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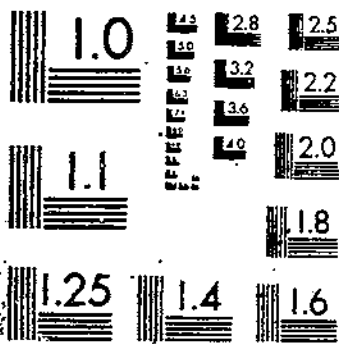
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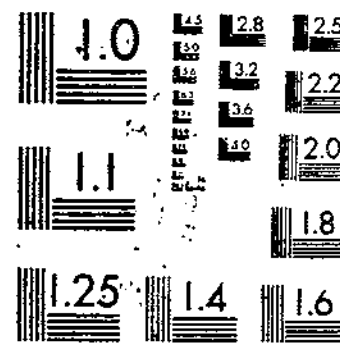
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TB 1626 (1980) USDA TECHNICAL BULLETINS UPDATA  
THE BIOLOGIC AND ECONOMIC ASSESSMENT OF STRYCHNINE, STRYCHNINE SULFATE, 1 OF 1

# START



MICROCOPY RESOLUTION TEST CHART  
NATIONAL BUREAU OF STANDARDS-1963-A



MICROCOPY RESOLUTION TEST CHART  
NATIONAL BUREAU OF STANDARDS-1963-A



THE BIOLOGIC AND ECONOMIC  
ASSESSMENT OF

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**STRYCHNINE**

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**STRYCHNINE SULFATE**

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**1080/1081**

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A report of the Strychnine, Strychnine Sulfate, 1080/1081  
assessment team to the rebuttable presumption against  
registration of Strychnine, Strychnine Sulfate, 1080/1081

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Submitted to the Environmental Protection Agency on  
March 7, 1977



UNITED STATES  
DEPARTMENT OF  
AGRICULTURE

IN COOPERATION WITH  
STATE AGRICULTURAL EXPERIMENT STATIONS  
COOPERATIVE EXTENSION SERVICE  
OTHER STATE AGENCIES

TECHNICAL BULLETIN  
NUMBER 1626



DEPARTMENT OF AGRICULTURE  
OFFICE OF THE SECRETARY  
WASHINGTON, D.C. 20250

March 7, 1977

Technical Services Division (WH-569)  
Office of Pesticide Programs  
U. S. Environmental Protection Agency  
401 M Street, S. W., Room 401, E. Tower  
Washington, D. C. 20460

Re: OPP-30000/8

Gentlemen:

Enclosed is the U. S. Department of Agriculture's (USDA) response to the U. S. Environmental Protection Agency's (EPA) Rebuttable Presumption Against Registration and Continued Registration of Certain Products, used on the Compounds 1080, 1081, strychnine and strychnine sulfate which appeared in the Federal Register on December 1, 1976.

To meet the March 7, 1977 deadline which EPA set as a 60-day extension of the initial timeframe indicated in the aforementioned Federal Register Notice, it was necessary to submit the response lacking annotation of references used by the Assessment Team. We will submit an updated version, including the reference citations, to EPA within two days of the receipt of this report.

Significant information pertaining to recent EPA/USDA rodent field tests exists in a final report that was not available to the Assessment Team prior to the March 7, 1977 deadline. We, therefore, request the opportunity to evaluate this report and submit to EPA our comments as an addendum to the March 7, 1977 response.

Sincerely,

For:  
ERRETT DECK  
Coordinator  
Office of Environmental Quality Activities

Enclosures

## PREFACE

This report is a joint project of the U.S. Department of Agriculture and the State Land-Grant Universities, and is the third in a series of reports recently prepared by a team of scientists from these organizations in order to provide sound, current scientific information on the benefits of, and exposure to, strychnine, strychnine sulfate, sodium fluoroacetate (Compound 1080), and fluoroacetamide (Compound 1081).

The report is a scientific presentation to be used in connection with other data as a portion of the total body of knowledge in a final benefit/risk assessment under the Rebuttable Presumption Against Registration Process in connection with the Federal Insecticide, Fungicide, and Rodenticide Act.

This report is a slightly edited version of the report submitted to the Environmental Protection Agency on March 7, 1977. The editing has been limited in order to maintain the accuracy of the information in the original report.

Sincere appreciation is extended to the Assessment Team Members who gave so generously of their time in the development of information and in the preparation of the report.

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Issued August 1980



## SUMMARY

The presumption against registration and continued registration of rodenticide products containing strychnine, strychnine sulfate, and Compounds 1080 and 1081 can be rebutted by available documentation regarding the products.

All four rodenticides can be highly toxic mammalian and avian pesticides.

The distribution of treated baits is specific to target species and controls them effectively. Most of the 1080 and strychnine are used on open ranges and agricultural lands west of the Mississippi River. Compound 1081 is used primarily in control of sewer rats.

It is contended that because of their acute toxicity the compounds are too dangerous to mammals and birds, and that a significant number of nontarget species are adversely affected. The Environmental Protection Agency (EPA) further contends that factors supporting the lack of emergency treatment are such that the human victim will "inevitably die if a 'fatal' dose enters the bloodstream." Evidence is presented to rebut these contentions.

