UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

BEFORE THE ADMINISTRATOR

In the Matter of Notice of Hearing on the Applications to Use Sodium Fluoroacetate (Compound 1080) To Control Predators	)	FIFRA Docket No. 502

Initial Decision

This is a proceeding under Section 6(d) of the Federal Insecticide, Fungicide and Rodenticide Act, as amended (7 U.S.C. 136(d)), to reconsider the Administrator's order (PR 72-2, March 9, 1972, 37 FR 5718, March 18, 1972) suspending and cancelling the registrations of sodium fluoroacetate (Compound 1080) for the control of predators. The proceeding was triggered by applications for registration or emergency exemption under Secs. 3 and 18 of the Act, filed by the Fish and Wildlife Service of the U.S. Department of Interior, and the States of Montana, South Dakota and Wyoming. The Administrator's determination to hold a hearing on the applications and the issues to be considered (Attachment A) are set forth in the Notice of Hearing, dated December 1, 1981 (46 FR, No. 234, December 7, 1981, at 59,622, et seq.). The issues to be addressed were expanded to include smear posts as a delivery mechanism by notice, dated March 3, 1982 (47 FR No. 47, March 10, 1982, at 10,288).

This proceeding is being conducted under the Rules of Practice governing hearings under the Federal, Insecticide, Fungicide and Rodenticide Act (40 CFR Part 164) and in particular Subpart D thereof. In accordance with Paragraph 164.131(a), the Administrator reviewed the applications for registration of Compound 1080 and determined that reconsideration of the suspension and cancellation order was warranted.

The cited section provides in part:

> "The Administrator shall determine that such reconsideration is warranted when he finds that: (1) the applicant has presented substantial new evidence which may materially effect the prior cancellation or suspension order and which was not available to the Administrator at the time he made his final cancellation or suspension determination and (2) such evidence could not, through the exercise of due diligence, have been discovered by the parties to the cancellation or suspension proceeding prior to the issuance of the final order."

Paragraph 164.132(a) of the Subpart D rules provides that the burden of proof in the hearing shall be on the applicant or applicants who shall proceed first. This section further provides:

> "The issues in the hearing shall be whether: (1) substantial new evidence exists and (2) such substantial new evidence requires reversal or modification of existing cancellation or suspension order. The determination of these issues shall be made taking into account the human and environmental risks found by the Administrator in his cancellation and suspension determination and the accumulative effect of all past and present uses, including the requested use, and uses which may reasonably be anticipated to occur in the future as a result of granting the requested reversal or modification."

The ALJ ruled that, although the initial determination under Paragraph 164.131(a) as to whether the evidence warrants reconsideration

of the suspension and cancellation order must be based on evidence not available at the time of the suspension and cancellation order of 1972, the decision as to whether the evidence required reversal of the prior cancellation and suspension order would be made on the entire record. This ruling was based in part on the Administrator's decision concerning Applications to Register Sodium Cyanide for Use in the M-44 Device to Control Predators (FIFRA Docket No. 382, September 16, 1975), wherein the Administrator ruled that evidence should not and could not be ignored simply because it was not new since the 1972 order, and in part, on the fact that, although the validity of the 1972 order is not at issue, such order is nevertheless being reconsidered. The Administrator determined that all issues bearing on the 1972 order would be adjudicated herein, and the provisions of 40 CFR 164.131(a) and 164.132(a), quoted supra, must be read and interpreted in the light of the issues the Administrator has noticed for determination. Issues such as the effectiveness of Compound 1080 large baits in reducing predation and whether the risks of primary and secondary poisoning were overestimated in 1972 can hardly be addressed without considering, inter alia, evidence of the extent of injury to non-target wildlife prior to 1972. In view of the conclusions herein, however, no part of this decision is dependent upon the validity of the ALJ's ruling in this respect.

No registrant or agrieved person filed timely objections to the 1972 suspension and cancellation order and no hearing was held thereon.

Active parties throughout this proceeding are the State of Wyoming, the Departments of Agriculture of the States of Colorado, Missouri and

Oregon, the West Virginia Commissioner of Agriculture, the Zuni Tribe, the National Cattlemen's Association and affiliates or similar organizations thereto in 36 states, the National Woolgrowers Association and affiliates or organizations similar thereto in 13 states, the Public Lands Council and the New Mexico Public Lands Council, various individuals including Dr. Walter Howard[1/] of the University of California, the foregoing parties referred to hereinafter as Wyoming, et al.; the States of Montana and South Dakota; the Fish and Wildlife Service; Ranchers Supply, Inc. and The Toxi-Collar Company; Dr. Clair E. Terrill; American Farm Bureau Federation, and Farm Bureaus in the States of Montana, New Mexico, Texas, Utah and Wyoming, hereinafter AFBF; National Animal Damage Control Association; Campbell County Predatory Association; Texas Department of Agriculture; New Mexico Department of Agriculture; Defenders of Wildlife, National Audubon Society, The Humane Society of the United States, The American Humane Association, Animal Protection Institute of America, National Parks and Conservation Association, The Animal Welfare Institute, The Fund for Animals, Natural Resources Defense Council, The Sierra Club, National Wildlife Committee, Friends of the Earth and Environmental Defense Fund, hereinafter referred to as Defenders of Wildlife, et al. or Defenders; National Wildlife Federation, hereinafter NWF; Friends of

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1/ Dr. Howard, a witness for Wyoming, et al. in this proceeding, filed an application, dated December 17, 1981, for an experimental use permit involving Compound 1080 in a Bait Delivery Unit (BDU) to control depredating coyotes.

Animals, Inc.; the United States Department of Agriculture and the Environmental Protection Agency.[2/]

Hearings on this matter commenced in Washington, D.C. on March 30, 1982 and were subsequently held in San Angelo, Texas and Denver, Colorado, concluding in Washington, D.C. on August 6, 1982.[3/]

Based on the entire record, including the proposed findings and conclusions and briefs submitted by the parties, I find that the following facts are established:[4/]

Findings of Fact

Issue 1(a) (Attachment A)

1. Although data on sheep losses to predation prior to 1972 are fragmentary and incomplete, the most reasonable conclusion is

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2/ In addition to briefs filed by active parties, amicus briefs were filed by the International Association of Fish and Wildlife Agencies, an inactive party, and by the Ohio Department of Agriculture and the California Department of Food and Agriculture. An amicus brief was also received from The Resources Agency of California, which is not a party to this proceeding. The Rules of Practice (40 CFR 164.31(d)) permit persons, who are not parties, to file amicus briefs by leave of the ALJ. Although the brief of The Resources Agency was not preceded or accompanied by an appropriate motion, the brief is accepted. Such a brief may not, of course, be used to introduce evidence into the record and facts alleged in the brief will be disregarded unless supported by the record.

3/ Although the Notice of Hearing specified that the hearing be concluded within 60 days, the parties found this schedule impossible to meet and the deadline for completion of the hearing was subsequently extended by the Administrator to August 6, 1982.

4/ Proposed findings not adopted are either rejected or considered unnecessary to the decision. Summary and detail findings (Attachment B) are to be read together.

that such losses were on the average within the range of 3.9 percent to 7.9 percent.

2. Numerous studies and surveys have been conducted on sheep and lamb losses to predators since 1971. The most comprehensive of these was the 1975 mail survey conducted by the Statistical Reporting Service of the U.S. Department of Agriculture, hereinafter Gee, et al., which gathered data on losses experienced by sheep producers in 15 western states in 1974 and which concluded, inter alia, that average losses to coyotes in that year were 8 percent of lambs and 2.5 percent of sheep. Reported losses to other predators were 3.3 percent of lambs and 0.9 percent of sheep.

3. The Gee, et al. results have been questioned for the reason, among others, that field or biological studies in Kansas, Idaho, Utah and Wyoming have resulted in findings of predator losses of sheep and lambs substantially less than reported by Gee, et al. for those states. Biological studies are very expensive and can only cover a limited area or number of flocks. Accordingly, it is concluded that the results of such studies cannot properly be extrapolated to larger areas, greater numbers of flocks, or to entire states. The data from these studies is inadequate to reach any statistical conclusions and the most that can be said is that the data provide an indication of loss trends. Moreover, despite extensive searches, some animals are simply missing and the cause of death or loss cannot be determined. Testimony from ranchers is to the effect that for every lamb killed by predators, which is located, there may be as many as two or three whose remains are never found.

4. Lamb losses reported by Gee, et al. include losses incurred before as well as after docking. Because many ranchers make no attempt to obtain an accurate count of lamb numbers until docking (this is almost always true in range lambing situations), producer estimates of losses to predators prior to docking must be viewed with some caution. Moreover, the record supports the conclusion that few ranchers maintain complete and accurate records on the causes of all losses.

5. Much time and attention at the hearing was devoted to the problem of non-response bias in conducting mail surveys, that is, ranchers suffering the highest predation losses or most concerned about predation would be most likely to respond to the questionnaire, while those suffering little or no predation might fail to answer the questionnaire. The Statistical Reporting Service of the USDA has been conducting mail surveys for many years, however, and must be regarded as expert in the conduct of such surveys. Moreover, the telephone and personal interview follow-up conducted with a sample of non-respondents, greatly reduced, if it did not eliminate entirely, non-response bias and any contention that those responding to the Gee, et al. survey were not representative of all sheep producers in the states surveyed is rejected. The questionnaire was constructed in such a manner as to de-emphasize predation losses (producers being asked to state total losses first) and thus minimize prejudice.

6. Predation losses reported by Gee, et al. have also been attacked upon the ground that the survey was instituted as a result of Congressional action sponsored by representatives of western states and that its purpose, that is, to obtain data supporting reversal of the decision suspending and cancelling registrations of 1080 for predator control, was well known. The resulting publicity and the emotional climate surrounding the issue of predator control are alleged to have resulted in exaggerated claims of predation losses. The evidence, however, does not establish that the purpose of the Gee survey was to obtain reregistration of 1080. Even if this was the purpose of the survey, there is no evidence that this alleged purpose was known to producers or publicized outside of Washington.

7. Emphasis has been placed on the difficulties encountered by producers in accurately determining the causes of deaths of sheep and lambs. While it is true, for example, that most ranchers would have great difficulty in distinguishing deaths caused by disease from those caused by poisonous plants, experienced ranchers have little or no difficulty in determining predator losses, if the remains are found within a reasonable time after the kill. Teeth or fang marks, indications of flowing blood,[5/] bits of wool and evidence of a struggle are indices of

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5/ It is recognized that suffocation is the normal cause of death resulting from coyotes biting the necks or throats of sheep and goats and that accordingly, blood flow may not be extensive.

predation well known to ranchers. In the great majority of instances where it has been possible to verify predation losses as reported by ranchers, it has been determined that the cause of loss was accurately reported. The assertion is made that a sheep or lamb dying of other causes might be scavenged and thus incorrectly identified as a predator loss. While this could happen if, for example an eagle or other carrion eating predator scavenged a carcass, it is unlikely in the case of coyotes because teeth marks in the throat, characteristic of a coyote kill, would be missing. Moreover, such scavenging would be more likely to occur in the winter or colder months because most predators prefer fresh meat in the summer. It is clear that the highest predation losses to lambs occur in the summer.

8. Ranchers conscientiously and in good faith strive to accurately report their losses, including losses to predators. However, because most ranchers do not maintain accurate records of the cause of losses, their reports of predation losses may be unintentionally inflated due to faulty memory or "telescoping," i.e., incorrectly attributing a loss or losses to one period of time, which, in fact occurred in another period. This would seem to be especially true of surveys asking for data on losses for several previous years or for a fiscal year. A fiscal year may bear no relationship to the rancher's production cycle, thus increasing the difficulty of accurately attributing losses to the period when the loss occurred.

9. Gee, et al. recognized that the mail survey approach depended upon the accuracy with which producers determine and report the number of sheep and lambs lost to various causes. Gee indicated that his report provided reliable indications of geographical areas and types of operations having the most predation and that the total number of producers affected was probably quite realistic, because most producers were aware of whether coyotes were preying on their herds. Gee, et al. stated, however, that numbers of sheep and lambs lost to coyotes and numbers of producers with different levels of loss must be considered more cautiously because the degree of producer judgment is higher.

10. Under all the circumstances, the most serious obstacle to accepting the Gee, et al. results is the high level of lamb losses attributable to predation. For example, in excess of 85 percent of lamb losses to all causes in Nevada were attributed to predation, approximately 59 percent in Colorado, approximately 54 percen in Utah and approximately 56 percent in Wyoming. Because these losses include pre-docking losses and substantial numbers of lamb deaths during that period are due to lambing complications, weather, disease, malnutrition, etc., these high reported predation losses are difficult to accept. Moreover, Gee, et al. state that while most of the large-scale operators reported losses from less than 5 percent to more than 20 percent, many small-scale producers had no predation problems at all, and that 5,000 or about one-tenth of the west's sheep ranchers,

reported losses exceeding 10 percent of lambs born. It is clear that high predation losses are suffered by a minority of sheepmen.

11. Combined sheep and lamb losses to all causes in 15 western states have remained stable during the period 1960-81, constituting 8.9 percent of the January 1 inventory plus lamb crop during the years 1960 to and including 1971 and 9.0 percent from the period 1972 to and including 1981. If lamb losses are separated from sheep losses, sheep losses to all causes in 15 western states have declined from an average of 7.9 percent during the period 1960-71 to an average of 6.9 percent during the period 1972 to and including 1981. The record will not support a finding that average predation losses in these states to sheep or to sheep and lambs combined have increased since 1972. Lamb losses to all causes as a percent of lamb crop have increased from an average of 10.4 percent during the period 1960-71 to an average of 12.3 percent during the period 1972 to and including 1981. While this might support an inference that lamb losses to predators on an overall basis have increased since 1972, the record does not establish that this is so. Lamb losses to predators as a percent of losses to all causes have not increased since 1972. In fact, lamb losses to predators appear to have declined since 1978. Individual producers have, however, suffered increased predation losses since 1972 and for some producers it is clear that predation is a very serious problem.

Issues 1(b) and (c)

12. Evidence in the record is to the effect that 0.4 percent of calves in the 17 western states were lost to predators in 1975. Because it could be inferred that cattle losses to predators were not a problem prior to 1972, predator losses of calves have increased since 1972. Texas is by far the largest goat producing state and the evidence supports the conclusion that losses of goats to predators in Texas have increased since 1972 and that losses of goats to predators as a percent of losses to all causes have also increased since 1972. It does appear, however, that losses of goats to predators declined in Texas in 1981.

13. Coyotes are by far the principle cause of predator losses to livestock. Foxes and/or feral dogs may be significant causes of predation in isolated instances. Where predation is caused by "feral dogs" it is usually packs of domestic dogs which have strayed from nearby towns or communities.

Issue 2 - Efficacy

14. The use of 1080 in toxic collars is likely to reduce predation in instances where sheep or goats are grazed in fenced pastures. The toxic collar is unlikely to reduce predation on open ranges because of the difficulty of targeting predator attacks to collared animals.

15. Compound 1080 in single-lethal dose baits (SLDs) has not been utilized for the control of predation in the United States. Similar baits containing strychnine, referred to as drop-baits, were extensively utilized for that purpose prior to 1972. Because of the concurrent use of strychnine baits and 1080 large-bait stations, it

is difficult to determine the effectiveness of either control method. SLDs containing 1080 are used concurrently with 1080 large-bait stations in British Columbia for the control of coyotes and wolves and in Austrailia for the control of dingoes. Expert testimony establishes that SLDs containing Compound 1080 could be used in conjunction with appropriate scents, lures or draw stations to remove particular depredating coyotes. The effectiveness of SLDs in these circumstances would not be dependent upon whether the livestock were grazed in fenced pastures or on open ranges.

16. The evidence does not establish that use of Compound 1080 in large-bait stations is an effective method of predator control. This conclusion is based upon the fact that large-bait stations are intended to suppress area or regional coyote populations and the evidence indicates that this purpose has not been accomplished. Although it is clear that no method of predator control is effective under all circumstances, it is not unfair to address the question of the effectiveness of Compound 1080 large-bait stations on the basis of their intended purpose. The declining number of 1080 bait stations placed by FWS and the increasing number of strychnine drop-baits used in the years immediately preceding 1972 would seem to constitute recognition that large-baits were losing their effectiveness. The phenomenon of bait shyness may explain at least in part why 1080 large-bait stations fail to consistently reduce coyote populations and predation.

17. It is not possible to determine from the record how much predation on an overall basis would be reduced by the use of Compound 1080 in toxic collars, SLDs or large-bait stations.

Issue 3 - Alternatives

18. Removal of denning pairs of coyotes or their young may, and frequently does, stop livestock predation in localized areas. Depending on terrain, tracking coyotes and locating their dens may be very difficult and time consuming and in any event, requires experience and skills. Aerial hunting and gunning is probably the most effective way of shooting coyotes. Use of this method has increased significantly since the 1972 order suspending the use of toxicants for predator control. Weather, terrain and vegetative cover may render aerial hunting ineffective or drastically limit its effectiveness. In addition, aerial hunting of coyotes, especially from fixed-wing aircraft, is hazardous and helicopters are very expensive. Hunting coyotes from the ground is more difficult and time consuming as they are wary and illusive animals.

19. Trapping by the use of steel leg-hold traps is a traditional and one of the most effective methods of predator control. Traps, however, frequently become inoperative in wet and freezing weather, can be and are disturbed by livestock and non-target animals, require considerable skill as to placement and use of scents or lures and require constant checking to assure operability. Snares may be effective in limited situations, i.e., where coyotes or other predators

attempt to pass under or through fences. Coyotes may jump fences or use other areas of travel and snares may be rendered inoperable by livestock, non-target species or by weeds or brush growing or being blown into the opening where the snares are set.

20. Although M-44's are quite selective to coyotes and foxes, certain soil conditions are corrosive and corrosion causes mechanical problems. In addition, heating and cooling of the units breaks the seals, allowing moisture to penetrate the sodium cyanide cartridge, thus rendering the device ineffective. M-44's may also be rendered inoperable by livestock or people and are ineffective in warm weather because coyotes are not attracted to the scents. Because of these problems and the restrictions placed on its use when it was registered in 1975, many ranchers are dissatisfied with the effectiveness of the M-44.

21. Aversive conditioning is the use of a chemical such as lithium chloride (LiCL) in a bait so as to induce an illness in a coyote or other predator. The theory is that the illness will be associated with a particular prey, e.g., a sheep or lamb, and that thereafter the coyote will refrain from attacking particular livestock with which the illness is associated. FWS has concluded that aversive conditioning using LiCL is not effective and that even if an aversion is established, the length of the aversion would not be sufficient to have any substantial effect on predation. Although experiments have been conducted from which it might be concluded that aversive conditioning using LiCL reduced predation rates for limited periods of time, variables such as the availability of alternate food sources, the

number of coyotes taken for pelts and the effect of usual coyote control methods on predation leave the results of these tests inconclusive. A dispute as to the determination of coyote kills and lack of loss data cast further doubt on the outcome of the tests. Moreover, witnesses participating in the tests acknowledged that the concentration of LiCL was critical to the aversion allegedly established, but beyond asserting that it should be the minimum necessary to produce an illness, appeared to be in doubt as to precisely what that concentration should be. It was also acknowledged that there might be other more suitable, less saline or strong tasting chemicals than LiCL. It is concluded that the effectiveness of aversive conditioning agents as a method of predator control has not been established. Such agents would, of course, require registration by EPA.

22. FWS has tested the use of diethylstilbestrol as an antifertility agent or reproductive inhibitor. These tests have been terminated, FWS concluding that until a more effective reproductive inhibitor than stilbestrol and a more effective delivery system were developed, reproductive inhibitors offered little promise of lowering predation. USDA has reached essentially the same conclusion and has terminated all tests of reproductive inhibitors. There is no other evidence in the record as to the effectiveness of reproductive inhibitors in reducing predation. While it is contended that termination of the tests was premature, it is obvious that the whole theory of reproductive inhibitors as a predator control technique is based on the assumption

that there is a direct relationship between the number of coyotes and predation losses of livestock. Opponents of the registration of 1080 dispute this assumption.

23. Tests of chemical repellants as a means of reducing coyote predation have been discontinued by FWS and USDA as showing no promise of effective predator control. There is no substantial evidence in the record to contradict these conclusions. Strobe-lights, sirens and propane exploders or zon guns have also been tested and utilized in attempts to control or reduce predation by coyotes. Tests by the FWS utilizing strobe-light/siren devices have shown encouraging results in reducing predation over limited periods of time. It was recognized, however, that additional work was necessary to identify stimuli, e.g., light, sound recordings, etc., that would most effectively repel coyotes. Other evidence in the record is to the effect that lights are totally ineffective in reducing coyote predation and that coyotes quickly become habituated to exploders or zon guns. It is concluded that repellants, chemical or mechanical, have not been shown to be an effective method of deterring or controlling predation.

24. Guard dogs have apparently been used to protect livestock from predators in Europe and Asia for hundreds of years. Guard dogs protect livestock not so much by attacking predators, but simply by their presence deterring predators from attacking livestock. The record reveals that in some instances, chiefly small fenced pastures, guard dogs can be effective in reducing predation. Guard dogs are, however, expensive. The purchase price ranging from $300 to as much as $800 each. Moreover, the dogs require extensive training

in that as much as two years may elapse from the time of acquiring a pup before it can be determined whether it will be effective as a mature dog. It is clear that guard dogs require supervision and a great deal of patient attention, that not every dog will develop into an effective guard dog and that some dogs prey on sheep they are suppose to protect. Although a survey in the record of ranchers using guard dogs in North Dakota indicated good to excellent results, ranchers who testified at the hearing who attempted using guard dogs did not have good experiences, indicating that it was difficult to keep the dogs with the sheep, that the dogs became sheep killers or that the dogs wondered onto neighboring pastures and were shot.

25. Shed lambing can reduce losses of lambs due to weather, lambing complications, malnutrition, disease and other causes. While ewes and lambs are subject to little or no predation during the period of confinement, predation can begin again or continue once the sheep are released into pastures or ranges. Shed lambing is labor intensive and is not an alternative method of reducing predation. Herders are essential to control and look after sheep in open range situations. Although additional herders could in theory reduce predation losses, experienced herders are in short supply and the cost of employing and maintaining them (as much as $1600 a month) may not be economically feasible.

26. It is theoretically possible to build fences in such a manner as to exclude coyotes. Testimony at the hearing centered on the question of the effectiveness of electric fencing in reducing predation. Evidence

indicating effectiveness of electric fencing chiefly concerned experiments whereby small plots were enclosed for test purposes. Although advanced chargers have been developed which minimize the likelihood of vegetation shorting out such fences, it is clear that electric fencing is nevertheless a high maintenance item. Moreover, because of terrain and soil conditions it may be difficult or impossible to construct a fence in such a manner that coyotes cannot pass or dig under the fence. Such fences constructed on open range, if effective, might well inhibit the movement of wildlife. In the last and final analysis, however, the major limitations to extensive use of fencing to exclude coyotes are economic. Total costs for the construction of such fencing have been estimated to range between $5 thousand to $10 thousand per mile depending on the type of construction and terrain. Assertions that the cost of such fencing could be amortized over a period of years by the savings from predation losses are unrealistic and fail to consider how such construction could be financed in view of the thin margin upon which sheep producers operate. There is evidence that ranchers are hard-pressed to maintain the fences they have let alone construct new ones. It is concluded that fencing is not an effective and economically feasible alternative method of predation control.

27. Penning or corralling sheep and goats at night can be very effective in reducing predation. It has no effect on predation that occurs in the daytime and is confined to farm flock operations as it is impractical to pen large flocks under range conditions. The so-called "Kansas Extension System" is basically an educational and training system whereby ranchers are taught to handle predation problems on

their own. It is not, however, an alternate method of predator control, because it is chiefly penning at night that results in low predation rates in Kansas.

28. Open range situations are grazing conditions under which it is least likely that any currently available method of predator control will be consistently effective and economically feasible.

Issue 4( ) - Benefits

29. The number of sheep in the United States has declined over the last forty years, from a high of 56,674,000 in 1942 to a low of 12,220,000 in 1979, increasing to 13,116,000 as of January 1, 1982. The decline is attributable to declining demand for lamb and mutton (per capita consumption being approximately 1.6 pounds annually), availability of synthetic materials as substitutes for wool (per capita consumption of wool being approximately one pound annually of which fifty percent is imported), the fact that raising cattle is less labor intensive than raising sheep and more attractive opportunities being available elsewhere. The decline cannot be attributed solely or even chiefly to predation. Approximately 80 percent of the sheep in the United States are raised in the 17 most western of the 48 contiguous states. Although approximately 51,000 western farmers and ranchers raise sheep (1974 data) only 21,000 or 41 percent have commercial operations of fifty or more stock sheep. These producers, however, own nearly 93 percent of all stock sheep in the region. Large scale producers with a thousand or more of stock sheep constitute only 6 percent of the producers, but account for 63 percent of the region's stock sheep.

30. Expert testimony from witnesses for the proponents of the registration of 1080 is to the effect that optimum utilization of large portions of the rangeland in the western United States requires grazing by cattle sheep and goats rather than by a single species. Grazing cattle, sheep and goats in the proper combinations and at suitable intensity not only increases the production of animal products per acre, but tends to maintain the carrying capacity of the land in that sheep and goats can help control weeds and brush, thus avoiding the use of herbicides or expensive mechanical methods of control. Because sheep and goats have the capacity to turn pasture and range vegetation into meat and fiber at a relatively low cost, the rising cost of energy in recent years has improved the economic competitiveness of sheep and goats relative to other meats and of wool and mohair relative to synthetics. This may explain the recent increase in sheep numbers.

31. Witnesses for the proponents of 1080 registration also testified that areas suitable for the grazing of sheep and goats were not being utilized for that purpose because of predation or the fear thereof that was forcing the abandonment of many sheep or goat operations. These witnesses asserted that young people were no longer entering the sheep or goat business because of predation and that excessive predation was a factor in lending institutions being unwilling to advance capital for such operations. The result of this situation assertedly includes alterations in the economy, decreased importance of agriculture to the economic base, a decline in industries which

depend on and support the agricultural sector, and forced changes in living conditions of rural families. While predation concerns are real and in some instances clearly justified, it is concluded that factors listed in finding 29 rather than predation are chiefly responsible for the decline in the number of operators raising sheep and goats in areas suitable for that purpose.

32. USDA conducted a survey of former sheep producers in Colorado, Texas, Utah and Wyoming. Predation was given as a significant factor in the decision to discontinue sheep production by former producers in each of the four states, although shortage of good hired labor, lamb and wool prices and age of the owner were other significant reasons. Financial returns were frequently meager or nil and the majority of former producers in Wyoming were suffering operational losses, i.e., not even meeting cash costs, when they discontinued production. The number of sheep producers declined by 12 percent in 1973, the year following restrictions on the use of toxicants, the greatest percentage of reduction since 1975. This decline was followed by further declines of 6 percent in 1974 and 10 percent in 1975. In Colorado and Texas more producers stopped production in 1969 and 1970 than in other years between 1968 and 1974. The biggest decline in number of producers in Wyoming and Utah occurred in 1969 and 1971, respectively. Declines in these four states in 1973 were not out of line with the number of producers discontinuing production in other years. It is concluded that although predation may have been a factor in producers discontinuing sheep operations, such discontinuance cannot be related to the suspension of the use of toxicants as a means of predator control.

33. Based on estimated losses of 4 to 8 percent of lambs and 1.5 percent to 2.5 percent of ewes at 1977 prices, producers' losses of sheep to coyotes have been estimated at $19 million a year. Based on estimated calf losses to coyotes of 0.4 percent in 1977 and 1977 prices, cattle producer losses have been estimated at $20 million. It is asserted that total economic losses to producers would nearly double if 1980 prices were used and would nearly quadruple if the higher range of estimated losses was used. Total economic losses to producers from coyote predation on sheep and calves in 1980 have been estimated to be in the range of $75 to $150 million. The latter figures are almost certainly far too high.

34. The USDA survey (Gee, et al.) estimated that sheep producers lost $27 million to predators, with consumers losing an addition $10 million due to higher prices and reduced supply. Losses in foregone lamb sales among the approximate 5,000 ranchers who reported lamb losses to predators exceeding 10 percent were estimated to average about $4,000. Based on 1977 prices, USDI estimated that sheep producers lost $19 million to coyotes and that other producers gained $6 million because of higher prices caused by reduced supply for a total net loss to producers of $13 million. Texas sheep producers are estimated to have lost $4,317,600 to predators in 1981 and goat producers are estimated to have lost $2,765,450 in that year. Dr. Nielson estimated direct income loss to Utah sheep ranchers between $3.6 million and $5.6 million annually. The Texas and Utah estimates were calculated by multiplying estimated losses times market values as appearing in USDA's statistics and make no allowances for price

changes caused by increased supply. The effect is to overstate dollar losses.

35. Whether an increase in supply of sheep and lamb would in fact result in a decrease in price depends on the sensitivity of price to the quantity sold, which is termed price flexibility or price elasticity of demand. "Price flexibility" is the percentage change in price which will result from a one percent change in the quantity offered for sale, while "elasticity of demand" is the percentage change in quantity purchased that results from a one percent change in price. There is evidence that the demand for lamb is inelastic and that in view of the fact that only a minority of producers suffer predation losses, the reduced prices caused by the increased supply might well result in lower total revenues to sheep producers as a whole. Other evidence is to the effect that the demand for lamb is elastic and that, because it is a luxury or specialty item, the reduction in price caused by increased supply would not offset increased revenues resulting from greater quantity being available for sale. It is concluded that the contention that the demand for lamb is inelastic has not been established. Irrespective of whether the demand for lamb is elastic or inelastic, it is clear, however, that only those producers suffering substantial predation losses would benefit significantly from a reduction in such losses. The evidence indicates that these producers are mostly the large open range operators.

36. Based on the assumption that the demand for lamb is inelastic and upon the further assumption that the average current loss of lambs

to coyotes is 6.5 percent, estimates have been made of the effect of various percentage reductions in losses to coyotes. A 1 percent reduction in losses to 5.5 percent would increase lamb production by 53,500 head and gross revenue to producers by $1.3 million. A 2 percent reduction in coyote predation losses to 4.5 percent would increase lamb production by 107,100 head and gross revenue to sheep producers by $2.7 million. Reducing lamb losses to 3.5 percent would increase production by 160,650 head and in gross income to U.S. sheep producers by $4.1 million. A further reduction to 1.5 percent would increase lamb production by 267,750 head and gross income to producers by $6.5 million. A 1 percent reduction in average coyote predation from 6.5 percent to 5.5 percent is in excess of 15 percent and a reduction in coyote predation from 6.5 percent to 1.5 percent would be a reduction of approximately 77 percent. It is clear that registration of Compound 1080 will not eliminate all predation and there is no evidence from which it could be concluded that reductions of such magnitude are likely from the reregistration of Compound 1080. Moreover, such reductions in coyote predation would hardly be costless and such cost should be deducted in considering overall benefits.

37. Using budgets prepared by the Cooperative Extension Service of Colorado State University, estimates have been made of the impacts on individual producers of reductions in lamb losses to coyotes for producers having 500, 2,000 and 2,400 head of sheep. These calculations indicate that for the 500 sheep operation having a reduction in lamb losses

of from 0.7 percent to 3 percent, gross income could increase from $317 to $1,260, production costs could increase from $107 to $429, and returns from predator control and to management could increase from $210 to $831. The largest benefits would be enjoyed by the 2,400 head sheep operator using range lambing having a reduction in lamb losses ranging from 1.5 percent to 12 percent. Gross income for this producer could increase from $1,845 to $15,454 and production costs could increase from $707 to $5,925, resulting in returns from predator control and to management increasing from $1,139 to as much as $9,529. These estimates do not include increases in cost for predator control. These are, of course, estimates based on losses considered to be average or representative and like all averages, could underestimate or overestimate the financial impact on individual producers suffering predation losses.

Issue 5 - Environmental Safety

38. In FWS tests with toxic collars, collars were lost, others were accidentally punctured and still others probably punctured and not recovered. Lost collars would most likely be found by the rancher or livestock owner who would be familar with the hazards represented by the collars. An adult finding an intact collar would be unlikely to open the reservoir, if he noticed the hazard notice printed thereon. While it is conceivable that a child of tender years might wander into a pasture or other area where collared livestock had been kept and find a punctured or leaking collar, get the solution

on his hands and then into his mouth, such a possibility is considered unlikely.

39. There is evidence that coyotes bury or cache toxic collars and these collars plus other intact collars that are lost would eventually deteriorate allowing the toxic solution to enter the soil. It appears, however, that there are certain bacteria in the soil which operate to detoxify the solution. The time required for detoxification would vary with the amount of toxicant, soil type, temperature, etc., but it appears that degradation of Compound 1080 may be accomplished in periods up to eleven weeks. Although it has been suggested that punctured, leaking or deteriorating collars might poison water supplies, this possibility is considered to be unlikely.

40. Toxic solution is also spilled in the course of a coyote attack whereby a collar is punctured. Pen tests indicate that spread of the dye after the collars were punctured by coyotes varied between 12 sq. ft. to 300 sq. ft. with the average being 138 sq. ft. Spread of the dye depended on whether the lamb was down or moving at the time the collar was punctured. It was estimated that an even distribution of Compound 1080 over the average dyed area of 138 sq. ft. would result in a concentration of 2.2 mg/sq.ft. The prospect that such a low concentration would cause serious environmental damage is considered remote and no such damage has been observed in field tests. Another route of potential exposure to non-target species is the carcasses of coyotes poisoned by puncturing toxic collars. Only turkey vultures appear to have scavenged any of the coyotes found during FWS tests with

the collar. Scavengers feeding on collared livestock killed by coyotes concentrated on viscera and muscle tissue rather than the collars. It also appears that scavengers feeding on collared livestock killed by coyotes do not ordinarily consume neck areas. Despite intensive searches, non-target deaths resulting from tests with the collars have not been observed by FWS and it is concluded that the probability of significant poisoning of non-target wildlife resulting from the use of 1080 in toxic collars is remote.

