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BIOLOGICAL DIVERSITY: THE CHALLENGE OF THE FUTURE

An address to the Southern Interior Silviculture Committee winter meeting at Vernon, March 1990; and to the Ministry of Environment's Habitat Biologist's annual meeting at Yellow Point Lodge, April 1990

By Brian Nyberg, Research Branch, B.C. Forest Service

I am going to talk today about biological diversity or biodiversity. This is a topic that is quickly becoming a catch-phrase of the environmental movement (and often a nearly meaningless one at that). In that respect, it is second only to "sustainable development" as a concept that most people would claim to feel strongly about but would have great difficulty defining explicitly.

There are signs, though, that biological diversity is becoming more than just a fuzzy, warm concept embraced only by the environmentalist fringes of society. For example, the Federal Government in the United States this year is considering for the second time the passage of a "National Biological Diversity Conservation and Environmental Research Act". This act would among other things, mandate preparation of a national strategy for biodiversity, require all environmental impact statements for federal programs to explicitly assess impacts on biodiversity, and establish a national centre for biodiversity and conservation research. Closer to home, British Columbia's Forest Productivity Council is considering a gene conservation strategy for the commercially valuable conifers in the province. And recently I saw a list of some of the questions one of our major forest companies was considering when trying to decide how to deal with local environmental activists. These questions were: "What is biodiversity?", "What is the long-term need for study of it in _____ Sound?", "How do we address it in the _____ Creek watershed?", and "How much and what types of forest should we leave to conserve biodiversity?". As a final example, during the Forest Resources Commission's recent hearings in Victoria, the Commission questioned the Ministry of Forests about the Ministry's position on biodiversity. It appears from these and other indications that biological diversity is on the way to becoming a mainstream conservation issue in this province.

Before I go on, I want to point out that I have no more special expertise in this field than most wildlife biologists and foresters could offer. I was asked to give this talk in part because of my familiarity with a few of the people and programs of the U.S. Forest Service, which are increasingly being directed to conserving biodiversity in their National Forests. Like many people though, I have a keen interest in biodiversity and a great concern about the world-wide challenge we face in sustaining the earth's living resources, so I am glad to have the chance to offer a few thoughts on the subject to you.

Since I haven't claimed to be a biodiversity expert, I had better give credit to those who have provided most of the material and ideas I am going to present. Hal Salwasser of the U.S. Forest Service was the author of the talk on which most of my presentation is based. Some of you heard him give it last fall at the "Habitat Futures 1989" workshop in Washington State. I have drawn other materials from a number of sources, especially Fred Bunnell of UBC, who has written and spoken on the subject a number of times, including at the Wildlife-Forestry Symposium at Prince George in March.

The title of my talk is "Biodiversity-The Challenge for the Future". The first item of business is to define just what biological diversity is. Simply stated, it is the full variety of life and its processes, including plants, animals, and other living organisms and their habitats. It encompasses ecosystems, species, and genes. It is a simple concept describing an inconceivably complicated biota. To paraphrase the ecologist Frank Egler, biodiversity is not only more complicated than we think, it is more complicated than we can think.

With that preamble, I am going to turn now to the slides. Although, as I said, this is largely Hal Salwasser's talk, I have made an effort to put the British Columbia situation in a national and, to a lesser extent, an international perspective.

Adapted from a talk by Hal Salwasser, USDA Forest Service

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1. Photo of species
or habitat

From Genesis to Gaia, people have cared about the richness of life on Earth. This concern, in the context of resource management and conservation, was expressed by Aldo Leopold in his essay on the Round River: "If the biota, in the course of eons, has built something we like but do not understand, then who but a fool would discard seemingly useless parts? To keep every cog and wheel is the first precaution of intelligent tinkering."

