VOLUNTARY LEAD REDUCTION EFFORTS WITHIN THE NORTHERN ARIZONA RANGE OF THE CALIFORNIA CONDOR

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ABSTRACT.—Lead exposure is a significant factor affecting the success of the California Condor (*Gymnogyps californianus)* reintroduction program in northern Arizona and southern Utah. Lead toxicity is the leading cause of mortality, with 12 confirmed cases, and the primary obstacle to a self-sustaining condor population. Research has identified incidental ingestion of spent lead ammunition found in animal carcasses and gut piles as the major lead exposure pathway. Peaks in condor lead exposure rates have corresponded with big game hunting seasons on the Kaibab Plateau in northern Arizona.

In response, the Arizona Game and Fish Department (AGFD) initiated a public education campaign in 2003 promoting voluntary lead reduction actions within condor range, including the use of non-lead ammunition by hunters. In addition, the AGFD implemented a free non-lead ammunition program for the 2005 and 2006 fall big game hunting seasons. This program resulted in 50–60% voluntary participation from Kaibab deer hunters. Although this represented an unprecedented voluntary effort, condor lead exposure data suggested that a 50–60% reduction in lead-laden carrion was not sufficient to maintain a self-sustaining population of free-foraging condors. Consequently, the Arizona Game and Fish Department intensified lead reduction efforts in 2007. Modifications included improved hunter outreach in the form of articles in sportsman's publications; distribution of an educational DVD and brochure; increased field communication; and added incentives for gut pile retrieval. Despite non-lead ammunition supply problems, 2007 voluntary efforts were successful and yielded over an 80% compliance rate from hunters. No lead toxicity fatalities occurred during the 2007 hunting season and preliminary data revealed that condor lead exposure rates declined. Voluntary lead reduction efforts must be further augmented to achieve a self-sustaining condor population. Future lead reduction efforts should also include southern Utah. *Received 16 May 2008, accepted 18 June 2008.*

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FOR NEARLY TWO DECADES, biologists have linked lead poisoning in wild California Condors (*Gymnogyps californianus*) to the ingestion of spent lead ammunition in animal carcasses (Janssen et al. 1986, Weimeyer et al. 1988, Snyder and Snyder 1989, 2000, Pattee et al. 1990). More recently lead from spent ammunition has been linked to lead exposure and lead toxicity in recently reintroduced

condors in both California and Arizona (Meretsky et al. 2000, Snyder and Snyder 2000, Fry and Maurer 2003, Cade et al. 2004). In Arizona, significant efforts to verify the association between spent lead ammunition and condor lead exposure, as well as to educate the public and engage hunters in voluntary lead reduction efforts, began in 2003.

The first release of California Condors in Arizona occurred on 12 December 1996. As of 15 March 2008, 102 condors have been released in northern Arizona. Sixty-three condors, including six wild-hatched chicks, inhabit northern Arizona and southern Utah. Although the project is making progress towards its goal of 150 free-flying birds, 40 condors have died since the initial release. The leading cause of death is lead toxicity with 12 confirmed cases. The first major lead exposure event in Arizona occurred in June 2000, resulting in the death of three condors (Woods et al. 2007). Since that time extensive trapping and testing of condors for lead exposure has occurred in Arizona. Condor blood tests have identified over 300 cases of lead levels indicative of lead exposure, while in 124 cases condors have been treated with chelation therapy to reduce dangerously high lead levels. Further, ingested lead pellets or more frequently bullet fragments have been recovered from 14 individual condors (Parish et al. 2007). Without the intervention of chelation therapy and other measures, additional condors would have succumbed to lead poisoning.

As elsewhere in their current range, the condors are supplied with a clean lead-free supplemental food source of calf carcasses at the release site in Arizona. As condors disperse from the release site, they forage on carcasses of wild animals such as Mule Deer (*Odocoileus hemionus*), Elk (*Cervus elaphus*) and Coyotes (*Canus lantrans*). Since 2000, the highest frequency of lead exposure in condors has been associated with increased condor movements away from the release site, and the consumption of non-proffered carcasses potentially containing lead (Hunt et al. 2007). Although field biologists have managed to reduce the number of condor deaths due to lead toxicity by pursuing a rigorous monitoring and treatment protocol (Parish et al. 2007), these efforts are highly invasive, labor intensive and costly. Moreover, the long-term sub-lethal effects of lead exposure and chelation therapy in condors are unknown (Snyder 2007). It is unlikely that condors in Arizona will achieve a self-sustaining population at the current lead exposure rates.