The history of use of the compounds demonstrates that product labels and use restrictions practically eliminate hazards to humans. If necessary, directions for use can be revised to minimize effects on nontarget species. Based on current use patterns, no endangered species are likely to be adversely affected; and state restrictions provide added protection to endangered species.

The known first aid treatments and supportive therapy and antidotes available for treatment of exposures to 1080, 1081, strychnine, and strychnine sulfate are sufficient to protect human health and meet regulatory requirements for registration and reregistration.

The available documentation indicates that when the four rodenticides are used according to label directions,

there are no unreasonable adverse environmental effects, and such uses will accomplish the claims made about them.

The A. D. Little report and other documentation demonstrate that benefits from proper use of the pesticides exceed the risks involved in such uses.

Because of the similarity in use patterns of these pesticides (except for 1081) and the identical triggers used to issue the rebuttable presumption (except for emergency treatment for 1080 and 1081), the following comments will apply to both notices of rebuttable presumptions.

It is felt that inadequate assessment was given to the various control procedures that are involved in the use of these pesticides under field conditions. The population dynamics and kinetics of both the target and nontarget species are extremely complex and are best understood following actual field experience. It would appear that the information used may have been such that it does not represent a full analysis.

The suspension and cancellation of 1080, strychnine, and sodium cyanide, as predacides, were based substantially on the information in the Cain Report, the 1971 reviews of EPA, and the position paper of the Environmental Defense Fund. On biological grounds, we question the adequacy of some of the information utilized in this action.

The Working Group (of EPA) appears to have relied rather heavily on information from California. We do not find that contrary evidence was addressed or that any conclusions regarding the difference in evidence were reached. A draft environmental statement of February 8, 1972 on animal damage control by the Bureau of Sport Fisheries and Wildlife, Department of the Interior, does not corroborate the conclusions of the Cain Report and serves to rebut the presumptions issued by EPA against these compounds.

We do not find that the Working Group assessed these chemicals as an economically feasible method available to users to control their rodent problems adequately, particularly in relation to the regulations requiring data as outlined in the Guidelines for Registering Vertebrate Pesticides. It is strongly felt that the more than 30 years' history of use of these compounds coupled with the available information on uses and the established effects of these uses were not adequately considered. This is particularly true when one also considers the information that is required to be printed on each label for every registered pesticide. Strychnine and 1080 have been the subjects of Section 18 requests by various States. In these requests, considerable information is required to permit proper evaluation of the requests. We were not able to find where the Working Group considered this information, even though it would have provided valuable insight into local needs.

There are indications that the loss of these pesticides will result in significant adverse economic impacts in the form of additional losses of agricultural commodities. Where these pesticides are no longer permitted and the pest problem continues, less effective control measures will have to be used. The alternate pesticides that have been suggested as replacements also have many of the same characteristics that are present in these RPAR'd pesticides.

The toxicity of strychnine, strychnine sulfate, 1080, and 1081 has been known for some time. The position paper does not establish that as a result of this toxicity factor significant adverse effects actually have occurred in local, regional, or national populations of nontarget species. Although the toxicity of the material is important, the toxicity itself does not determine risk. This is exemplified by the regulation on occupational safety of the Occupational Safety and Health Administration and the conclusion by the Consumer Product Safety Commission that

highly toxic materials can be stored in child-resistant containers.

For several years the Denver Wildlife Research Center, Fish and Wildlife Service has developed techniques to provide the most specific and acceptable bait and baiting techniques for target species. In addition the University of California, at Davis, has developed and provided specific directions for use of these pesticides. We were not able to determine whether this information was considered.

The studies of Schitoskey and Hegdal appear to have been the major sources of information to support the rebuttable presumptions against 1080 and 1081. Practical experiences of the State of California mitigate the conclusions of Schitoskey and Hegdal. For example, although the San Joaquin kit fox is classified as an endangered species, the fox appears to have expanded to fill its entire range in California. As a result of the increase in its population numbers, the State of California has requested the Department of the Interior to declassify the kit fox as an endangered species. The black-footed ferret is also an endangered species. Although there have been no sightings of this animal for 3 years, nevertheless in some States (e.g. South Dakota) no treatments of 1080 or 1081 are allowed to control prairie dog colonies if there is any indication of the presence of black-footed ferret.

Another endangered species is the California condor, which depends to a large extent on highway-killed carrion for its food. The condor's limited food supply, as well as its limited reproduction base, apparently is the explanation for the small number of condors.

Keywords: Strychnine, strychnine sulfate, Compound 1080, Compound 1081, rodent control, rodenticide, rat control in sewers, predicides, field rodent control, predator control, vertebrate pest control, rodenticide bait, crop losses, pesticide registration, RPAR, environmental exposure, human exposure.

## INTRODUCTION

The purpose of this report is to develop biological, exposure, and economic information related to the uses of strychnine, strychnine sulfate, 1080, and 1081.

