68 Integrated pest management: What is it? What has it done for the National Park System?

JERRY MCCREA, National Park Service Intermountain Support Office, P.O. Box 728, Santa Fe, New Mexico 87504-0728; gerald_mccrea@nps.gov

CAROL L.J. DISALVO, National Park Service, 1849 C Street NW, Washington, D.C. 20240; carol_disalvo@nps.gov

Background

For the last 21 years, a method known as integrated pest management (IPM) has been the cornerstone of the National Park Service's (NPS's) approach to pest management. Prior to that time, the agency was using a system that required Washington Office approval before a pesticide could be used, but the agency's analytical approach to pest management was not as comprehensive and systematic as the one used by today's IPM practitioners. However, in 1979, President Jimmy Carter issued a memorandum which directed federal agencies to implement IPM whenever possible. For NPS, 1980 ushered in the formal adoption of IPM as a systematic approach to analyzing and solving pest problems. This adoption followed the successful IPM pilot program tried by the National Capital Region in 1979 (Sherald and DiSalvo 1987).

IPM is well known in NPS for reducing the use of higher-risk pesticides and the overall amount of pesticide use. However, it has also served to have agency personnel take a broader view of pest problems, within the context of ecological processes (Sherald and DiSalvo 1987). In effect, pests usually are understood to be symptoms of underlying problems that need to be solved. Once corrective measures are applied to the underlying problem, the symptom (i.e., the pest) is eliminated. Institutionalization of this approach has been fostered by the development of a week-long IPM course, along with various specialty courses, offered by senior program personnel beginning in 1980. To date, over 800 students have been trained in these courses, which are still being offered due to the need created by ongoing personnel transfers in NPS as well as the discovery of new information, with the subsequent development of new pest management methods.

One of the solid attributes of the IPM process is its utility in managing pests of every sort. Whether it is used to manage plants or animals, this approach works well whenever comprehensive analysis and up-to-date treatment prescriptions are needed. IPM also crosses boundaries in park management, as all disciplines are involved. The full participation of natural and cultural resource managers, line managers, and maintenance, curation, concessions, administration, and interpretation personnel is needed, sooner or later, to resolve pest problems in parks. Consensus building is a key to success!

Definitions

First, a pest is defined as an organism that interferes with the management objectives of a site. Second, IPM is defined as a decision-making process that serves to reduce risks created by pests and associated pest management strategies. IPM is the coordinated use of pest and environmental information with available pest management methods to prevent unacceptable levels of damage. This analysis is done on a case-by-case basis, so that treatment prescriptions are tailored to local conditions. It uses the most economical means, with the least possible hazard to

From **Crossing Boundaries in Park Management: Proceedings of the 11th Conference on Research and Resource Management in Parks and on Public Lands,** edited by David Harmon (Hancock, Michigan: The George Wright Society, 2001).

people, property, and the environment. The goal of IPM is to manage pests and the environment so as to balance costs, benefits, public health, and environmental quality. IPM systems utilize a high quantity and quality of technical information about the pest and its interaction with the environment or site. Because IPM programs apply a holistic approach to pest management decision-making, they take advantage of all appropriate pest management tools, including, but not limited to, pesticides. Consequently, IPM is:

- A system which uses multiple methods to address both short and long-term pest management solutions.
- A decision-making process.
- A risk reduction system.
- Information intensive.
- Cost effective.
- Site specific (Currie 2001).

Based on the above, at a minimum a successful IPM plan consists of the following steps:

1. ***Identification of the organism.*** This step will determine what kind of action is needed, if any.
2. ***Consensus***. This involves defining the roles of the three types of people involved in the pest management equation (i.e., site occupant, pest manager, and decision-maker) to assure understanding and communication between them. If this step is omitted, failure is virtually guaranteed!
3. ***Management objectives***. The pest manager must determine the management objectives for a given site in order to solve the pest problem(s). This can be done by reviewing NPS policies and establishing priorities. A policy review includes determining if a species is native or exotic, locating the management zone, and evaluating the chances of successful management.
4. ***Set the action thresholds***. These are points when pest populations or environmental conditions indicate that action must be taken in order to prevent the pest population from crossing a pre-determined injury threshold; no action is taken until the threshold is reached.
5. ***Monitor***. This includes the site environment and the pest population. It should be done on a periodic, consistent basis to determine whether or not the action is effective.
6. ***Non-pesticidal action***. In this step, action is taken to modify the pest habitat to reduce the carrying capacity of the site, exclude the pest, or otherwise make the site's environment incompatible with the needs of the pest. This step, which involves applied ecology, is a critically important point.
7. ***Pesticidal action***. If non-pesticidal actions are not available or insufficient, approval is obtained to take appropriate pesticidal action. It should (a) use the least toxic, most effective, most efficient application technique that provides the longest dwell time in contact with the pest, (b) be applied when the pest is in its most vulnerable stage, and (c) carry the least possible hazard to people, property, and the environment.
8. ***Evaluate.*** This means checking the post-treatment results of the habitat modification or pesticide treatment actions by periodically monitoring the site and pest populations.
9. ***Records***. For each site, written records should be kept of pest management objectives, monitoring methods and data collected, actions taken, results obtained, and pesticides used.

