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STANDARDIZATION OF PROCEDURES FOR DEVELOPING VERTEBRATE CONTROL AGENTS

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ABSTRACT: In research to develop methods for controlling damage by vertebrates, chemical evaluation procedures vary with every investigator, so that data cannot be meaningfully compared. Toxicology is one common area where standardization is both applicable and desirable. It is recommended that standard guidelines be developed through an international body recognized by the members of the discipline.

INTRODUCTION

In research to develop methods for controlling damage by vertebrates, chemical evaluation procedures seem to vary with every investigator. Frequently, the procedures employed by an individual or a research team are arbitrarily altered with each study. The results of such studies may satisfy the specific objectives, but the data have limited use when considered as a contribution to the general information pool. To achieve the maximum return from these data, testing procedures must be standardized.

Toxicology is one area of study common to all control methods investigators, and the area where standardization is the most appropriate and applicable. With standardization, data from many sources can be assembled with some assurance of comparability, thus easing the task of registration and facilitating the extension of a chemical's usefulness. At the Denver Wildlife Research Center, we have recognized the advantages of standardization and are in the process of establishing guidelines for developing bird and mammal control chemicals. To detail these methods would burden the reader and exceed the page limitations set by the editorial committee, so I will present only a summary of the testing procedures we use for developing acute lethal agents for mammals. In reviewing these procedures, please understand that our interest at this stage is not clinical but is oriented toward the solution of problems for a variety of pest situations under field conditions.

EVALUATION PROCEDURES

LD_{50} Determination

The LD_{50} is perhaps the most useful information concerning the acute toxicity of a compound, but there are numerous ways of determining an LD_{50} and each procedure can produce significantly different results. It is, therefore, imperative that the test conditions be clearly defined to reduce variables and ensure a greater degree of reproducibility. Our test standards describe in detail: (1) selection of animals, based on condition, history, size, and sex; (2) fasting procedures; (3) carrier and volume permitted based on animal weights; (4) dosage progression; and (5) observation period.

LD_{50} figures are used as indicators and are important in understanding the properties of a compound. When working with wild animals, however, it is generally both impractical and unnecessary to get precise figures with close confidence limits. This would require large numbers of animals, but more important, the populations are often too heterogeneous to make the figures meaningful beyond that portion of the population sampled. Therefore, we have adopted the LD_{50} method described by Thompson (1947) and Thompson and Weil (1952). Using this procedure, we can determine an LD_{50} with as few as eight animals and establish confidence limits at the 95 percent level.

Acceptance Test

Differences in the order of toxicity make direct comparison of the acceptance of compounds difficult without at first establishing a common denominator. We have done this by adjusting the concentration of each compound on a selected bait carrier so that, for the mean animal size of any species, there is the equivalent of one LD_{50} on 1/10 of the daily amount of carrier usually consumed by one animal. The bait carrier is determined, and then standardized for each species. Feeding tests are conducted to determine daily consumption. Each test animal is offered an amount equal to 10 LD_{50}'s, and acceptance is expressed in number of LD_{50}'s consumed in the first 24 hours (Kverno and Hood, 1965). Effect, or percent mortality, is also of primary importance in the evaluation.

Results of a single acceptance test have little value, but after a series of compounds have been evaluated, comparisons can be made between compounds or between species. These data should provide leads as to the general effectiveness of a compound or the most promising compounds for a given species.

Concentration Effect

The next step in the development of a mammalian lethal agent is to determine the most effective concentration for the target species. This is accomplished by evaluating a series of baits, with the only variable being the concentration of the chemical. Assuming that selection of the compound was based on good acceptance resulting in high mortality, there should be several concentrations where 100 percent mortality is achieved. A decision can then be made, depending upon the pest situation, to use the concentration where maximum consumption occurred, or the minimum concentration required to produce high mortality.

Secondary Hazard

The extent of secondary hazard will, of course, depend largely upon intended use. Nevertheless, some knowledge of whether a compound is secondarily toxic is needed before field evaluation. In our initial tests, white rats are used as the primary and secondary animal. The primary animals are administered, by gavage, an amount of chemical equal to 10 LD_{50}'s. After death the head, skin, tail, and feet are removed and the remaining portion is ground and fed back at a ratio of one primary rat to one secondary rat (each secondary animal receives the equivalent of 10 LD_{50}'s).

