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## PART 1 BUILDING A FRAMEWORK FOR CONDUCTING A MULTIDISCIPLINARY ANALYSIS

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Chapter 7
Clean Water Legislation and Mosquito Control

Learning Objectives
- Understand that the epidemiological triad is a dynamic model, indicating that an intervention should be scrutinized not only for interrupting a chain of transmission but also for potentially creating one as well.
- Recognize that redundancy in governmental oversight is a foreseeable consequence of failing to identify and involve key stakeholders throughout the legislative process.
- Understand why it is an ethical duty to ensure that a safe built environment coincides with efforts to secure the social and natural environment.
Box 7.1: Broad Policy Issues

Epidemiological: rates of mosquito-related illnesses in regions of increased stormwater containment and treatment systems
Legal: scope of agency regulation, issuance of permits for treatment systems, and redundancy of federal laws on an issue (for example, laws about pesticide use)
Ethical: safety and accessibility of containment systems in the built environment in relation to concerns of failure and any potential impact on the social and natural environment
Economic: cost of containment and treatment systems
Political: involvement of key stakeholders during legislative activity to expand governance of either containment or treatment systems, in order to help lawmakers avoid redundancy in oversight, identify obstacles to sustainable management, and accommodate ethical and, particularly, safety concerns among persons responsible for implementing the systems

This case study emphasizes epidemiological, legal, ethical, and political issues.

A prominent issue around the world is the availability and protection of clean water. Modern water quality legislation in the United States has built on the 1948 Federal Water Pollution Control Act (FWPCA) to more aggressively address water pollution. The success of federal clean water policies and laws has varied historically and often depends on the clarity of legislation, political will, availability of funding, and sometimes, the technical complexity of situations. With the passage and implementation of the 1987 Water Quality Act (WQA), an amendment to the FWPCA, a potentially complex situation has come to light, involving the intersection of water policies and mosquito control policies. This case study provides an example of seeking a nuanced approach to tackling environmental health policy issues by recognizing the myriad of stakeholders that ought to be involved in evaluating the effects of novel legislation, creating safe and accessible sites of intervention to ensure sustainable management, and recognizing the impact of the built environment on the social and natural environments.
The WQA was created to expand on the 1972 Clean Water Act (also an amendment to the FWPCA) and target nonpoint sources of water pollution, a common water quality concern. Nonpoint sources of water pollution and stormwater refer to the runoff generated from rain or irrigation water as it runs over land and picks up pollutants such as sediments, oil, pesticides, trash, and animal wastes. The WQA requires that all entities generating stormwater runoff be covered by a permit (or be given "permission" to do so) from the United States Environmental Protection Agency (EPA). Among other things, requiring permits helps to ensure that pollutant levels in stormwater are reduced to allowable limits before this water is used for other purposes. As a result of the WQA and consequent federal funding to states, regional and local stormwater management programs have been created nationwide to aggressively develop and implement strategies that remove or mitigate sources of stormwater runoff and manage the associated permitting. Table 7.1 summarizes major federal legislation on water pollutants.

A method increasingly employed to reduce stormwater pollution is to install structures that capture stormwater and remove some of the suspended or dissolved pollutant load. These common but diverse containment structures and treatment systems include detention basins, swales, treatment wetlands, rain barrels, and proprietary devices (such as the CDS® and StormFilter® stormwater treatment systems and StormTech® chambers). Use of such structures is sometimes referred to as a best management practice (BMP) or low impact development (LID) practice. When installed these structures are typically connected to existing stormwater infrastructure (catch basins, storm sewer pipes and drains, and the like) from which the treated stormwater is released downstream and into waterways, cleaner, hopefully, than when initially captured.

A key component of these treatment systems is that, by design, they capture and retain stormwater for a period of time and expose polluted water to one or more pollutant removal processes (including trash capture, filtration, and sedimentation). Some systems, particularly treatment wetlands and belowground structures, are installed to hold water permanently. The consequence of this capture and treatment function is an ever-growing number of structures that hold standing water.
<table>
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<th>Federal legislation</th>
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| Clean Water Act     | 33 U.S.C. § 1251 et seq.; 33 U.S.C. § 1311 | To restore and maintain the chemical, physical, and biological integrity of the nation's waters (§ 1251(a)). “It is the national goal that the discharge of pollutants into the navigable waters be eliminated” (§ 1251(a)(1)). “It is the national goal that wherever attainable, an interim goal of water quality which provides for the protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water be achieved” (§ 1251(a)(2)). “Except as in compliance with this [the law], the discharge of any pollutant by any person shall be unlawful” (§ 1311(a)). To define a pollutant as including “dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste” (§ 1362(6)). To prohibit discharge of any pollutant into navigable waters from any “point source” unless the EPA issues a permit under the National Pollutant Discharge Elimination System permitting program (§ 1311(a)). To define a point source as “any discernible, confined, and discrete conveyance … from which pollutants are or may be discharged” (§ 1364(14)).
Table 7.1 (Continued)

