WILD SHEEP MANAGEMENT WORKSHOP

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Friday April 9, 1999 was the final day of the 2ND North American Wild Sheep Conference. We asked conference attendees to participate in a day-long workshop designed to identify specific recommendations for wild sheep management; 60 sheep biologists, managers, researchers, students, and advocates participated. At the minimum, we wanted to develop an outline with specific, succinct recommendations, to help guide wild sheep management in North America for the next 25 years.

After introductory remarks and instructions, we provided each participant with a simple, matrix-format table (Table 1) listing Dall, Stone, California, Rocky Mountain and desert sheep on the X-axis, and wild sheep management challenges and issues discussed the previous 3 days on the Y-axis. Conference organizers prioritized the issues in this matrix; the first seven matched individual sessions at the conference. We asked people to identify and develop distilled, "bullet" recommendations for the intersecting cells, based on their personal wild sheep management experience and knowledge. For example, under the first intersecting cell of advocacy groups and Dall sheep, we wanted specific recommendations on what could be done by or with advocacy groups to benefit Dall sheep management. We asked participants to develop recommendations based on what they knew, rather than what they thought they knew. We asked participants to work individually for 90 minutes, developing their recommendations. We then reassembled participants in thinhorn, California, Rocky Mountain, and desert sheep subgroups. For two hours, subgroup participants briefly discussed and recorded their recommendations on flip charts, sorted by management challenge/issue. In this round-robin format, every participant had the opportunity to list their recommendations, without argument from their peers, until all recommendations were exhausted. Then, subgroups were assembled into a large-group format, and subgroup recorders individually described each recommendation, again sorted by management challenge/issue. Additional recommendations were then offered by the entire group and recorded. After all four subgroups had presented their recommendations, without argument from their peers, a short general discussion was held and the workshop was adjourned.

It is important to understand that conference and program co-chairs were not seeking a finished or polished product from this one-day workshop. Rather, we wanted to, at a minimum, develop an outline which could be expanded upon in our publication. Also, we did not expect, nor are we claiming, that this sorted list would include every legitimate recommendation for wild sheep management. We were not looking to "reinvent" but to "update" the wheel. The 1971 wild sheep meeting in Fort Collins, Colorado, the 1974 wild sheep conference in Missoula, Montana, the 1980 Desert Bighorn Council guidelines, and numerous other publications provide extremely useful templates for comparing and evaluating where we are with wild sheep management at present. We were not looking for unanimity in recommendations; in fact, we encourage skepticism and healthy debate on wild sheep management, with arguments grounded in science, data, and knowledge. We expect and encourage each reader to question the recommendations included here, and decide for themselves which are most appropriate.

Using workshop notes, a transcript from a court reporter/stenographer, comments on the matrix-table sheets submitted or subsequently mailed by individual workshop participants, and subgroup flip charts, the following pages represent the "raw", bullet-like recommendations identified. These have been further edited for brevity,

but content has not been altered. Following this section and drawing on these "raw" recommendations and available literature, a synthesized compilation of management recommendations for wild sheep in North America is included.

Table 1. Workshop matrix, 2ND North American Wild Sheep Conference, Reno, NV, April 9, 1999.

Management Challenge/Issue	Dall	Stone	California	Rocky Mountain	Desert
Advocacy Groups (political action, fund-raising, network of support)					
Habitat Fragmentation/Human Disturbance (urban sprawl, subdivisions, planning/zoning, land ownership/acquisitions/easements/ consolidation, highways, fences, dams, industrial activities, ORV use, military, recreational), human dimensions					
Habitat Management (buffer zones, mineral/salt licks, water development, prescribed and natural fire, noxious weeds, logging, reclamation, mapping techniques, GIS modeling)					
State/Federal Relationships (formal wilderness designation/restrictions on needed management activities, forest plans, resource management plans)					
Hunting/Harvest (subsistence, trophy, ewe harvest, hunter orientation, mandatory horn registration/plugging, waiting periods)					
Capture/Transplant (minimum transplant sizes, source herds, herd health histories, techniques, evaluation of long-term transplant success)					
Disease (documentation, diagnosis, cooperative response, treatment options)					
Predation (documentation, management options and strategies)					
Population Management (density-dependent effects)					
Livestock (cattle, sheep, feral horses and burros)					
Genetics/Taxonomy (DNA databases/confounded by transplants, forensics)					
"Inter-Connectedness"/Corridors/Migration Routes/Metapopulation approach					
Threatened & Endangered Status/Listing					
Law Enforcement (poaching, pickup heads, record book entries/fair chase, forensics)					
Exotics					
Native Ungulates					
Information and Education/"Watchable Wildlife" strategies					
Other					

