TOMSK TAIGA 2005 REPORT

Tomsk Oblast
Central Southern Siberia
Russia

10th July – 7th August 2005

A University of Cambridge Expedition gathering ecological data to support an application for Forest Stewardship Council Certification

Patron: Sir Ranulph Fiennes

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2006

CONTENTS

ABSTRACT

Tomsk Taiga 2005 was a University of Cambridge expedition initiated by Kevin Hand of the Tree Council in collaboration with the International Institute for Environmental Safety (IIES), a Tomsk-based NGO, and Tomsk State University as part of a larger project funded by the Darwin Initiative. The expedition took place in Tomsk Oblast, Central Southern Siberia in July 2005, aiming to undertake ecological monitoring work and to gather biodiversity data in an area of taiga forest in order to support an application for Forest Stewardship Council (FSC) certification.

Ecological monitoring work studied tree species composition, volumes of fallen dead wood, numbers of standing dead trees and numbers of large living trees. Quantities of dead wood and the presence of large trees are widely recognised as indicators of potential biodiversity values in boreal and temperate forests. These data allowed identification and characterisation of different forest types and enabled an assessment of their potential biodiversity value. In addition to habitat structure, information was gathered on lichens and invertebrates from within several of the stands. The information derived from these surveys will be useful to FSC certification by indicating areas particularly worthy of conservation.

The data were gathered in such a way as to allow comparisons with similar forest types in other countries, showing that the forest in the study area compared very favourably with other countries in terms of biodiversity value. The methodology used was entirely repeatable such that follow-up studies will be able to assess the impact of changes in management on the area. The data also highlighted the importance of dead wood to biodiversity, a relatively new concept to Russian foresters.

Overall, the expedition was a success and paves the way for future collaborations between Russia and the UK, as well as providing data for FSC certification and contributing to knowledge about Siberian taiga forest.

FOREWORD

Everyone is aware that the world's tropical forests are diminishing in extent. Newspapers regularly highlight the scale and urgency of the problem. The threats that face the vast northern forests of Canada, Scandinavia and Russia are far less widely appreciated. This is partly because the tropical forests are extraordinarily diverse in their plant and animal species so the potential losses are immense and receive much publicity. But there is another factor. In the tropics the ongoing destruction of natural forest makes for striking headlines – the statistics of forest clearance in Amazonia and South-East Asia are depressingly familiar. There is no comparable devastating loss of forest area in the north where the problem is essentially one of management intensity. With increasing world demand for timber and wood products, the pressure on these forests has mounted and looks set to become more severe in the decades ahead. Nowhere are the northern forests more vulnerable than in the taiga – the vast natural boreal forests of Russia.

To many people in Western Europe the value of old forest stands is self-evident. These are rare places of enormous ecological, educational and aesthetic value. In Russia, however, the seemingly endless forests are often viewed from a different perspective and ecologists have perhaps tended to focus their attentions on the biodiversity hotspots such as the Altai and the Caucasus. The value and extent of the old growth forests in Siberia deserves greater recognition internationally for it is inevitable that conversion of taiga to managed forest will become more widespread. Some areas already receive special protection but further opportunities are needed to create large reserves free from logging and also to establish areas where future management will allow retention of valuable wildlife features and habitats. Forest Stewardship Council (FSC) certification offers one mechanism for achieving the latter for it requires that certified forests identify 10% of the forest area as a conservation zone where management will be conducted in ways that are compatible with the needs of biodiversity.

The project carried out in Western Siberia in 2005 by students of the Cambridge University Expedition Society is an excellent example of how the ecological importance of old-growth Siberian forests can be brought to wider attention. This study was conducted close to the major city of Tomsk at the extreme southern edge of the taiga zone. Several stands showed all the structural attributes of old growth with massive trees and large quantities of fallen wood. The project has demonstrated that even in this relatively accessible region, there are forest stands of great ecological value that deserve long-term protection. Exactly how this might be achieved has yet to be determined although it is hoped that FSC certification will become a reality. The data collected on this expedition is an extremely important first step in that process.

Dr Robert J Fuller
Director of Habitats Research
British Trust for Ornithology

INTRODUCTION

The Tomsk Taiga expedition arose as part of a wider project funded by DEFRA (the UK government Department for Environment, Food and Rural Affairs) through its Darwin Initiative. This project, 'Sustainable Support for Biodiversity and Forestry in Tomsk Taiga, Siberia', aims to monitor and conserve biodiversity of the taiga forest through raising awareness of its social, environmental and economic value, and to create a model for sustainable forestry use. This involves undertaking repeatable biodiversity monitoring work, increasing community involvement in and knowledge of the forest, and developing a market in Western Europe for forest products. It is expected that three expeditions will depart from the UK to Tomsk Oblast in order to undertake the biodiversity monitoring work: this expedition was the first of these. The project is a partnership of a number of British and Russian organisations, including the Institute of International Environmental Safety (IIES) and Tomsk State University Department of Ecology in Russia, and the Tree Council, the British Trust for Ornithology, the Forestry Commission, Pricebatch (Altai-UK) Ltd, Traidcraft and WTA Education Services in the UK. The student expedition team from the University of Cambridge was recruited by Kevin Hand, a key co-ordinator of the Darwin project.

A key objective of the Darwin project was to achieve Forest Stewardship Council (FSC) certification for a managed region of Siberian taiga in the Tomsk Oblast. This would serve two purposes: to protect the forest area from overexploitation, and to serve as a model to facilitate similar forest areas to gain FSC certification. Protecting managed forests in this way is important since they often have no existing protection, and with little pre-existing biodiversity data the effects of continued exploitation are hard to assess. Managed forests in the Siberian taiga are threatened by increased logging (both legal and illegal), oil and gas exploitation, uncontrolled fires, and lack of the knowledge necessary to inform future management plans, but they are very important as a carbon sink and may have high biodiversity value.

The FSC certification process requires that at least ten percent of the proposed area be set aside as a conservation zone. Within this conservation zone, half is to be entirely protected and unmanaged while the other half may be managed with the aim of conserving biodiversity and different habitats. The main aim of this first expedition was to use ecological monitoring techniques to select the area for conservation, with a view to choosing a region with maximal biodiversity. The University of Cambridge team aimed to carry this work out in conjunction with our Russian partners IIES and Tomsk State University.

The aims of the expedition, however, developed continually up until and even after arrival in the field. The area selected for monitoring (the Kaltayskii forest in the Tomsk region) was not finalised until shortly before departure, and at approximately 50 000 hectares it would have been unrealistic to gather useful data on the whole area. Sourcing adequate transport was also difficult; however, our Russian partners identified a suitable study area which could be monitored on foot, thus saving on transport time. This area (Lake Kireksoe and its surroundings) was already partially protected as a water protection zone, and was found to be extremely ecologically rich and diverse relative to the more managed areas nearer to the city of Tomsk. It was therefore proposed that this area should form the basis of the conservation zone, and that the data we were to gather would provide evidence supporting this.

It also transpired that accepted ecological methods and opinions differed between the UK and Russian scientists. Our ideas were largely aimed at setting up repeatable baseline monitoring and gathering quantitative data, while the Russian scientists tended to take a more descriptive and qualitative approach. Our aims developed to take account of and make use of this, as we used the Russians' data and knowledge and at the same time introduced them to methodology that would allow comparison of the taiga forest with European forests, and would enable quantitative comparisons to be made in future years following FSC certification. Our final aims were the following:

1. To provide scientific evidence to justify selection of the ten percent conservation area, a requirement of FSC certification.

2. To set up a method for repeatable long term monitoring. This will depend upon future expeditions and their aims but we designed our methodology to be highly repeatable, for example to ensure that FSC certification (should it be obtained) is having the desired effects.

3. To compare and contrast the dead wood volumes and biodiversity of the Tomsk region of Siberia with the results of similar monitoring carried out in other countries with similar forest ecosystems, such as Canada and Scandinavia. This would be a valuable scientific exercise given the lack of such investigations in the Siberian taiga relative to other countries.

4. To investigate a possible link between dead wood volume and biodiversity. It is widely accepted in Western Europe and Canada that there is a strong link[1] between these two factors, while in Russia this is a much less familiar concept. If evidence for this link were to be found in Siberian taiga forest as a result of the expedition, it may have effects on how dead wood is perceived in Siberia.

5. To provide data to inform future management of the area to be managed for conservation. As the maintenance of biodiversity is to be a major objective in this management, it is vital to have a picture of the current biodiversity status of the area and the various habitat types present.

These objectives seemed to be viable, and our methodology was finalised in the field with these aims in mind. In this report we shall discuss all aspects of the expedition, from the pre-departure preparation to the expedition itself, its members, and the data that was gathered. The Fieldwork and Research section (Pages 12-31) specifies in detail our scientific aims and methodology, our findings and the conclusions that can be drawn.

[1] See Fieldwork and Research Introduction.

EXPEDITION MEMBERS

UK Members: Students

Hannah Allum: Fieldwork Assistant
Due to study Natural Sciences at Robinson College, Cambridge (starting 2006).
Environmental Coordinator at previous school.
2003: 1-month project with the British Geological Survey.

Alex Benton: Technology Officer
Studying Mathematics (PhD) at Emmanuel College, Cambridge (due to graduate 2007).
BA (1995) and MEng (1996) at Cornell University, New York.
Work for Microsoft, Netscape, Newfire, and Align Technology.
Over ten years' professional software development experience, specialising in 3D graphics and data representation.
Travel to Iceland, Pakistan, Europe, Russia.

Kate Cochrane: Expedition Leader
Studied Philosophy at Girton College, Cambridge (graduated 2005).
2002: Expedition to climb Mount Kilimanjaro, Tanzania.
Five months spent in Tanzania, South West Africa, teaching a variety of subjects.
Independent and group travel throughout Africa; Tanzania to South Africa via Zambia, Botswana, Namibia.

Wing-Sham Lee: Methodology Researcher
Studied Natural Sciences at Newnham College, Cambridge (graduated 2005).
2004: Molecular Biology research projects at University of Cambridge and University of Manchester. 1-week field study course near Lisbon, Portugal, studying plant species and natural and semi-natural ecosystems.
2003: Molecular Biology research project at University of Manchester.

Katie Marwick: Medical Officer
Studied Medicine at Emmanuel College, Cambridge (graduated 2005).
2004: 4 weeks summer research volunteer at Robarts Institute, Canada: molecular biology laboratory assistant.
2003: 2 months in India working as workshop organiser and English teacher for the charity "English Language Scholarships for Tibetans".
Travel and work in Nepal, India, Peruvian Amazon and Alaska.

Sarah Parker: Finance Officer
Studying Natural Sciences at Fitzwilliam College, Cambridge (due to graduate 2006).
2003: Two-month research project in Switzerland investigating polymer composites.
2001: One month teaching English in Eastern Siberia, Russia, and promoting Guiding both in Irkutsk and in camps in the taiga.

Lucy Taylor: Logistics Officer and Report Co-ordinator
Studied Natural Sciences at Fitzwilliam College, Cambridge (graduated 2005).
2004: Molecular Biology research projects at University of Cambridge. 1-week field study course near Lisbon, Portugal, studying plant species and natural and semi-natural ecosystems.

UK Members: Researchers

Fred Currie:
Wildlife and Conservation Adviser to the Forestry Commission (FC), England, since 1988.
30 years experience in wildlife and conservation research and advice in FC in England and Wales.
Leader of Ancient Tree study tours to Poland and Romania.
Responsible in FC England for Woodland Priority Biodiversity Action Plan species and problem species, including initiating and leading national partnerships (e.g. Chair of UK Woodland Bird Group and England Squirrel Forum).
Policy and Best Practice development (e.g. lead author FC/RSPB Guide to Managing Rare Birds in Forests (1997)).

Dr. Robert Fuller:
Director of Habitats Research, British Trust for Ornithology since 1988.
BSc Zoology (1^{st}), Imperial College, London (1973). PhD University of London (1987): 'Composition and Structure of Bird Communities in Britain'.
25 years experience of researching relationships between birds and their habitats.
Research on ornithological consequences of land-use change, habitat management and habitat loss.
Undertaking a long-term experimental study of relationships between deer browsing, vegetation structure and bird populations.

Kevin Hand:
Environmental Consultant, and at the time Director of Campaigns, The Tree Council.
MSc (Hons) Conservation, University College London, BSc (Hons) Applied Biology, Liverpool Polytechnic.
2002: Research project on Ecotourism potential in Newfoundland former cod-fishing communities.
Course Director of Study Tours to Papua New Guinea, Madagascar (3), Queensland, Greece (12), Canary Islands (5), Portugal (5), Senegal and Gambia, Madeira.
Developed Ditch Management Handbook for MAFF.
Joint Author of Hedge Tree Handbook and The Good Seed Guide, both Tree Council publications.
1-month project on Land Use Conflicts in Flow Country, Scotland, as part of MSc.

Russian Members: Expedition Co-ordination

Konstantin Kozlov:
Project Director and Director of the Institute of International Environmental Safety (IIES).

