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# Variable retention harvesting: conceptual analysis according to different environmental ethics and forest valuation



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## Abstract

**Background:** Conceptual clarity is important to attain precise communication of scientific knowledge and to implement appropriate technological and policy actions. Many concepts referring to forest management are widely used by decision-makers, regardless of their complexity. Although the scientific and methodological issues of forestry practices are frequently discussed in the literature, their normative dimensions are rarely treated. Thus, linguistic uncertainty increases when different environmentally ethical perspectives and ways of valuing forests are considered. The objective was to compare different conceptualizations on the silvicultural systems suggested for forest management and the implications they have for conservation. We have conceptually contrasted high-intensity forestry practices with variable retention harvesting, considering different environmentally ethical perspectives and forest valuation alternatives.

**Results:** Clear boundaries between clear-cutting, selective logging, and variable retention harvesting can be evidenced when different ethical points of view and alternatives in the human-nature relationships are considered. We have found a variety of definitions of variable retention harvesting that can be analyzed under different ethical positions. Sharply contrasting views on variable retention harvesting can be evidenced if nature is considered to be purely at human's service or if it is conceptualized as humans co-inhabiting with nature. The latter position implies that the maintenance of ecological, evolutionary, and historical processes supported by unmanaged forest stands is a crucial step for forest management proposals based on variable retention harvesting.

**Conclusions:** Forestry practices that are focused on forest yields and that misinterpret functional uncertainty of forest functioning would be risky. Moreover, forestry with variable retention harvesting could imply good yields with reasonable conservation management in some contexts, while it could be unacceptable in other socio-ecological contexts. The improvement of conceptual clarity on the different meanings of variable retention harvesting and the development of indicators for forest management based on the variations of this concept can reduce controversies.

**Keywords:** Environmental ethical perspectives, Consequentialism, Deontological ethics, Virtue ethics, Policy options for forest and biocultural conservation

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## Background

We have acknowledged that the sustainable forest management (SFM) concept has different meanings (Gamborg & Larsen, 2003; Shifley, 2006; Batavia & Nelson, 2016); however, herein, we follow the ideas put forward by Foster et al. (2010), who said that it fundamentally involves those practices that imply perpetuating ecological, economic, and social forest assets, so as to secure livelihood for present and future generations. In general, this concept assumes that those practices related to ecologically SFM will not lead to the decline of forest species or to the alteration of ecological processes (Lindenmayer, 2007; Lindenmayer et al., 2012). Nevertheless, the recovering of biodiversity after forestry harvesting is poorly understood because most efforts have been focused on practices that ensure the regeneration of commercial tree species rather than on practices that maintain the ecological functionality of the original forest (Gustafsson et al., 2012; Lindenmayer et al., 2012; Baker et al., 2013; Soler et al., 2015, 2016).

Among the suggested practices for SFM, variable retention harvesting (VRH) is the most used in many regions of the world (e.g., Lindenmayer et al., 2012; Gustafsson et al., 2012; Soler et al., 2015, 2016). SFM has gained popularity mainly because of the conservation and environmental problems that high-impact forestry practices cause, such as clear-cuttings (e.g., Lindenmayer & Franklin, 2002). Specifically, VRH maintains the structural and functional complexity of the forest since it is more consistent with natural disturbances in harvested areas (e.g., Franklin et al., 1997) by retaining structural elements (standing trees, dead wood, understory vegetation patches, and associated fauna) which may generate successional mosaics in the landscape (Lindenmayer et al., 2012; Lindenmayer, Blair, & McBurney, 2019). VRH is thought as a practice that should ideally follow the habitat requirements of the local biota and the natural disturbance regime of the forested landscape (Lindenmayer & Franklin, 2002; Gustafsson et al., 2012; Johnson et al., 2014; Soler et al., 2015, 2016).

The complexity of the VRH concept is reflected in the cumulative number of published papers during the last decade as compared to different practices of forest management. In Lindenmayer's (2007) view, VRH encompasses a broad continuum of flexible silvicultural prescriptions and provides opportunities for adapting and applying the best approach to different forest stands. Gustafsson et al. (2012) have summarized the variations in the retention levels in boreal and temperate regions in relation to land tenure, including information on size of the cutting areas and on size and proportion of managed and unmanaged lands with the retention approach.

