Clinopodium micranthum* var. *sachalinense*, *Circaea alpina*, *Lycopodium dendroideum*, *Dryopteris crassirhizoma*, *Phegopteris connectilis*, *Sasa senanensis* and bryophytes, among conifer leaf litter on well-drained ground. It occurs in mosaics with G1 pure *Sasa* swards on the ground beneath planted *Abies sachalinensis* on an east-facing slope at the NE edge of the site.

The canopy and ground vegetation types sampled with quadrats at each of locations A-H is indicated in Table 1 below:

Table 1 Canopy and ground vegetation types sampled with quadrats at locations A-H at Horoka Tomamu Montane Forest, Hokkaido, Japan, in September 2016

Location	Canopy type	Ground vegetation type
A	C1 Species-rich mixed broadleaf canopy	G1 More or less pure <i>Sasa senanensis</i> swards
B	C1 Species-rich mixed broadleaf canopy	G1 More or less pure <i>Sasa senanensis</i> swards
C	C4 <i>Betula ermanii</i> -dominated canopy	G1 More or less pure <i>Sasa senanensis</i> swards
D	C2 Species-rich mixed broadleaves with c. 20% conifers	G2 <i>Sasa senanensis</i> with sparse associated flora
E	C3 Species-rich mixed broadleaves with c. 40% conifers	G3 Species-rich herb-sedge-fern-bryophyte banks
F	C3 Species-rich mixed broadleaves with c. 40% conifers	G3 Species-rich herb-sedge-fern-bryophyte banks
G	C6 <i>Alnus hirsuta</i> - <i>Betula</i> spp. - <i>Acer pictum</i> canopy	G4 <i>Brachypodium sylvaticum</i> - <i>Muhlenbergia huegelii</i> grass swards
H	C3 Species-rich mixed broadleaves with c. 40% conifers	G5 <i>Sasa senanensis</i> with wetland herbs and sedges

No quadrat samples were recorded in canopy types C7 (*Alnus-Salix*), C8 (*Alnus-Fraxinus-Acer*) and C9 (*Abies* plantation), and ground vegetation types G6 (*Phragmites*) and G7 (plantation woodland floor).

Table 2 below gives a summary of the numbers of plant species found in the quadrat samples of vegetation types in this survey. In the canopy layer the number of tree/shrub species in a 400 m² sample varies from 4 to 17 and is highest in the mixed broadleaf-dominated types C1, C2 and C3. The number of species in a 4m² sample of ground vegetation varies from 1 to 35 and is highest in the type G3 (species-rich herb-sedge-fern-bryophyte banks) with a mean of 26.5 species per sample, and lowest in type G1 (more or less pure *Sasa*) with a mean of only 1.7 species per sample.

Table 2 Summary of numbers of plant species recorded in quadrat samples of forest vegetation at Horoka Tomamu Montane Forest, Hokkaido, Japan, in September 2016

Tree/shrub canopy type	Number of samples	Mean number of species in a 400 m ² canopy sample
C1 Species-rich mixed broadleaf canopy	2	13.0 (range 11-15)
C2 Species-rich mixed broadleaves with c. 20% conifers	1	7.0
C3 Species-rich mixed broadleaves with c. 40% conifers	3	11.0 (range 7-17)
C4 <i>Betula ermanii</i> -dominated canopy	1	5.0
C5 <i>Betula platyphylla</i> -dominated canopy	0	-
C6 <i>Alnus hirsuta</i> - <i>Betula</i> spp. - <i>Acer pictum</i> canopy	1	5.0
C7 <i>Alnus hirsuta</i> - <i>Salix</i> spp. canopy	0	-
C8 <i>Alnus hirsuta</i> - <i>Fraxinus mandshurica</i> - <i>Betula platyphylla</i> canopy	0	-
C9 <i>Abies sachalinensis</i> plantation	0	-
All sampled canopy types combined	8	9.4 (range 4-17)
Ground vegetation type	Number of samples	Mean number of species in a 4 m ² ground vegetation sample
G1 More or less pure <i>Sasa senanensis</i> swards	15	1.7 (range 1-3)
G2 <i>Sasa senanensis</i> with sparse associated flora	5	6.8 (range 4-10)
G3 Species-rich herb-sedge-fern-bryophyte banks	10	26.5 (range 18-35)
G4 <i>Brachypodium sylvaticum</i> - <i>Muhlenbergia huegelii</i> grass swards	5	11.8 (range 9-16)
G5 <i>Sasa senanensis</i> with wetland herbs and sedges	5	11.4 (range 9-14)
G6 <i>Phragmites australis</i> swards	0	-
G7 <i>Sasa</i> -herb-fern-bryophyte assemblage in conifer plantation	0	-
All sampled ground vegetation types combined	40	11.0 (range 1-35)

Notes on the flora of this site

During the course of these surveys I found a total of 161 vascular plant species and 113 bryophyte species (81 mosses and 32 liverworts).

95 vascular plant species were recorded at Horoka Tomamu before my visit in September 2016. That previous list also included an additional 14 species of *Prunus* and *Salix* that had not actually been identified here but which were considered as species that could possibly occur given the location and nature of the site; six of these were found in my survey in 2016/2018, and among the remaining eight only *P. padus*, *P. sargentii*, *S. miyabeana* and *S. cardiophylla* are common enough in this part of Hokkaido (according to maps in <http://www.hinoma.com/maps/index.shtml>) to be realistic 'possible' species here. There appears to have been no previous bryophyte recording here.

Many of the vascular species on my list overlap with those on the previous list. Of the 95 vascular species recorded previously by other people, I found 76 but could not find 20 (18 herbs, one grass and one broadleaved shrub). I found many additional species not previously recorded here, so my survey list of 161 vascular species combined with the previous list gives totals of 181 vascular plant species and 113 bryophyte species recorded at this site. All of these species are listed in Appendix 2.

The areas with the highest diversity in ground vegetation species are the lower north-western slopes and the six stream gullies; these areas have steep, shaded, sheltered slopes and also some flatter areas that are also sheltered and shaded by the nearby N-NW-facing slopes. These areas were found to have the greatest diversity of ground vegetation species, and in comparison with the rest of the site they show a noticeably higher diversity of fern and bryophyte species which evidently benefit from the shade, shelter and humidity here.

Most of the vascular plant species recorded at Horoka Tomamu are native to this part of Japan, but ten (*Agrostis stolonifera*, *Anthoxanthum odoratum*, *Dactylis glomerata*, *Galium album*, *Lapsana communis*, *Oxalis stricta*, *Taraxacum* agg., *Trifolium pratense*, *T. repens* and *Verbascum thapsus*) are considered to be introduced here. *Abies sachalinensis* exists here mainly as native trees but also, at the NE edge, as planted trees. (There are plantations of *A. sachalinensis* and *Picea glehnii* just outside the site, to the east.)

All of the bryophyte species here are assumed to be native to this site.

Table 3 below gives a summary of the numbers of plant species in different groups (broadleaf tree, coniferous tree, herb, etc) recorded at Horoka Tomamu Montane Forest in this survey in 2016/2018 and also in all surveys combined.

Table 3 Summary of numbers of plant species recorded at Horoka Tomamu Montane Forest, Hokkaido, Japan

Group	No. of species from 2016/2018 survey	% of total no. of species found in 2016/2018 survey	No. of species from all surveys	% of total no. of species from all surveys
Coniferous trees	4	3 %	4	2 %
Broadleaf trees	29	18 %	29	16 %
Broadleaf shrubs	5	3 %	6	3 %
Broadleaf sub-shrubs	4	2 %	4	2 %
Climbers	3	2 %	3	2 %
Clubmosses	3	2 %	3	2 %
Horsetails	1	<1 %	1	<1 %
Ferns	20	13 %	20	11 %
Dwarf bamboo	1	<1 %	1	<1 %
Other grasses	13	8 %	14	8 %
Sedges	6	4 %	6	3 %
Rushes	3	2 %	3	2 %
Herbs	69	43 %	87	48 %
Total (all vascular plants)	161	100 %	181	100 %
Mosses	81	72 %	81	72 %
Liverworts	32	28 %	32	28 %
Total (all bryophytes)	113	100 %	113	100 %
Total vascular plants + bryophytes	273		293	

4 DISCUSSION

Position in relation to broader Japanese forest types

Hokkaido has been classified into four biogeoclimatic zones by Kojima (1979). These are listed below in order of decreasing altitude/increasing temperature (i.e. coldest first):

- Subalpine *Pinus pumila* zone (montane scrubby forest)
- Montane *Abies sachalinensis* zone (*A. sachalinensis*/*Picea jezoensis*/*P. glehnii* conifer forest)
- Nemoral *Acer mono* zone (deciduous forest)
- Nemoral *Fagus crenata* zone (beech forest of SW Hokkaido)

Horoka Tomamu lies within the third zone (nemoral *Acer mono* zone). Uemura (1993) described this zone as the most species-rich forest zone in Hokkaido in terms of the diversity of tree species, climbers, herbs and epiphytes. Nakamura & Krestov (2005) noted that “The presence of woody vines is a remarkable feature of the mixed broadleaved-*Abies sachalinensis* forest type” and that “One of the most remarkable features of the insular mixed broadleaved-conifer forests is the high significance of small monocarpic bamboos of the genus *Sasa* in the understorey”.

The dominance of dwarf bamboo *Sasa* on the ground is a feature very characteristic of the forests in Hokkaido generally (Takeda 1913, Uemura 1993), to such an extent that according to Toyooka *et al* (1983) (as quoted by Kudo *et al* 2011) “In Hokkaido, northern Japan, dwarf bamboo was estimated to occupy 89% of forested areas and accounts for 28% of the woody biomass”. The common occurrence of bamboo and dwarf bamboo species is one of the main floristic differences between these east Asian temperate forests and their counterparts in eastern North America where the climate is broadly similar.

Although *Sasa* is so dominant here and through much forest in Hokkaido, its dominance at any time in any individual population might be part of a longer term sequence of phases of changing abundance. Numata, 1970 (as quoted by Nakamura & Krestov, 2005) found that “These bamboos, monocarpics with a lifespan of 10-15 years, have been observed to die off over areas of several square kilometres”. Similarly, Makita (1992) described establishment, density-stable and thinning phases from a 10 year study of populations of *Sasa kurilensis* at 1150 m (in *Betula ermanii* forest) and 1350 m (open *Sasa* grassland) altitude in northern Honshu. Abe *et al* (2002) found that cycles of dominance and dieback of *Sasa* in beech forest in northern Honshu contributed to the species diversity of the tree canopy; for example *Sasa* death facilitated the emergence/survival of seedlings of certain tree species (including some found at Horoka Tomamu: *Acer japonicum*, *Tilia japonica*, *Chengiopanax sciadophylloides*, *Kalopanax septemlobus* and *Sorbus*

commixta) and when combined with the opening of gaps in the tree canopy it also promoted the emergence of seedlings of pioneer species including *Betula maximowicziana* and *Magnolia obovata*.

The vegetation of Horoka Tomamu also appears to belong within type 6 'subalpine broad-leaved forest' described in the classification of Japanese vegetation types in a report by the Environment Agency Nature Protection Bureau (1999).

Horoka Tomamu appears to be a good example of this type of mid-altitude northern Japanese forest, demonstrating a high diversity of tree species, a good number of ground flora species (despite the species-richness being low through much of the site) and a good diversity of epiphytes. It also has considerable variation in tree canopy species composition and in ground vegetation type; this reflects variation in slope aspect, humidity, rockiness, ground wetness and the abundance of the dwarf bamboo *Sasa senanensis*.

Forest history, land management and grazing in this area

The descriptions of habitats and vegetation in Hokkaido by Takeda (1913) also included open hill slopes, as follows: "The dry hillsides are usually covered with *Miscanthus*, with which various species of *Artemisia*, *Aconitum*, *Convallaria majalis*, *Geranium*, *Hemerocallis Middendorffii*, *Lespedeza*, *Platycodon*, *Rumex*, and Umbelliferae. In humid places of the mountain valleys we often find *Artemisia vulgaris* [*A. montana*], *Cacalia hastate* [*Parasenecio hastatus*], *Lilium cordifolium*, *L. Glehni* [*Picea glehnii*], *Petasites japonicus*, *Polygonum sachalinense*, *Urtica platyphylla*, and so on, most of which are very robust." This accords with the current understanding that the forests of Hokkaido are mostly secondary in nature, following a previous period (up until about the mid 20th century) during which there was more human land use here and a greater extent of open land where the original forest had been cleared.

Blocks of conifer plantation (of the native species *Abies sachalinensis* and *Picea glehnii*) are scattered commonly on the lower slopes of the mountains in this general area, and a very small part of one such area of plantation (of *Abies sachalinensis*) is within Horoka Tomamu reserve.

There are some open grassy areas to the east and south-west of Horoka Tomamu. These will have been felled some time in the past, and possibly used for growing crops. Nowadays they are evidently maintained as grassland areas by deer grazing.

Within the forest, the generally lush nature of the ground vegetation suggests that grazing is light. Other things consistent with this include the abundance of tree and shrub seedlings, and the varied canopy age structure (including saplings, young trees and mature trees) and the very limited signs of grazing on ferns (many fern species being palatable to deer and other large

herbivores). In one place, in the western riverside woodland a short distance in from one of the above-mentioned open grassland areas, evidence of more intensive grazing was seen on sedge *Carex* plants in October 2018 (see Photograph 50, which also shows a deer path here).

At two riverside locations on the western edge of the site, deer have evidently been rubbing the bark of *Alnus hirsuta* trees with their antlers. This has exposed bright orange wood beneath the outer bark, and there are also orange 'shavings' on the ground directly beneath the rubbed areas. An example of this is shown in Photograph 49.

The rather sharp-edged boundaries of the birch-dominated areas at Horoka Tomamu (canopy types C4 and C5), combined with the fact that their distribution patterns do not clearly reflect natural physical or climatic factors, suggests that this dominance of birches might be an effect of a past episode of fire after which the birches could have gained at least a temporary competitive advantage over other establishing tree species. There is an altitudinal separation between the *Betula ermanii* and *B. platyphylla* areas, the former being on higher ground than the latter. This reflects a pattern that is seen more widely in the general area and is also evident when looking at the distribution maps of the two species in the whole of Hokkaido (their distributions overlap considerably but *B. ermanii* has a more upland distribution than does *B. platyphylla* and actually dominates naturally in scrubby woodland toward the upper altitudinal limit of forest in Hokkaido (Uemura 1993). I was able to see the natural montane *B. ermanii* zone on a visit to Shiretoko National Park in 2016; it is very unlike the *B. ermanii*-dominated parts of Horoka Tomamu in having more twisted birch trees (whose shapes are influenced by snow cover and wind), a different type of ground flora, and close proximity of *Pinus pumila* scrub (a habitat not present at Horoka Tomamu).

Levels of botanical diversity

The tree and shrub canopy of the forest here is remarkably species-rich. During this survey a total of 38 native tree and shrub species was recorded: 33 trees (29 broadleaved and 4 coniferous) and 5 shrubs. This is a very good number of tree/shrub species, especially when seen from a British perspective. British woodland canopies are mostly relatively species-poor. Looking at a few of my surveys in Scotland the numbers of native tree/shrub species are clearly lower, even in larger areas of native woodland: 14 species in about 100 hectares at Rhidorroch in Wester Ross; 15 species in at least 250 hectares at Beinn Eighe in Wester Ross; 10 species in at least 100 ha at Coille Mhor, Lochalsh; 16 species in about 90 ha at Rahoy Hills, Morvern; 22 species in about 50 ha at Falls of Clyde in Lanarkshire. An exception is 26 species in about 30 ha at Killiecrankie in Perthshire, but that site has very high habitat diversity including two rocky rivers, steep rocky slopes, flatter areas of wet woodland and riverside shingles, and variation from acidic to calcareous rocks and soils.

The richness of the tree/shrub canopy at Horoka Tomamu is also seen in the number of tree/shrub species in 400m² quadrat samples: this varies from 4 to 17 species, with a mean of 9.4 species in a sample. This generally high species-richness on a small scale is quite unlike what is seen in Britain, even at rich sites such as Killiecrankie. It is quite striking that more native tree and shrub species were recorded within some individual 400m² sample areas at Horoka Tomamu than within entire large areas of woodland at some of the above-mentioned Scottish sites, and also that within its 50.5 hectares Horoka Tomamu has more native tree species than the total number of native tree species in the whole of Scotland, and about the same number of native tree and shrub species as the equivalent Scottish total.

Woody climbers are very common at Horoka Tomamu. The climber species seen in this survey are *Hyrangea petiolaris*, *Actinidia arguta* and *Vitis coignetiae*. The abundance of climbers, especially when combined with the luxuriant leafy swards of dwarf bamboo *Sasa*, gives the forest something of a 'jungle' appearance commonly associated with warmer parts of the world. It is of interest that climbing species grow so commonly and so well here, despite the cold snowy winters. Takeda (1913) noted this in the forests of Hokkaido generally, and mentioned that another author (Sargent) thought that the climbers grew up the trees in order to obtain more light than was available on the woodland floor where conditions were rather darkened by the abundant dwarf bamboo.

Through most of the site the ground vegetation is species-poor, evidently as a result of the strong dominance of *Sasa*, the very limited occurrence of rocks, and the apparent low variation in the acidity of the soils. In these respects it appears that species-poor ground vegetation is a natural feature of montane forest in this area, and it should not be judged negatively. However, relatively small areas along the NW, W and S margins, where there is more habitat diversity including rocks, wet areas and a river, are botanically varied and contribute significantly to the total site species list. Indeed, the total numbers of vascular plant and bryophyte species recorded here are good, especially when considering the general dominance of *Sasa* and (a limiting factor for bryophytes more than for vascular plants) the scarcity of rocks. The species totals are well within the range of what is recorded from areas of native woodland of similar size and similar habitat diversity in Britain. (In Britain the numbers of vascular plant and bryophyte species among sites of similar size vary greatly, depending largely on the diversity of habitat types but also in relation to location; for example bryophyte species totals are generally higher in the very rainy, equable, oceanic parts of western Britain and Ireland than they are in drier areas further east.)

