

Carbon stock protection and food production are key targets for conservation planning in a landscape of public and private lands
Carolyn R. Koehn (Boise State University, carolynkoehn@u.boisestate.edu), T. Trevor Caughlin, Sarah Halperin, Kelly Hopping, Rebecca Som Castellano, Jodi Brandt
Landscape Ecology

Online Resource A: Research Context

A.1 Research Overview

We used 21 NCP indicators in six NCP categories to estimate NCP across Idaho's Snake River Plain. To answer question 1, we used these 21 data layers along with polygons of land tenure to quantify the amount of NCP in each land tenure category. To answer question 2, we employed a two-part sensitivity analysis (Figure A1).

The first sensitivity analysis was performed six times, once for each NCP category. In each NCP category, we created a scenario with all NCP indicators and scenarios with each possible combination of NCP indicators. For each scenario, we generated optimal protection solutions that targeted 5-75% of each included NCP. We then compared each solution with the full solution in that NCP category, quantifying their dissimilarity at each target, and calculated the area under the EMD curve [AUC-EMD]. We selected NCP indicators from the scenario with a low AUC-EMD and fewer NCP indicators to be part of scenario that included all NCP categories.

The second sensitivity analysis was performed once. We created a scenario with the 14 NCP indicators selected in the first sensitivity analysis, and scenarios in which one NCP indicator or one NCP category was removed. Again, for each scenario, we generated optimal protection solutions that targeted 5-75%, incremented by 5%, of each included NCP. We then compared each solution with the all-NCP solution, quantifying their dissimilarity at each target, and

calculated the AUC-EMD. The most dissimilar solutions, those with the highest AUC-EMD, revealed which NCP were most influential to the all-NCP solution.