Initial Field Trial

The information gained from the preceeding bioassays is generally adequate to determine the feasibility of an initial field trial from the standpoint of effectiveness. However, before field testing some knowledge is also required on: (1) dermal toxicity, (2) phytotoxicity, (3) stability of the formulation, and (4) pharmacological action. A dialogue is maintained with the chemical supplier throughout the testing program, and often much of this information is provided by them. Here again, guidelines are desirable to eliminate some of the variables in these tests.

DISCUSSION

It is not our intent to imply that these tests are the ultimate. They merely represent one way of evaluating lethal agents for field use. Perhaps what is more important is that they offer a set of procedures that can be improved and expanded and, hopefully, eventually developed into a set of internationally accepted procedures. Developing such standards is of particular importance now, when there is considerable interest throughout the world in establishing new control methods research programs.

I realize that there is an inherent reluctance on the part of free-thinking scientific investigators to promote "standardization" because it connotes a restriction of individual freedom. However, the term also implies organization and maturity. Vertebrate damage control has, in my opinion, reached maturity, and it is time we established our identity as an organized scientific discipline. The development of guidelines for the evaluation of chemicals will not alone satisfy this need, but this step can act as a catalyst for further uniting us.

Standard guidelines can only be developed through an international body that is recognized by the majority of the members within the discipline. Later this month a meeting is scheduled to discuss ways of coordinating international vertebrate damage control programs. There will be representatives from several countries as well as international organizations. At this meeting an effort will be made to create the necessary forum to undertake this task.

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RODENT CONTROL PROBLEMS IN DEVELOPING COUNTRIES

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ABSTRACT: None of the so-called developing countries has an adequate rodent control program at present. In only a few of these countries is any rodent control research occurring despite the fact that rodent problems are actually quite serious in many regions and potentially so in others. Expertise, techniques and materials from the developed countries are of limited usefulness because of major differences in rodent species involved, standards for food handling and sanitation, and in the cultural contexts in which rodent control must occur. Trained personnel, both for control work and the basic research needed, are in very short supply. In addition, rodent control is frequently a low priority item in the generally meager budgets of developing countries. To date international agencies, foreign aid programs and foundations have had very limited success in altering this situation, although at present there is an upsurge of interest in rodent control problems.

The problems of rodent control are much the same in both the developing and the developed countries. The major difference is that these problems are far more serious, widespread and difficult to solve in the developing countries. Thus, it is more a question of degree than of kind. Even the problems arising from reluctance to kill rats because of religious beliefs in Asia have somewhat of a counterpart in laws preventing cruelty to animals in North America and Europe. This does not mean, however, that knowledge and techniques available in the developed countries are easily applicable in developing countries. Such a view ignores the profound technical, cultural and political differences not only between the two groups of nations but also among the developing countries themselves.

Among the technical problems the most serious is that the rodents themselves are very poorly known. Basic life history studies are badly needed throughout Asia, Africa and the Americas. In some regions, India and Pakistan, for example, much has already been published but it is largely anecdotal and fails to include work on population dynamics. There has, of course, been some research on the taxonomy of rodents in developing countries. But, even here, the murid rodents, which include a major share of pest species are a taxonomically difficult group and more work is needed.

One of the few major research efforts on the population dynamics of a pest rodent is the study on the Lesser Bandicoot Rat (*Bandicota bengalensis*) in Calcutta warehouses by Spillett (1968). He was able to demonstrate in this species one of the highest population densities and reproductive performances yet reported under natural conditions. His estimates on food losses, based on known intake and population density, are of considerable value in assessing the impact of this species on man.

This problem of assessing damage is an important one throughout the developing countries. In India estimates of rodent damage to foodstuffs range from 2.4 million to 26 million tons annually (Pingale *et al.*, 1967). When such estimates can range over an entire order of magnitude, there is clearly room for improvement. The chief difficulty lies in the extrapolation of very local and limited studies to very large regions, which magnifies any errors. The truth is, no one knows what food and goods losses from rodents are in the developing countries, or, for that matter, anywhere else. Fortunately, there is presently a U.S. AID rodent research team in the Philippines working on rat damage to rice. Equivalent work on other food crops is not under way.

