Water Quality and Agriculture in our Area:
A Summary of Available Information for Columbia County NY.

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www.hawthornevalleyfarm.org/fep/fep.htm
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DISCLAIMERS: MOST DATA THAT I HAVE FOUND ARE FROM THE 1990's; AS SUCH THEY MAY BE OUTDATED; ALSO, THE EFFECTS OF MANY POLLUTANTS ARE UNKNOWN – THIS CAN MEAN THAT THEIR EFFECTS GO UNHERALDED FOR A LONG TIME, BUT IT ALSO CAN MEAN THAT UNSUBSTANTIEATED FEARS CAN SPREAD.

ALSO, This is just an informal document – the information is gleaned from various published reports, undoubtedly I've introduced my own mistakes or selectivity.

Starting Point: Our own creek, the Agawamuck, contains somewhat elevated levels of nitrogen and phosphorus and the larger watershed to which it belongs, that of the Claverack Creek, possess high levels of Dieldrin, pyrene, selenium and, according to some measures, of fecal coliforms. Furthermore, our neighboring watershed to the north, that of the Kinderhook Creek, contains elevated levels of PCB's, DDE, pyrene, selenium, nickel and copper. The Roeliff Jansen Kill, to the south, was measured to have markedly high levels of Atrazine, Metolchlor, Simazine and Alachlor. (There were however many more pesticides and pollutants that were measured, but whose values in our waters were minimal – so don't despair, at least not completely!)

So what? Where does this stuff come from? Should you be concerned about it? How does it relate to land use, specifically what role might agriculture be playing?

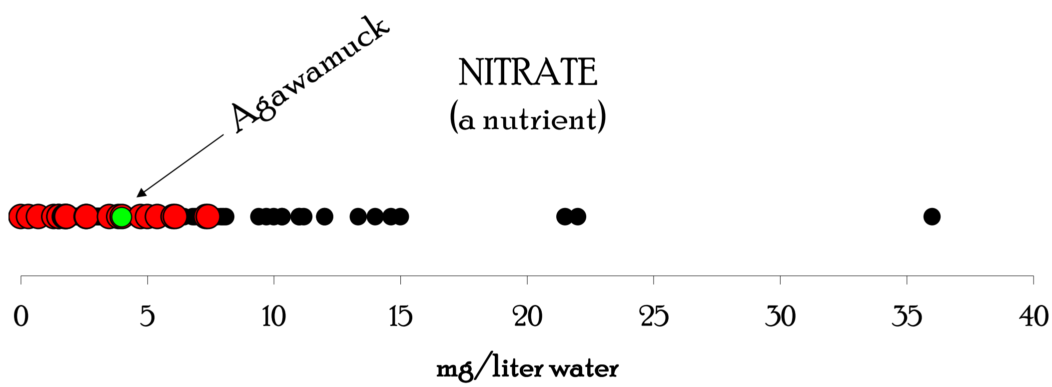
Some of the Ingredients:
There are a variety of potential water pollutants and ways that land use can affect aquatic habitats. Although I won't deal with them further here (because in part we have already discussed historic land use and in part because I haven't found good data), land cover changes have profoundly affected the ecology of our streams and wetlands by opening up cover, re-routing water courses, and increasing siltation.

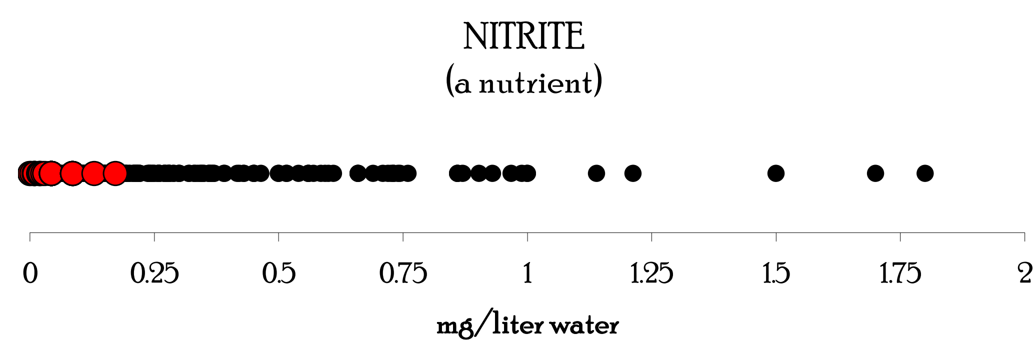
One can conveniently identify several different classes of water contaminants. Here, we will deal with *nutrients, pesticides, industrial pollutants, fuel by-products and bacterial contamination*. Pollution from household chemicals, medicines and health care products can also be substantial, and could be important in our watersheds; however, I don't have good local information on these pollutants.