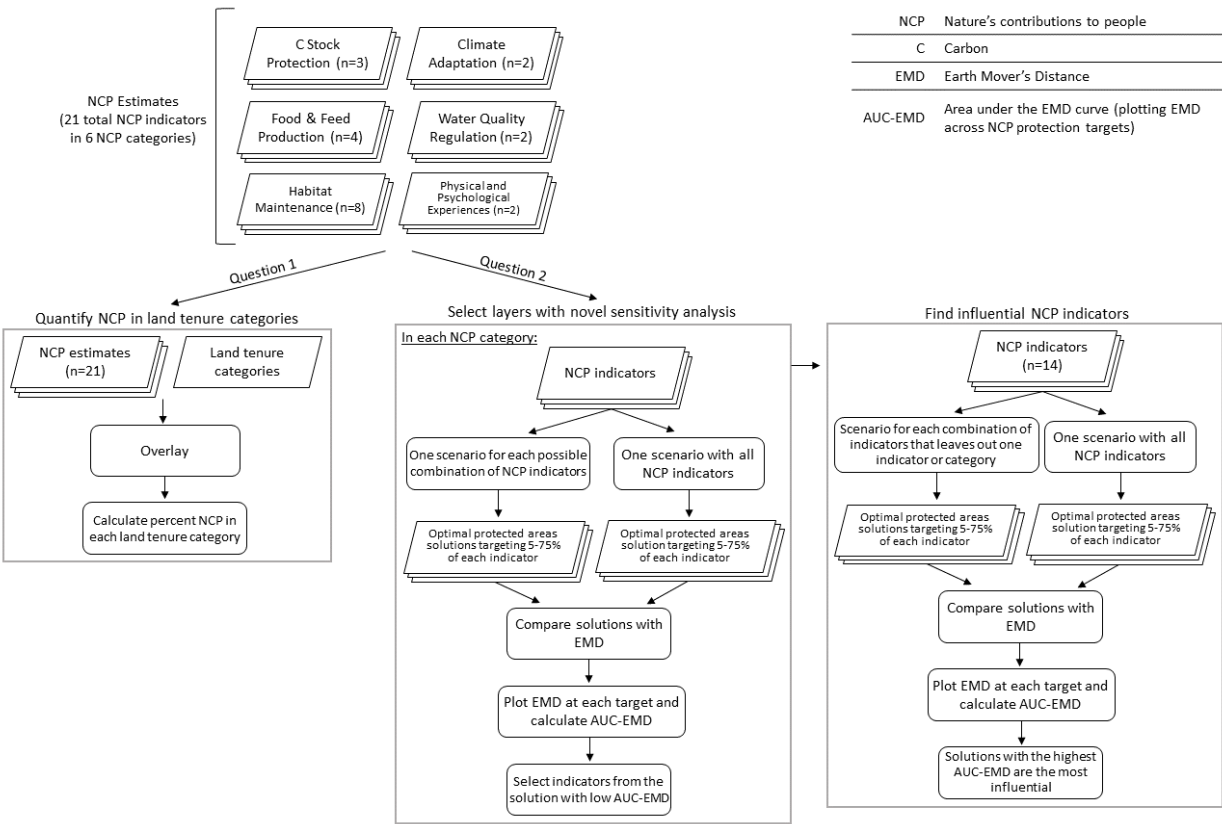


Figure A1: Workflow diagram for quantifying NCP in each land tenure category, selecting features for the systematic conservation planning using a novel sensitivity analysis, and evaluating the most influential NCP indicators in Idaho's Snake River Plain.

A.2 Land Tenure Categories

Land tenure can be broadly defined as the relationship between humans and land, with social, political, legal, and economic structures all influencing this relationship (FAO, 2002), and it dictates land use options, management actions, and protection mechanisms. Here, we focus on two categories of land tenure: public lands, where land is owned and managed by a governmental entity; and private lands, where land is owned and managed by an individual, a corporation, or any non-governmental organization, or owned by any of these parties and managed by non-

34 owners. Since land tenure dictates existing land protections and management actions (Table A1),
 35 it is critical to understand which NCP are present or absent from different types of land tenure.

Table A1: Land tenure categories used in our analysis of the Snake River Plain, Idaho, and their susceptibility to land use and NCP changes.

Type of Land	Description	Level of Protection	Spatial Data Source
Federal public lands	Federal lands are generally protected from residential development, but not always from resource harvesting (such as timber harvest and mining).	All federal lands are closed to intensive agriculture and residential development. Historically, federal lands have rarely been transferred to other tenure categories, but there is political pressure to make this exchange more frequent (Streater, 2024).	Bureau of Land Management (2023)
State public lands	State lands are closed to residential development, but are mandated to produce income over time for the state.	Sales of state land in Idaho to private entities are much more common than sales of federal land, so they are not as protected long-term as federal lands (Barker, 2016).	Bureau of Land Management (2023)
Private Protected Agricultural Lands (PALs)	Easements created to protect agricultural land.	Land use is agreed upon between landowner and easement holder on an easement-to-easement basis, but in general PALs must continue to be used for agriculture.	American Farmland Trust (2024)
Other protected private lands	Easements created for purposes other than agricultural land protection.	Land use is agreed upon between landowner and easement holder on an easement-to-easement basis.	NatureServe (2024)
Other private lands	Privately owned lands that have no known easements or other protections. They may be owned and managed by by an individual, a corporation, or any non-governmental organization, or owned by any of these	These lands have the lowest legal restrictions on land use and subsequent NCP change.	Bureau of Land Management (2023)

parties and managed by
non-owners.

37

A.3 Average size of agricultural easements

Table A2: The average size of easements differs based on the purpose and the focus area. The Protected Agricultural Lands Database (PALD) documents only agricultural easements, while the National Conservation Easements Database (NCED) documents all known easements. Different measures of average easement size from these databases are varied, but overall they average to about 1 km², the chosen spatial scale for this analysis.

Database	Mean easement size (sq km)	Median easement size (sq km)
Protected Agricultural Lands Database (PALD)	0.7	0.2
PALD (study area)	4.3	2.2
National Conservation Easements Database (NCED)	2.7	0.1
NCED (study area)	0.2	0.01

39 References

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