Preliminary Report to the Board on the 2023 Water Quality Study of Aerially Applied Herbicides in Forestry

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Maine Board of Pesticides Control

Department of Agriculture, Conservation & Forestry

Executive Summary

In 2021, the 131st Maine legislature voted to pass LD 125, An Act to Prohibit Aerial Spraying of Glyphosate and Other Synthetic Herbicides for the Purpose of Silviculture (Appendix I). Governor Janet Mills vetoed the bill and issued an executive order (EO 41 FY 2021) requiring state agencies to review the best management practices, rules and regulations, and potential consequences of aerial glyphosate application (Appendix II.) One of the key provisions of this executive order was the establishment of a surface water quality study specifically focused on the impact of aerial herbicide spraying in forestry. The Maine Board of Pesticides Control (BPC) was tasked with conducting this study, which was initially scheduled for completion in 2022.

Due to funding constraints, equipment and personnel availability, and significant changes in staffing, this project was conducted in the fall of 2023. BPC staff have undergone and overcome many changes and challenges while completing this study resulting in an extended timeline for completion.

Despite numerous hurdles, this report compiles the methodologies, data analyses, and results for the 2022 surface water quality study. The full dataset is also included in the appendix to provide transparency and facilitate further research. The findings of this study are crucial for understanding the potential environmental impacts of aerial herbicide spraying and informing future decisions regarding the practice.

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Introduction

Herbicide use is a key silvicultural tool in modern forestry practice. The aerial application of pesticides has been shown to increase timber yields, expedite reforestation, and reduce pressure from invasive species after logging has been conducted. While it offers several advantages, its environmental consequences also pose concerns. Parts of the scientific community, conservationists, and members of the public have challenged the validity of large-scale herbicide use in forestry due to its potential to impact biodiversity and contaminate surface and groundwater, posing risks to human health and aquatic life. (Wagner, 2004.)

This study intended to fulfill the requirements of Executive Order 41 (EO 41) and to find if, where, and in what quantity these aerially applied herbicides appear in Maine's surface waters.

Previous studies conducted by the BPC have detected and measured pesticides in the surface waters of Maine. Most recently, our 2021 study Surveillance for Current-Use Pesticides in Maine's Freshwater Resources Along a Population Gradient, otherwise known as the "10 Cities Project" found detectable and measurable levels of pesticides in the surface water of all 10 sites tested. Atrazine, imidacloprid, prometon, diuron, fipronil, and metolachlor had the most surface water detections in the 2021 study.

Samples included in this study were collected and analyzed from October 16, 2023, until November 9, 2023. Surface waters collected and tested were adjacent to and downstream from forest, agriculture, urban, and mixed-use land uses located in Aroostook, Franklin, Hancock, Kennebec, Oxford, Piscataquis, Penobscot, Somerset, and Washington Counties. The sampling sites encompassed various water bodies, including brooks, rivers, ponds, and lakes. Priority pesticides being monitored include glyphosate, aminomethylphosphonic acid (AMPA), aminopyralid, imazapyr, metsulfuron methyl, and sulfometuron methyl. These target pesticides were prioritized using records and data submitted to the BPC by foresters currently using herbicides in Maine. Additional pesticides detected and tested for are listed in Appendix III.

While the initial study design included a supplemental drift study to assess the potential for herbicide drift from aerial applications, this component was eliminated. Time constraints coupled with remote site location with difficult access played a role in this decision. The lack of suitable sites and dates available for testing hindered our ability to conduct a drift study.

Methods

Site Selection

Initially, site selection was built around exploring if the current distance cited in pesticide regulations restricting broadcast pesticide applications within 25' of waterbodies is sufficiently protective. However, timber harvesting by clearcutting is prohibited within 75 to 250' of a waterbody according to Department of Environmental Protection CMR 06-96 Chapter 310, and site exploration revealed that most harvesting happens 2000 – 2500' from water bodies. Site selection was re-evaluated and directed at watersheds downstream from herbicide application

sites. Sampling of these watersheds could provide an integrated understanding of the extent of pesticide movement downstream. There were 149 sites selected based on available access points and the probability they could receive drainage from forestry site preparation or conifer-release herbicide applications. This information was gathered using the aerial application plans submitted to the BPC by Clayton Lake Woodland Holdings LLC, Irving Inc., Katahdin Forest Management, Northridge Services, Seven Islands Land Company, Solifor Timberlands, and Worcester Holdings LLC in 2022. In addition to these individual sampling locations there were 6 duplicate samples taken and 18 field blanks submitted.

Surface Water Sampling

Grab sampling was determined to be the best method for testing the water from the selected sites. Grab samples are single samples collected at a single location manually. An SOP for surface water sampling, "Standard Operating Procedure for Collecting Surface Water Samples for Pesticides Analysis" was developed in October of 2023 and instructed field staff on proper sample collection. Many of the details are outlined in this study and the full Standard Operating Procedure can be found in Appendix IV.

Collection Equipment included 500mL amber, glass, certified pre-cleaned bottles for the collection of pesticides. The bottles had Teflon-lined caps. The site was visited, the bottle was labeled and held below the water's surface to collect the sample. The date and time were recorded at the time of the sampling along with a full recording of the inspector's name, precise geographic location, accuracy, access point and water flow direction, and any applicable notes about the collection.

Duplicate Frequency and Field Blanks

When duplicate samples were collected the bottles were submerged either side by side or one immediately after the other. Field blanks were triple rinsed with distilled or deionized water to 1-2" depth, shaken, and emptied. Pre-rinsing was performed three times and refilled with distilled or deionized water to the shoulder of the bottle.

Sample Storage and Transfer

All samples were packed in ice or refrigerated from the time of collection to delivery to the laboratory. Samples were shipped in coolers with ice packs and were well-packaged to prevent breakage. All samples arrived at the laboratory within the holding period established by the lab for analysis.

