Beware paradigm creep and buzzword mutation

by Andrew Park

ABSTRACT
The world of forest management is awash in buzzwords and acronyms—ecosystem-based management, adaptive management, Triad, emulation of natural disturbance (END), and latterly—resilience. Resilience is the concept du jour, and is increasingly employed as a catch-all term for a variety of management goals. There is peril in making excessive use of buzzwords as stand-ins for the complex goals that are the real target of forest management. In this paper, I explore the consequences of buzzword mutation, which leads to paradigm creep—the use of buzzwords far beyond their original sphere of application. Such inappropriate use threatens to dilute the meaning of the original metaphor and makes talking clearly about the legitimate targets of forest management more difficult. I use "sustainable development" as an exemplar of a buzzword that has mutated into uselessness. I then compare the descent of sustainable development with current trends in the use of "resilience", and offer some guidelines for rescuing this term from a similar fate.

Key words: resilience, multiple definitions stability concepts, sustainable development, buzzword, paradigm

Introduction
In the '60s ballad Me and Bobby McGee, Janice Joplin looks at freedom in a way that transcends most dictionary definitions. Nevertheless, her poetic interpretation of "freedom" stretches its legitimate definition in a new and creative direction. We can easily imagine that losing everything would give us a liberty of movement and action that the chains of property and relationships forbid.

Humpty Dumpty, on the other hand, has shaken off the chains of dictionary definitions altogether. If a word can mean anything you like, then the chances are that it will end up meaning nothing at all, as Alice intuitively understands. There is a fine line between Joplin's poetry, which created a new and potentially useful definition, and the sort of loose, Humpty Dumpty use of words that renders them meaningless. In an age of proliferating white papers, multiplying government initiatives, incessant academic research, and competing interest groups, this line is all too easily crossed.

These thoughts came to mind at the inaugural meeting of the Canadian Institute of Forestry (CIF) Forest Ecology Working Group in Jasper, Alberta. The theme was "Forest Ecosystem Resilience", and our proceedings emphasized the application of the resilience concept to forest ecosystem management. Keynote speaker Daniel Kneeshaw asked "What is resilience in forestry?—is the term another dead end or can it be applied across scales?" (Kneeshaw 2010). As our meeting proceeded, Kneeshaw's first question—what is resilience—
remained more or less unanswered. Resilience turned out to be a slippery concept when it came to applying it to real situations. Its interpretation was also complicated by the multiple mental filters of the workshop participants. By the end of the workshop I felt that: i) we were using the concept loosely and without precise definition, and ii) we had no common vision of how resilience could be effectively applied to complex management problems. I began to suspect that the answer to Kneeshaw’s second question was “yes”; resilience may, sadly, have become a dead end, a potentially useful ecological concept that must be consigned to the museum of failed paradigms. Unless, that is, its definition can be clarified and constraints on its application recognized.

There are two foundational definitions of resilience. The first concentrates on the ability of an ecosystem to remain close to equilibrium, and is characterized by properties such as its resistance to disturbance and the speed with which it returns to the equilibrium point. This is the famous ball-in-a-cup model, in which the ball can be dislodged from rest, but always returns to the lowest point of the cup (Holling and Gunderson 2002) (Fig. 1a). It is often characterized as an engineering definition of equilibrium, because it resembles homeostatic processes like a thermostat oscillating about a set point or a bridge whose structure can shift within certain strain limits.

But ecosystems are complex, and may have multiple basins of attraction. Depending on the internal and external forces “pushing” an ecosystem in different directions, it may develop along divergent, unpredictable trajectories (reviewed in Pender et al. 2007) (Fig. 1b). At critical points—the peaks between basins of attraction—large and essentially irreversible changes in the ecosystem may be induced by relatively small disturbances. This is often referred to as “path dependency”. For Holling and Gunderson (2002) these properties imply that “ecosystem resilience” is equivalent to buffering capacity—or the magnitude of disturbance that can be absorbed before an ecosystem makes the transition to some alternate state.

