Comments on the Weyerhauser Pasquia-Porcupine 2005 Vegetation Management Demonstration Project Proposal

By Paule Hjertaas,
Spokesperson and President of the Saskatchewan Network for Alternatives to Pesticides (SNAP)

On behalf of SNAP

Submitted on June 14, 2005

Introduction

The vastness of the boreal region makes it one of the few remaining places on earth where entire ecosystems function. These ecosystems support some of the greatest abundance of wildlife on
the continent including massive caribou herds, intact predator-prey systems with healthy populations of top predators like wolves and large numbers of birds." (Ricketts et al. 1999, quoted in Blancher) However, more and more of it is getting under management pressures, including from forestry.

According to the new edition of Elizabeth May's *At the Cutting Edge* (1), logging in the boreal forest is being done in an unsustainable manner all over Canada, including Saskatchewan. "Approximately 80% of everything logged in Canada is clear-cut, while 90% of the cut comes from primary and old-growth forests." Furthermore, "the area cut annually has steadily increased. The basic fact that nearly all the cutting is in the natural forest confirms that Canada is converting forest ecosystems to fibre farms". And "there is no track record of ecologically healthy second-and third-growth forests following heavily mechanized clear-cutting." (all references are 1)
"Local wood shortages are already occurring due to mill overcapacity, yet cutting and overcutting are justified on the basis of future investments in silviculture", although the reality of those benefits is increasingly questioned. Current research indicates that intensive forest management practices have little effect on volume of timber produced in most cases, although the volume is consistently increased in the mathematical models for calculating annual allowable cut."(1)

These comments are divided in three main sections.

The first addresses the use of herbicides in forestry related to current forest management practices, which allegedly create the problems for which herbicides are seen as a "band-aid" solution. (p.2)

The second part explains the licensing of pesticides in general and of glyphosate in particular, with their recognized shortcomings. (p.8) Human health effects starts on page 11. Comments on risk management section of the proposal are on p. 16.

The third part is a review of glyphosate effects on plants, animals and the ecosystem (p. 17) and includes a lot of new evidence on its effects of frogs (p. 21) and zooplankton, as well as its interaction with environmental factors such as pH. (p.17).Comments on monitoring in the Weyerhauser proposal are on p. 24.

The conclusion starts on p. 26. Appendix 1(p. 31) deals with labels and label information, and Appendix 2 (p. 34) reviews what is currently known of glyphosate formulants, except POEA which is dealt with in sections 2 and 3.

Before we discuss the proposal, we would like to offer comments on **public involvement**. We understand that Weyerhauser conducted consultations on the open house model, without an open and frank discussion of their proposal in an open forum. We only learnt about this proposal ourselves on May 16, 2005, from an email. While this model may fit the bill for mandatory consultation as far as government is concerned, we find the open house model unsatisfactory for public information and discussion, as members of the public will only come out with their own understanding of the issue, limited by the questions they think of asking and their ability to decipher whether the answers are truthful or informative enough.

Section 1
Forest Management in Saskatchewan creates the need for herbicide use

In Saskatchewan, 88 % of forests are Crown land. By definition, the Crown owns 100 % of the commercially allocated timberlands. Today, Weyerhauser is the dominant multi-national forest corporation in Saskatchewan, with control over 3 million acres of the province. As in the rest of Canada, about 80 % of the logging in Saskatchewan is clear-cutting. Furthermore, the Forest service is actively promoting reliance on clear-cutting. (1)

The government reduced the size of the Forest Management Agreement covering the original Weyerhauser logging by 1/3, but allowed the annual cut (ACC) to double. Weyerhauser's 20-year logging plan (2001) allows overall harvesting rates in its lease areas to increase 26 %, while the government admitted that the plan was "logging-bases", not "ecosystem-based". "Old-growth forests in the Weyerhauser FMA are being liquidated".(id) There is no doubt that the areas in the commercial zone are being overcut as, as one resource dwindles (softwoods), others of less value takes its place to maintain the economy.

Such substitution also took place in fisheries as cod and salmon became less abundant, to finally result in the crash of the fisheries.(id) Such overharvesting of prime resource and their replacement by others of lesser value to keep the economy going are not restricted to forestry and the cod fisheries. It has been documented by Jared Diamond in his recent book *Collapse* (2) as being a historical constant in most societies who chose to fail.

Not satisfactorily restocked (NSR) lands Linked to Damage due to Clear-Cutting
"According to the latest statistics available, Saskatchewan's percentage of not satisfactorily restocked (NSR) lands is the highest in Canada – 64 %," 25% of which being logged-over lands left by Simpson Timber. Government analysis suggest that the rate of increasing deforestation would lead to a 34% reduction in the annual allowable cut (AAC). (1)

A large amount of NRS is the main reason given by Weyerhauser for using intensive silviculture practices including planting and herbicide use.

Pasquia-Porcupine
According to Weyerhauser, 5 times more softwood were harvested than hardwoods in the Pasquia-Porcupine FMA area between 1975 and 1996. Weyerhauser recognizes that no effort was made to determine the pre-harvest stand description so this assessment of the area may lack accuracy.(3, p.6) Currently, "only 44 % of the area surveyed had some softwood present, and only 6 % had stocking of 60% or more conifer (considered pure softwood)." (3,p. 6) As outsiders, we do not know which area was surveyed, or how representative or complete it is of the previously cut areas.

Weyerhauser purchased the area from Saskfor MacMillan and attributes the poor regeneration of conifers to "both a lack of planting and the absence of tending activities on established conifer plantations." (3, p.7 of report) We need clarification on whether government or industry is responsible for restocking cut areas and NSR. (4)

Besides looking at the toxicity of herbicides or their desirability from an ecological point of view, it should be questioned whether herbicides can currently remedy overcutting, lack of planting or inadequate management. Experts in the field (9) document the replacement of conifers by deciduous cover across Canada, even where and when herbicides are used, and in spite of them, leaving the effectiveness of the treatments unanswered. It seems that Weyerhauser wants to use herbicides to achieve a shorter rotation, to be able to cut faster. Perhaps if the harvest was sustainable, instead of overcut, they could wait for natural succession to take its course.

Herbicide use
Herbicides are used to kill trees, bushes and other vegetation perceived as competing with the planted species. That is their purpose. Glyphosate kills everything it touches, that is why there are warnings about drift on all labels, and why most formulations cannot be sprayed by air for agriculture in Saskatchewan.(12) At lower concentration, it may set back plants, but mostly it kills. In a spray area, there may be some areas where plants will survive because protected by taller vegetation, but this has not been quantified.(9) While glyphosate is not as residual as many other herbicides, the time it takes for ½ the product to disappear (½

life) would depend on soil pH and other local conditions. Soil 1/2 life varies from 2 to 174 days.(7) Its breakdown product, AMPA is more persistent than glyphosate, with a soil ½ life of 119-958 days.(8) Although AMPA has low acute toxicity, it causes a variety of toxicological problems.(8)

Glyphosate gives no special status to endangered or useful plants. "Weeds" are present on forest lands because they are a symptom of clear-cutting. Clear-cutting, significantly damages the soil though mineral exposure, compaction, and erosion from ruts. It also destroys the subterranean mycorrhizal fungi that perform essential functions, leaving the soil nutritionally and functionally impoverished. It is known to lead to species conversion (replacement of a desirable species by others). (1, p. 29, 9)

"Herbicides are used only because clear-cutting has been so damaging that natural regeneration either needs "help", or has failed, and plantations need protection. But the so-called "weeds" are actually part of the healing process after disturbance." (1) Some fix nitrogen, and all prevent soil erosion and provide a microclimate for new growth. (1 p 31) This ground cover helps protect the water and soil from further deterioration and run-off. Indeed, treatment of riparian areas with glyphosate causes water temperatures to increase for several years following treatment.(8)

Aerial spraying is not discriminatory, and is known to drift (7,8). It would be an unlikely scenario that a spray applicator could actually identify rare species while ground spraying, and avoid it. Biodiversity is not enhanced or preserved by creating habitat for common species at the expense of those that need old growth forest or other specific conditions to thrive. (more in section 3)

Clear-cutting also increases the release of CO2 to the atmosphere.
As timber harvest increases, Canadian forests have already shifted from being a carbon sink to being a net source of greenhouse gases.(1) As currently practiced, timber harvest results in an a net flux of CO2 to the atmosphere. Clear-cutting itself increase the release of CO2 to the atmosphere. Exposed soil, especially if scarified, may decompose more rapidly. Saskatchewan, as most other Canadian provinces, has signed on "to a significant pledge found within the 2003-2008 National Forest Strategy: 'On a national basis, maintaining carbon reservoirs and managing the forests to be a net carbon sink, over the long term.' " (1, p 64) Killing all that may grow on a parcel of land, except the planted species, hardly seems conducive to carbon sequestration, or the maintenance of biodiversity.

Weyerhauser's intentions
At this point, Weyerhauser has already built 250 km of roads when they were allowed 100, and are currently doing 50 % of their logging in summer instead of the 3 % planned.(4) This hardly seems like good management. Now, to compensate for management errors, they are proposing to use herbicides in forestry.

The minutes of the Mar 23-24, 2005 joint Pasquia-Porcupine Management Committee indicate that herbicides are suggested mostly for winter cut block that cannot be site prepped. Dr Lautenschlager (6), an "expert" on forest disturbances, indicated that the main reason to use herbicide is summer clear-cutting, and that winter clear-cutting, form Ontario to the Maritimes, preserves the soil, reduces compaction, and preserves the natural seedlings which have already started, therefore saving the time and money needed for replant and "conifer release". This is absolutely contrary to what Weyerhauser is stating. We would like to see some evidence from Weyerhauser of their claim.

As stated in their document, Weyerhauser intends this demonstration project in order to ***"initiate the development of a standardized herbicide based vegetation management planning, approval, implementation, and reporting process."*** (3, obj.4) Let's put this proposal in perspective.

Recent Canadian herbicide use in forestry

Throughout the last decade, herbicides have been applied to approximately 175,000 (10) to 200,000 ha (11) of regenerating forest lands per year, equivalent to approximately 18-20 % of the area harvested. The majority of the treated area occurs in the province of Ontario, with somewhat lesser amounts in New Brunswick and British Columbia. In these three provinces, 41% of the area harvested is treated annually with herbicides. Considering that Saskatchewan has the

highest rate of "not satisfactorily restocked" (NSR) lands, it is likely that area sprayed would be higher on an annual basis.

In Canada, glyphosate dominates the forest herbicide use market with 90% of the national market. (2, 3). There have been no studies done of the effects of clear-cutting or herbicides at the landscape level (6, 9).

The future of herbicides in forestry according to Weyerhauser

The minutes of the Mar 23-24, 2005 joint Pasquia-Porcupine Management Committee offer more insight into what Weyerhauser really has in mind: to save money.

- Currently, Weyerhauser cuts an average of 6000 ha/yr in the area, of which 2000 are replanted.
- About 500 to 600 ha/year would require spraying (1/3-1/4 cut area)
- Spray costs 1/8 the cost of manual treatment. Using herbicide in the right conditions is really cost effective
- The plans for the province are to eventually use herbicide on 11 % of Weyerhauser land base, which would amount to 330,000 ha.
- This proposal is designed for Pasquia-Porcupine, but could be used in PA FMA, but Weyerhauser is proceeding cautiously
- Mechanical thinning is possible
- To the comment that this proposal is a "foot in the door", the "thin edge of the wedge", the answer was that: "You need to see this for yourself to get a clear understanding from the ground."
- Yes, it has been done before in other locations.
- Most things used in our houses are more toxic.

Some important questions remain:

1. Will spraying actually increase the volume of timber? Probably not.

"Current research indicates that intensive forest management practices have little effect on volume of timber produced in most cases, although the volume is consistently increased in the mathematical models for calculating annual allowable cut.(1)

2. Can silviculture (whether intensive or not) save conifers in the boreal forest, and the forest industry?

"Local wood shortages are already occurring due to mill overcapacity, yet cutting and overcutting are justified on the basis of future investments in silviculture", although the reality of those benefits is increasingly questioned.

3. Who will pay for the herbicide spraying?

The province already pays for roads, insecticide spraying, some replanting. Would Saskatchewan have to pay for the herbicide spraying too?

4. If research indicates that clear-cutting does not imitate natural disturbances and is, in fact, responsible for the change in species (1,9), who is looking at an alternate harvesting system that would do a better job of preserving our boreal resources? Maybe Weyerhauser' s funds would be better spent looking alternative cutting methods.

Standards and Certification

We understand that Weyerhauser has received the CSA stamp of approval for forest management [The ISO 14000 (environmental management systems)]. "Critics point out that, under ISO 9000, if you make a lousy widget, you could be quality certified as long as your widget is consistently lousy." (1, p.89) Under ISO 14,000, "it would remain the exclusive decision of the company forest manager to develop the approach to sustainable forest management." If he or she decides that the goals of preserving biodiversity are best met through clear-cutting and using herbicides, then those practices would be part of the Sustainable Forest Management System, certified by the CSA (Canadian Standards Association.)(1, p.89)

We believe this proposal of using herbicide in the Pasquia-Porcupine area is in fact an attempt at embedding herbicide use in forest management, as mentioned in the objectives of the plan and confirmed by Weyerhauser, and we disagree.