2. Title slide:
Biodiversity is variety

We now address these biotic cogs and wheels with the term biological diversity. In a general sense, biodiversity is the full variety of life and its myriad of processes. That includes all lifeforms, from bacteria, protozoa, and fungi to higher plants, insects, fishes, birds and mammals. It could total 10 to 30 million different species world-wide, plus countless millions of pathways, processes, and cycles that link organisms into populations, communities, ecosystems, and ultimately the entire biosphere.

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3. Photo of species
or habitat

Conserving biological diversity is integral to providing a future with healthy and productive renewable natural resources. And like all valued resources, it would be nice to perpetuate every part and process of the biota in every possible place. But growing human populations and their demands, attitudes, and artifacts mean that we must continually make choices on which aspects of the variety of life are of highest priority for conservation and how we should blend their perpetuation with other socially desirable goals. In this fundamental sense, conservation of biological diversity is like conservation of any other resource or thing of value: we must often choose to do one thing at the expense of another or select options that only reduce the rate of loss.

4. Title slide:
What, Why, How?

The big questions facing us today on the future diversity of life on Earth included: What specifically is biodiversity? What parts and processes are of highest immediate concern? Why should we be concerned with perpetuating those parts and processes? And how should we go about conserving biodiversity while satisfying the other needs of people for food, shelter, clothing, recreation, and livelihood? We'll be many years getting answers to these questions. But we need not wait for consensus before embarking on a path to conserve what we already know to be some of the most important parts and processes. This is a perspective on such a path.

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5. Title slide:

Parts and processes

Because biodiversity is so complex, and much of it is hidden from our view, it is necessary to find some "handles"--that is to address the more significant, distinct, and measurable parts. Most basic of these is **GENETIC VARIATION**. Genetic variation within and between populations or species affects their physical characteristics, viability, productivity, resilience to stress, and adaptability to change. So, genetic variation, especially in those species humans desire for resources, is a major part of biodiversity. Among the more easily recognized aspects of biological diversity are the different **SPECIES** that occupy a particular place. Some of these species, such as deer, trout, and Douglas-fir are valued resources. Others, such as grizzly bears, Vancouver Island marmots, or mountain caribou, face threats to viability or even extinction. Conserving biodiversity means perpetuating desired species in numbers and distributions that afford high likelihoods of long-term continued existence wherever possible. In some cases, special or unique associations of species in an area are the paramount concern. We refer to these associations as **BIOLOGICAL COMMUNITIES**, and usually recognize them as distinct stands, patches, or sites, such as old-growth forests, interior grasslands, and wetlands. Communities form the biotic parts of ecosystems. The variety of species in an ecosystem determines

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5. cont'd.

its functional integrity and the diversity of its ecological processes. Finally, at large geographic scales--from watersheds to the entire biosphere--we see variety in the kinds of ecosystems, their patterns, and linkages across REGIONAL LANDSCAPES. It is from these large, regional landscapes, such as the Rocky Mountain Trench, Thompson Plateau, or Vancouver Island, that people must derive sustainable yields of resources while perpetuating biologically diverse ecosystems. This classification of the parts and processes of biological diversity is admittedly artificial. And it has a distinct human context. But it helps us begin to get a grip on something that is infinitely varied and dynamic and that must be addressed in light of the full spectrum of human needs and aspirations.

6. Photo of Habitat

Let's take a closer look at BC's role in conserving the diversity of the temperate and norther forests of Canada and the world. We must first put this in perspective, though. The potential threats to biodiversity here are nowhere near what they are in tropical and subtropical areas. On the Island of Madagascar, for example, 93% of the original primary forest has been eliminated, putting at risk a huge portion of their approximately 8500 documented plant species and 170,000 animal species, 60% of which are endemic to their eastern strip of forest. And we must all be familiar by now with the building crisis in the Amazon rainforests.

