
CHAPTER 2

MONITORING

Monitoring is the backbone of an IPM program. The purpose of monitoring is to supply recent, accurate information with which you can make appropriate decisions for managing pests in your school. By appropriate we mean informed, intelligent, pest management decisions that “fit” your particular situation. What is appropriate for you will depend on the injury levels you choose to adopt (see Chapter 3), the management techniques you wish to use, and the results you hope to achieve.

Because IPM was developed for agriculture, the original concept of monitoring was applied to agricultural crops and their pests. Over the years, this concept has been adapted for gathering information on pests of urban plants and human structures. In the loosest sense, we also speak of “monitoring” pests of the human body, such as lice; however, in this context monitoring is reduced to simply looking for the pest before initiating treatment. In most situations encountered in schools, monitoring the plants and the structures will be a bit more complex.

This chapter provides a general overview of how to set up and operate a monitoring program. More detailed discussions on monitoring techniques for individual pests are provided in Chapters 5 through 19.

NOT ENOUGH TIME OR MONEY?

Obviously, time and especially money will constrain what you will realistically be able to do. The most important thing is to go out and look at the problems, and write down what you see. To insure that this job will get done, you may need to figure out how monitoring can be included along with routine maintenance activities. Make sure that personnel who are asked to monitor understand what to look for and how to record the information. Have them carry easy-to-use monitoring forms whenever they go out. An example of a monitoring form for the placement of cockroach traps in a school kitchen is provided in Appendix E. Data from this form is transferred to a simple computerized spreadsheet after each monitoring session in order to facilitate treatment decisions. If the school is contracting out its pest control services, give the pest control company a copy of this form to use or have them develop their own forms subject to the approval of the school.

LEVELS OF EFFORT USED IN MONITORING

Monitoring need not be time consuming. The idea is to match the level of monitoring effort to the importance of the problem. Monitoring can vary from the extremely casual to the statistically strict, depending on the seriousness of the problem. The levels of effort, listed from casual to strict, are:

1. Hearsay or reports from other people’s casual looking (not particularly helpful)
2. Casual looking with no record keeping (not particularly helpful)
3. Casual looking with written observations (useful for schools)
4. Careful inspection with written observations (useful for schools)
5. Regular written observations and quantitative descriptions (useful for schools)
6. Quantitative sampling on a regular basis (appropriate for research projects)
7. Statistically valid quantitative samples (appropriate for research projects)

WHAT IS MONITORING?

Monitoring is the regular and ongoing inspection of areas where pest problems do or might occur. Information gathered from these inspections is always written down.

WHY MONITOR?

A monitoring program helps you become familiar with the workings of the target system. This knowledge allows you to anticipate conditions that can trigger pest problems, and thus prevent them from occurring or catch them before they become serious. Monitoring enables you to make intelligent decisions about treatments.

Monitoring helps determine if treatment is needed.

- Is the pest population getting larger or smaller? And if you are monitoring plants, is the natural enemy population getting larger or smaller? These questions

affect whether or not you need to treat, and you can get the answers only by inspecting the problem sites on several different occasions.

- How many pests or how much pest damage can be tolerated? This is also referred to as setting injury and action levels, which is discussed in detail in Chapter 3.
- Even when tolerance for pest presence is at or near zero, as in the case of rats, monitoring will result in early pest detection, reducing the likelihood of unexpected pest outbreaks.

Monitoring helps determine where, when, and what kind of treatments are needed.

- This includes preventive treatments such as pest-proofing and sanitation. Monitoring will tell you where these are most needed.
- It is unnecessary (and expensive) to treat all parts of a building or all plants on the school grounds for a pest when all areas may not be equally infested. Monitoring will pinpoint infestations and problem areas.

- On plants, monitoring will help you time treatments to target the most vulnerable stage of the pest. The vulnerable stage may change depending on the type of treatment used.

Monitoring allows you to evaluate and fine-tune treatments.

Monitoring after a treatment will show you the success or failure of that treatment.

- Did the treatment reduce the number of pests below the level that causes intolerable damage?
- How long did the effect last?
- Did you have to repeat the treatments?
- Were there undesirable side effects?
- Do you need to make adjustments to your treatment plan?