Svetlana Kozlova:
Project Co-ordinator and Vice Chairperson of IIES.

Russian Members: Academic

Dr. Tatyana Blinova:
Professor of Ornithology in Department of Environmental Management of International Agricultural Faculty of Tomsk State University.

Professor Marina Olonova:
Professor of Botany in Department of Environmental Management of International Agricultural Faculty of Tomsk State University.

Dmitry Kurbatsky:
Post-graduate student in Entomology in Department of Invertebrates Zoology of Tomsk State University.

Sergey Aushev:
Post-graduate student in Dendrochronology in Department of Environmental Monitoring of Tomsk University of Management Systems and Radio Electronics.

Dmitrii Lebedev:
Undergraduate student in Department of Environmental Management of International Agricultural Faculty of Tomsk State University.

FIELDWORK AND RESEARCH

1. Introduction

Natural and near-natural forest habitats are diminishing throughout the boreal zone as pressures from logging and other forms of resource exploitation intensify. In Russia this is probably especially true in the relatively accessible Southern taiga and forest-steppe subzones. Many species of plants and animals depend on the structures provided by natural or near-natural stands in these regions.

The work described in this report was undertaken in order to contribute towards a bid for Forest Stewardship Council (FSC) certification for a region of forest west of the city of Tomsk, Siberia, a small part of which was the study site. The data gathered is hoped to justify selection of the study site to form a conservation zone, an important stipulation of FSC certification. Such certification would ensure that this region will be managed in a sustainable fashion and therefore at least partially protected from over-exploitation. It was important that the methodology was entirely repeatable, so that the effects of FSC certification can be assessed in the future.

It is also hoped that this work will provide a useful record in its own right. In most of Western Europe and Northern America, dead wood is considered to be an especially important feature of old stands, from both an ecosystem and biodiversity perspective (Falinski, 1986; Harmon *et al.,* 1986; Bobiec *et al.,* 2005). Dead wood plays a key role in nutrient cycling and provides a microhabitat for many organisms, notably fungi, bryophytes and invertebrates. Many vertebrates use dead wood as a source of invertebrate food while cavities in dead wood provide nesting and roost sites. It has also been suggested that species that depend on dead wood, such as woodpeckers, have considerable potential to act as indicators of wider forest biodiversity (Angelstam and Mikusiński, 1994; Scherzinger, 1998; Mikusiński *et al.,* 2001). Other studies have attempted to identify deadwood thresholds or particular microhabitats necessary for maintaining biodiversity (e.g. Bütler *et al.*, 2004, Mikusiński, 1997). In recognition of the ecological significance of dead wood an increasing number of studies have estimated quantities of dead wood in a range of stands (Kirby *et al.,* 1998 and references therein). However, the current perspective in many other countries, such as Russia, is that dead wood harbours pest organisms and has little value in its own right – a view evident in the compulsory practice of dead wood removal in managed forestry areas. One of the consequences of this is the lack of study on dead wood quantities present in forest stands in the Siberian taiga, and therefore little potential for comparison with taiga forest in other countries.

Also investigated was the habitat structure of old forest stands near Tomsk and the variation in habitat structure across the different stand types present. The work focussed on those elements of forest structure likely to be indicators of biodiversity value i.e. volumes of fallen dead wood and numbers of standing dead trees (snags). The presence of large trees is another characteristic of old forest stands of significant biodiversity. For example, several species of birds require large trees as nesting sites (Tucker and Heath, 1997), while the continuity of very old trees may be especially important for some lichens (Rose, 1976).

The project also incorporated collection of information on the presence and abundance of lichens. Lichens are species-rich elements of boreal forest biodiversity in their own right (Soderstrom, 1988; Lessica *et al.*, 1991; Esseen *et al.*, 1997) and are also correlated with species richness in some other classes of organisms such as beetles and spiders (Nilsson *et al.*, 1995; Gunnarsson *et al.*, 2004). In addition many studies have attempted to use lichens as indicators of 'ecological continuity' – a long period without disturbance to the habitat (for review see Rolstad *et al.*, 2002). Lichens are thought to have the potential to be good indicators of such continuity as some species have both low rates of dispersal and narrow habitat requirements, meaning that they are slow to recover from disturbance and can provide lingering evidence of events in woodland management in subsequent decades. (Rose, 1993; Sillett *et al.*, 2000).

The presence in the field of Dmitry Kurbatsky, a Russian graduate student in entomology, also made it been possible to include some data on the insect species present in our study area (Appendix II).

This report presents a summary of the findings and draws comparisons with dead wood volumes recorded in other boreal and temperate forests. We are unaware of any similar projects in this region. Overall, it is hoped that the information derived from this study will be useful in helping to raise awareness of the conservation value of old forest stands in this region, as well as providing data to support an application for FSC certification and inform the future management of the area.

2. Study area

The study site was selected by Russian collaborators as a potential conservation zone within a larger forest area being considered for FSC certification. The location of the study area was at the Southern edge of the taiga. Forests in this region are relatively accessible and could therefore be targeted in the future for intensified timber extraction or other exploitation, for example for oil and gas. The study site lay approximately 50 km west of the city of Tomsk and was centred on Lake Kireksoe (56^{o} 6.603´N 84^{o}14.000´E) within the Kaltayskii Forest.

Much of this forest was relatively even-aged managed Scots pine (*Pinus sylvestris*). These stands appeared to be managed either by small-scale felling or by systematic thinning which promoted massive regeneration mainly of Siberian pine (*Pinus sibirica*). These managed stands were typically dominated by *Pinus sylvestris* trees that were less than 20m in height and less than 40cm in diameter at breast height (DBH). The requirement by law that dead wood is to be removed (compulsory 'forest sanitation') meant that quantities of dead wood within these stands were extremely low.

In the vicinity of Lake Kireksoe there were several stands containing trees that were much larger than those in the managed parts of the forest and that had substantial quantities of dead wood; these were the focus of our study. Old stands selected for study were defined as stands with a minimum average canopy height of 20m. The tree composition of these old stands ranged from pure conifer to pure broadleaf [birch (*Betula* spp.) and aspen (*Populus tremula*)]. The dominant conifers in these old stands were *Pinus sylvestris*, (which occurred both as pure stands and in mixtures with *Betula*), Siberian pine (*Pinus sibirica*) and Siberian fir (*Abies sibirica*). Siberian spruce *Picea obovata* and larch *Larix sibirica* were occasional canopy trees. The relative abundance of old stands in the vicinity of Lake Kireksoe appeared to be a consequence of this area being established as a water protection zone with restricted management. Nonetheless, there was evidence of small-scale local timber extraction and it seems likely that some of the stands dominated by old birch were at an early stage of succession following logging. Therefore, although several of the stands showed attributes of old growth forest, none could be regarded as virgin forest.

However, one stand in particular showed characteristics of natural forest (56^{o} 5.1299´N 84^{o} 9.917´E). This contained huge *Pinus sylvestris* and *Pinus sibirica* with extensive patches of *Abies sibirica*. The characteristics that set this stand apart as being near-natural were the massive size of the trees, the multi-layered canopy, massive snags, much fallen wood and the presence of treefall gaps.

Other habitats in the vicinity of Lake Kireksoe were old and mostly abandoned hay meadows associated with the Tatar village of Kirek, and bog systems.

3. Methodology

Transect selection

The aim was to collect data evenly across a gradient of forestry stand types, from pure conifer to pure broadleaf. In order to help us realise this aim, we classified the stands we worked in as conifer, mixed and broadleaf types[2]. We were more interested in areas that had not been obviously managed in the recent history of the area, as this would give us a greater indication of the value of the region if it were to be left unmanaged – i.e. as part of a conservation zone. As such, we set our criteria for stands to be sampled as stands with a canopy height of > 20m, ideally > 25m where possible, and with no obvious signs of recent management, such as clear cut tree stumps.

We did sample some stands that had signs of management, but retained a tall, fairly continuous canopy. This was partly so that we had data that could be compared with the near-natural stands, but also partly for practical reasons as our means of transportation were limited. Thus it was difficult to search for more 'ideal' stands within an easily accessible range. However, areas of young or clearly replanted, even-aged tree stands were avoided.

Transect laying

Our method of transect laying was designed with the aim of setting out randomly chosen transects, in order to get a data set that represented the stand types as a whole, as far as this was reasonably possible[3]. Lines of three transects were laid out at a perpendicular angle to our starting point for that line on the road/track. This was done by setting a compass to the bearing perpendicular (± 90°) to that of the track direction at the start point (Figure 4). This bearing was also used to lie transects on a straight line. This method helped avoid personal bias in the selection of 'random' bearings used to determine the direction of transect lines. In general it also reduced the probability of transect lines crossing, although care had to be taken when setting up transects around bends in the track.

The first transect of each line was started approximately 20 m into the stand, measured either from the track itself, or from the beginning of the edge of the stand, if this was not at the edge of the road. Each transect was 50 m long, with flag poles used at 10 m intervals. A 10 m length of string was used to measure intervals between the positions at which the flag poles were set.

Each transect in the line was 50 m along the line away from the next one. Lines were terminated if any of the following were encountered before we had lain out three transects; a major change of stand, a bog, a meadow, an unnatural clearing (e.g. a logged area) or a second track. If this occurred, then a new line at the next starting point was laid.

[2] See the notes later on profiling the stand in which we laid out our transect lines.
[3] Exceptions to this rule had to be made on occasion, for example in like the old pine forest where there were no tracks.

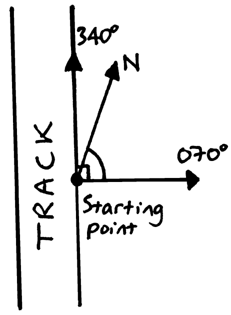

Figure 4: Determining the direction that transects were to be laid in.

We determined that the first starting point for a stand should be 100 m along the track from the start of the stand. Consequent transect lines within the same stand were started 200 m from the previous starting point[4] (Figure 5). This was to minimise the possibility of transect lines within the same stand crossing. Although the decision as to where a stand actually started was relatively subjective, the method appeared to work. It also avoided, as far as possible, the collection of data from transition stand areas.

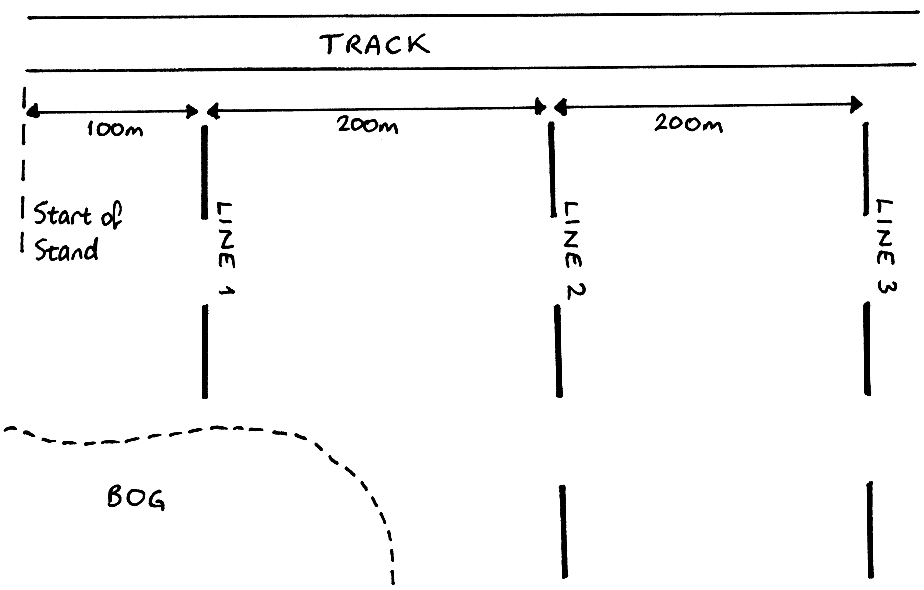

Figure 5: Setting up transect lines.

Each transect was given a unique identifier number and GPS co-ordinates were noted for each. This was important for data analysis. It also meant that we, or other members of the expedition, could return to transects and collect more data, for example on lichen abundance or insect diversity. The GPS data would allow future expedition teams to collect data from the same transect areas.

[4] Often this was measured by walking 200m (along the compass bearing measured on the track originally) from the end of the first transect line to the 'end' of the next. This seemed to work just as well, and minimised unnecessary walking.

Data collection

Due to our interest in the relationship between dead wood abundance and biodiversity, a lot of the data we collected was related to the volumes of fallen and standing dead wood present in our transect belts. We also looked specifically for signs of woodpecker activity in the vicinity of the area. Although we noted down the presence of any mammal signs that we encountered, we were all relatively inexperienced in identifying flora and animal signs and therefore did not concentrate on these aspects. In addition, the richness of the ground layer in many stands, especially in the predominately broadleaf stands, made it difficult to spot signs such as mammal tracks and droppings. Hence, to include mammal signs as a specific component of our data could potentially have lead to the establishment of an erroneous bias in the number of mammal signs found in coniferous stands, where the ground layer was sparser and mammalian tracks and dwellings were more visible.