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6. cont'd. BC does have tremendous variety, though: at least 2500 vascular plants, 1000 bryophytes, 10,000 or so fungi, 1000 lichen, 630 wildlife species, and perhaps 35,000 insect species. There are more than 800 rare plants in the province. We have lost some important wildlife species that were once native to BC: the passenger pigeon, the sage hen, and the wood and plains bison among them. In flooding parts of the interior Cedar-Hemlock zone with the Revelstoke and M dams, we apparently eliminated at least 4 plant species that occur nowhere else in the province. Who knows what other species are being lost, as we rapidly deplete our old-growth forest?
7. Bar Graph:
Resident Mammals This slide illustrates BC's place in the forefront of wildlife diversity in Canada. As you can see, of the 151 species of land mammals resident in Canada, B.C. has 70% of them, more than any other province or territory.
8. Bar Graph:
Breeding Birds The situation with breeding birds is similar, although our lead over other jurisdictions is slightly smaller.
9. Pie Chart:
Mammal Species When we look at the mammal species that are confined to only one province or territory, B.C.'s importance becomes even greater. Of 33 such mammal species in the country, 24 occur only in this province.

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10.	Pie Chart: Bird Species	35 of the 65 breeding species that occur in one jurisdiction occur only here.
11.	Pie Chart: Mammal Subspecies	The proportions are almost the same when we look at mammal subspecies, which is probably the appropriate level in the taxonomic hierarchy to concern ourselves with. Remember, if we don't recognize subspecies, coastal and interior Douglas-fir become one, as do mule deer and coastal blacktails.
12.	Bar Graph: Mammals by Country	Let's turn now to compare BC with other countries in the northern hemisphere. As this slide shows, BC has almost as many mammals as all of Europe, and more than either France or Sweden. These slides underscore what we already knew: that BC is a tremendously diverse and important area of the world.
13.	Photo of Species, Habitat, or Landscape	The second of our major questions is: "What parts and processes of biodiversity should be immediately concerned about? Should we care about sustaining and enhancing all genetic resources, recovering all endangered species, restoring all riparian areas, perpetuating all old-growth forests, or conserving all sundews, swamps, and salamander? The answers to these questions will not derive solely from scientific principles. They are going to touch on economics, quality of life, esthetics, and ethics as well as biology and ecology.

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14. Title slide:
Values of biodiversity
- Perhaps a look at how the variety of life serves people will offer insight into some immediate priorities. Our homes, air, foods, medicines, and recreational resources all contain elements that derive from biological diversity. For example, about 50% of prescription medicines are extracted from wild organisms, providing a commercial value of \$14 billion annually in the United States.
15. Photo of person enjoying
some aspect of
biodiversity
- We enjoy hiking in diverse forests, visiting biologically rich seashores, and savoring the bounty of diverse and productive fish and wildlife populations.
16. Title slide:
Values--ecological
services
- Diverse communities of plants, animals, and microorganisms also provide indispensable ecological services. They recycle wastes, maintain the chemical composition of the atmosphere, and play a major role in determining the world's climate.
17. Photo of species,
habitat, or landscape
- Moreover, many people believe humans should revere all life on Earth and bear an obligation for its stewardship.
18. Title slide: Concern?
- Of course, the potential values and uses of biological diversity far exceed our current knowledge. We know only a small fraction of the species on this planet, especially in tropical ecosystems, despite decades of scientific effort. Every year species are lost before we have a chance to describe them, let alone learn

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18. cont'd.

anything of their ecological roles and values. We will never know which potential foods, medicines, and commercial products are foregone with each reduction in biological diversity. One species of periwinkle from Madagascar's threatened forests produces an extract used in treating Hodgkin's disease, leukemia, and other cancers of the blood. That extract has a value of \$300 million per year in the United States alone. We may be losing organisms of similar or greater value from temperate forests, too.

Furthermore, many question our right to knowingly impoverish the biological heritage of future generations. The renowned biologist Edward O. Wilson put it this way: "What event...will our descendants most regret, even those living a thousand years from now? The worst thing..., the one process ongoing in the 1980s (and 1990s) that will take millions of years to correct, is the loss of genetic and species diversity by the destruction of natural habitats. This is the folly that our descendants are least likely to forgive us."

