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Bruce A. Colvin

Bechtel/Parsons Brinckerhoff

Curtis A. Meininger

Bechtel/Parsons Brinckerhoff

Michael J. Grealy

Bechtel/Parsons Brinckerhoff

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ADMINISTRATIVE PROCEDURES AND CONTRACTS FOR VERTEBRATE PEST PROGRAMS

BRUCE A. COLVIN, CURTIS A. MEININGER, and MICHAEL J. GREALY, Bechtel/Parsons Brinckerhoff, One South Station, Boston, Massachusetts 02110

ABSTRACT: A proactive (rather than reactive) approach to rodent control includes effective planning, administration, and coordination. Centralized coordination, detailed scheduling, and well-defined contract specifications provide a solid basis for managing an integrated pest management program. Documentation and data management help to ensure cost effective and efficient operations. The ability to work with people and bureaucracies is essential for the science of rodent control to be applied effectively in real world situations and for vertebrate pest programs to succeed.

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INTRODUCTION

Research and development for vertebrate pest control typically focuses on specific control techniques and efficacy. Although numerous techniques exist, the transition from development to efficient implementation of vertebrate pest programs is not as clearly defined. Scientists infrequently deal with the practical aspects of vertebrate pest programs, and thus the transition of science to the real world can easily result in an ineffective control program.

Several factors can limit the success of rodent control programs. These include ineffective scheduling of control procedures, failed public relations, inadequate financial resources, poorly defined personnel responsibilities, lack of commitment by policy-makers, ineffective agency coordination, and inefficient allocation of control resources. Furthermore, although vertebrate control strategies often are described in an integrated pest management (IPM) context, rarely is efficient administrative management considered as a vital component of IPM. IPM requires not only that correct techniques are chosen, but that control procedures are well coordinated, socially acceptable, and integrated in a manner that is cost and control effective. Therefore, administrative skills and management procedures must be considered as important components of vertebrate pest control.

The purpose of this paper is to describe some of the administrative elements and procedures pertinent to vertebrate pest programs (especially construction-related rodent control). Coordination, scheduling, and contract management will be highlighted. An existing multi-million-dollar rodent control program in Boston, in support of a 5-billion-dollar highway construction project (Central Artery/Tunnel Project), will be used to illustrate some of the management and contract procedures associated with a large-scale IPM program.

BACKGROUND

The Central Artery/Tunnel (CA/T) Project entails the depressing of the existing elevated interstate highway that bisects downtown Boston (I-93) and construction of a new harbor tunnel to Logan Airport (I-90). Construction will span several years, involve 12 km of mainline highway (7.3 km of which will be underground), and occur within the highly urbanized environment of downtown Boston. The magnitude of this construction, and the urban setting in which it will occur, has necessitated the development and implementation of a large-scale rodent control program (Colvin et al. 1990).

The objectives of that program are: 1) to prevent the displacement of Norway rats (*Rattus norvegicus*) and house mice (*Mus musculus*) to adjacent neighborhoods by establishing rodent-free construction sites prior to construction mobilization and 2) to prevent the re-infestation of construction work areas by establishing maintenance control that lasts for the duration of construction. To accomplish these objectives, the principles of construction management are being applied, for the first time, to the implementation of a comprehensive IPM program. That program includes public education and community outreach, surveys of sanitary conditions and rodent activity, enforcement of public health codes, poison baiting on both surface and subsurface levels, and extensive documentation.

COORDINATION, PERSONNEL, AND RESPONSIBILITIES

The amount of time necessary to effectively coordinate personnel and elements of an IPM program, to prepare for field mobilization, and to keep a program moving ahead on schedule should not be underestimated and can be considerable for a successful program. Coordination with State and local agencies, community groups, and local pest control operators (PCOs) is required.

The CA/T rodent control program involves participation by three city agencies (Inspectional Services, Code Enforcement, Water and Sewer), eight pest control contractors, community groups, and utility companies. Furthermore, the work is being performed in urban neighborhoods representative of at least seven major ecological settings (e.g., residential, commercial, industrial) with wide variation in human population density and infrastructure. These factors, and the fast pace and dynamics of construction operations, require centralized coordination and well-defined communication networks.