While California has implemented a ban on the use of lead ammunition within the condor range starting in July 2008, efforts in Arizona have focused on voluntary measures to reduce the amount of lead from spent ammunition available to condors in the wild. This is due to a consensus among the main project cooperators that voluntary measures are the best course of action to take in Arizona. Also, unlike releases in California, condors in Arizona are released under Section 10(j) of the Endangered Species Act, which provided assurances to people in the release area that no changes would occur in land management practices, including hunting (US Fish and Wildlife Service, 1996).

COLLECTING BACKGROUND INFORMATION

In May 2003, the lead mitigation subcommittee of the California Condor Recovery Team produced a report on condor-lead issues (Redig et al. 2003). As one of several recommendations, the U.S. Fish and Wildlife Service (USFWS) contracted with Wildlife Management Institute (WMI) to conduct surveys of hunters' knowledge and attitudes on the condor-lead issue in California, Arizona and Utah. WMI contracted with Responsive Management for the phone survey and D. J. Case and Associates (D. J. Case) for the focus group work in Arizona.

In late fall 2003, Responsive Management conducted phone surveys of 205 hunters who held tags that year in the core condor range (Responsive Management 2003). There were three key questions for the hunters in these phone surveys, 1) were they aware that lead poisoning was a problem faced by condors; 2) were they aware of any educational efforts to try and raise awareness of this issue; and 3) would they be willing to take action to help reduce lead exposure in condors (Responsive Management 2003). Key findings from this survey were that only 23% of surveyed hunters were aware that lead poisoning was a problem faced by condors and only nine percent were aware of any educational efforts to reduce condor deaths from lead poisoning (Re-

sponsive Management 2003). At this time, information had been published in the 2003 Arizona Hunting Regulations, each hunter surveyed had been mailed a letter regarding this issue and any successful hunter had been asked questions about use of lead ammunition when they completed the mandatory check in of their harvested deer. The survey did reveal that between 83 and 97% of surveyed hunters would be somewhat to very willing, depending on the requested action, to take some action to help condors (Responsive Management 2003). The actions requested included removing all carcasses from the field, burying or hiding all gut piles, removing bullets and surrounding impacted flesh, and using non-lead ammunition (Responsive Management 2003).

Once the survey results were in, D. J. Case interviewed condor professionals and reviewed the literature to develop some conservation and lead reduction test messages. In December 2003, they conducted three focus group meetings in Arizona where the test messages were discussed and rated on a five-point scale (D. J. Case 2005). The best scoring (1.89) communication message based on these focus groups was "Hunters and ranchers have a long history of caring for the land and conserving all kinds of wildlife. They can continue this tradition and help prevent lead poisoning in California Condors by taking one or more of the following actions in condor range: remove all carcasses from the field; hide or bury carcasses and gut piles; remove bullet and surrounding affected flesh or use non-lead ammunition" (D. J. Case 2005).

Focus groups also revealed that hunters and ranchers were not yet convinced that lead from spent ammunition was a problem for condors and requested credible data linking lead from spent ammunition and condor lead poisoning (D. J. Case 2005). They expressed a willingness to help condors if shown the data link and if asked by a credible source, such as the Arizona Game and Fish Department or sportsman's groups (D. J. Case 2005). Based on this information, D. J. Case proposed a communications strategy that included increased education, communication and cooperation between program partners and the hunting community, continued research on the condor-lead link, and consider implementation of a non-lead ammunition program (D. J. Case 2005).

