Forecasting Analysis for Agricultural Habitats for the Yolo Natural Heritage Program

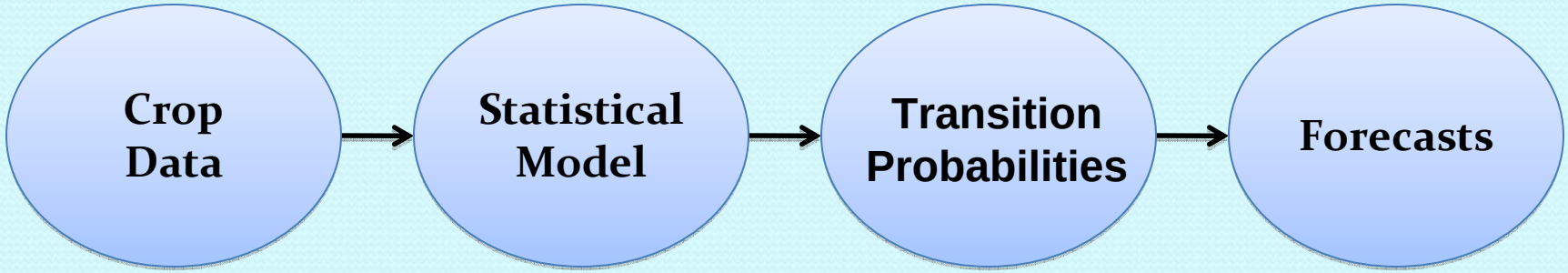
Dan Airola, presenting for
Dave Sunding,
Berkeley Economic Consulting

Agricultural Program Goals and Approaches

Goal: Implement a program that demonstrates the compatibility between wildlife conservation and agricultural needs throughout Yolo County

- Maintain a mixture of crop types and other agricultural uses that benefits sensitive wildlife and supports a vibrant agricultural economy
- Determine beneficial mixtures of crops that account for a changing agricultural landscape and varied values of crops to wildlife
- Allow for flexibility to respond to changing market conditions
- Create targeted incentives for voluntary management of agricultural lands to meet wildlife species goals

Overview of Analysis Steps



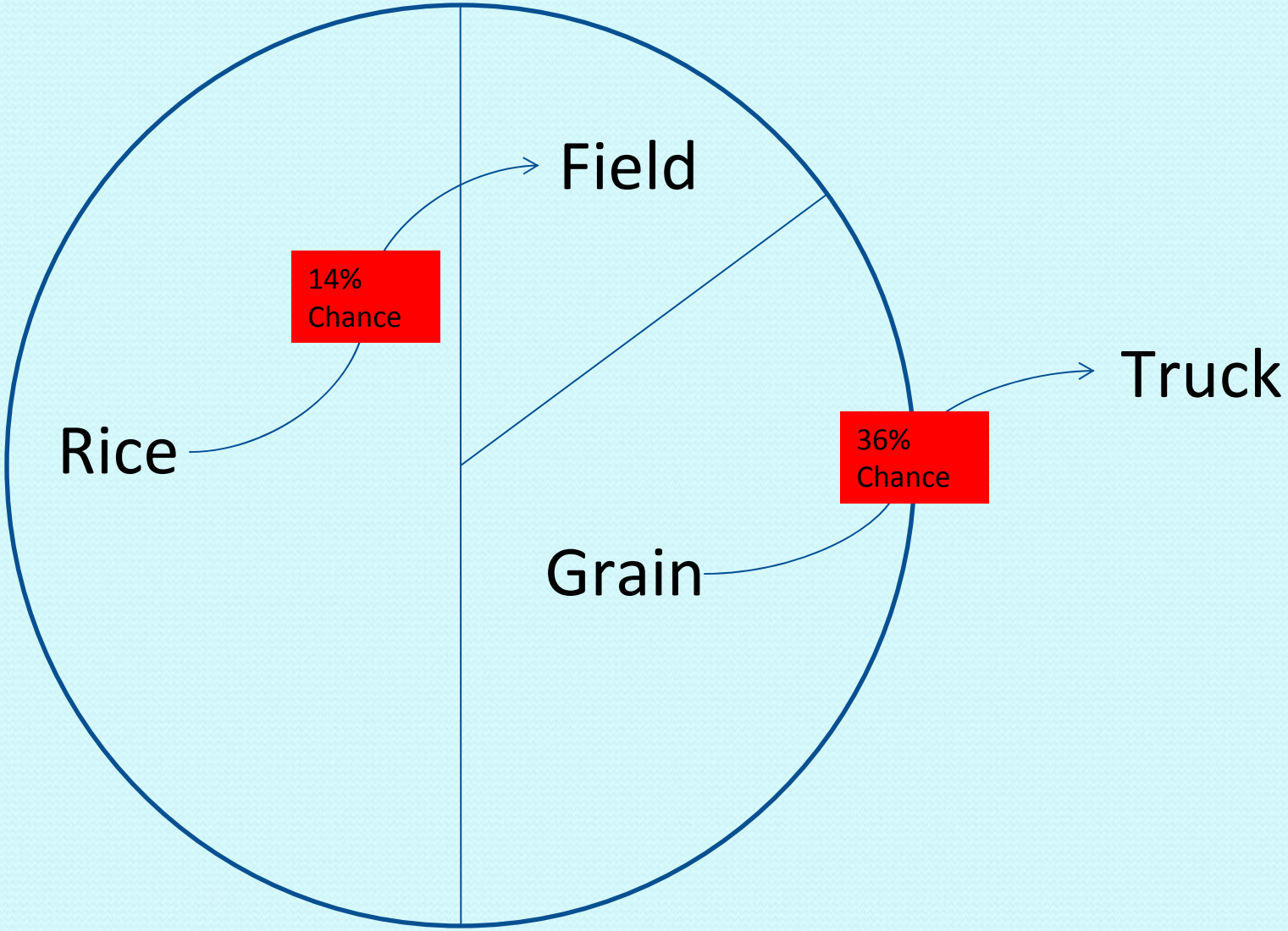
Key Aspect of Analysis:

- Habitat value of crop lands are evaluated based on Habitat Units (HUs)
- HUs = per acre habitat value (0.0 to 1.0) x No. acres
  - One acre of rice ≠ one habitat unit.
- Evaluate HUs for species' different habitat uses (foraging, breeding, etc.)
- Accumulate HUs for species among all crops

Key Aspect of Analysis:
Compare HUs Produced Vs. Goals

- Goals
  - Initially established by assigning overall species goal to agricultural lands
  - Set based on % of baseline habitat value
    - Baseline initially based on 1 year "snapshot" of acreage
    - But crop acreage changes from year to year
    - Therefore, baseline modified to reflect average crop acreage
- Changes in crop acreage
  - Model evaluates probabilities of changes from one crop to another

Habitat Components and Transition



Crop Acreage Forecasts

- Estimate the likelihood that covered species goals would be met without taking specific conservation actions.
- Provide probabilistic statements such as:
  - "Given the dynamic nature of agriculture in the county, there is an X% likelihood that the habitat goals for covered species Y will be met."
- Provide a "best expectation" of future outcomes.

Initial Short-Run Forecasts

- Most species meet their habitat goals within agricultural habitats without specific conservation action
  - 26 of 32 species-habitat goals (81%) have 100% chance of being met.
  - 29 of 32 targets (88%) have greater than two-thirds chance.
  - Only 3 of 32 species (12%) have less than 20% chance of being met

  Note: ultimately, species goals will be met with a combination of Agricultural, Uplands, and Riparian Strategies

Species	Habitat Element	Existing Agriculture (HU) [a]	Agricultural Target (HU) [b]	2008 Habitat Unit Simulation [c]	Probability of Achieving Target [d]
Giant garter snake	Active Season Aquatic	33,825	27,060	25,629	18%
Northwestern pond turtle	Aquatic Habitat	22,564	15,795	17,086	88%
White-tailed kite	Primary Foraging	66,217	46,352	78,476	100%
White-tailed kite	Secondary Foraging	55,897	27,948	31,689	100%
Bald Eagle	Secondary Foraging (Winter)	22,564	11,282	17,086	100%
Northern Harrier	Secondary Breeding	38,382	20,364	30,278	100%
Northern Harrier	Primary Foraging	120,878	96,702	104,801	100%
Northern Harrier	Secondary Foraging	34,828	16,636	19,495	100%
Swainson's Hawk	Primary Foraging	65,297	58,767	76,303	100%
Swainson's Hawk	Secondary Foraging	56,353	33,429	31,561	1%
Swainson's Hawk	Other Medium Value Foraging	1,275	637	1,869	100%
Swainson's Hawk	Other Low Value Foraging	2,680	0	1,862	100%
Golden Eagle	Secondary Foraging	845	338	859	100%
American Peregrine Falcon	Agricultural Foraging	51,619	30,972	47,962	100%
Prairie Falcon	Secondary Foraging	34,809	17,404	32,659	100%
Mountain Plover	Wintering	85,429	8,543	53,244	100%
Black Tern	Rice Field Complex or Isolated Patch	45,099	31,570	34,172	88%
Burrowing Owl	Primary Habitat	1,249	749	1,485	100%
Burrowing Owl	Other Potential Habitat	16,491	9,895	17,821	100%
Short-eared Owl	Secondary Foraging	8,315	5,821	8,621	100%
Loggerhead Shrike	Primary Foraging	21,246	14,872	26,990	100%
Loggerhead Shrike	Secondary Foraging	19,176	11,506	11,606	68%
Yellow-billed magpie	Secondary Breeding	18,212	9,106	15,483	100%
Yellow-billed magpie	Primary Foraging	191,673	134,171	157,873	100%
Yellow-billed magpie	Secondary Foraging	17,032	8,516	13,553	100%
Tricolored Blackbird	Primary Foraging	78,353	54,847	75,011	100%
Tricolored Blackbird	Secondary Foraging	48,046	19,218	34,792	100%
Tricolored Blackbird	Other Potential Foraging	41,972	16,789	40,922	100%
Yellow-headed blackbird	Breeding Season Foraging	7,688	6,151	5,527	13%
Western red bat	Secondary Roosting and Foraging	27,206	16,323	24,487	100%
Townsend's western big-eared bat	Secondary Foraging	65,714	19,714	63,933	100%
Pallid bat	Foraging	54,694	21,877	42,103	100%