Furthermore, recent reviews of the CSA certification found that the performance requirements were not being consistently implemented, undermining its value as a label assuring ecologically harvested forest products."(1, p. 89) In contrast, the Forest Standards Association (FSA) standards are based on the ecological acceptability of practices on the ground. (1, p 90) and now have a Canadian Boreal Standards. 1.4% of forest lands in Canada are certified under FSA, and we believe their products will have a market advantage. We feel that the FSA standards are the way to go to ensure sustainability of the forest resource in Saskatchewan.

Conclusion

Clear-cuts are necessary if the goal is even-aged stands, which are not ecologically desirable, being more vulnerable to insects and diseases.(1) Although glyphosate is a less toxic herbicide than many others to animals for the end-points tested until now, we know that some plants and animals are more susceptible than others. There is a current concern on the effect of glyphosate on frogs, for instance. Several species of algae and fish have also been identified as being negatively affected below the levels the expected environmental concentration (EEC). By changing the vegetation for several years, glyphosate has an indirect effect on animal species using the sprayed area during those years. See section 3 on the ecological effects of glyphosate for details on how it affects species and the environment.

It is important for Saskatchewan to decide which way we want to go in forest management. Current clear-cutting leads to a large amount of not satisfactorily restocked land (NSR), a net flux of carbon to the atmosphere, a heating and drying up of the area, making it harder for desirable species to establish, and loss of diversity. Now Weyerhauser is trying to establish standardized use of herbicide in the forest, which will potentially lead to thousands of kg of herbicide used per year on thousands of hectares, thereby potentially impacting water quality and biodiversity even more.

With global warming inevitable, and Canadians and indeed the world's mounting concern for sustainability, we must weigh the economic, ecological, and social costs of the current energy-intensive approach to forestry. Keeping forests healthy and resilient is a logical adaptation strategy to protect them from global warming. "Instead, industrial forestry practices stress natural systems to such a degree that many areas of forest will be unable to recover fro the intensive logging." (1) Industry and the government must both play a role in redesigning the system to truly protect forests.

These points cast doubt on the necessity of herbicides in forestry. We support dealing with the real problem first such as overcutting and clear-cutting rather than relying on herbicides. The use of herbicides in forest management should not be embedded into any standards.

References

1. May, Elizabeth; 2005; At the Cutting Edge The Crisis in Canada's Forests; Key Porter Books
2. Jared Diamond; 2005: Collapse How Societies Choose to Fail or Succeed; Viking books
3. Weyerhauser Pasquia-Porcupine 2005 Vegetation Management Demonstration Project Proposal; April 29.2005
4. Allison Brady, per. Comm. June 3, 2005
5. Jeff Keith, pers. comm.. Saskatchewan CDC June 1, 2005
6. R.A. Lautenschlager, pers comm. May 26, 2005 ; Atlantic Canada CDC; (506) 364-2661;
7. Cox, Carolyn; Glyphosate; JOURNAL OF PESTICIDE REFORM/ WINTER 2004 • VOL. 24, NO.4 http://www.pesticide.org/glyphosate.pdf
8. Cox, Carolyn; Glyphosate (Roundup); JOURNAL OF PESTICIDE REFORM/ fall 1998• VOL. 18, NO.3
9. Lautenschlager, R.A., and T.P. Sullivan. 2002. Effects of herbicide treatments on biotic components in regenerating northern forests. The Forestry Chronicle 78(5):695-731.
10. Thompson DG, Wojtaszek BF, Staznik B, Chartrand DT, Stephenson GR (2004) Chemical and biomonitoring to assess potential acute effects of Vision_ herbicide on native amphibian larvae in forest wetlands. Environ Toxicol Chem 23:843–849

11. Wojtaszek BF, Staznik B, Chartrand DT, Stephenson GR, Thompson DG (2004) Effects of Vision_ herbicide on mortality, avoidance response, and growth of amphibian larvae in two forest wetlands. Environ Toxicol Chem 23:832–842
12. Saskatchewan Agriculture, Food and Rural Revitalization; 2005 Guide to Crop Protection

Section 2
Debunking the Myths – Roundup and Regulations

Purpose of Weyerhauser's proposal
One of the stated objectives of Weyerhauser in putting this proposal is:
#4 *"To initiate the development of a standardized herbicide based vegetation management planning, approval, implementation, and reporting process in collaboration with SE for use by industry and government forest managers in Saskatchewan."*

In other words, now that Saskatchewan is developing standards of forestry, Weyerhauser wants the use of herbicides enshrined in Saskatchewan forestry management practices. This stated objective is the "thin edge of the wedge", allowing further expansion of herbicide use in Saskatchewan's boreal forest, an area recently untouched by direct herbicide applications (except under power lines and along roads)

Considering the expanse of the area under control of logging companies, the decision to use herbicides in the forest could lead to a large expansion of pesticide use in Saskatchewan, as admitted by Weyerhauser in the minutes of the Mar 23-24, 2005 joint Pasquia-Porcupine Management Committee.

***Discussion* of the conclusions of the *Saskatchewan Task Force on Use of Herbicides in Forest Management* report's**

The Weyerhauser proposal indicates that the conclusions of the *SK Task Force on Use of Herbicides in Forest Management's* report (1985) are still mostly valid.

Problems exist with several of the recommendations, which are based on several disproved assumptions which have to be exposed to properly understand the issue.

Recommendations
C. : "*Intensive research into environmental fate and efficacy of federally registered herbicides is done as part of the registration process".*

F. "That a public awareness program be proceeded with." And "of prime importance in these extension type activities is *to ensure that the public are aware of the stringent federal regulations controlling the registration of herbicides*." "The proposed demonstration project is one component of a public awareness program"

G. "*such (intensified forest management) practices require the judicious use of herbicides in many cases." "There is far greater availability of information at present on the benefits and risks associated with the judicious ruse of herbicides in forest management in Canada"*
"The issue is not proving that registered products and methods are safe of effective (completed a part of the federal registration process) but <u>whether a proven product or method is useful to meet the … management objectives in an approved forest management plan</u>."

<u>"whether a proven product or method is useful to meet the … management objectives in an approved forest management plan"</u> As seen in section one, it is questionable, considering the current evidence, whether using herbicide will achieve the goal of better reforestation in softwoods, or increase wood volume production. This section will deal with consistent statements that registered pesticides are safe.

In these recommendations, readers are led to believe that the Federal licensing and re-evaluation decisions of the Pesticide Management Registration Agency (PMRA) is a safety stamp of approval, and that they are based on total knowledge which is up to date and reliable. In fact, especially when a pesticide has been registered a long time ago like glyphosate, one wonders what it relies on. The following section will deal with the PMRA shortfalls as it relates to glyphosate.

In short:

- It is illegal to say or imply that the registration of a pesticide means safety
- Glyphosate has not yet been re-evaluated in Canada since its registration in 1976.
- This means that none of the studies done since then and sent to the PMRA have been properly considered in the registration of glyphosate.
- There are many health end points for which no studies are requested (respiratory problems, endocrine disruption, immune problems, mixtures, low dose studies), and no studies are mandated for indirect effects (loss of population due to loss of habitat for instance).
- The studies mandated by the PMRA deal with glyphosate by itself, and not in formulation. No one can claim that their results apply to formulations where glyphosate is used with other products because, when chemicals are mixed together, they can develop new properties (emergent properties) a well known phenomenon in many sciences.
- Vision ® (registration # 19899.00) contains the same active ingredient (a.i.) in the same concentration as Roundup®, and also contains the surfactant polyethoxylated tallowamine (**POEA**). Although not listed on the label, POEA is an ingredient of health and environmental concern. It makes glyphosate at least three times more toxic, and has significant toxicity of its own on aquatic organism by affecting the gills. It has also been considered the “guilty” ingredient in skin and eye reactions in humans.
- The surfactant is Catena is still unknown to us at this point, as most formulants are still secret in Canada. Mr Darryl Sande was refused the name by Monsanto because it is secret. However, 70 % of the formulants registered in the US are already listed as toxins in one or several US Acts.
- The Canadian government keeps no pesticide sales or use data base, which makes it difficult to determine whether a pesticide registered a long time ago, such as glyphosate, may pose new risks due to massively extended use and exposure.
- In the Prairie provinces, glyphosate and its degradation product AMPA are mostly <u>not monitored</u> in the environment because they are hard and expensive to analyze, and a reliable technology was not available until now. (Alan Cessna, pers comm. June 2, 2005)
- AMPA is residual longer than glyphosate, is toxic on its own.
- Other ingredients of glyphosate formulations have the potential to change how organisms react to glyphosate. For instance, glyphosate by itself is more toxic in acid water, but POEA makes it more toxic in alkaline pH. (see section 3- frogs)
- Other formulants used with glyphosate can be toxic and residual in the environment as well.

It is illegal for industry to claim that registration of a pesticide product means safety.

Such a statement is illegal under Canadian law, “unless authorized by the Minister” (PCP regulations (19). The reason such a statement cannot be made is specified in DIR96-02 under 2.0 general principles: “The terms “safe” or “safer” in the context of environmental claims may be misinterpreted as relating to personal safety and, as a result, may cause some confusion.” (PMRA Regulatory Directive DIR 96-02 and Pest Control Products Regulations)

Furthermore, the fact that a study is done does not necessarily imply it has been considered in a product’s re-evaluation. Glyphosate is a case in point.

Registration of glyphosate and health and safety issues

The first glyphosate products registered in Canada in 1976 (Roundup original). (see appendix 1)

No document can be found on the PMRA web site[1] pertaining to glyphosate in regulatory notes (REG series), re-evaluation decision documents (RDD series) or re-evaluation documents (REV series). Canada seems not to have publicly accessible re-registration eligibility decisions (RED) documents as the US EPA does, if we have any at all. Neither is the original glyphosate decision available on the PMRA web site. Indeed, two forms of glyphosate are due to be re-evaluated in the next five years, including the one used in Vision® forestry herbicide and Roundup®. There are nothing but assumptions regarding the basis on which glyphosate was registered, especially when one knows that glyphosate, as well as 2,4-D and many dozens of other pesticides (herbicides, insecticides etc) was on the list of chemicals for which IBT laboratories had done all or most of the safety testing. The IBT testing[2], as well as that of many other labs at that time and since was found to be fraudulent. [2] [3]

It is important to notice the pattern that continues to this day: Canada as well as the US EPA knew that there were no or few valid studies on which to base a glyphosate risk assessment and yet, **the chemical stayed on the market without any restriction knowing this important lack of information**[3] until new data was submitted and re-registered several decades later.(US EPA[4], but apparently not yet by Canada) Furthermore, when the PMRA has determined to restrict some uses of a product, the pesticide continues to be sold with labels that are known to be inappropriate to protect health and environment for several more years.[5]

Every five years, a pesticide formulation has to be re-registered.Presumably, any new studies mandated since the last registration should be submitted and considered adequate. However, data does not appear to be reviewed in a major way at the time, which is the purpose of a re-evaluation. In fact, a search for “re-registration” did not get any hit with that term on the PMRA web site. All that came up were re-evaluation documents, but none for glyphosate. (June 3, 2005)

The PMRA site indicates that glyphosate has had no major re-evaluation of its registration data since original registration in 1976. Indeed, the fact that 2 forms of glyphosate are earmarked for re-evaluation in the next 5 years[6] proves that no re-evaluation has yet taken place, as Canada is

---

[1] PMRA web site- index http://www.pmra-arla.gc.ca/english/main/azindex-e.html

[2] Novak, Roger A.; *The long arm of the lab laws*; Committing fraud in a chemical laboratory can be hazardous to your freedom; © 2001 American Chemical Society. (on their site)

[3] Van Strum, Carol; 1983; *A Bitter Fog Herbicides and Human Health;* Sierra Club Book, p.189-198 “
No registrations were suspended on the basis of falsified or shoddy IBT testing” p 188
p 192 “In April 1981, von Stackleberg files a Freedom of Information Act request for results of E.P.A. audits of other testing laboratories.”
‘The report they sent was on many more than eight or nine labs’, von Stackleberg says. ‘Of eighty-two labs audited, there were serious ‘deficiencies’ in twenty-five, and the routine destruction of laboratory reports and other documents made it impossible to audit the work of another twenty-two of the eighty-two labs.’

[4] US EPA re-registration eligibility decision (RED) for glyphosate (dated Sept 1993**)**
http://www.epa.gov/REDs/old_reds/glyphosate.pdf

[5] Will the PMRA recall all unsold products with old labels more permissive than current guidelines? Not in the past. A good example is racemic mecoprop which will be allowed for sale until Dec 31, 2009.

[6] **PMRA Re-evaluation Program (April 2005 to June 2009);**
Re-evaluation Note REV2005-04; http://www.pmra-arla.gc.ca/english/pdf/rev/rev2005-04-e.pdf
The purpose of this document is to provide advance notice to registrants, pesticide regulatory officials and the Canadian public of the active ingredients that will be re-evaluated by the Pest Management Regulatory Agency (PMRA) from April 2005 to June 2009.
Glyphosate acid 1071-83-6
Glyphosate: isopropylamine salt 38641-94-0

still far behind in even doing one re-evaluation on most older registered products.[7] It is clear from this information that the information on which the PMRA bases its registration of glyphosate are not up to date.

