STATE OF MAINE
DEPARTMENT OF AGRICULTURE, CONSERVATION AND FORESTRY
BOARD OF PESTICIDES CONTROL
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TO: Board of Pesticides Control Members
From: Mary Tomlinson, Pesticides Registrar/Water Quality Specialist
RE: Gulf of Maine Coastal Pesticide Study Update for 2015
Date: January 3, 2017 (Revised memo of Dec. 16, 2016)

In February 2014, the Environmental Risk Advisory Committee (ERAC) was convened to "examine whether current pesticide residues have the potential to affect the lobster industry in Maine directly or via impact on other marine organisms." Maine's Joint Standing Committee on Agriculture, Conservation and Forestry, in a letter to the BPC, supported the formation and purpose of the ERAC and requested reports in January 2015 and January 2017. Stormwater and sediment sampling were scheduled for 2014 and 2015. Due to laboratory contract issues and lack of significant rain storms, only sediment sampling occurred in 2014. Results from the 2014 sampling season were reported in the 2015 ERAC Report to the Legislature. Monitoring for the 2015 sampling season was completed in October 2015.

Based on the 2014 sediment sampling results, characteristics of juvenile lobster behavior and habitat, and resource constraints, the Environmental Risk Advisory Committee narrowed the focus to the Casco Bay region. Sediments were collected in 2015 from 13 intertidal sites in Casco Bay. One site on the Saco River, below Biddeford, was sampled to follow up a cypermethrin detection at that location in 2014. Sediment sample sites included previously identified and potential juvenile lobster habitats where fine-grained sediments intersected with cobble at low tide. Two sites with the highest bifenthrin detections in 2014 were sampled for temporal variability.

Sediment samples were analyzed for 21 pyrethroids, piperonyl butoxide (PBO), and methoprene. Montana Analytical Laboratory analyzed for 14 pyrethroids and piperonyl butoxide (PBO). Southwest Research Institute (SwRI) analyzed for 19 pyrethroids, piperonyl butoxide (PBO), and methoprene. Samples were also sent to the University of Maine Analytical Laboratory for analysis of total organic carbon and particle size. Results of the 2015 sediment sampling were received late 2015.

Montana Analytical Laboratory reported detections of bifenthrin in sediment at seven sites and esfenvalerate at one site; Southwest Research Institute reported bifenthrin detections at four sites (Table 1). Sediment samples were collected at two urban sites from April through October. Bifenthrin was detected in every sample at both of these sites. Montana results are reported in wet weight and SwRI results are reported in dry weight. Results cannot be compared among samples or sites until all results are converted to dry weight and normalized for organic carbon. Results can only be interpreted as detections at a single point in time. There were no detections in sediments collected from sites previously identified as juvenile lobster habitat or adjacent to lobster habitat. EPA aquatic life benchmarks are not applicable to sediments.

Stormwater sampling was conducted at 19 sites from Kittery to Whiting over one storm event in August 2015 and at one site in Ellsworth in September. The sample from Ellsworth was overlooked by the Southwest Research Institute (SwRI) and was not analyzed; therefore, only 19 sites were analyzed for pyrethroids, methoprene, and fipronil degradates. The Montana universal method does not include pyrethroids, methoprene, or the fipronil degradates and the detection limit for fipronil is parts per billion compared to parts per trillion used by SwRI. Please refer to the attached analyte lists.

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Twenty-two pesticides and fipronil degradates were detected in stormwater (Table 2). Fipronil, imidacloprid, and bifenthrin were the most frequently detected pesticides. Detection frequencies of fipronil degradates were similar to that of the parent compound. Results for fipronil and its degradates were detected in the parts per trillion range, but are displayed in Tables 2 and 3 as parts per billion (ppb) for comparison purposes.