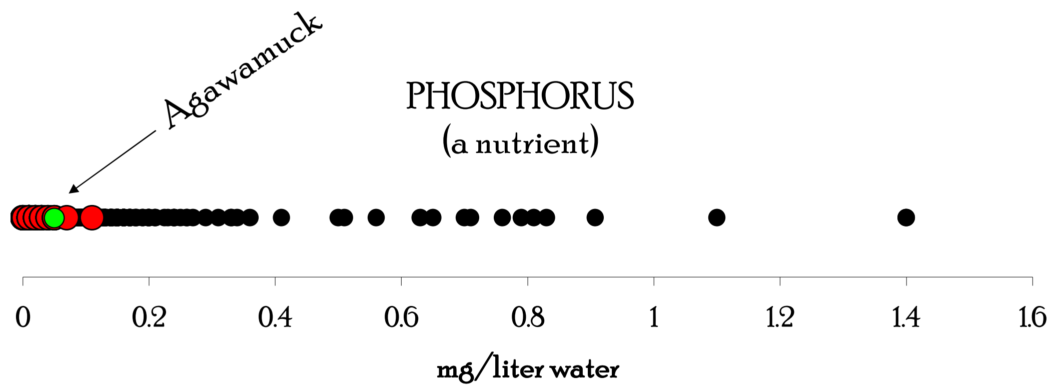
NUTRIENTS
One can get too much of a good thing. Fertilizer run-off from agriculture and lawn care can substantially alter wetlands. The process of *eutrophication* involves the unnaturally exuberant growth of water plants and algae due to excessive nutrients. This growth involves a major alteration in community structure, with aquatic plant composition usually changing substantially. Resulting oxygen depletion can also severely reduce fish populations. The major nutrients considered are usually nitrogen and phosphorus. Most organisms need these nutrients in order to survive and they are often in limited supply.

Hence, increasing these nutrients can really accelerate growth. Certain forms of these nutrients, in very high concentrations, can be directly toxic (nitrate is an example), but usually eutrophication is the central issue. Both of these nutrients are found in agriculture run-off. However, an attempt to evaluate the relative contributions of all sources to nitrogen pollution here in the Northeast concluded that human sewage was the main source of aquatic contamination, at least in large rivers.

An evaluation of the invertebrates in our streams shows altered communities, probably due to excessive nutrients (you can download this report from our project web page, www.hawthornevalleyfarm.org/fep/aalp.htm; there is more data on aquatic insects in the Appendix). Both nitrogen and phosphorus values were above natural levels in the Agawamuck. These measurements were made behind the School, above most input from our Farm, but not, of course, from up-stream farms. They were high relative to other values reported from the County and bear repeating. Controlling nutrient run-off involves managing the application of fertilizers and, especially on dairy farms, controlling run-off from stored manure.







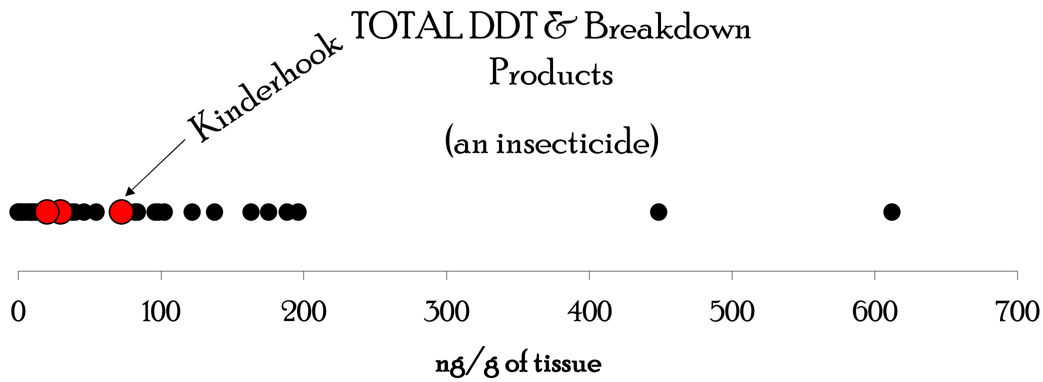
Values are concentrations found in water samples. **RED** circles are Columbia County data; **BLACK** circles are data from elsewhere in the mid-Hudson watershed. Data are from USGS on-line water quality data http://waterdata.usgs.gov/ny/nwis/qw

Nutrient enrichment may be one of the most important impacts to our local watershed. Our planned work for next year will include following nutrient levels in Hawthorne Valley waters.

