Electronic Supplementary Material

A framework for the social valuation of ecosystem services

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This material has not been peer reviewed

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Literature review: list of final valid papers included in the study

Agbenyega, O., P. J. Burgess, M. Cook, and J. Morris. 2009. Application of an ecosystem function framework to perceptions of community woodlands. *Land Use Policy* 26: 551–557. doi:10.1016/j.landusepol.2008.08.011.

Aretano, R., I. Petrosillo, N. Zaccarelli, T. Semeraro, and G. Zurlini. 2013. People perception of landscape change effects on ecosystem services in small Mediterranean islands: A combination of subjective and objective assessments. *Landscape and Urban Planning* 112: 63–73. doi:10.1016/j.landurbplan.2012.12.010.

Bowd, R., N. Quinn, D. C. Kotze, D. G. Hay, and M. Mander. 2012. The Identification of Potential Resilient Estuary-based Enterprises to Encourage Economic Empowerment in South Africa: a Toolkit Approach. *Ecology and Society* 17.doi:10.5751/ES-04840-170315.

Bryan, B. A., and J. M. Kandulu. 2011. Designing a Policy Mix and Sequence for Mitigating Agricultural Non-Point Source Pollution in a Water Supply Catchment. *Water Resources Management* 25: 875–892. doi:10.1007/s11269-010-9731-8.

Bryan, B. A., A. Grandgirard, and J. R. Ward. 2010. Quantifying and Exploring Strategic Regional Priorities for Managing Natural Capital and Ecosystem Services Given Multiple Stakeholder Perspectives. *Ecosystems* 13: 539–555. doi:10.1007/s10021-010-9339-0.

Burger, J. 2011. Valuation of environmental quality and eco-cultural attributes in Northwestern Idaho: Native Americans are more concerned than Caucasians. *Environmental Research* 111: 136–142. doi:10.1016/j.envres.2010.09.013.

Calvet-Mir, L., E. Gomez-Baggethun, and V. Reyes-Garcia. 2012. Beyond food production: Ecosystem services provided by home gardens. A case study in VallFosca, Catalan Pyrenees, Northeastern Spain.*Ecological Economics* 74: 153–160. doi:10.1016/j.ecolecon.2011.12.011.

Carvalho-Ribeiro, S. M., and A. Lovett. 2011. Is an attractive forest also considered well managed? Public preferences for forest cover and stand structure across a rural/urban gradient in northern Portugal. *Forest Policy and Economics* 13: 46–54. doi:10.1016/j.forpol.2010.09.003.

Castillo, A., A. Magaña, A. Pujadas, L. Martínez, and C. Godínez. 2005. Understanding the Interaction of Rural People with Ecosystems: A Case Study in a Tropical Dry Forest of Mexico. *Ecosystems* 8: 630–643. doi:10.1007/s10021-005-0127-1.

Castro, A. J., B. Martin-Lopez, M. Garcia-LLorente, P. A. Aguilera, E. Lopez, and J. Cabello. 2011. Social preferences regarding the delivery of ecosystem services in a semiarid Mediterranean region. *Journal of Arid Environments* 75: 1201–1208. doi:10.1016/j.jaridenv.2011.05.013.

De Chazal, J., F. Quetier, S. Lavorel, and A. Van Doorn. 2008. Including multiple differing stakeholder values into vulnerability assessments of socio-ecological systems. *Global Environmental Change-Human and Policy Dimensions* 18: 508–520. doi:10.1016/j.gloenvcha.2008.04.005.

Crossman, N. D., B. A. Bryan, and D. King. 2009. Integration of landscape-scale and site-scale metrics for prioritising investments in natural capital. In , ed. R. S. Anderssen, R. D. Braddock, and L. T. H. Newham.

Duguma, L. A., and H. Hager. 2011. Farmers' Assessment of the Social and Ecological Values of Land Uses in Central Highland Ethiopia. *Environmental Management* 47: 969–982. doi:10.1007/s00267-011-9657-9.

