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Spatial Prioritization of Protected Areas in East Asian Biodiversity Hotspots: Assessment of Conservation Bias and Long-term Effectiveness based on Ecological Big Data

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This research focuses on the spatial design of a protected areas network (PAN) in Japan and conducted spatial conservation prioritization (SCP) to develop action plans for achieving the Aichi Targets (Kubota et al., 2017). We have created a dataset on species occurrences, functional traits, phylogenies and fossils for multiple taxa across vascular plants and vertebrates, and modeled the distributions of 6,325 species (plants, amphibians, birds, freshwater fish, mammals and reptiles) at a 1-km grid scale. Using the predicted patterns of species distributions and functional/phylogenetic diversity, we have revealed macroecological processes underpinning biodiversity patterns along environmental gradients (Kubota et al., 2015, 2017a, b; Shiono et al., 2015, 2018). We have assessed the representativeness of the current protected areas network in Japan (Kusumoto et al., 2015, 2018), showed that the existing protected areas network (PAN) poorly captures potential biodiversity patterns, especially for vascular plants, and then identified priority areas for improving the conservation effectiveness of PAN.

In addition, we have applied the zonation to identify an area-efficient and balanced set of candidates for expansion of Japan's existing PAN (Lehtomäki et al., 2019). First, we analyzed each taxon individually to understand baseline priority patterns. Second, we combined all taxa into an inclusive analysis to identify the most important PAN expansions. Human influence was used as a proxy for potential socio-economic costs of PAN expansion. There was remarkably little overlap between priority areas for the individual taxa. Our inclusive prioritization analysis across all taxa identified priority regions, in particular in southern subtropical (Okinawa) and mountainous areas. Expanding the PAN up to 17%, as agreed in Aichi Target 11 of the Convention on Biological Diversity, would cover most ranges of rare and/or restricted-range species. On average, approximately 30 percent of the ranges of all species could be covered by the 17 percent expansion identified here. Our analyses identified top candidates for expansion of Japan's PAN (Fig. 1). Taxon-specific prioritization was informative for understanding the conservation priority patterns of different taxa associated with unique biogeographical processes. For the basis of PAN expansion, we recommended multi-taxon prioritization as an area-efficient compromise that reflected taxon-specific priority patterns (Fig. 2). Spatial prioritization across multiple taxa would provide a promising framework for the development of conservation plans aiming at long-term persistence of biodiversity in Japan.

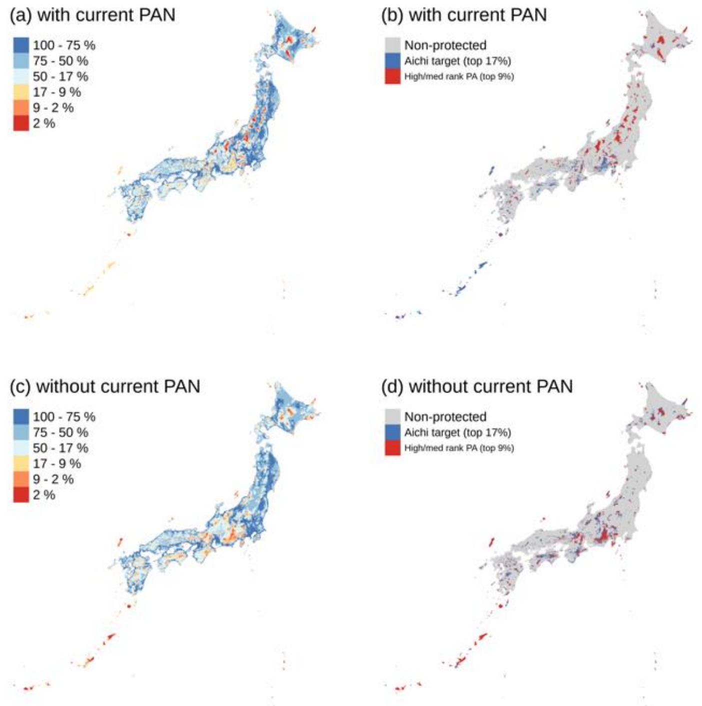

Fig. 1 Priority rank maps for the all-taxa analysis, computed with and without the PAN. (a) and (b) show a priority rank map expanded from the current PAN; the top 2% (red in (a)) and 9% (blue in (b)) correspond to high- and medium-ranked protected areas, respectively. Panels (c) and (d) show an ideal unconstrained prioritization, which assumes that the current PAN does not count and that only species occurrences matter. For comparison, (d) shows the same top-priority fractions in the same colours as (b). The analyses include all taxa, with 6,325 species total, in which individual species are weighted by Japanese Red List category, endemicity and evolutionary distinctiveness. Each taxon was weighted based on its importance for ecosystem functioning, ecosystem services and number of species. The 1-km grid cells were conditioned by a human influence index.

