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October 31, 2017

Water Quality Program
Washington State Department of Ecology
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Re: Supplemental Environmental Impact Statement for Control of Burrowing Shrimp using Imidacloprid on Commercial Oyster and Clam Beds in Willapa Bay and Grays Harbor, Washington

These comments on the draft Supplemental Environmental Impact Statement (SEIS) to Washington's Department of Ecology (Ecology) are submitted on behalf of our membership in the state of Washington. Beyond Pesticides is a grassroots membership organization that represents community-based organizations with members across the United States and worldwide –a range of people seeking to improve protections from pesticides and promote alternative pest management strategies that eliminate a reliance on toxic pesticides.

The draft SEIS is in response to the application from the Willapa-Grays Harbor Oyster Growers Association for a permit for annual application of the insecticide imidacloprid, to control ghost shrimp and mud shrimp (collectively known as burrowing shrimp) on 500 acres of shellfish beds within Willapa Bay and Grays Harbor, over a period of five years. A permit under the National Pollution Discharge Elimination System (NPDES) is needed to authorize such applications.

We oppose the spraying of Willapa Bay and Grays Harbor with any quantity of imidacloprid. Although the "no action" alternative is acceptable, the only really effective and protective alternative is restoration of the bays' ecology. Imidacloprid's use threatens to have long-term and possibly irreparable impact on aquatic communities, with cascading trophic impacts to both aquatic and terrestrial ecosystems.

Background

In 2015, Ecology approved a permit that would allow imidacloprid, to be sprayed in Willapa Bay and Grays Harbor to control burrowing shrimp on 2,000 acres of tidelands. Local residents feared that the use of imidacloprid would contaminate the oyster beds and the oysters the state was trying to protect. Consumers, environmental organizations, and prominent local chefs spoke out against the spraying. An environmental assessment conducted by Ecology found that, "The proposed use of imidacloprid to treat burrowing shrimp in shellfish beds located in Willapa Bay and Grays Harbor is expected to have little or no impact on the local estuarine and marine species….,"[1] and that imidacloprid was "safer" than the alternative; a carbamate insecticide, carbaryl. The National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS) also weighed in stating there are many unknowns regarding impact to other aquatic and terrestrial biota. NMFS finds that the native burrowing shrimp plays an important role in the natural ecosystem, and voiced concern for the green sturgeon – a "species of concern" under the Endangered Species Act (ESA), which could potentially be impacted via reduced food sources in its designated critical habitat. The shellfish industry eventually requested the permit withdrawn in response to strong public concerns.

Current Application

In 2016, oyster growers from the Willapa Grays Harbor Oyster Grower Association applied for a new pesticide permit for imidacloprid to control the burrowing shrimp. This time the permit was aimed at treating less acreage than the 2015 application: up to 485 acres in Willapa Bay and 15 acres for Grays Harbor, with application to be conducted from boats or ground equipment rather than aerial spraying.

To grant a NPDES permit certain factors must be considered in the SEIS, including impact to surface water, sediments, wildlife and human health. The identification of imidacloprid as a chemical option for control of burrowing shrimp began in the late 1990s as an alternative to the carbamate, carbaryl. Imidacloprid applications are proposed to be made using "adaptive management principles" to (1) preserve and maintain the viability of the commercial shellfish industry, (2) preserve and restore select commercial oyster and clam beds at risk from sediment destabilization.

Current Regulatory Oversight

Ecology has reviewed the recent imidacloprid aquatic assessment from U.S. Environmental Protection Agency (EPA) and Canada's Pest Management Regulatory Agency (PMRA). These two assessments find that imidacloprid pose risks to aquatic organisms, especially aquatic invertebrates. Notably, PMRA states, "[I]t is not possible to accurately predict how much use reduction would be necessary to achieve acceptable levels of imidacloprid in the environment and, therefore, any use-reduction strategy would require extensive and comprehensive water monitoring information to confirm that risk reduction targets are being achieved."[2] PMRA is correct that even mitigation strategies to reduce imidacloprid impact on the environment, like that being proposed in this new permit request, may not be realistic, and most likely not sustainable or achievable to protect sensitive organisms. This is one reason this agency proposed to phase out imidacloprid.

