2015

Pesticide Sales in British Columbia

Integrated Pest Management Program

BRITISH COLUMBIA
Ministry of Environment and Climate Change Strategy

Executive Summary

In order for any regulatory agency to operate in an effective, risk-based fashion, it is important to have current data on key aspects of the industries it regulates. The Ministry of Environment and Climate Change Strategy's Integrated Pest Management (IPM) Program regulates the sale and use of pesticides in British Columbia through the *Integrated Pest Management Act*, and strives to reduce risk to human health and the environment from pesticides. To help achieve this goal, the ministry undertook an analysis of data on the sale of commercial pesticides in the province in 2015 by licensed pesticide vendors. The sales of domestic pesticides are not included in this report, as the ministry does not collect this information from vendors.

The highlights of our results for 2015 commercial pesticide sales include:

- Pesticide vendors in B.C. sold a total of 3,030,410 kilograms of commercial formulated products, which represented a total of 1,436,275 kilograms of active ingredient.

- The top five active ingredients sold were insecticidal mineral oil, hydrogen peroxide, glyphosate, sulphur, and *Bacillus Thuringiensis Israelensis*.

- Herbicides accounted for 31% of the active ingredient sales, followed by insecticides at 29%, acaricides at 18%, fungicides at 18%, and all other pesticide types at 4%.

- Pesticide products sold into the agricultural sector accounted for 84% of all active ingredient sales, with industrial vegetation, noxious weed and forestry products accounting for 5% of sales, structural products accounting for 5% of sales, mosquito products accounting for 3% of sales, and landscaping products accounting for 2% of sales.

- Since 2010, sales of many active ingredients have changed considerably. The biggest increase in a single active ingredient is the sale of hydrogen peroxide for controlling sea lice in aquaculture facilities. Sales of many older active ingredients such as endosulfan, azinphos-methyl, quintozene, and strychnine have stopped, while sales of many newer actives such as clothianidin have increased. Sales of glyphosate have decreased by 4% and sales of 2, 4-D have decreased by 27% since 2010.

- In comparison to other provinces, B.C. pesticide sales are lower than those in Alberta, which reported sales of 14.8 million kilograms of active ingredient in 2013, and those in Québec, which reported sales of 4.1 million kilograms of active ingredient in 2016.

Some of the key factors driving the changes in the sales of many active ingredients include:

- Product registrations ending for many older pesticides,
- The registration of products with new chemistries, the increased use of hydrogen peroxide for controlling sea lice in BC fish farms,
- Increases in the mosquito control sector, and
- Forces affecting agriculture such as changes in crop type, pest pressures, and pest management practices.

The data demonstrates that industries using pesticides in BC are constantly evolving, and this type of reporting is essential to have current knowledge upon which to prioritize activities and implement effective strategies for risk reduction.

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Table of Contents

Introduction

Background

Each year, the Ministry of Environment and Climate Change Strategy's Integrated Pest Management (IPM) Program collects pesticide sales and use data from licensed pesticide vendors and users in B.C. The data collected represents valuable information on pesticide sales and use trends in different sectors and regions of the province over time. However, the large amount of data collected each year makes it challenging for the ministry to enter, analyze, and report on this data regularly. To improve this process, the ministry developed a database and information tracking system that can efficiently handle the large volume of annual sales and use data collected from pesticide vendors and users.

The last major report on B.C. pesticide sales data occurred in 2010 (Wins-Purdy, 2013). Previous to that, a comprehensive survey of pesticide sales and use data was conducted from the calendar year of 2003 (ENKON Environmental Limited, 2005). Previous surveys of B.C. pesticide sales and use had been conducted for data collected in 1999 (ENKON Environmental Limited, 2001), in 1995 (Norecol, Dames & Moore, 1997), and in 1991 (Norecol Environmental Consultants, 1993). The long-term objective of those surveys was to determine trends in pesticide sales and use over time.

A number of other regulatory bodies in Canada have also reported out on pesticide sales in recent years. Alberta has produced a summary of pesticide sales every five years since 1988, with the most recent report detailing pesticide sales in 2013 (Alberta Environment and Parks , 2015). Québec has tabulated sales data every year since 1992, with the most recent data available for 2016 (Ministère du Développement durable, de l'Environnement et des Parcs, 2016). Prince Edward Island (P.E.I.) has pesticide sales data available since 2008 and recently provided sales data in 2014 (P.E.I. Department of Environment, Energy and Forestry, 2015). The Pest Management Regulatory Agency (PMRA) recently published a national report on pesticide sales for 2016 (Pest Management Regulatory Agency, 2016). All of these reports emphasize the value in using sales data to understand trends in the pesticide industry and to guide strategies for risk reduction.

For the B.C. Ministry of Environment and Climate Change Strategy, the analysis and reporting of pesticide sales and use data is important for a number of reasons. It allows the ministry to detect broad trends in pesticide sales and use, and track trends for specific products and active ingredients over time. It is also important in identifying specific compliance issues, such as licensed companies selling or using products no longer registered in Canada. The data collected can be shared with other pesticide regulatory agencies, which may help to identify areas where efficiencies can be gained through collaborative projects. In addition, making data easily accessible to the public and stakeholder groups fits well with the B.C. government's broader goals of openness and transparency. Finally, a sound understanding of pesticide sales and use in the province informs how the ministry allocates resources, and is an important tool for the prioritization of activities and the development of an effective, risk-based regulatory system.