The CA/T staff includes five biologists responsible for program coordination, contract management, and quality assurance. Their efforts are supplemented and supported by technical experts on utility mapping, scheduling, graphics, urban design, contract law and procurement, cost estimating, computer programming, and statistics; public relations experts (written and visual media); and community relations personnel, assigned to specific geographical areas along the construction alignment. CA/T biologists also are assigned to specific geographical areas and are individually responsible for management of pest control field operations within their

assigned area. Each of the CA/T biologists also have projectwide responsibilities related to pest control, such as for agency, utility company, or right-of-entry coordination.

City of Boston health inspectors and code enforcement personnel, contracted by the project, are responsible for systematic door-to-door surveys (Davis et al. 1977), code enforcement, and distribution of educational material developed by the project. PCOs contracted by the project are responsible for weekly neighborhood surveys, poison baiting, and responding to any neighborhood complaints. CA/T construction engineers are responsible for enforcing sanitation requirements on construction work sites. All CA/T public relations, community relations, and construction personnel receive training in rodent control, and information on rodent control is widely disseminated within the project. All public interface is closely coordinated with the CA/T public affairs and community relations groups, and all interface with construction contractors and work sites is closely coordinated with CA/T construction engineers.

SCHEDULING AND ESTIMATING

Work responsibilities must be defined in context of a well-defined schedule. For construction-related pest control, detailed scheduling ensures efficiency of operations. However, scheduling must remain flexible to match ever changing environmental conditions. Scheduling must consider seasonal changes in rodent populations, seasonal weather effects on field mobilization, punctuated events of environmental disruption associated with construction, and the availability of control resources.

CA/T rodent control activities are scheduled to closely match projectwide construction activities. Scheduling ensures that the objectives of the IPM program are met (i.e., that rodent populations are effectively controlled in construction sites and adjacent neighborhoods prior to construction mobilization). Construction contractors are not authorized to mobilize on a work site until the location is determined by CA/T biologists to be rodent-free, and thus rodent control must be properly timed so as not to limit construction mobilization.

With more than 50 construction contracts, each with a different start and end date, and because of the potential for shifting construction schedules, scheduling and tracking requires a centralized effort. The project controls group provides CA/T biologists with up-to-date scheduling information weekly. Furthermore, all major rodent control events are scheduled by the project controls group and linked to the notice-to-proceed (NTP) for the various construction contracts. Primavera Systems, Inc. (1990) software is used to track and plot project events, allowing rodent control schedules to be shifted automatically with any change in construction schedules.

Scheduling involves the timing of rodent control in both time and space, and in the most cost effective and efficient manner possible. For the CA/T project, rodent control is divided into six major geographical areas, separated by distinguishable geography (e.g., Charles River, Boston Harbor) or major break points between construction contracts. This allows for rodent control responsibilities to be clearly distinguished among pest control contractors and for rodent control to be tracked and mobilized in manageable units. Within each geographical area, there are multiple construction contracts with varying start schedules and work locations; therefore,

pest control is implemented in phases, linked to the start and end of construction in any one portion of a particular geographical area. In this way, pest control services are mobilized and maintained only where and when necessary.

Long-term scheduling of program activities can also be used to help predict the need for personnel and materials and to estimate the cost of program operations. Long-term planning allows for resources to be available when needed. However, estimating person-hours for pest control work can be far less definable than for other aspects of construction management. This is because rodent abundance, and thus the extent of pest control services necessary, can be difficult to predict (especially in subsurface environments such as sewers), and rodent abundance and environmental conditions change seasonally. Personnel involved in cost estimating must contend with a live object that can move, rodent behavior, and population dynamics rather than a sedentary and inanimate object (e.g., a bridge or sidewalk). Clearly defined work specifications and schedules for pest control contractors is crucial for establishing realistic cost estimates.

PEST CONTROL CONTRACTS

Procurement

Procurement of a pest control firm involves development of a bid package with a scope of work, cost estimating, advertising, submission of proposals by bidders, and evaluation of the bids. For a typical construction project, pest control firms are subcontracted by each construction contractor. However, for the CA/T project, pest control firms are subcontracted directly by project management because of the magnitude of construction and the importance given to centralized coordination of pest control operations.

Procuring pest control firms that provide quality service at a competitive price can be a difficult task. Pest control firms are notorious for "low balling" bids, and these bids and/or the firms that make them often are equated to poor quality work.

