Proactive Approach for Managing Pesticide-Caused Aquatic Life Toxicity[1]

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Over the past half a dozen years, several groups in California have been studying the aquatic life toxicity that is present in stormwater runoff from urban and some agricultural areas that is attributable to the use of the organophosphate (OP) pesticides diazinon and chlorpyrifos. These pesticides are sufficiently mobile from their point of application so that they cause aquatic life toxicity to certain forms of zooplankton (*Ceriodaphnia dubia* and *Mysidopsis bahia*) in the receiving waters for the runoff from the area of application. This toxicity was originally discovered in urban stormwater runoff associated with monitoring runoff from urban areas in the San Francisco Bay region for assessing the impacts of constituents such as heavy metals that are present in the runoff waters above water quality criteria/standards. It was also discovered in the early 1990s, through the work of Dr. Chris Foe of the Central Valley Regional Water Quality Control Board in investigating aquatic life toxicity in the San Joaquin River and its watershed. It was found through the use of TIEs that the heavy metals present in urban stormwater runoff were not in toxic forms; however, there was appreciable toxicity due to the OP pesticides diazinon and chlorpyrifos. In agricultural areas, the toxicity is associated with the use of these pesticides on agricultural crops in the Central Valley. The Sacramento River, Feather River, San Joaquin River, Delta, and Upper San Francisco Bay are toxic each winter/spring due to the use of diazinon as a dormant spray in orchards.

In recent years, in both urban and residential areas, increasing use of pyrethroid-type pesticides is being made as a substitute for the OP pesticides. According to Kuivila (2000), there are over 150 pesticides used in the Central Valley of California. Very few of these are being monitored for their potential impacts to aquatic organisms. Further, a critical review of how the US EPA Office of Pesticide Programs, as well as the California Department of Pesticide Regulation, reviews pesticides in connection with registering their use shows that this review falls far short of providing the information necessary to reliably evaluate whether the replacements for the OP pesticides (such as pyrethroids and other types of pesticides) will cause adverse impacts to the environment.

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[1] Report of G. Fred Lee & Associates El Macero CA October (2000)

Basically, the situation today is one of where pesticides are registered for use without adequate evaluation for potential environmental impacts. Under the current passive approach, a somewhat superficial and certainly inadequate registration of pesticides occurs. It is only when substantial problems are found that there is restriction on the use of the pesticides. It is clear that there is need to significantly change from a passive to a proactive approach, in which pesticides that are in use today are evaluated by water quality management agencies for their impacts. It has been clear for some time that this evaluation cannot be done as part of pesticide registration, because of the tremendous pressure on registration agencies at the federal and state level, which effectively precludes requiring that pesticide registrants conduct an adequate evaluation of the potential for pesticides in urban area and, for that matter, agricultural stormwater runoff and agricultural field discharges to cause aquatic life toxicity in the receiving waters for the runoff.

In light of the current deficient regulatory approaches toward controlling aquatic life toxicity associated with pesticide use, there is need to conduct the necessary studies associated with use to determine whether there is aquatic life toxicity in runoff from areas where the pesticide is applied. The proactive approach toward evaluating whether pesticide use in a particular region is adverse to the beneficial uses of the receiving waters for stormwater runoff/drainage/discharges from areas where it is applied involves determining what, when and where pesticides are applied in the region. Associated with each application area should be a monitoring program of the receiving waters for the runoff from the application area. A combination of chemical and biological monitoring should be conducted immediately following, and then for some time after the application(s) occurs. This monitoring should use an event-based approach, in which the monitoring specifically targets stormwater runoff/discharge events when the pesticide is most likely to be present in the discharge. A combination of aquatic toxicity and aquatic organism assemblage information should be collected to assess potential biological impacts. The toxicity information should be not only at fixed locations downstream of the runoff location, but also sampling should be done in the runoff plume matching the transport of the water receiving the pesticides from the point of application.

Studies of this type should be conducted for several years associated with the use of a particular pesticide on a particular crop at a particular location. Eventually, provided that the formulation of the pesticide and its application remain the same, the monitoring program for that particular pesticide use at the test application can be significantly curtailed. Further, as experience is gained with this proactive approach,

it should be possible to greatly reduce the amount of monitoring/evaluation needed for pesticides for which there is an adequate information base to determine that their use does not pose a threat to the environment.

