

RESILIENCE & TRANSFORMATION

A REGIONAL APPROACH

Human resilience is the capacity
to effectively influence and adapt
to change.

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INTRODUCTION: A New Operating System

We live in a time of flux. The operating systems that guided human development in the 20th century are failing.

Too many people still struggle for access to food or education. Few societies have been able to organize for broadly shared benefits. Moreover, in our growing demand for nature's services, we weaken our ability to provide for human needs in years to come.

It's time to examine how our current operating systems – the institutions of social, political, and economic relations – leave us vulnerable. Then we can begin to draw a new map for navigating the territory ahead.

While individual maps may differ, a set of core principles for developing 21st-century institutions is common to us all. They are the principles of resilience. Stated simply, human resilience is the capacity to effectively influence and adapt to change. Through a culture of resilience, we cultivate the potential for novelty, institutional innovation, and social transformation.

As our maps should reflect, humans are dependent on natural resources and services for food, water, energy, and other basic needs. In the language of resilience, we exist within linked social-ecological systems – and these relationships matter.

Within social-ecological relationships, the scale of activities matters as well. Globalization fosters greater connectivity and efficiencies, at the expense of redundancy, diversity, and social capital. As a result, our

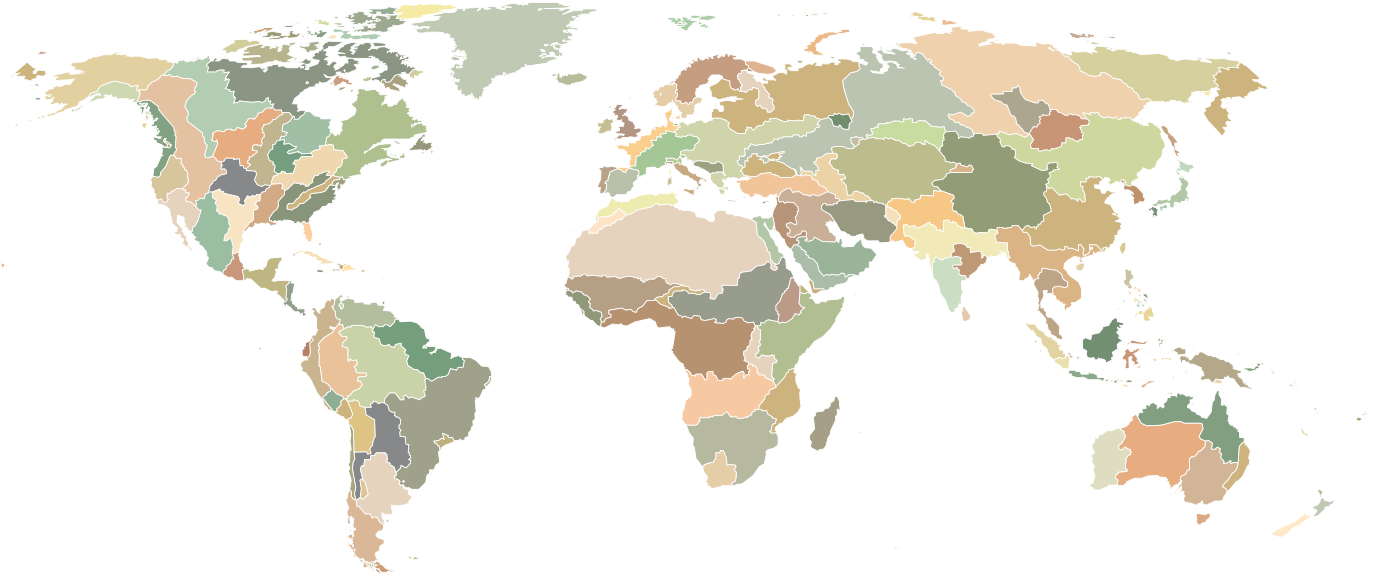
societies are more vulnerable to shocks from natural disasters, resource scarcities, climate change, financial disruptions, disease, infrastructure failures, and social unrest. To counter these vulnerabilities, we look to scales that better approximate the contours of the natural and cultural landscapes in which people live, work, and organize – regional scales, in which societies can more reliably steward nature's services and provide for human wellbeing. Greater diversity and viability of local and regional economies is key to bolstering resilience.

In this publication, we explore a culture of resilience, examine current vulnerabilities in our home region along the West Coast of North America, and present stories of how individuals and organizations are changing the nature of social, political, and economic interactions.

Although our focus is on regional scales, our vision is hardly regionally bounded. National and international regimes are stuck in maladaptive traps: entrenched ways of thinking, acting, and organizing. We believe that the innovation that emerges at local and regional scales can lead to large-scale transformation. We start with resilience at home in order to develop institutions that better support personal, social, and natural wellbeing for everyone.

“Civilization needs a new operating system, you are the programmers, and we need it within a few decades.”

Paul Hawken
University of Portland
Commencement Address, 2009



Resilience Regions

The Resilience Regions map offers a fresh way of looking at the relationships between people and place – a perspective that draws on the complexities of cultural and ecological factors. Lines on the map are fixed by necessity, but a dynamic and more realistic view would reveal smaller, nested, and overlapping scales, from the local and regional on up to the global.

A CULTURE OF RESILIENCE

Today's failures are not isolated, but interconnected. We draw upon the scientific literature on social-ecological resilience and bring a practitioner's perspective in order to develop an understanding of systemic responses to systemic challenges: a culture of resilience.

This culture begins at home, by nurturing the capacities that build resilience and enable transformation. It is a culture that manifests at multiple scales, from the personal to the community and region – on up to the species and planet.

We emphasize a regional approach because human needs for natural resources and services largely rely on regional resilience – and also because, in many places, effective regional institutions are missing or underdeveloped. It is critical that we start a broader conversation about the role of regions.

Our guiding questions:

- How might public and private individuals and organizations around the world cultivate resilience?
- What does transformation look like?
- In what ways are geographic scales significant to resilience and transformation?

“The problems that face us are linked. It's not a set of problems. It's a system of problems. Now it's time to look for a system of solutions.”

Janine Benyus
Nobel Laureate Symposium, 2011

Resilience Principles



Plan for change



Expand opportunities



Develop rich relationships



Design for learning



Consider multiple scales

Resilience in Practice

Human resilience is the capacity to shape and adapt to change. We share with many others the definition of resilience as a capacity – and extend the definition to encompass bundles of personal and social capacities. Public and private individuals and organizations can cultivate these capacities through the application of resilience in practice.

While some of these principles and practices may be culturally specific, we have attempted to universalize our understandings and to describe resilience as a necessary capacity for communities and societies around the world.



Plan for change

Develop capacities for:

- Flexibility
- Awareness of uncertainties
- Functional redundancy

Start by asking:

- When the unexpected happens, will system failures be disastrous or graceful?
- If prices rise or supplies are disrupted, how readily available are alternatives?
- How might institutions, infrastructures, and lifestyles be more flexible and adaptive to change?

Expand opportunities

Develop capacities for:

- Human potential
- Leadership, creativity, and entrepreneurship
- Diversity

Start by asking:

- Are the capacities to meet basic needs accessible to all?
- Are ownership and employment opportunities diverse and accessible?
- How might we foster personal and social wellbeing: senses of autonomy, trust, and purpose?





Develop rich relationships

Develop capacities for:

- Social capital
- Local and regional self-reliance
- Rich feedbacks

Start by asking:

- How might we support the viability of local and regional economies?
- What types of information might be more openly or broadly available?
- How might prices and incentives better support social and natural wellbeing?



Design for learning

Develop capacities for:

- Integration of knowledge and practice
- Social memory and learning
- Continuous institutional innovation

Start by asking:

- In light of failures and uncertainties, how might current knowledge be shared, reevaluated, and recreated?
- Whose voices are critical to the problems being diagnosed and decisions being made?
- How might we abandon ineffective rules and practices, improve others, and actively experiment with new ones?



Consider multiple scales

Develop capacities for:

- Systems thinking
- Foresight
- Compassion

Start by asking:

- How do our current lifestyles affect our individual health and wellbeing?
- How do our current lifestyles affect the environment, other peoples, and future generations?
- How might effective local and regional innovations be scaled up or replicated elsewhere?



The Language of Resilience

The Latin word *resilire* means to leap back or to rebound from a disturbance. We commonly understand resilience as the endurance and fortitude that carry us through challenges. “Think of resilience in terms of the old Timex commercial,” an expert on earthquakes explained in a 2011 *Washington Post* article: “it can take a licking and keep on ticking.”

This commonsense approach to resilience is part of our understanding as well. But it is incomplete. Here are additional ways to think about resilience.

Resilience of what?

Cockroaches, kudzu, and jellyfish are known for their resilience. They can endure environmental stresses and return to repopulate their ecosystems. But humans differ in important respects from other life on earth. With advanced capacities for foresight and self-reflection, we not only respond to change, we intentionally seek to influence it. And so the resilience of individuals and societies relies not only on the capacity for endurance, but also on capacities for intentional adaptation and transformation.

Resilience to what?

A 2011 World Economic Forum survey of global power brokers ranked energy price volatility and climate change among the top global risks. Resilience to these types of environmental stresses is critical for human wellbeing in the 21st century, and social and environmental stresses are tightly linked. In this publication, we examine resilience in systems that provide for essential needs: systems involving food, water, forests, energy, and finance, among others. A more comprehensive look would also examine resilience and wellbeing in systems that provide other vital components of human wellbeing, such as education and health care.

Resilience and vulnerability

A loss of resilience translates into a vulnerability. In ecosystem management, for example, a focus on narrow objectives can undermine resilience and increase vulnerability to environmental stresses. Attempts to optimize fish harvest have led to population crashes, and efforts to optimize production from forest, agricultural, and grazing lands can yield similar results.

The same can happen in supply chains as well. Efforts to optimize food distribution leave many big cities with limited food on hand at any time. They are vulnerable to supply shocks, as evidenced in the aftermaths of Hurricane Katrina in 2005 and the Tōhoku earthquake in 2011. Greater functional diversity and redundancy – many types of distribution channels, supplying food from many types of sources – would increase food system resilience.

Resilience and transformation

As social and environmental threats to human wellbeing mount, it is becoming more evident that business as usual cannot continue. But what *is* business as usual – and why is it so difficult to change?

In the language of resilience, business as usual represents a type of regime – a mutually reinforcing set of factors that create regularities in social-ecological interactions. These factors include value systems (worldviews, ideologies), institutions (social, political, economic), and material artifacts (infrastructures, technologies).

Just as political regimes can become entrenched and resistant to change, dominant regimes that regulate our relationships to people and places – our economic systems, our energy systems, our food systems – develop a kind of inertia that makes them difficult to transform.

By definition, business as usual is the dominant regime, but others are possible. The local food, food sovereignty, and seed-saving movements have each created alternatives to the industrial food regime. The clean energy and climate stabilization movements present alternatives to the fossil fuel energy regime. Alternatives to business as usual are all around us, but they have to surmount numerous formidable obstacles.

It is easy for social-ecological systems, settling in to ruts in a vast landscape of possibilities, to become stuck. We develop psychological and social attachments to dominant ways of thinking and living. The reigning power structures tend to reinforce the institutional rules, practices, and norms that shape and constrain our activities. Existing infrastructures and technologies further reinforce these patterns. Poverty, disease, and conflict limit possibilities in afflicted societies.

These are just some of the examples of rigidities that can inhibit social change. Resilience in the 21st century requires a fresh approach – new ways of thinking, acting, and organizing in the world. How will these innovations be recognized, supported, and financed? And how might traditional knowledge – memories of older worldviews, institutions, and experiences – inform our understanding of what might work better today?

Decades ago, Will Rogers set out the cardinal precept of social transformation: “When you find yourself in a hole, stop digging.” To stop digging means to stop supporting – or even to oppose – regimes that undermine wellbeing. And, even more important, to develop viable alternatives.

A Regional Approach

Watersheds, food systems, electric grids, and forest biomes – each occupy a specific geography, and their geographies matter more than our institutions and economies give them credit for. We live in neighborhoods and regions, but we interact through various jurisdictions and supply chains.

To address these mismatches, we adopt a regional approach. At the same time we recognize that regional boundaries are themselves hard to pin down. A region acquires a discrete character and form only with respect to a given watershed, foodshed, or energyshed. To further complicate matters, the watershed boundary aboveground may not correspond to that of the aquifer below. These “problemsheds,” as geographer Tony Allan calls them, demand an “ad hoc regionalism.” Precise and fixed boundaries are less important than adaptive collaboration among the people and organizations relevant to the geographic context.

When disaster strikes, we are vulnerable where we live. Geography, financial resources, political access, and social capital are all factors that can turn environmental stresses into vulnerabilities. Residents of the Ganges, Pearl, Mekong, Mississippi, and Rhine Deltas each face flood and displacement risks, but they are not equally vulnerable. As environmental stresses multiply, the ability to organize and act at local and regional scales becomes more critical.

Despite the many benefits of international trade and communication, globally interconnected economies also leave societies more vulnerable. Shocks and disturbances can transmit more readily from one region of the world to the next. Moreover, the homogenizing forces of globalization endanger the local knowledge, relationships, and regionally diverse cultures that once connected people and place.

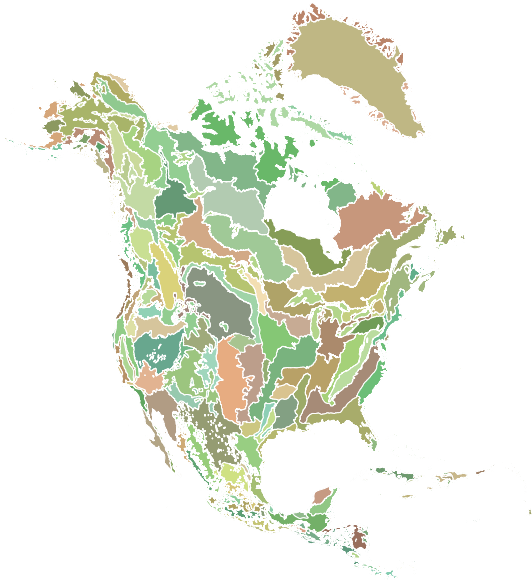
To describe some of the ways in which regional economies can bolster resilience, we posit the following:

- Diversity within and among regions reduces vulnerability to stresses and shocks from climate change, disease, shortages, transmission or transport failures, and so on.
- A greater diversity of production systems within and among regions offers greater opportunities for ownership, community investment, and social capital formation.
- Regional trade networks offer opportunities for more immediate and transparent feedback about the true costs of production and consumption.
- Regional trade networks offer opportunities for shared responsibility, stewardship, and community.
- Especially when national and international institutions prove rigid and inflexible, the emergence of novelty and innovation at local and regional scales can be critical to leadership on global problems such as climate change.

Terrestrial Ecoregions Map
The World Wildlife Fund, 1987

Resilience Regions Map
Ecotrust, 2011

Food Traditions Regional Map
Renewing America's Food Traditions, 2004



Based on expert opinion
of ecological factors



Based on spatial analysis
of both ecological and cultural factors



Based on expert opinion
of cultural traditions

Comparing Regions

We compare three maps of North American regions. Unlike the World Wildlife Fund and Renewing America's Food Traditions maps, the Resilience Regions map (center) is based on spatial analysis of both ecological and cultural factors.

We use a "cost-distance analysis" to determine regional boundaries. Starting with population centers, we examine variations between adjoining map cells. Greater variation entails a greater "cost" of inclusion in a region, until the point where cumulative costs between adjoining regions are equivalent, indicating a boundary. Costs are assigned based on variations in biophysical characteristics such as temperature, elevation, vegetation, and precipitation, as well as variations in language groups.

REGIONAL VULNERABILITIES

Today's world leaves individuals and societies vulnerable to environmental stresses such as resource depletion and climate change. In order to better understand efforts at social transformation, we take a look back at the evolution of today's dominant regimes: the value systems and institutions that guided growth in the 19th and 20th centuries.

To evoke our home region without implying specific borders, we use the term North Pacific America – a region extending from California through British Columbia and Alaska.

We examine seven systems of significance in this region. In each system, regimes have operated at numerous geographic scales. Each of these regimes has a distinct history – and their collective future is open to human influence. A more comprehensive view would include examinations of systems such as geology, rangelands, education, health care, and religion.

Our guiding questions:

- What types of worldviews, institutions, and relationships contributed to the development of today's dominant regimes?
- At what geographic scales do these regimes operate?
- In what ways do these regimes leave individuals and societies more vulnerable?

“At times, the state of the world may appear overwhelming.”

Sarah James
Ecotrust Indigenous Leadership Awards, 2004

Seven Systems of Significance



Oceans

Services include:

Food provision, energy provision, climate regulation, habitat and biodiversity, aesthetic and spiritual values, recreation.



Forests

Services include:

Fiber provision, energy provision, food provision, climate regulation, air quality regulation, habitat and biodiversity, water regulation, aesthetic and spiritual values, recreation.



Water

Services include:

Water provision, energy provision, food provision, natural hazard regulation, habitat and biodiversity, water regulation, aesthetic and spiritual values, recreation.



Food

Services include:

Food provision, energy provision, soil formation and retention, nutrient regulation, water purification, pollination, habitat and biodiversity, climate regulation, aesthetic and spiritual values.



Energy

Services include:

Energy provision, natural hazard regulation.



Built Environment

Services include:

Shelter, sanitation, transportation, communication, food provision, water provision, energy provision, stormwater management, recreation.



Finance

Services include:

Means of exchange, storage of economic value, credit.

Oceans

The North Pacific and California Currents flow eastward across the Pacific, the former turning north to the Gulf of Alaska and the latter turning south at Vancouver Island. The cold upwelling of the California Current supports phytoplankton production that feeds fish, whale, and seabird populations. Migrations of Pacific salmon transport these nutrients inland, contributing to the diet of over 130 species, including humans, and fertilizing algal and plant growth with their carcasses.