The CA/T project implemented a procurement process to help ensure contract award to firms that were qualified and capable of performing the work. Bidders must submit technical qualifications with their bid, and qualifications are evaluated by a review committee. Individual and corporate resumes, previous work history, and copies of pesticide applicator licenses with certifications are required. Qualification requirements, stated in the technical specification, include training and experience in commercial and residential pest control, communication and record-keeping skills, and training and experience in vertebrate and general pest control. Firms also must demonstrate that adequate personnel resources are available to do the work. For each contract advertised, contract award is made to the qualified bidder that has the lowest bid price. This process helps ensure award to competent firms and also a competitive bid price.

Commercial Terms

A contract's commercial terms establish the rights and obligations of the parties to perform the scope of services ("the work") according to a schedule for an agreed upon price. In part, these commercial terms protect the owners ("contractor") from claims against the pest control firm ("subcontractor") arising from the subcontractor's work performance. They also detail how and when the work shall be

performed, who will perform the work, and establish a procedure to make changes to the work. Contract provisions impose specific commercial obligations on the subcontractor. Examples include provisions which describe insurance, indemnity, bonding, and changes in services. These provisions give the contractor some protection against the failure of the subcontractor to perform the work or against the subcontractor's unacceptable work performance.

The insurance provision requires the subcontractor to maintain several different insurance policies at specified limits during the term of the contract. This includes comprehensive general liability insurance, covering pesticide application, with a limit of \$2,000,000 for each occurrence of bodily harm or property damage. It also includes comprehensive automobile liability insurance. These liability policies protect the subcontractor from law suits brought by third parties for injury suffered as a result of the subcontractor's work performance; they also protect the contractor, since the insurance provision requires the subcontractor to add the contractor to the liability policy as an additional insured. The obligation to buy and maintain insurance during the contract term ensures that there will be money available to settle any injury claims by third parties.

The indemnity provision obligates the subcontractor to pay any judgment and to defend any suit brought by a third party against the contractor for injuries suffered as a result of the subcontractor's work performance. The only exception in the indemnity provision is that the subcontractor will not have to indemnify the contractor for a third party injury which is caused solely by the contractor's own negligence. The insurance provision complements the indemnity provision by providing the funds to pay for the damages covered by the indemnity provision.

The bonding provision requires the subcontractor to purchase a payment bond and a performance bond, each in the amount of the work value as determined by the contractor. Bonds often are issued by an insurance company, and their cost is based on the value of the bond and the past performance of the firm requesting it. The payment bond protects the contractor if the subcontractor fails to pay for labor or materials. The performance bond protects against the subcontractor failing to finish the work. The bond document describes in some detail the conditions that must be met before the contractor can take advantage of the bond (e.g., notice and evaluation steps).

The provision describing changes in services recognizes that the contractor has the right to change the work during the contract term. It also gives the subcontractor the ability to suggest changes but does not require the contractor to accept them. Additionally, it provides for an equitable adjustment to the price of the work or the schedule if the change materially impacts cost or time of performance.

Technical Specifications

Detailed and comprehensive technical specifications for construction-related pest control did not exist prior to the CA/T project. The specifications developed for the project describe an IPM approach under a standard construction specification format (i.e., Description, Materials, Methods, Compensation). Contract packages also include a schedule, data sheets to be used, and maps showing work areas and the phasing of pest control activities. PCOs must attend an orien-

tation and training session prior to commencing the work.

PCOs are required first to perform a survey and then to submit the results of that survey with a plan for mobilization. Upon approval of the plan by the project, PCOs can initiate control efforts. PCOs must submit data sheets weekly and a report that summarizes activities and recommendations monthly. PCOs also must maintain and submit maps of all locations where bait has been placed. The supervisor for each contracted firm must meet weekly with CA/T biologists. PCOs also are responsible for obtaining any necessary permits.

PCOs must supply all pesticides and supplies, and pesticides must be used according to label directions and as acceptable to the project. All bait stations must be properly secured, individually numbered, and properly identified with the contractor's name. PCOs must record the amount of bait placed and consumed at each baiting location, and they must assign a unique number to every burrow, bait station, manhole, and catch basin so that baiting can be tracked at every location projectwide.

Baiting tasks are divided into initial and maintenance programs. All initial work (i.e., control of existing populations) must be completed prior to construction mobilization. During the maintenance program (i.e., construction period), PCOs are required to distribute control resources adequately to ensure continued control.

