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Faculty of Natural Resources and Agricultural Sciences

Considering Environmental Values during Timber Harvest

– A Study of Forest Machine Operators' Practice

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Abstract

The Swedish environmental objective to have sustainable forests by 2020 will not be achieved with current measures taken by the forestry sector. One problem is that the mandatory environmental considerations are not taken to a satisfactory degree in regeneration felling sites. The ones performing regeneration felling and the taking or not taking of environmental considerations are the forest machine operators.

The aim of this study is to develop understanding about forest machine operators' practice, how it hinders and facilitates the taking of environmental considerations in regeneration felling from the operators' own descriptions of their work situation, in answering the questions: What characterizes forest machine operators practice and their task of taking environmental considerations? What type of knowledge and skills are needed in order to take considerations to the environment? How can the development of forest machine operators' skills and possibilities of taking environmental considerations be understood?

Through a theoretical reading of transcripts from seven semi-structured interviews with forest machine operators, answers to these questions are given on the assumption, based on a socio-cultural perspective on practice and practical knowledge, that knowledge, intentions, aims, norms, routines and the meaning given to objects and situations are situated and developed in social interactions. The conditions for the taking of environmental considerations during timber harvesting are also assumed to be limited to the workings and properties inherent to the capitalistic system.

This study shows that the lack of considerations to environmental values in regeneration sites are not due to forest machine operators' lack of competence or that the forest machine operators have unfavorable attitudes towards environmental preservation. But during regeneration felling operators need to balance the task of taking environmental considerations with other tasks. It is operators' practical knowledge of recognizing environmental values and their skills of operating harvesting machines in varying forest landscapes that enables and guides the taking of environmental considerations. But considerations to environmental values are limited by the frames of harvesting practices and by the reality of timber production in a global capitalistic system. This study shows that the development of forest machine operators' knowledge and skills on how to consider environmental values, are better facilitated when operators' actions are acknowledged, questioned and analyzed in dialogue between operators, and managers of timber harvesting and environmental consideration with respect and sensibility for the others expertise and identity.

Keywords: environmental considerations, social practice, sustainable forestry, Swedish forestry.

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1 Introduction

The Forest Agency reports that the environmental goal set by the Swedish government to have sustainable forests by 2020 will not be achieved with current measures taken by the forestry sector in Sweden (Naturvårdsverket 2014, pp 184-195). One problem that the Forest Agency acknowledges is that the mandatory environmental considerations are not taken to a satisfactory degree in the regeneration felling sites. The Forest Agency initiated a dialogue project about environmental considerations between members of the agency and industry in order to improve the situation (Skogsstyrelsen 2015-01-30). During this process it was declared that the industry has different environmental consideration aims than the forest agency, that there is a lack of information, knowledge and commitment to environmental values in the industry, and that there are problems with responsibility, prioritization and planning when it comes to environmental considerations and that the agency's monitoring methods are unclear (Skogsstyrelsen 2011).

The ones performing regeneration felling and the taking or not taking of environmental considerations are the forest machine operators. It would be easy to conclude that the lack of considerations to environmental values in regeneration sites are due to forest machine operators' lack of competence and that they need further instructions; *that they can't do it*. Or that the forest machine operators have unfavorable attitudes towards environmental preservation and choose not to consider the environment; *that they won't do it*. Although even if there is 'truth' in these two alterative explanations, more questions about the forest machine operators' practice and task of taking environmental considerations must be answered before effective solutions can be prescribed. To answer these questions we need to know what it is like to be a forest machine operator in the practice of timber harvesting and taking of environmental considerations. The assumption, based on a socio-cultural perspective on practice and practical knowledge, is that knowledge, intentions, aims, norms, routines and the meaning given to objects and situations are situated and development in social interactions.

The forest machine operators' practices are not solely constructed by their institutional parameters; their practice is not a direct consequence of the instructions

and tasks handed to them alone. The task to consider environmental values while harvesting timber depends on how the forest machine operators understand and respond to requirements and instructions on how to consider environmental values. From a socio-cultural perspective it is evident that how the forest machine operators interpret reality will affect their actions and their taking of considerations. We can from this perspective only understand forest machine operators' actions by studying their own perspective and by investigating their situation.

In order to understand why considerations to environmental values have not been taken to a satisfactory degree in regeneration felling, it is important to develop knowledge on what the forest machine operators practice entails and how it is situated as well as what the task to take environmental considerations entails within the practice. Having a better and deeper understanding of forest machine operators practice makes it easier to develop relevant recommendations on which, and why, conditions needs to change in order to increase the possibilities for forest machine operators to fulfill their task to take these considerations.

1.1 Aim and Research Questions

The aim of this study is to develop understanding about forest machine operators' practice, how it hinders and facilitates the taking of environmental considerations in regeneration felling from the operators' own descriptions of their work situation. The aim is also to describe how the forest machine operators' descriptions of their practice can be understood from a socio-cultural perspective, discussing issues such as practical knowledge and learning, in order to explain why consideration to environmental values are not always taken in production forests. Understanding forest machine operators' perspectives, their knowledge and motivation are important in order to understand how environmental considerations are taken in Swedish forestry. But in order to balance this more narrow perspective with a global perspective on processes effecting the production and distribution of materials everywhere – and also affecting the taking of environmental considerations – I also aim to connect local perceptions with workings and properties inherent to the capitalistic system. In my research I aim to answer the following:

What characterizes forest machine operators practice and their task of taking environmental considerations?

What type of knowledge and skills are needed in order to take considerations to the environment while operating a forest machine and performing regeneration felling?

How does a socio-cultural perspective contribute to our understanding of the development of forest machine operators' skills and possibilities of taking environmental considerations?

2 Method

In order to develop deeper understanding of *how* it is to take environmental considerations during regeneration felling, this study has been performed as a qualitative study, as suggested appropriate by Kvale and Brinkman (2009) and Trost (1997). Qualitative studies contribute to the understanding of human reasoning and actions.

Seven semi-structured interviews with forest machine operators have been the method of gathering material, which were recorded and fully transcribed. The analysis was done as a *theoretical reading* (Kvale & Brinkman 2009) of the interview transcripts, using theories and perspectives that seemed relevant based on the interview material.

Contributing to a better understanding of the regeneration felling and timber harvesting context in Sweden, a literature study on the subject was done pre to the interviewing, some of which is presented below Two participative observations were also done in order to better grasp the context: one at the Swedish Forest Agency's conferences on the dialogue project concerning environmental considerations, and one manifestation recognizing the poor work conditions for forestry workers, both during the beginning of 2013.

2.1 Semi-Structured Interviews

The interviews took place during 2013; they were done face-to-face at the operators' workplace or in their homes, took between 40 minutes up to 1.5 hours without much disturbance or intrusion from others. The interviewed operators were asked 8 to 10 opened ended, but specific and concrete questions from an interview guide, while encouraging them to describe their work, regeneration fellings, harvesting machines, environmental considerations, management and the forest industry. The operators spoke freely and were asked follow up questions in order to clarify or verify their answers. For confidentiality reasons, the names of the opera-

tors and their employers are not mentioned in this study; instead the different operators' quotes are referred to as voices 2-8.

2.1.1 The Interviewed Forest Machine Operators

The operators were found through their employers or through their registered company telephone number. They all work within the boreal zone in Sweden. All of the 7 interviewed forest machine operators had experience of operating harvesting machines. Some of the interviewed operators had experience of operating forwarders, tractors and other forestry machines. One of the interviewed operators had experience of planning regeneration sites, and three of the interviewed operators run their own businesses – they were so called forestry *contractors*. The four remaining operators were employed by either big forestry companies, economic forest owner associations, or by contractors – but some of them had experience working for different employers. The interviewed operators had been in the profession between 15-50 years.

2.2 Structure of the Thesis

Some of the information found during the literature study on the Swedish forestry and environmental considerations is presented or referred to in part *3. Background to Environmental Considerations during Regeneration Felling*.

The theories used to analyze the interviewed operators descriptions of their task of considering environmental values and their practice of harvesting timber are presented in short in part *4. Theory*, and elaborated on in more detail together with the thesis findings.