Fagerholm, N., N. Käyhkö, F. Ndumbaro, and M. Khamis. 2012. Community stakeholders' knowledge in landscape assessments – Mapping indicators for landscape services. *Ecological Indicators* 18: 421–433. doi:10.1016/j.ecolind.2011.12.004.

Fontana, V., A. Radtke, V. BossiFedrigotti, U. Tappeiner, E. Tasser, S. Zerbe, and T. Buchholz. 2013. Comparing land-use alternatives: Using the ecosystem services concept to define

a multi-criteria decision analysis. *Ecological Economics* 93: 128–136. doi:10.1016/j.ecolecon.2013.05.007.

Frank, S., C. Fürst, L. Koschke, A. Witt, and F. Makeschin. 2013. Assessment of landscape aesthetics—Validation of a landscape metrics-based assessment by visual estimation of the scenic beauty. *Ecological Indicators* 32: 222–231. doi:10.1016/j.ecolind.2013.03.026.

Garcia-Llorente, M., B. Martin-Lopez, I. Iniesta-Arandia, C. A. Lopez-Santiago, P. A. Aguilera, and C. Montes. 2012. The role of multi-functionality in social preferences toward semi-arid rural landscapes: An ecosystem service approach. *Environmental Science & Policy* 19-20: 136–146. doi:10.1016/j.envsci.2012.01.006.

Garrard, R., T. Kohler, U. Wiesmann, M. F. Price, A. C. Byers, and A. R. Sherpa. 2012. Depicting community perspectives: repeat photography and participatory research as tools for assessing environmental services in Sagarmatha National Park, Nepal. *Eco Mont-Journal on Protected Mountain Areas Research* 4: 21–31.

De Groot, R. 2006. Function-analysis and valuation as a tool to assess land use conflicts in planning for sustainable, multi-functional landscapes. *Landscape and Urban Planning* 75: 175–186. doi:10.1016/j.landurbplan.2005.02.016.

Higuera, D., B. Martin-Lopez, and A. Sanchez-Jabba. 2013. Social preferences towards ecosystem services provided by cloud forests in the neotropics: implications for conservation strategies. *Regional Environmental Change* 13: 861–872. doi:10.1007/s10113-012-0379-1.

Hinojosa, L., and K. Hennermann. 2012. A GIS approach to ecosystem services and rural territorial dynamics applied to the case of the gas industry in Bolivia. *Applied Geography* 34: 487–497. doi:10.1016/j.apgeog.2012.02.003.

Hoehn, J. P., F. Lupi, and M. D. Kaplowitz. 2003. Untying a Lancastrian bundle: valuing ecosystems and ecosystem services for wetland mitigation. *Journal of Environmental Management* 68: 263–272. doi:10.1016/S0301-4797(03)00069-0.

Howard, D. C., P. J. Burgess, S. J. Butler, S. J. Carver, T. Cockerill, A. M. Coleby, G. Gan, C. J. Goodier, et al. 2013.Energyscapes: Linking the energy system and ecosystem services in real landscapes. *Biomass and Bioenergy* 55: 17–26. doi:10.1016/j.biombioe.2012.05.025.

Jim, C. Y., and W. Y. Chen. 2006. Perception and Attitude of Residents Toward Urban Green Spaces in Guangzhou (China). *Environmental Management* 38: 338–349. doi:10.1007/s00267-005-0166-6.

Kaplowitz, M. D. 2001. Assessing mangrove products and services at the local level: the use of focus groups and individual interviews.*Landscape and Urban Planning* 56: 53–60. doi:10.1016/S0169-2046(01)00170-0.

Koschke, L., C. Fürst, S. Frank, and F. Makeschin. 2012. A multi-criteria approach for an integrated land-cover-based assessment of ecosystem services provision to support landscape planning. *Ecological Indicators* 21: 54–66. doi:10.1016/j.ecolind.2011.12.010.