EPA identified aquatic insects as the most vulnerable to imidacloprid exposures, and specifically found that foliar spray and a combination of other application methods, including on-the-ground applications, have "the greatest potential risks for aquatic invertebrates. . ." EPA also acknowledges that "the potential exists for indirect risks to fish and aquatic-phase

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[1] Washington State Department of Ecology. 2013. Risk Assessment for Use of Imidacloprid to Control Burrowing Shrimp in Shellfish Beds of Willapa Bay and Grays Harbor, WA. http://www.ecy.wa.gov/programs/wq/pesticides/imidacloprid/docs/ImidaclopridRiskAssessment.pdf

[2] PMRA. 2016. Proposed Re-evaluation Decision PRVD2016-20, Imidacloprid. Health Canada. Ottawa, Ontario.

amphibians through reduction in their invertebrate prey-base."[3] We believe EPA's assessment warrants a federal restriction on the use of imidacloprid, similar to PMRA's proposal. Therefore, it would be counterintuitive for Ecology and the state of Washington to greenlight increased uses of this chemical.

Concerns with Imidacloprid in Aquatic Environments

Neonicotinoids like imidacloprid, affect the nervous system of insects and other invertebrates by interfering with their nicotinic acetylcholine receptors (nAChRs).[4] This mechanism of action shows higher selective toxicity in invertebrates compared to vertebrates.[5] Neonicotinoids are known for their action on non-target terrestrial insects, like the honey bee, but their neurotoxic activity in aquatic invertebrates like aquatic insects, crustaceans and worms also occurs when these chemicals get into waterways where these organisms reside.

There is generally little data for marine aquatic organisms, however preliminary studies found increased mortality at higher concentrations of imidacloprid.[6] Studies investigating the impacts of neonicotinoids on aquatic organisms find that these pesticides can have devastating impacts of aquatic communities and on the higher trophic organisms that depend on these communities. Van Dijk et al.'s (2013) comprehensive look at the effects of imidacloprid in surface water reports a wide variety of aquatic invertebrates adversely harmed by imidacloprid residues in water.[7] Even at low, sublethal levels imidacloprid has the ability to reduce survival and growth in these organisms, and can affect molting and larval development. In crabs, imidacloprid is highly toxic to juvenile and post-larval crabs, with post-larval crabs the most sensitive life stage. [8]

The effects of imidacloprid on certain aquatic organisms are wide-ranging and include significant reduction in abundance, significant reduction in survival, reduced feeding, and behavioral changes.[9] Benthic organisms in particular are at risk. Studies find that benthic communities in general experience significant reductions in abundance.[10,11]

Sublethal effects in fish have also been observed. Growth and development in some species have been reported, which was attributed to a loss of the aquatic invertebrates juvenile

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[3] USEPA. 2017. Preliminary Aquatic Risk Assessment to Support the Registration Review of Imidacloprid. Office of Chemical Safety and Pollution Prevention. Washington DC

[4]Ibid

[5] Van Dijk TC, Van Staalduinen MA, Van der Sluijs JP. 2013. Macro-Invertebrate Decline in Surface Water Polluted with Imidacloprid. PLoS ONE 8(5): e62374. doi:10.1371/journal.pone.0062374

[6] Pisa, LW, Amaral-Rogers, A, et al. 2015. Effects of neonicotinoids and fipronil on non-target invertebrates. *Environ Sci Pollut Res.* 22:68–102

[7] Van Dijk TC, Van Staalduinen MA, Van der Sluijs JP. 2013. Macro-Invertebrate Decline in Surface Water Polluted with Imidacloprid. PLoS ONE 8(5): e62374. doi:10.1371/journal.pone.0062374

[8] Osterber, J, Darnell, K,M, Blickley, M et al. 2012. Acute toxicity and sub-lethal effects of common pesticides in post-larval and juvenile blue crabs, Callinectes sapidus. *J Experimental Marine Biology and Ecology*. 424–425, 5–14

[9] Van Dijk TC, Van Staalduinen MA, Van der Sluijs JP. 2013. Macro-Invertebrate Decline in Surface Water Polluted with Imidacloprid. PLoS ONE 8(5): e62374. doi:10.1371/journal.pone.0062374

[10] Pestana JL, Alexander AC, Culp JM, et al. 2009. Structural and functional responses of benthic invertebrates to imidacloprid in outdoor stream mesocosms. Environ Pollut. 157(8-9):2328-34.

