Modeling and mapping riparian vegetation and habitat in the central Great Basin, NV

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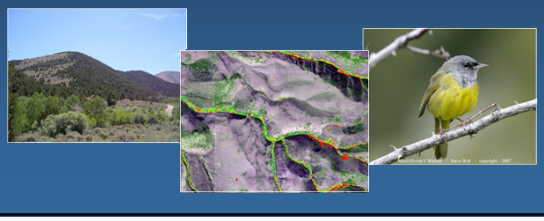
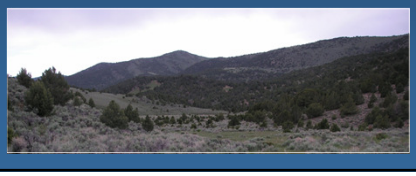
Outline

- Riparian land cover in the central Great Basin, NV
- Modeling and mapping riparian vegetation and habitat
- Estimating occupancy for breeding birds



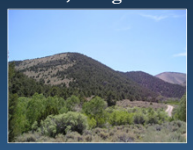
Riparian land cover

- Riparian land cover or "zones": mesic to wet edaphic environments, typically occupying low-lying terrain at the interface between terrestrial and aquatic environments
- Extent, location, composition, structure, status not well-characterized or represented in existing maps
- Previous models have not leveraged or integrated multiple image and data sources
- Can be overestimated or underestimated (a resolution problem)

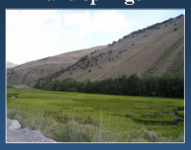


Riparian land cover

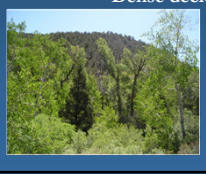
Deciduous shrubs, trees, and grasses



Wet meadows, seeps, and springs

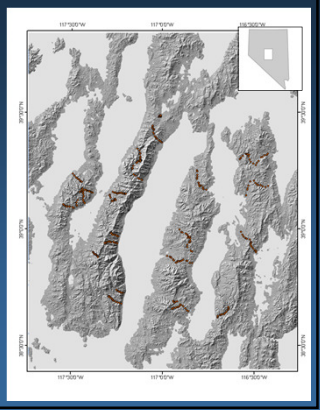


Dense deciduous tree cover



Focal Area

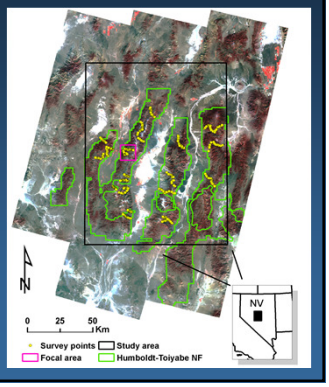
- ~15,000-km^2, four mtn ranges
- Humboldt-Toiyabe National Forest
- 319 field plots: # live trees, frequency of shrubs, % of riparian species in canopy



Modeling and mapping riparian vegetation

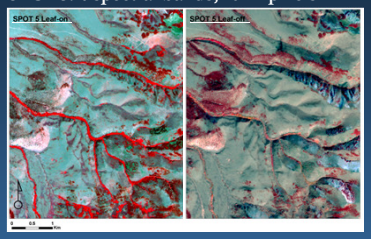
Principal objectives:

1. Identify riparian "zones" and vegetation types with an acceptable to high level of accuracy
2. Develop robust, low-cost mapping methods using ground-based and remotely sensed data
3. Develop outputs for integration into wildlife habitat quality and other models

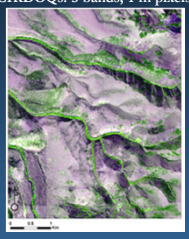


Satellite and aerial image data (2005, 2007)