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<th>Federal Legislation</th>
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<td>Federal Insecticide, Fungicide, and Rodenticide Act</td>
<td>7 U.S.C. § 136 et seq.</td>
<td>To require that all pesticides sold in the United States must be registered with the Environmental Protection Agency (§ 136 et seq.). The term “unreasonable adverse effects on the environment” means (1) any unreasonable risk to man or the environment, taking into account the economic, social, and environmental costs and benefits of the use of any pesticide, or (2) a human dietary risk from residues that result from a use of a pesticide in or on any food inconsistent with the standard under § 136 et seq.</td>
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The Epidemiological Triad as a Dynamic Model for Intervention

A public health problem associated with standing water is the proliferation of pests and disease-carrying mosquitoes. During their lifecycle, mosquitoes use standing water to complete their juvenile stage. After feeding on enough blood, female mosquitoes will seek out areas of standing water and lay their eggs on the water surface. A few days later the aquatic mosquito larvae hatch out and search for food in the form of small particulates in the water surface and water column. Once they have ingested enough food they pupate and eventually emerge from the water as adults. When the adult mosquito is a female, she will mate, search for blood to eat, and once she has fed, lay her eggs, beginning the cycle anew.

Once mosquitoes were first discovered over a century ago to carry human diseases such as malaria, dengue, yellow fever, and West Nile virus, agencies began to be created specifically to control these insects with insecticides and minimize sources of standing water. Often, because of the public health risk associated with mosquitoes, these agencies were established by local health and safety legislation. In Illinois, for example, the Mosquito Abatement...
District Act of 1925 was the forerunner of the more than twenty mosquito control programs found in the state today. Currently in the United States, there are over 1,800 agencies and programs that focus some or all of their efforts on managing mosquitoes and their diseases. Targeting the sources of standing water (an environment) interrupts a potential chain of infection by precluding a vector (mosquitoes) from utilizing an agent (standing water) to infect a host (a human), as displayed in figure 7.1.

With the proliferation of stormwater treatment systems, mosquito control agencies are increasingly incorporating these structures into their routine monitoring schedules and targeting them for treatment with larvicides (insecticides designed specifically to control aquatic mosquito larvae) (figure 7.2).

Figure 7.2  (a) Mosquito Control Inspector Checking Stormwater Treatment Basin for Larvae and Pupae; (b) Mosquito Larvae Found at a Basin Inlet

Source: Photos courtesy of Marco E. Metzger.
Figure 7.3 Mosquito Control Technician Applying a Biologically Based Larvicide to a Below-ground Stormwater Structure

Larvicides are often the insecticides used most by mosquito control programs, because it can be preferable to control these insects before they become biting adults. These larvicides, which are placed in areas of standing water (figure 7.3), are usually biologically based, employing naturally occurring bacteria such as *Bacillus thuringiensis israelensis* (Bti) that specifically target mosquitoes. Aggressive monitoring and larvicide treatment of containment structures is particularly important because they are often installed in highly populated urban areas. While this location strategy allows them to better capture the polluted runoff created by human activities, it is also a source of concern, because it unintentionally results in more potential mosquito sources in close proximity to people and increases the need for mosquito control activities.7

**Impediments to Coordination of Effort**

It is essential to manage stormwater runoff and it is also essential to control the mosquito population. Coordinating these activities at the points where they intersect can present a number of problems.

**Involvement of Multiple Agencies**

It is difficult for mosquito control programs to keep abreast of all new installations of stormwater treatment systems, especially when they are provided by a variety of agencies. For example, several separate city, county, and state stormwater programs may permit, install, or manage several systems within a geographical area that is monitored by a single mosquito control agency.
Inaccessible and High-Traffic Sites

Ensuring safe access for mosquito abatement staff trying to monitor stormwater structures can be difficult, particularly when these structures are installed near areas of high traffic such as highways and major roads. Additionally, below-ground structures, which can be major sources of mosquitoes, are usually covered by heavy cast-iron manhole covers that can weigh over 200 pounds. In both of these cases, some mosquito control agencies will forgo monitoring and treating these systems in order to protect their staff from injury (figure 7.4).

An Ever-Expanding Network of Systems

Structures like catch basins, rain barrels, and stormwater drains and channels were one of the first targets of early mosquito control efforts, and even today, a large portion of mosquito control operation resources is being used to target existing stormwater structures. In the city of Chicago, for example, mosquito control efforts focus almost exclusively on the city's catch basins,

Figure 7.4 Mosquito Control Technician Working Next to a Major Highway While Checking for Mosquitoes in a Treatment System Water Sample
of which there are now upward of 200,000. And like stormwater treatment systems, many of these structures are located in and along major roadways where safe access is a major issue. The growing stormwater infrastructure has put a strain on many mosquito control agencies and programs that already have limited budgets.

