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Research Brief

From the Okanagan Bioregion Food System Project 2021

Impacts of Agricultural Production on Wildlife and Biodiversity in the Okanagan Bioregion

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Abstract

The Okanagan Bioregion contains a large concentration of unique and sensitive species as well as vast resources in its natural lands. Farmlands have preferentially occupied the rich valley bottom areas and have become a substantial element of landscape habitat for many of these species. However, continued ad hoc conversion of non-production areas to farming and other uses poses a serious risk to the bioregion's ecosystems. Indicators of habitat composition and configuration used in this study have identified the critical role that natural habitats play in the larger agricultural landscape, and their vulnerability to the expansion of irrigated agriculture. Although potential future expansion threatened only 13.5% of natural lands, the impact is disproportionately borne by sensitive habitats. Mitigating these impacts by targeting conservation efforts to 'Very High ' conservation rank parcels as well as leveraging existing programs for on-farm plantings of hedgerows and riparian buffers can not only mitigate some of these impacts but greatly improve the connectivity of on-farm habitats to the greater mosaic of natural lands in the Okanagan bioregion. The recommendations of the 2014 Okanagan Biodiversity Strategy regarding targeted land conservation and on-farm management with landowners are reinforced by the results of this study.

Introduction

Agricultural regions are home to a great number of species that use a diversity of habitats. Although many species use crop fields for habitat, many species require non-production areas, such as hedgerows, forest stands or natural grasslands, for one or more of their life stages (Duelli and Obrist 2003). As agriculture is imposed and expands, the landscape tends to simplify and lose critical non-production habitats (Balmford, et al. 2012). Wildlife on farmland use these habitats to move through the landscape, take refuge from predators, nest and feed (BC Ministry of Agriculture 2010; Latimer and Peatt 2014). The connection of a habitat patch to a network of habitats is an essential aspect of its quality. Without this connection, wildlife can become isolated in areas where they will not be able to survive, or are at greater risk when they traverse the landscape (Hanski and Gilpin 1991).

The Okanagan bioregion contains a multitude of unique species and habitats, many of which are particularly sensitive to human impacts. Grasslands in BC account for only 1% of the land cover and approximately 90% of the area is located in the Southern Interior region (Wikeem and Wikeem 2004). The woodlands and wetlands of the region are also of critical concern. Many of the most sensitive and crucial habitats in the Okanagan include grasslands, bluffs, and riparian margins (OCCP & SOSCP 2014). Species such as burrowing owls, bighorn sheep, and salmon rely on the health of these habitats, however, these landscape elements are often co-located with human development in fertile valley bottoms. The extensive footprint of farmland in these valley bottom lands create a conflict but also an opportunity for farmers to support biodiversity in the bioregion (Latimer and Peatt 2014). The challenge is often identifying the correct strategies for a diverse mosaic of land owners and governmental agencies to implement a unified plan to protect and enhance conservation in a region (Parrott et al. 2019).

The “Keeping Nature in our Future” (2014) series presented assessments of the conservation value of the region’s habitats and provided recommendation for implementing beneficial strategies widely (OCCP & SOSCP 2014). The report identified valley bottoms as areas of focus and advised leveraging existing and potential programming for incentivizing private landowners to participate in conservation activities, such as Environmental Farm Plans (BC Ministry of Agriculture 2010). Other conservation strategy assessments have also provided similar recommendations with regards to farmers and ranchers on grassland parcels (G.G Runka Land Sense Ltd. et al. 2005). The role of farmlands in any strategy in the Okanagan is key and understanding the nature of habitat on farms can provide insights on development and implementation of strategies.

The objective of this wildlife habitat assessment was to build on similar research conducted in the Okanagan bioregion and assess the impacts of specific mitigation strategies on the landscape. The contribution of the landscape to conservation is complex and poorly captured in a single indicator (or multiple indicators for that matter). The range of needs for a given species can vary wildly and the qualities of specific sites can be key determinants of outcomes. This assessment takes a broad look at potential agricultural futures of the Okanagan bioregion and constitutes a coarse analysis which should be interpreted as generalized rather than definitive possible outcomes. The objective of the Wildlife Habitat Capacity (WHC) and Natural Patch Connectivity indicators is to evaluate how what we grow and where we grow it affects the quality of habitats available and the connectivity of natural habitats.