19. Photo of species,
habitat, or landscape

To this point, we have seen that biological diversity is the variety of life, and that this variety has great importance to us and future generations. But how do we determine priorities and carry out actions to conserve the described portions of all this variety?

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20. Title slide:

Threats to diversity

First, it will help to recognize the general threats to biodiversity. They are many. And they occur in just about every region of the planet. The best science and resource management will have few lasting effects if social and political systems do not come to grips with the "megathreats" of human population growth, poverty, pollution, and political instability--a new Four Horsemen of Environmental Apocalypse.

21. Title slide:

Factors eff. biodiv.

But for our purposes here, we will address a narrower focus; namely how to conserve those elements of biological diversity we desire in our forests and other wildland ecosystems. The factors affecting biodiversity at this scale are a bit more tangible. Yet still it will be difficult to reduce or mitigate them all. It's axiomatic that we cannot perpetuate all biological diversity while extracting an increasing portion of its productivity for growing human uses. Nor can we perpetuate desired species, communities, and ecological processes simply by trying to prevent change in them, whether natural or human-induced. Nor should we view diversity as trying to maximize edge contrast or the variety of life on every acre or in every watershed.

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22. Artwork on biodiv.

Conservation of biological diversity requires a "big-picture" perspective that recognizes humans and change as fundamental to any solution. Geographically it requires a regional ecosystem approach to long-term planning for a rich future. Management of genetic resources, species populations, ecosystems, bioregions, and human activities to perpetuate the desired variety of life while meeting short and long-term human needs must integrate many goals and considerations. It must also employ a full spectrum of conservation actions from protection, restoration, enhancement, and sustainable culture, to research, inventory, assessment, planning, monitoring, interpretation, marketing, and education. As most of you know, conservationists have been engaged in such efforts for many decades. But they have been focused on specific resources and specific places, seldom with biodiversity as a major concern.

23. Photo of research

To approach such a comprehensive goal as perpetuating biological diversity, we will need to better understand the natural functions and processes of regional populations and ecosystems, and their responses to human activities and management, then make prudent decisions on how to sustain and enhance their productivity for all values and uses. One might think of this as gaining new perspectives on

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27. Title slide:

Desired results

The goals for biodiversity, as defined by the U.S. Forest Service, include recovery of threatened and endangered species to viable levels; management of habitats and human actions to maintain viability of all other species' populations, well-distributed throughout their geographic ranges; protection, management, restoration, or enhancement of special habitats and biological communities; ensuring the functional integrity of regional ecosystems; and managing the genetics and populations of featured species for human well being. These are being translated into programs, plans, and actions to achieve specific, desired results for the biota in the U.S. National Forest System.

28. Title slide:

Responsibility

Canadian federal and provincial agencies, together with private entities such as The Nature Conservancy are also addressing their contributions to a biologically rich future. But overall, the policies and actions for conserving biodiversity in this country are fragmented and uncoordinated. We need to integrate them into a comprehensive conservation strategy. There remains much that can be done by building from existing laws, regulations, policies, and institutions; we haven't come anywhere near taking full advantage of their mandates and capabilities. A national strategy,

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assuming we chose to build and implement one, should be coordinated between all the agencies and organizations--public and private--that share interest or responsibility for natural resources. We must reduce the barriers--real and perceived-- that have been created between functional disciplines such as timber and wildlife, between science and management, between protected areas and multiple-use forests, between feds and provinces and between government and the private sector. On biodiversity they must all play complimentary roles.