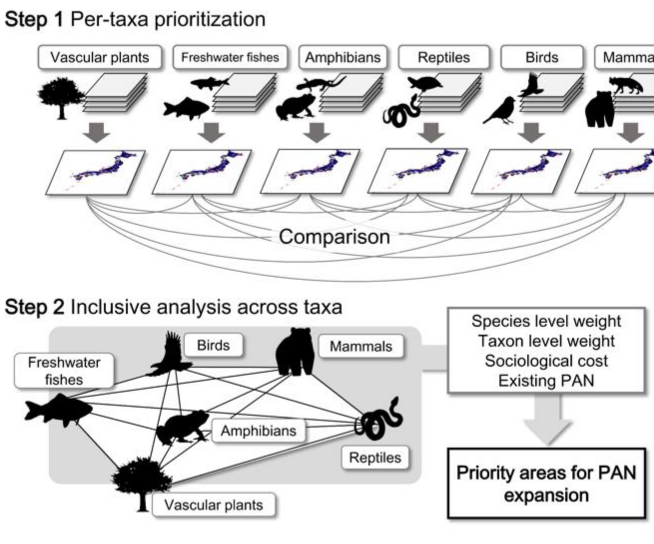

Fig. 2 Conceptual framework of the prioritization analysis in this study: the first step is a per-taxon analysis for detecting biogeographical patterns of priority areas in each taxon and revealing spatial inconsistencies between taxa; the second step is a multi-taxon analysis to identify priority areas for expanding the existing PAN in Japan.

References:

Kubota, Y., B. Kusumoto, T. Shiono and T. Tanaka (2017a)

Phylogenetic properties of Tertiary relict flora in the East Asian continental islands: imprint of climatic niche conservatism and in situ diversification. *Ecography*, 40: 436–447. https://onlinelibrary.wiley.com/doi/epdf/10.1111/ecog.02033

Kubota, Y., B. Kusumoto, T. Shiono and W. Ulrich (2017b)

Multiple filters affect tree species assembly in mid-latitude forest communities. *Oecologia*, 187: 245–253. https://doi.org/10.1007/s00442-018-4122-6

Kubota, Y., B. Kusumoto, J. Fujinuma and T. Shiono (2017)

Systematic conservation planning for biodiversity conservation: Basic concepts and outline of analysis procedure. *Japanese Journal of Ecology*, 67: 267–286. https://doi.org/10.18960/seitai.67.3_267

Kubota, Y., B. Kusumoto, J. Fujinuma and T. Shiono (2015)

Role of climate and geohistorical factors in driving plant richness patterns and endemicity on the East Asian continental islands. *Ecography*, 38: 639–648. https://onlinelibrary.wiley.com/doi/epdf/10.1111/ecog.00981

Kusumoto, B., T. Shiono, M. Konoshima, A. Yoshimoto, T. Tanaka and Y. Kubota (2018)

How well are biodiversity drivers reflected in protected areas? A representativeness assessment of the geohistorical gradients that shaped endemic flora in Japan. *Ecological Research*, 32: 299–311. https://link.springer.com/article/10.1007/s11284-017-1451-6

Kusumoto, B., T. Shiono, M. Miyoshi, R. Maeshiro, S. Fujii and Y. Kubota (2015)

Functional response of plant communities to clearcutting: management impacts differ between forest vegetation zones. *Journal of Applied Ecology*, 52: 171–180. https://besjournals.onlinelibrary.wiley.com/doi/epdf/10.1111/1365-2664.12367

Lehtomäki, J., B. Kusumoto, T. Shiono, T. Tanaka, Y. Kubota and A. Moilanen (2019)

Spatial conservation prioritization for the East Asian islands: a balanced representation of multi-taxon biogeography in a protected area network. *Diversity and Distributions*. DOI:10.1111/ddi.12869

Shiono, T., B. Kusumoto, R. Maeshiro, S. Fujii, L. Götzenberger, F. de Bello and Y. Kubota (2015)

Climatic drivers of trait assembly in woody plants in Japan. *Journal of Biogeography*, 42: 1176–1186. https://onlinelibrary.wiley.com/doi/full/10.1111/jbi.12503

Shiono, T., B. Kusumoto, M. Yasuhara and Y. Kubota (2018)

Roles of climate niche conservatism and range dynamics in woody plant diversity patterns through the Cenozoic. *Global Ecology and Biogeography*. https://doi.org/ 10.1111/geb.12755