

1999
JSC "FOREST-STARMA," SIZIMAN BAY, RUSSIA
ENVIRONMENTAL OVERSIGHT GROUP REPORT

Fifth Annual Visit
October 10-October 14, 1999

Team Members

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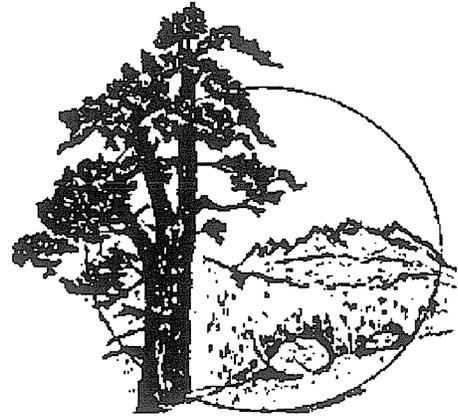
Richard L. Stauber, Forester, California Professional Forestry License No.403, Forestry and Wildfire Specialist, Boise, Idaho, Chairman



Dick Stauber Forests and Wildfire

November 4, 1999

Steve Kasnet
President
Pioneer Global Investments.
60 State Street (16th Floor)
Boston MA 02109-1820



Dear Mr. Kasnet,

The Oversight Committee Report for 1999 is enclosed.

The Siziman operations have reached a very competent level. The concern for the environment and operational safety appear to be routine. I know that such results require the persistent dedicated leadership of managers at all levels. Dave Daggett has been a major help each year for our Oversight Group. This year, his participation as the Company Representative was very effective and greatly appreciated. Please extend our personal thanks to Dave.

The Jaakko Poyry *Protected Species Habitat Survey* provided helpful answers for the Oversight Group. The participation of Group members A. Baburin, and H. Telitsyn in the field studies gave them an opportunity to review the Siziman operation in detail. This more comprehensive review confirmed the positive impressions we have concerning the operation. The implementation of the recommendations included in the "Survey" report will be an important objective for the Siziman operation during the coming year. We look forward to reviewing the accomplishments during our next visit.

On August 16-18, 2000 Khabarovsk will host an International Boreal Forest Fire Conference. We suggest that Henry Telitsyn and I attend two days of this conference and then begin the Oversight Visit. This would be an excellent opportunity to strengthen ties with officials of the Russian Forest Service and The Avialesookhrana (The Aerial Forest Fire Protection Service.)

Our continuing thanks to Valery Limerinko and the many people at Siziman and Komsomolsk who make this quick and strenuous trip effective and rewarding.

Sincerely,

Handwritten signature of Richard L. Stauber

Richard L. Stauber
Forester

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1. Statement of Purpose

The Oversight Group shall function as an independent monitoring and auditing entity, providing an "outside" assessment of the initial environmental and management principles of the project, and recommending strategies and specific programs for continued improvement in sustainable forest resource development at Siziman Bay

The Oversight Group is convened as prescribed. "The company shall appoint an independent environmental advisory committee the ("**Oversight Group**"), to be composed of three members chosen by the company, with OPIC's prior approval (such approval not to be unreasonably withheld) and one representative of the Company."

Shane Loonan contacted OPIC (Steven Smith) with a formal letter on August 30th to notify them of the scheduled to complete our Environmental Oversight Committee trip in compliance with the Finance Agreement between OPIC and Forest-Starma, section 5.12 (b). Steven Smith responded by fax approving the list of members and stating that no one from OPIC would be attending.

2. Commendation

2.1 Protected Species Habitat Survey

This survey is a great step forward in assuring the protection of protected species. The required training sessions have been completed for Forest Starma managers in Komsomolsk and two sessions in Siziman include harvesting foremen and the planning personnel.

2.2 Fire Preparedness and Training

Henry Telitsyn a Russian fire scientist and A Barburin participated in fighting a re-burn fire this past summer. They were very impressed with the coordinated and obviously experienced fire suppression action. Henry said "He has never seen a more efficient and effective fire crew." The two scientist carried hose and other needed items to support the active suppression crews.

2.3 Establishment of Sediment Ponds

Small catchments basins are being located at the bottom of road grades where silt might otherwise enter a stream. This run off is minor, but the basins provide filtration of any sediments and assures the protection of the streams. We observed only clear water in the streams following an all night rain

2.4 Waste Disposal Site

The present system utilizes many of the principals of a landfill. However, when the weather permits, flammable wastes are burned. The location protects water sources and is adequate for this isolated location.

2.5 Siziman Base Camp

Most of the basic elements of an efficient camp are now completed. Developing the John Cogan Recreation facility demonstrates a care for employees. A summary of the specific accomplishment is included in Section 6.

2.6 Production

Production has maintained at a stable level. The Master Logging Foremen have been given total responsibility for their job. The Master Foremen's control of the crew has pushed the production levels to a high monthly reality.

2.7 Road Construction

This year has been very busy with new road construction and existing road repairs. Two winter roads were reconstructed to allow year around use. Eleven (11) kilometers of main line road were constructed in the Snezhny area and 18 kilometers in the Bezmyanny unit. A 25-kilometer firebreak line was also constructed in the Chichimar drainage. This pioneered location will be completed to provide a main haul road in this area. There were also several spur roads constructed to provide access to cutting units.

3. Action Items (Priority items for the 2000 visit)

3.1 Evaluate a Possible Archeological item

A stone that appears to be a stone scraper was found in a disturbed area near the Siziman Bay camp. The area is beyond the original Log Yard drainage ditch in the general vicinity of the new access road to the fishing village. The exact location is unknown due to the similarity of the dozer tracks and grassy mounds. This is beyond the limits of the authorized camp. (See Appendix 7.6 for a sketch map showing the approximate location of the find.)

The Siziman camp location was previously the site of a GULAG supply village. (We were told that, the village was burned by the detainees when they were released, over 30 years ago.) This stone item was found in one of the numerous tracks apparently scraped some years ago by a dozer. When the Starma-Forest camp was being built young trees, brush, and the few remains of the village were pushed aside. This may have been when the dozer tracks were made. Finding an item in this disturbed location is very much of a surprise. People that we interviewed are not aware of any other artifacts being found. The general location of the finding as well as the item has been photographed.

An evaluation by a qualified archeologist is needed to determine the significance of the item and to provide suggestions for necessary follow-up. It is recognized that the location is outside of the leased area.

Please keep the Oversight Group informed concerning action taken involving this item.

3.2 Review the Habitat Survey Recommendation Implementation

The Jaakko Poyry survey included training needs and other recommendations to management that will require prompt action. Please record Planned and

accomplished actions and those instances where the recommendations cannot be implemented or have been modified.

3.3 Water Quality Monitoring

This activity appears to be on a very positive track. However, to assure success we will review the records and monitoring locations next year.

3.4 Field Observation of Group 1 Harvesting

This remains as an action item. Group 1 lands were not being actively harvested, and time constraints prevented us from visiting the old units. We will also need to visit logging areas that are and have been being harvested by standard Russian equipment rather than the mechanized units.

4. Review of Action Items for the 1999 Visit

4.1 Review of the Burned Areas

The majority of this review was accomplished this summer by A. Baburin and H. Telitsyn. Appendix 7.5 includes Anatoly Barburin's analysis.

4.2 Review Progress in Resolving Conflicts with Leskhoz

Dave Daggett assured us that a positive working climate exists. The issues when they occur can and are resolved with dispatch.

Our team's review of the documentation suggests that relationships are very good considering the local conditions and the conflicting rules and regulations. The following includes the detail of our review:

Forest Starma's leasehold is under supervision of two leskhoz: Tumninski and Vysokogorny. Starma's relationships with them covers forest fire protection and reforestation, prompt allotment of forest blocks for cut, transfer of the cutovers to the leskhoz, and observance of Harvesting Rules by JSC Forest Starma. We have analyzed all the written documents concerning these relationships.