41. Exposure of SLD baits containing 1080 to non-target wildlife depends, of course, on the rate of application and upon whether the baits are covered. In this connection South Dakota's application envisages a maximum of 10 SLD baits per square mile, Montana's application contemplates a maximum of 25 baits per square mile and Wyoming's application apparently contemplates that the number of baits will be left to the discretion of the certified applicators. Widespread application of such baits would, of course, increase their exposure to non-target species. While such exposure could be reduced if the baits were covered, covering of the baits increases the difficulty of retrieving uneatened baits and of monitoring the use of such baits. ASTM Method E-590 (1976) recommends that SLD baits be covered.

42. Because the use of 1080 SLD baits approved herein is upon the assumption that such use will be limited and for the purpose of taking particular depredating coyotes rather than as a coyote population suppression technique, the risk of non-target exposure under such circumstances is considered to be minimal.

43. Bureau of Sport Fisheries and Wildlife policy, prior to the suspension of the registration of Compound 1080, regarding large-bait stations was that the minimum number necessary to achieve effective coyote management was to be placed. This was generally interpreted as requiring or permitting the placement of not more than one station per township. The guidelines issued by the Bureau further stated that the use of 1080 large-baits was a technique reserved for areas where other control methods had not been effective in reducing coyote population to a desired level and where such use would have a minimum effect on non-target wildlife and domestic animals. Although it is clear that the total number of baits placed declined in the years immediately preceding the suspension of Compound 1080 in 1972, there is evidence that the number of bait stations placed in particular localities each year did not vary significantly and that the stations were placed in more or less the same locations each year. Placing not more than one large-bait station per township was on the theory that coyotes, being more mobile and having larger home ranges, would be more apt to come in contact with and feed on the station while smaller, less mobile animals with smaller home ranges, would be less likely to be exposed to the bait. It is clear, however, that there are no significant areas which may be said to be populated solely by coyotes. Moreover, raptors and other birds, which depend primarily on sight for the location of food sources, are more likely to be exposed to 1080 bait stations.

44. Bureau guidelines for the placement of bait stations specified that the baits be placed as late in the fall as practicable in keeping with safety to meat eating mammals and birds and conditions of weather and travel. Baits were also to be removed as early in the spring as weather and travel conditions permitted, the theory being that this would eliminate exposure to bears and other hibernating animals. Because of dense snow pack and other reasons, there were occasions when baits could not be removed and destroyed until early summer or later, which was long after animals would be out of hibernation.

45. Large baits were to be treated at the rate of 1.6 grams of 1080 per 100 pounds of bait. This was to be accomplished by using a syringe or meat pump and making injections of the toxic solution at evenly spaced intervals while the meat was still warm. Because bone, hide, etc., had to be deducted in determining the weight of the bait for application of the appropriate amount of toxic solution, and because of the field conditions under which the baits were prepared, even distribution of the toxic solution in the baits was difficult or impossible to achieve.

46. All but one witness who participated in or who was familiar with the 1080 large-baiting program testified that the deaths of non-target species were minimal. Searches for target and non-target animals, however, were normally conducted only at the time of disposal of the baits or the remains thereof and such searches varied widely in scope and intensity. The characteristic latency period after the ingestion of Compound 1080 makes it likely that all birds and animals poisoned thereby would not die in the immediate vicinity of the bait. Because

of these factors, it is probable that many birds and animals poisoned by 1080 were never located and reported.

47. The contention that Compound 1080 is a selective poison is based in principle part on differing levels of sensitivity to the poison. Carnivores are in general more sensitive to 1080 than other species, while canines are considered to be especially susceptible thereto. For example, the LD_{50} [6/] of 1080 for a coyote feeding on a properly dosed meat bait (treated at the rate of 1.6 grams per 100 pounds of meat) has been determined to be 0.10 mg/kg, while that for a man is estimated at 0.7 to 2.1 mg/kg and that for a golden eagle ranges from 1.25 to 5.00 mg/kg. A 30-pound coyote would therefore obtain an LD_{50} dose by consumption of only 1.4 ounces of bait material treated as indicated above, while a 150-pound man would obtain an LD_{50} by the consumption of from 47.6 ounces to 142.8 ounces. A golden eagle (average weight 7 pounds) would receive an LD_{50} by consuming from 4.0 ounces to 15.9 ounces of such bait material. An LD_{100} for a coyote has been estimated at 0.16 mg/kg. It is apparent that LD_{50} values for some species are not precise and have a considerable range. Tests to establish these values have obviously not been conducted on humans and the tests on many other species, including coyotes and eagles, have not been conducted on a sufficient number of animals that a statistical confidence interval can be established. Moreover, there is evidence that the LD_{50} value can vary depending on whether the mode of

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6/ An LD_{50} value is a statistical estimate of the dosage that would be lethal to 50 percent of animals tested.

administration is in a tallow bait or in water and that cold temperatures may have a great effect on the toxicity of the poison.

48. Athough several witnesses testified that non-target species, including eagles and badgers, were observed feeding on 1080 bait stations with no apparent ill effects, it is clear that these species as well as others were in fact killed by feeding on 1080 baits. It is also clear, however, that the loss of particular individuals is not generally a sufficient basis for determining adverse impacts on the population of a species as a whole and that there is no evidence that the population of any non-target species was adversely effected by 1080 bait stations. The evidence does not establish that this conclusion can be extended to endangered species. It must, of course be recognized that as to some species, e.g., the California Condor, loss of a single individual may be sufficient to have an adverse impact on the population of that species.

49. In tests conducted by the FWS to evaluate primary hazards of Compound 1080, dogs and magpies were allowed to feed on the carcasses of coyote killed sheep or goats having punctured collars. No ill effects were observed. In other tests, two golden eagles and a rough-legged hawk were orally administered 3 mg of active ingredient 1080 in beef tallow baits each day for four consecutive days. After administration of the third dose one of the eagles showed symptoms of toxicity, i.e., gross motor impairment, fluffed feathers and loss of appetite. This eagle recovered in about six days, the other eagle and the hawk showing no apparent ill effects.

50. In further tests to determine secondary poisoning hazards to raptors, two golden eagles and a rough-legged hawk were fed ground meat

obtained from five coyotes, each coyote having been administered an oral dose of 5 mg/kg active ingredient 1080. Coyote meat was the sole source of food for these birds over the 10-day period of the test. Analysis of the meat indicated that it contained from 1.8 mg/kg to 3.1 mg/kg 1080. No discernible effects from this consumption of meat containing 1080 were observed. The meat was obtained from skeletal or muscle tissue of the coyotes and it is recognized that raptors ordinarily feed first on the viscera of an animal and that the viscera might well contain higher levels of 1080 or fluorocitrate residues. Similar tests conducted with red-tailed hawks resulted in a finding of no toxic effects and that in fact, the hawks gained weight.

51. The 5 mg/kg of 1080 administered to the coyotes in the tests referred to in finding 49 was approximately 31 times the estimated LD_{100} of 0.16 mg/kg and a SLD bait of 5 mg 1080 would contain approximately three SLD_{100} doses for a 10 kg coyote. It has been estimated that a coyote puncturing a toxic collar would receive a maximum of 10 mg 1080 or approximately 6 LD_{100} doses for a 10 kg coyote. It is therefore unlikely that the carcass of a coyote killed by a SLD bait containing 5 mg 1080 or by a toxic collar would represent a hazard to raptors.

52. One of the difficulties in determining the primary and secondary hazards to non-target species from the use of 1080 has been the lack of reliable methods of measuring low levels of 1080 residues in tissues of animals suspected of being poisoned. The development and refinement of more sensitive testing methods, e.g., gas chromatography

with electron capture detection and mass spectrometry, have enabled the detection of less than 0.1 ppm 1080 in one gram samples. These methods will facilitate more accurate assessment of the hazards of 1080. Although current test methods can detect fluorocitrate, fluorocitrate would not be detected in a test for 1080 residues.

53. In other efforts to determine possible secondary poisoning hazards from the carcasses of coyotes poisoned by 1080, the FWS analyzed 1080 residues in tissues of coyotes which died after puncturing toxic collars. It was determined that the average 1080 concentration in muscle tissue of these coyotes was 0.31 ppm. Ten magpies[7/] were confined with skinned carcasses of coyotes that died after puncturing toxic collars with no other food available. Although four birds died and one of the four contained 1080 residues, it was concluded that these birds starved to death. The other six birds apparently showed no symptoms of 1080 poisoning. Expert testimony is to the effect that the metabolic effects of fluorocitrate mimic diabetes mellitus, which is a quasi-starvation state, and that the birds may well have died of 1080 poisoning rather than starvation.

54. In other tests, a coyote was given a massive overdose of 1080 (300 mg or the contents of a toxic collar), a LD_{100} being approximately 1.8 mg. This coyote was dissected soon after death and the soft tissue fed to one group of magpies for seven days and another group of magpies for two days. Even though the coyote tissue contained substantially

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7/ A LD_{50} for a magpie is in the range of 0.6 mg/kg to 1.3 mg/kg.

higher 1080 residues than were found in any coyote killed by puncturing toxic collar, no evidence of intoxication was observed. There is evidence that foxes died after feeding on kangaroo rats poisoned by 1080 used as a rodenticide and that coyotes died after feeding on ground squirrels poisoned by oats treated with 1080. Nevertheless, the FWS tests constitute substantial evidence that the risks of secondary poisoning to non-target wildlife from use of the toxic collar are not significant.[8/]

55. The citric acid or Kreb cycle is the final mechanism for converting food into energy in plants and animals. Sodium fluoroacetate, when ingested, is metabolized into fluorocitrate, which inhibits activity of the enzyme aconitase and deprives cells of energy. This enzyme inhibition results in the blocking of the Kreb cycle, which secondarily blocks glucose metabolism, a lesser energy producing process. Blockage of these processes causes the energy supplied to be reduced to the point where cellular permeability barriers are destroyed, resulting in loss of function and finally cellular death. The breakdown in intracellular processes eventually results in the appearance of gross organ or organ system disorders. Death may result from gradual cardiac failure or ventricular fibrillation, or progressive depression of the central nervous system with either cardiac or respiratory

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8/ Defenders emphasize the latency period from the time of ingestion of 1080 to the onset of toxic effects and the tendency of poisoned animals to hide as reasons why all animals and birds poisoned by 1080 bait stations were unlikely to be found and reported. These facts would also seem to make it less likely that the carcasses of poisoned birds and animals would be available to scavengers.

failure as the terminal event or respiratory arrest following severe convulsions. Death in carnivores is thought to be the result of central nervous system disorders.

56. Tests with rats treated with fluorocitrate have demonstrated marked kidney damage. Tests with rats wherein fluorocitrate was administered in drinking water in concentrations as low as 6 ppm for seven days have also shown morphological damage to testes. This test showed that there was some regeneration, although recovery was not complete, after 21 days. Rats given sub-lethal doses of fluorocitrate have been shown to grow normally for seven months and then to survive an intraperitoneal dose of fluorocitrate which would normally have been fatal. This indicates that a certain tolerance for fluorocitrate may be developed. Other studies have shown that repeated sub-lethal doses of monofluoroacetate have increased the tolerance of some species, e.g., golden eagles, rats, mice and possibly rhesus monkeys. Repeated sub-lethal doses of monofluorocitrate administered to dogs, guinea pigs, rabbits and mallard ducks, however, have accumulated to lethal levels. The reason more data isn't available on whether fluoroacetate accumulates in an animal is because it is so toxic.

Issue 6 - Human Safety

57. Sodium monofluoroacetate is a white, odorless, powdery, fluoro-organic salt similar in appearance to flour, powdered sugar or baking powder. It is essentially tasteless having only a mild, salty, sour or vinegar taste to individuals. It is highly soluble in water, but relatively

insoluble in organic solvents such as kerosene, alcohol, acetone, or in animal and vegetable fats and oils. Sodium fluoroacetate is absorbed through the gastrointestinal tract, through open wounds and the pulminary epithelium (the lining covering air passages in the lungs). It is not considered to be absorbable through intact skin. Monofluoroacetate, in general, is chemically stable due to the strength of the carbonfluorine bond. Sodium fluoroacetate poisoning in canines is characterized by a latency period from one-half hour to two hours after ingestion, which is related to the metabolic processes described previously (finding 55). In humans the latency period may be as long as five hours and death of any species is usually within 24 hours after ingestion.

58. Reported deaths attributable to 1080 have been in connection with its use as a rodenticide rather than as use as a predacide. There is testimony that 1080 poisonings are difficult to diagnose and that many poisonings are likely to go unreported. Although two witnesses who apparently suffered adverse effects from 1080 poisoning testified at the hearing, the preponderance of the evidence establishes that individuals handling 1080 in connection with the preparation of baits or toxic collars do not suffer ill effects provided proper precautions are taken.

59. Related to both environmental and human safety is the matter of possible misuse of Compound 1080. There is evidence that it was not possible to monitor or control the application of strychnine drop baits and it

may be assumed that similar difficulties would be incurred with the use of 1080 SLDs. These risks are real. The decision herein, however, limits the use of 1080 SLDs to government employees and it is considered that this restriction substantially reduces the possibility of misuse. Although the record establishes that there were violations of regulations and policies concerning the placement and disposal of 1080 bait stations, it also establishes that regulations and policies relating to, e.g., covering of strychnine drop-baits and removal of large-baits from higher elevations, were impractical and could not be followed in some instances. The use of such large-baits is not, however, being approved by this decision. Because the use of the toxic collar requires control of livestock, it is impractical to limit its use to government employees. Ranchers desiring to use the collars must be certified applicators and it is, of course, possible that some misuse will occur. This possibility is not a sufficient reason for refusing to register the use of 1080 in toxic collars.

60. Efforts to develop an antidote for sodium fluoroacetate poisoning have been unsuccessful to date and treatment is symptomatic, meaning that there is no specific treatment.

61. The only evidence in the record as to the use of smear posts as a delivery mechanism for Compound 1080 in the control of coyotes is testimony concerning three posts constructed for experimental purposes in the winter of 1956-57. Use of the posts would be in connection with specific attractants and lures and there is no data as to the composition and content of these lures and attractants. Although there is evidence from which it might be concluded that smear posts

are an effective method of coyote control and that their use involves minimal risks to non-target wildlife, it appears that smear posts are not intended for the purpose of removing specific depredating coyotes, but are instead intended as a general population suppressing mechanism.

Conclusions

1. The Administrator properly determined that reconsideration of the 1972 suspension and cancellation order involving uses of Compound 1080 for predator control (PR 72-2, March 9, 1982) was warranted and to hold a public hearing in accordance with 40 CFR 164.131.
2. Toxic collars and single-lethal dose baits (SLDs) as delivery mechanisms of Compound 1080 for predator control were either not available or not used in 1972 and consequently, were not considered in the 1972 order. Accordingly, all evidence concerning such uses may properly be considered substantial and new within the meaning of 40 CFR 164.131(a) and 164.132(a).
3. The evidence establishes that Compound 1080 when used in the toxic collar and in SLDs as authorized herein can be and is an effective method of predator control for the removal of particular depredating coyotes or foxes.
4. Among the concerns of the Administrator when the suspension and cancellation order was issued was the impact of the use of Compound 1080 and other toxicants on non-target wildlife and especially on endangered species. The Administrator was concerned about primary as well as secondary poisoning of non-target species. Although the

possibility of secondary poisoning cannot be ruled out, the evidence establishes that Compound 1080 when used in the toxic collar and in SLDs as authorized herein does not pose a significant risk to non-target wildlife.

5. Although there is no antidote for Compound 1080 poisoning and treatment is symptomatic, the record establishes that with appropriate precautions Compound 1080 can be used for predator control as authorized herein without significant or unreasonable risks to human health and the environment.

6. The record does not establish that overall losses of sheep or lambs to predators have increased since 1972. Nevertheless, for individual producers predation remains a significant cause of loss, which available alternative means of predator control are not consistently effective in reducing at costs which are reasonable and feasible.

7. Compound 1080 when used in large-bait stations as a means of predator control has not been shown to accomplish its intended purpose, that is, a reduction in area or regional coyote populations followed by a reduction in predation losses. Although no generalized reduction in the populations of non-target species from the use of 1080 large-baits has been shown, the evidence does not establish that this conclusion is applicable to endangered species, which was a major concern underlying the suspension and cancellation order. The burden of proof in these respects is clearly on the applicant. The hazards of 1080 large-baits to endangered or threatened species are clearly substantial. In view thereof and in view of the fact that sheep losses to predators on an overall basis have not been shown

to have increased since 1972, it is concluded that the risks do not outweigh the benefits and modification of the 1972 order with respect to this use of Compound 1080 is not required. Accordingly, the application for registration of Compound 1080 in large-bait stations will be dismissed.

8. Although the use of Compound 1080 in smear posts as a means of predator control was not considered in the 1972 suspension and cancellation order, for all that appears smear posts are also intended for the reduction of general coyote populations. The burden of proof being on the applicant, the application for this use will be dismissed as it has not been shown to be effective for that purpose.

9. The bait delivery unit (BDU) is not a delivery mechanism of Compound 1080 for predator control covered by the Administrator's notice (46 FR 59,622, December 7, 1981) or the amendment thereof (47 FR 10,288, March 10, 1982). Consequently, this delivery mechanism may not be considered or the use thereof authorized by this decision.

10. Substantial new evidence exists with respect to the use of Compound 1080 in the toxic collar and in single lethal dose (SLD) baits as means of predator control and modification of the 1972 order to permit these uses of Compound 1080 for predator control is required.

Discussion

Because no party has argued that the Administrator's determination that reconsideration of the 1972 suspension and cancellation order was warranted and to hold a public hearing in accordance with 40 CFR 164.131 was improper, it is not necessary to address this question.

Although, as stated at the outset of this opinion, no part of the decision is dependent upon the validity of the ALJ's ruling that the decision

as to whether the evidence required reversal or modification of the 1972 order would be made upon the entire record, this matter warrants mention.

Counsel for EPA have attempted to compartmentalize evidence properly admissible and for consideration in this proceeding. For example, while contending that the principle of finality precludes consideration of pre-1972 evidence concerning fundamental issues such as the effectiveness of 1080, counsel state that it may be appropriate to consider pre-1972 evidence related to such narrow issues as the predator loss rates and the size of the livestock industry. It is contended that the Administrator's decision in the M-44 proceeding (FIFRA Docket No. 382, September 16, 1975), to the effect that evidence available prior to 1972 could be considered in determining the availability of an antidote for sodium cyanide, is not precedent for consideration of pre-1972 evidence, because the 1972 finding that there was no antidote was erroneous and not supported by the record. Counsel argue that this ruling was proper, citing the rule concerning an agency's inherent power to correct its mistakes.[9/] It is asserted, however, that an agency's power to correct its mistakes does not extend to changing a basic decision or policy, e.g., suspension and cancellation of the use of 1080 as a predacide. Under this view the more egregious the mistake, the less power the agency has to correct it. Surely the Administrator has the authority to inquire into all findings

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9/ While the absence of an effective antidote is among the criteria that may trigger a Rebuttable Presumption Against Registration (RPAR) in accordance with 40 CFR 162.11, it is clear that the lack of an antidote is not in and of itself sufficient reason for either denying an existing application for registration or cancelling an existing registration. Accordingly, the existence or lack of an antidote is not a crucial or controlling finding and the decision in the M-44 proceeding would almost certainly have been the same absent an antidote for sodium cyanide.

upon which the 1972 order was based should it be considered appropriate or desirable to do so.

Counsel fail to explain how issues such as whether the risk of primary and secondary poisoning were overestimated in 1972 can be addressed absent consideration of pre-1972 evidence concerning the impact of 1080 on non-target wildlife. Moreover, by focusing on the "newly discovered evidence" requirement of 164.131(a), which is the requirement to hold a hearing, insufficient attention is given to the language of 164.132(a) providing in pertinent part "The determination of these issues shall be made taking into account the human and environmental risks found by the Administrator in his cancellation or suspension determination and the cumulative effect of all past and present uses, including the requested use, * * *." (emphasis supplied). The cumulative effect of all past and present uses can hardly be properly addressed by a rigid limitation concerning evidence available only since 1972.

Counsel's concern that scarce agency resources will be wasted in relitigating issues previously litigated and determined is understandable, but unwarranted. Since the issuance of the suspension and cancellation order in 1972, the Agency has previously denied applications for registration of 1080 and it is clear that applications deemed not meritorious may be denied in accordance with 40 CFR 164.131 without a public hearing. This provides ample authority to preclude the necessity of holding a public hearing where substantial new evidence which may materially effect the prior suspension or cancellation order in accordance with the cited section has not been submitted. Moreover, even if a public hearing is granted, the Administrator controls the issues to be adjudicated therein

in accordance with 40 CFR 164.131(c) and has ample discretion to preclude the re-opening of issues considered to have been properly determined in prior proceedings. For example, the Administrator might have limited the issues to 1080 delivery mechanisms not considered in the 1972 order, but appears to have chosen instead that all issues in connection with the use of 1080 as a method of predator control would be adjudicated.

The Administrator should not and cannot be required to ignore the fact that although the 1972 order might have been contested in administrative or judicial proceedings, no such contest was instituted, and that findings supporting the 1972 order remain highly controversial. Under these circumstances, rigid principles of finality appropriate for the courts are not applicable and inasmuch as the Administrator determined that all issues bearing on the 1972 order would be adjudicated herein, the Administrator and the ALJ may, after evidence meeting the criteria of 164.131(a) has been presented on the record, and consistent with 40 CFR 164.132, appropriately consider the entire record in determining whether reversal or modification of the 1972 order is required. Be that as it may, the 1080 delivery systems authorized herein, the toxic collar and SLD baits, were not considered in the 1972 order and were beyond the scope of that proceeding. Accordingly, there can be no question, but that evidence whether pre- or post-1972 is properly for consideration.

It has been contended that the testimony of Mr. Harry Loats, a witness for USDA who sponsored a mathematical model projecting the

effectiveness of Compound 1080 large bait stations in reducing predator losses of sheep and effects on non-target wildlife populations based on data from the use of such stations in Wyoming during the year 1976-77, should not have been admitted or if properly admitted, should not be given any weight, because the model was not produced for use by counsel in cross-examination. Mr. Loats' testimony has not been found to be persuasive for reasons, among others, that the model failed to consider immigration of coyotes, possible "bait shyness" and assumed that the resource base remained fixed. The objections, however, are rejected as lacking in merit essentially for the reasons set forth in the USDA Reply Brief, that is, counsel had access to Texas A&M University (TAMU)[10/] and other data upon which the model was based, but failed to make use of such data. Counsel objected to having the analysis run and displayed on the microcomputer present in the hearing room and are not in a position to complain if such a showing might have thrown additional light on operation of the model and suggested additional questions for cross-examination. Moreover, careful examination of the transcript reveals that although Mr. Loats did state that the model (computer codes) was considered to be proprietary, he did not flatly refuse to produce it, but stated that he would have to consider the matter. It appears that Mr. Loats did not fully understand the nature of a protective order that might have been issued by the ALJ in order to protect the data from unauthorized disclosure. In any event, the matter was not pursued by counsel and may not now be used as a basis for objecting to Mr. Loats' testimony.

10/ USDA asserts that the TAMU data were available to counsel for EPA and Defenders as early as April 1982.

The evidence establishes that Compound 1080 large-baits are intended as a general coyote population suppression technique from which it is assumed that benefits in the form of reductions in predation losses will flow. Wyoming, the applicant for registration of 1080 large-baits, has not established that use of such baits reduces coyote populations over large areas or that reductions in predator losses of livestock result from such use. In short, the effectiveness of 1080 large-baits as a predator control technique has not been established. This being so and the risks to at least endangered and threatened species from such uses not having been shown to have been overestimated in 1972, the applicant has not met its burden of proving that the benefits outweigh the risks. 11/ This conclusion is buttressed by the fact that overall losses of sheep and lambs to predators have not been shown to have increased since 1972. Accordingly, modification of the 1972 order with respect to 1080 large-baits is not required and the application for the registration of 1080 in large-baits will be dismissed.

Different considerations apply to the use of 1080 in toxic collars and in single-lethal dose (SLD) baits. Toxic collars are clearly for the removal of particular depredating coyotes and foxes and the findings herein establish that 1080 in the toxic collar can be used without unreasonable risks to health and the environment. If scattered or spread over wide areas, 1080 in SLD baits might also be used as a general coyote population suppression technique. Such use is open to the same objections as 1080 in large-baits, i.e., its effectiveness has not been

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11/ It is a well established principle that where the evidence does not preponderate in favor of one conclusion or another, the party having the burden of proof on that issue cannot prevail.

proved. The limited use of 1080 in SLD baits authorized herein is based on testimony that such baits used in conjunction with appropriate lures and scents can be effective in removing particular depredating coyotes without undue risks to non-target species. It is concluded that the hazards of 1080 in toxic collars and SLD baits as authorized herein are sufficiently minimal that broad prohibitions on their use within the range of endangered species are not required. The result would, of course, be different, if, for example, it was shown that endangered species such as the San Joaquin kit fox were in the area and that they might attack collared livestock or be attracted by scents designed for coyotes.[12/]

For all that appears, use of 1080 in the smear post is intended as a general coyote population suppression technique and this application is being dismissed for the same reason as the application for use of 1080 in large-baits, i.e., it has not been shown to be effective for the intended purpose.

Wyoming, et al. have contended that the evidence is sufficient to register the bait delivery unit (BDU) tested by Dr. Howard (note 1, supra) as a means of predator control. It is well settled, however, that the issues in a suspension or cancellation proceeding may not be expanded to include uses or restrictions not proposed in the notice issued by the Administrator. Shell Oil Company, et al., FIFRA Docket Nos. 401, et al. (Decision on Interlocutory Appeal, April 9, 1979).

12/ Because Executive Order No. 11643, February 8, 1972 (37 FR 2875), prohibiting the use of toxicants on Federal lands for predator control has been revoked (47 FR No. 20, at 4223, January 27, 1982), no prohibition of the use of toxic collars and SLD baits as authorized herein on Federal lands is being imposed.

The rationale for this decision is that under the statute only the Administrator or his delegate can issue a notice of intent to cancel or suspend and that such a notice necessarily sets the standard of relevance for the conduct of the hearing. The instant hearing is being conducted under Section 6 of the Act and the same reasoning is applicable. Accordingly, the ALJ has no authority to direct that the BDU be registered as a means of predator control.

The use restrictions for 1080 in SLD baits imposed herein bear little relationship to those proposed by the applicants. Stringent limitations are being placed on the use of such baits, however, because the evidence justifying their use is based on effectiveness in removing particular depredating coyotes. Use restrictions (Attachment C) are considered to be fully consistent with that purpose.

No effort has been made to deal with all of the multitudinous proposed findings of fact and arguments raised by the parties. The findings herein are deemed to be fully supported by the record and the conclusions are considered to be required by the findings.

Conclusion[13/]

The applications for registration or emergency exemption for the use of 1080 in large-bait stations and smear posts are dismissed.

13/ The notice of hearing issued by the Administrator specified that the ALJ would issue an initial decision. Unless appealed in accordance with 40 CFR 164.101, or unless the Administrator decides to review the same sua sponte as therein set forth, this decision will become the final decision of the Administrator in accordance with 40 CFR 164.90.

Applications for use of 1080 in toxic collars and in SLD baits in accordance with the restrictions set forth (Attachment C) will be granted. 14/

Dated this 22nd day of October 1982.

Spencer T. Nissen
Administrative Law Judge

Attachments A, B and C

14/ It is clear that this decision does not constitute registration for the uses authorized. Applications for registration will be processed in accordance with and must conform to usual procedures and regulations.

ISSUES TO BE CONSIDERED

1. Predation loss rates

Whether available data demonstrate that predation loss rates have increased since 1972:

(a) for sheep
(b) for cattle
(c) for goats

Whether current losses to predation account for a greater percentage of total losses than before 1972:

(a) for sheep
(b) for cattle
(c) for goats

Whether coyotes, foxes, and/or feral dogs are significant causes of predation.

2. Efficacy

Whether use of 1080 in toxic collars, single-lethal dose baits, and/or large-bait stations is likely to reduce predation:

(a) in open range grazing of livestock
(b) in fenced pasture grazing of livestock

If use of 1080 is likely to reduce predation, by how much?

3. Alternatives

Whether non-chemical methods of predator control, e.g., denning, shooting, trapping, and snaring, are generally effective in reducing predation.

Whether the M-44 device using sodium cyanide is generally an effective alternative to the use of 1080.

Whether non-lethal chemical methods of predator control, e.g., taste aversion chemicals, reproduction inhibitors, and repellants, are effective.

Whether husbandry practices, e.g., use of guard dogs, shed lambing, and additional herders, are generally effective in reducing predation.

With respect to all alternatives to 1080 predacides, whether there is any situation in which no currently available alternative is satisfactory, e.g., because of its cost or because of limitations on its use due to characteristics of the control method.

4. Benefits

What are the national, regional, and local effects of predation on the livestock industry and the general economy?

What impact would the availability of 1080 have on the profits of individual ranchers and the livestock industry, as a whole?

5. Environmental Safety

Whether available data indicate that use of 1080 in toxic collars and/or SLD baits would be likely to result in lower direct or indirect exposure to non-target wildlife than resulted from use of 1080 large-bait stations.

Whether available data indicate that the risk of primary and/or secondary poisoning was overestimated in 1972.

6. Human Safety

Whether use of 1080 in toxic collars, SLD baits, and/or large-bait stations is likely to result in human injury or death.

Whether an antidote and/or medical treatment exists which effectively counteracts the effects of 1080 poisoning.

7. Use Restrictions

Whether prohibition of the use of 1080 in the range of certain protected and/or endangered species, e.g., the San Joaquin kit fox or California Condor, would effectively reduce or eliminate the risks to those species, and what effect would such a prohibition have:

(a) in those areas
(b) on the livestock industry as a whole

Whether restriction of the use of 1080 to trained Government employees or certified applicators would reduce human and environmental risks without substantially reducing benefits.

Whether a requirement that livestock predation be verified by state employees before use of 1080 was authorized would limit use of 1080 to situations in which it was most likely to provide significant benefits.

Whether restrictions on the sites of use, the timing of use, or the delivery mechanism would reduce risks without substantially reducing the benefits.

Whether users should be required to post warnings in the vicinity of SLD baits and large-bait stations.

Whether users should be required to check toxic collars, SLD baits, and bait stations periodically.

Whether users should be required to keep records of their use of 1080, and if so, what records.

Whether other restrictions would reduce risks without substantially reducing benefits.

Table of Contents

Findings of Fact

Issue 1(a) (Attachment A)

1. The Cain Committee, hereinafter Cain or Cain, et al., whose report was the primary basis for the 1972 order suspending and cancelling registrations of Compound 1080 for the control of predators, referred to a study conducted by Utah State University, hereinafter the Nielsen-Curle study, on a 20 percent sample of Utah's sheep ranchers.[1/] The ranchers were asked to estimate their total losses during the Fiscal Year 1968-69 and to report the number of sheep lost to predators. The result showed an average predator loss of 61 ewes and lambs per 1,000 ewes, of which approximately 2/3 were to lambs. Data on the lamb crop per 1,000 ewes were not stated, but depending on that data, predator losses were 2 percent of the ewes, 4 to 5 percent of the lambs and perhaps 3 percent of the total flocks. Coyotes were reported as being the major cause of predator loss.

2. Cain, et al. also referred to estimates compiled by the Director of the Division of Wildlife Services for the State of Utah during the period of the early 1940's to 1965, referred to as the Owen Morse estimates. These estimates were compiled from yearly reports furnished by a leading sheep rancher in each county, who in turn contacted sheepmen in his county for data on sheep losses. Data reported were in terms of actual numbers of sheep lost and not

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1/ Pursuant to a motion filed by counsel for EPA, which was not opposed by any party, official notice is taken of the record upon which the 1972 suspension and cancellation order was based.

percentages. By dividing the total number of sheep in the state as reported by the Federal Crop and Livestock Reporting Service (CLRS), Cain arrived at percentages of losses to predation in the range of 7-10 percent in the late 1940's and losses of 2 to 4 percent since that time. Cain, et al. observed that this result was in close agreement with the Nielsen-Curle Study for 1969.

3. The Division of Wildlife Services compiled loss data, referred to as the Reynolds and Gustad Summaries, as reported by the Crop and Livestock Reporting Services for the States of Montana, Wyoming, Colorado and Texas. In the course of regular annual surveys, conducted by mail questionnaire, stockmen in the listed states were asked to report the numbers of sheep lost to predators during the years 1966 to 1969. Losses reported as a percentage of all sheep and lambs ranged from 3.6 percent in Texas in 1967 to 7.9 percent in Wyoming in 1969. Extrapolating this data to 16 western states, Reynolds and Gustad concluded that predators were responsible for 24.8 percent of all sheep and lamb deaths or 5.3 percent of the total inventory.

4. Cain, et al. also had available USDA Forest Service estimates which are based on records maintained by district rangers as to the numbers of livestock placed in national forests at the beginning of each grazing season and the number removed at the end of the each season. The difference between the two figures constitutes the

total loss to all causes during the season and the stockmen involved were asked to assess, as nearly as possible, the cause of losses, including those to predators. Results, compiled for Utah National Forests, showed losses to predators ranging between 0.4 and 1.4 percent of herds grazed. Because the grazing season on national forests last only two to three months of the year and because losses during other seasons, especially winter, which may be substantial are not included, Cain concluded that these figures agreed reasonably well with the Nielsen-Curle and Owen Morse estimates for the entire year.

5. Cain, et al. also had available data on inventories of sheep as of January 1 of each year, lamb crop and total losses to all causes as reported by USDA's Statistical Reporting Service (SRS). These data are compiled through mail questionnaires and do not attempt to breakdown losses to cause. Total losses thus reported varied between 9 and 11 percent in Utah (individual years ranging between 7.9 and 14.9); between 7 and 8 percent in Idaho (6.1 and 16.1 for extremes); and between 8 and 9 percent in Wyoming (5.4 and 13.8 for the extremes) during the same period. Cain, et al. regarded these total reported losses as setting a ceiling on predation losses. Based on an analysis of the Nielsen-Curle data, the committee concluded that most operators experienced minor losses in terms of percentages (with 80 percent of the total falling in the two lowest classes), while only a small fraction of the operators experienced heavy losses.