29. BEC map of B.C.

Inventory of the basic elements of biodiversity is a starting point for such coordination. In British Columbia, they are still known only generally for our comprehensive management purposes. British Columbia contains over 70% of the vertebrate species richness in Canada. We also have 70% of the major forest types, and 50% of the softwood growing stock. This only scratches the surface of the baseline knowledge needed on biodiversity for these lands. We need better inventories and assessment of the current conditions, abundances, distributions, and management direction for genetic resources, species populations, biological communities, and

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29. cont'd.		ecological systems. Heritage Programs in the U.S. are perhaps the best example of coordinated inventories, and Geographic Information Systems the most promising of new technologies.
30.	Photo of Vernon-intermixed lands	However, even a system as large and diverse as the Provincial Forests cannot sustain its biodiversity without cooperation of adjoining land owners and managers. We need to bring common inventories, assessments, plans, and policies into better coordination and coverage.
31.	Photo of regional ecosystem	Such multi-institutional coordination of plans and actions will be tough. Implementation will be even tougher. People must yield some of their autonomy and there will, no doubt, be adjustments in how areas of lands and waters are managed. That probably means changes in public policies for resource conservation.
32.	Photo of critters	Many of the rarest elements of biodiversity occur on public lands and waters. We must develop and change policies for how those lands and resources are managed by democratic means.
33.	Photo of IDT group	The days of authoritarian, all-knowledgeable rangers, biologists, game managers, and foresters are gone. We have an increasingly knowledgeable and concerned citizenry. They

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33. con't.

want a voice in making the tough choices we face regarding their resources. Eventually, agencies must open their planning and resource management processes much more than has occurred to date. The alternatives, centralized technology-driven planning, or solution by smoke-filled rooms of experts, run counter to our customer's (namely the public's) desires. Besides, they have never worked for long anywhere they have been tried.

34. Title slide:

Research and tech.

Since we're talking about regional perspectives and integrated ecosystems management as opposed to simple, functional, stand or population level goals, we'll need some new knowledge and technologies. Research and technology development must embrace large-scale, long-term biodiversity issues such as population viability, ecological resilience, landscape linkages, multi-resource yield functions, habitat fragmentation, biodiversity indicators, cumulative effects, and monitoring. We have a great need for additional knowledge about the nature of BC's forest ecosystems. While we have identified all of the vertebrate animals and probably all the vascular plants, there are undoubtedly many other organisms, from insects to lower plants and soil micro-organisms, that we

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34. cont'd.

are not even aware of. And, of course, we know almost nothing of the unique genetic or chemical characteristics of these species or of their roles in ecosystem functioning.

35. Table: ESSF
Habitat Value

We also need to make better use of the knowledge we do have. Because maintenance of biological diversity has not been a major land management goal, we have not yet developed tools to help us consider even how the majority of terrestrial wildlife species in the province can be protected or enhanced when we manage the forest. Our research programs have made a start on this, however, through the "Wildlife Habitat Handbook" project for the southern interior, which Andrew Harcombe of the Ministry of Environment has been heading up. This project has developed an information and analysis system for considering the habitat needs of a wide range of bird, mammal, amphibian, and reptile species in that area. This slide illustrates how that system displays the habitat use information for one wildlife species using the Engelmann Spruce-subalpine fir zone. A series of publications describing this diversity management system is going to be distributed shortly so it should be in your hands very soon.

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36. Marketing

Marketing is also desperately needed. Most people know what spruce trees, trout fisheries, and bald eagles are. Some even know the roles of management in their conservation. But biodiversity is another story. Scientists have yet to reach a consensus on what it is and hardly anyone is willing to admit they know how to conserve it while meeting other human needs. So we have an enormous job of interpretation, education, and marketing to gain awareness, understanding, and support. It is conceivable that investments in interpretation and education programs will have a higher long-term return for biodiversity than doing more science and technology development on something no one comprehends or is willing to do anything about.

37. Photo

These are just some of the changes that may need to happen if we decide to make conservation of biodiversity a national or provincial priority. It is time now to focus on some practical aspects of a conservation strategy; the doing part of conserving biodiversity. As conservationists, we know that reality is only what happens on the ground. Further, we are involved in a rich and varied enterprise with many tools and philosophies. We're going to need all of them and more.