Mutual undertakings, duties and responsibilities of the sides are legalized in the so called «Typical Agreement» («Типовой Договор» or «Tipovoi Dogovor») which stipulates the yearly scope of Starma's work on reforestation and fire suppression preparedness and the transfer of the cutovers to the leskhoz for further monitoring and care, and some other activity concerning road construction and maintenance, designing, prospecting, and etc.

According to this Agreement, Starma has to buy and plant seedlings for reforestation of the stands, where artificial reforestation is prescribed by the State Forest Inventory. The enterprise (Forest Starma) plans to prevent, detect and suppress forest fires. The leskhoz, from his side, undertakes to reimburse (pay) all the expenditures of Starma within a stipulated period of time.

Most of the disputes are related to penalizing Starma for so called «nedoruby» (undercut) which means uncut trees of dbh exceeding that established in the «Harvesting Ticket» (16 cm, and, in some forest stands -26 cm). Such trees are left uncut mostly in the so-called «NEPs» - sites in harvested blocks which Starma

leaves uncut for ecological consideration (conservation of biodiversity, prevention of erosion, conservation of old forests and stepping stones, etc.). The policy of protecting «NEP» has been highly recommended by Jaakko Poyry Consulting, Inc. However, Russian Harvesting Rules make Forest Users responsible for the trees allotted to cut but left uncut.

The leskhoz is ruled by this law and penalizes Starma for those NEPs. But Leskhoz's authorities, being educated and highly qualified foresters, understand and appreciate the appropriateness of the NEP policy but they cannot act against existing Russian law. There is a mutual understanding between Starma and Leskhoz and the amount of penalties are quite modest (as Mr. Soloviov says), and Starma agrees to pay them. Starma also understands that position of the Leskhoz: it needs some additional moderate income from its forestry activity. For example, Vysokogornyi leskhoz applies to the Arbitration Court its claim on Forest Starma to pay 142,406 roubles for «undercuts» (Letter #5 of September 14, 1999 to the Khabarovsk arbitration). But there were no court proceedings because Forest Starma has paid this amount voluntarily.

There is also a claim letter # 438 of August 4, 1999 to Forest Starma from Tumninski leskhoz to pay for «undercuts» 58,782 roubles. This amount has been paid.

The leskhoz, in their turn, should reimburse (according to Forest Code of RF) Forest Starma's expenditures for forest fire suppression in its leasehold. But, no leskhoz is able to pay these bills. Forest Starma spent in 1999 (July and August) 690.9 thousand rubles to suppress fires rubles. Perhaps, Starma should also file claims against the leskhoz before the Board of Arbitration for these fire suppression costs.

As a result of the great loss to forest fires in 1998, Russian Forest Service has assigned higher responsibility and bigger plans on leskhoz for artificial reforestation. The leskhoz arbitrarily increased the demand for forest users to plant more seedlings. Forest Starma has received orders from Vysokogornyi leskhoz (Agreement of March 25, 1999) to plant 250 hectares of larch seedlings (2000 seedlings per hectare). These volumes have been increased each year progressively (the first order was 30 hectares in 1996).

Relationships between Forest Starma and the Environmental Committee of Vanino District have become much better. Indeed, there were no written disputes this year.

4.3 Field Observation of Group 1 Harvesting

Review of the more distant logging sites was accomplished in conjunction with the Habitat Survey work. Group 1 land was not harvested this year. This action item will be continued next year. (Note: Anatoly Barbuin comments on the harvesting systems are included in Appendix 7.4. Other team members may not be as convinced as Mr. Barburin concerning the effects of the various treatments. They are worthy of consideration.)

4.4 Water Quality Monitoring

Progress has been made on this item. However it needs continued emphasis by the Chief Foresters. See Appendix 7.2 for more detailed information.

4.5 Five Year Harvesting Plan Review

Update the Oversight Group on the progress of the Five Year Harvesting Plan. Chief Forester Rick Sheldon's comments are included in Paragraph 5. *Forest Planning*.

4.6 Internet Connection with Khabarovsk Agencies

The Internet connection between Forest Starma and Avialesookhrana, as well as Khabarovsk Krai Forest Administration, is operational. We again encourage people to use it. Fire information and satellite images could be transmitted to the Siziman and Komsomolsk offices. This past season, the re-burn of a 1998 fire was spotted on the image by the Avialesookhrana and Siziman was notified. Transmission of the imagery is possible and would have been helpful. It may also be practical to use E-mail for informal business contacts with Leskhoz personnel.

5. Forest Planning (by Rick Sheldon Chief Forester)

Forest Starma has been working on a two year plan which should be completed by December 30,1999. This plan will have all cutting units and main roads laid out on the ground. A timber cruising crew has been hired and has been collecting cruise information to be utilized by the planning department and for purchasing permit tickets from the Leskhoz.

Forest Starma has entered a contract with the Far East State Forest Management Institute to carry out selective examinations of the changes of the forest stock. This includes fires, declining stands, and past harvesting. Forest Starma will also try, through legal channels to acquire recent air-photo materials to initiate a field reconnaissance for a five-year plan.

6. Siziman Bay Camp Improvements

The John F. Cogan Recreation Center is finished. This provides a pleasant atmosphere for workers that are off shift. A large TV room and a Poolroom are attractively furnished and decorated. Most employee quarters, as well as the office have been remodeled. A 16-bed living quarters was finished. A 20-bed unit is ready to finish when the normal settlement of the structure has occurred. Improvements have also been made to the laundry area.

The first objective of an isolated logging enterprise such as Siziman should have been the establishment of the basic elements of an efficient camp. The provisions for drinking water and sewerage treatment were exceptionally well done during the initial phase. However, the installation of used buildings and the lack of equipment repair shops, parts warehousing, and etc. were challenges to the local manager. Most essential facilities are now in place.

The continuous maintenance and remodeling is a necessity in the harsh climate. This work was compounded by the worn condition of some of the original buildings. This high level of attention is necessary.

Plans for the next season include the completion of the 20-bed living quarters and a six-room guesthouse. The kitchen and employees dining area are in need of expansion and renovation. An all weather vehicle servicing area and secure storage for oil are in the planning stages

The storage plan for the two log yards will be changed for winter storage. Number 1 and 2 saw logs will be decked in one yard. Number 3, 4, and pulp will be in the other yard. This will allow efficient access to any product ordered. To provide for additional storage, high decking will be standard during the winter (non-shipping) season.

7. Appendix

7.1 Contact List

“Forest Starma” International Joint Stock Company

Albert C. Hecker, General Director (Phone contact and support)
Valery A. Limarenko, Deputy Director (Facilitator and Host)
Dave Daggett, Deputy General Director (Oversight Group)
Vladimir P. Soloviov, Head of Production, Technical Department
Victor Voznuk, Layout Forester (Siziman Operation)
Andrey Zhuvakov, Chief of Technology
Julia Kocherova, Secretary, Komsomolsk
Victor N. Shulga, Shift Manager
Ludmilla Serebryannikova, Office Manager
Lidia Vologzhanina, Facilitator, Vysokogorny
Olga Stepanovna Yurieva, Camp Commandant
Igor Geiker, Master Forman

Siziman Project Pioneer Staff

Dan Turner, Deputy General Manager
Al Yates, Production Quality Control Supervisor
Rick Sheldon, Chief Forester
Dennis Armstrong, Camp Manager
Dave Gibson, Mechanic Advisor
Phil Gunnion, Mechanic Advisor
Mick Sneed, Mechanic Advisor

Fishing Village

Alexander Vitalievich Ananchenko, Manager of Fishery Enterprise
Alexander Anatolievich Sovinykh, Conservation Officer

Interpreters

Gennady Petrenko
Boris Nesterov

7.2 Water Quality Monitoring Plan

**J.S.C. FOREST STARMA
WATER QUALITY
MONITORING PLAN**

Prepared by:

Rick Sheldon, Chief Forester

Reviewed by:

Valery Limarenko, Deputy Director - Forest Starma

Vladimir Solovjov, Chief Engineer - Forest Starma

Approved by:

Albert Hecker, General Director

Siziman

May, 1999

FOREST STARMA

WATER QUALITY MONITORING PLAN

INTRODUCTION:

Forest Starma, a joint stock company, was established in 1993 to develop and use the forest resources of the Siziman area in the Khabarovsk Region of the Russian Far East. Forest Starma's timber concession area is located in portions of the Vysokogorny and Tumnin leskhozes. The Authorized Allowable Cut is 555 thousand cubic meters on approximately 390.1 thousand hectares.