One urban site (Portland) was selected for a four-hour time series. Bifenthrin, 2,4-D, fipronil, fipronil desulfinyl, fipronil sulfone, imidacloprid, and MCPP were detected every hour; fipronil sulfide the first three hours; and imazapyr, triclopyr, and cis/trans-permethrin the first two hours.

The number of pesticides detected in each community in descending order are: Portland (14); South Portland and Rockland (9); Biddeford (8); Kittery and Belfast (7); Boothbay Harbor (6); Ogunquit, Freeport, Bath, Camden (5); Yarmouth and Brunswick (4); Blue Hill (2); Ellsworth (1); Cherryfield and Columbia Falls (2); and Jonesboro, Machias, and Whiting (1).

Bifenthrin and cis/trans-permethrin totaled were the only pesticides detected that exceeded EPA aquatic life benchmarks (ALB) (Table 3). Cis-permethrin and trans-permethrin concentrations were totaled for each sample to obtain the total permethrin concentration for comparsion with the ALB. Bifenthrin exceeded one ALB at seven sites and three samples at the Portland time-series site. Permethrin exceeded two ALBs in two samples at the Portland site.

Table. 1 Pesticide residue concentrations in sediment, collected in 13 intertidal sites in Casco Bay and one Saco River site, April through October 2015.

Site	Montana Lab Results (wet wt)		SwRI Lab Results (dry wt)	
	Bifenthrin (RL= 0.045 ppb)	Esfenvalerate / Fenvalerate (RL= 0.13 ppb)	Bifenthrin (ppb)	Esfenvalerate / Fenvalerate (ppb)
Biddeford (Saco R)	0.11	ND	ND (RL=0.222)	ND (RL=0.444)
Kettle Cove*	0.064	ND	ND (RL=0.228)	ND (RL=0.456)
S. Portland (4/15)	0.31	ND	1.19	ND (RL=0.435)
S. Portland (6/12)	0.35	ND	2.15	ND (RL=0.520)
S. Portland (8/7)	0.36	ND	2.19	ND (RL=0.499)
S. Portland (10/7)	0.35	ND	2.06	ND (RL=0.501)
Falmouth-Foreside	0.19	ND	ND (RL=0.197)	ND (RL=0.395)
Falmouth-Foreside (duplicate)	0.17	ND	ND (RL=0.197)	ND (RL=0.394)
Yarmouth (4/15)	0.19	ND	3.23	ND (RL=0.528)
Yarmouth (6/12)	0.26	ND	2.8	ND (RL=0.594)
Yarmouth (8/7)	0.21	ND	2.81	ND (RL=0.632)
Yarmouth (10/7)	0.17	ND	2.39	ND (RL=0.587)
Winslow Park	0.063	ND	0.272	ND (RL=0.485)
Little Flying Point	ND	ND	ND (RL=0.221)	ND (RL=0.442)
Little Flying Point (replicate)	0.058	ND	0.423	ND (RL=0.450)
Lookout Point (Harpswell Center)*	ND	0.21	ND (RL=0.211)	ND (RL=0.422)
Lowell's Cove*	ND	ND	ND (RL=0.212)	ND (RL= 0.424)
Basin Point*	ND	ND	ND (RL=0.209)	ND (RL=0.418)
Cousins Island	ND	ND	ND (RL=0.196)	ND (RL=0.392)
Cheabeague Island*	ND	ND	ND (RL=0.202)	ND (RL=0.381)
Long Island*	ND	ND	ND (RL=0.197)	ND (RL=0.393)
Peaks Island	ND	ND	ND (RL= 0.190)	ND (Rl=0.405)

*Juvenile lobster habitat

Results are not normalized for organic carbon and are not comparable among sites or between laboratories.

MT lab reported results in wet weight versus dry weight report from SwRI; therefore, results are not comparable.

EPA aquatic life benchmarks are not applicable to sediments.

Table 2. Range of pesticide residue concentrations and number of sites with detections, from Kittery to Whiting, ME, August to September 2015. All results reported by Montana Analytical Laboratory (MT) unless specified as Southwest Research Institute (SwRI) results.