Scope of this report

The scope of this report includes the sales data from all licensed pesticide vendors who sold non-excluded Commercial- or Restricted-class pesticides in B.C. in the calendar year of 2015. This report includes data on both the quantity of formulated product and the quantity of active ingredient sold, and provides detailed summaries of every active ingredient sold in B.C. in 2015. In contrast to previous reports, the scope of this report is narrower in some aspects than the sales and use surveys conducted for B.C. between 1991 and 2010. This report does not include data on:

- Pesticide use reported by pesticide user license or confirmation holders,
- Sales of domestic pesticides, as this information is not collected by the ministry on an annual basis, and
- Sales or use of excluded pesticides, such as swimming pool algaecides, or anti-sapstain wood preservatives used by pressure-treatment wood preservation facilities.

Goals of this report

The specific goals of this report are as follows:

- To gain an accurate view of current pesticide sales broken down by pesticide type, sector of use, specific actives, and region of B.C.
- To compare the data with previous sales data collected for B.C., to examine how pesticide sales in B.C. have changed since 2010, and to compare sales in B.C. with sales data reported by other provinces in Canada.
- To identify any administrative errors and inconsistencies found in the data collected, with a view to providing constructive feedback to vendors and improving the data that is collected each year.
- To establish a process for analyzing data and reporting out regularly on pesticide sales for B.C., with a view to broadening the scope of future reports to include the use of pesticides by license holders, confirmation holders, and other pesticide users, such as wood preservation facilities.

Methods

Data collection

Each year, commercial pesticide vendors in B.C. are required to submit an Annual Summary of Reportable Pesticide Sales to the Ministry of Environment and Climate Change Strategy. For each non-excluded commercial- or restricted-class product sold, the vendor lists the product name, the active ingredient, the *Pest Control Products* (P.C.P.) *Act* registration number, and the total amount of the product sold, in litres or kilograms, over the previous calendar year. Each vendor is also required to maintain a register that includes the name and P.C.P. number of the pesticide purchased, the size and number of containers purchased, the name and address of the purchaser, and the name and certificate number of the dispenser who made the sale. While this register is not submitted annually to the Ministry, it must be kept for a period of three years, allowing Ministry staff to audit the information provided in the annual summary if necessary.

Annual Summaries of Reportable Pesticide Sales were received from 71 pesticide vendors, which represented 100% of the vendors licensed to sell commercial and restricted pesticides in B.C. in 2015, compared to 56 pesticide vendors in 2010.

Quality control and analysis was performed on the summary data reported, and several consistent types of errors were observed. A number of vendors incorrectly reported their sales of domestic pesticides, and these products were not included in the analysis. In addition, some vendors reported sales of certain commercial pesticides excluded from the licensing requirements, as they are listed in Schedule 2 of the *IPM Act* Regulation. For example, the sales of products such as swimming pool algaecides and hard surface disinfectants are not required to be reported; these products were also excluded from the analysis.

A number of summaries contained other errors and irregularities in the data reported. The most common errors included the pesticide name not matching the P.C.P. number, or the amount of pesticides sold reported in units other than litres or kilograms. For all summaries where a discrepancy or error could not be resolved, the vendor was contacted directly by ministry staff, and clarification obtained.

Data management

All summary data was entered into the annual sales and use database. This database contains information from the PMRA on all registered pesticides in Canada. For each pesticide entered, the database uses the percent active ingredient guarantee listed on the label to convert the quantity of product to quantity of active ingredient. If a product contains multiple active ingredients, the database calculates the quantity of each active ingredient present.

For some products, the quantity of active ingredient is listed on the label in non-standard units. For example, the product containing the biological pesticide *Bacillus Subtilis* lists only the bioactive units per litre or kilogram. *Bacillus Thuringiensis Israelensis* is another biological pesticide product where the bioactive units are listed per litre or milligram. Whenever possible, the ministry contacted the manufacturer to obtain the percent active ingredient for the product to calculate the amount of active ingredient sold, which was done for all products containing the biological pesticide *Bacillus Thuringiensis Kurstaki* (Btk) that do not list the percent active on the label. For any biological pesticide where we could not obtain information on percent active from the manufacturer (e.g. *Bacillus Subtilis* and *Bacillus Thuringiensis Israelensis*), one kilogram of formulated product was considered equal to one kilogram of active ingredient. While this method likely over-estimates the actual amount of active ingredient sold for these products, it is consistent with the approach used for previous pesticide sales surveys in B.C. (ENKON Environmental Limited, 2005).

Grouping of pesticides by type

Pesticides are commonly grouped by type based on the pest targeted or on their intended use. For the purposes of this report, we grouped the pesticides reported sold into the following types:

- Herbicides
- Insecticides
- Acaricides (includes hydrogen peroxide for sea lice control)
- Fungicides
- Rodenticides
- Fumigants
- Wood preservatives
- Soil fumigants
- Molluscicides
- Plant Growth Regulators
- Animal repellents
- Crop Bactericides
- Algaecides

A small number of pesticides can be categorized as falling under more than one pesticide type. For the purposes of this report, each of these products was categorized as only one pesticide type, based on the primary use pattern of the product. For example, lime sulphur may be used as

a fungicide or an insecticide, but was categorized as a fungicide because that represents the primary use pattern of the product.

Hydrogen peroxide for controlling sea lice in fish farms was categorized as an acaricide, as that is the categorization that the PMRA uses for this product.

Grouping of pesticides by sector of use

Each pesticide sold was also categorized by sector of use, based on the primary use pattern indicated on the label. While the majority of products clearly fall into a discrete sector of use, a number of products have multiple uses listed on the label that allow for use in different sectors. For example, many herbicides have both agricultural and industrial vegetation uses on the label, which makes it difficult to determine the sector of use simply from the sale of the product. For these products, the sector of use was determined by a combination of a) knowledge of the primary use of the product, b) the type of vendor who sold the product, and c) in some cases, personal communications with vendors to inquire as to who the primary users of the product are.

All products were categorised as belonging in one of five different groups based on sector of use:

1) *Agriculture* – includes all agricultural products, including those used in greenhouses, nurseries, livestock production, formaldehyde-containing products used in poultry and mushroom operations, and hydrogen peroxide for sea lice control.