Although these original definitions of resilience are not mutually exclusive, they are burdened with very different management interpretations. Engineering resilience implies an ability to control management outcomes that is largely absent from ecosystem resilience, where path dependence and variability limit our ability to control management outcomes (Gunderson and Holling 2002: 28).

Over time, numerous elaborations of the foundational definitions have been tacked onto the originals. These differ widely in their conceptions of ecosystem stability versus the ability of ecosystems to absorb change, in the importance they attach to species composition versus general ecosystem properties (e.g., Drever et al. 2006, Bodin and Wiman 2007, Campbell et al. 2009), and in their views of successional dynamics (Kimmins 2010). The overall effect has been to subject resilience to a process of cultural mutation as it passes through the minds of different thinkers and practitioners. “Resilience” has become a buzzword claimed by many disciplines and interest groups.

Resilience is not alone in being co-opted by practitioners with different world views (Hansén 2009). A general process of mutation leading to “paradigm creep” potentially afflicts any well-meaned management concept that gets simplified into a buzzword. In this article, I outline a conceptual model of the mutation process. I hope to convince you that we need to arrest paradigm creep and buzzword mutation (PCBM), both to conserve practical meanings for resource management concepts, and to prevent legitimate debates from deteriorating into unproductive arguments about semantics. I illustrate

![Fig. 1](image-url) (a) Engineering resilience conceived as a homeostatic ball and cup model. The analogy is the strain limit of a bridge structure with no alternative state but collapse after resilience limits have been breached. (b) Ecological resilience, conceived as a transition zone between stable states (F1 and F2). At either end of the transition curve drawn on the inclined plane, the system will be stable and elastic. Approaching the bifurcation point, however, recovery slows down, elasticity decreases (high autocorrelation) and the amplitude of a system’s response to disturbance increases (flicker noise) (Scheffer et al. 2009).
PCBM using the well-studied example of “sustainable development”; an older paradigm that has undergone a veritable Cambrian Explosion of mutation (Pezzey 1992), which rendered it close to useless as a guiding philosophy of development. I will then return to resilience to ask if it can be rescued from a similar fate, and whether it is a concept that can contribute to better forest management.

A Model of PCBM
Paradigms are ways of seeing the world that can be meaningful responses to real challenges or problems. Like resilience, “sustainability” or “sustainable development” began life as a split personality pressed into the service of potentially competing paradigms. An early definition from the International Union for the Conservation of Nature (IUCN) defined sustainability as sustainable utilization: “a simple idea: we should utilize species and ecosystems at levels and in ways that allow them to go on renewing themselves for all practical purposes indefinitely” (Allen 1980; in Pezzey 1992). An alternative, economically based definition paints sustainable development as “development that is likely to achieve lasting satisfaction of human needs and improvement of the quality of human life”.

These definitions began a process of divergent evolution almost immediately. By 1987, sustainable development had morphed into an imperative for quantitative economic growth. It was “directly concerned with increasing the material standard of living of the poor at the ‘grassroots’ level, ... quantitatively measured in terms of increased food, real income, educational services, health-care, sanitation and water supply, emergency stocks of food and cash, etc.” (my emphasis added). By contrast, environmental scientists emphasized maintaining the resource base that underpins all economies. For Goodland and Ledec (1987; in Pezzey 1992), “sustainable development implies using renewable natural resources in a manner which does not eliminate or degrade them, or otherwise diminish their usefulness for future generations”. To the economist Robert Solow, placing such a burden on the future seemed unreasonable, and he called upon innovation and investment to create future consumption opportunities to compensate for the depletion of current resources (Solow 1974).

Of course, some resources are inherently non-renewable, and will be depleted no matter how efficiently they are used. The general idea of sustainability therefore split into weak sustainability (making the most efficient use of non-renewables) and strong sustainability, which can only ever apply to organic renewable resources (Pearce and Barbier 2001).