As indicated in the letter of transmittal (page ii) to the Environmental Protection Agency (EPA), this information was provided in an original benefits assessment report (March 7, 1977) to EPA following its issuance of a rebuttable presumption against registration (RPAR) against these registered uses of strychnine, strychnine sulfate, 1080, and 1081.

Title 40, 162.11, of the Code of Federal Regulations for the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) as amended (86 Stat. 971, 89 Stat. 751, 7 U.S.C. 136 etseq.) provides that a rebuttable presumption against registration (RPAR) or reregistration shall arise if the Environmental Protection Agency (EPA) determines that the pesticide meets or exceeds any of the risk criteria relating to acute or chronic toxic effects set forth in the Regulations (Section 162.11 (a)(3)). A notice of RPAR is issued when the evidence related to risk meets the criteria set forth.

The RPAR may be rebutted by proving that:

(1) In the case of a pesticide presumed against pursuant to the acute toxicity or lack of emergency treatment criteria, "that when considered with the formulation, packaging, method of use, and proposed restrictions on the directions for use and widespread and commonly recognized practices of use, the anticipated exposure to an applicator or user and to local, regional or national populations of nontarget organisms is not likely to result in any significant adverse effects"; and,

(2) In the case of a pesticide presumed against pursuant to the chronic toxicity criteria, "that when considered with proposed widespread and commonly recognized practices of use, the pesticide will not concentrate, persist or accrue to levels in man or the environment likely to result in any significant chronic adverse effects"; or,

(3) In either case, that "the determination by the Agency that the pesticide meets or exceeds any of the criteria for risk was in error."

The regulations also provide that evidence may be submitted as to whether the economic, social, and environmental benefits of the use of the pesticide subject to the presumption outweigh the risk of use. If the risk presumptions are not rebutted the Administrator (of EPA) will consider the information in determining the appropriate regulatory action.

In the Federal Register of December 1, 1976, the Environmental Protection Agency published the announcements of the rebuttable presumption against registration and continued registration of certain products containing strychnine, strychnine sulfate, Compound 1080 (sodium fluoroacetate), and Compound 1081 (fluoroacetamide) (56,57).

EPA has determined that these pesticides meet or exceed the criteria set forth in 40 CFR 162.11 (a)(3).

An extension of time permitted interested parties to submit comments to the EPA up to the close of business on March 7, 1977 (58,59).

Pesticide products containing strychnine or strychnine sulfate were determined, by EPA, to meet or exceed the criteria of acute toxicity hazards

to wildlife and the effects on nontarget organisms as follows:

Available toxicity data, use patterns, nonselectivity, and mode of action of strychnine and strychnine sulfate clearly indicate that acutely lethal residue levels in the form of poisoned baits will be available to exposed nontarget species. These compounds exhibit a narrow range of toxic doses among exposed animals. Therefore, the same toxic properties which account for the efficacy of these compounds in killing target organisms will also cause the deaths of nontarget organisms. Thus, the available toxicity data can be reasonably applied to nontarget organisms.

EPA has determined that the placement of strychnine and strychnine sulfate in animal burrows will not result in significant exposure to nontarget species. Accordingly, products containing strychnine and strychnine sulfate which are registered for above ground use meet or exceed the criteria for acute toxicity -- hazard to wildlife.

The field studies of Howell and Wishart regarding the poisoning of Canada geese were cited as support of the likelihood of significant populations of nontarget species (98). A study by Schitoskey on the secondary hazard of three rodenticides to the kit fox was presented as experimental evidence suggesting that death of endangered species can be anticipated (146).

Regarding 1080 and 1081, the available toxicity data, use patterns, nonselectivity, and mode of action of 1080 and 1081 indicate that acutely lethal residue levels in the form of poisoned baits will be available to exposed nontarget species. These compounds exhibit a narrow range toxic dose among exposed animals. Therefore, the same toxic properties that account for the efficacy of these compounds in killing target species will also cause deaths of nontarget organisms. Thus,

the available toxicity data can reasonably be applied to nontarget organisms.

It is further stated that the extreme toxic nature of 1080 and 1081 and the nature of most uses indicate that their use might reasonably be anticipated to result in significant population reductions in nontarget species. The absence of valid field evidence of such occurrences is acknowledged.

Although there is no validated evidence that the use of 1080 and 1081 has resulted in deaths of endangered species, the work of Schitoskey (146) is cited as experimental laboratory evidence that such deaths can reasonably be anticipated.

The above statements are indicated in the announcement of the RPAR as evidence that the criteria for acute toxicity -- hazard to wildlife and the hazards to endangered species -- have been met or exceeded.

In the announcement it is also indicated that no reasonably available but effective emergency treatment is known for 1080 or 1081 intoxication. This statement is based on: 1) One bait placement represents a lethal dose for humans; 2) once a sufficient amount of 1080 or 1081 is absorbed into the bloodstream, the outcome is invariably fatal; 3) symptoms of 1080 or 1081 poisoning may not occur until a fatal dose has already been absorbed into the bloodstream; 4) the potentially most effective treatment for 1080 or 1081 poisoning, monoacetin, is not available in a pharmaceutical grade; and 5) although 1080 and 1081 are restricted to some extent, use around domestic dwellings is not specifically prohibited, and has resulted in accidental child poisoning. Of particular concern is the fact that the symptoms of 1080 or 1081 poisoning may not occur until a considerable amount of the poison has already been absorbed into the bloodstream. Once a sufficient dose is absorbed, the outcome is invariably fatal.

