Appendix A: Additional Priority Areas Identified by OTA A

In addition to the surface water quality, wildlife, and soil quality priorities discussed in the main text of this report, scientists prepared reports on seven other categories of environmental priorities related to agriculture. The priorities identified for rangelands, water conservation, groundwater quality, rural landscapes, wetlands and riparian areas, plant diversity and insect diversity are described in this appendix. In appendix B, the overlaps among all priority areas identified by the expert panel are presented in tabular form.

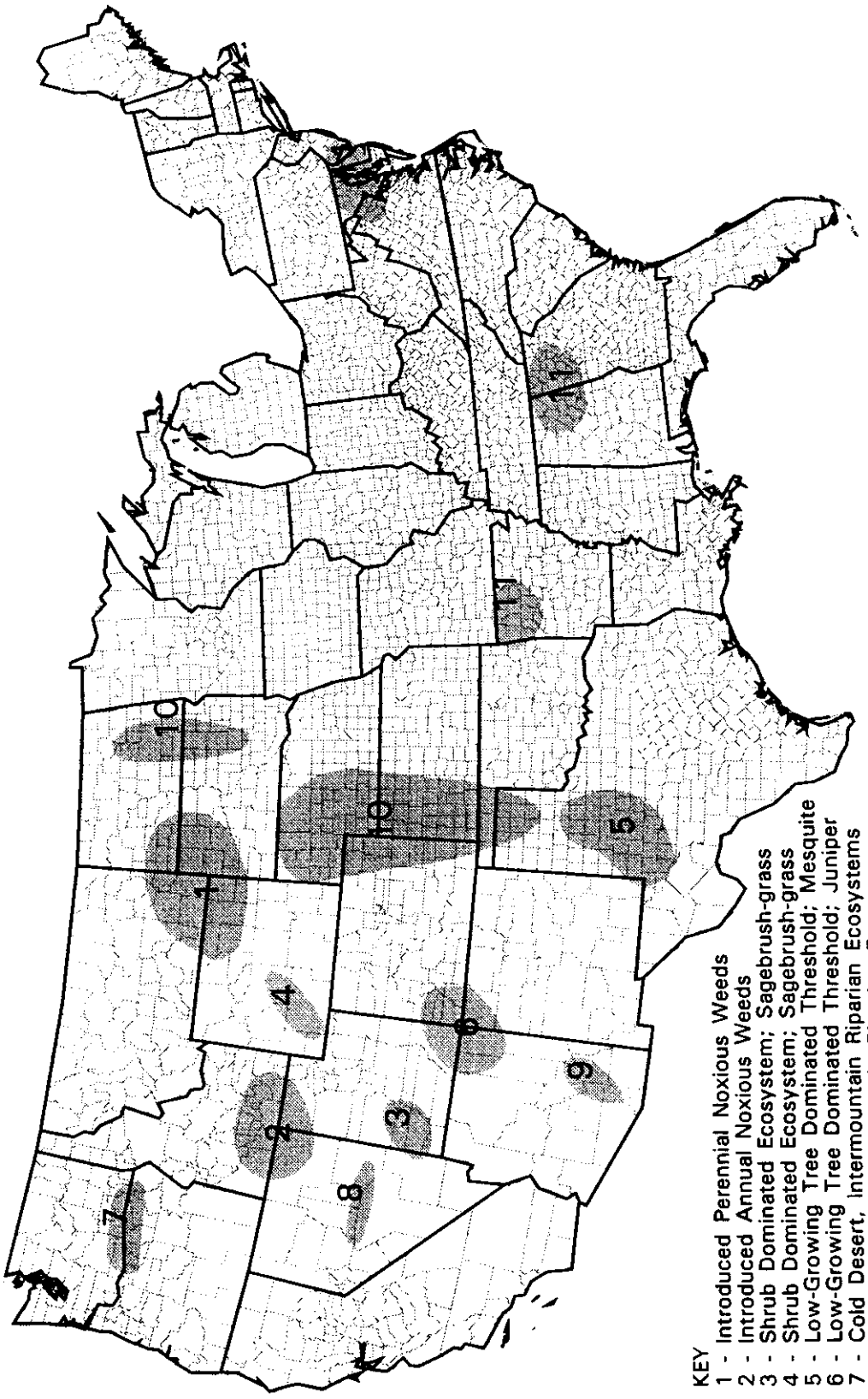
RANGELANDS

About half the nation's land is classified as grazing land, with most of that being rangeland. Many rangelands, two-thirds of which are privately owned, are not suitable for crop cultivation, but are very productive for supporting livestock and a host of unique plants. There are millions of acres of rangeland on which environmental problems exist, most of these related to soil erosion and loss of indigenous plant diversity.

The criteria used to assess the rangeland priorities included: 1) the likelihood that current conditions would have long-term negative effects on the ability of rangelands to provide ecological or commercial services; 2) observed conditions fail one or more of the standards for quality suggested by the National Research Council (NRC) study on rangeland health (56), and; 3) current or predicted conditions may lead to negative offsite problems. Many of the conditions reflected in identified priorities have resulted from poor management: harvesting plants inappropriately, grazing the "wrong kind of animal," poor distribution of grazing animals across a landscape, and inappropriate control of fire (including fire prevention, in some cases).

The 10 highest priorities related to rangelands include (see figure A-1):

1. Introduced (i.e, nonindigenous) perennial noxious weeds—Large areas in the western U.S. have been invaded by non-indigenous, herbaceous plants such as leafy spurge, knotted knapweed and St. Johnswort which are out competing native plants. These invasions have been compared to spread of "wild fire." The result is reduced biodiversity and reduced forage for wild animals and livestock. In Montana, Wyoming, and the Dakotas, about 1 million acres have been invaded by leafy spurge.
2. Introduced annual noxious weeds—Overgrazing and inappropriate use of fire have