In answering the 3 research questions formulated above, the theoretical analysis and some translated quotes from the interviews are presented in parts *5: The Practice of Timber Harvesting and the Task of Environmental Considerations* and *6: Operators' Learning to Improve the Taking of Environmental Considerations* below. In parts *5.1, 5.3* and *6* critical or socio-cultural perspectives on mode of production, practical knowledge and learning are used in order to analyze operators practice and what implications this could have on the management of environmental values in regeneration fellings. Part *5.2* is without a theoretical analysis, but describes operators own descriptions of how it is to consider environmental values and their explanations to why it sometimes fail.

3 Background to Environmental Consideration during Regeneration Felling

The overarching principle that the forestry has to abide by is an equal goal of keeping both production and environment sustainable in the Swedish production forest (Skogsstyrelsen 2015-01-30). This means that there are some rules forest owners must follow that force owners both to cut down fully grown forests, and also to preserve their important environmental values (Skogsstyrelsen 2014a). The Swedish forest agency monitors both aspects, and helps provide information and management recommendations on both. But this is mainly provided to the small scale foresters. Large scale forestry is primarily controlled through a mandatory processing of approvals, made by the forest agency at least 6 weeks before any sites larger than 0,5 hectares can be harvested (Skogsstyrelsen 2014a, 15§). The 30§ of the Forestry Act implies that considerations should always be taken to natural, cultural, historical and social values in the forest when felling (Skogsstyrelsen 2014a, 30§). The forest agency also prescribes further details on which environmental aspects that are of value and recommendations on measures that can preserve these during felling.

As a separate mission, the forest agency also monitors environmental considerations. Officers from the agency visit random sites before and after felling, in order to qualitatively evaluate the considerations. Quantitative data, from these qualitative evaluations, are then gathered and presented showing to what percentage the different categories of environmental values has been successfully considered. These reports have shown disappointing results, with failed attempts at considering environmental values, for some categories in up to 30 percent of the evaluated cases (Skogsstyrelsen 2015). It is the responsibility of the forest owner that these considerations should be taken into measure when felling (Skogsstyrelsen 2014a). In cases of significant violation of this responsibility, the forest owners can be charged and fined for malpractice. As the environmental goal, formulated by the government, to have sustainable forest ecosystems by 2020 will not be achieved

by foresters merely abiding by regulation, they need to be even more ambitious (Naturvårdsverket 2014, pp 184-195). The idea is that foresters should be able and motivated to reach the environmental goal through self governance, with help from experts at the forest agency, but also by acknowledging that sustainable forest ecosystems are a prerequisite for a sustainable forestry business. In fact about 80 percent of the Swedish forests are certified according to FSC or PEFC (Forest Stewardship Council Sweden, Svenska PEFC, Skogsstyrelsen, 2015-01-30).

3.1 Concerns in the Forestry Sector

The forest legislation has been thoroughly studied, and measures to preserve forest ecosystem functions have been tested and suggested by researchers for years. Forsberg (2012) writes that the forest policy is supposed to 'softly' govern landowners through *self-governance*, but with the number of actors required to execute a regeneration felling it becomes unclear who really bears the responsibility for environmental considerations. Forsberg has investigated whether the Swedish forest policy and regulation really responds to the ecological challenges or meets the international standard that Sweden has agreed to (Forsberg 2012). Appelstrand (2012) has looked into this freedom and tried to answer how it could encourage responsibility to be taken, and suggested that officers at authorities could take on a more facilitative role enabling cooperation between citizens, forestry workers and forest owners in order to preserve ecosystem functions in the forest landscape. Appelstrand has also assisted the Forest Agency in the ongoing project (also mentioned in the introduction above) to create a dialogue between different forest stakeholders, where opinions about what is lacking in the management of environmental considerations during regeneration felling has surfaced (Skogsstyrelsen 2011). Apart from the lack of clarity of responsibility division with a flawed chain of production, forestry workers are said not to have the right knowledge when it comes to the task of taking environmental consideration. Also the planning of regeneration felling was said to be flawed and environmental considerations not being prioritized. It is also said that opinions differ between the different actors and stakeholders on the actual ecological state of the forests and that a common vision was missing on how to take environmental consideration when felling. There were complaints about the discussion focusing too much on the monitoring of environmental considerations when felling and not on improvements (ibid).

The aim of the project *Dialog om Miljöhänsyn* (translated title: *Dialogue on Environmental Consideration*) was also to find a consensus on responsibility, find ways of reaching a common vision, increase the knowledge on regulations and to develop improved ways of monitoring the environmental considerations in regeneration felling (Skogsstyrelsen 2015-01-30). Participating were mostly representa-

tives from all forestry companies or forestry associations for landowners and representatives from groups concerned with recreational and environmental issues. But the dialogue was quickly criticized from the environmental, cultural and nature organizations for being too focused on the forest industry's issues and missing the holistic perspective on the sustainability of the forest ecosystems and landscape (Naturskyddsföreningen 2011, Naturskyddsföreningen 2012, Världsnaturfonden 2012). They also claimed that the research and expert perspective was lacking. Later in the dialogue process, it was expressed by representatives from the different participating companies and interest groups that the general interest for environmental consideration in the forestry was too low, that the issue has even been met with pure resistance by some members of the industry (Backman & Erlandsson 2011). More knowledge, leading to more motivation to execute the task, was agreed upon, by the group of representatives, to be the key to success in environmental consideration when felling (ibid).

4 Theory

The conditions for the taking of environmental considerations during timber harvesting are in this study assumed to be limited to the workings and properties inherent to the capitalistic system, recognized and described already in the nineteenth century by Marx and currently developed further, in order to understand environmental changes as mediated by various social asymmetries and types of power, in the research field of political ecology (Hornborg et al 2012). In political ecology, human social relations and human relations to the environment are recognized as inextricably intertwined phenomena (Peet & Watts 1996, Bryant & Baily 1997, Low & Gleeson 1998, Paulson & Gezon 2005, Biersack & Greenberg 2006, Peet et al 2011). From a political ecology perspective, power elites' strategies to accumulate power and wealth have shaped the human use of land and material resources throughout the development of societies and given rise to environmental load displacement and uneven resource flows – propagated by discourses on efficiency, economic and technological progress and even nature conservation (Hornborg et al 2012). In this study, forest machine operators' practices and their task of considering environmental values are in part analyzed from this perspective from political ecology, and from Marx's explanations of *The Working Period, The Time of Production* and *The Time of Circulation* (Marx 1985, pp. 207-229).

Actions taken in order to consider environmental values during timber harvest are here assumed to depend on forest machine operators' understanding of their tasks and the purposes of their practice. In this study, operators' understandings are not assumed to be transmitted to them from others in the harvesting enterprise. Operators' practices are here analyzed from the socio-cultural theories on knowledge and the meaning of actions as being developed in social practices, developed by Wenger (1998) and by Säljö (2000). As Wenger (1998, p. 6) wrote: *"Workers organize their lives with their immediate colleagues and customers to get their jobs done. In doing so, they develop or preserve a sense of themselves they can live with, have some fun, and fulfill the requirements of their employers and clients. No matter what their official job description may be, they create a*

practice to do what needs to be done." Implying that, in the socialization process, as forest machine operators would adapt to values, norms, memories and knowledge when engaging in a timber harvesting practice, they would not only be fostered by management demands, but the operators would develop the meaning of their own role and practice within their community of co-workers, and that meaning would also have to make sense for themselves as individuals.

In this study, forest machine operators' descriptions of their practice and tasks are analyzed from a theory of practical knowledge initiated by Schön (1983), and developed further by Molander (1993). Molander (1993) describes how practitioners culture are constructed of complex systems of actions with specific goals, objectives, tasks or functions, and how the personal integrity for a practitioner is in them being able to meet the requirements of their practice. That practice being the commonly agreed methods which are most suitable, taking into account the knowledge, tools, materials and required results, and how communication, or specifically *dialogue*, is important in the development of a practice and of practitioners knowledge. Molander (1993, p. 17) explains that a practitioners' knowing can be understood as something that is acquired when practicing something, when discussing used techniques or reflecting on previous actions, or when entering into a tradition or practice by learning from others. Forest machine operators' described actions and knowledge are here analyzed from this theoretical perspective in order to better understand the task of taking environmental considerations.