The above statements are cited as evidence that the criteria regarding first aid have been met or exceeded.

For more detailed information the reader is directed to the Federal Registers that have been cited. Additional information may be obtained from the Environmental Protection Agency.

The issues raised by the rebuttable presumptions against registration are compounded by the absence of hard data. Nevertheless, we believe that available

information can be evaluated and utilized in arriving at decisions relative to the likely degree of risk that is actually present in the environment.

Studies are underway regarding the use of 1080 and strychnine for the control of certain ground-dwelling rodents (76,101,190). Although the results of these studies are not available for inclusion in this report, we believe that the information that will be gained will be beneficial to all who are interested in these problems.

### ASSESSMENT TEAM

In response to the RPAR notice published in the Federal Registers, a National Assessment Team for Strychnine, Strychnine sulfate, 1080, and 1081 was assembled. The members of this team were chosen based on their expertise in the field of animal control.

The information presented in this report was developed by this group of knowledgeable experts from the State Land-Grant Colleges and Universities and

the U.S. Department of Agriculture. Extensive use of published and unpublished information was made and is cited in the appropriate places in the report. In addition, other published and unpublished information was consulted and many of these references, though not specifically cited in the report, are listed as supporting references. Coupled with this information is the in-depth knowledge of the members of the team.

### RISK OF EXPOSURE TO HUMANS AND NONTARGET ANIMALS

The discussion follows the individual categories of concern expressed by the Environmental Protection Agency in the position documents relating to the presumptions raised against the individual compounds (2,51,53,56,57, 60,61,63,64).

#### Formulation

The registered 1080 and 1081 rodenticide formulations are of the following general types: wet bait, grain, cabbage, paste, and coyote bait station.

These formulations were developed primarily by research conducted by the Fish and Wildlife Service of the Department of the Interior and the University of California at Davis, California (1,8, 22,28,30,33). These formulations are considered as the most efficacious.

The grain bait is formulated with oat grain that is especially cultivated because of the large size of the seed. The extra dimension allows it to be rolled into a flattened grain, which distorts the appearance and also allows for better absorption of the technical pesticide combined with a fixative. Grain treated with 0.11% 1080 toxicant is used for open rangeland applications, and grain treated with 0.55% 1080 toxicant is used in forestry application (118). By contrast, the level of zinc phosphide for rangeland application is 0.92%.

If less control is achieved, a longer bait exposure period is required to control the same population (49). A second application may be required, making the compound more available to other susceptible species. Thus,

formulation is critical to the success of any rodent control program. The 1080 formulations are at near optimum as a result of extensive research investigations and feedback from field use (4,6,8,31,68,70,140,166,167,168,177). Further investigations may result in better formulations with less active ingredient per unit of bait.

Risk depends upon exposure. If the exposure is limited through proper placement, formulations, and so forth, the risk will be limited and the pesticide will have little or no significant adverse effect on the environment (13,30,38,39,72,73,74,99,102,136,152,186).

### Packaging

The review of the documentation accompanying the RPAR did not indicate any comments regarding the packaging of the pesticides. It will be beneficial to review the present packaging for the registered pesticides under discussion. The goal should be to minimize exposure, both to the finished bait and the technical materials. During transport, the materials should be in tamper-resistant and leakproof containers. All containers designed for public use should be of the child-proof type. Where the materials are to be used in the control of pests in structurally-related situations, the bait boxes or stations should be constructed of either wood or metal and should be tamper-proof with baffle entrances. These requirements are not new; and the pest control industry has had considerable experience in the use of properly constructed bait boxes or stations (13,21,23,35,36,66,67,68,69,70,71,122,123,152,173,188).

Aspirin has been one of the leading causes of accidental injury and death to children (87). The use of child-resistant containers has markedly reduced the incidence of harm. Although the new caps have not eliminated the risk, they have dramatically reduced the number of harmful incidents. Requirements for safe packaging are one of the regulatory functions of the EPA.

### Methods of Use

The methods of use are controlled to some extent by the target pest's acceptance or rejection of the treated bait(s) (10,12,19,30,52,115,129,145,148,150,160,184). Certain techniques, if administratively required, will alter the opportunity for exposure, and hence the risk, that triggered the rebuttable presumption. In addition, these techniques will reduce the potential for effect on nontarget organisms (136,150,160,174,177).

The rodenticide 1081 is used effectively in sewers for the control of rats (14,17,21,81,185). Placement in tamper-proof boxes that are locked and have a baffle entrance effectively restricts the exposure and subsequent risk. The physical location in the sewers automatically reduces the opportunity for exposure to nontarget animals. This use would certainly qualify for restrictions to use by certified applicators.