The richness in ground-dwelling bryophytes is highest in ground vegetation type G3 (species-rich banks) where the quadrats show a mean of 7.4 bryophyte species in a 4m² sample. This is a much greater richness in bryophytes than in the other vegetation types at this site, the other sampled

types having a mean of 0.267 species in a sample. Type G1 is especially poor in bryophytes, with none recorded in any of the 15 quadrat samples. The dense *Sasa* evidently plays a role in limiting the richness of bryophytes (as well as that of vascular plants). The effect of the *Sasa* in limiting bryophyte growth can be seen by noting the presence of patches of mosses on the ground within and at the edges of the paths cleared through otherwise non-mossy *Sasa*, even on southerly aspects where bryophytes can be expected to be relatively sparse.

Despite the scarcity of bryophytes on much of the *Sasa*-dominated ground, mosses and liverworts are widespread and common on tree trunks within all of the ground vegetation types at this site. The abundance and diversity of epiphytic bryophytes was found to be highest on the steep N-NW-facing slopes in the NW of the site and in gullies; this evidently reflects the more shaded, sheltered and humid conditions in these places. Most of the epiphytic bryophyte vegetation here consists of mosses; liverworts play a relatively minor role. Epiphytic bryophyte growth is generally concentrated on the lower parts of tree trunks - a pattern also found in Britain where it appears to reflect the higher levels of shelter and humidity closer to the ground; in very sheltered, humid places bryophyte growth can extend further up the tree trunks than it does in more sunny or wind-exposed places. This pattern is seen at Horoka Tomamu, where the bryophyte growth generally extends higher up tree trunks in the more sheltered north-western parts of the site and in gullies. The extent of epiphytic bryophyte growth varies among tree species: it is very sparse or absent on the trunks and branches of conifers and *Betula* species, presumably because their bark is too smooth (providing insufficient foothold for bryophyte colonization), too loose (for example the peeling bark of *Betula ermanii* and *Taxus cuspidata*) or perhaps too acidic. *Acer*, *Ulmus*, *Salix* and *Populus* species have relatively well-developed epiphytic bryophyte assemblages, reflecting a rougher-textured bark that is probably more or less neutral to basic.

Lichens are widespread and common on tree trunks at Horoka Tomamu. As I am not an expert lichenologist I could not record lichens in detail here, but the lichen flora appears to be rich and varied, including species of the genera *Lobaria*, *Sticta*, *Heterodermia*, *Menegazzia*, *Nephroma*, *Pseudocyphellaria*, *Peltigera*, *Cetrelia*, *Caloplaca* and *Parmelia*. Small crustose lichens are widespread and are able to occupy bark surfaces that are too dry, smooth or exposed to support bryophyte growth. The occurrence of *Lobaria*, *Sticta* and *Pseudocyphellaria* species suggests that atmospheric pollution is at a low level here, as these lichens are known to be vulnerable to air pollution.

The relationship between canopy and ground layer in terms of species-richness is very different from that in Britain. It is typical for British native woodland to have a species-poor canopy over a relatively species-rich ground layer. In many British woods the ground vegetation is moderately to heavily grazed by deer, cattle or sheep. While this level of grazing can greatly limit the growth of young tree regeneration, it also prevents the development of

very dense and tall growths of a few very robust species; this in turn allows many small species of herbs, grasses, sedges and bryophytes to grow successfully in species-rich assemblages because they are not outcompeted by larger plants. Where there is a more natural lower intensity of grazing in British woodland, the ground flora can be less species-rich but the tree canopy still quite species-poor compared with that at Horoka Tomamu.

In Britain, a high degree of habitat/botanical diversity is common in many landscapes and is commonly looked upon favourably by many ecologists, even though the habitats are mostly semi-natural and not completely natural. However, much of the high diversity in British landscapes is clearly the result of a history of human land management; the diversity in the original native vegetation (mostly forest) might well have once been lower, at least in some respects. From this perspective, the ground vegetation at Horoka Tomamu could be judged as having rather low habitat/botanical diversity, but this should not be seen as an indication of low ecological/conservation value. Rather, it appears to be a direct result of the ongoing natural processes operating in this area where native forest has been largely left to develop in its own way for the last 70 years or so. Horoka Tomamu has clear ecological value in being a significant extent of naturally developing montane forest set in a much larger landscape that appears to be made up mainly of similarly undisturbed and naturally developing forest. This landscape scale occurrence of forest apparently shaped mainly by natural processes is of great ecological value, regardless of the level of diversity on landscape or smaller scales.

Relationships with natural physical factors within the forest

The floristic variation among the ground vegetation plant communities at Horoka Tomamu appears to be associated mainly with (a) ground wetness, with canopy types C6, 7 and 8 and ground vegetation types G5 and G6 reflecting wetter soils, and (b) ground steepness and instability, both of which appear to affect the abundance of *Sasa* (i.e. least abundant where ground is steeper and/or less stable). In Britain the native woodland plant communities (Rodwell *et al* 1991-2000) vary mainly in relation to wetness and the acidity of the soils. If *Sasa* were not so extensively dominant in forest vegetation in Hokkaido it is possible that more floristic vegetation might be apparent here and that this variation might be related in part to soil acidity.

The flora of this site suggests that the soils vary from acid to locally more calcareous, and might be mainly more or less neutral. From a British perspective I can make some assessment of the possible acidity of the soils on the basis of the presence of plant species growing here that are also found in Britain and whose soil preferences in Britain are well known to me. The best examples of these (ignoring species recorded only rarely in this survey) are listed in Table 4 below (accepting of course the possibility that their edaphic preferences might vary throughout their world range). Among the species found only rarely in this survey, some such as *Gymnocarpium robertianum* and the moss *Saelania glaucescens* suggest that conditions are locally quite

calcareous. Among the tree and shrub species here, *Salix caprea* is also found as a native species in Britain, where it grows mainly on neutral soils. No other tree and shrub species recorded at Horoka Tomamu are found also as natives in Britain, but one may note the British soil preferences of tree/shrub genera that are shared with Horoka Tomamu: *Betula* - acid; *Quercus* - acid to neutral; *Alnus* - neutral; *Fraxinus*, *Ulmus*, *Viburnum*, *Euonymus*, *Prunus*, *Acer* and *Taxus* - neutral to basic.

Various natural physical process taking place add to the habitat diversity and thereby to the plant species diversity at Horoka Tomamu. These include:

- **Fallen tree bases** (example shown in Photograph 44). The bare soil on these upturned tree bases is a good habitat for small pioneer bryophytes such as the mosses *Ceratodon purpureus* and *Dicranella cerviculata*, as well as larger bryophytes such as the moss *Atrichum undulatum*. Bryophyte cover and depth will gradually increase and become more suitable for small vascular plants to establish so that eventually the vegetation will become more typical of that found on the forest floor; by the time of that later stage, decay will cause the old fallen tree base itself to become more merged with the forest floor.
- **Rotting logs** (examples shown in Photographs 41 and 42). Fallen dead tree trunks and branches are widespread at Horoka Tomamu and provide important habitats for bryophytes. The barer dead wood surfaces are the main habitats here of the liverworts *Bazzania denudata*, *Calypogeia japonica*, *C. neesiana*, *Cephalozia bicuspidata/otaruensis*, *Jamesoniella autumnalis*, *Lepidozia reptans*, *Lophocolea bidentata*, *L. heterophylla*, *Riccardia palmata* and *Scapania bolanderi*, and various fungi. These can be pioneer species in this habitat, and at a slightly later stage they can be joined by other species such as the mosses *Callicladium haldanianum*, *Myuroclada maximowiczii*, *Plagiomnium cuspidatum*, *P. rostratum*, *Rhizomnium striatulum*, *Saelania glaucescens*, *Trachycystis flagellaris* and *Taxiphyllum aomoriense*. More mature bryophyte assemblages exist on some large logs and include the large mosses such as *Bryonoguchia molkenboeri*, *Loeskeobryum cavifolium*, *Pleurozium schreberi*, *Pleuroziopsis ruthenica*, *Polytrichastrum formosum*, *Thuidium tamariscinum*, *T. delicatulum* and *Rhynchostegium pallidifolium*. This last assemblage has some floristic overlap with that found on parts of the forest floor (for example on some steep or rocky riverside banks).
- **Fallen timber affecting river flow and riverside habitats** (example shown in Photograph 46). Fallen trees and branches are very common along the river at the western edge of the site. Some fallen trees span the whole width of the river at a good height above water level, but others have accumulated around water level to lead to natural damming up of some of the water as well as localised deposition of

silty and stony material. This leads to increased habitat diversity along the course of the river; this habitat diversity is likely to be beneficial to mammals, birds, insects, and, on the fallen timber itself, epiphytic mosses, liverworts, lichens and fungi.

- **Fallen leaf litter** (examples shown in Photographs 47 and 48). Carpets of leaves that have fallen from trees are a prominent feature every autumn, and at this time of year a more patchy and more temporary cover of fallen leaves is seen above ground level among *Sasa* leaves and on horizontal lower branches of the conifers *Abies sachalinensis* and *Picea jezoensis*. Although all of these leaf litter carpets are temporary, it seems likely that they will affect their habitats/microhabitats in some way, perhaps by adding nutrients (when the leaf litter breaks down) or by creating complex microhabitats (with internal multi-layering) suitable for various uses by insects.

- **Paired trees** (example shown in Photograph 45). An interesting feature, seen most commonly on the N-NW-facing slopes in the northern part of the site, is that of two or more trees of different species (but in most cases with one of the trees being *Abies sachalinensis* or *Picea jezoensis*) growing immediately adjacent to each other. Exactly what has led to the occurrences of such closely grouped trees is unclear, but a few possibilities come to mind:
 - a) Both trees might have benefitted at the establishment stage from a period of localised ground disturbance and associated bare ground.
 - b) If one tree of a pair is significantly older than the other, it could be that the younger tree, once established at the seedling or sapling stage, benefitted from the additional shelter provided by the adjacent trunk of the older tree.
 - c) If one of the pair is older than the other, soil or humus in between spreading roots of the older tree base might have been a good microhabitat for a tree seed to settle and germinate. This idea came from my daughter Elen while she was taking photographs of some paired trees in this forest.
 - d) If one of the pair is older than the other, the area immediately around the older tree's base might, at the time of the younger tree's establishment, had less *Sasa* than other ground nearby (because its tree base might have had been slightly raised up above the level of adjacent ground and its roots might not have been good habitat for *Sasa* growth) and might therefore have been a better habitat for the younger tree to establish without being outcompeted or overshadowed.

Another interesting habitat feature that I noticed often during this survey is the uneven nature of much of the ground surface. Even where terrain looks smooth from a distance (on slopes or on more level areas) it can contain a surprising abundance of raised banks and sunken depressions. Whether or not these directly reflect the nature of the underlying bedrock is uncertain, as there is a deep layer of soil/humus/leaf litter over most of the ground and there is very little exposed bedrock. I have wondered if the raised parts are where plant litter (especially the ubiquitous *Sasa* leaf and stem litter) has, over a number of years, built up a humus/soil layer over fallen tree trunks, and if some of the depressions were originally formed when the root plate of a tree was lifted out of the ground when the tree fell over, but there might be other factors involved.

Relationships with climate

The vegetation of Horoka Tomamu shows features which reflect the cool temperate climate with warm summers and cold, snowy winters. For example the dominance of broadleaved tree and shrub species is typical of areas of the world with a temperate climate, but the additional native conifer species of *Picea* and *Abies* marks a floristic link with colder, more boreal regions. Mosses and liverworts are common enough here to indicate that the climate is rather wet, but their scarcity or absence more than about 3 m up tree trunks, combined with the relative scarcity of liverworts, fits with the climate being less wet and less equable than in rainforest regions where bryophytes are generally more abundant (including a prominent abundance and diversity of liverworts) and commonly grow well up the trunks and branches of trees.

The Hokkaido forests experience particularly high levels of snowfall compared with other east Asian temperate forest areas (Uemura 1993). Snow cover through the winter probably helps to protect ground-dwelling plants, including delicate herbs, ferns, mosses and liverworts, from the lowest air temperatures. The site has a rich fern flora, with 20 species recorded. (From a British perspective this is a very good total for a site as small as this.)

With its large temperature variation from cold, snowy winters to fairly hot summers, the climate in Hokkaido shows something of a continental (rather than oceanic) character. In this regard the occurrence here of the filmy fern *Hymenophyllum wrightii* is of interest. This genus is found mainly in more oceanic parts of the world (including temperate rainforests) where frequent rainfall is combined with mild winters; this restriction does not seem surprising when one looks at the thin, delicate, translucent fronds of *Hymenophyllum* species. *H. wrightii* is known from Japan and Korea, and its occurrences (as an uncommon species) in Hokkaido and Korea must be just about within its limits of cold tolerance of this genus. An increase in climatic oceanicity is seen where the humid continental climate of Hokkaido and the mountains of central and northern Honshu grades into the warmer humid subtropical climate of the Pacific coast areas of central and southern Honshu. Further north-east, the climate of the Kuril Islands, with cool summers and

cold winters, is intermediate between that of Hokkaido and the subpolar oceanic climate of the Aleutian Islands.

Several plant species found here are known from mainland eastern Asia and various parts of North America including eastern USA and Canada where the climate is broadly similar to that in Hokkaido.

Many of the native plant species found in this survey are widespread in the northern hemisphere and are known to occur as native species in Britain and Ireland. The proportion of the native Horoka Tomamu flora that is also native to Britain and Ireland is much higher for bryophytes than for vascular plants. Among the 161 vascular species I have recorded at Horoka Tomamu that are native to Hokkaido, 23 (14%) are also native to Britain and Ireland. Among the 113 bryophyte species recorded at Horoka Tomamu (all of these assumed to be native here), 61 (54%) are also native to Britain and Ireland.

Summary of the ecological value of the vegetation of Horoka Tomamu Montane Forest

The main points of interest found in this survey are summarized very briefly below:

- Horoka Tomamu is a good example of native montane forest in this part of Hokkaido, and its setting among much more extensive native forest increases its value as an example of this forest type.
- It provides an excellent demonstration of a species-rich tree canopy.
- There is a good diversity of vascular plant, bryophyte and lichen species.

From ecological and conservation viewpoints the value of Horoka Tomamu reserve is not just in the quality of the habitats within the reserve boundary but also in its setting within a whole landscape consisting mainly of what appears to be at least broadly similar semi-natural native forest. This landscape-scale forest is itself something of great value. In Britain it is common for the conservation importance of a site to be assessed largely on the basis of its quality (for example naturalness, diversity, or presence of rare species or habitat types) within the site boundary. This approach is not surprising because at so many sites in Britain the land use in the general area has been relatively intensive and caused fragmentation of habitats and a general reduction in naturalness, so the site itself is seen as a relatively small fragment of high ecological value within a landscape of mainly lower ecological value. In Britain we do not have natural or semi-natural native forest developing along mainly natural lines on such a large landscape scale as seen here in Japan. In my view the ecological value of Horoka Tomamu is higher as a result of its setting within this forest-dominated landscape than it

would be if it were a fragment of native forest within a more modified landscape.

From the point of view of the botanical interest of the vegetation and the naturalness of the habitats at Horoka Tomamu, I do not see a clear need for active forest management within the reserve. I think it would be best to let the forest continue to develop in its own way along predominantly natural lines, and to maintain paths to provide access for people to come and experience, appreciate and study this native forest environment. Following on from what is said in the previous paragraph, I also think it would be ecologically highly beneficial to maintain the large scale dominance of what appears to be relatively undisturbed, naturally developing native forest within the surrounding area, so that the Horoka Tomamu reserve continues to exist as a part of this larger scale native forest-dominated landscape.

Table 4. Soil acidity preferences in Britain, of plant species found in quantity category 2, 3 or 4 (= occasional, frequent or abundant) in this survey, that are also found in Britain

Species	Acid	Neutral	Basic
VASCULAR PLANTS			
<i>Brachypodium sylvaticum</i>		+	+
<i>Circaea alpina</i>		+	+
<i>Dryopteris expansa</i>	+		
<i>Equisetum arvense</i>		+	
<i>Oxalis acetosella</i>	+	+	
<i>Petasites japonicus</i>		+	
<i>Phegopteris connectilis</i>	+	+	+
<i>Rubus idaeus</i>	+	+	
<i>Solidago virgaurea</i>	+	+	
BRYOPHYTES			
<i>Atrichum undulatum</i>	+	+	
<i>Bartramia pomiformis</i>	+		
<i>Calliergonella lindbergii</i>		+	
<i>Dicranum scoparium</i>	+		
<i>Fissidens dubius</i>		+	+
<i>Homalia trichomanoides</i>		+	+
<i>Hypnum cupressiforme</i>	+	+	+
<i>Plagiomnium cuspidatum</i>		+	
<i>Plagiomnium rostratum</i>		+	
<i>Plagiothecium nemorale</i>		+	
<i>Rhizomnium punctatum</i>		+	
<i>Thuidium delicatulum</i>		+	+
<i>Thuidium tamariscinum</i>	+	+	+
<i>Conocephalum salebrosum</i>		+	

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Uchida-san (botanist at Shiretoko National Park, Hokkaido) made additional corrections on native/non-native status of two species and Japanese names of two other species.

Akio Imamura (botanist at Hokkaido University, Asahikawa) kindly corrected one of my previous species identifications.

Dr Neil Bell of the Royal Botanic Garden Edinburgh (RBGE) kindly loaned me his copy of the *Illustrated Moss Flora of Japan* and received my bryophyte specimens posted from Japan to RBGE for me to collect upon my return to Scotland. I also thank Dr David Long (ex-RBGE) for the loan of additional Japanese bryophyte books and making arrangements for me to use facilities at RBGE, and Dr Brian Coppins (lichenologist; ex-RBGE) for checking the identification of the lichens mentioned in this report.

Finally, but very significantly, I say a great big “thank you” to my daughter Elen Averis for accompanying me on these visits to Japan. The visits would not have been as special without her.