2) *Industrial vegetation, noxious weeds, and forestry* – includes all herbicides used for controlling industrial vegetation and noxious weeds, and all herbicides and insecticides used in forestry and forest health programs.

3) *Mosquito* – includes all larvicides and adulticides used for mosquito control.

4) *Structural and fumigation* – includes all structural products, all rodenticides, all fumigants, and all wood preservatives.

5) *Turf, golf course, and landscaping* – includes all turf and lawn care products, all products used on golf courses, and other products used primarily in a landscaping context, such as for controlling pests on ornamental plants in landscapes.

Reporting of sales of selected active ingredients

The ministry chose to highlight the sales of a number of active ingredients which may be of particular interest to regulators, industry groups, or members of the public with respect to potential concerns for human health and environmental impacts. The sales of each of these active ingredients were compared to sales reported in 2010 to obtain the percent change since 2010.

Results

Overall pesticide sales

Pesticide vendors across B.C. reported selling a total of 677 unique pesticide products in 2015 (i.e. either commercial or restricted pesticides). These 677 pesticides contained a total of 298 unique active ingredients.

In total, vendors reported sales of 3,030,410 kg of formulated product in 2015, which represents 1,436,275 kg of active ingredient (Table 1). Herbicides, insecticides, acaricides, and fungicides represented the majority of pesticides sold.

Table 1: Quantity of pesticide formulated products and active ingredients sold in B.C. in 2015

Pesticide type	Quantity of formulated product sold (kg)	Quantity of active ingredients sold (kg)
Herbicide	1,175,251	445,607
Insecticide	660,893	422,628
Acaricide	516,823	257,707
Fungicide	507,373	251,819
Rodenticide	81,340	91
Fumigant	35,992	35,733
Wood Preservative	17,476	12,990
Soil Fumigant	10,798	4,859
Molluscicide	10,003	173
Plant Growth Regulator	8,546	1,513
Animal Repellent	4,395	2,640
Crop Bactericide	903	483
Algaecide	620	31
Grand Total	**3,030,410**	**1,436,275**

Expressed as a percentage of the total quantity of active ingredient sold, herbicides represented 31%, insecticides represented 29%, acaricides represented 18%, fungicides represented 18%, and all other types of pesticides represented 4% (Figure 1).

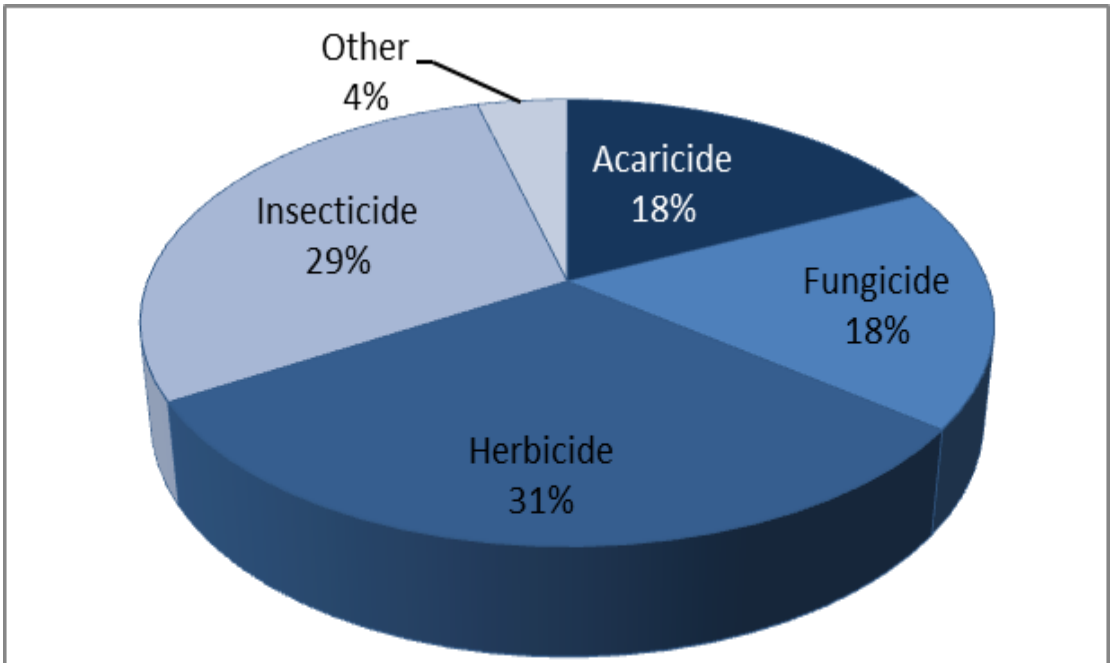

Figure 1: Pesticide sales by type

Table 2: Pesticide sales in B.C. in 2015 by sector of use indicated on product label

Sector(s) of use	Quantity of product sold (kg)	Quantity of active ingredient sold (kg)
Agriculture	2,416,672	1,212,512
Industrial vegetation, noxious weeds, and forestry	242,873	70,634
Structural and fumigation	49,002	48,942
Turf, golf, and landscaping	1098	34
Mosquito	223,265	73,927
Other	97,500	30,226
Grand Total	3,030,410	1,436,275

Pesticide sales by sector

Sales of products into the agricultural sector represented the largest amount by sector in B.C. in 2015 (Table 2). Expressed as a percentage of the total quantity of active ingredient sold, 84% of pesticides were sold for agricultural uses, 5% sold for industrial vegetation, noxious weeds, and forestry uses, 5% sold for structural uses, 3% were sold for mosquito control, with the remaining 2% sold for turf, golf course, and landscaping, and less than 1% was sold to all other sources (Figure 2).