The rodenticides 1080 and strychnine have been used effectively in the control of rodents in agricultural structures, unoccupied buildings, and in agricultural and forestry pest control programs (19,24,27,38,39,40,43,75,83,95,115,116,117,130,136,148,150,156,164,170,176,180,185). Some States require the mapping of each bait location (13,124,190). Requirements are in force in some areas regarding a schedule for new baits to be put out and the uneaten baits to be picked up (12,124,169,170). Unoccupied buildings can be effectively treated by including requirements that the buildings be temporarily fenced, locked, or rendered inaccessible until after the treatment has been completed and all unused baits and dead pests have been collected (13,19,124,169). The 1080 training manuals of Lystad, Inc. (113), as well as the training documents of the various professional pest control organizations (3,13,67,68,69,70,122,123,124,161,162,163,169,186), describe many of the practices that can be utilized to permit the safe and effective use of these pesticides.

The use of the pesticides that contain 1080 and 1081 should be restricted to certified applicators. In addition, the uses should be limited to those presently registered where the directions incorporate proper restrictions as to methods of application, qualifications of applicators, location of bait stations, and other necessary safeguards.

The purposes of this RPAR trigger, the basic exposure problem, and especially the danger to children, can be addressed by proper labeling as to hazard and strict restriction as to site of use and qualification of user.

The bulk of the accidents involving children has occurred in and around the home (55,65). These materials should not be registered or labeled in a way that will permit their use or storage in or near the home. This problem can be solved by use of existing regulations and authorities. We believe the FIFRA amendments recognized problems of this nature and provided for them in the training and certification requirements for the use of pesticides. Requirements for exposure prevention provided by leakproof and tamper-resistant closures and containers, properly placed and locked bait boxes and stations, strict restrictions on applicators, and the conditions of use are the answer to the problem, not the banning of the pesticides.

#### Restrictions

Pesticides containing 1080 and 1081 should be used only by certified applicators. Warnings and restrictions on these pesticides should appear prominently on the main or principal panel of the label (13,62,66,67,68,69,70,71,90,169,186) to indicate, for example:

1. For use by trained and certified applicators only.
2. Not for use in or around homes or other occupied dwellings.
3. Not to be stored in or around the home or other dwellings.

(Although it is recognized that these pesticides are not to be used in

and around the home, it is possible that someone may store them in or around the home unless it is especially prohibited.)

4. Not for sale to, or use by, the general public.

5. The technical materials not to be sold to formulators in less than 10-pound tamper-resistant packages.

6. Formulated baits should be shipped in tamper-resistant packages and should be restricted to a certified applicator or a designee of the certified applicator. Use could be restricted to a certified applicator or the certified applicator could be required to be present during the application and recovery.

7. Commodities normally recognized as human foods should not be used as baits. Appropriate coloring or other appropriate means of marking should be a requirement.

8. Structural and sewer applications should be applied only in locked, tamper-proof, baffled boxes of wood or metal and bearing appropriate warnings and identification.

9. Baits for structural or agricultural uses should be of the type that cannot be carried away by rodents.

10. All dead rodents, resulting from structural treatment, as well as all uneaten baits, should be collected and destroyed. Destruction can be accomplished by incineration or burying. If incineration is used, the ashes should be buried.

#### Directions for Use

On July 24, 1972 the EPA sent a letter (93) to the Department of the Interior regarding the labeling of zinc phosphide. We believe that the instructions given in this letter will serve as an excellent basis for the development of the appropriate directions for field use.

#### Commonly Recognized Use Patterns

The directions for use and the appropriate restrictions on the label should be adhered to strictly. When these pesticides have been applied according to directions on the label,

unreasonable adverse effects on the environment have not occurred (128,132, 164,190).

One of the triggers for the rebuttable presumptions is that the residue, immediately after application of bait, presents an undue hazard to nontarget organisms. Such evidence that presently exists fails to substantiate the hazard (177,190).

According to the report of the Arthur D. Little Company (111), more than 50% of the use of 1080 for ground squirrel control programs has been in California. Based on the monitoring programs that have been conducted in conjunction with the control programs in California, significant adverse effects have not been indicated (83,95,96,99, 114,189).

The risk to nontarget species and to humans is reduced by limitations on use. For example, California requires special authorization for aerial application of bait (33). Long-term assessments have demonstrated the lack of hazard to endangered species in that State (94,149,190). The California Department of Fish and Game has not opposed the use of these materials when applied according to specific instructions (33). To this may be added the fact that the International Association of Fish and Game Commissioners has indicated the approval of the retention of such uses (126).

In California, where an endangered species may be involved in a rodent control program, the area occupied by the endangered species is defined and set aside and no treatment is permitted (107,120,157,190). In South Dakota control programs for prairie dogs, the prairie dog town is carefully examined for the presence of the black-footed ferret. If there is any sign of the presence of the ferret, the prairie dog town is not treated (109,110).