However, the US EPA published its re-registration eligibility decision (RED) for glyphosate (4) indicating that some glyphosate end-use products are strong eye and skin irritants (p.3), that some inerts (in Canada called formulants) are toxic to fish and have to be labeled if used over water (POEA is one of them), and that labeling does not preclude off-target movement of glyphosate by drift. It also give a re-entry interval of 12 hours. Only the eye, water and drift warnings makes it in precautions section in Canada, while skin is dealt with under first aid, and there is no re-entry interval mentioned on either Vision® or Catena labels. (see appendix 1)

The EPA also requested additional data on nontarget terrestrial plants and spray drift, which *"are not part of the target data base for reregistration of glyphosate*." That means they would not be considered in a further re-registration decision. It also states that "The Agency **does have concerns regarding the potential hazard to endangered plant species and the Houston toad**. However, the Agency is *not requiring any modification of use or label changes in this document*." (4)

Following the pattern amply documented for the US pesticide licensing and re-evaluations,[8] the value section of the recent risk-benefit assessment of 2,4-D[9] is poorly documented (3 references and no consideration of alternatives in the assessment) and seemingly done without any science at all. As there is no public access to the Canadian glyphosate registration decision, no comments can be made on the validity of the safety data and value assessment of glyphosate.

Human Toxicity of glyphosate

Glyphosate is at least 10 times more toxic when breathed in than when eaten. Signs of toxicity were apparent in all animals, even in the lowest concentration tested. [11] "According to reports made to the California Pesticide Illness Surveillance Program, symptoms of exposure to glyphosate herbicides include eye irritation and inflammation, burning eyes, blurred vision, skin rashes, burning or itchy skin, nausea, sore throat, asthma and difficulty breathing, headache, lethargy, nose bleed, and dizziness". **Error! Bookmark not defined.**

"Irritation" can seem like a less serious symptom than those caused by other pesticides. However, it can be significant. For example, Italian dermatologists in 2004 reported treating

---

[7] Report of the Commissioner of the Environment and Sustainable Development to the House of Commons; The Commissioner's Perspective – 2003 http://www.oag-bvg.gc.ca/domino/other.nsf/html/99repm_e.html (The Commissioner passed similar comments in 1999 and 2002, reports also available on the site)

[8] Benbrook, Charles M, Ph.D.; 1996; *Pesticides at the Crossroads*; cconsumers Union; Yonkers, NY

"Despite the quantity and quality of intellectual effort applied to this task, risk assessments for pesticides remain hotly disputed, especially when debated within contested regulatory proceedings. Compared to risk assessment, benefits assessment methodology for pesticides has been developed through less intense, less openly participatory process, and has received less attention in the regulatory process. But benefits assessment is a structurally flawed and weal leg on the regulatory stool." P. 93

"A benefits assessment is generally carried out only when a pesticide is in regulatory trouble, and can serve as a registrant's last line of defense." P.93

"Non-chemical preventative practices or biointensive IPM options are generally not seriously considered. EPA does not require such data and registrants understandably pass up the chance to be so thorough. Lacking this information, the EPA has no basis on which to reach a judgment that non-chemical alternatives are effective and therefore has no basis to lower the estimate of benefits associated with use of a pesticide." P.94

"Registrants and others defending the use of a pesticide under EPA review have often predicted major crop and economic losses if products ere banned, frequently citing benefits assessment studies. In fact, we don't know of a single documented case in which such high losses actually materialized…The benefits assessment process is routinely biased in favor of chemical solutions and against biological and management-based pest management systems."

"Paradoxically, while high projected benefits have helped preserve high risk pesticide registrations, assessments showing low or negative benefits have rarely hastened cancellation of a pesticide." P.94

[9] Proposed Acceptability for Continuing Registration (PACR Series) 2005 Re-evaluation of the Lawn and Turf Uses of (2,4-Dichlorophenoxy)acetic Acid [2,4-D] (PACR2005-01)

a patient who knelt on the ground where her son had just sprayed a glyphosate-containing herbicide. She then put on clothing that had been on the ground where he had sprayed and napped. Within hours her skin was burning and she developed a blistering rash on her back, legs, and feet that lasted for a month." [10] Among other outcomes, past studies have linked glyphosate to circulatory problems, cancer, mutations, and reproductive effects.[11]

As science progresses, new questions arise and mechanisms of action are identified and can then be tested. There have been a lot of studies published since the "comprehensive review" of glyphosate in forestry references quoted (2000), including many studies indicating negative effects of glyphosate on several toxicity end-points not currently considered by regulatory authorities (immune, sex hormones, Attention Deficit Disorder) or considered and previously estimated as negative (cancer, mutagenicity).[10] Research may indeed be done, but most of the research considered by the PMRA is its re-evaluations are financed and submitted by industry, and is still mostly secret. (for instance the February 21, 2005 draft 2,4-D[9] document had an incomplete bibliography, and the all industry submitted data was still inaccessible for evaluation by third parties). All the newer research on glyphosate is unlikely to have considered by the PMRA in product registration as it has not yet been formally evaluated.[6]

Weyerhauser refers to only two review studies on glyphosate to imply the safety of the product. Both studies are dated 2000. One of these articles is a compendium with only the abstract available, and the other a review. Weyerhauser mentions that a lot of information was generated since the *Report of the Task Force on Use of Herbicides in Forest Management*. Although we have not yet been able to obtain these articles, they are listed in the references of more recent articles. Many articles were reviewed for these comments, and it became obvious the reader should NOT strictly rely on the conclusions of an abstract. I have not yet seen an article that supplies all its raw data, and the write-ups of methodology at times leave a lot of unanswered questions regarding methodology, from the numbers of animals used (important for statistics), to unmeasured important variables, or how data were analysed.

A lot of recent information indicates that negative impacts, even death, are occurring for several aquatic species at lower concentrations than considered acutely toxic to ½ a population in 96 hours (LC50) by the PMRA (1.43mg active ingredient/L), concentrations which have been documented to occur in water in aerial application of glyphosate in field studies.

These recent environmental studies are discussed in section 3.

Other considerations about Federal Pesticide Regulation

Glyphosate qualifies to be included in the federal *Commissioner of Environment and Sustainable Development*'s consistent criticism of the PMRA documenting the agency's shortcomings such as the slowness and inadequacy of the re-evaluation process over many yearly reports.[7]

It is also important to realize that we are presently at a major change period in the regulatory process. Canada is harmonizing regulations more and more with the US, and the US EPA is making many changes which have to be relevant to Canadian pesticide registration and re-evaluations.

1. The first change is the **EPA's review of their cancer risk assessment**:

---

[10] Cox, Carolyn; Glyphosate; JOURNAL OF PESTICIDE REFORM/ WINTER 2004 • VOL. 24, NO.4 http://www.pesticide.org/glyphosate.pdf

[11] Cox, Carolyn; Glyphosate (Roundup); JOURNAL OF PESTICIDE REFORM/ fall 1998• VOL. 18, NO.3

"*In the first such update in nearly 20 years, the EPA said children 2 years old and younger might be 10 times more vulnerable than adults to certain chemicals. Children between the ages of 2 and 16 might be three times more vulnerable to certain chemicals*." [12]

The EPA also said it is seeking new ways to gather scientific data on possible carcinogens. It said "the consideration of new, peer-reviewed scientific understanding and data in an assessment can always be consistent with the purposes of these cancer guidelines." [12]

This review should change the balance of the evaluation of all previous cancer data and it will, if the White House allows it, allow the EPA to use their new assessment.

At least three recent epidemiological study is linking glyphosate to cancer.[10] [13]

2. The second is that the **EPA proposes to update and revise its data requirements** for the registration of conventional pesticide products. The inadequacy of the mandated tests, and how outdated they are, have been brought forward for many years in Canada as well as in the US.[14]

The chemicals I have reviewed usually show a number of missing data. As most laboratory toxicity testing is done at high dose and by ingestion, acute inhalation toxicity (LC50) are often missing. IN the case of glyphosate, we know it is at least 10 times more toxic when breathed in than when eaten. Both Vision® and Catena formulations mention eyes in the precautions but skin only under first aid. Neither label mentions a re-entry interval. Generally, the level at which there is no effect on the respiratory system (No effect level: NOAEL) has not been determined for most chemicals.

---

[12] Heliprin, John**;** March 30, 2005; EPA Says Children May Be Vulnerable than Adults to Carcinogens; Associated Press

[13] DeRoos, AnneclaireJ et al; January 2005; Cancer Incidence among Glyphosate-Exposed Pesticide Applicators in the Agricultural Health Study; Environmental Health Perspectives. VOLUME 113 | NUMBER 1

Ccox 04

[14] NATIONAL CENTER FOR ENVIRONMENTAL RESEARCH (U.S. Environmental Protection Agency, National Institute for Occupational Safety and Health, National Institute of Environmental Health Sciences); COMPLEX CHEMICAL MIXTURES; FY 2000 Science to Achieve Results (STAR) Program; Opening Date: April 10, 2000, Closing Date: July 10, 2000;

Location of quote: Under "Research Goals and Scope," then find "Exposure Assessment."

"*Since the data requirements …were first codified in 1984, information needed to support the registration of a pesticide chemical has evolved as the general scientific understanding of the potential hazards posed by pesticides has grown*."[14] Over the years, updated data requirements have been applied on a case-by-case basis to support individual applications, or imposed via Data Call-In (DCI) on all registrants of similar products. "*Although the data requirements imposed have progressed as scientific understanding and concerns have evolved, the codified data requirements have not been updated to keep pace. This proposal involves changes to the codified data requirements that pertain to product chemistry, toxicology, residue chemistry, applicator exposure, post-application exposure, nontarget terrestrial and aquatic organisms, nontarget plant protection, and environmental fate. Coupled with updating data requirements, EPA proposes to add a few new studies, reformat the requirements, and revise its general procedures and policies associated with data submission. By codifying existing data requirements which are currently applied on a case-by- case basis, the pesticide industry, along with other partners in the regulated community, attain a better understanding and are better prepared for the pesticide registration process. This proposed rule does not apply to the data requirements for the registration of antimicrobial pesticide products; inert ingredients for pesticide products; spray drift, product performance (efficacy); or biochemical, and microbial pesticides*."

The EPA states clearly there are no methods for assessing the toxicity of mixtures of chemicals. "A major, long-term challenge for regulatory agencies is to develop defensible means of combining exposure assessments in a manner that provides meaningful ways of determining potential health risks from total exposures to many chemicals. Lacking are methods to characterize potential toxicological risk."

3. **Unknown effects of mixtures of pesticides, or pesticides and formulants or any other chemical**

There are still no or very few data to evaluate the effect of mixtures, even for the pesticides most commonly used together. (e.g. 2,4-D, mecoprop and dicamba, or glyphosate and POEA) .Even the US EPA admits to floundering when evaluating mixtures.[14]

As glyphosate is not used alone in real world applications (see appendix 2 -glyphosate formulation facts), the studies on the isolated pure glyphosate are therefore not the only relevant matter to the toxicity of Roundup or any other pesticide formulations which we encounter every day.[15] This is especially true and is well documented in the case of the increased toxicity of glyphosate formulations containing POEA. "Regulatory" studies cannot and do not account for the whole reality.

Even studying each formulant separately would not give the whole story either any more than knowing all there is to know about pure oxygen or pure hydrogen can give an idea of the properties of H2O, water. David Suzuki referred to this as an "emergent properties" which is a well known fact in many branches of science. In the case of glyphosate, there are many studies done with formulations containing POEA such as Roundup ® or Vision ®. Only those studies can give a more accurate idea of the toxicity of the formulation product.

In the US, at least 12 formulants are known to be used in various glyphosate formulations. Nine of those are registered in Canada, in addition to **polyethoxylated tallow amine** surfactant (CAS # 61791-26-2, list 4B) which is acknowledged by Monsanto in all Canadian registered forestry products. Except for **polyethoxylated tallow amine**, we don't know if, or in what product, they are used, because they are secret. They may be present in the 50 % of the formulation which is not glyphosate or POEA. In the U.S., 88.8 % (8/10) are already recognized as chemically, biologically, or toxicologically active. 60% (6/10) are listed as being or having been used as active ingredients (3 are food preservatives).

Of these 10 formulants, 50% (5/10) are listed by the Pest Management Regulatory Agency (PMRA) as potentially toxic: 10 % (1/10) on (List 2) and 40% (4/10) as "may be toxic but insufficient data" (list 4B), including **polyethoxylated tallow amine**. One only is a minimum risk product (list 4A), and 40% (4/10) are on List 3 (not on other lists). (see appendix 2 for details on glyphosate formulants)

4. **Endocrine-disruption** is no longer in question in science and governments,[16] although research protocols are still in development.[16] It is qualified as a daunting task to study complex interactions which often are species-specific, life-stage specific, and tissue-specific.[16]
Low dose and mixture studies are also planned.[16] These bring up fundamental questions for the current regulatory approach also followed by the PMRA. *"The issue (of low dose) is an important one because the presence of such effects would challenge the validity of our current approaches to hazard identification and risk assessment for endocrine disruptors…EPA's entire chemical regulation framework is based on the presumption that as dose increases, so does the prevalence and severity of adverse effects."*[16]

Endocrine-disrupting, immune, low dose, and developmental neuro-toxicology studies are thus not yet part of mandated studies by regulatory agencies, and regulatory decisions are made

[15] See appendix 3 for Hertaas fact sheet on formulants
[16] SUBCOMMITTEE ON ENDOCRINE DISRUPTING CHEMICALS; March 4, 2005; Endocrine Disrupting Chemicals; (EDC) Research Program Review; Final Report of the Subcommittee on Endocrine Disrupting Chemicals; http://www.epa.gov/OSP/bosc/pdf/edc0503rpt.pdf

without input on these end-points, and based on the old "presumed"[16] criteria of the dose makes the poison and a threshold below which there are no effects.