[11] Hayasaka, D, Korenaga, T, Suzuki, K et al. 2012. Cumulative ecological impacts of two successive annual treatments of imidacloprid and fipronil on aquatic communities of paddy mesocosms. *Ecotoxicology and Environmental Safety.* 80:355-362.

fish rely on as a food source.[12] Further, others have reported decreased viability and hatching success, leading them to conclude that imidacloprid is more toxic to fish in early developmental phases, even at low concentrations. [13]

The impacts of imidacloprid on Willapa Bay and Grays Harbor cannot be overstated. Native ghost shrimp (*Neotrypaea californiensis)* and mud shrimp (*Upogebia pugettensis)* have important function in this ecosystem, which shellfish growers blame for their declining industry. According to an analysis conducted by the Xerces Society, "The benefits from these species are likely to include ecosystem services such as substrate bioturbation, improving water quality and nutrient availability."[14] Other species like migratory birds that depend on shoreline aquatic invertebrates can also be significantly impacted. These trophic impacts are also extended to other aquatic predators in the Bay. These disruptions can have long-term cascading effects on food webs and habitats in or near aquatic environments.

The Draft SEIS

Imidacloprid is a broad-spectrum insecticide that will have direct and indirect impacts on non-target organisms in Willapa Bay and Grays Harbor. At treatment sites, it is expected that there will be high mortality for a wide range of aquatic invertebrates. Ecology reviewed the available scientific literature and identifies impacts to zooplankton, benthic invertebrates and crustaceans (Dungeness crab), as well as short-term and longer-term impacts to surface waters and sediments. Indirect impacts to fish species like the green sturgeon and birds, due to reduced invertebrate availability, have also been recognized.

The SEIS notes that imidacloprid concentrations as high as 1,600 ppb (4,200ppb in other studies) is expected at treated sites after application with flushing to "undetectable levels" within 2 to 3 tide cycles.[15] According to the assessment, 2014 field trials in Willapa Bay documented detectable concentrations of imidacloprid at up to 2,316 feet from the edge of sprayed plots. Ecology finds that due to tidal dilution there will be low to moderate potential to cause ecological impacts in non-target areas after successive tidal cycles.[16] In sediment, levels of imidacloprid that were high enough to pose risks that linger after 14 days, with slower dilution rates. Concentrations were still detected after 56 days. The environmental persistence of imidacloprid after initial application in these aquatic environments poses risks to non-target organisms. Studies report that chronic impacts on aquatic invertebrates occur at levels as low as 0.01 ppb, with current federal aquatic life benchmarks for chronic effects at 1.05 ppb.[17]

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[12] Sánchez-Bayo F and Goka K. 2005. Unexpected effects of zinc pyrithione and imidacloprid on Japanese medaka fish (Oryzias latipes). *Aquat Toxicol.* 74(4):285-93.
[13] Tyor,A and Harkrishan. 2016. Effects of imidacloprid on viability and hatchability of embryos of the common carp (*Cyprinus carpio* L.). *International Journal of Fisheries and Aquatic Studies.* 4(4): 385-389.
[14] The Xerces Society (December 2014). Letter to Derek Rockett, Washington State Department of Ecology Water Quality Program. Re: *Draft National Pollution Discharge Elimination System, Waste Discharge Permit No. WA0039781* (draft permit) and *Draft Environmental Impact Statement: Control of Burrowing Shrimp* [*U*]*sing Imidacloprid on Commercial Oyster and Clam Beds in Willapa Bay and Grays Harbor, Washington* (draft EIS).
[15] Washington State Department of Ecology. 2017. Supplemental Environmental Impact Statement for Control of Burrowing Shrimp using Imidacloprid on Commercial Oyster and Clam Beds in Willapa Bay and Grays Harbor, Washington – Draft. Water Quality Program. Olympia, Washington.
[16] Ibid
[17] Harriott, H and Shistar, T. 2017. Poisoned Waterways. Pesticides and You.