6. Dr. Maurice Shelton, an Animal Scientist of Texas A&M University, Texas Agricultural Experiment Station and a witness for Wyoming, et al., authored an article "Predator Losses In One Flock of Sheep and Goats," which reported on losses to flocks maintained by the Texas Agricultural Experiment Station. Sheep losses to predators during the five-year period 1967 through 1971 averaged approximately 3.4 percent of the inventory, while losses to all causes averaged 9.27 percent of the inventory. These percentages include losses to lambs, which were considered essentially post-marking as lambing occurred in confinement. Predator losses as a percent of all losses averaged 36.30 percent, the highest being 42.14 percent in 1971 and the lowest being 28.32 percent of all losses in 1969. For the most part, animals were observed and losses recorded on a daily basis. Coyotes or possibly a hybridization of coyotes and the red wolf were the principal predator,[2/] this hybridization being considered a possible explanation for the fact adult sheep were readily killed, while coyotes, which are not hybrids, tend to prey more heavily on lambs. Predation losses were stated to be considerably underestimated because, unless the carcass was observed shortly after the kill, it would be scavenged by vultures, making impossible accurate determination of the cause of death. These losses were incurred despite intense efforts to prevent predation and predation control efforts at a level

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2/ Mr. Roy McBride (finding 85, infra) considered this cross-breeding or hybridization as a possible reason for the extinction or near extinction of the red wolf.

greater than the average producer could afford. Although 1080 was apparently not used in this area prior to 1972, strychnine and sodium cyanide, the latter in the coyote getter, were used.

7. The foregoing makes it clear that data on pre-1972 predation losses to sheep are fragmentary and that no one loss figure is possible. The most reasonable conclusion, however, is that predation losses of sheep are somewhere between 3.6 and 7.9 percent as reported in the Reynolds and Gustad summaries. Cain, et al. had questioned the Reynolds and Gustad data because it implied that predation was a major cause of total losses, which was questioned, because of the statistical distribution of predation losses, i.e., only a small proportion of the producers suffering major predation losses.

Post-1972

8. In 1975, a mail questionnaire to determine sheep and lamb losses to predators in 15 western states in 1974 was conducted by the Statistical Reporting Service of the U.S. Department of Agriculture (Agricultural Economic Report No. 369, April 1977, hereinafter Gee, et al.). Of 28,000 questionnaires mailed, responses were received from 8,910 farmers and ranchers or 32 percent representing

all sizes and types of sheep operations and all geographical areas of 15 western states. To insure reliability, a sample of those not responding was contacted by mail and personal interview. This was the most comprehensive survey of sheep and lamb losses to predation ever conducted. Predation, principally by the coyote, was the major cause of sheep and lamb deaths during 1974, losses attributed to coyotes numbering 728,000 lambs and 229,000 adult sheep, representing a third of the total lamb deaths to all causes and a fourth of the adult sheep deaths. Lambs were attacked much more than adult sheep, overall losses to coyotes being 8 percent of the lambs and 2.5 percent of the sheep. Loss rates of lambs and sheep to coyotes were highest in states with public range grazing and mountainous terrain while comparatively few deaths from coyotes were incurred in the States of Kansas, Nebraska and North and South Dakota. Predation losses other than to coyotes, constituted 3.3 percent of lambs and 0.9 percent of sheep.

9. Gee, et al. reported that lambs lost to predators constituted 11.4 percent of lambs born and 49.3 percent of losses of lambs to all causes. Adult sheep lost to predators totaled 3.4 percent of the January 1 inventory and constituted approximately 33 percent of

deaths to all causes. Gee, et al. further indicated that lamb loss rates to all causes have been increasing, while sheep loss rates have been declining slightly. The Gee report stated that while most of the large scale sheep operators reported losses from less than 5 percent to more than 20 percent, many small scale producers had no predation problems.

10. Mr. Gary Littauer, a wildlife management specialist for the New Mexico Department of Agriculture and a witness for Wyoming, et al., summarized sheep and lamb losses before and after 1972 for eight states in which comparable data were available. Relying on data collected from surveys by the Colorado Department of Agriculture as reported in Gee, et al., which indicated lambs lost to predators as a percent of lambs born were 8.2 in 1966, 7.2 in 1970 and 7.7 percent in 1971 as compared to 16.5 percent in 1974 as reported by Gee, et al., Mr. Littauer concluded that lambs lost to predators more than doubled. Adult sheep lost to predators as a percent of stock sheep on hand as of January 1 of each year in Colorado were 2.5 percent in 1966, 2.2 percent in 1970 and 3.5 percent in 1971. The comparable Gee figure for adult sheep lost to predators for the year 1974 in Colorado was 3.5 percent.

11. Lambs lost to coyotes in Idaho as a percentage of lambs born totaled 3.1 percent in 1970-71, 3.2 percent in 1972-73 and 5.2 percent in 1974, the latter based on Gee, et al. Ewe losses attributed to predation were 2.6 percent of inventory in 1970-71 and 2.8 percent in 1972-73. These figures are to be compared with the 1.8 percent of stock sheep lost to coyotes in Idaho in 1974 (2.0 percent lost to predators) reported by Gee, et al. The 1970-71 and 1972-73 loss data are based on a study of range sheep operators, which presumably would have higher loss rates than farm flock operations.

12. Lambs lost to predators in Montana as to a percent of lambs born totaled 7.8 percent in 1968, 6.1 percent in 1969 and 17.5 percent in 1974. The majority of the losses (13.3 percent) in 1974 were to coyotes. Adult sheep lost to predators in Montana for the above years as a percentage of stock sheep on hand as of January 1 constituted 1.6 percent in 1968, 1.5 percent in 1969 and 6 percent in 1974. All of these figures appear in Gee, et al., the source of the loss to predators for 1968 and 1969 being the Montana Crop and Livestock Reporting Service.

13. For Nebraska, lambs lost to predators as a percent of lambs born totaled 7 percent in 1971, 8 percent in 1972, 8.7 percent in 1973 and 1.8 percent in 1974. Adult sheep lost to predators as a percent of stock sheep on hand as of January 1 totaled 3 percent in 1971, 3.5

percent in 1972, 4.6 percent in 1973 and 1 percent in 1974. All of these figures are from Gee, et al., the source of the loss figures for 1971, 1972 and 1973 being Nebraska Livestock Loss Reports (1972-74).

14. In New Mexico, lambs lost to predators as a percent of lambs born were 5.4 percent in 1972, 5.6 percent in 1973, 5.18 percent in 1975 and 7.35 percent in 1976. These results, which are based on surveys of 99 ranches in southeastern New Mexico (81 ranches in 1975 and 75 ranches in 1976) are limited to post-docking losses and are to be compared with the 17.1 percent loss rate as a percentage of lambs born in 1974 reported by Gee, et al. Adult sheep lost to predators as compiled by Mr. Littauer, based on surveys sponsored by the New Mexico Woolgrowers, show a predation loss rate of 2.5 percent in 1970, 3.5 percent in 1971 and 1972, 6.1 percent in 1973 and 9.6 percent in 1974. These data were collected from 33 ranches in a survey sponsored by the New Mexico Woolgrowers, Inc. in which the ranchers were asked to report on predation losses for the preceding five years. These results are to be compared with the loss rate of adult sheep to predators reported by Gee for New Mexico in 1974 of 5.9 percent.

15. Losses of lambs to predators as a percentage of lambs born in South Dakota were 1.2 percent in 1963, 2.3 percent in 1970 and 3 percent in 1974. Losses of adult sheep as a percentage of stock

sheep one year older on hand as of January 1 were 1 percent in 1966, 1.1 percent in 1970 and 0.4 percent in 1974. All of these figures were obtained from Gee, et al., 1963 and 1970 results being obtained from South Dakota Livestock and Poultry Losses (1970). A table compiled from USDA SRS data showing losses of sheep and lambs to all causes in South Dakota for the years 1960 to and including 1981 shows that combined losses ranged from a low of 6.6 percent in 1961 to a high of 9.8 percent in 1967, were 9.7 percent in 1972, and ranged from a low of 7.3 percent in 1973 to a high of 10.0 percent in 1977, declining to 8.0 percent in 1981. Lamb deaths to all causes as a percentage of lambs docked ranged from a low of 7.3 percent in 1961 to a high of 13.0 in 1971, were 12.5 percent in 1972, and ranged from a low of 10.7 percent in 1973 to a high of 15.4 percent in 1979, declining to 11.8 percent in 1981. Losses of sheep to all causes for the years 1973 through 1980 are lower than for the years 1965 through 1972. Although he acknowledged that he had no data on the percentage of lamb losses attributable to coyotes, Mr. Roger Pearson, Secretary of the South Dakota Department of Agriculture, contended that it was logical to attribute increased lamb losses since 1972 to predators.

18. Lambs lost to predators as a percentage of lambs born in Texas totaled 4.5 percent in 1967, 7.3 percent in 1971, 5.3 percent in 1972 and 8 percent in 1973 and 1975. This data was collected and compiled by the Texas Crop and Livestock Reporting Service and, with the exception of the data for 1967, is also contained in Gee, et al. Gee, et al. reported lamb losses in Texas to predators as a percentage of lambs born totaled 11.8 percent in 1974 of which 5.8 percent of lambs born were lost to coyotes. This corresponds closely with the 11.4 percent of lambs born lost to predators as reported by the Texas Crop and Livestock Reporting Service. Although lambs lost to predators as a percent of lambs born as reported by the Texas Crop and Livestock Reporting Service totaled 8 percent in 1975, Mr. Littauer revised this figure upward to 11.0 percent based on data contained in Texas Sheep and Goat Death Losses and Marketing Practices (1979) and USDA SRS data on lamb crops for the years 1967 and 1971-78. Mr. Littauer made a similar calculation and derived lamb losses as a percent of lambs born of 12.3 percent in 1976, 9.2 percent in 1977 and 14.9 percent in 1978. The losses of adult sheep as a percent of stock sheep one year or older on hand as of January 1 as reported by the Texas Crop and Livestock Reporting Service totaled 1.9 percent in 1967, 3.1 percent in 1971, 1.7 percent in 1972 and 2.4 percent in 1973 and 1.7 percent in

1975. These figures are contained in Gee, et al. and are to be compared, with the Gee reported adult sheep lost to predators in Texas as 2.9 percent of stock sheep in 1974.

17. The Wyoming Crop and Livestock Reporting Service has collected and reported data on the percent of lambs docked lost to coyotes since 1965. This data as compiled by Mr. Littauer shows a loss rate ranging from 3.31 percent in 1968 to 6.43 percent in 1972, increasing to 8.28 percent in 1973 and 9.29 percent in 1974. Gee, et al. report lamb losses to predators as a percent of lambs born of 11.7 percent in 1974, of which 9.3 percent were to coyotes. Based on a publication, Wyoming Agricultural Statistics, Gee, et al. report lambs lost to predators as a percent of lambs born totaling 5.6 percent in 1966, 4.6 percent in 1968, 6.8 percent in 1969, 7.7 percent in 1970, 7.4 percent in 1971, 7.9 percent in 1972, 10 percent in 1973 and 10.8 percent in 1975. Wyoming USDA SRS data showed lamb losses to coyotes as a percentage of lambs docked totaling 9.13 percent in 1975, 8.2 percent in 1976, 7.10 percent in 1977, 7.07 percent in 1978 and 11.03 percent in 1979. Adult sheep lost to predators as a percent of stock sheep on hand as of January 1 of each year as reported by the State Reporting Service and the Wyoming Crop and Livestock Reporting Service were 2.3 percent in 1966, 1.6 percent in 1968, 2.3 percent in 1969, 2.2 percent in 1970, 1.7 percent in 1971, 1.8 percent in 1972, 2.9 percent in 1973 and 2.8 percent in 1975. The Comparable Gee, et al. figure for 1974 was 3.5 percent.

18. Mr. Larry Bourret, Director of Government Affairs for the Wyoming Farm Bureau Federation, a former commissioner of the Wyoming Department of Agriculture and a witness for AFBF, prepared a table of sheep and lambs lost to all causes in Wyoming for the years 1971 through and including 1980 from data obtained from the Wyoming Crop and Livestock Reporting Service. Dividing total reported losses during the 10-year period of 2,9),000 by the cumulative inventory during that period of 15,046. 00, he arrived at an average loss rate of 14.26 percent. According to Mr. Bourret, these losses were calculated in exactly the same manner as total losses were calculated by Cain, et al., which had arrived at an 8.3 percent average total loss rate in Wyoming for the period 1950-70. Comparing this rate with the 7.9 percent average loss rate in Wyoming for the period 1940-49, Cain, et al. had concluded that loss rates had not significantly changed during the period when 1080 was used. By contrast, Mr. Bourret's calculations indicated that an approximate 6 percent increase in the total average sheep and lambs lost during the period 1971-80 or an approximate 71 percent increase in total losses during the period.

19. The inventory figures used by Mr. Bourret to make the calculations referred to in the preceding finding were based on stock sheep on hand as of January 1 of each year. This stock sheep inventory is exclusive of sheep and lambs on feed and Mr. Bourret used these

figures because he maintained those were figures used by Cain, et al. Mr. Bourret's calculations also included pre-docking losses to lambs as reported by the Wyoming Crop and Livestock Reporting Service, while Cain Committee data was limited to losses to lambs after docking. Mr. Bourret is correct that Cain, et al. used stock sheep inventory thus excluding sheep on feed. It is not clear whether sheep on feed were excluded from the total inventory because that was the only data available or because Cain, et al. considered that predation and other losses to such sheep would be minimal. Be that as it may, if the calculations made by Mr. Bourret are adjusted so as to include sheep on feed in the inventory and to exclude pre-docking losses, the average loss rate for all causes for the period 1971-80 is reduced to 8.82 percent rather than the 14.2 percent calculated by Mr. Bourret.

20. Mr. Bourret summarized the percentage of the January 1 sheep inventory loss to coyotes as furnished by the Wyoming Crop and Livestock Reporting Service for the years 1965 through 1980, with the exception of 1967 for which data were not available. These percentages range from a low of .86 percent in 1968 and 1971, to a high of 2.18 percent in 1976 averaging 1.29 percent over the 16-year period. The percentage of lambs born lost to coyotes range from a low of 3.10 percent in 1968 to a high of 11.04 percent in 1979, averaging 5.53 percent over the 16-year period. In 1980, 6.5 percent

of lambs lost were lost after docking. Loss to predators constituted 31.4 percent of all losses of sheep in 1980, while losses to coyotes were 25.8 percent of total losses.

21. Dr. Darwin Nielsen, Professor of Economics at Utah State University, the Nielsen involved in the Nielsen-Curle study cited in Cain, et al., and a witness for the AFBF, completed a study of the characteristics of sheep ranchers reporting high predation losses and those reporting low predation losses in 1977. Based on Gee, et al., Dr. Nielsen concluded that high loss ranchers experienced losses of docked lambs to predation of 8 percent or more, while low loss ranchers experienced predation losses of 3 percent or less. Dr. Nielsen's study is referred to in Gee, et al. and included producers from Colorado, Idaho, Nevada, Oregon, Utah and Wyoming. Data gathered was for the period 1971-74 and showed that high loss ranchers had lamb losses of 7.0 percent in 1971, 10.0 percent in 1972, 12.5 percent in 1973 and 14 percent in 1974. Low loss ranchers had lamb losses of 2.2 percent in 1971, 4.0 percent in 1972, 4.7 percent in 1973 and 3.8 percent in 1974. Dr. Nielsen concluded that this data indicated a substantial increase in predation losses since 1972. The personal interview survey was conducted in 1975 and ultimately required 37 high loss producers and 29 low loss producers to estimate or recall predation losses for the preceding four years. He acknowledged that he could have constructed a sample of low loss ranchers experiencing no predation losses, that he did not know whether the ranchers involved had records of losses for those years

and that the survey was conducted after the ban on Compound 1080 and publicity surrounding the predator control controversy. Although the survey was conducted in 1975, preliminary data for that year indicated that 16 percent of high loss ranchers reported increased predation losses for that year, 62 percent reported lower predation losses and 22 percent reported no change in losses for that year. From this it might be concluded that losses were decreasing from 1974 to 1975.

22. The study "The Economics of Sheep Predation in Southwestern Utah" attempted to verify predation losses on ten ranches having range flocks in southwestern Utah during the period 1972-75. This study indicated that the predation loss rate of lambs in 1975 was less than half of that prevailing in 1972. Lost or missing animals whose carcasses were never located were apparently attributed to predators and other causes in the same proportion as verified losses. Though he did not dispute the figures reported, Dr. Nielsen questioned whether the area could be considered representative of the State of Utah or of the 17 western states.

23. Statistical data from USDA and Utah indicate that combined sheep and docked lamb losses to all causes for the years 1931 to and including 1980 have fluctuated in a relatively narrow range, varying from a low of 8.2 percent in 1966 to a high of 13.75 percent in 1975, decreasing to 8.6 percent in 1979 and 9 percent in 1980.

24. In 1980, Dr. Nielsen in conjunction with a graduate student conducted a study, the study becoming the graduate student's thesis, of farm sheep flocks in Utah. The study was primarily concerned with the economics of farm flock production, was conducted by personal interview and included a sample of producers having from 100 to 500 breeding ewes. Coyotes were reported to have accounted for 5.6 percent of the annual lamb crop losses, including pre-docking losses, and 1.4 percent of adult ewes.

25. Dr. Clair E. Terrill, a retired Animal Scientist formerly employed by the U.S. Department of Agriculture and a witness in this proceeding, 3/ presented data purportedly showing a dramatic increase in predation loss rates on sheep and lambs since 1972 and the ban on Compound 1080. Dr. Terrill appeared to attribute almost the entire reduction in sheep inventory from the 57 million in 1940 to 30 million in 1950 to predation. He developed an index to determine trends and losses using percentages of deaths of lambs minus percentages of deaths of sheep as reported in USDA s statistics showing inventories on hand as of January 1 of each year and deaths from all causes for the years 1940 to 1980. He found that this index was highly related to predation losses as reported in data compiled by the U.S. Forest Service. His calculations are based on the theory that when predator losses are increasing, the percentage of lamb deaths increases faster than the percentage of sheep deaths. He concluded that lamb and sheep deaths from predation acount for a much greater percentage of

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3/ Although Dr. Terrill stated at the hearing that he represented the American Society of Animal Science, no notice or other appearance by that organization has been made in the proceeding.

total losses than before 1972. According to Dr. Terrill, overall lamb losses to predation as a percent of losses to all causes were 72 percent in 1970, 80 percent in 1972, 78 percent in 1974, 84 percent in 1977 and 82 percent in 1980. Likewise, he concluded that losses of sheep to predators as a percent of losses to all causes were 21 percent in 1970, 27 percent in 1972, 30 percent in 1974, 38 percent in 1977 and 33 percent in 1980. He acknowledged that predation loss percentages decreased in the late 1970's, i.e., 1978 through 1980, which is consistent with other evidence in the record. Because the evidence establishes that only a small percentage of sheep producers incur heavy predation losses, Dr. Terrill's estimates of predation losses as a percentage of total losses are too high and are not accepted.

26. Mr. Douglas Murfield, Statistician in Charge of the Texas Crop and Livestock Reporting Service and a witness for the Texas Department of Agriculture, submitted testimony to the effect that predation upon the Texas sheep and goat industry has been continuously escalating since 1967. His testimony was based on surveys of Texas sheep and goat producers conducted by the Service in 1968 and 1979, which reflected losses incurred by producers in the preceding years. Losses of sheep and lambs to predators totaled 172,000 out of an inventory of 4,802,000 sheep and lambs in 1967 for a loss rate of 3.5 percent as compared to 241,000 out of any inventory of

2,460,000 in 1978 for a loss rate of 9.7 percent. Mr. Murfield testified that in 1967 the number of sheep and lambs killed by predators amounted to 25 percent of all losses incurred, while predation losses had risen to 58 percent of losses to all causes in 1978. He further testified that coyotes were responsible for 24 percent of all sheep and lamb losses in 1978. According to Mr. Murfield, the predation loss rate for lambs was 4.5 percent of the lamb crop (includes losses before and after docking) in 1967, 8.7 percent in 1973, 12.9 percent in 1974, 12.5 percent in 1975, 13.5 percent in 1976 and 16.6 percent in 1978. These loss rates are based on the special death loss surveys conducted by the Texas Crop and Livestock Reporting Service in 1968, conducted by mailed questionnaire, and upon information as to losses garnered by the Texas Crop and Livestock Reporting Service as part of its normal yearly inventory and total loss surveys.

27. It will be noted that the loss rates reported by Mr. Murfield for the years 1972 through 1978 do not agree w th those calculated by by Mr. Littauer (finding 16) for the years 1972 through 1978, those reported by Mr. Murfield being consistently higher. Because both the Littauer and Murfield data are based upon lamb losses before and after docking the reason for the divergence in loss rates is not apparent. Acceptance of Mr. Murfield's loss rates, however, requires the

conclusion that although unknown causes of sheep and lamb deaths amounted to 18 percent of all losses in 1967, unknown causes of deaths were only 7 percent of all losses in 1978.

28. Although the loss figures reported by Mr. Murfield included lambs born during the year which were lost to predators, the loss rates were not calculated by adding the lamb crop for the year in question to the inventory as of January 1. Mr. Murfield defended this result, rejecting the idea that the lamb crop during the year should be added to the January 1 inventory in order to calculate the percentage of predation losses, because, inter alia, the inventory as of January 1 of each year included lambs born since October 1 of the preceding year and adding the lamb crop would result in duplication. It appears, however, that lamb crop for each year as reported by SRS includes lambs born from October 1 of the preceding year through September 30 of the succeeding year. Accordingly, the duplication referred to by Mr. Murfield does not appear to be real. A table produced by Defenders reflects the percent of sheep and lamb losses to all causes in Texas as a percent of the January 1 inventory plus the lamb crop for each year from 1962 and including 1981 as reported by the SRS and the Crop Reporting Board of the U.S. Department of Agriculture. The table reflects that combined losses to all causes were 10.4 percent in 1960, 9.7 percent in 1967, 7.3 percent in 1974 and 6.6 percent in 1981. This table is in accord

with the Gee, et al. conclusion that losses of sheep and lambs to all causes in Texas in 1974 and previous years were trending downward. Moreover, Mr. Murfield testified that Texas sheep producers lost 102,800 animals (sheep and lambs) to predators in 1981. Considering a January 1, 1981 sheep inventory of 2,360,000 and 1981 lamb crop of 1,250,000, this results in a predator loss rate for sheep of approximately 3 percent and a predator loss rate of lambs in 1981 of approximately 3.7 percent.

29. Dr. Dale A. Wade, Extension Wildlife Specialist, Texas Agricultural Extension Service, a former animal damage control agent for the Fish and Wildlife Service of U.S. Department of Interior and a witness for Wyoming, et al., made a literature review of data on predation in the western United States. He concluded that precise data on losses of livestock to predation were available only from selected farms and ranches, but that estimates suggested that losses to coyotes were approximately 4 percent to 8 percent of lambs and 1.5 percent to 2 percent of ewes produced in the 17 western states. This data appears in Council for Agricultural Science and Technology, Special Publication No. 10 (March 1982), authored by Dr. Wade and in evidence, but its source appears to be a Department of the Interior publication not in evidence.[4/] Predation loss data compiled by Dr. Wade appears to

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4/ This publication "Predator Damage In The West: A Study of Coyote Management Alternatives" (USDI, 1978), was identified as FWS Exh 3 and proffered as an exhibit. The proffer was withdrawn, however, upon objections that the authors were not available for cross-examination Wyoming, et al. subsequently moved that the publication be admitted into evidence, arguing that it was entitled to be admitted without a sponsoring witness. FWS offered to make sponsoring witnesses available, however, the proffer was again withdrawn.

be in line with such losses incurred prior to 1972 when 1080 was being used.

30. Dr. Maurice Shelton (finding 6), noted the wide variety of predation loss estimates and asserted that those who yearn for a single accurate and dependable figure for such losses were bound to be disappointed, because such an objective could never be realized. He testified that the wide variation in estimates of losses due to predation could reasonably be explained by: (1) coyote density; (2) number of sheep (or goats) involved; (3) presence of control efforts; (4) season of the year; (5) age of prey animals; (6) alternative food sources or prey species; (7) animal management protection; and (8) methods of collecting and expressing predation losses. He further testified that only rarely is predation observed and thus several alternatives existed for determining and expressing such losses. He listed these as recording as predation losses: (1) only those observed; (2) those verified as predator kills based on appropriate diagnostic techniques; (3) extrapolating on a percentage basis from those verified as predator losses to a larger population; (4) including all missing animals as predator kills; (5) producer estimates from interviews; and (6) producer estimates from mailed surveys. He was of the opinion that producer estimates of losses came closer to the true situation existing in the industry than most efforts at research verification.

31. Dr. John Grandy, Vice President for Wildlife and Environment of The Humane Society of the United States, a member of the Interior Department's Animal Damage Control Study Advisory Committee in 1977 and a witness for Defenders of Wildlife, et al., submitted testimony to the effect that surveys conducted by mail questionnaires, Gee, et al. in particular, substantially overestimated losses to predators. He pointed out that there was a paucity of reliable data on the extent of predation losses to sheep prior to 1972 and maintained that publicity surrounding the Gee, et al. survey and the emotional climate surrounding the predator control issue, biased reported predation loss figures upward.

32. Dr. Grandy fashioned a table comparing field studies on selective ranges in Wyoming, Idaho, Utah and Nevada during years encompassing the 1974 results reported by Gee, et al. In field or biological studies, investigators make an effort to find the carcasses of all dead animals and verify the cause of death. Obviously, such studies are labor intensive, very expensive, depend on the cooperation of the ranchers or producers concerned and can only cover a limited area or number of herds. This, of course, means that such studies are simply indications of what is happening and cannot be viewed as representative of losses incurred by greater numbers of flocks, producers in large areas or in states as a whole. Moreover, despite extensive searches, some animals are simply missing and the cause of loss or death cannot be determined. It should also be pointed out that extensive human activity in connection with searches for dead and missing animals, might in and of itself be a factor reducing predation

below what it would be in the absence of such activity. Dr. Grandy acknowledged that data from field studies was inadequate to permit any proper statistical analysis or conclusions.

33. A 3-year study of five ranches in southern Wyoming resulted in predation being confirmed as causing loss of 1.5 percent of lambs docked in 1973, 2.1 percent in 1974 and 3.2 percent in 1975. Corresponding confirmed ewe losses to predators were 0.2 percent of the inventory in each of the three years which is to be compared with 1974 losses reported by Gee of 11.7 percent of the lambs born and 3.5 percent losses of ewes. A study of 9 bands of sheep in Idaho reported confirmed predation loss of lambs to be 1.5 percent of lambs born in 1973, 1.7 percent in 1974 and 1.2 percent in 1975. Ewe losses as a percent of total ewe inventory were 1.6 percent in 1973, 0.7 percent in 1974 and 0.8 percent in 1975. An "adjusted" predator loss rate was determined by applying the percentage verified predation losses bore to total losses and applying this percentage to missing animals. This resulted in lamb losses being 3.1 percent of lambs born in 1973, 3.3 percent in 1974 and 1.3 percent in 1975. Adjusted ewe losses were 2.5 percent, 1.0 percent and 0.8 percent, respectively, for each of the three years. These loss rates are to be compared with a predation loss rate for Idaho of 5.8 percent of lambs and 2.0 percent of sheep in 1974 reported by Gee, et al.

34. A study of 10 large sheep operations in Utah resulted in reported confirmed lamb losses to predators of 1.7 percent of lambs docked in 1972, 1.5 percent in 1973, 2.6 percent in 1974 and 2 percent in 1975.

Adjusted lamb losses were 7 percent of lambs docked in 1972, 4.7 percent in 1973, 5.8 percent in 1974 and 2.9 percent in 1975. Data on ewe losses were not available. By contrast, Gee, et al., found Utah predator lamb losses of 12.9 percent of lambs born and ewe losses to predators of 5.2 percent of the inventory as of January 1 in 1974. Another field of biological study appearing on Dr. Grandy's table is that of two migratory sheep bands in Nevada which were studied during the period 1973-1974. Reported losses to predation were 6.5 percent of lambs docked and 0.7 percent of the ewe inventory for the year 1974. This is to be compared with the lamb losses reported by Gee, et al. in Nevada in 1974 as 30.4 percent of lambs born and ewe losses in that year of 11.7 percent of the January 1 stock sheep inventory. Because the lamb losses to predators in Nevada reported by Gee exceeded 85 percent of total lamb losses, Dr. Grandy asserted that they could not be taken seriously.

35. Gee, et al. predation lamb loss percentages were calculated on the basis of lambs born and thus included pre-docking losses. This was not true of the Wyoming, Utah and Nevada studies referred to above and shown in Table 1 of Dr. Grandy's testimony, as these studies based the lamb count on lambs docked. Gee, et al., however, also calculated post-docking losses to predators and if pre-docking losses are eliminated the percentage of lamb losses to predators for the cited states are reduced to 9.2 percent for Wyoming, 11 percent for Utah and 14.8 percent for Nevada.

36. Dr. Grandy also mentioned studies underwritten by the Fish and Wildlife Service in an effort to determine predation losses in the absence of predator control. He referred to a study of a band of range sheep under the control of herders in an area in California, during the period June 8 to September 29, 1976, where there had been no predator control practiced for over nine years. The fact that the band was under the care of herders would seem to negate this as a no control study. Reported verified lamb loss to predators was 6.3 percent and the total loss of ewes and lambs to predators was 3.8 percent. This study being of less than 4 months duration is, of course, very short. Moreover, although the researchers in this study were confident that they had found possibly 100 percent of the losses, there was apparently an incorrect count at shearing, leading to the conclusion that verified losses exceeded by 53 the number of animals counted [probably, short at shipping time].

37. A "no control" study was conducted in 1974 and 1975 in New Mexico on fenced lambing operations without herders. The losses to predation in 1974 were 15.6 percent of the lambs. No adult sheep were lost to predators. In 1975, 12.2 percent of the lambs and 0.9 percent of adult sheep were killed by predators. Because adjoining ranchers intensified predator control efforts, the researchers recognized that the "no control" goal was not entirely fulfilled. Another study designed to measure losses in the absence of predator control was conducted on the Cook Ranch in Montana. Sheep were run in fenced pastures and the loss rate of lambs to predators amounted to 29.3 percent. Dr. Grandy

asserted that management practices contributed to this high loss rate and noted that the loss rate declined substantially under improved management practices and partial predator control.

38. Included in Dr. Grandy's testimony is a table showing losses to poisonous plants and predators of sheep and goats grazed on U.S. Forest Service lands from 1940 to 1976. The table shows predation losses as a percent of animals grazed during the period of 1080 use ranged from a low of 0.79 percent in 1950 to a high of 2.39 percent in 1972. Losses in the post-1080 years as a percent of animals grazed were 2.07 percent in 1973, 2.60 percent in 1974, 2.17 percent in 1975 and 1.88 percent in 1976. These loss rates are based on producer estimates of the cause of loss. Actual percentages of losses to predators are approximately one-half of losses in the table, because the number grazed includes only adults (a ewe or nanny with a lamb or kid being counted as one), while predation losses include lambs and kids. As indicated previously (finding 4) it should, of course, be remembered that these figures include only the summer grazing season, which averages 2 1/2 to 3 months per year, that lambing has usually been completed prior to movement onto Forest Service lands and that predation losses in winter and early spring may be substantial. The table shows predation as a percent of total losses ranging from a low of 37 percent in each of the years 1951, 1952 and 1953, to a high of 64 percent in 1975.

39. Because he concluded that SRS inventory and total loss data published by the USDA (without attempting to assign a cause for loss) were the

most reliable, Dr. Grandy constructed a table showing sheep and lamb losses to all causes for the 15 western states for the years 1960-1971 and 1972 to and including 1981. Average losses to all causes for the 1960-71 period were determined to be 8.9 percent of the January 1 inventory plus the lamb crop and 9.0 percent for the period 1972-81. He concluded that there was essentially no change in losses to all causes over the 22-year period and no change in total losses during the 12-year period 1960 to 1971, when 1080 was used and during the 10 years following the suspension of 1080. The result changes, however, if lamb losses are separated from sheep losses and lamb deaths are calculated as a percentage of the lamb crop using SRS data. These calculations result in an average lamb loss of 10.4 percent during the years 1960 to 1971, while the average for the period 1972 to 1981 years is 12.3 percent. Sheep deaths as a percentage of the inventory as of January 1 of each year average 7.9 percent during the years 1960 to and including 1971 and 6.9 percent during the period 1972 to and including 1981.

40. Dr. Frederic Wagner, Associate Dean of the College of Natural Resources and Director of the Ecology Center at Utah State University, a member of the Cain Committee in 1971 and a witness for the National Wildlife Federation, testified that higher sheep loss rates of recent years, which appear to be real, are merely the culmination of a trend beginning in the 1950's. Although his written testimony refers to predation loss rates, he made it clear that he was actually referring

to total losses. He asserted that these losses rose during the period of intensive 1080 use and that the rate of increase during the post-1080 years did not appear to be any higher than that of the period when 1080 was used.

41. Dr. Wagner analyzed SRS data separating lamb and sheep losses. His calculations suggested that lamb loss rates during the 10 years following the inception of 1080 use were lower by an average of approximately 1.5 percent than in the decade prior to 1080 use in Nevada, Utah and Colorado. Average losses during the 1951-1960 period, however, in Montana, Wyoming, Idaho, Texas, New Mexico and Arizona were not statistically different from average losses during the period 1941-50. Summarizing these results, he concluded that there was some decline in sheep losses in Nevada, Utah and Colorado in the early 1950's following the introduction of 1080 as a coyote control strategy. There was no convincing evidence of a similar generalized reduction in sheep losses in the three southern states (Texas, New Mexico and Arizona) where less 1080 was used and no evidence of a generalized state-wide reduction in such losses in the northern States of Montana, Idaho and Wyoming.