5. **Varying toxicity of Isomers**
Recent research also brought to the forefront the varying toxicity of isomers, mentioning that regulatory agencies are currently not paying enough attention to this problem. This may not apply in the case of glyphosate.

6. **Unknown effects of pesticides with environmental factors**
Many recent articles studied synergy between different combinations of pesticides, or interactions and potential synergy of pesticides with metals, predation, disease, food availability, pH, and other stressors. For instance, the insecticide carbaryl becomes ***46 times*** more toxic to frogs in the presence of the smell of a predator. Other studies identified variation in response between various related species. The relevant studies performed with glyphosate (mostly Roundup or Vision ®) on frogs, zooplankton, and aquatic ecological communities are analyzed in Section 3.

Lautenschlager and Sullivan are calling for identifying, before initiating a study, the important points that should be measured and that would be meaningful ecologically."[17] These latest studies looking at relevant ecological influences on the effect of a pesticide fit the bill. New important ecological parameters have to be integrated in new research, which cannot be taken into consideration until they are recognized. Older studies will not have looked at them.

A few recent studies illustrate how little we actually know about how a pesticide affects the real health and environment. A recent study identified a synergistic effect between a commonly prescribed drug and a subsequent exposure to chlorpyrifos.[18] The study authors used the following statement *"certain early drug or chemical exposures can predispose people to particular ailments."* Another [19] identified that preconceptional paternal exposure to a drug leads to increases in embryo loss, malformations, and behavioral deficits in offspring and these abnormalities are transmissible to subsequent generations. Yet another [20] identified a new type of mechanism: that exposure when very young can *permanently reprogram cells* so that, combined with a genetic alteration, it drives tumor development. Endocrine disrupting chemicals are suspected of reprogramming cells in other ways. None of these types of studies are currently conducted for pesticide registration.

Nobody is 'average' for everything. The fact that there is no consensus on how to do a study (one of industry's main arguments to discount endocrine effects[21]) does not mean that effects do not occur, or that they are considered unimportant by governments, contrarily to the statements from PMRA in past correspondence. It merely indicates that it is a new area of science for which

---

[17] Lautenschlager, R.A. and Thomas P Sullivan; Winter 2004; Improving research into effects of forest herbicide use on biota in northern ecosystems; Wildlife Society Bulletin, Vol. 32, Iss. 4, p. 1061-1070 (10 pp.)

[18] Duke University Press Release, March 30, 2004; Labor Drug Sensitizes Brain to Pesticide Injury;
Slotkin, T. et al; March 2004; *Toxicology and Applied Pharmacology*.
Chlorpyrifos-terbutalin
Both chemicals independently caused brain injuries not seen in the control rats, including the loss of brain cells and the nerve cell projections critical to communication among neurons. The effects persisted into adulthood. In addition to aggravation of the chemicals' damaging effects on the brain, rats exposed to combined chemical treatment showed reduced nerve cell activity, and suffered significant loss of brain cells and nerve cell projections in portions of the brain central to learning and memory

[19] Barton, Tara S., Bernard Robaire and Barbara F. Hales; 2005; Epigenetic programming in the preimplantation rat embryo is disrupted by chronic paternal cyclophosphamide exposure; PNAS, May 31, 2005**,** vol. 102, no. 22, pp 7865-7870 http://www.pnas.org/cgi/content/full/102/22/7865

[20] Reiberg, Steven; Health Day reporter; 2005 Early Environmental Exposure May Set Stage for Cancer; http://abcnews.go.com/Health/print?id=807737

[21] http://www.lawnfacts.ca/article-0013.shtml
Landscape Ontario's Lawn Facts

standards have yet to be set, and illustrates better than anything else why no one can say that any pesticide is “safe”, whether used according to label or not.

Risk Management in Operations (Weyerhauser proposal, p. 19)

The measures described seem to follow published guidelines and look good on paper. During a study phase, they are more likely to be followed than in later applications, if herbicides become a forestry standard. We suspect that block security and signage would be the first measure to go, putting the public at risk in the future. Experienced operators may not always be available either.

There is one error in the text, as Roundup’s binding to soil is readily “reversible”, which it means it can move, and kill vegetation at a site distant from application. One study found that 80% of the added glyphosate desorbed in a two hour period, and concluded that “this herbicide can be extensively mobile in soils.”[11] Cessna thinks that it is likely that it will be found to do so more often with new monitoring equipment and techniques. Conclusions drawn without taking this fact in consideration are bound to be flawed.

Section 3 Glyphosate ecotoxicity and monitoring
Review of recent relevant studies on the toxicity of Roundup® or Vision ®

We found no studies done with Catena. As Monsanto identified the surfactant as being a type of

Effects of glyphosate on Plants

Lautenschlager and Sullivan (2002) review the effects of herbicide treatments on biotic components in regenerating northern forests. What these studies illustrate is that conifer release treatment has been used in site preparation, and/or from one to twenty-one years after site preparation and planting. It has a major effect in setting back the “successional clock” by reducing cover of trees and shrubs after treatment, often ferns and herbs and, in the only study looking for it, in mosses and lichens.

From the data presented in the review, it is difficult to infer the type of treatment or timing with glyphosate, whether aerial, backpack spray equipment, brush saw or other mentioned such as experimental or repeat applications. The review also does not mention the application rates. Undoubtedly, the type and extensiveness of treatment and application rate would lead to varying results on local plants, which cannot be sorted out through this review.

Neither could the potential change in species be inferred, because most studies only report visual estimates, and looked at % cover of each group and basal area density, and not at individual species. Several studies said no species were lost, but it is unclear whether they look at general diversity or individual species.

Clear-cutting affects most plants in the area directly or through compaction and change of habitat (more light, drier, etc). (May) This is indeed another unknown in any of the experiments conducted. Treated areas are compared to others which have been cut at the same time but untreated (control) or treated in a different manner. Also, little to nothing is mentioned in the review about the method or season of cutting.

Fruits and berries (Lautenschlager and Sullivan)
However, some constants were a decrease in shrubs for over 5 years, and “fruit-producing shrub cover” by over 60 % or more, depending on the study, one year after treatment, and reduced availability for at least 3-4 years after treatment.

One study showed that cut blocks treated when less than 6 years old were dominated by grasses and red raspberries, whereas untreated areas has a greater diversity of other berry-producing species. One study reports raspberry cover was still held back after 2 years. Another reports an increasing cover reduction of raspberry, elderberry, and pin cherry with increasing rate of active ingredient one year after treatment. A Maine study noted 13 species reduced or eliminated by glyphosate, while 5 increased and 3 remained the same. Three years later, fireweed recovered but not strawberry.

Mosses and lichens were dramatically reduced in richness and abundance by forest harvesting. Post-harvest herbicide treatment further significantly reduced species richness and abundance slightly, while brush cutting did not for 2 years.

Browse for animals (Lautenschlager and Sullivan)
Another constant is that less shrubs means a decrease in moose forage and moose for up to 5 years after treatment. However, after 10-12 years, moose were more abundant because there were less trees and shrubs to interfere with the preferred herb foods.

Deer do not seem affected, and the clear-cutting more than the herbicide treatment is affecting snowshoe hare density. They return after 7-8 years.

Endangered Plants
Some wildflowers are almost 100 times more sensitive than others to glyphosate; drift in amounts equal to 1/1000 of typical application rates will damage these species. (Cox, 1998)

According to the Saskatchewan government, 29 % of endangered plants are found in the commercial forest region (1, p. 259) A quick check of the Saskatchewan CDC data base indicates 154 plant species listed (S1 to S3) for the mid-boreal uplands, 86 for the mid-boreal lowland and 113 for the boreal transition, the three zones in which the demonstration sites are located. In all cases, these endangered plants include a number of ferns, orchids and wetlands plants. They also include shrubs such as one willow, two honeysuckles, one hawthorne, one elderberry and one rose (SK CDC web site). It is likely they will not be the species found in abundance after clear-cutting, but if perchance one or several of these species re-establish in planted areas, they would face the extra hurdle of surviving herbicide application. It is possible, as the data base in these poorly studied areas is based on the reported information only (Keith). These listed plants are likely plants of the mature forest, which is what is currently being cut. This habitat is not likely to be recreated again in a 60 to 80 year rotation.

The US EPA expressed a concern for rare plants in its 1993 glyphosate re-registration decision. (US EPA). Cox's review (1998) mentions other effects on non-target plants. "These include effects on endangered species, reduced seed quality, reduction in the ability to fix nitrogen, increased susceptibility to plant diseases, and reduction in the activity of mycorrhizal fungi." (Cox, 1998)

Sublethal treatment of cotton with Roundup "severely affects seed germination, vigor and stand establishment under field conditions." "At concentrations corresponding to typical application rate, glyphosate reduced by 70 % the number of nitrogen-fixing nodules on clover planted 120 days after treatment." "Treatment of a grass field with Roundup increased nitrate loss up to 7 weeks after treatment." "Glyphosate increases the susceptibility of crop plants to a number of diseases." (all quotes from Cox 1998) Only one study was reported in Lautenschlager and Sullivan review on susceptibility of conifers to two insects. It concluded glyphosate had no effect.

Mushrooms and fungi (Lautenschlager and Sullivan)
In the one study done, fruiting bodies of fungi were reported as common as in the control plot, but the authors give no details on method of cutting or site preparation. We only know that the study was done 4 years after cutting and two years after planting. There is also no mention of how many kinds of mushrooms there were. Considering that Elizabeth May reports that clear-cuts tend to affect the diversity of soil fungi, again, one can wonder about the comparison. It may be that only a few kinds resistant to disturbance are left and these are not affected by herbicide. See above for effect on mycorrhizal fungi and nitrogen-fixing nodules.

Small mammals (Lautenschlager and Sullivan)
Red-backed voles and shrews seem to decrease after glyphosate use for a few years, but are replaced by other small mammals. Their populations seem to recover after a few years. The changes have been related to changes in habitat rather than direct toxicity and are considered within normal fluctuations. (Lautenschlager and Sullivan)

Other groups
It is difficult to separate whether insects and terrestrial invertebrates are affected by the change of habitat or directly by glyphosate. Lautenschlager and Sullivan report that foliar-dependent insects are reduced in abundance following successful treatment, but start to recover as broad-leaved

plants re-invade. Most others seem “relatively unaffected”, although some increase, and some are less active. “As with plants, invertebrate species are seldom eliminated, and new species often arrive to occupy newly created niches.”

Glyphosate has temporarily reduced in 1/2 the number of spiders in one study (one year). Cox (1998) also reports that Roundup killed over 50 % of three species of beneficial insects, and 50 % of a predatory mite. Probable indirect effects through habitat loss have also been reported in other studies. (Cox, 1998)

Residues in meat and plant food (Lautenschlager and Sullivan)
Most animals ate sprayed but not dead vegetation without any problems. They do not avoid sprayed vegetation. Some differences were found in the amount of protein and digestible dry matter in forage and other plants such as raspberries, up to 2 years after spraying.

Analysis of glyphosate residues in food is “in general laborious, complex, and costly.”(Cox, 98) It is therefore not regularly monitored. However, some monitoring studies were done for glyphosate in wild foods although, considering the stated difficulty, one may wonder at their accuracy.

From the following quote, glyphosate does not seem to accumulate in wild meat.

“In a study of the fate of glyphosate in a forest ecosystem, Newton *et al*. (1984) concluded that exposure of mammalian herbivores, carnivores, and omnivores varied with food preferences. However, all species examined by Newton *et al*. (1984) had visceral and body contents of glyphosate at or below observed levels in ground cover and litter. This **suggests** that glyphosate does not accumulate in higher trophic levels. Brewster *et al*. (1991) documented metabolism of glyphosate in rats fed 10 mg/kg body weight and found that 35–40% of the administered dose was absorbed from the gastrointestinal (GI) tract; while 60–65% was initially eliminated via urine and faeces. They also reported that **any residue in the body after seven days (approximately 1% of the administered dose) was associated with bones**. Because there was little evidence of metabolism, Brewster *et al*. (1991) concluded that virtually no toxic metabolites of glyphosate were produced. Legris and Couture (1991) examined flesh samples from snowshoe hare, white-tailed deer, and moose harvested inside or close to areas that had been treated with glyphosate approximately two months before sampling. Although 0.146 υg/g was found in one sample of moose flesh, the authors concluded that this was likely due to contamination, because **the 31 other samples showed no detectable residues**. Based primarily on data from snowshoe hare, they concluded that glyphosate ingested with vegetation was mainly eliminated through the urinary and faecal tracts, and that consuming meat or organs such as liver of animals that have fed in or near treated areas poses little risk to humans.” (Lautenschlager and Sullivan)

It is difficult to visualize how to do the experiment on berries, as most of them disappear from the sprayed area from the effect of glyphosate, but caution may be advised in eating fruit from sprayed areas for a few years. Of course it may not be an issue, as so few are left for several years following application.