SOURCE: Office of Technology Assessment, 1995

facilitated a conversion from native sagebrush and grasses to weeds such as cheatgrass in parts of Idaho, Utah, Nevada, and Oregon. Cheatgrass is well-adapted to growing in disturbed settings, so poor range management aids its establishment; but cheatgrass provides poor forage for wildlife and livestock compared to a mixed grass, shrub and forb community.

3. and 4. Shrub-dominated threshold ecosystem—Poor grazing management in parts of Utah and Wyoming has enhanced the dominance of sagebrush. Cattle avoid sagebrush and have reduced native grasses by overgrazing. The conversion to sagebrush dominance is very difficult to reverse, and an imbalance between sagebrush and grasses reduces the function of these grasslands for livestock and wild animals.
5. Low-growing, tree-dominated threshold ecosystem with high erosion—Extensive areas of west Texas have become dominated by mesquite, a long-lived and resilient tree. Rangelands dominated by mesquite provide less forage and are more prone to erosion because plants affording ground cover can not compete with mesquite.
6. Low-growing, fire-tolerant, tree-dominated threshold ecosystems—Juniper and pinyon pine have become dominant on many acres of rangeland in parts of Colorado, New Mexico, and Arizona, thereby reducing their function as grazing land for livestock and wild animals. These low-growing trees, which can reach several hundred years of age, were historically constrained to rocky outcrops by periodic natural fires on grassland. Grazing has diminished grasses to the point that they can not carry fire, and this has permitted juniper and pinyon pine to spread, relatively unchecked.
7. through 9. Riparian ecosystems—Riparian ecosystems are landscapes adjacent to streams that gain their distinctive characteristics from periodic flooding and the proximity of groundwater. Well-managed riparian areas provide flood control and habitat, and trap sediment before it enters waterways. Grazing management that permits destruction of riparian areas reduces their water quality and habitat properties.
10. Highly erodible lands in CRP—Lands from the Texas panhandle to eastern Montana have historically experienced several periods of severe erosion, brought about by extensive plowing of soils that are inherently fragile. Restoration of these highly erodible lands to permanent grass cover, most recently through the Conservation Reserve Program, can be compatible with grazing uses.