42. Elaborating on his testimony that sheep loss trends have been rising since the early 1950's, Dr. Wagner stated that the level of lamb losses to all causes is now higher than it was in the pre-1080 period. He indicated that the lower losses in the pre-1080 period, if real, started five to seven years before 1950 and that the

reduction in losses immediately following 1950 may have been attributable to factors other than the use of 1080. He pointed out that starting in 1955-56 lamb losses rose steadily during the period of 1080 use, and continued to rise from three to five years after the suspension of 1080 in 1972. He noted that losses appear to have declined by from three to six percent in the past four or five years.

43. Dr. Robert Robel, a Professor of Environmental Biology at Kansas State University and a witness for Defender's of Wildlife, et al., testified that in 1975-76 he supervised a study which focused on sheep losses to predators and other causes in a nine-county area of south central Kansas. The producers taking part in the study had 40 percent of the sheep in the nine-county area, constituting 21 percent of the sheep in Kansas. Although the primary purpose of this study was to evaluate the effectiveness of various husbandry practices in reducing predation, the study reported losses to all causes were 6.8 percent of the sheep and 7.9 percent of the lambs on an annual basis. Proportionate causes of lamb deaths prior to docking included lambing complications 74.6 percent, dogs 0.7 percent and coyotes 5.4 percent. Proportionate causes of post-docking lamb losses included disease, weather, unknown and other causes totaling 79.9 percent, while predation losses were coyotes 14.9 percent and dogs 2.1 percent. Annual losses to predators were 0.9 percent of the stock sheep inventory and 0.9 percent of the lambs born. Of losses to predators, coyotes killed 73.1 percent of the sheep and 80.6 percent of the lambs. Dogs killed 24.9 percent of the sheep and 19.4 percent of the lambs. These results

are to be compared with 3.4 percent of lambs born lost to predators, and 3.8 percent of the inventory of stock sheep on hand as of January 1 lost to predators in Kansas in 1974 reported by Gee, et al. Only a small percentage of the dead sheep and lambs were actually necropsied to determine the cause of death. Dr. Robel, nevertheless, expressed confidence in the accuracy of the study, because cooperating ranchers reported their losses on a monthly basis, thus reducing reliance on the producer's memory. Although it is likely that Kansas has a larger coyote population than any other state,[5/] with the possible exception of Texas, the low predation rates are attributable in part to the fact that most sheep are maintained in farm flocks which enhances management practices, such as penning at night, to reduce or minimize predation. Another possible reason is that most lambing in Kansas occurs in the fall, when the food pressures on coyotes are minimized due to the fact that pups are born in the spring.

44. Dr. John Schaub, an Economist, Chief of the Pest Control Branch, Economic Research Service, USDA, and a witness for USDA, submitted testimony on trends in sheep, lamb and calf losses. Based on an examination of USDA SRS data on sheep and lamb inventories, births and losses for the period 1961 through 1981, he concluded that there was an increase in lamb losses to all causes after the suspension of 1080

5/ This is based on an annual coyote harvest or take during the years 1977 and 1979 of over 100,000 (93,648 in 1979 and 75,391 in 1980), for exceeding the estimated total take of approximately 70,000 for the States of Idaho, Montana, Nevada and Wyoming in 1977 and 1978, these states being considered to have relatively high coyote populations.

in 12 of the 15 western states. He further concluded that there was no statistically significant change in lamb losses in the States of Arizona, Idaho and Texas. He testified that it was not possible to identify the proportion of loss caused by coyote predation. A similar analysis conducted for sheep losses showed the percent of sheep lost to all causes increased after the suspension of 1080 in California, North Dakota, Montana, Nebraska and New Mexico. In Arizona, Oregon, South Dakota and Texas there was a statistically significant decrease in sheep losses and no statistically significant change in losses in Colorado, Idaho, Kansas, Nevada, Utah and Wyoming.

45. As part of a special 1980 meat animals cost of production survey, conducted in the spring of 1981 by personal interviews with 528 randomly selected sheep producers, data on losses of lambs and sheep by cause, including predators, were also collected. The result of this survey indicated that predators were responsible for approximately 61 percent of the losses to all causes of post-docked lambs, while coyotes were responsible for approximately 43 percent of such losses. Losses to all causes totaled 10.39 percent of the lamb crop, with coyotes being responsible for 4.45 percent of losses to all causes. Comparing such estimated losses with the 35 percent of estimated lamb losses to coyotes reported by Gee, et al. for 1974, Dr. Schaub concluded that the two surveys may indicate that the percentage of lambs lost to coyotes has increased. The 1980 survey, however, was confined to post docking losses and if, the comparison is made using 1974 data on losses of post-docked lambs as reported

by Gee, et al., losses to coyotes were over 53 percent of losses to all causes in 1974.[6/] This comparison would, of course, indicate that losses to coyotes were decreasing rather than increasing. According to the 1980 survey, total losses of stock sheep to all causes constituted 10.22 percent of the January 1 inventory with coyotes being responsible for loss of 1.52 percent of the inventory or 14.9 percent of total losses. In comparison, the 1974 survey as reported by Gee, et al. showed that total losses of stock sheep to all causes constituted 10.4 percent of the January 1 inventory and that coyotes were responsible for the loss of 2.5 percent of that inventory or approximately 24 percent of total losses. This again would indicate losses of stock sheep to coyotes have declined as a percentage of losses to all causes.

46. Testimony as to predation losses incurred by producers or former sheep producers in Colorado, Idaho, Montana and Wyoming is in the record. The highest rates of losses to predators, chiefly coyotes,

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6/ Although entitled "Lamb and Sheep Losses In The 17 Western States," the 1980 USDA study referred to apparently relied on data collected from only 13 western states, the States of North Dakota and Kansas, which had been included in the Gee, et al. results for 1974, being omitted from the 1980 survey. A table prepared by Defenders compares the 1974 Gee, et al. results with the 1980 data after subtracting inventory and loss figures from these two states. This subtraction, however, does not significantly change the percentage losses caused by coyotes bear to losses to all causes nor the percentage losses caused by predators bear to losses to all causes.

were reported by Mr. Terry Snyder, a Norwood, Colorado purebred sheep producer and a witness for the AFBF. He testified that losses to lambs during the period of birth through sale were 2 percent in 1972, 20 percent in 1974, 22 percent in 1975, 27 percent in 1976 and approximately 30 percent in 1978. These losses are in terms of percent of lambs born. Losses in 1975 and 1976 were all to coyotes. He stated that loss records during the summer months were maintained by a man and his wife who looked after the sheep and that because the sheep were in fenced pastures, it was possible to locate nearly all the kills. His current predation rate was stated to be 10 percent of sheep and lambs and 1 percent to guard dogs. He attributed the reduction in loss rates to the use of guard dogs, fences and use of a helicopter in aerial hunting of coyotes.

47. Mr. R. K. Siddoway, a large migratory sheep operator from St. Anthony, Idaho and a witness for Wyoming, et al., testified that he and his sons have suffered high predator losses, in one year losing about 600 lambs from a total of 9,000 to 10,000 or approximately 5 to 6 percent. He further testified that the highest percentage of losses from docking to shearing was due to disease and that 30 to 40 percent of losses from shearing to the time the sheep are trailed to summer range were due to predation. He stated that most of the weak or sick lambs had been "weeded out" by the time the sheep are on the summer range and that 90 percent of losses during the summer were due to predation. He acknowledged that he hadn't kept good records on losses to all causes and that for every lamb lost to coyotes, there might be

two or three more whose remains could not be located. Although he testified that his predation loss rates dropped dramatically when Compound 1080 was first used in his area in the early 1950's, his overall loss rate from 1965 to 1971 ranged from 7.8 to 11 percent and from 1972 to 1980 his loss rate to all causes ranged from 5 to 11 percent and thus was in the same range as before the ban on the use of Compound 1080.

48. Mr. Dan Tracy, a sheep and cattle rancher from Carr, Colorado and a witness for Wyoming, et al., testified that predation losses started increasing in 1973, the year after 1080 was banned. Mr. Carr increased his herd of ewes from 150 in 1976 to 1,100 in 1980. During this period his lamb losses to predators, almost all to coyotes, increased from .058 percent in 1976 to 24 percent in 1979 and a staggering 59 percent in 1980. His losses of ewes to predators during this period increased from .013 percent in 1976 to .047 percent in 1980. Mr. Carr was forced to reduce the size of his operation, decreasing the number of ewes to 550 in 1981, when he incurred a predator loss rate to lambs of 7.8 percent and a loss rate to ewes of .025 percent. Mr. Carr keeps a written record of his losses of sheep and cattle. He weaned his lambs at a weight of approximately 40 pounds in 1981 and placed them in a feed lot, because he asserted that he was losing one a day to predators.

49. Mr. John Papoulas, a third generation sheep rancher from Craig, Colorado and a witness for Wyoming, et al., submitted a table showing lamb losses in numbers as 83 in 1968, 75 in 1969, 94 in 1971, 185 in 1973, 176 in 1974, 272 in 1976, 300 in 1977, 220 in 1979, 87 in 1980 and 270

in 1981. Because he did not have records of lambs born or docked, it is not possible to convert these numbers into percentages. He testified that he suffered high losses to predators while lambing on the open range. He stated that they converted to a partial shed lambing operation in 1980, wherein approximately 50 percent of the ewes were shed lambed. He further stated that in 1981 extremely high coyote losses were incurred when one month old shed lambs were turned onto the summer range. In one month coyotes killed 70 of 590 lambs. He testified that predator losses were due to coyotes except for an occasional bear. Although his written statement is to the effect that they have not suffered any losses to eagles in 15 years, he testified that in 1982 to the date of the hearing 106 lambs were killed by eagles and 73 by coyotes. The only loss records maintained by Mr. Papoulas are losses to predators. He attributed the low losses in 1980 to the fact that trappers found four or five coyote dens in the fall of 1979.

50. Mr. Nick Theos, a sheep rancher from Meeker, Colorado and a witness for Wyoming, et al., testified that his losses to predation had been steadily increasing ever since 1972, the year 1080 was banned. He testified that prior to 1972 when he was running approximately 4,000 lambs and 3,000 ewes, his losses to lambs numbered approximately 120 or 3 percent and his losses to ewes numbered approximately 60 or 2 percent. He further testified that in 1981 when he was running virtually the same number of sheep (4,200 lambs and 3,100 ewes) predation losses reached an all time high, totaling 13 percent of lambs

(520) and 9 percent of ewes (290). Mr. Theos maintains no record of lamb losses between birth and docking and makes no attempt to diagnose causes of death or keep records other than predator losses.

51. Mr. Michael Devlin, a sheep and cattle rancher from Terry, Montana, a member of the Montana Legislature and a witness for Wyoming, et al., submitted a table showing that lamb losses to coyotes ranged from a low of 2.0 percent in 1971 to a high of 14.5 percent in 1976, declining to 4.3 percent in 1978 and rising to 9.6 percent in 1981. At the hearing, it developed that this table included only losses of black-faced lambs to coyotes. Mr. Devlin explained that was because the black-faced lambs are considered to be the cash crop, while all or a portion of the white-faced lambs would be kept for replacements. He acknowledged, however, that the white- and black-faced lambs were run in the same pastures and subject to the same predation, disease, weather and other problems. If white-faced lambs are added to the total, the percentage of lambs lost to coyotes in 1975 is reduced from 12.2 percent to 11.9 percent, the percentage lost to coyotes in 1976 is reduced from 14.5 percent to 12.7 percent and the percentage of lambs lost to coyotes in 1977 is reduced from 12.5 percent to 12 percent. During the 14-year period from 1968 to and including 1981, Mr. Devlin kept records of losses to other than predators in only five of those years, because he stated that the biggest percentage of death losses through the years

is from coyotes. The foregoing losses to coyotes are only those counted from the time of docking and a loss was not recorded as being caused by coyotes unless Mr. Devlin or his sons examined the carcass and verified the cause of death. Because the bodies of some missing lambs are never found, Mr. Devlin testified that it was quite possible that his predation losses were even higher than his records indicated.

52. Mr. Edward B. Smith, a sheep and cattle rancher from Dagmar, Montana, a Montana State Senator and a witness for Wyoming, et al., testified that in 1975 he sold his entire flock of sheep after losing 96 of 500 lambs to coyotes, nearly a 20 percent loss. He further testified that from the time Compound 1080 bait stations were placed on his ranch in 1947 until the use of 1080 was banned in 1972, he did not lose a single lamb to predation. He stated that his losses of lambs to coyotes were 10 percent in 1973. Mr. Smith acknowledged that he maintained no records of causes of losses of lambs and that the foregoing loss percentages were from memory.

53. Mr. Joe T. Helle, a sheep and cattle rancher from Dillon, Montana, submitted a table showing the total lamb losses between docking and shipping in the fall were 5.8 percent in 1967, 12.2 percent in 1974, 19.1 percent in 1975, 14.2 percent in 1976, 12.8 percent in 1977 and 8.1 percent in 1981. He attributed the increase in losses after 1972 to predation, in particular coyotes, and the increase in coyote predation to the ban on the use of Compound 1080. Although he testified that herders kept records of predator losses on summer ranges, he

estimated that they actually observed only 10 to 20 percent of coyote kills. He asserted that the remains of a lamb killed by a coyote would be either eaten by the coyote or would "melt down" within two days.

54. Mr. Chase Hibbard, a fourth generation sheep and cattle rancher from Helena, Montana and a witness for AFBF, testified that the family ranch was best suited for sheep and has historically been a sheep ranch. He stated that in 1969 they were running 3,000 ewes and lost 8 percent of the lamb crop between docking in early June and shipping in late September. During the next five years losses rose from 14 percent in 1971 to 39 percent in 1973 and 35 percent in 1974. He acknowledged that these were total losses and that it would be very difficult to estimate the loss rate attributable to coyote predation. He asserted, however, that he was attributing the majority of the losses to predators, chiefly coyotes, and that when the numbers jump from 6 percent in 1970 to 39 percent in 1973, something was happening other than deaths to natural causes. He asserted that the only way they were able to survive was by switching from sheep to cattle and that in 1975 they sold most of the remaining commercial sheep.

55. Mr. Truman Julian, a sheep rancher from Kemmerer, Wyoming and a witness for Wyoming, et al., began keeping loss records in 1975 shortly after joining his father's sheep ranch. He testified that in 1977 they lost 700 lambs or 24 percent of the herd and in 1981 they lost 635 lambs or 10 percent of the herd. Herd figures are based on the numbers of lambs docked. He asserted that 477 or 68 percent of the 700 lambs lost in 1977 were lost to predators. He testified that the 477

figure was based on actual observations between the herders and himself. He applied the 68 percent predation rate in 1977 to the 635 lambs lost to all causes in 1981, estimating that 431 lambs were lost to predators in that year. He stated that he knew coyote losses were very low in the period prior to 1972 when 1080 was in use, losses being approximately 2 to 3 percent.

56. Mr. Leo Tass, a sheep and cattle rancher from Buffalo, Wyoming and a witness for AFBF, testified that they were experiencing more and more losses from coyote predation and that he was forced to confine his sheep for three months of each year because of coyotes. By confinement, he meant a small pasture. He further testified that he sold land, which he had homesteaded in the 1920's, located approximately 20 miles east of the ranch in 1974 because he could not use it after 1972 because of predation. Although he apparently had data on his lamb crop and on total losses, he submitted no figures on the percent of lambs lost to coyotes and other predators.

57. Mr. Marion Scott, a third generation rancher from Campbell County, Wyoming and a witness for AFBF, testified that during the 25 years prior to 1972, sheep and calf losses to coyotes were minimal. He stated that in 1958, he acquired a small flock of sheep (250 ewes) to supplement the income from his cattle operation. Although his written testimony is to the effect that they had few problems with predators until 1974, he sold the last of his sheep in 1972,

discontinuing the sheep operation, because he saw more coyotes and anticipated predator problems. He further stated that his daughter had a small flock (12 ewes) of purebred sheep and that she was forced to sell in 1976 because of losses to predators, mostly coyotes.

58. Mr. Jw Nuckolls, a sheep and cattle rancher from Hulett, Wyoming and a witness for AFBF, testified that in the ten years prior to 1981 his losses had been 11 ewes and slightly over a thousand head of lambs to coyotes. He asserted that a thousand head of lambs amounted to the lamb crop for one year. He further testified that he lost 111 lambs to coyotes in 1981. His heaviest losses appear to have been in 1977, when he lost 164 or 14 percent of his lambs to coyotes. However, in comparing figures of lamb and sheep losses incurred during the period 1972 to and including 1976 as listed in an affidavit executed by Mr. Nuckolls in connection with an application for the placement of a 1080 bait station on his property, it appears that his lamb losses averaged about 4 percent during the years mentioned and that he lost only five adult sheep to coyotes during that period.

59. Mr. Don Meike, a sheep and cattle rancher from Kaycee, Wyoming, currently Chairman of the Board of the National Woolgrowers Association and a witness for Wyoming, et al., testified that recurring kills of sheep and lambs were common on his ranch in the 1930's and 1940's. He stated that when toxicants were introduced in the predator control program in the 1950's and 1960's, losses to predators

dropped to almost zero and that it was the exception rather than the rule to find coyote kills. He stated that Johnson County, the county of his residence, had established and funded its own predator control program which had been very effective. He asserted that adjoining counties, which had depended largely on the Federal cooperative program for predator control, were not as fortunate and that when 1080 was banned, the resulting coyote population increases began to spill over into Johnson County and losses began to increase. He testified that currently loss levels were similar to the 1940's.

60. Regarding the controversy over the accuracy of predation losses reported by ranchers, Mr. Meike cited a study conducted in southern Iowa wherein of 227 carcasses examined, 94 percent were correctly reported by farmers as killed by predators. Although his written testimony states that sheep ranchers count their lambs when they are born, docked and again when they are shipped in the fall, the first accurate count on his ranch is made at docking. Over a period of years, normal loss levels are established for each particular ranch operation. He asserted that losses above normal levels are evaluated against weather (which is the major variable), disease, nutrition, poisonous plants, predation and other factors effecting the level of loss and that while exact numbers of losses to predators may be difficult to determine, year-to-year trends were apparent. Mr. Meike was unable to produce records showing sheep and lamb losses. He did, however, have records of losses for 1981 which indicated, inter alia, that sheep and lambs lost to predators totaled 68 and that there were 623 losses from unknown causes. He stated that

some of the sheep and lamb losses in the unknown category were simply missing at the end of the year and that he could not account for the cause of that loss.

61. Mr. John J. Hines, a sheep and cattle rancher from Gillette, Wyoming, President of the Campbell County Predatory Association, and a witness for the Association, testified that there had been a decline in sheep numbers in Campbell County from 119,171 in 1972 to 57,822 in 1981. He attributed this decline principally to predation problems and attached statements from ranchers who had either gone out of the sheep business or reduced their herds because of predator problems. He indicated that the numbers of coyotes in Campbell County have increased since 1972, basing this on the fact that bounties were paid on an average of 156 coyotes per year in the seven years preceding 1972, while that number had increased to 501 for 1976. He further testified that the number of fox bounties paid in Campbell County averaged 185 per year during the seven year period prior to 1972, but averaged 666 per year during the period 1972 through 1976. Although the table submitted with his testimony appears to show a decline in bounties paid for both coyotes and foxes after 1976, no bounties on foxes were paid in 1978 and thereafter, bounties were paid only during the period April 1 through October of each year, because prices paid for furs were considered a sufficient incentive to hunt coyotes and foxes. An affidavit executed by Mr. Hines on December 14, 1976, is to the effect that he had no confirmed losses of sheep and lambs to coyotes during the years 1972 to and including 1975, that he lost 60 lambs to coyotes in 1976, 50 of which were before docking, that three coyotes were killed and that to his knowledge, he had no other [coyote] kills during the balance of 1976.

62. Mr. Barton Martza, Director of Fish and Wildlife for the Zuni Tribe of New Mexico and a witness for Wyoming, et al. testified that based on contact with members of his family and other stockmen in the Pueblo, both coyote numbers and predation have increased immensely in the region since cancellation of the use of 1080. He submitted the results of a survey of sheep producers in the Pueblo which indicated that during the period July 1 through October 30, 1977 losses to predators, chiefly coyotes, totaled 1,076 ewes, 1,331 lambs and 124 rams. Although he stated there were approximately 18,000 heads of sheep on the reservation at the time of the hearing, inventory figures for 1977 were not reported and it is not possible to convert these loss figures to percentages. From these figures, it appears that losses of adult sheep to predators were approximately 90 percent of losses of lambs. Based on reports from sheep producers, Mr. Martza stated that predation losses were gradually increasing and that the numbers in the flocks were decreasing. He acknowledged, however, that the producers did not keep any records. While he asserted that producers were mostly blaming predation for the decline in sheep numbers, he readily conceded they had problems with overgrazing. From scent-post surveys and aerial observation, he concluded that there were a lot of coyotes on the reservation.

Issue 1(b)

63. Cain, et al. apparently had no data on losses of cattle to predators and, in any event, made no reference thereto. The only survey data in the record as to cattle losses to predators since 1972 is that in CAST Special Publication No. 10, authored by Dr. Wade (finding 29),

which is to the effect that 0.4 percent of calves in the 17 western states were lost to predators. 7/ Statistical analysis included with the testimony of Dr. John Schaub (finding 44) shows that calf losses to predators have increased since 1972 in 13 of 15 western states, only New Mexico and North Dakota showing no statistically significant changes. Individual ranchers from Colorado, Texas and Wyoming testified as to predation losses to cattle, chiefly calves, since 1972. From this testimony it could be inferred that predation to cattle was not a problem prior to 1972. Coyotes are the principal predator on cattle, preying on calves at birth or shortly thereafter.

64. Mr. Jim Barron, III, a rancher from Spur, Texas, who with his family owns and operates two cattle ranches, and a witness for Wyoming, et al., testified that prior to 1972 losses of cows and calves to predators on the smaller ranch (Spur Headquarters) were minimal. He further testified that Compound 1080 had been used on the Headquarters Ranch until the mid-1950's and that it was used on neighboring ranches after that time, creating a perimeter, which coyotes seldom penetrated. He stated that in the winter of 1972-73, they lost about 36 calves and five cows to predators, chiefly coyotes. This amounted to 12.46 percent of calves and 1.73 percent of cows. A table showing cattle losses on the Headquarters Ranch, attached to his testimony, indicates

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7/ A document "Cattle and Calf Losses to Predators--Feeder Cattle Enterprises in the United States" by C. Kerry Gee, publishing the results of an industry survey in 1976 by the USDA and reporting losses for 1975, was used as a cross-examination exhibit, but is not in the record.

these losses occurred in 1972. The table reflects that highest losses to predators were incurred in 1973, numbering 53 calves and four cows, constituting 17.60 percent and 1.33 percent, respectively of the herd. Mr. Barron testified that some calf losses attributed to unknown causes, two in 1972 and three in 1973, were actually indirectly caused by predation, i.e., the calves acquired scours from the practice of penning heifers and cows to protect them from coyotes.

65. Confronted with a table from Gee (note 7, supra) which appeared to show average cattle losses in the Southwest Region, which includes Texas, substantially below those shown in his table, Mr. Barron responded that neighboring ranchers were losing the same amount and that ranchers were just beginning to realize the extent of losses to coyotes. He stated that calf losses to coyotes on the larger of his ranches (Tongue River) averaged 3 percent of the calf crop from 1975 through 1981. Calf losses to predators on the smaller ranch have declined substantially, numbering six in 1980 and three in 1981, or 1.79 percent and 0.89 percent of the herd respectively. No cows were lost to predators in either of these years. Mr. Barron attributed the decline to aerial hunting by the FWS, the use of M-44's, guard dogs and ground hunting of coyotes for their pelts.

66. Mr. Dan Tracy (finding 48) submitted a table showing predator losses of calves of one each in the years 1973 and 1975, and two in 1974. He had no losses of calves to predators in 1976 and 1977. He did, however, lose two calves to predators in 1978 and 1981, three in 1979 and four in 1980.

67. Mr. Marion Scott (finding 57) testified that he had few problems with predators in his cattle operation prior to 1974, but in 1974 he lost five calves to coyotes and has lost one to five calves for that reason every year since that time, with the exception of 1982. He did not lose any calves to coyotes in 1982, because he adopted a semi-confinement calving operation in order to minimize predation losses. He stated that this substantially increased costs for feed and labor.

Issue 1(c)

68. Cain, et al. made no reference to losses of goats to predators. As we have seen (finding 38), USDA Forest Service data combines producer reports of losses of sheep and goats to predators and poisonous plants. Losses to predators as a percent of animals grazed during the period of 1080 use, ranged from a low of 0.79 percent in 1960 to a high of 2.39 percent in 1972. Losses to predators in the post-1080 years as a percent of animals grazed were 2.07 percent in 1973, 2.60 percent in 1974, 2.17 percent in 1975 and 1.88 percent in 1976. Because the number of animals grazed does not include lambs and kids (a ewe and lamb or a nanny and kid being counted as one), while losses to predation does include lambs and kids, actual predation losses are approximately one-half of the above percentages.

69. The article by Dr. Shelton (finding 6) reflected that goat losses to predators averaged 4.90 percent of inventory (adults and kids) during

the five-year period 1967 through 1971, with the highest being 10.07 percent in 1970 and the lowest being 2.11 percent in 1969. Losses to all causes during this period averaged 12.01 percent of inventory and losses to predators as a percent of all losses averaged 40.79 percent, ranging from a high of 85.29 percent in 1970 to a low of 26.13 percent in 1967. Because kidding was essentially a confinement operation, these are post-marking losses.

70. Data on the precise number of goats in the United States are apparently unavailable. Texas, however, has a greater number of goats than any other state (1,450,000) as of January 1, 1982. Surveys by the Texas Crop and Livestock Reporting Service indicate that predators were responsible for the loss of 45 percent of all losses of goats and kids in 1967 and this had risen to 72 percent in 1978, with coyotes being responsible for 24 percent of all losses of goats and kids. It appears, however, that predator losses of goats in 1981 totaled 67,450 head or approximately 4.6 percent of inventory.

71. The only rancher owning goats to testify was Mr. L. Charles Howard, Jr. of Meridian, Texas. He testified that he started goat production in 1965 and did not have any problems with predators until 1974. He asserted that coyotes began killing his lambs, forcing him to sell his small flock of sheep and that during the period 1974 to 1978, he was losing approximately 40 goats per year out of a flock of 200 to predators. In 1977 and 1978, Mr. Howard joined with a group of ranchers having predation problems in hiring a private trapper, who removed approximately 50 coyotes per year from the Howards'

pastures and adjoining areas. Thinking that the number of coyotes had been reduced to the point that he could expand his operation, he increased his goat herd to 1100 head in 1979. He testified that as soon as nannies and kids were turned out of the shed, coyotes began killing them in the pastures. When the goats were penned at night, coyotes would kill in the daytime. He stated that because of severe predation losses in large brushy pastures, he was forced to confine his goats to a 130-acre pasture by day and a four-acre trap at night, which resulted in a severe parasite problem.

72. Mr. Howard lost 91 adult goats to coyotes in 1979 and an additional 91 adults lost to parasites were attributed to predation caused by the necessity of penning the goats at night or confining them to small pastures for protection from coyotes. Out of a herd of 300 breeding nannies, he normally could have expected a crop of at least 240 kids. Only 27 survived, however, and he estimated that predators killed or otherwise caused the loss of 213 kids or approximately 89 percent of the crop. The remains of approximately one-half of these were found, others being missing or simply obliterated. As an example, he indicated that a hoof or an ear would be found. Intensive control measures, including use of the toxic collar (findings 75 - 79, infra), were instituted and losses of adult goats declined to 45 out of 1500 head (approximately 3 percent) in 1980 to 32 out of 1800 (1.8 percent) in 1981. Losses of kids to predators were 17 in 1980 and 27 in 1981, 15 of which were attributed to coyotes and 12 to raccoons or grey fox.

Issue 2

73. The toxic collar consists of a rubber reservoir containing a toxic liquid, in this case a solution of 1080,[8/] attached to the necks of sheep or goats by straps. Use of the toxic collar is based upon the principle that coyotes normally attack sheep and goats by biting the necks or throats. The idea is that in the course of such an attack the collar would be punctured and the coyote would receive a lethal, oral dose of 1080. Although puncture of the collar in this fashion results in removal of the offending coyote, the coyote's attack usually also results in the death of the sheep or goat to which the collar was attached.

74. The toxic collar has been extensively tested by the FWS under an experimental use permit and the FWS has applied for registration of Compound 1080 in the toxic collar. Field tests of the collars were conducted in Idaho, Montana, Texas and Alberta, Canada, during the period June 7, 1978 to and including March 31, 1980. Of 28 field tests during this period, 17 were considered successful in that predation either stopped or declined following use of the collars. Eleven tests were unsuccessful because predation stopped for unknown reasons or coyotes did not attack collared animals. Of 52 attacks by coyotes on collared sheep during the period June through October 1978, 36 or 69 percent of collars were punctured

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8/ In addition to sodium fluoroacetate, field tests of the collar have been conducted using sodium cyanide and diphacinone as the toxicant. Sodium fluoroacetate has been adjudged most successful.

by coyotes. Carcasses of five poisoned coyotes were found. Of 42 attacks on collared sheep or goats during the period November 1978 through March of 1980, 30 collars or 71 percent were punctured. Because coyotes were removed by conventional control techniques on the test ranches or on adjacent properties during the period of the tests, it is not possible to attribute the decline or cessation of predation solely to the collars. It is clear, however, that such a reduction or cessation following evidence of coyote attacks on collared animals whereby collars were punctured, constitutes convincing, if circumstantial, evidence of collar effectiveness. All tests of collars to date have been in fenced pastures.

75. Extensive tests of the toxic collar on goats have been conducted at three separate sites on the L. C. Howard Ranch, Meridian, Texas (finding 71) beginning in late July 1979. At the time, the Howards were losing one or more Angora goats to coyotes each day, 12 coyote kills having been verified as occurring in the week ending July 23, 1979. Upon the beginning of the tests (Texas Test No. 1), collars were placed on 20 small kids. Collared kids were killed and collars punctured on the nights of July 27, August 10, September 6, 12, 21 (a collared kid killed and the collar missing, but probably broken) and 22, October 7, 22, 23 (the collar missing but probably broken), January 11 and 25 and February 22, 1980. Coyote predation declined markedly, there being three kills in November and one in December

1979, three in January, four in February and one in March of 1980. Although no poisoned coyotes were found, it was concluded that at least 13 coyotes were probably killed as a result of puncturing collars. Because at least 15 coyotes were taken by conventional means within a five-mile radius of the test site during the same period, the reduction in predation could not be attributed solely to use of the collar.

76. During the period of the test referred to in the preceding finding at least one coyote avoided the collar by attacking goats from the rear or flank, killing one uncollared kid, one adult goat and two collared goats in October, one collared goat in November 1979, and two adult goats in February and one collared kid in March of 1980. Although this point of attack is characteristic of dog kills, dog kills were ruled out because of clear coyote tracks in the vicinity of some of the remains. Obviously, the collar is ineffective under such circumstances.

77. Tests at another site on the Howard Ranch (Texas Test No. 2) resulted in the killing by coyotes of one collared kid and a collared nanny on August 19 and another collared kid on August 22, 1979. All three collars were punctured and there was no further predation at this site into March 1980. While no dead coyotes were found, it was concluded that two or three were probably killed. Twelve coyotes were taken by conventional means within a five-mile radius of this site during the period late August 1979 through May of 1980. This test was considered successful and especially noteworthy

because, in spite of the absence of predation after August of 1979, there was evidence of occasional coyote activity in the area.

78. Texas Test No. 3, also on the Howard Ranch, consisted of two adjacent 600 acre pastures. This site had not been used for goats for several years prior to 1979 and coyote predation began shortly after goats were introduced in late July and early August. Fourteen uncollared goats were killed by coyotes during the month of August. Three collared goats were killed on August 23, 24 and 28, 1979, and the collars punctured. A dead coyote was found on August 24 and analysis of tissues from this coyote revealed substantial levels of 1080. A fourth collared goat was attacked from the rear, but not killed. The collar was not punctured. This goat was put to death because of the severity of its wounds.

79. Despite the almost certain removal of one coyote by the toxic collar and the probable removal of two others, predation at Texas Test No. 3 continued in September, another 14 uncollared goats being killed by the normal method of coyote attack, bites to the throat. Two uncollared goats were killed by attacks from the rear. Three collared goats were killed and the collars punctured. Two dead coyotes having pink stains on their teeth, presumably from the Rhodamine B dye in the collars, were found on September 24 and October 5, 1979. Compound 1080 residues were found in muscle

samples from the coyote found on September 24. Predation at this site dropped dramatically thereafter, there being no predator kills in October, only one in November, three in December 1979, one in January and two in March of 1980. Although 19 coyotes were taken by other means within a five-mile radius of this site, this test was considered successful, six coyotes being probably taken by the collar, and the chronological record of collar punctures by coyotes, providing convincing, if circumstantial evidence, of the effectiveness of the collar.

80. Tests of the toxic collar in 1979 at another ranch in Texas, which had apparently suffered heavy losses of goats to foxes and coyotes, were unsuccessful, because predation ceased or declined for undetermined reasons and no attacks on collared livestock occurred. At Idaho Test Site No. 2, coyotes killed 14 percent of lambs between docking and marketing in 1978. Losses the previous year were approximately 50 percent greater. Toxic collars were used beginning in June and nine collars were punctured during July and August 1978. At least eight coyotes were considered to have been killed, although no dead coyotes were found. Predation declined markedly, there being only two kills in September and five in October 1978. Three more collars were punctured one in December 1978, one in June 1979 and one in August 1979. There were two kills in November and December 1978, none during the period January through April 1979,

four in May, three in June, two each in July and August, four in September, eight in October and three in November 1979. The cooperating rancher attributed lower predation losses in 1979 to successful use of the collar in 1978. While circumstantial evidence was considered to support this conclusion, other forms of predator control employed concurrently precluded unequivocal adoption thereof.