Berries
“Less than 10% of the glyphosate penetrated fruit during the first 9 hours after treatment, thereafter residue levels declined with time. Blueberries lost 50% of the herbicide residue within 20 days and raspberry lost 50% within 13 days. Residue levels 33 and 61 days were approximately 6 and 4%, respectively, of the initial peak. Because the spray solution was applied directly over foliage and after treatment fruit these experimental treatments likely led to greater glyphosate residues.” (Lautenschlager and Sullivan)

Effects of glyphosate on Birds

The boreal forest is globally significant for breeding birds. “In fact, the Boreal Forest Region represents 26% of the land area of the U.S. and Canada - yet this report shows that it supports

nearly 50% of North America's bird species". A recent Bird Studies Canada study "demonstrate(s) that the Boreal Forest Region is critical to the well-being of many species of familiar waterfowl, shorebirds, waterbirds and landbirds found in the U.S. and Canada. Nearly half of all North American birds (325 species) rely on the Boreal Forest Region. Over 300 of those species regularly breed in the Boreal Forest Region. The responsibility of the region in sustaining some bird populations is even more impressive." 30% of landbirds and shorebirds, 38 % of waterfowl and an unknown % of water birds breed in the boreal forest. (Blancher and Wells)

As the boreal in under increasing threat, ornithologists are increasing their monitoring and studies of boreal birds.

The following research works with a control of similar age (11-22 years old) and finds effects, although Lautenschlager and Sullivan would argue that it has no value, because using herbicide sets back the successional age so is not an appropriate comparison. They claim that comparison should be made with areas also in early succession stage.

Little experimental research on the effects of removing deciduous vegetation on the selection of nesting sites by forest songbirds has been done, (Easton and Martin) however their study indicates that one application of glyphosate on cut stumps (in 1992) had long term effects on the amount of deciduous trees. "The number of deciduous trees increased annually after thinning and was similar to the number in the control 3 years after treatment. Three years after thinning plus herbicide, the plantations remained depauperate of deciduous trees."(id)

This loss of deciduous trees negatively impacted bird diversity (average of 9 species in control, 8 in thinning and down to 6 species with herbicide treatment) and recruitment. Despite the large differences in the proportion of deciduous trees available for nesting in each treatment, 50 % of nests were located in deciduous trees, and 57% of successful nest were in deciduous trees. All species preferred nest patches significantly associated with more shrub cover and deciduous trees in all plots, and the number of Douglas-fir stems in the control and thinned plots). In the thinned and herbicide-treated plots, birds more strongly selected deciduous trees and shrubs, and patches with more conifers than what was available in the control and thinned treatments.

Thinning plus herbicide application tends to homogenize the composition, density and structure of vegetation reducing the natural diversity and density of nest sites and food sources. Nesting success was also decreased from 30 % in control and 45.8 % in thinned areas, to 13.6 % with herbicide used. This low nesting success can make herbicide-treated areas *sinks* for some bird species such as the Dusky Flycatcher, whose nesting success dropped from 50 % to 13 %.

Several indirect ecological effects of pesticides are also never considered by regulatory agencies such as ecological effects deriving from elimination of plants or insect food, or the increased susceptibility of the crop to insect or disease damage.

Dr Julie Ewald from England showed that it is not necessary for pesticides to accumulate in the food chain in order to produce indirect effects, if such chemicals are applied with sufficient frequency (which hopefully will never happen here, unless Saskatchewan moves to intensively managed silviculture). Continuous agricultural applications of even short-lived chemicals created conditions capable of reducing partridge populations as herbicides eliminated plants essential for insect cover and food, and insecticides further reduced insect populations. (Rachel Carson Council)

Effects of glyphosate on fish

The Pesticide Management Registration Agency (PMRA) the agency licensing pesticides in Canada, deals with the toxicity of glyphosate for fish by adding a precaution not to spray over water on labels.

Both glyphosate and the commercial products that contain glyphosate are acutely toxic to fish. The formulations containing POEA surfactant are more toxic because it is like a detergent-like ingredient. Roundup is 20-70 times more toxic to fish than glyphosate itself. Acute toxicity of glyphosate to fish varies widely: they range from 2 to 55 ppm, depending on age (young fish are more sensitive), species, and test conditions, and product. It also varies in soft versus hard water, and whether the fish have recently eaten or not. Toxicity increases with increased water temperature. “Treatment of riparian areas with glyphosate causes water temperature to increase for several years following treatment because the herbicide kills shadowing vegetation. (Cox, 1998)

Sublethal effects of glyphosate occur at low concentrations. ½ to 1/3 of the LC 50 caused erratic swimming in some fish species, and trout exhibited labored breathing. Less than 1% of the LC 50 causes gill damage in carp and less than 2 % causes changes in liver structure. (Cox, 1998) Cox (2004) reports on new studies indicating genetic damage to fish, and disruption of their immune system due to glyphosate.

Some of the effects also occur in algae, amphibians and fish at concentrations lower than the calculated expected environmental concentration (EEC) (Thompson 2004, Relyea), concentrations which have been recorded in small wetlands after spraying of Vision®.(Thompson) (further discussion under amphibians) No fish or other aquatic organisms studies were reviewed in by Lautenschlager and Sullivan.

Effects of Glyphosate on Amphibians

So little was known about the effects of glyphosate on amphibians and reptiles, that Lautenschlager and Sullivan only reports four studies, none of which looked at any of the parameters described below. They were very coarse studies by today’s standards, because researchers did not know what to look for. They just looked at % of cover, or numbers of animals trapped.

In the boreal, small wetlands are ubiquitous, seldom identified on topographical maps, and difficult to see and avoid during aerial spray applications. Hopefully these small wetlands can be avoided with backpack sprayers and should not theoretically be affected by herbicide applied to sawcuts. Most of these small wetlands or ponds of various sizes and depths can harbour frogs, as well as a number of other organisms and plants. Such ponds do not benefit from buffer zones from aerial spraying. (Thompson)

All the concentrations below are in mg of active ingredient (a.i.) per liter of water.

Pesticide hazard identification is based on the relation of the expected environmental concentration (EEC) to lethal concentration estimates LD50 or LC 50 after 96 hours (the dose or concentration that kills ½ of the animals after 96 hours). “In accordance with Canadian Regulatory Authorities, the EEC was calculated as the maximum concentration of active ingredient predicted to occur in a body of water 15 cm deep if directly oversprayed with the maximum application rate. (Edington). The EEC for glyphosate and its surfactant, based on the maximum application rate of Vision ® …is 1.4 mg a.i./L and 0.2 mg/L. respectively.” (Edington) Relyea however quotes Geisy et al (2000) as setting the maximum concentration after spraying to 3.7mg a.i./L.. This discussion of acute toxicity also indicates that the only toxicity considered by the PMRA is the direct toxic effect of glyphosate, not the ecological effects or cascades of effects that may result from a spray event.

Although the PMRA does not currently mandate toxicity trials on amphibians for the pesticide registration process (Relyea, 2005c), worldwide amphibian decline has recently been linked to pesticides (Sparling, Relyea, Thompson) which has initiated a flurry of studies. We now know that

pesticide toxicity can be amplified by various stresses such as pH (Relyea, Thompson, Eddington, Wojtaszek), temperature (Boone and Bridges 1999), predation clues (Relyea 2003, 2004a), or combinations of pesticides (Relyea 2004b, Sparling). Other stresses contributing to increased pesticide toxicity mentioned in the literature are food availability, competition (Relyea 2005c), and ultra-violet light (id).

Some of these effects happened at levels below the "official" tested concentration at which glyphosate kills ½ the animals (LC 50). Also, various pesticides have different effects on closely related species (Edington, Relyea 2003, 2004a, 2004b, Sparling). Some of the effects also occur in algae, amphibians and fish at concentrations lower than the calculated EEC (Thompson 2004, Relyea), concentrations which have been recorded in small wetlands after spraying of Vision®.(Thompson)

Low dose pesticides have also been found to alter tadpole growth (Fordham et al), swimming performance (Bridges) avoidance response (Wojtaszek- above 1.43 mg/L), factors which may affect the ability of a population to maintain itself through decreased reproduction capacity or increased predation pressure.

Amphibians present in the Pasquia-Porcupine area earmarked for glyphosate trials include Leopard Frog, Wood Frog, Boreal Chorus Frog, Canadian Toad and Tiger Salamander. The tadpole stage of amphibians have been found to be several times more sensitive to the effects of pesticides than either adults or embryos. (Edington) As glyphosate aerial application is to be conducted either before planting, or near the end of summer to reduce effects on conifers, it is important to know which species of amphibians may still be present as tadpoles in the area.

According to Sustainable Resource Development of the Alberta government, all five species can be found as tadpoles until mid-August to early September. Furthermore, Tiger Salamanders can overwinter in water as tadpoles, and Leopard Frogs hibernate as adults in the bottom of ponds. Of these, the western race of the Leopard Frog is listed (SK CDC, AB government) but tends to breed in permanent water bodies, which may be protected from aerial spray by a buffer if they are large enough to show on a map.

Glyphosate toxicity is peculiar. By itself, glyphosate acid becomes more toxic to fish and aquatic invertebrates as pH decreases (acid), while Vision® becomes more toxic as pH increases. (Edington, Relyea, Wojtaszek).

Glyphosate also persists a lot longer in water as the pH increases. Wojtaszek (2004) states that "dissipation of glyphosate depends on local conditions and is therefore site specific. She measured that the time taken for 50% of concentration at spraying (½ life) to dissipate from water at pH 6.4 was 4.2 days, and 26.4 days at pH 7. Relyea (2005a) quotes the 1/2 life of Roundup as 7-70 days (from Giesy, 2000). Vision® contain 15% by weight of polyethoxylated tallowamine surfactant (Edington), and it has been demonstrated that this surfactant blend is the principal toxicant to aquatic organisms in the Vision formulation. (Wojtaszek, 2004)

Northern Ontario wetlands were found to be in the pH range of 4.5-9.1 with a mean of 7.0 (Edington, Thompson) At this time, we are not aware of any such measurements in Saskatchewan, but they are likely similar. The use of Vision® therefore has a serious potential to affect the organisms living in small forest wetlands with a pH of 7 or higher both because Vision® is more toxic at that pH, and because it remains significantly longer in the water. (Edington)

Only three of the amphibian species present in the Saskatchewan boreal forest have been subject to any toxicity or eco-toxicity studies of pesticides. The most studied both in the laboratory and in nature is the Leopard Frog (*Rana pipiens*). Its estimated LC 10 and 50 at 96 hours (the rate at which 10 and 50 % respectively of the population die after 96 hours) for Vision® is calculated at .85 to 3.5 mg a.i./L (Thompson). Chen (2004) found that Leopard frog tadpoles all

died at a concentration of .75 mg/L and a pH of 7.5. Most of them also died at 1.5mg/L and pH 5.5, both with high and low food. A high pH increased the toxic effects on all response variables for both species. Especially at lower dose, the mortality occurred after the 96 hours usually studied.

Relyea (2005c) found that survival of Wood Frogs (*Rana sylvatica*) was 65% in the absence of predator cues, and only 30 % with predator cues when exposed to Roundup® (same as Vision®) at a pH of 7.8-8.3 and an active ingredient concentration of 1 mg a.i. /L. There was also a trend of lower survival with predator cues at .1 mg a.i./L, but the trend was not significant. "The estimated LC50 for wood frogs was 1.32 mg./L without predator cues and .55 mg./L with predator cues."(id) Relyea (2005a) reports on Smith's (2001) study of the toxicity of Kleer-Away, another form of glyphosate containing the same surfactant, POEA. Nearly ½ of the Boreal Chorus frogs (*Pseudacris triseriata*) tadpoles died at .74 mg a.i./L, and plains leopard frog larvae (*Rana blairi*) experience 0% and 100% survival at .75 mg a.i../L in two separate experiments. Relyea does not mention the pH at which this study was conducted. Relyea's studies also last for 16 days instead of four, and he often found that tadpoles start dying after 4 days, putting in question the 4 day length of toxicity tests currently done as
representative of the real toxicity of a product.

The US EPA expressed a concern for the Houston Toad in its 1993 glyphosate re-registration decision. Recent studies indicate LC 50s of .5 to 4.7 mg a.i./L for North American amphibians, which moves Roundup® one toxicity category up to *moderately to highly toxic* to North American amphibians (Relyea 2005a). These concentrations are well within concentrations found in small wetlands after Vision® spraying, measured at up to 1.95 mg a.i./L. (Thompson), reported from other authors up to 2.3 mg a.i./L (Relyea 2005b), and predicted by Giesy up to 3.7 mg/L (id). However, Thompson's study would be a lot more useful if he had analyzed the toxicity of Vision related to concentration and pH of glyphosate, instead of whether the wetlands were buffered, adjacent or oversprayed. It would also be a lot more relevant to know the percentage of wetlands that received the different concentrations of Vision in each treatment, instead of the means for treatment, especially after it was determined that "the difference (in mean concentration) was not statistically significant because of the high variation levels within each wetland classification." (Thompson) (That meant the spray drifted out of the target area)

Although immuno-supppresion by glyphosate has now been shown in fish, to our knowledge it has not yet been tested in frogs. Immuno-suppression has been demonstrated by Gilbertson (2003) in Leopard Frogs from exposure to malathion, DDT and dieldrin, so it is possible.

Effect of Roundup on aquatic communities (Relyea, 2005a)

Relyea built communities of 20 species and exposed them to one of two insecticides and two herbicides, including Roundup®. At 3.8 mg/L, Roundup had no effect on snails, but completely eliminated two species of tadpoles (Leopard Frog and Gray Tree Frog) and nearly exterminated a third (wood frog survival was reduced to 2 %), resulting in a 79% decline in the species richness of tadpoles. The addition of soil did not diminish the toxic effect. Roundup also increased the biomass of periphyton (algae etc) by 40 % by removing a large fraction of the herbivores. No diving beetle larvae survived. *Eurytemora* zooplankton was nearly absent with Roundup. Relyea's results must be taken with caution here. The pH of Relyea's experiments is quite high, usually between 7.8-8.1 and, in this experiment, he used a concentration higher than what has currently been measured after application.