I attempt to chart this PCBM as a general process in Fig. 2. As previously stated, we start with challenges—in this case unsustainable resource use and poverty. The problem stimulates a response from the policy community or academics, who look for pathways or techniques to put some practical flesh on the original, abstract visions. So far so good. The next stage, though, sees the original meaning of sustainability co-opted by different interest groups. They force the concept to go through an analogue to speciation, which produces some hopeful monsters but a lot of misleading dead ends. Sometimes, these new “species” evolve into new “families”, as when the idea of sustainable growth mutated into “climate-friendly growth” (de Boer 2008). “Backcrosses” to prior concepts also occur. These produce such extravagant hybrids as Tolba’s (1987) statement that “economic development and environmental quality are interdependent and, in the long term, mutually reinforcing. The rational management of the world’s threatened natural resource base forestalls a loss in environmental quality and enhances sustainable economic growth”. This mash-up of conflicting assertions begs for clarification and demands evidence for such decisive premises. But the needed clarifications and evidence are rarely provided. “Rational management” is undefined. There is little evidence for the assertion that economic growth and environmental quality are mutually reinforcing. “Forestalls” is a weasel word that implies the existence of an escape clause, which would somehow allow sustainable development to coexist with environmental deterioration.

At this point, we might agree with David Victor that “something has gone horribly wrong” (Victor 2006). By the 1990s, “speciation” among sustainability buzzwords had drowned the original concepts in contradictory goals and objectives. For Victor (2006), “Human rights watchdogs, large chemical companies, small island nations, green architects, and nuclear power plant operators have attached themselves to the fashionable notion, only to subvert it for their own ends... Sustainable development, the compass that was designed to show the way to just and viable economics, now swings in all directions.”

Resilience and Forest Management
Like sustainable development, resilience appears to be pre-primed for PCBM. It is an already-familiar term that we apply to many things. A tree is mechanically resilient when it bends in the wind, a person may be resilient in the face of illness or unemployment, or a lake’s biota may be resilient to a certain burden of pollution (Pendall et al. 2007). This susceptibility to generalization has allowed the engineering and ecological definitions of resilience to be muddied by attempts to accrete further layers of meaning on top of the original concepts. The Resilience Alliance WEB site defines ecosystem resilience as “the capacity of an ecosystem to tolerate disturbance without collapsing into a qualitatively different state... controlled by a different set of processes”. This definition is further qualified by three postulated qualities: (1) The amount of change the system can undergo and still retain the same controls on function and structure, (2) The degree to which the system is capable of self-organization, and (3) The ability of the system to build and increase the capacity for learning and adaptation.2

These revisions do not adequately distinguish engineering from ecosystem resilience. Instead, they appear to produce a hybrid of the two (Fig. 3). The three qualifying conditions invite further questions. How do we recognize and delimit “qualitatively different states?” What is meant by “the same controls over structure and function?” What controls are we talking about, and how does an ecosystem “learn” and “adapt?” Finally, are not all ecosystems, whatever their state, “self-organizing?” Thus, the basins of attraction in Fig. 1b represent the set of possible states that can be generated by self-organizing communities (Drake et al. 1999).

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2http://www.resalliance.org/index.php/resilience
The terminological confusion can be illustrated with some examples of path dependency discussed in the Jasper forest ecology workshop. Lodgepole pine forests decimated by the mountain pine beetle (*Dendroctonus ponderosae* Hopk.) may burn and revert to lodgepole pine monocultures, or they may develop into structurally diverse uneven-aged mixed forests of pine, hybrid spruce and fir (Burton et al. 2010). We could interpret this dynamic as a resilient forest entering an alternative basin of attraction. On the other hand, if resilience is interpreted as the ability of a forest to return to its pre-disturbance species composition (Thompson et al. 2009), lodgepole pine-dominated stands may be thought of as resilient to fire, but not to repeated pine beetle infestations. If, however, our metric of resilience is the ability to maintain wood production over longer periods of time, the two forest conditions may actually be similar.