We collected data in two transect belt widths, 4 m and 20 m. This was because we thought that a belt width of greater than 4 m would be too difficult to work with, given that the ground cover of the forest areas was often quite high. However, we were keen to record the presence of large trees in the stand types, and any evidence of woodpecker activity within transects. Large trees are important for biodiversity, as they constitute a whole environment for wildlife in themselves, and they also provide an indication of the recent management history of the stand. Very few large trees in an area might suggest that these were left as seed trees and the area itself has been managed relatively recently. In contrast, the presence of many large trees could mean that there has been no recent management. As large trees (i.e. greater than 40 cm diameter at breast height) were always relatively rare, it was decided to record them in a wider transect belt of 20 cm wide so that they would be represented within our data. This was also true with the sightings of woodpecker rings and excavations on trees within transects.

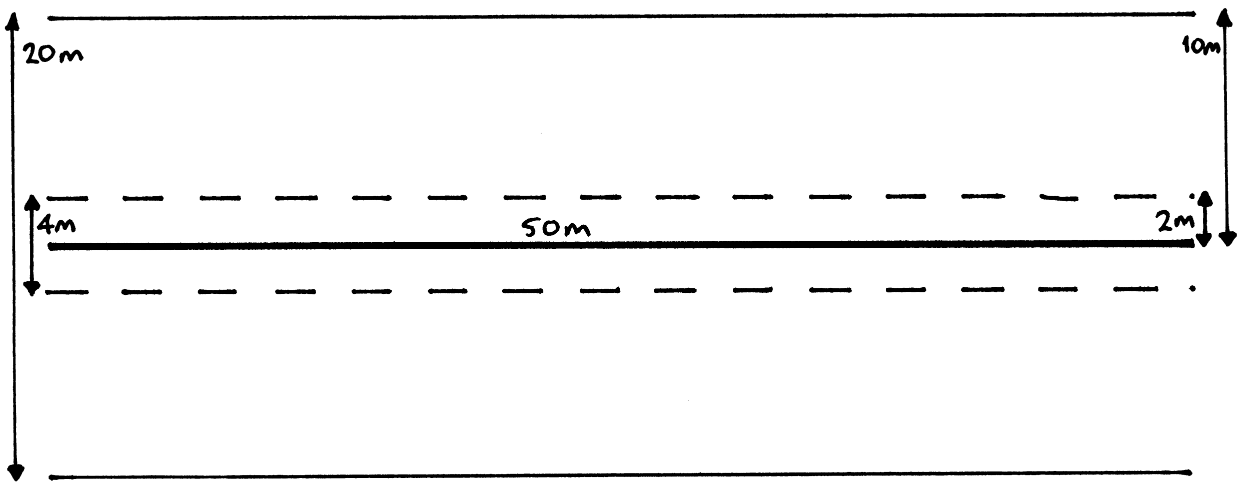

Figure 6: A diagram to show how our transect belts were laid out.

Summary of the data collected

Data collected in the 4 m belt included:

- Fallen dead wood > 10 cm diameter
- Standing dead wood:
  - Snags > 10 cm DBH (Diameter at Breast Height), >2m in height
  - Stumps < 2 m in height
- Root plates > 1 m in height
- Lichen species present
- Mammal signs and ant hills

Data collected in 20 m belt:

- Large trees > 40 cm DBH, living or dead
- Woodpecker rings (i.e. sap-sucking rings) and excavations

Profiles:

- Canopy tree composition within a 25 m radius from the midpoint (25 m) of the transect
- Percentage cover of canopy, shrub and field layer within a 5 m radius, taken at 0 m, 25 m and 50 m along the transect.

For the sake of consistency and also for ease and speed of work, each member of the team concentrated on collecting data for one particular item(s) throughout the expedition. For example, one member recorded the occurrence of snags or stumps within the transect belt in all transects, whilst another member recorded the number of large trees within the 20 m belt (See Endnote 2, Page 22). Data was collated onto paper forms and onto PDAs at the end of each transect, and inputted into a computer at the end of each day, when this was possible.

Methods used to collect data

(a) Dead Wood

Both fallen and standing dead wood[5] were recorded within transect belts that extended 2m on either side of the transect line. Standing dead wood was separated into two different classes, snags and stumps, as dictated by convention. In all cases, the length (or height) and diameter of the wood was recorded. In addition, the state of decay that the wood appeared to be in[6], and the presence of any woodpecker excavations or sap rings were all recorded. The tree species that the wood was likely to originate from was recorded wherever possible, although this was often difficult when wood was in an advanced state of decay[7].

The stage of decay that the wood had reached was recorded using the following codes:

S = Sound	(bark almost intact; newly fallen)
P = Partially rotten	(areas of bark lost, but majority retained)
R = Really rotten	(most of bark lost OR pieces fall off when kicked)

[5] See Appendix I for details of classification of dead wood
[6] Determining which stage of decay dead wood had reached was quite subjective. One expedition member recorded all the data for fallen dead wood, whilst another measured all the standing dead wood (see endnote 2). It was hoped that this would enable data between transect lines to be more comparable and more consistent.
[7] See endnote 1.

(i) Fallen Dead Wood

Only pieces of dead wood that were longer than 20 cm and greater than 10 cm in diameter were recorded. This was mainly because dead wood of any smaller dimensions was unlikely to be of any real ecological use. The length of these pieces (to the nearest 0.5 m) and diameter (to the nearest 10 cm) were recorded, but only those parts that were physically contained within the 4 m transect belt. The diameter of fallen dead wood was measured at the part of wood that was closest to (or actually on) the transect line itself. This allowed the approximate volume of fallen dead wood within the transect belt to be calculated.

(ii) Snags

Pieces of standing dead wood (i.e. those with one end still in the ground) that were over 2 m high were classified as snags. Only snags with a DBH of over 10cm were recorded. Heights were given to the nearest 1 m, or to the nearest 5 m if the snags were taller than 12 m, as it was difficult to be more accurate with the higher snags (i.e. 10 m, 11 m, 12 m, 15 m, etc). The diameter at breast height was recorded to the nearest 10 cm.

(iii) Stumps

Standing dead wood less than 2 m high was counted as stumps, and only stumps with a minimum height of 0.5 m were actually recorded. Stump height was measured to the nearest 0.5 m and the diameter measured at a height of 0.5 m on the stump, to the nearest 10 cm. In addition, whether or not the stump was hollow (due to decomposition of the wood) was recorded, as this would affect volume calculations.

(b) Root Plates

As root plates can provide micro-environments for small wildlife, the presence of root plates within the 4 m transect belt was recorded. They were only counted if the centre of the root plate fell within the 4 m belt, and they were over 1 m tall. In addition, the root plate had to have soil between the roots for it to be classified as such.

(c) Large Trees

Trees within the 20 m transect belt that were over 40 cm DBH were classified as large trees. These were recorded, with a record made of their DBH to the nearest 10 cm, species and whether they were dead or alive. This was to give an indication of how many old trees there were in a given area, and possibly an idea of whether recent management was likely to have occurred there.

(d) Profiles

Profiles were taken along each transect, at 0 m (start of transect), 25 m (midway) and 50 m (end of transect). These were intended to give a description of the stand type or habitat type of each transect, in terms of tree species distribution and vegetation coverage. Vegetation coverage was considered at three strata within the forest infrastructure:

1. Field layer, < 1 m in height
2. Shrub layer, 1-5 m in height
3. Canopy, canopy height > 5 m in height

The main species encountered in the shrub and canopy layers were *Pinus sylvestris* (Scots Pine), *Pinus sibirica* (Siberian Pine), *Populus tremula* (Aspen), *Betula pendula* (Silver Birch), *Abies sibirica* (Siberian Fir), *Picea obovata* (Siberian Spruce), *Larix sibirica* (Siberian Larch), *Salix spp* (Willow species), *Prunus padus* (Bird Cherry), and *Sorbus aucuparia* (Rowan).

Tree composition in the area around the transect was estimated only at the 25 m centre point, considering trees present within a 25 m radius of this point. Estimates of the proportion of individual tree species present were given to the nearest 5% - e.g., the proportion of tree species in an area might be estimated as 80% birch, 10% aspen and 10% Scots pine. If any species made up less than 5% of the trees present, it was classified as being present in 'trace' ("+") quantities.

The average height of the tree canopy was also estimated, to the nearest 5 m, within a 25 m radius of the transect midpoint, as was the average DBH of the trees in the area (to the nearest 5 m). This gave some indication to an approximate average tree age in the stand. Both measurements were estimated by eye.

The percentage coverage of all 3 layers was estimated to provide an indication of the habitat structure in terms of strata. Where possible, species present within the shrub layer were identified. The field layer was described in terms of presence or absence of species types – namely, grasses, herbs, ferns, mosses and *Equisetum* (horsetail family). Species that were not thought to fall into any of these groups were classified as 'Other'. Specific species identification was not thought to be required for the purposes of our fieldwork, and to do so would have taken much longer. The average height of field layer was also recorded, with estimates given to the nearest 10 cm.

Many of these measurements could only be estimated, and were potentially very subjective, but to ensure consistency two team members were kept as 'profile specialists'.

It was thought that having a descriptive record of the stand habitats would be important, especially in enabling us to correlate habitat types with the quantities of dead wood (or other indicators of biodiversity) we found in different stands.

(e) Lichens

104 transects (out of a total of 112) were surveyed for lichens. All lichens observed within the 4 m band were noted, unless thallus diameter was so small (< 1 cm) as to make them unidentifiable. The upper vertical limit of observation was approximately 2 m – what could be clearly seen from the ground. Species on all substrates were included – e.g. twigs, shrubs, trunks, stumps, and the ground. Lichens were sampled in cases where identification was uncertain. Approximately 30 minutes were spent surveying lichens on each transect.

Abundance estimates were made on 28 of the transects, selected to provide a range of stand types. All trees with a DBH > 20 cm in a 2 m radius from the midpoint of the transect were sampled. A 20 cm x 20 cm quadrat with a 100 square grid was used to assess percentage cover of different species at 0.5 m and 1.5 m centred on the south facing aspect of the tree.

(f) Insects

Insect species in certain transect areas were sampled by soil snares, Malesa snares and hand catching with the aid of a lift net. Captured insects were killed and preserved, and species were identified by Dmitry Kurbatsky after the expedition

(g) Other signs

(i) Woodpecker excavations and sap holes/rings

Sightings of woodpecker excavations and sap holes or sap rings were recorded, with details of the tree(s) on which they were seen. This was recorded (by * on the form) for every tree measured elsewhere (e.g. snags and large trees) and noted in comments if found elsewhere within the 20 m belt. This is because woodpecker feeding sites are seen as an indicator of biodiversity, especially on dead wood.

(ii) Mammal signs

Droppings, holes/homes, feeding signs, foraging signs, digs, bark scrapings (elk), and other mammal signs, as well as actual sightings, were recorded for each transect.

Note: The detectability of these signs depended upon the density of foliage in these areas, and therefore these recordings do not form an important part of the data analysis.

(iii) Additional comments

Any relevant information about transects or other sightings was recorded separately on the data collection forms, for example, if transects were laid in marshland[8].

Endnote 1: Caveats associated with the data.

(a) Fallen dead wood measurements

The apparent state of decay of the wood in birch and pine stands differed considerably. Pine wood appeared to disintegrate more evenly, whilst birch wood often decayed in the middle first, leaving much of the bark. Therefore the state of decay of fallen pine wood was determined by studying how much bark was retained on the log, whilst that of birch wood was measured by seeing how easily the wood was damaged when standing on it.

In marshland areas, moss often grew over dead wood, making measurements of these pieces not possible. It was noted that much of the ground in these areas appeared to consist of fallen logs and tree roots with a thick layer of moss. Fallen wood that has been covered by foliage and moss is not likely to be of much use to woodpeckers and mammals. Therefore their omission from the data should not affect considerations of the link between dead wood and biodiversity.

(b) Woodpecker sightings

It was very difficult to observe woodpecker signs in decaying fallen dead wood. As the bark on birch wood appeared to decay more slowly compared to that of pine wood (see above), sap rings and woodpecker excavations were more noticeable on dead birch logs.

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[8] See endnote 1.

Endnote 2: Methodology development

A major consideration during the development of the methodology was how to sample a large enough number of transects to make our data statistically viable. The team decided to focus on obtaining quantitative data that showed an approximate but wider picture of the region studied, as opposed to obtaining lots of qualitative values.

All the members of the team practiced pacing before fieldwork commenced, in order to ensure that we could estimate 50 m, 100 m and 200 m to a reasonable level of accuracy. It was also important that all expedition members were confident that they could make good estimates of the distances and lengths they would be measuring (for example, 10 cm for diameter classes, and 0.5 m for estimating the length of dead wood). The Russian botanist on the expedition, Marina Olonova, was very helpful when team members needed to familiarise themselves with the main shrub and canopy species they would encounter.