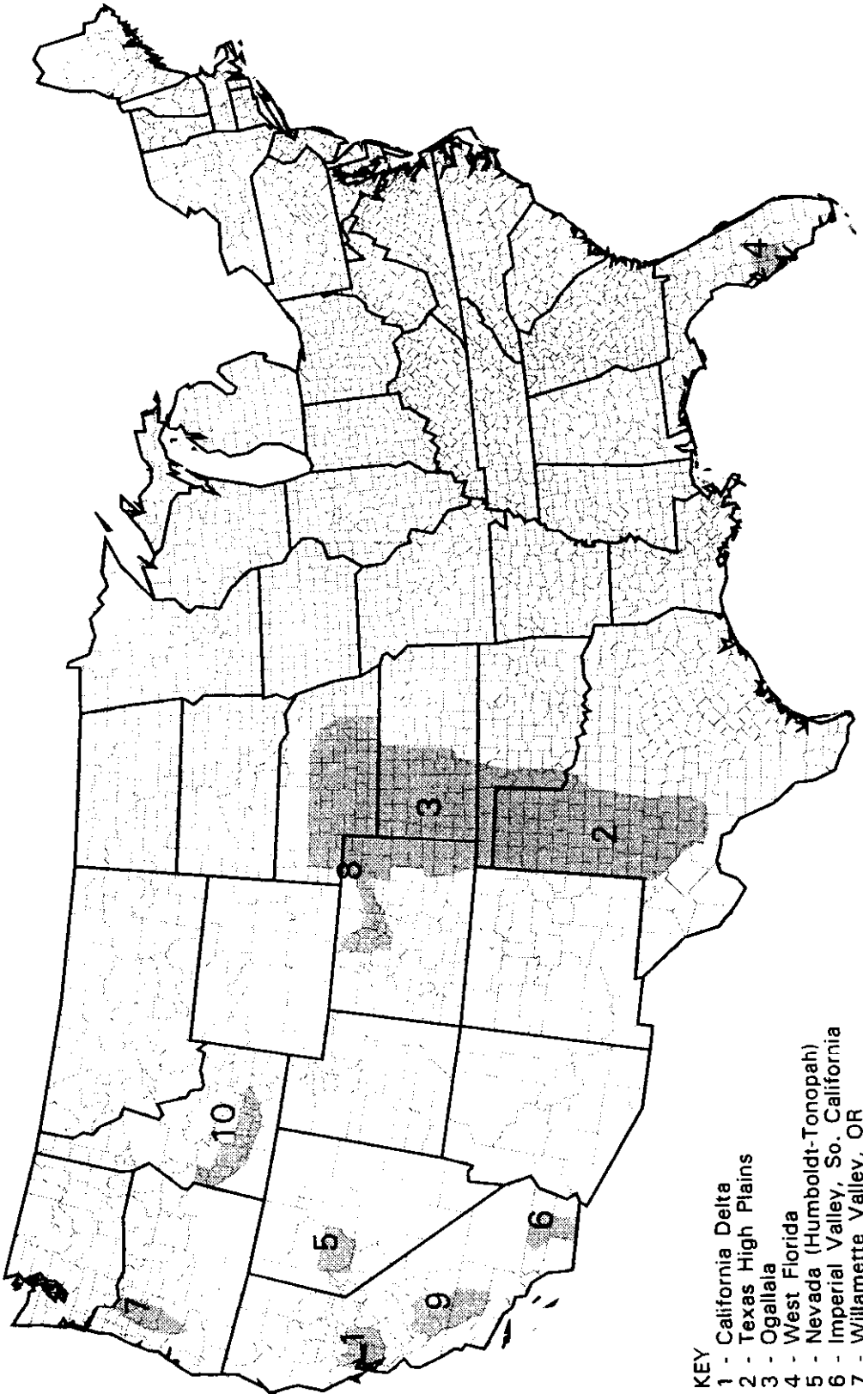
An eleventh category where poultry and other animal wastes are routinely spread on pasture lands was defined for parts of Arkansas, Alabama, Georgia, and the DelMarVa peninsula.