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38. Photo of managers

The keys to success on a biodiversity strategy are integration and on-the-ground action. We will need to take advantage of all our lands and resources, from the most highly protected to the most intensively managed, and use all the management tools we can muster.

39. Bar chart

Conservation of biodiversity can start with reserved areas such as parks, wilderness, and natural areas but it cannot stop there. Only about 6 1/2% of Canada is in parks, wilderness, and nature preserves. Few countries in the world have protected a larger proportion of their lands.

40. Pie chart

Multiple-use lands will be critical to the solution. It has been argued--and I agree--that they are even more important to the solution than the parks and preserves. However, even they will not be enough. We cannot meet our resource production needs and save major elements of biological diversity just on public multiple-use and reserved lands. Private lands, including those benignly neglected and those intensively managed for products must play significant roles also. High productivity from any piece of land or water may allow other parcels to be managed for other purposes, including restoration or enhancement of some rare or sensitive element of biodiversity.

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41. Title slide:
Dimensions

A comprehensive, long-term, regional perspective on biodiversity implies that we will integrate our plans and actions along three dimensions: Biological, Temporal, and Geographic. This may strike you as being about as hard to comprehend as the ecologists' n-dimensional hypervolume concept of the niche. Sorry--no one ever said biodiversity was going to be simple.

42. Stand to region

However, we can get a feel for the need to integrate different dimensions by thinking of it as blending our plans and actions for major indicators of diversity from stands to watersheds to regions with attention to consequences for long periods of time.

43. Title slide:
Integration

The need for increased integration is fundamental to conservation of biodiversity and it is a far greater challenge than anything conservation science or management have yet tackled. I like to think of our situation as being a bit like NASA must have felt in the early 1960s, when President Kennedy said the U.S. was going to the moon by the end of the decade. They must have been excited by the prospect, proud to have been given such a chance, and scared to death that they didn't know exactly how to get there: I am sure they did not have all the scientific knowledge they needed, and that forced them to experiment and take some sizeable risks. To say in 1990, that we would like to perpetuate major portions of

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43. cont'd.

biological diversity while meeting growing human needs for resources must be the conservation counterpart to the moon-shot challenge.

44. Cadre of experts

Of course, like NASA in 1963, we are not at square 1 on biodiversity. We have a lot of knowledge and a cadre of skilled people in place to accept the challenge. Like NASA, we will have to experiment, take risks, and make lots of adjustments if we decide to embark on the journey. But we need to get started soon because we're continually losing our capital assets.

45. Title slide:

FS on biodiversity

Allow me to close by summarizing what I think are some of the key roles we in the Forest Service can play in an overall provincial strategy for biodiversity. We can start with stewardship of the 74 million hectare Provincial Forest System--7 1/2% of the nation's total area. I will return to this in just a minute. We can also contribute to the development of national and international policies, basic knowledge and technologies, and we can help to interpret, educate, and demonstrate the need for sustainable management of renewable natural resources.

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46. Title slide:
FS Plan

Now, about the Provincial Forest System. What specifically can these Forests and Rangelands do better or differently than any other kinds of lands? For one thing, the B.C. Forest Service manages over 50 million hectares of land that is not suitable for timber harvesting or grazing, an area larger than all the national and provincial parks in Canada. We care for the habitats of at least 500 wildlife species. Securing their viability in well-distributed populations would go a long way toward perpetuating forest diversity in this country. B.C.'s Provincial Forests are an unequalled storehouse of genetic diversity, especially for species of high commercial value. There is no valid reason to postpone action on the vital role that management of genetic resources on Provincial Forests can play. The Provincial Forests also hold many of the most highly valued biological communities in the country. These include much of the remaining old-growth forest, over a hundred thousand miles of riparian areas, most of the alpine ecosystems that occur outside the national and provincial parks, and potentially the most complete system of Ecological Reserves in the country. Our market share demands that we feature their conservation. The Provincial Forests are also B.C.'s greatest resource of wild species featured for commercial, recreational, or subsistence uses. This includes 43 million hectares of productive Crown forest land and