Rat problems are aggravated by the fact that most of the species involved are native to the developing countries and are abundant and well-adapted to these areas. For example, the skin collections in East African universities contain a bewildering variety of rat and mouse species, many of them already serious pests and many more of them potential pests to developing agricultural regions. In India and Pakistan over 14 species are serious pests (Bentley, 1968; Pingale *et al.*, *op. cit.*).

Particularly in Asia, agriculture is very ancient and rodents have had a long time to adapt to human-dominated environments. This raises the question of the occasional calls for rodent "eradication." It is very doubtful that we could successfully eliminate all the pest rodents from regions as complex as those in the tropics and subtropics. Even if this were possible, our current lack of understanding of the other roles played by rodents in their ecosystems rules out such drastic measures. Rodents may consume insects, weed seeds and a variety of other items which are important to man's agriculture and public health.

Even where specific control measures have been instituted and show some success, we are hampered by a lack of field testing of alternative methods on a comparative basis. In India, for example, one control program was based on the use of traps and the acute poison zinc phosphide (Deoras 1968). In another location, rat control is done with the slow, cumulative anticoagulants (Krishnamurthy et al., 1968). Practitioners of these two approaches, both operating at the village level, disagree on their relative effectiveness. What appears to be needed are well-designed, large-scale field tests comparing the methods. To the best of my knowledge, this has yet to be done.

A complicating factor in developing countries is the danger of using acute poisons among populations with a high level of illiteracy and low nutritional levels. In these populations which contain large numbers of children, there is an ever-present danger of accidental poisoning; hungry children the world over, will eat almost anything. Yet the acute rodenticides, especially zinc phosphide, are the most widely used, and the relatively safe anticoagulants are quite limited in application. A major reason for this is the time and attention required for effective application of the anticoagulants. Where poverty is widespread and population density is high, most of the labor force is busy from dawn to dusk eking out a living, they have little time or inclination to tend bait stations. This situation is changing, however, as the level of sophistication in farming practices rises.

The widespread use of acute poisons under these circumstances generally requires that the technical personnel employed be specifically trained for rodent control work. This introduces additional complications. A major problem in developing countries is the shortage of technically trained workers. Since other programs (e.g., industrialization, agricultural production) are generally of a higher priority, few rodent control workers are trained.

It is a characteristic of human behavior in all fields of activity to institutionalize and bureaucratize. The field of rodent control is no exception. In developing countries this may reach particularly vexing proportions, partly because of the large educational gap between the control technicians and those they serve. Thus, it is typical that most rodent control is done by periodic rat-killing campaigns which are organized and imposed from outside the villages involved. While these campaigns frequently produce spectacular kills, follow-up work is seldom attempted and instead the control crews move on to other villages. Since there is little direct involvement of the beneficiaries, there is essentially no residual impact and after the campaign things return quickly to "normal" problem levels. It would, of course, be desirable for follow-up work to be done by agricultural extension workers, but these too are in very short supply.

Poor communication is at the root of yet another problem. Extensive outbreaks of rodents may occur without the knowledge of responsible government agencies. Travel to the hinterlands in developing countries tends to be difficult at best, especially during rainy seasons. By the time reports of rodent damage or, for that matter, rodent-borne disease, reach the population centers, major damage or illness has already occurred. It is not unusual to get two entirely different accounts of rodent problems, one from officials, the other from farmers and slum-dwellers. Of course, the developing countries have no corner on this particular problem, as recent events in the U.S. Congress will testify!

Where human beings have been living with large numbers of rodents for a very long time, they develop a pretty high tolerance for the rodents. It is thus necessary to educate such people to the actual impact rodent pests have on their lives. Rodent damage to crops may be simultaneously widespread and difficult to detect. This paradox exists in part because rodents may spread their depredations widely through fields of small-grains such as rice, wheat and barley, where the vegetative growth is dense. Usually the damage to these crops can be detected only by a laborious, time-consuming search for cut tillers, unless the affected areas are relatively small. Rodent depredation is more easily detected in crops such as maize, because any plant attacked is likely to be extensively damaged: rodents climb the stalk and do conspicuous damage to all or most of the ears.

