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A summary of *The nature of wellbeing: how nature's ecosystem services contribute to the wellbeing of New Zealand and New Zealanders**

No matter who we are or where we live, our well-being depends on the way ecosystems work[1]

What do we need for a 'good life'? At one level, the answer to this question will differ for each person. Yet at a deeper level, we all share a common set of fundamental needs that must be met for us to experience wellbeing. Understanding those needs and the crucial contribution of nature's services in enabling us to meet them is the subject of this report.

Research is increasingly demonstrating that our wellbeing is heavily dependent upon the ongoing supply of the services that nature provides. Yet, ironically, many of the negative impacts that humans have on ecosystems and ecosystem services are driven by our desire to improve our wellbeing – in pursuit of wellbeing we are harming a key source of our wellbeing. This irony becomes even more profound when we realise that in our pursuit of wellbeing, we are often making choices that are not delivering the wellbeing benefits we expect. Some of our consumption and behaviour choices are not making us any happier, yet are damaging the natural systems we depend on, and so are not sustainable in the long run. However, this conundrum presents an opportunity: if we can become more aware of the key sources of our wellbeing, and how ecosystems support wellbeing in our day-to-day lives, and also be clearer about the negative impacts some of our consumption is having on our wellbeing, on biodiversity and on ecosystem functions, we could achieve the 'double dividend'[2,3,4,5,6,7] of enhanced wellbeing and flourishing ecosystem services.

There has been a massive upsurge in research on ecosystem services in the last 20 years, including much detailed research and discussion about how to classify and categorise the types of ecosystem services that contribute to wellbeing, and numerous studies attempting to determine the monetary value of various

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ecosystem services. Most of this research has been by ecologists and economists focusing on the supply and valuation of ecosystem services, but there has been little focus on what is driving our demand for ecosystem services – a desire for enhanced wellbeing.

The report brings together research on wellbeing and research on ecosystem services, focusing principally on the services that come from indigenous ecosystems in New Zealand.

What types of benefits do we obtain from ecosystems?

The largest research project to date to document the benefits that people obtain from ecosystems, or 'ecosystem services' has been the Millennium Ecosystem Assessment, which involved more than 1300 natural and social scientists from 95 countries[8]. This has shown that natural systems act as humanity's 'life-support system', providing four types of services:

- Supporting (e.g. nutrient cycling and primary production)
- Provisioning (e.g. food, fresh water and fuel)
- Regulating (e.g. climate regulation and water purification)
- Cultural (e.g. aesthetic, spiritual and recreational)

What factors affect our wellbeing?

Philosophers and poets have striven to understand what leads to human happiness and wellbeing for most of human history. There has been a massive upsurge in research on this topic in recent times, with the number of published papers increasing from less than 10 per year in the 1960s to more than 2000 per year in the last decade[9]. The research reveals some sources of happiness are universal (e.g. close relationships with others, feelings of fulfilment and satisfaction, a feeling of belonging, pleasures of small moments, learning new things, physical fitness, and spending time in natural areas), and many of these have a low environmental footprint. Conversely the evidence is now very strong that those who focus on extrinsic goals, such as financial success or material acquisitions report lower levels of happiness, less vitality and self-actualisation, and more depression and anxiety, when compared to people who focus on intrinsic goals such as affiliation, self-acceptance and community feeling[10]. Thus, widespread adoption of materialistic values not only leads to increased resource use and attendant impacts on the natural systems we depend upon, it also reduces our wellbeing.

In 1991, Max-Neef identified nine fundamental needs that are common to all humans[11]:

1. Subsistence	4. Understanding	7. Creation
2. Protection	5. Participation	8. Identity
3. Affection	6. Idleness	9. Freedom

We commonly assume that economic goods and/or commodities are the main satisfiers of these needs – i.e. that increased wealth leads to greater development and wellbeing. However, there are, in fact, many different ways in which we can satisfy these needs, some of which are much more effective than others[11].

There has been a growing recognition that the maintenance of natural capital and ecosystem services is fundamental to development and wellbeing. In recognition of this, the World Bank has sought to consider the depletion of natural and physical capital in its own measures of wealth since the 1990s[12], and the OECD now requires estimates of natural capital stocks as part of each nation's national accounts. Figure 1 (next page) illustrates the relationship between natural capital, ecosystem services, human needs, satisfiers and wellbeing.