Desert Bighorn Sheep

Advocacy Groups

- Expand vision toward long-term conservation of wild sheep.
- Educate groups about wild sheep habitat needs and reality of land-use planning and NEPA.
- Recognize contribution of and cultivate financial support from these groups.
- Contribute information and articles to advocacy group publications.
- Expand advocacy groups to include conservation groups, and increase their involvement as interested parties.
- Help groups with diverse objectives realize their commonality.
- Expand upon funding needs.
- Explain potential limitations of short-term research findings; obtain funding for longer-term research.
- Help groups better evaluate funding requests.
- Continue working with groups in retiring and/or purchasing domestic sheep grazing permits.

Habitat Fragmentation and Human Disturbance

- Recognize importance of inter-mountain corridors for conservation of metapopulations which travel across intervening desert valleys.
- Consider all lands used by desert bighorn sheep as important.
- Explain how population persistence declines as populations become more isolated.
- Unfragmented habitat in good condition which includes corridors must receive high management priority.
- Involve biologists in land exchanges, which must be evaluated for their impact on sheep habitat.
- Recognize that recreational use also fragments habitat.
- Restore movement corridors with vegetative treatments, especially where tamarisk has encroached.
- Restoration of movement corridors includes decreasing recreation, acquiring land through easements, restrictions on use by hikers, and decreasing vegetation to improve visibility through burning, chemical treatment, and logging.
- Evaluate human impacts to determine their adversity on desert sheep and their habitats.

Habitat Management

- Continue to use existing BLM guidelines for fencing in bighorn sheep habitats.
- Document and evaluate benefits of artificial water development.
- Restore natural waters rather than just concentrating on artificial water development.
- Support natural fire, restore natural fire frequency; implement prescribed burns to improve habitat.
- Develop a database to demonstrate how we're losing habitat by vegetative encroachment.
- Provide adequate protection, buffer zones, and seasonal restrictions for oil, gas, mining, and other extractive commodity practices near suitable mountain sheep habitat.

State/Federal Relationships

- Wilderness legislation should include a description of the minimum tools which can be used.
- Include stipulation to continue use of current management practices in wilderness and wilderness study areas (WSAs), as they become designated wilderness areas.
- Encourage better communication between state/federal agencies on wilderness management goals.
- Hold annual meetings involving upper management to discuss current issues and problems.
- Encourage more education and information sharing among resource specialists.

- In land-use plans, important, occupied bighorn habitat needs to be identified and assigned management priority, to establish a legal basis for actions to benefit bighorn sheep. This may include amending existing land-use plans to eliminate domestic sheep allotments as they become vacant.
- In land-use plans, recognize options to reallocate forage for wildlife as livestock grazing permits are retired or relinquished.
- Involve state agencies in the scoping process for land-use/ecosystem plans, and throughout process.
- Land management agencies should prohibit or closely manage packing with domestic goats in wild sheep habitat.
- Encourage more cooperative management between the U.S. and Mexico for shared bighorn herds.

Hunting and Harvest Strategies

- Encourage hunter orientation programs in states where desert bighorn sheep are hunted.
- Develop predictable, reliable information and survey methodology on which to allocate sheep permits, and develop consistency in those. Standardize between and within states.