All components of this system must be addressed and implemented in some form for it to be most effective. Deletion of portions of the system leads to greater and unnecessary dependence upon repeated pesticide treatments (Cacek 2001; Currie 2001).

Prevention

IPM practitioners realize that prevention plays a key role in holding down pest management costs. An initial investment measured in hours, days, or weeks per year may very well result in the prevention of infestations that could become measured in generations of effort and millions of acres of infestation. Examples of exotic pests in this category include yellow star thistle (infesting 20 million acres in the state of California alone), leafy spurge, saltcedar, various knapweed species, and purple loosestrife.

Inclusiveness

IPM is an ecological discipline that considers the use of all methods for immediate and long-term management. Although the classification of the methods may vary slightly by author, the available tools include, but are not limited to, the following:

- ***Educational measures***. This is a key element, for education creates understanding and promotes acceptance of needed actions. This has been done in many different ways, depending on the audience.
- ***Regulatory measures***. Examples are: the use of weed-free forage, fill, and mulch; inspections of horse trailers at entrance kiosks; and inspection of vehicles in campgrounds for gypsy moth egg masses.
- ***Planning***. This has a strong prevention aspect. One of the best examples is the multi-disciplinary team in the National Capital Region, which weighs options to select the best landscape materials for a given site.
- ***Cultural measures***. In general, these pertain to plant growth or how things are grown. It may also involve changing patterns of human behavior. One example is proper turf management (cultivar selection, aeration, fertilization, mowing height, appropriate irrigation, proper drainage, etc.). Crop rotation is an agricultural example.
- ***Physical measures***. This involves the installation of passive materials, or changes in the physical environment. Examples are the use of mortar, sheet metal, steel wool, and hardware cloth to exclude rodents from buildings.
- ***Mechanical measures***. This refers to the use of machinery to manage pests. Examples include deep plowing to destroy pupae in croplands, setting traps for rodents, etc.
- ***Biological measures***. This involves the use of living organisms to manage pests. The use of exotic species, and even some native species, as biocontrols of plants is regulated by the U.S. Animal and Plant Health Inspection Service (APHIS). APHIS issues both the importation and release permits. In line with the NPS 2001 management guidelines (NPS 2000), biocontrol agents proposed for use in the National Park System will be reviewed by the IPM program.
- ***Chemical measures***. This involves the application of pesticides to kill the target pest. "Pesticide" is a broad term. It includes insecticides, rodenticides, herbicides, fungicides, etc. Secondly, based on section 2(u) of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), pesticides are defined as "any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest." This also includes plant regulators, defoliants, and desiccants, among other things. In the case of NPS, the pesticide use proposal (PUP) system is used to provide oversight of all pesticides, except disinfectants.

- ***Genetic measures***. Genetic engineering is a new arena for the NPS's IPM program. It can involve the combination of genetic material from two entirely different organisms, such as "*Bt* corn," in which corn has been combined with the soil bacterium *Bacillus thuringiensis*, which produces an insect-killing toxin for phytophagous insects. In addition, some crops are being engineered to be "Roundup ready"; that is, herbicide-resistant crops ("Roundup" is a brand-name herbicide) can now be sprayed for emerged weeds, without injury. In the new NPS management policies (NPS 2000), it is indicated that designated IPM specialists will review the use of bio-engineered products in accordance with the as-yet unpublished NPS Director's Order 77-7.

Results

National pesticide usage. In the May 1977 environmental assessment for NPS's pest control program, the projected annual use of major pesticides for the 1976-1985 period was 222,900 pounds of active ingredient per year (NPS 1977). Analysis of actual use data for the 1983-1986 period showed that 25,000-40,000 pounds of active ingredient were being used per year. This translates into reductions of 82-89% per year under the projected level. Data from 1989 showed 34,636 pounds used (Savage 2001)—an 84% reduction. This happened despite the increase in the number of parks in (287 units in 1977; 378 in 1998) and the extent of (approximately 31,000,000 acres in 1977; 83,700,000 acres in 1998) the National Park System.