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46. cont'd.

such world-class resources as Dall sheep, Douglas-fir, elk, coho salmon, and Kamloops trout. Finally, our agency needs to open the public resource decision-making process to broad involvement and interagency coordination. We're taking a lot of licks for not doing this right now. Change is essential for conservation to be responsive to new market forces, attitudes, and knowledge. A good imagination could certainly build on this start. I'm sure there will be much more to a biodiversity strategy than this. However, as most of us know, these are all tough issues in their own right and even this simple start would be an enormous task. So, if we were to look at the plans and on-the-ground conditions in a regional ecosystem, what might indicate that a strategy for conservation of biological diversity is in place and working?

47. Endangered species

We should start by looking to see that aggressive and successful actions were underway to recover and conserve all threatened or endangered species.

48. Sensitive species

Then we would see if management standards and guidelines, based on the new principles of conservation biology, are assuring viable populations of sensitive species, well-distributed throughout the region, thus securing their functional roles in ecosystems and precluding the need to list them as threatened or endangered.

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49. Genetic resources

We would want to find that major genetic resources are under special management programs to ensure desired variation and protect native strains that might be needed in the future. Examples of representative ecosystems would be protected in categories such as parks, wilderness areas and ecological reserves. These would help to protect many of those biotic "cogs and wheels" that Aldo Leopold cautioned us to keep, and would provide invaluable benchmarks for comparison with the state of managed lands.

50. Special habitats

Special habitats such as snags and old growth would be managed or enhanced to perpetuate their key roles in regional ecosystems, bringing in the new ideas coming out of diversified silviculture.

51. Plantation

Most high productivity sites, the flat ground with deep loamy soils, and featured species would be managed to intensify production of resources desired by people, thus meeting human needs with minimal impacts on more fragile sites and sensitive species.

52. Restoration

Sites, waters, and soils degraded by past human actions would be on the road to restoration and renewal, embracing the concepts and methods of restoration ecology and management.

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53. Fire

Ecosystems would be managed to meet specific objectives for ecological conditions that yield desired economic and social goals while balancing conflicts between uses and values. The use of prescribed fire and a full range of silviculture options would be needed here.

54. Landsat

The entire regional landscape would be the area on which multiple-uses and multiple-values are planned and scheduled to secure desired elements of biological diversity as integral parts of the whole bioregion. This would blend the contributions of different ownerships, using incentives preferentially to regulation of entrepreneurial activity or infringement of private property rights. Concepts such as Biosphere Reserves and Coordinated Resources Management might be employed.

55. People

And unprecedented degrees of human interaction and coordination between agencies and affected citizens would occur. Perhaps consensus building and negotiated problem solving would be offsetting our dependency on technology-driven planning.

56. Title slide:
Context

This is an ideal. It may be only partially achievable. In fact, the trends toward loss of diversity are bound to continue for 20 years or more no matter how aggressively we attack the

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56. cont'd.

problem. But we should aim far beyond what we think we can achieve. Conserving biodiversity is not going to be easy. Goals for specific ecological conditions will have to compete effectively with goals for specific resources.

57. Timber-Deer

Tradeoffs will be inevitable because there is only one land base and there is no free lunch.

58. Charlie Price art

Forestry for multiple-values and multiple-uses has come a long way on the path toward biodiversity in recent years. But we also have a long way to go. The journey is sure to be challenging, difficult, and not without a few deadends.

59. Biodiversity art
with words

But it is a worthwhile journey. The future richness and productivity of life on Earth depends on our taking this journey.

60. Hunters on path

And the future quality of life for all life depends on us sustaining earth's greatest miracle: its web of life.