In keeping with the theory of practitioners' knowledge, this study assumes that operators are experts of their practice and have first-hand-experience of what is needed in order to fulfill their task of considering environmental values in the production forests. As pointed out by Schön (1983), there is a reoccurring view within the western societies, of practitioners' activity as merely consisting of mechanistic problem solving by the application of scientific theory and techniques when doing their tasks, in that the managers often see themselves as superior to those who take actions. Schön (1983) argues that this divide is a consequence of positivist ideas of reality as something that can be correctly understood and that optimal solutions thus can be found for our problems, by using technical rationality – it is thought to be an efficient system.

5 The Practice of Timber Harvesting and the Task of Environmental Considerations

Presented below are the theoretical analysis and findings from the interviewed forest machine operators that are interpreted from socio-cultural and critical perspectives on practical knowledge, learning and mode of production. The analysis and findings are based on operators' descriptions of the managerial and labor organization of regeneration fellings.

Most of the interviewed operators grew up in rural areas and in families where forestry work was common, and judging from their statements they seemed to identify themselves as particularly suited for forestry work. They talked about how one needs to enjoy the solitude, and that they were *'born into this profession*' (voice 8). And most of the interviewed operators said not only to enjoy working in the forest, but they also appreciated forestry products and the forest landscapes, most of them owned their own forests or lived near forests. Even though the operators said to enjoy their practice, they also told about the downsides of their profession – inconvenient working hours and harsh working environment, high demand for efficiency and broad competences.

The operators had experience of, and were working with other forestry practices than of merely regeneration felling. They were however interviewed on regeneration felling and the environmental considerations taken during harvest.

5.1 Characteristics of Forest Machine Operators' Practice

When listening to the forest machine operators' explaining their practice it became apparent that it involves a wide range of tasks and that it seems to demand some very different skills and knowledge. A metaphor told by the operator in the first interview stuck with me throughout the rest of my investigation and was also confirmed by the other interviewees was namely that of a *forestry machine*, mainly a harvester, being just like a *small factory*. But this factory is on wheels and is being

steered, operated and maintained by only one person at the time. And these small factories are most commonly owned by the workers themselves, but they do not own their product and do not profit from timber sales. But they still have to invest in all different types of capital to remain in the business of timber production.

5.1.1 Mode of Timber Production

As described in Part II of *Capital,* timber production differs from other industries in that trees grow independently of added labor or capital – even when artificial elements are added to the production, whatever is added is still "*inconsiderable compared with the action of natural forces*" in timber production (Marx 1985, p. 218, translated, quoting Kirchhof 1852). Another difference in the forestry industry described in *Capital* is that the production of timber is such an extended process that a small scale forestry owner will not yield enough returns in order to be able to make a living off it (Marx 1985). So if a person or company does not own vast tracts of forest land and hold timber that can be harvested regularly while many more acres of trees still are growing, making profit on capital invested in forest land would be impossible. It is therefore the power asymmetries and social inequalities in society that has made modern forestry possible, and thereby shaped the use of timber products and the management of forest resources.

Surprising no one, forestry is an industry driven to accumulate capital by increasing efficiency and maximizing yield of timber products. The inherit market forces in the capitalistic system will lead the forest industry to increased harvesting efficiency – by investments in machines and in adapting the forest composition and landscape, and lowering of employment costs – by hiring cheap labor, or fewer laborers with education and fast working pace (Marx 1985). As the Swedish forests cannot be moved to where labor is cheap, the labor efficiency and work intensity will have to increase in timber production and delivery. The organization will be stream-lined and forest machine operators will have to work fast to get those trees onto the timber market. All that stands in the way of timber order and delivery will have to be slimmed down. In fact, the standing volume of Swedish forests has increased in the Swedish forest sector, and productivity has increased dramatically because of the technological development, but this has also caused skilled labor to be displaced and the use of under-paid immigrant workers (Alarcón Ferrari 2012, p. 219, referring to Norberg 2009).

Production Efficiency and Pressure

In the interviews the operators told of pulp industries and sawmill being shut down, organizations being slimmed down, reduced budgets and of people given notice from their jobs. One operator explained the situation in the industry as such that '*the pressure comes in all different directions. Last recession everyone shut*

down business and denounced people. We stood still for two weeks I think. When we began the managers called and said that we had to start working three shifts because the industry had created a timber shortage – in three weeks! Then we had to keep on for two months of working three shifts to catch up' (voice 3). Then they clarified and said that '*nobody wants timber lying on stock. It's too expensive!'* (voice 3). And the general understanding of the Swedish forestry industries situation, held by the interviewed operators, were one of concern. '*It is not going well for the Swedish timber today*' they said. They said that companies are investing money abroad, '*but we cannot move the Swedish forests, and that is why we still have jobs'* (voice 8).

It seemed like the operators management wanted to limit their shared working time in order to increase production efficiency – more time spent harvesting and less time talking. Operators talked about the one hour that they still spent together each work day, and said: *'That hour is scheduled, but the management does not want us to use it that way, but we do it anyway. They believe that production can be increased further if we do not have the hour together. But we think it is important to meet'* (voice 5). The operators also told about how they felt rushed by a computer program installed in the harvesters: *'If we leave the machine for more than 5 minutes, a question will pop up on the computer asking what you are doing. As soon as we are not driving the machine, we have to register what we do, the information ends up in the repair and operation file which is sent to management. It's a bit stressful, I mean, we have no breaks. You get tired of that damn question popping up, you don't want see it' (*voice 6).

The practice of timber harvesting was in general described as hectic by the interviewed forest machine operators. Forest machine operators employed by forestry companies and economic forest owner association told that although they are producers of timber, their input in the industry is seen as a cost. And the contractors, or operators working for contractors, have tight schedules of paid hours for each regeneration felling. '*We are always working against costs'* (voce 8) said an operator employed directly by a big forestry company, while describing how their employers sees every move they made during a work shift when GPS coordinates and other geographical information is sent from the harvesting machines computer system to the central office. '*They see what our work costs, down to the smallest detail'* (voice 8).

If not working against costs, forest machine operators said to experience that they are working against time. A contractor stated about the forest machine operating business that '*It is trying to get as much timber as possible in the shortest time. That's what it's about'* (voice 2). '*It is quite stressed. They talk about saving, sometimes seconds here and seconds there that adds up to be a lot in one year.*

And that saves 10,000 here and 10,000 there. It is very much like that all the time' (voice 8).

Operators said that the companies' strategy is a bit shortsighted, that fellings could be made more efficient if more roads were build, but that long term investments are not supported by the tight budgets. One operator said that '*the trees are harvested at a younger age; it is most economical that way they say. But if it had been my forest then I would have wanted to wait until the trees were older than 80 years'* (voice 8). Another said that '*the forest industry is a damn panic industry. It's always panic in some direction. Either it's a panic to get the wood, or it's panic because there is too much wood. And it can change in just one week, from panic in one direction, to panic in the other'* (voice 3).

The current situation is that Swedish producers need to keep harvest cost low in order to compete on a global market of timber products. Even with all the stress operators have to endure, and all the efficiency measures taken in the industry, Sweden's import of forest raw material is much larger than its total exports. Sweden's export of round wood was 915,000 m^3 in 2013, while imports were 7.5 million m^3 in (Skogsstyrelsen 2014b).

Power Asymmetry and Insecure Working Conditions

The forest machine operators not only told about how recruiting newly educated people is hard today, because working in the forest has become unattractive to the younger generations, but they said that today it is also hard to get work in the forest. One forest machine operator employed by a large forestry company said that in the past everyone could get work in the forest. Being very satisfied with their employment, the operator said that '*I would not want to be self-employed today. I do not think anyone has a secure employment anymore. But I think I have much more secure employment than if I had been an employee of a contractor'* (voice 5), while also claiming that most of the fellings executed for that company are done so by contractors.

In order to make a profit it is important that the forest machine operators work fast – contractors are paid by the volume produced per hour. A contractor told that '*Profitability depends on the drivers and the machines and that there are jobs all the time and at the right price. The companies are terrible, they are always pressing prices. Forest owner associations offer higher prices, but then what they offer is many small fellings. That makes our business more slow, as we instead end up moving all the time. Maybe it's 150 forest owners per year that we're working for, and then we have to move in between'* (voice 2).