The difficulty of detecting rodent crop damage also stems from the fact that very poor accounting methods typify agricultural production in developing countries. Grain grown for home use is not weighed or measured, and the farmers have only a sketchy knowledge of actual production. This makes detection of stored grain losses difficult. Home storage of grain for family use accounts for up to 70% of production in the countries of Asia. Most of this grain is stored in bins, jute bags, or in rooms that are neither insect nor rodent proof. Losses are widespread and rarely does one examine such storage without finding rodent damage. The house mouse (*Mus* sp.) is an especially serious pest of grain stored under such conditions, and its habit of widespread nibbling adds to the difficulties in detecting losses.

Thus, another major rodent control problem is providing rodent-proof storage containers. A variety of such bins has been devised, generally from sheet metal, and some are unquestionably affective. The major difficulty is cost. Where subsistence farming is the rule, the cash outlay for such bins is generally prohibitive without extensive subsidies. At present, such funds are in generally short supply and the outlook for the immediate future is not good. There is a real need for research on effective alternatives to current storage facilities, especially on the adaptation of indigenous materials and techniques familiar to farmers.

The rapid expansion of population and increased demands for additional food have resulted in an extension of agriculture into previously unfarmed areas. These "new lands" programs have on several occasions been accompanied by a dramatic increase in rodent damage. An enormous outbreak of rodents, which reached a peak in 1953, occurred in the Philippines on the island of Mindanao (Clark, 1958). This outbreak coincided with extensive new agricultural development and was so severe that relief supplies had to be brought in to the beleaguered farmers to prevent starvation. There are scattered reports, generally undocumented, of such "new lands phenomena" throughout the developing countries. The most recent one I am aware of was reported in Ethiopia, where losses in barley planted on new lands exceeded 50%. Unfortunately, we suffer from the same problem as do epidemiologists. By the time news of such out-breaks reaches us, the critical time to study and understand how such events developed has passed. Consequently, much of what we can say about these rodent outbreaks is conjectural.

The increases in agricultural production involve not only opening new lands, which are in short supply, but most especially the use of better seeds and improved farming practices on land already in production. This increases the concentration of available food/acre not only for man but also for his pests. Rodent damage to higher yielding varieties of grain may be very severe and such situations support high rodent concentrations. Also, cropping is being extended into traditionally "off" seasons when water has been in short supply. This results from using drought-resistant grains and improving irrigation. Rodent damage to these off-season crops may be especially severe, particularly if the fields are surrounded by uncultivated areas. One can also imagine that such increases in food during seasons normally difficult for rodents will increase the carrying capacity and larger populations will be present at the beginning of the usual cropping season.

I think it is clear from the foregoing that there is no shortage of rodent problems in the developing countries. Despite this, the contribution of the developed countries to solving these problems has been slight. The reasons for this are complex. Technologically and scientifically North America and Europe (including the USSR) are best equipped to develop rodent control programs, and most of the theoretical background research on rodent populations has been done in these regions. With the possible exception of the USSR, however, rodent pests are not the serious agricultural problem in temperate regions that they are in the tropics and subtropics, notably in South Asia and the Pacific Basin. There has been some good research on agricultural rodent pests in each of the "developed" regions, but the demand for such work is not great.

The most important rodent pests in North America and Europe are the commensal rodents closely associated with human habitation. Our primary attention has been focused on town and city rodent populations living in relatively simple environmental circumstances. Certainly, from a theoretical viewpoint these rodents, most of them introduced from elsewhere, are easy to control by manipulating their environment. There is ample evidence that good sanitation, harborage removal and rodent-proofing of buildings will greatly reduce or eliminate these pests. The chief problem lies in changing human behavior to achieve these results. From a practical viewpoint this is extremely difficult to achieve, so much so that many biologists and rodent control specialists have considered it beyond the realm of their professional capabilities. This has resulted in a serious stalemate in urban rodent control and reliance on such short-term and relatively simple procedures as rat killing campaigns and spot treatments in answer to complaints. Efforts are currently being made in some of the major cities of the U.S. to break this stalemate, but the sociological and public affairs orientation of these programs is of limited applicability to cities in other human cultures or to the problems of agricultural areas. This is also true of the "rat-free" towns program in Germany where intensive poisoning and superior sanitation give good results (Jackson, 1968). While the general level of sanitation in German towns may be a model to emulate in the villages of South Asia, it is extremely unrealistic to believe that this can be accomplished in the near future. It is a tribute to Teutonic determination that the Federal Republic of Germany is trying to adapt this approach at present to the barrios of the Philippines.