LEAD RESEARCH

Based on the phone survey and focus group information, it was apparent that more information on the link between lead from spent ammunition and condor lead poisoning needed to be provided to hunters (D. J. Case 2005). AGFD and The Peregrine Fund (TPF) responded by funding and conducting research projects related to the issue. First, TPF biologists detailed lead exposure and lead ammunition ingestion by condors starting in 1999 (summarized to 2005 in Parish et al. 2007). Second, TPF condor biologists summarized lead mortality rates (Woods et al. 2007). Data from these two studies verified that lead exposure was a critical management issue for the Arizona condor program. Third, starting in 2003, AGFD purchased 21 GPS satellite transmitters to more precisely track condor movements and relate movements to lead exposure rates (Hunt et al. 2007). This comparison showed that the highest lead exposure period coincided with the hunts on the Kaibab Plateau (Game Management Unit 12A Figure 1). Fourth, TPF conducted research from 2002 to 2004 to determine the extent of lead bullet fragmentation in rifle-killed deer (Hunt et al. 2006). This study demonstrated that standard lead bullets fragment into hundreds of pieces before exiting the deer and that these fragments remain in the deer carcasses as well as the gut pile. The study also confirmed that pure copper bullet fragmentation is minimal (Hunt et al. 2006). The final study is an ongoing lead isotope study funded by AGFD and conducted by the University of Arizona in Tucson using TPF provided biological samples as well as lead fragments removed from condors. Lead isotope ratios of condor blood and the removed fragments are being compared to lead isotope ratios from ammunition and other environmental sources (Chesley et al. 2006). Preliminary results have established a direct match between lead ammunition and lead found in condor blood samples and digestive tracts (Chesley, pers. comm.).