Despite this, it was obvious very early on that many of the measurements would be subjective to an individual's judgement. This was especially true with the profiles that were recorded at different points along the transect lines. As the aim was to collect data that could be compared between stands in a range of stand types (i.e. different habitat types) present in the region, this was not a problem, as long as individuals were consistent. The easiest way to do this whilst collecting data quickly was for each member of the team to specialise on one particular aspect of data collection. As each member gained more experience over the course of the expedition, the team was able to work more quickly and lay down more transect lines, without omitting important details.

4. Analytical procedures

The list of variables that were recorded or derived from measurements made in the field is presented in Table 1. Most of these are self-explanatory. Fallen dead wood volumes were estimated directly from the measurements made within the 50 m x 4 m transect belt. The volume of each individual piece of dead wood was calculated using:

$$\pi \text{ (median diameter/2)}^2 \text{ x length}$$

where the median diameter was the median of the 10 cm diameter class recorded for that piece of wood, in cm (i.e. 25 cm for the 20 cm – 30 cm diameter class). The total volume (in cubic meters) of all logs in each class of extent of decay was calculated.

Ordination analysis (Lepš & Šmilauer, 2003) was used to examine variation in the forestry structure and tree species composition of the 112 transects from which data was recorded. The purpose of ordination is to identify axes, composed of more than one variable, that show the greatest variability. Individual samples (in this case, transects) can then be plotted onto the axes, essentially allowing samples with multiple variables to be viewed in two dimensions. Each transect is therefore represented by a dot on the ordination diagram, and samples that are close together are more similar than samples far apart from one another.

Detrended Correspondence Analysis (DCA) is one form of ordination analysis, and was used to explore gradients of tree species composition that were evident between and even within different stands. DCA is an appropriate technique to use when species are expected to show unimodal distribution patterns across an environmental gradient, as long as they are measured using the same units.

Kruskal-Wallis tests were used to test for differences between stand types, (differentiated on the basis of tree species composition), with respect to the different variables listed in Table 1.

One-way Analysis of Variance (ANOVA) tests were used to test for significant differences in lichen coverage on trees in different stand types.

Variable	Variable description
HEIGHT	Estimated canopy height (m)[a]
DBH	Average diameter (cm) at breast height of trees[a]
%ASP	% canopy contributed by aspen[a]
%BIR	% canopy contributed by birch[a]
%LAR	% canopy contributed by larch[a]
%SCP	% canopy contributed by Scots pine[a]
%SIP	% canopy contributed by Siberian pine[a]
%SIF	% canopy contributed by Siberian fir[a]
%SPR	% canopy contributed by spruce[a]
%CON	% canopy contributed by all conifer species[a]
FIELD	Cover of vegetation in field layer (%)[b]
SHRUB	Cover of vegetation in shrub layer (%)[b]
CANOPY	Canopy cover (%)[b]
FALL _S	Fallen dead wood volume (m^3) - sound condition[c]
FALL _P	Fallen dead wood volume (m^3) - partially rotten[c]
FALL _R	Fallen dead wood (m^3) – rotten[c]
FALL _TV	Total volume of fallen dead wood (m^3)[c]
SNAGS10	Number of snags 10-20 cm dbh[c]
SNAGS20	Number of snags 20-40 cm dbh[c]
SNAGS40	Number of snags >40 cm dbh[c]
SNAG_No	Total number of snags >10 cm dbh[c]
SNAG.WDP	Number of snags >10 cm dbh with woodpecker excavations[c]
STUMP_No	Number of stumps[c]
STUMP.WD	Number of stumps with woodpecker excavations[c]
TREE40D	Number of dead trees 40-60 cm dbh[d]
TREE60D	Number of dead trees >60 cm dbh[d]
TREE _TD	Total number of dead trees >40 cm dbh[d]
TREE40L	Number of live trees 40-60 cm dbh[d]
TREE60L	Number of live trees >60 cm dbh[d]
TREE _TL	Total number of live trees >40 cm dbh[d]

Table 1: List of variables included in the full ordination.

(a) Variables estimated by a single estimate at the transect centre
(b) Variables averaged from 3 estimates at the ends and centre of the transect
(c) Variables estimated from measurements made in the 4 m transect belt
(d) Variables relating to standing large trees, estimated from measurements made in the 20 m transect belt

5. Results

Three stand types can be discerned on the basis of tree species composition

The pattern in tree species composition was explored using DCA (see Page 23). The DCA ordination diagram (Figure 7) shows clear grouping of transects into three main stand types. Axis 1 of the DCA plot represents a gradient from conifer stands to broadleaf stands. Axis 2 reflected a gradient in conifer composition, from stands that were mainly dominated by *Pinus sibirica* and *Abies sibirica* (though *Pinus sylvestris* was also often present) to ones containing relatively high quantities of *Pinus sylvestris*. Transects clustered into three distinct groups of stand types on these two axes: broadleaved stands, stands with pure Scots pine or mixtures of Scots pine and broadleaved trees, and coniferous stands dominated by Siberian pine and/or Siberian fir. These will be referred to as 'Broadleaf' (44 transects), 'Scots Pine' (50 transects) and 'Other Conifers' (18 transects). Each stand type contained some transects with varying ratios of coniferous to broadleaved trees. The spread of the broadleaf stands on axis 2 is relatively narrow, as axis 2 reflects a gradient in coniferous tree species composition. The Scots pine stands often occurred as mixtures of pine and broadleaf trees, hence their intermediate position on axis 1.

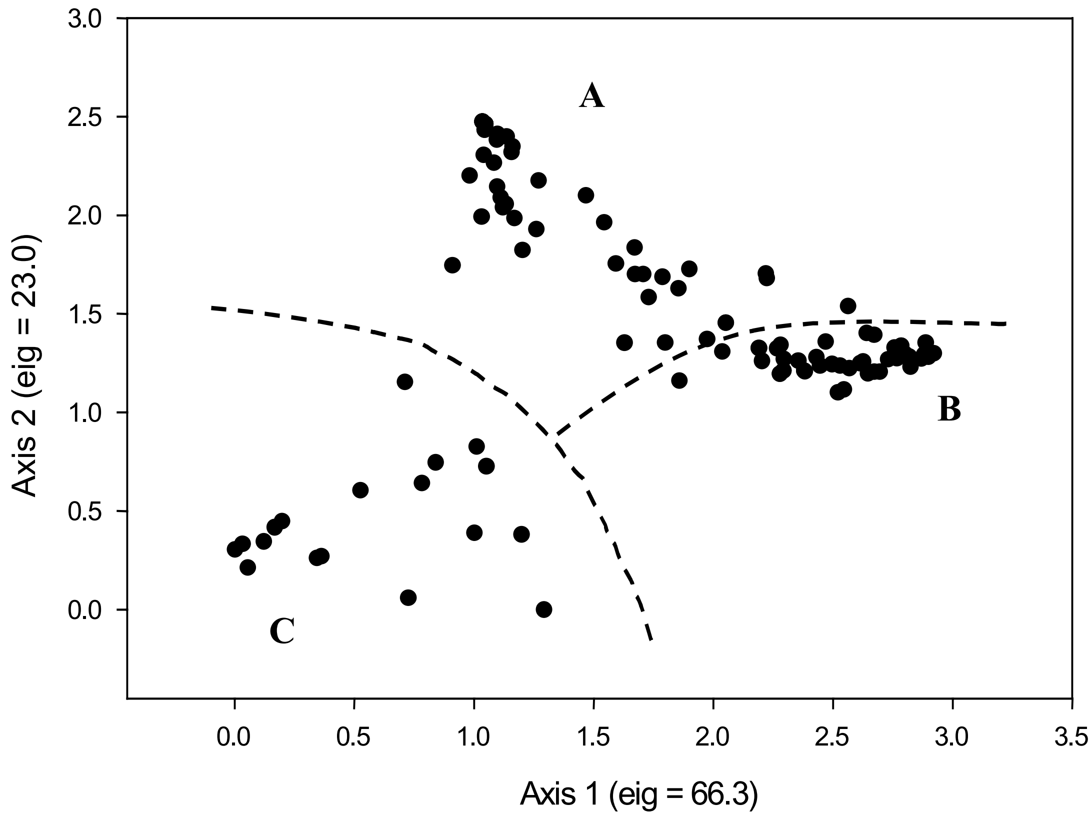

Figure 7: Ordination (Detrended Correspondence Analysis) of the 112 samples in terms of tree species composition.
The following tree species were included in the analysis: Scots pine, Siberian pine, Siberian fir, birch, aspen. The three groups are interpreted as: A. Pure Scots pine and mixtures of Scots pine and broadleaved trees; B. Broadleaved stands (birch/aspen); C. Coniferous stands dominated by Siberian pine and/or Siberian fir.

The three stand types have different dead wood characteristics

Table 3 shows individual structural variables for each of the three stand types, including quantities of different classes of dead wood. Only variables which show statistically significant differences between the stand types have been shown. There were similar quantities of total dead wood (fallen and snags) in the 'broadleaf' and 'Scots pine' classes. However, total fallen dead wood volumes were more than twice as high in the 'other conifers' stands. Most of the fallen dead wood was classified as 'rotten' and the distribution of fallen rotten wood between the stand types closely followed that of total fallen wood. Total number of snags in 'other conifers' was also higher: 70% higher than in 'Scots pine' and 110% higher than in 'broadleaf'. Similarly, numbers of stumps were highest in 'other conifers' and lowest in 'broadleaf'. Large live trees were also far more abundant in 'other conifers' than elsewhere.

		Broadleaf	**Scots Pine / mixed**	**Other coniferous**	**P**
HEIGHT	Canopy height (m)	27	26	**30**	0.0049
FIELD	Field layer cover (%)	**94**	88	86	0.0001
FALL_R	Fallen rotten (m^3)	0.58	0.71	**1.43**	0.0002
FALL_TV	Fallen total volume (m^3)	0.73	0.78	**1.66**	0.0006
SNAGS20	Snags dbh 20-40 cm	0.36	0.4	**0.78**	0.0087
SNAG_No	Snags total	1.32	1.64	**2.78**	0.0030
STUMP_No	Stumps number	0.55	1.82	**2.56**	0.0002
TREE60D	Dead trees dbh >60 cm	**0.32**	0.02	0.28	0.0046
TREE_TD	Large dead trees total	1	0.34	**1.33**	0.0046
TREE40L	Live trees dbh 40-60 cm	3.98	3.64	**7.28**	0.0007
TREE_TL	Large live trees total	5.05	4.42	**9.11**	0.0002

Table 3: Mean values for structural variables across three forest types.
Only variables showing significant differences between stand types at $P<0.01$ are listed. Tree species variables are also excluded. The types correspond to the three groups identified in Figure 8. Means per transect are shown for all variables that differed significantly across the woodland types. Significance tests were Kruskal-Wallis tests. See Table 1 for variable descriptions.

All stand types have internationally high amounts of dead wood

Since dead wood is an important indicator of the biodiversity value of a forest (Falinski, 1986; Harmon *et al.,* 1986; Bobiec *et al.,* 2005), providing a microhabitat for many organisms, these results indicate that the 'other conifers' stands may have the highest biodiversity, and therefore would form an important part of the conservation zone required for FSC certification. However, all three stand types had high values of dead wood when compared to forests in other countries. Total volumes of fallen dead wood were 37 m^3ha^{-1}, 39 m^3ha^{-1} and 83 m^3ha^{-1}, for 'broadleaf', 'Scots pine' and 'other conifers' stands respectively. Kirby *et al.* (1998) cited a median volume of 78 m^3ha^{-1} of dead wood in temperate old-growth forests in Poland and the USA. Therefore, the value for 'other conifers' in our study site compares very favourably with this. In terms of snags, the estimated densities in 'broadleaf', 'Scots pine' and 'other conifers' stand types were 66 ha^{-1}, 82 ha^{-1} and 139 ha^{-1} respectively. These are all notably high values, especially when one considers that a value of > 50 ha^{-1} would be regarded as high in British forests (Kirby *et al.,* 1998).

Lichen species richness does not vary between stand types

In total, 83 species of lichen (macrolichens and microlichens, growing on any substrate) were found in the Lake Kireksoe area. For the full species list, see Appendix I. The vast majority, 89%, of these were epiphytic (found growing on trees or shrubs) whilst the remainder were ground dwelling. A comparison of lichen species richness (the total number of lichen species present) across the stand types defined above showed that there was a negligible difference in species richness between the stand types. Mean lichen species richness per transect was, respectively, 14, 12 and 13 for 'Scots pine', 'broadleaf' and 'other conifers' stand types. The maximum and minimum number of lichen species found in individual transects was also similar across stand types (data not shown).