Budget

This work was funded by a United States Environmental Protection Agency (EPA) Region 1 grant supporting the Board of Pesticides Control projects under the Federal Insecticide, Fungicide & Rodenticide Act (FIFRA) Cooperative Agreement.

Results

Surface Water Grab Samples

All counties sampled had at least one detection of a target herbicide (Table 1). None of the detections in this study reached any of EPA's lowest benchmarks (Table 2).

Field Blanks

Results from October 31st, 2023 were removed from the study due to consistencies found between the results and the positive field blanks. Identical compounds were found in similar concentrations suggesting that the field blanks could have become contaminated during transportation, packaging, or sample collection. To ensure the integrity of the data and to eliminate the possibility of cross-contamination affecting the conclusions of the study, the samples were discarded from the analysis.

Results with Exclusions

There were 98 detections of pesticide compounds across 53 sites, 50 of which were above the designated reporting limit. Imazapyr and metolachlor ES, a metabolite of metolachlor, had the highest number of detections. Three of the target compounds were detected. Imazapyr was detected in 25 samples, sulfometuron methyl was detected in 3 samples and metsulfuron methyl was detected in 1 sample. Of the 25 sites that had detections of the target pesticides, 7 were within a drainage divide where spraying occurred, 8 sites were in drainage divides adjacent to where aerial spraying occurred. 76 samples did not have any detections.

Table 1.

Field identification numbers not present on this table did not result in any detections. All units are represented in µg/L (ppb). 'Q' indicates a detection below the reporting limit that is adequate for identification but not sufficient for quantification.

SAMPLE DESCRIPTION	2,4-D	Alachlor OA	Aminocyclopyrachlor	Atrazine	Azoxystrobin	Carbaryl	DEA
Reporting Limit (ug/L (ppb)	0.009	0.0084	0.025	0.0022	0.0052	0.014	0.002
231016LRSLITTL06			Q				
231017BETHE07							
231017COLFLS02							
231017COLUM03							
231017ELSIE06		0.0085					
231017HANOVW05							
231017MACHI04							
231017WOODSS10				Q			Q
231018Allag04N							
231018LRSTHEFO09							Q
231018T13R1206							
231018T15R902E							

231018T15R1105						Q	
231019Allag01N							
231019Eagle07							Q
231019Walla05							
231019Winte08							
231020Ashla07W							
231020LRSFAIRF03							
231020LRSNEWPO01							
231020LRSPALMY02				Q			0.005
231020Masar01N							
231020Masar02W							
231020Masar03S							
231020Masar06E							
231020T8R504N							
231020T8R505W							
231023Carib03E				Q	Q		
231023Limes04							
231024Carib01W							
231024INDUS01				Q			Q
231024Sincl07					Q		
231024Squar06							
231024StAga10	Q						
231024Stock04S							
231024Washb11							
231024Westl02							
231027Conno07							
231027FortK05					Q		
231027NewCa04							
231027VanBu06							
231031ADAMS08				Q			Q
231101HERMO01							
231101KENDU02				Q			0.003
231101LINCO05	Q						
231101WINN06							
231101WINN06							
231102MEDWA03							
231102T11R701							
231102T6R1108				Q			Q
231102T9R1305							

Table 1. Continued

SAMPLE DESCRIPTION	Dimethenamid	HA	Hexazinone	Imazapyr	Imidacloprid	Isoxaben	Metalaxyl
Reporting Limit (ug/L (ppb)	0.006	0.004	0.0015	0.0035	0.0018	0.003	0.0035
231016LRSLITTL06				0.0044			
231017BETHE07							
231017COLFLS02			0.0066				
231017COLUM03			0.007				
231017ELSIE06							
231017HANOVW05							
231017MACHI04			0.0019				
231017WOODSS10							
231018Allag04N				0.012			
231018LRSTHEFO09							
231018T13R1206				Q			
231018T15R902E							
231018T15R1105	0.0092		Q	0.005			
231019Allag01N				Q			
231019Eagle07				Q			
231019Walla05				Q		0.0046	
231019Winte08				Q			
231020Ashla07W				0.016			
231020LRSFAIRF03							
231020LRSNEWPO01		Q					
231020LRSPALMY02		0.0041		Q			
231020Masar01N				0.045			
231020Masar02W				0.011			
231020Masar03S				0.01			
231020Masar06E				0.034			
231020T8R504N				0.048			
231020T8R505W				0.1			
231023Carib03E				0.0098			
231023Limes04					0.0043		Q
231024Carib01W				0.013			
231024INDUS01							
231024Sincl07					Q		Q
231024Squar06				0.038			
231024StAga10							
231024Stock04S				0.043			
231024Washb11				0.019			
231024Westl02				0.11			
231027Conno07				0.063			
231027FortK05							
231027NewCa04							

231027VanBu06							
231031ADAMS08							
231101HERMO01							
231101KENDU02		Q					
231101LINCO05							
231101WINN06							
231101WINN06							
231102MEDWA03							
231102T11R701				0.017			
231102T6R1108							
231102T9R1305				0.0043			

Table 1. Continued

SAMPLE DESCRIPTION	Metolachlor	Metolachlor ESA	Metolachlor OA	Metsulfuron methyl	Nicosulfuron	Pyroxsulam	Sulfometuron methyl	Tebuthiuron
Reporting Limit (ug/L (ppb)	0.024	0.005	0.042	0.01	0.011	0.013	0.0025	0.0011
231016LRSLITTL06								
231017BETHE07		Q						
231017COLFLS02								
231017COLUM03								
231017ELSIE06								
231017HANOVW05		0.006						
231017MACHI04								
231017WOODSS10								0.0015
231018Allag04N								
231018LRSTHEFO09								
231018T13R1206								
231018T15R902E		Q						
231018T15R1105					Q	Q		
231019Allag01N								
231019Eagle07		Q						
231019Walla05		Q						
231019Winte08								
231020Ashla07W		Q						
231020LRSFAIRF03		0.013						
231020LRSNEWPO01		0.015						
231020LRSPALMY02		0.34	0.085					
231020Masar01N		Q						
231020Masar02W								
231020Masar03S								
231020Masar06E							Q	
231020T8R504N							0.0042	
231020T8R505W				Q			0.0055	