Law Enforcement

- Reduce poaching by making the sale or barter of pickup sheep heads illegal.
- Discontinue pinning pickup heads, which makes them basically legal.
- Collect and store horn samples as part of the pinning requirement for legal heads.
- Develop a DNA or mineral database to assist law enforcement.
- During capture and transplant operations, pin or somehow mark transplanted rams, for future identification.
- Emphasize potential DNA analyses to identify populations for research and law enforcement.

Capture and Transplant

- Generally support the 1973 DBC guidelines, with one specific exception. Remove the recommendation to utilize enclosures following transplant.
- Historical sheep distribution information should be used in determining suitable transplant areas.
- Evaluate cause of initial sheep decline. Determine whether that cause has been effectively eliminated.
- Do not transplant new sheep into sites where prior transplants failed, without attempting to determine and rectify problems that occurred with the original transplant.
- Recognize different transplant objectives, including establishment of new populations, expanding the range of existing populations, or creation of migratory behavior.
- Evaluate predation potential before the transplant and the need to consider predator control. Transplant populations are especially vulnerable to predation.
- Examine disease potential and status of source herds, and consider what diseases may be carried with transplanted sheep.
- Minimize diseases that transplanted sheep carry, and consider possible disease effects on augmented herds.
- Do not transplant large numbers of animals from small herds, to minimize impact on source herd.
- Develop and establish updated protocol for capture and reestablishment of bighorn sheep herds.
- Use transplants to create linked male populations.
- Use transplants to expand distribution and habitat use of existing populations.
- Avoid establishing isolated populations which are likely going to struggle. Use transplants to create linked populations, create metapopulations, or expand existing metapopulations.

- Develop guidelines for the best possible management of bighorn sheep captive facilities.

Disease

- Support research regarding effects of llamas, domestic goats, and cattle on bighorn sheep.
- Assess health of source bighorn herds. When capturing animals, develop a database on the diseases herds have been exposed to, particularly if transplanted sheep will contact other wild sheep.
- Bighorn and domestic sheep must be separated, to minimize potential disease transmission.

Predation

- Evaluate transplants of sheep into densely occupied deer habitat, which often have abundant mountain lion populations.
- Conduct research on predation impacts on lamb production and survivorship.
- Support ability of managers to remove mountain lions where they are a documented problem, especially with struggling bighorn herds.
- Improve habitat visibility to reduce vulnerability of bighorns to predation.
- Design artificial water developments so that predation at water sources is reduced or eliminated.

Population Management

- Do not assume density-dependent responses in bighorn sheep populations. Responses of bighorn sheep to population reductions are complex, and dissimilar to other ungulates (e.g., white-tailed deer).

Livestock

- Discourage habitat degradation by cattle and minimize habitat overlap between cattle and bighorn sheep. Anticipate more overlap with yearling cattle than with cow-calf pairs.
- Prohibit recreational goat packing in bighorn habitat, since we don't know what disease implications there might be, and also because escapee goats can survive very well in bighorn habitat.
- Manage burros within established appropriate management level (AML) guidelines.
- At water sources, bighorn sheep need to be separated from domestic stock and other feral animals, because bighorns tend to be displaced or outcompeted.

Genetics and Taxonomy

- Support Captive Breeding Specialist Group (CBSG) workshops to obtain more information on impacts of inbreeding. Establish an adequate information base to manage inbreeding effects.

Endangered and Threatened Status

- When justified, designation as T&E status should be pursued. Once sheep are designated, federal land management agencies then have legal requirements (e.g., reduction in direct take, killing, harassment) they must follow. Use T&E status to help obtain needed funds. Indirect take requires consultation on any habitat loss or negative impacts.
- Investigate alternatives (e.g., conservation plan) to listing for declining populations.

Exotics

- Do not introduce exotic mammals and/or plants to bighorn sheep range.
- Attempt to eliminate existing exotic plants and/or mammals from bighorn sheep range.