In general, the arrangement of the retained habitat under silvicultural practices promoting SFM seems to be

crucial for ecosystem functioning and for maintaining the majority of taxonomic groups. Nevertheless, the functionality of the system in the long-term under VRH implies a complex ecological knowledge that is usually not available, and thus, the goals of SFM may not be guaranteed. In consequence, many circumstances have opened the debates on which practices make the best option under the umbrella concept of VRH for SFM. The reasons behind those debates are, for example, because of (i) controversial results for VRH and for those experimental trials combining VRH with other forestry practices; (ii) different conceptualizations and perceptions according to variations within practices referring to VRH; or (iii) the knowledge lacuna on the forest functionality in large timescales after VRH (Foster et al., 2010; Ribe, Ford, & Williams, 2013; Baker et al., 2013, 2015; Johnson et al., 2014; Messier et al., 2015; Batavia & Nelson, 2016; Pinzon et al., 2016).

Human societies make a profuse use of concepts to such an extent that these concepts have become ubiquitous in the speech of different social actors and decision-makers, independently of their complexity to be understood in the way they should be. When analyzing a particular concept, an important issue is to recognize the foundations of the research area (e.g., timber forestry) in the philosophy of science because human-nature relationships differ among environmental ethics which can be used simultaneously. Further, it should be acknowledged that practices involve values and, beyond a particular conceptualization, there is a hierarchy of values reflecting the perspectives of some social actors and decision-makers (Poole et al., 2013). Which values are highlighted and which ones are obscured with different conceptualizations is an important theme to analyze from the ethical point of view. For example, concepts and definitions about forests and forest practices exert an influence over how we assess and interpret the forest management (Batavia & Nelson, 2016; Chazdon et al., 2016). In consequence, societies would have different dominant interests when they promote clear-cutting and the incomes of provisioning some forest services or when they promote VRH with a more balanced relationship between the incomes of provisioning services and the other ecosystem services linked to biodiversity conservation.

Different social groups are involved, directly or indirectly, in decisions about policies that regulate the ecosystem management. These groups neither necessarily share the same values, worldviews, and objectives, nor equally understand the diversity of forestry practices and their effects on the sustainability of complex socio-ecological systems (Batavia & Nelson, 2016). The possibility of disentangling the diversity of worldviews beyond

the use of some concepts, as VRH, would be a contribution to improve the selection of contextualized ecological practices. The concepts encapsulate the ways in which human societies think about the functioning of nature and also the power relationships between social actors, including the differences among epistemological and ethical views. These points are not considered in detail in this paper, but we want to provide some reflections contrasting different environmental ethics beyond some widely used conceptualizations in forestry science. Here, we compare conceptualizations of silvicultural practices considering both different forest valuation approaches and ethical perspectives beyond those practices. We have expanded on the ideas of a recent review on ecological forestry (Batavia & Nelson, 2016) through the analysis of ethical perspectives and the variations of the VRH concept. Specifically, we have conceptually contrasted forestry practices considering three different environmentally ethical perspectives and forest valuation alternatives.

## Methods

We have reviewed the literature looking for definitions of (i) different practices of forest management and (ii) variations in the conceptualization of VRH. In order to obtain different definitions from the literature analysis, we have conducted a search for papers using the Google Scholar database (up to August 2019; we have used Google Scholar because this database includes gray literature). First, we used this keywords' combination: "forestry practices" OR "variable retention harvesting" OR "retention forestry" OR "retention cutting" AND "biodiversity" AND "ethic\*" AND "mean\*" OR "signif\*"

OR "defin\*". These keywords matched 765 references. We carefully read through the most cited 200 articles to select papers whose focus was forest management and/or retention harvesting. A second searching round was performed with the same keywords' combination but narrowing it down to a recent period of publication (2014 up to August 2019). These keywords and specific period of publication matched 166 references. We read through all these references. Then, we have selected some of these references obtained from the two searching processes to show variations in the conceptualization of the forestry practices. Moreover, some of the selected examples for VRH were then compared taking into account different forest valuation approaches and ethical perspectives beyond the variations in the definition of the concept.