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APPENDIX 1 - Quadrat data recorded in this vegetation survey at Horoka Tomamu Montane Forest, Hokkaido, Japan, in September 2016

At each of locations A-H, tree and shrub canopy species were recorded in a single quadrat measuring 20 m x 20 m (re-shaped to a longer and narrower rectangular area of 400 m² at location E in order to match the narrower riparian zone there), and within this 400m² area a set of five 2 m x 2 m quadrats was recorded for the ground vegetation. Between them these quadrats cover most of the types of vegetation found and described in this survey. In the quadrat tables below, values are those of the DOMIN scale unless specified otherwise.

DOMIN scale:

- | | | |
|-------------------------------------|------------------|--------------------|
| 1 = <4% cover (few individuals) | 5 = 11-25% cover | 9 = 76-90% cover |
| 2 = <4% cover (several individuals) | 6 = 26-33% cover | 10 = 91-100% cover |
| 3 = <4% cover (many individuals) | 7 = 34-50% cover | |
| 4 = 4-10% cover | 8 = 51-75% cover | |

sp. = identified to genus level only, because of identification difficulties or lack of certain parts of the plant (such as flowering parts for some vascular plants).

/ (two names separated by a forward slash) = from the material found in this survey it was possible to make identification only to the level of this pair of species which are very similar to each other.

? = determination tentative because of identification difficulties (only one such species).

The canopy and ground vegetation types sampled at each location are as follows:

Location	Canopy type	Ground vegetation type
A	C1 Species-rich mixed broadleaf canopy	G1 More or less pure <i>Sasa senanensis</i> swards
B	C1 Species-rich mixed broadleaf canopy	G1 More or less pure <i>Sasa senanensis</i> swards
C	C4 <i>Betula ermanii</i> -dominated canopy	G1 More or less pure <i>Sasa senanensis</i> swards
D	C2 Species-rich mixed broadleaves with c. 20% conifers	G2 <i>Sasa senanensis</i> with sparse associated flora
E	C3 Species-rich mixed broadleaves with c. 40% conifers	G3 Species-rich herb-sedge-fern-bryophyte banks
F	C3 Species-rich mixed broadleaves with c. 40% conifers	G3 Species-rich herb-sedge-fern-bryophyte banks
G	C6 <i>Alnus hirsuta</i> - <i>Betula</i> spp. - <i>Acer pictum</i> canopy	G4 <i>Brachypodium sylvaticum</i> - <i>Muhlenbergia huegelii</i> grass swards
H	C3 Species-rich mixed broadleaves with c. 40% conifers	G5 <i>Sasa senanensis</i> with wetland herbs and sedges

The eight tables for each individual location (A-H) are followed by a summary table giving the frequencies (number of quadrats) of each species at each location, along with summaries of basic information such as vegetation height and the percentage cover of bare ground.

Quadrat data for location A (canopy type C1; ground vegetation type G1)

Species Latin name	Species group	QA1	QA2	QA3	QA4	QA5	N
Altitude (m)		560	560	560	560	560	
Slope gradient (degrees)		30	30	25	20	20	
Slope aspect		E	E	E	E	E	
CANOPY (type C1; one 400m² sample):							
Canopy height (m)		15 m					
Canopy cover (%)		90%					
<i>Acer japonicum</i>	Broadleaf tree	5					
<i>Acer pictum</i>	Broadleaf tree	4					
<i>Betula ermanii</i>	Broadleaf tree	5					
<i>Fraxinus mandshurica</i>	Broadleaf tree	4					
<i>Magnolia obovata</i>	Broadleaf tree	4					
<i>Phellodendron amurense</i> (= <i>P. sachalinense</i>)	Broadleaf tree	4					
<i>Picea jezoensis</i>	Coniferous tree	1					
<i>Salix caprea</i>	Broadleaf tree	1					
<i>Tilia japonica</i>	Broadleaf tree	6					
<i>Ulmus davidiana</i> var. <i>japonica</i>	Broadleaf tree	4					
<i>Ulmus laciniata</i>	Broadleaf tree	4					
No. of tree and shrub species		11					
<i>Actinidia arguta</i>	Climber	1					
No. of climber species		1					
GROUND VEGETATION (type G1; five 4m² samples within 400m² canopy sample area):		QA1	QA2	QA3	QA4	QA5	N
Soil/litter (%)		80	60	75	95	50	
Bare rock (%)							
Fallen wood (%)							
Avg. ground veg. height (cm)		120	160	150	150	160	
VASCULAR PLANTS							
<i>Achlys japonica</i>	Herb				1		1
<i>Hydrangea petiolaris</i>	Climber			1	1		2
<i>Sasa senanensis</i>	Dwarf bamboo	10	10	10	8	10	5
<i>Vitis coignetiae</i>	Climber		1				1
No. of vascular plant field layer species		1	2	2	3	1	4
No. of bryophyte species		0	0	0	0	0	0
Total no. of ground veg. species		1	2	2	3	1	4

Quadrat data for location B (canopy type C1; ground vegetation type G1)

Species Latin name	Species group	QB1	QB2	QB3	QB4	QB5	N
Altitude (m)		650	650	650	650	650	
Slope gradient (degrees)		0	3	2	10	0	
Slope aspect		-	W	W	E	-	
CANOPY (type C1; one 400m² sample):							
Canopy height (m)		12 m					
Canopy cover (%)		85%					
<i>Abies sachalinensis</i>	Coniferous tree	4					
<i>Acer caudatum ssp. ukurunduense</i>	Broadleaf tree	1					
<i>Acer japonicum</i>	Broadleaf tree	5					
<i>Acer pictum</i>	Broadleaf tree	4					
<i>Betula ermanii</i>	Broadleaf tree	5					
<i>Fraxinus mandshurica</i>	Broadleaf tree	4					
<i>Hydrangea paniculata</i>	Broadleaf shrub	4					
<i>Magnolia obovata</i>	Broadleaf tree	4					
<i>Phellodendron amurense</i> (= <i>P. sachalinense</i>)	Broadleaf tree	4					
<i>Prunus maximowiczii</i>	Broadleaf tree	5					
<i>Quercus mongolica</i>	Broadleaf tree	1					
<i>Salix caprea</i>	Broadleaf tree	4					
<i>Tilia japonica</i>	Broadleaf tree	5					
<i>Ulmus laciniata</i>	Broadleaf tree	4					
<i>Viburnum furcatum</i>	Broadleaf shrub	4					
No. of tree and shrub species		15					
<i>Hydrangea petiolaris</i>	Climber	4					
<i>Vitis coignetiae</i>	Climber	1					
No. of climber species		2					
GROUND VEGETATION (type G1; five 4m² samples within 400m² canopy sample area):		QB1	QB2	QB3	QB4	QB5	N
Soil/litter (%)		90	80	80	90	80	
Avg. ground veg. height (cm)		120	130	120	120	120	
VASCULAR PLANTS							
<i>Achlys japonica</i>	Herb	1					1
<i>Astilbe thunbergii var. congesta</i>	Herb			1			1
<i>Hydrangea petiolaris</i>	Climber		1		1		2
<i>Leucothoe grayana</i>	Broadleaf sub-shrub			1			1
<i>Sasa senanensis</i>	Dwarf bamboo	10	10	10	10	10	5
No. of vascular plant field layer species		2	2	3	2	1	5
No. of bryophyte species		0	0	0	0	0	0
Total no. of ground veg. species		2	2	3	2	1	5

Quadrat data for location C (canopy type C4; ground vegetation type G1)

Species Latin name	Species group	QC1	QC2	QC3	QC4	QC5	N
Altitude (m)		620	620	620	620	620	
Slope gradient (degrees)		0	0	0	0	2	
Slope aspect		-	-	-	-	E	
CANOPY (type C4; one 400m² sample):							
Canopy height (m)		15 m					
Canopy cover (%)		80%					
<i>Betula ermanii</i>	Broadleaf tree	8					
<i>Phellodendron amurense</i> (= <i>P. sachalinense</i>)	Broadleaf tree	4					
<i>Picea jezoensis</i>	Coniferous tree	1					
<i>Quercus mongolica</i>	Broadleaf tree	4					
<i>Tilia japonica</i>	Broadleaf tree	4					
No. of tree and shrub species		5					
<i>Hydrangea petiolaris</i>	Climber	1					
<i>Vitis coignetiae</i>	Climber	1					
No. of climber species		2					
GROUND VEGETATION (type G1; five 4m² samples within 400m² canopy sample area):		QC1	QC2	QC3	QC4	QC5	N
Soil/litter (%)		95	85	95	90	80	
Bare rock (%)							
Fallen wood (%)							
Avg. ground veg. height (cm)		120	130	130	120	140	
VASCULAR PLANTS							
<i>Hydrangea petiolaris</i>	Climber			1			1
<i>Sasa senanensis</i>	Dwarf bamboo	10	10	10	10	10	5
No. of vascular plant field layer species		1	1	2	1	1	2
No. of bryophyte species		0	0	0	0	0	0
Total no. of ground veg. species		1	1	2	1	1	2

Quadrat data for location D (canopy type C2; ground vegetation type G2)

Species Latin name	Species group	QD1	QD2	QD3	QD4	QD5	N
Altitude (m)		600	600	600	600	600	
Slope gradient (degrees)		0	1	5	5	5	
Slope aspect		-	N	NW	W	NW	
CANOPY (type C2; one 400m² sample):							
Canopy height (m)		20 m					
Canopy cover (%)		90%					
<i>Abies sachalinensis</i>	Coniferous tree	4					
<i>Betula ermanii</i>	Broadleaf tree	6					
<i>Kalopanax septemlobus</i>	Broadleaf tree	4					
<i>Phellodendron amurense</i> (= <i>P. sachalinense</i>)	Broadleaf tree	4					
<i>Picea jezoensis</i>	Coniferous tree	7					
<i>Tilia japonica</i>	Broadleaf tree	1					
<i>Ulmus laciniata</i>	Broadleaf tree	5					
No. of tree and shrub species		7					
<i>Hydrangea petiolaris</i>	Climber	1					
No. of climber species		1					
GROUND VEGETATION (type G2; five 4m² samples within 400m² canopy sample area):		QD1	QD2	QD3	QD4	QD5	N
Soil/litter (%)		85	90	90	70	75	
Fallen wood (%)						15	
Avg. ground veg. height (cm)		80	70	75	70	80	
VASCULAR PLANTS							
<i>Acer pictum ssp. mono</i>	Broadleaf tree (seedling)	2	1	1		1	4
<i>Achlys japonica</i>	Herb	3	3	2	3		4
<i>Astilbe thunbergii var. congesta</i>	Herb				1		1
<i>Dryopteris expansa</i>	Fern			1			1
<i>Hydrangea petiolaris</i>	Climber	3	2	2	3		4
<i>Ilex rugosa</i>	Broadleaf sub-shrub	3	2				2
<i>Lycopodium dendroideum</i>	Clubmoss				1		1
<i>Pachysandra terminalis</i>	Herb	1	2	3	5	1	5
<i>Sasa senanensis</i>	Dwarf bamboo	9	8	8	8	8	5
<i>Sorbus commixta</i>	Broadleaf tree (seedling)	1					1
<i>Tilia japonica</i>	Broadleaf tree (seedling)					1	1
<i>Viburnum furcatum</i>	Broadleaf shrub			1			1
BRYOPHYTES							
<i>Rhynchostegium pallidifolium</i>	Moss	4			2		2
<i>Thuidium delicatulum</i>	Moss	3					1
<i>Calypogeia neesiana</i>	Liverwort	3					1
No. of vascular plant field layer species		7	6	7	6	4	12
No. of bryophyte species		3	0	0	1	0	3
Total no. of ground veg. species		10	6	7	7	4	15

Quadrat data for location E (canopy type C3; ground vegetation type G3)

Species Latin name	Species group	QE1	QE2	QE3	QE4	QE5	N	
Altitude (m)		525	525	525	525	525		
Slope gradient (degrees)		75	75	75	80	75		
Slope aspect		NW	NW	NW	NW	NW		
CANOPY (type C3; one 400m² sample):								
Canopy height (m)		20 m						
Canopy cover (%)		85%						
<i>Abies sachalinensis</i>	Coniferous tree	5						
<i>Acer japonicum</i>	Broadleaf tree	1						
<i>Acer pictum</i>	Broadleaf tree	4						
<i>Alnus hirsuta</i>	Broadleaf tree	4						
<i>Betula ermanii</i>	Broadleaf tree	1						
<i>Fraxinus mandshurica</i>	Broadleaf tree	4						
<i>Hydrangea paniculata</i>	Broadleaf shrub	1						
<i>Magnolia obovata</i>	Broadleaf tree	1						
<i>Phellodendron amurense</i> (= <i>P. sachalinense</i>)	Broadleaf tree	4						
<i>Picea jezoensis</i>	Coniferous tree	4						
<i>Quercus mongolica</i>	Broadleaf tree	4						
<i>Sorbus commixta</i>	Broadleaf tree	4						
<i>Taxus cuspidata</i>	Coniferous tree	1						
<i>Tilia japonica</i>	Broadleaf tree	4						
<i>Ulmus davidiana</i> var. <i>japonica</i>	Broadleaf tree	4						
<i>Ulmus laciniata</i>	Broadleaf tree	4						
<i>Viburnum furcatum</i>	Broadleaf shrub	1						
No. of tree and shrub species		17						
<i>Hydrangea petiolaris</i>	Climber	1						
No. of climber species		1						
GROUND VEGETATION (type G3; five 4m² samples within the above 400m² canopy sample area):		QE1	QE2	QE3	QE4	QE5	N	
Soil/litter (%)		70	60	70	25	15		
Bare rock (%)					25			
Avg. ground veg. height (cm)		20	15	25	30	35		
VASCULAR PLANTS								
<i>Abies sachalinensis</i>	Coniferous tree (seedling)	1					1	
<i>Acer japonicum</i>	Broadleaf tree (seedling)			1			1	
<i>Acer pictum</i>	Broadleaf tree (seedling)	1		1			2	
<i>Achlys japonica</i>	Herb		5	2	3	1	4	
<i>Aconitum sachalinense</i> ssp. <i>yezoense</i> ssp. <i>yezoense</i>	Herb	3	2	3	2	2	5	
<i>Angelica sachalinensis</i>	Herb	1			2		2	
<i>Aruncus dioicus</i> var. <i>camschaticus</i>	Herb	1	1	2			3	
<i>Calamagrostis hakonensis</i>	Grass	5		5	5	7	4	
<i>Cardamine scutata</i>	Herb				2		1	
<i>Carex pisiformis</i> (= <i>C. sachalinensis</i>)	Sedge	3					1	
<i>Carex</i> sp. (medium-sized)	Sedge			4	5	5	3	
<i>Cirsium kamschaticum</i>	Herb	2	2	1	1		4	

Species Latin name	Species group	QE1	QE2	QE3	QE4	QE5	N
<i>Clinopodium micranthum</i> var. <i>sachalinense</i>	Herb			1	3	3	3
<i>Deparia pycnosora</i>	Fern					2	1
<i>Dryopteris crassirhizoma</i>	Fern	4			5	1	3
<i>Dryopteris expansa</i>	Fern		1		1	1	3
<i>Equisetum arvense</i>	Horsetail					1	1
<i>Eupatorium chinense</i> ssp. <i>sachalinense</i>	Herb					1	1
<i>Fraxinus mandshurica</i>	Broadleaf tree (seedling)			1	1	1	3
<i>Galium kamtschaticum</i>	Herb	3		3			2
<i>Galium trifloriforme</i>	Herb			1	3	1	3
<i>Hydrangea petiolaris</i>	Climber	4	5	2	3	3	5
<i>Maianthemum dilatatum</i>	Herb	2	1	2	1		4
<i>Osmundastrum cinnamomeum fokiense</i>	Fern			1			1
<i>Oxalis acetosella</i>	Herb		3	3			2
<i>Pachysandra terminalis</i>	Herb	5	3	4	3	3	5
<i>Peracarpa carnosae</i>	Herb			1	1		2
<i>Petasites japonicus</i> ssp. <i>giganteus</i>	Herb					1	1
<i>Phegopteris connectilis</i>	Fern	3	2	3	3	2	5
<i>Polystichum braunii</i>	Fern		4		1		2
<i>Rubus pseudojaponicus</i>	Herb			3	3		2
<i>Sasa senanensis</i>	Dwarf bamboo	4	2	1	5	5	5
<i>Senecio nemorensis</i>	Herb					1	1
<i>Solidago virgaurea</i> ssp. <i>leiocarpa</i>	Herb	1	1	1	1		4
<i>Thalictrum sachalinense</i>	Herb			1		1	2
<i>Ulmus davidiana</i> var. <i>japonica</i>	Broadleaf tree (seedling)			1			1
<i>Ulmus laciniata</i>	Broadleaf tree (seedling)					2	1
<i>Viola grypoceras</i>	Herb					1	1
<i>Viola selkirkii</i>	Herb	2	3	1		3	4
BRYOPHYTES							
<i>Amphidium lapponicum/mougeotii</i>	Moss				3		1
<i>Atrichum undulatum</i>	Moss	2		1	3	2	4
<i>Bartramia pomiformis</i>	Moss		1	1	1		3
<i>Brachythecium</i> sp.	Moss		3	3	3	2	4
<i>Bryhnia novae-angliae</i>	Moss	4	3	5	3	2	5
<i>Fissidens dubius</i>	Moss	3	2	1	2		4
<i>Loeskeobryum cavifolium</i>	Moss	1					1
<i>Mnium thomsonii</i>	Moss		3	1	3		3
<i>Plagiothecium neckeroideum</i>	Moss	1	2	3			3
<i>Pleuroziopsis ruthenica</i>	Moss			1			1
<i>Rhytidiadelphus triquetrus</i>	Moss		1				1
<i>Thuidium delicatulum</i>	Moss	3	3	1			3
<i>Conocephalum japonicum</i>	Liverwort			1	3	3	3
<i>Conocephalum salebrosum</i>	Liverwort			1	3		2
<i>Diplophyllum taxifolium</i>	Liverwort				1		1
<i>Pellia epiphylla/neesiana</i>	Liverwort				2	1	2
No. of vascular plant field layer spp.		17	14	25	21	22	39
No. of bryophyte species		6	8	11	11	5	16
Total no. of ground veg. species		23	22	36	32	27	55