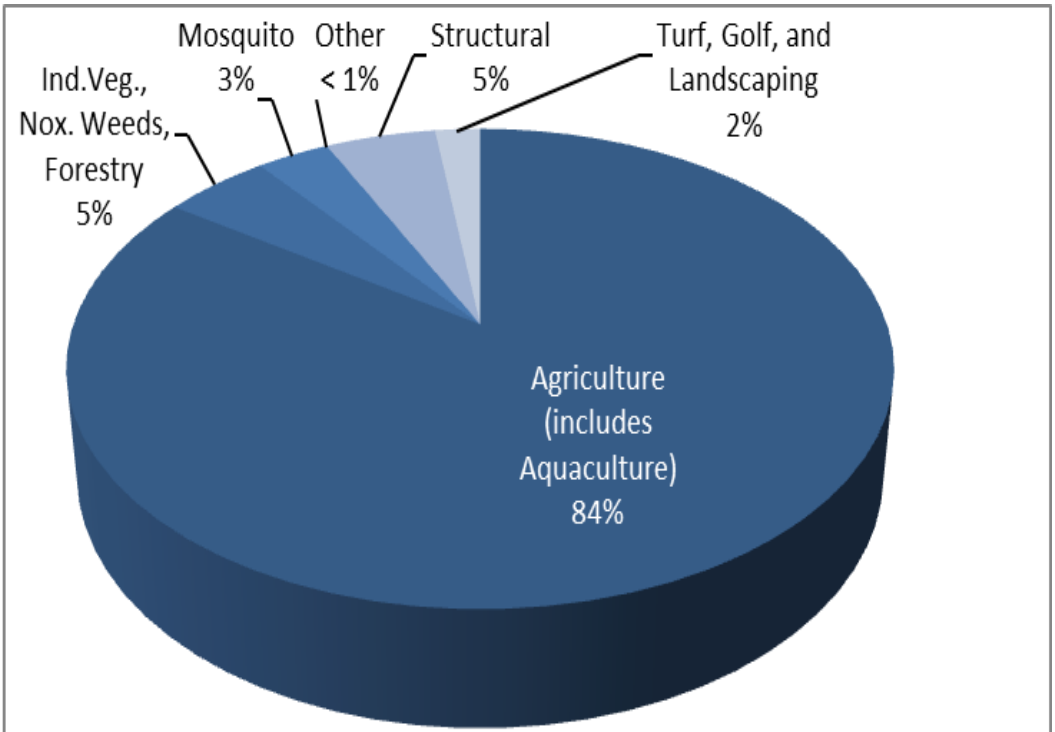

Figure 2: Pesticide sales by sector

The top 20 active ingredients sold

The top 20 active ingredients sold in B.C. in 2015 are listed in Table 3. The full list of all active ingredients sold in B.C. in 2010 is given in *Appendix 1*.

Table 3: The top 20 pesticide active ingredients sold by quantity in B.C. in 2015

Active ingredient	Pesticide type	Primary sector(s) of use	Quantity sold in 2015 (kg)	Quantity sold in 2010 (kg)	% change since 2010
Mineral oil	Fungicide/ insecticide	Agriculture	262,513	344,616	-24%
Hydrogen peroxide	Acaricide	Agriculture (aquaculture)	257,332	603	+42,601%
Glyphosate	Herbicide	Various: Agriculture, Ind. veg., landscapes	250,505	260,326	-4%
Sulphur	Fungicide	Agriculture	57,875	73,408	-21%
Bacillus thuringiensis Israelensis	Insecticide	Mosquito control	48,657	11,949	+307%
Diazinon	Fungicide/ insecticide	Agriculture	42,651	28,518	+50%
Mineral spirits	Herbicide	Agriculture	40,180	40,180	0%
Chlorothalonil	Fungicide	Agriculture, Turf management	40,051	50,768	-21%
Carbon dioxide gas	Fumigant	Fumigant	35,139	0	N/A
Clodinafop-propargyl	Herbicide	Agriculture	27,687	897	+2,986%
Lime sulphur	Fungicide	Agriculture	26,280	31,111	-16%
Metam-sodium	Insecticide/ soil fumigant	Agriculture	23,859	4601	+419%
Copper oxychloride	Fungicide	Agriculture	22,061	21,091	+5%
MCPA	Herbicide	Agriculture	21,556	24,470	-12%
2,4-D	Herbicide	Turf management, Ind. veg.	20,460	27,943	-27%
Captan	Fungicide	Agriculture	17,655	16,378	+8%
Mancozeb	Fungicide	Agriculture	16,693	16,863	-1%
Bacillus thuringiensis **(berliner) Ssp *Kurstaki* Strain Hd-1**	Insecticide	Forestry	13,490	2503	+439%
Glufosinate ammonium	Herbicide	Agriculture	11,553	9737	+19%
Carbaryl	Insecticide	Agriculture	11,532	18,677	-38%

Sales of selected active ingredients

Listed in alphabetical order, the sales of selected active ingredients which may be of particular interest to regulators, industry groups, or members of the public are given in Table 4 below (note: some of these products also appear on the previous table).