- Reduce potential for colonization of exotic plants on bighorn range by requiring use of certified hay and controlling or eliminating off-road vehicles.

Education

- Watchable wildlife programs should not increase disturbance on bighorn sheep ranges. Biological input into these programs is needed. Programs should emphasize ethical viewing of wildlife, especially by photographers.
- Use Project Wild to disseminate information about bighorn sheep.

Rocky Mountain Bighorn Sheep

Advocacy Groups

- Expand the FNAWS network in states and provinces that don't currently have chapters/affiliates.
- Review the FNAWS grant-in-aid process and offer suggestions to improve that process.
- Improve coordination between the FNAWS network and states/provinces in the political arena.
- Seek increased funding for sheep management from the general public and non-consumptive NGOs.
- Expand outreach to include nonhunters. Recognize nonhunted populations as potential source herds.
- Be aware of expectations and conditions associated with funding (i.e., *quid pro quo*).
- Reinforce that advocacy groups are advisory while agencies retain responsibility and decisionmaking.
- Invite advocacy groups to meetings where they traditionally are not invited.
- Ensure that money from auctioned complimentary sheep licenses goes back into sheep management.
- Advocacy groups should get more involved in public and private land-use planning.
- Encourage and improve youth education in sheep projects.
- Advocacy groups should be strong proponents of hunter ethics.

Habitat Fragmentation and Human Disturbance

- Continue human disturbance studies and develop specific recommendations for specific herds.
- Use technology (e.g., Internet) to distribute herd-specific information on human disturbance studies.
- Integrate existing information between groups on how human disturbance is affecting bighorn sheep.
- Minimize human disturbance during critical times of year for bighorn sheep.
- Assess risk and map vulnerability (e.g., GIS) of herds on a five-year basis.
- Map cumulative effects of human disturbance and model future impacts, depending on land uses.
- Synthesize what is known about, and recommend further human disturbance research topics.
- Constrain time and location of recreational activities to enhance bighorn sheep habitat security.
- Work with metropolitan planners and local/state/private organizations to reduce human disturbance.
- Discourage habitat fragmentation and require mitigation of impacts.
- Work with public/private partners to expand/facilitate land exchanges, easements and acquisitions.
- Develop interpretive signs, brochures, pamphlets about ethical viewing of sheep.

Habitat Management

- Implement habitat improvements on a large scale.
- For pinyon/juniper burning, implement a 50-year-or-less fire frequency, and reseed with grass and forbs. For sagebrush-dominated habitats, that fire frequency should be 25 years or less.
- Synthesize and share knowledge about necessary fire frequency and fire management practices for different vegetative communities which comprise sheep habitat.
- Aggressively pursue or create options to improve habitat within wilderness areas.
- Include habitat management techniques in wilderness planning, implementation, and legislation.
- Seek consistency from land managers on what habitat management practices are allowed in wildlife management areas, wilderness areas, or wilderness study areas (WSAs).
- Recognize wild sheep as a primary wilderness component.
- Assess, evaluate, and monitor wildlife habitat treatments and manipulation.
- Aggressively pursue chemical, mechanical, and biological control of noxious weeds in sheep habitat.
- States and provinces need written goals or plans for sheep restoration and distribution.
- Produce current and historic maps of known or suspected bighorn sheep habitat.
- Standardize terminology for sheep seasonal habitats.
- Standardize mapping scales and integrate mapping techniques
- Analyze and evaluate habitats prior to transplants, to ensure suitability before moving sheep.

State/Federal Relationships

- Better coordinate state and federal planning for domestic sheep grazing in wild sheep habitat.
- Amend BLM and USFS land-use plans to recognize importance of wild sheep habitats. Describe specific management actions to achieve recognition of important wild sheep habitats.
- Modify existing MOU's to clearly establish state wildlife agency jurisdiction over wild sheep transplants, perhaps through the Western Association of Fish and Wildlife Agencies (WAFWA).
- Improve communication between states and National Park Service on bighorn sheep management.
- Develop bighorn sheep management plans where absent, particularly in the National Park Service.