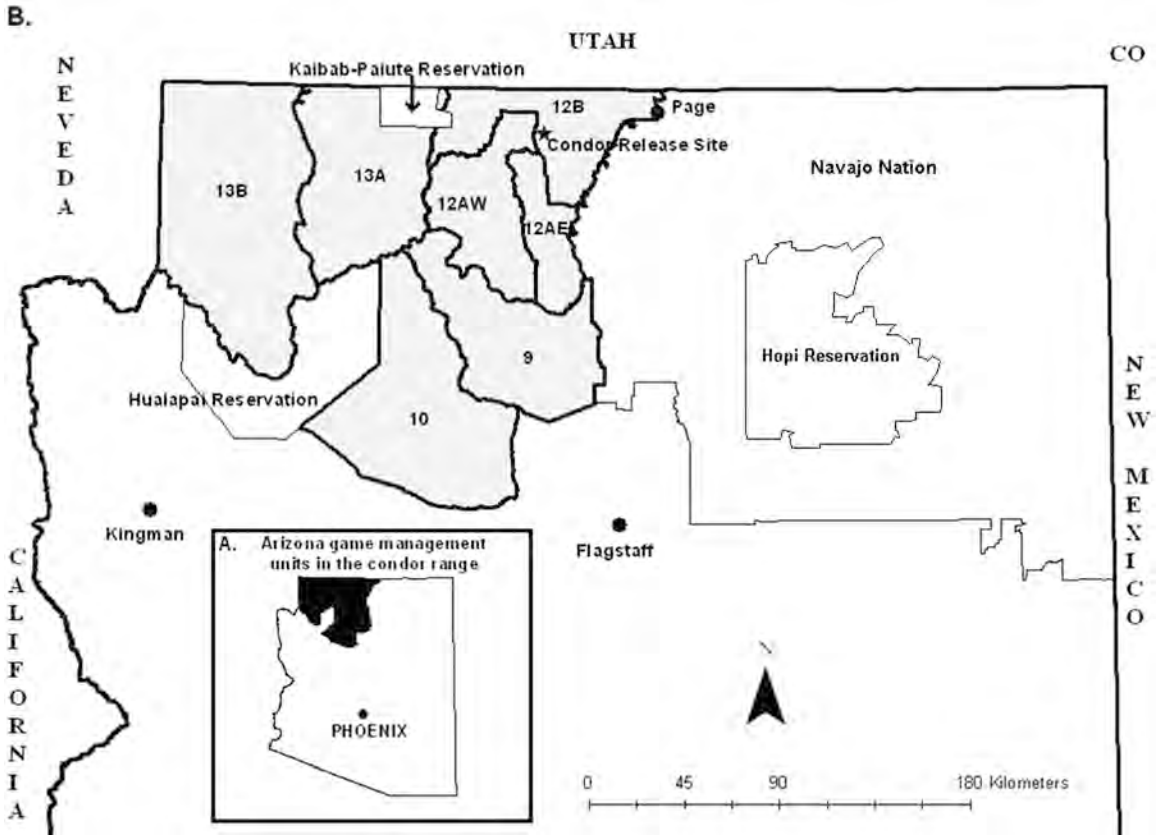

Figure 1. Game Management Units (B) within the condor range in Arizona (A). Hunters drawn for deer, pronghorn, buffalo, and bighorn sheep hunts in Units 12AE, 12AW, and 12B qualified for the free non-lead ammunition program. Hunters drawn for big game hunts in Units 9, 10, 13A, and 13B were mailed letters asking them to take voluntarily lead reduction actions.

COMMUNICATION WITH HUNTERS

Using the information from both the phone survey and focus groups AGFD set out to create an education and communication strategy to encourage hunters to support voluntary lead reduction efforts in Arizona's condor range. In 2003 and 2004, these efforts included a full page information piece in the annual hunting regulations booklet as well as mailings to between 2,000 and 7,000 hunters drawn for a big-game tag in the condor range (Figure 1). During this same period, AGFD made presentations to all the major sportsmen's organizations in the state asking them to join the "condor coalition" and lend their name and support for voluntary lead reduction efforts in the condor range. The current members of the Arizona coalition are the Arizona Antelope Foundation, the Arizona Desert Bighorn Sheep Society, the Arizona Deer Association, the Arizona Elk Society and the Arizona Chapter of the National Wild Turkey Foundation. Also in August 2005, WMI and D. J. Case presented two sessions of "one-voice" communication training for program partners and hunter group representatives to encourage uniform, consistent and accurate information dissemination in all outreach efforts regardless of who initiates the outreach. In addition to these efforts, the general public started to receive the condor conservation and lead reduction message in all outreach forums such as educational presentations, wildlife fair displays, legislative contacts, the AGFD web page and through general media outlets, including the AGFD Wildlife Views magazine and television program.

In the fall 2005, using money allocated to AGFD through the Arizona State Lottery, AGFD implemented a voluntary free non-lead ammunition program for hunters in the core condor range. AGFD partnered with Sportsman's Warehouse® for in store purchases and Cabela's® for mail order sales and sent each hunter drawn for a deer, pronghorn, sheep or bison tag in Game Management Units 12A and 12B (Figure 1) a coupon they could redeem for two free boxes of non-lead ammunition. These coupons came with a letter outlining condor lead poisoning issues and asking hunters to voluntarily help in reducing the amount of lead available to condors from spent ammunition. In 2005, 65% (n = 1,551) of eligible hunters redeemed their coupons with 50% of those harvesting deer using non-lead ammunition.

To evaluate the first year of this program, AGFD worked with D. J. Case to develop two post-hunt surveys, one for non-lead ammunition program participants and one for non-participants. Surveys were mailed to all 2,393 eligible hunters with 46% (1,105) surveys returned, including 943 participants (61%) and 162 non-participants (19%). For the participants, 85% tested the ammunition before their hunt, 60% rated the ammunition accuracy as excellent or above average, 70.5% said it performed as well as lead with 22.6% saying it performed better than lead. Most would use it again if provided free, with 55.8% saying they would use it again even if not provided free. The majority (72%) said they would recommend the ammunition to other hunters and 81 percent used it on their hunt with 41.6% using it to harvest their deer. When asked why they participated, the majority said because AGFD asked them to, followed by it helped condors, because it was free and because they had heard or read that non-lead ammunition had good ballistics (D. J. Case 2006).

The primary reason for those not participating in the program was that the non-lead ammunition was not available in their caliber. The next most important reasons were that the non-lead ammunition was not available in their preferred bullet weight and that it takes too long to sight in new ammunition. The next most important reasons were that redeeming the coupon was too complicated or too much hassle, that they were not convinced that lead from spent ammunition is a problem for condors and that they think the program is an effort by anti-hunters to ban the use of lead. Other reasons were that they hand load their own ammunition, non-lead bullets were not covered by the program, they had heard that non-lead didn't perform as well as lead and they had tried non-lead and it didn't meet their expectations (D. J. Case 2006).