81. Tests of two other sites in Idaho in the summer of 1978 gave no information as to collar effectiveness because problem coyotes were apparently removed by other means and collared animals were not attacked. Like the tests on the Idaho site referred to in the preceding finding, tests of the collar at Montana Test No. 1 were continued from 1978. Predation stopped from late September 1978 through April of 1979 after two collars were punctured by coyotes in September of 1978. Although collars were reintroduced in late May of 1979, after five lambs were killed and again in June after three more lambs were killed, no collared lamb was attacked and the only puncture of a collar was attributed to wire. Difficulty of targeting attacks to collared sheep was attributed to the presence at a distance of about one-half mile of a flock not involved in the test.

82. Alberta Test No. 1 was begun on a sheep ranch in Cardston, Alberta, after six coyotes killed about 15 sheep in early October of 1979. Nine young ewes weighing approximately 100 pounds each were collared and placed in an 80-acre pasture on October 19. On October 23, six collared ewes were killed along with three bucks in a nearby field. Four of the ewes were bitten below the collars and thus the collars were not punctured. One collar was punctured and one collar was missing, but appeared to have been punctured. No further predation occurred at this site through March of 1980, although coyotes continued to frequent the area. This test was listed as apparently successful, notwithstanding the fact eight coyotes were shot in the vicinity of the test site in October of 1979, because these coyotes were apparently killed prior to October 23. The fact that coyotes were able to bite the throats of sheep without puncturing some of the collars emphasized the need for larger collars on large sheep.

83. The Texas Agricultural Experiment Station applied for and was granted (May 1980) an experimental use permit (EUP) for testing of 1080 in the toxic collar for the control of coyotes. Initially for a period of one year, the EUP has been extended and the tests are presently scheduled to end in December of 1982. During the period August 1980 through December 31, 1981, collars were deployed on 10 ranches (including the Howard Ranch, Meridian, Texas), 60 collared animals were killed or attacked by coyotes or dogs and 33 collars were punctured. A total of 116 uncollared animals were attacked

or killed in target pastures. Five coyotes and one dog were found, which were considered to have been killed by puncturing toxic collars. Various targeting strategies were tested, the most effective being collaring all animals in a target flock or collaring all small animals (lambs or kids) within the target flock. The latter strategy appeared to be effective at most sites. Ineffectiveness of collars was attributed chiefly to difficulties in directing attacks to collared animals. Coyotes were taken by conventional means on the test sites or on adjacent properties and all instances of apparent success of the collar in reducing or eliminating predation could not be attributed solely to the collar.

84. Toxic collars have also been tested by the New Mexico Department of Agriculture in 1981 under an experimental use permit. These tests were conducted by ranchers who were qualified as certified applicators and issued approximately ten collars each. Because of an inadequate number of collars, problems with managing sheep so as to direct coyote attacks to collared animals and failure of coyotes to puncture the collars at least five of six tests were unsuccessful.

85. Mr. Roy McBride, a self-employed predator control biologist from Alpine, Texas, inventor of the toxic collar and a witness for The Toxi-Collar Company, emphasized the selectivity of the collar and its ability to remove depredating coyotes which could not be taken by conventional techniques. He testified that the only experience required for successful use of the collar was recognition of the circumstances where it would work. He had conducted tests of the collar under the FWS experimental use permit on 15 sites in Texas in 1978, nine of which were successful. He acknowledged that he had biased the results in favor of success by rejecting proposed sites, e.g., sporadic killing over a wide area, where the collar was not likely to work. He stated that if a coyote was killing consistently in a localized area, use of the collar was more likely to be successful.

86. Mr. McBride testified that to his knowledge, the collar had not been tested under open range conditions and that because of the difficulty of targeting attacks to collared livestock, the collar was unlikely to be effective in such situations. He rejected suggestions that coyotes seemed to sense something different about collared animals and thus declined to attack them, or moved elsewhere, asserting that coyotes had killed lambs wearing bells and that if it was that easy to discourage coyote attacks, coyote predation would not be a problem. He also rejected criticism that targeting coyote

attacks on collared animals was inhumane, declaring that lambs were being killed by coyotes anyway, the only difference being that if the coyote punctured the collar, the coyote was also killed.

87. Among the disadvantages of the toxic collar is the necessity of sacrificing collared livestock in order to remove problem coyotes. Another disadvantage is the labor involved in penning or removing from the area of anticipated coyote attack uncollared livestock so that the attack will most likely be on collared animals. Also labor required to install the collars, in checking and resetting collars which have slipped out of proper position, i.e., the larnyx region immediately below the ears, can be extensive. Although these labor costs exceed the cost of the collars ($15.50 to $16.75 each) and the cost of sacrificial animals, the collars are too expensive to install on large numbers of livestock. Mr. McBride indicated that if the collars were more widely used, the unit cost could be reduced. Collars are, of course, ineffective against particular coyotes and other predators, which attack livestock at other than throat areas and because of the difficulty in targeting attacks to collared animals, the collar does not appear to promise much hope of success under range conditions.

88. Single lethal dose baits (SLDs) consist of a bite size cube or ball of meat, tallow or similar material into which has been inserted a dose, lethal to canines, of toxicant. Although Montana (Department of Livestock), South Dakota (Department of Agriculture) and Wyoming (Department of Agriculture) have applied for the registration of sodium fluoroacetate in SLDs to control coyotes, SLDs using Compound 1080 have not been extensively tested in the United States. Large quantities of similar baits, referred to as drop baits, containing strychnine were used prior to 1972 for the control of predators, chiefly coyotes.

89. Dr. James W. Glosser, State Veterinarian, Administrator of the Animal Health Division of the Montana Department of Livestock and a witness for Wyoming, et al., reported on the use of 1080 in SLDs to suppress the population of stray dogs and cats on Guam in 1967 and thus control an outbreak of rabies. At the time of the first confirmed cases of rabies (March 1967), the population of stray dogs and cats on the island was estimated to range from 20,000 to 60,000. A program of capturing and vaccinating these animals was unsuccessful as they easily escaped detection and capture in the dense jungle growth. A program involving the pick-up of stray animals, shooting of stray dogs and cats, and the use of snares and traps was begun in June 1967. These methods resulted in the removal of approximately 12,000 animals. Additional cases of rabies were confirmed in August of 1967 and it was determined that more drastic means of reducing the population of stray dogs and cats were required.

Strychnine was considered but rejected because of its high toxicity to all birds and animals and the risk to humans; the "coyote getter" was tried briefly but its use was discontinued, because it was ineffective against cats, not sufficiently effective against dogs, required too much time to retrieve and reset and was extremely dangerous to humans; and Compound 1080 in large meat-baits placed at garbage dumps was tried, but found wanting, because dogs were not lured out of the villages and the baits spoiled rapidly in Guam's climate.

90. A program involving the use of Compound 1080 in SLDs was instituted in October 1967. Each one-ounce bait contained 3.4 mg. of 1080. Baits were placed at night and on paper plates at least 200 feet apart in order to minimize the possibility of target species consuming more than one bait and to facilitate retrieval. All uneaten baits were removed on a daily basis (by 4 a.m.) in order to minimize risks to humans and non-target species. The program continued for 15 months, with the period of most intensive use October through December 1967. Although only approximately one-third of the animals considered to have been poisoned by 1080 during this period were found, Dr. Glosser estimated the number of cats and dogs destroyed by 1080 during the October - December 1967 period at roughly 6,000. Of 16,239 baits placed during the 15-month SLD program, 14,053 or 86.1 percent were taken. A total of 16,799 dogs and cats were destroyed by all means in 1967, declining to 3,035 in 1968. This

includes only carcasses collected by government personnel and is exclusive of animals destroyed privately or on military reservations.

91. There were no confirmed cases of rabies after September of 1967, and other means of control were used concurrently with 1080. Although he acknowledged that, depending on whether the original estimates of the dog and cat population were on the high side, there could have been as many as 25,000 dogs and cats on Guam when the 1080 program was discontinued, Dr. Glosser considered the program a success, contending that the removal of an additional number of dogs and cats lessened their density and stopped animal-to-animal transmission of rabies. There is evidence that stray dogs and cats are still considered a problem on Guam and that SLDs containing 1080 were being used in their control as late as December of 1975.

92. SLDs containing 1080 are currently used for wolf and coyote control in British Columbia. For the latter case, 3 mg. of 1080 in a powder formulation are inserted into approximately 50 grams of bait material. A maximum of 12 baits are placed at the site of a confirmed coyote attack, that is, around a livestock carcass or scenting station. Normally, however, only two to four baits are placed as the number is limited to the number of coyotes considered to be causing the problem. Baits are well spaced and buried under soil or snow to minimize the chances of more than one bait being eaten by the same coyote or the poisoning of non-target species. Of 108 baits placed in 1980 and 1981 for coyote control, 64.8 percent were taken by coyotes, 3.7 percent by non-target species and the balance were retrieved by Ministry of

Environment personnel in accordance with established procedures. In 1980-81, four 1080 bait stations weighing approximately 8 kg. each were placed, of which 18 kg. or 56.3 percent were considered to have been consumed by coyotes. Dr. Frank S. Tompa, Ministry Staff Specialist in Carnivore and Wildlife Management, and Coordinator of Predator Control Programs, Ministry of Environment, British Columbia and a witness for Wyoming, et al., considered the Compound 1080 program to be as successful as other predator control methods in removing wolves and coyotes preying on livestock. Because of regulations requiring baits to be retrieved no more than 14 days after placement, he acknowledged that there were occasions when depredation continued after the baits were removed. The predator control program in British Columbia is relatively small, Dr. Tompa estimated that the number of coyotes taken by predator control personnel each year by all methods may be as low as 100 to 120, while the number taken annually for their pelts was in the range of 3,000 to 5,000.

93. SLDs impregnated with Compound 1080 are currently used for dingo control in Queensland, Austrailia. Beef, horse or kangaroo meat is used as bait and the minimum bait size is 125 grams. While preparation of the baits is apparently restricted to government or authorized personnel, distribution of the baits (land or air) is by the landholder. The 1080 program is considered effective, its use being credited with marked reductions in the numbers of "bitten" calves and an increase in lambing percentages. Compound 1080, however, is also used in large baits and evidence in the record is not sufficient to enable evaluation of the effectiveness of these methods of 1080 delivery.

94. Cain, et al. had available data indicating that 632,187 strychnine drop-baits were placed by ADC personnel of the FWS in 1960, that placements increased to approximately 924,000 in 1964, decreased to approximately 545,000 in 1969 and increased to approximately 821,000 in 1970-71. During this period, the placement of 1080 large-bait stations declined from 15,349 in 1960 to 11,373 in 1970. The concurrent use of 1080 large-bait stations complicates the matter of determining the effectiveness of drop-baits.

95. Dr. Samuel L. Beasom, Associate Professor in the Department of Wildlife and Fisheries Sciences at Texas A&M University and a witness for the Texas Department of Agriculture, performed a study in 1971 and 1972 to determine effects of predation on white-tailed deer populations. The study was performed by application of intensive control techniques to remove predators from a 5,400 acre area of the King Ranch in South Texas and comparing the results with a similar sized area without predator control approximately five miles distant. Specific control techniques instituted on February 1 of each year and terminated on June 30 of 1971 and 1972, included steel traps, M-44's, strychnine meat-and-egg-baits and shooting both at night and during the day. Approximately 2,000 strychnine treated egg-baits were used in each of the two years and approximately 3,500 meat-baits were used in 1971 and 4,500 in 1972. A total of 188 coyotes and 120 bobcats were removed from the experimental area during the two-year period. Strychnine drop-baits were considered to have been responsible for the removal of 40 coyotes and two bobcats.

Fifty-six coyotes were taken by M-44's, which means that approximately 51 percent of coyotes removed were taken by toxicants. Dr. Beasom concluded that essentially all coyotes and bobcats had been removed from the approximately nine-square-mile area. From aerial transects, it was determined that the fawn:doe ratio on the experimental area was 0.47 in 1971 and 0.82 in 1972, while that in the control area was 0.12 and 0.32, respectively. It was concluded that intensive predator control could greatly increase white-tailed deer densities.

96. Mr. Joseph B. Gurba, Head of the Crop Protection and Pest Control Branch of the Alberta Department of Agriculture and a witness for Wyoming, et al. presented a table showing the numbers of cyanide cartridges, strychnine cubes and 1080 bait stations used in the Province during the period 1951 to and including 1980/81. The table reflects that strychnine cubes were first used in Alberta in 1953, that 195,500 of such cubes were used in 1955 and that the number has since steadily declined to 3,340 in 1980/81. Fifty 1080 meat-bait stations were placed in 1951, the number increasing to 778 in 1957, declining to zero in 1978 and numbering 14 in each of the years 1979/80 and 1980/81.

97. Mr. Gurba characterized the Alberta predator control program as successful, explaining that its object was not to exterminate coyotes, but to reduce predator damage to tolerable levels. He attributed the success of the program, notwithstanding the steady decline in the number of 1080 meat-bait stations, to the use of strychnine drop-baits,

cyanide guns and the hiring by the Province of eight predator control specialist in 1972-73. He asserted that most 1080 meat-bait stations were placed in southwestern Alberta where one-third of the sheep production in the Province was concentrated and which had a high level of coyotes. He stated the 1080 stations were an area control program, while cyanide guns and strychine drop-baits were used in specific cases to take killer coyotes. He estimated the average number of coyotes taken annually by each 1080 bait station, if the bait was completely consumed, at 30, even though only 20 coyotes considered to have been poisoned by 1080 were found in the last five years. Mr. Gurba indicated that the number of coyote pelts marketed annually in Alberta in recent years ranged from 27,000 to 35,000, while the average number taken by all methods each year in the predator control program ranged from 1,500 to 3,000 over the last five years.

98. The Montana Department of Livestock's application for an emergency exemption under Section 18 of the Act so as to permit the use of 1080 in SLDs for the control of depredating coyotes and feral dogs was filed under date of July 24, 1981. The application envisaged the placement of 3.6 mg. of 1080 in 15 grams of bait material and that a maximum of 25 baits would be placed on each section. In September of 1981, the Montana Department of Agriculture submitted a plan proposing a field test of SLDs in order to address questions of, inter alia, the attractiveness of such baits to all forms of wildlife. The plan stated that research was needed to assess the

selectivity of such baits to coyotes under various delivery conditions. Dr. Glosser (finding 89) agreed that this research was necessary and testified that the plan was in the process of being formulated or completed.

99. Implementing the planned field test, baits were placed on the surface, at elevations approximately 18" above the ground and buried. Coyotes accepted 76 percent of baits placed on the surface, 48 percent of those placed at elevations and 67 percent of those buried. After 25 days, apparently non-target species predominantly accepted the baits. During the initial period of the test, there were a substantial number of site visits by non-target, small mammals. These tests were conducted using lures or attractants, but not toxicants. Dr. Glosser acknowledged that SLDs used in Montana could not have the same degree of safety at the present as was achieved in Guam (nightly or daily retrieval of uneaten baits being impractical) and that additional testing and work to minimize acceptance and hazards to non-targets was necessary. He insisted, however, that sufficient data was available to support registration because of the oral toxicity data on 1080, its selectivity and the lack of documented instances of human deaths or illnesses from use of 1080 as a predacide. He indicated that some "fine tuning" would be required as to dosage, placement, type of lure, etc. to minimize non-target risks. He considered these to be judgment matters for those administering the program.

100. Testimony on methods of application of SLDs was given by Dr. Major L. Boddicker, Extension Wildlife Specialist, Department of Fishery and Wildlife Biology, Colorado State University, and a witness for

USDA. According to Dr. Boddicker, efficient placement of SLDs and placement of baits for trap use are identical. He explained that effficient SLD bait placement in relation to large features of the landscape (macro location) is the same as for traps, that is, along roads, streams and mountain features. He further explained that SLD bait placement was identical in relocation to small features (micro locations) of a locality (cow chips, grass hummocks, trail intersections). Dr. Boddicker testified that the carcass of a dead horse, sheep or cow are often used as "draw baits" or stations to concentrate coyote activity in an area and increase the probability that the coyotes could be taken by mechanical devices or SLDs. He asserted that baits can be formulated and tailored to the season, animal food preferences, animal behavior, animal size and capacity to hold food. He described a wide variety of lures which can be used to attract an animal to a trap, snare or an SLD. He stated that the selectivity of lures and baits could be increased by choosing those most appealing to the target species and by placement, e.g., coyotes preferring open feeding areas. Dr. Boddicker described two instances of specific coyote predation problems on Colorado ranches where he considered that placement of SLDs containing 1080 in conjunction with appropriate lures would have an excellent probability of providing either immediate relied or removing the offending coyotes within three days. Although Dr. Boddicker did not advocate any specific limit on the number of SLDs per square mile, township or otner area, it is obvious that he contemplates use of SLDs with 1080 will be extremely limited ("minor use" in his words) and only after

study of the particular circumstances and determination by a professional that such use is appropriate. Dr. Boddicker apparently contemplated covering some of the SLDs with flat stones or other objects. He testified, however, that efficiency (coyote acceptance) was reduced by approximately 40 percent to 60 percent over that of placing the baits on elevated locations up to 24" above ground level.

101. In 1981, the Fish and Wildlife Service applied for an experimental use permit in order to test the effectiveness and selectivity of 1080 in SLDs. A study "Field Evaluation Of An Antifertility Agent, Stilbestrol, For Inhibiting Coyote Reproduction," in evidence, conducted over a five-year period (1963 through 1967) by the FWS suggested that other carnivores, with the possible exception of skunks and foxes, seldom ate individual baits intended for coyotes. This was attributed to selective bait placement, the relatively small number of baits per square mile and the extended home range of coyotes. Coyotes, however were credited with taking only 22 percent of the baits. Mr. Roy McBride (finding 85), an employee of the FWS at the time, participated in the distribution of these baits in southwestern Texas. He considered that coyote acceptance of the baits was poor. A March 1981 FWS report on evaluation of baiting techniques, using markers, i.e., radioactive or similar material rather than toxicants, with which Dr. Glosser was familiar, reflects difficulty in determining coyote and non-target acceptance of baits. Dr. Glosser pointed out that the sample size was not satisfactory. This was apparently due to the necessity of killing or capturing particular coyotes and other animals that had consumed baits.

102. Large-bait stations are substantial portions of horse, cow or sheep meat into which has been injected an acqueous solution of 1080. Injection was by means of a syringe or meat pump at a concentration of 1.6 grams of 1080 per hundred pounds of meat. FWS, formerly Bureau of Sports Fisheries and Wildlife, presently Animal Damage Control Division, policy was that injections be made at evenly spaced intervals of approximately four inches while the meat was still warm in order to facilitate even distribution and avoid hot spots. The minimum number of stations required to achieve effective management normally were to be placed, not to exceed an average of one per township. As indicated (finding 94), 15,349 bait stations were placed in 1960, 16,692 in 1963 and 11,373 in 1970. All stations were placed west of the 100th meridian. Cain, et al. concluded that evidence that the stations were effective in reducing coyote predation on livestock was lacking. This conclusion was based on evidence indicating that losses of sheep to all causes remained constant and that there was no evidence of a significant decline in coyote populations.

103. Compound 1080 impregnated in large meat-baits appears to have first been used in the United States for the control of predators in the winter of 1944-45. A 1948 article by Weldon Robinson, referred to in the testimony of Dr. Wagner (finding 40) but not in evidence, reports on the experimental placement of 1080 baits in Colorado, Nevada and Idaho in areas of several hundred square miles during the

winters 1944-45, 1945-46 and 1946-47. The poison thallium was used concurrently in similar placements and had apparently been used for seven previous winters. Reports from ranchers indicated that lamb losses were reduced by an average of 87 percent. Rates of predation loss suffered by the ranchers previous to these experiments were not furnished.

104. Dr. Wagner also referred to a 1981 article by Lynch and Nass (not in evidence), which compiled information on annual sheep and goat losses to predation in national forests (Forest Service Regions 1-6) during the years 1960-78, and on the annual number of 1080 stations used in the same areas during the period 1960-72. Correlating annual sheep-and-goat-loss values with the annual number of 1080 stations and finding them statistically significant, Lynch and Nass concluded that the declining number of 1080 stations was causally related to increasing sheep and goat losses. Dr. Wagner questioned whether this correlation represented cause and effect, emphasizing that although lamb losses in the early 1950's following the introduction of 1080 appeared to be lower than in previous years; such losses began rising in the mid-1950's and continued to rise during the period of 1080 use, peaking three to five years after the 1972 ban on 1080.

105. Being of the belief that widespread use of 1080 large-bait stations was for the purpose of suppressing regional coyote populations on the assumption that there was a relationship between coyote densities and predation, Dr. Wagner concluded that the effectiveness of the use of

1080 in such stations must be judged primarily on its effectiveness in reducing regionwide or statewide coyote populations, and ultimately sheep losses over areas of this size. Sheep losses were considered ante (findings 41 -42). In an effort to determine if coyote populations had been effected by the use of 1080, during the Cain Committee deliberations, he developed an index from the man-years of effort and the number of coyotes taken by all methods from FWS records for the States of Montana, Wyoming, Idaho, Utah, Colorado, Texas, New Mexico and Arizona. He reasoned that if coyote populations were high, the number of coyotes taken per man-year of effort would be high and that correspondingly, if coyote numbers were low, the number of coyotes taken per man-year of effort would also be low. For each state, he divided the number of coyotes taken by the man-years of effort expended for each year and graphed the results, in order to compare the values prior to the period of 1080 use (1940 to 1948-50) with those prevailing during the period of such use (1948-50 to 1970). The results showed markedly lower index values during the 1080 period than in the pre-1080 period for Idaho, Montana, Wyoming and Utah and little, if any, differences in the other four states between the two periods. He acknowledged that the validity of this index depended on the assumption that the level of effort in predator control by FWS personnel remained constant.

106. An index similar to that of Dr. Wagner's, was developed by Linhart and Robinson in 1972 based on the number of coyotes caught in traplines set by FWS personnel in Wyoming, Colorado and New Mexico during the

years 1941, 1950, 1960 and 1970. Coyotes caught in traps in Wyoming in the latter three years were 19, 8, and 21 percent, respectively of those caught in 1941, prior to the use of 1080. The numbers of coyotes caught in Colorado and New Mexico in 1950 were substantially below the numbers caught in 1941. By 1960 and 1970, however, coyote catches equalled or exceeded the 1941 catch. Validity of this index is, of course, dependent upon a constant level of trapline effort. Dr. Wagner pointed out that these results appeared to parallel data in his index, i.e., an apparent reduction in coyote numbers in Wyoming, but little, if any, effect in Colorado and New Mexico during the two-decade period of 1080 use. He noted that the data suggested that 1080 may have reduced coyote populations materially in the northern and central intermountain states, but had no significant impact on statewide coyote populations in the more southerly states. The apparent reduction in coyote populations in Idaho, Wyoming and Colorado did not appear to result in a corresponding decrease in predation (finding 41).

107. In an effort to measure trends in coyote and other predator populations, the FWS in 1972 developed an annual network of "scent-post lines" in 18 states. A scent-line consists of 50 scent stations spaced at 0.3 mile intervals totaling approximately 15 miles in length. A scent station consists of a three-foot circle of bare, smoothed or sifted earth in the center of which is placed a capsule of scent attractive to coyotes and other carnivores. Observers check the

scent-stations for four successive nights each fall, record the number of tracks by coyotes and other mammals (tracks of a species being recorded as a single visit regardless of number) and smooth the soil for the following night. Results are expressed as total visits per 1,000 scent-station nights and are totaled for the lines in each of the 18 states. Scent-station visits are presumed to bear a constant relationship to population density and the indices provide only a measure of relative abundance and not an estimate of actual numbers. Data from an FWS publication "Indices of Predator Abundance In the Western United States" (1980), which reports results of scent-line surveys, plotted by Dr. Wagner indicates that coyote populations appeared to have increased following the suspension of 1080 in 1972, declined from the period 1975 to 1977, increased slightly in 1978, and have since remained almost constant. This information implies no significant change in coyote populations. Dr. Wagner speculated that a possible reason for the coyote population remaining constant or relatively so since 1972, was increased aerial gunning by FWS animal damage control personnel and increased harvest of coyotes for their pelts since 1975.[9/] Mr. Hawthorne (finding 109) was critical of scent-line survey data, asserting that of 60 lines in

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9/ This seems a better explanation than the spread of the parvo virus, a disease apparently fatal to canines, which Dr. Terrill advanced as a reason for an apparent decline in predation losses during the period 1978-80.

Texas, 24 were not run in 1980, that there were problems with the scent and to rely very much on such data would, in his opinion, be an error.

108. Mr. Norman C. Johnson, an ADC Wildlife Biologist employed by the FWS in Albuquerque, New Mexico and a witness for Wyoming, et al., considered 1080 meat-baits a nearly perfect control tool, in terms of environmental safety and cost efficiency, for the reduction of coyotes in local areas. He testified that Compound 1080 bait stations provide the capability of selectively reducing concentrations of coyotes in livestock production areas prior to lambing and calving seasons at minimum costs in terms of manpower and other operational expenses. He contended that this "preventive control" in livestock production areas allowed ADC field personnel to devote more time to individual problem coyotes, which had eluded the baits or moved in from adjacent areas. This testimony was based on extensive experience Mr. Johnson acquired as a District and State Supervisor of ADC operations in 1959-64 and 1968-71 in North and South Dakota, Nebraska and Colorado, during which 1080 impregnated meat-baits were used for control of coyotes and red foxes. He acknowledged that, while the need for a bait station in a particular area was based on the presence of coyotes, there was no attempt to determine coyote numbers or a particular level of coyote population in an area the baits were intended to achieve. He also acknowledged that the number of coyotes taken by the baits was not known, because very few poisoned coyotes were found.

109. Mr. Donald W. Hawthorne, State Supervisor of the Texas Animal Damage Control program for the FWS and a witness for Wyoming, et al., testified that during his four years (1965 through 1969) of using 1080 bait stations in Utah and Oklahoma, it was apparent that the stations provided substantial benefits in reduction of livestock losses, particularly in the Oklahoma Panhandle. He pointed out that Texas was the leading sheep producer in the U.S. and also the leading state in Angora goat production. He asserted that Texas sheep and goat production was concentrated in the Edwards Plateau area of West Central Texas, which due to intensive control efforts was literally coyote-free from 1945 to 1970. He stated that since the 1972 ban on 1080, strychnine and sodium cyanide, it was no longer possible to prevent coyote ingress into the Plateau and all counties in that area now incur livestock losses to coyotes. Another important sheep producing area in Texas is the Trans-Pecos Region, which borders the Edwards Plateau on the west. Mr. Hawthorne testified that sheep production in the Trans-Pecos had decreased by 48 percent since 1972, many producers switching to cattle and those remaining having great difficulty in reducing or preventing predation losses. The 48 percent decrease in sheep production was based on data compiled by the Texas Crop and Livestock Reporting Service. He regarded predation as a major cause of this decrease and forecast that predation losses

would increase as coyote numbers increased, present control methods being inadequate to control coyote predation. His testimony that predation losses had greatly increased since 1972 was also based on reports by the Texas Crop and Livestock Reporting Service.

110. In an effort to document the effectiveness of 1080 bait stations in reducing predation, Mr. Hawthorne attached to his testimony excerpts from the annual reports of the FWS, Predatory Animal Control Operations, Texas District, for the Fiscal Years 1950, 1952 through 1955, and 1961 through 1964. It appears that most Compound 1080, at least for Fiscal Year 1953, was used in the Panhandle area, extending as far south as Ward and Crane Counties and as far west as Culberson County. Although the reports do not contain any statistical data, they do contain observations of a great reduction in coyote sign and rancher reports of a reduction or cessation of coyote predation on calves and sheep. The report for the Fiscal Year 1955 states that generally bait stations placed in Texas after the middle of January are of little value. Nevertheless, the report for the Fiscal Year 1961 states that 1080 stations were used effectively to "roll back" heavy coyote infestations in Webb, Maverick and Duval Counties in the extreme southwestern part of Texas, next to the Mexican Border. It is indicated that, although these are not counties with big sheep and goat populations, it is the constant drift of coyotes from these areas into the prime she

and goat country to the north and east that must be guarded against. Heavy predation losses in the sheep country were not experienced, nevertheless, depredations in that area were reported in every month of the year. In a subsequent narrative on the use of Compound 1080 in South Texas, it is reported that coyotes eat the baits as readily in February and March as they do in November and December and that spoilage is reduced by cutting the baits into portions not over 75 pounds in weight and placing baits on logs or similar elevated objects.

111. Predator control reports for the Fiscal years 1962 through 1964 state that Compound 1080 is the only practical method of coyote control in large arrid areas of the Trans-Pecos Region, that consumption of bait has been good (up to 98 percent in some areas), that trappers' catches of coyotes in important counties adjacent to the sheep and goat country have been greatly reduced, that fewer coyotes were observed in areas where 1080 stations were placed and that losses were heavy on a ranch adjacent to an area where the landowners did not wish coyotes to be removed. It is also related that the practice of placing land in the "soil bank" created cover for coyotes and that traps, snares and "coyote getters" were still being used and were "hard to beat" when correctly applied. Compound 1080 stations were considered to be useful to reduce coyotes to a lower level in the big cow country.

112. Mr. Lyle A. Crosby, Administrator of the Rodent and Predator Control Program for the Wyoming Department of Agriculture and a witness for Wyoming, et al., testified as to the use of Compound 1080 bait stations in Wyoming during the period 1975-1977.[10/] Department employees, who were qualified as certified applicators, began placing baits in assigned areas of the State on or about October 15, 1975. Rancher certification of predation losses as well as landowner consent to placement of baits were required. A total of 1051 baits were placed on 399 ranches in the 1975-76 baiting program. Because of heavy feeding by predators, baits were replaced on approximately 43 percent of the ranches. Baits were again placed beginning on November 4, 1976, a total of 1,005 baits being placed on 373 ranches.

113. Mr. Crosby considered the program a success, citing the FWS publication "Indices of Predator Abundance in the Western United States," which

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10/ Although an injunction issued by the Federal District Court upon the ground EPA had not complied with the National Environmental Policy Act prior to issuance of the order suspending and cancelling registrations of Compound 1080 for predator control in 1972, was overturned (Wyoming v. Hathaway, 525 F.2d 66, 10th Cir. 1975), Wyoming took the position that it was entitled to use 1080 for predator control under an intrastate registration in accordance with the provisions of Section 24 of FIFRA and 40 CFR 162. Use of 1080 for predator control in Wyoming was halted in 1977 as part of a settlement of an enforcement proceeding instituted by EPA.

showed the Wyoming index for coyotes at 74.2 in 1975 and at 41.1 and 41.2, respectively, in the years 1976 and 1977. He also cited data collected by the Wyoming Crop and Livestock Reporting Service on lamb losses to coyotes for the years 1970 to 1980 inclusive, which showed, inter alia, losses of 84,500 or 8.5 percent of lambs born in 1974, 72,000 or 7.8 percent of lambs born in 1975, 65,000 or 7.7 percent in 1976, 51,000 or 6.4 percent in 1977, 43,500 or 6.1 percent of lambs born in 1979. While he acknowledged that there were fluctuations in losses of lambs to coyotes in other years which could not be attributed to the 1080 baiting program and which he could not explain, Mr. Crosby maintained that the reduction in losses during the period 1976 through 1978 was due at least in part to use of bait stations.

114. Mr. Harry Loats, a Mathematician, President and Chief Scientist of Loats Associates, Inc., a firm specializing in mathematical analysis and modeling related to population dynamics, host-area mapping, risk/benefit assessment for pesticides, pesticide drift and other natural resource related phenomena, and a witness for USDA, submitted the results of analytic evaluations of animal population dynamics (modeling) based upon actual bait consumption of 1080 large-baits at 640 sites for which data was available in Wyoming during the 1976-77 period. The analyses were performed under a contract with the Animal Plant Health Inspection Service (APHIS) of the USDA. Expected sheep and lamb loss reduction in Wyoming was computed by aggregating individual bait sites in each county into Crop Reporting Districts

(CRDs) and by evaluating or projecting bait consumption over a ten-year period at levels spanning the lower, middle and upper range of field gathered bait consumption data for each CRD. The results indicated that population reduction of coyotes from 1080 bait placements in high sheep vulnerability areas could result in sheep loss reduction estimated to be approximately 7,000 sheep and lamb per year. He defined high vulnerability areas as areas where baits were placed based on assumed predation losses to sheep and a high coyote density. The model is hypothetical, there being no real method of measuring population (coyote and non-target) densities for the whole area, resource (apparently prey) availability was assumed to be constant and bait consumption by non-targets was estimated based on assessments of bait attractiveness to such species, bait visits, consumption and population densities. Mr. Loats testified that the model could be used to test the actual use of 1080 over a ten-year period in Wyoming, provided data on bait consumption relative to distributed sites, population density, etc. were available. He acknowledged that the output of the model depended on the validity of inputs and that inputs such as effect of 1080 on population dynamics of target and non-target species, animal specific data inputs, trapper field experience, locations and densities of target and non-target species, attractiveness of bait sites and their probable effects on species, animal presence and abundance, were supplied by animal management experts, i.e., Dr. Dale Wade, Lyle Crosby and John Wood of APHIS. He also acknowledged that dispersal or migration of coyotes was not considered.

115. Mr. George S. Rost, a retired employee of the FWS with 28 years experience in the Animal Damage Control Program, President of the National Animal Damage Control Association, Inc. (NADC) and a witness for the Association, testified that the use of Compound 1080 in large-bait stations was effective in reducing coyote numbers to a level where the agriculture-business communities could survive. His data on effectiveness appeared to be based primarily on the reduction in the number of bait stations placed in FWS Region 2 (Arizona, Colorado, New Mexico, Oklahoma, Texas, Utah and Wyoming) from a high of approximately 8,100 baits in 1962-63 to a low of approximately 4,600 in 1969. He indicated that the decreased number of baits placed was related to the lower number of requests from ADC trappers or district field assistants (DFAs) in the districts, who were in the best position to assess the need for such stations.