Lichen species composition and coverage of tree trunks does vary between stand types

Differences between the stand types did emerge when the compositions of epiphytic lichen species in the forest types were considered. Two species were widespread throughout the region and appeared to grow equally well in all stand types (*Hypogymnia physodes* and *Parmelia sulcata*). Most lichens showed a preference for one stand type but were also present to a lesser degree in the other stand types. However, 22% of all epiphytic species were found exclusively in one stand type only (Table 4). Another difference emerged when the lichen coverage on large tree trunks examined in each stand type was calculated. Trees in 'other conifers' stands had approximately twice as high a percentage of lichen coverage on their trunks than trees in 'Scots pine' or 'broadleaf' stands. One-way ANOVA analysis found this difference to be extremely significant. The high percentage of tree trunk covered by lichens further suggests the 'other coniferous' stand is of high ecological interest.

Stand Type	**Number of Lichen Species Exclusive to Stand Type**	**Number of Transects Surveyed**
Scots Pine/Mixed (A)	7	46
Broadleaved (B)	5	40
Other Coniferous (C)	4	18

Table 4: Number of lichen species found in only one of each of the three forest types.

Insect biodiversity is highest in mixed stands and hay meadow areas

The insect data collected indicated that the areas with highest insect biodiversity were mixed *Pinus sibirica-Populus tremula-Betula pendula* stands, and also hay meadow areas, in which transect data was not collected. The list of species found (Appendix II) largely reflects the results of previous studies made in the region to the South of Tomsk. Notably, *Formica rufa* (Red Forest Ant), an important indicator of forest health, was found in all the areas. Also found was the bumblebee *Bombus sporadicus*, a Red Data Book species in the nearby Kemerovo region.

6. Discussion

The area surrounding Lake Kireksoe has internationally high quantities of dead wood

All three stand types identified by DCA ('broadleaf', 'Scots pine' and 'other conifers') contain internationally high dead wood volumes, snag densities and numbers of large trees, all of which are important for biodiversity. The 'other conifers' stands carried the highest quantities of dead wood and large live trees; however, all three stand types were comparible to data on old growth forests in Poland and the USA (Kirby *et al.,* 1998). The 'other conifers' stands generally exhibited closer characteristics to old-growth forest than either the Scots pine or the broadleaf stands. There is therefore a strong case to maximise the area of these 'other conifers' stands included in the conservation zone required for FSC certification.

All stand types have considerable biodiversity interest

Although the 'Scots pine' and 'broadleaf' stands had almost certainly been cut over at some point in the last 100 years, they were also of considerable potential biodiversity interest. Most of these stands contained large trees, whilst all contained at least moderate quantities of fallen dead wood and fairly high densities of snags. The birches and aspens in some of these stands were of exceptional size, with the canopy frequently reaching over 30m. Birch and aspen are seen as poor quality wood, and the Russian foresters informed us that areas containing these trees tend not to be logged as intensively, which is likely to have allowed these trees to reach such large sizes.

The 'broadleaf' stands in particular contained high numbers of large standing dead trees. Such stands are probably not to be found in Western Europe. Tree coring of ten conifers (8 *Pinus sylvestris*, 2 *Abies sibirica*) within mixed birch-pine stands gave an indication of the likely age of these stands – the range was of 44 – 105 years, with a median age of 72 years. Birches are more difficult to core, and so the only tree for which a date was available was 52 years old. The 'other conifers' stand type was clearly exceptional in terms of features likely to indicate high biodiversity value. This was especially true of the near natural stand located at 56^{o} 5.1299′N 84^{o} 9.917′E (see description in Study Area, Page 14). The total sample size for this stand type was small relative to the other two, due to the relative scarcity of suitable stands within our study area. However, we do not know whether this reflects the relative proportions of the stand types in the wider region, as logistical constraints prevented wider exploration by the expedition team. Whilst detailed forestry maps were available to us, experience showed that these maps did not always reflect exact variation in tree species composition on the ground as stands were classified by single species.

Lichen species composition indicates that a range of stand types should be conserved

The species composition of the lichen communities shows clear differences between stand types. The majority of lichens were found predominantly in one stand type, and 16 epiphytic lichens (22% of the total number of epiphytic lichens) were found to be limited solely to one stand type. This suggests that all of the stand types contribute to lichen diversity and that to maximise diversity in the region it is necessary to conserve a range of the stand types identified.

However, analysis of the composition of the lichen communities suggests that the 'other conifers' stand type, and in particular the near natural stand, may be particularly important for biodiversity. The high percentage of lichen coverage on tree trunks in the near natural area distinguished this stand as being of particular importance for lichens and also for nutrient cycling and the diversity of other organisms that depend on lichens for food, shelter and nesting materials (Esseen *et al.,* 1996). Given that the 'other conifers' stand types, of which the near natural stand was a part, contained particularly high quantities of dead wood, this suggests an association between dead wood and biodiversity, one of the aims of our expedition.

Many studies have attempted to identify 'indicator species' of lichen whose presence provides evidence for a long period of forest continuity, suggesting that a forest may be not just old growth, but ancient old growth (for a review of this subject, see Rolstad *et al.,* 2002). Such indicator species tend to vary from country to country, and even within countries. To our knowledge no other attempt has been made to link lichen species composition with forest continuity in the Tomsk region, or in Russia, so unfortunately it is not possible to place the Lake Kireksoe area in the context of its peers.

Conclusions

The stands with abundant large *Pinus sibirica* and *Abies sibirica* (the 'other conifer' stands) undoubtedly merit special protection from logging, due to their high quantities of dead wood compared to forests in other countries. However, the entire complex of stands in the vicinity of Lake Kireksoe is potentially of high biodiversity value and a strong case can be made for this area to form a conservation zone with minimum logging within any future FSC certification. We have also found some evidence for a link between lichen species composition and tree coverage with dead wood quantities. Our methods are entirely repeatable, and could be used to reassess the forest in future years following FSC certification, which would be useful to assess the effects of management strategies.

7. Future Work

It is hoped that our work will be published in an ecological journal, under the guidance of Dr. Rob Fuller. We also hope that our data will be of use to the Russians, and will complement their own data on the area, when submitting an application for FSC certification. The second expedition team, again consisting of University of Cambridge students, are currently in the planning stage of their expedition, and aim to gather data on hay meadow succession in order to ascertain whether these habitats are in need of protection. They also hope to explore the sociological reasons behind hay meadow abandonment, which will also provide information on current use of the forest.

8. Acknowledgements

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ADMINISTRATION AND LOGISTICS

1. Recruitment and Preparation

E-mail contact between expedition members was established during the Christmas vacation 2004, and the first meeting was at the start of Lent Term 2005. The main aim of the first meeting was to meet the other team members, to discuss the aims, context and format of the expedition, and to assign preliminary tasks and roles in the expedition, depending on personal interests and experience. Kate Cochrane was selected as Expedition Leader, Sarah Parker as Finance Officer, Wing-Sham Lee as Methodology Researcher, Katie Marwick as Medical Officer, and Lucy Taylor as Logistics Officer and Sophie May as Press Liaison Officer. Hannah Allum later joined the team to assist with the fieldwork, with Alex Benton joining the team at the end of March as Technology Officer. Sophie May withdrew from the team in May due to other commitments.

Subsequent meetings were arranged at approximately 2-week intervals, and took place in Fitzwilliam College or Newnham College. The format of the meetings was relatively informal, with a pre-agreed agenda and minutes being taken. The main aims of the meetings were to assess progress of fundraising and to assign funding applications to individuals; to discuss dates and logistics of the expedition itself (e.g. travel plans, inoculations, equipment etc.); to discuss methodology; and to deal with any concerns or arising matters. Meetings were also an important part of team-building, and attendance was important not only to keep up to date with the progress of the expedition, but also to allow team members to get to know one anothers' strengths and characters.

2. Pre-Expedition Training

A camping trip to Thetford Forest was organised on the weekend of 6th -7th May 2005, with the primary aim of developing methodology, but also to provide a valuable opportunity for the team to work together and get to know one another.

The expedition team travelled to the British Trust for Ornithology, Thetford, and there met Fred Currie and Rob Fuller. The morning was spent discussing methodology, with particular regard to bird surveys and dead wood transects. After an excursion around the BTO to practise listening for bird songs, the team set off for King's Forest and set up camp. The evening was spent assessing the general structure of the forest, followed by dinner and social activities. The team went on a dawn walk the following morning to identify bird species present, and the rest of the day was spent practising dead wood transect laying. Wilderness survival training was provided by Mark Northfield, a former member of the Parachute Regiment.

The weekend proved to be a highly useful exercise, both in terms of assessing what methods would be practicable and in terms of team building.

3. Finances

A Natwest Charities Bank Account was set up in March 2005, in the name of Tomsk Taiga, to accept any grants awarded to the whole team and to make payments on behalf of the team. Although a number of banks were investigated, and attempts to open bank accounts with matched funding were made, the Natwest Charities Account was eventually chosen due to its reasonable interest rates and low charges. There were three signatories, Kevin Hand, the senior expedition leader, Sarah Parker, the financial officer and Lucy Taylor, the logistics officer, with two signatures required for any withdrawal.

Since fund-raised money was largely not available until just before the expedition began, and any overdraft on the bank account incurred large interest rates, the group agreed to fund initial expenses themselves, and to wait until money was available before being reimbursed. It was decided that the money raised should be used firstly to fund items to be used by the whole group, including the medical kit, the first aid training of three group members and the tech kit, then to pay for in country subsistence and finally, any remaining money should be given to team members to cover the cost of their insurance, flights, vaccinations and visas. Since each group member arranged flights, vaccinations and insurance separately, depending on their differing needs, different amounts were paid out to different people. It is possible that if flights, insurance and vaccinations had been arranged for the whole group, a discount could have been arranged.

Around £3500 was set aside for in-country costs such as accommodation and food. Some of this money was placed onto a credit card, held by Kevin Hand, and wherever possible, the card was used to pay hotel and restaurant bills. The card was also available for use in emergencies. Kevin Hand took $4100 of HSBC (American Express) Travellers Cheques to Russia. Each student also took enough money, as a mixture of cash or travellers cheques, to cover their own travel following the trip.

Although MasterCard and Visa credit cards are accepted in many hotels and restaurants, throughout Russia, a large number of bills had to be paid by cash. There is not yet a network of Cirrus or Maestro cash machines in Russia, so cash needed to be taken into the country. The Russian rouble is not yet widely available in the UK, but Euros or US Dollars can be changed for roubles once inside Russia. Although many banks in Russia can now change large amounts of cash, it is easier to change money when it is in the form of new (never used) notes, of intermediate value ($10 or $20). Although Travellers Cheques could be changed without difficulty in Moscow, it was extremely difficult to change them in Tomsk, and doing so incurred a 3% charge. If Travellers Cheques are to be taken, then they should probably be changed in Moscow.

A summary of the accounts is provided below (Table 5). The remaining £5, not spent, was left in the bank account as a donation to the Tomsk Taiga 2006 team.

INCOME		EXPENDITURE		
Corporate Liaison Office	3300	Training		499
Panton Trust	1500	WMT Course (3 places)	448	
Travis Perkins	1000	Thetford trip	11	
Royal Geographical Society	900	Field Guides	40	
Cambridge Expeditions Fund	600			
Worts Travelling Scholars Fund	500	Flights		3454
Girton College	500			
Emmanuel College	500	Insurance		373
Newnham College	350			
Robert Daglish Fund	250	Vaccinations		1104
Cambridge European Trust	250			
Talk	183	Visas		453
Fitzwilliam College	180			
Mrs E Parker	100	Equipment		1676
		First Aid Kit	361	
		T-Shirts	216	
Personal Contributions	1385	Waders	20	
		PDAs	333	
TOTAL	**11498**	GPS	213	
		Power Supplies	166	
		Cameras	117	
		Satellite Phone	250	
		Admin and Fundraising		199
		Postage	21	
		Photocopying	1	
		Travel to Interviews	42	
		Website	25	
		Report	110	
		In Country Costs		3735
		Expedition Costs to IIES	2650	
		Hotel Bills	417	
		Food	108	
		Mobile Phone Purchase	9	
		Internet	421	
		Changing Money	72	
		Excess Baggage (First Aid Kit)	58	
		TOTAL		**11493**

Table 5: Summary of Accounts

4. Fundraising

Each member of the student team had to raise a total of £1,500, to cover the costs of flights, insurance, vaccinations, visas, in-country subsistence, technical equipment, first aid and safety equipment and training, so fund-raising was done in a number of ways. These included: grant applications; corporate sponsorship; fund-raising events and personal contributions. In addition, The Darwin Initiative project 14-045, 'Sustainable Support for Biodiversity and Forestry in Tomsk Taiga', funded some of the equipment used on this expedition. The Darwin project also covered the travel and subsistence costs of Kevin Hand and Rob Fuller; Fred Currie and Hannah Allum paid their own costs.

Grant Applications

Information on grant-making bodies was obtained from variety of sources, including past Cambridge Expedition Committee reports, the Cambridge University Reporter – Awards, Funds, Studentships and Prizes Edition, the RGS website, college staff and CUEX members. Frequently, making one funding application led to suggestions of other possible funding sources.