231023Carib03E		0.02						
231023Limes04		Q						
231024Carib01W		0.013						
231024INDUS01								
231024Sincl07		0.37	0.12					
231024Squar06		0.026						
231024StAga10		0.024						
231024Stock04S								
231024Washb11		Q						
231024Westl02								
231027Conno07								
231027FortK05		Q						
231027NewCa04		0.1	Q					
231027VanBu06		0.0068						
231031ADAMS08								
231101HERMO01		0.016						
231101KENDU02	Q	0.34	0.13					
231101LINCO05								
231101WINN06		0.043						
231101WINN06		0.043						
231102MEDWA03		Q						
231102T11R701								
231102T6R1108								
231102T9R1305								

Table 2. Pesticide Summary by Lowest and Human Benchmark

Pesticide	Number of Detections	Highest Detection (ppb)	Lowest Benchmark (ppb)	Acute Human Health Benchmark (ppb)
2,4D	2	Q	299.2	400
Alachlor + analytes	1	0.0085	1.64	N/A
Aminocyclopyrachlor	1	Q	8900 Freshwater Invertebrate (Chronic)	16500
Atrazine + analytes	23	0.014	4.6 Vascular Plants	N/A
Azoxystrobin	3	Q	44	1070

			Freshwater Invertebrate (Chronic)	
Carbaryl	1	Q	0.5 Freshwater Invertebrate (Chronic)	N/A
Dimethenamid	1	0.0092	8.9 Vascular Plants	300
Hexazinone	4	0.007	7 Nonvascular Plants	N/A
Imazapyr	25	0.11	24 Vascular Plants	15000
Imidacloprid	2	0.0043	0.01 Freshwater Invertebrate (Chronic)	500
Isoxaben	1	0.0046	10 Vascular Plants	300
Metalaxyl	2	Q	1200 Freshwater Invertebrate (Chronic)	3000
Metolachlor + Analytes	26	0.4	N/A	N/A
Metsulfuron methyl	1	Q	0.36 Vascular Plants	1500
Nicosulfuron	1	Q	N/A	7400
Pyroxsulam	1	Q	2.57 Vascular Plants	6000
Sulfometuron methyl	3	0.0055	0.45 Vascular Plants	1630
Tebuthiuron	1	0.0015	50 Nonvascular Plants	N/A

Full data set available by request. Please email julia.vacchiano@maine.gov for complete testing results.

Glyphosate

There were no detections of glyphosate in any locations or in any samples. Similarly, there were no detections of AMPA, a primary breakdown product of glyphosate, or Glufosinate, a similar herbicide. Glyphosate and its breakdown byproducts bind tightly to the soil and are

unlikely to enter the groundwater when bound to most soil types (National Pesticide Information Center, 2019.)

Discussion

This study confirms the presence of various pesticides in the waters of Maine, including but not limited to the pesticides commonly used in the forestry industry. The degree to which these substances exist in Maine's surface water varies from questionable detections below the reporting limit to clear and quantifiable results. These results align with water quality reports from states with significant forestry sectors like Wisconsin (Wisconsin Department of Agriculture, 2023), Minnesota (Minnesota Department of Agriculture, 2023), and Washington (Sandison, 2024.) The active ingredients found were primarily broad-spectrum herbicides. Imazapyr and a degradation product of Metolachlor were detected at a higher frequency than other pesticides in the study. Atrazine and one of its degradation products, deethylatrazine (DEA) are also detected more often than other pesticides despite field blanks with possible contamination being removed from the data. While pesticides were present, there were no detections that exceeded EPA established benchmarks for aquatic life, terrestrial life, or humans.

Trends

The study suggests that pesticide presence in the surface water is clustered. While most samples showed no pesticide detection, samples taken from certain areas had a wide range of pesticides present. The map below shows detections and pesticide compounds clustered in positive samples. Three samples had six detections each.

No single pesticide was detected in more than 20% of samples taken, indicating that detections are generally rare.

These findings suggest that reporting limits influence the detection of certain compounds. The analytes detected most frequently had the lowest reporting limits, implying a higher likelihood of detection. However, most of the analytes detected were broad-spectrum herbicides or their breakdown products. Despite the higher likelihood we would detect certain analytes, this specific kind of herbicide has variable reporting limits. This indicates that we are finding more broad-spectrum herbicides not due to their reporting limits, but because there is more of it leaching into the surface water.