Waves of 19th-century immigrants found ample fishing opportunities from the Strait of Georgia lingcod fishery to the San Francisco Bay shrimp fishery. Then, one species after another, populations crashed. The Fraser River's white sturgeon catch plummeted from over a million pounds in 1897 to just 3 percent of that figure a few years later. By the mid-20th century, valuable Pacific sardine fisheries had collapsed all along the coast. Salmon, herring, and other species declined as well.

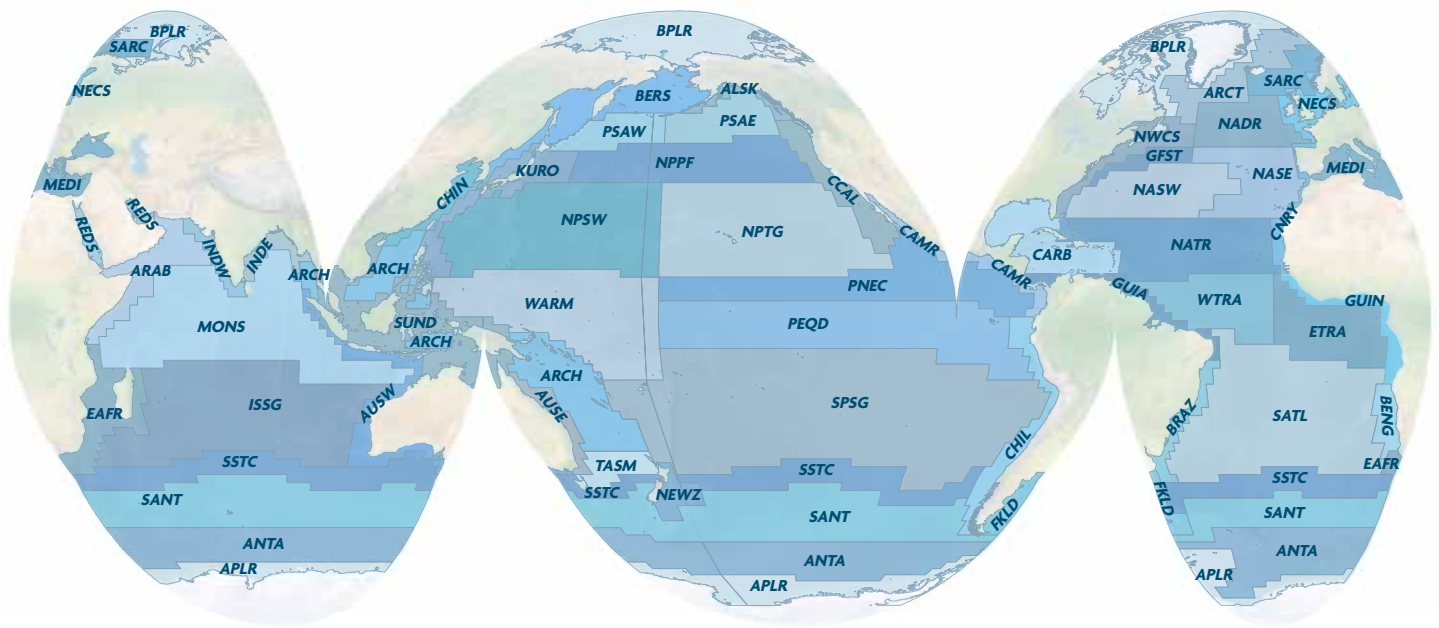
Ocean conditions are naturally variable, which challenges efforts to better understand marine systems. Variability increases the likelihood of overharvest and complicates efforts by scientists to estimate safe harvest levels. Reliance on harvest targets identified as "maximum sustainable yields" reflects a focus on optimization of resource use, rather than on broader values such as community and ecosystem wellbeing. And scientific recognition of the cyclical Pacific Decadal Oscillation, a recurrent shifting of marine circulation in the North Pacific, with its significant influence on productivity, did not come until the 1990s.

The domestication of salmon represents an attempt to control for this natural variability. Partial domestication through hatcheries and complete domestication through aquaculture each provides greater reliability of an important food source. However, both methods of production discount ecosystem interactions that can harm wild salmon populations. Salmon aquaculture, unlike that of herbivorous fish such as tilapia or catfish, results in a net loss of available edible protein. Furthermore, most salmon hatcheries could not survive financially without government subsidies: the cost of production per harvested fish is greater than its market value.

Coastal waters are publicly owned, and governance of fisheries activity is largely shared across the U.S. North Pacific Fishery Management Council, the International Pacific Halibut Commission, Fisheries and Oceans Canada, and the U.S. Pacific Fishery Management Council, in coordination with provincial and state authorities and with Alaska Natives, First Nations, and tribes. Administrative mismatches and gaps are common. For example, the Dungeness crab fishery that spans the West Coast is managed by each state individually, even though fishing vessels (and crabs) routinely cross state boundaries

Major Vulnerabilities in North Pacific America

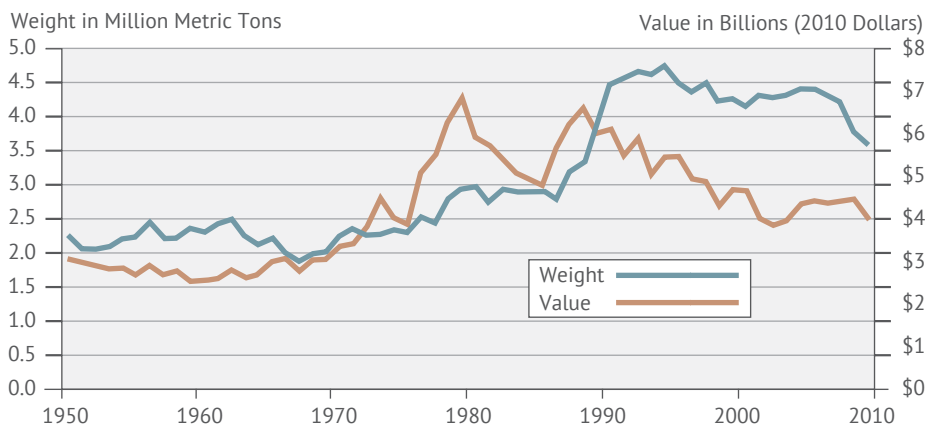
- Oceans acidify as carbon dioxide emissions are absorbed from the atmosphere.
- Memories of past fisheries abundance are lost and recent levels are accepted as normal (a phenomenon known as "shifting baselines syndrome").
- Concentrations of ownership in vessels, fishery quotas, processing facilities, and distribution systems weaken social wellbeing.
- Markets reward some values (efficiency, scale of production) over others (community wellbeing, ecosystem health).



Ocean Biogeographic Provinces

This partition of the world's oceans into provinces is one way to understand "natural" scales of ocean activities. Provinces are dynamic, with cyclical and seasonal fluctuations, and their delineation is based on the role of currents in distributing phytoplankton. Migratory species move among provinces, exploiting multiple domains.

Data source: Vlaams Instituut voor de Zee, 2009.



Weight and Value of U.S. Fish Brought to Market, 1950–2009

Over the last two decades, while U.S. fishery landings have been at 60-year highs, revenues to fishermen have gone down. Rising production and falling prices are indicative of commodity systems in which efficiency and scale of production are valued over community wellbeing and ecosystem health. These patterns are prevalent in fishery, agricultural, ranching, and forestry markets.

Data source: NOAA, 2010.

Forests

Stretching from the redwoods of California to the spruce and hemlock of Alaska, North America's temperate rain forest is characterized by abundant rainfall, cool summers, and infrequent fire. Inland, east of the Cascade and coastal mountains, conifers grow in a drier environment – and are more immediately vulnerable to changes in climate.

Early U.S. land policy directed the distribution of public lands to private ownership as a means of economic expansion and tribal “pacification.” In places such as Oregon's Willamette Valley, immigration's initial effect was an expansion of woodlands. Indigenous peoples had burned the hills every year, and this practice was discontinued.

Meanwhile, forests in the U.S. Northeast and Great Lakes regions were rapidly depleted, and by 1882, *The Oregonian* could claim for the Pacific Northwest the country's “last great supply of first-rate timber.” Alarm among some in Washington, DC, prompted Congress in 1891 to authorize the reservation of public lands. This distinction in forest regimes, public and private, is reflected in today's management practices.

The region's timber industry emerged in the 1850s, shipping to San Francisco from Puget Sound, Grays Harbor, the Columbia River, and Coos Bay. Railroads extended markets, and land parcels granted to railroad companies – 131 million acres in total – created checkerboards of forestland ownership that fragment today's landscape. Until the 1940s, when public land harvests increased during World War II, private forests supplied 95 percent of U.S. domestic timber. Timber production peaked in Washington (1929), Oregon (1955), and California (1959), then moved northward, expanding into British Columbia, where harvests are licensed by the provincial government, and Alaska, where Native corporations play a major role.

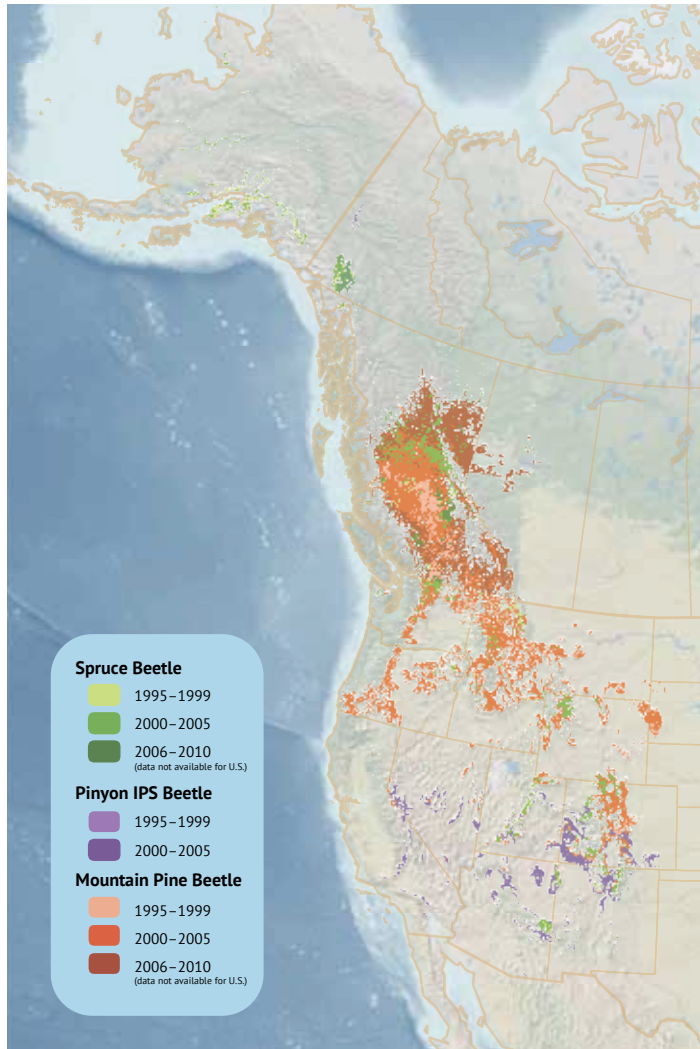
The 1994 Northwest Forest Plan, which halted logging on large areas of national forestlands, sought to stop overharvest and protect endangered species. Timber-dependent communities bear the costs of the industry's repeated boom-and-bust cycles. Factors contributing to these cycles include overharvest and overextended investment, as well as technological development.

Since the 1990s, U.S. forestland ownership as an investment class has grown significantly. Integrated forest management companies, which own manufacturing facilities as well as forestlands, have in many areas been replaced by investment management organizations and real estate trusts.

Social values and services provided by forestlands include carbon sequestration, which helps mitigate human influences on a changing climate. Temperate rain forests are the world's most productive in this regard, storing more carbon than any other forest type and reaching peak rates of growth at ages up to a hundred years or more. On the private industrial lands of North America's temperate rain forest, this productivity is seldom realized. The dominant practice is to clear-cut at about 40 years and replant: an early harvest encouraged by financial considerations based on interest rates and discounted expectations of future earnings.

Major Vulnerabilities in North Pacific America

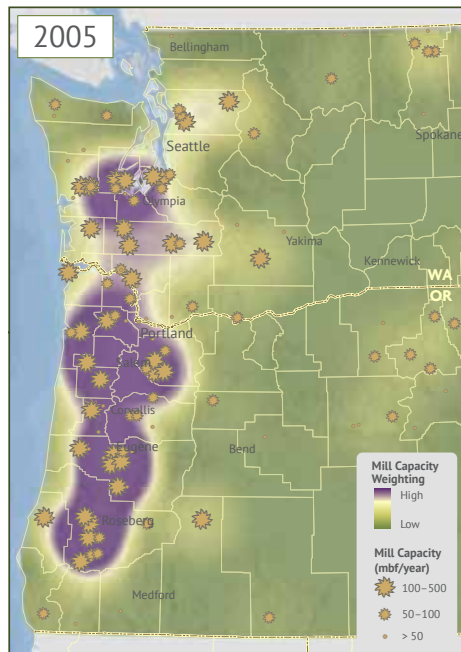
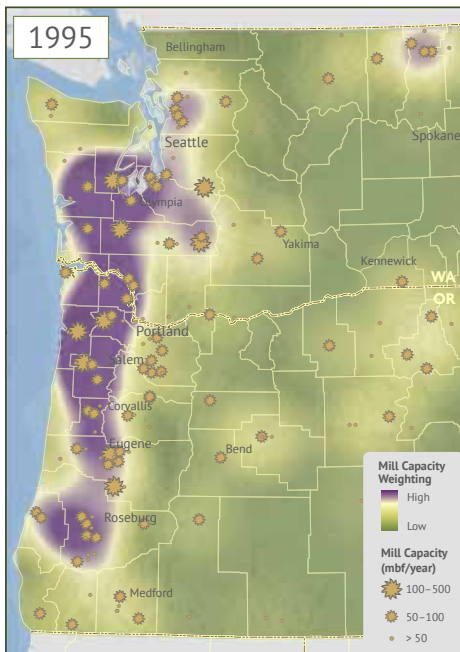
- Homogenous, landscape-scale management results in simplified forest structures, reduced ecological diversity, and increased vulnerability to fire and insect disturbances.
- The decades-long regrowth necessary to restore forested landscapes represents an opportunity cost to landowners.
- Markets reward some values (efficiency, scale of production) over others (community wellbeing, ecosystem health).



Recent Mortality of Conifers to Bark Beetles Across the North American West

Recent warmer winters have led to bark beetle outbreaks across the North American West. The legacy of harvests, fire suppression, and simplified forest structures has increased the vulnerability of dense, young forests to these indigenous pests.

Data sources: Alberta Sustainable Resource Development; British Columbia Ministry of Forests, Lands, and Natural Resource Operations; Government of Yukon Energy Mines and Resources Forest Management Branch; Canadian Forest Service; and USDA Forest Service.



Concentration of Mills in Oregon and Washington

From 1995 to 2005, Oregon and Washington milling capacity was concentrated along the I-5 corridor that runs from Roseburg to Eugene to Portland, then on to Olympia and Seattle. In 1995, logs were hauled 21,683 board-foot miles to mills. (Two logs of equal size transported from one place to another cover twice the “board-foot miles” as a single log.) In 2005, this figure had risen to 28,434 miles, an increase of 31 percent, despite the drop in harvests during this period. The closure of rural mills has made some logging operations economically unfeasible and has constrained harvest management options.

Data source: Spelter et al., 2005 and 2001.

Water

As moist Pacific air crosses the coastal mountains, it rises and cools, releasing from 40 inches to upwards of 200 inches of rain and snow a year. Inland, precipitation levels drop, and a more arid landscape is nourished by the region's mighty rivers and their tributaries.

In these lands, Southwest Native Americans, California Franciscans, and Utah Mormons all diverted water for agriculture. California gold miners, dependent on water, formulated a principle to match their mining claims: "First in time, first in right." This doctrine of prior appropriation, affirmed by California in 1851 and Congress in 1866, became central to U.S. Western water law. With state-by-state variations, these laws declare: water belongs to the public, states issue allocation permits, older permits take priority over newer, and allocations must be used or be forfeited. Canadian law, like that of the Eastern U.S., follows the English riparian doctrine: property owners adjoining a water body are entitled to use, as long as their use does not diminish that of others.

The U.S. Reclamation Act of 1902 authorized engineering projects to divert water from public lands and sought to enable small farm ownership by limiting recipients to 160-acre tracts. Irrigation and flood control were primary goals of California's Central Valley Project. On the Columbia River and its tributaries, project goals also included hydroelectric generation and navigation. There are 14 dams on the main stem Columbia. In contrast, there are none on the main-stem Fraser, where proposals were rejected over concerns for salmon.