WATER CONSERVATION

Water conservation priorities relate to the protection of quantities of water, primarily in streams, rivers, and aquifers. Water conservation in agricultural areas can also be related to management of water held in soil.

Priorities selected reflect geographic areas in which emergent competition is occurring between agricultural and environmental (and perhaps also municipal or commercial) uses. In all priorities, water quantities are insufficient to meet existing or future water needs. Accordingly, priorities reflect cases where greater complementarity in usage may be possible, or where an existing constituency may have already formed to deal with issues related to competition for water. All except one of the priorities pertain to western water (see figure A-2):

1. California Delta—Issues of concern include water quality (salinity and pesticides), endangered species, and conflicting state and federal political jurisdictions. Increased water flow is considered essential to maintain the Delta aquatic ecosystem, including the endangered Delta smelt. This will almost certainly entail reducing water supplies to agriculture.



SOURCE: Office of Technology Assessment, 995.

2. Texas High Plains—Falling water tables and nitrate pollution affect this southern reach of the Ogallala aquifer; the Ogallala is a primary water source to this geographic area of west-central Texas.
3. Ogallala—Falling water tables and nitrate pollution affect this western Nebraska region that also depends on the Ogallala aquifer. Areas 2 and 3 are related and show that a single water conservation concern can involve more than one state.
4. West Florida—Competing demands between agriculture and municipal uses of water also have implications for the condition of south Florida wetlands.
5. Nevada (Humboldt-Tonopah)—This area contains the Stillwater Wildlife Refuge which is vulnerable to changes in water quantity or quality caused by agriculture. Residential development of the Sierras creates conflicting demands between municipal and agricultural uses of water and engenders jurisdictional competition between agencies.
6. Imperial Valley, Southern CA—Heavy competing demands between irrigation districts in Coachilla and Imperial Valleys and the metropolitan water district in Los Angeles have implications for water conservation by agriculture, for salinity concerns in surface water, and for endangered fish species.
7. Willamette Valley, OR—Competing demands between agricultural and other uses, and competing agency jurisdictions over water use are at issue.
8. Front Range and South Platte, CO—Competing demands for water, nitrate leaching to groundwater, and pockets of salinity are concerns.
9. San Joaquin–Tulare, CA—Competing demands and jurisdictions over water use are compounded by groundwater and surface water concerns; these include salinity from irrigation return flows and nitrate leaching from an increasing number of dairies. Furthermore, water conservation measures may change underground flow in unanticipated ways.
10. Snake River, ID—Competing demands, competing jurisdictions over water use and pockets of salinity are emergent issues. This case provides an opportunity to do long-range planning to avert future crises.

GROUNDWATER PRIORITIES

Although science and data to identify and fully characterize groundwater quality conditions related to agriculture are incomplete, existing data analyzed by the U.S. Geological Survey (USGS) show that certain regions are relatively more vulnerable to contamination from nutrient residues from fertilizer and livestock manure and from pesticides. Regions of greatest vulnerability include parts of the Northeast, Midwest, and West Coast. The well-drained soils typical of these regions have little capacity to hold water or chemicals, and these soils also receive some of the highest applications of agrichemicals in the nation. This combination of characteristics sets the stage for potential leaching to groundwater.

Four criteria were used in assessing the comparative severity of groundwater concerns across the country: 1) vulnerability to leaching, based on soil/water system properties and drainage patterns; 2) rate and amount of chemical use; 3) importance of regional water resource for drinking water; and 4) evidence of groundwater pollution from agriculture. In some cases, priorities were selected because contamination has already occurred, while in others, the likelihood of contamination together with potential human health exposure formed the rationale for selection. For example, a case where the risk of leaching to an aquifer is determined to be high, and millions of people utilize that aquifer for drinking water may be identified as a priority. This precautionary approach was taken because aquifers are difficult or impossible to clean up once they are contaminated with agricultural chemicals, and waiting for slow natural replacement of water in aquifers may be an unrealistic option.