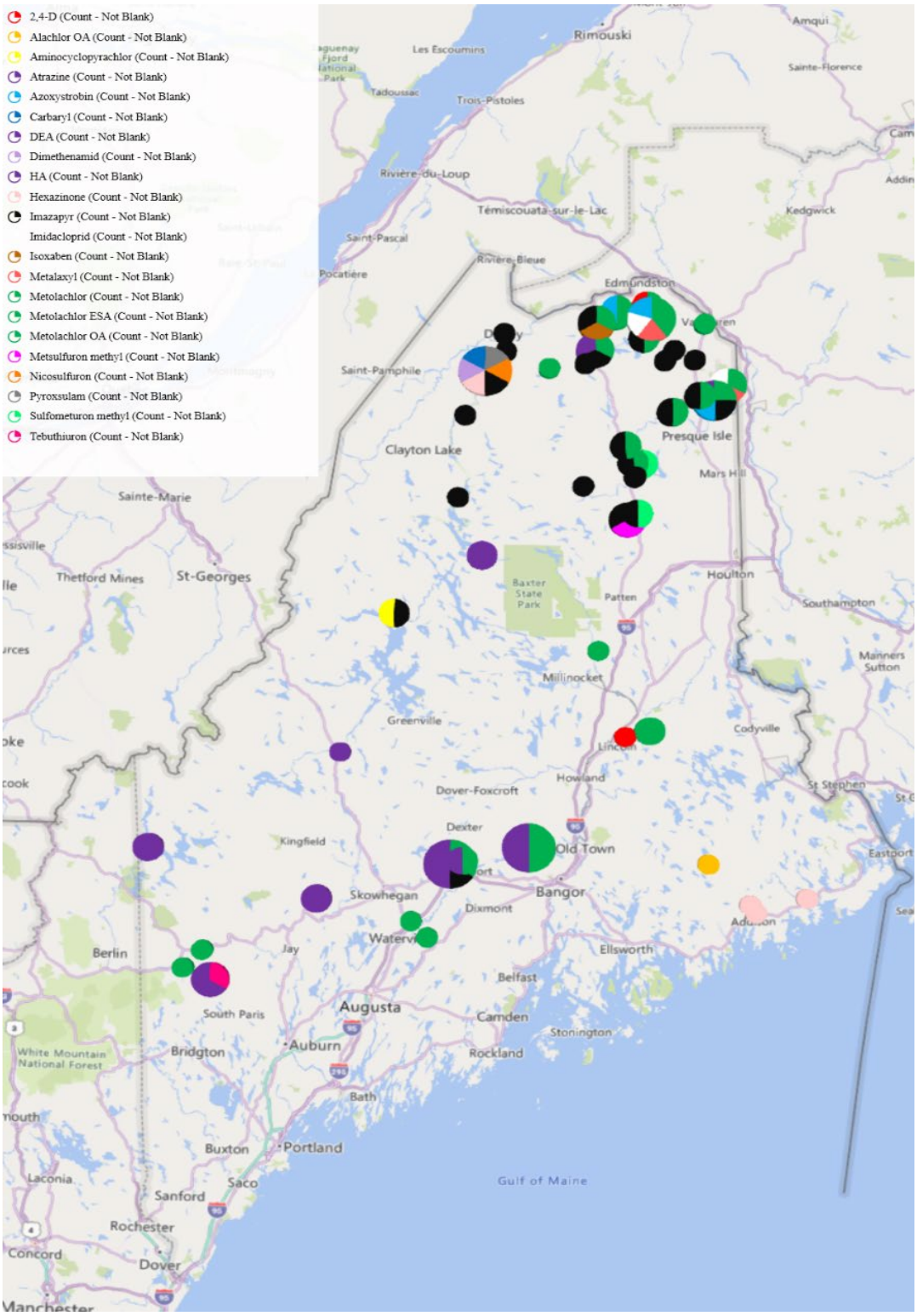

Figure 1. Detections and Analytes found. Map displays GPS coordinates with detections and points are divided by which compounds were detected.

Thresholds and Reporting Limits

Aquatic Life Benchmarks are presented with the data and determined by the United States Environmental Protection Agency. These benchmarks are intended to indicate the point at which a pesticide concentration begins to affect a population. There are no definitive levels at which all organisms of a singular category are injured but EPA evaluation has determined these benchmark figures are the levels where concern should be raised. As stated previously there are no samples in this study that are above any determined benchmark, but sample concentrations can be viewed and their absolute proximity to these determined figures can be evaluated to predict future issues that could arise. Levels in this study do not necessarily beg immediate action but encourage further monitoring.

It is also prudent to assess the benchmarks in relation to the reporting limits of the laboratory used. Reporting limits are the levels at which the methods of detection can identify an analyte in a sample. The only active ingredient in the study with a reporting limit above any EPA-determined benchmark was Chlorpyrifos. A non-chlorpyrifos non-detect in this study means that, regardless of whether the study can detect it, it is present at a concentration below the level of concern. Additionally, the use of chlorpyrifos began to be phased out in Maine with the signature of L.D. 316 on June 8, 2021.

Individual Compounds Most Commonly Found

Metolachlor

Metolachlor is a broad-spectrum herbicide used for weed control outdoors that has applications for agricultural fields, turf and lawns, ornamentals, trees, shrubs, vines, rights of way, and in forestry. Metolachlor was first registered with the EPA in 1976 and Maine has 46 registered products in 2024 containing the active ingredient or metabolites of metolachlor. According to the EPA, it has relatively low toxicity and is mostly non-irritating to the skin and eyes. It is classified as a likely carcinogen to humans. The highest risk of exposure is handlers and applicators who may be mixing, loading, and applying the pesticide in any of its liquid or granular formulations. Metolachlor is moderately persistent in the environment and is mobile in a variety of soil types. Half-life in water is about 200 days. It is toxic to birds exposed chronically and moderately toxic to freshwater fish when exposed acutely. Potential risk to nontarget plants is a likely consequence of runoff, leaching, and drift (United States Environmental Protection Agency, 1995.)

Imazapyr

Imazapyr is a systemic, non-selective herbicide used for the control of a wide variety of terrestrial and aquatic weeds in agricultural, industrial, residential, forestry, and ornamental settings. Imazapyr was first registered with the EPA in 1985, and Maine currently has 44 Imazapyr products registered. According to the EPA, this active ingredient has relatively low acute toxicity through oral and dermal exposure while it is determined to have a slightly higher toxicity when inhaled. It does not present dermal irritation but can cause irreversible eye damage. It is classified as non-carcinogenic in humans. The highest risk of exposure is, again, to applicators mixing, handling, or applying the product at higher concentrations. Risk evaluations

of Imazapyr show that it is both mobile and persistent and degrades in surface water with a half-life of 3-5 days. There is very little risk to birds, mammals, bees, or aquatic organisms when levels in the surface water are below the established benchmarks. However, there are risks to aquatic vascular plants, particularly those on the federal and state endangered species lists (United States Environmental Protection Agency, 2006.)