PESTICIDES

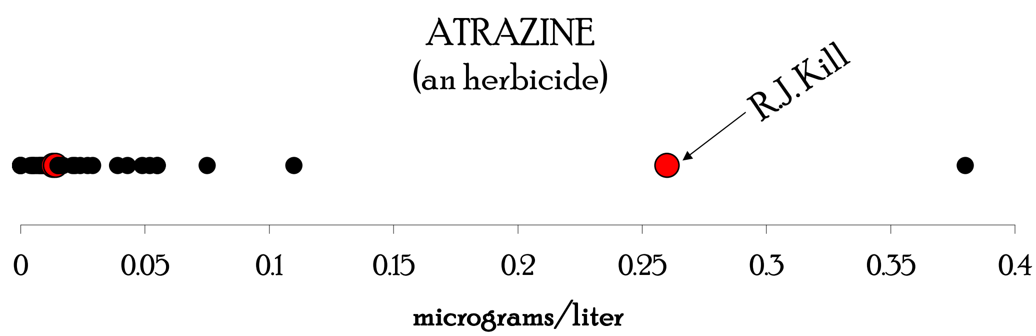
Pesticides are chemicals used to control pests (what constitutes a "pest" is often in the eye of the beholder). They are usually broken down into herbicides (chemicals used to control plant pests, i.e., weeds) and insecticides used to control invertebrate pests. In some Columbia County waters, several pesticides have appeared in alarming concentrations. These include DDE, Atrazine, Metalochlor, Simazine, Alachlor and Dieldrin.

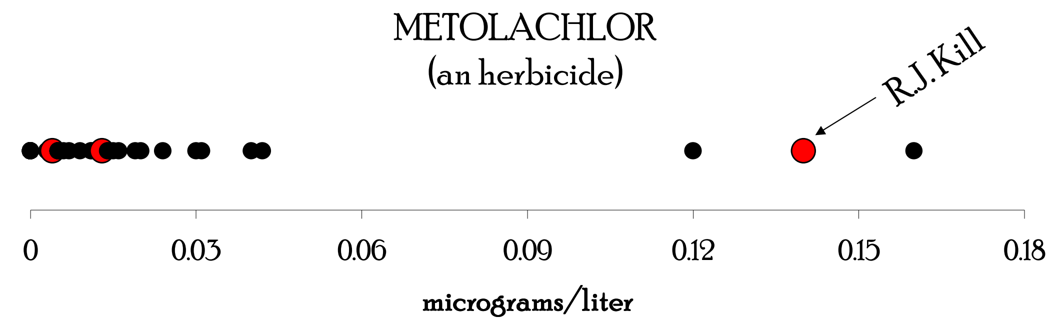
DDT is a long-lasting insecticide implicated in widespread affects on bird life. Its production in the U.S. was banned in 1972, although it is still used in some other parts of the world as part of malaria control programs. However, this chemical is so persistent in the environment that, almost 30 years later, DDT (and/or its breakdown products) is still common is some of our waters. In the Hudson Valley, DDT seems to be most common in urban rather than agricultural watersheds. This might reflect where the chemical was last used and/or differing rates of DDT breakdown. Kinderhook Creek, this County's most urban watershed, had the highest DDT concentrations of our County's waters (see Figure below).

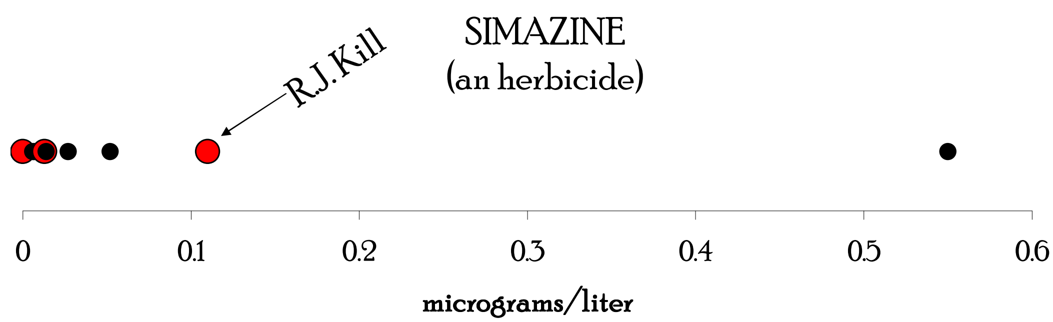


Values are concentrations found in the tissues of aquatic invertebrates. **RED** circles are Columbia County data; **BLACK** circles are data from elsewhere in the mid-Hudson watershed. Data are from the published report, Bode et al. 2001. Biological Assessment of Tributaries of the Lower Hudson River.New York State DEC DOW

Atrazine and Metolachlor are herbicides commonly used for weed control in corn fields and, sometimes in orchards. Because feed-corn production is often associated with dairy farming (although not here at Hawthorne Valley), these two chemicals have been detected in Columbia County waters, especially in our most agricultural watershed, the Roeliff Jansen Kill (see Figures below). Atrazine is a known carcinogen, a known inhibitor of reproduction and/or development, and a suspected hormone disrupter (i.e, they or their derivatives can mimic or interfere with animal hormones, causing physiological problems). Metolachlor is a possible carcinogen and suspected hormone disrupter. Both readily enter groundwater and, hence, in areas such as ours that depend on wells for household water, can be common in the drinking water supply. The use of Atrazine use is registered in 3 European countries, but it is banned or restricted in 6 others (it is also banned or restricted in 3 African countries). Metolachlor is registered for use in 3 European countries. Both can still be used in the US and Canada.