Therefore, low residues of imidacloprid, that not only migrate from treatment sites but persist in water and sediment in Willapa Bay and Gray Harbor, will continue to pose systemic risks to non-target organisms.

Further, there are acknowledged "knowledge gaps" in Ecology's SEIS. Ecology notes that its current scientific review contains data gaps, including "effects of imidacloprid to marine invertebrates from chronic exposure, the long-term persistence of imidacloprid in marine sediments, and indirect effects to species or food chains due to reductions in invertebrate numbers following imidacloprid exposure." Therefore, Ecology must resolve these data gaps before it issues a permit for imidacloprid in this marine environment.

Known Impacts

The finding highlighted by the Washington State Department of Ecology that use of imidacloprid would result in "Immediate adverse, unavoidable impacts to juvenile worms, crustaceans, and shellfish in the areas treated with imidacloprid and the nearby areas covered by incoming tides" is consistent with research on imidacloprid and other neonicotinoid insecticides. A 2015 scientific review by Christy Morrissey, PhD, Pierre Mineau, PhD, and others, on the impacts of neonicotinoids in surface waters from 29 studies in nine countries finds that these chemicals adversely affect survival, growth, emergence, mobility, and behavior of many sensitive aquatic invertebrate taxa, even at low concentrations.[18] Neonicotinoids were also recently evaluated by a large panel of international experts chartered under the International Union for the Conservation of Nature (IUCN), which found that these chemicals have "wide ranging negative biological and ecological impacts on a wide range of non-target invertebrates in terrestrial, aquatic, marine and benthic habitats."[19]

Uncertainties Identified in the SEIS

The SEIS points out a number of issues that have not been adequately addressed by research. In some cases, the SEIS suggests that a research component might be incorporated into the permit. This is an inadequate approach, which essentially assumes that the impacts in question will not be substantial. The questions should be resolved <u>before</u> the permit is issued:

Efficacy of Imidacloprid

Crucially, the SEIS identifies uncertainties regarding the efficacy of imidacloprid for controlling burrowing shrimp. In discussing impacts of imidacloprid on other marine invertebrates, the SEIS states, "[I]mpacts to invertebrates from spraying imidacloprid have generally been limited in either extent or duration. For example, on-plot invertebrate measurements have generally not been more than 50 percent different than those on control plots after 14 or 28 days, although reaching appropriate statistical power has been difficult to achieve. In part, this may be due to

[18] Morrissey, C, Mineau, P et al. 2015. Neonicotinoid contamination of global surface waters and associated risk to aquatic invertebrates: A review. Environment International 74: 291–303.

[19] Van der Sluijs J.P., et al. 2014. Conclusions of the Worldwide Integrated Assessment on the risks of neonicotinoids and fipronil to biodiversity and ecosystem functioning. Environ Sci Pollut Res doi:10.1007/s11356-014-3229-5

high recolonization rates of invertebrates following treatment, survival of organisms on-plot despite treatment, or both."

The SEIS said that impacts on invertebrates "would be expected within the boundaries of the treatment plots as imidacloprid is applied directly to the substrate or in shallow water. These on-plot impacts are generally expected to be short-term, as field trials have shown that benthic invertebrate populations recover (e.g., repopulate treated plots). For example, trials with imidacloprid have demonstrated invertebrate recovery within 14 days of chemical applications." This does not support the use of imidacloprid as an effective control for burrowing shrimp.

Other uncertainties related to the need for imidacloprid and its efficacy that were raised by the SEIS include the following:

- "A well-defined method for determining the treatment threshold to ensure efficacy of the product on the target species of burrowing shrimp (Neotrypaea californiensis and Upogebia pugettensis) has not yet been formulated from the preliminary research data on imidacloprid."
- "It is not yet known whether the target species of burrowing shrimp may become resistant to the effects of imidacloprid over time."
- "Field research data are lacking regarding how burrowing shrimp affect clams, and the threshold for damage to clam beds."
- "There is uncertainty whether imidacloprid treatments during periods of low water temperature will have successfully reduced burrowing shrimp populations."