Atrazine

Atrazine is a systemic herbicide used for broadleaf weeds and certain grasses. It is labeled for use on soil, roadsides, lawns, agricultural fields, and athletic fields. It was first registered by the EPA in 1958 and there are currently 39 products registered in Maine containing Atrazine or its metabolites. The EPA has determined that acute oral and dermal toxicity is low and inhalation toxicity is very low. There are minimal effects to the skin or eyes. Atrazine is not likely to be carcinogenic to humans. Human exposure is most likely for people handling and applying the product. Atrazine is broken down by water, sunlight, and microorganisms in the soil and has a half-life of around 578 days in water. Atrazine is moderately mobile, does not bind well to soil, and breaks down more slowly in colder climates. It is slightly to moderately toxic to fish, and highly toxic to other aquatic organisms while being essentially non-toxic to bees, worms, birds, and mammals. Due to runoff potential and mobility, off-target plants are likely to be injured by applications of atrazine and its breakdown products (NPIC, 2020.)

Conclusions

This study demonstrates that pesticides both used in and apart from the forestry industry can be found in the surface waters of Maine. Detections of pesticides appear to be clustered. None of the pesticides detected reached any level of concern established by EPA benchmarks. This data contributes to our understanding of pesticide presence and movement in the state and monitoring to show the progression of these figures is encouraged.

Contributors

This section acknowledges the valuable contributions of the individuals involved in this research. Their expertise and support were essential to the successful completion of this project.

Jennie Poisson - Region 1 Inspector, Southwest

Lucien Soucier – Region 2 Inspector, Midcoast

Shannon Gustafson - Region 3 Inspector, Central

Keith Brown – Region 5 Inspector, Northern

Randy Lagasse – District Forester, Maine Forest Service

Curtis Bohlen, Ph.D. – Director, Casco Bay Estuary Partnership

Pamela J. Bryer Ph.D. – (BPC Toxicologist 2018-2023)

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Appendix

Appendix I

130th MAINE LEGISLATURE

FIRST REGULAR SESSION-2021

Legislative Document **No. 125**

S.P. 58 In Senate, January 21, 2021

An Act To Prohibit the Aerial Spraying of Glyphosate and Other Synthetic Herbicides for the Purpose of Silviculture

Received by the Secretary of the Senate on January 19, 2021. Referred to the Committee on Agriculture, Conservation and Forestry pursuant to Joint Rule 308.2 and ordered printed.

DAREK M. GRANT
Secretary of the Senate

Presented by President JACKSON of Aroostook.
Cosponsored by Speaker FECTEAU of Biddeford and
Senators: BENNETT of Oxford, MAXMIN of Lincoln, Representatives: O'NEIL of Saco, PLUECKER of Warren.

Be it enacted by the People of the State of Maine as follows:

Sec. 1. 7 MRSA §606, sub-§3 is enacted to read:

3. Aerial spraying of glyphosate and other synthetic herbicides. A person may not conduct an aerial application of glyphosate or other synthetic herbicides for the purpose of silviculture, including reforestation, regeneration or vegetation control after any timber harvest.

Sec. 2. 12 MRSA §8869, sub-§1, as enacted by PL 1989, c. 555, §10, is amended to read:

1. Standards for regeneration after harvests. The commissioner shall adopt rules to ensure adequate regeneration of commercial tree species on a site within 5 years of completion of any timber harvest. Rules to implement this requirement ~~shall~~ must include identification of commercial tree species, minimum stocking standards ~~and,~~ methods to mitigate inadequate regeneration and a prohibition on the aerial application of glyphosate or other synthetic herbicides pursuant to Title 7, section 606, subsection 3. In developing regeneration standards, the commissioner shall take into consideration regional differences in forest types, tree species and physiographic conditions.

Sec. 3. 12 MRSA §8869, sub-§7-A, as amended by PL 2013, c. 542, §5, is further amended to read:

7-A. Exemption for outcome-based forestry areas. An outcome-based forestry area designated under section 8003, subsection 3, paragraph Q is exempt from the requirements of this section if specifically exempted in the agreement establishing the outcome-based forestry area. The agreement may not provide an exemption from the prohibition on the aerial application of glyphosate or other synthetic herbicides pursuant to Title 7, section 606, subsection 3.

SUMMARY

This bill prohibits the aerial application of glyphosate or other synthetic herbicides for the purpose of silviculture, including reforestation, regeneration or vegetation control after a timber harvest.

Office of
The Governor

No. 41 FY 20/21
DATE June 30, 2021

AN ORDER ESTABLISHING THE GOVERNOR'S REVIEW OF THE AERIAL APPLICATION OF HERBICIDES FOR FOREST MANAGEMENT

WHEREAS, Maine forests cover 89 percent of the state and support an important forest industry that is central to our natural resource-based economy, soil health, wildlife habitat, and quality of life, and its sustainable management is a top priority for the Administration;

WHEREAS, It is the policy of the State to promote the principles of integrated pest management and other science-based technology to minimize reliance on pesticides and herbicides while recognizing that outbreaks of disease, insects, and other pests will necessitate fluctuations in their use;

WHEREAS, State agencies, in cooperation with private interest groups, must work to educate pesticide users and the general public on the proper use of these chemicals and to determine other actions needed to accomplish the state policy and minimize the harm from the application of any harmful chemicals;

WHEREAS, The aerial application of herbicides in forest management is extremely limited, such that in 2019, the acreage treated amounted to less than five percent of the total acres harvested statewide and, in the last 30 years, Maine has seen an 82 percent reduction in acres treated;

WHEREAS, There are widespread concerns about the chemical glyphosate and whether the aerial application of herbicides is currently being performed safely and responsibly;

WHEREAS, It is State policy to allow the full growth of our forests to decarbonize our environment and achieve goals related to the disastrous effects of climate change, and eliminating undergrowth that limits the growth of these forests is done by limited application of synthetic pesticides and herbicides for which there is no known organic substitute;

WHEREAS, The Board of Pesticides Control authorized an independent assessment of Maine's pesticide use regulations concerning aerial application by industrial forest management companies

in 2020, and the independent auditor, SCS Global Services, concluded, "The State of Maine regulatory framework, within which aerial application of herbicides in forest operations takes place, is functioning as designed."