Values are concentrations found in sampled water. **RED** circles are Columbia County data; **BLACK** circles are data from elsewhere in the mid-Hudson watershed. Data are from Wall and Phillips, 1997, Pesticides in Surface Waters of the Hudson RiverBasin, New York and Adjacent States, USGS Fact Sheet FS 238-96, available on-line at http://ny.usgs.gov

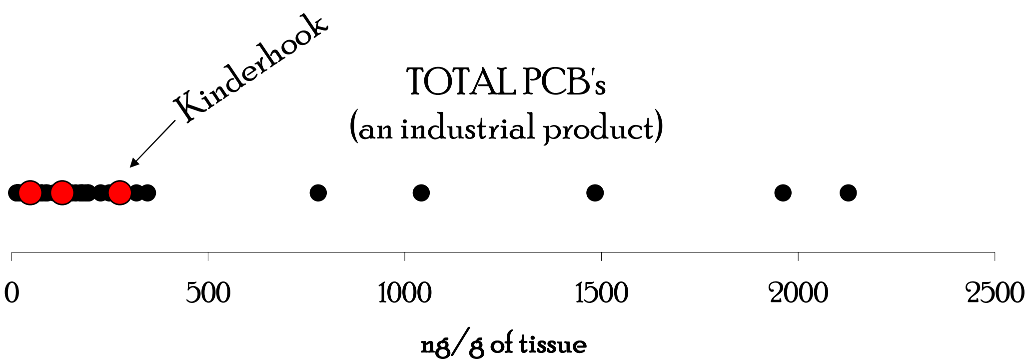
Simazine (Figure above) and Alachlor (not shown) are also herbicides. Their use seems somewhat less widespread than that of Atrazine and Metolachlor. Simazine is a possible carcinogen, a known inhibitor of reproduction and/or development, and a suspected hormone disrupter. Alachlor is a known carcinogen, a known inhibitor of reproduction and/or development, and a suspected hormone disrupter. These chemicals also readily enter our groundwaters and may thus be in well-water. They were both relatively high in the waters of the Roeliff Jansen Kill. Simazine is registered for use in 4 European countries and banned from 1; Alachor use is registered in 2 European countries but banned from two others. Both are permitted in the US and Canada.

Dieldrin was used as an insecticide on crops and in household pest control. It is also a break-down product of Aldrin, another similarly used insecticide. Both of these chemicals are thought to be relatively toxic, capable of producing both immediate poisoning and, through bioaccumulation, long-term toxicity. Nervous and excretory systems seemed to be the most acutely affected parts of the human body, although other effects may exist. It is likewise highly toxic to wildlife. Because of these effects, in the US its use with crops was outlawed in 1974, and its use to control household pests was banned in 1987. It was heavily used prior to that and can persist for years in the environment. Here in Columbia County, Dieldrin was most concentrated in Claverack Creek (see Appendix).

Atrazine, for its prevalence, toxicity and continued use, would seem to be of especial concern. However, we have only very partial information on pesticides in our water and the effects, especially in the long-term, of these chemicals. Our planned work for next year will include measuring Atrazine and Simazine levels in our surface waters.

INDUSTRIAL POLLUTANTS

These are not the direct result of agriculture however they can affect farming by contaminating agricultural crops. PCB's are one of the most notorious industrial contaminants. PCB's were produced by several industries in the region and have heavily contaminated parts of the Hudson and Housatonic watersheds. This chemical persists for long periods in the sediments. It's best known use was as an insulator for transformers, however, PCB's were also used in a wide variety of products including lubricants, printing inks, plastics, varnishes and fluorescent lights. PCB's are believed to have an array of serious health effects. There is good evidence that they are carcinogens and, in addition, can have effects on the nervous, reproductive and immune systems. Locally, they are known mainly from Kinderhook Creek (see Figure below), having leaked from a large landfill located in Rensselaer County. That landfill was used by GE and other large corporations and is within the Kinderhook watershed. GE also burned or stored PCB's in the Bouchard Junkyard located along Route 20 in New Lebanon, similarly within the Kinderhook Creek watershed. PCB's are not water soluble, but readily enter the food chain when sediment-living organisms incorporate it into their bodies and are, in turn, consumed by other animals.