Nine priorities were identified:

1. Central Valley, CA—Documented pesticide and nitrate pollution pose high drinking water risks.
2. Willamette Valley, OR—High vulnerability for agrichemical pollution poses a medium drinking water risk.
3. Palouse/Columbia irrigation plateau, WA—Documented pesticide and nitrate pollution, with greater concentrations in areas of coarse, alluvial sand, pose a medium drinking water risk.
4. Snake River, ID—Supplemental irrigation flushes pesticides and nitrate into aquifers, and this poses a medium risk to drinking water uses.
5. Northern High Plains—Substantial evidence of nutrient and pesticide pollution exists in areas of glacial deposits overlaying fractured sedimentary rock. This poses medium to high drinking water risk.
6. Corn Belt—Elevated concentrations of nutrients and pesticides are detectable under sandy soils which are vulnerable to leaching. Tile drainage may reduce groundwater pollution in some areas by diverting drainage to surface water. Drinking water risks associated with these conditions are medium to high.
7. Long Island/New Jersey Coastal Plain—Groundwater contamination from potato and other intensive vegetable production poses a high drinking water risk.
8. Mid-Atlantic Coastal Plain—High nitrogen fertilizer and pesticide use takes place in areas with vulnerable soil/water properties, and there is the potential for large population exposure.
9. Hawaii—Soil and water properties are especially susceptible to contamination from leaching of pesticides and fertilizers.

RURAL LANDSCAPES

Some agricultural landscapes have great historical, aesthetic and ecological—"heritage"—value. They can provide links to the past, lifestyle or psychic rewards in the present, and preservation of environmental resources needed for the future. While no landscape is "better" than another, some are more complex (that is, diverse), and complexity may be perceived as more valuable. The inherent value of a diverse mix of landscapes across the nation was an implicit criterion in the selection of priorities.

Some additional characteristics considered in evaluating landscape priorities related to agriculture pertained to the relative vulnerability of landscapes, on a national basis and within specific regions, to function and remain aesthetically pleasing while rapid changes occur in the technologies and structure of agriculture. Certain landscapes may be prone to rapid loss of unique character and complexity due to agricultural change, and such losses may impose significant social or economic costs.

While the risk of losing "heritage" value is not a common measure of environmental quality and may not alone provide a rationale for special protection, the coincidence of heritage characteristics with environmental sensitivity may help identify priority targets.

Priorities identified include:

1. Lancaster County, PA—Pennsylvania German old-world agriculture has high aesthetic and tourism value.
2. Blue Grass Region, KY—Settlements are known for tobacco and horse cultures.
3. Shenandoah Valley, VA—This premier colonial frontier zone also holds mixed agricultural uses.
4. Lower Mississippi River, (Louisiana, Mississippi, Arkansas)—Old South plantation and cotton cultures are reflected here.
5. Taos-Santa Fe, NM—Traditional Native American and Spanish rural cultures are found here.
6. Upper Mississippi Driftless Region, (Wisconsin, Illinois, Iowa, Minnesota)—Scenic, traditional dairy farms and vestiges of early trading, mining, trapping, missionary and lumbering activities shape the character of this landscape.

7. Connecticut Valley, (Connecticut, Massachusetts)—The fertile New England farm zone captures early settlement character.
8. Central Valley, CA—Rural landscapes here display the most highly developed form of western agricultural specialty farming reflecting the corporate, irrigation model of organization.
9. Southern Palouse District, (Washington, Oregon, Idaho)—Large-scale agriculture in distinctive small grain landscapes with western features characterizes this landscape.
10. Willamette Valley, OR—Distinctive rural landscapes showing conjunction of forest and field economies are also marked by a New England imprint.

WETLANDS AND RIPARIAN AREAS

The functions of wetland and riparian areas generally depend on configuration, soils, vegetation, hydrology, and landscape context. These critical parameters determine the physical, biological, and economic functions and values that may be affected by agriculture.