The topography is hilly and mountainous. The relief is characterized by mountain ridges and rather wide valleys. The micro-relief is moderate with occasional basalt outcrop of rocks in the form of cliffs. Ecotypically, the Siziman forests belong to Far Eastern mountain taiga. The main tree species are: Yeddo spruce, Dahurian larch, Khingan fir, and Ermans and yellow birch. The understory is composed of a thick layer of moss and organic matter supporting a heavy component of huckleberry, lavender tea and other numerous brush and forb species.

OBJECTIVES:

One of Forest Starma's primary objectives for the timber project is to:

- Develop and utilize timber resources in an environmentally sound and sustainable manner.

As such, Forest Starma has the responsibility to protect and enhance all natural resources located within the boundary of the concession.

The purpose of this plan is to monitor the water resources to meet or exceed Russian Federation suspended sediment standards in the waterways of the concession. This plan is in addition to any Russian government bodies testing programs or to Forest Starma's drinking water or sewage treatment testing projects.

RESPONSIBILITIES

Forest Starma's Chief Forester will be responsible for insuring the accuracy of collection of water samples and for data analysis of this program. In the event that suspended sediment loads exceed water quality standards; the Chief Forester will advise the Deputy General Director at Siziman Bay of the sampling results. Obvious point source pollution will be rectified immediately using best

management practices. These practices will include, but not be limited to cross ditching, constructing ditches or sediment traps, applying rock aprons or check dams or mulching. If needed, open lines of communications will be established between the government bodies and Forest Starma's staff to identify point or non-point source of pollution. If Forest Starma is at fault; then Forest Starma will implement corrective actions to mitigate long-term impacts of suspended sediment to the water quality of the stream.

The Chief Forester, Deputy General Director and Shift Bosses will delegate the actual collection of the samples and the lab works to the appropriate departments.

METHODS:

Forest Starma is committed to meeting the regulations listed in *Rules of Wood Harvesting in the Forests of the Russian Far East, Moscow 1993*. As such, the potential for sediment entering stream courses is kept to a minimum. Due to the heavy organic layer and porous characteristics of the parent material, surface erosion and overland flow is limited. Because of this, peak flows are generally low in volume and duration during spring run off and rainfall events. This results in a "steady state" flow rate of most streams in the concession.

The greatest potential for long term impacts of suspended sediment loading to the stream courses is from logging roads. Therefore, monitoring stations will consider this source of pollution.

Field Procedures:

The monitoring stations will initially be located at bridge sites. Each site will have a permanent site number. The water sample collection site will have a blazed post with pertinent information (distance and bearing) inscribed on the post. Each station will have two samples taken. One-sample 50 meters above the bridge and one sample 50 meters below the bridge.

Lab Procedures:

Trained personnel will implement the lab work and the attached lab form will be completed and signed by the lab technician (see Appendix A). The testing will be in accordance with the attached Total Suspended Solids (TSS) Testing Procedure instructions (see Appendix B). The results of the test will be delivered to the Chief Forester and to the Shift Boss. The results will be kept on file in the Siziman Bay office.

Standards:

The Chief Forester will work with Anatoly A. Baburin, of the Institute for Water and Ecological Issues, Russian Academy of Science, Khabarovsk, to determine government standards. These standards or PDK (the limit of allowable

concentrations of suspended sediment) will be determined for the Siziman timber concession area.

Samples that show large differences from the PDK standard may require a baseline study to calibrate the natural suspended solids of the particular stream course in question.

MONITORING SITE LOCATIONS:

The number one priority for monitoring sites is androgenous fish bearing streams. Since Shirokaya River and Tunguska Creek are salmon bearing streams, they will continue to be monitored. The Serebryanaya is added to the list for the same reason.

To achieve a more reliable estimation of suspended sediment loads to stream courses, Forest Starma will add monitoring stations to other fish bearing streams and to streams of significance (main tributaries). These sites will be in close proximity to active logging or road building activities.

It should be noted that the list of monitoring stations would be added to or changed to reflect the scheduling of logging and road building operations. Appendix C is a vicinity map showing the proposed monitoring stations.

Frequency:

Samples will be collected starting in the spring runoff season. This is generally in late April to early June. The remainder of the year, until freeze up in December, samples will be collected once a month. Abnormal weather such as heavy intensity/short duration rain events or heavy rain on snow events may require sampling once a day during peak flows.

Potential problems will be access to sampling sites due to heavy snow or soft road surfaces.

Samples will continue to be collected 2 years after timber sale closure to insure sediment transport to stream channels complies with government standards. These samples will be collected in the spring and fall. Due to the importance of salmon bearing streams, sampling will continue every year.

CONCLUSIONS:

Forest Starma is committed to keeping or improving the health of the stream courses within its concession. We will continue to conduct logging operations to meet these goals. By monitoring the stream courses for suspended sediment, we will have a way to judge and quantify our actions and to take appropriate actions to mitigate any long-term influence to the stream environment.

(Please note that the *Stream Sediment Form, Equipment list, Testing Procedures, and Map* are not included in this appendix but can be obtained from the Chief Forester if needed)

7.3 Siziman Area Protected Species Habitat Survey and Biodiversity Management Guidelines (Summary) *(This is a copy of the first several pages from the original report dated October 99 prepared for Pioneer Forest Inc. by Jaakko Poyry Consulting)*

Introduction

Justification of the study

Large-scale harvesting has significant impacts on the forest environment, changing the habitats of plants and animals. In addition to direct disturbances imposed by reduction of tree-covered areas, harvesting may lead to serious indirect impacts: windfall, erosion, and increased fire hazard. Furthermore, increased pressure by other human activities like hunting, fishing, gathering, and tourism, and increased number of non-indigenous plants and pest animals can be secondary impacts of forestry development.

Forestry activities have an impact on the biota, and particularly on its most vulnerable part - rare plants and animals - the majority of which are stenotopic (species which occupy a very narrow ecological niche). The condition of populations of rare species is a very sensitive indicator of the status of the ecosystem.

Protection of rare and endangered species in connection with forestry activities requires additional measures, in addition to those stipulated by the Russian legislation (Constitution of the Russian Federation, Environmental Act, Forest Code, Water Code, Act on Ecological Expertise, Resolution on Keeping Red Data Book, etc.).

JSC Forest Starma, both by the requirements of the legislation and by its own incentive, implements environmental protective actions. For example, in addition to the protective zones required by the legislation, the company has designated "zones of non-disturbance" in an area of over 37 000 hectares of its leasehold in March 1999. Moreover, all forestry activities have been suspended in the coastal zone. In harvesting, mainly soft technologies (low-intensity selection cuts, prolonged gradual cuts; no clear-cuts) are used in the leasehold, and non-exploitation patches (NEP) are left uncut in the harvesting blocks as a rule. To secure regeneration of forests, several trees are left standing, and artificial planting is used where it is considered helpful.

In addition, harvesting in the leasehold of Forest Starma is spread over a large area, leaving broad uncut areas between the cut areas, not creating large continuous harvested areas, thus avoiding major changes in the environment.