The CA/T project involves baiting on both surface and subsurface levels, and thus initial and maintenance baiting programs are implemented for each level. Baits placed at surface level must be checked at least weekly. Baits placed in manholes are checked approximately every two weeks where consumption occurs during the initial program, and then approximately every three to six months during the maintenance program (depending upon the history of bait consumption). PCOs must utilize utility maps, to help determine the most effective distribution of bait placements, and baiting data to help determine the baiting schedule for each manhole.

Buildings to be demolished are to be cleared of all rodent activity within the building and in adjacent areas by one week prior to demolition. As with construction activities, rodent control must be maintained until all demolition work is completed.

PCOs also are required to conduct inspections and surveys of work sites and adjacent neighborhoods weekly for rodent activity and sanitary violations. Additionally, they must respond to any public complaints within 12 hours when directed by the project, maintain records of work activities in a manner acceptable to the project, and be prepared to respond to pest problems other than rodents (e.g., insects, birds, skunks, opossums). Any visible dead animals must be removed by the PCOs, and all unconsumed rodenticide and equipment must be removed at the completion of field operations.

In addition to the specifications for pest control contractors, the CA/T project includes a specification for site sanitation in every construction contract. Construction contractors must submit a site sanitation plan before mobilizing, and that plan must designate lunch and coffee break areas, ensure use of rodent-proof refuse receptacles that will be emptied daily, and include the maintenance of work sites free of weeds.

Measurement and Payment

A basis for payment must be defined as part of any pest control contract. Some pest control work can be predicted in advance (e.g., weekly inspections and monthly reports), while other work cannot (e.g., complaint calls). Number of rodents killed or number of baits placed might seem like a logical way, to a cost estimator, for measuring the work; however, a practical and fair method is needed considering the dynamics of rodent populations and the human element of rodent control programs (i.e., factors that are not under the control of the contractor). For example, rodent abundance in a sewer system cannot be easily determined prior to commencing work when there is no history of baiting, and the public can strongly influence a pest control contractor's work load by not adhering to sanitary codes.

Lump sum pay items relate to work that can be evaluated in advance with a reasonable degree of certainty. These pay items can include: 1) initial program - the work necessary to control an existing infestation within a specified time period and to establish a maintenance program; 2) monthly maintenance - for a defined location and series of tasks to ensure a pest-free condition; and 3) building demolition - for a specific building, control established prior to demolition and continuing until all demolition work is completed and materials are removed.

Hourly rate pay items relate more to work tasks which are characteristically unpredictable in magnitude. Examples of these pay items include subsurface (manhole) baiting and responding to complaint calls from the public.

In some cases, the extent of pest control services is limited to a specific problem, time period, or location, and an overall lump sum bid for all services may be the simplest and most reasonable way to manage the contract.

DOCUMENTATION AND DATA MANAGEMENT

Effective management of an IPM program requires up-to-date evaluation of information provided from a variety of sources. Data is obtained from baiting records, neighborhood surveys, building inspections, and sanitation records. Information may also be obtained from the public through community liaison efforts or through complaints received by telephone. Data from these sources can be used to evaluate the effectiveness of an IPM program and to determine the most effective distribution of control resources, especially when maintained in a computer database.

Data management procedures were developed for the CA/T project that allow timely data entry and review. The system was designed to record IPM program data in a manner that would interface with other project applications, such as those used by the scheduling and mapping groups, and thus for associating IPM events with projectwide conditions and construction activities.

Data recording sheets were developed to standardize data collection and reporting by CA/T biologists, PCOs, and city personnel. Data entry was simplified by creating database entry forms similar in appearance to the recording sheets; this consequently minimizes entry errors. For data fields common to several databases, entry menus were established. These menus are accessed through database entry screens and allow itemized selections for entry. Entry menus include standard-

ized descriptions for: premises, manhole types, inspection types, violation codes, PCO companies, landuse, interior descriptions, bait formulations, etc.

While data recording sheets were designed specifically for each source of information, the database system relies on common fields that associate them by time (i.e., date) or geography (e.g., addresses, manhole numbers, project geographic coordinates). Relational databases also streamline data entry. By using relational databases (linked by common fields) information distributed among several databases can be simultaneously accessed for report generation or analysis. Report review was facilitated by establishing standard formats for information typically reviewed by CA/T biologists (e.g., PCO baiting results).

IPM program databases used to document conditions during construction include: catch basin surveys (data from city personnel); neighborhood sanitation and rodent surveys (data from city personnel and PCOs); site inspections (data from CA/T biologists); sanitation violations (data from city personnel); surface baiting (data from PCOs); manhole and catch basin baiting (data from PCOs); complaint logs and investigations (records of public complaints directed at the project).