NOW, THEREFORE, I, Janet T. Mills, Governor of the State of Maine, pursuant to *Me. Const. Art V, Pt 1, §1 and §12*, do hereby Order as follows:

I. ESTABLISHMENT AND PURPOSE

The Board of Pesticides Control shall, in consultation with the Maine Forest Service and other stakeholders and interested parties, review and amend rules related to the aerial application of glyphosate and other synthetic herbicides for the purpose of silviculture, including reforestation, forest regeneration, or vegetation control in forestry operations.

The process shall include:

A. A review of the existing BMPs for aerial application of herbicides including:

a. A review of the findings and recommendations of the independent assessment on aerial applications conducted in 2020.
b. A review of the current international scientific literature regarding the aerial application of herbicides for forestry purposes, taking into account the species addressed in other states and countries.
c. A review of Integrated Pest Management guidelines as they apply to aerial application of herbicides for forestry purposes to assess the relative effectiveness and costs of other treatment methods.

B. Development of a surface water quality monitoring effort to focus on aerial application of herbicides in forestry to be conducted in 2022.

C. A review undertaken by the Department of Inland Fisheries and Wildlife to assess wildlife habitat impacts related to sites treated by aerial application of herbicides.

D. A review of the existing regulatory framework for aerial application of herbicides in forest operations, to include:

a. A proposal to amend rules to expand the buffers and setbacks to further protect rivers, lakes, streams, ponds, brooks, wetlands, wildlife and human habitats and other natural resources.
b. A proposal to amend rules to expand the buffers for areas next to Sensitive Areas Likely to be Occupied (SALO) and other sensitive areas to include farming operations.

E. A series of public meetings to share and obtain public input on the results of the review before finalizing.

II. PROCEEDINGS

The Board of Pesticides Control and the Maine Forest Service shall solicit feedback from, and consult with, the University of Maine School of Forest Resources, Department of Inland Fisheries and Wildlife, forest landowners, foresters, licensed applicators, conservation groups, and others as necessary to complete their tasks.

The effort shall be led jointly by the Board of Pesticides Control and the Maine Forest Service and co-chaired by the respective directors. The meetings shall be held in locations determined by the chairs or will be held virtually but the proceedings of the group are not otherwise "public proceedings" within the meaning of 1 M.R.S. section 402.

III. RECOMMENDATIONS

The Board of Pesticides Control and the Maine Forest Service shall submit a summary of the review process and findings and any corresponding recommendations to the Governor on or before January 2, 2022, after which the authority of this Executive Order will dissolve.

IV. EFFECTIVE DATE

The effective date of this Order is June 30, 2021.

Janet T. Mills, Governor

Appendix III

List of 102 pesticides analyzed by Montana Department of Agriculture Analytical Laboratory. "Universal Method for the Determination of Polar Pesticides in Water Using Solid Phase Extraction and Liquid Chromatography/Mass Spectrometry/Mass Spectrometry."

Analyte	Reporting Limit ug/L (ppb)
2,4-D	0.009
Acetochlor	0.14
Acetochlor ESA	0.02
Acetochlor OA	0.0084
Alachlor	0.11
Alachlor ESA	0.044
Alachlor OA	0.0068
AMPA	1
Aminocyclopyrachlor	0.025
Aminopyralid	0.03
Atrazine	0.0022
Azoxystrobin	0.0052
Bentazon	0.0022
Bromacil	0.0041
Bromoxynil	0.012
Carbaryl	0.014
Chlorpyrifos	0.06
Chlorsulfuron	0.0056
Clodinafop acid	0.013
Clopyralid	0.088
Clothianidin	0.016
Deethyl atrazine (DEA)	0.0017
Deethyldeisopropylatrazine (DEDIA)	0.1
Deisopropyl atrazine (DIA)	0.04
Dicamba	0.88
Difenoconazole	0.011
Dimethenamid	0.006
Dimethenamid OA	0.0072
Dimethoate	0.0022

Disulfoton sulfone	0.0066
Diuron	0.0053
FDAT (indaziflam met)	0.0051
Fipronil	0.0024
Fipronil desulfinyl	0.14
Fipronil sulfide	0.08
Fipronil sulfone	0.04
Flucarbazone	0.0024
Flucarbazone sulfonamide	0.0039
Flumetsulam	0.029
Flupyradifurone	0.045
Fluroxypyr	0.035
Glufosinate	1
Glutaric acid	0.03
Glyphosate	1
Hydroxy atrazine	0.004
Halosulfuron methyl	0.01
Hexazinone	0.0015
Imazamethabenz acid	0.0025
Imazamethabenz ester	0.001
Imazamox	0.0057
Imazapic	0.003
Imazapyr	0.0035
Imazethapyr	0.004
Imidacloprid	0.0018
Indaziflam	0.002
Isoxaben	0.003
Isoxaflutole	0.13
Malathion	0.028
Malathion oxon	0.0024
MCPA	0.0046
MCPP	0.0044
Metalaxyl	0.0035
Methomyl	0.012
Methoxyfenozide	0.01
Metolachlor ESA	0.005
Metolachlor OA	0.042
Metolachlor OA	0.042
Metsulfuron methyl	0.01

Nicosulfuron	0.011
NOA 407854	0.0052
NOA 447204	0.02
Norflurazon	0.02
Norflurazon desmethyl	0.02
Oxamyl	0.01
Parathion methyl oxon	0.012
Phorate sulfone	0.024
Phorate sulfoxide	0.003
Picloram	0.28
Picoxystrobin	0.0075
Prometon	0.001
Propiconazole	0.01
Prosulfuron	0.005
Pyrasulfotole	0.02
Pyroxsulam	0.013
Saflufenacil	0.01
Simazine	0.0026
Sulfentrazone	0.035
Sulfometuron methyl	0.0025
Sulfosulfuron	0.0054
Tebuconazole	0.014
Tebuthiuron	0.0011
Tembotrione	0.073
Terbacil	0.0048
Terbufos sulfone	0.011
Tetraconazole	0.0039
Thiamethoxam	0.02
Thiencarbazone methyl	0.04
Thifensulfuron methyl	0.022
Tralkoxydim	0.0051
Tralkoxydim acid	0.005
Triallate	0.3
Triasulfuron	0.0055
Triclopyr	0.022
Trifloxystrobin	0.02