Hunting and Harvest Strategies

- Coordinate with tribal managers on shared herds.
- Manage herd population size and density with ewe removal strategies.
- Articulate biological basis for why we hunt these sheep herds.
- Management should be adaptive and based on management experiments.
- Publish results from management experiments (e.g,. any-ram hunting), to build on that research.
- Standardize regulations between states.

Law Enforcement

- Standardize legality of pickup heads and associated regulations on pinning and sale of pickup heads.
- Support stiffer penalties and fines for illegal harvest of bighorn sheep, perhaps to felony level.
- Enforce existing regulations and laws on wildlife violations and human-related disturbances (e.g., ORVs, dogs, planes). Elevate poaching of bighorn sheep to felony status.
- Work with advocacy (e.g., FNAWS network) and wildlife law enforcement groups (e.g., North American Wildlife Enforcement Officers Association) to promote, fund, and expand existing law enforcement relative to wild sheep.
- Support efforts to restrict or eliminate game farming.

- Support efforts to restrict or eliminate trafficking of wildlife parts.
- Improve coordination with tribal law enforcement officials.

Capture and Transplant

- Optimize transplant stock between states and provinces.
- Improve communication on the need for, and availability of, different transplant stocks.
- Evaluate compatibility of transplant stocks to new habitats.
- Maintain database on transplant histories.
- Continue to use transplants to return sheep to historic ranges.
- Perform rigorous suitability evaluation of potential transplant areas.
- Evaluate success/failure of transplants, and publish that information.
- Transplant at least 30 sheep initially, then transplant additional animals via multiple releases, to increase the likelihood of a successful transplant.
- Formalize transplant guidelines in states and provinces.
- Perform disease testing on transplanted sheep, and include results in accessible transplant database.
- Establish minimum requirements and protocols for handling transplanted sheep.
- Where lacking, develop capture and transplant manuals.
- Determine individual mortalities two weeks post-transplant, to evaluate success of the transplant.
- Develop health and DNA histories for source herds, including linkage to prior transplants.
- Synthesize knowledge about appropriate interval between a die-off and reintroduction of sheep.
- Evaluate deer density and numbers, and the cougar situation, in potential transplant sites.
- Develop management strategies for metapopulations (i.e., sheep population size > 500).
- When transplanting sheep, radiocollar as many mature animals as possible to facilitate monitoring, while recognizing watchable wildlife viewing issues.
- No equipment should be used between herds unless properly sanitized, to decrease disease transmission.

Disease

- Develop and share detailed health assessments of source herds.
- Promptly remove wild sheep after known interaction with domestic sheep.
- Share data on bighorn sheep disease, perhaps through the Western Wildlife Health Cooperative.
- Work with livestock industry and interested publics on the concerns of using domestic sheep for vegetation management (i.e., weed control) in bighorn sheep habitats.
- Continue to acknowledge fatal pneumonia transmission from domestic to wild sheep.
- Summarize and share available knowledge on effectiveness of treatments for diseases.
- Assess risk of potential interaction with domestic sheep and reduce this risk where possible.
- Synthesize information on risk of disease transmission from other livestock and wildlife species.

Predation

- Encourage research that examines prey and predator populations simultaneously.
- Synthesize existing information on predation and its effect on bighorn sheep.
- Determine not only if predation is occurring, but if there is a population-level effect from predation.
- Recognize the complexity of predation.
- Monitor and evaluate effectiveness of predator control/management actions

Population Management

- Status and trend of sheep herds should be monitored by taxonomic units and bioregions, not just state and provincial political units.
- Develop population management plans for wild sheep herds.
- Stress importance of high quality habitat coupled with appropriate density of sheep (i.e., "more sheep is not always better").
- Acknowledge the potential for different limiting factors on males and females in the population.
- Monitor specific population parameters to determine status relative to carrying capacity, and make data-based management decisions.