The Need to Respond to Unintended Consequences

Finally, mosquito control programs must respond to the environmental health concern that mosquito control larvicides could negatively affect nontargeted plants and animals. Although the active ingredients of these larvicides are designed to precisely target mosquitoes, larvicide use has come under scrutiny as a result of clean water legislation. On January 7, 2009, in National Cotton Council et al. v. EPA, the US Sixth Circuit Court ruled that pesticide applications must be regulated under the FWPCA because they can represent a source of water pollution. As a result, those applying pesticides (including mosquito control larvicides and other insecticides) must do so with a permit from the EPA. While this ruling may appear reasonable, pesticides are already regulated through the EPA via the Federal Insecticide, Rodenticide and Fungicide Act (FIFRA) of 1947 and its associated amendments. It was owing to this existing regulation that the EPA exempted pesticides from FWPCA permitting in 2006. That decision was, however, overturned by the Sixth Circuit Court’s 2009 ruling. Since these developments, many in the mosquito control community feel overregulated, and also unfairly targeted given that the great majority of pesticide use in the United States (and the rest of the world) occurs in agricultural settings rather than public health interventions.

Collectively, all these issues can create a situation where mosquito control and stormwater programs appear in conflict with each other. Each group has a legislated mandate to protect the health and welfare of the public, but each group’s essential activities and purposes may appear to run counter to the activities and purposes of the other group. To alleviate some of these perceived contradictions, it has been suggested that increased collaboration and communication, at least on a local scale, could improve working relationships between these groups and encourage the development of
stormwater containment and treatment systems that are safer to access and more mosquito resistant. To start collaborating and communicating, however, managers and administrators of these programs must be proactive and have incentives to work cooperatively. Without explicit direction to do so in state and federal legislation, many programs may find this kind of collaboration difficult.

Please read the following scenario, and then discuss the four focus questions, applying the relevant ideas presented in this chapter and the chapters in part 1.

Scenario

Recently, the State Water Board identified a lack of uniform compliance and consistency in achieving the Clean Water Act’s total maximum daily load (TMDL). The TMDL is the maximum amount of a pollutant that a water body can receive and still meet water quality standards. As a result, local municipalities are scrambling to review their own water quality measures and permitting to ensure they are in compliance. At the same time, many municipal and county governments are struggling to maintain their existing stormwater infrastructure, install more stormwater treatment structures, and incorporate associated permitting programs due to budgetary concerns and lack of political will. Many are considering either imposing monthly stormwater fees on area residents and businesses or raising existing fees to increase the funds available for these needs.

The East County Mosquito Abatement District (ECMAD) provides mosquito control services for fifteen municipalities in the northern part of this state. The primary targets in ECMAD’s efforts to reduce West Nile virus cases and pest mosquitoes are the approximately 70,000 catch basins located along street curbs and highways and in parking lots in the district. ECMAD hires twenty seasonal workers from May to July to drive district trucks throughout the area to apply a new, biologically based larvicide to these structures. This larvicide is believed to last ninety days (potentially an entire breeding season). Although the active ingredient of this larvicide has been used in agriculture for decades, there is a limited amount of scientific literature on the environmental effects of its use in catch basins. At the end of July, a mosquito control technician
notices a Vector truck vacuum cleaning catch basins in one of the district’s municipalities. ECMAD staff contact that city’s public works department and learn that most of the cities in ECMAD’s area are currently performing maintenance on stormwater structures owing to water quality and flooding concerns, the same structures that ECMAD has already treated with larvicide. ECMAD staff must now decide whether to spend the agency’s own limited resources on reapplying the larvicide to most of these basins or to forgo additional pesticide treatment.

Focus Questions

1. Should each city within ECMAD’s boundaries be required to notify ECMAD of its catch basin maintenance, and how would such a policy be enforced?
2. Should ECMAD be using this catch basin larvicide, given that there is only limited information about its environmental effects?
3. Should ECMAD wait until a certain number of studies have established that this larvicide has few or no environmental effects, and who decides what that number is or when a consensus on the larvicide’s effect has been reached?
4. Does ECMAD have an obligation to test the environmental effects of the larvicide on its own, despite its limited budget and relative lack of technical expertise in organisms other than mosquitoes?

Conclusion

The epidemiological triad is a dynamic model, as illustrated by the aggressive monitoring and treatment of stormwater treatment systems. This process also demonstrates that an intervention may simultaneously produce benefits and harms and that managing it requires optimal coordination among governing agencies and stakeholders. At times, efforts may appear in conflict with each other, as mosquito control and stormwater programs do. The difficulties of resolving such conflicts are further compounded by the responsible agencies’ shared mandate to protect the health and welfare of the public. Eliminating redundancy in governmental oversight and enhancing communication and collaboration among agencies and stakeholders is essential to securing our social and natural environments.
REFERENCES


5. For an example of the work of one of these agencies, visit the North Shore Mosquito Abatement District’s web page, www.nsmad.com.

6. For example, the American Mosquito Control Association, www.mosquito.org, is a “professional association with members in over 50 countries, representing researchers, educators, vector control professionals, industry representatives, and students.”