Direct and Indirect Impacts of Imidacloprid

The SEIS identified uncertainties related to the assessment of damage caused by imidacloprid, including the following:

- "The results of multi-year studies (> 2 years) are not yet available to affirm whether imidacloprid accumulates in sediments, and if so, the "worst-case" scenario of such accumulation."
- "Due to the preliminary nature of research data available at the time of this writing, there is uncertainty regarding whether imidacloprid may have potential long-term sediment toxicity effects on benthic and free-swimming invertebrate communities, the species that utilize them as food sources, and the ability of the Willapa Bay and Grays Harbor estuary ecosystems to maintain homeostasis, as a whole."
- "The effects of imidacloprid on zooplankton species are largely unstudied." However, in reviewing studies showing impacts on crab megalopae (last planktonic stage), the SEIS dismisses this uncertainty, saying "[G]iven the abundance of zooplankton, effects are expected to be localized and temporary." (See discussion of Dungeness crabs, below.)
- "Limited information in marine environments is available regarding the possible sub-lethal effects of imidacloprid on non-target aquatic organisms. Ultimately, burrowing shrimp are controlled through sub-lethal effects."
- "Limited information is available regarding imidacloprid impacts to marine vegetation." Although field studies showed that imidacloprid is taken up by eelgrass,

this is dismissed with “Imidacloprid is an acetylcholinase (sp) inhibitor and plants do not have a biochemical pathway involving acetylcholinase (sp). Therefore, it is unlikely that imidacloprid would adversely affect eelgrass or other marine vegetation.” However, its impacts on organisms that feed on marine vegetation should be assessed.

- “Limited field verification data are available at the time of this writing regarding the toxicity and persistence of imidacloprid degradation products.”
- “A limited number of field studies have been conducted in the estuarine environment to confirm the off-plot movement of imidacloprid following applications of the flowable and granular forms on commercial shellfish beds.” Field data from both 2012 and 2014 trials in Willapa Bay “showed a strong pattern of high on-plot and low off-plot concentrations during the first rising tide. Imidacloprid was detected at considerable distances off-plot, but at highly variable concentrations (e.g., 0.55 ppb to 1300 ppb). These varying results suggest that site-specific differences in how tidal waters advance and mix during a rising tide are important in determining both the distance traveled and concentration of imidacloprid off-plot.”
- “It is not possible to quantify the total acreage of commercial shellfish beds to be treated with imidacloprid over the five-year term of the NPDES permit.”

These uncertainties with regard to imidacloprid’s long-term toxicity must be resolved before a permit is approved.

Cumulative and Synergistic Effects

Cumulative Impacts

Another shortcoming is the lack of consideration of aggregated imidacloprid concentrations and exposures in the SEIS. It is known that agricultural runoff poses major challenges to water quality. These exposures, combined with applications proposed for this permit, would conceivably result in higher residues in Willapa Bay and Grays Harbor, and thus elevated and unassessed risks. Ecology must go back and take into conduct a cumulative/ aggregate impact assessment for imidacloprid. Additionally, the science shows that there can be additive and synergistic effects on non-target communities from imidacloprid exposures. Some pesticide combinations, for example, include certain fungicides combined with either pyrethroid or neonicotinoid insecticides that can increase toxicity synergistically.[20,21] Imidacloprid has been found to act synergistically with inert ingredient mixtures that result in reduced populations of aquatic species when compared to imidacloprid alone. [22]

Synergistic Chemical Impacts

Here there are again some known unknowns. The imidacloprid products consist primarily of so-called “inert” ingredients by volume. The granular products are 99.5% unspecified ingredients. One flowable formulation identifies propylene glycol as part of the 78%

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[20] Wachendoorff-Neumann, U. et al. 2012. Synergistic mixture of trifloxystrobin and imidacloprid. Google patents United States Bayer CropScience AG.