The funding of these types of studies should be provided by the pesticide manufacturers, where the costs are passed on to the users of the pesticides. Adoption of this proactive approach would significantly change the current after-the-fact definition of problems associated with pesticide use to detecting them when they first begin to be used. This approach should be considered part of the registration/re-registration process, where any registration would be provisional, subject to immediate revocation if it is found that the pesticides are adverse to non-target organisms associated with the stormwater runoff/discharges.

Best Professional Judgment/Weight of Evidence Triad for Evaluation of Significant Pesticide Impacts on the Beneficial Uses of Waterbodies

It is becoming increasingly clear and accepted among the professional community that a best professional judgment/weight of evidence triad approach is the appropriate approach to evaluate potentially significant water quality impacts associated with chemical constituents in the environment. The weight of evidence triad consists of:

- appropriately developed information on the toxicity/bioaccumulation of the constituents of concern to aquatic life or within aquatic organism tissue;
- information on the alteration of aquatic organism assemblages within the area of potential impact, relative to appropriate reference situations which are not impacted by the chemical(s) of concern; and
- appropriate chemical information on the concentrations and, in particular, chemical species present in the waters of concern associated with a stormwater runoff event discharge situation.

The toxicity and chemical concentration information should define the magnitude of toxicity and concentration as a function of time of exposure for organisms potentially impacted by the pesticide. A key component of the chemical information is toxicity identification evaluation studies to specifically determine the constituent(s) responsible for the toxicity. It should not be assumed that, because a constituent exists at elevated concentrations, it is in fact responsible for the toxicity. Incorporation of aqueous environmental chemistry information coupled with toxicity assessment can provide reliable assessments of the chemical species responsible for the toxicity.

Studies of pesticides focusing only on measuring chemical concentrations can provide highly misleading information on aquatic life toxicity and the impacts of the pesticides found on the beneficial uses of waterbodies. All pesticide water quality impact studies should include assessing total toxicity to a suite of types of organisms. Further, and most importantly, where toxicity is found a dilution series should be conducted to determine the magnitude of the toxicity and whether, through TIEs, all of the toxicity can be accounted for based on known toxicants in the samples.

The weight of evidence triad information should be presented to a panel of experts who would first critically review the information provided for its adequacy and reliability, and then define what, if any, additional studies are needed to make a proper adverse impact evaluation. This panel should conduct its review in a full public interactive peer review arena, where the panel's deliberations would be open to the public for review and comment.

The typical peer review that occurs today of regulatory processes is often significantly deficient in providing a comprehensive, reliable assessment of issues that should be considered in evaluating the impact of a particular constituent(s) on the beneficial uses of waterbodies. The public interactive peer review process (Lee, 1999) that is recommended could, if properly implemented, significantly improve the quality and reliability of peer reviews of environmental issues.

The panel would present a preliminary assessment of its findings, with appropriate supporting information. Those who feel that the panel has not properly considered the information available would be provided the opportunity to comment on the panel's initial deliberations, providing any additional information that they feel is important. The panel then would issue a final determination, which would present their conclusions on the issue. Based on this information, the regulatory authorities would then determine whether the pesticide(s) or other constituents are significantly adverse to the beneficial uses of a waterbody.

The adoption of this best professional judgment/weight of evidence triad, interactively peer-reviewed approach would lead to far more technically valid assessments of adverse impacts of pesticides and other constituents on the beneficial uses of waterbodies. The funding for this type of review should be provided by the pesticide manufacturers, who would, in turn, pass this cost on to those who wish to use the pesticides.

References

Kuivila, K. M., "Pesticides in the Sacramento-San Joaquin Delta: State of Knowledge," CALFED Bay-Delta Program Science Conference 2000, Sacramento, CA, October, 2000.

Lee, G. F., "Public Interactive Peer Review Process for Water Quality Technical Dispute Resolution: A Guide For Implementation of H&S Code Section 57004 for Conducting Peer Review of Proposed Policy," Report of G. Fred Lee & Associates, El Macero, CA, October (1999). Available from www.gfredlee.com.