Livestock

- Partitioning of forage resources should be based on best available knowledge, including temporal, spatial, and dietary overlap.
- Recognize bighorn sheep habitat needs when allocating forage.
- Increase enforcement of trespass livestock.
- Encourage federal land managers to manage feral horses to appropriate management levels (AMLs).
- Research and recommend fence designs compatible with wild sheep daily or seasonal movement.
- Eliminate or modify net wire fences in wild sheep habitat, to facilitate passage by bighorn lambs.

Genetics and Taxonomy

- Collect, analyze, store and share DNA information (e.g., blood, tissue, hair) on wild sheep.
- Develop and publicize an accessible database where this information is stored.
- Minimize loss of genetic diversity in our herds.
- Repopulate historic ranges with native subspecies when possible; if not, use closest ecotype available.
- Develop guidelines for mixing California and Rocky Mountain bighorn sheep via transplants.
- Determine and use most appropriate genetic stock for transplants.

Metapopulations

- Recognize importance of corridors between populations. Be aware of potential disease transmission.
- Develop metapopulation strategy for Rocky Mountain bighorn sheep that addresses genetic diversity and potential disease transmission.
- Maintain metapopulations and genetic linkage for Rocky Mountain bighorns.

Exotics

- Remove free ranging exotic ungulates. Seek effective and prompt responses for game farm escapees.

California Bighorn Sheep

Advocacy Groups

- Foster education, develop and improve communications and dialogue, provide information and data, and cooperate with those groups who seek information.
- Inform advocacy group about their opportunities for input into wild sheep management.
- Promote cooperation with other groups, including ranchers and forests products industry.

Habitat Fragmentation and Human Disturbance

- Produce a seamless habitat map at 1:250,000 scale, identifying historic, occupied, and potential habitats of all wild sheep species/subspecies. Focus on U.S./British Columbia/Alberta by 2005; Alaska/Yukon/NW Territories by 2010.
- Identify problems with urban sprawl, animal damage, and developed areas where wild sheep may become a nuisance.
- Include wild sheep goals in range management and forest plans, and planning and zoning documents, listing specific objectives for wild sheep management, at the earliest opportunity.
- Develop, retrieve, and share existing guidelines on forestry and roads in British Columbia.
- Recommend distance from roads to fences be at least one-half mile, so sheep harassed off a highway/road do not immediately encounter a fence barrier.
- Develop guidelines on ORVs, military overflights, air space use, recreation, to minimize disturbance.

Habitat Management

- Utilize adequate buffer zones for separation between domestic and wild sheep.
- Evaluate management practice of placing salt on bighorn ranges. Determine physiological demand for salt of California bighorns. Recognize the utility in treating some diseases and the potential for increased disease transmission (e.g., contagious ecthyma) with salt.
- Prescribed burning and fire management for California bighorns can be used to control juniper and conifer encroachment, but site-specific fire management planning should be done in advance.
- In general, fires should be avoided if they result in shrub loss in California bighorn habitat, but prescribed fire may promote desirable forage, enhance visibility, or decrease noxious weeds.
- Leafy spurge and other noxious weeds in bighorn habitat should be controlled chemically, rather than by use of domestic sheep.
- Provide forest and mining industry guidelines to maintain and enhance bighorn sheep habitat.
- Standardize terminology used in bighorn sheep management (e.g., defining habitat effectiveness).

State/Federal Relationships

- Stress the importance for federal land management agencies to manage vegetation in designated wilderness and wilderness study areas (WSAs). Noxious weed control and prescribed burning to attain vegetation objectives for bighorn sheep are necessary.
- Stress the importance of being allowed to develop and maintain water sources in WSAs.
- Cooperatively identify time periods for sheep management activities in WSAs, to minimize overlap with heavy recreational use season(s).
- Cooperatively determine timing and frequency of helicopter use and landings in wilderness for sheep management practices.
- Recommend mitigation measures to address Department of Defense use of air space over WSAs and other seasonally important bighorn habitat.
- Identify and seek federal land agency approval for various habitat management activities in WSAs.