Methods

The Okanagan bioregion wildlife habitat assessment was comprised of two indicators that addressed both the composition and configuration aspects of habitat quality:

Wildlife Habitat Capacity (WHC) - the measure of overall quality of habitat on agricultural lands, including both natural and anthropogenic lands.

Natural Patch Connectivity - a spatial measure of the distance between patches of natural habitats and the number of patches in the landscape. Habitat quality is greater in landscapes with more patches that are closer together.

Together these indicators provide a well-rounded assessment of landscape-level wildlife habitat quality – neither can be used in isolation of other components. Although these indicators assess habitat generally, species-specific measures may vary widely based on the specificity of their habitat requirements.

These metrics were calculated and compared for three land use configurations representing potential agriculture futures (scenarios) in the Okanagan bioregion:

1. Baseline - 2016 land cover with 2017 ALUI natural vegetation.

2. Expand Land - conversion of natural lands that are farmable and with access to irrigation water to agriculture.

3. Mitigate Habitat Impacts - conversion of natural lands that are farmable and with access to irrigation water to agriculture (same as above), with the addition of on-farm habitat enhancements through hedgerow and riparian buffer plantings where possible and retention of existing critical habitats.

Thus, the Mitigate Impacts scenario demonstrates the potential mitigation and enhancement of wildlife habitats on farmland with two modeled constraints to agriculture expansion:

Critical Habitat Conservation - prescriptive protections of any parcels having a Very High conservation rank. These can include vegetated and non-vegetated habitats but are non-production natural areas.

Habitat Enhancements - on-farm plantings of (A) hedgerows on all road and parcel boundaries (6m wide); and (B) riparian buffers within 150m of major waterways and water bodies composed of either woodlands or the conversion of managed pasture to natural pasture where possible.

These are only two possible examples of farmland habitat enhancement measures; others may be recommended for site-specific benefits or to address particular ecosystem or species concerns. Our land configuration scenarios did not consider lands outside of the Agricultural Land Reserve (Agricultural Land Commission 2017) and Agriculture Land Use inventory (BC Ministry of Agriculture 2017).

Wildlife Habitat Capacity (WHC)

The WHC index was developed by Javorek and Grant (2011) for the purposes of estimating the contribution of agricultural and non-production land covers to wildlife habitat in Canada. The authors evaluated the relationship of 377 regional species with 31 crops, non-production areas and other land covers (see Appendix for complete list). The habitat value of agricultural and natural land covers was weighted according to its proportion of the modelled Okanagan area. The WHC value of each modelled scenario was calculated as the sum of the Species-Specific Habitat Availability (SSHA):

$$SSHAbf = \Sigma\ (\%LCb \times HUVb) + \Sigma\ (\%LCf \times HUVf)$$

What are Hedgerows?

Hedgerows (also shelterbelts or windbreaks) are linear features on farm field margins can take many forms and should be tailored to the site as well as the landowner's needs. Plantings primarily composed of a variety of natural vegetation will provide the greatest benefit to wildlife and will vary according to the local environment. Hedgerows can also provide benefits to the farmer such as pollinator habitat, wind/runoff protection, and even barriers to trespassers.

Local conservation organizations, such as the South Okanagan Similkameen Conservation Program, link landowners with resources for assessing how to add these types of wildlife friendly landscape features to their farms.

The SSHA factors in breeding (b) and feeding (f) habitat use value (HUV) and the given land cover (LC) proportion in the bioregion. The results are interpreted per the following levels: Very Low, 30 or less; Low, 30-50; Moderate, 50-70; High, 70-90; and Very High, 90 or greater.

Natural Patch Connectivity

The configuration of natural land covers within the farm landscape can impact the amount and accessibility of habitat available to a species within an area (Parrott et al. 2019). In this study, configuration comprised two metrics: (1) Proximity or the average nearest neighbor (ANN) of natural patches; (2) Density or the number of patches (n) in the landscape. These indicators were calculated in ArcMap 10.7 (ESRI 2019) using Patch Analyst 5.2 (Rempel 2016) with a rasterized 2017 ALUI natural land covers (see Appendix for list). The analysis focused on lower elevation (< 750m) areas where there were substantially fewer contiguous natural land parcels and pressure from agricultural land conversion (per the Expand Land scenario). Results were calculated for the entire Okanagan bioregion, but also for sub-regions of the study area to account for major obstacles (such as Lake Okanagan).