Significant negative effects of Vision® were measured at concentrations lower than the calculated worst-case value (EEC = 1.4 mg/L) for the species of zooplankton *Simocephalus vetulus*, and Leopard frog tadpoles. All *S. vetulus* adult died after 8 days at pH 7.5 and 1.5mg/LVision®. Cumulative reproduction and reproduction rate were also negatively affected in *S. vetulus* by herbicide alone, and in combination with a pH of 7.5 at both concentrations of .75 and 1.5 mg/L.

Negative effects were consistent with these findings for juvenile *S. vetulus.* The author notes that the development response seems to be more sensitive to low herbicide than the survival response. (Chen, 2004)

Effects of pesticides on aquatic ecosystems

While the following study does not deal with Roundup, it illustrates the large potential of several pesticides at low levels to affect endangered species in an aquatic environment. Hardly any of the studies presented on glyphosate toxicity (or on most other chemicals in North America) have attempted to quantify effect on more sensitive species in their environment. This is in large part because we still know so little about most species that occur here. One can hope that, as the technology to measure pesticides in the environment and our knowledge of species improves, monitoring will become easier, and we will have a better idea what to monitor for.

A new European study designed to find patterns in aquatic invertebrate community composition related to the effects of pesticides (several, as measured in rivers) is showing a significant relationship between "toxic units" for Daphnia magna, a species very sensitive to pesticides, and the number of species at risk present. The study documents that measured pesticide concentrations of 1:10 of the acute 48-h median lethal concentrations (LC50) of *D. magna* led to a short-and long-term reduction in abundance and number of Species at Risk (SPEAR) and a corresponding increase in species not at risk. Concentrations of 1:100 of the acute LC 50 of *D. magna* correlated with a long-term change of community composition. It also documents the positive influence of upstream undisturbed sections on community composition. (Liess)[22] To our knowledge, no such study has been performed on glyphosate.

Environmental monitoring of glyphosate

Air

Studies indicate that 75 % of aerial glyphosate is recovered in the target area. This means that 25% drifts. (Lautenschlager and Sullivan). Drift has been measured as far as the monitoring took place. (200 meters from helicopter applications), the intended aerial method considered by Weyerhauser, and 400m from fixed-wing aircraft application. One of these studies calculated that buffer zones of between 75-1200 m would be required to protect non-target vegetation. (Cox, 1998). In the US, where drift incidents are reported, drift incidents involving glyphosate are common. "Glyphosate is the second most common pesticide involved in complaints. Reserchers at Carleton University (Canada) and Environment Canada who studied glyphosate drift describe its potential effects as "severe ecological changes." (Cox, 2004)

Soil

Glyphosate persistence in soils varies widely, with a ½ life from 2-174 days. Initial breakdown is faster than the subsequent breakdown of what remains. It seems to remain longer in northern forestry sites: 259-296 days in Finland, 335 days in Ontario and 360 days in 3 BC sites. The EPA considers it "extremely persistent under typical application conditions." (Cox, 1998) If the measurements are true, the apparent speed at which the area can be replanted after use needs an explanation. (Lautenschlager and Sullivan)

The binding of glyphosate to soils is reversible. In one study, 80% of glyphosate desorbed (dispersed) in a two-hour period. (Cox 1998) Cessna believes that, now that there is a better methodology, we will likely find that it behaves like most other pesticides and moves around.

Water

Glyphosate is not as residual in water as in soils. Monitoring has shown a ½ life of 4.6 to 60 days, and depends on pH. (Cox, 1998, and Wojtaszek, 2004). It can persist from 120 to over 365 days in pond sediments. It can be carried to water attached to soil particles. (Cox, 1998)

Currently, glyphosate is not a pesticide widely monitored in the environment, because of the difficulty and cost of doing so, and the recent development of the methodology.(Cessna) In the Prairies, there are mostly no data for drift or air and water concentrations. Even in the US, there are no comprehensive national statistics about contamination of rivers and streams by glyphosate, as there are for many other pesticides (Cox 2004). A regional study in the mid-west indicates that glyphosate can be a common water contaminant. It was found in 1/3 of water sample collected, and its breakdown product AMPA was found in 2/3, from spring to fall.(id) Another study of urban streams in King County, Washington, found glyphosate in all six streams tested. (id)

Buffers for water seem to be set at 25 meters (p.23), which is more than the minimum required 15 meters(Murphy), but less than what was shown effective in preventing contamination of most buffered wetlands in one study: 30-60 meters (Thompson) (section 3)
However, all wetlands too small to show on a map and which are fundamental to amphibians and many other organisms would not be buffered.(Thompson). As drift has been measured at the furthest distance sampled (200 meters), it is unknown to us at this time whether it will be sufficient to prevent water contamination. We do not know either whether fish fry or amphibians may be present in wetlands or small streams too small to be marked on a map, and which may be in danger of being oversprayed. They would also have to be present at the right time of year.

Monitoring in Weyerhauser proposal (p. 28)

It is unclear from the text whether monitoring of all plant species present will be done and recorded, or just successional changes and the increase in growth of the crop trees. What is ecologically important to know is whether any species disappear or not, and how long it would take them to come back, if they do.

There is no plan to monitor effects on any animal component, or concentrations of glyphosate in the environment. In view of the recent literature on toxicity of glyphosate to frogs, and its relationship to water pH, we do not feel this is sufficient or acceptable.

Conclusions:

Section 1 Forest Management
Evidence presented by Lautenschlager and Sullivan (2002), indicates that the "regeneration following harvesting seems to be unlike that which followed the natural disturbances." They also quote research that supports the view that "clearcut logging has converted forests dominated by pioneer, fire tolerant conifers to those dominated by pioneer, fire-tolerant broadleaved tree species."

Lautenschlager and Sullivan (2002) also conclude that in spite of planting conifers, tending, and even using herbicides on them, conifers are still disappearing from the landscape across Canada". "At the stand level, complete success at re-establishing conifers has been **unusual**" even though "that establishment… is often a legal requirement." They also mention that "a limited number of ecological studies have recently attempted to document landscape-level effects of forest management on key biotic (living) components (e.g., Potvin *et al*. 1999, Mitchell *et al*. 2001), those studies seldom examine effects of clearcutting per se and have not examined effects of herbicide treatments".

The authors also mention that**"** the literature illustrates large variability in vegetation abundance found following "identical" (chemical and rate) treatments". These changes are likely due to the previous disturbance of the site (method of cutting, damage done to the site, rainfall and other physical factors, as well as the "quality of the site" as mentioned by the authors. It likely also illustrates the different effects of various application methods, that at least 25 % of the herbicide does not reach the site (75 % is recovered), and how the vegetation structure present at the site at times allows pockets of native vegetation to remain untouched because taller vegetation protected them from the herbicide.

In spite of the studies done, the authors consider that "post-treatment vegetation changes, especially longer-term changes, are poorly documented and need more study."

The general feeling generated by reading this review is that we are still at the experimental stage in our understanding of the effects of clear-cutting with heavy machinery, as well as herbicide use in forestry. We still don't know why it works in one location and not another. "Researchers documenting biotic consequences of silvicultural treatments also must identify if the silvicultural objective(s) of the treatment(s) were achieved; e.g., did conifer crop trees become established, survive, or grow better because of the treatment? If so, how much better and for how long? Both biotic and silvicultural consequences must be documented before the full effect of existing or proposed treatments can be determined... **Unfortunately, we know little about the consequences of these or the combination of treatments, such as site preparation, fertilization, genetic improvement, and conifer release on crop survival, growth, or the environment.**" In other words, research so far has not done a very good job of asking and answering the right questions. Does conifer release increase volume of wood? Why is the response not uniform? Why does it not work in many cases? Can silviculture be used to skip natural steps in stand regeneration? We don't know.

The future will likely bring more changes in management. "For instance, using patch as opposed to broadcast treatments has become more common and there is increasing interest in dividing landscapes into specific management zones, **including zones dedicated to intensive silviculture.** Therefore, in the future, although the herbicide active ingredients will likely change little**, treatments designed to increase fibre production may be applied sooner and more often and treatment areas may be at a higher density within designated zones."**

In the meantime, I have been advised of ground-breaking research by several researchers of many universities including Susanne Simard of University of British Columbia regarding the importance of deciduous vegetation for better coniferous growth (related to mychorrizae fungi), published in "Nature".

Lautenschlager and Sullivan's review therefore supports Elizabeth May's conclusions, expressed in her book "At the Cutting Edge": "there is no track record of ecologically healthy second-and third-growth forests following heavily mechanized clear-cutting", and "cutting and overcutting are justified on the basis of future investments in silviculture", although the reality of those benefits is increasingly questioned. Current research indicates that intensive forest management practices (including herbicides) have little effect on volume of timber produced in most cases, although the volume is consistently increased in the mathematical models for calculating annual allowable cut. (May)

Our research also indicates that even where herbicides are used the most, the results are not consistent and that complete success is unusual. We feel that the use of herbicide in forestry is a cop-out for not dealing with the effects of modern clear-cutting, and will not adequately resolve the problem of NSR. It is not justifiable.

Section 2 Glyphosate – regulation and human safety

Glyphosate was first registered in Canada in 1976 and has not yet been re-evaluated. In fact, two forms are due to be re-evaluated in the next five years. This means that the data on which the registration is based is outdated. Our Canadian regulatory system is behind in re-evaluations and suffering from a chronic lack of independent data.

Furthermore, a lot of recent research on glyphosate has reiterated the concerns for major human health effects such as cancer, mutations and reproductive effects, and linked it to newer health effects. Reactions to glyphosate are often reported in California (the state with the best reporting system), and glyphosate is at least 10 times more toxic when breathed in than when eaten. Irritation of eyes and skin are the most common recognizable acute effects. They can be serious, chronic, and require medical attention.

Weyerhauser is starting from the false assumption that Roundup is tightly bound in soils, while studies indicate that its binding to soil is readily "reversible". Conclusions drawn without taking this fact in consideration are bound to be flawed. Safety precautions described here will likely erode, starting with posting the area, if herbicide use becomes entrenched in forestry, putting people at risk.

Section 3 Ecological effects and monitoring

Lautenschlager and Sullivan's major review noted some short-term ecological effects on several groups of plants and animals. The changes of vegetation in the sprayed area seem to indirectly affect animals, more than they are affected from direct toxicity. Lautenschlager and Sullivan note that the changes in vegetation may be important for individual species. It may also be important to people who use the area for food, medicine or hunting by temporarily altering resources such as berries in the sprayed areas.

The toxicity to water organisms was not well covered in Lautenschlager and Sullivan. Glyphosate is acutely toxic to fish, and recent studies have determined that several environmental conditions such as a high pH or the smell of predator can significantly increase its toxicity to frogs and zooplankton. In fact, 100% death of tadpoles and zooplankton has been recorded at concentrations measured in the environment.

The monitoring section indicated that glyphosate is considered persistent in soils, close to 9-12 months in the northern forest. Now that better and more affordable monitoring is available, glyphosate surprised scientists in being found from spring through fall in rivers. It can also be carried into water on soil particles, which is likely to happen with lack of vegetation.

In this proposal, plant monitoring seems insufficient and inadequate. The total lack of monitoring for glyphosate both in the environment and for effects on animals, especially aquatic vertebrates, is unsatisfactory considering that damage to fish, amphibian, zooplankton and algae can occur at levels below maximum allowable environmental concentration (EEC). The pH of local wetlands would also have to be known.

General conclusion

Considering that glyphosate is among the world's most widely used herbicides, the almost total lack of knowledge and monitoring is astounding. In spite of the almost total absence of data on glyphosate use and its environmental burden, there is no hesitation in suggesting a use expansion for glyphosate in Saskatchewan.

Glyphosate registration is not up to date with recent research because it has not been re-evaluated. Recent research confirms its direct toxicity to fish and amphibians and some zooplankton at concentrations found in the environment after spraying in forestry settings. New mechanisms of toxicity and new end points are uncovered all the time, outdating information faster than regulatory agencies can make updates to their tests, and therefore to their licensing and re-evaluations. Our concerns that this proposal may lead to entrenchment of herbicides in forestry standards, leading to more widespread use in Saskatchewan is confirmed by Weyerhauser.

Far from being a tried and true method, herbicide use in forestry is still reported as a guessing game, as it does not regularly result in appropriate conifer release, or increase in wood volume. In fact, clear-cutting is identified as the problem, and herbicides are like applying a band-aid in the hope that "it will make it better." **We therefore do not support the use of herbicides in forestry**.

With global warming inevitable, and Canadians and indeed the world's mounting concern for sustainability, we must weigh the economic, ecological, and social costs of the current energy-intensive approach to forestry. Keeping forests healthy and resilient is a logical adaptation strategy to protect them from global warming. "Instead, industrial forestry practices stress natural systems to such a degree that many areas of forest will be unable to recover fro the intensive logging." (May) Industry and the government must both play a role in redesigning the system to truly protect forests. We believe that the Forest Standards Association (FSA) standards are based on the ecological acceptability of practices on the ground, and provide a market advantage. **We feel that the FSA standards are the way to go to ensure sustainability of the forest resource in Saskatchewan**.