116. Mr. John R. Beck, President of Biological Environmental Consultant Services, Inc., a former animal damage control agent for the FWS with over 32 years experience in predator control and a witness for Wyoming, et al., related an incident concerning a sudden increase in coyote predation on lambs and calves in the early 1950's in Northwestern North Dakota near the confluence of the Big Missouri and Yellowstone Rivers. He testified that while it did not appear that coyote numbers had increased, predation certainly had and that removal of many coyotes by traps, aerial hunting and coyote getters failed to abate the losses. Losses were attributed to coyote movements concentrating coyotes in the area and a baiting program was instituted

in the winter of 1953-54. Baits were placed on five townships as close together as regulations allowed and badlands area of the Little Missouri River was also treated. According to Mr. Beck, the amount of 1080 treated bait consumed in his assigned area during that period was greater than anywhere else in the United States. He testified that during the next four years predation in that area was at a very low rate and that 1080 was not used there the next season, there being no need for it. He was of the opinion that with qualified applicators Compound 1080 was a major positive factor in canid predator management.

117. Mr. William K. Pfeifer, a Biologist, Supervisor of Animal Damage Control for the FWS in North Dakota, having about 25 years experience in predator and coyote control, and a witness for Defenders of Wildlife, et al.,[11/] testified that there was little doubt that Compound 1080 bait stations had reduced the coyote population. He estimated the reduction at about one-third of the population. Strychnine drop-baits were also used prior to 1972. Mr. Pfeifer testified that sheep losses to coyotes increased after 1972 going from 0.26 percent in 1972, to 0.42 percent in 1974 and 1975, 0.48 percent in 1977, and then declining to 0.13 percent in 1979 and increasing to 0.33 percent and 0.28 percent in 1980 and 1981, respectively. He was of the opinion that these figures, which include only ADC confirmed losses, supported the effectiveness of 1080 in reducing predation. He attributed the decline in predation after 1977 to a harsh winter and an increased harvest of coyotes for their pelts.

11/ Mr. Pfeifer was called as a witness by Defenders because he had conducted or supervised a survey of North Dakota ranchers using guard dogs for predator control.

118. Mr. Terry Anderson, a former FWS employee with 14 years experience in the ADC program, a United Methodist Minister from Estancia, New Mexico, and a witness for Wyoming, et al., testified that 1080 large-bait stations were an effective method for reducing coyote predation on sheep, goats and calves. He based this conclusion on the fact that placing stations resulted in fewer signs of coyotes, such as tracks and droppings, fewer damage complaints and a reduced catch of coyotes by trappers. Mr. Anderson first became involved in the placement of 1080 bait stations in 1962 in an area south of the Edwards Plateau in Texas and which he referred to as the "coyote factory of the United States." He also placed and supervised the placement of bait stations in Colorado and Utah during the period 1964-67. He testified that after the ban on the use of 1080, indicators of coyote populations increased, citing an instance in Gray County, Texas where 40 helicopter-hours of hunting resulted in a huge take of approximately 200 coyotes. He asserted that while 1080 was in use approximately 25 to 40 percent of that number of coyotes would be expected to be taken by that amount of aerial hunting.

119. Dr. Samuel Beasom (finding 95) conducted a study in 1975 and 1976 on the effects of predator control on Angora goat mortality in northern Zavala County, Texas in the South Texas Plains. Survivability and productivity of Angora goats were compared between a 225-hectare treated and a 201-hectare untreated (no predator control) pasture. The study area is known to have a heavy infestation of coyotes. The two pastures were separated by seven kilometers.

Mammalian predators were removed from a 1,550 hectare area including the treated pasture and a 1.6 km. buffer zone on three sides. Sixty-nine coyotes, 11 bobcats and 52 smaller mammalian predators were killed on the treatment area in 1975. The take in 1976 was 63 coyotes, seven bobcats and 32 smaller predators. Predator activity on the treated area, determined by scat counts, was 80 percent less than that on the untreated area. Predation losses on the untreated pasture were 33 percent of the kid crop, while unknown losses (disappeared without a trace) totaled 62 percent of the kid crop. Comparable figures on the treated pasture were 16 percent and 43 percent respectively. Most of the unknown losses were attributed to predators because of the presence of coyote scats containing mohair concurrent with an animal's disappearance, because survival rates were higher on the treated area and because disease and abnormalities among the kid crop were rare. Predation of adult goats was 24 percent of the flock on the untreated pasture and zero on the treated area. The study concluded that intensive predator control could substantially increase the survival rate of kids and goats, but was insufficient to curtail large losses to predation when conducted on a small scale or at a level no greater than that in the study.

120. Basic to the opposition to the use of Compound 1080 in large-bait stations is the contention that heavy and sustained exploitation of coyote populations merely results in increased reproduction, lower

mortality from other causes and increased immigration from other areas, the result being that the coyote population remains essentially the same and that attempts to suppress coyote populations over wide areas are counterproductive and doomed to failure. Opponents of 1080 also contend that there is no demonstrated relationship between coyote populations and livestock predation. The coyotes taken per-man-years-of-effort index developed by Dr. Wagner and his conclusion that use of 1080 appeared to suppress coyote populations in the early period of its use in the States of Idaho, Montana, Wyoming and Utah has previously been mentioned (finding 105). Dr. Wagner noted that the population reduction did not appear to be lasting and that there was no corresponding reduction in predation. It should be noted, however, that Dr. Wagner acknowledged that application of intensive predator control techniques in areas could depress coyote populations and reduce predation losses. Dr. Grandy (finding 31) impliedly recognized this fact when he excused the heavy predation losses on the Cook Ranch in Montana as a "no control" study.

121. As evidence that coyotes can be removed from a large area, the Edwards Plateau area of Texas, which was literally coyote free during the period 1930-70, is frequently cited. Coyotes were reportedly removed from the area by the use of steel traps, strychnine, and hunting, aided by fences constructed for livestock control. It is not clear, however, whether this was an area of historically large coyote populations or whether the principal predator removed was not the red wolf, an animal less adaptable and more easily extirpated than the coyote.

122. A study which examined the effect of exploitation on coyote populations was conducted by Dr. Robert P. Davison, Legislative Representative for the Fisheries and Wildlife program of the National Wildlife Federation and a witness for the NWF, as part of his doctoral dissertation. The study, conducted during the period 1974-78, examined separate coyote populations in the Curlew Valley of Utah and Idaho, which was subject to moderate to high exploitation, and on the Idaho National Engineering Laboratory (INEL), which was considered to be unexploited or at least moderately so. The study areas are approximately 100 km apart and environmentally similar. Availability and utilization of prey were also similar. Neither spring nor fall density estimates of coyotes were significantly different between areas in any given year or overall. Hunting accounted for roughly 39 percent of all adult coyote losses and 54 percent of juvenile deaths in the Curlew Valley. About 25 percent of adult deaths and 12 percent of juvenile deaths were due to hunting in the INEL. Dr. Davison concluded that his study showed that substantial exploitation would not be effective in reducing coyote densities over wide areas, because exploitation losses would be quickly offset during fall and winter by reduced losses to other causes and by reduced migration and are further offset the following spring by increased recruitment (birth and immigration). He concluded that increased recruitment would prevent any lasting reduction in coyote density. Despite apparent differences in the levels of human exploitation, there were no statistically significant

differences in hunting deaths of adult coyotes between Curlew Valley and INEL. Dr. Davison insisted, however, that this did not undercut the validity of his study because there were statistically significant differences in hunting caused deaths of juvenile coyotes between the two areas. He acknowledged that conventional wisdom among trappers and biologists was that juvenile coyotes had lower survival rates than adults and were more vulnerable to exploitation. He also acknowledged that no effort was made to evaluate the level of coyote control on areas adjacent to the study areas and that defining any coyote or wildlife population was somewhat arbitrary.

123. Testimony that coyotes were primarily scavengers, reluctant to risk injury by attacks on animals of any size, was given by Hope Ryden, an author and a witness for Friends of Animals, Inc. who had spent over two years closely observing packs of coyotes in Montana and Wyoming. It appears, however, that Ms. Ryden's observations were made primarily in the winter months in areas of heavy snow cover and that animals the coyotes did not attack were adult elk, deer, bighorn sheep and antelope, which would normally be of sufficient size to defend themselves against coyotes. Her observations were made on packs of coyotes in Yellowstone National Park and National Elk Refuge and thus the coyotes were protected from human exploitation. She acknowledged that during the spring and summer, coyotes were primarily predators on small animals, such as rabbits and rodents, and that they were opportunistic feeders and did kill

livestock. She contended that predator control programs disrupted the social organization, pack hierarchy and territorial imperatives of coyotes and that, if left alone, coyote populations would stabilize at a lower level, with the likely consequence of a lower rate of livestock predation.

124. Dr. Franz Camenzind, a Biologist and a witness for Friends of Animals, Inc., who has conducted extensive research on coyote populations essentially free of man-caused mortality, supported the theory that a stable, unexploited coyote population would likely lead to lower rates of livestock predation. He observed coyotes over an eight-year period on the National Elk Refuge near Jackson Hole, Wyoming. He testified that a stable coyote population consisted of social units or packs of from four to six adults having clearly defined hierarchies or peck orders and well defined territories. He explained that with moderate to heavy control, the social structure becomes disrupted or destroyed, the population is in a constant state of flux, territories are not outlined or defended and that the result may be more prey killed per coyote than would be the case in a stable population. Contrary to some theories, Dr. Camenzind did not find that a decrease in coyote populations resulted in an increase in litter size. He acknowledged that the use of poisons could reduce the number of coyotes.

125. Mr. Eugene Allen, Administrator of the Wildlife Division of the Montana Department of Fish, Wildlife and Parks and a witness for the State, testified as to the results of a study of coyote ecology

conducted by his Department during the period 1976-82 in the Missouri River Breaks of North Central Montana. The study was conducted by capturing 37 coyotes and fitting 26 with radios and 11 with neck collars. Coyote density in the approximately 100 square-mile study area was determined to average approximately one per square-mile during the summer. The study of coyote movements concluded that coyotes could generally be classified into one of four social behavior modes: den breeders, den super numeraries, nomads and dispersers. Den breeders were adult parents of a litter. Den supernumeraries were adults and probably pups from the previous year. Nomads were adult coyotes, which left the den area and established large travel areas. Dispersal coyotes were young, supernumerary or injured den breeders which permanently left the study area. Den coyotes constituted approximately 40 percent of the population and had home ranges of three or four square miles. Other coyotes ranged over areas from 30 to 50 square miles. Dispersing coyotes were killed by hunters at distances from eight to 95 miles from den sites. A conclusion of the study was that an effective coyote control program must have the capability of addressing site-specific problems caused by den coyotes with a very small home range or site-specific problems caused by a nomad coyote or dispersing juvenile coyotes. Predation control was practiced on the study area and it is questionable whether this study can be said to contradict the Ryden and Camenzind theories referred to in the preceding findings.

126. There is conflicting evidence in the record as to whether coyotes become bait-shy. Mr. Crosby (finding 112) asserted that the existence of such shyness was pure speculation. He acknowledged,

however, that there were times when baits were not accepted by coyotes for one reason or another and that if one method of coyote control was used constantly, bait-shyness could develop in some circumstances. Mr. Richard Randall, a former OFA for the FWS, North Central Field Representative for Defenders of Wildlife and a witness for Defenders, was of opinion that coyotes did learn to avoid or develop an aversion to baits. Mr. Robert Burgee, an ADC agent for the South Dakota Department of Game, Fish and Parks with 37 years of experience in trapping and a witness for the State, testified that he would have to be convinced of any such shyness, because after consuming the bait no learning experience by a coyote was possible. It does appear, however, that the effectiveness of baits declined over time, which has been analogized to resistance to pesticides developed by certain insects. Moreover, Dr. Major L. Boddicker (finding 100) testified that continuous use of a particular baiting system results in development of coyote populations with a high proportion of coyotes not attracted to that baiting system and that by 1964 it was widely accepted that 1080 large-baits were unacceptable to some coyotes.

Issue 3

127. Testimony as to the effectiveness of denning, shooting, trapping and snaring in reducing predation was remarkably consistent whether from proponents or opponents of the use of 1080. All seemed to agree that none of these methods were effective under all situations

or were consistently effective or that they had drawbacks in terms of manpower, cost or non-selectivity such that they could not be regarded as a solution to the problem of predation. For example, Mr. Randall (finding 126) described the process of denning, that is, locating the den where coyote pups are being reared, as requiring tracking of adult coyotes. Depending on terrain, this tracking may be very difficult and time consuming and, in any event, requires experience and skill. A table in evidence, reflects that in 1976 6.2 percent of coyotes taken by ADC personnel of the FWS were taken by denning. Dr. Wade testified that removal of denning pairs of coyotes or their young may, and frequently does, stop livestock predation in localized areas. This testimony was confirmed by Messrs. F. Robert Henderson and Edward K. Boggess, Wildlife Biologists, Cooperative Extension Service, Wildlife Damage Control, Kansas State University[12/] and witnesses for Defenders.

128. Aerial hunting or gunning is probably the most effective way of shooting coyotes.[13/] Use of this method has significantly increased since the 1972 order suspending the use of toxicants for predator control. A table reflects that in 1976, 40.2 percent (28.6 percent by helicopter and 11.6 percent by fixed-wing aircraft) of coyotes taken by ADC personnel were shot from the air. Terrain and heavy

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12/ Mr. Boggess has changed his employment and is presently employed by the Minnesota Department of Natural Resources, St. Paul.

13/ Shooting or hunting wildlife from the air is prohibited except under state authorization or permit (16 USC 742j). Kansas and Arizona have not authorized aerial hunting of coyotes.

vegetative cover may make it difficult to see coyotes or afford them hiding places and thus render aerial hunting ineffective. Weather conditions may also prevent or inhibit aerial hunting of coyotes. Hunting coyotes from fixed-wing aircraft can be hazardous. Mr. Randall (finding 126), who while an FWS employee, shot hundreds of coyotes from the air, having been involved in two plane crashes, and Mr. Hawthorne (finding 109) alluding to a fatal crash of an ADC plane in New Mexico. Use of helicopters is probably the most effective and least hazardous way of hunting coyotes from the air. Operating a helicopter is, however, very expensive, as evidence in the record is to the effect that the hourly cost of such operation has risen from $90.00 to as high as $375.00 during the last eight to ten years. Aerial hunting is, of course, selective to coyotes. Extensive flying whereby every coyote observed is shot, is, however, not selective to coyotes depredating on livestock. Mr. Randall termed it "war on the species" and asserted that it didn't necessarily solve a particular rancher's predation problems.

129. Coyotes are, of course, hunted from the ground. ADC personnel shot 6.3 percent of coyotes taken in 1976 from the ground. A method of luring coyotes within gun-shot range is by use of a call, which mimics an animal in distress, thus bringing a coyote in search of a meal. Coyotes are also hunted by sportsmen and those interested in taking coyotes for their pelts. Herders and ranchers frequently carry rifles and shoot at coyotes they see. While this scares coyotes away, it is unlikely that many coyotes are taken in this manner.

130. Trapping by the use of steel leg-hold traps is a traditional and effective method of predator control. In 1976, 37 percent of coyotes taken by ADC personnel were taken by traps. Traps frequently become inoperable in wet and freezing weather, are frequently disturbed by livestock and non-target animals, require considerable skill as to placement and require constant checking to assure operability. Coyotes become trap-wise. Although the selectivity of traps can be improved by increasing the pan tension so that the trap will not be sprung by smaller non-target species, traps are non-selective. If the traps are not checked frequently, an animal may be caught in the trap for days or a week or more, which is not humane.

131. Snares are simply a wire loop placed along a trail or more frequently a hole in a fence in such a manner as to encircle the neck of an animal attempting to pass. The loop tightens and the animal usually strangles to death. In 1976, 3.8 percent of coyotes taken by ADC personnel were taken by snares. Coyotes may jump fences and the snares may be rendered inoperable by weeds or brush growing or being blown into the opening where the snare is set. Snares may also be rendered inoperable by livestock or non-target species.

132. The M-44 is a spring loaded cylindrical device, which when activated by a coyote or other animal tugging on an attached scent or lure, expels a charge of sodium cyanide into the animal's mouth, killing it almost instantly. The M-44 is quite selective to coyotes and foxes.

In 1976, 6.3 percent of coyotes taken by ADC personnel were taken by the M-44. Some soil conditions are corrosive causing mechanical problems with the M-44 and heating and cooling of the units breaks the seals and allows moisture to penetrate the sodium cyanide cartridge, thus rendering the M-44 inoperable. They are also rendered inoperable by livestock and people and are ineffective in warm weather because coyotes are not attracted to the scents. Because of these problems and the restrictions placed on its use when it was registered in 1975, many ranchers are dissatisfied with the M-44. A 1979 report by the Texas Crop and Livestock Reporting Service revealed that only 14 percent of 1,196 ranchers responding to the survey were using M-44's.

133. Aversive conditioning using lithium chloride (LiCL) as the aversive agent has been laboratory tested by the FWS. The theory is that a coyote or other predator will become ill from ingesting meat such as mutton or bait laced with LiCL, will associate the illness with the particular prey and thus become averted and refrain from attacking sheep thereafter. Mr. Guy Connolly, Wildlife Research Biologist in the Predator Management Research Section of the Denver Wildlife Research Center, FWS stationed at Twin Falls, Idaho and a witness for the FWS, described the results of these tests. One gram, two grams and four grams of LiCL per 500 grams of bait were tested. Mr. Connolly testified that coyotes didn't like the salty taste of LiCL and that the tests were designed to produce the most violent illness without

the coyote regurgitating. He indicated that the one gram level of LiCL gave the longest aversion time, an average of 4.3 days before the coyotes again began eating baits.

134. In a second group of tests, eight coyotes of approximately the same age were divided into two groups. One group (experimental) was fed jackrabbit bait containing LiCL for three consecutive days, while the other (control) was fed jackrabbit bait without LiCL. On the fourth day each group was given the choice of a live chicken or a live jackrabbit, the theory being that the experimental group would eat more chicken and less jackrabbit. Mr. Connolly testified that there was no difference as each group killed the same number of jackrabbits and chickens. He regarded the tests as a failure, asserting that they have since learned that there is no dosage of LiCL sufficient to effect coyote behavior that cannot be directed by them.[14/] These were all laboratory or pen tests, no field tests having been conducted.

135. Dr. Carl Gustavson, a Research Psychologist, Associate Professor of Psychology at North Dakota State University and a witness for Defenders, cited the results of a study he participated in on the 3,000-acre Honn Ranch in Washington State as demonstrating that aversive conditioning using LiCL laced baits could be effective in reducing predation. The study, begun in January 1975, involved the placing of 12 bait stations using two types of baits: one of dog food laced with LiCL and wrapped in a sheep hide, and the second,

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14/ .This conclusion was based on research conducted by Dr. Stuart Ellins (finding 138, infra).

carcasses of sheep, which had died of natural causes, were injected with LiCL. Six grams of LiCL were used per 340 grams of dog food bait and the solution injected into the sheep carcasses consisted of 82.4 grams of LiCL per liter of water. Dr. Gustavson indicated that he would recommend using a slightly lower dose of LiCL at present. The study conducted through May 15, 1975, suggested a reduction in predation losses of sheep of from 40 percent to 60 percent. The report on this study indicates that the range of predation reduction was from 30 percent to 60 percent. This was based on a comparison of the rancher's predation losses for the preceding three years. The wide variation in possible predation reduction was attributed to uncertainty as to whether particular losses were due to coyotes. Dr. Gustavson acknowledged that because of the inability to incorporate adequate controls, the study did not conclusively establish the efficacy of aversive conditioning in deterring predation. Moreover, a dispute arose between the researchers and the rancher regarding the determination of coyote kills and the results of this study were left in doubt.

136. Dr. Gustavson also cited a study in which he participated conducted in Saskatchewan, Canada. This study, conducted over the three-year period 1976-78, involved the distribution to ranchers of ground sheep meat wrapped and tied in sheep hide laced with LiCL at the rate of 6 and 4 grams per 100 grams of bait. Ten flocks having a total mean size of 10,508 completed the three-year test and fulfilled requirements

for statistical analysis. The total average percent lost to coyotes was 12.72 percent in 1975, 1.34 percent in 1976, 1.38 percent in 1977 and 1.60 percent in 1978. Analysis of variance indicated that the reduction in losses to predators was significant. Because flock sizes for each ranch over the four-year period are given in terms of means, while the reported percentages lost to coyotes were averaged, it is not possible to determine actual losses from data submitted. The study concluded, however, that the evaluation did not allow for the specification of program variables responsible for the reduction in losses and that factors such as a possible increase in numbers of coyotes taken for their pelts, possible bias or error in determination of coyote kills, and activities on the ranches could not be evaluated. It was also noted that factors such as repellancy rather than aversive conditioning may have been involved.

137. Dr. Gustavson was critical of the study referred to by Mr. Connolly (finding 134). His criticism, however, was based on a literal reading of the protocol of the study as "the test situation being repeated daily until each coyote had killed and fed on three or more jack-rabbits and one or more chickens." Dr. Gustavson contended that the number of animals to be killed was established by the protocol, that there was no dependent variable and that it was impossible for the two numbers to differ significantly. Because there is no indication the number of chickens available to the treatment group was limited, this criticism is not valid.

138. Field application of taste aversive conditioning was evaluated in Antelope Valley, California over a two-year period by Dr. Stuart Ellins, a Research Psychologist, Professor of Psychology at California State College, San Bernardino and a witness for Defenders. In 1976, the first year of the study, two herds of sheep were evaluated, one from 3,000 to 7,000 head, and the other numbering from 2,000 to 2,500 head. Bait (sheep) carcasses were injected with a solution of 450 grams of LiCL or 225 grams of sodium chloride (NaCL) in 11.5 liters of water. Baits were placed in areas known to be frequented by coyotes. There were a substantial number of kills in Herd No. 1 during the first seven weeks of the study, followed by a marked reduction during the remaining 11 weeks of the study. The use of NaCL for a period of time (after week 9) on this herd was for the purpose of having a control during which time it was anticipated that kills by coyotes would increase. This apparently did not happen. In Herd No. 2, heavy losses occurred during the first week of the study followed by a dramatic reduction in kills thereafter. According to Dr. Ellins, this indicated that after encounters with LiCL laced baits, aversions to carrion baits were established in the coyotes and that these aversions were transferred to live sheep, thereby inhibiting predation. In the second year of the study, which ran from August 1976 to April 1977, three herds of sheep were tested, ranging in size from 1,500 to 3,500 head. Coyote predation was considered to have been reduced as

compared to the previous year. There was, however, evidence that dogs were heavy takers of the baits and responsible for far more sheep kills than coyotes on one of the herds.

139. Although Dr. Ellins conceded that the proper concentration of LiCL was critical in that the aversion developed might be to LiCL rather than to the prey (sheep), he was unable to say precisely what level of LiCL was necessary to develop an aversion in coyotes to sheep. He acknowledged that the concept of aversive conditioning was based on the assumption alternate food sources for coyotes were available, that no attempt was made to evaluate these factors in Antelope Valley, that there was not a close correspondence between the time the LiCL baits were placed and a decrease in kills, that it was assumed that other coyote control measures (trapping, denning and shooting) remained constant and that there might be other more suitable, less saline or strong tasting chemicals than LiCL. Although four ranchers participating in the project signed statements to the effect that they considered the taste aversion program to be a useful method of controlling coyotes and reducing predation, they refused to continue the program on their own once the study was completed.

140. Testimony as to the neurological basis for flavor or taste aversive conditioning was given by Dr. John Garcia, Professor of Psychology and Psychiatry at the University of California, Los Angeles and a witness for Defenders. Dr. Garcia has conducted extensive research

in aversive conditioning and the neurology of learning. He considered that taste aversive conditioning was a viable predator control alternative, asserting that predation was basically a feeding problem and that both laboratory and field studies demonstrated the promise of taste aversion conditioning in controlling predatory behavior. He testified that the dosage of LiCL should be at concentrations not detectable as salt by the coyote or the aversion would be to the salt. He indicated that a proper dosage would be .12 or .15 molers,[15/] the quantity of NaCL present in natural flesh. Although he considered that the field studies by Drs. Gustavson and Ellins demonstrated that aversion conditioning could reduce predation, Dr. Garcia recognized that further research was necessary to perfect the technique and make it more workable for ranchers to implement.

141. The tests by the FWS of the use of diethylstilbestrol as an antifertility agent or reproductive inhibitor have previously been mentioned (finding 101). A report on these tests indicates that the study areas in Texas and New Mexico were treated with tallow baits containing stilbestrol approximately one month before the peak of the coyote breeding season. Difficulties with coyote acceptance of the baits and high reproductive success necessitated a change in

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15/ A mole is a unit based on molecular weight. It is not clear that the concentration recommended by Dr. Garcia corresponds with that used by Drs. Gustavson and Ellins in field tests.

experimental design so that baits were made available to coyotes over longer periods of time. Subsequent tests, however, failed to achieve marked reductions in reproductive success and it was concluded that better delivery systems of such baits were needed. Moreover, because stilbestrol exerts its primary effect on the female coyote during a relatively short period of time, development of other antifertility agents was recommended. Mr. Connolly (finding 133) testified that because of these and other problems, studies of antifertility agents by the FWS have been terminated. Dr. Norman L. Gates, Veterinarian and Assistant Dean of Veterinary Medicine at Washington State University, a witness for Wyoming, et al. and formerly a research veterinarian at the USDA Sheep Experiment Station, Dubois, Idaho testified that tests on the control of coyotes by use of reproductive inhibitors had not been successful and had been discontinued by USDA. There is no other evidence in the record as to the effectiveness of reproductive inhibitors in reducing predation.

142. Mr. Connolly testified that the use of repellants as a means of deterring coyote attacks on livestock have not been developed to the point of practical field application. Dr. Gates (finding 141) stated that evaluation of all chemicals claimed to have repellant properties as to coyotes, e.g., plictran, crude extract of bitter sneezeweed, extract of red pepper and decenovonillylamide resulted

in the conclusion that these chemicals showed little, if any, promise in reducing sheep losses to predators. Mr. Devlin (finding 51) used a repellant spray "Sheep Perfume," which was apparently successful in repelling or deterring coyote attacks on sheep for an 18-day period. Once the effects of the substance wore off, Mr. Devlin declined to use it again because he was concerned about possible contamination of meat and wool.

143. Guard dogs, which are to be distinguished from dogs used for herding and gathering livestock, have apparently been used in Europe and Asia to protect sheep and goats from predators for hundreds of years. Guard dogs perform their function not so much by attacking predators, but simply by their presence deterring predators from preying on livestock. Common breeds used as guard dogs include the Great Pyrenees (origin: France and Spain), Komondor (origin: Hungary), Shar Planinetz (Yugoslavia), Meremma (Italy) and Korabash and Akbash (Turkey). According to Ms. Catherine de la Cruz, a Sonoma, California woolgrower, breeder of Great Pyrenees dogs and a witness for Defenders, these dogs share numerous traits: they remain aloof from strangers, are not overly responsive to human affection, prefer the company of sheep to that of humans or other dogs and are not overly responsive to verbal commands.

144. Ms. de la Cruz has been raising and training Great Pyrenees since 1957. She has placed guarding dogs with ranchers in several states including California, Canada, Wyoming and Texas. She regards repeat

sales, i.e., to the same rancher as an indicator of guard dog effectiveness and stated that she had six of such sales in the year 1981-82. She testified that the training process must begin when the pups are very young and as early as four weeks of age. The pups must be raised with the sheep, preferably in a training corral located where their activities can be closely observed and aggressive behavior toward the sheep corrected. She usually places pups with ranchers when the pups are approximately seven weeks of age. Written training instructions are given to the purchaser at the time. Ms. de la Cruz estimated that the dogs could be trained in approximately one-half hour a day over a year to 18-month period, but that this should not be regarded as a block of time because training the dog should be melded in with other ranch chores and activities. She testified that the dogs were effective in reducing predation on the ranches upon which they had been utilized. She acknowledged that the dogs would be a year to 18 months of age before it is clear whether they are effective, that they are more effective in farm-flock, fenced pasture situations up to 500 acres, that because of temperament of either the dog or the rancher, the dogs did not always work out and that the ultimate effectiveness of guard dogs had to be determined by the individual user. She insisted that guard dogs could be effective in range situations, but asserted that more aggressive dogs such as Komondorok would be more effective for this purpose than Great Pyrenees. Ms. de la Cruz guarantees her dogs to be effective by 18

months of age and has replaced or refunded the purchase price on approximately ten percent of dogs placed.

145. Ms. de la Cruz charges $300 each for her dogs and estimated the annual cost for food, veterinary care, depreciation, etc. at $250. She considers the average useful life of a Great Pyrenees to be from six to eight years following a two-year training period.

146. Dr. Marion J. Levy, Professor of Sociology and International Affairs at Princeton University, and his wife Joy, raise Komondorok dogs as a sideline. They obtained their first Komondor in 1967 and over the years have raised about ten litters or approximately 60 dogs, of which approximately 15 have been placed with sheep or goat ranchers in the United States and Canada. Dr. Levy testified that while guard dogs were extremely territorial and would tend to stay in a particular area if they knew the boundaries, they also identified with the livestock and moved with them. He stated that the dogs should be trained never to play with the livestock, to stay with the livestock and to know their territory, but that otherwise they should be given leeway to follow their instincts and make their own decisions. He asserted that the dogs need a minimum of maintenance, but that they should be fed once a day and regularly checked for injuries, health problems, flies, ticks, etc. He testified that placing a dog with a proper owner was critical in that the ultimate success depended partly on the individual dog, but even more on the personality of the rancher. Dr. Levy indicated that people who

understood dogs and were good at handling them would often relate that they did not have to do anything for the dog to be a successful guardian.

147. Dr. Levy was of the opinion that guard dogs were generally effective in reducing predation. He stated that he and his wife had not had any complaints from ranchers with whom they had placed dogs, that they had not had any dogs returned and that their experience was consistent with surveys reported in literature to the effect that the majority of ranchers using Great Pyrenees or Komondorok for guarding livestock considered them good to excellent in reducing predation. He testified that an effective guard dog was partly a question of training and partly a question of maturity.

148. Dr. and Mrs. Levy charge $600 each for dogs that are of "pet" quality and up to $800 for dogs that are considered outstanding. In an article appearing in the December 1981 issue of the National Woolgrower, Dr. Levy cautioned against exaggerated claims as to the effectiveness of guard dogs, that not every dog would turn out to be a marvelous guard dog and that not every farmer or rancher can properly use such a dog even if it matures well. He pointed out that Komondorok did not fully mature until they were at least three years of age and that until the dog learned the routines and duties expected by its owner, it required supervision and a great deal of patient attention.

149. Dr. Jeffrey S. Green, Wildlife Research Biologist at the USDA Sheep Experiment Station, Dubois, Idaho, and a witness for USDA, has been involved with research on the effectiveness of guard dogs in reducing predation since 1977. Of 69 dogs involved in the study, 45 have actually been tested sufficient that performance data is available (21 Komondor, 18 Great Pyrenees, 4 Akbash and 2 Shar Planinetz), the others being considered too young. Forty dogs have been tested sufficient that subjective ratings could be assigned: good-dog generally remained near sheep, predation was markedly reduced or kept to a minimum and problems were minor in nature; fair-dog showed potential and would probably improve with experience and maturity, predation was somewhat reproduced and benefits outweighed the problems; and poor-no apparent influence on predation, dog exhibited undesirable behavioral traits and problems outweighed the benefits. Twenty dogs were rated good (7 Komondors, 9 Great Pyrenees, 3 Akbash and 1 Shar Planinetz), 15 dogs were rated fair (7 Komondors, 8 Great Pyrenees and 1 Shar Planinetz), and four dogs were rated poor (12 Komondor, 1 Great Pyrenees and 1 Akbash). Seventeen dogs failed a test. However, seven of these dogs were successful in other tests. It was concluded that more mature and experienced dogs had a greater likelihood of success and that a majority of dogs could perform successfully provided they were tested under conditions suited to temperament and ability.

150. Tests of 12 guarding dogs on rangeland have been tabulated. Dogs appeared to be influential in reducing sheep losses to predators in seven of the 12 tests, effectiveness of dogs in two of the tests was questionable and in three of the tests dogs had little apparent influence on the number of sheep killed by predators. Komondorok were not as successful on rangeland as on pastures, while Great Pyrenees appeared to be equally successful on rangeland as on fenced pastures.

151. Dr. Green testified that while no special skills were required to rear and train a successful guarding dog, patience and persistence over a period of at least a year may be required in order for a dog to be effective. He asserted that a reservoir of trained dogs was not available and that guard dogs could not be viewed as a rapidly deployable form of predator control. He further testified that guard dogs were not free of problems in that they must be integrated into the sheep operation, that they may harass, injure or maim livestock they were supposed to protect (two of the dogs at USSES having killed sheep and four others having been implicated in such incidents), that dogs may bite people, usually strangers (three dogs at USSES having bitten a person at least once) and that they are subject to illness and injury. Dr. Green viewed guard dogs as one of a number of methods for reducing predation on sheep, asserting that they would not normally eliminate predation.

152. Dr. Green testified that the purchase price of a Great Pyrenees would average $300 to $350 and that of a Komondor $400 to $600. He estimated annual food costs at approximately $200. He indicated USSES had lost 11 dogs to various causes including disease and that five had been shot, three maliciously by unknown persons, and two by a cooperating rancher who was loaned the dogs for test purposes. He stated that neighbors and adjoining ranchers should be informed that guard dogs are being used so as to lessen the chances they will be shot as marauders if they stray into a neighbor's pasture.