Results and Discussion

The natural lands in the Okanagan bioregion's ALUI/ALR account for nearly three quarters of the land area, not taking into account the extensive undeveloped regions surrounding farmland (Table 1). Unlike some highly developed agricultural regions, the bioregion is in an enviable position to implement conservation without major restoration efforts required for other more extensively modified landscapes (Parrott et al. 2019). The development of the valley bottoms is currently surrounded by low use intensity uplands, making farmlands in the Okanagan a vital link between lowland and upland habitats.

Future expansion of agricultural production is the region is strongly limited by water availability, and so a full expansion of agriculture onto all arable, irrigation-accessible lands (see full report) would only result in a loss of 13.5% of natural lands (Table 1). Much of this conversion would be in woodlands (51.1% of total loss) and mixed grassland (37.0% of total loss); however, the greatest loss to individual habitat distributions was seen in riparian woodlands (57.6% converted) and natural wetlands (45.9% converted). These highly sensitive habitats are already under great threat (OCCP & SOSCP 2014) and future agricultural expansion is likely to lead to land conversion of these areas. Very High conservation rank riparian woodland composed 34.6% of all riparian area (by far the greatest contributor), while 64.1% of natural wetlands (NWV) were Very High conservation ranked, however, they account for only 0.4% of the bioregion's ALUI/ALR. Although the potential loss in the future Expand Land scenario was small overall, the component of highly valued (mixed grassland) or sensitive habitats (riparian woodlands and wetlands) was substantial and would warrant concerted planning efforts to mitigate. The critical losses were also reflected in a 9-point reduction in WHC (from High to Moderate), which is substantial given the overall percentage of natural land covers in the bioregion.

The Expand Land scenario also resulted in a change in the configuration of natural lands. As undeveloped parcels within the ALUI/ALR are converted to crop production, remaining natural patches decrease in number and are increasingly clustered together (Table 1). Although the loss in total area was low, the overall concentration of natural habitat areas into a more limited area results in lower connectivity overall. These impacts are largely seen in areas with greater capacity for irrigated agricultural expansion, which are primarily located along the central part of the Okanagan Valley, vis-a-vis Kelowna, Shuswap West, and Penticton East and West (Figure 1). A reduction of the refuge and travel corridors, particularly in these regions, may disproportionately impact wildlife that requires a mix of valley bottom and upland habitats and may isolate vulnerable wildlife due to a conversion of those important habitat elements.

The Mitigate Impacts scenario investigated the potential for the addition of regionally appropriate hedgerows and riparian buffers, as recommended by the Environmental Farm Plan program. The addition and protection of approximately 13,500 ha in critical habitats and habitat enhancements

What are Riparian Buffers?

Riparian buffers naturally vegetated areas surrounding rivers, lakes, and wetlands which provide wildlife habitat and water quality protection for waterways. These features are a critical component of fish habitat protections, particularly for salmon-bearing streams. Generally wider than hedgerows, these features are often remnant or afforested areas of natural trees and shrubs. In the Okanagan, these often contain cottonwood, birch, willow, and dogwood as well as many small plants and natural grasses. Riparian areas can be restored and protected through the seasonal exclusion of livestock and well-planned animal water access. The Environmental Farm Plan offers Riparian Management Workbooks (2005) as well as consultations to improve riparian health. Local conservation organizations can connect farmers with resources on protecting their on-farm riparian areas or developing plans for restoration.