Appendix IV

Standard Operating Procedure for Collecting Surface Water Samples for Pesticides Analysis

APPROVALS

Approved by: _____ Date: _____

Megan Patterson, Director
Maine Board of Pesticides Control

Approved by: _____ Date: _____

John Pietroski, Program Manager
Maine Board of Pesticides Control

Prepared by: _____ Date: _____

Pam Bryer, Pesticides Toxicologist
Maine Board of Pesticides Control

Standard Operating Procedure for Collecting Surface Water Samples for Pesticides Analysis

1.0 PURPOSE AND SCOPE

1.1 This document delineates The Maine Board of Pesticides Control (BPC) Standard Operating Procedures (SOPs), for manual collection and handling of surface water grab samples, to be analyzed for a suite of pesticides at the Montana Agricultural Laboratory.

1.2 This SOP is a supplement to the BPC's general SOP for surface water grab samples.

1.3 This SOP establishes standard methods to assure the chemical and physical integrity of the samples. Consistent sampling techniques are essential for facilitating statistical analysis and comparability of results.

2.0 DEFINITIONS

2.1 **Grab Sample:** A discrete, single sample collected at a single location either manually or with an automatic sampler.

2.3 **Split Samples:** Samples formed by combining and mixing multiple samples collected at a single location, during a single sampling event, to be divided for analyses by two or more laboratories.

2.4 **Surface Water:** All inland waters of the state, excluding groundwater and estuarine and marine waters.

3.0 HEALTH AND SAFETY

3.1 Safety is a top priority. Two people should always be present for all field work conducted during inclement weather conditions or when there is risk to personal safety.

3.2 Hazards may include: fast moving and/or deep water, steep slopes to sampling locations, slippery rocks, incoming tides, and traffic.

3.3 Precautions should be taken when collecting and handling water samples, exiting vehicles, walking along roadsides, and accessing sampling sites. Protective gloves and other safety gear, as dictated by site conditions, should be worn.

4.0 MATERIALS

4.1 Field and Personal Safety Equipment

4.1.1 Reflective vests and/or highly visible clothing
4.1.2 Waders or water boots
4.1.3 U.S. Coast guard approved personal flotation device
4.1.4 Powder-free, Latex or nitrile gloves
4.1.5 Traffic cones or flagging
4.1.6 First aid kit

4.2 General materials

4.2.1 Record keeping: Chain-of-Custody forms; field data sheets; clip board; #2 pencil or waterproof, permanent pen
4.2.2 Map, satellite photos, directions
4.2.3 Sample container labels
4.2.4 Decontamination: de-ionized (or distilled) water, rinse bottles, paper towels
4.2.5 Re-closable one-gallon plastic Zip-Lock bags
4.2.6 Cooler and ice
4.2.7 Camera capability
4.2.8 GPS capability

4.3 Collection Equipment

4.3.1 Samples bottles: 500 mL, amber, glass, certified pre-cleaned for collection of pesticides; Teflon-lined caps (Bring extra bottles to each sampling event.)

4.3.3 (Optional) Swing sampler extension pole and adjustable clip

5.0 COLLECTION PROCEDURE

5.0.1 Select representative sample location according to BPC SOP for manual collection of surface water grab sampling. Ensure site is safely accessible from shore or a bridge.

5.0.2 Label the sample container prior to collection using #2 pencil or permanent, waterproof marker and waterproof labels.

5.0.2.1 Unique sample identification number (Write sample ID number on all sample containers and caps for each site.) Use format: **YYMMDDXXXXX##** where YY = last two digits of year; MM = two digit month; DD = two digit day; XXXXX = first five letters of the town (example: AUGUS for Augusta) -or- the entire township grid coordinate (example: T11R10); ## = the sample number for that day. If there is more than one sample location within the same town add a direction to the end of the town portion of the sample ID; N for northern, E for eastern, and so on.

(Example: Sample 1 = 140825AUGUSN01, Sample 2 = 140825AUGUSE02, etc.)

5.0.2.2 Type of sample (Grab)

5.0.2.3 Sample location - town

5.0.2.4 Date and time

5.0.2.5 Analysis to be conducted

5.0.3 Don a fresh pair of powder-free, Latex or nitrile gloves before sampling.

5.1 Stream Grab Sampling

5.1.1 Manual Collection

5.1.1.1 If stream is not wadeable, sample from the bank, reaching as close to center of stream as is safe and practical.

5.1.1.2 Remove the cap/lid. Do not touch the inside of the cap and keep hands away from the opening to avoid contaminating the cap, neck, or inside of the bottle. When not needed place cap on clean work surface with the opening up; do not place cap on the ground.

5.1.1.3 Downstream or away from the sample collection location triple rinse the collection container in the site water. Triple rinse as follows: remove cap, mostly fill with water (using at least an inch or two of water in the container), replace the lid and shake, dump the rinsate out on shore or in an area where it cannot reach the sampling location, repeat twice more prior to taking the sample.

5.1.1.4 If possible, hold the container near the base with the opening facing upstream. Plunge the sample bottle, mouth down to about elbow depth and sweep bottle up through the water column. Avoid disturbing the sediment.

5.1.1.5 Fill bottle and securely replace cap. Rinse exterior of bottle with deionized/distilled water. Place sample bottle in a re-closable bag and seal. Place in a cooler, completely cover with ice at 4°C for transport.

5.1.1 Collection Using a Sampling Pole (Optional)

5.1.2.1 Secure bottle onto swing sampling pole. Enter downstream from the sample location, limiting disturbance of sediment.

