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The structure of human well-being related to ecosystem services in coastal areas: A comparison among the six North Pacific countries

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ABSTRACT

The concept of human well-being and its relation to ecosystem services has been defined by the Millennium Ecosystem Assessment (MEA). To visualize the structure of human well-being related to ecosystem services in coastal areas, and to make an international comparison of these structures, this study investigated the satisfaction level of human well-being by using questionnaire survey, and the interactions among these components in the coastal areas of the six countries (Canada, China, Japan, Korea, Russia, and the US). The questionnaire items were selected according to the components of human well-being as defined by MEA. The analysis suggested a common hierarchical structure. Findings suggest the levels of satisfaction with 'Security' and 'Basic materials for a good life' functioned as the most fundamental variables among the five components of human well-being, while 'Health' and 'Good social relations' functioned as mediating variables of 'Freedom of choice and action'. The degree of interaction among the five components varied by country. In Canada and Russia, satisfaction with 'Security' had a more significant effect on 'Health' and 'Good social relations' than did 'Basic materials for a good life.' In the other countries, satisfaction with 'Basic materials for a good life' had a more significant effect on 'Health' and 'Good social relations' than did 'Security'. This study suggests that the structure of human well-being is dependent upon a range of natural and social factors. Knowledge of the differences which occurs across nations will be significant in establishing societal goals, and for societal engagement in marine conservation policy.

1. Introduction

Assessments of ecosystem services as indices for assessing the value of ecosystems have been conducted worldwide [8,22,27]. A variety of methods and tools for evaluating the economic value of ecosystem services which are directly or indirectly utilized by human beings have also been developed [7,12,29]. Improvements in assessment methodologies, such as evaluation of people's willingness to pay for the support of ecosystems and environments [15,40,48,51] have also made it possible to more comprehensively assess the overall value of ecosystems, including non-use values which have hitherto not been evaluated due to difficulties in quantification.

It is important to assess subjective aspects in addition to economic factors. Since the concept of 'human well-being' was first suggested as a tool for evaluating the subjective benefits derived from ecosystems and environments [27]. In the last decade, there are a number of studies that human well-being can be attributed to the marine environment (including ecosystem services) [2,43,44]. Growing attention has been paid to the interaction between ecosystems and human society, because natural environments are affected by this interdependence [1,13,41]. Evaluation of the subjective aspects as well as the economic value of ecosystems (i.e., ecosystem services) has been considered important for the comprehensive evaluation of the value of specific ecosystems and environments [5,32]. As the subjective aspect derived from ecosystem services, the Millennium Ecosystem Assessment of the United Nations (MEA) [27], classifies the components of human well-being. The Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) has a conceptual framework built on the basis of previous influence, most notably that of the MEA [8,37]. It has the goal of 'strengthening the science-policy interface for biodiversity and ecosystem services for the conservation and sustainable use of biodiversity, long-term human well-being, and sustainable development' [39]. 'Human well-being' is also the key feature, to consider about nature and its contributions to a good quality of life within IPBES. The recognition of human well-being as a goal for environmental management is an important first step to addressing issues [6].

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2. Human well-being and ecosystem services

In daily life, people need ecosystems, and it contribute to human well-being in various ways. MEA established the concept of ecosystem services on the global agenda. Ecosystem services have defined the benefits people obtain from ecosystems. These include provisioning services, regulating services, cultural services, and supporting services [27]. According to MEA, human well-being derived from ecosystem services is assumed to have multiple constituents, including the 'basic material for a good life', 'health', 'good social relations', 'security', and 'freedom of choice and action', including the opportunity to achieve what individual values doing and being. Similar to biophysical systems, human well-being is complex, and no single component exists entirely independent of another component [2]. Unfortunately, the structure and its relationship to process conditions are not sufficiently understood at this time. While recent trends in marine policy seek to consider the effects of natural resource management on human well-being, they embody few indicators of actual human experience [2]. Because of the difficulty in addressing and measuring human well-being derived from ecosystem services is that there is no consensus on its clear definition since MEA, and it was reported individually by each study.