Quadrat data for location F (canopy type C3; ground vegetation type G3)

Species Latin name	Species group	QF1	QF2	QF3	QF4	QF5	N
Altitude (m)		530	530	530	530	530	
Slope gradient (degrees)		80	80	30	40	60	
Slope aspect		N	N	N	N	N	
CANOPY (type C3; one 400m² sample):							
Canopy height (m)		20 m					
Canopy cover (%)		85%					
<i>Abies sachalinensis</i>	Coniferous tree	5					
<i>Acer pictum</i>	Broadleaf tree	5					
<i>Alnus hirsuta</i>	Broadleaf tree	4					
<i>Betula maximowicziana</i>	Broadleaf tree	6					
<i>Picea jezoensis</i>	Coniferous tree	5					
<i>Prunus ssiroi</i>	Broadleaf tree	6					
<i>Quercus mongolica</i>	Broadleaf tree	4					
<i>Ulmus davidiana</i> var. <i>japonica</i>	Broadleaf tree	4					
<i>Ulmus laciniata</i>	Broadleaf tree	4					
No. of tree and shrub species		9					
<i>Hydrangea petiolaris</i>	Climber	1					
No. of climber species		1					
GROUND VEGETATION (type G3; five 4m² samples within the above 400m² canopy sample area):		QF1	QF2	QF3	QF4	QF5	N
Soil/litter (%)		30	60	40	30	25	
Avg. ground veg. height (cm)		35	30	25	35	30	
VASCULAR PLANTS							
<i>Abies sachalinensis</i>	Coniferous tree (seedling)			1			1
<i>Acer japonicum</i>	Broadleaf tree (seedling)			1		1	2
<i>Acer pictum</i>	Broadleaf tree (seedling)	1		2	1		3
<i>Achlys japonica</i>	Herb	3	3	4	3	4	5
<i>Aconitum sachalinense</i> ssp. <i>yezoense</i> ssp. <i>yezoense</i>	Herb	2	1				2
<i>Artemisia montana</i>	Herb		1				1
<i>Aruncus dioicus</i> var. <i>camschaticus</i>	Herb	1	3				2
<i>Astilbe thunbergii</i> var. <i>congesta</i>	Herb		4				1
<i>Brylkinia caudata</i>	Grass			1			1
<i>Carex pisiformis</i> (= <i>C. sachalinensis</i>)	Sedge	6	4		4	6	4
<i>Carex</i> sp. (large; dark-leaved)		3		6	5	5	4
<i>Caulophyllum robustum</i>	Herb					1	1
<i>Circaea alpina</i>	Herb		1				1
<i>Cirsium kamschaticum</i>	Herb		1		1	2	3
<i>Deparia pycnosora</i>	Fern	4	1				2
<i>Dryopteris crassirhizoma</i>	Fern	5	5	1		5	4
<i>Dryopteris expansa</i>	Fern				2	1	2
<i>Fraxinus mandshurica</i>	Broadleaf tree (seedling)		1	2	1		3
<i>Galium kamschaticum</i>	Herb					1	1
<i>Galium trifloriforme</i>	Herb	1	1	1	2	3	5
<i>Hydrangea petiolaris</i>	Climber	4	3		2		3

Species Latin name	Species group	QF1	QF2	QF3	QF4	QF5	N
<i>Ilex rugosa</i>	Broadleaf sub-shrub				1		1
<i>Maianthemum dilatatum</i>	Herb	1	1	1	2	2	5
<i>Oxalis acetosella</i>	Herb		3			3	2
<i>Pachysandra terminalis</i>	Herb	4	4	4	3	3	5
<i>Paris tetraphylla</i>	Herb		1			1	2
<i>Peracarpa carnosia</i>	Herb			1			1
<i>Phegopteris connectilis</i>	Fern	4	4			1	3
<i>Polystichum braunii</i>	Fern	1	1				2
<i>Polystichum tripterum</i>	Fern			1	1	1	3
<i>Prunus ssiiori</i>	Broadleaf tree (seedling)			2		1	2
<i>Sasa senanensis</i>	Dwarf bamboo	5	1	4	6	1	5
<i>Senecio nemorensis</i>	Herb		1				1
<i>Solidago virgaurea ssp. leiocarpa</i>	Herb					2	1
<i>Ulmus davidiana var. japonica</i>	Broadleaf tree (seedling)	1	1	2	1	2	5
<i>Viola selkirkii</i>	Herb	1	3			1	3
BRYOPHYTES							
<i>Atrichum undulatum</i>	Moss		2				1
<i>Aulacomnium heterostichum</i>	Moss	2	4		1	1	4
<i>Bartramia pomiformis</i>	Moss		2	1		2	3
<i>Brachythecium sp.</i>	Moss		3	3			2
<i>Bryhnia novae-angliae</i>	Moss	5	3	3	3	4	5
<i>Fissidens dubius</i>	Moss		1	1	2	3	4
<i>Homalia trichomanoides</i>	Moss		3				1
<i>Loeskeobryum cavifolium</i>	Moss			1			1
<i>Mnium thomsonii</i>	Moss			2			1
<i>Plagiomnium rostratum</i>	Moss	2					1
<i>Plagiothecium neckeroideum</i>	Moss	1	3			3	3
<i>Rhynchostegium pallidifolium</i>	Moss	3					1
<i>Thamnobryum subseriatum</i>	Moss			2			1
<i>Thuidium delicatulum</i>	Moss			3		3	2
<i>Lepidozia reptans</i>	Liverwort			2			1
<i>Metzgeria conjugata</i>	Liverwort		1				1
<i>Pellia epiphylla/neesiana</i>	Liverwort		3				1
LICHEN							
<i>Peltigera hymenina</i>	Lichen			1			1
No. of vascular plant field layer species		17	23	16	15	21	36
No. of bryophyte species		5	10	9	3	6	17
No. of lichen species		0	0	1	0	0	1
Total no. of ground veg. species		22	33	25	18	27	54

Quadrat data for location G (canopy type C6; ground vegetation type G4)

Species Latin name	Species group	QG1	QG2	QG3	QG4	QG5	N
Altitude (m)		520	520	520	520	520	
Slope gradient (degrees)		0	0	0	0	0	
Slope aspect		-	-	-	-	-	
CANOPY (type C6; one 400m² sample):							
Canopy height (m)		12 m					
Canopy cover (%)		90%					
<i>Abies sachalinensis</i>	Coniferous tree	1					
<i>Acer pictum</i>	Broadleaf tree	1					
<i>Alnus hirsuta</i>	Broadleaf tree	8					
<i>Betula platyphylla</i>	Broadleaf tree	6					
<i>Salix rorida</i>	Broadleaf tree	4					
No. of tree and shrub species		5					
<i>Hydrangea petiolaris</i>	Climber	1					
No. of climber species		1					
GROUND VEGETATION (type G4; five 4m² samples within 400m² canopy sample area):		QG1	QG2	QG3	QG4	QG5	N
Soil/litter (%)		10	15	15	20	70	
Avg. ground veg. height (cm)		35	35	50	40	30	
VASCULAR PLANTS							
<i>Abies sachalinensis</i>	Coniferous tree (seedling)	1			1	1	3
<i>Acer japonicum</i>	Broadleaf tree (seedling)		1	1			2
<i>Acer pictum</i>	Broadleaf tree (seedling)		1	1	1	1	4
<i>Aconitum sachalinense ssp. yezoense ssp. yezoense</i>	Herb		1				1
<i>Alnus hirsuta</i>	Broadleaf tree (seedling)			1			1
<i>Aquilegia buergeriana</i>	Herb			1			1
<i>Brachypodium sylvaticum</i>	Grass	7	5	2	7	6	5
<i>Brylkinia caudata</i>	Grass			2			1
<i>Calamagrostis hakonensis</i>	Grass				2		1
<i>Cardamine scutata</i>	Herb			2	2	1	3
<i>Carex dispalata</i>	Sedge	5					1
<i>Cirsium kamtschaticum</i>	Herb			1			1
<i>Clinopodium micranthum var. sachalinense</i>	Herb				1	1	2
<i>Equisetum arvense</i>	Horsetail	2		1		1	3
<i>Fraxinus mandshurica</i>	Broadleaf tree (seedling)			1	1		2
<i>Galium trifloriforme</i>	Herb	3	2	3	1	2	5
<i>Jacobaea cannabifolia</i>	Herb	2	2	1		1	4
<i>Muhlenbergia huegelii</i>	Grass	6	6	8	7		4
<i>Petasites japonicus ssp. giganteus</i>	Herb			4		1	2
<i>Prunus ssiiori</i>	Broadleaf tree (seedling)	1					1
<i>Rubus idaeus</i>	Broadleaf sub-shrub		1	4	5	5	4
<i>Thalictrum sachalinense</i>	Herb				1		1
<i>Ulmus davidiana var. japonica</i>	Broadleaf tree (seedling)	1					1

Species Latin name	Species group	QG1	QG2	QG3	QG4	QG5	N
<i>Viola grypoceras</i>	Herb			2	3	3	3
<i>Viola selkirkii</i>	Herb				1		1
BRYOPHYTES							
<i>Pleuroziopsis ruthenica</i>	Moss					2	1
<i>Thuidium delicatulum</i>	Moss		3				1
No. of vascular field layer species		9	8	16	13	11	25
No. of bryophyte species		0	1	0	0	1	2
Total no. of ground veg. species		9	9	16	13	12	27

Quadrat data for location H (canopy type C3; ground vegetation type G5)

Species Latin name	Species group	QH1	QH2	QH3	QH4	QH5	N
Altitude (m)		525	525	525	525	525	
Slope gradient (degrees)		2	1	0	1	2	
Slope aspect		N	N	-	N	N	
CANOPY (type C3; one 400m² sample):							
Canopy height (m)		20 m					
Canopy cover (%)		85%					
<i>Acer pictum</i>	Broadleaf tree	5					
<i>Alnus hirsuta</i>	Broadleaf tree	8					
<i>Fraxinus mandshurica</i>	Broadleaf tree	5					
<i>Hydrangea paniculata</i>	Broadleaf shrub	1					
<i>Phellodendron amurense</i> (= <i>P. sachalinense</i>)	Broadleaf tree	1					
<i>Prunus ssiori</i>	Broadleaf tree	1					
<i>Ulmus laciniata</i>	Broadleaf tree	4					
No. of tree and shrub species		7					
<i>Hydrangea petiolaris</i>	Climber	1					
No. of climber species		1					
GROUND VEGETATION (type G5; five 4m² samples within the above 400m² canopy sample area):		QH1	QH2	QH3	QH4	QH5	N
Soil/litter (%)		20	5	15	15	5	
Bare rock (%)							
Fallen wood (%)							
Avg. ground veg. height (cm)		80	40	50	90	50	
VASCULAR PLANTS							
<i>Abies sachalinensis</i>	Coniferous tree (seedling)			1			1
<i>Acer pictum</i>	Broadleaf tree (seedling)			1			1
<i>Achlys japonica</i>	Herb			1		1	2
<i>Aconitum sachalinense</i> ssp. <i>yezoense</i> ssp. <i>yezoense</i>	Herb	1					1
<i>Anemone debilis</i>	Herb			1			1
<i>Angelica sachalinensis</i>	Herb				1		1
<i>Cardamine scutata</i>	Herb		1				1
<i>Carex dispalata</i>	Sedge	8	10	8	7	8	5

Species Latin name	Species group	QH1	QH2	QH3	QH4	QH5	N
<i>Chrysosplenium kamtschaticum</i>	Herb	3	3				2
<i>Circaea alpina</i>	Herb	3					1
<i>Cirsium kamtschaticum</i>	Herb			1	1	1	3
<i>Clinopodium micranthum</i> var. <i>sachalinense</i>	Herb	4	4				2
<i>Dryopteris crassirhizoma</i>	Fern			1			1
<i>Filipendula camschatica</i> (= <i>F. kamtschatica</i>)	Herb		3		3		2
<i>Fraxinus mandshurica</i>	Broadleaf tree (seedling)		1			1	2
<i>Galium trifloriforme</i>	Herb	2	2	3		1	4
<i>Hydrangea petiolaris</i>	Climber			1		3	2
<i>Impatiens noli-tangere</i>	Herb				3		1
<i>Jacobaea cannabifolia</i>	Herb	1					1
<i>Laportea bulbifera</i>	Herb	1		5	1	3	4
<i>Maianthemum dilatatum</i>	Herb	1					1
<i>Mimulus tenellus</i>	Herb	1	5				2
<i>Osmundastrum cinnamomeum fokiense</i>	Fern	4					1
<i>Pachysandra terminalis</i>	Herb			3	2	4	3
<i>Parasenecio hastatus</i> ssp. <i>orientalis</i>	Herb			1	1		2
<i>Peracarpa carnosa</i>	Herb					1	1
<i>Sasa senanensis</i>	Dwarf bamboo	7	1	5	8	7	5
<i>Thalictrum sachalinense</i>	Herb			1			1
<i>Viola grypceras</i>	Herb		1				1
BRYOPHYTES							
<i>Lepidozia reptans</i>	Liverwort					2	1
<i>Lophocolea bidentata</i>	Liverwort					2	1
No. of vascular plant field layer species		12	10	14	9	10	29
No. of bryophyte species		0	0	0	0	2	2
Total no. of ground veg. species		12	10	14	9	12	31

Summary of quadrat data

The quadrat data presented above for locations A-H are summarized in the table below. The figures in cells are frequencies of species within sets of quadrats, so the figures are 0 or 1 for canopy/shrub layers (just one large quadrat at each location) but range from 0 to 5 for ground vegetation (a set of five 400m² quadrats at each location). In this table, canopy data are presented first, followed by ground vegetation data (with the ordering of ground vegetation species being as follows: vascular plants > mosses > liverworts > lichens).

Species Latin name	Species group	Location code							
		A	B	C	D	E	F	G	H
Altitude (m)		560	650	620	600	525	530	520	525
Slope gradient (degrees)		25	3	0.4	3.2	76	58	0	1.2
Slope aspect		E	E/W/L	E/L	N-NW	NW	N	L	N
CANOPY:									
Canopy type		C1	C1	C4	C2	C3	C3	C6	C3
Canopy height (m)		15	12	15	20	20	20	12	20
Canopy cover (%)		90	85	80	90	85	85	90	85
<i>Abies sachalinensis</i>	Coniferous tree	0	1	0	1	1	1	1	0
<i>Acer caudatum ssp. ukurunduense</i>	Broadleaf tree	0	1	0	0	0	0	0	0
<i>Acer japonicum</i>	Broadleaf tree	1	1	0	0	1	0	0	0
<i>Acer pictum</i>	Broadleaf tree	1	1	0	0	1	1	1	1
<i>Alnus hirsuta</i>	Broadleaf tree	0	0	0	0	1	1	1	1
<i>Betula ermanii</i>	Broadleaf tree	1	1	1	1	1	0	0	0
<i>Betula maximowicziana</i>	Broadleaf tree	0	0	0	0	0	1	0	0
<i>Betula platyphylla</i>	Broadleaf tree	0	0	0	0	0	0	1	0
<i>Fraxinus mandshurica</i>	Broadleaf tree	1	1	0	0	1	0	0	1
<i>Hydrangea paniculata</i>	Broadleaf shrub	0	1	0	0	0	0	0	0
<i>Hydrangea paniculata</i>	Broadleaf shrub	0	0	0	0	1	0	0	1
<i>Kalopanax septemlobus</i>	Broadleaf tree	0	0	0	1	0	0	0	0
<i>Magnolia obovata</i>	Broadleaf tree	1	1	0	0	1	0	0	0
<i>Phellodendron amurense</i> (= <i>P. sachalinense</i>)	Broadleaf tree	1	1	1	1	1	0	0	1
<i>Picea jezoensis</i>	Coniferous tree	1	0	1	1	1	1	0	0
<i>Prunus maximowiczii</i>	Broadleaf tree	0	1	0	0	0	0	0	0
<i>Prunus ssiiori</i>	Broadleaf tree	0	0	0	0	0	1	0	1
<i>Quercus mongolica</i>	Broadleaf tree	0	1	1	0	1	1	0	0
<i>Salix caprea</i>	Broadleaf tree	1	1	0	0	0	0	0	0
<i>Salix rorida</i>	Broadleaf tree	0	0	0	0	0	0	1	0
<i>Sorbus commixta</i>	Broadleaf tree	0	0	0	0	1	0	0	0
<i>Taxus cuspidata</i>	Coniferous tree	0	0	0	0	1	0	0	0
<i>Tilia japonica</i>	Broadleaf tree	1	1	1	1	1	0	0	0
<i>Ulmus davidiana var. japonica</i>	Broadleaf tree	1	0	0	0	1	1	0	0
<i>Ulmus laciniata</i>	Broadleaf tree	1	1	0	1	1	1	0	1
<i>Viburnum furcatum</i>	Broadleaf shrub	0	1	0	0	1	0	0	0
No. of tree and shrub species		11	15	5	7	17	9	5	7
<i>Actinidia arguta</i>	Climber	1	0	0	0	0	0	0	0
<i>Hydrangea petiolaris</i>	Climber	0	1	1	1	1	1	1	1
<i>Vitis coignetiae</i>	Climber	0	1	1	0	0	0	0	0
No. of climber species		1	2	2	1	1	1	1	1