While the United States and Canada have succeeded in supplying nearly universal water and sanitation, gaps and concerns still exist. Nearly one in 20 households lacks complete indoor plumbing among American Indians and Alaska Natives. The effects of water pollution and chemical runoff remain a concern in many places. Vancouver, Seattle, and Portland metropolitan

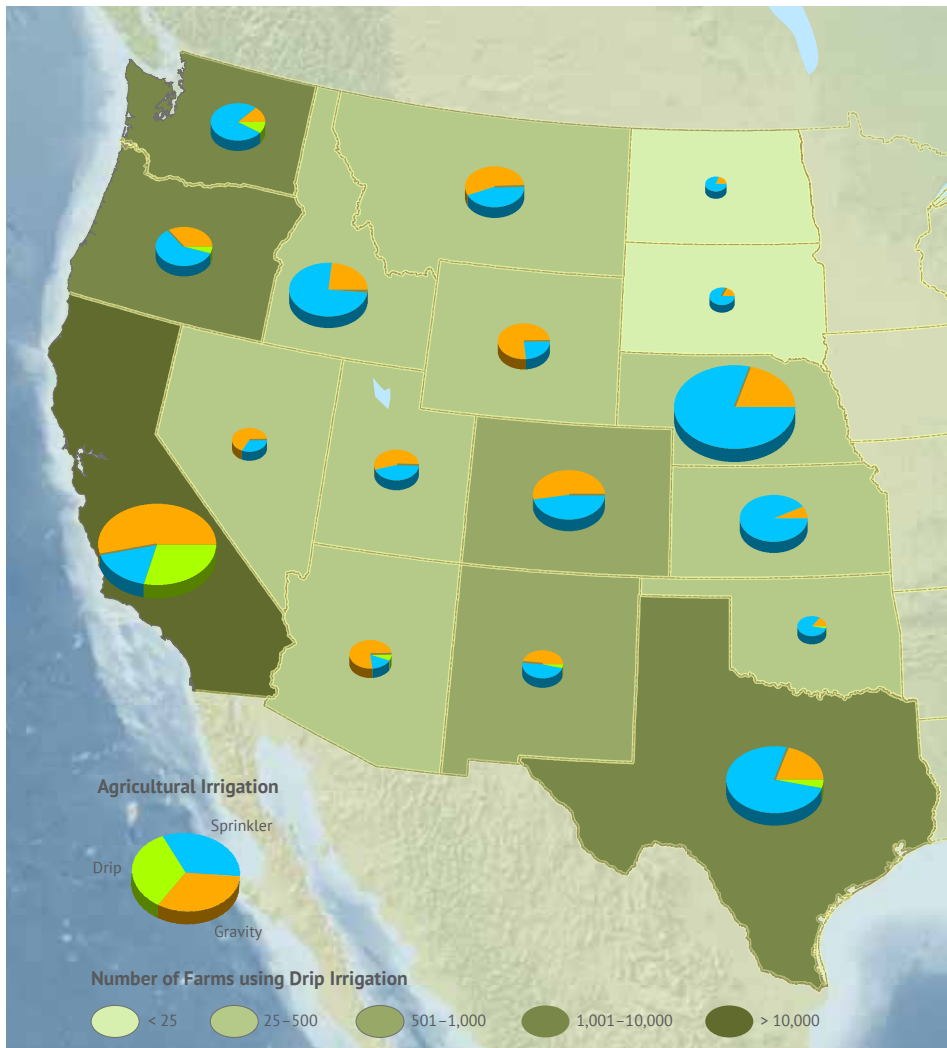
areas are supplied by nearby watersheds: the Capilano, the Seymour, and the Coquitlam in Vancouver (serving 2.3 million people); the Cedar and the Tolt in Seattle (1.3 million); and the Bull Run in Portland (800,000). Both San Francisco and Los Angeles rely on more remote water sources.

Because long-distance liquid water transport, except when enabled by gravity, is generally unfeasible or costly, vulnerabilities to drought or water depletion are largely experienced locally and regionally. In California, water use consumes 19 percent of the state's electricity, partially due to long-distance pumping. But while these vulnerabilities are regional, water consumption is, in effect, global. Regions export their water through international trade in goods and services, which embody the water required for their production. The majority of the world's water trade is in the form of agricultural products. From 1997 through 2001, Australia, Canada, and the United States were the world's leading water exporters, and Japan was the leading importer.

Water is essential to all life, yet the price of water hardly reflects its value. Current institutions have not developed the flexibility to value water according to the many ways it is understood: as a blessing, as a right, and as a commodity.

Major Vulnerabilities in North Pacific America

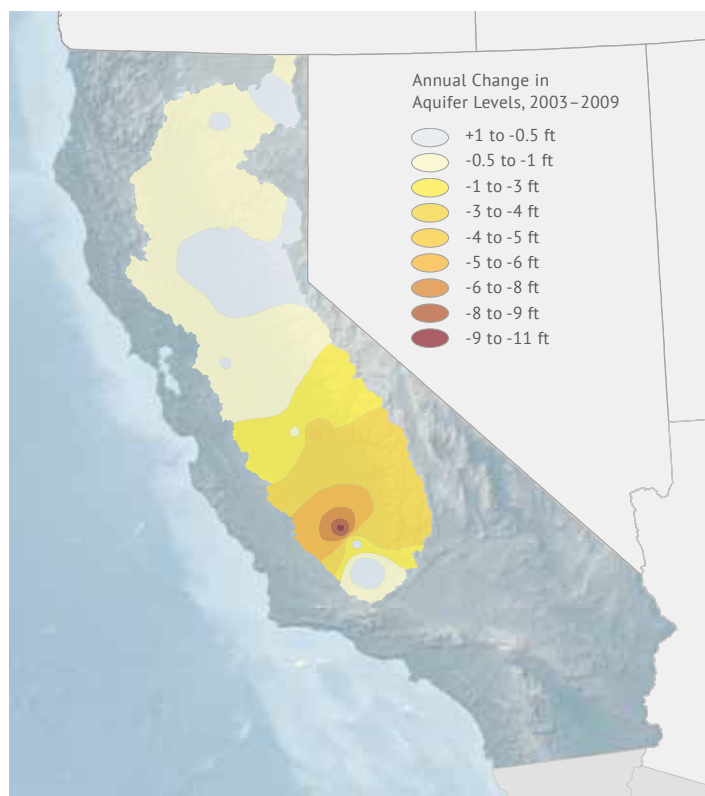
- Cumulative water claims leave many streams and rivers oversubscribed.
- Climate projections forecast reduced snowpacks and, hence, diminished summer water availability.
- Current water metering systems are insufficient for understanding changes in supply or demand.
- Existing infrastructure fails to distinguish water quality required for final use – and does not enable reuse of water already in the pipes.
- Inefficient use of water exacerbates regional vulnerabilities.



Types of Irrigation Used in Agriculture, 2008

State-by-state agricultural irrigation is shown by type of system (slice of each pie), amount of land under irrigation (relative size of the pies), and number of farms using drip irrigation (color of each state). Irrigation efficiency depends on factors such as precision, uniformity, and timing of application. According to the U.S. National Research Council, "Shifting to trickle or drip irrigation has been the greatest strategic improvement in water-use efficiency and energy savings over the past three decades."

Data source: USDA farm and ranch irrigation survey, 2008



Satellite View of California's Groundwater Depletion, 2003–2009

NASA's GRACE satellites find groundwater depletion across most of California's Central Valley, most seriously in the San Joaquin region. Much of California's agricultural production depends on irrigation, and more than a third of that irrigation depends on underground aquifers. Monitoring aquifer use rates has been confounded by multiple factors, but NASA's satellites can detect groundwater fluctuations through the strength of Earth's gravitational forces.

Data source: NASA, 2009.

Food

People obtain food through various methods (fishing, hunting, foraging, agriculture, aquaculture, animal husbandry). Trading food may include activities like processing, distribution, and marketing. All food is consumed or disposed of. The sum of these types of activities, as well as supporting activities and infrastructures, among a particular people in a particular place, is described as a food system.

Evidence indicates that indigenous peoples along the West Coast actively cultivated the landscape for numerous foods, including salmon, deer, huckleberries, acorns, and camas. In the 1800s, immigrants to the region brought non-native plant and animal species, creating intentional and unintentional changes. Pigs ate camas; livestock grazing led to invasions of Canadian thistle, which suffocated other plants; and California's Tulare Lake Basin was planted "wall-to-wall wheat."

As the railroad connected distant markets, food production increased. Numbers of farms nearly tripled in the Willamette Valley between 1870 and 1900. Salmon canneries shipped out 30 million pounds of fish from the Columbia River in 1885 and 300 million pounds from around the North Pacific in 1913.

A pattern of agricultural industrialization emerged: concentration of land ownership, mechanization and specialization of production, and increased use of inputs such as patented seeds, fertilizers, pesticides, and irrigation. U.S. Secretaries of Agriculture urged farmers to "get big or get out." The result was a boom in productivity: fewer people produced more food at cheaper prices. These practices were exported and adopted elsewhere, and over the 20th century, worldwide average farm yields increased fourfold. For many, a globally connected food system became the norm.

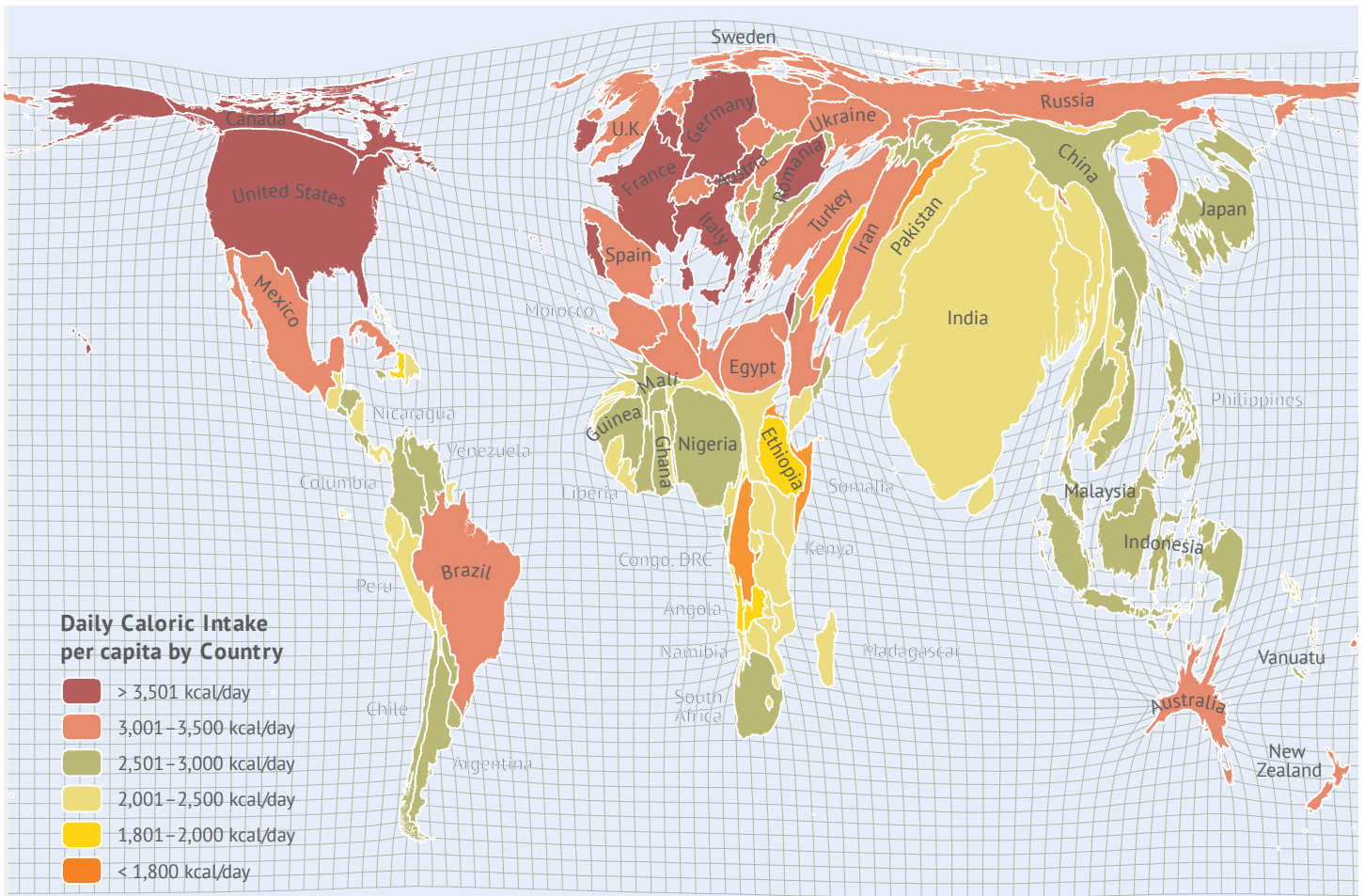
The paradox of this accomplishment is that nearly a billion people around the world continue to live in chronic hunger. In Oregon, more than half-a-million people face food insecurity. Food abundance does not necessarily mean food availability to people in

need. Ongoing concerns over the social and ecological implications of agricultural industrialization include:

- *Dependence on inputs:* Global energy inputs, mostly from fossil fuels, increased 80 times over the 20th century.
- *Increasing cost of inputs:* Since 1970, the increase in U.S. farm revenues has been cancelled out by an increase in costs of production.
- *Impaired water quality:* Crops absorb an estimated 30–50 percent of applied nitrogen fertilizer; the rest is lost to the environment. Pesticides are found in nearly all major rivers and streams around the United States.
- *Loss of on-farm diversity:* In 1920, U.S. farms sold an average of 5.6 primary products; by 2002, they specialized in just 1.3 products.
- *Intensification of production:* In 2002, 7 percent of U.S. farms accounted for 75 percent of farm sales.
- *Concentration of ownership:* Five or fewer firms account for 45–85 percent of the U.S. market in sectors that include corn seed supply, broiler production, beef packing, and food retailing.
- *Labor concerns:* The median wage for U.S. hired farm labor is roughly the minimum wage, for work that is often only seasonally available.

Major Vulnerabilities in North Pacific America

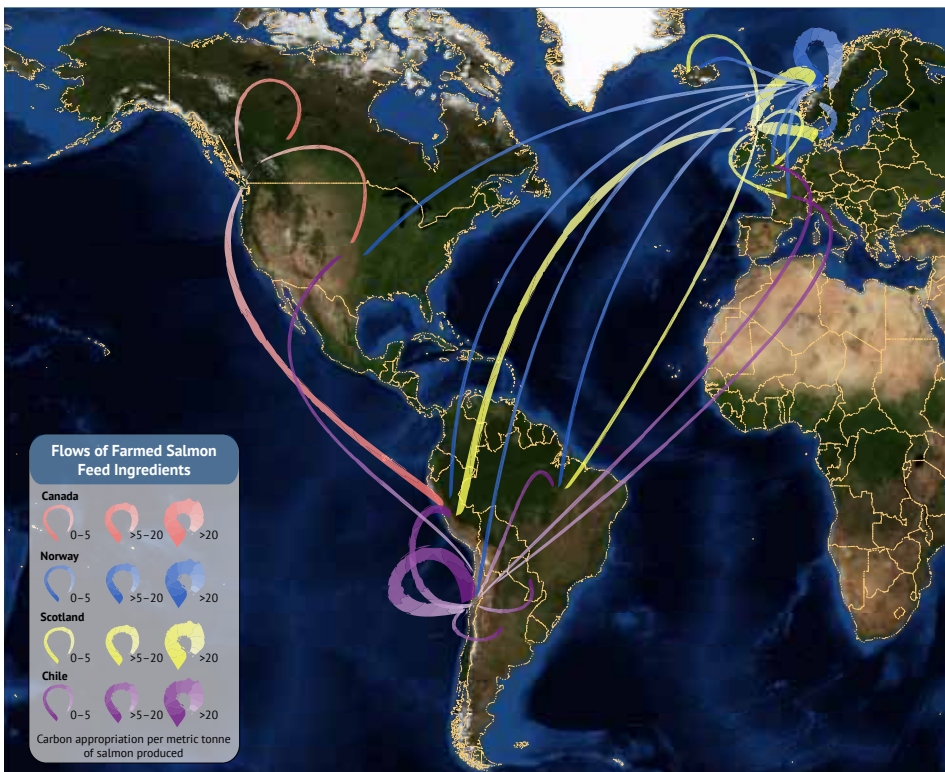
- Eaters are dependent on a food system that puts ecological productivity at risk.
- Eaters are dependent on a food system that undermines the personal and social wellbeing of food producers.
- Agricultural lands are displaced by the built environment.
- Some people suffer health risks from over- and malnourishment, while other populations suffer food insecurity.



Daily Caloric Consumption, by Country, 2005–2007

Daily consumption of calories is shown in two ways for each country: per capita (in color), and for the total population (in area, as a distorted size). The U.S. and Austria have the highest per-capita consumption; India has the highest total consumption. The UN Food and Agriculture Organization finds that malnutrition occurs at less than 1,800 kilocalories (kcal) per day. The U.S. Food and Drug Administration recommends that adults consume 1,800–2,500 kilocalories per day.

Data source: FAO Statistics Division, 2010.



Global Flows of Salmon Feed Ingredients, 2007

Flows of farmed salmon fish-meal ingredients illustrate the globally interconnected food system. Ingredient flows to farmed salmon-producing countries (Canada, Norway, Scotland, and Chile) are standardized and calculated as primary productivity, the appropriation of carbon from the environment. Chilean farmed salmon, for example, are fed fish meal that includes ingredients derived from poultry products from France and Brazil, anchoveta meal from Peru, maize gluten meal from the U.S., sunflower meal from Argentina, and wheat gluten meal from the U.K.

Data source: Pelletier et al., 2009

Energy

Annual migrations of Pacific salmon brought abundant food energy to indigenous peoples of the Pacific Rim, enabling the development of advanced, settled societies. Food energy, thermal energy for heating and cooking, and the use of fire for brush clearing were the primary energy services of preindustrial times.

Expanded energy services have largely depended on carbon-based, effectively finite geological materials: petroleum, coal, and gas. In the language of a 1952 General Electric film, “A world that had plodded down the centuries suddenly found out how to use a force that had waited to go to work since before the daybreak of history.” Transformations in lifestyle were wondrous, and vulnerabilities were little understood or easily overlooked.

Energy systems can be characterized in a variety of ways, such as by sources and materials, or by environmental impacts. Characterizing these systems as services — electricity, mobility, heating, and so on — places emphasis on the quality, scale, and infrastructural delivery of desired energy performance.

Electric services

In 2003, the U.S. National Academy of Engineering named electrification the top achievement of the 20th century. The grid that covers much of North America instantaneously balances supplies to meet variable demand, offering cheap and reliable service.

Regulatory and market institutions emerged in an era of resource abundance. Companies benefited from economies of scale and regulated profit margins. But this regulated ecosystem, with its complicated institutional authorities and over 3,000 U.S. electric utility companies, is less well suited to an era that demands innovation.