Values are concentrations found in the tissues of aquatic invertebrates. **RED** circles are Columbia County data; **BLACK** circles are data from elsewhere in the mid-Hudson watershed. Data are from the published report, Bode et al. 2001. Biological Assessment of Tributaries of the Lower Hudson River.New York State DEC DOW

Heavy metals, such as selenium, nickel and copper, are natural elements. However, they can accumulate to especially high concentrations through many human actions, including industrial processes and products. In parts of the World, natural concentrations of heavy metals can reach unhealthy levels. They are found, for example, around garbage dumps and incineration sites, and can bioaccumulate. Copper and nickel, along with the likes of lead and mercury, are more likely to be toxic. Heavy metals are still ubiquitous in our environments, although some of the most troubling sources (e.g., lead in gasoline and paints) have been reduced at least in the US. In relation to agriculture, both irrigation with metal-laden waters and fertilization with sludge have been associated with heavy metal accumulation, and subsequent occurrence in foods. However, heavy metal concentrations in aquatic insect tissue were highest in our most urban creek, the Kinderhook (see Appendix).

Due in part to our proximity to two former industrial hubs – Albany and Pittsfield some of our watersheds, especially Kinderhook Creek, are polluted by PCB's and heavy metals. PCB production has ceased in the region, but the legacy is still being dealt with. Dredging of the Hudson has been approved so as to remove PCB-laden sediments.

FUEL BY-PRODUCTS

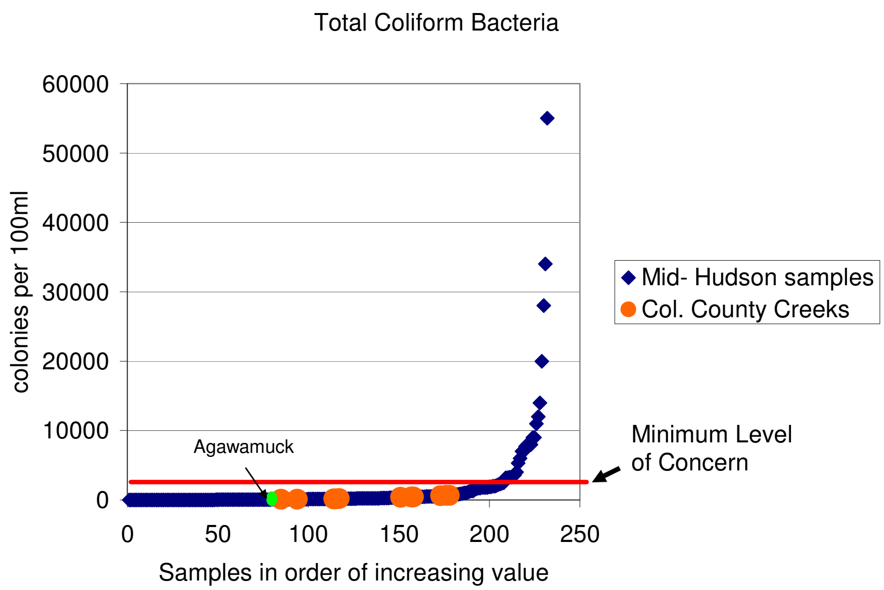
Incomplete burning of hydrocarbons fuels (hydrocarbons include both fossil fuels and other combustibles such as wood and paper) results in the production of hydrocarbon by-products and residuals; fuel leaks and spills can likewise result in contamination of this sort. This group is generally referred to as PAH's (or polycyclic aromatic hydrocarbons). Pyrene is a locally important (it was relatively high in Kinderhook Creek, see Appendix) example of such a chemical; it has been associated with potential immune system and organ damage, although it does not appear to be as toxic as some other PAH's.