WHAT TO MONITOR

Monitoring plants and their pests includes the regular observation and recording of

- the condition of the plants (their vigor and appearance)

Table 2-1. Plant Condition Rating*

Please find this table at end of chapter.

Table 2-2. Pest and Plant Damage Abundance Rating*

Please find this table at end of chapter.

- the kind and abundance of pests (insects, mites, moles, weeds, etc.) as well as natural enemies (ladybugs, spiders, lacewing larvae, syrphid fly larvae, etc.)
- the amount of plant damage
- weather conditions (record any unusually dry, hot, wet, or cold weather in the last few weeks)
- human behaviors that affect the plants or pests (foot traffic that compacts the soil, physical damage to plants caused by people, insistence on having certain plants grow in inappropriate situations, etc.)
- your management activities (pruning, fertilizing, mulching, treating pests, etc.) and their effects on the plants and the pest population

Tables 2-1 and 2-2 provide more information to help you quantify the first three points, above. Using the four abundance ratings in Table 2-2 will make monitoring faster and easier and will help to standardize observations. If you get to a point where you need more precision in your data, you can count the number of pests or their signs in a given area or on a certain number of leaves.

Monitoring structures involves the regular observation and recording of

- the conditions of the building inside and out (structural deterioration, holes that allow pests to enter, conditions that provide pest harborage)
- the level of sanitation inside and out (waste disposal procedures, level of cleanliness inside and out, conditions that supply food to pests)
- the amount of pest damage and the number and location of pest signs (rodent droppings, termite shelter tubes, cockroaches caught in traps, etc.)

- human behaviors that affect the pests (working conditions that make it impossible to close doors or screens, food preparation procedures that provide food for pests, etc.)
- your management activities (caulking, cleaning, setting out traps, treating pests, etc.) and their effects on the pest population

Table 2-3 provides

specific information on monitoring tools for both plants and structures.

IDENTIFYING THE TARGET PEST

It is extremely important to correctly identify the pest that is causing problems. You cannot manage a pest effectively without knowing what it is. For instance, putting out mouse traps to control what is really a rat problem can only result in failure. Chapters 5 through 19 provide information that will help you identify some of the most common pests found in and around schools. If you are uncertain of the identity of your pest, take a specimen to a professional for identification. Appendix F describes how to properly collect and preserve an insect or plant specimen when seeking an identification.

Once the pest is identified, read about its life cycle, food sources, habitat preferences, and natural enemies. Chapters 5 through 19 will provide this information for the common pests, but if your pest is not included here, check the Recommended Reading section at the end of this manual for books that can help you. Knowing the life habits of your pest will give you clues about what to look for when monitoring and help you decide how to best manage the pest.

If only damage symptoms and not the pest itself are visible, a sleuthing job is in order. More observation or observation at a different time of day may be necessary. You can also talk to other pest management professionals, local gardeners, nursery personnel, Cooperative Extension staff, or university researchers.

TIMING MONITORING ACTIVITIES

Timing and frequency of monitoring differs depending on the site and the pest(s). Outdoors, monitoring usually begins when plants put out new leaves in spring, and

Table 2-3. Tools Used in Monitoring

Please find this table at end of chapter.

ends when leaves fall in autumn. Plants with annually recurring pest problems receive more attention than relatively pest-free plants. Monitoring can be incorporated into routine grounds maintenance activities such as weekly mowing, or can be a separate activity that occurs bi-weekly, monthly, or less frequently, depending on plant, pest, site, weather, etc.

Indoors, monitoring might occur weekly during the early stages of solving a serious pest infestation,

then taper off to monthly, once the pest problem is under control.

Some pests are more active at night than during the day. Thus, some monitoring may need to occur after dark. However, this is usually only necessary when you are trying to identify a nocturnal pest or trying to determine its travel routes, feeding habits, etc. Once this is known, nighttime monitoring can often be replaced by daytime inspection of traps, plant foliage, etc. for signs of pest presence.

RECORD KEEPING

A monitoring program is only as useful as its record keeping system. Records function as the memory of the IPM program. Human memory is unreliable and can lead to erroneous conclusions when comparing effects of treatment or other variables on the pest problem.