The "heart" of the data management system exists within a few databases (master databases) where unique details are recorded on the identity of survey and baiting locations, addresses, utility corridors, and manhole and catch basin structures. The master databases document where rodent control activities occur, and these databases are updated as construction and the IPM program progresses. Because details are documented in these master databases, errors resulting from a repetitive entry format are again avoided. Most importantly, the master databases contain dates and geographic coordinates. The coordinate fields are those used by the project mapping group. IPM operations are thereby geographically and historically linked with project construction; i.e., rodent control events (baiting, sanitation violations, etc.) can ultimately be mapped for any time period and/or geographic area. Furthermore, data can be queried by date and location, then statistically analyzed. Statistics generated by database reports, or by using other applications, can also be presented geographically using mapping applications.

By documenting changes in conditions, CA/T biologists can evaluate practices and performance on an ongoing basis. Patterns revealed during the project can be used to improve the IPM program's efficiency, thus reducing project cost.

QUALITY ASSURANCE

Pest control in urban areas is commonly performed with little evaluation of effectiveness. PCOs rarely work for a client that has the technical ability to evaluate their work performance or under circumstances where the work is clearly defined. Therefore, a situation of low bid and minimum (low quality) work performance commonly evolves.

With the CA/T project, PCOs and city agencies are expected to maintain their own quality control efforts related to both field activities and submittals. Furthermore, documentation requirements imposed on PCOs and city agencies provide much of the basis for quality assurance by CA/T biologists. Data sheets submitted weekly are scrutinized for accuracy and completeness. Additionally, CA/T biologists inspect work sites and adjacent neighborhoods weekly and

commonly accompany PCOs when baiting is being performed. Snap-trapping and census baiting (with non-toxic bait blocks) are used by CA/T biologists, especially in commercial and industrial areas of the construction alignment, to help test for the presence or absence of rats and mice. The results of quality assurance activities help determine when work tasks have been completed.

The ultimate test of work performance, and an important component of quality assurance for any rodent control program, is the amount and type of public response. Complaints from the public actually are helpful in identifying rodent infestations, and the number of valid complaints (or compliments) can serve as a strong indicator of a program's effectiveness.

DISCUSSION

A proactive (predictive) approach is required for an efficient and cost effective rodent control program. In contrast (and historically), most rodent control programs are reactive; this especially has been true for rodent control during construction projects. A proactive approach includes effective planning, scheduling, coordination, and communication.

Construction-related pest control involves a blend of agricultural and urban pest control strategies. Although construction may occur in an urban setting, the environmental disruptions of construction parallel those occurring, for example, with cultivation or crop harvest. Agricultural and construction environments are both dynamic, characterized by punctuated and seasonal events. Thus, rodent control in support of construction is planned similar to that for an agricultural system, while at the same time considering complexities of an urban infrastructure.

The use of scheduling and contract principles should have broad application to enhance the effectiveness of rodent control programs, regardless if the situation is construction, urban, or agriculture related. For example, research farms impacted by rat damage (such as those for rice research) should consider strong administrative principles to improve the effectiveness of rodent control operations (Fiedler 1990).

Definition of roles and gaining acceptance of responsibilities is the most crucial and difficult aspect of any rodent control program. This includes adherence to public health codes by residents and businesses. Responsibilities also must be accepted by policy-makers and government agencies for adequate resources to be made available and for public health regulations to be enforced.

The crux of urban rodent control is involvement and thus, when initiating an IPM program, broad involvement and acknowledgement of responsibilities must be emphasized and achieved in the early stages of program development and implementation. Failing to adequately educate policy-makers will ensure a failed or limited rodent control effort, as will failing to clearly define public responsibilities and to firmly establish points of public motivation. Therefore, scientists must become increasingly aggressive about, and capable of, expressing to the public and policy-makers (in layperson terms) the actions that are required and the reasons for proactive rodent control programs.

The capability to control rodents is infrequently limited by science technology. However, rodent control efforts are commonly limited by real world bureaucracies and logistics. Scientists must develop administrative, communication, and procedural skills so that the science of vertebrate pest management can be effectively translated and implemented in today's business environment. Administrative techniques must be strongly recognized as a vital element of IPM. Only then will the principles of IPM function in an efficient and cost effective manner, and thereby reach their full potential.

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