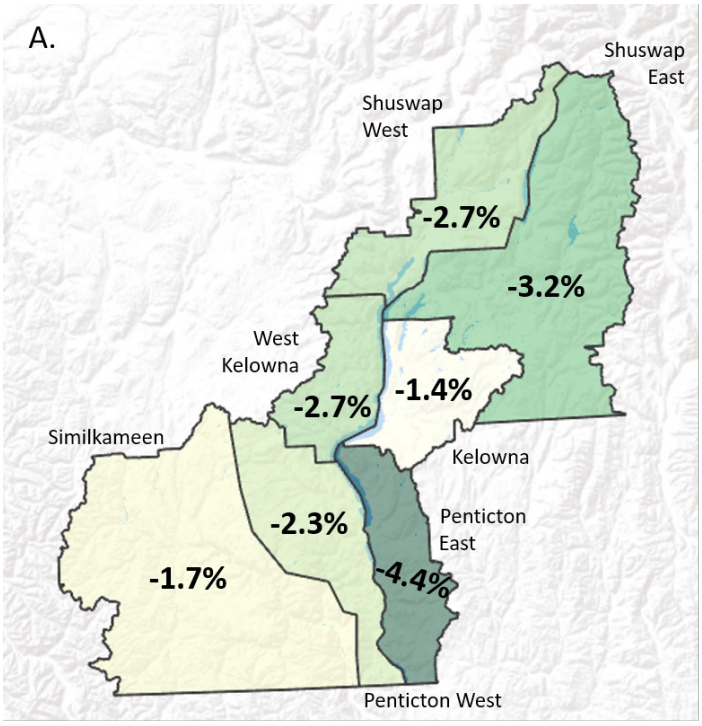
	Baseline	Expand Land	Mitigate Habitat Impacts
Total Natural Land Area	73.6%	63.6%	69.4%
Δ natural area	-	-13.5%	-5.6%
Δ ANN of patches	-	4.3%	-29.2%
Δ n of patches	-	-23.9%	166.6%
WHC	72	63	67
Habitat Constraint area (ha)	-	-	13,520

Table 1: Change in natural lands between land use scenarios relative to Baseline (2017) land scenario. Relative values reflect changes in the bioregion as a whole.

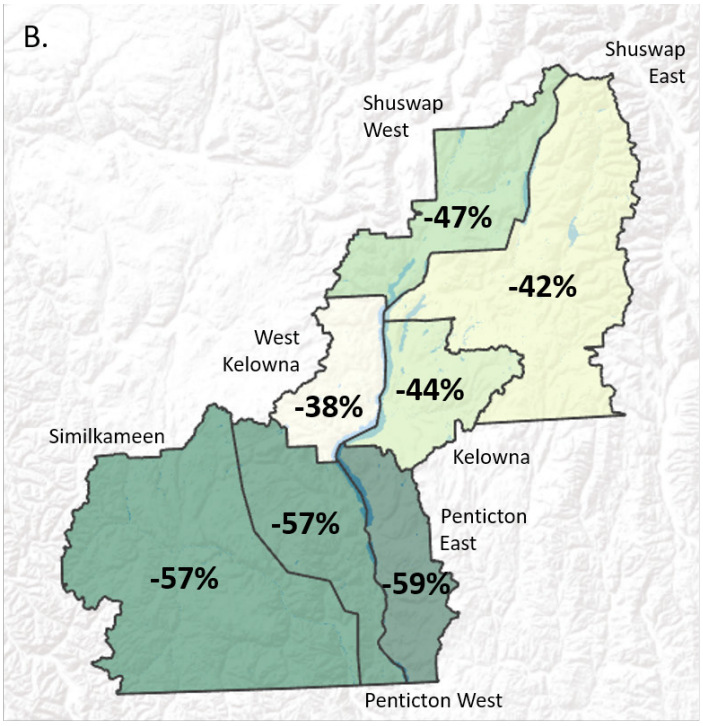
(see above for definitions) reduced overall loss of natural land by 7.9% while greatly improving the connectivity of the landscape and reducing the impact to WHC from agriculture expansion by about half. Although hedgerows and riparian buffers do not replace the value of unique and established habitats that are lost in land conversion, such improvements to landscape quality can mitigate some of the adverse impacts of conversion such as detrimentally isolating wildlife. The benefits to connectivity were highest in the southern Okanagan where, overall, the lower elevations and valley bottoms had fewer existing natural parcels than the northern Okanagan. The Kelowna region saw moderate improvements to connectivity; however, these improvements are valuable in light of the high pressure on this area due to urban and irrigated farmland expansion. The potential loss of ~40% of natural habitat patches would results in substantial overall loss of connectivity in an area of high risk for wildlife.