We do not believe that the California condor has been affected by rodent control programs as a result of

the use of these chemicals. The range of the condor is influenced by the availability of carrion more than by any other factor. The greatest concentration of carrion is along highways. The limitation on the amount of carrion and the reproduction ratio appear to be the major factors in inhibiting the growth of the condor population (18,29, 83,149).

Some bird losses have been reported associated with rodent control programs. In some cases the association is well established, whereas in others the cause of death is not so well identified (11, 15,16,24,37,38,39,135). These losses, however, do not represent a significant adverse effect on bird populations (83, 119,148). With the exception perhaps of endangered species, which are or can be protected by Federal or State regulations, the losses associated with programs will be rather rapidly replaced by normal means (142,155). The reports of bird losses suffer from an apparent failure to separate losses associated with rodent control from normal losses due to the probabilities of dying, the age of the populations, the general health of the population, the time of the year, and other population parameters (5,9,20,45,48,82,103,121,134,135, 137,138,141,144,147,153,183,185,191).

The nationwide breeding bird survey of 1,600 routes measured by the Patuxent Wildlife Research Center does not indicate any problems associated with the proper use of the pesticides under discussion. An examination of the winter field studies of the Audubon Society and the American Bird Study does not indicate any such problems. The enforcement reports on migratory birds do not show any significant adverse effects on local, regional, or national populations (190).

The Department of the Interior's guidelines for the use of poisons in nonpredatory animal damage control (172), primarily field rodenticides, state that: "Since baits are treated at the lowest concentration effective against target animals, the possibility



of secondary poisoning effects occurring under field conditions is remote." The Wildlife Research Report Number 1 of the Department of the Interior, covering an analysis of the population dynamics of selected avian species, states that the impact of pesticides on mortality and recruitment rates of nongame birds indicated no increase in postfledgling mortality rates of species during the past 25 years (since 1945) (92). Inasmuch as there was no evidence of increased mortality rates, the Department of the Interior concluded that the accelerated decline of several species studied resulted from lowered reproductive success and not from pesticides. The Department reports that no change in "recruitment rates" was apparent among the species feeding primarily on mammals.

The Department of the Interior, in a letter (175) dated June 2, 1975 to Mr. Laird Noh, pointed out that the eagles autopsied by the Department of the Interior from March 11, 1975 to May 1, 1975 were not killed by either 1080 or 1081. These eagles were recovered from States whose programs include the use of 1080 and strychnine for field rodent control. In addition, the Department's Denver Wildlife Research Center's analysis of residues found in eagles since the early 1950's indicates that such residues would have no effect up until "almost a full lethal dose" (112,137,190). The lethal dose of 1080 for an eagle is estimated to be 5 mg/kg. The Department of the Interior points out that "there is no way one can infer or imply that those eagles died of 1080 simply because they showed traces."

Studies of removal repopulation of breeding birds (142,155) do not support the concern expressed in the documentation (60,61) accompanying the rebuttable presumption regarding the adverse effects on the local, regional, or national populations of those bird species reportedly affected by 1080, 1081, strychnine, or strychnine sulfate. The factors that affect the yearly abundance of passerine birds have not been related to the compounds under

discussion (103). The bird simulation models of the Department of the Interior, that are currently in use, do not demonstrate the likelihood of significant adverse effects to these same bird populations (46,190).

The wild nontarget mammals that are most likely to be affected are the carnivores. The population responses of these mammals to morbidity and mortality from deliberate harvest demonstrate that the few individual animals lost to the animal damage control programs, where the pesticides under discussion are properly used, do not represent a significant adverse effect to the population of that species or to the environment on a local, regional, or national basis. The nontarget species have not in previous control programs experienced significant population reductions greater than that which can be compensated for by reproduction and ingress (11,77,127,143,159,182,187). This compensation ability is shared by the predaceous target populations (38,39,77,150,159).

The review by the National Assessment Team indicates that the furbearers are the mammalian carnivores most likely to be affected. The analysis shows that even when 25 to 80% of populations such as fox, opossum, skunk, racoon, muskrat, coyote, weasel, nutria, and badger are deliberately taken out of normal populations, no significant adverse effects occur. This is biologically evident when population dynamics, kinetics, and energetics are examined for the potentially affected species (34).

An analysis conducted by Dr. R. W. Risebrough of the effects of pesticides and other toxicants shows that even losses of 10,000 or more birds have not significantly affected those species. Dr. Risebrough indicated that the judicious use of methods of control utilizing chemicals does not mean significant adverse effects on wildlife (139).

Drs. Stearns and Ross (154), in their chapter on the effects of urbanization and technology on wildlife, show

that power lines killed 15,000 birds of 149 different species in Florida during a 6-year period without significant adverse effects on any species. Their data indicate that vehicles on and off the road kill thousands of mammals annually. No significant adverse effects have been reported in the local, regional, or national skunk, fox, racoon, and porcupine populations.

Where these pesticides have been used correctly in forest pest control

programs conducted by the U.S. Forest Service, there has been no indication of impacts that would support the triggers used for the rebuttable presumption (179,180, 181).

The Smithsonian Institution Center for Short-Lived Phenomena information does not indicate any adverse effect to mammals or birds from the use of the pesticides under discussion (151).