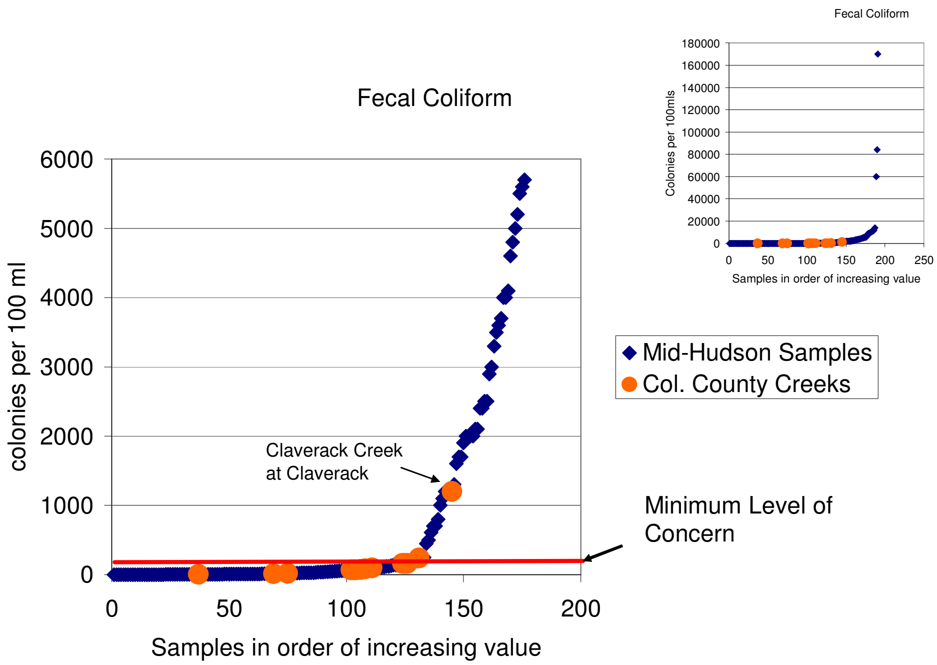
Chemicals like pyrene can make their way into our foods when they contaminate animals and vegetables. "Rocket Lettuce" from California is the most recent example of PAH's in our foods. In this case, irrigation with water contaminated from jet fuel resulted in lettuce with high levels of these pollutants. Such contamination could occur on both conventional and organic farms. The dirty burning of fuels, such as occurs in much farm equipment, produces more PAH pollution than combustion in the usually cleaner engines of modern passenger vehicles. On-farm PAH pollution could also occur through fuel leaks and spills. Home heating, open burning and certain industrial processes are calculated to be at least as important as motor vehicles in terms of causing PAH air pollution.

Fuel by-products are just about ubiquitous in our environment. It seems unclear to what degree the most common pollutants are significant health hazards in the concentrations usually encountered.

BACTERIAL CONTAMINATION

Finally, water can bear diseases. Bacterial transmission through water is a common source of disease in many parts of the world, although I don't think that it has been recently implicated in our region. One of the most commonly measured and mentioned bacterial classes are the coliform bacteria (so described because of their little tails). These are frequently chosen as indicators because they are very common in the mammalian digestive tract but occur rarely in clean water supplies. Their presence is thus a good indicator of fecal contamination – that is, contamination from human or other animal sewage. An even more specific measure focuses only on "fecal coliforms". The coliforms in and of themselves can be innocuous, however their presence indicates sewage contamination and thus the potential for disease transmission. Our waters generally seem clean although one measurement from near Claverack showed high levels of these bacteria (see Figures below). Levels in the Agawamuck are low (total coliforms at 77 colonies/100ml). Farms can produce bacterial contamination when there are excessive amounts of manure run-off from animal holding facilities. Because many digestive tract and disease bacteria persist for only limited time outside of the animal's bodies, holding ponds can be effective in reducing the problem.





Values are concentrations found in water samples. The inset in the lower graph indicates the full range of the data. Extremely high values are not shown in the larger graphic so that our County data can be more easily appreciated. Data are from USGS on-line water quality data http://waterdata.usgs.gov/ny/nwis/qw

Coliform bacteria serve as an indicator of potential disease transmission. Waterborne bacteria do not currently seem to be a major problem in our area. Our work next season will include the incubation of water samples in order to get bacterial counts.

In Sum:
Our region's waters are considered to be neither highly contaminated nor crystalline. To what degree the existing levels of pollutants pose appreciable health and ecological risks is unclear. Those interested should delve deeper into the subject. Agriculture's main contribution to water pollution appears to be in terms of pesticide contamination, although nutrient and bacterial run-off are also potential issues. We plan to focus much of our work next year on evaluating the Valley's waters and aquatic habitats.

Selected References

Bode, R.W., M.A. Novak, L.E. Abele and D.L. Hietzman. 2001. Biological Assessment of Tributaries of the Lower Hudson River. DEC – Division of Water. Albany, N.Y.

Wall, G.R., K. Riva-Murray and P.J. Phillips. 1998. Water Quality in the Hudson River Basin, New York and Adjacent States, 1992-95. USGS Circular 1165 (available on-line at http:/ny.usgs.gov/projects/hdsn/)

www.scorecard.org – a great site for getting info. on all aspects of national and regional environmental issues.

http://waterdata.usgs.gov/ny/nwis/qw - a data trove that gives you access to the sample results of water tests done around the country by USGS.

http://www.hudsonbasin.org/ - the Hudson Basin River Watch web page. There guidance document (available as a download) has lots of good information about evaluating water quality in the Hudson River watershed using volunteers.

http://www.dec.state.ny.us/website/dow/stream/index.htm - New York State DEC's on-line key to our aquatic invertebrates.