5.1.2.2 Remove the cap/lid. Do not touch the inside of the cap and keep hands away from the opening to avoid contaminating the cap, neck, or inside of the bottle. Place cap on clean work surface with opening up; do not place cap on the ground.

5.1.2.3 Extend the sampling pole upstream, as close to the center of the channel as possible, with the opening of the bottle facing upstream. Submerge the bottle, mouth down, and sweep bottle up through the water column.

5.1.2.4 Fill to neck of the bottle (avoid overfilling) and securely replace cap. Rinse exterior of bottle with deionized water. Place sample bottle in a

re-closable bag and seal. Place in a cooler, partially filled with ice, at 4°C for transport.

5.2 **Field Blank Sampling:**

5.2.1. Overall, field blanks should be collected on a one-in-ten basis.

5.2.2. Each individual collecting samples should collect a field blank at the beginning and end of the project, at their first and last field sites respectively.

5.2.3. Water for field blanks should be recently purchased distilled water.

5.2.4. Wearing fresh gloves, remove the cap/lid of the sample collection container. Do not touch the inside of the cap and keep hands away from the opening to avoid contaminating the cap, neck, or inside of the bottle. When not needed place cap on clean work surface with the opening up; do not place cap on the ground.

5.2.5. Triple rinse as follows: remove cap, mostly fill with water (using at least an inch or two of water in the container), replace the lid and shake, dump the rinsate out on shore or in an area where it cannot reach the sampling location, repeat twice more prior to taking the sample.

5.2.6. Fill bottle and securely replace cap. Rinse exterior of bottle with deionized/distilled water. Place sample bottle in a re-closable bag and seal. Place in a cooler, completely cover with ice at 4°C for transport.

5.2 **Storm Drain Sampling:** <Not applicable to this sampling effort>

5.3 **Stormwater Grab Samples** <Not applicable to this sampling effort>

5.4 **Collection of a Composite Sample** <Not applicable to this sampling effort>

5.5 **Storage of Sample:** Refrigerate samples at 4°C overnight and until shipment.

6.0 DECONTAMINATION

6.0.1 As needed, triple rinse equipment with site water prior to sampling.

6.0.2 Prior to each discrete sample and prior to leaving site, triple rinse equipment with tap water, then triple rinse with deionized water to prevent cross-contamination from one sample and site to the next.

6.0.3 Store equipment in clean plastic bags.

7.0 CHAIN OF CUSTODY

7.0.1 All samples must be packed in ice or refrigerated from time of collection to delivery to the laboratory. Ship samples in coolers with ice packs and well packaged to prevent breakage.

7.0.2 Ensure samples are shipped to arrive at the laboratory within the holding period established by the laboratory for the specified analytical analyses.

7.0.3 Complete the chain of custody (COC) form for all samples. Note any special instructions or clarifications.

7.0.4 Send the white copy with the samples; keep other copies on file with field notes and data sheet.

7.0.5 Packages being shipped to Montana Agricultural Laboratory should be shipped Monday through to Thursday, not Friday, to ensure the package can be received and placed in cold storage upon arrival.

8.0 QA/QC

7.0.1 Quality Assurance/Quality Control (QA/QC) will be conducted in accordance with Standard Operating Procedures.

7.0.2 Ideally, ten percent of the total number of samples will be submitted as field blanks, field duplicates, and split samples.

7.0.2.1 **Field Split Sample:** <Not applicable to this sampling effort>

7.0.2.2 **Field Replicates/Duplicates:** Collect two samples, at the same sample event, by collecting side by side or by collecting one sample immediately after another. Label the routine sample and the duplicate sample separately. Example: The routine sample would have a sample ID of **140825AUGUS01**, and the duplicate would have a sample ID of

140825AUGUS02. Each inspector will be taking one duplicate sample during this project; ideally the duplicate will be taken in the middle of the sampling sequence.

7.0.2.3 **Field Blanks:** Triple rinse the field blank containers with distilled water. Pour a small volume of distilled or deionized water (to a depth of an inch or two) into the labeled sample bottle, replace the lid, shake, and empty. Repeat this pre-rinsing step twice more. Fill to the shoulder of the bottle. The blank will have its own sample ID number.

REFERENCES

Bureau of Land and Water Quality. Maine Department of Environmental Protection. 2006. Standard Operating Procedures and Visual Monitoring Guidelines for Stormwater Discharge Associated with Industrial Activities. Document number DEPLW0768

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USEPA (U.S. Environmental Protection Agency). 2009. Industrial Stormwater Monitoring and Sampling Guide. http://water.epa.gov/polwaste/npdes/stormwater/upload/msgp_monitoring_guide.pdf. Accessed August 21, 2014.

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APPENDIX B: Order of Sample Collection

In order to reach our quality assurance objectives, each inspector shall follow the this framework of organizing sample collection. Field Blanks are collected at the beginning and end of the project for each inspector and on a one in every ten basis. Each inspector should take one duplicate field sample when they have reached the middle of their data collection.

The following table shows the sample sequence needed for someone collecting samples from 19 unique sites.

Sample Location	Sample Order	>	Sample Type
1st	1st	>	Field Blank
1st	2nd	>	Sample
2nd	3rd	>	Sample
3rd	4th	>	Sample
4th	5th	>	Sample
5th	6th	>	Sample
6th	7th	>	Sample
7th	8th	>	Sample
8th	9th	>	Sample
9th	10th	>	Sample
10th	11th	>	Sample
10th	12th	>	Duplicate
11th*	13th	>	Field Blank
11th	14th	>	Sample
12th	15th	>	Sample
13th	16th	>	Sample
14th	17th	>	Sample
15th	18th	>	Sample
16th	19th	>	Sample
17th	20th	>	Sample
18th	21st	>	Sample
19th	22nd	>	Sample
19th	23rd	>	Field Blank

*This field blank could be collected at the 10th location; however, it makes more sense to move it to the following location to avoid clustering the QA samples at one site.