However, these actions are not totally sufficient for efficient protection of rare and endangered species. Effective protection of these species requires that they are identified, their actual or potential habitats are located, and they are properly considered in the harvesting plans, actual harvesting and other activities. Therefore a specific study was felt to be necessary to clarify these issues.

Objectives, approaches and methods of the study

The objective of the study is to identify the internationally protected species and their habitats found or potentially existing in the Forest Starma (FS) leasehold in Siziman, allowing their efficient protection. The study shall meet the terms of Pioneer's covenant with OPIC.

Thus, the main tasks of the study were:

1. Identify the protected species present or potentially present in the FS leasehold

2. Describe specific habitat needs of these species, and define important habitat for the species (key habitats)
3. Predict and identify occurrence of the protected species' habitats / key habitats in the FS leasehold
4. Develop and recommend appropriate biodiversity management and mitigation measures to prevent adverse impacts caused by FS's activities
5. Train FS staff to identify and protect endangered species and key habitats

For the purposes of the study, internationally protected species are defined as being those species that are rare or endangered in the Russian Far East, based on the fact that according to the international Convention on Biodiversity every country is responsible to protect all species in their territory. In practice, the following species are considered to be internationally protected for the purposes of this study:

- Species included in the Russian Red Data Book on endangered species
- Selected species in the Khabarovsk Krai Red Data Book
- Species that are known by the scientific community to be endangered although not yet included in the Red Books (also invertebrates)
- Species that are well known to be endangered/protected in international context (e.g. brown bear, wolverine)

Since it is impossible to cover in detail the whole area of FS's leasehold in Siziman (over 300 000 ha), the study introduced an approach where the protection needs of species are translated into practical recommendations for FS to implement as an integral part of their procedures and activities. A schematic description of the approach for the work and the details are presented in Annex I.

The study was conducted in three phases:

- Phase 1: preliminary analysis based on existing published data and other documented sources
 - Appraisal of the current condition of ecosystems and species in the leasehold area
 - Assessment of rare and endangered species there,
 - Identification of possible impacts of FS's activities in the area.
- Phase 2: field studies
 - Identification of occurrence of these species and their habitats
 - Evaluation of the condition of ecosystems in the leasehold,
 - Assessment of FS's efforts to mitigate the impact of its activity on the ecosystems
- Phase 3: development of recommendations on additional measures for mitigation concerning protected species and their habitats.

Field studies were conducted in more than 25 sites and 7 walking routes of total length about 60 km. All-terrain-vehicles were used to access the areas, daily routes were about 50-160 km each. Particular attention was paid to the harvested blocks, the blocks to be harvested within the nearest 5 years, wetlands, higher belts of mountains, and watershed communities. While visiting the sites and walking along

routes, the team recorded rare and endangered species of flora and fauna, and also species unusual and unexpected for this area. Attention was paid to the occurrence of animals, and to their tracks or other signs of their activity. Overall descriptions and photographs of the surveyed ecosystems were made. All the rare plants was also collected and put into a herbarium.

The team also used a questioning method. The interviewed people, 16 persons in total, were mostly employees of FS who have been involved in the Siziman forestry activities and road construction for 3-4 years. These discussions proved to be very fruitful, and they also served the purposes of training of the FS staff. Moreover, we took consultations from Mr. B.A.Voronov, Ph.D., ornithologist, director of Institute Water and Ecological issues, and from Mr. A.V.Andreev, Ph.D (biology), Institute of Biological Issues of the North.

The team used the following available maps:

- Map of Khabarovsk krai, scale 1:200 000.
- Scheme of the road net and fire hazard in the leasehold, scale 1:200 000
- Maps of forest stands, scale 1:100 000.

When planning the study, and making conclusions and recommendations, the study has used also the landscape ecological planning approach, a system that is at present used for biodiversity management in forestry e.g. in the Nordic countries and the United States. In this approach, specific measures to protect biodiversity are planned, e.g. preserving protected areas, ecological corridors and stepping stones for species that are dependent on specific habitats, and saving elements of old-growth forests also in the managed forest areas (stands and larger areas of old trees, dead trees, decaying wood, etc.). Specific attention is given to endangered species; here the most important issue is to manage properly those sites and processes that have an impact on the status of the endangered species, especially protecting key habitats.

To implement the recommendations, especially concerning the identification of endangered species and key habitats, training sessions were arranged for FS staff on protected species and biodiversity management (cf. Annex I). FS has agreed to arrange further training, and this can be done using the material presented in this study report, mainly Section 4 (Recommendations) and Annexes II - V (Rare and endangered species and Important habitats, descriptions and pictures).

Forest Starma and Siziman Leasehold Area

Forest Starma was established in 1992 as a joint venture between the Pioneer Group and the Russian partner Starma Holding for the timber harvesting project at Siziman bay in Khabarovsk Krai of the Russian Federation.

FS was given a leasehold area of 394 700 in Siziman for 49 years (forested area in the latest inventory is 319 000 ha). This area is

characterised by stands dominated by spruce, fir and larch, about 50 % of which has been classified as mature or overmature, with dominant trees more than 120 years old (see details in Annex VI).

The annual allowable cut for the leasehold area is calculated and approved as 555 000 m³/a, but in practice less is being harvested (see details in Annex VI).

There are specially protected sites in the leasehold area, based on the Russian legislation:

- Forest stands on steep slopes (31 degrees and steeper)
- Stands of creeping pine (*Pinus pumila*),
- Forest sites where standing stock is less than 50 m³ per hectare
- Sites approved as model forest sites or permanent seed-production forests
- Forest zone 200 m wide along the watershed boundaries in the mountains
- Forests of Group 1 (see below)

Forests of Group 1 are represented by watershed protection zones along rivers, brooks, lakes and other bodies of water, including zones along sea coasts. Russian Forest Code permits limited exploitation harvesting in the forests of Group 1, but Far East harvesting rules includes stricter restrictions on harvesting in Group 1 forests.

Tumninski Leskhov and the administration of Vanino district have given FS a licence to harvest 230 000 m³ of timber yearly, including 65 000 m³ in Group 1 forests. The method of harvesting was nominated mainly as selection cuts where logs having a certain diameter (usually 26 cm at breast height) are extracted from the forest, leaving the understory (cf. Annex VI). In Group 1 forests maximum 40 % of the overstory may be taken from the harvested block.

Harvesting plans have been drafted for 5 years (1996-2002) by the Far-East State Forest Inventory Enterprise ("Lesproject").

ENVIRONMENTAL SITUATION IN FOREST STARMA'S LEASEHOLD

General description of the Siziman area

Geographical data

Siziman area is a part of Vanino district of the Khabarovsk krai. The climate of the area can be described as follows:

Number of days with snow cover	165 days	
Absolute minimum temperature		43 °c (January)
Absolute maximum temperature		+36 °c (July)
Average date of formation of stable snow cover		18 October
Average date of full melting of snow cover		23 May
Average thickness of snow cover		46 cm
Yearly precipitation		611 mm
Prevailing wind directions		north-west

Depth of winter freezing of the ground

3.15 m

The hydrological network is well developed in the area. The Tumnin River is the main river in the region crossing the area from the north to the south. The tributaries of the Tumnin are numerous: e.g. the Snezhnaya, the Serebriany, the Besymianny. They cross the area mainly in the east-west direction. The eastern part of the leasehold is drained by the Siziman river and smaller creeks flowing directly into the sea. Most of the rivers and creeks of Siziman area are spawning waters of Pacific salmon species.

The prevailing soils are poor, mostly clayish, with thin podzol layer. The soils are mainly permeable for water, so surface rainfall flow is negligible.

The vegetation in the region can be described as conifer-dominated boreal forest (taiga).