This analysis provides insight into the potential landscape improvements landowners could make to enhance on-farm and regional habitat. Current recommendations for improving connectivity have identified hedgerows, riparian vegetation, and other common farm features as ideal to improve both farmscape and landscape level connectivity (Latimer and Peatt 2014). The results of this assessment and projections confirm the high positive impact potential of these small changes. Targeting sub-regions with high potential for positive impacts from these habitat improvement measures, along with species- and ecosystem-specific natural patch types would reduce negative impacts to the overall contiguity of the bioregion's natural landscape from agricultural expansion. Parrott (2019) demonstrates tools for planning regional connectivity which can be utilized to harmonize both non-agricultural and agricultural efforts to improve landscape connectivity for wildlife. Although such habitat provisions do impose burdens on farmers, leveraging programs such as Salmon Safe and Environmental Farm Plans as well as integrating carbon stock valuation (see Carbon Stock Brief), may incentivize farmland owners to contribute to regional conservation in coordination with non-agricultural efforts.

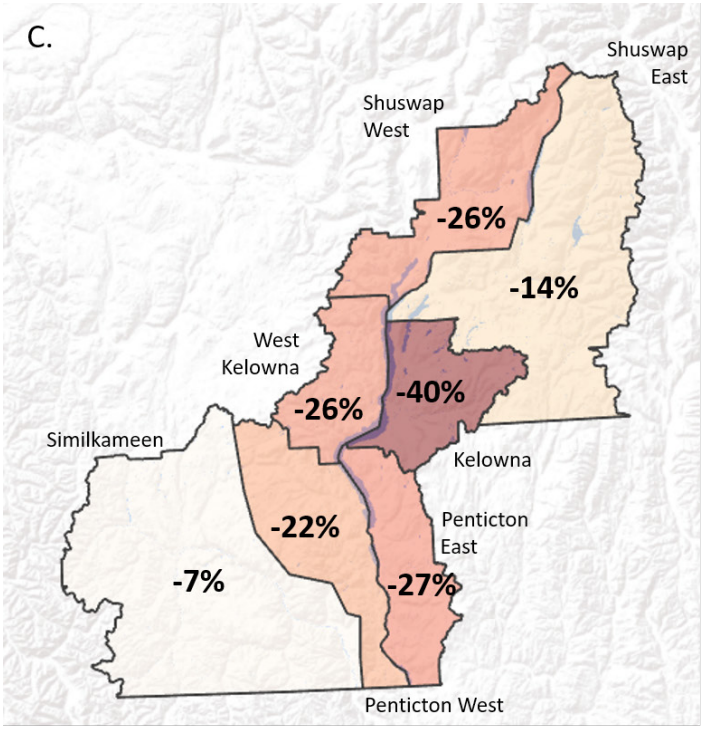
The valuation of ecosystem services, that is, ecological processes that provide functions beneficial to human communities, would identify the true benefits of implementing these landscape-wide programs in economic terms. Critical among these are the protection of important economic and cultural food species, particularly salmon, which benefit greatly from enhanced riparian margins. The natural resources of the Okanagan bioregion are a critical asset to the community and the province; pre-emptive interest and investment in the bioregion by governmental and non-governmental organizations will in time allow for synergy between economic development and conservation.



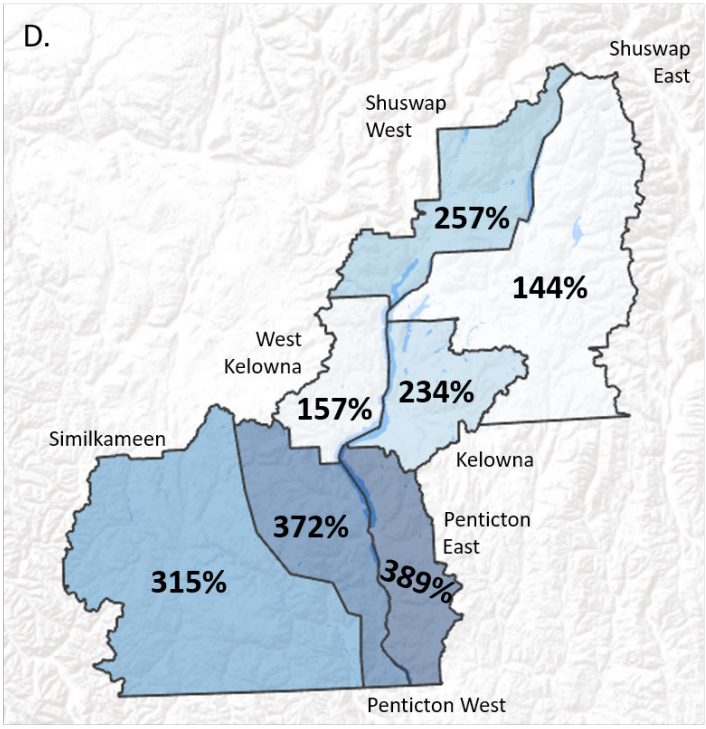
A) Change in natural patch connectivity relative to Baseline (2017) land configuration by region: **Expand Land**