Species Latin name	Species group	Location code							
		A	B	C	D	E	F	G	H
GROUND VEGETATION:									
Ground veg. type		G1	G1	G1	G2	G3	G3	G4	G5
Soil/litter (mean %)		72	84	89	82	48	37	26	12
Bare rock (mean %)		0	0	0	0	25	0	0	0
Fallen wood (mean %)		0	0	0	15	0	0	0	0
Mean height (cm)		148	122	128	75	25	31	38	62
VASCULAR PLANTS									
<i>Abies sachalinensis</i>	Coniferous tree (seedling)	0	0	0	0	1	1	3	1
<i>Acer japonicum</i>	Broadleaf tree (seedling)	0	0	0	0	1	2	2	0
<i>Acer pictum</i>	Broadleaf tree (seedling)	0	0	0	4	2	3	4	1
<i>Achlys japonica</i>	Herb	1	1	0	4	4	5	0	2
<i>Aconitum sachalinense</i> ssp. <i>yezoense</i> ssp. <i>yezoense</i>	Herb	0	0	0	0	5	2	1	1
<i>Alnus incana</i> ssp. <i>hirsuta</i>	Broadleaf tree (seedling)	0	0	0	0	0	0	1	0
<i>Anemone debilis</i>	Herb	0	0	0	0	0	0	0	1
<i>Angelica sachalinensis</i>	Herb	0	0	0	0	2	0	0	1
<i>Aquilegia buergeriana</i>	Herb	0	0	0	0	0	0	1	0
<i>Artemisia montana</i>	Herb	0	0	0	0	0	1	0	0
<i>Aruncus dioicus</i> var. <i>camschaticus</i>	Herb	0	0	0	0	3	2	0	0
<i>Astilbe thunbergii</i> var. <i>congesta</i>	Herb	0	1	0	1	0	1	0	0
<i>Brachypodium sylvaticum</i>	Grass	0	0	0	0	0	0	5	0
<i>Brylkinia caudata</i>	Grass	0	0	0	0	0	1	1	0
<i>Calamagrostis hakonensis</i>	Grass	0	0	0	0	4	0	1	0
<i>Cardamine scutata</i>	Herb	0	0	0	0	1	0	3	1
<i>Carex dispalata</i>	Sedge	0	0	0	0	0	0	1	5
<i>Carex pisiformis</i> (= <i>C. sachalinensis</i>)	Sedge	0	0	0	0	1	4	0	0
<i>Carex</i> sp. (medium-sized)	Sedge	0	0	0	0	3	0	0	0
<i>Carex</i> sp. (large, dark-leaved)		0	0	0	0	0	4	0	0
<i>Caulophyllum robustum</i>	Herb	0	0	0	0	0	1	0	0
<i>Chrysosplenium kamtschaticum</i>	Herb	0	0	0	0	0	0	0	2
<i>Circaea alpina</i>	Herb	0	0	0	0	0	1	0	1
<i>Cirsium kamtschaticum</i>	Herb	0	0	0	0	4	3	1	3
<i>Clinopodium micranthum</i> var. <i>sachalinense</i>	Herb	0	0	0	0	3	0	2	2
<i>Deparia pycnosora</i>	Fern	0	0	0	0	1	2	0	0
<i>Dryopteris crassirhizoma</i>	Fern	0	0	0	0	3	4	0	1
<i>Dryopteris expansa</i>	Fern	0	0	0	1	3	2	0	0
<i>Equisetum arvense</i>	Horsetail	0	0	0	0	1	0	3	0
<i>Eubotryoides grayana</i> var. <i>grayana</i>	Broadleaf sub-shrub	0	1	0	0	0	0	0	0

Species Latin name	Species group	Location code							
		A	B	C	D	E	F	G	H
<i>Eupatorium chinense</i> <i>var. sachalinense</i>	Herb	0	0	0	0	1	0	0	0
<i>Filipendula camschatica</i> (= <i>F. kamschatica</i>)	Herb	0	0	0	0	0	0	0	2
<i>Fraxinus mandshurica</i>	Broadleaf tree (seedling)	0	0	0	0	3	3	2	2
<i>Galium kamschaticum</i>	Herb	0	0	0	0	2	1	0	0
<i>Galium trifloriforme</i>	Herb	0	0	0	0	3	5	5	4
<i>Hydrangea petiolaris</i>	Climber	2	2	1	4	5	3	0	2
<i>Ilex rugosa</i>	Broadleaf sub- shrub (seedling)	0	0	0	2	0	1	0	0
<i>Impatiens noli-tangere</i>	Herb	0	0	0	0	0	0	0	1
<i>Jacobaea cannabifolia</i>	Herb	0	0	0	0	0	0	4	1
<i>Laportea bulbifera</i>	Herb	0	0	0	0	0	0	0	4
<i>Lycopodium dendroideum</i>	Clubmoss	0	0	0	1	0	0	0	0
<i>Maianthemum dilatatum</i>	Herb	0	0	0	0	4	5	0	1
<i>Mimulus tenellus</i>	Herb	0	0	0	0	0	0	0	2
<i>Muhlenbergia huegelii</i>	Grass	0	0	0	0	0	0	4	0
<i>Osmundastrum cinnamomeum fokiense</i>	Fern	0	0	0	0	1	0	0	1
<i>Oxalis acetosella</i>	Herb	0	0	0	0	2	2	0	0
<i>Pachysandra terminalis</i>	Herb	0	0	0	5	5	5	0	3
<i>Parasenecio hastatus</i> <i>ssp. orientalis</i>	Herb	0	0	0	0	0	0	0	2
<i>Paris tetraphylla</i>	Herb	0	0	0	0	0	2	0	0
<i>Peracarpa carnososa</i>	Herb	0	0	0	0	2	1	0	1
<i>Petasites japonicus ssp.</i> <i>giganteus</i>	Herb	0	0	0	0	1	0	2	0
<i>Phegopteris connectilis</i>	Fern	0	0	0	0	5	3	0	0
<i>Polystichum braunii</i>	Fern	0	0	0	0	2	2	0	0
<i>Polystichum tripterum</i>	Fern	0	0	0	0	0	3	0	0
<i>Prunus ssiori</i>	Broadleaf tree (seedling)	0	0	0	0	0	2	1	0
<i>Rubus idaeus var.</i> <i>aculeatissimus</i>	Broadleaf sub- shrub	0	0	0	0	0	0	4	0
<i>Rubus pseudojaponicus</i>	Herb	0	0	0	0	2	0	0	0
<i>Sasa senanensis</i>	Dwarf bamboo	5	5	5	5	5	5	0	5
<i>Senecio nemorensis</i>	Herb	0	0	0	0	1	1	0	0
<i>Solidago virgaurea ssp.</i> <i>leiocarpa</i>	Herb	0	0	0	0	4	1	0	0
<i>Sorbus commixta</i>	Broadleaf tree (seedling)	0	0	0	1	0	0	0	0
<i>Thalictrum sachalinense</i>	Herb	0	0	0	0	2	0	1	1
<i>Tilia japonica</i>	Broadleaf tree (seedling)	0	0	0	1	0	0	0	0
<i>Ulmus davidiana var.</i> <i>japonica</i>	Broadleaf tree (seedling)	0	0	0	0	1	5	1	0
<i>Ulmus laciniata</i>	Broadleaf tree (seedling)	0	0	0	0	1	0	0	0
<i>Viburnum furcatum</i>	Broadleaf shrub	0	0	0	1	0	0	0	0
<i>Viola grypceras</i>	Herb	0	0	0	0	1	0	3	1
<i>Viola selkirkii</i>	Herb	0	0	0	0	4	3	1	0
<i>Vitis coignetiae</i>	Climber	1	0	0	0	0	0	0	0

Species Latin name	Species group	Location code							
		A	B	C	D	E	F	G	H
MOSESSES									
<i>Amphidium lapponicum/mougeotii</i>	Moss	0	0	0	0	1	0	0	0
<i>Atrichum undulatum</i>	Moss	0	0	0	0	4	1	0	0
<i>Aulacomnium heterostichum</i>	Moss	0	0	0	0	0	4	0	0
<i>Bartramia pomiformis</i>	Moss	0	0	0	0	3	3	0	0
<i>Brachythecium sp.</i>	Moss	0	0	0	0	4	2	0	0
<i>Bryhnia novae-angliae</i>	Moss	0	0	0	0	5	5	0	0
<i>Fissidens dubius</i>	Moss	0	0	0	0	4	4	0	0
<i>Homalia trichomanoides</i>	Moss	0	0	0	0	0	1	0	0
<i>Loeskeobryum cavifolium</i>	Moss	0	0	0	0	1	1	0	0
<i>Mnium thomsonii</i>	Moss	0	0	0	0	3	1	0	0
<i>Plagiomnium rostratum</i>	Moss	0	0	0	0	0	1	0	0
<i>Plagiothecium neckeroideum</i>	Moss	0	0	0	0	3	3	0	0
<i>Pleuroziopsis ruthenica</i>	Moss	0	0	0	0	1	0	1	0
<i>Rhynchostegium pallidifolium</i>	Moss	0	0	0	2	0	1	0	0
<i>Rhytidiadelphus triquetrus</i>	Moss	0	0	0	0	1	0	0	0
<i>Thamnobryum sandei</i>	Moss	0	0	0	0	0	1	0	0
<i>Thuidium delicatulum</i>	Moss	0	0	0	1	3	2	1	0
LIVERWORTS									
<i>Calypogeia neesiana</i>	Liverwort	0	0	0	1	0	0	0	0
<i>Conocephalum japonicum</i>	Liverwort	0	0	0	0	3	0	0	0
<i>Conocephalum salebrosum</i>	Liverwort	0	0	0	0	2	0	0	0
<i>Diplophyllum taxifolium</i>	Liverwort	0	0	0	0	1	0	0	0
<i>Lepidozia reptans</i>	Liverwort	0	0	0	0	0	1	0	1
<i>Lophocolea bidentata</i>	Liverwort	0	0	0	0	0	0	0	1
<i>Metzgeria conjugata</i>	Liverwort	0	0	0	0	0	1	0	0
<i>Pellia epiphylla / neesiana</i>	Liverwort	0	0	0	0	2	1	0	0
LICHEN									
<i>Peltigera hymenina</i>	Lichen	0	0	0	0	0	1	0	0
Mean number of species in a 4m ² ground vegetation quadrat	Vascular plants	1.8	2	1.2	6	19.8	18.4	11.4	11
	Bryophytes	0	0	0	0.8	8.2	6.6	0.4	0.4
	Lichens	0	0	0	0	0	0.2	0	0
	All species	1.8	2	1.2	6.8	28	25	11.8	11.4

APPENDIX 2 - List of all plant species recorded at Horoka Tomamu Montane Forest, Hokkaido, Japan, in September 2016 and October 2018

This list combines the findings in this vegetation survey in 2016/2018 (161 vascular plant species + 113 bryophyte species) with the previous list of 95 vascular species (which largely overlaps the 2016/2018 vascular plant list; 20 species recorded here before were not found in the 2016/2018 survey).

Latin, Japanese and English names. For the purpose of this report the Latin names are considered to be the best ones to use because (a) they are better for communication between people of different nationalities and (b) the lists of Japanese and English names are currently incomplete (and some species lack English names anyway).

Quantity column = approximate quantity: 1 = rare; 2 = occasional; 3 = frequent; 4 = abundant; 0 = not seen by me in 2016/2018 but included in previous (2011 or earlier) list of vascular plant species.

Native/introduced status of species. All species listed here are native to this area except for *Agrostis stolonifera*, *Anthoxanthum odoratum*, *Dactylis glomerata*, *Galium album*, *Lapsana communis*, *Oxalis stricta*, *Taraxacum* agg., *Trifolium pratense*, *T. repens* and *Verbascum thapsus*, which are introduced here. *Abies sachalinensis* exists here as native trees and, at the NE edge, as planted trees. (There are plantations of *A. sachalinensis* and *Picea glehnii* just outside the site, to the east.)

Habitat codes indicating substrate type (soil, rock, tree trunks/branches, etc) are given for bryophytes because these plants occupy a wide range of substrates. Habitat codes of this type are not given for vascular plants, which grow here almost entirely on soil.

/ (two names separated by a forward slash) = from the material found in this survey it was possible to make identification only to the level of this pair of species which are very similar to each other.

Latin name	Japanese name	English name	Group	Quantity
VASCULAR PLANTS				
<i>Abies sachalinensis</i>	トドマツ	Sakhalin fir	Coniferous tree 針葉樹	3
<i>Acer caudatum</i> ssp. <i>ukurunduense</i>	オガラバナ	Ukurundu maple	Broadleaf tree 広葉樹	2
<i>Acer japonicum</i>	メイゲツカエデ	downy Japanese maple; fullmoon maple	Broadleaf tree 広葉樹	3
<i>Acer palmatum</i>	イロハモミジ	Japanese maple	Broadleaf tree 広葉樹	2
<i>Acer pictum</i>	イタヤカエデ	painted maple	Broadleaf tree 広葉樹	4
<i>Achlys japonica</i>	ナンブソウ	Japanese vanilla leaf	Herb 草本	4
<i>Aconitum sachalinense</i> ssp. <i>yezoense</i> ssp. <i>yezoense</i>	エゾトリカブト	Ezo aconite	Herb 草本	4
<i>Actaea asiatica</i>	ルイヨウショウマ	baneberry	Herb 草本	1
<i>Actinidia arguta</i>	サルナシ, コクワ	monkey pear, hardy kiwi	Climber ツル	2
<i>Adiantum myriosorum</i>	クジャクシダ	northern maidenhair	Fern シダ	1
<i>Agrimonia pilosa</i>	キンミズヒキ	hairy agrimony	Herb 草本	1
<i>Agrostis stolonifera</i>	ハイコヌカグサ	creeping bent	Grass イネ	1
<i>Alnus hirsuta</i>	ケヤマハンノキ	Manchurian alder	Broadleaf tree 広葉樹	3

Latin name	Japanese name	English name	Group	Quantity
<i>Amphicarpaea edgeworthii</i> (= <i>A. bracteata</i> ?)	ヤブマメ	hogpeanut	Herb 草本	1
<i>Anemone debilis</i>	ヒメイチゲ		Herb 草本	1
<i>Anemone flaccida</i>	ニンソウ		Herb 草本	0
<i>Angelica sachalinensis</i>	エゾノヨロイグサ		Herb 草本	2
<i>Anthoxanthum odoratum</i>	ハルガヤ	sweet vernal-grass	Grass イネ	1
<i>Aquilegia buergeriana</i>	オオヤマオダマキ	granny's bonnets	Herb 草本	3
<i>Aralia elata</i>	タラノキ	Japanese angelica tree	Broadleaf shrub 低木	2
<i>Artemisia montana</i>	オオヨモキ	mountain mugwort	Herb 草本	2
<i>Aruncus dioicus</i> var. <i>camschaticus</i>	ヤマブキショウマ	goat's beard	Herb 草本	2
<i>Asarum heterotropoides</i>	オクエゾサイシン	Ezo hollyhock	Herb 草本	0
<i>Aster ageratoides</i> / <i>microcephalus</i>	エゾノコンギク	Michaelmas daisy	Herb 草本	1
<i>Astilbe thunbergii</i> var. <i>congesta</i>	トリアシショウマ	false goat's-beard	Herb 草本	2
<i>Athyrium multidentatum</i>	エゾメシダ	glandular lady fern	Fern シダ	1
<i>Athyrium vidalii</i>	ヤマイヌワラビ	Japanese lady fern	Fern シダ	1
<i>Betula ermanii</i>	ダケカンバ	Erman's birch	Broadleaf tree 広葉樹	4
<i>Betula maximowicziana</i>	ウダイカンバ	monarch birch	Broadleaf tree 広葉樹	3
<i>Betula platyphylla</i>	シラカンバ	Japanese white birch	Broadleaf tree 広葉樹	3
<i>Brachypodium sylvaticum</i>	ヤマカモジグサ	false brome	Grass イネ	2
<i>Brylkinia caudata</i>	ホガエリガヤ		Grass イネ	2
<i>Calamagrostis hakonensis</i>	ヒメノガリヤス		Grass イネ	2
<i>Caltha palustris</i> var. <i>barthelii</i>	エゾノリュウキンカ	marsh marigold	Herb 草本	0
<i>Calystegia sepium</i>	ヒロハヒルガオ	hedge bindweed	Herb 草本	1
<i>Cardamine leucantha</i>	コンロンソウ		Herb 草本	0
<i>Cardamine scutata</i>	タネツケバナ		Herb 草本	2
<i>Cardiocrinum cordatum</i> var. <i>glehnii</i>	オオウバユリ	heartleaf lily	Herb 草本	2
<i>Carex dispalata</i>	カサスゲ		Sedge セッジ	2
<i>Carex mollicula</i>	ヒメシラスゲ		Sedge セッジ	2
<i>Carex pisiformis</i> (= <i>C.</i> <i>sachalinensis</i>)	サハリナイトスゲ		Sedge セッジ	2
<i>Carex utriculata</i>	オオカサスゲ	Northwest Territory sedge	Sedge セッジ	1
<i>Carex</i> sp.	(スゲ属の一種)		Sedge セッジ	1
<i>Caulophyllum robustum</i>	ルイヨウボタン	Asian blue cohosh	Herb 草本	1
<i>Chengiopanax sciadophylloides</i>	コシアブラ	koshiabura	Broadleaf tree 広葉樹	1
<i>Chloranthus japonicus</i>	ヒトリシズカ	wild chloranthus	Herb 草本	1
<i>Chrysosplenium flagelliferum</i>	ツルネコノメソウ	stolon golden saxifrage	Herb 草本	2
<i>Chrysosplenium kamtschaticum</i>	チシマネコノメソウ	golden saxifrage	Herb 草本	2