National trends. NPS tends to be ahead of the curve in the public sector. In fact, in the mid-1990s, Consumer's Union concluded that NPS has led federal agencies in the adoption of IPM (Benbrook et al. 1996). For example, simply by selecting lower toxicity materials we eliminated the indoor use of chlorpyrifos long before the Environmental Protection Agency banned some of its uses. We began using insect growth regulator bait stations for termites shortly after they reached the market in the mid-1990s. More toxic or environmentally mobile materials, such as the herbicides paraquat and atrazine, are not used. Scouting programs have been emphasized for our agricultural lessees. At Delaware Water Gap National Recreation Area, which has NPS's largest agricultural program, all the growers use scouting (Cacek 2001). Lastly, lower-risk materials are being increasingly emphasized, such as insecticidal soaps and horticultural oils. Two related points should be noted here. First, during the 1990s there was an evolution towards more of a balance between reducing pesticide use and seeking the most effective pest management available. Second, the amount of active ingredient may rise as we obtain more funding for vegetation management (Cacek 2001).

Park examples

Grand Canyon National Park. The park has many partners and has developed a very extensive volunteer program for exotic plant management, which has been experiencing significant growth. In 1997, for instance, 10,000 hours of volunteer time were logged. This contrasts with 2000, when 1,661 volunteers logged 16,174 hours of work. This is close to a 62% increase over a three-year span. Approximately 30 organizations help the park in this effort.

Park partners include the Sierra Club, Girl Scouts, Grand Canyon Association's Field Institute, Boy Scouts, Australia Trust, and many others. Volunteers help the park in many ways. They set up the nursery's drip irrigation system in the spring; they plant, mulch, water, collect, and process seed; survey for weeds; and hand-remove or spray exotic plants. In 2000, 17,460 Mediterranean sage plants were pulled from over 91 sites, 41,000 Russian thistle plants were pulled from 17 sites, and 1,130 diffuse knapweed plants were pulled. All told, plants of ten species were removed by hand from the park.

Support comes in other ways as well; collectively, they include 23 soft-money accounts, a complement of seasonal employees, and, in 2000, the work of 1,661 volunteers. It all adds up to a program that is making significant strides in reducing the Grand Canyon's exotic plant populations (Lori Makarick 2001).

Yellowstone National Park. The park has identified weed containment and partnerships as two especially critical parts of its exotic plant management program. To cite one case study, nine years ago a park volunteer mapped leafy spurge over a 4,000-acre tract on the Targhee National Forest. The survey revealed 17 relatively small infestations of leafy spurge, including one in the park. The Forest Service (USFS) site is within two miles of the park and has been subject to clearcutting, hunting, and other backcountry uses, so the Yellowstone staff was concerned that the leafy spurge infestation would spread into the park. Over the years, USFS has treated the tract once and NPS has treated the tract annually.

Another part of the story is that the park is also a member of the 1.5-million-acre Henry's Fork Weed Management Area (WMA). This includes Fremont County, Idaho; Teton County, Wyoming; Targhee National Forest; Yellowstone National Park; the Bureau of Reclamation; and four Idaho departments: Game and Fish, Transportation, Lands, and Recreation.

Because Yellowstone is a member of the WMA, the park was eligible to apply for a grant from the Idaho Department of Agriculture; $2,500 was obtained as a result. In addition, an $8,500 grant was obtained from the Greater Yellowstone Coordinating Committee. Consequently, the total of $11,000 will allow the park to re-survey the original 4,000 acres, plus an additional 6,000 acres, for weeds. The objectives will be to monitor the 4,000 acres for change and to do an initial assessment of the 6,000 acres.

The park has been making good progress on reducing the leafy spurge population. This can be seen by the decline in herbicide use. Initially, it took 9 gallons of spray mix to treat the population. This has declined to 2 gallons of mix, which is a 77.8% reduction. In addition, the nearest infestation is now a half-mile away from the park (McClure 2001).

Summary

IPM's decision-making process has been used successfully throughout the National Park System. It has provided a low-risk way to protect the visiting public, park staff, pesticide applicators, and the environment. Finally, since IPM is very information intensive, much of its success can be attributed to networking and partnering with academia, industry, non-governmental organizations, and other agencies.

References

Benbrook, Charles M., Edward Groth III, Jean M. Halloran, Michael K. Hansen, and Sandra Marquardt. 1996. *Pest Management at the Crossroads.* Yonkers, N.Y.: Consumers Union.

Cacek, Terry. 2001. National Park Service, Washington Office. Personal communication.

Currie, William. 2001. International Pest Management Institute, Prescott, Arizona. Personal communication.

Makarick, Lori. 2001. National Park Service, Grand Canyon National Park. Personal communication.

McClure, Craig. 2001. National Park Service, Yellowstone National Park. Personal communication.

NPS [National Park Service]. 1977. *Environmental Assessment: The Guidelines and Program for Pest Control in the National Park System, May 1977.* Santa Fe, N.M.: National Park Service.

———. 2000. *Management Policies 2001.* Washington, D.C.: NPS.

Savage, Susan. 2001. U.S. Fish and Wildlife Service, Alaska Peninsula/Becharof National Wildlife Refuge. Personal communication.

Sherald, James L., and Carol L. J. DiSalvo. 1987. Integrated pest management in the National Capital Region of the National Park Service. *Journal of Arboriculture* 13:10, 229-235.