The contractors interviewed in this study are providing the same services to different big forestry companies and economic associations, they might even do work for private forest owners. But in order to stay in business they have contracts

signed with costumers managing large areas of forestland – employment agreements – promising them minimum amounts of timber volumes that they will harvest for a specific price per volume. It is according to these contracts that they manage their business, determine how many operators they can hire and how much they should invest in machines, and so on. One contractor said to have an employment agreement with a big forestry company that reaches over 3 years. Another interviewed contractor had a contract that extended over only 1 year; and furthermore said '*and I have a six months' notice – so in actuality I'm contracted for six months at a time. It's really very short contracts I think. It allows little space for planning of the economy, if you need to invest in anything new; because it's expensive machines we are driving'* (voice 4). The contracts promise a certain amount of work specified in timber volume, and price per volume produced. The customers give out work in the form of felling sites. Each felling site has a documented tree trunk mean with an expected timber volume. The contractors get paid after sending an invoice to the customer after each regeneration felling, and this is what they are compensated for. Another way in which the operator manages the money and time pressures is by investing in new machines, and one told that '*we have operated one kind of harvester for 23 years. But then we switched to a machine with a different driving style. And since we learned to operate the new machines, production has gone up 5-10%'* (voice 7). The contractor explained that the business was complicated and that '*you do not earn more money the more machines you have; it is not self-evident'* (voice 7).

The operators said that sometimes a regeneration felling takes much more time than expected due to forest composition. One of the contractors said that '*If you're working for a forestry company and get a contract saying that tree trunk mean is 0.45, then you know that almost every single tree is around 0.45. But if you come to a private owned forest, where it is said to be 0.45 tree trunk mean, and then you know that it can be lots of 0.18 and an occasional tree that is 1.5 cubic meters. That means a lot for the production with a harvester made for regeneration felling, much more than you think. We could have a deviation of minus 25% of expected output in such a case. As you understand, one can lose a lot of money that way'* (voice 7).

When the forestry companies and the economic forest owner association use contractors instead of hiring enough forest machine operators of their own, the risks associated with investment in fixed capital is removed from their business. Historically all forestry workers were hired directly by the companies. But during the 70s forestry machine investments and repair costs were almost entirely removed from the companies by offering the workers to take over the forestry machines and become self-employed: workers were given the chance to manage their own business and have the chance to make some profit out of it. In the interviews,

the operators told about how forestry contractors came into business as a consequence of forestry companies outsourcing of harvesting services: '*The companies originally had their own employees and their own machines, but they sold off the machines to the employees. That was a smart way for companies to be free of machine costs and save a lot of money' (*voice 7). While some contractors' enterprises flourished, and others had to work even harder than before in order to keep business afloat, most of them became dependent on signing contracts with very few and very powerful customers: and even more so when private forest owners are organized under economic associations running their enterprise much like the big forestry companies.

The operators talked about changes in the timber harvesting profession, and explained how they had more time for other tasks than mere harvesting before, when there were more workers in the forest. They told about how they used to spend more time investigating the harvesting sites, but that they also had to spend much more time on service of the forest machines back then. The contractors are today investing in expensive machines and balancing their economy within small margins.

In order for the Swedish timber to be able to compete on a global market, harvests need to be so efficient today that the use of highly advanced, well-functioning machinery, that is also adapted to the specific forest landscape and types of timber, is a necessity. Contractors told how investing in harvesting machines that can keep up with demanded production efficiency is hardly profitable, as by the time they have paid off the loans for a machine it is usually time to invest anew. And while contractors are indebted and taking the risks associated with investing in fixed capital, companies can push prices and have the upper hand in negotiations as the contractors' businesses depend on these contracts, and sometimes have to compete for one big customer against each other (for contracts with a forestry company or forest owner association).

5.2 Operators' Task of Taking Environmental Considerations

The operators described themselves as being nature enthusiasts, while also having an interest for forestry and forestry products. They were all generally positive towards nature conservation – '*I believe that both I and my college are involved in nature conservation'* (voice 6) – to such a degree as to consider themselves contributing to nature conservation: *'That's what we do! We create natural values. We are not only destroying, as some believe, but we are creating natural values with our measures'* (voice 7). The operators generally also expressed how taking environmental considerations made their job more interesting and easy: *'It's fine to take environmental considerations. It's just that we no longer need to operate near*

marshes, lakes and such. In this way it's better. It's terribly easy to save trees really!' (voice 2). And, *'The environmental considerations are good for us, because the forest should not be cut as clean anymore, as it was before in the 70's and 80's'* (voice 4).

5.2.1 The Importance of Careful Planning

One thing that the operators said made taking environmental considerations an easy task was careful planning – when the planner has marked everything in the landscape or on the map so that the operators know exactly what they need to do. The planners are hired by forestry companies and forest owner associations, and they inspect the forest area before harvest and make notes of what should be taken extra consideration to. Their plans are then added to the harvesting directives that are given to the forest machine operators. *'It's pretty easy to take environmental considerations. It's not hard. Everything is there on the map. The planners walk on bare ground and mark everything on the map that should be saved*. *Basically it is just to operate after their descriptions'* (voice 5).

But according to operators it is not always evident what the planners mean with their markings and descriptions, when it comes to taking environmental considerations. They talked about how it was good when they could develop some sort or relationship to or understanding for the planners – when the planners are few and stay on in the profession for some time. Then their descriptions and markings are easier to interpret. They also said that the planners' descriptions and markings are made even more understandable and appropriate to the maneuvering of forestry machines when the planners have experience of driving harvesters and forwarders. Some of the interviewed operators also talked about the importance of their making harvesting plans of their own, in order to take proper environmental considerations and avoid harming environmental values.

When asked about the disappointing reports coming from the Forest Agency, saying that environmental considerations are not taken to a satisfactory degree in regeneration fellings, the operators could not really describe why all environmental considerations were not taken. But when asked more specifically about what could go wrong during a regeneration felling, the forest machine operators proved to have experiences of situations where taking of environmental considerations was difficult. Based on their stories, I have identified a number of situations obstructing their task of taking environmental considerations. These situations are all, directly or indirectly related to planning: *When vision is restricted*, when *planners*' *markings* are off point or wrong, during *rainy seasons*, when considerations are *unpractical* or even *dangerous*, or when the *forest owners* make it difficult to consider environmental values. I describe these factors in more detail below. But

first, and foremost, it seems that when there are a lot of things to consider, there are also a lot of things that can go wrong.

When the operators' vision is restricted, the operators said that mistakes can happen – like when it is dark outside, or when the forest landscape is covered in snow. They talked about this as a big problem contributing to a lot of mistakes, and how this problem must be planned for in order to avoid those mistakes from happening. Like, '*When it is dark outside you cannot have the same overview everywhere'* (voice 6). And, *'In winter it can be a lot of snow, and the snow is hanging from the trees, everything becomes heavy. Then it is difficult to spot everything'* (voice 8).

The operators explained that the planners work was very important for the taking of environmental considerations, but that their plans could not be trusted entirely. *'The planners do not look at every square meter, so they can miss some environmental values'* (voice 8). But the planners' markings were not only said to be imperfect because of not covering entire felling sites, but also because the markings could be off point in the maps, or have disappeared from the landscape. Some of the operators shared experiences of having severely damaged environmental values because of faults in planning and markings: *'Once we run over an underground stream. It was in December, there was snow everywhere and impossible to see. If it had been marked on the map then we would have taken a different route'* (voice 8).

One particular type of environmental consideration – namely the one stating that damage caused by forestry operations should be avoided or limited on land and in water – was especially hard to take at times. It was essentially said that the heavy machines were the main factor causing soil damage. But the operators explained that the timing of the harvest was important, as the ground could become really sensitive in some areas during periods of heavy rain. *'If you have a very rainy autumn then you will get tracks in the ground no matter what you do. As long as we are ground-borne, we will make tracks. Even if we use smaller forwarders, the timber will weigh the same'* (voice 7).

The operators explained how the most determining factor when it comes to protecting the ground from severe vehicle damage was timing. Some forest floors could become really sensitive during rainfall, and it is the managers' job to send the operators to harvest where the forest floor is strong enough to carry the heavy machines. The operators explained that the only way to not damage the ground during rainy seasons was to operate in areas where the ground is strong. And in order to vacate sensitive areas, the operators need other options on where to move their operation to.