APPENDIX – WATERSHED BIOLOGICAL AND BIOACCUMULATION DATA

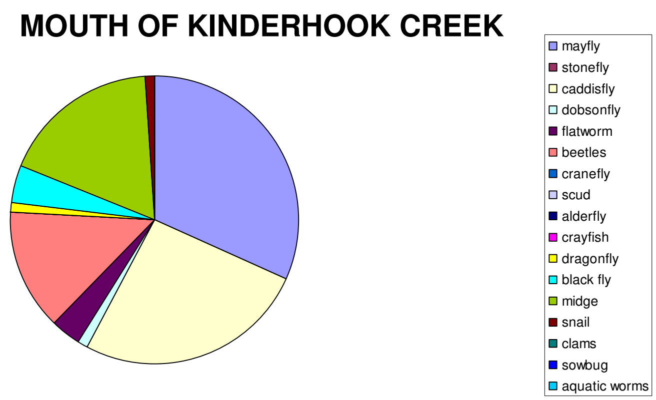
Chemical values are relative concentrations found in the tissues of aquatic invertebrates. All data are from the published report, Bode et al. 2001. Biological Assessment of Tributaries of the Lower Hudson River.New York State DEC DOW. The pie diagrams show the relative composition of the benthic invertebrate community, one indicator of water quality. For more information on this approach, visit the Hudson Basin River Watch web site and NYS DEC Stream Bioassessment web site, both listed in the links above.

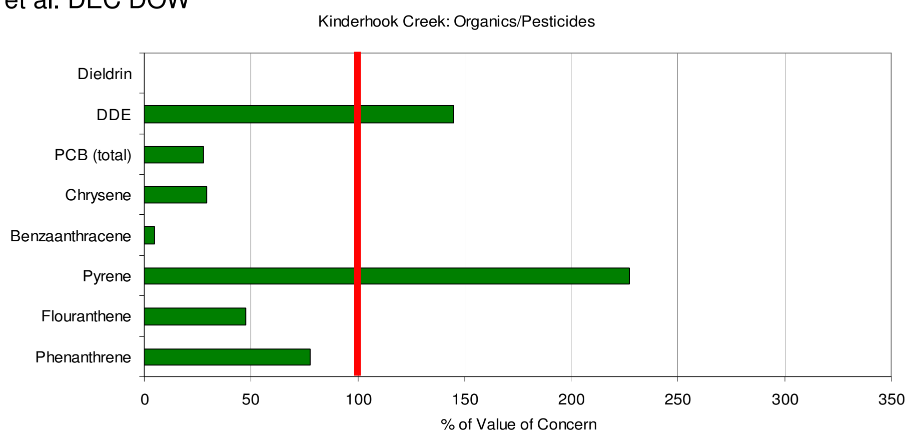
COLUMBIA

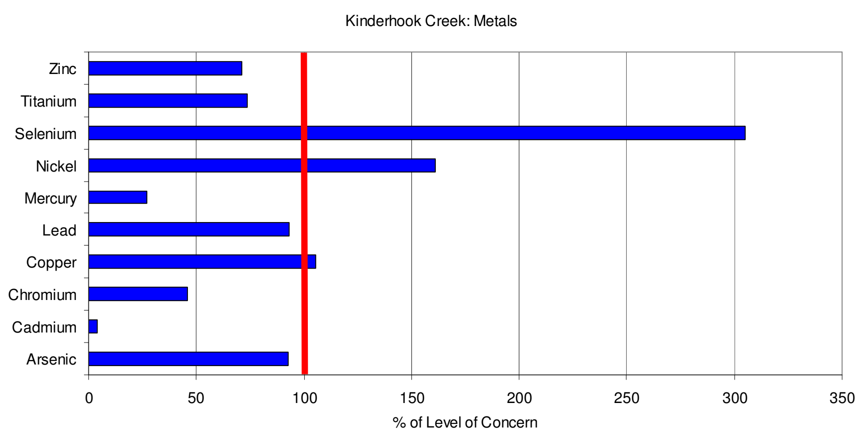
COUNTY

WATERS

from: Biological Assessment of Tributaries of the Lower Hudson River. 2001. Bode et al. DEC DOW