[21] Andersch, W. et al. 2010. Synergistic insecticide mixtures. US Patent US 7,745,375 B2. Bayer CropScience AG

[22] Van Dijk TC, Van Staalduinen MA, Van der Sluijs JP. 2013. Macro-Invertebrate Decline in Surface Water Polluted with Imidacloprid. PLoS ONE 8(5): e62374. doi:10.1371/journal.pone.0062374.

"inert" ingredients. Since "inert" ingredients are present to make the product more effective, it is imperative that the potential for additive or synergistic impacts of imidacloprid and "inert" ingredients be investigated.

The synergistic effects of imidacloprid and the herbicides imazamox, imazapyr, and glyphosate, which are used to control *Zostera japonica* and *Spartina*, is dismissed, based on factors such as limited overlap in exposure (imazapyr) and different modes of action (imazamox). These factors lead to <u>assumptions</u> of limited risk, not actual evaluations of the risk. Other toxic chemicals found in Willapa Bay and Grays Harbor should also be included in the risk analysis for synergistic effects.

Dungeness Crabs

New research on the impacts of imidacloprid on crabs is reviewed in the SEIS. This research supports the conclusion in the SEIS that "[S]ome Dungeness crab juveniles and planktonic forms are likely to be killed by the proposed application of imidacloprid on shellfish beds." It does not support the conclusion, "[I]midacloprid effects are not expected to impact bay-wide populations of Dungeness crab in these estuaries."

The California Department of Fish and Game finds, "There seems little doubt that [Dungeness] crab populations, with their extremely fecundities and vulnerable early larvae stages, are prone to large natural fluctuations in abundance."[23] Variability in population size has long been understood to be a factor increasing the risk of extinction.[24] For example, drastic population fluctuations are believed to have increased the susceptibility of the passenger pigeon to human exploitation, leading to its extinction.[25] Dungeness crabs are susceptible to a number of threats, including changes in water chemistry and the presence of pollutants.[26] Recently, research has identified acidification due to climate change as a threat.[27] The synergistic impacts of imidacloprid with these other threats must be evaluated.

Ecosystem-Mediated Impacts

The SEIS says, "[I]t is unlikely that imidacloprid would impact plants present on treated plots immediately after treatment since plants lack the nervous system pathway through which imidacloprid impacts some organisms." This statement ignores the fact that plants are the system for delivering neonicotinoids such as imidacloprid to insects in agriculture. The chemical is taken up by plants, distributed through plant tissues, and insects are poisoned –with

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[23] California Department of Fish and Game, 2001. California's Living Marine Resources: A Status Report. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=34263&inline.

[24] Soulé, M.E. and Simberloff, D., 1986. What do genetics and ecology tell us about the design of nature reserves?. Biological conservation, 35(1), pp.19-40.

[25] Hung, C.M., Shaner, P.J.L., Zink, R.M., Liu, W.C., Chu, T.C., Huang, W.S. and Li, S.H., 2014. Drastic population fluctuations explain the rapid extinction of the passenger pigeon. *Proceedings of the National Academy of Sciences*, *111*(29), pp.10636-10641. http://www.pnas.org/content/111/29/10636.full.

[26] Encyclopedia of Puget Sound. 3. Dungeness Crabs. https://www.eopugetsound.org/science-review/3-dungeness-crabs.

[27] Marshall, K.N., Kaplan, I.C., Hodgson, E.E., Hermann, A., Busch, D.S., McElhany, P., Essington, T.E., Harvey, C.J. and Fulton, E.A., 2017. Risks of ocean acidification in the California Current food web and fisheries: ecosystem model projections. *Global change biology*, *23*(4), pp.1525-1539. https://www.researchgate.net/publication/312279519_Risks_of_ocean_acidification_in_the_California_Current_food_web_and_fisheries_Ecosystem_model_projections.

sublethal to lethal effects— when they consume plant tissues or products such as pollen, nectar, and sap. Given this background, it is incumbent on Ecology to demonstrate that there will be no effect on non-target organisms feeding on plants contaminated with imidacloprid.

Habitat Restoration –An Alternative Not Considered.