153. As indicated (finding 117), Mr. Pfeifer conducted a survey of North Dakota ranchers using guard dogs for predator control. Of 36 ranchers known to be utilizing guard dogs, data was collected from 33, the other three having pups which were not yet being used. The result of the survey indicated a 93 percent reduction in predation. This reduction was computed based on the ranchers' memory of the extent of losses. The dogs (44 Great Pyrenees and 2 Komondorok) were utilized in fenced pastures in Western North Dakota, an area of rolling hills, brush, wetlands and a large coyote population. The Great Pyrenees worked in pastures of 10 to 1200 acres guarding flocks of 10 to 1300 animals, with the typical Great Pyrenees guarding an average flock of 590 sheep in a 250 acre pasture. Larger flocks and pastures were generally guarded by two or more dogs. Ranchers testifying at the hearing, who tried using guard dogs, did not have good results, indicating that it was difficult to keep the dogs with the sheep, that the dogs became sheep killers, or that the dogs wandered onto neighboring pastures and were shot.

154. Shed lambing can reduce losses of lambs due to weather, lambing complications, malnutrition (failure of the ewe to accept her lamb or failure of the lamb to nurse from the ewe for one reason or another), disease and other causes. While the ewes and lambs are subject to little or no predation during the period of confinement, predation can begin again or continue once the sheep are released into pastures or ranges and shed lambing is not an alternative method of reducing predation. Shed lambing is labor intensive. Moreover, unless proper precautions are taken with regard to cleanliness confining sheep or goats can actually increase losses due to disease, parasites, etc.

155. In open range situations herders to control and look after the sheep are essential. While at least as a theoretical matter additional herders could reduce predation losses, experienced herders are in short supply. Testimony from ranchers is to the effect that herders' salaries range from $550 to $750 a month, but that the total cost of maintaining a herder, i.e., for groceries, supplies, etc. can be as high as $1,500 to $1,600 a month.

156. Dr. Gates (finding 141), while at the USDA Sheep Experiment Station, tested electric fencing, referred to as New Zealand type, as a non-lethal method of predator control. The designation New Zealand refers to a type of charger whereby fence wires can be energized by use of a 12-volt battery developed in that country. The charger is of high

capacity permitting line voltages of 3,000 to 5,000 volts. This reduces the possibility of the energized wires being grounded by contact with vegetation thus rendering the fence ineffective. While placement of warning signs is recommended, Dr. Gates explained that the pulsating current made it unlikely that any person would be electrocuted or injured by contact with the fence. The configuration of the fence tested by Dr. Gates consisted of 12 alternatively energized and grounded wires to a height of approximately five feet. An additional energized wire (trip wire) was placed 20 cm from the fence and 15 cm above the ground. The alternatively energized and grounded wires are for the purpose of assuring that a coyote attempting to pass through the fence would receive a substantial shock. The trip wire is to prevent coyotes from digging under the fence.

157. Although Dr. Gates considered the tests were successful, he cautioned that such fences would not have universal application. He pointed out that terrain may prevent construction of the fence in such a manner as to preclude coyotes from passing under it. He stated that in sandy soil a coyote could easily dig under the fence. Moreover, if the fence was effective, the matter of hindering movements and migration of wildlife might preclude its use in some areas. Fencing large areas could easily result in fencing in coyotes already there. Material costs were estimated at $1,000 per km. Dr. Gates asserted

that the lamb market was down to 42 cents this past year and at those prices an average rancher in Idaho could not maintain the fences he has, much less go out and build new fences. Dr. Gates operates a small sheep ranch or farm and indicated that he has incurred losses for the past three years.

158. FWS has field tested electric fencing as a means of predator control in North Dakota and Kansas. In the North Dakota tests, new fences were constructed using alternatively charged and grounded wires. Coyote predation was not deterred until 12 wires were used and the height of the fence was raised to 168 cm, the configuration essentially being as in the fence tested by Dr. Gates. All of these tests were in small enclosures, the largest being 3.7 acres in size. In the Kansas tests, electric wires were installed on conventional woven and barbed wire sheep fences. The addition of four and five charged wires effectively deterred predation. Again these tests were on small enclosures, the largest being 4.2 acres. Material costs (1980) for the 12-wire electric fence were estimated at $1,580 per mile. It is not clear whether this includes the charger.

159. The FWS has conducted a survey of ranchers using electric fences to protect pastured sheep from coyotes. Of 37 ranchers interviewed, only 14 seemed to have adequate information to permit a comparison of losses before and after installation of the fences. According to these ranchers, losses to coyotes over a combined total of 271 months

and 27 lambing seasons totaled 1,064 sheep. Losses after the installation of electric fences, over a period of 228 months and 22 lambing seasons, totaled 51 sheep or a 94 percent reduction in losses. A report of the survey noted, however, that data gathered was based in part on opinions and estimates from memory, that psychological factors undoubtedly played a part and that several ranchers providing information were franchised to sell fencing materials. The only rancher using electric fencing as a means of predator control to appear at the hearing was Mr. Lindon Montgomery, a McDonald, Kansas, rancher and farmer and a witness for Wyoming, et al., who testified that since enclosing approximately 25 acres around his farmstead with electric fencing in 1978, he hadn't suffered any losses of sheep or lambs to coyotes within the fenced area.

160. Dr. Maurice Shelton (finding 6) testified that while it was virtually impossible to totally exclude coyotes, it was generally possible to exclude them by fencing. He indicated that the major limitations were economic, pointing out that pastures in large areas of Texas are stocked at the rate of 100 sheep per square mile and that the cost of conventional fencing around a section (4 miles) would likely cost $4,000 to $6,000 per mile or up to $240 per head, which is many multiples of the gross income. Regarding electric fencing, he related his attempt to exclude coyotes from a 200-acre pasture in McMullen County, Texas in the South Texas Plains, an area of known high coyote density. Fence utilized was seven-wire, alternately charged and

grounded, with a barbed and a trip wire subsequently added to make it more difficult for coyotes to dig under the fence. The experiment was conducted over an approximate one-year period. Although only three coyotes were removed from the pasture (by traps and use of a helicopter), after installation of the trip wire, Dr. Shelton testified that not a single young goat was raised, coyote kills being confirmed in some cases and inferred in others and that the fence was considered ineffective. He estimated material costs for the fence at $2,500.

161. Strobe-lights, sirens and propane exploders or zon guns have also been tested and utilized in attempts to control or reduce predation by coyotes. Tests by the FWS utilizing strobe-light/siren devices at ranches in Colorado, Idaho, Oregon and South Dakota, indicated reduced predation over a period of 6 to 14 weeks at seven of ten tests sites. The results were considered encouraging, but additional work was considered necessary to identify stimuli, e.g., light, sound recordings, that most effectively repel coyotes. Dr. Shelton testified that he had inestigated the use of lights under field conditions and found them totally ineffective. Testimony at the hearing was to the effect that coyotes soon became habituated to the sound of exploders and even used them to locate flocks of sheep.

162. Penning or corralling sheep and goats at night can be very effective in reducing predation. This practice, of course, has no effect on predation that occurs in the daytime. Moreover, the usefulness of this practice is confined to farm flock operations as it is impractical to pen large flocks under range conditions.

Issue 4

163. The number of sheep in the United States has declined over the last 40 years, from a high of 56,674,000 in 1942 to a low of 12,220,000 in 1979, increasing slightly to 12,941,000 in 1981.[16/] The number of sheep increased to 13,116,000 as of January 1, 1982. Per capita consumption of lamb and mutton is approximately 1.6 pounds annually (carcass basis) of which 9 percent is imported. Per capita consumption of wool is approximately one pound annually 50 percent of which is imported. Approximately 80 percent of the sheep in the United States are raised in the 17 most western of the 48 contiguous States. Although approximately 51,000 western farmers and ranchers raise sheep, only 21,000 or 41 percent have commercial operations of 50 or more stock sheep. These producers, however, own nearly 93 percent of all stock sheep in the region. Large scale producers with a 1,000 or more stock sheep constitute only 6 percent of the producers, but account for 63 percent of the region's stock sheep.

164. Data on goats have previously been discussed (finding 70). Texas is the principal goat producing state and the majority of goats produced in Texas are Angoras, raised for their mohair. There are approximately 800,000 dairy goats and 500,000 Spanish or meat-type goats in the United States. Texas produced 9.3 million pounds of mohair in 1979 worth an estimated $47.4 million of which approximately $30 million

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16/ These figures are from tables included with the testimony of Dr. Terrill, which are based on USDA statistics. Figures in other documents in evidence which are also purportedly based on USDA statistics differ slightly.

was exported. Data in the record indicate that gross income received by Texas producers from mohair in 1980 was $30.8 million.

165. Testimony that optimum utilization of much of the rangeland in the western United States requires grazing by cattle, sheep and goats rather than a single species was given by Mr. Robert H. Kensing, Extension Economist, Texas A&M University, Dr. Carl Menzies, Resident Director of Research at the Texas A&M University Agricultural Research and Extension Center at San Angelo, and by Dr. James E. Bowns, Range Ecologist, Utah State University, witnesses for Wyoming, et al. It was pointed out that cattle prefer grass, that sheep and goats select some grass, but that sheep select large amounts of low-growing herbaceous plants (forbs), while goats select large amounts of browse. Sheep and goats are able to graze rougher terrain and areas which are more sparsely vegetated than cattle. Grazing cattle, sheep and goats in the proper combinations and at suitable intensity not only increases the production of animal products per acre, but tends to maintain the carrying capacity of the land in that forbs not properly utilized become a weed problem and browse not properly utilized becomes a brush problem. Indeed, sheep and goats can be used for the control of weeds and brush, thus avoiding the use of herbicides or expensive mechanical methods of control.

166. Because sheep and goats can turn pasture and range vegetation and crop residues into meat and fiber at relatively low cost,[17/] the rising cost

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17/ Lower labor, machinery, fuel, transportation, tillage, fertilizers, herbicides, etc. required for range livestock production are sometimes referred to as "cultural energy."

of energy in recent years has improved the economic competitiveness of sheep and goat meats relative to other meats and of wool and mohair relative to synthetics. According to The U.S. Sheep and Goat Industry Products, Opportunity and Limitations, CAST Report No. 94 (May 1982), the potential exists for increasing the production of sheep and goats in the major range areas by at least 50 percent by utilizing the best available technology in range livestock management, by grazing areas not now used for sheep and goats and by combining or alternating the grazing of sheep and goats with cattle grazing. Dr. Menzies (finding 165), who chaired the committee which authored the above report, described the 50 percent figure as a reasonable assumption. He testified that the greatest potential for improving efficiency was through improving the percentage of kids or lambs raised from a flock. He was of the opinion that increased production and lower prices for lamb and wool would increase consumption of these items.

167. Dr. Menzies noted that among the limitations on the efficiency and productivity of raising sheep and goats were infectious diseases, parasites, nutritional diseases, poisonous plants, availability of labor, marketing problems, small size of the industry and predation. He asserted that predation lowers the efficiency of production costing both the producers suffering losses and indirectly the consumer. He indicated that an often overlooked effect is the inefficient use of land resources that result when high predation losses prevent the use of land resources by sheep and goats.

168. Mr. Kensing (finding 165) cited data indicating that in 1943 there 8.6 million head of cattle, 10.8 million stock sheep and 3.3 million goats in Texas. By 1972, the figures were 13.5 million cattle, 3.5 million sheep and 1.5 million goats and that by 1980, the figures were 13.2 million, 2.4 million and 1.4 million, cattle, sheep and goats respectively. He asserted that the significant point about the number of animals was the change in species mix, and the drastic decline and even complete elimination of sheep and goats in some areas. He denied that the present predominance of cattle numbers was because cattle were more profitable. He pointed out that it was not practical in much of Texas to substitute cattle for sheep and goats on an equal animal unit basis,[18/] that not only was the range more suitable for grazing by cattle, sheep and goats rather than a single species, but that such diversified operations resulted in more reliable cash flow and were in the best interests of the operators. He therefore concluded that the switch to cattle was due to one or more external factors over which operators had little or no control. He asserted that one of these factors was predation. He acknowledged, however, that low prices played a part in some years and that sheep and goats were more labor intensive for shearing, drenching, etc. in addition to being more susceptible to predation. Among Mr. Kensing's duties as an extension economist with Texas A&M University is the preparation of cost and return budgets for livestock enterprises. He

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18/ Traditionally an animal unit of one cow and calf equals five ewes and lambs.

testified that the most recent projections for an animal unit of sheep showed a net return of $13.38, which he asserted established that producers could not long tolerate an additional loss of ten percent. He indicated that this was to counter assertions in some quarters that sheep producers were making money and could easily absorb an additional ten percent loss to predators.[19/]

169. Dr. Bowns (finding 165) testified that predation causes serious economic losses to many producers, forcing the abandonment of many livestock operations. He asserted that these losses reach levels that prevent proper use of range land and proper utilization of forage resources. He stated that producers in Arizona, Colorado, Montana, New Mexico, Utah and Wyoming have abandoned or avoided sheep and goat operations because of excessive predation and that many persons feel that predators and fear of losses were a major factor preventing young people from entering sheep or goat businesses. He further testified that an encroachment of coyotes on the Edwards Plateau in Texas has caused many ranchers to abandon sheep and goat production and that other ranchers would prefer to utilize sheep and goats for better management and brush control, but were unwilling to risk major capital investments in areas of high predator populations. He indicated that some banks and loan agencies will no longer risk capital on sheep and goats in areas of high predator populations without additional collateral as security. According to Dr. Bowns, the result of this

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19/ Although counsel for Defenders asserted that this was setting up a "strawman," Dr. Power (finding 174, infra) cited a study which purportedly demonstrated that Idaho range sheep producers could breakeven at a 14.5 percent predation rate.

situation includes alterations in the economy, decreased importance of agriculture to the economic base, a decline in industries which depend on and support the agricultural sector, and forced changes in living conditions of rural families. Under cross-examination, Dr. Bowns acknowledged that he had not conducted any surveys of ranchers abandoning sheep and goat operations or declining to enter the business because of predation. He did indicate that he had talked to individual producers that have abandoned the sheep industry who gave predation as a predominent factor in the change in operations. He was unable to give numbers or names of these individuals.

170. In 1977, the USDA published a report "Factors In the Decline of the Western Sheep Industry." In gathering data for the report, a survey of a sample of former sheep producers in Colorado, Texas, Utah and Wyoming was conducted. The report concluded that farm flock producers have declined rapidly in number because more attractive opportunities existed elsewhere for similar or better returns with less time and labor required. Although large-scale operations declined less rapidly than farm flock producers, they accounted for most of the decline in sheep numbers. Low prices for lamb and wool, frustration with predation and restraints against strong corrective action, and difficulties in obtaining good hired labor were reported as reasons for the decline. Financial returns were frequently meager or nill and the majority of former producers in Wyoming were suffering operational losses, i.e., not even meeting cash costs, when they discontinued production. The number of sheep producers declined by

12 percent in 1973, the year following restrictions on the use of toxicants, the greatest percentage of reduction since 1975. This decline was followed by further declines of 6 percent in 1974 and 10 percent in 1975. In Colorado and Texas, more producers stopped production in 1969 and 1970 than in other years between 1968 and 1974. The biggest decline in number of producers in Wyoming and Utah occurred in 1969 and 1971, respectively. Declines in these four states in 1973 were not out of line with the number of producers discontinuing production in other years. Predation was given as a significant factor in the decision to discontinue sheep production by former producers in each of the four states, although shortage of good hired labor, lamb and wool prices and age of the owner were other significant reasons. Predation was generally more of a problem to the larger scale former producers than to the small operations.

171 CAST reports in the record estimate producer losses of sheep to coyotes at $19 million a year, based on estimated losses of 4 percent to 8 percent of lambs and 1.5 percent to 2.5 percent of ewes produced at 1977 prices. Calf losses to coyotes in 1977 were estimated at 0.4 percent valued at $20 million. It is indicated that total economic losses to producers would nearly double if 1980 prices were used and would nearly quadruple if the higher range of estimated losses was used. Economic losses to producers from coyote predation on sheep and calves in 1980 were estimated to be in the range of $75 to $150 million. Dr. Terrill concluded that annual average producer losses of sheep and lambs to predators during the period 1972-80 were $60 million. He used a multiplier of three in projecting the impact of these losses on the economy. Gee, et al. estimated total 1974 losses

to farmers and ranchers because of predation at $27 million, with consumers losing an additional $10 million due to higher prices and reduced supply. Losses in foregone lamb sales among the approximate 5,000 ranchers who reported lamb losses to predators exceeding 10 percent were estimated to average about $4,000. USDI (1978) (finding 29) estimated that sheep producers with coyote predation lost $19 million, and that other producers gained $6 million because of higher prices caused by reduced supply for a total net loss to producers of $13 million. 20/

172. Mr. Murfield (finding 26) calculated that Texas sheep producers lost $4,317,600 to predators in 1981 (102,800 head). Based on goat losses totaling 67,450 head, he calculated losses to goat producers in Texas in 1981 at $2,765,450. He stated that these figures did not include losses of wool and mohair. Based on 1974 loss estimates reported by USDA (finding 8) and 1978 loss estimates by USDI (finding 29) and 1981 prices, Dr. Nielsen (finding 21) estimated direct income loss to Utah sheep ranchers at between $3.6 million and $5.6 million annually. These calculated losses as well as those reported in CAST and by Dr. Terrill in the preceding finding were determined by multiplying estimated losses times market values as appearing in USDA statistics. Because these computations make no allowance for price changes caused by increased supply, the effect is to overstate

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20/ Although the USDI publication is not in evidence (finding 29), economic loss data therein are in evidence through the testimony of Dr. Power and other witnesses.

dollar losses. The contention has been made that predation losses should be offset by expenses for shearing, veterinary fees and supplies, etc. that would otherwise have been incurred but for predation losses of particular animals. Fixed costs for property taxes, pasture leases, or range permits do not ordinarily vary with death losses. Moreover, absent extremely heavy losses labor costs in managing flocks would remain approximately the same. Costs for shearing, veterinary fees and supplies, etc. would, of course, be lower for a lesser number of animals, but are not ordinarily significant.

173. In addition to direct losses caused by killing livestock, predation also results in indirect costs or losses. Dr. Bowns listed these as (1) reduced animal production caused by molestation; (2) reduced production and death losses caused by efforts to evade losses (examples parasite infestation and smothered animals resulting from close confinement); (3) cost of supplemental feed for confined animals; (4) labor for gathering sheep scattered by predator attacks and treating injured animals; (5) direct costs of control efforts; (6) reduced attention to other phases of farm and ranch operations and (7) inability or unwillingness of ranchers to produce sheep and goats in areas well suited thereto. He acknowledged that to the extent restrictions were placed on the use of 1080, in the event it was reregistered, at least some of these indirect costs would necessarily be incurred.

174. Dr. Thomas M. Power, Professor of Economics, Chairman of the Economics Department at the University of Montana, and a witness for Defenders, disputed the view that greater or more effective predator control

would necessarily benefit sheep producers as a whole. He pointed out that available data (Gee, et al.) were to the effect that 46 percent of commercial producers in the western United States had no lamb losses to predators, that 67 percent incurred no sheep losses to predators and that only 23 percent had predator losses of lambs greater than 10 percent. He explained that an increase in supply might well decrease prices sufficiently that gross revenue to the industry would be reduced and that in such an event, producers suffering little or no predation would receive lower prices and no corresponding benefits. Producers with high predation rates would gain at the expense of producers with low predation. Whether an increase in supply would, in fact, result in a decrease in prices depends on the sensitivity of price to the quantity sold which is termed "price flexibility or price elasticity of demand." "Price flexibility" is the percentage change in price which will result from a one percent change in the quantity offered for sale, while "elasticity of demand" is the percentage change in quantity purchased that results from a one percent change in price. Dr. Power stated that crudely one could be regarded as the reciprocal of the other. He testified that the price flexibility coefficient utilized by USDI of -.17 translated to a minimum demand elasticity of 5.88, meaning that a one percent decrease in price would result in an increase of almost 6 percent in quantity purchased. He asserted this had never been observed and was unrealistic.

175. Dr. Power calculated a farm level price flexibility of -1.64 and price elasticity of demand for lamb of -0.61, which means that a one percent increase in supply would result in a greater than a one percent decrease in the price. This decrease in price would increase demand by less than one percent. He cited other studies showing price flexibility within the range of his calculations, noted that his calculations (based on 1970 to 1980 data) assumed that the demand for lamb was constant, whereas the data suggested demand was declining and therefore asserted that his estimated price elasticity of -0.61 was an overestimate. He concluded that the demand for lamb was less elastic than his estimate or inelastic and that increased effective predator control would depress prices more than enough to offset increased revenue from the sale of animals not lost to predation.

176. Dr. John Schaub (finding 44) testified that the price relationship for lamb was elastic, i.e., that an increase in quantity marketed would result in a less than equivalent or corresponding decrease in price. He asserted that this conclusion was supported by a preponderance of the literature and that both producers and consumers would benefit by a reduction in predation losses and an increased supply of lamb. In calculating increases in revenue resulting from assumed decreases in predation losses attributable to use of 1080 and increases in the number of lambs marketed, Dr. Schaub used a price flexibility value or coefficient of -.42 (farm level, yearly basis) taken from a USDA publication (Usman & Gee) not in evidence. He

adhered to the view that -.42 was the appropriate price flexibility value even though such values for other common meat items such as beef, pork and chicken were all greater than one, indicating that the demand was inelastic. He defended this result upon the ground that lamb was now so expensive, it was more of a luxury or specialty item.[21/] He acknowledged that price flexibilities change over time and that the data in the cited USDA publication was only current through 1975. He pointed out, however, that Dr. Power had not reported the confidence interval associated with his coefficient of elasticity and that Dr. Power's single estimate did not indicate that sufficient tests had been conducted that it could be considered a reliable estimate.

177. Using an estimated average current loss of lambs to coyotes of 6.5 percent, Dr. Schaub calculated that a one percent reduction in losses to coyotes to 5.5 percent would increase lamb production by 53,500 head and gross revenue to producers by $1.3 million. This calculation is based on the -.42 price flexibility value referred to in the preceding finding. He defended the 6.5 percent estimated loss figure as reasonable based on Gee, et al., who derived an average loss to coyotes of 6.4 percent, even though he acknowledged that precise data on lamb losses to coyotes were not available. He also acknowledged that data on the extent to which use of 1080 would decrease coyote predation were not available, but defended his assumptions as reasonable.

21/ This is contrary to a study cited in the testimony of Dr. Power which is to the effect that the price of specialty items could be expected to be more responsive to changes in supply.

A one percent reduction in average coyote predation from 6.5 percent to 5.5 percent is in excess of 15 percent. Dr. Schaub calculated that reducing coyote predation losses to 4.5 percent would increase lamb production by 107,100 head and gross revenue to sheep producers by $2.7 million. Reducing lamb losses to 3.5 percent would increase production by 160,650 head and gross income to U.S. sheep producers by $4.1 million. A further reduction to 1.5 percent would increase lamb production by 267,750 head and gross income to producers by $6.5 million. Dr. Schaub indicated that accompanying decreased losses to coyotes would be modest decreases in prices which would benefit consumers. A reduction in coyote predation from 6.5 percent to 1.5 percent would be a reduction of approximately 77 percent, which is unlikely even under the most optimistic assumptions as to the effectiveness of 1080. Dr. Schaub asserted, however, that coyotes prey not only on lambs, but on calves, goats, swine and poultry and that these estimates should be regarded as a lower bound of potential gain from reduced predation. Such reductions in coyote predation would hardly be costless and these costs should be deducted in considering overall benefits.

178. Dr. Schaub used sheep production budgets prepared by the Cooperative Extension Service, Colorado State University, in estimating impacts of the use of 1080 on individual producers. He indicated that it was unlikely that farm flock operators would benefit to any appreciable

extent from the reregistration of 1080 because they had medium or low predation loss rates. Larger operations using public land and range lambing would most likely be the principal beneficiaries. Utilizing Cooperative Extension Service budgets, Dr. Schaub calculated estimated economic impacts of reductions in lamb losses to coyotes for western Colorado producers of from 0.7 percent to 3.0 percent for a producer having 500 sheep and shed lambing, from 0.8 percent to 3.4 percent for 2,400 sheep with shed lambing and from 1.6 percent to 12 percent for a producer having 2,400 sheep and range lambing. Economic impacts were also estimated for an Eastern Colorado producer having 2,000 sheep, shed lambing and an estimated reduction in coyote losses of from 0.5 percent to 2.7 percent. In doing so, he made certain assumptions, i.e., that additional lambs would be marketed for slaughter, that feed, travel, and hired labor costs would increase at the average ewe rate contained in the original budget and that range and family labor costs would be constant. Gross income for the producer with 2,400 head utilizing range lambing would increase from $1,845 to $15,454 depending on the magnitude of the reduction in losses to coyotes. Production costs could increase from $707 to $5,925 resulting in returns from predator control and to management increasing from $1,139 to $9,529. Comparable increased returns for the producer with 2,400 head of sheep utilizing shed lambing were $1,217 to $5,300, while production costs could increase from $539 to $2,310, resulting in returns from predator control and to management increasing from

$687 to $2,990. For the 500 sheep operation, gross income could increase from $317 to $1,260, production costs could increase from $107 to $429 and returns from predator control and to management could increase from $210 to $831. The eastern Colorado producer was assumed to operate on private land and to have lower predation rates. For this operator, gross income could increase from $822 to $4,245, production costs could increase from $533 to $2,756 and returns from predator control and to management could increase from $288 to $1,489. None of these estimates include increases in costs for predator control. Dr. Schaub testified that these estimates were for losses considered to be average or representative, and that like all averages, they could severely underestimate the financial impact on individual producers suffering high predation and thus be misleading.

179. Mr. Bill D. Sneed, President of First Coleman National Bank of Coleman, Texas, a rancher actively engaged in raising sheep, goats and cattle and a witness for Wyoming, et al., testified that his bank had denied requests for loans on sheep and goats (apparently using them as collateral) because of coyotes. He explained that there were certain areas of Coleman County, which were heavily infested with coyotes and that if land in one of those areas changed hands, his bank would decline a loan on sheep and goats in one of those areas. He asserted that a number of ranchers in the County had gone out of business because of losses to coyotes. He acknowledged that there were other reasons for

declining loans such as insufficient collateral. Mr. Sneed cited data indicating that in 1976, there were 77,000 ewes in Coleman County and that by 1981, the number was down to 50,000. He stated that there were 204 sheep producers in the County in 1977, but only 164 in 1981. He contended that the sheep industry was vital to the County and that many areas were more suited to sheep production or a combination of sheep and cattle production rather than just cattle. He said that on a particular 575-acre lease, he was unable to run sheep due to predation by coyotes and that he was only one of many faced by that problem. He further contended that only with the reinstatement of Compound 1080 could coyotes be controlled and money returned to the pockets of the producers. Another side of the economics of predator control was presented by Mr. Robert Carpenter, a Drewsey, Oregon cattle rancher and a witness for Defenders. Mr. Carpenter has not suffered any livestock losses to predators and was highly indignant at FWS ADC control operations, because he considered these operations deprived his sons and others of needed income from the sale of coyote pelts.

180. Mr. Charles Howard (finding 71) estimated that his total income from goats in 1979 was approximately $28,000, while his predation losses to goats totaled $35,619. This included direct costs of $14,637 comprised of $10,647 for loss of goats and mohair, $1,470 for travel to pastures to pen goats and $2,520 for ranch expenditures in the control of predators. Indirect costs included $5,400 loss of adult goats to parasites and complications, $3,600 loss on goats sold because of

parasites and resulting complications, $4,100 in reduced adult mohair production assertedly due to penning, $13,419 in losses of kids and mohair and $823 in veterinary fees and drugs. These figures (direct and indirect costs) totaled $41,979 from which was subtracted $6,360 for expected normal losses of adult goats, kids and mohair.

Issue 5

181. Mr. Connolly (finding 133) testified that intact, unbroken collars did not pose an environmental hazard and were not a significant hazard to collared livestock. In the FWS field tests with the toxic collar a total of 313 collars were used,[22/] of which 26 were recovered after having been punctured by coyotes, four more collars were probably punctured and not recovered and 14 were lost. In addition, 11 collars were accidentally punctured. Although the report of the evaluation of these tests by Mr. Connolly acknowledged that the hazard posed by lost collars was difficult to objectively assess, it was pointed out that the collars were most likely to be found by the livestock owner, who would be aware of the potential hazard rather than a third person unfamiliar therewith. It was further pointed out that the principal danger to the finder would be from opening the collar and taking the 1080 orally, which he would do only if he failed

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22/ The actual number of collars used was 151 small and 94 large collars, the 313 figure being the result of counting separately collars used on more than one test. Small collars contained approximately 300 mg toxic solution while large collars contain twice that amount.

to heed the hazard notice printed on each collar. It was suggested that a child might wander into a pasture, find a punctured or leaking collar, get the toxic solution on his hands and then into his mouth. While this possibility cannot be ruled out, it is highly unlikely. Mr. Connolly recognized that lost collars would eventually deteriorate, allowing the toxicant to enter the soil where it would be detoxified by bacterial action. The time required for detoxification would vary with the amount of toxicant, soil type, temperature, etc., but studies summarized in Atzert were to the effect degradation of Compound 1080 in soil required from 0 to 11 weeks. In pen tests with eight collared lambs using dye rather than Compound 1080 in the collars, spread of the dye after the collars were punctured by coyotes varied between 12 sq. ft. to 300 sq. ft. with the average being 138 sq. ft. Spread of the dye depended on whether the lamb was down or moving at the time the collar was punctured. It was estimated that an even distribution of Compound 1080 over the average dyed area of 138 sq. ft. would result in concentration of 2.2 mg per sq. ft. The prospect that such a low concentration would cause serious environmental damage was considered remote and no such damage was observed in field tests. In initial tests with the collars in Idaho, some of the collars leaked and six collared lambs died. Although Mr. Connolly initially thought the lambs had absorbed the toxicant through the skin, he subsequently concluded that the 1080 solution dripped into their mouths and that the mode of ingestion was oral.

182. Accidental punctures of collars were attributed to wire or cactus thorns. No evidence of such punctures was observed on animals with punctured collars or on the ground even though the toxic solution contained Rhodamine B dye as a safety indicator. Another route of potential exposure is the carcasses of coyotes poisoned by puncturing toxic collars. Only turkey vultures appear to have scavenged any of the coyotes found during FWS tests with the collar. Turkey vultures, black vultures, magpies, ravens, red-tailed hawks, caracaras, a skunk and a coyote were known to have scavenged collared livestock killed by coyotes. Scavengers feeding on collared livestock killed by coyotes concentrated on viscera and muscle tissue rather than the collars. Mr. Connolly testified that he had never observed scavenging on the neck areas of collared livestock. Photos in the record of collared livestock heavily scavenged show neck areas largely intact. Although it is possible that there were some non-target kills resulting from use of the collars, none was observed. Mr. Connolly stated that if there had been any substantial number of non-target kills, they would have been located by the intensive searches on the Charles Howard Ranch, Meridian, Texas. Based on these field observations, it was concluded that there was no reason to expect significant poisoning of non-target wildlife resulting from the use of 1080 in toxic collars. Non-target deaths of animals suspected of being poisoned by 1080 have not been observed to date in tests with the collars by Texas A&M University.

183. As indicated (finding 88), SLDs containing 1080 have not been extensively tested in the United States. They have been and are being used in British

Columbia and Austrailia. Large quantities of similar strychnine baits, were used by ADC personnel for the control of coyotes prior to 1972 (finding 94). Although SLDs used in British Columbia are covered to minimize the possibility of targets consuming more than one bait and to minimize exposure to non-target species, the applications for the use of 1080 in SLDs by Montana, South Dakota and Wyoming apparently do not envisage that baits will be covered. Mr. Randall (finding 126) testified that he was never informed that strychnine drop baits should be covered. He further testified that it would have been very difficult to do because in many areas where baits were placed there weren't enough cow chips and rocks were frozen to the ground. He asserted that no one covered strychnine baits; notwithstanding a memorandum, dated December 18, 1970, that it was Bureau policy the baits be covered. He was of the opinion that there was no way to keep track of such baits or that such a program could be properly monitored.

184. The exposure of SLDs to non-target species depends, of course, on the rate of application. Montana's application for registration of Compound 1080 envisages 3.6 mg of 1080 in a 15-gram bait with a maximum placement of 25 per square mile. South Dakota's application is also for 3.6 mg of 1080 in each bait with no more than two baits to be placed at any one draw station and no more than five such stations to be located in one square mile. Assuming maximum usage,

there could be 360 baits per township containing approximately 1.3 g of 1080 or slightly less than the 1.6 grams per 100 pounds used in a large station. Wyoming's application apparently intends that the amount of 1080 in each bait as well as the maximum application rate be left to the judgment of the applicators. Dr. William Buck, Professor of Veterinary Toxicology and Director of the Animal Poison Control Center, University of Illinois, Urbana and Dr. Val R. Beasley, Doctor of Veterinary Medicine and Research Associate in Toxicology at the University of Illinois, witnesses for Defenders, testified that because SLDs were designed for more widespread use, they were more likely to be more available to domestic dogs and cats and use of SLDs could result in the poisoning of large numbers of these and other small non-target carnivores. Dr. Buck acknowledged, however, that a requirement that baits be placed no nearer than a mile or two from a home or occupied dwelling would lessen the hazard to these animals.