Forest Starma's Present Environmental Practices

Observance of Harvesting Rules

FS's harvesting technique is in compliance with the basic and single environmental document for the forestry in this region: "Rules of exploitation (final) harvesting in the forests of the Russian Far East" (hereunder Harvesting Rules) approved by the resolution of the Russian federal forest service #201 of 07.30.1993. The study team did not discover violations of these Rules during the whole period of field studies in the harvested areas. More than that, FS implements many innovations directed to mitigate the impact on the environment beyond what the Harvesting Rules require.

Main provisions of the Harvesting rules concerning the Siziman type of forest and the harvesting activity, are as follows:

In the forests of Group 1 only selection cuts and narrow-strip overstory-removal may be used.

For Group 3 forests, in slopes of steepness up to 20°, series (gradual) two-entry cuts, prolonged-series (gradual) cuts, and full overstory removal are permitted. In the slopes of 21-30° only selection cuts are permitted in the stands which canopy (crop) density is 0.7 and more, and the volume of harvested timber should not exceed 25 % of the available stock in the stand.

If canopy density is less than 0.7, selection cuts are prohibited, and only narrow-strip overstory removal are permitted, but the cut area should not exceed 5 hectares, and only 3 such cut areas are permitted per 1 km of length of the spur-road. Also there should be the guarantee that those cut areas will be reforested during 2-3 years after harvesting.

In virgin forest stands the intensity of the first entry may be increased by 10 % as compared with other

forest stands. But the canopy density may not be reduced more than 0.3, and resulted canopy density may not be less than 0.5.

Prolonged-gradual (series) cuts are designated for spruce-fir stands. Basic criteria for nominating such cuts are: bonitet (forest site) class should not be less than 4, density 0.7-0.8, the average stock 200 m³ per hectare.

Percentage of taking timber in stands of density 0.7 in slopes up to 10° steepness shall not exceed 50 %, and 45% in slopes 11-20° ; and in stand of density 0.8 - 60 and 55 % correspondingly.

For prolonged gradual cuts, 400-500 vital trees per hectare should be left in the cut area after first entry. Also the minimum breast-high diameter (d.b.h.) of the trees allotted for cut should not be less than the average d.b.h. of the harvested stand for every intensity (percentage) of the volume of timber taken from the stand.

Area of a cut block in forests Group 1 harvested by narrow-strip overstory-removal method shall not exceed 5 hectares, and next entry to the adjacent block shall be in 5 years, excluding the year of cut.

In forests Group 3, the maximum admitted area of a cut block is 25 hectares for full overstory removal in slopes 10-20° steepness, and 50 hectares - for slopes up to 10°. For gradual cuts - 50 and 100 hectares, correspondingly.

In virgin conifer forests, where harvesting is carried out by gradual or selection cuts, and young trees are left safe in the harvested area, next entry to the adjacent blocks may be done next year. In all the other conditions (non-virgin forests, full overstory removal, understoreys injured) the next entry to the adjacent blocks may not be done earlier than in 4 years for conifer, and 2 years for deciduous type of stands.

When young growth is left safe after cut, the time for next entry is reduced to 3 years for spruce and fir and 2 years for larch.

All the above instructions of Harvesting Rules are followed by FS, so they describe accurately how FS is doing its harvesting (see also photographs in Annex VII). But in addition, FS goes yet further in its efforts to keep nature safe. These additional mitigation efforts will be described below.

Additional actions of FS for mitigation of forestry impact

Non-Exploitation Patches (NEPs)

Each block allotted for harvesting, which area is usually 25 hectares, is first surveyed by the foreman, and in connection with marking the skidding trails, a patch about 1.5-2 hectares is marked by him at his discretion to be left as a so-called non-exploitation patch (NEP). Trees inside the marked area are not to be cut, and this whole area is kept untouched, thus leaving the patch for conservation of biodiversity. Percentage of these patches in the harvested area is normally 7-8 %. Often the area for NEPs is selected where dry spruce trees are abundant. In many cases NEPs are patches of old forest inside the harvested area. This NEP-policy, which has similarities in the Nordic guidelines for biodiversity management in forestry, has been practised by FS since 1998.

Implementation of prolonged gradual cuts

There is a resolution of Khabarovsk krai Forestry Administration of February 20, 1998, concerning cuts in spruce stands in steep terrain. It says: "Prolonged gradual cuts are strongly recommended in slopes up to 20 degrees steep, where spruce-fir stands are of bonitet class 4 or better, density 0.7-0.8, volume of standing timber more than 200 m³ per hectare. Percentage of harvested timber should be 50 % on slopes up to 10 degrees, and 45 % on steeper slopes (11-20 degrees), and in more dense stands 60 and 55 %, correspondingly." Next entry to such cutovers may be done judging by the commercial value of standing trees.

FS follows this recommendation. This policy results in higher percentage of saplings and pole trees left after harvesting, thus reducing the environmental disturbance caused by harvesting.

Safety of watershed communities

To mitigate the impact of harvesting activity on the forest environment, watershed zones are stipulated in the Far East Harvesting Rules. The width of this zone is 25 m for both banks of the creek length up to 10 km, and 100 m for both banks of the river length up to 50 km (see Annex IX). Along the Tummin river, a protection zone 5 - 6 km wide has been established, since it is an important river for salmonid fish (Annex IX). Normally, FS leaves watershed bands much wider, because the riparian forests do not usually have enough dense stands of big trees to be attractive for harvesting. Actually, the whole width of valleys are often left untouched. This practice results in:

- Securing high quality of water in rivers and creeks;
- Protection of spawning sites in rivers;
- Mitigation of water temperature fluctuations;
- Prevention of riverbank erosion processes;
- Protection of the environment for wetland fauna and flora.

There are watershed protection zones also along the mountain ridges, their width is 200 m on both sides of the ridges. This practice of

conservation of zones on the ridges protects the mountain tops from erosion. Also these watershed bands absorb rainwater flow from bare tops of mountains, and add the refuge area for wildlife. FS has recently adopted the practice of leaving these non-harvested watershed bands along the ridges.

Protected wetlands

Wetlands comprise some of the most valuable and important environment for wildlife. Thus, wetlands of Siziman were first priority also in our field studies. What we have seen in Siziman, indicates that FS is performing well considering conservation of wetlands: Roads are constructed mainly in higher terrain (with a few exceptions where wetlands are partly disturbed by crossing them with roads). Harvesting is not conducted in the wetlands, because of the protection of riparian forests, and the fact that there is not enough valuable timber in the wetlands. FS has practically fully excluded all the wetlands from its exploitation forest areas.

Protected coastal zone

The coastal zone in Siziman is defined as a band 5-8 km wide along the coast of the Tartar Strait in Siziman lecnichestvo of Tumninski Leskhos (see map in Annex IX). This zone belongs to the forest Group 1. It is important as a refuge and habitat for very diverse wildlife. In 1996-1997 there were harvesting operations in some compartments in this zone in accordance with Harvesting Rules for Group 1 forests (selection cuts). Now this forestry activity is suspended by FS's own order #35pr of March 13, 1999. Thus, the area of 41 410 hectares with total standing timber volume over 5 million m³ is outside of logging operations and now supports biodiversity conservation.

Zones of non-disturbance

To conserve wildlife and to support viable populations of species, FS, by its Resolution #36 of March 13, 1999, allocated zones of non-disturbance covering an area of 37 712 hectares within Group 3 forests of its leasehold area (Table 7, and map in Annex IX). No forestry activity will be conducted in these zones.