There were also other environmental considerations that at times could be difficult to take. The operators said that they could not always leave dead wood stand-

ing as it was sometimes unpractical, and could even be dangerous; *'We are supposed to save dead wood. We cut down standing dead trees that are in the way for us as barriers. We should leave as many standing as possible. Though that consideration can be a bit tricky in some places where there are many dead trees. They can swing and knock down on top of the machine, and rip down the lights ramps and everything. Once a tree hit the windscreen so hard that it exploded. We are constantly trying to put down standing dead trees to the side so we do not get them on top of us'* (voice 5).

Another factor affecting the preservation of environmental values after regeneration felling that some of the interviewed operators had firsthand experience of, was of difficult forest owners. They said that forest owners sometimes cut down eternity trees, snags and other forms of dead wood, after operators had left a felling site. They said that some forest owners had also ordered the operators not to take environmental considerations. *'There are forest owners who do not want us to take environmental considerations, "don't mind that nonsense, just drive, and take that stuff down" they tell us. But in the end it is the forest owner's responsibility. They are the one's signing the final document'* (voice 7).

5.3 Knowledge and Skills Enabling Environmental Considerations

The forest machine operators need the skills to steer in a tricky, rough landscape containing obstacles that should be preserved for wildlife, ecosystem functions and services, or for societal and recreational purposes. They need the skills to be able to operate the machine efficiently and correctly. And they need technical skills to keep the machine running, doing routine maintenance and repairs. They need to interpret and write documents and reports. They need to handle geographical information systems and digital maps in the forest machine computers. As being producers of forest products, the forest machine operators, and especially the contractors running their own business, also need to have knowledge about forestry products and services, market prices and business efficiency.

Knowledge that was rarely explicitly described in the interviews, but said to be of main importance by the interviewed operators, were practical knowledge of how to steer and maneuver the machine in the forest landscape. *'It is what the ground looks like, the structure of it, that determines how we operate in the forest, and the trees determine it of course. And after that it is the environmental considerations that determine how we operate, if things are marked here and there. Besides that we just have to try to do everything as accurately as possible at all times'* (voice 6).

When trying to understand practitioners' knowledge, it is important to acknowledge that practical knowledge, unlike theoretical knowledge, cannot be

detached from an action context and become pure speculation (Molander 1993, p. 21). The basis of practical knowledge is constructed by others example, and by practicing and by personal experience. The very basis of practical knowledge is not in language, but in the doing (Molander 1993, p. 40). It is from this theoretical perspective of practitioners' knowledge that we need to look at forest machine operators practice in order to better understand the taking of environmental considerations. Alike, we could also gain from understanding a practice as a culture, being constructed of complex systems of actions with specific goals, objectives, tasks or functions. And from understanding that within a practice there are commonly agreed methods that are most suitable, taking into account the knowledge, tools, materials and required results (Molander 1993, p. 22). We could gain from understanding that the personal integrity for, and what is motivating, a practitioner is in being able to meet the requirements of their practice and specific culture.

When interpreting the forest machine operators' stories about how it is to maneuver a forest machine it seems to be a very complicated process, involving both practical skills learned through experience and lots of specific knowledge about the forest landscape and processes. This practical knowledge seems hard to explain in words, and may even slip by unnoticed by the operators themselves until they have to operate in a new way. One operator explained the characteristics of their practice as such: *'One should think of everything always. And they always come up with even tougher demands on us. But you learn everything as it goes'* (voice 8).

Based on the interviews and drawing upon Molander (1993) I have identified two partly overlapping (but still distinct) types of practical knowledge that seem to be of importance for taking environmental consideration: the mastery of seeing, and the mastery of balancing taking of environmental considerations with other tasks of relevance for the forest machine operators' practice. These are discussed below.

5.3.1 The Mastery of Seeing

From the interviewed operators stories about their practice it becomes evident that *seeing*, and *looking around* is an important part of their job. That may sound a bit too basic, as no one would drive a machine without using their eyesight. But for a forest machine operator seeing seems to imply something more meaningful. The operators' stories all contained explanations of their practice as one that requires the operator to *recognize* elements in the landscape, and to be able to *see* how one should maneuver. This *vision* that the operators have described comes out of practice and experience, it is a form of practical knowledge so strongly build into the actions and reactions of the operators that it *goes without saying*. As Molander (1993) explains it, one part of practical knowledge can be understood as a mastery

of seeing: knowledge and attention are interrelated, our senses and perception is not separated from our knowledge (ibid, p. 84). Familiar situations become a pattern or a model for interpretation of new situations. The trained eye sees similarities, making it possible for the practitioner to act appropriately (ibid, p. 146). Moreover, Molander explains, when we learn to master tools, it is as if we expand our own body, we become familiar with our equipment (ibid, p. 128). As an example, the operators said to use their *seeing* when determining how to steer and operate: *'I have been in this profession for so long, I can see pretty quickly if it is possible to operate without problems'* (voice 2), and when taking environmental considerations: *'I think that experience means a lot, it allows you to see things that should be considered'* (voice 6)', and *'You have to have the eye to see what you should do. You can complicate things if you do not know how to do it really'* (voice 2).

5.3.2 The Mastery of Balancing Different Tasks

Knowing what to do, and how to do, in varying and complex situations require a certain type of knowledge, that is acquired by experience within the practice – to take suitable decisions a practitioner needs *orientation knowledge* (Molander 1993, p. 17).

As described above, the forest machine operating practice entails a lot of different tasks and a lot of different knowledge. They said that what guides their actions while harvesting timber was primarily the forest landscape and when deciding where and when to preserve environmental values. In order to do this, the operators need to be attentive: *'When we operate in the forest things may appear all the time, ditches and everything else that we need to keep track of. We're supposed to cut down the forest according to the directives and also save all that we have learned to save, dead trees, alder trees, and some other deciduous trees and so. And we have this rule that we should save a grove of trees after harvesting for 200 meters. There are many things you must keep track of'* (voice 8).

According to Molander, our attention is trained in a practice, attention is a skill, and it is a part of orientation knowledge (1993, p. 59). For the skilled practitioner it is important to be attentive to the atypical, the unexpected and the unknown. However for that to work it is required for part of the practice to run on routine without requiring any considerate attention. But the more that goes on routine the more difficult it is to be attentive to the unexpected – there is therefore always a tension between routine and attention in a practice (Molander 1993, p. 60).

The operators do not only need to be attentive to the landscape, but they also need to keep the pace of the other machines in mind when harvesting and placing timber, and when choosing routes and preparing the ground for the heavier machines. '*When the snow melts the trucks may not be able to access the timber that*

we have laid out. And during spring, we cannot pile up so much timber as it can get infested by insects, the timber should not lay outside for more than a week.' (voice 3). As suggested by Molander (1993), the knowledgeable practitioner is attentive while doing tasks. In addition, the knowledgeable practitioner has an overview of the situation: they know what has happened and not, and can anticipate what could happen. As the knowledgeable practitioner sees every situation as unique, they are always prepared for unexpected things to happen. And an experienced practitioner can remain confident while performing tasks. Keeping several options open prepares the practitioner for change of strategy while acting.

The operators said that they usually acted based on what was possible or practical. As for example when choosing where to leave eternity trees: *'If they do not stand in my way too much, then I let all the aspen trees stand. But if there are many aspen trees, and a couple of them are in my way, I cut them down. You have to consider what is practical and not. But if there is only one aspen tree then I will drive around it'* (voice 6). Or when deciding not to leave a buffer zone: *'Sometimes, the directive states that we should leave a buffer zone and only take out some of the trees next to a stream that runs right through a felling. Then sometimes we cut down everything anyway. I do not think there's any reason to save large spruces of 1 to 1.5 cubic meters in the middle of a felling site, they usually blow down very easily had we saved everything they asked for in such cases, the whole stream would blow apart by uprooted trees'* (voice 6).