Generation portfolios vary by region. Hydropower contributes a majority of production in British Columbia (86 percent), Washington (70 percent), and Oregon (58 percent), but is less significant in California (14 percent). Hydropower offers numerous benefits. With sufficient water flow, it operates continuously, smog- and carbon-

free. However, dams hinder fish passage — and thus reduce the productivity of another resource.

Mobility services

Liquid fuels are highly dense and versatile, and their depletion poses unique challenges, including the circular conundrum of fuels required to access and process new fuels. In the 1930s, U.S. oil flowed easily, and the energy return on investment was roughly 100 to 1: a hundred barrels gained for every one spent on recovery. This ratio for energy from today’s more challenging environments and materials, such as the Alberta tar sands, is estimated to be as low as 6 to 1.

People in San Francisco, Portland, and Vancouver are less dependent on vehicles than residents of some other cities. For Portland, that savings in time and transportation costs has been estimated at \$2.6 billion a year over other large U.S. metropolitan areas.

Thermal services

Among the most basic energy needs are thermal services such as heating and cooking. Woody biomass can be used efficiently for thermal energy but has proved controversial, due to social and environmental concerns. Meanwhile, British Columbia exports woody biomass for energy uses to Northern Europe: 775,000 tons of pellets in 2008, enough to heat over 250,000 homes.

Major Vulnerabilities in North Pacific America

- Remote and effectively finite material resources are vulnerable to supply shocks and price volatility.
- Toxic material wastes are harmful to human and environmental health.
- Imports of material resources create a drain on regional economies.
- The existing electric grid cannot accommodate significant quantities of variable sources such as solar and wind.
- Carbon dioxide emissions disrupt the planet’s climate system.

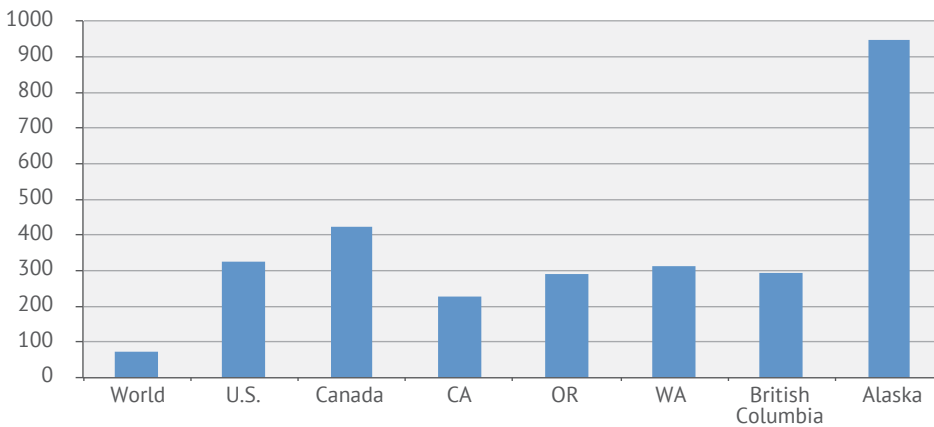


The Western Electric Grid and its Balancing Authorities

Balancing authorities each manage electric transmission within their domains of the Western grid (Western Interconnection). These territorial stakes illustrate the challenges of modernizing the electric grid – challenges that are as much about governance, coordination, and standardization as they are about technology.

Data source: Western Electricity Coordinating Council as of August 17, 2011. (Boundaries are approximate and for illustrative purposes only.)

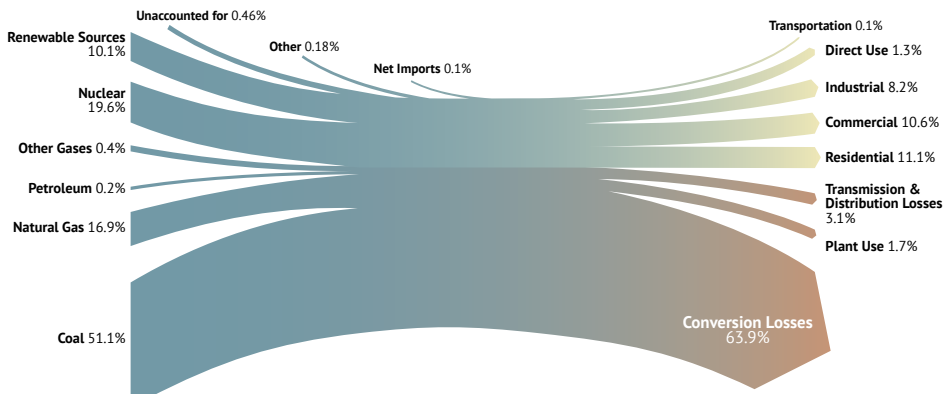
Million BTUs



Energy Consumption per Capita, 2008

Per-person consumption of energy varies greatly, both within and among countries around the world. North American consumption is four times the world average.

Data source: U.S. Energy Information Administration, 2009; Natural Resources Canada, 2008.



Efficiency of U.S. Electricity Generation

The efficiency of U.S. electricity generation has stagnated at roughly 34 percent since the 1960s, with nearly two-thirds of the energy lost as heat. This loss is partially due to the diseconomies of large-scale generation facilities. Smaller-scale, distributed facilities, providing both electric generation and on-site thermal services, can offer opportunities for energy savings.

Data sources: U.S. Department of Energy, Northwest Clean Energy Application Center, accessed August 20, 2011.

Built Environment

The built environment – including cities, buildings, and supporting infrastructure – serves a variety of human needs: shelter, transportation, communication, sanitation, education, spiritual fulfillment, and more. Invested with social energies and financial capital, these structures reflect the aspirations of their times and shape living patterns long after construction.

Cities are places of social and economic interaction. As their growth accelerates, it often leads to greater diversification, specialization, and productivity – but also to *diseconomies*, such as air pollution and traffic congestion. City planning can influence both economies and diseconomies.

Town planning on a street grid was introduced to the Americas in the Spanish Caribbean colony of Santo Domingo, and nearly every town in the Western United States began as a planned settlement. Planning for streetcar lines guided the development of many North American cities, including Vancouver, Seattle, Portland, and Los Angeles.

In 1922, soon after U.S. urban populations first exceeded rural, the Supreme Court found that land use regulations might create a *negative externality*, an unjust taking of private property. The reverse occurs as well. A *reverse taking* is when private activities enclose or degrade public resources, and *positive externalities* are created when land use regulations support social wellbeing that benefits individual landowners.

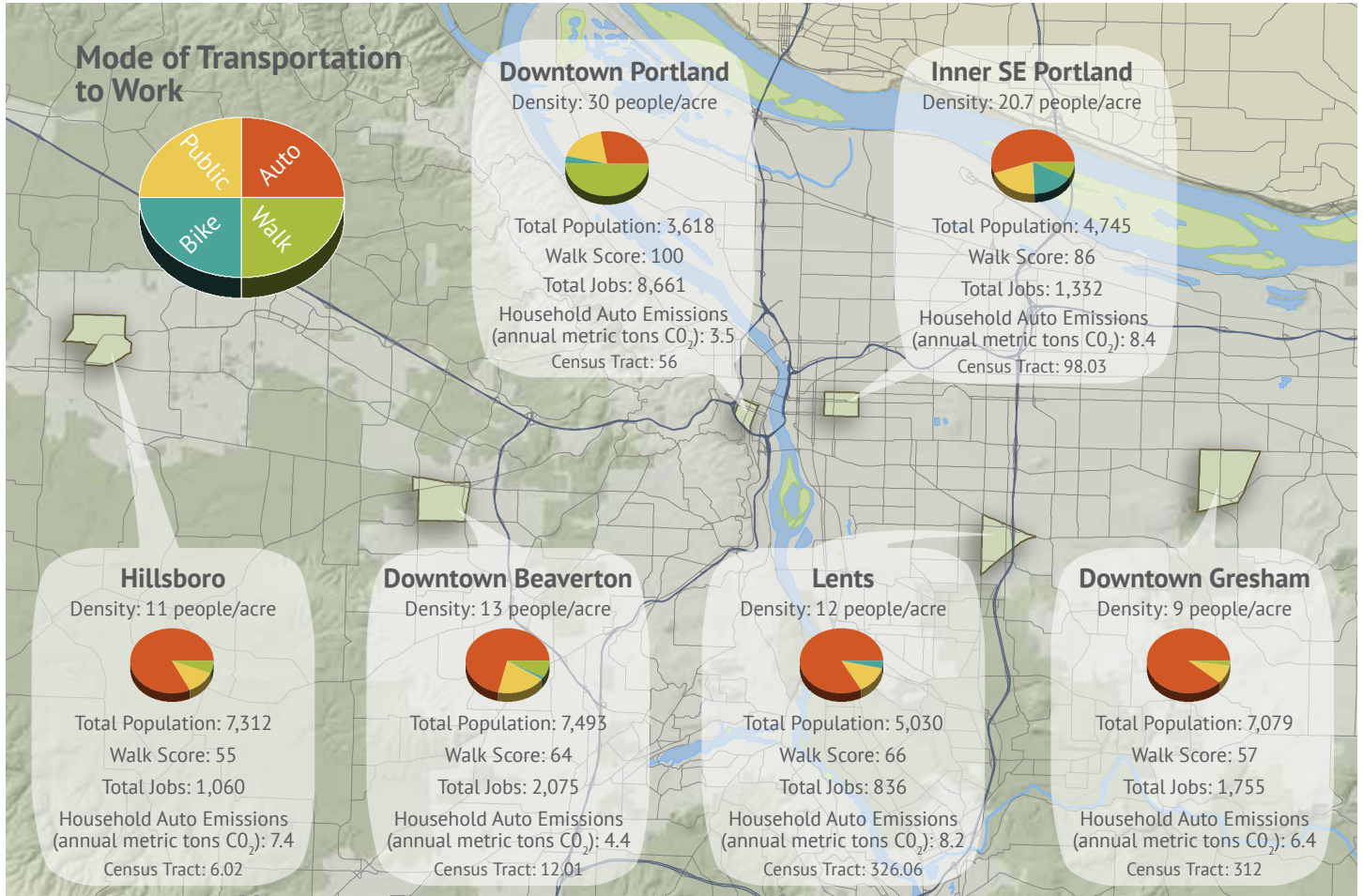
By the mid-20th century, the automobile enabled growing populations to seek more dispersed settlement. A backlash against road building occurred in 1970s Portland, when citizens and officials concerned about urban livability stopped plans for the Mt. Hood freeway and removed a riverfront roadway. A similar freeway proposal was blocked in 1970s Vancouver. Daily travel is now roughly 78 percent by personal vehicle in both the Portland-Salem, Seattle-Tacoma, and San Francisco-Oakland-San Jose areas, 73 percent in metropolitan Vancouver, and 83 percent in U.S. metropolitan areas overall.

The built footprint creates social-ecological impacts that include loss of agricultural and forest land, diminished water quality, and loss of biodiversity. Impervious pavement covering as little as 10 percent of a watershed can be harmful to salmon populations. In the 1970s, both British Columbia and Oregon adopted laws to protect farmland and open spaces from development: the former with Agricultural Land Reserves, the latter with Urban Growth Boundaries.

Settlement and housing regulations have often reflected historical racial and ethnic sensibilities. In Oregon, the first state constitution excluded black settlers, and in Seattle, housing restrictions enforced neighborhood segregation. Availability of affordable housing and equitable provision of public services remain challenges for most cities in North America. Both “trendsetter and hinterland” is how historian Carlos Arnaldo Schwantes characterizes the Pacific Northwest. Today, the region continues to attract new generations of immigrants.

Major Vulnerabilities in North Pacific America

- The built environment often displaces forest and agricultural lands.
- The built environment retains heat, leading to higher temperatures that, combined with climate change, can affect the health and welfare of urban residents.
- Impervious surfaces impair watershed function.
- Existing infrastructure represents a sunk cost and constrains habitual patterns of activity.
- Markets do not provide for equitable access to needs such as affordable housing, and governmental planning has not traditionally considered food access.
- Disparities in access to public transportation and services often disproportionately affect lower-income households.



Neighborhood Variations

Neighborhoods in and around the Portland, Oregon, metropolitan area exhibit variations in population densities, job opportunities, and transportation options and impacts. Where one lives and how land use decisions are made greatly affect social and environmental outcomes.

Data sources: U.S. Census Bureau; American Community Survey, 2009; U.S. Census Bureau, Local Employment Dynamics Program, 2009 Area Profile Analysis of Primary Jobs; Walk Score, accessed August 9, 2011; Center for Neighborhood Technology, 2003–2012.

Finance

The indigenous peoples of North Pacific America used monetary systems that included blankets, small white shells (*higua*), and, later, ornamental coppers. These served as basic units of exchange and benchmarks of value, much as the dollar does today.

Native peoples in our region also practiced the potlatch, a ceremonial exchange of gifts. Along with other social and ritual functions, the potlatch served as a nascent financial system, distributing resources to those who needed them. The advent of the fur trade and influx of manufactured goods eventually triggered inflationary pressures that destabilized the potlatch's economic function. It was an early experience with the fragility of money and finance.

In all societies, money evolved to support greater divisions of labor and broader exchanges of goods and services. Modern money includes currency as well as credit. It is tied to neither land nor region, and financial systems facilitate the flow of credit and capital at increasingly larger scales.

The scope and speed of financial activity have eliminated critical feedbacks. Early financial markets channeled savings into local investments in economic activity, employment, and infrastructure. In contrast, in today's global financial system, a dollar deposited in a commercial bank may wind up anywhere. Creditors are no longer familiar with their borrowers and may have little direct contact with the communities they support. Without social relationships to support creditworthiness and repayment, creditors instead require onerous collateral and credit standards.

Despite the great variation in credit needs worldwide, today's credit standards have been reduced to a single metric: the market rate of return. This narrow criterion tends to reward high-volume, quick-payoff transactions and exclude the capital needs of the majority. Women, minorities, indigenous communities, and middle- and lower-income borrowers struggle to attract affordable credit. Innovations and activities with long-term goals have difficulties as well. Funding from government,

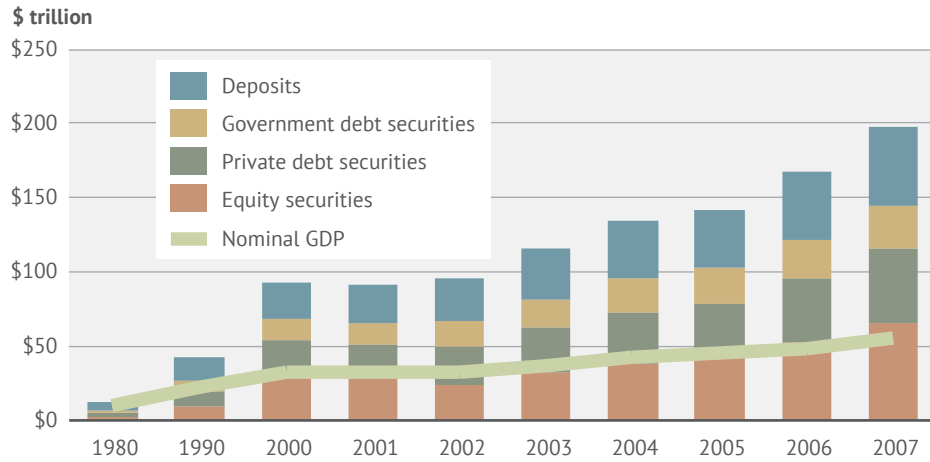
philanthropy, and community development banks satisfies some of these needs, but this funding has diminished due to financial instabilities.

The Depression of the 1930s revealed the vulnerability of the economy to financial market speculation, and subsequent U.S. regulations led to a period of relative stability. Over the last several decades, however, most of these measures have been removed. Speculative activity has increased – with today's risks extending to individual retirement accounts and pensions.

In the wake of the recent financial meltdown, banks retrenched. Lending declined more sharply in 2009 than in any year since the Depression, despite the fact that the real assets of the economy had not changed. Human capital, manufactured capital, and natural capital were no less productive than they had been the year before, yet for lack of credit they could no longer be fully utilized. In Oregon, for example, lending to small businesses declined by 37 percent from 2007 to 2009, and unemployment rates jumped from 5 percent to nearly 12 percent. Regions of the country with greater reliance on community banks typically fared better. North Dakota, for example, is the only state to operate its own bank. It continues to run budget surpluses and enjoys some of the lowest credit default and unemployment rates in the country.

Major Vulnerabilities in North Pacific America

- Without capital controls, the global financial system is more susceptible to speculative shocks and bubbles.
- Speculative activity contributes to the price volatility of basic goods, such as housing, food, and energy.
- Financial markets allocate capital based on market rates of return, without direct consideration of social wellbeing.
- Individuals lack sufficient mechanisms for investing directly in their own communities.



Value of Global Financial Activity and GDP: 1980–2007

Leading up to the 2007 financial crisis, the total value of the world's financial assets – including equities, deposits, and private and government debt – outpaced growth in real economic activity, a process known as financial deepening. Financial assets topped \$196 trillion in 2007, and global financial depth (the ratio of financial assets to GDP) reached 359 percent.

Data source: McKinsey Global Institute, 2008.

STORIES OF INNOVATION

We find ourselves facing interconnected and systemic vulnerabilities. If we could design a system of solutions – if resilience could be designed into our policies and economies, and could thus become part of our cultural narratives – what would that look like?

Imagine a world of diversity and innovation, dependent on openness, flexibility, and participation; a world in which social, political, and economic relationships support a more reliable prosperity: the wellbeing of peoples, in the places where we live.

While this vision is aspirational, the path to its realization is incremental and pragmatic. As resilience ecologist C. S. “Buzz” Holling instructs, “In each project, make the overall goal large and unattainable – things related to justice, equity, and opportunity. However, make the first step tough, simple, doable, and open.”