Record keeping is important to you because

- you can learn about your specific pests and their management faster if you write down your observations
- you can learn more about your specific pest problems because you won't forget what you observed, which treatments you tried, and when you tried them

Record keeping is important to the school system and the IPM program because

- monitoring records form the basis for making decisions on the most sensible distribution of available resources to the areas most in need of attention or observation
- information can be easily and accurately passed from one employee to another
- information is not lost when employees leave or retire

What Should The Record Show?

The record should always show

- what you are monitoring—name of the pest (common name and scientific name, if possible), stage of the pest (immature, adult), and for landscape pests, the name of the plant

- where you are monitoring—a map is always useful
- when you are monitoring—date and time
- who is doing the monitoring

The rest of the information you will need to record is listed under “What to Monitor,” above. As mentioned before, the information in Tables 2-1 and 2-2 will help you to standardize some of your observations. Table 2-1 is specifically for plants, but Table 2-2 can be used for structural pests as well as plant pests.

It is also important to standardize the format and the process by which the records are kept in order to maintain continuity from season to season and person to person. See Appendix E for sample forms. You may want to design forms with boxes to be checked off so less writing will be necessary.

Pest patterns emerge quickly when data gathered during monitoring is made visual, facilitating decision-making. This can be done by hand on graph paper, or by using one of the many graph-making computer programs included in spreadsheet software. Figure 2-1 shows fluctuations in cockroach trap counts.

No Time?

Try to make record keeping as easy and practical as possible. A person who is on the site frequently should be the person who monitors and keeps records. Try other solutions such as

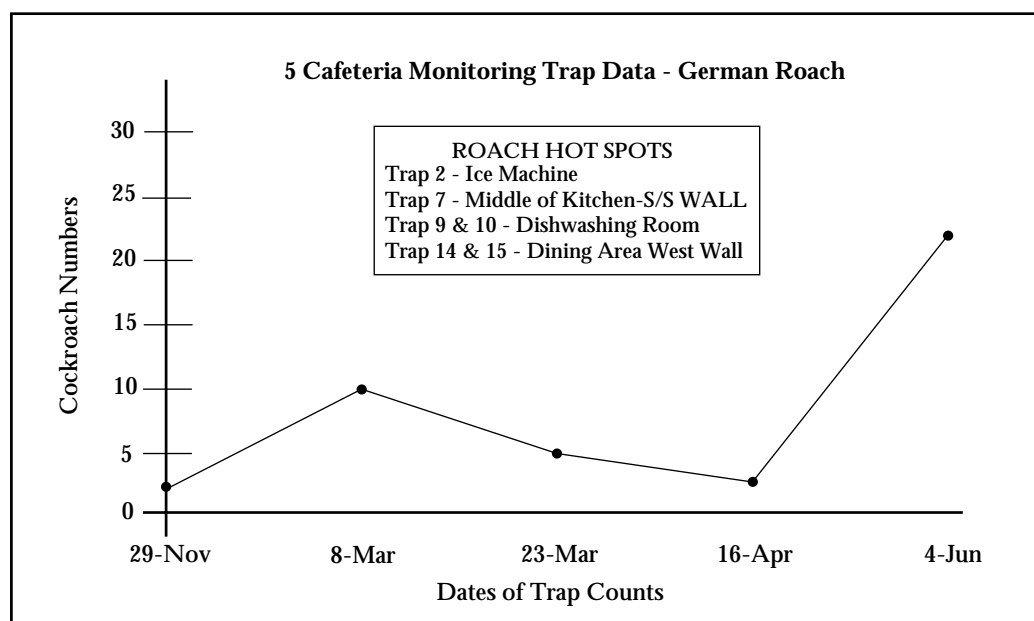


Figure 2-1. A graph of Fluctuating Cockroach Trap Counts

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- asking an interested parent to help record monitoring information, either by following the pest manager or by interviewing the person later
 - setting up a small student project to follow pest managers around and record what they do
 - having a quarterly or monthly meeting to discuss monitoring and using a cassette recorder to record the information

Evaluating Your Actions

Without evaluating the actions you took to reduce the pest problem, you will not be able to improve your management program from year to year. Ask yourself the following questions:

- Was the pest problem a significant one?
- Were the actions I took necessary or would the problem have gotten better if I had left it alone?
- Did the actions I took and the treatments I used adequately solve the problem?