Pesticide	Number of Sites with Detections	Concentration Range (ppb)	Reporting Limits (ppb)
2,4-D	5	Q-4.6	0.09
Atrazine	ND	*See hydroxy atrazine*	0.022
Hydroxy atrazine	1	Q	0.04
Bentazon	1	0.037	0.022
Bifenthrin† (SwRI)	7	0.0012(J) - 0.016	0.0024-0.0031
Carbaryl	1	Q	0.14
Diuron	1	Q	0.053
Fipronil (SwRI)	12	0.00061-0.00543 •	0.0005
Fipronil desulfinyl (SwRI)	11	0.00024(J)-0.00139•	0.0005
Fipronil sulfide (SwRI)	8	0.00026(J)-0.00046(J)•	0.00021-0.00059
Fipronil sulfone (SwRI)	12	0.00040 (J)-0.00279•	0.0005
Hexazinone	6	Q-0.22	0.015
Imazapyr	2	Q-0.052	0.035
Imidacloprid	11	Q-0.73	0.018
MCPA	2	Q-0.072	0.046
MCCP	4	Q-1.1	0.044
Metolachlor ESA	2	Q-0.15	0.05
cis-permethrin*† (SwRI)	1	0.014-0.020	0.010-0.019
trans-permethrin*† (SwRI)	1	0.017-0.023	0.015-0.029
(Permethrin*)	*See cis/trans*	(0.031-0.043)	(0.025-0.048)
Prometon	2	Q-0.047	0.01
Propiconazole	1	Q	0.1
Terbacil	2	Q-0.052	0.048
Triclopyr	1	Q	0.22

J = estimated value, ND = nondetect, Q = present at less than reporting limit

*Permethrin was not analyzed. Cis/trans-permethrin residue concentrations in each sample were totaled and entered for permethrin.

†SwRI: Reporting limits (RLs) apply only to samples with undetected analytes; RLs not provided by lab for samples with reported concentrations

EPA Aqautic life benchmarks are not applicable to sediments.

Table 3. Range of pesticide residue concentrations detected in 24 stormwater samples collected at 20 sites from Kittery to Whiting, ME, August to September 2015. EPA aquatic life benchmarks provided for comparison. All results reported by Montana Analytical Laboratory (MT) unless specified as Southwest Research Institute (SwRI).

Range of Pesticide Concentrations		EPA Aquatic Life Benchmarks Freshwater (ppb)					
		Fish		Invertebrates		Non-vascular Plants	Vascular Plants
Pesticide	Concentration Range (ppb)	Acute	Chronic	Acute	Chronic	Acute	Acute
2,4-D	Q-4.6			12500			
Atrazine	ND	2650		360	60	0.001	
Hydroxy atrazine	Q	*Refer to atrazine benchmarks*					
Bentazon	0.037	>5000		>5000		4500	5350
Bifenthrin (SwRI)	0.0012(J) - 0.016	0.075	0.04	0.8	0.0013		
Carbaryl	Q	110	6	0.85	0.5	660	1500
Diuron	Q	200	26.4	80	200	2.4	15
Fipronil (SwRI)	0.00061-0.00543 •	41.5	6.6	0.11	0.011	140	>100
Fipronil desulfinyl (SwRI)	0.00024(J)-0.00139•	10	0.59	100	10.3	140	>100
Fipronil sulfide (SwRI)	0.00026(J)-0.00046(J)•	*No EPA benchmarks*					
Fipronil sulfone (SwRI)	0.00040 (J)-0.00279•	12.5	0.67	0.36	0.037	140	>100
Hexazinone	Q-0.22	137000	17000	75800	20000	7	37.4
Imazapyr	Q-0.052	> 50000	43100	> 50000	97100	12200	24
Imidicloprid	Q-0.73	41500	1200	34.5	1.05	>10000	
MCPA	Q-0.072				300	170	
MCCP	Q-1.1			>45500	50800		
Metolachlor ESA	Q-0.15	24000		>54000		>99450	43000
cis-permethrin* (SwRI)	0.014-0.020	*Refer to permethrin*					
trans-permethrin* (SwRI)	0.017-0.023	*Refer to permethrin*					
(Permethrin*)	(0.031-0.043)	0.395	0.0515	0.0106	0.0014	68	
Prometon	Q-0.047	6000	19700	12850	3450	98	
Propiconazole	Q	425	95	650	260	21	4828
Terbacil	Q-0.052	23100	1200	32500	640	11	140
Triclopyr	Q	58500		66450		32500	