A number of applications were made on behalf of the whole group. These included applications to: the Royal Geographical Society Geographical Fieldwork Grants (which are awarded for field research with a geographical bias); the Cambridge Expeditions Fund (which are awarded, on the basis of need, to any Cambridge Expeditions Committee approved expedition); the University of Cambridge's Active Community Fund, administered by the Corporate Liaison Office, (which provides money to encourage students and staff at the university to volunteer) and the Worts Travelling Scholars Fund.

Each team member applied to their college travel award fund, and these applications were generally successful. Applications were also made to the Panton Trust (via Emmanuel College), Cambridge European Trust's Vacation Study grant and the Robert Daglish Fund.

Unsuccessful applications were made to the Isaac Newton Trust (where we probably did not meet the community involvement requirements), various Rotary clubs, the RGS Henrietta Hutton Fund, the Sir Albert Howard Travel Exhibition and the Shell Personal Development Fund.

Had extra funds been needed, we would have considered applying for Lottery funding and British Council funding. We would also have looked through online directories of Grant-Making Bodies, such as Trustfunding.

Corporate Sponsorship

Letters were sent out to all WWF 95 companies. These companies have all pledged to trace the location their timber originates from back to source. We offered them opportunities for publicity and advertising as well as the chance to fund a project which would eventually increase the supply of sustainably managed forest. We received one positive response, from Travis Perkins, who donated £1000. Some team members followed up personal contacts within companies, but this approach was not successful.

The team also approached a number of suppliers of outdoor equipment, to discuss the possibilities of obtained discounted goods. Although a few retailers seemed keen on this, it was not followed up as the discounts eventually obtained were small.

Fund-Raising Events

One fund-raising event was held. This was a talk by Charles Swithinbank about his work in the polar regions. We were fortunate to be able to use the room for free and a large amount of publicity meant that we raised £183. This event had the additional benefit of introducing us to a number of people who were able to help us with the expedition. Although we had intended to hold a fund-raising ceilidh, this did not happen, due to difficulty finding a venue.

Personal Contributions

Due to the success of the fundraising, each group member contributed only around £50 to the overall expedition costs. However, all group members purchased significant amounts of personal equipment prior to the trip and funded all personal travel in Russia.

5. Insurance

Most of the UK expedition members chose to use STA insurance, either the Premium or Annual policy, which provides a suitable level of coverage, including Search and Rescue. Other insurers used were Travellers Choice Insurance Worldwide Annual, through Blue Swan Insurance (Jersey) Ltd, and the annual multi-trip policy from Columbus Direct.

6. Medical Arrangements

Pre-Departure Preparation

a) First-Aid Training

Three members of the team, including the Medical Officer, attended the RGS Wilderness Medicine weekend course in March. All the other members of the team were also given the chance to attend a 6-hour course run by Cambridge University First Aid Society, also aimed at first aid 'when help is not just a phone call away'.

b) Questionnaires

All UK members of the team were asked to complete a medical questionnaire before departure. This was read in confidence by the Medical Officer to allow identification of any specific treatment needs (e.g. drug allergies) or likely problems during the expedition. It also contained details of medical insurance. Sealed copies of the questionnaire were kept with the first aid kit and with the individual, to be opened by any member of the team in an emergency. The questionnaires were destroyed after the expedition (on a bonfire on an island in Lake Baikal).

c) Vaccinations

Team-members were advised to plan vaccinations with their GP. However, research suggested that the following would be required: Tick Borne Encephalitis and Rabies plus the travel standards: Hepatitis A, Hepatitis B, Diptheria, Meningitis, Polio, Tetanus, Typhoid and Tuberculosis. The first two were expensive but Tick Borne Encephalitis was thought to be necessary due to the prevalence of ticks in the forest, and rabies necessary due to the region's remoteness.

d) First Aid Kits

Team members were advised to bring their own individual first aid kits containing common items and their own regular medicines. A team kit was also prepared. Costing over £300, this was fairly extensive as we were unsure how far away from medical assistance we would be. A major item of expenditure was antibiotics. Contents of the first aid kit were sourced from the St. John Ambulance, Nomad Travel (for the prescription only medicines), Boots and the University Occupational Health department.

In the Field

a) Medical Problems

All medical events in the field were minor, being mainly cuts and insect bites. The main items used from the medical kit were for: Cuts (plasters, Savlon, antiseptic wipes, Micropore tape, Betadine), Insect Bites (anti-histamine cream, hydrocortisone cream, tea-tree oil, 'zapper'), Water Purification (iodine), and Pain Relief (ibuprofen).

The Russians sharing a campsite with us also asked on occasion for first aid from us, accounting for roughly a third of incidents requiring first aid. Again all incidents were minor, comprising mainly colds, a mildly infected ear lobe and a foreign object in the eye.

b) Potential Medical Problems

There were three 'near misses': incidents which could have lead to serious injury but did not. The first of these was when a party got lost for several hours in a bog. Dehydration and exposure could have occurred to a much more serious extent than they did had the party been caught out overnight. The second was when a group got caught on a raft in a sudden storm, and struggled to return to shore. There was no shelter on the raft and some people were very cold - hypothermia was a risk. The third incident was when a bear was approximately 10m from a group of three. Fortunately this was noticed and the group promptly left the area, otherwise serious trauma or even death could have occurred. There were a couple of other instances to our knowledge when the group was close to bears, and in general bears seemed to pose the most likely serious threat to health.

In addition, road traffic accidents had an unfortunately increased probability due to the poor roads in the forest, and the fact that some Russian drivers appeared to have a more relaxed attitude to drinking and driving than those in the UK. There were at least two instances when a vehicle became stuck and had to be rescued, in one case after an overnight wait. One group felt compelled to walk around difficult stretches of road as they were so badly bumped by being in the vehicle.

However, some health risks proved to be less than we feared. The possibility of contracting Lyme's disease (due to the bacterium *Borrelia burgdorferi*) from infected ticks caused us great concern prior to the expedition as Tomsk has a high prevalence of infected ticks. On arrival in Tomsk we were offered a prophylactic penicillin injection, but many of the team members had doubts about the wisdom of this, given our lack of knowledge on the injection. In the event the doctor was unavailable to give the injection. Fortunately we saw about two ticks for the entirety of the expedition and no-one was bitten by one to their knowledge. Had they been, our Russian partners were well versed in what to do, and stated that the tick would have been removed and kept so that it could be analysed soon after at a specialist centre that would have calculated the risk of infection with *B. burgdorferi.*

c) Evacuation Procedures

There was generally a vehicle and driver at the campsite which would have taken 2-3 hours to get back to Tomsk, the nearest town with a hospital. A village nearby also had occupants with vehicles who could have been approached in an emergency.

We had a satellite phone for use when there were no vehicles at the campsite, someone was injured far from the camp, or was unable to be transported by jeep. We had the numbers of our Russian colleagues whom would in turn have contacted the Russian emergency services for us (circumventing the language barrier).

Recommendations

The following are recommended additions to the first aid kit:

- more plasters and of better quality – the waterproof ones we took did not adhere well.
- local anaesthetic cream for insect bites, although tea tree oil did soothe the bites effectively.

Future teams might want to consider taking bells to wear as they walk. We relied on singing to scare the bears away, but bells might be easier.

7. Permission and Permits

Business visas were purchased for most participants, as this allowed for travel of longer than 1 month. The London-based Russian travel company Scotts Tours were used to obtain the visas, avoiding the need for time spent at the Russian Embassy in London and giving a greater guarantee that visas would be granted. Letters of invitation were supplied by Tomsk Tourist office through IIES.

Visas needed to be stamped shortly after arrival in Russia. This was arranged by IIES in Tomsk; those staying in Moscow first needed to do this by using registered accommodation, which was more difficult. IIES also arranged the necessary permissions needed from the authorities to perform the fieldwork in the forest.

8. Travel

All UK expedition members made their own way to Moscow Domodedovo airport on Saturday 9th July, where the team met and boarded an overnight Siberia Airlines flight to Tomsk. At Tomsk airport the team was met by Russian members Konstantin and Svetlana Kozlov, and transported by bus (hired by Konstantin) to Hotel Rubin in Tomsk. Two days were spent meeting the Russian partners, discussing fieldwork, finalising plans and buying supplies and equipment.

On Tuesday 12th July the entire team left Hotel Rubin by bus and 4-wheel drive to Timiyazevo village, where the team transferred into an off-road truck arranged by Konstantin and driven by foresters. A three-hour off-road drive brought the team to the camp, a foresters' hut next to Lake Kireksoe. The return journey to Tomsk on Friday 5th August was made in a similar fashion. From Tomsk the team split up and went their separate ways either by train or plane.

In the field, the team had no guaranteed access to any transport other than walking. Most fieldwork was conducted at sites within walking distance, up to a two-hour trek from camp. On occasion it was possible to be transported by one of the foresters in their own four-wheel drives to sites further afield.

9. Food and Accommodation

The team spent the duration of the time in the field at a foresters' hut next to Lake Kireksoe. Almost all UK members chose to sleep in their own tents, and the Russian members slept on the top floor of the foresters' hut, which was also available to us as 'office' space. The team shared the facilities with the foresters: a long-drop toilet; a banya hut (for washing and socialising, with wood-burning stove); and a kitchen hut (with a stove burning bottled gas). Food was brought in approximately every 5 days by Konstantin, who used a four-wheel drive to return to Tomsk. It mostly consisted of tinned meat, bread, grain (rice, buckwheat or oats), potatoes, vegetables and fruit, and pasta. Water was used either from the lake (filtered and either boiled or iodine-treated), or from a nearby spring (boiled or iodine treated).

10. Website

It was agreed that a website for the expedition would be designed and set up early in the planning process. The website would be useful when applying for funding from various organizations and would also be a means of keeping interested parties up-to-date with advances in our plans. The website was designed using Dreamweaver, and hosted by Doteasy.com. As the expedition members designed the site themselves, the only cost involved was the fee for using our domain name, www.tomsktaiga.com. This came to £25 for three years.

It is now planned to redesign the website so that its contents represent the Darwin project as a whole, whilst retaining pages to inform visitors to the site about the progress of each year's expedition team. This is currently underway, but the website continues to be updated by the Tomsk Taiga 2006 team.

11. Communications

As we had little idea of how easy it would be to contact the outside world from the camp, we decided to prepare for the worst eventuality and so hired a satellite phone, for use in emergencies to call help. The satellite phone was hired from 3rd Planet Communications for a cost of approximately £250.

In the event, we found that we had a very small mobile signal in the camp itself. This was insufficiently reliable to be used to call for help, or even to hold a conversation, but did allow us to use the Internet, via GPRS and Bluetooth to the laptop (Figure 8). We were therefore able to email friends and relatives occasionally, although usage was limited due to the slow speed of the connection as well as the high cost.

12. Specialist Equipment

Technology

The goal of the technology on this trip was to provide a dependable, organised way to gather, store and analyse data, and to reduce time spent entering data into a laptop. We wanted to gather data in a manner that could be easily reproduced by follow-up teams, using technology that they could re-use or recreate easily.

Before heading to Russia, we purchased seven Compaq iPaq 3630 Personal Digital Assistants (PDAs) and five compact flash Global Positioning System (GPS) devices through eBay.com. We acquired a wide set of power adapter, connective cables and support hardware, through eBay and local electronics stores. Finally we purchased three flexible, roll-up 32-watt solar panels from Uni-Solar. Two of the PDAs had to be dismantled for spare parts and the batteries were replaced in all five field devices. In the field, we kept the PDAs in waterproof map bags to protect them from the weather. We also took an IBM T43 ThinkPad laptop running Windows XP SE. The Russian team purchased a Dell laptop, but it was only used as a backup.

Once we were in the field, we borrowed a truck battery from the Russian forest rangers and used it as a reservoir/regulator for the solar panels. The three solar panels could generate one and a half times the power demands of the laptop; we could keep the laptop fully-charged and recharge the PDAs as well, all off the truck battery which was replenished each day by solar power. We also had a DC-to-AC 12-240 transformer, but we tried to use it sparingly to charge cell phones and digital cameras, as such transformers are inefficient and drained the truck battery much more quickly.

Until arrival in the field, the precise details of the data to be gathered had not been finalised. Consequently, the first week of fieldwork time was spent developing WinCE software (and a matching PC server application) that replicated the transect forms that the team was filling out by hand. The handheld digital forms could be used to record everything the team saw and also to report GPS locations. All software was developed in MSDEV 6 and MS eMbedded Visual C++.

Problems

Our biggest problem came from the poor quality of the PDAs we chose. The battery capacity of the 3630 is very poor: one device with an active GPS attached lasts at most four to five hours, which is only half a day of fieldwork. Worse still, if a 3630 lost all battery charge it also lost all of its memory, destroying the data gathered for the day. They were also not very shock-resistant; their screens tended to drift out of alignment and sometimes a PDA would simply become unresponsive until it was rebooted. This caused some frustration among the team and led to the PDAs being treated as backups for the paper records taken that day, rather than vice-versa.