- Could I manage the problem better next time? If so, how?
- Do I need more or better information to make treatment decisions in the future?

BIBLIOGRAPHY

- Daar, S. 1997. Structural IPM successes at NASA's Ames research center. *IPM Practitioner* 19(2):1-11.
- Davidson, J.A., C.F. Cornell, and D.C. Alban. 1986. The untapped alternative. *American Nurseryman* 167(11):99-109.
- Davidson, J.A. et al. 1988. Making the pilot fly. *American Nurseryman* 169(10):51-60.
- Michigan State University. 1980. *Pest Management Manual*. Departments of Resource Development, Entomology, & Forestry, East Lansing, MI.
- Owens, J.M. and G.W. Bennett. 1983. Comparative study of German cockroach (Dictyoptera: Blattellidae) population sampling techniques. *Environmental Entomology* 12:1040-1046.
- Rust, M.K., J.M. Owens, and D.A. Reiersen. 1995. *Understanding and Controlling the German Cockroach*. Oxford Univ. Press, New York. 430 pp.

Table 2-1. Plant Condition Rating*

PLANT CONDITION RATING	INDICATORS OF PLANT CONDITION			
	Leaf Color	Amount/Size of Growth	Damaged Plant Parts	Presence of Pest Problems
	Good	Adequate	None to few	No major ones
GOOD	Good	Slightly reduced	Few to common	A few minor ones
FAIR	Poor	Much reduced	Common to abundant	Either major <u>or</u> minor ones occurring frequently
POOR	Poor	Severely reduced	Innumerable	Both major <u>and</u> minor ones occurring frequently

Leaf Color: Note that there are healthy plants that do not have bright green leaves. Leaves can be purple, yellow, or sometimes a mottled yellow and green (variegated). “Good” leaf color will not always be the same; it will depend on the kind of plant.

Amount/Size of Growth: This refers to the length of the new growth for the season as well as the number of new leaves, and the size of the leaves, flowers, or fruit.

Damaged Plant Parts: Look at the whole plant. Are there leaves with holes, spots, or discolorations? Are there wilted or dead leaves? Are there dead twigs or branches? Is the damage only on old leaves while new leaves look perfectly healthy?

Presence of Pest Problems: A major pest problem is one that has seriously affected or injured the plant and requires management. A minor pest problem may or may not have affected or injured the plant and may or may not require management.

*Adapted from Michigan State University 1980

Table 2-2. Pest and Plant Damage Abundance Rating*

Abundance Rating	Indicators of Abundance
Few	Organisms or plant damage occasionally found, but only after much searching
Common	Organisms or plant damage easily found during typical searching
Abundant	Organisms or plant damage found in large numbers-obvious without searching
Innumerable	Organisms or plant damage extremely numerous-obvious without searching

*Adapted from Michigan State University 1980

Table 2-3. Tools Used in Monitoring

TOOLS	PLANTS	STRUCTURES
Monitoring forms--use these to write down what you see	X	X
Maps or site plans of the buildings or grounds--use these to mark where you find pests and where you put traps	X	X
Clipboard-use this to hold your monitoring forms and maps	X	X
Flashlight with a halogen bulb-use this to detect nighttime pest activity. A blacklight bulb can be substituted to detect scorpions.	X	X (for viewing areas under counters, in closets, etc. during the day)
Sticky traps-use these to monitor a variety of insects, mites, and small rodents.	X (for many insects the important, e.g., thrips are attracted to blue; whiteflies prefer yellow)	X (glue boards for color of the trap is monitoring rodents)
Hand lens-This is a small magnifying glass. Use this to help you see mites and small insects. A lens that magnifies things at least 10 times (=10x) is usually adequate. A 15x lens can be used to distinguish among various mite species and other similarly small pest organisms such as thrips.	X	X
Plastic bags or small vials-use these to hold specimens for later examination or identification.	X	X
Small knife or screwdriver	X (use to dig up weeds for specimens or for control)	X (use to probe damaged wood, extract insect droppings from wood, etc.)
Ladder	X	X
Camera-use this for documenting pest damage to plants or structures before and after IPM methods have been applied	X	X