A large number of professionals concerned with pest control in the developing nations were trained in the U.S. and Canada. Since these regions do not have an agricultural rodent pest problem of serious dimensions, the education given there does not often consider these pests. Certainly we do not have much familiarity with the problems as they are encountered in the fields and villages of the developing nations.

It is extremely important to realize just how much rodent problems are, in reality, cultural problems. The way a farmer tends his fields and handles his grain is strongly influenced by tradition. Levels of tolerance for rodents are a product of the culture itself and are interwoven with accepted standards for such things as sanitation, food contamination and dwelling construction. In India the reverence for life extends to rats and in many villages rat-killing is impossible. At Deshnoke in the Rajasthan desert is a beautiful temple dedicated to the rat where a population of thousands of Rattus rattus are fed and protected. Ganesh, a very important Hindu god, reputedly rode on the back of the rat, and this god typically has a rat portrayed at its feet. It seems clear that cultural and social considerations are generally of overriding importance in rodent control. The usual level of understanding of other cultures by specialists from developed countries is inadequate, and we must accept the fact that control of rodents in developing countries will only begin to be effective when directed by those who understand these cultural implications. Only then can our rodent control technology be translated into effective local programs.

Finally, although we have indeed made great strides toward understanding the complex interactions governing population size, much remains to be learned, especially about the applicability of our models to reality. It is difficult to justify the expenditure of large amounts of time and money on some of the more sophisticated and long term rodent control proposals until we can more accurately predict the outcome. And meanwhile, the problems won't wait! Thus we are forced to do what we can in the name of expedience to satisfy the need and demand for rodent control. This, coupled with the usual shortages in funds and manpower, results in programs designed for immediate, visible results of a predictable sort.

The result of all these difficulties is that rodent control in the developing countries is in a rudimentary stage at present. There is a big gap between what is being done, in the form of rat campaigns, and what is possible through application of the ecological principles underlying effective long-term control. Fortunately, a number of international agencies, national governments and foundations have shown renewed interest in these problems. If the entire complex of technical, cultural and political factors are taken into account by these agents, we can hope for some signs of improvement in what is presently a fairly bleak situation.

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THE OUTLOOK FOR VERTEBRATE PEST CONTROL

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ABSTRACT: Because of the increased concern for the environment and the public's positive action toward preservation of all forms of plant and animal life, future control methods for pest animals will require a greater degree of specificity than in the past. Vertebrate pest control does not face a very promising future unless the independent and cooperative effort of both industry and government is expanded. The time has passed when one could use a chemical simply because it was a good poison or repellent. Now, especially when food or feed crops are involved, it is necessary to know a lot more about a chemical than just its effect on the target species. Our knowledge now must include: (1) chemical and physical properties, including chemical structure, (2) micro-analytical methods for detecting or measuring the chemical, (3) degradation rates and resultant by-products, (4) oral and dermal toxicity (acute and chronic) to target and non-target animals, (5) efficacy as toxicant or repellent, (6) phytotoxicity, (7) pharmacology, and (8) secondary hazards.

At present there is need for more chemists and pharmacologists in the field of vertebrate pest control research. Due to the comparatively small market for chemicals used in vertebrate pest control most chemical companies are reluctant to spend the large sums necessary for their development. Also, a potential source of personnel for increasing this type of research is available at many state universities and experiment stations. Support from these institutions should be encouraged.

Six years ago at the Second Vertebrate Pest Conference, it was stated appropriately that in controlling pests in agricultural crops one must consider residues; phytotoxicity; accumulations of the pesticide in the soil; effect on beneficial species of insects and mites; the effect on wildlife species; hazards to humans, pets and livestock; and the problem of environmental contamination. A lot has happened since that conference; for example, the earth's gravity has been overcome and men have been transported to the moon and back. Of equal importance, in the last decade, the public finally began to show a real concern about the things man does and can do to his environment. Along with this public awareness of fish and wildlife values, both economic and esthetic, has been increased. As stated by Baldwin (1964), "There is a growing concern, coupled with positive action for the preservation of all forms of plant and animal life." The report of the Secretary's Commission on Pesticides and Their Relation to Environmental Health, more commonly referred to as the Mrak report, demands that all control programs be critically reviewed. Congressman Henry S. Reuss, the Chairman of the subcommittee on Conservation and Natural Resources has summarized the situation as follows: "Too many people -- particularly too many affluent people -- cause air and water pollution, make noise, emit harmful chemicals, crowd open spaces, cause traffic congestion and otherwise reduce the quality of life in our predominately urban society." When we couple this statement with the fact that the human population in the United States is increasing at the rate of 3 million per year we can begin to appreciate the magnitude of the problem.