Our guiding questions:

- What examples of institutional innovation are emerging?
- How do these examples demonstrate resilience in practice?
- Based on these examples, what recommendations can we make?

“My experience — having many times created a vision and then brought it, in some form, into being — is that I never know, at the beginning, how to get there. But as I articulate the vision and share it with people, the path reveals itself.”

Donella Meadows
International Society for Ecological Economics, 1994

Working with Nature



“The traditional orientation to nature is positive and proactive,” relates restoration ecologist Dennis Martinez. “Native American management envisions human beings as an essential element in any ecosystem.”

The proactive orientation to nature described by Martinez informs today’s practices in areas as diverse as agro-ecology, permaculture, green infrastructure, and ecosystem services. The idea is that instead of relying on engineered or industrial approaches to environmental management, we can work with nature to develop strategies that produce services such as food productivity, water filtration, and carbon storage, and enhance the capacities of human and natural systems to respond to climate change and other stressors. Such approaches can deliver financial savings as compared to business-as-usual practices.

The work of Tualatin’s Clean Water Services offers one example. In 2001, that Oregon utility engaged private landowners in restoring 35 miles of riparian forest on the Tualatin River. The \$5 million restoration, aimed at maintaining water temperatures for salmon and other aquatic species, helped eliminate the need for a \$60–\$150 million cooling tower. Energy inputs are reduced and the trees provide additional benefits, such as carbon storage.

Green infrastructure for capturing rainfall in the urban environment offers another example. In Portland, where big-pipe engineering solutions have caused water bills to skyrocket, decentralized designs such as green roofs, bioswales, and permeable paving for stormwater

management help city residents save on energy, pumping, and treatment costs. Additionally, the city has found that green infrastructure contributes broadly to community health and quality of life.

A largely unrealized opportunity lies in a go-slow style of forestry, which is suited to the region’s long-lived trees. Over the long term, and compared with the rapid rotations and chemical inputs of industrial management, this style of ecological forest management could provide more wood, store more carbon, and offer better wildlife habitat. One incentive for landowners to adjust management practices is emerging in California’s carbon market, which will be the largest regulated carbon market in the world to account for improved forest management practices. The market will be open to landowners around the country and offers one model of what a broader regional market for ecosystem services might look like.

Factors common to the Portland and Tualatin experiences — and missing in the forestry example — include policy incentives for environmental improvement and broad engagement with private landowners. These examples of working with nature bolster resilience in several ways, notably by aligning incentives with social and natural wellbeing, and by cultivating functionally diverse, decentralized, and adaptive approaches to meeting social goals.



Bioswales are a means of working with nature to allow for stormwater infiltration.

RECOMMENDATIONS

- Develop practices for working with nature to enhance conservation and restore ecosystem function — on land and sea.
- Develop policy incentives that can create demand and enable market development for ecosystem services.
- Develop processes and tools for decision makers, land managers and citizens to visualize, monitor and evaluate the role of nature’s services in providing for social wellbeing.

Connecting Value Chains

RESILIENCE IN PRACTICE



“Decommodify or die!” urges Country Natural Beef’s Connie Hatfield. The Oregon-based ranchers’ cooperative differentiates its product in the food marketplace through attention to shared values. “What is it we really produce?” she asks. “We produce a sustainable lifestyle for our members by filling a customer need for taste, integrity, and a healthy environment.”

Karl Kupers, cofounder of Shepherd’s Grain, a Washington-based wheat growers’ cooperative, tells a similar story. “The idea is simply that supply chains, which constitute a typical food system, can be broken on pennies, but a value chain, which is developed on relationships, will weather those storms.”

While other midsize farms and ranches across North America have gotten squeezed, these two cooperatives have thrived. Practices common to this “ag of the middle” include the ability to set prices that include a fair rate of return, rather than rely on prices set by commodity markets, and the preservation of product and producer traceability along the value chain.

These types of business practices are being adopted in other natural resource sectors as well. Community-supported fisheries link sellers with buyers of seafood, and groups such as the Build Local Alliance connect markets for lumber. Meanwhile, online platforms like FoodHub and Thisfish facilitate regional market connections and product traceability.

Regional food systems offer no panaceas. They can exhibit the problems of the global commodity system, including resource depletion and environmental pollution. Nor is strict regionalization always desirable: the natural competitive advantages of the Pacific Northwest provide for exports of signature products such as apples, timber, and salmon.

Still, regional food systems bolster resilience in numerous ways. They enable better feedback between producers and consumers. If production practices cause water tables to drop, that knowledge can be more rapidly disseminated — and the impacts localized. They foster a greater diversity of farm types and farming practices — a diversified overall agricultural portfolio that reduces vulnerabilities to a changing climate. And they offer greater opportunities for diversity of ownership and partnership, foundations of personal and social wellbeing.

RECOMMENDATIONS

- Develop policies and programs to better support the viability of local and regional food and timber producers, including: preferential regional purchasing, incentives and financing, extension services, sustainability certification, payments for ecosystem services, and community-supported agriculture, fishery and forestry networks.
- Develop relationships and practices that enable large-scale purchasers — schools, hospitals and so on — to better support local and regional producers.
- Develop regional “hubs” to better connect local and regional producers with distributors, processors, and consumers.



Connie and Doc Hatfield of Country Natural Beef



Karl Kupers and Fred Fleming of Shepherd's Grain

Strengthening Collaborative Management

“The West Hawaii Fisheries Council is the best thing that ever happened to fisheries management in Hawai‘i,” declares Tina Owens of the Lost Fish Coalition. “Honolulu retains final authority – but we do all the legwork to reach agreements and make sure the policies work for us.”

This relationship between Honolulu’s Department of Aquatic Resources and the council on the island of Hawai‘i is a notable example of collaborative management of public resources. Co-management relationships can be characterized as ongoing processes of testing and revising institutional arrangements and ecological knowledge. The West Hawaii Fisheries Council emerged from a local process that succeeded in designating over 30 percent of coastal waters as off-limits to aquarium collection. Ten years later, abundance of aquarium species is up and the industry is thriving, with more collectors catching more fish.

Co-management in West Hawai‘i is informed by the traditional *ahupua‘a* system of ecosystem and community responsibility. “The ancient Hawai‘ian customs are proving more appropriate for modern times than anyone would have imagined,” says Owens. “The trick is to divide the resources into smaller areas, among local people that know the region and have a stake in working together.”

Collaborative forms of management of public lands and waters are emerging elsewhere as replacements for top-down decision making. Former “timber war” adversaries have reached common ground on



The yellow tang, an aquarium fish native to Hawai‘i

RESILIENCE IN PRACTICE



stewardship contracting agreements for U.S. National Forests, enabling flexible management for forest health. In the Umatilla and Klamath Basins of Washington-Oregon and Oregon-California, homegrown solutions to restore watersheds have bridged diverse stakeholder divides, avoiding the need for costly litigation. And in California’s Mattole region, seasonal forbearance agreements among landowners limit water withdrawals to ensure year-round stream flow for aquatic animals.

Specific practices that have proven successful in strengthening co-management capacities include participatory research and monitoring, community-based scenario development, and deliberations that link local expertise and broader scientific knowledge.

These types of collaborative management foster resilience by enabling both flexibility and feedback, as well as creating social institutions for adaptive learning. They facilitate participatory and transparent decision making that can protect stakeholders’ collective interests and conserve long-term ecological, economic, and social value.

RECOMMENDATIONS

- Develop collaborative processes for characterizing and monitoring social-ecological systems, including: relevant geographic extents, ecosystem services and community wellbeing.
- Develop deliberative processes for participant engagement in iterative scenario development and problem solving.
- Develop iterative and adaptive management interventions to test key hypotheses about ecosystem functions.
- Develop processes and tools to integrate local and traditional knowledge and experience into public decision-making.

Sharing Resources

RESILIENCE IN PRACTICE



“Anything we can do to have fewer cars on the road is a good thing,” says Eli Spevak. “I love all kinds of sharing, and car sharing just makes a lot of sense.”

Spevak rents out his 2005 Honda Civic Hybrid through Getaround, an online marketplace for matching would-be drivers with available vehicles. His North Portland neighbors can check availability and make reservations through web or phone apps. Spevak sets an hourly rate. Getaround takes 40 percent and covers insurance; renters pay for gas.

Unlike car-sharing industry leader Zipcar, which operates its own vehicle inventory, Getaround relies on a peer-to-peer model based on the willingness of its members to share their vehicles through a network that builds reputation and trust. Other business models are being tested as well. Vancouver-based Modo runs a car co-op. Daimler’s Car2Go operates in Vancouver BC, Austin TX and San Diego CA on a floating basis: members are charged by the minute for individual trips in the company’s Smart cars, which may be picked up and dropped off anywhere in the urban operating zone.

By all estimates, U.S. cars are typically parked 22 or more hours a day, an idling of capital and resources. Researchers at the University of California, Berkeley, found that among 6,281 surveyed North American car-sharing households, car ownership dropped by nearly half after people became members. Researchers at Frost & Sullivan found that European and North American car-sharing members reduced their driving by 31 percent.

As early-adopter Spevak tells it, the Getaround story is also about a “culture of sharing,” a passion he expresses in his day job as well. As a contractor and developer, Spevak builds pocket neighborhoods, co-housing communities, and accessory dwelling (“granny”) units. In addition to green-building features like solar panels and in-floor radiant heat, each project includes shared amenities such as bike storage, laundry facilities, Internet access, and guest rooms.

Newfangled car sharing and old-time accessory units have much in common. They both exemplify the opportunities emergent in the “sharing economy” — a large and growing marketplace that lowers costs and waste while forging community ties and neighborly values. Unfortunately, both face legal and regulatory hurdles that are out of sync with the times. Only California and Oregon have clarified insurance legalities that enable peer-to-peer car sharing. And inconsistent city-by-city regulations can inhibit builders of small homes.

A culture and institutions of sharing bolster resilience by expanding access and opportunities and providing the flexibility to meet human needs at appropriate scales.



Eli Spevak and Noelle, car-sharing enthusiasts



Cohousing in Portland, Oregon

RECOMMENDATIONS

- Develop business and product models that enable asset and skill sharing.
- Develop work and living environments that allow for asset and skill sharing.
- Remove legal, regulatory and other barriers to asset and skill sharing.
- Strengthen the shared institutions and infrastructures of community and civic participation.

Shifting to Renewables

“We wanted to find a stable funding mechanism for renewable energy,” recalls Judy Barnes of Oregonians for Renewable Energy Policy. “We’re just average citizens that did our research and went down to Salem for days on end, meeting with anyone who would talk with us.”

Barnes’s passion is the feed-in tariff, a per-kilowatt payment made by utilities for renewable electricity supplied to the grid by individual homes or businesses. The Environmental Law Alliance helped Barnes and her colleagues draft a feed-in tariff bill, and soon after, the state legislature passed a pilot program into law. However, the Oregon pilot falls short of mandating a full feed-in incentive, which would require that utilities offer long-term contracts for all of the renewable energy produced, at prices that cover costs of production.

Over 60 countries have adopted feed-in tariffs, and a 2008 European Commission report calls them “the most efficient and effective support schemes for promoting renewable electricity.” In 2009, Ontario adopted a feed-in tariff program as part of its Green Energy Act – a program that the provincial government credits with creating over 20,000 jobs, with another 30,000 anticipated by the end of 2012.

The transition to renewable energy can be pursued at multiple scales. Feed-in tariffs can be used in conjunction with other incentives that encourage a shift to renewables, such as British Columbia’s carbon tax or



Residential solar panels

RESILIENCE IN PRACTICE



California’s cap-and-trade program, renewable energy standards, or laws that decouple utility profits from sales.

Except for large-scale hydropower, the renewable energy potential of North Pacific America has hardly been tapped. In-state generation from wind, rooftop solar, conventional geothermal, small-scale hydro, and combined heat and power could supply all of current electric demand in Washington, Oregon, and California. Integrating variable sources such as wind and solar into the electric grid presents both challenges and opportunities.

Greater integration will require private and public investment, innovative financing arrangements to reduce initial outlays for renewable energy systems, and changes in regulations and policy. Compared with the failures of the Fukushima nuclear plant and Deepwater Horizon oil spill, and the public health costs associated with burning fossil fuels, a diversified portfolio of renewable energy generation would be highly resilient.

RECOMMENDATIONS

- Encourage the development of locally and regionally appropriate renewable energy resources, technologies and manufacturing.
- Encourage development of community-based thermal or electric energy self-reliance at the neighborhood or city scale.
- Develop effective processes for participatory and streamlined siting of renewable energy infrastructure.
- Develop financing mechanisms to reduce initial capital outlays for renewable energy systems and energy efficiency improvements.
- Enable growth of renewable energy markets through accreditation of renewable energy designs, equipment, and contractors.
- Establish building code and government procurement policies to support renewable energy development.

Reforming Capitalism

“Businesses need to be part of the solution – but business itself needs to be fundamentally restructured,” asserts B Lab’s Stephanie Ryan. In a TEDx talk, B Lab cofounder Jay Coen Gilbert cuts to the chase: “The system that we’re working to evolve is the system called capitalism.”

By law, corporations must maximize financial profits, and all too often they do so at the expense of everything else. Corporations enjoy the rights of people, but without most of our legal, social, and ethical responsibilities. It’s time to reevaluate how corporate and financial institutions might better serve their real purpose: to harness private enterprise for the public good.

B Lab has become a leading advocate of corporate reform, with a suite of programs to match. It certifies companies as “benefit corporations” (or B corporations): businesses that pass a comprehensive impact assessment, and that incorporate into their governing documents the interests of employees, consumers, communities, and the environment. In partnership with the American Sustainable Business Council, B Lab also promotes state-by-state adoption of legislation that defines the benefit corporation as a corporate class. Benefit corporations meet similarly rigorous standards for social and environmental performance, accountability, and transparency. Currently, over 500 companies in North America are certified, and seven U.S. states have passed legal reform.



B Corps are changing the way we do business.



Private enterprise can better serve the public good.

RESILIENCE IN PRACTICE



Other changes to business as usual are emerging among community-based organizations. The Alaska Sustainable Fisheries Trust offers a community-based model for achieving healthy fisheries and fishing economies. Community development banks, such as One Pacific Coast Bank, lend explicitly for social and environmental impact. Organizations such as the Center for Community Self-Help, originally based in North Carolina, and the Four Bands Community Fund, on the Cheyenne River Reservation, offer financial services, business development classes, technical support, and advocacy to individuals that have been excluded from credit and equity markets.

Furthermore, communities around the United States – as well as the federal government – are showing interest in social impact bonds, a public-private program developed in the United Kingdom. Under these “pay for success” bonds, the government contracts with private investors who guarantee payments for improved social outcomes.

These legal and business innovations can unleash the ingenuity and risk-taking of private capital to address social problems. A reformed capitalism offers greater opportunities for social entrepreneurship and seeks to develop rich feedbacks that align private incentives with the public good.

RECOMMENDATIONS

- Develop institutions and innovations that strengthen corporate enterprise on behalf of the public good.
- Develop institutions and innovations that strengthen impact investing.
- Develop institutions and innovations that strengthen local and regional investment models.
- Develop institutions and innovations that strengthen community trust models.

Planning for Equity

RESILIENCE IN PRACTICE



“Equity does not happen organically,” insists Amalia Alarcón de Morris, director of Portland’s Office of Neighborhood Involvement. “Every time we allocate resources, or plan programs or set policy, we need to ask ourselves: Who benefits by this policy or program and who is burdened by it?”

In Portland, as in most cities, the distribution of benefits and burdens has all too often split along class, race, ethnic, and geographic lines. To the city’s credit, it is working to fundamentally change the way its policies and programs address equity issues. Portland’s 25-year strategic plan, currently in public draft, begins with an equity framework for guiding the delivery of public services.

The challenges of planning for equity are, in part, confounded by geographic boundaries and political jurisdictions. One place that has reduced disparities in tax-base funded services at a regional metropolitan scale is Minnesota’s Twin Cities. Since 1975, each jurisdiction in a seven-county area has contributed 40 percent of commercial and industrial tax-base growth into a common pool managed by the region’s Metropolitan Council. Recent studies cited by the council show a reduction in per-capita tax-base disparities among jurisdictions from 10 to 1 to 3 to 1.

Across the country, inequities have also widened along rural-urban lines. In Washington and Oregon, for example, poverty levels in some rural counties exceed 20 percent or more. There is already urban-to-rural

support for critical services such as education and health care, with urban areas contributing more in-state financing than they receive. Yet in these states there is no strategic rural-urban equity planning akin to that undertaken by the city of Portland.

Initial pieces of such a plan are already in place, however. In both states, broad coalitions have joined together behind farm-to-school legislation that supports the viability of regional farms. Both states have invested in salmon habitat restoration. These initiatives exemplify the opportunities for rural job creation by working with nature to improve ecosystem services. Additional investments are sorely needed in forest and rangeland restoration. Taken together, these types of initiatives could form the core of a new rural-urban compact.

As for the significance of equity planning, research shows that lower income disparities correlate with a wide range of positive social benefits, including health, productivity, school achievement, and social trust. Equity is about more than fairness. It is a quality of public life that is critical to bolstering resilience – by both building social capital and expanding opportunities that, in turn, benefit all of society.



Equity is a concern along rural-urban lines.



Access to public transportation is part of planning for equity.

RECOMMENDATIONS

- Reduce disparities in access to public resources.
- Invest in public goods and community self-help capacities.
- Develop rural-urban partnerships to support viable business opportunities for providing ecosystem products and services.