B) Change in natural patch connectivity relative to Baseline (2017) land configuration by region: **Mitigate Habitat Impacts**



C) Change in number of habitat patches relative to Baseline (2017) land configuration by region: **Expand Land**



D) Change in number of habitat patches relative to Baseline (2017) land configuration by region: **Mitigate Habitat Impacts**

Figure 1: Change in natural patch connectivity metrics relative to Baseline (2017) land configuration by region. Relative changes in Proximity in (A) (B) show the addition of Habitat Constraints in (B) greatly reduces the distance between natural habitat patches, particularly in the south end of the bioregion. The number of patches in (C) is most heavily reduced in areas with greater access to future irrigated acreage. The addition of Habitat Constraints in (D) shows a very large increase in overall density of habitat patches despite the overall 5.6% loss of natural lands.

Suggested Citation

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Appendix

Summary of Javorek and Grant (2011) WHC land cover categories and their application to the Okanagan Bioregional land cover data.

Agricultural Products:

Land cover area for this series calculated through modelled crop area.

- Berries: all fruit crops grown on perennial shrubs
- Cereals: all grain crops, including grain for livestock
- Corn: all corn crops
- Fruit Trees: all fruit crops grown on perennial trees and vines
- Improved pasture: all livestock pasture
- Other crops: potatoes
- Oilseed: crops used for oil production, including canola
- Pulses: all legume crops, including beans
- Tame pasture: managed vegetation adjacent to barns, greenhouses, and other structures (multiplied by a factor of 0.1 to account for structures and management impacts)
- Vegetables: all field crops excluding crops grown in greenhouses

Natural Lands

Land cover area for this series calculated using ALUI land covers.

- Woodlands (interior): NTV V100
- Grassland-Shrubland-Herbaceous Woodland: NTV V200, V300, V400, V500, NTB
- Riparian Woodlands: NTV V100 within 150m of major waterways and water bodies (includes Riparian Buffer Habitat Enhancement)
- Riparian Grassland: natural grasslands on floodplains
- Shelterbelt Trees: Hedgerows within 6m of roadways and parcel boundaries (Habitat Enhancement Only)
- Wetlands (with and without margin): NVW and NWW
- Wetland, planted: anthropogenic wetland plantings, AVW
- Idle Land: all unaccounted for ATVC land, including ATVC C900 (other)
- Open Water: waterways and water bodies, including lakes and rivers, AWW

About the Institute for Sustainable Food Systems

The Institute for Sustainable Food Systems (ISFS) is an applied research and extension unit at Kwantlen Polytechnic University that investigates and supports sustainable agriculture and regional food systems as key elements of sustainable communities. We focus predominantly on British Columbia but also extend our programming to other regions.

Our applied research focuses on the potential of regional food systems in terms of agriculture and food, economics, community health, policy, and environmental integrity. Our extension programming provides information and support for farmers, communities, business, policy makers, and others. Community collaboration is central to our approach.

About the Okanagan Bioregion Food System Project

Communities and governments are increasingly looking to strengthen regional food systems as a way to address many complex agriculture and food challenges. The Okanagan Bioregion Food System Project explores the social, economic, and ecological outcomes of a regional food system in the Okanagan. This multidisciplinary research project, initiated by ISFS and regional partners, can guide conversations among communities and decision-makers seeking to advance their regional food system.

The Okanagan Bioregion Food System Project considers and builds upon existing food system planning and other related work to support local and regional food systems in the bioregion.

For the full report and more research briefs visit: www.kpu.ca/isfs/okanagan-bioregion

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