COLUMBIA

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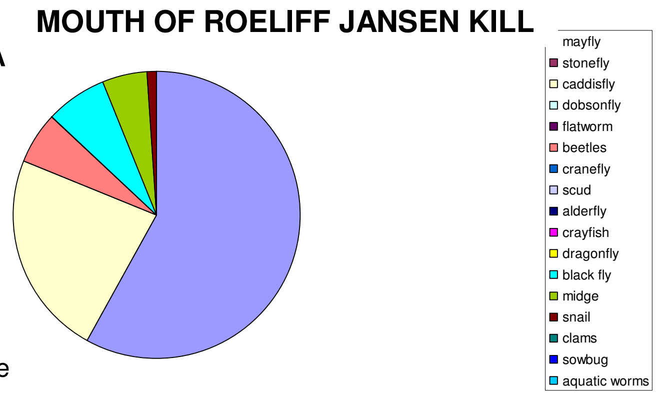
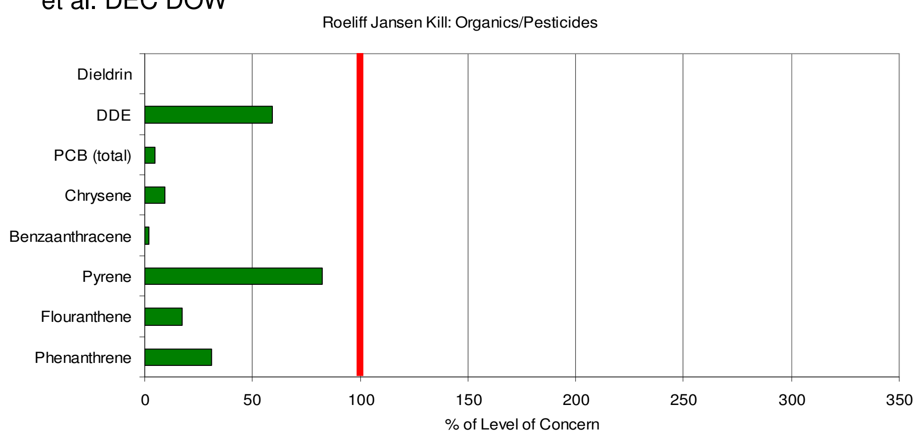
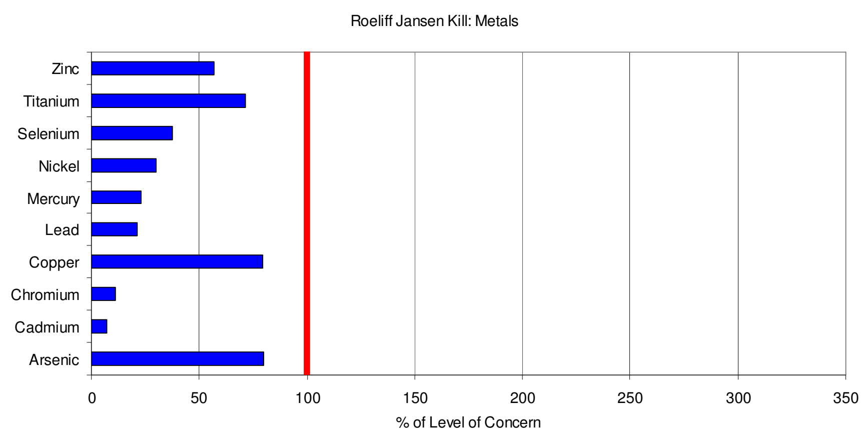


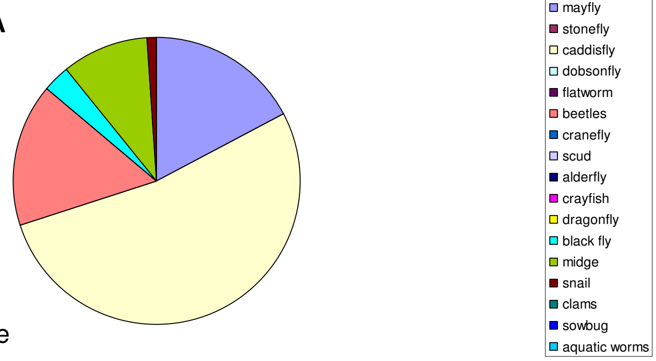




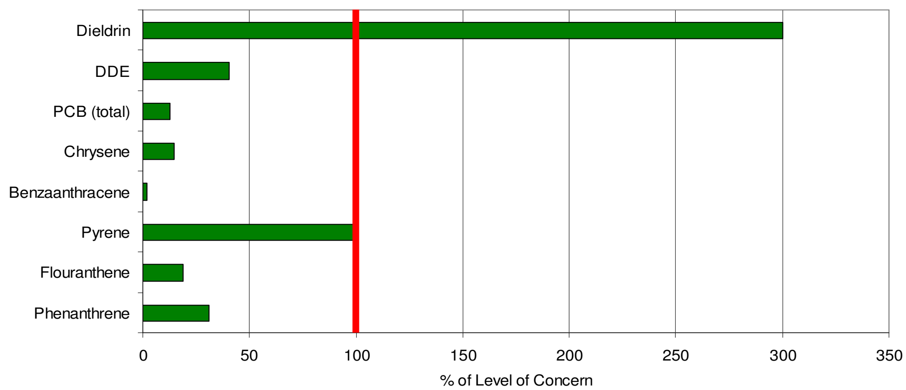
COLUMBIA COUNTY WATERS

from: Biological Assessment of Tributaries of the Lower Hudson River. 2001. Bode et al. DEC DOW

MOUTH OF CLAVERACK CREEK



Claverack Creek: Organics/Pesticides



Claverack Creek: Metals