Hunting and Harvest Strategies

- Develop a biological framework for harvest recommendations. Identify alternative harvest strategies to attain the same management objective.
- Trap/transplant surplus sheep to fill potential habitats prior to implementing limited ewe harvest.
- Recognize that hunting is a valid and legitimate population control method for California bighorns.

- Explain the importance of biological data collection relative to status, trend, and impact of hunting.
- Discourage the unethical practice of using aircraft for scouting by hunters.
- Minimize survey/inventory flights to minimize disturbance and displacement of bighorn sheep.
- Support mandatory horn plugging/pinning of legally harvested rams. In states where private possession of pickup heads is legal, pickup heads should also be pinned.
- Require permit for private possession of sheep heads, but disallow sale, to reduce illegal commerce.
- Subsistence harvest by native peoples should be monitored and reported.
- All harvest for herds shared by state/provincial/tribal jurisdictions should be recorded and shared.
- For California bighorn sheep, limited entry hunting rather than over-the-counter, general license hunting is preferred. If limited entry licenses are set appropriately, minimum horn curl regulations are not necessary.

Law Enforcement

- Seek consistency between and among states, provinces, and tribes on legality of pickup sheep heads.
- Eliminate the potential for private ownership of native species of wild sheep.
- Oppose game farming, private ownership, sale, trade, or interstate transfer of wild sheep except between government agencies and tribal governments.

Capture and Transplant

- Develop a standardized capture procedure.
- Develop and document herd health histories.
- Pretest source herds, especially for interstate or international transplants.
- Be extremely cautious about mixing stocks from different sources.
- Transplant of California bighorns outside traditional range should be allowed if they are the best adapted or most appropriate stock to fill available habitat if, and only if, separation from other wild sheep is assured.
- Standardize protocols for release sites, including a prerelease evaluation of each site.
- Identify preferable family group units when capturing stock for transplants.
- Use caution in transplanting sheep into marginal sites. Many states are nearing completion of transplants into their most preferred sites. To continue their program, they may be transplanting sheep into marginal sites. It may be better to leave those as buffer areas without sheep, or allow the core population to expand into those areas, rather than risk compromising the entire area with the possibility of introducing disease.

Predation

- States should establish protocols for predator management and maintain opportunities to utilize all tools necessary for predator management. Predator control or management may increase the success or decrease the risk of new transplant herds or herds in decline.

Population Management

- Urge formal application of a modified metapopulation model, defining a metapopulation as an area of distinct herds or subgroups where periodic interchange may occur, bounded by topographic or mechanical barriers that preclude all but rare movement across those barriers.
- Consider weather and climate as explicit variables, along with topographic, vegetative and nutritive factors in determining habitat suitability and herd performance.

- Improve the ability to monitor herd performance.
- Further delineate and seek to understand mortality and risk factors in population management.

Livestock

- Cattle grazing may be compatible with wild sheep, but managers should minimize the potential for direct contact and forage competition, wherever possible.
- Wild horses should be managed to appropriate levels, to minimize impacts to wild sheep (e.g., water holes, habitat destruction and/or modification, range condition).
- States and provinces should prevent interaction between mouflon sheep and California bighorn sheep. The presence of mouflon sheep precludes opportunities for establishing new bighorn herds.
- Managers should strive to encourage blood testing and serum banking of California bighorn sheep, to develop species-specific standards, as opposed to cattle standards now used for disease exposure.

Inter-Connectedness and Corridors

- Identify, map, secure, and/or recover corridors for dispersal and seasonal movement between distinct herds and segments of herd. Once corridors are identified, identify potential blockages to movement.
- Identify private lands critical to wild sheep conservation.