Another issue that cropped up about halfway along was a sudden rainstorm which caught the hardware out and soaked the power system. Two fuses blew in the rain, including one on the 1-to-4 DC outlet multiplexer, which had to be repaired with a knife and tape and a length of wire: the lesson learned was to carry spare fuses!

A deeper concern over the utility of the technology was that we had no clear idea in the field of what detailed analysis to do with our data. We could therefore have managed with only a few handheld GPS devices for use in the field, without the additional panoply of laptops and solar panels. However, the PDAs and laptop did allow our data to be backed up, and saved a substantial amount of time entering data on return to the UK.

Conclusions

The 3630s were a mistake and should have been more advanced and robust systems. The CF GPS devices worked beautifully in the forest canopy and the solar panels kept everything charged wonderfully. However, the technology described here was more than sufficient for the expedition and overall it functioned extremely well in the field. Had the team had a more in depth knowledge of statistics, the initial data analysis could also have taken place in the field.

13. Risks and Hazards

During preparation, a Risk Assessment and Crisis Management Plan were written. This in itself was a useful exercise in learning what the potential hazards and routes of evacuation were. For the full Risk Assessment and Crisis Management Plan, see Appendices V and VI respectively.

CONCLUSIONS

The Tomsk Taiga expedition to Siberia had multiple, overlapping aims. Its principal focus was as an ecological monitoring expedition to gain data to support FSC certification in the taiga forest of the Tomsk area. However, this was not its sole purpose, and even this objective itself was subject to various subsidiary aims which evolved throughout the expedition.

As laid out in the introduction, a variety of aims were developed in the field with regard to our survey work:

1. To provide scientific evidence to justify selection of the ten percent conservation area, a requirement of FSC certification.

2. To set up a method for repeatable long term monitoring. This will depend upon future expeditions and their aims but we designed our methodology to be highly repeatable, for example to ensure that FSC certification (should it be obtained) is having the desired effects.

3. To compare and contrast dead wood volumes and biodiversity of the Tomsk region of Siberia with the results of similar monitoring carried out in other countries with taiga forest ecosystems, such as Canada and Scandinavia. This would be a valuable scientific exercise given the lack of such investigations in the Siberian taiga relative to other countries.

4. To investigate a possible link between dead wood volume and biodiversity. Providing evidence for this in Siberian taiga forest was a valuable goal given the controversial nature of this hypothesis in Russia, and may have effects on how dead wood is perceived in Siberia.

5. To provide data to inform future management of area to be managed for conservation. As the maintenance of biodiversity is to be a major objective in this management, it is vital to have a picture of the current biodiversity status of the area and the various habitat types present.

So it is important to assess our success against these aims. But it is also important to emphasise that these aims were underpinned by further and broader goals. These included, for example, the desire to raise awareness of the cause that we were working towards: the preservation and protection of the Siberian forests. Also central was the desire to highlight the value of those forests as a vast and necessary resource, in order to provide reasons and motivation for such protection. Furthermore, we wished to contribute to the formation of strong and long-lasting relations with the Russian members of the expedition, in order to provide a foundation for future research and collaboration.

These broader objectives were equally as important as our specific scientific aims, and it is therefore vital that they are included in any consideration of the expedition's overall success. They are less quantitatively measurable, but their impact is more wide-reaching; our research focused upon one relatively small region, while the same needs for preservation and protection apply to the entire forest.

So considering these many inter-weaving aims, how successful was the expedition?

Over the 5-week period, we successfully carried out monitoring of the selected ten percent of the region. We gathered a substantial amount of data (over 100 transects) that allowed confidence that we had truly represented the areas of forest monitored. Analysis of this data has allowed comparison of different stand types ('broadleaf', 'Scots Pine' and 'other conifers'), showing that the 'other conifers' stands are of particular importance, and that all stand types in the study area had considerable biodiversity interest when compared to data from forests in other countries. Therefore all stand types surveyed were worthy of protection, and this was supported by the lichen data, with each stand type containing lichen species unique to the stand type.

The data gathered illustrate that the area surrounding Lake Kireksoe is of sufficiently high biodiversity value to form the ten percent conservation area required for FSC certification. The monitoring methodology used is entirely repeatable, and this adds to the value of the work given its potential as the initial stage of a long-term monitoring program. Should FSC certification be achieved, this would allow an assessment of its impact upon the conservation zone. The focus of the research upon dead wood as an indicator of biodiversity will allow quantitative assessment over time of how this changes, and perhaps comparison between managed and unmanaged zones.

It is therefore possible to conclude that we were largely successful with meeting the first, second and fifth aims as described above, with a proviso. This is that the satisfaction of all three of these aims could have been more comprehensive given greater transport capacity and more time. This does not detract from the value of the work carried out but it does imply that there is room for its extension.

The third aim was to compare and contrast deadwood volumes in the Tomsk region with those of boreal forests elsewhere. This aim was successfully achieved, and it was found that the fallen dead wood measurements compared favourably with old-growth forests in Poland and the USA, particularly in the 'other conifers' stands, and that snag measurements in all stand types compared extremely favourably with measurements in the UK.

With regards to the fourth aim, the investigation of the link between dead wood and biodiversity, we managed to do this to some extent. The stand type with the highest quantity of dead wood, 'other conifers' also had the highest coverage of trees by lichens, indirectly indicating that it was likely to have the highest diversity of organisms dependant on lichens. However, it is possible that this aim was in slight conflict with some of the others: if we are to rely upon this link in using our data to measure the biodiversity of the area in order to justify its selection as the ten percent due to its high biodiversity, then it is perhaps not also possible to use that data to demonstrate the link itself.

We can conclude, then, with regard to our specific ecological aims, that a significant amount of data was collected, and that its analysis reveals important conclusions about the region of taiga monitored. It shows the high biodiversity value of the forest, both in comparison to forests in other countries and in terms of forming the conservation zone stipulated by FSC requirements.

But beyond this, we can also conclude that our broader aims were achieved extremely successfully. Our presence in the forest as UK researchers taking a scientific interest in the forest served to highlight its value. We have since found out that even this has had noticeable impact: applications for logging licences in the area in which we worked have since been scrutinised more closely. Our presence was noticed and appreciated by many local officials and foresters, and this has served to raise awareness that there is international interest in the forest.

Moreover, the extent of collaboration throughout the expedition as a whole has been a substantial success. This incorporates not only the various strands of work carried out by both Russian and UK sides, but also the nature of the expedition as a combined team that formed relations between us, the Cambridge student team, the Tree Council, BTO and Forestry Commission on the UK side, and our Russian partners IIES, Tomsk State University and local forestry officials. This collaborative approach allowed us to build strong and long-lasting relations with our Russian partners that will lay the groundwork for future projects and expeditions. Plans and preparations for another expedition this year, 2006, are indeed already underway, and it is extremely likely that further trips will be planned into the foreseeable future.

Forming such international relations is therefore one of the key successes of the expedition; not only did it strengthen the work done this year, but it also served to create a basis for future work. And this means that the value of this year's expedition can be seen for many expeditions to come, in ever-strengthening relations that work towards a common aim – the preservation and protection of the Siberian taiga.

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Girton College
Newnham College
Panton Trust
Robert Daglish Fund
Royal Geographical Society (Geographical Fieldwork Grant)
Travis Perkins
University of Cambridge Active Community Fund (Corporate Liaison Office)
Worts Travelling Scholars Fund

Appendix I: Lichen Species List

Arthonia mediella	*Melanelia olivacea*
Arthonia spp	*Melanelia subaurifera*
Buellia disciformis	*Mycoblastus fucatus*
Buellia erubescens	*Mycoblastus sanguinaris*
Buellia griseovirens	*Parmelia sulcata*
Buellia schaereri	*Parmeliopsis ambigua*
Caloplaca cerina	*Parmeliopsis hyperopta*
Caloplaca phlogina	*Peltgiera malacea*
Candellaria vitellina	*Peltigera apthosa*
Chaenotheca chrysocephala	*Peltigera leucophlebia*
Chaenotheca ferruginea	*Peltigera membranacea*
Chaenotheca stemonea	*Peltigera polydactylon*
Chaenotheca trichialis	*Peltigera praetextata*
Cladina furcata	*Pertusaria albescens*
Cladina rangiferina	*Pertusaria alpina*
Cladina stellaris	*Pertusaria amara*
Cladonia botrytes	*Pertusaria hemisphaerica*
Cladonia cenotea	*Pertusaria ophthalmiza*
Cladonia chlorophaea group	*Pertusaria pupillaris*
Cladonia coniocraea	*Phaeophyscia orbicularis*
Cladonia cornutas	*Phylctis argena*
Cladonia crispara var crispata	*Physcia aipolia*
Cladonia gracilis	*Physcia ascendens*
Cladonia pleurota	*Physcia dubia*
Cladonia polydactyla	*Physconia detersa*
Cliostomum pallens	*Pycnora sorophora*
Evernia mesomorpha	*Pycnora xanthococca*
Flavopunctelia soredica	*Ramalina dilacerata*
Fuscidia arboricola	*Ramalina intermedia*
Graphis scripta	*Ramalina obtusa*
Hypocenomyce scalaris	*Ramalina roesleri*
Hypogymnia physodes	*Ramalina sinensis*
Imshaugia aleurites	*Rinodina degeliana*
Lecanora chlarotera	*Rinodina efflorescens*
Lecanora expallens	*Rinodina exigua*
Lecanora impudens	*Scoliciosporum chlorococcum*
Lecanora pulicaris	*Trapeliopsis flexuosa*
Lecanora symmicta group	*Usnea hirta*
Lecidea nylanderi	*Vulcipida pinastri*
Lecidella elaeochroma	*Xanthoria fallax*
Lecidella flavosorediata	*Xanthoria ulophyllodes*

83 species were found in total. Selected samples will be deposited in the herbarium of the Royal Botanical Garden Edinburgh.

Dr Brian Coppins (Principal Scientific Officer, Royal Botanical Garden Edinburgh) confirmed all identifications and performed identification of difficult specimens.

Appendix II: Insect Data

Data was analysed according to biotope, the study areas being divided into seven biotopes as follows. All data was gathered and analysed by Dmitry Kurbatsky. More detailed data and analysis can be found in the Russian report (English translation).

Biotope 1: Grass-cereal meadows.
Biotope 2: Pine forest and mixed spruce-Siberian pine-birch forest, with little ground cover.
Biotope 3: Mixed Siberian pine-aspen-birch forest, with dense shrub layer.
Biotope 4: Mixed birch-Siberian fir-spruce-Scots pine forest.
Biotope 5: Mossy cedar forest, with areas of bog.
Biotope 6: Mixed birch-Siberian fir-Scots pine forest, with little ground cover.
Biotope 7: Mixed Siberian fir-Scots pine-Siberian pine forest

Order	**Biotope**							**Total**
	1	**2**	**3**	**4**	**5**	**6**	**7**	
Aranei	4	-	25	12	11	16	-	68
Odonatoptera	1	-	-	-	-	-	-	1
Orthoptera	1	-	1	-	-	-	-	2
Homoptera	-	2	-	1	-	2	1	6
Hemiptera	9	7	13	8	5	5	1	48
Mecoptera	-	1	-	-	-	1	-	2
Neuroptera	-	-	1	-	1	1	-	3
Psocoptera	-	-	-	-	1	1	1	3
Coleoptera	6	12	22	6	3	3	3	55
Hymenoptera	29	5	4	3	3	4	3	51
Diptera	2	6	8	1	1	1	1	20
Trichoptera	-	1	-	-	1	-	1	3
Lepidoptera	6	-	1	1	1	1	-	10
Total	**58**	**34**	**75**	**32**	**27**	**35**	**11**	**272**

Appendix III: Stores and Inventory

Equipment packed by each team member:

CLOTHING

2 x long trousers
1 x thermal top
5 x underwear
5 x walking socks
2 x T-shirts
Swimming costume
Long-sleeved shirt
Fleece
Waterproof jacket
Waterproof trousers
Sunhat
Fleece hat
Gloves
Walking boots
Sandals

DOCUMENTS

Passport
Visa
Travellers' cheques
Copy of each of above
Money ($ and travellers cheques)
Money belt
Mobile phone

PERSONAL

Towel
Toothbrush
Toothpaste
Hairbrush
Book
Sunglasses
Watch
Insect repellent (50% DEET)
Permethrin
Mosquito net
Mosquito head net
Toilet paper
Sun cream
Camera
Biodegradable soap
Water purification (iodine)
Vitamin supplement

PRACTICAL

Spare laces
Light sticks
Torch
Batteries
Notebook
Pen & pencil
Compass
Whistle
Rucksack cover
75L rucksack & liner
Day sack
Sewing kit
Duck tape
Emergency blanket
Candles
String
Duck tape
Penknife

FIRST AID KIT (personal)