References

Alberta Government

- Canadian Toad (*Bufo hemiophrys)* http://www3.gov.ab.ca/srd/fw/amphib/ct.html Tadpoles may be present up to mid- September.
- Leopard Frog (*Rana pipiens*) http://www3.gov.ab.ca/srd/fw/amphib/nlf.html Unlike most other frogs, the northern leopard frog hibernates under water at the bottom of ponds. It can take 9-12 weeks for the tadpoles to transform into juvenile frogs, at which time the froglets will be about 25 mm long. These froglets will not become sexually mature until 2 or 3 years later
- Wood Frog (*Rana sylvatica)* stay as tadpoles for 6-12 weeks depending on T; tadpoles until early Sept Tadpoles will grow from 7-10 mm to 50 mm during their development; http://www3.gov.ab.ca/srd/fw/amphib/wf.html
- Boreal Chorus Frog (*Pseudacris triseriata*)They are quite small when hatched (4-7 mm) but grow to about 30 mm before transforming into juvenile frogs in about two months time. Transformation until 3rd week in Aug; presently excluded from areas where pesticides are heavily used, http://www3.gov.ab.ca/srd/fw/amphib/bcf.html
- Tiger Salamander (*Ambystoma tigrinum*) When first hatched, the larvae are about 15 mm long but they quickly grow to 75-80 mm over the next few weeks http://www3.gov.ab.ca/srd/fw/amphib/ts.html

Transformation occurs from Aug to mid- Sept or larvae overwinter in water

Blancher, Peter and Jeffrey Wells; April 2005; The Boreal Forest Region: North America's Bird Nursery; Commissioned by the Boreal Songbird Initiative and the Canadian Boreal Initiative; Bird Studies Canada. http://www.bsc-eoc.org/download/Blancherborealnurseryrpt2005.pdf

Boone, M.D. et Christine M. Bridges; 1999; The Effect of Temperature on the Potency of Carbaryl for Survival of Tadpoles of the Green Frog (*Rana clamitans*); Envir Toxicol Che; vol 18, no 7 pp 1482-1484

Bridges, C.M.; 1997; Tadpole Swimming Performance and Activity Affected by Acute Exposure to Sublethal Levels of Carbaryl; Envir. Toxicol Chem vol 16, no 9, pp 1935-1939

Cessna, Allan; personal communication June 2, 2005

Chen, Celia Y, et al; 2004; Multiple Stress Effects of Vision® herbicide, pH, and Food on Zooplancton and Larval Amphibian Species from Forest Wetlands; Environmental Toxicology andChemistry; Vol 23, no 4, pp 823-831

Cox, Carolyn; Glyphosate; JOURNAL OF PESTICIDE REFORM/ WINTER 2004 • VOL. 24, NO.4; http://www.pesticide.org/glyphosate.pdf

Cox, Carolyn; Glyphosate (Roundup); JOURNAL OF PESTICIDE REFORM/ fall 1998• VOL. 18, NO.3

Easton, W.E. and K. Martin. 2002. Effects of thinning and herbicide treatments on nest-site selection by songbirds in young managed forests. The Auk 119:685-694

Edington, Andrea N. et al; 2004; Comparative Effects of pH and Vision ® Herbicide on Two Life Stages of Four Anuran Amphibian Species.; Environmental Toxicology and Chemistry, vol 23, no 4, pp. 815-822

Keith, Jeff, persl comm

Lautenschlager, R.A., and T.P. Sullivan. 2002. Effects of herbicide treatments on biotic components in regenerating northern forests. The Forestry Chronicle 78(5):695-731.

Lautenschlager, R.A., personal communication May 26, 2005

Fordham, Carolyn L, John D Tessari, Howard S. Ramsdell, and Thomas J.Keefe; 2001; Effects of Malathion on Survivala, Growth, evelopment nad Equilibrium Psoture of Bullfrog Tadpoles (*Rana catesbeiana)*; Environ. Toxicol. Chem vol 20 no 1 pp 179-184

GILBERTSON, MARY-KATE et al ; Immunosuppression in the Northern Leopard Frog (*Rana pipiens*) Induced by Pesticide Exposure; Environmental Toxicology and Chemistry, Vol. 22, No. 1, pp. 101–110, 2003

Liess, Matthias, and Peter Carsten Von Der Ohe; 2005; Analyzing Effects of Pesticides on Invertebrate Communities in Streams; Environ Toxicol Chem vol 24, no 4, pp 954-965

Murphy, Kevin; Saskatchewan Environment; pers. comm. June 14, 2005.

Rachel Carson Council News # 91- papers of Wildlife, Pesticides and People, a conference sponsored by the Rachel Carson Council at George Mason University, Sept 25 and 26, 1998.)

Relyea, Rick A. and Nathan Mills; February 27, 2001; Predator-induced stress makes the pesticide carbaryl more deadly to gray tree frog tadpoles (Hyla versicolor); PNAS u u vol. 98 u no. 5 u 2491–2496; www.pnas.orgycgiydoiy10.1073ypnas.031076198

Relyea, Rick A.; 2003; Predator Cues and Pesticides: A Double dose of Danger for Amphibians; *Ecological Applications,* 13(6), 2003, pp. 1515–1521

Relyea, Rick A.; 2004a; Synergistic Impacts of Malathion and Predatory Stress on six Species of North American Tadpoles; Environmental Toxicology and Chemistry, Vol. 23, No. 4, pp. 1080–1084, 2004

Relyea, R.A.; 2004b; Growth and Survival of Five Amphibian Species Exposed to Combinations of Pesticides; Envir Toxicol chem. Vol 23, no 7, pp 1737-1742

Relyea, R.A.; 2005a; The Impact of Insecticides and Herbicides on the Biodiversity and Productivity of Aquatic Communities; Ecological Applications, 15(2) pp 618-627

Relyea, R.A.; 11/04/05 b; Dr Relyea responds to Monsanto's concerns; http://www.pitt.edu/~relyea/Roundup.html

Relyea, R.A.; 2005c; The Lethal Impact of Roundup and Predatory Stress on Six Species of North American Tadpoles; Arch Environ Contam Toxicol. 48, 351-357

Sparling, D.W., Gary M. Fellers and Laura McConnell; 2001; Pesticide and Amphibian Population Declines in California, USA; Envir.Toxicol Chem vol 20, no 7, pp 1591-1595

Saskatchewan Conservation Data Center http://www.biodiversity.sk.ca/

Sullivan, T.P. and D.S. Sullivan; Vegetation management and ecosystem disturbance: impact of glyphosate herbicide on plant and animal diversity in terrestrial systems; Environ Rev./Dossiers Environ. 11(1): 37-59 (2003

Thompson DG, Wojtaszek BF, Staznik B, Chartrand DT, Stephenson GR (2004) Chemical and biomonitoring to assess potential acute effects of Vision_ herbicide on native amphibian larvae in forest wetlands. Environ Toxicol Chem 23:843–849

US EPA re-registration eligibility decision (RED) for glyphosate (dated Sept 1993**)** http://www.epa.gov/REDs/old_reds/glyphosate.pdf

Wojtaszek BF, Staznik B, Chartrand DT, Stephenson GR, Thompson DG (2004) Effects of Vision_ herbicide on mortality, avoidance response, and growth of amphibian larvae in two forest wetlands. Environ Toxicol Chem 23:832–842

papers referred to by primary authors:

Giesy, J.P., S. Dobson, and K.R. Solomon; 2000; Ecotoxicological Risk Assessment for Roundup® herbicide. Reviews of Environmental Contamination and toxicology 167:35-120

Smith, G.R.; 2001; Effects of Acute Exposure to a commercial formulation of glyphosate on the tadpoles of two species of anurans. Bulletin of Environmental Contamination and Toxicology, Volume 67, pp. 483-488

Appendix 1 Glyphosate Formulations facts

ROUNDUP ORIGINAL LIQUID HERBICIDE (registration # 13644.00) from MONSANTO CANADA INC. was, we believe, the first glyphosate product registered in Canada (July 1,1976). Its active ingredient is:

GLYPHOSATE (PRESENT AS ISOPROPYLAMINE SALT)
N-(PHOSPHONOMETHYL) GLYCINE ISOPROPYLAMINE SALT
CASN = 38641-94-0 (GUAR = 356 G/L)

The surfactant polyethoxylated tallowamine (**POEA**), although not listed on the label, is another ingredient of health and environmental concern in this formulation. It significantly multiplies the toxicity and health and environmental effects of glyphosate, and has significant toxicity of its own.

VISION SILVICULTURE HERBICIDE B MONSANTO (or Vision ®) (registration # 19899.00) from MONSANTO CANADA INC, first registered on 24 March 1987, contains the same active ingredient in the same concentration, and **also contains POEA**.

Most research using Vision® or Roundup® mention the presence of POEA in the formulation. Note that the label (below) does not.

Vision partial label

http://eddenet.pmra-arla.gc.ca/4.0/4.1.2.asp?regn=19899%2E00&page=1&uniqueid=6%2F3%2F2005+4%3A05%3A45+PM

10-AUG-2000
((LABEL))
VISION(R)
SILVICULTURE HERBICIDE
COMMERCIAL
CAUTION IRRITANT
WATER SOLUBLE HERBICIDE FOR SILVICULTURAL SITES
READ THE LABEL AND ATTACHED BROCHURE BEFORE USING.
GUARANTEE: Glyphosate 356 grams acid
equivalent per litre present as
isopropylamine salt
REGISTRATION NO. 19899 PEST CONTROL PRODUCTS ACT
READ NOTICE BEFORE BUYING OR USING. IF NOTICE TERMS ARE NOT
ACCEPTABLE, RETURN AT ONCE UNOPENED.
NET CONTENTS 10 LITERS
MONSANTO CANADA, INC.
Box 667
Mississauga, Ontario L5M 2C2
Fredericton - Montreal - Thunder Bay - Winnipeg - Edmonton
PRECAUTION!
KEEP OUT OF REACH OF CHILDREN.
MAY CAUSE EYE IRRITATION.
HARMFUL IF SWALLOWED.
Avoid contact with eyes or prolonged contact with skin.
FIRST AID: **IF IN EYES**, immediately flush eyes with plenty of water for at least 15 minutes. Call a physician or contact a poison control centre.
IF ON SKIN, immediately flush with plenty of water. Remove
contaminated clothing. Wash clothing before re-use.
IF SWALLOWED, this product will cause gastro-intestinal
irritation. Immediately dilute by swallowing water or milk.

Call a physician or contact a poison control centre.
Have container, label or product name and Pest Control
Registration number available when seeking medical attention.
TOXICOLOGICAL INFORMATION:
Treat symptomatically.
-
Do not mix with any surfactant, pesticide, herbicide oils or any other material other than water unless specified in this label.

CATENA HERBICIDE (registration # 27199.00) from MONSANTO CANADA INC.
Was first registered on July 4, 2002 and contains a slightly higher concentration of the same active ingredient :

GLYPHOSATE (PRESENT AS ISOPROPYLAMINE SALT)
N-(PHOSPHONOMETHYL) GLYCINE ISOPROPYLAMINE SALT
CASN = 38641-94-0 (GUAR = **360 G/L**) (Data Last Modified:
2005-05-24)

It is unknown if the product contains its own surfactant, but it can be mixed with the following two:
6.2.1.1 SURFACTANTS
The following is a list of approved surfactants for use with Catena herbicide for control of quackgrass for ground applications on non-cropland uses when water volumes exceed 150 litres per hectare:
Agral 90 Companion
Ag Surf Frigate

The label contains exactly the same Precaution and first aid information as Vision®.
http://eddenet.pmra-arla.gc.ca/4.0/4.1.2.asp?regn=27199%2E00&page=1&uniqueid=6%2F3%2F2005+4%3A11%3A05+PM

NOTE:
In spite of the warnings for eyes and skin, and re-entry interval of the 1993 EPA registration decision, neither label mentions potential skin problems under precautions, and neither specifies a re-entry interval, which is the time after which regulatory agencies deem it is safe to re-enter the area. (EPA said 12 hours)

In addition, both labels include the following:
(Catena)
1.4 ENVIRONMENTAL HAZARDS
Avoid direct applications to any body of water. Do not contaminate water by disposal of waste or cleaning of equipment.

3.1 PRECAUTIONS
ATTENTION: AVOID CONTACT WITH FOLIAGE, GREEN STEMS, OR FRUIT OF CROPS, DESIRABLE PLANTS AND TREES SINCE SEVERE INJURY OR DESTRUCTION MAY RESULT.
APPLY THESE SPRAY SOLUTIONS IN PROPERLY MAINTAINED AND CALIBRATED EQUIPMENT CAPABLE OF DELIVERING DESIRED VOLUMES.
AVOID DRIFT – EXTREME CARE MUST BE USED WHEN APPLYING THIS PRODUCT TO PREVENT INJURING DESIRABLE PLANTS AND CROPS.
Do not allow spray mist to drift since even minute quantities of spray can cause severe damage or destruction to nearby crops, plants or other areas on which treatment is not

intended, or may cause other unintended consequences. Apply only in wind conditions in compliance with local and/or provincial regulations. Do not apply when other climatic conditions, including lesser wind velocities, will allow drift to occur. When spraying, avoid combinations of pressure and nozzle type that will result in fine particles (mist) which are more likely to drift.