In dealing with vertebrate pest problems we must be increasingly concerned with the effect these programs may have on the environment. I do not wish to imply that these responsibilities have been ignored in the past, but they must be of major concern in the future. More research is needed to increase our basic understanding of animal and plant ecology. We need more information on the life history, habitat requirements, and interrelationships with other animals and on specific or behavioral characteristics which may provide the key to specific control. It is important that we do not devote all of our efforts to chemical controls but that we give due consideration to ecological approaches in the solution of vertebrate pest problems. Just last week a conference on the Ecological Control of Animals by Habitat Management was sponsored by the Tall Timbers Research Station in Tallahassee. The purpose of the conference was to explore the role of habitat management in regulating pest animal populations. Also, the National Science Foundation has recently selected four universities to share in a research training program on non-chemical means of controlling pests. One of the universities, North Carolina State, will emphasize natural means of controlling mammals and birds. The other cooperating universities are the University of California, the University of Oregon and Cornell University.

During the past decade only a few new vertebrate pest control chemicals have been developed or introduced into the market. These include Avitrol, Gophacide, Ornitrol, Phostoxin, Starlicide, R-55 Rodent Repellent and BioMet 12 Rodent Repellent. Although the numbers are few, they do represent some significant developments. Avitrol is a fright-producing chemical which causes certain species of birds to fly erratically and produce alarm or distress calls, thereby frightening away the rest of the flock. Ornitrol is the first chemosterilant to be used in managing populations of feral pigeons. Although these chemicals represent a new approach to control much remains to be learned about their use. Avitrol, at present, is not registered for use on food or feed crops. It is hoped that before the next corn growing season a temporary tolerance will be established so that additional field tests may be made. Ornitrol is registered only for use on pigeons; future work may lead to the development of other uses.

One reason for the apparent delay in developing new chemicals is the vast amount of information that is needed to support a request for registration. This is particularly the case if the chemical is to be applied to a food or feed crop. In addition to the usual amount of information on the efficacy of the material, it is necessary to know (1) the chemical and physical properties, including structure, (2) a micro-analytical method, (3) degradation rates and the by-products, (4) oral and dermal toxicity (acute and chronic) to target and non-target animals, (5) phytotoxicity, (6)pharmacological action, and (7) secondary hazards. The precise requirements for registration may well be illustrated by citing Avitrol. Although only .1362 to .4086 grams of the chemical on a cracked corn bait is uniformly applied to an acre of standing corn (milk, dough or dent stage) it must be demonstrated that harmful residues do not exist in the plant or the grain. Much of this basic information can only be obtained by a team of experienced chemists.

For some reason the development of chemicals for vertebrate pest control has not progressed as rapidly as have insecticides or herbicides. Presumably this is influenced by the limited, potential market. Unfortunately the potential market for vertebrate pest control chemicals is not fully known. If we consider damage by mammals and birds to agriculture, forestry, stored foods and structures plus the damage by birds to aircraft the total would undoubtedly approach one-half billion dollars annually. This does not include the health or esthetic aspects. Another indication of the size of the damage problem is the response to letters sent to 37 Agricultural Experiment Station directors, primarily in corn producing states. Replies were received from 32 states; 18 indicated that bird damage to corn was an important problem and 16 indicated a willingness to cooperate in a research project to alleviate the damage. Many other examples of the extent of damage have been reported but more factual information is needed to adequately support an expanded program.

In order to speed up the development of new chemicals and control studies there is need for better coordination of effort between the chemical companies, the federal government and the states. Also, a budget more in keeping with the size of the problem is necessary. As keynote speaker at the First Vertebrate Pest Control Conference, Mr. W. C. Jacobsen, former director of the California Department of Agriculture and long time worker and counsellor on pest control problems, made a statement which summarizes the situation now as well as it did 8 years ago: "Truly, hundreds of dollars have been spent where thousands of dollars are needed. The field is large enough so that more of the better equipped educational and research institutions can and should embrace it. All efforts in this direction will yield the best results if there is adequate correlation."