Conflicts between wetlands and agriculture occur nationwide, but primarily where wetlands are preeminent in the landscape and agriculture is a dominant land use. Historically, agriculture has been the cause of most wetlands conversion (or destruction). During the last decade, the CRP and the WRP have restored sizable amounts of wetlands in agricultural regions.

The primary function of a given wetland helps define its vulnerability to agricultural activities. For example, wetlands with a primary flood control function may not be as vulnerable to damages from cropping or other agricultural activities as are wetland and riparian areas that provide unique habitat.

The kind of agricultural activity under consideration also determines the potential effects on wetlands and riparian areas. For instance, all wetlands can be seriously damaged by drainage, channelization, and uncontrolled grazing on riparian (streambank) areas. But not all will be damaged by periodic cropping or controlled grazing.

It is possible both to identify categorical concerns related to wetlands and agriculture (eg., destruction of buffers), and to identify specific geographical areas where conflicts between wetlands and agriculture have been or are particularly severe (e.g., the Everglades). To the extent that targeting may benefit from identifying specific areas, the necessity of understanding wetland function, values, uniqueness, and interaction with farming activities across the country increases. The importance of combining national and local targeting to identify the most suitable wetland priorities related to agriculture is thus emphasized.

Wetlands priorities selected illustrate both geographic areas and categorical concerns. Almost all priorities overlap with those for other environmental categories. The rationales for their selection are briefly stated below:

1. Florida Everglades—Water diversions from groundwater and surface water deplete water flows that are critical for maintaining the unique character of the Everglades ecosystem. Nutrient residues in agricultural runoff reach the Everglades and promote “eutrophication,” a process that degrades the wetland.
2. North Carolina Agriculture Forestry Conversions—Cutting, drainage, and construction of access roads fragment and diminish wetlands and riparian ecosystems.
3. Lower Mississippi Valley—Cutting and drainage for soybean production degrades wetland/riparian systems. Diking alters water flow in the drainage basin.
4. Upper Mississippi–Lower Mississippi—Diking, channelization, drainage, and cutting alter water flow patterns and water quality; this affects the ability of riparian areas and wetlands to regulate water flow and provide a variety of habitats.
5. Prairie Potholes—Drainage and cutting for agricultural uses diminish wetlands in the area, which is a primary breeding ground for North American waterfowl.

6. Sand Hills, NE—Groundwater withdrawals for irrigation reduce the water table and this decreases the water available to wetland areas.
7. Degradation of wetlands from agricultural drainage—Drainage from cropland can carry a variety of pollutants that may accumulate in wetlands. Irrigation drainage flows can carry high concentrations of salts and metals that degrade wetland habitats. One of the most notable cases of this problem occurred at Kesterson National Wildlife Refuge in California.
8. Water competition from agriculture—Diversion of water to agricultural uses can reduce instream flows required to maintain stream habitats, riparian habitats and wetland habitats. An example is the case of the Truckee River in Nebraska.
9. Riparian zone and wetlands destruction by grazing—If grazing animals, usually cattle, are permitted to trample and graze on streambanks, severe soil erosion can occur and streambank vegetation may be depleted. This directly degrades or destroys riparian ecosystems and degrades stream and wetland habitats as well. An example is the case of the Platte River.
10. Riparian zone destruction by channelization, dikes, and dams—As already described, "improvement" of streams to facilitate irrigation or drainage on agricultural lands generally results in the straightening of waterways (which reduces the miles of water habitat), removal of trees and grasses from streambanks (which degrades riparian habitat) and alters instream water flows (which can affect both water quality and quantity). Southern California provides relevant examples.

PLANT DIVERSITY AND INSECT DIVERSITY

Two further dimensions were dealt with by the expert panel but for which specific geographical targets proved extremely difficult to identify because of immature science. The dilemma between protecting what is left intact and restoring what is gone, and the lack of knowledge about the base inventory of plants and insects dominated both discussions. However, the process of trying to identify these priority targets served to deepen and embellish the overarching concept of agroecosystems as dynamic and comprised of many elements of environmental quality contributing to biological health.