The operators also told about how they would not always do what was practically possible, but when choosing how many trees to save and where on the felling site to leave them, or where to put dead wood – they would base their decision on what was economically reasonable or most efficient from a production perspective. Therefore it seems to me like the operators' balancing of different tasks guided them away from the task of taking consideration to the environment and instead prioritize production: *'The forest ground must be productive. If you save pines here and there it will inhibit the production from the shading'* (voice 2). Even when the operators firmly expressed that considerations should not be compromised with, they seemed to add that there are financial limits to what should be done during harvest: '*There should not be any damage by vehicles on the ground, there is never any question about it in the company, we must minimize damage by vehicles and that cost is allowed. There has never been any discussion about that, but it's up to us. But everything has its limit. If you harvest 200 cubic meters of timber and spent half the time on spreading branches and on repairs – then it is difficult to justify and defend. That is how it feels. It's important to keep that balance'* (voice 7). Further, it seemed like the operators' economical awareness could sometimes make their task of taking environmental considerations a difficult decision. As an example one operator said about creating dead wood in the shape of

snags: *'We have demands on us that we should create and leave a certain amount of dead wood per hectare. But it is up to us to decide where we place dead wood, and to some extent how large volumes. Maybe we should save 15 seed pines, but if you just leave the nicest and thickest ones, it feels a bit harsh. I have my own slice of forest and I feel like, "oh well, later 3 of these will have to get cut off and become snags." It is perhaps a little bit disturbed to think that way, it is my duty to create deadwood'* (voice 3).

What I am suggesting, based on the interviews, is that it is not operators' attitude or lack of instructions of how to take environmental consideration that hinders them to sometimes fulfill this task. Generally they seem fully aware of the importance of considering environmental values. But during regeneration felling they need to balance the task of taking environmental considerations with other (sometimes contradictive) tasks. This act of balancing at times results in that other tasks are given higher priority. Molander explains that our actions are what they are because of their larger context of coherent activities, professional practices, social institutions and so forth (Molander 1993, p. 119). To master anything in practice is not just due to our maneuvering and understanding. To master a practice means mastering a cultural and material whole. It requires knowledge about the operational limits of the practice and about our personal limits (ibid). I am suggesting that the limits to environmental considerations were experienced by the interviewed operators to be of economical restraints – *operational limit* – or of practical restraints – *personal limit*. In the next chapter I discuss how forest machine operators' practice of taking environmental considerations can be developing, within these limits.

6 Operators' Learning to Improve the Taking of Environmental Considerations

In aiming to understand what is enabling operators to take proper environmental considerations, while as described above, it is operators' knowledge that enables and guides the taking of environmental considerations, but as also presented above, considerations to environmental values are limited by the frames of operators' practice and by the reality of timber production in a global capitalistic system. If we want to understand how knowledge of environmental considerations and how forest machine operators' tasks and practice are developed, then we can gain from looking at knowledge as situated and socially constructed, and not as transmitted truths.

As Schön has expressed, practitioners experiment (Molander 1993, p. 150). And because the practitioner is alert they learn at the same time, and their repertoire of examples and experiences change – therefore the attentive practitioner is also a learning practitioner. This corresponds well with the socio-cultural perspective, according to which we are always learning. Knowledge is not something that is transmitted to us, but we are always participating in social practices where we learn how to adapt to the norms of those particular practices. The practice of machine operators is no exception. For instance, one operator describes how different and difficult it was to learn a new way of maneuvering the machine when they were given the task of collecting branches and treetops for biofuel, but how they today find it normal. *'In the late 90s we started to get a demand on tree tops and branches. At that time, I did not want to collect it, because I was not used to it, I did not know how. Today I do not want to fell timber without collecting the tree tops and branches, it happens almost automatically to me now'* (voice 6).

The norms direct our attention to certain objects and events, and away from other. Säljö explains (2000, p. 66) that we learn to pay attention, describe and act in real life in the way that the environment allows and encourages. From a constructivist view of learning, we are active and we create meaningful wholes of the

things we perceive (Säljö 2000, p. 59). When we act and learn from our experiences, we learn within the context of the interpretations and thought patterns appropriate for the social practice we are participating in, which are used, provided to us, and developed within that practice (Säljö 2000, p. 67). In this chapter different opportunities for operators to learn more about taking environmental considerations are elaborated and discussed in more detail.

6.1 The Importance of Communication for Workplace Learning

Communication is important in a practice because language is material in its meaning and in its consequences (Säljö 2000, p. 89). Communication is not only used to discuss, make sense and give meaning to objects and events, but it can also *move people to action* (ibid). Within each practice there is advice, guidance and there are disagreements. In such cases, we must reason between different alternatives and argue for or against. Descriptions of various kinds are often useful, but descriptions can mean many different things depending on the context (Molander 1993, p. 43). Intentional action is part of a specific context with its own meanings and aims – language and communication is a constitutive part of action (Molander 1993, p. 155).

The operators talked about how communication helped them to cooperate and execute their tasks in an efficient way. But some talked more about how communication was important in order for the foreman or contractor to be able to control what the operators are doing. One contractor spoke about how they had made routine of checking whether the operators had read the harvesting directives before arriving at the regeneration felling site: *'Usually when something goes wrong it is because the lack of communication! I do not think the machine operators always ventilate their thoughts enough. Sometimes they have not read the directives before the felling. I always interrogate those I work with. I always read the directives, and I usually ask them control questions so that I notice if they have done the same'* (voice 7). These claimed interrogations were not said to be made out of disbelief in the operators' capacity, but seemed to resonate with the responsibility role that the contractor had taken on for themselves - it seemed to be the contractor's task to directly address and remind the forest machine operators of their tasks before harvesting.

Some of the operators spoke about how communication between coworkers helped them take proper environmental considerations: *'Most of the environmental considerations are already marked by the planner. But if we come across something that looks valuable or vulnerable, that we are uncertain about, then we can go and look together and discuss how we should proceed. Even though all the special considerations should be marked by the planner, there are the general*

considerations that we must take in addition to that. We have to plan those, and it requires a lot of communication for it to be done properly' (voice 8). One of the operators that were working for a big forestry company spoke about how they communicated a lot within their own workgroup and how this facilitated the effectiveness of their practice. They had made a habit of discussing their days work when changing shifts and they had regular weekly discussions, and even longer monthly discussions with their foreman. The operator said that the regular communication and discussions created an awareness – kept them from falling into routine – and that the communication made them more coordinated during harvest – that they had the same goals. *'It's important to discuss things so that it doesn't turn out so that one does one thing and the other does the complete opposite. But it's also hard to actually do what you settled on; because it could easily happen that you fall back into the routine way of doing things'* (voice 8). Also that, *'It is a strength to be able to talk to each other in the working group, it means that you can become organized, everyone will work in the same direction. I think that is how our team is. We work together towards common goals; we are trying to improve everything. You might hope that it could happen straight away, but it can take time'* (voice 8). The operator explained that the time spent discussing helped them execute fellings more efficiently.

Molander (1993) argues that the dialogue is a basic model for learning, and that the goal of the Socratic dialogue is to discover knowledge and insight that the participants already possess, even if they are not aware of it (Molander 1993, p. 89). Questions, answers and reflection make non reflected knowledge and insights available. The goal is to achieve practical and theoretical knowledge, in the character of how we should act and knowledge of how reality appears (Molander 1993, p. 89). When communicating, or more specifically, when participating in dialogue, forestry workers develop shared understanding of the aims, goals, working environment and reality of their practice of regeneration felling. Molander explains that what Socrates does in his dialogues is to reveal ignorance. The dialogue procedure is such that the participants may themselves discover their lack of knowledge (Molander 1993, p. 90). It is when operators participate in dialogue that they can develop knowledge on how to maneuver in the forest landscape and how to properly consider environmental values. In order to improve their skills and knowledge on how to maneuver in the forest, how to recognize and consider environmental values, operators need insight about their limits and faults – they need insight about their *personal limits*. The operators need time and space for reflection in order to seriously understand what caused the end result of a harvest, by thinking and discussing through the actions taken during the regeneration felling (Molander 1993, p. 155).