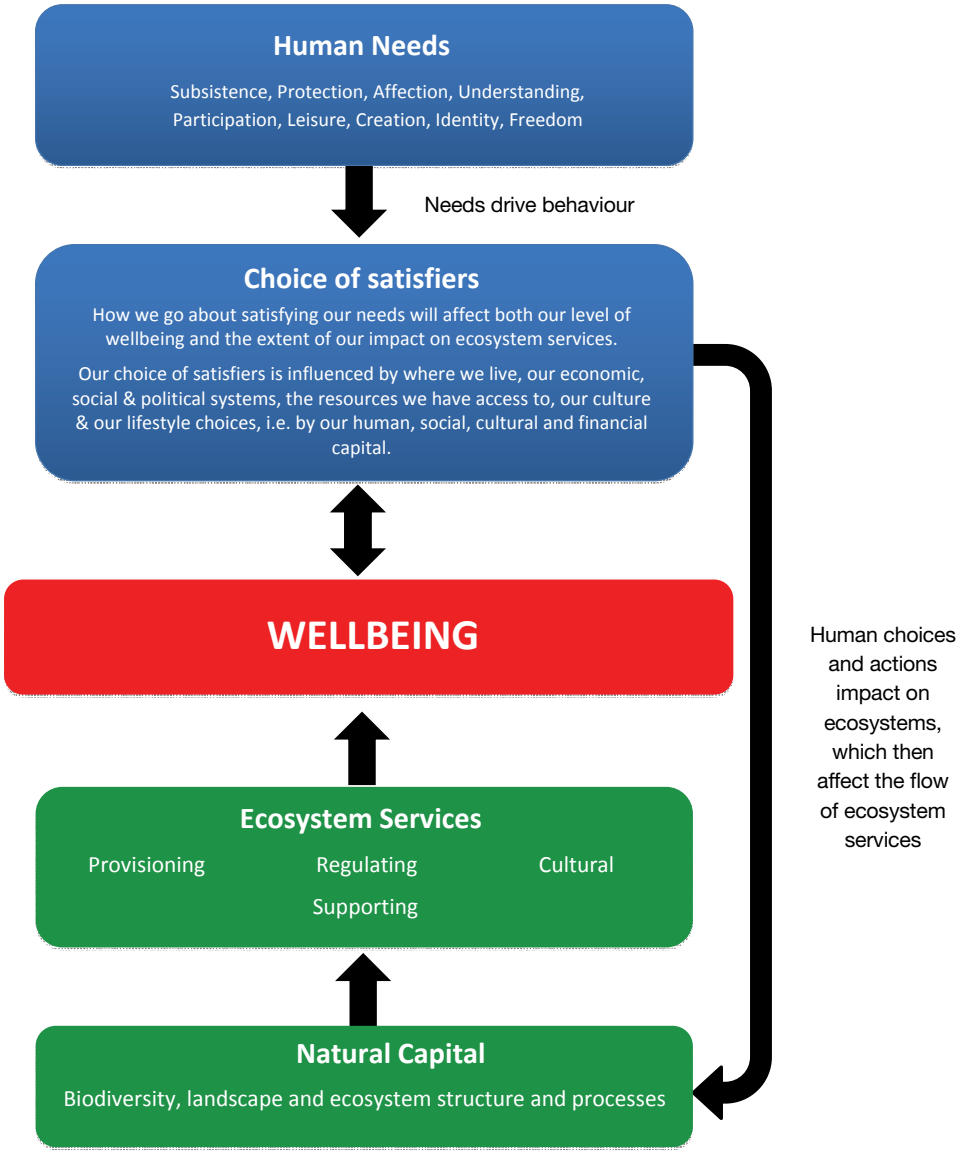

Figure 1. The relationship between natural capital, ecosystem services, human needs, satisfiers and wellbeing.

How do ecosystem services contribute to our wellbeing?

To date, little research has investigated the ways in which different aspects of our wellbeing are affected by ecosystem services and, in turn, how our attempts to achieve wellbeing may impact on these services. The following sections and Table 1 (end of report) summarise some of the many examples in the report of the key ways in which ecosystem services bring wellbeing benefits to New Zealanders by allowing them to satisfy each of Max-Neef's basic needs.

1. Subsistence

To survive and flourish, we need nutritious food, clean water to drink, fresh air to breathe, and the ability to grow our food, create shelter and produce energy, all of which are provided by nature.

In New Zealand, the mountains and high-country areas play a vital role in providing fresh water, while the streams, rivers and aquifers act as arteries, delivering this water to more heavily populated lowland and coastal areas. High-country lakes also provide a natural water storage service, from which hydroelectricity can be generated; and upland areas provide water for irrigation via hill-fed rivers and lakes and groundwaters, supporting approximately 620 000 ha of irrigated land and contributing an estimated $920 million to gross domestic production in 2002[13].