Lamarque, P., U. Tappeiner, C. Turner, M. Steinbacher, R. D. Bardgett, U. Szukics, M. Schermer, and S. Lavorel. 2011. Stakeholder perceptions of grassland ecosystem services in relation to knowledge on soil fertility and biodiversity. *Regional Environmental Change* 11: 791–804. doi:10.1007/s10113-011-0214-0.

Lewan, L., and T. Söderqvist. 2002. Knowledge and recognition of ecosystem services among the general public in a drainage basin in Scania, Southern Sweden. *Ecological Economics* 42: 459–467. doi:10.1016/S0921-8009(02)00127-1.

López-Medellín, X., A. Castillo, and E. Ezcurra. 2011. Contrasting perspectives on mangroves in arid Northwestern Mexico: Implications for integrated coastal management. *Ocean & Coastal Management* 54: 318–329. doi:10.1016/j.ocecoaman.2010.12.012.

Lovell, S. T., V. E. Mendez, D. L. Erickson, C. Nathan, and S. DeSantis. 2010. Extent, pattern, and multifunctionality of treed habitats on farms in Vermont, USA. *Agroforestry Systems* 80: 153–171. doi:10.1007/s10457-010-9328-5.

Maass, J. M., P. Balvanera, A. Castillo, G. C. Daily, H. A. Mooney, P. Ehrlich, M. Quesada, A. Miranda, et al. 2005. Ecosystem services of tropical dry forests: Insights from long-term ecological and social research on the Pacific Coast of Mexico. *Ecology and Society* 10.

Martin-Lopez, B., I. Iniesta-Arandia, M. Garcia-Llorente, I. Palomo, I. Casado-Arzuaga, D. Garcia Del Amo, E. Gomez-Baggethun, E. Oteros-Rozas, et al. 2012. Uncovering Ecosystem Service Bundles through Social Preferences. *Plos One* 7. doi:10.1371/journal.pone.0038970.

Newton, A. C., K. Hodder, E. Cantarello, L. Perrella, J. C. Birch, J. Robins, S. Douglas, C. Moody, et al. 2012. Cost–benefit analysis of ecological networks assessed through spatial analysis of ecosystem services. *Journal of Applied Ecology* 49: 571–580. doi:10.1111/j.1365-2664.2012.02140.x.

Oikonomou, V., P. G. Dimitrakopoulos, and A. Y. Troumbis. 2011. Incorporating Ecosystem Function Concept in Environmental Planning and Decision Making by Means of Multi-Criteria Evaluation: The Case-Study of Kalloni, Lesbos, Greece. *Environmental Management* 47: 77–92. doi:10.1007/s00267-010-9575-2.

Oteros-Rozas, E., J. A. Gonzalez, B. Martin-Lopez, C. A. Lopez, P. Zorrilla-Miras, and C. Montes. 2012. Evaluating Ecosystem Services in Transhumance Cultural Landscapes An Interdisciplinary and Participatory Framework. *Gaia-Ecological Perspectives for Science and Society* 21: 185–193.

Pavlikakis, G. E., and V. A. Tsihrintzis. 2006. Perceptions and preferences of the local population in Eastern Macedonia and Thrace National Park in Greece. *Landscape and Urban Planning* 77: 1–16. doi:10.1016/j.landurbplan.2004.12.008.

Petrosillo, I., R. Costanza, R. Aretano, N. Zaccarelli, and G. Zurlini. 2013. The use of subjective indicators to assess how natural and social capital support residents' quality of life in a small volcanic island. *Ecological Indicators* 24: 609–620. doi:10.1016/j.ecolind.2012.08.021.

Petz, K., E. L. Minca, S. E. Werners, and R. Leemans. 2012. Managing the current and future supply of ecosystem services in the Hungarian and Romanian Tisza River Basin. *Regional Environmental Change* 12: 689–700. doi:10.1007/s10113-012-0284-7.

Plieninger, T., S. Dijks, E. Oteros-Rozas, and C. Bieling. 2013. Assessing, mapping, and quantifying cultural ecosystem services at community level. *Land Use Policy* 33: 118–129. doi:10.1016/j.landusepol.2012.12.013.