SPOT5: 4 spectral bands, 10-m pixels



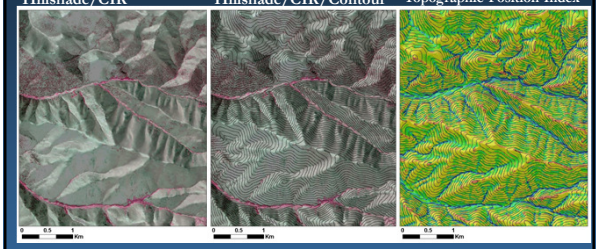
CIRDOQs: 3 bands, 1-m pixels



- Higher spatial *vs.* higher spectral or temporal resolution data
- Integrated imagery and coupled with ground data to train and validate models
- Spectral characteristics used to derive model variables. Red and NIR bands allow calculation of vegetation indices, e.g., NDVI

Terrain data (10-m National Elevation Data)

Hillshade/CIR | Hillshade/CIR/Contour | Topographic Position Index

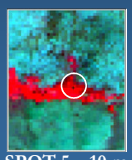


- Terrain models (e.g., TPI) to define "canyon bottom" areas
- Constrain model predictions and minimize 'noise'

Model training and validation

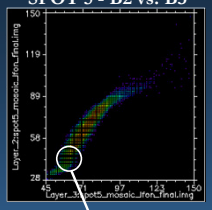
SPOT 5 (leaf on)

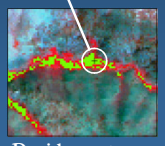
SPOT 5 – 10 m



CIR – 1 m

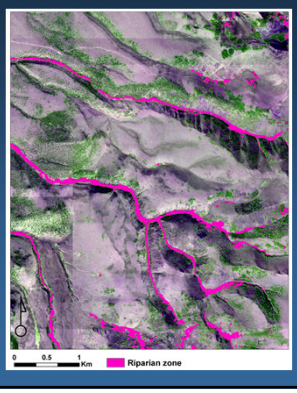
SPOT 5 - B2 vs. B3



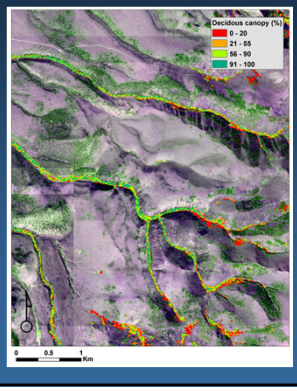


Deciduous trees

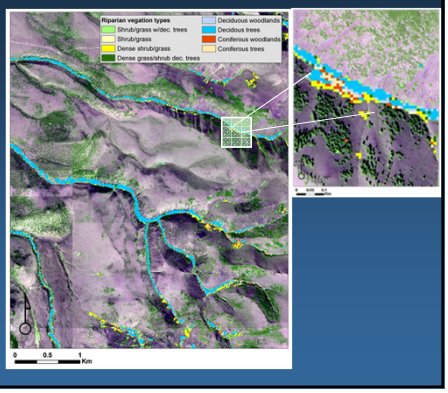
Riparian zone model/map: SPOT 5 and terrain data



Deciduous canopy map



Riparian vegetation type map



Model training and validation

Rule set: percent canopy cover by vegetation type

Derived riparian vegetation type	Deciduous tree	Conifer	Shrub or grass
Deciduous forest (trees)	>50%		
Deciduous woodland	≤50% and >35%		
Coniferous forest (trees)		>50%	
Coniferous woodland		≤50% and >35%	
Dense grass + shrub w/ deciduous trees	≤35% and >10%		>50%
Shrub + grass w/ deciduous trees	≤35% and >10%		<50% and >15%
Dense shrub + grass	≤10%		>50%
Shrub/grass	≤ 10%		<50% and >15%

Error assessment (10-fold cross validation)

Error matrix summary – Riparian zone map

Mapped category	Producer's accuracy[1]	Users accuracy[2]	Overall
Riparian	95.6%	84.3%	95.9%
Non-Riparian	96.0	99.0	

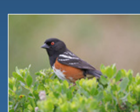
Error matrix summary – Riparian vegetation layers (subset)

Shrub/grass	94.9%	96.4%	90.1%
Conifer trees	78.2	74.9	
Deciduous vegetation	90.7	91.2	

[1] Number of correct pixels for a class divided by the actual number of ground truth pixels.
[2] A measure of how well the classification performed in the field by category (rows), and details errors of commission (misclassification).