Another example: recent beetle infestation compounded by historic hi-grading may cause Ponderosa pine stands in southern BC to be replaced by grassland or to dense interior Douglas fir (Vye et al. 2010). Ponderosa pine may therefore largely disappear from the landscape, reducing the diversity of forest types that is a core objective of the B.C. Ministry of Forest and Range's Future Forest Ecosystems Initiative (Hopkins 2009). Again, we must ask whether the grassland / forest parkland conditions are different ecosystems altogether or represent alternative states of the same system. Resilience definitions and abstract models (Fig. 1) do not help us to resolve these questions because qualitative differences depend entirely on what we decide to measure. Do we use species composition, primary productivity, genetic diversity, abstract biodiversity indices? And what are the limits we place on the acceptable range of basins of attraction? The answer to such questions depends on the management goals that are chosen for a given forest.

### Tightening Up the Definitions

Resilience itself is part of an explosion of concepts centred on the older idea of ecosystem stability. Grimm and Wissel (1997) identify 163 definitions for 70 stability concepts described by 40 variables. Recognizing enormous redundancy among concepts, these authors reduce them to six ecological qualities: "constancy" (remaining unchanged), "resilience" (return to reference state after disturbance), "resistance" (remaining unchanged despite disturbance), "persistence" (the longevity of an ecosystem condition), "elasticity" (speed of return to a reference state), and the "domain of attraction" (the suite of potential states that are possible for a system). These are united under the general umbrella of sta-
bility properties, which appears as the parent concept of resilience in Fig. 3.

Unfortunately, these separate concepts are constantly threatening to merge. Resilience has been confused with "resistance" or "stability" (e.g., Thompson et al. 2009: 5). Elasticity (speed of return to a reference condition) has been interpreted as resilience. If elasticity is a positive attribute then small disturbances with short recovery times would appear to be favoured over larger and more disruptive ones (e.g., surface versus crown fires). "Trajectory stability", implying succession towards a particular end point—or Clementsian succession, has also been tacked onto the engineering resilience ball-and-cup model (reviewed in Bodin and Wiman 2004). Bodin and Wiman (2007) separate trajectory stability from ecosystem inertia (resistance to disturbance / change), "cyclic stability" (oscillation within the basin of attraction) and elasticity. Of these ideas, cyclic stability and elasticity have clearly been sliced away from Holling and Gunderson’s (2002) original definition of engineering resilience.

Resilience is also conflated with ecosystem complexity (Campbell et al. 2009: 9) and biological diversity (Thompson et al. 2009). But it is far from clear that either complexity or diversity automatically promote resilience. Many Canadian forests exist as natural monocultures of the dominant tree species. Under these conditions, intraspecific genetic diversity, mobile generalist consumers and stand age diversity may promote engineering resilience at the landscape scale. There is little evidence at least for northern forests, that mixed species stands are more productive than monocultures, (assuming we accept productivity as a sign of resilience) (Chen et al. 2003, Paquette and Messier 2009).

Evidence for a relationship between biological diversity and resilience (sensu Holling and Gunderson) is also thin on the ground. Most of the literature in this hotly disputed area refers to the "diversity-stability” debate (Campbell et al. 2009: 5). Furthermore, ecological models (Bodin and Wiman 2004) and laboratory microcosms (Scheffer et al. 2003) have associated increased diversity with chaotic behaviour. This suggests that path dependency in diverse ecosystems may be more sensitive to small disturbances, leading them to be less resilient and stable than “simpler” ecosystems.

The idea of “socio-ecological resilience” has spun off from the realization that resource-dependant communities are profoundly affected by conditions in the ecosystems in which they are embedded. Ecological resilience is promoted as a route to “social and economic sustainability goals” (Campbell et al. 2009: 1). A new buzzword, “community resiliency” has also been coined, and defined, simply, as “adaptability”. In turn, adaptability is “the capacity for humans to change their behaviours, economic relationships, and social institutions
such that economic vitality is maintained and social stresses are minimized” (reviewed in Joseph and Krishnaswamy 2010). In this view, “community resiliency” is redundant to adaptability, implying a community that changes in response to external pressures. An alternative definition has resiliency as “a community’s ability to maintain, renew, or reorganize social system functions and ecological functions—the robustness and buffering capacity of a community in a changing system” (Varghese et al. 2006; in Joseph and Krishnaswamy 2010). The latter definition alludes to buffer capacity, part of the original resilience definition, as a property of a human community, but simultaneously suggests that neither societies nor ecosystems should be expected to rebound to a reference state.