Table 7

Zones of non-disturbance in Forest Starma's leasehold area

Leskhoz's name	Lesnichestvo's name	Number of zone	Zone's Compartment numbers	Group of forest	Area, hectares
Tumninski	Sizimanskoe	1	162; 163	1	996
	Mulinskoe	2	57	1	554
	Mulinskoe	3	12; 13	3	1,396
	Mulinskoe	4	140	3	770
	Mulinskoe	5	43; 48	3	1,273
Vysokogorni	Verkhne-Tumnin	6	513; 514	3	1,676
	Verkhne-Tumnin	7	324; 331	3	1,666
	Verkhne-Tumnin	8	416; 417	3	1,928
	Kenadskoe	9	58; 59; 66	3	1,385
Tumninski	Sizimanskoe	10	21; 22; 29; 30	3	3,002
	Sizimanskoe	11	55; 60; 61; 62; 63; 69; 70	3	4,654
Vysokogorni	Verkhne-Tumnin	12	501; 502; 503; 504	3	1,757
	Verkhne-Tumnin	13	526; 527; 528; 529	3	2,936
	Verkhne-Tumnin	14	539; 540	3	2,048
	Verkhne-Tumnin	15	544; 545	3	1,578
	Kenadskoe	16	45; 60; 61; 67; 78; 79; 80; 81; 88; 99	3	6,022
	Kenadskoe	17	119; 120; 121; 122; 134; 135	3	4,621
Total in 1 Group:				1	1,550
Total in 3 Group:				3	37,712
TOTAL:				1+3	39,262

Zones of non-disturbance are actually protected forests, so they contributes greatly to ensure safe habitats for rare and endangered

species of plants and animals in the leasehold area. They are established on different habitats, including a large area that were partly burned in the 1950s (about 6 000 ha).

Old forests

Some spruce forests in the leasehold are in the process of declining due to their old age (classified as “overmature”, 180-200 years; the average percentage of overmature trees is about 60 % in Tumninski leskhoz, and 35 % in Vysokogornyi leskhoz). There are relatively large areas that have identified as declining forests, most of which have plenty of dead trees (see map in Annex VIII). In many areas, where there is a large percentage of dry spruce trees (over 60 % of the standing stock), young trees have already formed a dense canopy among the dead trees. These old forests contribute much to the conservation of biodiversity, they are a refuge for a number of species that depend on old forests and dead trees. FS leaves these areas outside its harvesting activity for the sake of keeping young regeneration safe.

Another important group of old forests is the marshy larch-dominated lowland forests with specialised fauna and flora. These areas are less prone to forest fires (“fire-refugia”), and thus they may have existed undisturbed for several hundred years, and therefore can contribute much to the conservation of biodiversity. These forests are not attractive to FS because of their relatively small volume of valuable timber, and consequently they are not harvested.

Impacts of forestry on biodiversity in the Siziman area

Harvesting timber is a major disturbance in the forest environment, equivalent to forest fires and massive windfalls. The result of harvesting is a major change in the age structure of the forests, changes in the microclimate, and replacement of species. In more severe cases, associated with large scale clearcutting, decline of watershed capacity of forests, loss of soil or decrease of its fertility, and reduction of productivity, are possible. When harvesting is conducted applying environmental mitigation measures, as in the case of FS in Siziman, the impacts are less severe.

Harvesting changes the age structure of the forest, creating young forests and decreasing the share of old forest, and thus reduces the habitat for species that depend on the environmental conditions prevailing in an old forest: specific microclimate, abundance of dead trees, standing and fallen, decaying wood in different degrees of decay, etc. This has had a major impact on the biodiversity of forested areas in many areas of the world where logging has been intensive.

Removal of trees, even if it is removal of the overstory, as practised in Siziman, change radically the light, temperature and moisture conditions within a forest stand, having a clear impact on the understory and the ground vegetation. The species that have strict requirements concerning these environmental factors, are replaced

by other, usually by more tolerant species. For instance, several species of mosses disappear, and grasses and light preferring herbs appear. This has a clear impact on the fauna, too: populations of many species of invertebrates and some birds suffer, and other species benefit, e.g. some birds, deers and rodents.

The environmental measures taken by FS listed above (section 2.2.2) mitigate effectively the impacts of logging. It can be claimed that many of the features and processes of the boreal forest are maintained in Siziman leasehold despite significant harvesting. The harvesting operations have many common features with the natural processes of renewal of forest, mainly forest fires caused by lightning and windfalls caused by storms. These features include the following: no major areas are clear-cut, several trees are left standing in harvested areas, patches of untouched forest are saved, wetlands are outside disturbed areas, and there is plenty of dead wood in the forest.

Erosion may be increased after logging, but in Siziman this is limited to the skidding trails, landings, and roads due to the favourable structure of the forest soils. Moreover, erosion has been taken into consideration by FS, e.g. by leaving the riparian areas outside harvesting, and by constructing proper ditches and culverts for the roads. Some cases of significant erosion along the roads were observed, but the erosion material had not entered the streams. No significant siltation of rivers that would have an impact on the fish and invertebrates were observed.

The practised strip harvesting method may lead to massive windfall of trees left in the logged area, and the result resembles a clear-cut area. The trees left after windfall are not always able to produce enough seeds needed for natural regeneration of forest. In these cases Forest Starma can resort to planting. The team has surveyed new plantations of larch in a few areas in Siziman, and evidenced the viable condition of the seedlings.

Protected species in the area of FS leasehold

Introduction

During the literature survey, Siziman area has proved to be “terra incognita” for botanists and zoologists, for its flora and fauna has not been surveyed before. The team have studied thoroughly all the published and other authorised descriptions of flora and fauna of the Russian Far East for the period from 1755 to the present day, and no descriptions were discovered concerning Siziman Bay area. There was no data on Siziman in those sources concerning rare and endangered species either. All the examined lists (Kharkevich, Kachura, 1981; Shlotgauer, Melnikova, 1990; Sapozhnikova, 1994, 1997, etc.) do not contain any protected species for Siziman, though 30 protected species are identified for Vanino district.

However, some conclusions concerning the flora and fauna (species' diversity, location, abundance, availability of rare, endangered and endemic species) of the FS leasehold can be obtained from studies conducted in adjacent territories.

During our field studies (16-30 July, 1999) we have surveyed all the key types of landscape in the region that were accessible by ground vehicles and by foot within one or two days:

- All types of virgin forests
- Harvested blocks of various percentage of taking timber and time of cut, burnt areas, wetlands, cliffs, bare tops of mountains, taluses and screes slopes and a mountain lake

We used also the questioning method. Valuable data were given to us especially by Yu. A. Bazarnov - foreman of preparation works, A.I. Zhuvakov - head technologist, and Brian Slavens - road building consultant

7.4 Comments on the Rules of Final Harvesting in the Far East of Russia», as compared with Forest Starma's practice By Anatoly Barburin

The "Comments on the Rules of Final Harvesting in the Far East of Russia" (Comments) are professional suggestions for changes to the existing Rules of Final Harvesting for the Far East of Russia. These suggested interpretations have not been accepted by the Russian Forest Service.

According to the (Comments), basic principles of selection of the type of cut are:

- a) Maximum rationality
- b) Constancy of percentage of tree covered lands
- c) Maximum promotion of natural reforestation

Based on these three principles, the type of cut should be chosen (or nominated) taking into account the following conditions: forest group (1st or 2d or 3d), terrain, forest stand composition.

Basic requirements to be met by any type of the final cuts are:

1. Satisfaction of citizens' and economy demand for wood;
2. Forestry reasonability to conduct the cuts promptly.
3. Ecological necessity to conserve forest bio-eco-systems (if there is a hazard for their decline)
4. Ecological necessity to conserve bio-diversity.

All that above mentioned is possible only if the cut is profitable (economically sound).

To meet these requirements, the forest user shall take into account the natural characteristics of his leasehold to adapt his harvesting technique to the local conditions.

Those local conditions to be taken into account are: forest group (1,2,3), biological particularities of main forest species, age structure, erosion vulnerability of soil, availability and condition of the understory.

Forest user may choose (within a certain range of variety) for his leasehold, after approval of the Leskhoz, any type of permitted harvesting systems (overstory removal, gradual cuts, or selective cuts), which ensures him the maximum benefit, corresponds to his technical opportunity, and satisfies his (and Leskhoz's) economic and forestry objectives (correspondingly).