Table 4: Quantity of selected active ingredients of interest sold in B.C. (in kilograms)

Active ingredient	Pesticide type	Primary sector(s) of use	Quantity sold in 2015 (kg)	Quantity sold in 2010 (kg)	% change since 2010
2,4-D	Herbicide	Agriculture, Turf, Ind. veg.	20,460	27,943	-27%
Acetamiprid	Insecticide	Agriculture	146	219	-33%
Aluminum phosphide	Fumigant	Fumigation	231	2879	-92%
Atrazine	Herbicide	Agriculture	1458	43	+3291%
Azinphos-methyl	Insecticide	Agriculture	0	25,532	-100%
Brodifacoum	Rodenticide	Structural	0.50	0.57	-12%
Bromadiolone	Rodenticide	Structural	2.01	1.25	61%
Carbaryl	Insecticide	Agriculture	11,532	18,677	-38%
Carbofuran	Insecticide	Agriculture	0	236	-100%
Chlorothalonil	Fungicide	Agriculture, turf	40,051	50,768	-21%
Chlorpyrifos	Insecticide	Agriculture	2021	4235	-52%
Clothianidin	Insecticide	Agriculture	326	86	+278%
Cypermethrin	Insecticide	Agriculture	133	333	-60%
Deltamethrin	Insecticide	Agriculture	665	956	-30%
Diazinon	Insecticide	Agriculture	42,651	28,518	+50%
Dichlobenil	Herbicide	Agriculture	6938	6338	+9%
Endosulfan	Insecticide	Agriculture	368	2101	-82%
Glyphosate	Herbicide	Various	250,505	260,326	-4%
Hydrogen peroxide	Acaricide	Aquaculture	257,332	603	+42601%
Imidacloprid	Insecticide	Agriculture	1156	1297	-11%
Mcpa	Herbicide	Agriculture	21,556	24,470	-12%
Metam-sodium	Soil fumigant	Agriculture	23,859	4601	+419%
Methomyl	Insecticide	Agriculture	268	2278	-88%
Methyl bromide	Fumigant	Fumigation	363	3296	-89%
Oxamyl	Soil fumigant	Agriculture	329	1068	-69%
Paraquat	Herbicide	Agriculture	4317	8052	-46%
Permethrin	Insecticide	Agriculture	1665	1485	+12%
Quintozene	Fungicide	Agriculture, turf	0	9873	-100%
Strychnine	Rodenticide	Agriculture	0	28	-100%
Thiacloprid	Insecticide	Agriculture	20	118	-83%
Thiamethoxam	Insecticide	Agriculture	29	113	-74%

Discussion

Overall pesticide sales

In this report, direct comparisons were made between the number of pesticide sales between 2010 and 2015 to see how they changed over time. In B.C., pesticide vendors sold 1,436,275 kilograms of pesticide active ingredient in 2015. This total is approximately 10% (146,342 kg) higher than the total quantity of active ingredient reportedly sold by pesticide vendor license holders in 2010, when 1,289,933 kilograms of active ingredient were reported sold. Pesticide usage increases in B.C. can be primarily attributed to the sale of a single active ingredient, hydrogen peroxide, for controlling sea lice in aquaculture facilities. A total of 257,322 kilograms of hydrogen peroxide was sold in B.C. in 2015. Hydrogen peroxide sales and usage will likely continue to increase in the future; this product is increasingly used under Pesticide Use Permit for controlling sea lice in fish farms off the B.C. coast, as aquaculture operators seek additional chemotherapeutant tools for managing this pest.

The total amount of commercial pesticides sold in B.C. can be compared to reported pesticide sales from several other provinces in Canada. While B.C. sold 1.43 million kilograms of active ingredient in 2015, Alberta reported sales of 14.8 million kilograms of active ingredient in 2013, and P.E.I. reported sales of 1.01 million kilograms in 2014 (Table 5). Québec reported sales of 4.17 million kilograms of active ingredient for both commercial and domestic pesticides in 2016.

Table 5: Comparison of recently-reported sales of commercial pesticides in B.C., Alberta, Québec, and Prince Edward Island (P.E.I.)

	British Columbia (2015)	**Alberta (2013)[1]**	**Québec (2016)[2]**	**Prince Edward Island (2014)[3]**
Kilograms of active ingredient sold	1,436,275	14,816,354	4,170,291*	1,019,297

[1] - (Alberta Environment and Parks , 2015)

[2] - (Ministère du Développement durable, de l'Environnement et des Parcs, 2016)

[3] - (P.E.I. Department of Environment, Energy and Forestry, 2015)

*- Total amount of pesticide sales, which includes both commercial and domestic

Sales by pesticide type

Sales by pesticide type were markedly different in B.C. compared to Alberta, Québec, and Prince Edward Island. By amount of active ingredient sold, herbicides and insecticides made up a relatively balanced 31% and 29%, respectively, of the total sales in B.C. In contrast, herbicides and insecticides made up 86.7% and 1.3%, respectively, of total sales in Alberta (Alberta Environment and Parks , 2015), 54.9% and 25%, respectively, of total sales in Québec (Ministère du Développement durable, de l'Environnement et des Parcs, 2016), and 15.8% and 18.7%, respectively, of total sales in Prince Edward Island (P.E.I. Department of Environment, Energy and Forestry, 2015). The proportionately greater sales of insecticides in B.C. compared to Alberta and Prince Edward Island is likely driven by industries such as the tree fruit, grape, and berry producers, which typically experience higher levels of insect pest pressure than weed pressure, and therefore generally use relatively greater quantities of insecticides than herbicides during production.

Sales of pesticides by sector

The majority of pesticides sold in B.C. in 2015 were sold into the agricultural sector, with 84% of active ingredient sales. This percentage is slightly more than that reported in Québec, at 81.9% (Ministère du Développement durable, de l'Environnement et des Parcs, 2016), however it is less than that for Alberta, at 95.3% (Alberta Environment and Parks , 2015). Differences in percentage sales into the agricultural sector between provinces are likely related to a number of factors, including the relative size of the agricultural sector compared to other industries that use pesticides, total crop acreage, differences in crop type, and differences in pest pressure.

Pesticide sales data for each sector in B.C. can currently be compared for 2010 and 2015. The largest notable increase for pesticide sales was in the structural sector as sales increased from 1% in 2010 to 5% in 2015 followed by the mosquito sector increasing from 1% in 2010 to 3% in 2015. In the agricultural sector, pesticide sales have declined from 87% in 2010 to 84% in 2015, followed by the turf, golf course, and landscaping sector declining from 5% in 2010 to 2% in 2015, and the industrial vegetation, noxious weeds, and forestry sector declining from 6% in 2010 to 5% in 2015.