Another Vision product is licensed in Canada but not earmarked for this study: VISION MAX SILVICULTURE HERBICIDE (# 27736.00) from MONSANTO CANADA INC., first registered 2004-07-15

Active Ingredient(s):

GLYPHOSATE (PRESENT AS POTASSIUM SALT)
N-(PHOSPHONOMETHYL) GLYCINE POTASSIUM SALT
CASN = 70901-12-1 (GUAR = 540 G/L)]

http://eddenet.pmra-arla.gc.ca/4.0/4.1.asp?page=1&uniqueid=5%2F29%2F2005+10%3A59%3A04+AM accessed may 29, 2005) (for all of the above)

Glyphosate Formulants fact sheet

A pesticide is rarely used by itself. It is formulated with one to several active ingredients (pesticides) and several others, which are added to make the pesticide more potent or easier to use.[i] Solvents, surfactants, propellants and carriers are some of the kinds of ingredients commonly used as formulants.[i]

The U.S. EPA estimates that, on average, 2/3 of every pesticide product is made of formulants.[i]

Knowing the toxicity of an individual chemical in its pure form is therefore only a small part of the the toxicity of its formulations. When you mix chemicals together, they spontaneously develop new "emergent" properties.[ii] This is commonly known by scientist.

In Canada, as in the U.S., formulants are classified in lists by their toxicity. While most formulants have never been studied for their toxicity, many formulants have a toxicity of their own. List 1 are known toxins (identified as being of significant concern), list 2 - potentially toxic, list 3 - formulants that do not meet the criteria of any other list, list 4A - minimum risk, list 4B - some may be toxic but no sufficient data.[iii]

In Canada, even under the New Pesticide Act[iv], formulants remain trade secrets, and no one is allowed to know in which product each formulant is used. Only list 1 formulants (known toxins) had to be listed on labels[iii] as well as a few allergenic substances[iii]. List 2 formulants (potentially toxic) must be listed on pest control product labels by January 9, 2006.[v] Active pesticide ingredients used as preservatives will also have to be listed on labels in the future.[v]

Formulants in glyphosate

In the US, at least 12 formulants are known to be used in various glyphosate formulations.[vi] Nine of those are registered in Canada,[v] [vii] in addition to **polyethoxylated tallow amine** surfactant (CAS # 61791-26-2, list 4B) which is acknowledged by Monsanto in all Canadian registered forestry products.[viii]**Error! Bookmark not defined.** Except for **polyethoxylated tallow amine**, we don't know if, or in what product, they are used, because they are secret. They may be present in the 50 % of the formulation which is not glyphosate or POEA. In the U.S., 88.8 % (8/10) are already recognized as chemically, biologically, or toxicologically active. 60% (6/10) are listed as being or having been used as active ingredients (3 are food preservatives).[i]

Of these 10 formulants, 50% (5/10) are listed by the Pest Management Regulatory Agency (PMRA) as potentially toxic: 10 % (1/10) on (List 2) and 40% (4/10) as "may be toxic but insufficient data" (list 4B), including **polyethoxylated tallow amine**.**Error! Bookmark not defined.** One only is a minimum risk product (list 4A), and 40% (4/10) are on List 3 (not on other lists).[vii] (see appendix 2 for details)

Several like *antifreeze*[ix] can be readily absorbed through the skin or by breathing them in, as well as by ingestion. Petroleum products are easily absorbed through breathing and ingestion[x]. It is important to note that eating such a product may not produce the same effects as breathing it in.

Negative health effects of three of these toxic formulants are as follows:

• **Light aromatic petroleum distillate** Reduced fertility and growth of newborns in laboratory tests. This chemical is of concern because Canada considers it potentially toxic and has put in on list 2. List 2 ingredients will not have to be disclosed on Canadian labels until January 9, 2006.

• **3-Iodo-2-propynyl butyl carbamate** is severely irritating to eyes, caused thyroid damage and

decreased growth in laboratory tests. It is or has been used as active ingredient, and has to be declared as a pollutant in the US Toxic Release Inventory. Can also cause skin and respiratory irritation. Also toxic to fish.Avoid water contamination.[xi]

Propylene glycol (antifreeze) caused genetic damage, reduced fertility, and anemia in laboratory tests.[10] It is on list 4B in Canada, and is or has been used as an active ingredient.

Conclusion

Neither buyer or user of any pesticide product knows what ingredients it contains, or how much more dangerous or toxic the formulation is than the individual pesticide active ingredient tested.

Use at your own risk

Partial list of "INERT" or "FORMULANT" INGREDIENTS IN GLYPHOSATE HERBICIDES

Inert ingredients in commercial glyphosate herbicide products, with examples of their hazards, include the following:

Formulants (6)	**CAS #**	**Canada list # (7)**	**US listed (1)**
polyethoxylated tallow amine surfactant (15) [syn. MON 0139, polyoxyethyleneamine (POEA)]	61791-26-2	4B	-
• **5-Chloro-2-methyl 3(2H)-isothiazolone**[1] caused genetic damage and allergic reactions in laboratory tests.[2]	?	?	?
no direct hit in ChemIDplus http://chem2.sis.nlm.nih.gov/chemidplus/ProxyServlet?objectHandle=DBMaint&actionHandle=spellChecker&nextPage=jsp%2Fchemidlite%2FspellCheck.jsp&responseHandle=JSP **closest:** **5-Chloro-2-methyl-4-isothiazolin-3-one** **3(2H)-Isothiazolone, 4-chloro-2-octyl-**	**RN: 26172-55-4** **RN: 64359-80-4**		
• **F.D.&C. Blue No.1 caused genetic damage and skin tumors in laboratory tests (3)**	3844-45-9	3	-
• **Glycerine**[1] caused genetic damage in tests with human cells and laboratory animals. It also reduced fertility in laboratory tests.[4]	56-81-5	4A	CA
• **3-Iodo-2-propynyl butyl carbamate**[1] is severely irritating to eyes, caused thyroid damage and decreased growth in laboratory tests.5	55406-53-6	3	AI, TRI
• **Light aromatic petroleum distillate** Reduced fertility and growth of newborns in laboratory tests.[6]	64742-95-6 1	**2**	**AI**
• **Methyl p-hydroxybenzoate**[1] (syn: Methylparaben)	99-76-3	4B	AI

• **Polyoxyethylene alkylamine**[1] is an eye irritant.[8] It is also toxic to fish.[9]	?	?	?
no direct hit; 3 close all having te c=same number : RN: 26635-75-6 Polyoxyethylene (6) lauryl amide(syn: Lauramide) Polyoxyethylene (3) lauryl amide (syn: Lauramide) Polyoxyethylene (5) lauryl amide (syn: Lauramide) Or/and Polyoxyethylene lauramide [syn: Poly(oxy-1,2-ethanediyl), alpha,alpha'-(((1-oxododecyl)imino)di-2,1-ethanediyl)bis(omega-hydroxy-] RN: 31587-78-7	not listed	not listed	
• **Propylene glycol**[1] caused genetic damage, reduced fertility, and anemia in laboratory tests.[10] (Antifreeze)	57-55-6	4B	AI
• **Sodium sulfite**[1] caused genetic damage in tests with both laboratory animals and human cells.[11]	7757-83-7	3	AI
• **Sodium benzoate**[1] caused genetic damage in tests with human cells and laboratory animals. It also caused developmental problems and reduced newborn survival in laboratory tests.[12]	532-32-1	4B	CA, AI
• **Sodium salt of o-phenylphenol**[1] is a skin irritant. It also caused genetic damage and cancer in laboratory tests.[13]	132-27-4	not listed	C, TRI, AI
• **Sorbic acid**[1] is a severe skin irritant and caused genetic damage in laboratory tests.[14]	110-44-1	3	CA

1. U.S. EPA. Office of Prevention, Pesticides, and Toxic Substances. 2004. Response to Freedom of Information Act request of October 19, 2004. Washington, D.C. Response dated November 17.
2. National Institute for Occupational Safety and Health. 2003. RTECS: 4-Isothiazolin-3-one, 5-chloro-2-methyl-. www.cdc.gov/niosh/rtecs/nx7c76b2.html.
3. National Institute for Occupational Safety and Health. 2000. RTECS: Ammonium, ethyl (4-(p-(ethyl(m-sulfobenzyl)amino)-alpha-(o-sulfophenyl)benzylidene)-2,5-cyclohexadien-1-ylidene)(msulfobenzyl)-, hydroxide, inner salt, disodium salt. www.cdc.gov/niosh/rtecs/bq481908.html.
4. National Institute for Occupational Safety and Health. 2003. RTECS: Glycerol. www.cdc.gov/niosh/rtecs/ma7ad550.html.
5. U.S. EPA. Prevention, Pesticides and Toxic Substances. 1997. Reregistration eligibility decision (RED): 3-Iodo-2-propynyl butylcarbamate (IPBC). www.epa.gov/pesticides. p.7.
6. National Institute for Occupational Safety and Health. 1998. RTECS: Solvent naphtha (petroleum), light aromatic. www.cdc.gov/niosh/rtecs/wf33e140.html.
7. National Institute for Occupational Safety and Health. 2003. RTECS: Benzoic acid, p-hydroxy-, methyl ester. www.cdc.gov/niosh/rtecs/dh256250.html.
8. National Institute for Occupational Safety and Health. 1997. RTECS: Ethomeen T/15. www.cdc.gov/niosh/rtecs/ko92dda8.html.
9. W.T. Haller and Stocker R.K. 2003. Toxicity of 19 adjuvants to juvenile Lepomis macrochirus (bluegill sunfish). Environ Toxicol Chem. 22:615-619.
10. National Institute for Occupational Safety and Health. 2003. RTECS: 1,2-Propanediol. www.cdc.gov/niosh/rtecs/ty1e8480.html.
11. National Institute for Occupational Safety and Health. 2003. RTECS: Sodium sulfite. www.cdc.gov/niosh.rtecs/we20ce70.html.
12. National Institute for Occupational Safety and Health. 2003. RTECS: Benzoic acid, sodium salt. www.cdc.gov/niosh/rtecs/dh657890.html.
13. National Institute for Occupational Safety and Health. 2003. RTECS: 2-Biphenylol, sodium salt. www.cdc.gov/niosh/rtecs/dv757e20.html.
14. National Institute for Occupational Safety and Health. 1998. RTECS: Sorbic acid. www.cdc.gov/niosh/rtecs/wg200b20.html.
15. pers comm. with Darryl Sande, Weyerhauser, Sat, 04 Jun 2005 15:30:38 -0600

The surfactants found in all Canadian Monsanto forestry herbicides belong to class of surfactants known as Alkyl Amines. Monsanto has been using these types of surfactants in its products for over 30 years. A polyethoxylated tallow amine

surfactant (CAS **number 61791-26-2**) which is a mixture of long-chain alkylamines synthesized from animal-derived fatty acids is the predominant surfactant used in glyphosate-based surfactants. The surfactant is typically 15% or less of the formulation.

REFERENCES

[i] Northwest Coalition for Alternatives to Pesticides; 1998; "*Toxic Secrets Inert Ingredients in Pesticides 1987-1997*"; report by Californians for Pesticide Reform

[ii] David Suzuki, April 25, 2005 presentation, Regina

[iii] PMRA PRO2000-04; http://www.pmra-arla.gc.ca/english/pdf/pro/pro2000-04-e.pdf

[iv] Bill C-8; Pesticide Act – Canada; Thursday, December 12, 2002

[v] PMRA: Regulatory Directive DIR2004-01 "*Formulants Program"* http://www.pmra-arla.gc.ca/english/pdf/dir/dir2004-01-e.pdf (which replaces PRO 2000-04)

[vi] Cox, Carolyn; Glyphosate; JOURNAL OF PESTICIDE REFORM/ WINTER 2004 • VOL. 24, NO.4 http://www.pesticide.org/glyphosate.pdf

[vii] PMRA list of formulants; PMRA: Regulatory Directive DIR2005-01; http://www.pmra-arla.gc.ca/english/pdf/reg/reg2005-01-e.pdf

[viii] pers comm. with Darryl Sande, Weyerhauser, Sat, 04 Jun 2005 15:30:38 -0600
"The surfactants found in all Canadian Monsanto forestry herbicides belong to class of surfactants known as Alkyl Amines. Monsanto has been using these types of surfactants in its products for over 30 years. A polyethoxylated tallow amine surfactant (CAS **number 61791-26-2**) which is a mixture of long-chain alkylamines synthesized from animal-derived fatty acids is the predominant surfactant used in glyphosate-based surfactants. The surfactant is typically 15% or less
of the formulation."

[ix] Agency for Toxic Substances and Diseases Registry (ATSDR); "ToxFAQs for Ethylene Glycol and Propylene Glycol" http://www.atsdr.cdc.gov/tfacts96.html#bookmark04

[x] Agency for Toxic Substances and Disease Registry (ATSDR -US); Public Health Statement for Total Petroleum Hydrocarbons (TPH) http://www.atsdr.cdc.gov/toxprofiles/phs123.html
"Very little is known about the toxicity of many TPH compounds."

[xi] 3-Iodo-2-propynyl butyl carbamate MSDS; http://64.233.179.104/search?q=cache:HmeSr-lBip0J:www.jeen.com/cartexe/pdfs/msds%2520JEECIDE%2520IPBC%2520100%2525.pdf+3-Iodo-2-propynyl+butyl+carbamate+msds&hl=en