Latin name	Japanese name	English name	Group	Quantity
<i>Circaea alpina</i>	ミヤマタニタデ	alpine enchanter's nightshade	Herb 草本	2
<i>Cirsium kamtschaticum</i>	チシマアザミ	Kamchatka thistle	Herb 草本	3
<i>Clinopodium micranthum</i> var. <i>sachalinense</i>	ミヤマトウバナ		Herb 草本	3
<i>Commelina communis</i>	ツククサ	Asiatic dayflower	Herb 草本	0
<i>Coniogramme intermedia</i>	イワガネゼンマイ	intermediate bamboo fern	Fern シダ	1
<i>Corydalis fumariifolia</i>	エゾエンゴサク		Herb 草本	0
<i>Dactylis glomerata</i>	カモガヤ	cocksfoot	Grass イネ	1
<i>Dennstaedtia wilfordii</i>	オウレンシダ		Fern シダ	1
<i>Deparia pycnosora</i>	ミヤマシケシダ	tapering glade fern	Fern シダ	2
<i>Digitaria violescens</i>	アキメヒシバ		Grass イネ	1
<i>Diphylleia grayi</i>	サンカヨウ	skeleton flower	Herb 草本	0
<i>Disporum smilacinum</i>	チゴユリ		Herb 草本	0
<i>Dryopteris crassirhizoma</i>	オシダ	wood fern	Fern シダ	3
<i>Dryopteris expansa</i>	シラネワラビ	northern buckler-fern	Fern シダ	2
<i>Epilobium amurense</i>	イワアカバナ		Herb 草本	1
<i>Epilobium ciliatum</i>	カラフトアカバナ	American willow-herb	Herb 草本	1
<i>Equisetum arvense</i>	スギナ	field horsetail	Horsetail トクサ	2
<i>Euonymus hamiltonianus</i>	ニシキギ	Hamilton's spindle tree	Broadleaf tree 広葉樹	1
<i>Euonymus macropterus</i>	ヒロハノツリバナ	spindle tree	Broadleaf tree 広葉樹	1
<i>Eupatorium chinense</i> ssp. <i>sachalinense</i>	ヨツバヒヨドリ	Chinese eupatorium	Herb 草本	2
<i>Filipendula camschatica</i> (= <i>F. kamtschatica</i>)	オニシモツケ	Kamchatka meadowsweet; giant meadowsweet	Herb 草本	2
<i>Fraxinus mandshurica</i>	ヤチダモ	Manchurian ash	Broadleaf tree 広葉樹	3
<i>Galeopsis bifida</i>	チシマオドリコソウ	bifid hemp-nettle	Herb 草本	1
<i>Galium kamtschaticum</i>	エゾノヨツバムグラ	boreal bedstraw	Herb 草本	2
<i>Galium album</i> (= <i>G. mollugo</i>)	カスミムグラ	hedge bedstraw	Herb 草本	1
<i>Galium odoratum</i>	クルマバソウ	woodruff	Herb 草本	1
<i>Galium spurium</i>	ヤエムグラ	false cleavers	Herb 草本	1
<i>Galium trifloriforme</i>	オククルマムグラ		Herb 草本	3
<i>Gymnocarpium robertianum</i>	イワウサギシダ	fern; limestone oak fern	Fern シダ	1
<i>Huperzia serrata</i>	トウゲシバ	toothed clubmoss	Clubmoss ヒカゲノカズラ	2
<i>Hydrangea macrophylla</i>	エゾアジサイ	mountain hydrangea	Broadleaf shrub 低木	0
<i>Hydrangea paniculata</i>	ノリウツギ	panicked hydrangea	Broadleaf shrub 低木	3

Latin name	Japanese name	English name	Group	Quantity
<i>Hydrangea petiolaris</i>	ツルアジサイ	climbing hydrangea	Climber ツル	4
<i>Hymenophyllum wrightii</i>	コケシノブ	Wright's filmy fern	Fern シダ	1
<i>Hypericum erectum</i>	オトギリソウ		Herb 草本	1
<i>Hypericum ascyron</i>	トモエソウ	great St John's-wort	Herb 草本	0
<i>Ilex rugosa</i>	ツルツゲ	Tsuru holly	Broadleaf sub-shrub 小低木	2
<i>Impatiens noli-tangere</i>	キツリフネ	touch-me-not balsam	Herb 草本	1
<i>Jacobaea cannabifolia</i>	ハンゴンソウ	Aleutian ragwort	Herb 草本	3
<i>Juncus decipiens</i>	イグサ	lamp rush	Rush イグサ	1
<i>Juncus tenuis</i>	クサイ	slender rush	Rush イグサ	1
<i>Juncus wallichianus</i>	ハリコウガイゼキショウ		Rush イグサ	1
<i>Kalopanax septemlobus</i>	ハリギリ	prickly castor oil tree	Broadleaf tree 広葉樹	2
<i>Laportea bulbifera</i>	ムカゴイラクサ		Herb 草本	3
<i>Lapsana communis</i>	ナタネタビラコ	nipplewort	Herb 草本	1
<i>Leptorumohra miqueliana</i>	ホソバナライシダ		Fern シダ	2
<i>Leucothoe grayana</i>	ハナヒリノキ	sneeze tree	Broadleaf sub-shrub 小低木	1
<i>Lycopodium clavatum</i>	ヒカゲノカズラ	stag's-horn clubmoss	Clubmoss ヒカゲノカズラ	1
<i>Lycopodium dendroideum</i>	マンネンスギ	tree groundpine	Clubmoss ヒカゲノカズラ	2
<i>Lycopus uniflorus</i>	エゾシロネ	northern bugleweed	Herb 草本	1
<i>Lysimachia japonica</i>	コナスビ	loosestrife	Herb 草本	1
<i>Magnolia obovata</i>	ホオノキ	Japanese bigleaf (or whitebark) magnolia	Broadleaf tree 広葉樹	3
<i>Maianthemum dilatatum</i>	マイヅルソウ	false lily of the valley	Herb 草本	2
<i>Matteuccia orientalis</i>	イヌガンソク	Oriental ostrich fern	Fern シダ	1
<i>Matteuccia struthiopteris</i>	クサソテツ	ostrich fern	Fern シダ	1
<i>Mimulus tenellus</i>	ミゾホオズキ	Nepal monkey flower	Herb 草本	2
<i>Muhlenbergia curvيارistata</i> var. <i>nipponica</i>	ミヤマネズミガヤ		Grass イネ	0
<i>Muhlenbergia huegelii</i>	オオネズミガヤ		Grass イネ	2
<i>Muhlenbergia japonica</i>	ネズミガヤ, 鼠萱		Grass イネ	2
<i>Osmundastrum cinnamomeum fokiense</i>	ヤマドリゼンマイ	cinnamon fern	Fern シダ	1
<i>Oxalis acetosella</i>	コミヤマカタバミ	wood-sorrel	Herb 草本	3
<i>Oxalis stricta</i>	エゾタチカタバミ	yellow woodsorrel	Herb 草本	1
<i>Pachysandra terminalis</i>	フッキソウ	Japanese spurge	Herb 草本	4

Latin name	Japanese name	English name	Group	Quantity
<i>Parasenecio auriculatus</i>	ミミコウモリ	eared Indian plantain	Herb 草本	0
<i>Parasenecio hastatus ssp. orientalis</i>	ヨブスマソウ		Herb 草本	3
<i>Paris tetraphylla</i>	ツクバネソウ		Herb 草本	1
<i>Paris verticillata</i>	クルマバツクバネソウ	verticillate paris	Herb 草本	0
<i>Peracarpa carnos</i>	タニギキョウ	fleshy pericarp	Herb 草本	2
<i>Persicaria lapathifolia</i>	オオイヌタデ	pale Persicaria	Herb 草本	1
<i>Persicaria sagittata</i>	アキノウナギツカミ	arrowleaf tearthumb	Herb 草本	1
<i>Persicaria thunbergii</i> (= <i>Polygonum thunbergii</i>)	ミゾソバ		Herb 草本	1
<i>Petasites japonicus ssp. giganteus</i>	アキタブキ	giant butterbur; bog rhubarb	Herb 草本	2
<i>Phalaris arundinacea</i>	クサヨシ	reed canary-grass	Grass イネ	1
<i>Phegopteris connectilis</i>	ミヤマワラビ	beech fern	Fern シダ	2
<i>Phellodendron amurense</i> (= <i>P. sachalinense</i>)	ヒロハノキハダ	Sakhalin cork tree	Broadleaf tree 広葉樹	3
<i>Phragmites australis</i>	ヨシ	common reed	Grass イネ	1
<i>Picea glehnii</i>	アカエゾマツ	Sakhalin spruce; Glehn's spruce	Coniferous tree 針葉樹	1
<i>Picea jezoensis</i>	エゾマツ	Jezo spruce; Yezo spruce	Coniferous tree 針葉樹	3
<i>Plantago asiatica</i>	オオバコ	Chinese plantain	Herb 草本	1
<i>Poa annua</i>	スズメノカタビラ	annual meadow-grass	Grass イネ	1
<i>Polypodium fauriei</i>	オシャグジデンド		Fern シダ	1
<i>Polystichum braunii</i>	ホソイノデ	Japanese tassel fern; Braun's holly fern	Fern シダ	2
<i>Polystichum retroso-paleaceum</i>	サカゲイノデ		Fern シダ	1
<i>Polystichum tripterum</i>	ジュウモンジシダ	trifid holly fern	Fern シダ	2
<i>Populus suaveolens</i>	ドロノキ	Japanese poplar; Maximowicz's poplar	Broadleaf tree 広葉樹	2
<i>Populus tremula</i>	チョウセンヤマナラシ	aspen	Broadleaf tree 広葉樹	2
<i>Potentilla norvegica</i>	エゾノミツモトソウ	rough cinquefoil; Norwegian cinquefoil	Herb 草本	1
<i>Prunella vulgaris ssp. asiatica</i>	ウツボグサ	Asian self-heal	Herb 草本	1
<i>Prunus maximowiczii</i>	ミヤマザクラ	Miyama cherry	Broadleaf tree 広葉樹	1
<i>Prunus ssiori</i>	シウリザクラ	Hokkaido bird cherry	Broadleaf tree 広葉樹	1
<i>Pteridium aquilinum</i>	ワラビ	bracken	Fern シダ	1
<i>Quercus mongolica ssp. crispula</i>	ミズナラ	Mongolian oak	Broadleaf tree 広葉樹	4
<i>Ranunculus silerifolius</i>	キツネノボタン		Herb 草本	1

Latin name	Japanese name	English name	Group	Quantity
<i>Rhododendron pentandrum</i> (= <i>Menziesia pentandra</i>)	コヨウラクツツジ		Broadleaf shrub 低木	2
<i>Rubus idaeus</i> ssp. <i>melanolasius</i>	エゾイチゴ	raspberry	Broadleaf sub-shrub 小低木	2
<i>Rubus parvifolius</i>	ナワシロイチゴ	Japanese raspberry	Broadleaf sub-shrub 小低木	1
<i>Rubus pseudojaponicus</i>	ヒメゴヨウイチゴ		Herb 草本	2
<i>Salix caprea</i>	バッコヤナギ	goat willow	Broadleaf tree 広葉樹	2
<i>Salix rorida</i>	エゾヤナギ	Siberian willow	Broadleaf tree 広葉樹	1
<i>Salix schwerinii</i>	エゾノキヌヤナギ	osier	Broadleaf tree 広葉樹	1
<i>Salix udensis</i>	オノエヤナギ	dragon willow; Japanese fantail willow	Broadleaf tree 広葉樹	2
<i>Sambucus racemosa</i>	ニワトコ	red-berried elder	Broadleaf shrub 低木	1
<i>Sanicula chinensis</i>	ウマノミツバ	black snakeroot	Herb 草本	2
<i>Sasa senanensis</i>	クマイザサ	dwarf bamboo	Dwarf bamboo ササ	4
<i>Scirpus wichurae</i>	アブラガヤ		Sedge セッジ	1
<i>Senecio nemorensis</i>	キオン		Herb 草本	1
<i>Setaria viridis</i>	エノコログサ	green foxtail; green bristlegrass; wild foxtail millet	Grass イネ	1
<i>Silene baccifera</i>	ナンバンハコベ	berry catchfly	Herb 草本	0
<i>Solidago virgaurea</i>	ミヤマアキノキリンソウ	goldenrod; woundwort	Herb 草本	2
<i>Sonchus brachyotus</i>	ハチジョウナ		Herb 草本	1
<i>Sorbus alnifolia</i>	アズキナシ, 小豆梨	Korean mountain ash	Broadleaf tree 広葉樹	1
<i>Sorbus commixta</i>	ナナカマド	Japanese rowan	Broadleaf tree 広葉樹	3
<i>Stachys riederi</i>	イヌゴマ		Herb 草本	0
<i>Streptopus amplexifolius</i> var. <i>papillatus</i>	オオバタケシマラン	twisted-stalk	Herb 草本	0
<i>Symplocarpus renifolius</i>	ザゼンソウ	skunk cabbage	Herb 草本	0
<i>Taraxacum</i> agg.	セイヨウタンポポ	dandelion	Herb 草本	1
<i>Taxus cuspidata</i>	イチイ	Japanese yew	Coniferous tree 針葉樹	1
<i>Thalictrum minus</i> var. <i>hypoleucum</i>	アキカラマツ	lesser meadow-rue	Herb 草本	1
<i>Thalictrum sachalinense</i>	エゾカラマツ	meadow-rue	Herb 草本	2
<i>Tiarella polyphylla</i>	ズダヤクシュ	foam flower	Herb 草本	1
<i>Tilia japonica</i>	シナノキ	Japanese lime	Broadleaf tree 広葉樹	4

Latin name	Japanese name	English name	Group	Quantity
<i>Trifolium pratense</i>	ムラサキツメクサ	red clover	Herb 草本	1
<i>Trifolium repens</i>	シロツメクサ	white clover	Herb 草本	1
<i>Trillium apetalon</i>	エンレイソウ	Japanese trillium	Herb 草本	0
<i>Trillium tschonoskii</i>	ミヤマエンレイソウ		Herb 草本	0
<i>Ulmus davidiana</i> var. <i>japonica</i>	ハルニレ	Japanese elm	Broadleaf tree 広葉樹	4
<i>Ulmus laciniata</i>	オヒョウ	Manchurian elm	Broadleaf tree 広葉樹	3
<i>Urtica platyphylla</i>	エゾイラクサ	Ezo nettle	Herb 草本	2
<i>Verbascum thapsus</i>	ピロードモウズイカ	great mullein	Herb 草本	0
<i>Viburnum furcatum</i>	オオカメノキ	forked viburnum; scarlet-leaved viburnum	Broadleaf shrub 低木	3
<i>Viola grypoceras</i>	タチツボスミレ		Herb 草本	2
<i>Viola selkirkii</i>	ミヤマスミレ	Selkirk's violet; great-spur violet	Herb 草本	3
<i>Vitis coignetiae</i>	ヤマブドウ	crimson glory vine	Climber ツル	3

Total number of vascular plant species recorded in this survey of Horoka Tomamu in 2016/2018	161
Total number of vascular plant species, from all records made at Horoka Tomamu	181

Bryophytes (mosses and liverworts) and lichens - all recorded by Ben Averis in 2016/2018.

Quantity column = approximate quantity: 1 = rare; 2 = occasional; 3 = frequent; 4 = abundant.

Habitat codes: S = soil; R = rock; T = trees (trunks and branches); TB = tree bases; DW = decaying wood.

Species	Japanese name	Quantity	Habitat
MOSSES			
<i>Anomodon giraldii</i>	オオギボウシゴケモドキ	2	T
<i>Anomodon minor ssp. integerrimus</i>	ギボウシュゴケモドキ	3	T
<i>Anomodon rugelii</i>	エゾイトゴケ	2	T
<i>Amphidium lapponicum/mougeotii</i>	カゴメゴケ	1	R
<i>Anoetangium aestivum</i>	ネジレラッキョウゴケ	1	R
<i>Atrichum undulatum</i>	ナミガタタチゴケ	4	S, R
<i>Aulacomnium heterostichum</i>	ナガミチョウチンゴケ	2	S, R, TB
<i>Bartramia pomiformis</i>	タマゴケ	2	S, R
<i>Boulaya mittenii</i>	チャボスズゴケ	2	T
<i>Brachythecium brotheri</i>	アラハヒツジゴケ	2	S
<i>Brachythecium buchananii</i>	ナガヒツジゴケ	2	S
<i>Brachythecium velutinum</i>	キヌヒツジゴケ	1	T
<i>Brachythecium sp.</i>	アオギヌゴケ属	3	S, R, TB, DW
<i>Bryhnia novae-angliae</i>	ヤノネゴケ	3	S, R
<i>Bryonoguchia molkenboeri</i>	ホンシノブゴケ	2	S, TB, DW
<i>Bryum pseudotriquetrum</i>	オオハリガネゴケ	1	S
<i>Callicladium haldanianum</i>	アオクサゴケ	1	DW
<i>Calliergonella lindbergii</i>	エゾハイゴケ	2	R, S
<i>Ceratodon purpureus</i>	ヤノウエノアカゴケ	1	S
<i>Claopodium pellucinerve</i>	フトハリゴケ	1	T
<i>Climacium dendroides</i>	フロウソウ	2	S
<i>Climacium japonicum</i>	コウヤノマンネングサ	1	S
<i>Cratoneuron filicinum</i>	ミズシダゴケ	1	S
<i>Dichodontium palustre</i>	ヒロハススキゴケ	1	S
<i>Dichodontium pellucidum</i>	シメリイワゴケ	2	R
<i>Dicranella cerviculata</i>	コブオバナゴケ	1	S
<i>Dicranum flagellare</i>	ヒメカモジゴケ	2	T
<i>Dicranum hamulosum</i>	カギカモジゴケ	1	T
<i>Dicranum scoparium</i>	カモジゴケ	3	T, TB, DW
<i>Dicranum viride var. hakkodense</i>	タカネカモジゴケ	1	T
<i>Fissidens dubius</i>	トサカホウオウゴケ	3	S, R
<i>Forsstroemia japonica</i>	イトスズゴケ	1	T
<i>Forsstroemia trichomitra</i>	スズゴケ	1	T
<i>Helodium sachalinense</i>	カラフトシノブゴケ	1	S
<i>Homalia trichomanoides</i>	ヤマトヒラゴケ	3	S, R, TB, T
<i>Homalothecium laevisetum</i>	アツブサゴケ	2	T
<i>Hygrohypnum eugyrium</i>	タカネシメリゴケ	2	R
<i>Hygrohypnum subeugyrium</i>		1	R
<i>Hylocomium splendens</i>	イワダレゴケ	1	S, TB, DW