## Results

In Table 1, we present different environmentally ethical perspectives with a brief definition and examples relating these views to different forestry aims. Clear boundaries between clear-cutting, selective logging, and variable retention harvesting can be evidenced when different ethical points of view and alternatives in the human-nature relationships are considered. Clear-cutting fits well under consequentialism, with a utilitarian market-biased point of view (i.e., the ends are the maximum crop of forest products; Table 1). For clear-cutting, nature is at human's service and, consequently, humans cannot see themselves as part of nature. Selective logging can be placed under deontological ethics because the harvested timber is important as well as forest conservation. In this practice, humans interact with nature to obtain benefits

**Table 1** Environmental ethical perspectives, definitions, and examples with different forestry practices

Ethical positions	Brief definition	Examples with forestry practices
Consequentialism	Consequentialism is a family of theories that are united by one central idea: rightness is based on the consequences of an act and not on the act by itself (Shafer-Landau, 2013; Brennan & Lo, 2016).	Forests practices are developed according to their direct instrumental value to markets (e.g., products, as timber, obtained from the ecosystem that have exchange value and can be sale in markets).
Deontological ethics	In contrast, deontological ethical theories maintain that an action is right or wrong regardless of whether its consequences are good or bad (Shafer-Landau, 2013; Brennan & Lo, 2016). Goodness or rightness is determined by examining acts, independently of the consequences.	Forest practices are developed considering not only the extraction of products but also the functionality and conservation of the forests. These practices expect to guarantee the forest uses (e.g., economical, recreational) under sustainable principles.
Virtue ethics	The theoretical focus is not so much on what kinds of things are good/bad or on what makes an action right/wrong. Indeed, the richness of the language of virtues is cited as a reason for exploring a virtue-based approach to the complex and always-changing questions of sustainability and environmental care (Brennan & Lo, 2016). Virtue ethics resist any effort to identify just a single model of the good and virtuous life, rejecting the idea that there is just a single ultimate ethical principle that is applicable to all people, in all situations. This combination of views entails that there is no single picture of a virtuous life, but rather a variety of equally tenable pictures (Shafer-Landau, 2013). Virtue denotes doing the right thing, in the right way, at the right time, for the right reason.	Forest practices are developed considering forests as providers of common goods for all co-inhabitants (including humans) of the ecosystem. Every living co-inhabitant of the ecosystems is relevant and should be preserved (independently if it has exchange value or not) because it is involved in ecological processes.

but they also consider their impacts on the current and future human generations (Table 1).

We have selected a variety of definitions of VHR that could be analyzed under different perspectives, with an evolution in the elaborateness of the concept (Table 2). The VRH concept includes variations in methods and aims according to the (i) level of retention of structural components, (ii) locations around the world, (iii) time-scales of the retained components, (iv) inclusion (or not) of a proportion of dead wood, (v) age of the retained trees, and (vi) a combination (or not) of this practice

and fire (Table 2). There is a huge difference between seeing humans interacting with nature or nature serving human needs since beyond those ethical positions, arise different perspectives for the forestry practices, mainly in the long-term perspective.

The analysis of forestry practices through different ethical points of view can also help to clarify variations in the practices because they are value-laden. In consequence, variations in the VRH practices fit well with different positions in both environmental ethics and human-nature relationships (Table 2). Sharply

**Table 2** Summary of the valuation modes beyond some conceptualizations for variable retention harvesting (VRH). Some examples of different definitions are included (see references)

VRH	Definition	Nature conceptualizations	Human-nature relationships	Predominant ethical view (how humans value nature)
(i) VRH focused on clear-cutting	VRH is still controversial, at least in certain social circles where it is perceived as just sloppy clear-cuts (Nelson et al., 2017).	Nature is at humans' service, because here VRH is conceptualized as providing products for market.	Humans are separated from nature.	Consequentialism (market biased). Ends: the maximum crop of forest products.
(ii) VRH with dispersed and/or aggregated retention	VRH is an approach to harvesting based on the retention of structural elements or biological legacies from the harvested stand for integration into the new stand to achieve various ecological objectives (Helms, 1998). Sustainable forestry sustaining ecological, economic, and/or social capital (Foster et al., 2010). VRH should include dead wood (Kruys et al., 2013) or should be combined with prescript fires (Heikkala et al., 2016). VRH approach to forest harvest combines different spatial distributions of structural retention to meet the objectives of forest managers. For example, dispersed retention (scattered trees) and aggregate retention (patches of continuous original forest) are two contrasting spatial models often applied together to gain the ecological benefits of both approaches (Soler et al., 2015, Soler et al., 2016).	Nature brings direct and indirect benefits to humans because it provides goods and benefits (including esthetic and cultural values) for the current and future human generations.	Humans interact with nature to obtain benefits.	Deontological ethics. Ends: forest products and biodiversity conservation.
(iii) VRH and the ecosystem functionality	We define retention forestry as an approach to forest management based on the long-term retention of structures and organisms, such as live and dead trees and small areas of intact forest, at the time of harvest. The aim is to achieve a level of continuity in forest structure, composition, and complexity that promotes biodiversity and sustains ecological functions at different spatial scales (Gustafsson et al., 2012). Management practices, such as aggregated retention and other forms of VRH, which increase the proportion of harvested area under forest influence, may provide a mechanism to promote the recolonization of mature-forest species (Baker et al., 2014), and where monitoring of VRH should include different taxonomic groups (Baker et al., 2015).	Humans share nature with the other co-inhabitants.	Relational system of interdependency between nature and people.	Ethics of virtue (eco-centric, eco-social, bio-cultural). Common goods for all ecosystem co-inhabitants (including humans).