Genetics and Taxonomy

- Retain existing nomenclatures until evidence can be clearly established and independently validated that new taxonomy merits acceptance by all parties concerned.
- Recognize that species are more than their genetics. Maintain unique ecotypes.
- Identify how much genetic diversity exists. Discuss how much diversity is being lost because small populations are experiencing genetic drift, with some populations being extirpated or in decline.

Endangered and Threatened Species

- Threatened or endangered status for British Columbia-derived populations of California bighorn sheep is unnecessary.

Exotics

- Urge federal land management agencies to be more restrictive with mouflon sheep on public lands.

Records Book Listing

- Support records book listing for California bighorn sheep if entered heads are plugged/pinned and supported by a valid hunting license. No pickup heads should be allowed in records book listings.

Thinhorn Sheep

Advocacy Groups

- Enhance and maintain existing alliances.
- Initiate new, less traditional alliances, being particularly attentive to learning and teaching in developing and maintaining those relationships.

Habitat Fragmentation and Human Disturbance

- Enthusiastically participate in land management planning and review.
- Firmly educate involved publics concerning probable negative impacts to wild sheep.
- Monitor impacts and increase certainty of recommendations for future management of wild sheep.
- Anticipate problems and proactively plan for specific wild sheep management.
- Teach the public that sheep populations can support many managed uses, and that parks meet needs for special nonconsumptive uses.
- Recognize wild sheep habitat needs when analyzing land tenure adjustments and large-scale land exchanges.

Habitat Management

- Protect basically pristine thinhorn habitats from degradation. Habitat degradation of pristine habitats will be negative for thinhorn sheep.
- Managers should not rush to "improve" pristine habitats.

State/Provincial/Territorial/Federal Relationships (Intergovernmental Relationships)

- Work locally with other governmental agencies, advocating a return to or establishment of a functional management system.

Hunting and Harvest Strategies

- Harvest of only mature rams has minimal effect on thinhorn populations and can be sustained with minimum population monitoring or management action.
- Harvest of ewes or immature rams may adversely affect population size, productivity, and trend, and is not universally appropriate. It must be closely monitored where it occurs.

Law Enforcement

- Inform and educate the public on the rationale for existing regulations, in an effort to minimize violations because people understand and comprehend those regulations.
- Support law enforcement and aggressively support fines equal to the established market value of poached animals, when convictions have been obtained.

Capture and Transplant

- Capture only as necessary. Use the best data available to select the most appropriate capture method.
- Oppose transplants in thinhorn ranges.

Disease

- Aggressively pursue legislation and regulations assuring no domestic sheep, goats or cattle interact with thinhorn sheep.
- Establish baseline studies to examine the health and disease status across thinhorn sheep range.

Predation

- Retain predator control as a management option, apply it with great care, and make sure you identify why, how and what your thresholds are for application.
- Predation is seldom an important limiting factor in Dall sheep populations. In isolated cases where predation may be a problem, the biology of the situation should be carefully documented and demonstrated, and then appropriate action taken.

- Additional research and documentation on situations where predation can have an effect are needed. If predator control/management is undertaken, the program should be thoroughly documented and evaluated.
- Where consistent with applicable constitutional mandates and legal constraints, managers should support implementation of predator management to facilitate attainment of defined population size and human use objectives.

Population Management

- Thinhorn populations are not subject to density dependent effects. Rather, they are held below carrying capacity by other factors, such as weather.
- Managers should take no management action which may reduce population size without clear and consistent data indicating a density-dependent limitation exists.

Genetics and Taxonomy

- Examine the issue of the Fannin subrace of Stone and Dall sheep.
- Genetics is an academic rather than a management concern for thinhorns.
- Maintain pristine ecosystems and let natural systems operate.

Endangered and Threatened Species

- View thinhorn sheep as subspecies, not jurisdictional groups.
- Do not let thinhorn populations become endangered.

Exotics

- No introduction of exotics in thinhorn habitat.

Native Ungulates

- Manage total predator/prey systems, not single species management. To target management for one species often can be detrimental to other species. Management should be designed at the landscape scale.
- Maintain intact ecosystems.