Species	Japanese name	Quantity	Habitat
<i>Hypnum cupressiforme</i>	ハイヒバゴケ	2	R
<i>Hypnum pallescens</i>	キノウエノコハイゴケ	1	T
<i>Loeskeobryum cavifolium</i>	フトリュウビゴケ	2	S, DW
<i>Mnium lycopodioides</i>	ナメリチョウチンゴケ	2	S
<i>Mnium thomsonii</i>	ヒメチョウチンゴケ	2	S, R
<i>Myuroclada maximowiczii</i>	ネズミノオゴケ	2	TB, DW
<i>Neckera pennata</i>	ハネヒラゴケ	2	T
<i>Neckera yezoana</i>	エゾヒラゴケ	2	T
<i>Orthotrichum sordicum</i>	タチバヒダゴケ	2	T
<i>Plagiomnium cuspidatum</i>	ツボゴケ	3	S, R
<i>Plagiomnium rostratum</i>	オオバチョウチンゴケ	3	S
<i>Plagiothecium curvifolium</i>	ナンブサナダゴケ	1	S
<i>Plagiothecium neckeroideum</i>	オオサナダゴケ	2	S
<i>Plagiothecium nemorale</i>	エゾサナダゴケ	2	S
<i>Platyhypnidium riparioides</i>	アオハイゴケ	1	R
<i>Pleuroziopsis ruthenica</i>	フジノマンネングサ	1	S, TB, DW
<i>Pleurozium schreberi</i>	タチハイゴケ	2	S, TB, DW
<i>Pogonatum contortum</i>	アオスギゴケ	2	S
<i>Pogonatum inflexum</i>	コスギゴケ	1	S
<i>Pogonatum spinulosum</i>	ハミズゴケ	1	S
<i>Pohlia wahlenbergii</i>	チョウチンハリガネゴケ	1	S
<i>Polytrichastrum formosum</i>	オオスギゴケ	1	DW
<i>Pylaisiella subcircinata</i>	マキハキヌゴケ	2	T
<i>Raiella fujisana</i>	バンダイゴケ	3	T
<i>Rhizomnium punctatum var. elatum</i>	セイタカウチワチョウチンゴケ	2	S, R
<i>Rhizomnium striatulum</i>	スジチョウチンゴケ	2	S, DW
<i>Rhynchostegium pallidifolium</i>	コカヤゴケ	3	S, R, TB, DW
<i>Rhytidiadelphus triquetrus</i>	オオフサゴケ	2	S
<i>Saelania glaucescens</i>	アオゴケ	2	S, R, DW
<i>Sanionia uncinata</i>	カギハイゴケ	2	T
<i>Schistidium apocarpum</i>	ギボウシゴケ	1	R
<i>Schistidium rivulare</i>	ミズギ ボウシゴケ	1	R
<i>Sciuro-hypnum plumosum</i>	オオハネヒツジゴケ	2	R
<i>Taxiphyllum aomoriense</i>	アオモリサナダゴケ	1	DW
<i>Thamnobryum subseriatum</i>	オオトラノオゴケ	2	S, R
<i>Thuidium delicatulum</i>	コバノエゾシノブゴケ	3	S, R
<i>Thuidium tamariscinum</i>	オオシノブゴケ	3	S, R, DW
<i>Tortella fragilis</i>	ヒロハヨリイトゴケ	1	S
<i>Trachycystis flagellaris</i>	エゾチョウチンゴケ	3	T, S, DW
<i>Trachycystis ussuriensis</i>	ユガミチョウチンゴケ	1	T
<i>Ulota crispa</i>	カラフトキンモウゴケ	3	T
<i>Ulota drummondii</i>	ナガサヤキンモウゴケ	1	T

Species	Japanese name	Quantity	Habitat
<i>LIVERWORTS</i>			
<i>Bazzania denudata</i>	タマゴバムチゴケ	2	DW
<i>Blepharostoma trichophyllum</i>	マツバウロコゴケ	1	S, R
<i>Calypogeia japonica</i>	フソウツキヌキゴケ	1	S, DW
<i>Calypogeia neesiana</i>	タカネツキヌキゴケ	1	S, DW
<i>Cephalozia bicuspidata / otuarensis</i>	オタルヤバネゴケ	1	DW
<i>Chiloscyphus polyanthos</i>	フジウロコゴケ	2	S
<i>Cololejeunea macounii</i>		1	T
<i>Conocephalum japonicum</i>	ヒメジャゴケ	2	S, R
<i>Conocephalum salebrosum</i>	タカオジャゴケ	2	S, R
<i>Diplophyllum taxifolium</i>	ホソバコオイゴケ	1	S, R
<i>Frullania bolanderi</i>		2	T
<i>Frullania hamatiloba</i>	カギヤスデゴケ	1	T
<i>Frullania muscicola</i>	カラヤスデゴケ	2	T
<i>Frullania parvistipula</i>	ヒメアカヤスデゴケ	1	T
<i>Jamesoniella autumnalis</i>	アキウロコゴケ	1	DW
<i>Lepidozia reptans</i>	ハイスギバゴケ	1	DW
<i>Lophocolea bidentata</i>	トガリバトサカゴケ	2	DW
<i>Lophocolea heterophylla</i>		2	DW
<i>Lophocolea minor</i>		2	T, R
<i>Metzgeria conjugata</i>	ヤマトフタマタゴケ	1	R
<i>Metzgeria consanguinea</i>	コモチフタマタゴケ	1	T
<i>Metzgeria furcata</i>	ミヤマフタマタゴケ	1	T
<i>Moerckia erimona</i>		1	S/R
<i>Pellia epiphylla / neesiana</i>	ミズゼニゴケ	2	S, R
<i>Plagiochila ovalifolia</i>		2	S, R
<i>Porella fauriei</i>	ケクラマゴケモドキ	2	T, R
<i>Porella grandiloba</i>	オオクラマゴケモドキ	2	T
<i>Ptilidium pulcherrimum</i>	テガタゴケ	1	TB
<i>Radula complanata</i>	ヒラケビラゴケ	2	T
<i>Riccardia multifida</i>		1	S/R
<i>Riccardia palmata</i>	モミジスジゴケ	1	DW
<i>Scapania bolanderi</i>	キヒシヤクゴケ	1	DW
Total no. of bryophyte species recorded	Moss 蘚類	81	
	Liverwort 苔類	32	
	All すべて	113	

Species	Japanese name	Quantity	Habitat
<i>LICHENS (some species noted during the vegetation survey)</i>	地衣類		
<i>Caloplaca flavorubescens</i>	カプトゴケ	3	T
<i>Cetrelia chicitae</i>	コフキトコブシゴケ	2	T
<i>Cladonia coniocraea</i>	ヤリノホゴケ	2	T, DW
<i>Cladonia squamosa</i>	ウロコハナゴケ	1	T
<i>Heterodermia isidiophora</i>	コウヤクゴケ	3	T
<i>Heterodermia obscurata/japonica/tremulans</i>		3	T
<i>Leptogium</i> sp. - possibly <i>L. saturninum</i>		2	T
<i>Lobaria fuscotomentosa</i>	ウラグロエビラゴケ	1	T
<i>Lobaria pulmonaria</i>	カプトゴケ	3	T
<i>Lobaria quercizans</i>	カラフトエビラゴケ	2	T
<i>Menegazzia subsimilis</i>		3	T
<i>Menegazzia terebrata</i>	センシゴケ	3	T
<i>Nephroma</i> sp. - possibly <i>N. bellum</i>	ナメラウラムゴケ	1	T
<i>Parmelia praesquarrosa</i>	ナメラカラクサゴケ	3	T
<i>Peltigera collina</i>	ヘリトリツメゴケ	2	T
<i>Peltigera hymenina</i>		2	S
<i>Pseudocyphellaria crocata</i>	ニセキンブチゴケ	1	T
<i>Sticta fuliginosa</i>	コウヤクゴケ	2	T
<i>Sticta nylanderiana/wrighti</i>	テリハヨロイゴケ / アツバヨロイゴケ	1	T

APPENDIX 3 - Photographs of habitats and plant communities at Horoka Tomamu Montane Forest, Hokkaido, Japan

These photos, taken by Ben Averis during vegetation survey work in September 2016 and October 2018, begin with landscape scale views of large areas (photos 1-6) followed by views of habitats and vegetation types within the forest (photos 7-44) and a few additional photos showing other aspects of natural processes taking place here (photos 45-50). Photos of individual plant species are provided in a separate document.

Photograph 1. Horoka Tomamu Montane Forest from the SW in September 2016. The tree canopy visible in this photo is mainly of type C1 (species-rich mixed broadleaf-dominated).



Photograph 2. Part of the same SW slope of Horoka Tomamu in October 2018.



Photograph 3. Another view of the SW slope in October 2018, showing some open glades dominated by *Sasa senanensis*. The tree canopy visible in this photo is of type C1 (species-rich mixed broadleaf-dominated).



Photograph 4. Part of E side of Horoka Tomamu Montane Forest in October 2018. The tree canopy visible in this photo is a mixture of types C1 species-rich mixed broadleaf-dominated (along skyline and extending downslope on the left), C4 *Betula ermanii*-dominated (upper slopes near right edge) and C5 *B. platyphylla*-dominated (lower ground).



Photograph 5. Another part of the E side in October 2018. The tree canopy visible in this photo is a mixture of types C1 species-rich mixed broadleaf-dominated (upper slopes) and C5 *Betula platyphylla*-dominated (lower ground).



Photograph 6. Looking E from the S slope of Horoka Tomamu (within forest with canopy type C1 species-rich mixed broadleaves dominant) to show part of the surrounding extensive forested mountain landscape.



Photograph 7. Canopy type C1 (species-rich mixed broadleaves) and ground vegetation type G1 (species-poor *Sasa senanensis*) at location A in September 2016.



Photograph 8. Canopy type C1 (species-rich mixed broadleaves) and ground vegetation type G1 (species-poor *Sasa senanensis*) at location B in September 2016.



Photograph 9. A view of canopy type C1 (species-rich mixed broadleaves) in the S part of Horoka Tomamu in October 2018.



Photograph 10. Another view of canopy type C1 (species-rich mixed broadleaves) at Horoka Tomamu in October 2018.



Photograph 11. Bright red autumn leaves of *Acer japonicum* against a background of other species in canopy type C1 (species-rich mixed broadleaves) at Horoka Tomamu in October 2018.



Photograph 12. Varied sizes and colours of mixed tree species in canopy type C1 (species-rich mixed broadleaves) at Horoka Tomamu in October 2018. Yellow = *Acer pictum*. Red = *A. japonicum*. Large dark trunk at upper right = *Betula ermanii*; most *B. ermanii* trunks are younger, thinner and paler (e.g. foreground tree at right) but old ones can be dark and very rough. Ground vegetation is type C1 (species-poor *Sasa*).



Photograph 13. Canopy type C2 (mixed broadleaves + c.20% conifers) and ground vegetation type G2 (*Sasa senanensis* + scattered other species) at location D in September 2016.



Photograph 14. Canopy type C2 (mixed broadleaves + c.20% conifers) and ground vegetation type G2 (*Sasa senanensis* + scattered other species) in the N of the site in September 2016, also showing *Abies sacahalinensis* blown down by recent typhoon.



Photograph 15. View within area of canopy type C3 (mixed broadleaves + c.40% conifers) in NW of the site at Horoka Tomamu in October 2018. Ground vegetation here is mostly G1 (species-poor *Sasa*).



Photograph 16. Local dominance of conifers (mainly *Abies sachalinensis*) within area of canopy type C3 in NW of site in October 2018. Large *Quercus mongolica* tree also present (left of centre, with thick vertical trunk dividing about 3-4 m above ground into many spreading branches)). Ground vegetation is G1 (species-poor *Sasa*).



Photograph 17. Canopy type C4 (*Betula ermanii*) and ground vegetation type G1 (species-poor *Sasa senanensis*) at location C in September 2016.



Photograph 18. Canopy type C4 (*Betula ermanii*) in the NE part of the site in October 2018. Red leaves of *Acer japonicum* in foreground/at left. Ground vegetation is type G1 (species-poor *Sasa senanensis*).



Photograph 19. Canopy type C5 (*Betula platyphylla*) on low ground in SE part of Horoka Tomamu in October 2018. Ground vegetation is type G1 (species-poor *Sasa senanensis*).



Photograph 20. Another view of canopy type C5 (*Betula platyphylla*) on low ground in SE part of Horoka Tomamu in October 2018, again with type G1 ground vegetation.



Photograph 21. Canopy type C6 (mainly *Alnus hirsuta*) and ground vegetation type G4 (grass- and grass/sedge-dominated swards) at location G, by river at the NW edge of the site in September 2016.



Photograph 22. The same area in October 2018.



Photograph 23. Canopy type C7 (with *Alnus hirsuta* and *Salix* species) and ground vegetation mainly of type G1 (species-poor *Sasa*) near the W edge of the site in September 2016.



Photograph 24. Canopy C7 (with abundant *Alnus hirsuta*) over ground vegetation type mainly G1 in W of site in October 2018.



Photograph 25. Ground vegetation type G6 (*Phragmites*-dominated) with canopy type C8 (with much *Alnus hirsuta*) at the SE edge of the site in September 2016.



Photograph 26. Ground vegetation type G6 (*Phragmites*) with canopy type C8 (with much *Alnus hirsuta*) at the SE edge of the site in October 2018.



Photograph 27. *Abies sachalinensis* plantation (canopy type C9) and ground vegetation type G7 (*Sasa senanensis* with various low grown species) in the NE part of the site in September 2016.



Photograph 28. Looking from the edge into a *Sasa*-dominated glade in the NE part of site in October 2018.



Photograph 29. Looking down (SE) into the W-E orientated gully on the eastern slope of Horoka Tomamu in October 2018.



Photograph 30. Looking upslope in one of the gullies draining S-SW down the western slope of Horoka Tomamu in October 2018, showing the typical gully habitat of mossy rocks and a tiny streamlet bordered by steep, moist banks with mixtures of *Sasa*, ferns and bryophytes.



Photograph 31. Ground vegetation type G3 (species-rich banks) beneath canopy type C3 (mixed broadleaves + c.40% conifers) at location E, by the river at the NW edge of the site in September 2016.



Photograph 32. Ground vegetation type G3 (species-rich banks) beneath canopy type C3 (mixed broadleaves + c.40% conifers) at location E, by river at the NW edge of the site in September 2016.



Photograph 33. Ground vegetation type G3 (species-rich banks) beneath canopy type C3 (mixed broadleaves + c.40% conifers) at location E, by the river at the NW edge of the site in September 2016.



Photograph 34. Ground vegetation type G3 (species-rich banks) beneath canopy type C3 (mixed broadleaves + c.40% conifers) at location F at the NW edge of the site in September 2016.



Photograph 35. Ground vegetation type G3 (species-rich banks) beneath canopy type C3 (mixed broadleaves + c.40% conifers) by the river at the NW edge of the site in October 2018.



Photograph 36. Steep banks with ground vegetation type G3 (including abundant and varied ferns) in the gully on the eastern slope of Horoka Tomamu in October 2018.



Photograph 37. Ground vegetation type G5 (*Sasa* + wetland species) beneath canopy type C3 (mixed broadleaves + c.40% conifers) at location H, at the NW edge of the site in September 2016.



Photograph 38. Ground vegetation type G5 (with wetland species) by small stream beneath canopy type C3 (mixed broadleaves + c.40% conifers) in the NW part of the site in September 2016.



Photograph 39. Rich epiphytic flora on old *Ulmus davidiana* in the W part of the site in September 2016. Epiphytes here include *Hydrangea petiolaris*, *Polypodium fauriei* and many bryophytes.



Photograph 40. Two more old *Ulmus davidiana* trees with well-developed epiphytic vegetation; near the river in the W of the site, in October 2018.



Photograph 41. A rotting log supporting many moss and liverworts species in the N part of the site in October 2018.



Photograph 42. A large old log with abundant bryophyte growth in a gully draining S on the W slope of Horoka Tomamu in October 2018.



Photograph 43. A large rock by the river in the N of Horoka Tomamu in October 2018.



Photograph 44. A mix of soil and stones (good habitat for colonisation by certain pioneer bryophytes) on the upturned base of a fallen tree by the river in the W of the site in October 2018.



Photograph 45. One of many pairs of trees growing next to each other at Horoka Tomamu. These pairs (or in some cases groups of 3-4) are most common in the N of the site. The species in this example are *Betula ermanii* (L) and *Picea jezoensis* (R). October 2018.



Photograph 46. One of many examples of fallen timber forming a habitat of mixed trunks, branches, twigs, stones and silt along the river in the N/W of the site. October 2018.



Photograph 47. One of many examples of horizontal layers of conifer foliage intercepting and holding an abundance of leaves that have fallen (in October 2018) from nearby broadleaved species at Horoka Tomamu. As a temporary but annual natural process, this might have some effect on some aspect of the ecology of the forest.



Photograph 48. Fallen autumn leaves can be very abundant on riverside stones at Horoka Tomamu. This annual cover of foliage could have some effect on the riparian ecosystem. Photographed in October 2018.



Photograph 49. Riverside *Alnus hirsuta* bark that has been rubbed by deer's antlers. October 2018.