Sales of specific active ingredients

The results suggest that between 2010 and 2015, there have been significant changes in the sales of a number of active ingredients which may be of particular interest. Discussion on highlights of some of these changes since 2010 include:

- Sales of the fumigant methyl bromide have declined by 89%. This change likely reflects changes in the fumigation industry in the Lower Mainland, where an industry-driven shift away from the use of methyl bromide and toward the use of aluminum phosphide has occurred in recent years. This sales report indicates that aluminum phosphide sales have declined by 92%; however, follow up compliance work indicated that this decline is likely due to unreported sales by a manufacturer that did not possess the required pesticide vendor license.

Approximately 12,292 kg of aluminum phosphide active ingredient was reported used in 2015, which indicates a significant increase in usage. Ministry inspectors have conducted additional compliance verification on this issue to ensure that sales of fumigants are conducted in compliance by licensed vendors.

- Sales of glyphosate in B.C. declined by 4% between 2010 and 2015. In contrast, glyphosate sales reported in Alberta between 2008 and 2013 have increased by 40%. The authors of the Alberta sales report attributed the increase in glyphosate usage largely to herbicide tolerant canola, other herbicide resistance, and adoption of zero-tillage practices (Alberta Environment and Parks , 2015). Glyphosate sales in B.C. have likely not seen the same growth as Alberta, as harvest/ripening control and zero tillage practices are less commonly used.

- Sales of products containing the hydrogen peroxide have increased from 603 kg in 2010 to 257,332 kg in 2015. Hydrogen peroxide sales have increased exclusively as a result of the use of this product for sea lice control in aquaculture facilities.

- Sales of 2,4-D in B.C. declined by 27% between 2010 and 2015, which is similar to the 32.7% decrease reported in Alberta between 2008 and 2013 (Alberta Environment and Parks , 2015). Given the broad range of uses on the labels of these products, a more detailed analysis of the use of 2,4-D products by licensed landscape companies, industrial vegetation companies, and agricultural users in B.C. would be necessary to determine which sectors are reducing their usage of this active ingredient. However, the decline may be impacted by increasing restrictions on cosmetic pesticide use in municipal bylaws.

- Sales of the agricultural herbicide atrazine increased from 43 kg in 2010 to 1458 kg in 2015. This is likely a result of recently-registered products containing atrazine that have labels that allow their use in B.C.

- Sales of products containing carbofuran, azinphos-methyl, quintozene, and strychnine have all declined by 100% in 2015 as they are no longer registered for use in Canada. All uses of carbofuran have been phased out due to unacceptable risks to human health and the environment, with the last date of retail sale being December 31, 2010 (Pest Management Regulatory Agency, 2010). As of April 13, 2006, the PMRA phased out azinphos-methyl after re-evaluation due to unacceptable risks to human health (Pest Management Regulatory Agency, 2007). Quintozene was re-evaluated by the PMRA in 2009 where most uses of the active were cancelled and was discontinued as of April 26, 2015 due to human health and environmental concerns (Pest Management Regulatory Agency, 2014). The PMRA also re-evaluated strychnine recently in 2018 and have determined that the active does not meet current environmental protection standards and proposed cancellation of its sale (Pest Management Regulatory Agency, 2018).

- Sales of products containing the agricultural soil fumigant metam-sodium increased by 419%, from 4,601 kg in 2010 to 23,859 kg in 2015. As this product is most commonly used during replanting, this difference could be a result of a higher level of replanting among berry producers.

- Sales of products containing endosulfan decreased by 82% since 2010. As the PMRA discontinued all uses of this product after 2016 (Pest Management Regulatory Agency, 2011), sales of this product should now have ceased altogether.

- Sales of products containing clothianidin have increased by 278%, from 86 kg in 2010 to 326 kg in 2015. This increase may simply be related to the increased availability of products containing this active ingredient.

- Sales of products containing diazinon increased by 50%, from 28,518 kg in 2010 to 42,651 kg in 2015. As several products containing diazinon were scheduled for phase out by Health Canada during this time, the spike in sales could be related to vendors selling remaining stocks of products containing this active.

The significant changes in sales, either increasing or decreasing, for a number of these key active ingredients suggests it is important for the Ministry of Environment and Climate Change Strategy to continue to track sales on a regular basis in the future, to ensure our risk-reduction strategies are based on current information.

Limitations of data

Annual sales summaries were received from all companies who possessed a license to sell commercial pesticides in B.C. in 2015, which provided a complete dataset from all licensed vendors. Unfortunately, the data does not account for products purchased outside of the province and brought in, internet sales, or sales from unlicensed companies operating within B.C. However, it is estimated the volume of commercial products from those sources is likely relatively low, and there is confidence that the analysis is based on a reasonably complete data set for the province. In addition, the information gained from this analysis allowed the ministry to identify and rectify some of these gaps going forward, for example the sale of aluminum phosphide by an unlicensed manufacturer.

Whenever possible, any errors and inaccuracies discovered during the quality control and analysis stage were corrected by directly contacting the vendor for clarification.

Reporting of both quantity of actives and quantity of formulated product

Most pesticide regulatory agencies that report on annual pesticide sales do so only for quantities of active ingredient sold. However, the ministry chose to report on both quantities of formulated products and active ingredients sold to give a comprehensive picture of the nature of pesticide sales in the province. This is especially true for certain types of pesticides where there are very low concentrations of active ingredient in the product, which creates a large differential between the amounts sold for formulated product versus active ingredient. For example, most

rodenticides are formulated at less than 0.01% active ingredient. In 2015, there were 81,340 kg of formulated rodenticides sold in B.C., however that represented only 91 kg of active ingredient sold. If the data is used to prioritize activities on areas of higher risk, in the case of rodenticides, it is useful to know the amount of formulated product sold in addition to the amount of active ingredient sold, as even small amounts of most formulated rodenticides have the potential to cause serious harm to humans, pets, or wildlife if used improperly.