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THE POCATELLO SUPPLY DEPOT

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The Pocatello Supply Depot is operated by the Division of Wildlife Services, Bureau of Sport Fisheries and Wildlife, a branch of the U. S. Fish and Wildlife Service -- all a part of the Department of Interior.

The operation was originally started in McCammon, Idaho, in 1926. In 1931, the mill, grain facilities, and other equipment were moved to a new site in Pocatello, Idaho, where better location and transportation facilities were available. In 1938 an addition was completed under authority of an act of Congress June 1936 (49 Stat 1913 16 USC 667). This addition completed the facility as it now stands, consisting of approximately 1,5000 square feet of office space and 30,000 square feet of storage and manufacturing space.

The major purpose of the Supply Depot is to provide rodent and predator control materials not available to the general public, to cooperating Federal, State and private agencies. On occasion materials are also provided to Canada and to South American countries as well as other foreign countries after a review of justification by the Central Office.

The Bureau of Sport Fisheries and Wildlife maintains its own research laboratory and scientists who devote their full time to developing materials and methods for controlling rodents, predators and birds. This laboratory is within the Division of Wildlife Research and most of the activity is headquartered at the Denver Research Center located at Denver, Colorado. The research and development of control materials sometimes takes years before all the requirements of Federal registration have been fulfilled. These requirements are based on collection of basic field data and safeguards to other target species. After the basic data has demonstrated the product's value, the safety demonstrated and all requirements met, the product is registered under the Federal Insecticide, Fungicide and Rodenticide Act. All proposed items for registration are reviewed by the U. S. Department of Agriculture, Health Education and Welfare and the Department of Interior. The Pesticides Regulation Division of the U. S. Department of Agriculture is responsible for the administration of the Federal Insecticide, Fungicide, and Rodenticide Act. It is concerned with the registration and enforcement activities relating to economic poisons that enter into interstate commerce. Following Federal registration the product must be registered in all states where it is to be sold. State requirements in some instances can be more restrictive than Federal regulations. As an item of note, control materials which are not shipped in interstate commerce do not need Federal registration. Upon satisfaction of both Federal and State registration requirements the product then can be manufactured and sold by the Supply Depot to governmental agencies and their cooperators.

In preparing toxic grain rodent bait materials only the highest quality, largest grained number-one oats and wheat are used, most of which are grown in the Buckskin Basin, east of Pocatello. The grain bait material, even though it will be coated with a toxic agent, must be pure and weed free because of interstate shipments. The oats are steamed and rolled which opens up the shell to enable the toxic agent to be placed directly onto the kernel.

Finished bait materials are not stockpiled for future orders. All orders are prepared the same day they are received by the Supply Depot. It has been proven that good freshly prepared bait material will be accepted more readily by the rodents and consequently provide better control. Since establishment of the Depot, several rodent and predator materials have become available through commercial outlets. Because of this, some toxic compounds have been dropped from the Depot's stock and others have been limited for sale only to governmental agencies. This is done to avoid government competition with private enterprise.

Approximately 70% of the work done by the plant's twelve full and part-time employees is directed toward filling rodent control orders received from Division of Wildlife Services State Supervisors in various parts of the country. The remaining 30% of the Depot work is devoted to manufacturing various predator control materials. No order is filled by the Supply Depot unless it is approved by the State Supervisor of the state placing the order.

The Pocatello Supply Depot functions on a non-profit basis. Prices are based on cost of materials plus manufacturing and overhead costs. It is a self supporting installation and requires no Federal or State supporting funds.

If control materials are purchased from the Supply Depot by cooperators for resale, it is requested that they be sold on a non-profit basis.

Over the years the products provided at a minimum cost by the Pocatello Supply Depot have made possible large scale control programs feasible for Federal, State and cooperating agencies. Because of the availability of these materials it has been possible for more effective cooperative control measures.

Through our research facilities, the Supply Depot is constantly keeping abreast and informed of the latest techniques and developments of control materials which are in turn relayed to our cooperators. As a result of the services we are able to offer and because of our long time experiences with public agencies the Supply Depot has become a liaison for the farmer, livestock producer and timber manager on control information and procedures.