Another way of making sure that the harvesting is running smoothly and efficiently, was to communicate and seek understanding with forest owners, timber buyers or others in the organization that in some ways could affect the harvesting operation. Some of the interviewed contractors also explained how it was important for the taking of environmental considerations that they could have fair discussions and agreements with the clients. The cooperation with people external to the harvesting operation would primarily make sure that the forest machine operators would have enough time to do their job properly. The operators told of many factors that need to be aligned in order for the harvesting to run smoothly. One operator told about how their felling site had not been prepared properly that very same day that we met, and said that they had experienced many similar problems where the management had told them to go harvest in felling sites that was not yet prepared, or during the wrong season.

The dialogic aspect, and importance of communication, shows itself in the way contractors are trying to achieve justified, mutual understanding of concepts, norms, reasons, descriptions, and ways of acting and so on (Molander 1993, p. 97). Participants in a dialogue need to share basic skill and experience, since a dialogue is collaboration. A major driver in the dialogue is the ability to question, visualize and analyze. To make the familiar into something alien is a vital part of the learning strategy (Molander 1993, p. 127).

6.2 Courses and Audits Aiming to Improve the Taking of Environmental Considerations Skills

Besides the workplace learning described above, developed by the practice itself and contributing to improving the knowledge and skills of the operators, there are also formal courses on how to take environmental considerations that the operators need to partake in. From a socio-cultural perspective on learning it is not certain that what they learn during those occasions will make any difference when the operators go back to their usual practice of regeneration felling, if the knowledge created during those specific occasions does not easily conform to their usual practice of harvesting timber.

According to the interviewed forest machine operators, every company and contractor seemed to have different routines and standards for what type of education they participate in when it comes to learning about environmental considerations. One contractor talked about how they had just taken a web based course and was very pleased with the learning results. Some of the contractors seemed to have very organized schedule with courses, and some other interviewed operators had less structured education programs, but sounded confident in that they would receive the education they needed anyway. The operators explained that contractors

and their workers need to have *green cards* that they get after finishing one type of environmental education.

The operators also receive feedback from internal or external audits that are arranged by forestry companies and forest owners' associations once or twice per year. They audit the fulfillment of certification criteria and taken environmental considerations. Most of the annual auditing takes place in randomly selected regeneration felling sites where the operators have harvested earlier during the year. They usually walk around in the area together with their foreman and someone from the organization that is responsible for environmental issues and look at environmental considerations taken in order to discuss how they were executed or how they could do better in the future.

From the operators' explanations it seems that the courses are not always about receiving new information, but sometimes more of a platform for discussions and reflection that is appreciated by the operators: *'The courses have been different. Sometimes we have gone out with other machine teams, in groups of 20 people. But now, last time, it was only our team, we dared to ask more questions. Then you recognize where you have been driving and why you acted in a certain way. I think that's good, having follow-ups in such small groups'* (voice 8).' From a sociocultural perspective we can understand why the operators appreciated discussing environmental values together, because knowledge is not in objects or events, but in our descriptions and discussions about them (Säljö 2000, p. 63). Knowledge is developed with and sedimented in language. Communication precedes thinking and to learn about objects and events is to learn how to think according to a particular social practice (Säljö 2000, p. 67). Even though practical knowledge can be *tacit* – unspoken – the meaning of those practical skills is developed and learned in a social practice. A lot of our practical knowledge can be discussed in abstract terms and developed into a language shared within a social practice. But as objects and events have different meanings in different social practices, it can be helpful to use lesser abstractions when, as an example, expertise is brought in to discuss environmental considerations with timber harvesting professionals.

The operators expressed differing opinions about the usefulness of the audits when it comes to learning how to better take environmental considerations. Not all operators said that the discussions taking place there were enough. Some of them seemed upset that the felling sites audited were randomly selected when they had experienced some difficulties in a particular harvesting site that they would have wanted to learn from instead: *'Often we would have wanted to visit other harvesting sites than the randomly selected once. Last year we did a harvesting against a stream that we handled with much uncertainty – there was a lot we had wanted to find out from that site'* (voice 8). And similarly, some operators seemed upset that the areas where environmental consideration courses took place in are much too

ideal places, where environmental values are too obvious, and wished that they could learn what to do in forests that looked more like the production forests that they usually worked in: *'During the education we only look at nice conservation areas. I would like to visit places where there are no obvious environmental values and learn what I should do there. It would be more interesting to look at the problematic areas than only at nice natural forests. But besides that, I think the education is good, it refreshes the memory, and that is important'* (voice 3).

Our social practices, as Wenger explains (1998, p. 51), are *"first and foremost, a process by which we can experience the world and our engagement with it as meaningful."* It is within our social practices that we develop, negotiate and share our understanding of the world, it is where we give objects and events meaning, it is where we can make sense of things (Wenger 1998, p. 48). If courses and audits on environmental considerations are experienced as useless by the forest machine operators – if what is communicated during those occasions does not conform to or can be made to fit with the norms and aims shared within operators practice of forest harvesting in production forests – then what is learned during those occasions might not develop operators practical knowledge of how to take proper consideration to environmental values during regeneration felling.

6.3 Acknowledging Operators' Actions Motivates Development of Knowledge and Skills

Some of the operators spoke about how their managers wanted to limit their time together as much as possible, which seemed to upset them. *'When we meet, we discuss how the day has been, and what we should pay attention to and such. That hour is very important I think. It would be very sad if they removed it'* (voice 5). The operators' expressed need to meet and discuss their practice can easily be understood from a socio-cultural perspective, where a justification process is never understood as a purely individual process. Our own understanding of what we do and other peoples' perceptions and descriptions of our actions must be made to coincide (Molander 1993, p. 244). When individuals search for reasons for their actions or for justifications of their decisions, they do this in relation to the other participants in the social practice – it is done in a dialogue, imagined or actual. In a social practice, where actions require collaboration, it is also important to know each other well and have a common understanding of the enterprise, in order to act appropriately and jointly (Molander 1993, p. 227).

We can from Molander's argument understand operators frustration with their managers when they feel that their time together with coworkers are restricted and when they have no say in what feedback they receive in the annual audits. From a socio-cultural perspective on practice and intentional action, it is important to

acknowledge individuals actions and intentions, and not only present statistics of forest machine operators' joint performance, costs and errors, and give feedback on randomly selected harvested sites. As explained by Molander (1996, p. 131), participants who are never recognized or acknowledge in their social practice *turn into objects* and without acknowledgement our actions *turn into movements of objects* (ibid). Objectifying operators' actions devalues the operators' expert knowledge and skills, and brings with it the risk of operators loosing pride in their workmanship.

Although the operators identify themselves as fit for the solitude of their profession, they said that they enjoy meeting and discussing the harvests with forest owners, and they said that they enjoy getting confirmation for doing a good job. *'I have always enjoyed working in the forest. It's quiet and nice, you are often alone. So you'll probably have to be in a certain way to want to work there. But when we go to a felling site we have contact with the forest owners who we work for, and they can sometimes come out and visit. I think that's good, then you get a better idea of their forest, when talking to the owner directly'* (voice 4). And, *'I like when the forest owner comes out and shows interest, gives feedback. Most people think we are doing a good job. It feels great when you can deliver good quality and that the owners think it is good'* (voice 7).

I have often encountered the assumption that the lack of actions taken to consider environmental values in the forests is due to operators' bad attitude towards nature conservation. Based on this study, I suggest that lack of recognition and dialogue in the management of timber harvesting and environmental considerations could have contributed to lost environmental values and poorly executed regeneration fellings. My analysis of forest machine operators' stories, shows that to take proper consideration to the environmental values operators need for their actions to be acknowledged in dialogue in order to facilitate development of their knowledge and skills. In doing that it need to be kept in mind that when operators are learning, they are also creating and preserving their perception of their own identity and actions (Molander 1996, p. 255). In dialogue, people's actions and identities are at risk; there is a personal side to the reasons people give to justify their actions that cannot be removed, and that is why it should take place in a dialogue between people with respect and sensibility for the others expertise and identity (Molander 1996, p. 261).

7 Conclusions and Discussion

The answer to the question of what characterizes forest machine operators practice and their task of taking environmental considerations, posed in the introduction can be summarized as follows; what seem to be characteristic of operators' practice are time and money pressures due to the inherit market forces of the capitalistic system in combination with the nature of forest growth. The timber harvesting practice generally also seem to demand some very different skills and knowledge, as operators need to be able to operate and maintain highly advanced machinery, while maneuvering in tricky and varying forest landscapes, while also keeping in mind and reporting on all of their varying tasks: having to do with production, efficiency, orders and contracts, safety, regulations and certification criteria. The operators also sometimes have to cope with forestry employers shortsighted business strategies, while there are apparent asymmetries between powerful clients and small-scale producers of timber products that are working under insecure contracts.