Conclusions and future work

The results indicate that sales of many individual active ingredients have changed considerably since 2010, reflecting significant changes in recent years in many of the sectors that use pesticides in the province. Furthermore, the ministry anticipates that sales for certain active ingredients will continue to change as a result of product registrations ending, new products being registered, and changes in market forces. This suggests that to be effective, our risk-reduction strategies should be based on current information and flexible in nature, to adapt to trends in industries as they occur.

As the scope of this report was relatively narrow, it is hoped that the scope of future reports can include:

- The use of pesticides by Pesticide User License, Confirmation, or Permit holders in B.C. This could include an analysis of the reported annual pesticide use in key sectors such as forestry, structural pest control, and industrial vegetation management.
- The sale of domestic pesticides. While domestic sales are not tracked by the Ministry of Environment and Climate Change Strategy, this data may be available through vendors, distributors, or the PMRA.
- The high-volume use of certain excluded pesticides, such as the use of anti-sapstains and other wood preservatives.

If future work can include these types of analyses and be conducted on a regular basis, a more complete picture of pesticide trends in this province will emerge, which may help to explain some of the reasons behind the changes in commercial pesticide sales observed in this report.

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Appendices

Appendix 1: Quantity of active ingredient sold (kg) for all reportable Commercial and Restricted pesticides in B.C. in 2015

Active ingredient	Quantity sold (kg)
Mineral oil	262,513
Hydrogen peroxide	257,332
Glyphosate	250,505
Sulphur	57,875
Bacillus thuringiensis israelensis	48,657
Diazinon	42,651
Mineral spirits	40,180
Chlorothalonil	40,051
Carbon dioxide gas	35,139
Clodinafop-propargyl	27,687
Lime sulphur	26,280
Metam-sodium	23,859
Copper oxychloride	22,061
MCPA	21,556
2,4-D	20,460
Captan	17,655
Mancozeb	16,693
Bacillus thuringiensis (berliner) Ssp *kurstaki* strain Hd-1	13,490
Glufosinate ammonium	11,553
Carbaryl	11,532
Bacillus subtilis	11,416
Didecyl dimethyl ammonium Chloride	10,334
Malathion	9,850
Surfactant blend	8,444
Formaldehyde	8,344

Active ingredient	Quantity sold (kg)
Bromoxynil	7,737
Dichlobenil	6,938
Nonylphenoxypolyethoxy ethanol	6,575
Copper hydroxide	5,341
Mecoprop-p-dimethylammonium	5,023
Paraquat	4,317
Linuron	4,142
Boscalid	3,994
Bentazon	3,528
Propiconazole	3,394
Fenoxaprop-p-ethyl	3,375
Napropamide	3,040
Simazine plus related active Triazines	2,982
Mono- And dipotassium phosphite	2,962
Azoxystrobin	2,873
Dimethoate	2,818
Available chlorine	2,740
Picloram	2,583
Fosetyl-al	2,560
Ferbam	2,493
Propamocarb hydrochloride	2,414
Aluminum silicate	2,363
Aminopyralid	2,338
Mesotrione	2,334
Iprodione	2,279

Active ingredient	Quantity sold (kg)
Thiophanate-methyl	2,274
Diquat	2,229
Acetic acid	2,198
S-metolachlor And r-enantiomer	2,087
Chlorpyrifos	2,021
Mineral oil - paraffin base	1,935
Pyrasulfotole	1,745
Permethrin	1,665
Metiram	1,648
Pyraclostrobin	1,556
Dicamba	1,555
Pyrimethanil	1,485
Atrazine	1,458
Disodium octaborate tetrahydrate	1,443
Paraffin base petroleum oil	1,399
Bifenthrin	1,353
Pottassium bicarbonate	1,339
Trifluralin	1,288
Triglyceride ethoxylate 10 poe	1,230
Iodocarb	1,217
Imidacloprid	1,156
Clopyralid	1,110
Thiabendazole	1,045
Dazomet	1,009
Fluroxypyr	977
Pendimethalin	818
Fenhexamid	814
Aromatics	806
Trichoderma harzianum strain krl-ag2	788

Active ingredient	Quantity sold (kg)
Penthiopyrad	772
Metalaxyl-m and s-isomer	769
Cyprodinil	768
Tralkoxydim	723
Spirotetramat	720
Octylphenoxypolyethoxy ethanol	699
Amitrole	697
Deltamethrin	665
Sethoxydim	661
Spinetoram	644
Myclobutanil	639
Metrafenone	630
Thiram	624
Quizalofop p-ethyl	611
Acephate	610
Fludioxonil	606
2,4-db-ethylhexyl ester	575
Alcohol ethoxylate	552
Potassium peroxymonosulfate compound triple salt	488
Flumioxazin	481
Carbathiin	480
Chlormequat chloride	463
Aureobasidium pullulans	456
Metsulfuron-methyl	441
Chlorantraniliprole	436
Triticonazole	429
Quinoxyfen	415
Daminozide	406
Trifloxystrobin	396

Active ingredient	Quantity sold (kg)
Endosulfan	368
Methyl bromide	363
Hexazinone	363
Triforine	362
Thifensulfuron-methyl	357
Clethodim	339
Spinosad	334
Oxamyl	329
Clothianidin	326
Triclopyr-butotyl	304
Mecoprop-p-potassium	288
Bacillus sphaericus	283
Pinoxaden	281
Methoxyfenozide	280
Siloxylated polyether	280
Tribenuron-methyl	272
Methomyl	268
Prothioconazole	263
cyantraniliprole	244
Fluopyram	236
Metalaxyl	231
Aluminum phosphide	231
Naled	222
Oxadiazon	214
Bifenazate	203
Ethofumesate	202
Tefluthrin	202
Piperonyl butoxide	197
Cyromazine	196
Saflufenacil	196
Terbacil	178