We require oxygen to breathe, and the oxygen that makes up 20% of Earth's atmosphere has accumulated over billions of years from the activity of plants. New Zealand's forests (both indigenous and plantation) produce around 12.24 million tonnes of oxygen per year. The marine environment also plays its part, with half the annual oxygen production on Earth estimated to come from phytoplankton in the open ocean[14], and coastal waters having high rates of productivity and gas exchange.

Food harvest and production in New Zealand not only provides nourishment, but also satisfies a range of cultural, social and recreational needs. Although most of the food species we farm on our land are imported, their production relies on the clean water, fertile soils and nutrient cycling provided by our natural ecosystems and indigenous biodiversity. Native and imported pollinators are crucial to the production of many crops[15,16,17], and it is estimated that 99% of agricultural pests and diseases are controlled by their natural enemies – predators, parasites and pathogens[18]. Our rivers, wetlands and lakes also sustain fisheries of indigenous species (e.g. tuna/eel, whitebait and kōura/freshwater crayfish). The eel fishery is the most important commercial freshwater fishery in New Zealand, with annual export sales of $0.8–3.5 million between 1990 and 2004[19]. Eels are also generally considered the most important freshwater fish for Māori[20], who have particularly strong cultural and historic links to freshwaters. Our food from the sea comes almost entirely from species whose natural habitat is here in the South Pacific, living in ecosystems that depend on a whole suite of ecosystem processes and services for their effective functioning. The Freight on Board export value of our commercial fishing and aquaculture was $1.568 billion in 2012[21], and the recreational and customary take are additional to this.

All of the energy that powers our lives comes from nature—from fossil fuels to hydroelectricity, wind energy, geothermal energy, biofuels and tidal power. In 2011, New Zealand was second in the OECD (after Iceland) in terms of the proportion of its national primary energy supply that comes from renewable energy[22]. Many of New Zealand's larger urban centres (e.g. Auckland, Hamilton, Christchurch) use anaerobic digesters to capture biogas for electricity production, and NIWA is currently investigating the development of a pond-based wastewater-treatment system that will not only recover energy from wastewater solids in the form of biogas, but will also use the wastewater nutrients to grow single-celled algae for biofuel.

2. Protection

Indigenous forests bring a wide range of benefits to the landscape and climate, helping to stabilise slopes and reducing sediment transportation in streams through their extensive root systems[23]; moderating water flow through their catchments by intercepting precipitation with their large canopies[23,24,25]; and playing an important role in climate regulation through the uptake of carbon dioxide – for example, 80% of the carbon that is stored above ground in vegetation is stored in indigenous forest and scrub (compared with 5% in planted forest)[26,27]. Trees and forests also filter pollution from the air by trapping particles on their leaves and branches. This not only improves our health, but also reduces damage to structures and materials[28]; for example, it has been estimated that urban trees in Christchurch removed 300 tonnes of pollutants in 2002, a service with an estimated value of $19.6 million[29].

Marine ecosystems also help to mitigate climate change through 'blue carbon sequestration'[30], absorbing nearly one-third of the carbon dioxide produced by human activity[31].

Wetlands, lakes and rivers provide important services, transporting, regulating and storing freshwater[32,33], and purifying the water that passes through them[19,34]. For example, in the Tukituki River, levels of nitrogen and phosphorus are reduced to near zero concentrations only 30–60 km downstream from agricultural and treated sewage inputs during summer low-flow periods[35].

Plants and microorganisms are also extremely important sources of medicines—80% of the world's population relies upon traditional medicines, 85% of which are derived from plant extracts. Rongoā—the traditional medicinal practices of Māori—make extensive use of a range of native plants, including kūmarahou, kawakawa, mānuka, kōwhai, rātā and harakeke[36].

3. Affection

The need to give and receive affection is a fundamental component of wellbeing, and there is evidence that people who place importance on their relationships with others also value their relationship with nature. Adults require direct contact with the natural aspects of their environment to develop a sense of place[37], and many adults remember natural or outdoor environments as being the most significant places of their childhood[38,39]. Affection for particular places and for the sound and sight of the native species found there has been a key driver for Project Halo, which aims to bring tūī and bellbirds back to Hamilton City.

4. Understanding

Experiencing natural environments has been shown to contribute to physical, motor, cognitive and emotional development. Natural environments also help us to learn more about ourselves both through experiential learning and therapeutic opportunities[40], and nature can reduce the general stress of life in rural children[41].

Ecosystems provide a wide range of learning opportunities and there is evidence that some types of learning are enhanced in natural settings—and we do not necessarily need to venture into the wilderness to obtain these benefits; for example, community gardens can be an ideal setting for children's learning in many domains of the curriculum[42].