## EMERGENCY TREATMENT - 1080 AND 1081

In the EPA position paper (60) regarding the lack of emergency treatments for 1080 and 1081, seven sub-areas were presented. We would like to comment on each of these in turn:

### Availability of Pesticides

The EPA Working Group (60) indicated its desire to limit the household use of these pesticides, primarily because of the child exposure. We concur with this desire and will support programs in this area.

### Dose Likely to be Consumed

As soon as the pesticides are removed, by regulation, from the home environment, the opportunity for consumption by children will be greatly decreased. The Working Group (60) indicated its concern with the consumption of the bait possibly exceeding the LD<sub>50</sub>. Although we share this concern, we would like to point out that a LD<sub>50</sub> is a probit level with certain confidence limits which probably have not been definitely ascribed to humans. We take little comfort in the thought that the LD<sub>50</sub> indicates the level at which one-half of the test population died. A single serious injury or death, which could have been avoided, is a shocking and grievous occurrence. With regard to baits to be used in the field, including properly safeguarded buildings, registration requirements should

be such that it is not permissible to formulate baits in such a manner that they can be confused with human foods. This in itself will further reduce the probability of accidental ingestion by humans.

### Treatment of Poisoning Cases

In the interest of a safe transition from the use of chlorinated hydrocarbon pesticides to the organophosphate pesticides the EPA, in cooperation with many others, conducted a very successful program known as "Project Safeguard." The written supporting material for this project included three types of treatments that are important in the treatment of pesticide poisoning cases (54). They are:

1. Supportive therapy.
2. Decontamination of patient.
3. Administration of antidotes when available.

All three types of treatment are available for 1080, 1081, strychnine, and strychnine sulfate poisoning (7,26,41,47,54,78,79,80,85,86, 88,100,124,125,131,133,158,189). It is commonly recognized that there are not specific antidotes for all chemicals and that final diagnosis may require extensive laboratory and clinical testing with the accompanying time periods. Supportive therapy can begin almost immediately.

Supportive therapy has been successful in a number of very intensive 1080 poisonings (131). One case involved an individual who had inhaled technical 1080; however, through the use of supportive therapy and decontamination, he survived. It is reported that during the entire incident the patient experienced no actual pain or discomfort other than that of alarm and anxiety. Evidence indicates that the longer the patient is given supportive therapy, even in conditions of convulsion, the more likely the patient is to recover. In one case a young boy who ingested 1080 received supportive therapy for 6 days, and upon recovery was determined to be "clinically well" (131).

#### Availability of Emergency Treatment

The position paper (60) indicated that first aid treatment is available. This, plus supportive therapy, may give the patient sufficient time to reduce the level of toxicant sufficiently to permit complete recovery. Cases of poisoning were cited in the position paper. It is not our intention to dispute these cases, but only to point out that we believe that there are similar cases in which the patient recovered. The exposure to these compounds does not automatically lead to serious consequences such as death. The cases that were cited can, we believe, be prevented in the future by the adoption of the suggestions in the Project Safeguard recommendations (54), as well as those that have been made regarding changes in labeling and uses of the pesticides. Because there are relatively few cases of pesticide poisoning in the records of county, city, state, and federal health agencies, it is very difficult to determine the actual impact of pesticides in general or any pesticide in particular (42,44,50,55,84,89,171,178).

#### Working Group Conclusions on the Emergency Treatment Criterion

The assumption that once a fatal dose of 1080 or 1081 enters the bloodstream the victim inevitably will die is not supportable from a toxicological or enzymatic standpoint. Several case histories have shown that symptoms have occurred before a fatal dose has been absorbed into the bloodstream and supportive treatment has been instituted (131,189).

The current labels do not restrict 1080 and 1081 around homes. We believe that this restriction should be on the label. The National Pest Control Association has supported this restriction for several years (122).

There are cases where people, including children, appear to have ingested "lethal doses" of 1080 and have been in the convulsive state for more than 24 hours and recovered completely (41,131). We believe that 1080 and 1081 can be packaged and labeled to the degree necessary for Class 1 pesticides with the appropriate warnings and first aid treatments with supportive therapy. A good overview is provided by 40 CFR 162.10(h)(1)(iii)(A), which was originally published in the Federal Register on March 9, 1972.

Fluoroacetate is a competitive inhibitor of aconitate hydratase and can be reversed. In the laboratory, both the central nervous system and cardiac effects of fluoroacetate may be prevented and reversed (32). The authors (32) concluded that monoacetin is an "effective and practical antidote for fluoroacetate poisoning." Monoacetin is not available in a pharmaceutical grade, but may be in the future.

#### **BENEFITS**

EPA's Arthur D. Little's draft report "Economic Review of Rodenticide Usage in the U.S." (111) indicates that benefits are substantial and suffi-

cient to outweigh the risks. The Little document is the only indepth analysis presently available on the economics of vertebrate animal damage control.