Measuring What Matters

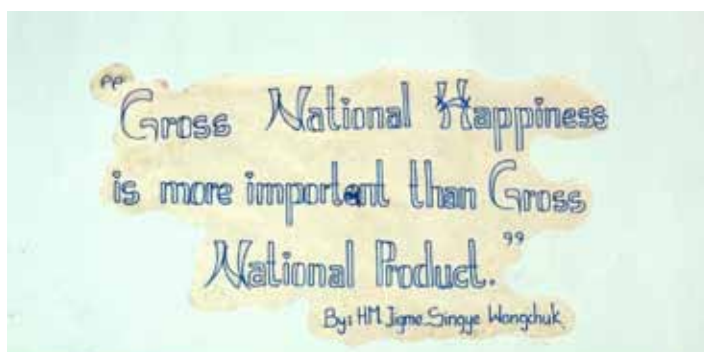
“Our ultimate goal is experiencing that our lives are going well,” says Juliet Michaelson of the New Economics Foundation. The London-based nonprofit has been a leader in promoting novel ways to measure what matters.

Around the world, a standard benchmark of progress is Gross Domestic Product (GDP), a blind and indiscriminating measure of economic activity. The more weapons that are purchased or prisons that are built, the more GDP rises. On the other hand, GDP finds no value in something that has not been paid for, such as at-home child care or nature’s services for food production, water filtration, and carbon storage.

There have been many efforts to adjust GDP to account for the value of such “nonmarket” activities, but only recently have researchers tried to indirectly measure wellbeing, which is often understood as a personal sense of thriving or happiness.

In 2009, a commission chaired by Nobel Prize-winning economists Joseph Stiglitz and Amartya Sen insisted on the issue’s urgency: “The time is ripe for our measurement system to shift emphasis from measuring economic production to measuring people’s wellbeing.”

Research on wellbeing is now growing rapidly. In 2011, the United Kingdom’s Office of National Statistics incorporated four questions on subjective wellbeing into its household survey. They are: Overall, how satisfied are you with your life nowadays? Overall, how happy did you feel yesterday? Overall, how anxious



“Gross National Happiness is more important than Gross National Product” by Jigme Singye Wangchuk, king of Bhutan, appears on a wall in Thimphu’s School of Traditional Arts

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did you feel yesterday? Overall, to what extent do you feel the things you do in your life are worthwhile? Many researchers consider the senses of purpose and accomplishment reflected in the last question – along with senses of autonomy, connectedness, and trust – as foundational to wellbeing.

A personal sense of wellbeing is, in turn, closely related to social wellbeing. In the U.K. jurisdictions of Manchester, Hertfordshire, and South Tyneside, the Young Foundation worked with local authorities to examine community development through a wellbeing lens. They found that personal wellbeing increased through regular contact among neighbors, greater involvement in local decision making, and greater responsibility for collaborative management of public resources. We have described resilience as a capacity that is critical to personal, social, and natural wellbeing. The relationship between resilience and wellbeing is mutual: each reinforces the other.

Other experiments in tracking wellbeing include Bhutan’s index of Gross National Happiness and, more recently, the Winnipeg community indicator system, the Greater Victoria Happiness Index Partnership, and the Seattle Area Happiness Initiative.

Economic activity alone cannot account for what really matters in our lives. Broadening our notions of wellbeing and improving our measurements can better indicate, and indeed can promote, the health and resilience of human and natural systems.

RECOMMENDATIONS

- Develop a richer understanding of the relationships between people and place and the specific factors that influence wellbeing.
- Develop maps and metrics to track wellbeing.
- Develop measures of wellbeing that are politically salient and can contribute to specific policy choices and outcomes.

Deepening Democracy

“I think people are looking for better ways to ‘do democracy,’” observes Tyrone Reitman of Healthy Democracy Oregon, advocate for the Citizens’ Initiative Review, a process for publicly evaluating state ballot measures.

The process works like this: A panel of citizens is recruited to be demographically representative of the state’s age, gender, ethnicity, geography, education, and party affiliation. The panel deliberates on a ballot measure for several days, informed by expert testimony. Then their findings – how many voted which way and why – are published in the official voters’ pamphlet. A study of the 2010 pilot found that it both enabled high-quality deliberation and proved helpful to voters.

“There is a point when people who have been somewhat passive participant-observers switch to being owners of the process,” relates Reitman. “Everybody can feel when it happens – and that’s when I see the potential.”

Around the world, that potential is being realized in the form of greater participation in municipal spending decisions. The process of participatory budgeting started in Porto Alegre, Brazil, where thousands of citizens contribute to annual decisions at neighborhood and citywide scales. A World Bank report credits the program with “a noticeable improvement in the accessibility and quality of various public welfare amenities” in the Brazilian cities where it has been adopted. More recently, Chicago and Toronto have run



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participatory budgeting exercises, and in 2012, residents of four New York City districts will prioritize \$6 million of public funds.

Other experiments in democracy include the Occupy Wall Street general assemblies, which use a consensus model of decision making. Several local and state jurisdictions around the United States have worked to remove big money from politics through “clean elections,” in which candidates depend only on public funds and small contributions. Both British Columbia and Ontario have convened citizens’ assemblies on electoral reform. Dozens of local jurisdictions around the United States have adopted community bills of rights that seek to limit the destruction of local resources by outside companies. And Ecuador and Bolivia are experimenting with constitutional reforms to recognize and protect the “rights of nature” and the rights of people and communities to access nature’s services.

Strengthening democratic practices and rights bolsters resilience by expanding opportunities through more equitable decision making, improving decision making through knowledge sharing and deliberation, and enabling greater flexibility and legitimacy in governance.

RECOMMENDATIONS

- Develop experiments in participatory decision making and governance.
- Protect citizen voices in the electoral process by removing special interests and supporting public-funding and other clean-election measures.
- Encourage legal protections to support the rights of communities and nature.

START HERE

The innovation stories we have profiled are stories of transformation, from the vulnerabilities of our current systems to plausible and more resilient alternatives. They demonstrate the potential for creating new rules, practices, and norms that can support the wellbeing of diverse people and places. Collectively, they inform our understanding of what is possible and how we can get there. Similar innovations could emerge elsewhere, in other sectors and at other scales. Across these stories, some fundamental themes become evident, including robust leadership, determined self-reliance, and a spirit of collaboration. Other common themes among these innovations include:

- Home-grown solutions that are bottom-up rather than top-down
- Systemic strategies that generate widely shared social, economic, and ecological benefits
- Legal, business, and financial innovations that depart from business as usual

- Approaches that are locally appropriate and reflect the politics of place
- The avoidance of ideological conflicts
- New ways of understanding and measuring wellbeing
- Innovations and initiatives that are scalable and replicable

Recognizing these patterns of resilience gives us a platform for initiating our own change. Transformation begins at home – at personal, local, and regional scales. We can start by experimenting; trying new approaches and adapting to our successes and failures. We can develop new partnerships among public and private sectors that allow for more opportunities. We can work to remove barriers and develop feedbacks that foster innovation. And, we can measure our success by the wellbeing of people and place. Change starts here, at every scale and every region.

“We’re moving, if we’re lucky, from the world of few and big to the world of small and many.”

Bill McKibben

“The Era of Small and Many,” *Orion Magazine*, 2011



Resilient Economies: How Will We Create Wellbeing for People and Place? (detail)

EPILOGUE: Learn by Going

Two decades ago, we at Ecotrust charted a course. We fixed bearings for where conservation meets development. On modern maps, this was mostly uncharted territory: the common ground on which economy works with ecology to create a more natural model of development.

Starting with early projects to characterize and map the status of temperate rain forests and Pacific salmon, we expanded to develop initiatives in mission-based banking, green building, spatial planning, indigenous leadership, forest management, and rural-urban market connections. A few examples of our work are mentioned in the stories of innovation.

The idea for this publication emerged in 2005. We had been working with California's Roots of Change Council to develop a vision, agenda, and indicators for cultivating a sustainable and inclusive food system. As the consulting drew to a close, we began to wonder how the project might be reconceived to span multiple social-ecological systems, at broader geographic scales. What would the world look like if its societies reorganized around the wellbeing of people and place?

The following year, we received a surprise. A group of Australian scientists and philanthropists reached out to "learn about the Ecotrust model." How might our approach be used to understand the very different terrain of Australia's North? Listening to their stories, we felt a sense of common cause – and began to see the potential of connecting across cultures and continents, in order to share and learn from each other's institutional experimentation.

In 2008, Buzz Holling joined the board of Ecotrust Canada. Holling, who first developed theories of

ecological resilience in the 1970s, stimulated a nascent enthusiasm at Ecotrust for organizing our thinking around the ideas of resilience. Looking back on the first 20 years of our work, we began to see that resilience – the attempt to enhance resilience in social and natural systems – runs through it like a red thread.

These experiences led to our 2011 work on *Resilience & Transformation*. Our goal has been to translate resilience theory into practical principles, and then to test and interrogate them in the context of the region we know best. Our hope has been that the resulting framework will both translate to other regions – which share similar human needs, but have differing endowments of natural, social, and economic capital – and inform further work in our home region.

As the project progressed, we sought advice and participation from multiple sources. Twenty-three people, representing a wide range of expertise, joined us in scenario-based conversations about current trends, emerging innovations, and "signposts" of change. Nine others offered their stories as examples of innovations that are already effecting institutional transformation.

Forty-four extraordinary leaders from around the world came together in September 2011 for the first Resilience Regions convening. Despite vast differences in geography, culture, and language, all regions of the world are confronting similar and unprecedented challenges. The leaders and innovators who convened in Portland share a vision of a resilient world that can more reliably and equitably provide for human and natural wellbeing. We all recognize that strategies for building this resilience begin at home, in the geographic regions that condition our interdependence with each other and with nature – where the implications for

wellbeing are most profound. We all see the potential to align policies, economies, and metrics to support living cultures and living systems.

Now is the time for regional leadership, for inspiring innovation and practice, and for a global alignment of visions and actions. An emerging international community committed to the practices of resilience offers opportunities to come together to compare challenges, barriers, and breakthroughs in our own regions; to discover what is deeply common among us; to identify tools and tactics for transformation; and to forge a shared agenda and the beginnings of a pan-global alliance to act on it. This community network enables cross-scale support and knowledge sharing, embodying the type of “scaling out” that is essential to a robust regionalism.

We hope that *Resilience & Transformation* and the emergent network will inform and inspire the work of many who seek to foster wellbeing for people and place. As for Ecotrust, we strive to follow the words of poet Theodore Roethke: to learn by going where we have to go.

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Scenario-based Conversations

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Marilyn Sewell, former senior minister, First Unitarian Church of Portland
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Jodie Toft, fisheries ecologist, Natural Capital Project
Courtney White, executive director, Quivira Coalition
V. John White, executive director, Center for Energy Efficiency and Renewable Technologies
Bob Wise, senior project manager, Cogan Owens Cogan, LLC
Aaron Wolf, professor of geography, Oregon State University
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Additional Conversations

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Additional Graphics

John Hendrix - Resilient Economies: How Will We Create Wellbeing for People and Place?
Jeremy C. Joseph - Western Electric Grid and its Balancing Authorities
Wade Larsen - Efficiency of U.S. Electricity Generation; Possibility Landscape; Weight and Value of U.S. Fish Brought to Market

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Emily McGinty, Clara Sachsse

Transcription

Juliana Baseman, Cailin Bell, Claire Draudt, Dan Mazuz, Carin Pike, Lauren Schleyer

Glossary

Human resilience: The capacity to effectively influence and adapt to change.

Institutions: The formal and informal structures that organize social and social-ecological interaction: rules, practices and social norms.

Institutional innovation: An activity that develops the social, political, and economic relationships of an alternative to the dominant regime.

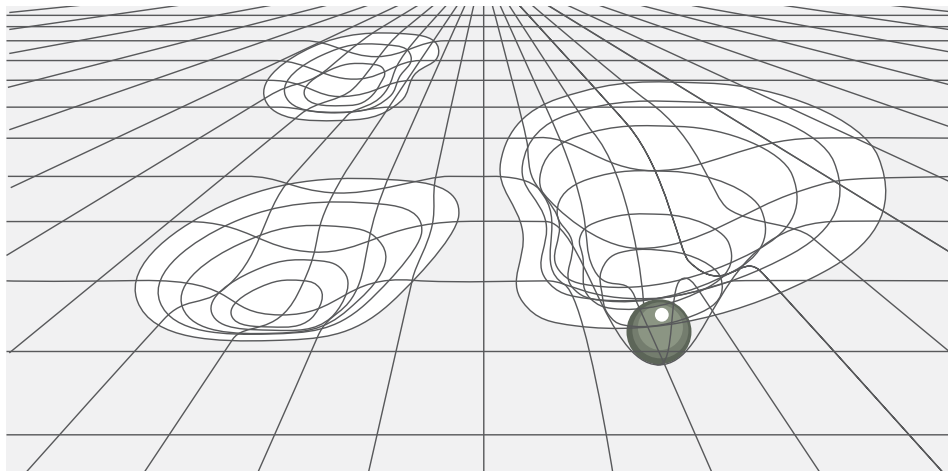
Possibility landscape: The total extent of potential regimes in a given system.

Regime: A mutually reinforcing set of factors – value systems, institutions, infrastructures, and technologies – that shape and are shaped by ecological interdependence.

Region: A discreet area, ecologically influenced, that represents a set of social activities.

Transformation: A change in dominance from one regime to another in the possibility landscape; a “regime shift.”

Trap: A persistent maladaptive state; a dominant regime that undermines resilience and human wellbeing.



Possibility Landscape

A possibility landscape illustrates the extent of all potential regimes in a system. Regimes are pictured as basins, and a ball indicates the dominant regime, with alternatives also in view. The contours of the landscape and its basins are constantly evolving, through both “natural” ecosystem processes and human interactions.

Notes

A CULTURE OF RESILIENCE

Resilience and transformation: Walker et al. (2006); Folke et al. (2010); Walker (2011).

Institutions: North (1990); Scott (2001); Hotimsky et al. (2006).

Resilience in Practice

Resilience and wellbeing: Armitage et al. (forthcoming).

Psychological resilience: Ungar (2008).

The Language of Resilience

Resilience and Timex commercial: Achenbach (2011).

World Economic Forum: Van der Elst & Davis (2011).

Efforts to optimize resource productivity: Holling (1995).

Regimes: Holtz et al. (2008); Sendzimir et al. (2008); Westley et al. (2011); Hill & Kolmes (forthcoming).

Getting stuck in traps: Scheffer & Westley (2007); Carpenter & Brock (2008).

A Regional Approach

Regionalism: Jacobs (1961); Katz (1990); Calthorpe & Fulton (2001); Seltzer & Carbonell (2011).

Problemsheds: Allan (1998).

Ad hoc regionalism: Porter & Wallis (2002).

Resilience and regions: Peterson et al. (1998); Bristow (2010); Pendell et al. (2010); Vynne et al. (2011).

REGIONAL VULNERABILITIES

The phrase “North Pacific America”: Stadler (2008).

Oceans

Fishery declines: McEvoy (1990); Glavin (1996); Lichatowich (1999).

Fraser River sturgeon: Semakula & Larkin (1968).

Aquaculture net loss: Naylor et al. (2002).

Hatcheries and subsidies: Knapp (1999); Williams et al. (2003); Hatchery Scientific Review Group (HSRG) (2009).

Administrative gaps and scale matching: Francis et al. (2008).

Commodity systems: Sustainability Institute (2003); Lyson et al. (2008); Conathan (2011).

Forest

Temperate rain forests: Wolf et al. (1995).

Land distribution: White (1991:137–54); Worster (1992:234–35); Robbins (2000:6–7).

Native burning: Robbins (1997:94).

Oregonian on Midwest depletion: Robbins (1997:210).

Congressional action: Wilkinson (1992:122–24); Worster (1992:234–35); Hirt (1996:29).

Exports to San Francisco: Robbins, (1997:94, 209).

Railroad land grants: Henry (1945); Wilkinson (1992:122).

Private ownership of pre-WWII harvests: Hirt (1996).

Harvest peaks: Robbins (1989:242, 246).

Northwest Forest Plan: Robbins (2004:205–12).

TIMOs and REITs: Binkley (2007).

Boom and bust, overinvestment: Robbins (1989:236–37).

Water

Early agricultural irrigation: Dunbar (1983:1–35).

Gold mining: Wilkinson (1992:34–43); Hundley (2001:69–79).

Western water law: Dunbar (1983:59–132); Bastasch (1998:43–58).

Reclamation: Dunbar (1983:46–58); Hundley (2001:203–302).

Main stem Fraser dam proposals: Lichatowich (1999:195–96).

Indoor plumbing among American Indians and Alaska Natives: Gasteyer (2009).

California water sector as consumer of energy: Klein et al. (2005).

Virtual water import and export: Chapagain & Hoekstra (2008).

Water and climate projections: Barnett et al. (2008).

GRACE satellite and California groundwater withdrawals: Kenny et al. (2005); Christian-Smith et al. (2011); Famiglietti et al. (2011); Nelson (2011).

Food

Indigenous cultivation: Sproat (1868:220); Krech (1999:106); Turner (2005:147–77); Fryer (2007); Johnsen (2009).

Introduction of non-native species: White (1991:231–32).

“Wall-to-wall wheat”: Preston (1981:94).

Farm numbers in Willamette Valley: Robbins (1997:114).

Salmon canneries: Smith (1979:63–72).

Patterns of agricultural industrialization: Cochrane (1993); Gardner (2002).

Global yields: Smil (2001:4).

Get big or get out: Woeste et al. (2010).

Chronic hunger: Food and Agriculture Organization (2010).

Social and economic factors behind famine: Sen (1983).

The paradox of industrial agriculture: Scott (1998:262–306).

Global inputs: Smil (2001:4, 40–41).

Cost of inputs: National Research Council (2010:67–68).

Nitrogen absorption: Tilman et al. (2002).

Pesticides: Gilliom & Hamilton (2006).

Loss of on-farm diversity: Gardner (2002:61).

Livestock production: McBride (1997).

Intensification of production: National Research Council (2010:46).

Concentrations of ownership: Hendrickson & Heffernan (2007).

Labor concerns: National Research Council (2010:71).