When non-participants were asked what could be done to encourage more participation they offered that the ammunition should be offered in more calibers and bullet weights, that more information should be provided on how lead from spent ammunition is a problem for condors, that bullets for reloading should be offered and that sports groups should endorse the program (D. J. Case 2006). Fortunately, at least Federal Ammunition, using Barnes bullets was increasing the variety of calibers and bullet weights each year and AGFD started offering reloading components as part of the program.

In 2006, the voluntary free non-lead ammunition program was continued in nearly the same manner as 2005. The primary difference was an effort to provide significantly more information about the link between lead from spent ammunition and condor lead poisoning. Along with the free ammunition program, individual mailings to hunters in non-core areas were sent information which also requested their voluntary help. Although we were responding to what we thought hunters wanted on providing a link between lead and condors (D. J. Case 2006) we received negative responses to providing too much information and found that most hunters did not read it. Participation in the voluntary free non-lead ammunition program was similar to the previous year, but due to increased field outreach during hunts, 60% of successful Kaibab deer hunters took lead reduction actions during their hunt, an increase of 10% from 2005. Even with this level of participation, 95% of the birds were exposed to lead (Parish et al. 2009, this volume). One factor that is likely contributing to this continued high exposure is that the condors are increasing their use of southern Utah habitats (Figure 2). To date Utah has not implemented any extensive outreach or programs for raising awareness on this issue, but are working on plans to do this in 2009.

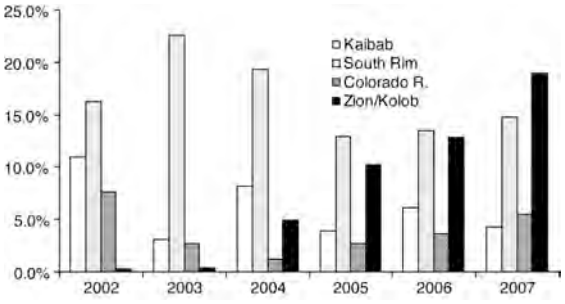

Figure 2. Condor roost locations by region. Condor foraging in southern Utah (Zion/Kolob region) has increased steadily since 2004 and several lead exposure incidents have been directly linked to this area. To be effective, future lead reduction efforts should therefore include southern Utah.

With this high lead exposure rate and only slightly increasing participation, we gathered a group of people involved in the program and brainstormed ideas for trying to achieve at least 80% participation for 2007. This effort resulted in eight new actions to improve outreach efforts. First, we asked our sports group supporters to publish articles in their magazines about the program because they were viewed as credible sources of information. Second, we increased general media stories about how hunters were helping to recover condors through their voluntary efforts and this was another example of how hunters were aiding recovery of a species. Third, we decided to simplify our outreach message to "use non-lead ammunition." Previous outreach had included options such as hiding or burying gut piles or removing impacted flesh but these messages seemed to confuse people and were not clear enough direction. Fourth, we developed an 11-minute DVD, with Nolan Ryan as host, entitled "How to be successful in your upcoming deer hunt." The DVD provided about 6 minutes of successful hunt information followed by 5 minutes of information on lead exposure, and asked hunters for their help. Based on field visits with hunters, the majority of people said they had viewed the video before their hunt. Fifth, we combined the outreach material and the DVD in the mailing with their tag. In previous years the information had been mailed separately. Sixth, any hunter not redeeming their coupon within two months of their hunt dates was sent follow up information encouraging them to participate in the program. Seventh, we dramatically increased our field staff to directly contact hunters in the field during all hunt weekends between October and December. One staff member for each 200 permitted hunters allowed us to achieve between 60 and 70% direct field contact with hunters in the field. And finally, we implemented a gut pile raffle. This came from the realization that once a hunter was in the field with lead ammunition, options for asking for their help were more limited. Trash bags were provided, along with a flyer, during field contacts and hunters were asked to bring their gut pile, if shot with lead ammunition, to the mandatory check station when they checked in their deer. The Peregrine Fund provided $1,000 to purchase gift certificates to a sporting goods store as an incentive for hunters assisting with this effort. In 2006, without the incentive, only a handful of hunters brought in gut piles. In 2007, the number rose to 170, resulting in 54% of hunters who used lead ammunition to kill their deer to carry their gut pile out of field. Overall, with these changes, participation in the voluntary program increased to 83%, with 62% of successful hunters using non-lead ammunition and 21% participating in the gut pile raffle. One of the biggest obstacles to increasing participation was the lack of available non-lead ammunition from our vendors for anyone who waited until close to their hunt and then looked for the free ammunition. This was in spite of the fact that this was the third year of the program, and the number of eligible hunters was provided early to the vendors. Plans are underway to continue the program in 2008, retaining all of the 2007 outreach changes while at the same time working with vendors to increase supply and make it easier to find non-lead ammunition in the stores with displays located in one area of the store.