Continuing on the first question, in answering what characterizes operators' task of taking environmental considerations; it seems to be that it is a generally easy and appreciated task, as it often entails leaving trees and valuable objects in the production forest. But as the harvesting of timber takes place almost all year around, and often around the clock, the conditions for taking environmental considerations are not always optimal. Environmental values can be hidden under snow, be unseen during nighttime, unmarked in maps or in the landscape if too much time has passed since planning. Sometimes it is almost unavoidable to damage the forest floor, water bodies or other environmental values if the weather is unfavorable or when the felling sites contain myriads of environmental values or have crossing streams, paths or some form of historical remnants – then taking environmental considerations to a satisfactory degree is difficult.

Answering the second question posed in the introduction, of what type of knowledge and skills are needed in order to take considerations to the environment while operating a forest machine and performing regeneration felling, can be

summarized as follows; what seems to be needed include skills in operating harvesting machines fast and correctly, be able to recognize environmental values in varying landscapes and knowing which specific measures that are most suitable in order to consider these, while being able to overview the harvesting area, interpreting the harvesting plans, and keeping track of the pace and place of the forwarder, timber tucks, or other forestry workers. These skills and knowledge are learned by practicing and participating in the timber harvesting practice, and developed between coworkers' mutual understanding of goals, and most suitable measures and strategies on how to reach these goals.

Answering the final question, of how a socio-cultural perspective contributes to understanding the development of forest machine operators' skills and possibilities of taking environmental considerations, can be summarized as follows; as the practices of timber harvesting are developed in social interactions between operators and their interpretation of managements', clients', and other coworkers' expectations and wishes of them, the taking of environmental considerations are part of a specific context with its own meanings and aims. It is the norms and aims of operators' practices that direct their attention and guides their actions. Attention is a skill trained in a practice. In order to improve their skills and knowledge on how to consider environmental values within the operational limits of timber harvesting, operators need insight about their personal limits and faults. My analysis shows that in order for forest machine operators to take proper consideration to the environmental values they need for their actions to be acknowledged, questioned and analyzed in dialogue in order to facilitate development of their knowledge and skills. More dialogue could lead to nature conservation becoming a higher priority and to the development of knowledge about how to take environmental considerations, and perhaps better planning of regeneration fellings (maybe even more efficient harvests?).

7.1 Questioning Aim and Norms of Timber Harvesting Practices

This study shows that lack of opportunities for dialogue and reflection, might facilitate a tendency within operators' practice to slip into an economistic thinking and prioritize production over nature conservation, when they find themselves in situations where they have to choose one or the other. The question is whether timber harvesting practices really facilitates operators to develop all of the skills and take all of the time needed in order to never harm environmental values during regeneration felling? As practitioners' integrity is to meet the requirements of their profession, operators' professional integrity would lead them to take proper environmental considerations; according to Molander (1996, p. 22, translated quote) "*A craftsman never allows himself to get excited or take shortcuts. Work will take*

the time it needs and the material that are most appropriate." Could it be that the norm of economic profit has been internalized in operators' practice to such a degree that the norm of taking environmental considerations has become secondary – only performed when it does not jeopardize production? The operators' did say that their practice was about *getting as much timber as possible in the shortest time* and *it has always been about saving seconds here and there*. And so, these questions about the norms and aims of operators' practice might be worth looking into, maybe by observing operators' behavior in action during regeneration felling, and by interviewing them directly after and having them motivate their actions.

But, setting aside operators direct influence over the taking of environmental consideration, as contractors and forest machine operators have to harvest within restrictions set by managers according to company and association plans and budgets. The responsibility for nature conservation becomes displaced, when contractors and forest machine operators become accountable for taking proper environmental considerations. As timber prizes are set by market value and depend on demand and competition: budgets, plans and contracts for regeneration fellings reflect market values instead of labor intensity. If the forest landscape and tree composition is not properly accounted for when harvesting assignments are given to the contractors and forest machine operators, taking proper consideration to environmental values can be very difficult.

The questions remains whether it could that the strive for efficiency and maximum yield takes priority over environmental considerations, and if this trend might sustain as long as the global capitalist system sustains – no matter what the Forestry Act might state? But being aware of the market forces' effect on natural resources does not mean that we can give up on conserving environmental values in the production forests entirely. Maybe the mode of production will continue to develop in the same way, leading to faster and even more efficient timber harvests. Because environmental values considered today will probably still be preserved during the next 70-100 years, until next harvest, and saving these could mean a lot for forest ecosystems, recreation and cultural history conservation locally. And we should keep in mind that usually, the loss of environmental values cannot be undone!

But despite this argument, it is also important to ask if considering environmental values during regeneration felling really is an effective way of attaining sustainable forest ecosystems? This question should of course better answered within the research field of conservation biology. But one can still wonder if the aim of combining production and conservation within the productive forest area is based on sound ecological reasoning, or a consequence of the forestry sectors wish to control nature? This wish to control and foresee what will happen with nature can not only be objected to by researchers, but can also be experienced and recog-

nized by practitioners working with natural resources, and by local people living near and off the lands. It could be time to start a dialogue between those experiencing the forests and those trying to control it in order to find new ways of management. Even Molander (1993), in trying to understand practitioners' knowledge, put forward a concern for the dominating role technology and science has taken on in our modern societies:

> "Modern technology and science has given us the ability to master and manipulate an increasing number of 'parts' of reality, reality seen as an object, for it is this perspective that determines modern science. Now we have become increasingly aware of the consequences of our actions, that we previously knew nothing about or could not foresee, even if we cannot oversee them all and completely. The complete overview is a myth. However, we see enough of negative consequences, such as issues about the environment, in order to realize beyond all doubt that we do not know what we can control. Thus, we can be sawing off branches that we are sitting on without knowing that this is what we doing. We are now aware of this. It applies not only to the technical systems but also to the social systems – and what is 'technical' and what is 'social' is not always meaningful to try to distinguish, we live in a socio-technical system." (Molander 1996, p. 195, translated quote)

7.2 Reliability of the Study

A study's reliability is traditionally meant to measure whether the study could be repeated with the same results, but it also presupposes that the investigated phenomenon is static (Trost 1997, p. 99). But a study's credibility can be questioned when reflections on interview method, interpretation and reporting of results are missing entirely (ibid, p. 102).

As this is a qualitative study, and does not have the ambition to report on verifiable facts about Swedish current forestry, everyone may not recognize the arguments made. Every forest machine operator must certainly have their own way of experiencing their situation, and of explaining it in words. Similarly, the interviewed operators did not give uniform descriptions of their practices, as they are different, and their work situations are different, and their situations are not static. The practices of timber harvesting and the task of considering environmental values in production forests are probably changing while I am writing this here now. But even if this study does not present generally applicable facts about the forestry sector, it does provide an applicable perspective that could be tried out and kept in mind in the forestry organization and management of regeneration felling and environmental conservation. This study's assumption that lies in accordance with Molanders pragmatic perspective on knowledge is that "*Knowledge opens up the*

world, shapes it and leads us in the best way forward" (Molander 1996, p. 256, translated quote). So, the validity of the conclusions made here can really only be measured when applied in reality.

But returning to the question of reliability of interview method, interpretation and reporting of results, I would argue that the interview questions were open enough for the operators' to give similar answers if asked again. As the interviews were recorder and transcribed, the interview method precision should be thought of as reliable. But what was interpreted as important in the interview material, and which perspectives that were chosen for the theoretical reading of the material might certainly have been different if done by another researcher. Nevertheless, the arguments presented in this study do hopefully make valuable claims of why we should value and consider forest machine operators' experience and knowledge in the management of regeneration felling and environmental considerations. And even if we do not choose to make decisions based on Marxist theories on inherent forces of the capitalistic system, it is a perspective hard to disclaim, and could very well be valuable to have in mind when managing natural resources and environmental values.

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