Over- and malnourishment: Centers for Disease Control and Prevention (2009).

Food insecurity: Nord et al. (2010).

Energy

General Electric film: Wolff Studios, Inc. (1952).

Energy worldviews: Nye (1999).

Grid history: Fox-Penner (2010:2–5).

Economies of scale: Sovacool (2008:16).

Over 3,000 electric utilities: Energy Information Administration (2007).

Hydropower: British Columbia Ministry of Energy and Mines (2009); Energy Information Administration (2009).

Energy return on energy investment: Hall & Day (2009).
Portland savings on mobility: Cortright (2007).
B.C. biomass exports: Bradley (2009).
Grid governance, cooperation, and standards: National Institute of Standards and Technology (2010).
Efficiency gains of combined heat and power: Ayres & Ayres (2009).
The benefits of distributed generation: Lovins et al. (2002).

Built Environment

Cities as places of diversification, specialization, and productivity: Bettencourt & West (2010).
Early town planning: Reps (1982); Nicholas (1999); Nelson & Lang (2009:4–7).
Streetcars and their removal: Condon (2010:17–38).
Mt. Hood freeway: Ballestrem (2011).
Daily travel: National Household Travel Survey (2009); Mustel Group Market Research & Halcrow Consulting Inc. (2010).
Land use and land cover change: Ellis (2010).
Impervious surfaces and watershed health: Booth et al. (2004).
Neighborhood segregation in Seattle: Silva (2009).
Oregon's constitution: Oregon Historical Society (2008).
Trendsetter and hinterland: Schwantes (1989:503–22).
Disparities in access to public transportation and services: Yosick (2009).

STORIES OF INNOVATION

Process of visioning: Meadows (1994); Holling (2011).

Working with Nature

Clean Water Services: Cochran (2011).
Forestry for multiple ecosystem services: Franklin et al. (2000); Davies (2011).

Connecting Value Chains

Ag of the middle: Lyson et al. (2008).

Strengthening Collaborative Management

West Hawai'i Regional Fishery Management Area: Tissot et al. (2009).
Practices for strengthening co-management capacities: Berkes (2009).

Sharing Resources

U.S. cars parked 22 or more hours a day: Hu and Reuscher (2004:44).
Berkeley car-sharing study: Martin et al. (2010).
Frost & Sullivan car-sharing study: Zhao (2010).
Home size as a determinant of environmental impact: Palmeri (2010).

Shifting to Renewables

Sixty countries using feed-in tariffs: REN21 (2011).
European Commission report on feed-in tariffs: Commission of the European Communities (2008).
Ontario's feed-in tariff program: Ontario Ministry of Energy (2011).
In-state renewable electricity generation potential: Farrell and Morris (2010).
Denmark grid integration: Lindboe (2011).

Planning for Equity

Twin Cities Metropolitan Council experience with regional tax-base sharing: Orfield & Wallace (2007); Metropolitan Council (2010).
Washington and Oregon income disparities: Bureau of Economic Analysis (2011).
Washington and Oregon county-level poverty: U.S. Census Bureau (2011).
Relative rural-urban contributions to state budgets: Cortright (2011).
Correlation with positive benefits: Wilkinson and Pickett (2009).
A "new rural-urban compact": Dabson (2007); Gutman (2007).

Measuring What Matters

Wellbeing: Huppert and So (2009); Abdallah et al. (2010); Helliwell (2011); Seligman (2011).

Deepening Democracy

Study of Citizens' Initiative Review: Gastil and Knobloch (2011).
World Bank study on participatory budgeting: Bhatnagar et al. (2003).

Bibliography

- Abdallah, Saamah, Sorcha Mahony, Nic Marks, Juliet Michaelson, Charles Seaford, Laura Stoll and Sam Thompson. 2010. Measuring our Progress: The Power of Well-Being. New Economics Foundation.
- Achenbach, Joel. 2011. Japan's 'black swan': Scientists ponder the unparalleled dangers of unlikely disasters. The Washington Post on the web 17 Mar. 2011. Accessed 29 Jul. 2011 <http://www.washingtonpost.com/national/japans-black-swan-scientists-ponder-the-unparalleled-dangers-of-unlikely-disasters/2011/03/17/ABj2wTn_print.html>.
- Allan, Tony. 1998. Watersheds and Problemsheds: Explaining the Absence of Armed Conflict Over Water in the Middle East. Middle East Review of International Affairs 2.1. Accessed 1 Aug. 2011 <<http://meria.idc.ac.il/journal/1998/issue1/jv2n1a7.html>>.
- Arbitise, Alan, Anne V. Moudon, and Ethan Selzer. 1997. Cascadia: An Emerging Regional Model. In Robert Geddes (ed.), *Cities in Our Future*. Island Press: Washington, DC.
- Armitage, D., E. Allison, M.C. Badjeck, C. Bene, T. Charles, R. Chuenpagdee, S. Coulthard, D. Johnson, G. Murray, and I. Perry. (forthcoming). The Interplay of Wellbeing and Resilience Concepts: Towards a Social-Ecological Perspective.
- Ayres, Robert U. and Edward H. Ayres. 2009. *Crossing the Energy Divide: Moving from Fossil Fuel Dependence to a Clean-Energy Future*. Prentice Hall: Upper Saddle River, NJ.
- Ballestrem, Val. 2011. Mt. Hood Freeway. The Oregon State Encyclopedia / Portland State University. Accessed 29 Jul. 2011 <http://www.oregonencyclopedia.org/entry/view/mt_hood_freeway/>.
- Barnett, Tim P., David W. Pierce, Hugo G. Hidalgo, Celine Bonfils, Benjamin D. Santer, Tapash Das, Govindasamy Bala, Andrew W. Wood, Toru Nozawa, Arthur A. Mirin, Daniel R. Cayan, Michahel D. Dettinger. 2008. Human-Induced Changes in the Hydrology of the Western United States. *Science* 319(5866): 1080-1083.
- Bastasch, Rick. 1998. *Waters of Oregon: A Source Book on Oregon's Water and Water Management*. Oregon State University Press: Corvallis, OR.
- Benyus, Janine. 2011. Janine Benyus: Entrepreneurship and biomimicry. 2011 Nobel Laureate Symposium: Stockholm Dialogue. Accessed Fryer, Janet L. 2007. *Quercus kelloggii*. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. Accessed 15 Jan. 2012 <<http://www.fs.fed.us/database/feis/plants/tree/quekel/all.html>>. d 10 Aug. 2011 <<http://www.stockholmresilience.org/42/seminar-and-events-/seminar-and-event-videos/5-23-2011-janine-benyus-entrepreneurship-and-biomimicry.html>>.
- Berkes, Fikret. 2009. Evolution of Co-management: Role of Knowledge Generation, Bridging Organizations and Social Learning. *Journal of Environmental Management* 90:1692–1702.
- Bettencourt, Louis and Geoffrey West. 2010. A unified theory of urban living. *Nature* 467: 912–913.
- Bhatnagar, Deepti, Animesh Rathore, Magüi Moreno Torres and Parameeta Kanungo. 2003. Empowerment Case Studies: Participatory Budgeting in Brazil. World Bank.
- Binkley, Clark S. 2007. The Rise and Fall of the Timber Investment Management Organizations: Ownership Changes in U.S. Forestlands. Pinchot Distinguished Lecture. Pinchot Institute for Conservation. Accessed 10 Aug. 2011 <<http://www.pinchot.org/files/Binkley.DistinguishedLecture.2007.pdf>>.
- Booth, Derek, James R. Karr, Sally Schauman, Christopher P. Konrad, Sarah A. Morley, Marit G. Larson, and Stephen J. Burges. 2007. *Reviving Urban Streams: Land Use, Hydrology, Biology, and Human Behavior*.
- Bradley, Douglas. 2009. Canada Report on Bioenergy. Climate Change Solutions; Canadian Bioenergy Association; Canadian Renewable Fuels Association; Natural Resources Canada-Canadian Wood Fibre Centre.
- Bristow, Gillian. 2010. Resilient Regions: Re-'Place'ing Regional Competitiveness. *Cambridge Journal of Regions, Economy and Society* 3:153–167.
- British Columbia Ministry of Energy and Mines. Electric Generation and Supply (2009). Accessed: 20 Aug. 2011 <<http://www.empr.gov.bc.ca/EPD/Electricity/supply/Pages/default.aspx>>.
- Bureau of Economic Analysis. 2011. Personal Income and Employment Summary (CA04). U. S. Department of Commerce. Accessed 30 Nov. 2011 <<http://www.bea.gov/iTable/iTable.cfm?ReqID=70&step=1&isuri=1&acrdn=5>>.
- Calthorpe, Peter. 2011. *Urbanism in the Age of Climate Change*. Island Press: Washington, DC.
- Calthorpe, Peter and William B. Fulton. 2001. *The Regional City: Planning For the End of Sprawl*. Island Press: Washington, DC.
- Carpenter, Stephen R. and William A. Brock. 2008. Adaptive capacity and traps. *Ecology and Society* 13(2): 40.
- Centers for Disease Control and Prevention. 2009. Childhood Overweight and Obesity. Accessed 22 Aug. 2011 <<http://www.cdc.gov/obesity/childhood/data.html>>.
- Chapagain, Ashok K., Arjen Y Hoekstra. 2008. The global component of freshwater demand and supply: and assessment of virtual water flows between nations as a result of trade in agricultural and industrial products. *Water International* 33(1): 19–32. Accessed 22 Aug. 2011 <<http://www.waterfootprint.org/Reports/ChapagainHoekstra-2008-GlobalVirtualWaterFlows.pdf>>.
- Christian-Smith, Juliet, Morgan C. Levy, Peter H. Gleick. 2011. Impacts of the California Drought from 2007 to 2009. Pacific Institute. Accessed 22 Aug. 2011 <http://www.pacinst.org/reports/california_drought_impacts/>.
- Cochran, Bobby and Charles Logue. 2011. A Watershed Approach to Improve Water Quality: Case Study of Clean Water Services' Tualatin River Program. *Journal of the American Water Resources Association* 47:29–38.
- Cochrane, Willard W. 1993. *Development of American Agriculture: A Historical Analysis*. University of Minnesota Press: Minneapolis, MN.
- Commission of the European Communities. 2008. Commission Staff Working Document: The Support of Electricity from Renewable Energy Sources. Commission of the European Communities.
- Committee on Twenty-First Century Systems Agriculture and National Research Council. 2010. *Toward Sustainable Agricultural Systems in the 21st Century*. National Academies Press: Washington, DC.
- Conathan, Michael. 2011. Fish on Fridays: Waking from the Gluttony. American Progress. Accessed 22 Aug. 2011 <http://www.americanprogress.org/issues/2011/03/fof_031111.html>.
- Condon, Patrick M. 2010. *Seven Rules for Sustainable Communities: Design Strategies for the Post-Carbon World*. Island Press: Washington, DC.

- Cortright, Joe. 2007. Portland's Green Dividend: A White Paper from CEOs for Cities. Accessed 22 Aug. 2011. <<http://www.ceosforcities.org/files/PGD%20FINAL.pdf>>.
- Cortright, Joseph. 2011. Who Pays, Who Benefits? An Analysis of Taxes and Expenditures in Oregon. In Hibbard, Michael, Ethan Seltzer, Bruce Weber and Beth Emshoff (eds.). *Toward One Oregon: Rural-Urban Interdependence and the Evolution of a State*. Oregon State University Press: Corvallis, OR.
- Dabson, Brian. 2007. *Rural-Urban Interdependence: Why Metropolitan and Rural America Need Each Other*. Brookings Institution.
- Davies, Brent. 2011. Forestry Balances Profit and Conservation in the Pacific Northwest. *Solutions* 2(6): 57–63.
- Dunbar, Robert G. 1983. *Forging New Rights in Wester Waters*. University of Nebraska Press, Lincoln, NE
- Ellis, Erle. 2010. Land-use and Land-cover Change. *The Encyclopedia of Earth*. Accessed 10 Aug. 2011 <http://www.eoearth.org/article/Land-use_and_land-cover_change>.
- Energy Information Administration. 2007. *Electric Power Industry Overview 2007*. U.S. Department of Energy. Accessed 10 Aug. 2011 <<http://205.254.135.24/cneaf/electricity/page/prim2/toc2.html>>.
- Energy Information Administration. 2009. *State Energy Data System*, U.S. Department of Energy. Accessed 10 Aug. 2011 <<http://205.254.135.24/state/seds/>>.
- Famiglietti, J.S., M. Lo, S.L. Ho, J. Bethune, K.J. Anderson, T.H. Syed, S.C. Swenson, C.R. de Linage, M. Rodell. 2011. Satellites measure recent rates of groundwater depletion in California's Central Valley. *Geophysical Research Letters* 38, L03403, doi:10.1029/2010GL046442. Accessed 22 Aug. 2011 <<http://www.agu.org/pubs/crossref/2011/2010GL046442.shtml>>.
- Farrell, John and David Morris. 2010. *Energy Self-Reliant States: Second and Expanded Edition*. Institute for Local Self-Reliance.
- Fishman, Charles. 2011. *The Big Thirst: The Secret Life and Turbulent Future of Water*. Free Press, Florence, MA. Accessed 22 Aug. 2011 <<http://www.amazon.com/The-Big-Thirst-ebook/dp/B0043RSJVI>>.
- Folke, Carl, Steven R. Carpenter, Brian H. Walker, Marten Scheffer, Terry Chapin, and Johan Rockström. 2010. Resilience thinking: integrating resilience, adaptability and transformability. *Ecology and Society* 15(4): 20.
- Food and Agriculture Organization. 2010. 925 Million in Chronic Hunger Worldwide. Accessed 30 Aug. 2011 <<http://www.fao.org/news/story/en/item/45210/icode/>>.
- Fox-Penner, Peter. 2010. *Smart Power: Climate Change, the Smart Grid, and the Future of Electric Utilities*. Island Press: Washington, DC.
- Francis, R. C., J. E. Little, and J. Bloeser. 2008. Matching Spatial Scales of Ecology, Economy, and Management for Groundfish of the U.S. West Coast Marine Ecosystem: A State of the Science Review. A report to the Lenfest Ocean Program at The Pew Charitable Trust.
- Franklin, Jerry, David Perry, Reed Noss, David Montgomery and Christopher Frissell. 2000. *Simplified Forest Management to Achieve Watershed and Forest Health: A Critique*. National Wildlife Federation.
- Fryer, Janet L. 2007. *Quercus kelloggii*. In: *Fire Effects Information System*, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. Accessed 15 Jan. 2012 <<http://www.fs.fed.us/database/feis/plants/tree/quekel/all.html>>.
- Gardner, Bruce L. 2002. *American Agriculture in the Twentieth Century: How it Flourished and What it Cost*. Harvard University Press: Cambridge, MA.
- Gasteyer, Stephen, Rahul T. Vaswani. 2004. *Still Living without the Basics in the 21st Century*. Rural Community Assistance Partnership, Inc. Accessed 30 Aug. 2011 <<http://www.rcap.org/stilllivingwithoutbasics>>.
- Gastil, John and Katie Knobloch. 2011. *Evaluation Report to the Oregon State Legislature on the 2010 Oregon Citizens' Initiative Review*. University of Washington.
- Geddes, Robert, ed. 1997. *Cities in Our Future*. Island Press: Washington, DC.
- Gilliom, Robert J. and Pixie A. Hamilton. 2006. *Pesticides in the Nation's Streams and Ground Water, 1992–2001 – A Summary*. U.S. Geological Survey.
- Glavin, Terry. 1996. *Dead Reckoning: Confronting the Crisis in Pacific Fisheries*. David Suzuki Foundation: Vancouver, BC.
- Gliessman, S.R. 1998. *Agroecology: Ecological Processes in Sustainable Agriculture*. Ann Arbor Press: Chelsea, MI.
- Gutman, Pablo. 2007. Ecosystem services: Foundations for a New Rural–Urban Compact. *Ecological Economics* 62: 383–387.
- Hall, Charles A. S. and John W. Day. 2009. Revisiting the Limits to Growth after Peak Oil. *American Scientist* 97: 230–237.
- Hatchery Scientific Review Group (HSRG). 2009. *Report to Congress on Columbia River Basin Hatchery Reform*. Hatchery Scientific Review Group.
- Hawken, Paul. 2009. *Commencement Address: Healing or Stealing?* University of Portland. Accessed 10 Aug. 2011. <<http://www.up.edu/commencement/default.aspx?cid=9456>>.
- Helliwell, John F. 2011. How Can Subjective Well-Being be Improved?, In Gorbet, F. and A. Sharpe (eds.). *New Directions for Intelligent Government in Canada*. Centre for the Study of Living Standards: Ottawa, Canada.
- Hendrickson, Mary and William Heffernan. 2007. *Concentration of Agricultural Markets*. Accessed 20 Aug. 2011. <<http://www.foodcircles.missouri.edu/07contable.pdf>>.
- Henry, Robert S. 1945. The Railroad Land Grant Legend in American History Texts. *The Mississippi Valley Historical Review* 32(2). Accessed 30 Aug. 2011 <<http://www.jstor.org/pss/1898207>>.
- Heying, Charles. 2010. *Brew to Bikes: Portland's Artisan Economy*. Ooligan Press: Portland, OR.
- Hill, Greg and Steve Kolmes. (forthcoming). *Adaption and Transformation in the Columbia River Basin*.
- Hirt, Paul W. 1996. *A Conspiracy of Optimism: Management of the National Forests Since World War Two*. University of Nebraska Press: Lincoln, NE.
- Holling, C.S. 2011. *Lessons from Active Adaptive Management Experience: Speech to 2011 Annual Applied Biology Conference*.
- Holling, C. S. 1995. What Barriers? What Bridges?, p.3–34 in *Barriers and Bridges to the Renewal of Regional Ecosystems*. Columbia University Press.
- Holtz, George, Marcela Brugnach, and Claudia Pahl-Wostl. 2007. Specifying "regime" - A framework for defining and describing regimes in transition research. *Technological Forecasting and Social Change* 75: 623–643.