Water purification tablets
Compeed
Plasters & wound dressings
Antiseptic wipes & Savlon
Field dressings
Tape (Micropore & plaster)
Spare insect repellent
Antihistamine cream
Tea tree oil
Needles
Syringes
Tweezers
Scissors
Paracetamol
Ibuprofen
Antacid
Iodine
Emergency dental kit
Athlete's foot powder
Vaseline

COOKING

Lighter
Waterproof matches
Bowl
Plate
Mug
Cutlery
Can opener
Water bottles
Emergency food
Tea / coffee & dried milk
Dishcloth
Scourer
Biodegradable detergent
Salt
Sugar
Curry powder & herbs
Wooden spoon
Flint

CAMPING

Tent
Sleeping bag
Sleeping mat

Equipment shared by expedition members

Shovel
Saw
Fuel
Stoves
Pans
Solar panel
Laptop
3 x GPS
3 x PDA
Radios
Satellite phone
Maps
10 x binoculars
Field guides
First aid kit
Water purification (filter)

Equipment carried while monitoring

Day sack
First aid kit
Emergency rations
Compass
Whistle
Emergency blanket
Passport etc.
Waterproof jacket
Sunhat
Mosquito head net
Sunglasses
Sun cream
Water (purified)
Torch
Notebook
Pen
Camera
GPS
PDA
Radio
Binoculars

Appendix IV: Risk Assessment

Hazards	Risk Level	Control Measures	Additional Action
Mosquito Bites (Mosquitoes are common in the taiga forest but we are not visiting a malarial area.)	High • Possibility of infection	• Insect repellent containing DEET to be worn at all times, especially during evenings and early mornings • Long sleeves and long trousers to be worn • Mosquito nets will be used when sleeping	• Antihistamines and disinfectants will be carried in the group First Aid Kit
Brown Bear Attack (Although the brown bear can be found in the taiga forest, attacks on humans are very rare)	Slight • Possibility of death	• Group to remain in pairs at all times (brown bears are exceptionally unlikely to attack groups of people) • Pepper spray to be carried at all times • Group members to be regularly reminded of the recommended procedure on meeting a bear (e.g. don't run away, don't make eye contact, play dead)	• Any sightings to be reported to the group leader who will reassess surveying activity
Trip or Fall (Much of our survey work will be done on foot, however the terrain visited should not be difficult.)	Moderate • Possibility of fractures	• Suitable footwear to be worn at all times • Group to remain in pairs at all times (one person will carry out the survey work, the other will look out for obstacles)	• Group members to be regularly reminded of risk
Traffic accident (It is likely that the roads used during he expedition will be quiet but of a poor standard.)	Moderate • Possibility of death	• Before use, any motor vehicle will be checked for road-worthiness (state of tyres, lights, brakes, spare tyres etc.) • Safety belts will be worn by the team • Only Russian team members will drive during the expedition • Drivers should not be over-tired	• Team members to be reminded of risks of crossing and walking on roads

Boat Capsize (Some of our survey work will be carried out by boat, along the River Ob and its tributaries. We may also use boats as a form of transport)	Slight • Possibility of drowning and of loss of equipment	• The boat will be assessed for river-worthiness before use and where appropriate alternative plans made • The boat will remain close to the shoreline at all times • Heavy clothes and boots will not be worn whilst on the boat • There will always be more than three people in the boat so that help can be given to any group member who falls overboard	• All group members will know the procedure to follow in the event of a capsize • If possible, buoyancy aids will be carried in the boat • Essential equipment will be packaged in waterproof packaging before transport in the boat
Loss of group members during survey work	Slight • Possibility of death	• Training and practice in map-reading will be given to all UK members prior to departure • Full up-to-date maps of the area will be carried by each surveying group • Short-range two-way radios to be carried by group members to allow communication in cases where group members have got lost • Groups to remain in pairs at all times	• More experienced group members will be teamed up with less experienced members, especially in the early stages of the expedition
Drinking Water (We cannot assume that the water provided will be safe to drink.)	Moderate • Possibility of gastrointestinal problems	• Water will only be drunk after boiling or purification • Drinks containing ice will be avoided • Glasses and other drinking containers will be thoroughly cleaned before use	• Antibiotics, anti-diarrhoea drugs and oral rehydration sachets included in First Aid Kit
Food Hygiene	Moderate • Possibility of gastrointestinal problems	• Fruit and vegetables will only be eaten following cooking or peeling • Raw and undercooked meat will be avoided	• Antibiotics, anti-diarrhoea drugs and oral rehydration sachets included in First Aid Kit

Sanitation (We are unlikely to be camping at recognised campsites)	Moderate • Possibility of infections (especially diarrhoea, dysentery etc)	• Food preparation and toilet areas to be kept separate • Team to be briefed on importance of personal hygiene and campcraft	
Fire (During some of the expedition we will be cooking for ourselves on camping stoves or on open fires.)	Moderate • Possibility of burns	• Cooking to occur at a distance from our tents • All participants to be trained in use of the stoves • All fires to be completely extinguished following use	• Team members to be regularly reminded of risks of burns
Heat Exposure (Whilst we are in Tomsk, the average temperature is likely to be 20 °C)	Slight • Possibility of death	• Wide brimmed hats and suncream will be worn • During the hottest part of the day, regular drinks breaks will be taken • Group to remain in pairs at all times	• If necessary and possible, work will be rescheduled for cooler times of day • All group members will be familiar with the symptoms and will monitor one another
Hostage, kidnapping or terrorist attacks (Current FCO guidelines state that further terrorist attacks in Russia are likely, particularly in large cities and in areas bordering Chechnya.)	Slight • Possibility of death	• At no time will any group member travel to the areas near to the Chechen borders • Team members will remain vigilant whilst in crowded areas in Moscow and Tomsk	• Continued monitoring of FCO guidelines and appropriate alteration of travel plans
Plane crash (Safety standards on Russian internal flights are often lower than those on international flights.)	Slight • Possibility of death	• Only airlines with a good safety record and which conform to international safety standards will be used	
Victims of street crime	Moderate • Possibility of injury	• Team to remain in pairs at all times • Valuables to be kept hidden	

Loss of data (Data may be lost due to theft or environmental problems)	Moderate • Reduced success of expedition • NO health and safety problems	• Where possible, data should be kept in two separate places and in two different forms	
Loss of equipment (Equipment may be lost due to theft or transport problems)	Moderate • Reduced ability to deal with emergencies	• Essential equipment (e.g. First Aid Kit) to be carried at all times • Where possible, luggage will not be left unattended	
Tick Borne Encephalitis (Untreatable viral disease, transmitted through the bite of an infected tick, in the first instance causes flu-like symptoms, in 25% of cases a more serious febrile illness is seen.)	Moderate • Possibility of death	• All group members to receive TBE vaccinations prior to the expedition • As far as possible, avoid tick infested areas • Wear light-coloured clothing which fully covers body (e.g. tuck trousers into socks and line cuffs with insect repellent) • Routinely check for and remove ticks from body • Avoid unpasteurised dairy products	• All group members aware of symptoms • Report any tick bites to the expedition leader, if necessary the area of work will be changed
HIV/AIDS (HIV/AIDS is far more prevalent in Russia than in the UK.)	Moderate • Possibility of infection	• All team members to be briefed on risks of infection • Team to carry own supply of sterile needles • Team members to undergo full medical and dental check-ups before departure, to reduce the risk of requiring hospital treatment	

Appendix V: Crisis Management Plan

The Risk Assessment is a statement of the hazards that have the potential to cause harm and an indication of how likely the hazard is to happen. Control measures for each identified hazard are designed to minimise the likelihood of occurrence. The RGS states that the key to Crisis Management is:

(a) To put in place planning systems and measures which help to recognise a crisis in the making.

(b) To prevent one from happening in the first place.

(c) To effectively handle a crisis is one does occur.

(a) Recognising a Crisis in the Making

Central to this is our development of the Risk Assessment. Every team member has been involved in writing the Risk Assessment and is familiar with it, so they are aware of potential hazards and are better able to identify a crisis in the making. Our Russian counterparts will be fully briefed before we start the fieldwork, and have already conducted similar studies in this area. We will have a safety briefing/discussion each morning to review potential hazards for that day and how we can minimise the risk. We will be in regular contact with the IIES in order to learn of potential difficulties.

(b) Preventing a Crisis from happening in the first place

The Risk Assessment and daily briefings are important here. Safety will be the primary factor in any decision regarding the team. Time will be taken at the beginning of the expedition, in the first few days in the field, to train team members in fieldwork and camping skills, and to acquaint the team with our Russian counterparts, thus allowing for effective and efficient communication. External hazards are harder to minimise but proper information flows through regular contact with Britain and Tomsk will enable us to adjust our plans whilst in the field according to any unforeseen events. Because we will be mobile whilst in the field it will be essential to maintain a current casualty evacuation plan. This will depend on proximity to local villages, the river (for boat access) and potential helicopter landing sites. Given the flat nature of the landscape, helicopters should be able to land in any reasonably sized forest clearing.

(c) Handling a Crisis Effectively

The RGS advocates worse case scenario planning and using the following 8-step process as a framework on which to base a Crisis Management plan:

(i) Immediate care of a casualty/ies and other involved parties

Three members of the expedition will undertake the RGS Wilderness Medical Training course, and all remaining members will complete a Basic First Aid course. Relevant briefings (dehydration, potential risks in different study areas) will be given by the Medical Officer (Katie Marwick) and by Russian members of the expedition.

(ii) Evacuation to relevant medical care

If casualties are mobile, kit will be distributed to non-injured members and the team will walk to the nearest village in order to arrange LandRover and/or boat transport to Tomsk. Our Russian counterparts will be able to liase with locals to arrange this. If casualty is immobilised, stretchering to the nearest village may be appropriate. If this is not possible, air rescue will be arranged via satellite phone to our contact in Tomsk (Svetlana Kozlova, IIES). This will be covered by our insurance policies.

In the worst case scenario of multiple emergency immobilisations, two mobile team members, including a Russian member, will be sent to the nearest village to ask for assistance in moving casualties to the nearest helicopter landing site.

(iii) Revision of expedition logistics/objectives

With a team of 20 (10 Russian and 10 British), a casualty situation would not necessarily mean evacuating all members. However, should a crisis occur that necessitates complete evacuation, all mobile members will move to a village and then establish contact with Tomsk, and arrange removal by LandRover and/or boat. Given that helicopters generally have a carrying capacity of four, if a casualty situation did necessitate complete evacuation, the team would have to be split, with casualties travelling by air and non-injured members by LandRover and/or boat.

(iv) Communication with interested parties at home and overseas

A satellite phone will be carried in the field. Standard mobile phones and landlines should also be usable in the villages. Weekly updates will be phoned to our contact in Tomsk, and the expedition website will then be updated to allow interested parties to know progress.

(v) Monitoring of casualty/ies in care

Casualties will be evacuated to hospital in Tomsk, and our contact in Tomsk will be able to monitor the casualties and inform us (via satellite phone) of developments.

(vii) Liaison with families/close relatives

Communication in normal circumstances will be via satellite phone and our Tomsk contact to provide website updates that relatives can view. In a crisis, communication to Tomsk would be relayed to our home agent, The Tree Council, who will have all contact details for family in the UK.

(vii) Liaison with insurers/assistance agencies

Call direct from the field. Also, our contact in Tomsk will have contact details for insurers should direct contact not be possible.

(viii) Follow-up and review

The team will immediately review the situation, and a medical review will be filed in the Expedition Report.

(d) Additional Information

(i) Medical Umbrella

All British team members will have basic first aid training and the Medical Officer and two others will have attended the Wilderness Medicine Training course run by RGS. Briefings will be run pre-expedition and on arrival. The nearest hospital is Tomsk, but our Russian counterparts have run similar expeditions in the past and will have details of local doctors and health clinics.

(ii) Communications

Our primary link to both the UK and Tomsk whilst away from villages will be a satellite phone. It is important to train the team in use of the phone, and this will be undertaken before departure. A solar panel will be taken for recharging the phone while in remote areas.

The communications protocol entails contact with the Tomsk contact once a week. This should be possible even while in remote areas, as the forest is unlikely to be dense enough to preclude satellite communication. Should communication be lost, and no contact is made by the expedition for one day after scheduled arrival at a village, the 'lost communications' procedure will be initiated by our contact in Tomsk. This will involve contacting the village from which the team departed and initiating a search party. Should the situation become more urgent, an air search party would be arranged to fly over our expected area.

(iii) Insurance

The insurance cover will cover emergency evacuation by helicopter, hospital treatment and if necessary transport home. All expedition members will take out a comprehensive policy.

(iv) Legal Considerations

The Wilderness Medical Training covers legal issues on the medical side. We will develop a set of legal considerations resulting from this, and also any other non-medical legal issues.

(v) Contacts

All team members will carry a list of contact information for: home and Russian contacts (The Tree Council and Svetlana Kozlova), the British Embassy, and the insurance company.