Ideas of ecological and societal resilience come together in the concept of a fire-resilient landscape. Fitzgerald (2004) defines a fire-resilient forest as one “better able to withstand a wildfire and come through it relatively intact or rebound from its effects”. In ponderosa pine forests experiencing catastrophic stand-replacing fires after a century of grazing and fire suppression, the meaning of resilience is fairly clear—restore the open stands and surface fire regimes of yesteryear (Covington 2004). A fire-resilient landscape must be much more than this, however. Managers must calculate the comparative economics of fire-fighting versus fuel reduction and thinning. In extensively settled landscapes they also have to manage the wildland–urban interface (WUI), negotiate property protection, wildlife concerns, balance the maintenance of representative forest types with changes wrought by global warming, and, somehow, arrive at a suite of socially acceptable policies. All this must be done while navigating divergent and changing opinions about forest management (Cloughesy 2004).

The sheer number of different concepts, scales and challenges that have to be considered in creating a fire-resilient landscape transcend any reasonable definition of resilience. Community resiliency is similarly burdened when it is expected to be an umbrella for 15 (Joseph and Krishnaswamy 2010) or 23 (Community Resilience Project Team 1998) social processes. Such collapsing of terms fosters the illusion that fundamentally different processes, some of which may be mutually incompatible, can seamlessly serve a single objective.

**Rescuing Forestry from PCBM**

The term resilience is journeying down a mutation highway similar to the one followed by sustainable development on its descent into meaningless. As a quality of ecosystems, resilience is primed for mutation by being “inherently, somewhat inexact” (Drever et al. 2006), and inexact concepts tend to make poor paradigms. To clarify its definition, we need to ask what it is that is resilient (tree composition, the landscape matrix, primary production, carbon storage?), and to what these attributes are resilient (fire, insects, climate change, forest harvesting, urban sprawl?) (Walker 1998, Drever et al. 2006). We also need to clearly distinguish related ecological ideas (e.g., inertia, persistence, elasticity) that have complicated the original definitions of resilience.

Even with such clarification, is resilience worth saving as a resource management paradigm? To answer this, I suggest that we subject concepts like resilience to a few simple utility tests. First, is the concept wholly or partially redundant to older ideas and philosophies? Second, does the concept clarify (help to define) or obscure (oversimplify) the path to legitimate management goals? And finally, is it seductive, sounding good when you say it while remaining ambiguous and open to multiple interpretations? If the answer to one of these questions is “yes”, then the concept needs clarification; if the answer to all of them is “yes”, then the concept may cause more problems than it solves.

In my opinion, resilience is at least partially redundant to the emulation of natural disturbance (END) management strategy and the coarse filter concept that accompanies it, as well as to ecosystem-based management and adaptive management. Over-reliance on using resilience in forest management discourse may inhibit more direct discussion of specific goals that we have for a particular forest unit (e.g., fire exclusion for property protection, or selection harvesting for local watershed protection). Finally, imprecise resilience concepts are prone to a variety of interpretations, sometimes within the same document. Resilience is not unique in this respect. “Adaptive management” (Bormann and Keister 2004), END (Klenk et al. 2008) and historic range of variability (HRV) (Landres et al. 1999, Millar and Woffenden 1999) are subject to enough conflicting interpretations that resource managers often gain very different impressions of what these terms mean. Such confusion can inhibit the implementation of coherent resource management strategies (Bormann and Keister 2004).