- Hotimsky, S., R. Cobb and A. Bond. 2006. Contracts or Scripts? A Critical Review of the Application of Institutional Theories to the Study of Environmental Change. *Ecology and Society* 11(1): 41.
- Hu, Patricia S. and Timothy R. Reuscher (2004). Summary of Travel Trends, 2001 National Household Travel Survey, Table 15. Federal Highway Administration, U.S. Dept of Transportation.
- Hudson, Ray. 2010. Resilient regions in an uncertain world: Wishful thinking or a practical reality? *Cambridge J Regions Econ Soc* 3: 11–25.
- Hundley, Norris Jr. 2001. *The Great Thirst: Californians and Water-A History*, Revised Edition. University of California Press: Berkeley, CA.
- Huppert, Felicia A. and Timothy T. C. So. 2009. What Percentage of People in Europe are Flourishing and What Characterises Them? University of Cambridge Well-Being Institute.
- Jacobs, Jane. 1961. *The Death and Life of Great American Cities*. Random House: New York, NY.
- Johnsen, Bruce D. 2009. Salmon, Science, and Reciprocity on the Northwest Coast. *Ecology and Society* 14(2): 43. Accessed 30 Aug. 2011 <<http://www.ecologyandsociety.org/vol14/iss2/art43/>>.
- Katz, Bruce, ed. 2000. *Reflections on Regionalism*. Brookings Institution Press: Washington, DC.
- Kenny, Joan F., Nancy L. Barber, Susan S. Hutson, Kristin S. Linsey, John K. Lovelace, Molly A. Maupin. 2009. Estimated Use of Water in the United States in 2005. U.S. Geological Survey Circular 1344. Accessed 22 Aug. 2011 <<http://pubs.usgs.gov/circ/1344/>>.
- Klein, Gary, Martha Krebs, Valerie Hall, Terry O'Brien, B.B. Blevins. 2005. California's Water-Energy Relationship Report. California Energy Commission Final Staff Report. <http://www.energy.ca.gov/2005publications/CEC-700-2005-011/CEC-700-2005-011-SF.PDF>
- Knapp, G.P. 1997. Alaska salmon ranching: an economic review of the Alaska Salmon Hatchery Programme. Accessed 22 Aug. 2011 <<http://www.cabdirect.org/abstracts/20001808175.html;jsessionid=A1E3672001B90F1EFD3F48AA0C7FC2B0>>.
- Krech III, Shepard. 2000. *The Ecological Indian: Myth and History*. W. W. Norton & Company: New York, NY.
- Lichatowich, Jim. 1999. *Salmon Without Rivers: A History of the Pacific Salmon Crisis*. Island Press: Washington, DC.
- Lindboe, Hans Henrik. 2011. Enabling Renewable Energy Integration in Denmark. TomKat Center for Sustainable Energy. Accessed 15 Nov. 2011 <http://cyperusmedia.com/tomkat/GRID_2011_Integration.html#vid5>.
- Loorbach, Derk, Niki Frantzeskaki and Wil Thissen. 2011. A Transition Research Perspective on Governance for Sustainability, In Jaeger, Carlo C., J. David Tabara and Julia Jaeger (eds.). *European Research on Sustainable Development: Transformative Science Approaches for Sustainability*. Springer-Verlag: Berlin, Germany.
- Lovins, Amory B., E. Kyle Datta, Thomas Feiler, Karl R. Rabago, Joel N. Swisher, Andre Lehmann, and Ken Wicker. 2002. *Small Is Profitable: The Hidden Economic Benefits of Making Electrical Resources the Right Size*. Rocky Mountain Institute.
- Lyson, Thomas A, W. Stevenson, and Rick Welsh. 2008. *Food and the Mid-Level Farm: Renewing an Agriculture of the Middle*. The MIT Press: Cambridge, MA.
- Martin, Elliot, Shaheen, Susan A. and Jeffrey Lidicker. 2010. Impact of Carsharing on Household Vehicle Holdings. Transportation Research Record: Journal of the Transportation Research Board 2143:150–158.
- McBride, William D. 1997. Change in U.S. Livestock Production 1969–92. *Agricultural Economics Report* 754: 52. Accessed 30 Aug. 2011 <<http://www.ers.usda.gov/Publications/AER754/>>.
- McEvoy, Arthur F. 1990. *The Fisherman's Problem: Ecology and Law in the California Fisheries, 1850-1980*. Cambridge University Press: Cambridge, UK.
- McKinsey Global Institute. 2008. *Mapping Global Financial Markets: Fifth Annual Report*. Accessed 30 Aug. 2011 <http://www.mckinsey.com/mgi/reports/pdfs/fifth_annual_report/fifth_annual_report.pdf>.
- Meadows, Donella H. 1996. *Envisioning a Sustainable World*. In Costanza, Robert, Olman Segura and Juan Martinez-Alier (eds.). *Getting Down to Earth, Practical Applications of Ecological Economics*. Island Press: Washington DC.
- Metropolitan Council. 2010. Fiscal disparities law seen as big asset for Twin Cities area. Metropolitan Council. Accessed 15 Nov. 2011 <<http://www.metrocouncil.org/newsletter/planning2010/FiscalDisparitiesOct4.htm>>.
- Mustel Group Market Research & Halcrow Consulting Inc. 2010. TransLink's 2008 Regional Trip Diary Survey. Presented to: South Coast British Columbia Transportation Authority. Mustel Group Market Research & Halcrow Consulting Inc.
- National Household Travel Survey. 2009. Person Trips. U.S. Department of Transportation. Accessed 18 Aug. 2011 <<http://nhts.ornl.gov/tables09/ae/work/Job16711.html> and <http://nhts.ornl.gov/tables09/ae/work/Job16747.html>>.
- National Institute of Standards and Technology. 2010. NIST Framework and Roadmap for Smart Grid Interoperability Standards, Release 1.0. National Institute of Standards and Technology, Department of Commerce.
- National Research Council (Committee on Managing Global Genetic Resources: Agricultural Imperatives). 1993. *Managing Global Genetic Resources: Agricultural Crop Issues and Policies*. National Academy of Sciences.
- Naylor, Rosamond L., R. Goldberg, M. Beveridge, J. Clay, C. Folke, N. Kautsky, J. Lubchenco, H. Mooney, J. Primavera, M. Troell. 2002. *Aquaculture: A Net Loss? Conservation Biology in Practice* 2(4).
- Nelson, Arthur C. and Robert Lang. 2009. *The New Politics of Planning*. Urban Land Institute: Washington, DC.
- Nelson, Rebecca. 2011. Uncommon Innovation: Developments in Groundwater Management Planning in California. *Water in the West Working Paper* 1. Accessed 30 Aug. 2011 <http://www.stanford.edu/group/waterinthewest/cgi-bin/web/sites/default/files/Nelson_Uncommon_Innovation_March_2011.pdf>.
- Nicholas, James C. 1999. *Symposium: State and Regional Land Use Planning: The Evolving Role of the State*. St. Johns Law Review Association.
- Nord, Mark, Alisha Coleman-Jensen, Margaret Andrews, and Steven Carlson. 2010. Household Food Security in the United States, 2009. *Economic Research Report* 108: 66. Accessed 30 Aug. 2011 <<http://www.ers.usda.gov/Publications/err108/>>.
- North, Douglass C. 1990. *Institutions, Institutional Change and Economic Performance*. University of Cambridge Press: Cambridge, UK.
- Nye, David E. 1999. *Consuming Power: A Social History of American Energies*. MIT Press: Cambridge, MA.

- Ontario Ministry of Energy. 2011. McGuinty Government Continues To Build Ontario's Clean Energy Economy. Ontario Ministry of Energy. Accessed 30 Nov. 2011 <<http://news.ontario.ca/mei/en/2011/10/moving-renewable-energy-forward.html>>.
- Oregon Historical Society. 2008. The History Minutes: Oregon's Exclusion Laws. Oregon Historical Society. Accessed 10 Aug. 2011 <<http://www.ohs.org/education/history-minutes-oregons-exclusion-laws.cfm>>.
- Orfield, Myron and Nicholas Wallace. 2007. The Minnesota Fiscal Disparities Act of 1971: The Twin Cities' Struggle and Blueprint for Regional Cooperation. *William Mitchell Law Review* 33: 591–612.
- Ostrom, Elinor. 2009. A Polycentric Approach for Coping with Climate Change. World Bank Policy Research Working Paper. The World Bank.
- Palmeri, Jordan. 2010. A Life Cycle Approach to Prioritizing Methods of Preventing Waste from the Residential Construction Sector in the State of Oregon. Oregon Department of Environmental Quality.
- Pendall, Rolf, Kathryn A. Foster, Margaret Cowell. 2009. Resilience and regions: building understanding of the metaphor. *Cambridge Journal of Regions, Economy, and Society* 3:71–84.
- Pelletier, Nathan, Peter Tyedmers, Ulf Sonesson, Astrid Scholz, Friederike Ziegler, Anna Flysjo, Sarah Kruse, Beatrice Cancino and Howard Silverman. 2009. Not all Salmon Are Created Equal: Life Cycle Assessment (LCA) of Global Salmon Farming Systems. *Environmental Science and Technology* 43: 8730–8736.
- Peterson, Garry, Craig R. Allen and C. S. Holling. 1998. Ecological Resilience, Biodiversity, and Scale. *Ecosystems* 1: 6–18.
- Porter, Douglas R. and Allan D. Wallis. 2002. Exploring Ad Hoc Regionalism. Lincoln Institute of Land Policy: Cambridge, MA.
- Preston, William L. 1981. Vanishing Landscape: Land and Life in the Tulare Lake Basin. Olympic Marketing Corp: Minnetonka, MN.
- REN21. 2011. Renewables 2011 Global Status Report. REN21 Secretariat.
- Reps, John W. 1982. *Forgotten Frontier: Urban Planning in the American West Before 1890*. University of Missouri Press: Columbia, MO.
- Robbins, William G. 2004. *Landscapes of Conflict: The Oregon Story, 1940-2000*. University of Washington Press: Seattle, WA.
- Robbins, William G. Introduction: In Search of Western Lands. 2000. In Robbins, William G. and James C. Foster (eds.), *Land in the American West: Private Claims and the Common Good*. University of Washington Press: Seattle, WA.
- Robbins, William G. 1997. *Landscapes of Promise: The Oregon Story, 1800–1940*. University of Washington Press: Seattle, WA.
- Robbins, William G. 1989. The Western Lumber Industry: A Twentieth-Century Perspective. In Nash, Gerald D. and Richard W. Etulain (eds.), *The Twentieth Century West: Historical Interpretations*. University of New Mexico Press: Albuquerque, NM.
- Scheffer, Marten, and Frances R. Westley. 2007. The evolutionary basis of rigidity: locks in cells, minds, and society. *Ecology and Society* 12(2): 36.
- Schwantes, Carlos A. 1996. *The Pacific Northwest: An Interpretive History*. University of Nebraska Press: Lincoln, NE.
- Scott, James C. 1999. *Seeing Like a State: How Certain Schemes to Improve the Human Condition have Failed*. Yale University Press: New Haven, CT.
- Scott, W. Richard. 2001. *Institutions and Organizations*. Sage Publications: Thousand Oaks, CA.
- Seligman, Martin E. P. 2011. *Flourish*. Free Press: New York, NY.
- Seltzer, Ethan and Armando Carbonell. 2011. Planning Regions. In Seltzer and Carbonell, eds., *Regional Planning in America: Practice and Prospect*. Lincoln Institute of Land Policy: Cambridge, MA.
- Semakula, Samson and Peter Larkin. 1968. Age, growth, food and yield of the white sturgeon (*Acipenser transmontanus*) of the Fraser River, British Columbia. *Journal of the Fisheries Research Board of Canada* 25: 2589–2602.
- Sen, Amartya. 1983. *Poverty and Famines: An Essay on Entitlement and Deprivation*. Oxford University Press: New York, NY.
- Sendzimir, Jan, Piotr Magnuszewski, Zsuzsanna Flachner, Peter Balogh, Geza Molnar, Attila Sarvari, and Zsuzsanna Nagy. 2007. Assessing the Resilience of a River Management Regime: Informal Learning in a Shadow Network in the Tisza River Basin. *Ecology and Sociology* 13(1): 11.
- Silva, Catherine. 2009. Racial Restrictive Covenants: Enforcing Neighborhood Segregation in Seattle. Seattle Civil Rights & Labor History Project. Accessed 10 Aug. 2011 <http://depts.washington.edu/civilr/covenants_report.htm>.
- Smil, Vaclav. 2001. *Feeding the World: A Challenge for the Twenty-First Century*. The MIT Press: Cambridge, MA.
- Smith, Courtland. 1980. *Salmon Fishers of the Columbia*. Oregon State University Press: Corvallis, OR.
- Sovacool, Benjamin K. 2008. *The Dirty Energy Dilemma: What's Blocking Clean Power in the United States*. Praeger Publishers: Westport, CT.
- Spelter, Henry and Matthew Alderman. 2005. *Softwood Sawmills in the United States and Canada*. Research Paper FPL-RP-630. U.S. Department of Agriculture, Forest Service, Forest Products Laboratory.
- Spelter, Henry and Tim McKeever. 2001. *Softwood Sawmills in the United States and Canada*. Research Paper FPL-RP-594. U.S. Department of Agriculture, Forest Service, Forest Products Laboratory.
- Sproat, Gilbert Malcolm. 1868. *Scenes and studies of savage life*. Smith, Elder and Company: London, UK.
- Stadler, Matthew. 2011. *Where We Live Now*. Oregon Humanities.
- Sustainability Institute. 2003. *Commodity System Challenges: Moving Sustainability into the Mainstream of Natural Resource Economies*. Sustainability Institute.
- Tilman, David, Kenneth G. Cassman, Pamela A. Matson, Rosamond Naylor and Stephen Polasky. 2002. Agricultural Sustainability and intensive production practices. *Nature* 418: 671–677. Accessed 30 Aug. 2011 <<http://www.nature.com/nature/journal/v418/n6898/full/nature01014.html>>.
- Tissot, Brian N., William J. Walsh and Mark A. Hixon. 2009. Hawaiian Islands Marine Ecosystem Case Study: Ecosystem- and Community-Based Management in Hawaii. *Coastal Management* 37: 255–273.
- Turner, Nancy J. 2008. *The Earth's Blanket: Traditional Teachings for Sustainable Living*. University of Washington Press: Seattle, WA.
- U.S. Census Bureau. 2011. *Small Area Income and Poverty Estimates*. U.S. Census Bureau. Accessed 15 Nov. 2011 <<http://www.census.gov/did/www/saie/county.html>>.

- Ungar, Michael. 2008. Resilience across Cultures. *British Journal of Social Work* 38: 218–235.
- Van der Elst, Kristel and Nicholas Davis, eds. 2011. *Global Risks 2011, Sixth Edition*. World Economic Forum.
- Vynne, Stacy, Steve Adams, Roger Hamilton and Bob Doppelt. 2011. *Building Climate Resiliency in the Lower Willamette Region of Western Oregon: Summary for Decision Makers*. Climate Leadership Initiative.
- Walker, Brian. 2011. Resilience propositions on trial: Briefings for the mock court. Resilience 2011 Conference. Accessed 10 Aug. 2011 <<http://csid.asu.edu/resilience-2011/invited-speakers/videos/brian-walker/>>.
- Walker, Brian, Lance Gunderson, Ann Kinzig, Carl Folke, Steve Carpenter, and Lisen Schultz. 2006. A handful of heuristics and some propositions for understanding resilience in social-ecological systems. *Ecology and Society* 11(1): 13.
- Westley, Frances, Per Olsson, Carl Folke, Thomas Homer-Dixon, Harrie Vredenburg, Derk Loorbach, John Thompson, Maⁿs Nilsson, Eric Lambin, Jan Sendzimir, Banny Banerjee, Victor Galaz and Sander van der Leeuw. 2011. Tipping Toward Sustainability: Emerging Pathways of Transformation. *Ambio* 40: 762–780.
- White, Richard. 1993. *It's Your Misfortune and None of My Own: A New History of the American West*. University of Oklahoma Press: Norman, OK.
- Wilkinson, Charles F. 1993. *Crossing the Next Meridian: Land, Water, and the Future of the West*. Island Press: Washington, D.C.
- Wilkinson, Richard G. and Kate Pickett. 2009. *The Spirit Level: Why More Equal Societies Almost Always Do Better*. Bloomsbury Press: New York, NY.
- Williams, Richard N., James A. Lichatowich, Phillip R. Mundy, and Madison Powell. 2003. Integrating artificial production with salmonid life history, genetic, and ecosystem diversity: A landscape perspective. Trout Unlimited.
- Woeste, Keith E., Sterling B. Blanche, Karen A. Moldenhauer, and C. Dana Nelson. 2010. Plant Breeding and Rural Development in the United States. *Crop Science* 50: 1625–1632.
- Wolf, Edward C., Andrew P. Mitchell, and Peter K. Schoonmaker. 1995. *The Rain Forests of Home: An Atlas of People and Place*. Ecotrust, Pacific GIS, and Conservation International.
- Wolff (Raphael G.) Studios, Inc. 1952. *Freedom and Power*. General Electric.
- Worster, Donald. 1992. *Under Western Skies*. Oxford University Press: New York, NY.
- Yosick, Bonnie Gee. 2009. *Housing and Transportation Cost Study*. Portland Plan Background Report. City of Portland Bureau of Planning and Sustainability.
- Zhao, David. 2010. *Carsharing: A Sustainable and Innovative Personal Transport Solution with Great Potential and Huge Opportunities*. Frost & Sullivan. Accessed 15 Nov. 2011 <<http://www.frost.com/prod/servlet/market-insight-top.pag?Src=RSS&docid=190795176>>.

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