A proprietary report, "A Risk Benefit Analysis of Compound 1080 and 1081 and Strychnine" by Ketron, Inc., analyzed the A. D. Little report and other documents and concluded that the benefits of the use of the three compounds outweighed the risk (104).

The Ketron report (104) takes the position that the benefits of using 1080 alone amount to at least \$10 million annually. Furthermore, it concludes that the substitute use of zinc phosphide for strychnine would amount to a loss of between \$5 million and \$23 million in citrus groves, zero to \$27 million in Washington State apple orchards, and about \$23 million in alfalfa.

In addition, the report estimated that the use of anticoagulants in place of 1080 for structural-agricultural rodent control would result in a loss of nearly \$7.5 million.

Ketron estimates that in California alone an additional \$1 million loss would occur through the use of zinc phosphide in ground squirrel control on range lands, and \$2 million additional loss would occur if diphacinone were used (104).

A second proprietary report by Ketron, Inc. (105), estimates that the energy savings directly attributable to rodent control programs are as follows:

Energy saved, equivalent barrels crude oil in alfalfa farming and in range operations

	Alfalfa	Range Operations
California	10,000	20,000
United States	25,000	330,000

These are partial benefits -- the total benefits could be much higher.

The U.S. Department of the Army's "Draft Environmental Impact Statement--Ground Squirrel Control, Fort Ord Complex" (165) and "Orientation on Military Services Pest Control Programs and Procedures" (106) analyzed by Ketron, Inc. show that when 1080 is used in ground squirrel control to contain diseased populations, it will not necessarily cause any unreasonable adverse effects on humans or nontarget species.

The Ketron, Inc., report provided an analysis of alternative methods of ground squirrel control and determined that the preferred and most effective control agent is the toxic chemical approach using Compound 1080 (106).

Ketron, Inc., estimated that the costs of the Army's aerial application of ground squirrel control were considerably less than the costs the Army would have suffered had it used zinc phosphide or strychnine. They concluded that a denial of registration of 1080 would be a failure to safeguard the public, or the environment, or both, in emergency conditions.

## CONCLUDING COMMENTS

In its position papers (60,61), the Working Group appears to rely rather heavily on the findings of the Cain Report (25). We are informed that not all of the authors continue to agree with the conclusions of the report. <sup>1/</sup> In addition, there are other scientists

who have questioned these conclusions (97,190). Neither the Cain Report (25) nor the Leopold Report (108) provides sufficient data to support the recommendations of the Working Group. The compounds under consideration were suspended as predicides, not rodenticides. The public concern at the time of both reports was related to a misuse of the products as predicides, not as rodenticides.

<sup>1/</sup> Wagner, F. H. 1973. Personal communication.

No significant adverse effects have been demonstrated, in the position papers, to local, regional, or national populations of nontarget species as a result of strychnine use. Schitoskey's report (146) does not contain the field data necessary to support a finding of significant potential risk. The study of acute toxicity does not demonstrate that the risks to endangered species can be extrapolated to field conditions because it does not take into consideration many of the variables that are normally encountered in the field. The small number of test animals in Schitoskey's laboratory study, and the lack of the inclusion of the variables known to occur in food preference testing, detract from the confidence one can place in the study.

With regard to Hegdal's studies, we have serious reservations regarding the manner in which the programs were conducted, particularly as the programs would be related to preferred field activities (91). From the study, it appears that there may have been errors in the study that could have had a profound impact on the results. For example, we question the extrapolation of bird counts from across the 9,000 acres and believe that there is room to question the biometrical confidence of the results and the statistical significance of the counts. A failure to color the bait properly prior to baiting appears to have been a potentially significant factor in the primary poisoning of the nontarget birds. As far as secondary poisoning is concerned, when strychnine is used above ground, the field conditions are such that it does not appear that the hazard of a substantial effect on nontarget animals is a considerable possibility. The time of the year that field treatments are normally applied for the control of

ground squirrels dictates a rather rapid "melt down" of the carcass. The amount of treated bait that may remain in the cheek pouches or the viscera of the dead squirrels normally will be low. The extent of the hazard is reduced by the tendency of squirrels to return to or remain in their burrows when poisoned.

The strychnine geese poisonings reported (57,61,98) in the EPA position papers were clearly a case of misuse as indicated by the admission of the applicator. The numbers of geese lost, although regrettable, were few compared with the legal harvest that is permitted. The legal harvest has been found not to affect significantly the overall population of the geese.

Strychnine, strychnine sulfate, 1080, and 1081 are effective for the use(s) intended, and registered, and when used as directed by the label, including the warnings and cautions, do not cause an unreasonable adverse impact on the environment. The history of these compounds substantiates the conclusion that the public has been protected and that further protection can be obtained by updating the label warnings and directions for use. In addition, the EPA has within its jurisdiction sufficient legislative and regulatory authority to cause appropriate changes in registrations, or labeling, or both, to restrict these pesticides to properly trained and certified individuals and to include requirements on packaging. In view of the very specialized use requirements for these pesticides and the long experience history associated with these pesticides, we believe that the public interest would best be served by retaining these rodenticides with modifications in registration where such modifications are indicated.

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