185. The contention that Compound 1080 is a selective poison is based in principal part on differing levels of sensitivity to the poison. Carnivores are in general more sensitive to 1080 than other species, while canines are considered to be especially susceptible thereto. For example, the LD_{50} [23/] of 1080 for a coyote has been determined to be 0.10 mg/kg, while that for a man is estimated at 0.7 to 2.1 mg/kg

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23/ An LD_{50} value is a statistical estimate of the dosage that would be lethal to 50 percent of animals tested.

and that for a golden eagle is 1.25 to 5.00 mg/kg. This indicates that an LD_{50} dose for a 30-pound coyote would be obtained by consumption of only 1.4 oz of bait material treated at the rate of 1.6 g of 1080 per 100 pounds of bait, that a 150-pound man would obtain an LD_{50} by the consumption of from 47.6 oz to 142.8 oz and that a golden eagle (average weight 7 pounds) would receive an LD_{50} by consuming from 4.0 oz to 15.9 oz of such bait material. An LD_{100} for a coyote has been estimated at 0.16 mg/kg. It is apparent that the LD_{50} values for man and the eagle as well as other species are not precise and have a considerable range. Tests to establish these values have obviously not been conducted on humans and the tests on many other species including coyotes and eagles have not been conducted on a sufficient number of animals that a statistical confidence interval can be established. Inasmuch as the food consumption of an eagle is approximately two pounds a day, it is clear that an eagle could obtain a potentially lethal dose in feeding on a bait station. This is, of course, also true of other non-target species. There is evidence that the LD_{50} value can vary depending on whether the mode of administration is by a tallow bait or water. Moreover, Drs. Buck and Beasley (finding 184) referred to a study indicating that a median lethal dose of 1080 at 22°C was 21 mg/kg, while at 8°C, the equivalent dose was 4.5 mg/kg, indicating that temperature had a great effect on the toxicity of the poison. LD_{50} values are more likely to have been established in laboratories at or near normal room temperatures.

186. Bureau of Sports Fisheries and Wildlife policy (prior to the suspension of the registration of Compound 1080) regarding large-bait stations was that the minimum number necessary to achieve effective coyote management was to be placed. This was generally interpreted as requiring or permitting the placement of not more than one station per township. With the approval of the State Supervisor, up to two stations per township could be placed where terrain required additional placements in order to achieve needed control. Guidelines issued by the Bureau further stated that the use of 1080 large baits was a technique reserved for areas where other control methods had not been effective in reducing coyote population to a desired level and where such use would have a minimum effect on non-target wildlife and domestic animals. If a selected site did not meet these requirements, 1080 was not to be used. Mr. Randall (finding 126), however, testified that in practice the number of bait stations placed each year did not vary significantly and that the stations were placed in more or less the same locations each year. The testimony that baits were placed in approximately the same locations each year was confirmed by Mr. Gene Chapel, a Montana cattle rancher, a former ADC employee of the FWS and a witness for the AFBF. The theory of not more than one large-bait station per township was, of course, that coyotes being more mobile and having larger home ranges would be more apt to come in contact with and feed on the station while smaller, less mobile animals with smaller home ranges would be less likely to find it. Mr. Randall asserted that there was no place where only coyotes lived. He

testified that the guidelines were unrealistic in specifying that baits be placed so as to minimize exposure to non-target species in that many ADC field personnel couldn't identify tracks of various species, and they had no data on locations of endangered species and other non-target animals. The result was that baits were placed away from water and on elevated locations where the snow would most likely be blown off and without regard to non-targets.

187. Bureau guidelines also called for bait stations to be placed as late as practicable in the fall in keeping with safety to meat-eating mammals and birds, effectiveness in controlling damage, and conditions of weather and travel. Baits were to be removed as early in the spring as weather and travel conditions permitted, after allowing a suitable, but minimum time for exposure. In theory this eliminated or minimized exposure to bears and other hibernating animals. Mr. Randall related that in many instances because of the snowpack at higher elevations and the press of other duties, bait stations could not be removed until early summer or later, which was long after hibernating animals would be out.

188. As indicated previously (finding 102), large-baits were to be treated at the rate 1.6 grams of 1080 for each 100 pounds of meat. Mr. Randall described the difficulties in obtaining proper distribution of 1080 in large meat-baits. He testified that even after 1080 was distributed

in vials of 0.8 g and 1.6 g, it was impossible to distribute 16/1000 ths of a gram evenly through each pound of bait. He described the equipment used, a Morton meat pump for the purpose of sugar curing hams, as a medieval method of application, and asserted that the plungers frequently leaked and that the pumps did not work properly if used in below freezing or zero weather. He stated that 1080 had an affinity for protein and would not penetrate membranes. If the needle hit a membrane, it automatically created a hot spot, i.e., an area of more concentrated solution. He indicated that even after ADC field personnel were furnished scales, it was still necessary to estimate the amount of bone, hide, etc. in each portion in determining the proper quantity of 1080 solution to apply. He stated that graduated containers would have been of assistance in mixing the proper quantity, but that such containers were not available.

189. With the exception of Mr. Randall, testimony from all witnesses who participated in or who were familiar with the 1080 baiting program was to the effect that deaths of non-target species from the baits were minimal. Because of the characteristic latency period for toxic effect after the ingestion of Compound 1080, it is probable that many animals and birds feeding on the stations and receiving a lethal dose would not die in the immediate vicinity. The evidence is that searches for birds and animals thought to have been poisoned by the stations were chiefly conducted at the time of disposal of remains of the baits and that these searches varied widely in scope and intensity. By that

time, the remains could have decomposed or been scavenged by other birds and animals. Although Bureau policy called for the reporting of coyotes as well as non-target species found in such searches, Mr. Randall indicated that this was for public relations purposes and that there was a tacit understanding among field personnel with whom he was familiar that the actual magnitude of non-target deaths not be reported.

190. Mr. Randall testified that he commonly found dead badgers near 1080 baits or the remains of such stations. He explained that badgers would dig a hole underneath the station and attempt to drag the meat into the hole for their winter food supply. He stated that in the spring as many as four dead badgers would be found in one hole. In contrast, Mr. Johnson (finding 108) stated that he had observed a badger living under a bait station which appeared to be in good health and Mr. Anderson (finding 118) testified that badgers frequently burrowed beneath bait stations, spending their winters there and using the station as a food source without apparent ill effects. He stated that he had observed this personally on approximately one-half dozen occasions and that it had been mentioned to him by others as well. He attributed an incident involving the finding of seven dead badgers at bait stations in Texas to improper dosage caused by use of insufficient water in treating the horse meat bait. The LD_{50} for a badger is from 1.0 to 1.5 mg/kg, which indicates that a badger (average weight 19 pounds) would obtain an LD_{50} dose by consuming from 8.0 ozs to 13.0 ozs

of bait material treated at the rate 1.6 g of 1080 per 100 pounds of bait. It is therefore probable that a badger feeding on a bait station for any length of time could receive a lethal dose. A summary in evidence indicates that during the period 1965 to 1969, 1080 residues were found in a sample from a condor, 13 golden eagles and one bald eagle received at the Denver Wildlife Research Center. Tests on one of the golden eagle samples were positive for strychnine.

191. In the fall of 1969, the Division of Wildlife Services instituted a policy of including a tracerite in 1080 solutions and strychnine drop-baits. Tissue samples of a bird or animal killed by either of these poisons would fluoresce under ultraviolet light. According to Mr. Randall, the same tracerite was placed in strychnine and 1080 baits and the purpose of the program was not to monitor wildlife killed by the baits, but to be in a position to defend against claims from dog owners and others whose animals were poisoned. While still an employee of the FWS, Mr. Randall collected carcasses of birds and animals which he considered had been poisoned by strychnine drop-baits or 1080 and subjected them to ultraviolet light in the basement of his home. A table in evidence reflects that he autopsied 46 mammals (8 dogs, 12 coyotes, 17 badgers, 2 bobcats, 2 pine martens, 1 mink, 1 skunk and 3 weasels) of which 20 showed evidence of strychnine tracer and 19 showed evidence of 1080 tracer. Of 36 birds autopsied (10 golden eagles, 2 great-horned owls, 2 red-tailed hawks, 11 magpies, 3 prairie falcons, 5 unidentified hawks, 1 sharp-skinned hawk, 1 Canada jay and 1 rough-legged hawk) six showed strychnine tracer and

13 showed 1080 tracer. Mr. Randall acknowledged that because the tracer in strychnine drop-baits and 1080 was the same, those conclusions were actually based on the location of the carcass in relation to proximity of baits and other evidence rather than of tracer. There is, of course, no doubt that 1080 bait stations and strychnine drop-baits killed birds and animals in addition to coyotes. Dr. Wagner (finding 40) testified that there was no evidence of significant adverse impacts on the populations of non-target species from the use of 1080. He asserted that the loss of some individuals was not a sufficient basis for determining adverse impacts on the population of a species. He indicated, however, that there was no evidence to show an effect or lack thereof on endangered or threatened species.

192. In tests conducted by the FWS to evaluate primary hazards of Compound 1080, dogs and magpies were allowed to feed on the carcasses of coyote-killed sheep or goats with punctured collars. No ill effects were observed. In tests to determine the primary toxicity of 1080 to raptors, two golden eagles and a rough-legged hawk were each orally administered 3 mg active ingredient 1080 in a beef tallow bait, approximately 9 grams in weight, each day for four consecutive days. Over the four-day test period, each bird consumed 12 mg of 1080, which is equivalent to 3.2 and 3.1 mg/kg for each of the two golden eagles and 9.5 mg/kg for the rough-legged hawk. After administration of the third dose, the eagle receiving 3.1 mg/kg showed symptoms of toxicity (gross motor impairment, fluffed feathers and loss of appetite). Dr. Peter J. Savarie, Research Pharmacologist at the Denver Wildlife Research Center and an expert witness for the FWS, testified that this

eagle recovered in about six days with no apparent side effects and that similar symptoms were not observed in the other eagle and the hawk. These results are based solely on observation of the birds. Dr. Savarie acknowledged that it would be desirable to conduct more tests with a greater number of animals in order to fully assess primary hazards to non-target species from the use of 1080.

193. In tests to determine secondary poisoning hazards to raptors, the two golden eagles mentioned in the primary hazard tests referred to previously and a different rough-legged hawk were fed ground meat obtained from five coyotes each administered an oral dose of 5 mg/kg active ingredient 1080. Coyote meat was the sole source of food for these birds over the ten-day period of the test, no food being offered on the fifth day. Analysis of the meat indicated that it contained from 1.8 mg/kg to 3.1 mg/kg 1080. Uneaten meat was retrieved and weighed to determine consumption. It was determined that one eagle ate 2,630 g of meat equivalent to 6.55 mg 1080 or an average of 0.73 mg per feeding and that the other eagle consumed 3,005 g of meat equivalent to 7.44 mg of 1080 or an average of 0.83 per feeding. The hawk was determined to have consumed the equivalent of 3.55 mg of 1080 or an average of 0.39 mg per feeding. No discernible effects from this consumption of meat containing 1080 were found. Similar tests with red-tailed hawks resulted in a finding of no toxic effects on the hawks and in fact, the hawks gained weight. Dr. Savarie pointed out that 5 mg/kg 1080 administered to the coyotes was approximately 31 times the estimated LD_{100} of 0.16 mg/kg and that a SLD of 5 mg 1080 would contain about three SLD_{100} doses for a ten kg coyote. He estimated that a coyote puncturing a toxic collar would receive a

maximum of 10 mg 1080 or approximately six LD_{100} doses for a ten kg coyote. Dr. Savarie concluded that the carcass of a coyote killed by a SLD containing 5 mg 1080 or by a toxic collar would not present a hazard to raptors.[24/]

194. Dr. Savarie (finding 192) testified that one of the difficulties in determining the primary and secondary hazards to non-target species from the use of 1080 has been the lack of reliable methods of measuring low levels of 1080 residues in tissues of animals suspected of being poisoned. Problems with the use of colorimetric and gas chromatographic (flame ionization detector) test methods include the relatively large sample sizes (50 to 100 g) required for determination of 1080 levels as low as 0.5 ppm. Dr. Savarie indicated that the development and refinement of more sensitive methods, e.g., gas chromatography with electron capture detection and mass spectrometry, have enabled the detection of less than 0.1 ppm of 1080 in one gram samples. He asserted analytical methods currently available would facilitate more accurate assessments of the hazards of 1080. Although Dr. Savarie stated that current methods could detect fluorocitrate, he acknowledged that fluorocitrate would not be detected in a test for 1080 residues.

195. In other efforts to determine possible secondary poisoning hazards from the carcasses of coyotes poisoned by 1080, FWS analyzed 1080 residues

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24/ Coyote meat fed the raptors consisted of skeletal or muscle tissue. It is recognized that raptors normally feed on viscera first and that viscera might well contain higher 1080 or fluorocitrate residues.

in tissues of coyotes which died after puncturing toxic collars. It was determined that the average 1080 concentration in muscle tissue of these coyotes was 0.31 ppm. Average 1080 concentration in vomitus of poisoned coyotes was 0.14 ppm. Ten magpies[25/] were confined with skinned carcasses of coyotes that died after puncturing toxic collars with no other food available. Although four birds died and one of the four contained 1080 residues, it was concluded that these birds starved to death. The other six birds apparently showed no symptoms of 1080 poisoning. The conclusion the birds died of starvation was based in part on the fact the skinned coyote carcasses dried up in the heat and it was concluded that the magpies could not eat it. Dr. Ronald Bogusky, M.D., Ph.D., an Assistant Professor in the Nephrology Division of the School of Medicine at the University of California at Davis, and a witness for Defenders, pointed out that the metabolic effects of fluorocitrate mimic diabetes mellitus, which is a quasi-starvation state and asserted that Mr. Connolly had not proved his contention that the birds died of starvation. In further tests, a coyote was given a massive overdose of 1080 (300 mg or the contents of a toxic collar), an LD_{100} being approximately 1.8 mg. This coyote was dissected soon after death and the soft tissues fed to one group of magpies for seven days and another group of magpies for two days. Even though the coyote tissue contained substantially higher 1080 residues than were found in any coyote killed by puncturing a toxic collar, no evidence of evidence of intoxification was observed. It was concluded that the potential for secondary poisoning of non-target

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25/ An LD_{50} for a magpie is in the range of 0.6 mg/k to 1.3 mg/k.

wildlife was not significant. There is, however, evidence that foxes died after feeding on kangaroo rats poisoned by 1080 used as a rodenticide in California and that coyotes died after feeding on ground squirrels poisoned by oats treated with 1080 in Montana.

196. The citric acid or Krebs cycle is the final mechanism for converting food into energy in plants and animals. Sodium fluoroacetate, when ingested, is metabolized into fluorocitrate, which inhibits activity of the enzyme aconitase and deprives cells of energy. This enzyme inhibition results in the blocking of the Krebs cycle, which secondarily blocks glucose metabolism, a lesser energy producing process. Blockage of these processes causes the energy supply to be reduced to the point where cellular permeability barriers are destroyed, resulting in loss of function and finally cellular death. Because of this cell destroying capability, fluoroacetate is referred to as a cellular poison. The breakdown in intracellular processes eventually results in the appearance of gross organ or organ system disorders. Death may result from gradual cardiac failure or ventricular fibrillation, or progressive depression of the central nervous system with either cardiac or respiratory failure as the terminal event or respiratory arrest following severe convulsions. Death in carnivorous species is thought to be the result of central nervous system disorders. Dr. Savarie (finding 192) cautioned that these were assumed modes of action based on tests with rats and had not been proved as to most species. He asserted that there could be other unidentified metabolites which contributed to the toxicity of monofluoroacetate. Dr. Norman Zimmerman,

Senior Toxicologist for the Michigan State Toxic Substance Control Commission and a witness for Defenders, acknowledged that all details of the exact mode of action by which Compound 1080 exerted its toxic effects were not known. He asserted, however, that its mechanism was generally accepted in the scientific community and that it was known that 1080 could lethally disrupt basic chemical metabolism in all animals including man.

197. Dr. Bogusky (finding 195) surgically removed kidneys from normal rats and perfused them with an oxygenated buffer solution containing serum albumin in an incubator controlled for temperature, Ph and oxygen. Under these conditions, kidneys were able to maintain normal functions for at least one hour. He added fluorocitrate to the profusing medium up to a final concentration of 0.1 mM. During the course of the experiment kidneys were instantly frozen after 20 minutes of perfusion prior to adding fluorocitrate and at timed intervals thereafter. Frozen kidneys were extracted and analyzed for tissue metabolites. He concluded that fluorocitrate caused a significant fall in kidney tissue adenosine triphosphate (ATP), a major source of energy, to 43 percent of normal, that kidney function was reduced to 1/10 of normal and that serious kidney damage had occurred. The purpose of his experiment was to determine how kidneys produce ammonia rather than to test the effects of fluorocitrate on kidneys. Although Dr. Bogusky considered that the concentration of fluorocitrate used was low, it was approximately seven times the one

mg/kg Dr. Savarie considered a coyote would receive by biting a toxic collar. Dr. Bogusky assumed that the conversion of fluoroacetate into fluorocitrate would be on a one-to-one basis. He defended this conclusion as reasonable asserting that the amount of fluoroacetate not converted would be trivial even though he had no specific data to support that conclusion. Dr. Zimmerman (finding 196) testified that all fluoroacetate would not be converted to fluorocitrate and that the quantity converted would vary with the tissue and the species. Dr. Savarie stated that based upon metabolism studies a small percentage of fluoroacetate would be converted to fluorocitrate. Dr. Bogusky considered that damage to kidneys demonstrated by his experiments would be the same if fluorocitrate or fluoroacetate were taken orally. He acknowledged that he had not performed those experiments and that other bodily functions could impact ingested fluorocitrate before it reached the kidney. He also acknowledged that the concentrations of fluorocitrate used in his experiments on kidneys as single organs would have been lethal to rats. Although Dr. Bogusky is clearly an expert on kidneys and their functions, he is not an expert on Compound 1080 or the amount of fluoroacetate converted to fluorocitrate when ingested.

198. Dr. Zimmerman cited a study (Cater, et al., 1961) with rats treated with fluorocitrate, which demonstrated marked kidney damage. He referred to another test (Sullivan, 1979) where rats introduced to

concentrations of fluorocitrate in drinking water as low as six ppm for seven days showed morphological damage to testes. This test showed that there was some regeneration, although not complete, after 21 days. Rats given sub-lethal doses of fluorocitrate in drinking water have been shown to grow normally for seven months and then to survive on an intraperitoneal dose of 40 mg/kg which would normally have been fatal (Peters, 1971). This indicates that a certain tolerance for fluorocitrate may be developed. Studies cited by Atzert also show that repeated sub-lethal doses of monofluoro-acetate have increased the tolerance of some species, e.g., golden eagles, rats, mice and possibly rhesus monkeys. Repeated sub-lethal doses of monofluoroacetate in dogs, guinea pigs, rabbits and mallard ducks, however, accumulated to lethal levels. Dr. Bogusky pointed out that the reason more data wasn't available on whether fluoroacetate accumulates was because it was so toxic and that animals in the wild would not normally receive repeated sub-lethal doses.

Issue 6

199. Sodium monofluoroacetate is a white, ordorless, powdery, fluoro-organic salt similar in appearance to flour, powdered sugar or baking powder. It is essentially tasteless, having only a mild salty, sour or vinegar taste to individuals. It is highly soluable in water, but relatively insoluable in organic solvents such as kerosene, alcohol, acetone, or in animal and vegetable fats and oils. Sodium fluoroacetate is absorbed through the gastrointestinal tract, through open wounds and the pulminary epithelium, the lining covering

air passages in the lungs. It is not readily absorbable through intact skin. Monofluoroacetates, in general, are chemically stable due to the strength of the carbon-fluorine bond. Available data (finding 181), however, indicate that fluoroacetate breaksdown in the soil, being decomposed by certain soil bacteria. Sodium fluoroacetate poisoning is characterized by a latency period of from one-half hour to two hours after ingestion, which is related to the metabolic processes described above (finding 196). Death is usually within 24 hours after ingestion. Dr. Barry Rumack, Associate Professor of Pediatrics at the University of Colorado, Director of the Rocky Mountain Poison Control Center, Denver and a witness for Defenders, testified that he did not consider sodium fluoroacetate to be an accumulative poison in the chronologic sense. He indicated that the latency period in a human may be as long as five hours.

200. Reported deaths attributable to 1080 have been in connection with its use as a rodenticide rather than use as a predacide. Dr. Rumack (finding 199) contended that this was irrelevant because 1080 was highly toxic however used. He testified that 1080 poisonings were difficult to diagnose and that many poisonings were likely to go unreported. Evidence in the record is to the effect that individuals handling or exposed to 1080 in connection with preparation of bait stations or toxic collars did not suffer any ill effects provided proper precautions such as wearing protective clothing were taken. For example, Mr. Charles Howard (finding 71) ruptured the reservoir from a toxic collar in the process of adjusting or removing a collar

from a goat, spilling the solution on his hands. He washed his hands and suffered no ill effects. The spilled area was covered with dirt. Mr. Randall testified that in the course of injecting meat baits with 1080 solution, the solution frequently spilled on his pants and shoes. He suffered no ill effects.

201. Mr. Glenn Dahlen, a Gunnison County, Colorado, Deputy Sheriff became ill and began hallucinating after handling a piece of meat in a plastic wrapper in the course of investigating a complaint concerning the poisoning of some dogs. Mr. Dahlen was hospitalized, treated and released. Subsequent tests revealed that the meat contained 1080. Although Mr. Dahlen did not touch other than the wrapper in which the meat was contained, he did not wash his hands for some time after handling the wrapper containing the meat. Another witness, apparently suffering an adverse reaction to Compound 1080, was Mr. Brian Mitchell who suffered localized numbness after being bitten in the thumb by his dog which was poisoned by carelessly placed 1080 baits intended for the control of rats. Mr. Mitchell was treated as an outpatient at the Logan County Hospital (Colorado) and sent home. Ms. Carey Hopkins, the owner of the dogs involved in the incident investigated by Mr. Dahlen, was hospitalized suffering from what Dr. Rumack described as classic symptoms of 1080 poisoning. Classic symptoms of 1080 poisoning include nausea, vomiting, diarrhea and hyperactivity. Ms. Hopkins apparently became ill after washing blankets upon which her dogs had vomited. Although Dr. Rumack testified that survivors of

1080 poisoning were likely to suffer permanent, irreversible damage, Messrs. Dahlen and Mitchell and Ms. Hopkins recovered with no apparent adverse effects. Dr. Rumack was unable to cite any instances of patients recovering from 1080 poisoning who suffered permanent damage.

202. Related to both environmental and human safety is the matter of possible misuse of Compound 1080. The 1972 order cited instances of misuse of toxicants and indicated that it was appropriate to consider "commonly recognized practice" and that the likelihood of label directions being followed may effect their adequacy.[26/] It will be recalled that Mr. Randall testified that it was not possible to monitor or control the application of strychnine drop-baits. He indicated that if the baits were covered, they could not subsequently be found. He also referred to the placement in the fall of 1969 of 51 bait stations, some of which were on Federal Government property, which had not been approved by either the Forest Service or the Bureau of Land Management or for location by DWS. He stated that these baits were placed because of pressure from sheepmen and an overzealous supervisor in the area. An October 1969 DWS memorandum, of which

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26/ It is noted that one of the decisions relied upon for the proposition that commonly recognized practice may affect the adequacy of labelling directions (In Re Stearns, 2 ERC 1364 (1970) was set aside on appeal, sub nom Stearns Electric Paste Company v. EPA, 4 ERC 1164, 461 F. 2d 293 (7th Cir., 1972).

Mr. Randall was one of the recipients, indicated that based on the quantity of 1080 used and the number of baits placed, baits were being overtreated, there was poor record keeping or that adjustments were not being made for breakage and spillage.

203. Although Wyoming guidelines for the use of 1080 bait stations during the 1975-77 baiting program called for an average of one station per township, maps of placements in the record indicate that more than one station was placed in several townships in at least Campbell County. Mr. Crosby explained that more than one bait was permissible if there were barriers such as a highway or a mountain range that would separate coyote populations. In any event, it is clear that baits were not placed in every township and considering the total number of townships, the average of one per township was not exceeded. Mr. Crosby also referred to unauthorized moving of baits and to the fact that in certain instances ranchers were allowed to destroy the remains of bait stations where because of weather and other factors authorized personnel were not available to do so. During the New Mexico tests with the toxic collar under an EUP, an employee of one rancher was suspected of removing the toxic solution from three collars and of storing the solution in an unlabelled container. The collars and the solution were confiscated and the particular rancher was not allowed to participate further in the program. Although similar incidents cannot be ruled out, the collars in this instance were furnished free of charge to participating ranchers by the New Mexico

Department of Agriculture and it is unlikely that given the $16.50 cost of the collars many ranchers would purchase collars for the purpose of obtaining 1080. Mr. McBride likened such a practice to buying a pickup in order to obtain a tank of gasoline.[27/] In sum, while it is clear that the extreme toxicity of Compound 1080 requires careful monitoring if it is to be used in any form, the violations of use restrictions shown by this record are not a sufficient basis to deny its registration for the uses authorized herein.

204. Efforts to develop an antidote for sodium fluoroacetate poisoning have been unsuccessful to date and treatment is symptomatic, meaning that there is no specific treatment. A three-year old girl (Shelley Woodward) was hospitalized in a comatose condition after being found with a mouthful of oats which had been soaked in an unknown amount of sodium fluoroacetate. She was treated with ethyl alcohol, sodium acetate and acetamide. She revived after 50 hours and appeared completely normal after 72 hours. Dr. Rumack, however, insisted that the treatments had nothing to do with her recovery, the child having received a sub-lethal dose and that the significance of hospitalization was in supportive care, i.e., maintenance of bodily functions. He testified that if the treatments were effective, she would have revived more quickly. Dr. Bogusky was of the opinion that she had received a sub-lethal dose, but nevertheless stated that she would have died without the treatments.

27/ It is noted, however, that South Dakota's application for the use of 1080 in the toxic collar contemplates that control of retrieved collars will remain with ADC personnel and it is not clear that it is intended the collars be sold to ranchers.

205. Disputing the assertion that 1080 is a humane method of predator control, Defenders have shown a film of a dog dying after being administered sodium fluoroacetate. Of concern here is the assertion that an animal administered 1080 is in agony. This would seem to depend on whether the animal is conscious. While this question cannot be answered with certainty from evidence in the record, Dr. Rumack, describing the symptoms of 1080 poisoning, stated that patients often complain of a tart, sour taste in their mouths. He asserted that the unpleasant taste was soon followed by nausea and/or vomiting, tingling sensations in the nose, spreading to the arms and legs and facial numbness. Still later, in more serious poisonings, the patient suffers spasmodic muscle contractions followed by generalized seizures. Dr. Rumack explained that the most serious 1080 symptoms primarily involve the central nervous system and the cardiovascular system and that after the numbness, tingling, contractions and seizures referred to above, patients may also suffer from agitation followed by depressed consciousness and eventually coma and death. It is the hyperactivity, muscle contractions and seizures that give the viewer the impression that an animal dying from 1080 is in agony. In this connection, the only apparent mention of pain in the hospital record of Shelley Woodward (finding 204) is when she began to recover after 50 hours. In any event, animals caught in traps and snares and wounded, but not killed, after being shot, are also likely to be in agony.

Smear Post

206. Although Wyoming has applied for the registration of Compound 1080 in a smear post formulation, the only witness to testify regarding such use was Mr. Robert Burgee (finding 126). The application envisages a formulation of 0.50 percent sodium monofluoroacetate, 95.50 percent Rhodamine B dye and 4.0 percent water. Mr. Burgee described a smear post as a 4 x 4 post into which holes were drilled or which was scored with an axe in order to hold scent material and which was placed in the center of an approximately 24-square foot enclosure. He explained that five barbed wires were used for enclosing the post if the post was used on sheep range and four if the post was on cattle range. These wires were for the purpose of keeping livestock away from the post and would not prevent entry by dogs, small mammals and birds. The formulation used was two ounces of 1080 to a gallon of scent material. Mr. Burgee referred to the scent material used as H-40 without further explanation. He indicated that there was lanolin in the formulation, that it readily stuck to the post and that one gallon would be sufficient to treat at least three posts. Smear posts would be placed near draw stations (dead livestock), the intent being that coyotes would be attracted to the post by the scent material and in the course of licking it would receive a lethal dose of 1080. Wyoming's application is silent as to the scent or attractant to be used and the adhesive to enable the formulation to stick to the post.

207. Mr. Burgee considered that one smear post per township would be adequate and that smear posts would be used only during the and cold-weather months. He indicated that more could be used depending on predation and the number of sheep. Given the current cos of horses, which he referred to as "tankers" and which he used as 1080 baits prior to 1972, and the fact that the rancher usually furnished the posts and wire, Mr. Burgee testified that smear posts were cheaper than bait stations. Although his experience with smear posts was limited to three constructed for experimental purposes in the winter of 1966-67, Mr. Burgee testified that they were effective, asserting that he had trailed and identified by green dye coyotes that were killed by the smear posts. He stated that he had not found any non-target animals near smear posts because there was little or no non-target traffic during the winter.

DANGER — POISON

1351

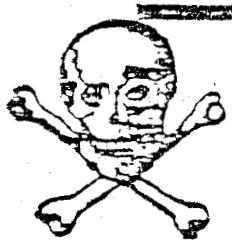
TO CONTROL STOCK-KILLING COYOTES

SHEEP OR GOATS IN THIS AREA ARE WEARING

NECK COLLARS THAT CONTAIN A POISON, COMPOUND 1080
(Sodium Fluoroacetate)

DO NOT TOUCH COLLARED LIVESTOCK, COLLARS, OR DEAD ANIMALS.

DO NOT RELEASE LIVESTOCK



PELIGRO — VENENO

EL VENENO, COMPUESTO 1080,
ESTÁ EN UN COLLAR TÓXICO EN LAS OVEJAS O CABRAS QUE ESTÁN ATADAS

NO TOQUE LOS ANIMALES, LOS COLLARES, NI LOS ANIMALES MUERTOS. NO SUELTE A LAS OVEJAS O CABRAS.

USE RESTRICTIONS

FOR SODIUM MONOFLUOROACETATE (COMPOUND 1080)

LIVESTOCK PROTECTION COLLARS

1. Use of collars shall conform to all applicable Federal, State and local regulations.

2. Collars shall be sold or transferred only by registrants or their agents, and only to certified applicators or persons under the direct supervision of certified applicators.

3. Certification of applicators shall be performed by appropriate State regulatory agencies. Prior to certification, each applicator shall receive training which will include, but need not be limited to:

   (a) Training in safe handling and placement of collars,
   (b) Training in disposal of punctured collars, contaminated animal remains, and contaminated vegetation and soil,
   (c) Instructions for practical treatment of 1080 poisoning in humans and domestic animals.
   (d) Instructions on record keeping.

4. Registrants shall keep records of all collars sold or transferred. Records shall include name and address of each recipient along with dates and numbers of collars received.

5. Each certified applicator will keep written records showing the numbers of collars:

   (a) Purchased
   (b) Placed on livestock,
   (c) Punctured or ruptured (along with apparent cause of each puncture),
   (d) Lost or unrecovered,
   (e) In use on Livestock, and
   (f) In storage.

   Applicators also will record the species, date, and location of each animal found poisoned as a result of the use of toxic collars.

6. Any poisoning of non-target species will be reported immediately to EPA or the appropriate State regulatory agency. Each accident or injury to humans or domestic animals will likewise be reported.

7. Collars will be filled with 1080 solution only by manufacturer (registrant). Certified applicators will handle only filled collars.

8. Collars shall be used only to take wild canids that prey upon domestic livestock.

9. Where collars are in use, each logical point of access shall be conspicuously posted with a bilingual (English/Spanish) warning sign not less than 8" x 10" in size. Such signs shall be inspected weekly to insure their continued presence and legibility, and will be removed when collars are removed.

10. Each collar in use shall be inspected by the applicator at least once a week to insure that it is properly positioned and unbroken.

11. Damaged or broken collars shall be removed from the field and either returned to the manufacturer for repair or disposed of properly.

12. Disposal of punctured or unserviceable collars and contaminated animal remains, vegetation and soil shall be accomplished by deep burial at a safe location, preferably on property owned or managed by the applicator.

13. All persons authorized to possess and use 1080 collars shall store such collars under lock and key in a dry place away from food, feed, domestic animals and corrosive chemicals. Collars will not be stored in any structure occupied by humans.

USE RESTRICTIONS

FOR SODIUM MONOFLUOROACETATE (COMPOUND 1080)

SINGLE-LETHAL DOSE (SLD) BAITS FOR PREDATOR CONTROL

1. Use of baits shall conform to all applicable Federal, State and local laws and regulations.

2. Baits shall be prepared, sold or transferred and used only by Federal or State employees responsible for animal damage control (ADC), who are certified applicators.

3. Certification of applicators shall be performed by appropriate state regulatory agencies. Prior to certification, each applicator shall receive training which will include, but need not be limited to:

   (a) Training in safe handling and placement of baits,
   (b) Training in disposal of baits, contaminated animal remains, and contaminated vegetation and soil,
   (c) Instructions for practical treatment of 1080 poisoning in humans and domestic animals,
   (d) Instructions on record keeping.

   Each bait shall contain no more than 3.6 mg of sodium monofluoroacet (Compound 1080) and shall be composed of lard, tallow or other anima tissue. Baits shall contain a scent known to attract coyotes.

5. Baits shall contain an inactive dye unattractive to birds and readil identifiable by humans.

6. Baits shall be placed only after verification by Federal or State ADC personnel that a coyote kill or kills have occurred. Selection of bait sites and placement shall be only by qualified ADC personnel who are certified applicators.

7. Baits shall not be placed within 300 feet of open water or nearer than one mile to occupied human dwellings.

8. Baits may be placed in conjunction with draw stations (animal carcasses). However, not more than two baits shall be placed at any one draw station and no more than one of such stations or two baits shall be located on one section (640 acres) of land.

9. Baits shall be covered with cow chips, stones, grass or hay or similar materials. If baits cannot be covered, baits will not be placed.

10. Baits shall be removed when: (1) the offending animal or animals are eliminated, or (2) within 30 days from time bait is placed.

11. Baits shall be monitored at least every seven days. After a bait is consumed every reasonable effort will be made to locate the animal, which consumed the bait.

12. When baits are placed, each logical point of access shall be conspicuously posted with a bilingual (English/Spanish) warning sign not less than 8" x 10" in size. Signs will be inspected weekly and will be removed when baits are removed or determined to have been consumed.

13. ADC personnel shall keep written records of the number, location and dates baits were placed. A detailed map showing location of baits placed shall also be maintained.

14. Reports of human injuries and of all animals taken, target as well as non-target, will be made by ADC personnel to EPA or the appropriate State regulatory agency.