Over the course of this study, to visualize the structure of human well-being related to ecosystem services provided in coastal areas, an international comparative analysis was conducted among the six PICES (North Pacific Marine Science Organization) Member Countries (Canada, China, Japan, Korea, Russia, and the US), all of which face the Pacific Ocean, and in which different utilization patterns of ecosystem services are expected. Subjective well-being represents self-reported assessments of overall individual well-being [44]. It is defined by each individual, is often measured with life satisfaction or happiness surveys. Objective well-being, which is defined by others, for example, the UNDP Human Development Index [49], the OECD Better Life Index [34] etc. are included. Recent measures of subjective well-being contain multiple items. For example, the PANAS (Positive and Negative Affect Scale) [52] measures both positive and negative affects, each with 10 affect items, and the Satisfaction With Life Scale assesses life satisfaction with items such as, "In most ways my life is close to my ideal," and "So far I have gotten the important things I want in life" [38]. In this way, 'satisfaction-level' using as the indicator to assessing subjective well-being [9,17,19,23,45]. This study, focus on the subjective side of human well-being, while the satisfaction level and the interactions of the five components of human well-being as defined by the MEA were investigated using questionnaire survey. And attempted to investigate, for each country, which factors most influenced the structure of human well-being and interrelationships.

3. Materials and methods

3.1. Sampling design

Surveys using web-based questionnaires were conducted in the coastal areas of six countries along the Pacific Ocean (PICES Member Countries: Canada, China, Japan, Korea, Russia and the US). In marine (coastal) ecosystems, an increasing number of studies that assess the economic value of ecosystem services [35], human intentions [17,50] have employed questionnaires. The residential location of potential respondents was restricted to within a one-hour drive by car from the coast, to select for people who are more dependent on marine (and coastal) ecosystem services and to minimize the geographical effects of each country. Data for this study were ultimately obtained responses to a self-explanatory questionnaire randomly distributed by a research company. In this survey, respondents aged 20–60 years answered the questionnaire and tried to make the number of each generation as equal as possible.

The responses to the questionnaires were obtained in May 2013 in Japan, August 2013 in the US, September 2013 in Korea, October 2015 in China, December 2015 in Russia, and April 2016 in Canada. A total of 3238 responses were included in the analysis (Canada: 550, male (M) = 275, female (F) = 275; China: 550: M = 351, F = 199; Japan: 468, M = 241, F = 227; Korea: 540, M = 283, F = 257; Russia: 574, M = 300, F = 274; USA: 556, M = 279, F = 277). The average age of the respondents was 39.4 (SD: 13.3) in Canada, 33.0 (6.5) in China, 46.2 (13.7) in Japan, 42.2 (13.1) in Korea, 37.0 (12.3) in Russia, and 44.6 (13.9) in the US.

Table 1
Question items in relation to the five components of human well-being which were scored by five levels depending on satisfaction.

Components of human well-being	Question items
Security	to live with peace of mind and safety to protect oneself from danger to use energy and resources appropriately to give an appropriate response when a disaster strikes
Basic material for a good life	to secure the basics for a good life to regulate life-environment (e.g. lifeline such as electricity, gas, and water) to have enough food to have somewhere comfortable to live to get daily necessities
Health	to keep one in good health to have the capacity to live grow or develop to feel comfortable to secure clean air and water
Good social relations	to produce a good relationship to cooperate with the social community to hold someone in high esteem to be able to support someone
Freedom of choice and action	to give a child a fair chance to succeed to have a chance to achieve a goal to enjoy one's hobbies

3.2. Questionnaire items

The questionnaire items were selected and grouped according to the five components of human well-being (Basic materials for a good life, Health, Good social relations, Security and Freedom of choice and action) as defined according to the MEA [27]. Three to five items were selected for each component: three items for 'Freedom of choice and action', four for 'Health', 'Good social relations', and 'Security', and five for 'Basic materials for a good life'. Thus, 20 questions were included in the questionnaire (Table 1). Each question was scored by the respondent based on a five-point Likert-type scale, according to their satisfaction level: 5 = very satisfied, 4 = somewhat satisfied, 3 = neither satisfied or dissatisfied, 2 = dissatisfied, and 1 = very dissatisfied. The average and standard deviation of the satisfaction scores were calculated for each item and country.

3.3. Reliability analysis

Prior to running the model, a reliability analysis was conducted to evaluate the stability and consistency of each question item within the five components of human well-being. Cronbach's Coefficient (α) [26] was calculated as follows.

α = number of question items within a component (N)/(N − 1) × [1 − (sum of the variance of the satisfaction scores of all items/variance in the sum of the satisfaction scores of all items within a component)].

The models are reliable when α is higher than 0.7 [26,33]. In the present reliability analysis, α was 0.86 for 'Security', 0.89 for 'Basic materials for a good life', 0.85 for 'Health', 0.88 for 'Good social

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