5. Participation

Being involved in activities and sharing experiences with others enhances our feeling of connectedness, trust, mutual obligation and belonging, which has a large impact on our own wellbeing and that of our community[43,44]. The natural spaces of New Zealand provide a wide range of settings for shared activities, such as tramping, climbing, sailing, swimming, picnicking, walking and cycling. There is also some evidence that environmental volunteering may not only benefit our ecosystems, but may also confer health and wellbeing benefits on the volunteers themselves[45,46].

6. Leisure – idleness

Participation in leisure time activities has been positively linked to both our physical and mental health[47,48]. Both physical and non-physical leisure activities reduce depression and anxiety, produce positive moods, enhance self-esteem, facilitate social interaction and improve cognitive functioning. Further, there is a significant correlation between time spent interacting with nature and life satisfaction and relaxation[49].

Water-based leisure activities are central to New Zealand culture, be it on the coast, at the beach, or at the lake or river. Typically, the quality of the experience is influenced by the quality of the environment – for example, when visiting the coast, Auckland residents place the greatest importance on water clarity, the quality of underfoot conditions and ecological health[50]. Anglers also wish to fish in unmodified landscapes – particularly international anglers, who showed a marked preference for backcountry and headwater river fisheries in the 2009/10 season[51].

Tourism is regarded as a key component of the New Zealand economy and culture. Overall, the tourism sector contributed $6.2 billion (3.3%) to GDP in 2011/12[52], which is very similar to the dairy sector[53] – and domestic tourism is even greater, contributing $13.8 billion internal expenditure[53]. Ecosystems are central to New Zealand's tourism industry, with approximately 70% of all international and 22% of all domestic trips reported as involving 'nature-based' activities[54] – with walking and trekking, land-based sightseeing, and visiting scenic natural attractions the most popular activities for international visitors.

7. Creation

The ability to express ourselves creatively and experience the creativity of others makes us feel happier, more enthusiastic and optimistic[55,56]. Many artists have drawn inspiration from New Zealand landscapes and wildlife. For example, Māori cave drawings included depictions of extinct moa and the New Zealand eagle[57]; and the kōwhaiwhai patterns painted on the rafters of Māori meeting houses are often based on the koru, the young curled frond of a fern plant[58]. New Zealand art is considered to have 'come of age' when artists such as Rita Angus, Rata Lovell Smith and Bill Sutton depicted landscapes that could only be found in New Zealand[59]; and many New Zealand writers have used the landscape and wilderness to provide a setting for their novels, short stories and poetry, beginning as early as Samuel Butler's Erewhon in 1872[60].

8. Identity

A strong sense of identity makes us feel distinctive and successful, and enhances our self-esteem and sense of worth. As New Zealanders, our sense of self-definition, and the way in which we portray ourselves to customers[61], tourists[62], immigrants[63] and the rest of the world is heavily bound up with our natural world. Traditional Māori beliefs are centred on the view that Māori are an intrinsic part of the natural world[64], and whakapapa links to particular mountains, waters and resources are fundamental markers of Māori identity. Further, we refer to ourselves as 'kiwis' and our top sports teams wear the silver fern: both endemic species.

9. Freedom

Environments that allow us to feel autonomous, competent and connected provide us with greater levels of wellbeing[65]. A high proportion of natural ecosystems in New Zealand are freely accessible, giving New Zealanders more freedom to explore the natural environment than most other nationalities. Access to the coastline is a free right for everyone, and access to parks and reserves is a 'free' public good, creating greater equality than if areas of the foreshore were privately owned or if one had to pay for access to parks. However, inequality of income means that some New Zealanders are unable to access the natural estate, in particular those parts that require extended travel or costly equipment to explore safely. Many recreational activities in the natural environment involve deliberately seeking risk and adventure, as a means of testing and challenging oneself—and interaction with pristine natural environments is generally considered a prerequisite to satisfying wilderness experiences.

10. Material wealth

For most New Zealanders, material wealth is an important means of meeting at least some of the basic needs outlined above and employment is one of the most common means of generating income[66]. Employment also

contributes to our sense of identity, promotes self confidence, allows us to participate in voluntary economic exchanges and provides opportunities for social engagement[66]; and secure employment gives us a feeling of financial security, which reduces stress and enhances our wellbeing[67]. Happiness research suggests, however, that beyond a certain level, the happiness returns on increased income steadily taper off – and furthermore, a focus on material goods is actually linked with decreased wellbeing.