Modeling breeding bird site occupancy

- Detection histories for 303 sites, 2005-2009 breeding seasons
- Focused analyses on MacGillivray's Warbler, a riparian obligate, and Spotted Towhee, which breeds in both riparian and non-riparian vegetation
- Developed competing *a priori* models using common set of habitat variables measured (or estimated) at each site
- Modeled probabilities of detection and occupancy in PRESENCE



Dickson, B. G., E. Fleishman, D. S. Dobkin, and S. R. Hurteau. 2009. Relationship between avifaunal occupancy and riparian vegetation in the central Great Basin (Nevada, U.S.A.). Restoration Ecology 17:722-730.

Modeling breeding bird site occupancy (ψ), 2005-2009

Model	*K*	AIC	ΔAIC	w_i
MacGillivray's Warbler				
$\psi(FS + R^2 + C^2 + E^2 + PS)$	17	2085	0.0	0.91
$\psi(R^2 + C^2 + E^2 + PS)$	16	2090	5.6	0.06
$\psi(FS + C^2 + E^2 + PS)$	15	2091	6.5	0.03
$\psi(FS + R^2 + E^2 + PS)$	15	2095	10.5	0.01
$\psi(FS + R^2 + C^2 + E^2)$	16	2121	36.6	0.00
$\psi(.)$	9	2199	114.7	0.00
Spotted Towhee				
$\psi(FS + R^2 + C^2 + E)$	17	2462	0.0	0.66
$\psi(FS + R^2 + C^2 + E + PS)$	18	2463	1.8	0.26
$\psi(FS + R^2 + E + PS)$	16	2467	5.7	0.04
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$\psi(.)$	7	2502	40.5	0.00

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Modeling breeding bird site occupancy

	MacGillivray's Warbler			Spotted Towhee		
Habitat variable	β	SE	*Z*	β	SE	*Z*
Frequency of shrubs	0.48	0.17	2.69	0.66	0.18	3.59
Roughness	0.72	0.28	2.55	0.73	0.26	2.77
Roughness^2	-0.08	0.05	-1.61	-0.10	0.04	-2.14
Woodland canopy	1.62	0.46	3.52	1.23	0.40	3.02
Woodland canopy^2	-0.72	0.21	-3.33	-0.39	0.16	-2.45
Elevation	0.86	0.56	1.53	-0.97	0.35	-2.76
Elevation^2	-0.41	0.28	-1.45	--	--	--
Proportion of deciduous shrubs (riparian model)	2.14	0.59	3.61	--	--	--
Intercept	*-1.34*	*0.42*	*--*	*0.56*	*0.35*	*--*

Modeling breeding bird site occupancy

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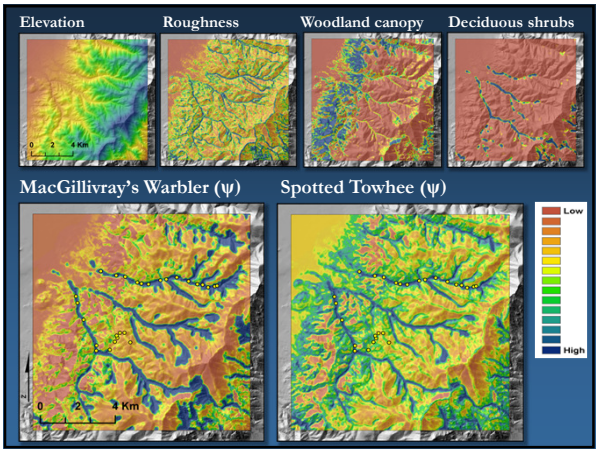

Concluding remarks

- No-to-low-cost data and the approaches used provide an accurate means to map riparian zones and vegetation
- Compared to CIRDOQs (e.g., NAIP) alone, leverages multi-date/season imagery, three infrared bands
- Higher spatial resolution, more accurate, and more contemporary than, e.g., Landfire or NLCD products
- These data can assist with modeling and evaluating habitat quality, connectivity, and change over extensive and relevant spatial scales

Collaborators and sponsors

- Erica Fleishman
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- John Fay
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- Jim Thomson

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