Human activity has affected the Willapa Bay and Grays Harbor, throwing the ecosystem out of balance, leading to the loss of some native predators, an increase in invasive species, and slumping oyster productivity. In the mid-1800s, logging began to alter stream morphology and increase sediment load flowing into the bays. Effluent from pulp mills dumped into waterways, also impaired water quality and contributed to the decline of fish populations like salmon and sturgeon. Floodplains were cleared for agriculture and then later urbanized, leading to a loss of the natural riparian vegetation.[28] At the same time, the native Washington oyster, *Ostrea lurida*, began to decline due to over-harvesting and declining environmental quality. This led oystermen to import the Pacific oyster from Japan and to create artificial oyster beds to help boost productivity.

By the early 1920s, numbers of the native burrowing shrimp began growing. Some believe that changes in oystering practices led to the shrimp's success. The natural layer of shell deposits to which oysters attach is typically removed during harvest, exposing bare sediment, and allowing the shrimp to burrow.[29] This, coupled with the declining predatory fish populations in the bay, led to an explosion in shrimp populations. Early efforts to prevent shrimp from burrowing –graveling, shelling— were not effective, and soon gave way to chemical control options.

In addition, Spartina (*Spartina alterniflora*) and the non-native eelgrass (*Zostera japonica*) now grow on much of the tide flats in the bays.[30] Chemical treatment for these non-native species has been performed for years, further endangering the long-term health of the bays' ecosystem.

Several efforts are underway to restore salmon species in the Pacific Northwest, including Willapa Bay. Stream enhancement and restoration improves habitat for fish, amphibians, and invertebrates. These species can help control bountiful populations of burrowing shrimp and aquatic plants.[31] Unfortunately, chemicals have been employed to reduce "invasive" plants and the borrowing shrimp. The use of these chemicals only serves to further threaten the long-term health of the sensitive ecosystem by adversely affecting other non-target species, and potentially throwing other communities out of balance. It is essential that non-chemical options be explored, such as encouraging the revival of native fish and the development of natural oyster beds to suppress shrimp populations.

[28] Hatchery Scientific Review Group. 2004. Willapa Bay. Hatchery Reform Recommendations. Puget Sound and Coastal Washington Hatchery Reform Project Hatchery Scientific Review Group.
[29] Feldman, K, Armstrong, D. et al. 2000. Oysters, Crabs, and Burrowing Shrimp: Review of an Environmental Conflict over Aquatic Resources and Pesticide Use in Washington State's (USA) Coastal Estuaries. Estuaries. 23(2):141-176.
[30] Washington State Department of Ecology. Spartina, http://www.ecy.wa.gov/programs/sea/coast/plants/spartina.html.
[31] A Snail's Odyssey: a journey through the research done on west-coast marine invertebrates –predators and defenses. http://www.asnailsodyssey.com/LEARNABOUT/SHRIMP/shriPred.php.

Conclusion

Imidacloprid has been identified as a replacement for the toxic carbamate, carbaryl, which has been used in the Bay. However, replacing one toxic chemical with another is not a viable option. Ecology must work with the applicant to explore other biological or cultural methods to adapt to the challenges of farming while respecting ecology of the native burrowing shrimp, which have their own ecological importance to the Willapa Bay and Grays Harbor. We are willing to work with Ecology and other stakeholders to find long-term sustainable and ecologically sound solutions for shellfish farmers in the state, which is important to the local economy.

It is undisputed that imidacloprid poses significant dangers to aquatic organisms, and by extension to other species that depend on them as a food source. Ecology's SEIS does not support the use of imidacloprid in Willapa Bay and Grays Harbor. There are several data gaps that, without being resolved, preclude the agency from making a decision to grant a NDPES permit for imidacloprid. Imidacloprid is too toxic for the control of burrowing shrimp in such a sensitive tidal area, and the efficacy of such treatment has not been established. Simply attempting to monitor for ecological effects does not protect Willapa Bay and Grays Harbor from the long-term effect of a five-year long pesticide program. All parties would be better served by implementing an alternative plan to restore the ecology of Willapa Bay and Grays Harbor.

Respectfully,

Nichelle Harriott
Science and Regulatory Director