New Zealand's natural ecosystems, indigenous biodiversity and/or protected areas provide many employment opportunities. For example, tourism concessions in Tongariro National Park were estimated to have generated about 14% of the Ruapehu-Taupo region's tourism employment in 2004/05[68]. New Zealand's economic wealth is also heavily dependent on the natural environment and indigenous biodiversity, with the primary sector and tourism being particularly important contributors[66]. For example, the medicinal mānuka honey industry is worth around $75 million and acts as a driver for the growth of the total New Zealand honey industry[69]; and the Ministry for the Environment found that the average consumer would purchase 54% less New Zealand dairy export products (equivalent to a loss of $241–569 million per year) if New Zealand were to lose its 'clean green' image[70].

How can we take ecosystem services into account in decision-making?

It is clear that ecosystem services bring a multitude of benefits to individuals and communities, both in terms of overall wellbeing and economic value. It is important that all of these benefits (alongside other contributors to wellbeing) are equally and fairly considered when making decisions or policies, especially since a decision to enhance one benefit may be at the expense of others. As a result, various tools and approaches have been developed to help decision-makers to take such trade-offs into account. Economic valuation is one such approach, which can be used to assess relative values and the possible impacts of different decisions or management actions on these. As for other countries, New Zealand valuation studies have primarily focussed on subsistence, protection, affection and leisure needs. Such studies can help decision-makers to understand what communities value.

Conclusions

New Zealand's indigenous biodiversity and natural landscapes provide a wide range of ecosystem services that contribute in a variety of ways to the wellbeing of New Zealanders – and these benefits come from private as well as public land, agricultural as well as conservation land, and urban as well as rural land, and from water in all its forms from the mountain tops to the deep sea. However, since New Zealand's indigenous biodiversity is in decline and natural ecosystems are continuing to degrade, we cannot assume that these services will continue indefinitely – and there is a risk that New Zealanders may not come to realise the full consequences to their wellbeing of environmental degradation and biodiversity decline until the situation has become irreversible, or at least very costly and difficult to overturn.

By fostering discussion, research and education on the different components of wellbeing, we will gain a greater understanding of the many factors that contribute to our personal and national wellbeing. Further, by exploring the impact of our individual and collective choices of satisfiers on both our own wellbeing and on the wellbeing of our ecosystems, we will be able to make better decisions about how we use, manage and protect our ecosystems and indigenous biodiversity, and how we reduce our impacts on these.

For the full report, see:

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Table 1. How services delivered by New Zealand's indigenous biodiversity and natural landscapes contribute to satisfying Max-Neef's (1991) nine fundamental needs.

NEED	SERVICES
Subsistence	Clean fresh water to grow our food and provide electricity Clean air to breathe Food from land, rivers, wetlands, lakes, canals and the seas supported by nutrient cycling, pollination and biological control of pests and diseases Mental and physical health – opportunities for leisure and recreation in green spaces Energy – current and ancient (fossil) biofuels, sun, hydro, wind, geothermal Timber for housing and furniture Clothing and other resources Income derived from meeting the subsistence needs of others
Protection	Flood and erosion protection Water purification Gas and climate regulation – Carbon storage in forests and oceans – Regulating mesoclimate and microclimate Diversity, resilience and insurance Plants and microorganisms as a basis for many medicines Air filtration Noise reduction Liquid and solid waste treatment, processing and storage
Affection	Opportunities to experience strong affection and respect for nature (biophilia), and particular landscapes, building a sense of place, and to share positive experiences with friends and loved ones in a natural setting
Understanding	Enhanced learning and development in natural settings Nature as teacher – wild places as settings for personal development experiences (e.g. Outward Bound) Indigenous knowledge Research and education from preschool to tertiary levels leading to greater understanding of how ecosystems function and how our actions affect the provision of these services
Participation	Settings for a range of shared activities – walking, climbing, sailing, swimming, picnicking Volunteers participating in biodiversity restoration projects
Idleness/leisure	Settings for passive and active leisure and recreation—relaxing at the beach or climbing a mountain Tourists attracted by such settings for their holidays
Creation	Inspiration for artists – carvers, weavers, painters, photographers, fiction and non-fiction writers, poets, cinematographers, and musicians – and for the artist in us all Inspiration for innovation in science, technology, engineering and business
Identity	Our sense of self-definition, our heroes, and how we portray ourselves to customers, tourists, immigrants and the rest of the world Whakapapa linkages as fundamental markers of identity
Freedom	Free access to the coast and natural spaces Opportunities to test oneself and take risks in a range of environments Wilderness as freedom from sounds and signs of industrialised society, and opportunity for extraordinary experience, flow and adventure