contrasting views on VRH can be evidenced if nature is considered to be purely at human's service or if it is conceptualized as humans co-inhabiting with nature (Table 2). The most frequent definition of VRH was the second one (VRH with dispersed and/or aggregated retention forest stands; Table 2). Although we have cited only some examples of the reviewed literature, the least frequent conceptualization was the one that perceives VRH as just sloppy clear-cuts (Nelson et al., 2017; Table 2). Nevertheless, there is a continuum in the literature between these two extremes that we have synthesized in Table 2 according to how humans value nature within these three ethical points of view.

## Discussion

The different practices conceptualized in the framework of the VRH are surely better in terms of biodiversity conservation than industrial logging, because VRH tries to promote the ecological functionality of the original forests when logging commercial tree species (e.g., Lindenmayer & Franklin, 2002; Gustafsson et al., 2012; Lindenmayer et al., 2012; Baker et al., 2013; Johnson et al., 2014; Soler et al., 2015, 2016). A meta-analysis comparing selective harvesting with VRH found that the latter was more effective in conserving biodiversity possibly because it can preserve species richness at the stand level equivalent to figures of primary unmanaged forests (Mori & Kitagawa, 2014). Nevertheless, Baker et al. (2013) have synthesized the available information showing that forest influences most biodiversity groups into harvested areas at short distances (less than 100 m) and calling our attention that most studies were carried out during the first few years after logging. Moreover, although VRH practices are related to the connectivity theory in the management of natural landscapes, the ecological responses of most of the biodiversity groups following harvesting remain unknown (Paillet et al., 2010; Gustafsson et al., 2012; Lindenmayer et al., 2012, 2019; Baker et al., 2013; Soler et al., 2015, 2016). Apart from this, Soler et al. (2015, 2016) have shown the positive effects of VRH practices (aggregated and dispersed) over different structures and ecosystem functions, including biodiversity components (e.g., native and alien species) in the short- and medium-term (first 12 years after harvesting). Gustafsson et al. (2012) mentioned that VRF could be a concept with great variation in application, which implies differences in the management objectives, in forest types, and in the social and policy contexts. Nevertheless, they highlighted that this practice should include the basic requirement of "the provision for continuity in structural, functional, and compositional elements from the pre-harvest to the post-harvest forest." This requirement excludes some of the definitions of VRH that we have included in Table 2.

Decision-making includes values, desires, beliefs, and perspectives of different social actors with emerging conflicts when discussing forestry practices. The cultural context for the free-market has simplified biodiversity (including forests) as natural resources (e.g., objects as wood) with exchange value (usually monetizing nature). Under this view encouraged by the rhetoric of modernization and economic growth, the market controls the appropriation of nature (e.g., determining the enclosure of this specific view) and marginalizes most people through the dispossession of territories, ecosystems, and biodiversity (Harvey, 2003; Rozzi, 2013). Nevertheless, forestry seems to be not value-laden and neutral under the market-biased view because it frames a society-nature relationship associated with a cognitive shift in seeing wood as necessary, exchangeable, and with economic value, naturalizing its commodification. This consequentialism view supports practices with social and environmental negative consequences, with uneven distribution of nature's costs and benefits to people (Scales, 2014). In consequence, the cultural notion that nature is at human's service is widespread and imposed by those particular dominant agents which do not contribute to eco-social justice through the conservation of biological and cultural diversity (Rozzi, 2013). On the contrary and when the ethical view conceptualizes that humans are co-inhabiting nature, people actions are based on biodiversity inherent values on the respect for the environment and all other living beings. Co-inhabitants are valued as subjects (not objects) when policies are developed for ecosystem sustainability and in respectful forms of co-inhabitation with socio-environmental justice (Rozzi et al., 2013).