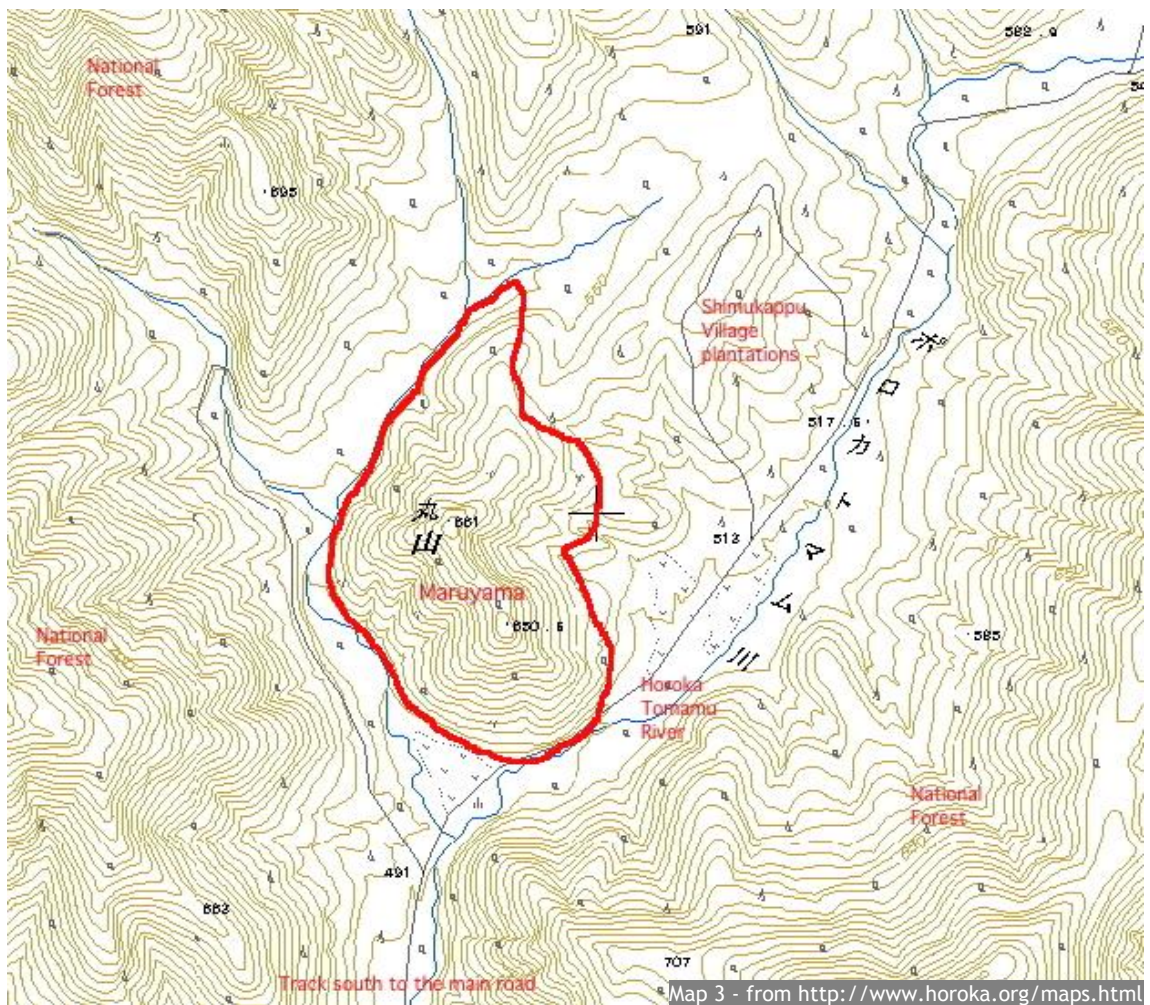
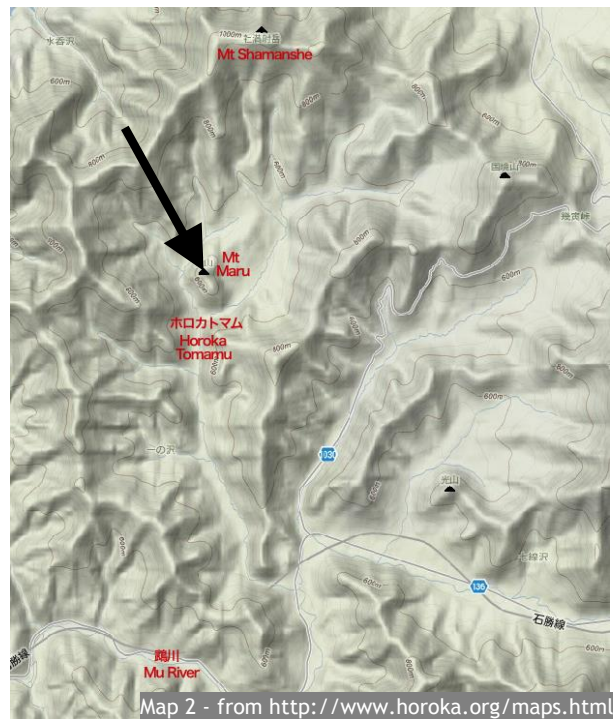
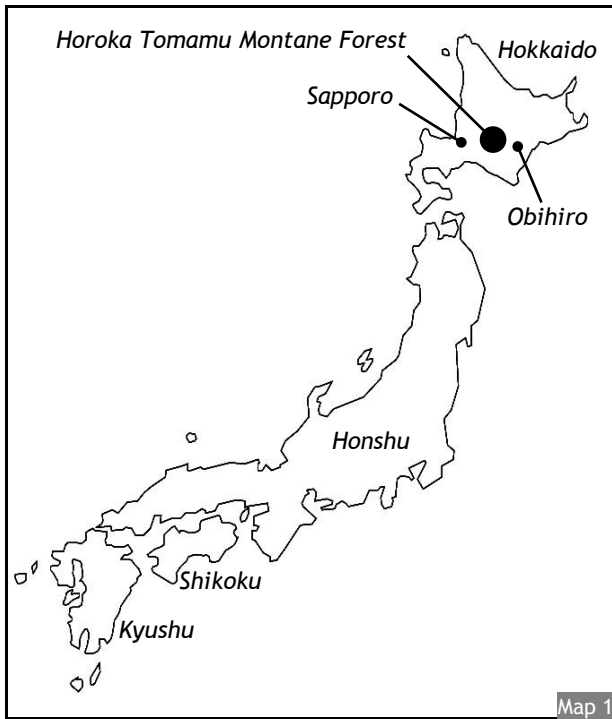


Photograph 50. Left: deer path by the river in the W of the site. Right: at this same location, a sedge (*Carex* sp.) that has been grazed, presumably by deer. October 2018.



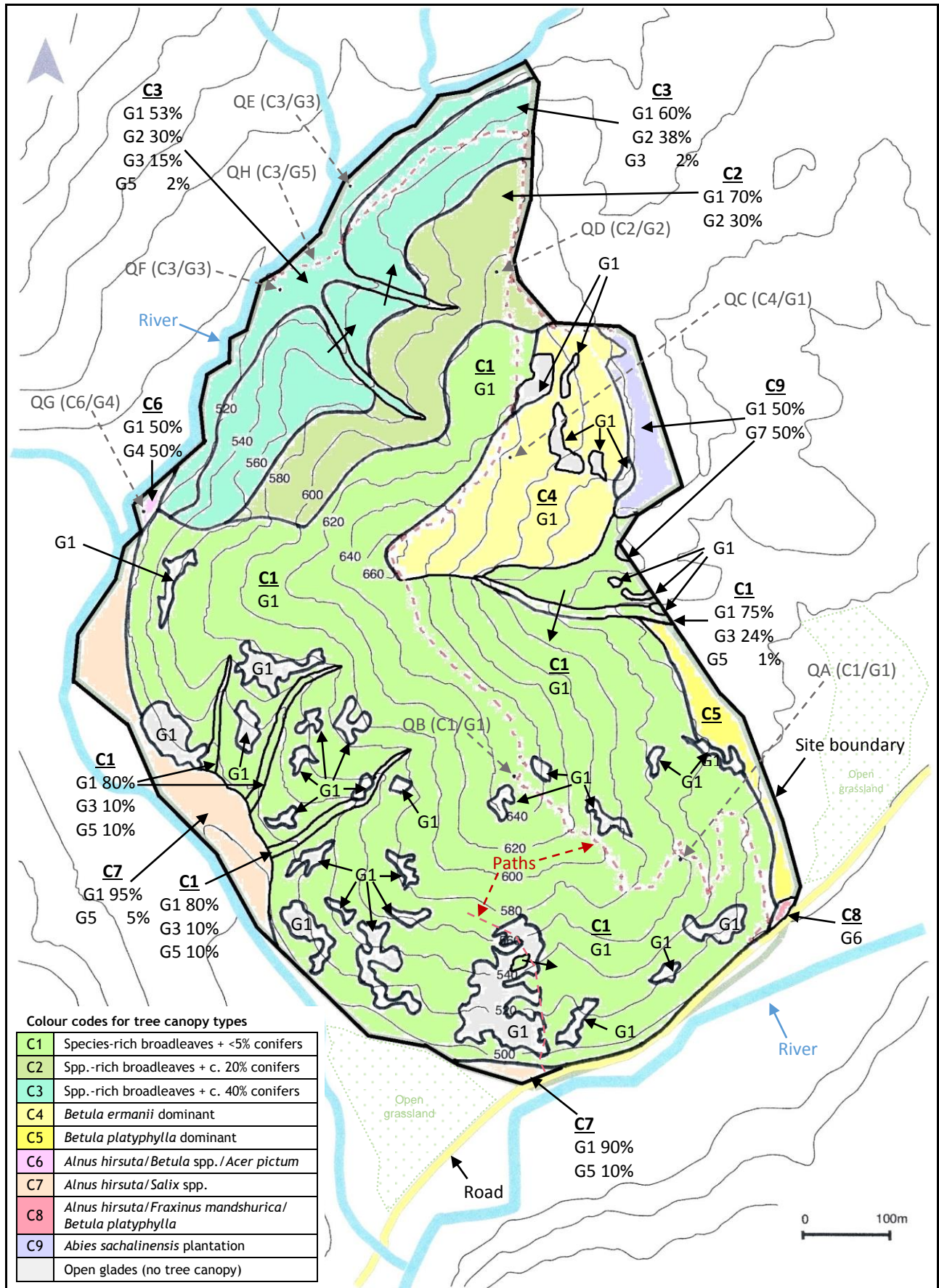
APPENDIX 4 - Maps

Maps 1-3: Location of Horoka Tomamu Montane Forest, Hokkaido, Japan



Map 4: Vegetation map of Horoka Tomamu Montane Forest, Hokkaido, Japan

Location: 43.1° N; 142.513° E. Vegetation mapped by Ben Averis in September 2016 and October 2018. C1-9 = tree canopy types. G1-7 = ground vegetation types. Colours = tree canopy types (see key). For ground vegetation types refer to 'G' codes in the labels. See survey report for botanical details for all C/G types. For complex mosaics of two or more ground vegetation types the labels give an estimated percentage for each one (e.g. G1 70% G2 30%). QA, QB... = quadrat sample locations (also indicating the C and G types sampled there).



Key to vegetation codes in Map 4

Tree canopy types

C1	Species-rich mixed broadleaf canopy. Mixed broadleaves (<i>Acer pictum</i> , <i>Quercus mongolica</i> , <i>Tilia japonica</i> , <i>Ulmus davidiana</i> , <i>U. laciniata</i> , <i>Betula ermanii</i> , <i>B. maximowicziana</i> , <i>Fraxinus mandshurica</i> , <i>Phellodendron amurense</i> , <i>Alnus hirsuta</i> and smaller amounts of <i>Acer japonicum</i> , <i>A. caudatum</i> , <i>A. palmatum</i> , <i>Sorbus commixta</i> , <i>S. alnifolia</i> , <i>Betula platyphylla</i> , <i>Kalopanax septemlobus</i> , <i>Chengiopanax sciadophylloides</i> , <i>Magnolia obovata</i> , <i>Prunus maximowiczii</i> , <i>P. ssiori</i> , <i>Populus tremula</i> , <i>Euonymus</i> spp. and <i>Salix caprea</i> , and the shrubs <i>Hydrangea paniculata</i> and <i>Viburnum furcatum</i>) >90%; conifers <i>Abies sachalinensis</i> and <i>Picea yezoensis</i> <10%. Sampled by 400m ² quadrats at locations A and B.
C2	Species-rich mixed broadleaves with c. 20% conifers. Mixed broadleaves (as in C1) c. 80%; conifers <i>Abies sachalinensis</i> and <i>Picea yezoensis</i> c. 20%. Sampled by 400m ² quadrat at location D.
C3	Species-rich mixed broadleaves with c. 40% conifers. Mixed broadleaves (as in C1) c. 60%; conifers <i>Abies sachalinensis</i> , <i>Picea yezoensis</i> and a very little <i>Taxus cuspidata</i> c. 40%. Sampled by 400m ² quadrats at locations E, F and H.
C4	<i>Betula ermanii</i>-dominated canopy. <i>Betula ermanii</i> >90%; other broadleaves (mainly <i>Acer pictum</i> , <i>Quercus mongolica</i> , <i>Tilia japonica</i> , <i>Ulmus davidiana</i> , <i>U. laciniata</i> , <i>Fraxinus mandshurica</i> , <i>Phellodendron amurense</i> , <i>Alnus hirsuta</i> , <i>Betula platyphylla</i> and <i>Magnolia obovata</i>) <10%; conifers <i>Abies sachalinensis</i> and <i>Picea yezoensis</i> <1%. Sampled by 400m ² quadrat at location C.
C5	<i>Betula platyphylla</i>-dominated canopy. <i>Betula platyphylla</i> c.90%; other species: <i>B. ermanii</i> , <i>Acer pictum</i> , <i>Quercus mongolica</i> , <i>Ulmus davidiana</i> , <i>Alnus hirsuta</i> , <i>Abies sachalinensis</i> , <i>Picea yezoensis</i> and <i>P. glehnii</i> .
C6	<i>Alnus hirsuta</i> - <i>Betula</i> spp. - <i>Acer pictum</i> canopy. <i>Alnus hirsuta</i> (> 50%) + other broadleaves including <i>Acer pictum</i> , <i>Betula ermanii</i> , <i>B. platyphylla</i> and <i>Salix rorida</i> . Sampled by 400m ² quadrat at location G.
C7	<i>Alnus hirsuta</i> - <i>Salix</i> spp. canopy. <i>Alnus hirsuta</i> , <i>Salix udensis</i> , <i>S. caprea</i> and <i>Ulmus davidiana</i> , with smaller amounts of <i>S. schwerinii</i> , <i>S. rorida</i> , <i>Acer pictum</i> , <i>Fraxinus mandshurica</i> , <i>Betula ermanii</i> , <i>Quercus mongolica</i> , <i>Populus suaveolens</i> , <i>P. tremula</i> and <i>Abies sachalinensis</i> .
C8	<i>Alnus hirsuta</i> - <i>Fraxinus mandshurica</i> - <i>Betula platyphylla</i> canopy. <i>Alnus hirsuta</i> , <i>Fraxinus mandshurica</i> , <i>Betula platyphylla</i> and a little <i>Ulmus davidiana</i> .
C9	<i>Abies sachalinensis</i> plantation. Mainly planted <i>Abies sachalinensis</i> , with very thinly scattered broadleaves including <i>Betula ermanii</i> , <i>Quercus mongolica</i> and <i>Phellodendron amurense</i> .
	Open glades (no tree canopy)

Ground vegetation types

G1	More or less pure <i>Sasa senanensis</i> swards. <i>Sasa senanensis</i> overwhelmingly dominant, with few or no accompanying plants; mainly on well-drained slopes but locally on flatter ground. Sampled by 4m ² quadrats at locations A, B and C.
G2	<i>Sasa senanensis</i> with sparse associated flora. <i>Sasa senanensis</i> strongly dominant, with a sparse, species-poor scatter of other species including <i>Hydrangea petiolaris</i> , <i>Pachysandra terminalis</i> , <i>Achlys japonica</i> , <i>Ilex rugosa</i> , <i>Lycopodium dendroideum</i> and <i>Huperzia serrata</i> , on well-drained level to sloping ground. Sampled by 4m ² quadrats at location D.
G3	Species-rich herb-sedge-fern-bryophyte banks. Species-rich assemblage including <i>Hydrangea petiolaris</i> , <i>Achlys japonica</i> , <i>Pachysandra terminalis</i> , <i>Aconitum sachalinense</i> ssp. <i>yezoense</i> , <i>Oxalis acetosella</i> , <i>Galium kamtschaticum</i> , <i>G. trifloriforme</i> , <i>Maianthemum dilatatum</i> , <i>Rubus pseudojaponicus</i> , <i>Sanicula chinensis</i> , <i>Solidago virgaurea</i> , <i>Thalictrum sachalinense</i> , <i>Viola selkirkii</i> , <i>Cirsium kamtschaticum</i> , <i>Circaea alpina</i> , <i>Calamagrostis hakonensis</i> , <i>Carex</i> spp., <i>Phegopteris connectilis</i> , <i>Deparia pycnosora</i> , <i>Dryopteris crassirhizoma</i> , <i>Polystichum braunii</i> , <i>P. tripterum</i> and many bryophytes, with sparse <i>Sasa senanensis</i> ; mainly on steep, well-drained banks. Sampled by 4m ² quadrats at locations E and F.
G4	<i>Brachypodium sylvaticum</i> - <i>Muhlenbergia huegelii</i> grass swards. Grass-dominated vegetation (including <i>Brachypodium sylvaticum</i> , <i>Muhlenbergia huegelii</i> and <i>Brylkinia caudata</i>) with a sparse growth of herbs and sedges, on more or less level, well-drained ground. Sampled by quadrats at location G.
G5	<i>Sasa senanensis</i> with wetland herbs and sedges. Mixtures of <i>Sasa senanensis</i> and other species including <i>Clinopodium micranthum</i> var. <i>sachalinense</i> , <i>Chrysosplenium kamtschaticum</i> , <i>Filipendula camschatica</i> , <i>Laporteia bulbifera</i> , <i>Peracarpa carnosa</i> , <i>Pachysandra terminalis</i> and sedges including <i>Carex mollicula</i> , on damp, level to sloping ground. Sampled by 4m ² quadrats at location H.
G6	<i>Phragmites australis</i> swards. Dominated by <i>Phragmites australis</i> ; also a little <i>Artemisia montana</i> , <i>Jacobaea cannabifolia</i> , <i>Angelica sachalinensis</i> and <i>Carex</i> sp.; on wet, level ground.
G7	<i>Sasa</i>-herb-fern-bryophyte assemblage in conifer plantation. Sparse scatter of plants, including <i>Hydrangea petiolaris</i> , <i>Pachysandra terminalis</i> , <i>Achlys japonica</i> , <i>Rubus idaeus</i> , <i>Clinopodium micranthum</i> var. <i>sachalinense</i> , <i>Circaea alpina</i> , <i>Lycopodium dendroideum</i> , <i>Dryopteris crassirhizoma</i> , <i>Phegopteris connectilis</i> , <i>Sasa senanensis</i> and bryophytes, among extensive conifer leaf litter on well-drained ground.

QA-QH = quadrat locations (with codes of sampled vegetation types shown in brackets)