Forest Starma practices the following types of cuts (as we have observed.):

1. Overstory Removal
 - a) Narrow strip cut («Timpco», «Harvester», «Hahn»)
 - b) Wide strip cut (chain saw felling, skidding trees with Russian caterpillar skidders)
2. Selective cuts (overstory is not removed in full at any entry)
3. Gradual cuts (overstory is removed in result of 2-3 entries)
 - a) Selective short gradual (no examples were seen)
 - b) Selective long gradual cut

Overstory removal usually used to be nominated in plain habitat and on slopes up to 20 degrees in forests group 3 only. Width of cut block is up to 250 m for fir-spruce and larch forests. Time interval for the entry to adjacent forest blocks is not restricted.

Selective cuts are nominated on slopes 20-25 degrees, and can be applied also for slopes up to 20 degrees, at the Harvester's will.

In particularly protected forests of Group 1 (example: watershed zone forests) this cut is permitted only in the winter-time and the percentage of taken timber may not exceed 20 %.

In forest Group 3 this cut is nominated not as obligatory but as the preferable type of cut.

Gradual cuts are nominated in plain habitats and on slopes up to 20 degrees. In forests Group 1 the taken timber is 30 % of the growth at each entry of two (only two entries are permitted for fir-spruce forests).

Selective long gradual cuts in fir-spruce forests of Group 3 permit the volume of taken timber to be up to 70 %, but at the 1tg entry - only up to 60 %.

Some critical notes on Forest Starma's activity in forests:

Overstory removal by «narrow strip» method at the lowest taken d.b.h. 16 cm are ecologically more negative than selective or gradual cuts because:

- a) in 1-2 years after cut the cutover is fire-hazardous due to windfall. Saved trees has but little time for seeding the area. But the understory is still viable because

in 1-2 years it is shadowed by standing trees and has enough time to adapt itself to the direct sun rays. Only large saplings die.

- b) bare skid trails and landing sites are not shadowed and in no time became covered with grass and brush (*Calamagrostis*, raspberry, etc.), or with seedlings of birch, larch, aspen, willow, etc. This also increases fire hazard of the area.

Part cuts (gradual and selective) in the leasehold of Forest Starma are conducted a) by USA machines (Timpco,) and narrow strip method, and b) chain saw felling and skidding by Russian cat skidders (wide strip method). In these both technologies windfall is sharply reduced, skid trails are shaded (because of lesser percentage of taken timber), grasses do not grow, understory and moss cover are saved. But the economics is effected because of the higher expenses for building roads and spurs.

Analysis of Forest Starma's experience of harvesting fir-spruce forests by selection-long-gradual cuts reveals that

Overstory removal is the most effective type of cut almost in every kind of forest, but the experience of harvesting of fir-spruce forests of density 0.6 and more, shows that part cuts are the priority.

7.5 PERSPECTIVES FOR REHABILITATION OF BURNT AREAS OF FOREST STARMA'S LEASEHOLDBASED ON STUDIES OF MUTA FIRE OF 1998 by Anatoly Baburin

The recent, accurate data on forest fires of 1998 in the leased area of Forest Starma shows that the total burnt area of all the three fires is 76,000 hectares. This is 20 % of the leasehold. The last figure is substantially higher than the 3% average for the krai. The three fires of the summer 1998 were catastrophic, according to the Russian scale, due to their size and extremely high intensity. They were crown and ground fires simultaneously, "poyalny" in the Russian classification, which means the full consumption of all the organic matter, including foliage of crowns, thinner branches, bark, understory, shrubs, litter, duff, moss and peat, if any. i.e. fires totally eliminated the forest. Tree covered area in the leasehold is almost 100 %, so the loss is great: not only cutovers and areas being harvested were burned but also virgin stands. The fire loss of timber expressed in cubic meters is about 7.8 million cu m. The Leskhoz should compensate Forest Starma by adding additional commercial forest area to the leasehold.

Great expenditures were made by Forest Starma to suppress the three fires.

The first one covered the upper streams of the Chichimar (northern part of the leasehold).

The second one burned the basins of the streams: Levaia Chagoma, Losinaya, Sludianoj, Mokhovoi and Muta. This is the middle part of the leasehold. This fire has eliminated fully the thickets of *Pinus pumila* around the cupola of the Sishka mountain.

The third fire has eliminated forests in the basins of rivers flowing to the sea in the south-eastern part of the leasehold (the Medvezhia, the Golod, the Taiozhnitsa, the Malaya Tosia).

Taking into account that forest fuel models of all the tree fires are very similar (mountainous dark conifer green-moss taiga), and all three fires were burning at the same time. The second fire, "Muta fire" was studied more or less in detail in 1998. We examined this fire in October 1999 to forecast the trend of natural reforestation of burnt areas of the leasehold, and, as far as it is possible, to recommend some measures for promoting rehabilitation, based on characteristics of Muta fire only.

Burned area of Muta fire is about 20,000 hectares, so the surrounding unburned forests are some 6-8 km from the center of the burned area. Fortunately, in the middle of the burned area there are small clusters, or single viable trees left safe and able to produce seeds. There is some hope for natural reforestation of forest. However this hope is weak, and there are quite a variety of ways for further natural development of this area.

The Muta fire, area prior to the fire, was harvested in some patches, and for these areas there were two disturbances, first by harvesting, and then by fire. For the purpose of further description, we call these patches "cut-burned sites". The virgin forests there was only one disturbance fire, we call them "burned sites".

Now, one year after, certain differences between the two sites are seen: In "burned sites" we see fragmentary grass cover (50-70% of coverage) of *Epilobium augustifolia*, *Carex*, *Calamagrostis langsdorfii*, raspberry (*Rubus sakhalinensis*), *Jambucus*. In "cut-burned sites" the grass cover is dense, made mainly of *Calamagrostis*, other plants are sparse and single specimens.

Before burning, all the forests in Muta fire area were composed of fir and spruce, with a sparse mixture of birches (*Betula lanata*, *Betula platiphilla*), mountain ash-tree (*Sorbus amurensis*) and, more rarely, aspen (*Populus davidiana*). Also, there were very old (about 200 years) over mature single trees of larch mixed (up to 10 %) in lower parts of slopes. Birch was distributed differently: white birch was seen in lower parts of slopes, and stone birch occurred in the upper part.

The following describes how the spatial distribution of surviving tree species will influence the future development of various parts of the burned area.

The process of natural reforestation of a burn is variable and develops depending on many factors. With a favorable set of circumstances this process will be rapid and result in a desirable forest stand. Less favorable conditions result in very slow

development not always leading in a satisfactory direction, most probably resulting in formation of swamps, grass-shrub thickets, sparse stands and even waste lands. These are possible in the leasehold since some areas have been disturbed by both fires and cuts.

The influencing circumstances are:

- 1) Type of the original (pre-fire) vegetation and the level of its diversity (mosaic nature);
- 2) Fire intensity and the type of fire (crowning, ground, or peat);
- 3) The dimensions of burned area (large, small);
- 4) The availability of seed sources, or the ability of the species to reproduce from roots;
- 5) biodiversity both of species and ecosystems.

The lower the biodiversity the fewer the number of natural replacement species in burned areas. In the leasehold, only five tree species are present: spruce, fir, larch and two birches.

It is very important to note that all the vegetation of the leased area of Forest Starma is fire replacement vegetation. Studying this area we find old charcoal everywhere, i.e. under roots of old wind-fall trees and in skid trails. The fact that old burned areas are now 100 % tree-covered is very encouraging, leading us to believe that the areas of 1998 fires will be properly rehabilitated in due time. Consequently, our task is to find measures that will accelerate development towards the more desirable replacement communities.