Active ingredient	Quantity sold (kg)
Eptc	176
Ethephon	174
Metconazole	170
Phosmet	168
Metribuzin	167
Boracic acid	164
Prometryne plus related active triazines	163
Dimethenamid-p	163
Metarhizium anisopliae	159
Cymoxanil	159
Chloridazon	159
Fenbutatin oxide	155
Acetamiprid	146
Fluazifop-p-butyl	138
Flonicamid	137
Orthoboric acid	135
Nicosulfuron	134
Mecoprop-p	134
Cypermethrin	133
Imazamethabenz-methyl	133
Lambda-cyhalothrin	127
Metaldehyde	120
Pymetrozine	119
Polyoxyalkylated alkyl phosphate ester	117
Dimethomorph	109
Dichlorvos	108
Streptomyces griseoviridis strain k61	104
Spirodiclofen	< 100
Prohexadione calcium	< 100
Thiencarbazone-methyl	< 100

Active ingredient	Quantity sold (kg)
Alkoxylated alcohol non-ionic surfactants	< 100
Pyrethrins	< 100
Dichlorprop-p-dimethylammonium	< 100
Trinexapac-ethyl	< 100
Surfactant mixture	< 100
Zinc phosphide	< 100
Flucarbazone	< 100
Octylbicyclo heptene dicarboximide	< 100
Iron hedta	< 100
Carfentrazone-ethyl	< 100
Acequinocyl	< 100
Novaluron	< 100
Imazamox	< 100
Trinexapac-etyl	< 100
Thiamethoxam technical	< 100
Chlorpropham	< 100
Tebuconazole	< 100
Pyridaben	< 100
Extract of reynoutria sachalinensis	< 100
Methylated seed oil of soybean	< 100
Beauveria bassiana strain gha	< 100
Sulfoxaflor	< 100
Oxyfluorfen	< 100
Spiromesifen	< 100
Mandipropamid	< 100
Propyzamide	< 100
Dried blood	< 100
Kresoxim-methyl	< 100

Active ingredient	Quantity sold (kg)
Fenbuconazole	< 100
Famoxadone	< 100
Ferric phosphate	< 100
Etridiazole	< 100
Difenoconazole	< 100
6-benzylaminopurine	< 100
Isoxaben	< 100
Dodemorph-acetate	< 100
Desmedipham	< 100
Phenmedipham	< 100
Florasulam	< 100
Penflufen	< 100
Petroleum hydrocarbon blend	< 100
Copper sulphate pentahydrate	< 100
Cyfluthrin	< 100
Dichlorprop-p-2-ethylhexyl	< 100
Indaziflam	< 100
BLAD polypeptide	< 100
Paclobutrazol	< 100
Thiamethoxam	< 100
halosulfuron	< 100
Kinoprene	< 100
Chlorfenapyr	< 100
Fenamidone	< 100
Thiacloprid	< 100
Streptomycin present as Sulphate	< 100
Cyflumetofen	< 100
Abamectin	< 100
Octadec-9-enoic acid	< 100

Active ingredient	Quantity sold (kg)
Xde-742	< 100
Cyazofamid	< 100
Aviglycine hydrocloride	< 100
Clofentezine	< 100
Mcpb	< 100
Tebufenozide	< 100
Copper naphthenate	< 100
Bromacil	< 100
Fluvalinate-tau	< 100
Tetrachlorvinphos	< 100
Methyl ester	< 100
Imazethapyr	< 100
Triallate	< 100
Gibberellic acid	< 100
Cinerin I	< 100
Imazapyr	< 100
N-octyl bicycloheptene dicarboximide	< 100
Diuron	< 100
Naphthylacetic acid	< 100
Fluazinam	< 100
Gibberellic	< 100
Lactic acid	< 100
Kasugamycin	< 100
Pyroxsulam	< 100
Dichlorprop	< 100
Streptomyces lydicus	< 100
Pantoea agglomerans strain e325	< 100
Copper sulphate	< 100
Maleic hydrazide	< 100
Hydramethylnon	< 100

Active ingredient	Quantity sold (kg)
Propoxur	< 100
Pyriproxyfen	< 100
Sedaxane	< 100
Methyl anthranilate	< 100
Citric Acid	< 100
Gibberellins	< 100
Verbenone	< 100
Rimsulfuron	< 100
Isofetamid	< 100
Garlic	< 100
Bispyribac-sodium	< 100
Paecilomyces fumosoroseus	< 100
Naphthaleneacetamide	< 100
Naptalam	< 100
Fungus: gliocladium catenulatum	< 100
Tetraconazole	< 100
Topramezone	< 100
D-phenothrin	< 100
Bromadiolone	< 100
Muscalure	< 100
D-trans allethrin	< 100
Gibberellic a4a7	< 100
Acibenzolar-s-methyl	< 100
Amitraz	< 100
Fluopicolide	< 100
Chlorophacinone	< 100
Ipconazole	< 100
Brodifacoum	< 100
Autographa californica nucleopolyhydrosis virus	< 100
Methoprene	< 100

Active ingredient	Quantity sold (kg)
Difethialone	< 100
Flutriafol	< 100
Cydia pomonella granulosis virus	< 100
Uniconazole-p	< 100
Saponins of chenopodium	< 100

Active ingredient	Quantity sold (kg)
Bromethalin	< 100
Ancymidol	< 100
Coniothyrium minitans strain Con/m/91-08	< 100
1-MCP	< 100
Grand total	**1,436,275**