Quétier, F., F. Rivoal, P. Marty, J. de Chazal, W. Thuiller, and S. Lavorel. 2010. Social representations of an alpine grassland landscape and socio-political discourses on rural development. *Regional Environmental Change* 10: 119–130. doi:10.1007/s10113-009-0099-3.

Rawlins, A., and J. Morris. 2010. Social and economic aspects of peatland management in Northern Europe, with particular reference to the English case. *Geoderma* 154: 242–251. doi:10.1016/j.geoderma.2009.02.022.

Rehr, A. P., M. J. Small, P. Bradley, W. S. Fisher, A. Vega, K. Black, and T. Stockton. 2012. A Decision Support Framework for Science-Based, Multi-Stakeholder Deliberation: A Coral Reef Example. *Environmental Management* 50: 1204–1218. doi:10.1007/s00267-012-9941-3.

Richnau, G., P. Angelstam, S. Valasiuk, L. Zahvoyska, R. Axelsson, M. Elbakidze, J. Farley, I. Jönsson, et al. 2013. Multifaceted Value Profiles of Forest Owner Categories in South

Sweden: The River Helge å Catchment as a Case Study. *AMBIO* 42: 188–200. doi:10.1007/s13280-012-0374-2.

Ronnback, P., B. Crona, and L. Ingwall. 2007. The return of ecosystem goods and services in replanted mangrove forests: perspectives from local communities in Kenya. *Environmental Conservation* 34: 313–324. doi:10.1017/S0376892907004225.

RuizFrau, A., G. EdwardsJones, and M. J. Kaiser. 2011. Mapping stakeholder values for coastal zone management. *Marine Ecology Progress Series* 434: 239–249. doi:10.3354/meps09136.

Russell, M., J. Rogers, S. Jordan, D. Dantin, J. Harvey, J. Nestlerode, and F. Alvarez. 2011. Prioritization of Ecosystem Services Research: Tampa Bay Demonstration Project. *Journal of Coastal Conservation* 15: 647–658. doi:10.1007/s11852-011-0158-z.

Rutgers, M., H. J. van Wijnen, A. J. Schouten, C. Mulder, A. M. P. Kuiten, L. Brussaard, and A. M. Breure. 2012. A method to assess ecosystem services developed from soil attributes with stakeholders and data of four arable farms. *Science of The Total Environment* 415: 39–48. doi:10.1016/j.scitotenv.2011.04.041.

Sanon, S., T. Hein, W. Douven, and P. Winkler. 2012. Quantifying ecosystem service trade-offs: The case of an urban floodplain in Vienna, Austria. *Journal of Environmental Management* 111: 159–172. doi:10.1016/j.jenvman.2012.06.008.

Schaberg, R. H., T. P. Holmes, K. J. Lee, and R. C. Abt. 1999.Ascribing value to ecological processes: an economic view of environmental change.*Forest Ecology and Management* 114: 329–338. doi:10.1016/S0378-1127(98)00363-6.

Silvano, R. A. M., S. Udvardy, M. Ceroni, and J. Farley. 2005. An ecological integrity assessment of a Brazilian Atlantic Forest watershed based on surveys of stream health and local farmers' perceptions: implications for management. *Ecological Economics* 53: 369–385. doi:10.1016/j.ecolecon.2004.12.003.

Suneetha, M. S., J. S. Rahajoe, K. Shoyama, X. Lu, S. Thapa, and A. K. Braimoh. 2011. An indicator-based integrated assessment of ecosystem change and human-well-being: Selected case studies from Indonesia, China and Japan. *Ecological Economics* 70: 2124–2136. doi:10.1016/j.ecolecon.2011.06.010.

De la Vega-Leinert, A. C., D. Schröter, R. Leemans, U. Fritsch, and J. Pluimers. 2008. A stakeholder dialogue on European vulnerability. *Regional Environmental Change* 8: 109–124. doi:10.1007/s10113-008-0047-7.