DISCUSSION

There are many factors to consider when designing an outreach program that asks people to do something different. Using social psychology and marketing principles can aid in outreach design. We used six principles of influence identified from the field of social psychology (Cialdini 1993) to design our outreach program:

1. Reciprocity—give someone something in exchange for their action—achieved through the free ammunition program.
2. Commitment and consistency—insure dedication to what you are asking for—achieved by a multi-year dedication to a voluntary program and a consistent message.
3. Social proof—show that others are also participating—achieved by use of sports group publications for outreach.
4. Liking—show that others like them are also participating—achieved by the use of hunter quotes in outreach materials and also by consistently thanking hunters for their help.
5. Authority—exert influence on the decision—achieved through the use of AGFD, the regulatory agency for hunting and fishing, doing primary outreach.
6. Scarcity—indicate that not participating might limit future actions—achieved by stating that voluntary efforts could reduce calls for mandates or regulations.

We also incorporated lessons learned from similar experiences in the past. In the early 1990s, a ban was put in place on the use of lead ammunition for waterfowl hunting throughout the United States. A survey among people involved in that ban revealed useful ideas on what they would have done differently in hindsight (Association of Fish and Wildlife Agencies 2007). Among their ideas were:

1. More thought, study, and action should have been invested in obtaining input from hunters before any decision was made.
2. There should have been more analysis of supply issues.
3. Moving too fast on the issue didn't allow groups to be informed, educated, and convinced, and this included agencies, nongovernmental organizations, manufacturers, dealers, and the media.
4. Education is the key to a smooth transition.
5. One negative media article can nullify all the factual information.
6. Training sales people, especially in large stores, is important because they may be the main sources of information for buyers.
7. Unlike the 1990s, there is an increased emphasis today on hunter recruitment and retention throughout the nation, and mandates could be an obstacle to this objective.
8. Any program needs to establish sources for reliable, accurate information, and a common understanding of the goal.
9. Ideas should be advanced through leaders of change in hunting and sports groups as well as outdoor retailers.
10. Having a consistent, united voice by all parties is important.
11. Hunter education instructors can play an important role in getting the message to new hunters.
12. The use of focus groups to develop and refine messages can aid the process.
13. Technical articles can hinder, rather than help, the process so using marketing professionals to tailor messages is important.

In Arizona, we have found that manufacturers respond slowly to demand, so a significant transition time is needed to reach appropriate production and distribution levels. We have found that, like us, people respond better to requests so we should ask for their help and bring them along, rather than taking the short term fix of a mandate. We realize that the cost of non-lead ammunition is going to be a continuing issue. While non-lead ammunition is comparable in price to premium lead ammunition, and moving those using premium lead over to non-lead ammunition may be relatively easy, many hunters buy the cheapest lead ammunition available and non-lead ammunition can be up to three times more expensive. Focus groups can help refine outreach messages, but more importantly they can also aid in determining who should do the outreach. A continuing challenge is working with those groups and organizations that the focus groups view to be non-credible to keep them engaged in the program while limiting their outreach efforts. We are proud of the response of our hunters and partners to the call for a voluntary effort to reduce the amount of lead from spent ammunition available to condors, and think our program can serve as an example to others.

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