There are two probable versions of the rehabilitation of burned areas in Siziman:

1) Natural reproduction without replacement of original species. The probability of this event is very low, practically nil for spruce-fir forests, but it is most probable for larch and birch forests.

2) Natural reproduction through replacement of species. This way is the normal way for reproduction of spruce-fir forests. The first stage of this process is the formation of larch and mixed larch-birch forests as seen widely in the leasehold. Many miles of obviously post-fire young larch forests can be seen from the road in the northern part of the Siziman area. This is the evidence that old, large burned areas are naturally reforested with larch during the first 5-10 years after the fire. The second phase will be the appearance of seedlings of dark conifer species under the shady larch canopy. This process is slow, so we see multi-aged stands of spruce in the leasehold. Larch seedlings also sprout under spruce canopy but these can not compete with shade-tolerant spruce and fir.

Let's consider this second version in more details for burned areas where no viable vegetation remains. Following the year of the fire the changes will be as follows:

1-2 years It is being covered with so called pioneer (initial) vegetation: raspberry,

carex, other grasses.

3-5 years Seedlings of pioneer tree species appear: larch, birch, aspen, willow,

poplar.

5-10 years Young larch and deciduous forests are formed with shrubs cover composed of ledum, lingoberry, other shrub species.

10-20 years Understory of dark conifer species appears under the canopy of young larch and deciduous forests.

20-40 years Maturing larch and deciduous forests with the second story of dark conifer species.

40-60 years The overstory is composed of maturing and mature dark conifer species. This stage lasts infinitely longer and is susceptible only to stand replacement fires or diseases of aging, though it is mainly stable climax community.

This rather long process can be accelerated up to 30-50 years through artificial reforestation, but it would be hardly effective both commercially and ecologically due to low quality of forest sites (bonitet).

The above scheme can be disturbed any time by events of catastrophic nature. Most vulnerable stage is the early stage of transition from pioneer (initial) species to the final species when grasses (*Calamagrostis* is particularly aggressive) make cover the soil and compete with tree seedlings for water and sunlight.

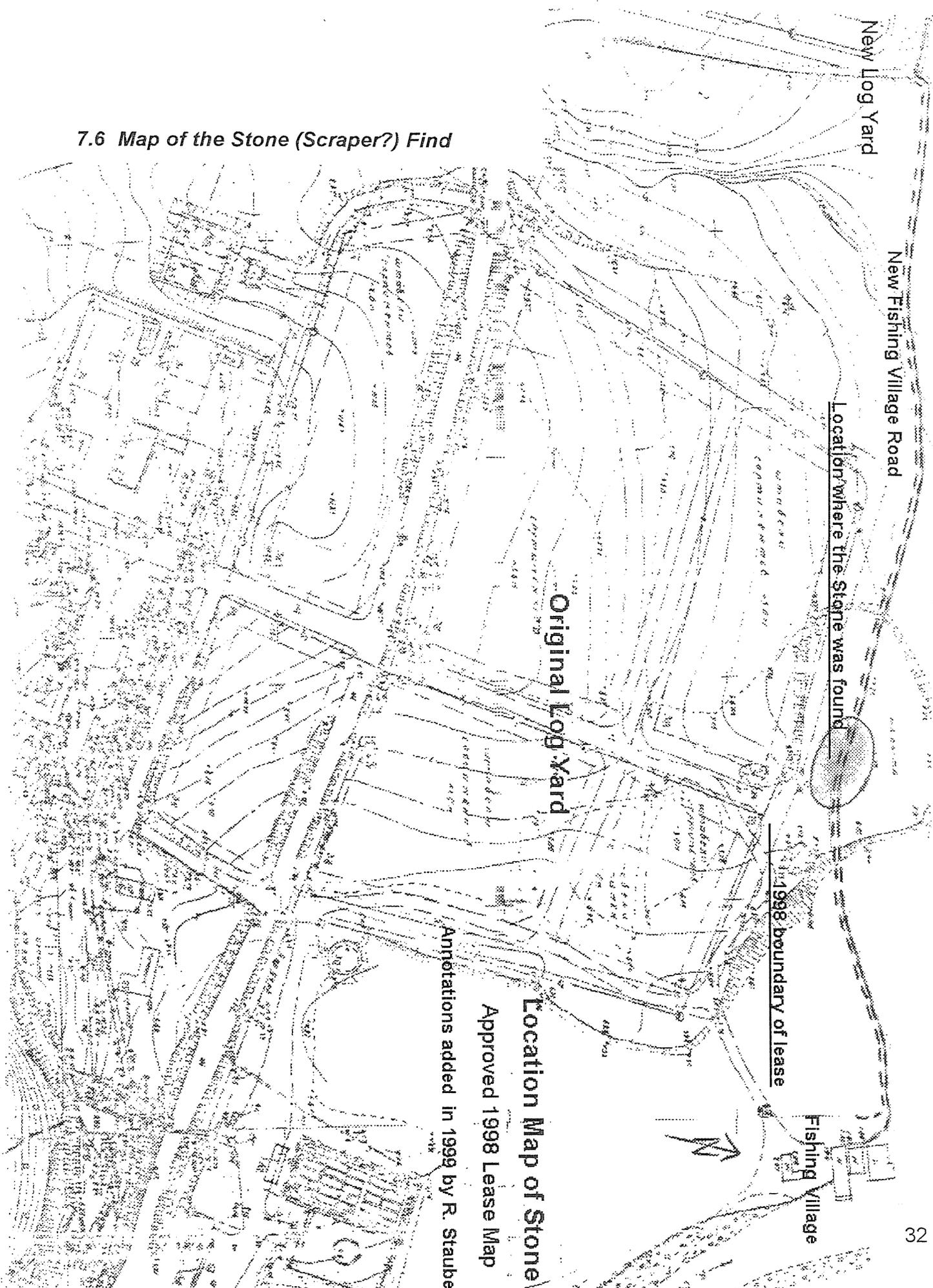
Calamagrostis is a powerful competitor and needs direct sunrays for its growth. When shaded, it does not produce seeds, but it can propagate by its roots vegetatively. So, it quickly occupies "cut-burned" sites and, during several years, forms thick "blanket" of dead grass that is very flammable during droughts. This "blanket" also prevents the germination of seeds of tree species. Thus the risk of undesirable version of rehabilitation of "cut-burned" sites, i.e. formation of "waste" or grassy areas is greatly increased. (According to Russian forest inventory rules, waste areas are the areas that are not reforested in 10 years following a fire or cut). Such areas requires artificial reforestation such as, planting seedlings, or scarification of soils. In case of repeating fires those "cut-burned" sites can be transformed into swamps, meadows in flatter terrain, and into talus, bare rocks in steep slopes.

Among various methods of artificial rehabilitation of waste areas the most popular method is to plant seedlings of larch trees in the areas scarified with bulldozer. In most cases such plantations are designated to the restoration of wood (timber) resources. The rate of this restoration is much slower than the rate of timber loss because of fires, i.e. this method will never result in full reforestation. Currently proposals are being discussed to plant forests only in the places ecologically important. Some examples are the "key points of landscape", "ecological corridors", on very steep slopes, or along banks of rivers. Planting might be

accomplished to provide strips of trees in wide "waste" areas thus creating seed production strips for expanded natural propagation of forest.

Scarification of soil surface is also useful for natural reproduction of forests, particularly larch stands. Our survey of the leasehold showed that larch is readily restored in scarified patches. So, in larch forest cutovers, it is not reasonable to plant larch seedlings, they will surely appear next year if scarified patches are available. Grassy areas (those covered with calamagrostis, in the first years), both cutovers and burned sites where there is no new generation, should be scarified.

7.6 Map of the Stone (Scraper?) Find



Location Map of Stone
Approved 1998 Lease Map
Annotations added in 1999 by R. Stauber