Vihervaara, P., A. Marjokorpi, T. Kumpula, M. Walls, and M. Kamppinen. 2012. Ecosystem services of fast-growing tree plantations: A case study on integrating social valuations with land-use changes in Uruguay. *Forest Policy and Economics* 14: 58–68. doi:10.1016/j.forpol.2011.08.008.

Willaarts, B. A., M. Volk, and P. A. Aguilera. 2012. Assessing the ecosystem services supplied by freshwater flows in Mediterranean agroecosystems. *Agricultural Water Management* 105: 21–31. doi:10.1016/j.agwat.2011.12.019.

Zendehdel, K., M. Rademaker, B. De Baets, and G. Van Huylenbroeck. 2009. Improving tractability of group decision making on environmental problems through the use of social intensities of preferences. *Environmental Modelling & Software* 24: 1457–1466. doi:10.1016/j.envsoft.2009.05.017.

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List of cards used to rank ecosystem services preferences by stakeholders.

Ecosystem services (left column) were valued by stakeholders through the ranking of preferences via cards (brightly coloured, originally in Spanish); these comprised one column with the topic, a second column explaining the main idea that each ecosystem services represents and a third column including an example that applies to the River Piedra floodplain. Here, we attempted to capture the widest range of ecosystem services valuable to stakeholders based on a previous observation of the main activities developed around the River Piedrafloodplain.

Ecosystem Service	Topic	Main idea	Applied example
Climate regulation	**CLIMATE**	TEMPERATURE and environmental MOISTURE regulation	We feel much cooler under a poplar tree or by the river than in the middle of a field.
Water flow regulation	**WATER**	AQUIFER recharge, water drains underground	A part of the floodwater can be drained through the soil.
Water quality regulation	**WATER**	Water PURIFICATION: the stream water is purified downstream.	Turbidity disappears. Stream water is drinkable.
Water supply	**WATER**	Householdand farming CONSUMPTION.	Stream water is used for drinking, washing, cooking, gardening, and farming. Household water comes from a well by the side of the river.
Soil formation **& Nutrient regulation**	**SOILS**	Nutrient-rich FERTILE SOIL is created. Soils are retained.	Floods bring sediments that are good for farming. Riverbank vegetation prevents soil losses by floods.

Pollination	**PLANTS and ANIMALS**	POLINATION (in fruit groves and elsewhere).	Fruit-groves give fruits thanks to pollen carried by bees.
Genetic resources	**PLANTS and ANIMALS**	LOCAL VARIETIES of vegetables, herbs and animals	Our local varieties better support low temperatures and droughts. In the river there are animals only found in this area.
Medicinal	**PLANTS and ANIMALS**	MEDICINAL	We use plants for remedies.
Food provision (Crops)	**PRODUCTION**	CROPS (orchards, fruit groves, cereal) for selling or own consumption	Crops generate richness.
Food provision (Fish, Crabs, Hunting)	**PRODUCTION**	FISHING, HUNTING	Fishing and hunting are good to obtain food.
Sheep Food provision	**PRODUCTION**	PASTURES for livestock	Livestock use pastures or stubble by the river.
Raw materials	**PRODUCTION**	MATERIALS, wood, etc.	Woods and gravels are used for building.
Energy	**ENERGY**	HYDROELECTRICITY (la Requijada, la Tranquera)	Hydroelectricity is generated by the river
Landscape & Aesthetic & Habitat provision	**LANDSCAPE**	A VARIETY of LANDSCAPES	The river provides the landscape with a different value.
Sense of place **& Social relations**	**CULTURAL**	SENSE-OF-PLACE SOCIAL RELATIONSHIPS	I feel attached to this place because of the river. There is a festival we celebrate together by the river.
Recreation & Tourism	**CULTURAL**	LEISURE TOURISM	We usually walk the river or fish there. Tourism attracts money here.
Educational & Scientific value	**CULTURAL**	EDUCATIONAL	School-children come to the river to learn.

Spiritual & Relaxation & Life quality	**CULTURAL**	RELAXATION LIFE QUALITY	The river is relaxing. Living close the river or being able to come to visit provides me with a good life quality.