Assessing Impacts of Environmental Changes on Biological Diversity of Forest Ecosystems: An Introduction to Project PC-71-30

Valin G. Marshall

Forestry Canada, Pacific Forestry Centre
Victoria, B.C.

The sustainability and use of forest resources depend on the continuation of essential ecological processes. These processes, affecting carbon, nutrient, and hydrologic cycles, are biological in nature and result from activities of the entire complement of forest organisms. Among the most important of these organisms are invertebrates and microorganisms inhabiting the soil and soil surface. The many thousands of named and unnamed species perform a vital role in decomposing litter, by transforming dead organic matter into a complex web of new substances and foodchains that characterize much of the edaphic environment. They are essential to the productivity, high level of biodiversity, and homeostasis of undisturbed forests (Marshall 1993). Little is known about these decomposer organisms or about the "non-crop" flora, how they interact, and how they influence the healthy functioning of forest ecosystems.

In addition to its value in contributing to ecosystem productivity and stability, Burton *et al.* (1992) listed four other reasons for promoting biodiversity: (1) to maintain non-timber values, notably the securing of furs, foods, and pharmaceutical products; (2) to enable the use of indicator species in monitoring and predicting ecological changes; (3) to retain alternative resources for future use as insurance against economic and climatic changes; and (4) to support aesthetic and ethical considerations. Foresters and other land managers should therefore recognize all these biological assets and learn how to manage them.

An essential prerequisite to proper forest management is an inventory of all biological components. This is currently difficult because of the large number of species expected to be present in forest ecosystems. Estimates for all living organisms in the world range from 5 to 80 million species. A rough estimate for British Columbia forests suggests over 55 000 species of living organisms (Table 1). The Very Dry Maritime portion of the Coastal Western Hemlock biogeoclimatic zone, where Douglas-fir predominates, likely includes tens of thousands of these species. Among mycorrhizal fungi alone, Trappe (1977) estimated that over 2000 species are potential associates of Douglas-fir. Since it is impossible to measure all biodiversity in an area, we have started with a catalogue of relevant and interesting groups whose taxonomy is well known or for which expertise is available. Table 1 also shows areas where our knowledge is deficient, for example, those of bacteria, fungi, and vertebrates. Future research could be concentrated on these groups.

In this project, we investigate how impacts from the conversion of old-growth to second-growth forests are manifest in organisms supporting the forest ecosystem. Our focus is on invertebrates and microorganisms inhabiting the soil. We shall expand the often limited taxonomic base, particularly among lesser known groups that are highly significant in self-perpetuating ecosystems. In addition, we shall extend our investigations to plant species, in particular bryophytes and other "non-economic" plants, that influence the microenvironments of the forest. We shall also investigate a number of vertebrate groups that are immediately linked to the invertebrate fauna by foodchains, notably salamanders and birds. It is at this last level, which features more conspicuous species, that public concerns over biodiversity are commonly expressed. However, the sustaining processes that affect carbon and nutrient pools (such as decomposition) occur at the more cryptic levels where much of this project is focused.

Our strategies include the following:

- to establish a taxonomic and ecological basis for evaluating effects of anthropogenic activities on soil biota in chronosequences in the Very Dry Maritime portion of the Coastal Western Hemlock (CWH) zone;
- to improve institutional and technical arrangements for incorporating biodiversity into management objectives; and
- to contribute to the training of young scientists in the area of biodiversity at both the undergraduate and graduate level.

TABLE 1. Major groups of organisms expected in forest ecosystems

Category	Status[a]	Estimated species	
		B.C. forests[b]	World[c]
Kingdom Monera	-	[2 100]	30 000
Kingdom Fungi		13 000	1 500 000
Mycorrhizae	+	?	?
Kingdom Plantae			
Algae	-	[4 200]	60 000
Multicellular	+	10 000	250 000*
Kingdom Animalia			
Protozoa	-	250	100 000
Rotifera	-	50	?
Nematoda	+	500	1 000 000
Tardigrada	-	80	?
Arthropoda			
Acari	+	4 000	1 000 000
Collembola	+	200	?
Insecta		20 000	1 000 000
Carabidae	+	?	?
Mollusca			50 000*
Gastropoda	+	100	?
Annelida	+	125	12 000*
Chordata			
Amphibia	+	20	4 200
Aves	+	450	9 100
Total		> 55 075	

[a] + = Ongoing studies in Project PC-71-30; - = No studies.
[b] [ ] = 0.7% ratio based on land area.
[c] For world estimates, data modified from Wilson (1988) and Hawksworth and Mound (1991).
* = Already described species, total estimates not known.

References

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