Unfortunately, bureaucracies, governments and civil society organizations are awash in buzzwords that began life as useful leitmotsifs intended to focus attention on particular problems. Over time, excessive use of these catch-all terms short-circuits critical thinking about the actual challenges for which they were supposed to be convenient metaphors (Hansen 2009). When this happens, their value is diminished. Worse, as happened to sustainable development (Victor 2006), overuse can lead to their cynical appropriation by vested interests.

Answers to my utility questions indicate that resilience has advanced some distance down the mutation highway. Nevertheless, it may still be useful as a unifying metaphor for policies to promote socio-ecological landscapes that remain productive in the face of inevitable change. As a metaphor for complex objectives, resilience “resonated” with forest managers faced with complex management problems (Patrick Daigle, B.C. Ministry of Environment, personal communication, 2010). We might therefore distinguish technical definitions of resilience from the “resilience approach”—a general mind-set for addressing complex management problems (Brand and Jax 2007). One could argue that adopting a resilience approach would have produced a very different response to the mountain pine beetle epidemic. Instead of a short-term focus on salvage logging, a more nuanced approach by companies and regulators would recognize the biological legacies of abundant regeneration and mixed stands, acting to conserve these and buffer annual harvests over time (Burton 2010). By moving with the flow of natural disturbance in this way, forestry might become more synchronized with the natural dynamics of the landscape, replacing the brittle policy of maintaining allowable cuts with a more elastic, buffered analog to ecological resilience.
Recent research also supports aspects of the original “basins of attraction” model, and refines it in ways that may be useful for setting management goals. Systems theory supported by autocorrelational models demonstrates that recovery from small disturbances gets slower (i.e., less elastic) as complex systems approach the peak between basins of attraction (Fig. 1b). “Critical slowing down” is accompanied by temporal autocorrelation of system properties and “flicker” behaviour as fluctuations in population, regeneration, fire intensity or other variables get larger in response to small disturbances (Scheffer et al. 2009). If they could be identified—a very large challenge in big, slowly changing systems like forests—such statistical patterns could act as early warning signs of declining ecological resilience.

The search for critical indicators of approaching transitions may assume greater importance as climate change pushes some forests towards undesirable alternative states. In this context, ecological resilience, as originally formulated, may eventually provide a valuable tool to inform management decisions. On the other hand, ecological resilience can be an adjunct, not a substitute for successional theory, which provides a well-established template with clear terminology for measuring and assessing forest ecosystem processes (Hamish Kimmins, professor emeritus, UBC, personal communication, 2010). The “resilience approach” to setting strategic management goals can still act as a guiding metaphor to inform our thinking, provided we acknowledge it is no more than that. It should not be confused with ecological resilience, whose original definitions (left hand side of Fig. 3) are at least testable. Nor should it be extended to woolly notions of “resiliency” in social systems, which have confused and diluted understanding of the original definitions of resilience Brand and Jax (2007) think this very vagueness might promote greater communication across disciplines. I disagree with this view; personal experience suggests that PCBM of resilience metaphors has promoted misunderstanding within and among disciplines.

We should therefore resist the temptation to resort to “resilience-speak” in advance of defining the actual processes and scales that we want to manage. If we talk about natural forest regeneration, species composition, forest succession, stand diversity, primary production, and the spread of the WUI—together with their spatial context, we will achieve greater clarity of communication, and achieve it more rapidly. Only then should we collect these processes under the umbrella of the resilience approach, and acknowledge that our goal is to conserve the ecological resilience (suitably defined) of this or that landscape. For example, if the key ecological property was “fire resilience”, management objectives might aim to “create and maintain managed fire landscapes, in which property values, commercial timber, ecosystem services and the variety of native biogeoclimatic associations are conserved over time”. Wordy? Perhaps; and it certainly does not roll off of the tongue like “resilience”. But at least it avoids the vice of Humpty Dumpty, for whom clarity was the enemy: “They’ve a temper, some of them—particularly verbs: they’re the proudest—adjectives you can do anything with, but not verbs —however, I can manage the whole lot of them! Impenetrability! That’s what I say!”

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