Summarizing, it would be important to acknowledge the fact that social actors and stakeholders can hold two or more understandings of the VRH concept (e.g., mostly when they are placed under different environmentally ethical perspectives). Controversy, among the conceptualizations of VRH, implies there are some variations regarding not only the methodological approaches for forestry practices, but also in the values and criteria associated with planning tools and policy instruments to measure yields, stands, conserve biodiversity, and improve benefits to nature and people. Moreover, variations in the forestry practices within the VRH concept suggest discrepancies between human-nature relationships, mainly because they are rooted in different ethical views. Pickett (2013) denoted that the use of complex concepts requires acknowledging the technical models and data they employ, together with the connection to the specific values beyond them. We adopt this perspective, considering that philosophical and ethical literacy allows recognition of the different meanings of a concept and that it may improve communication to propose

solutions when discussing environmental appreciations, methods, and decision-making in forestry science. Under the virtue ethical approach, policy and decision-making should include a discussion of the associated values to different forestry practices. In particular, this ethical view highlights that environmental changes and ecosystem degradation are caused by some actions of particular agents (e.g., global corporations, particular social groups, or the implementation in some countries) and not by humans as a species (Rozzi et al., 2013). It is necessary to acknowledge that forests and forestry practices are facing unprecedented biological, political, social, and climatic challenges since they involve complex social-environmental systems which are constantly changing (Messier et al., 2015).

## Conclusions

The important question would be how we can determine good practices within the VRH umbrella concept, assuring both timber yields and forest conservation in the long term. A starting point could be the agreement on the improvement of some indicators monitoring ecological processes in natural forest ecosystems when applying VRH practices to guarantee biodiversity conservation. For example, in the research area of forest fragmentation and habitat loss, an interesting framework has been proposed. This approach combines fragment size and isolation (which could be the configuration of the retained forest area) into a unique indicator to represent the habitat amount in a local landscape, defined as a buffer area surrounding a sampling site (e.g., Jackson & Fahrig, 2012; Fahrig, 2013; Miguet et al., 2016). This view is based on the assumption that the relationship between biological responses of a given group of organisms (e.g., timber tree species, but also birds, mammals, and insects), and the surrounding environmental variables depends on the spatial scale at which these variables are measured, because of the fact that the scale of the effects will be variable according to the different groups of organisms in the community. Under this perspective, the main challenge is to produce the socio-ecological knowledge necessary to define VRH aligned with the goals of SFM, which can be understood as those practices that imply perpetuating ecological, economic, and social forest assets in order to secure livelihood for present and future generations (Foster et al., 2010). In consequence, different criteria for VRH could imply good yields with reasonable conservation management in some contexts, while it could be unacceptable in terms of yields or conservation status for other socio-ecological contexts. As Batavia and Nelson (2016) pointed out, developing a normative framework for these kinds of forestry practices will be challenging and complex. The improvement of conceptual clarity on the different meanings of VRH

and the development of indicators for forest management based on the variations of this concept can reduce controversies.

## Abbreviations

SFM: Sustainable forest management; VRH: Variable retention harvesting

## Acknowledgements

We thank three anonymous reviewers for the constructive comments and suggestions that improved previous versions of the MS, Julia Galletto for English professional editing, and the encouragement of many colleagues to write this paper for this special volume.

## Authors' contributions

All the authors collaborate in equal participation to write the manuscript. All authors read and approved the final manuscript.

## Authors' information

No additional information.

## Funding

We thank CONICET (11220120100055CO), SECyT (UNC; 411/18), and FONCYT (PICT 2015–0538) for the financial support.

## Availability of data and materials

None.

## Ethics approval and consent to participate

No ethics or conflict of interest exists.

## Consent for publication

The authors consent to publish the data included in this draft.

## Competing interests

The authors declare that they have no competing interests.

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Received: 17 July 2019 Accepted: 20 September 2019

Published online: 16 October 2019

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