J = estimated value, ND = nondetect, Q = present at less than reporting limit

*Permethrin was not analyzed. Cis/trans-permethrin residue concentrations in each sample were totaled and entered for permethrin.

2015 Montana Analytical Laboratory Stormwater Analyte List

2,4-D
Acetochlor
Acetochlor ESA
Acetochlor OA
Alachlor
Alachlor ESA
Alachlor OA
AMBA
Aminocyclopyrachlor
Aminopyralid
Atrazine
Azoxystrobin
Bentazon
Bromacil
Bromoxynil
Carbaryl
Chlorpyrifos
Chlorsulfuron
Clodinafop acid
Clopyralid
Clothianidin
Deethyl-atrazine
Deethyl deisopropyl atrazine
Deisopropryl-atrazine
Dicamba
Difenoconazole
Dimethenamid
Dimethenamid OA
Dimethoate
Disulfoton sulfone
Diuron
FDAT (indazaflam met)
Fipronil
Fipronil desulfinyl (FDS)
Fipronil sulfide
Fipronil sulfone
Flucarbazone
Flucarbazone sulfonamide
Flumetsulam
Fluroxypyr
Glutaric acid
Hydroxy-atrazine (HA)
Halsulfuron methyl
Hexazinone
Imazamethabenz methyl acid metabolite
Imazamethabenz methyl ester
Imazamox
Imazapic
Imazapyr
Imazethapyr
Imidacloprid
Indaziflam
Isoxaben
Isoxaflutole
Malathion
Malathion oxon
MCPA
MCPP
Metalaxyl
Methomyl
methoxyfenozide
Metolachlor
Metolachlor ESA
Metolachlor OA
Metsulfuron methyl
Nicosulfuron
Pinoxaden metabolite (NOA 407854)
Pinoxaden metabolite (NOA 447204)
Norflurazon
Norflurazon desmethyl
Oxamyl
Parathion methyl oxon
Phorate sulfone
Phorate sulfoxide
Picloram
Picoxystrobin
Prometon
Propiconazole
Prosulfuron
Pyrasulfotole
Pyroxsulam
Saflufenacil
Simazine
Sulfentrazone
Sulfometuron methyl
Sulfosulfuron
Tebuconazole
Tebuthiuron
Tembotrione
Terbacil
Terbufos sulfone
Tetraconazole
Thiamethoxam
Thiencarbazone methyl
Thifensulfurone
Tralkoxydim
Tralkoxydim acid
Triallate
Triasulfuron
Triclopyr
Trifloxystrobin

2015 Southwest Research Institute Stormwater Analyte List

Allethrin - Total
Bifenthrin
lambda-cyhalothrin
Cyfluthrin - Total
Cypermethrin - Total
Deltamethrin - Total
Fenvalerate/esfenvalerate
Etofenprox
Fenpropathrin
tau-Flauvalinate - Total
Imiprothrin - Total
Methoprene
cis-Permethrin
trans-Permethrin
PBO
Prallethrin
Pyrethrum
Resmethrin - Total
Phenothrin/Sumithrin
Tefluthrin
Tetramethrin
Fipronil
Fipronil desulfinyl
Fipronil sulfide
Fipronilsulfone