Notes:

[a] Is the habitat units as estimated by the biologists

[b] Is the agricultural habitat target established by the biologists

[c] This is the estimated habitat units as simulated from the ML model

[d] This is the simulated estimation of [c] achieving [b] accounting only for time varying and exogenous variables

Short-Run Forecasts

- Relied only on crop "transition probabilities" and 2008 crop acreage
  - While useful for identifying potential crop change issues, limited usefulness for long-run policy making.
- As a result, developed long-run forecasts to incorporate both transition probabilities and crop types from prior years.

Long-Run Forecasts

- Multiple-years' acreage modeled

Species	Habitat Element	Existing Agriculture (HU) [a]	Agricultural Target (HU) [b]	2008 Habitat Unit Simulation [c]	Probability of Achieving Target [d]	Long Run Simulation (HU) [e]	Probability of Achieving Target [f]
Giant garter snake	Active Season Aquatic	33,825	27,060	25,629	18%	29,914	70%
Northwestern pond turtle	Aquatic Habitat	22,564	15,795	17,086	88%	19,955	91%
White-tailed kite	Primary Foraging	66,217	46,352	78,476	100%	74,637	100%
White-tailed kite	Secondary Foraging	55,897	27,948	31,689	100%	34,025	100%
Bald Eagle	Secondary Foraging (Winter)	22,564	11,282	17,086	100%	19,955	100%
Northern Harrier	Secondary Breeding	38,382	20,364	30,278	100%	28,837	100%
Northern Harrier	Primary Foraging	120,878	96,702	104,801	100%	107,184	100%
Northern Harrier	Secondary Foraging	34,828	16,636	19,495	100%	24,151	100%
Swainson’s Hawk	Primary Foraging	65,297	58,767	76,303	100%	72,813	100%
Swainson's Hawk	Secondary Foraging	56,353	33,429	31,561	1%	34,144	75%
Swainson's Hawk	Other Medium Value Foraging	1,275	637	1,869	100%	929	71%
Swainson's Hawk	Other Low Value Foraging	2,680	0	1,862	100%	2,415	100%
Golden Eagle	Secondary Foraging	845	338	859	100%	787	100%
American Peregrine Falcon	Agricultural Foraging	51,619	30,972	47,962	100%	50,390	100%
Prairie Falcon	Secondary Foraging	34,809	17,404	32,659	100%	30,241	100%
Mountain Plover	Wintering	85,429	8,543	53,244	100%	60,800	100%
Black Tern	Rice Field Complex or Isolated Patch	45,099	31,570	34,172	88%	39,886	91%
Burrowing Owl	Primary Habitat	1,249	749	1,485	100%	1,512	100%
Burrowing Owl	Other Potential Habitat	16,491	9,895	17,821	100%	18,143	100%
Short-eared Owl	Secondary Foraging	8,315	5,821	8,621	100%	8,837	100%
Loggerhead Shrike	Primary Foraging	21,246	14,872	26,990	100%	25,641	100%
Loggerhead Shrike	Secondary Foraging	19,176	11,506	11,606	68%	20,152	100%
Yellow-billed magpie	Secondary Breeding	18,212	9,106	15,483	100%	16,162	100%
Yellow-billed magpie	Primary Foraging	191,673	134,171	157,873	100%	163,257	100%
Yellow-billed magpie	Secondary Foraging	17,032	8,516	13,553	100%	14,637	100%
Tricolored Blackbird	Primary Foraging	78,353	54,847	75,011	100%	78,700	100%
Tricolored Blackbird	Secondary Foraging	48,046	19,218	34,792	100%	33,866	100%
Tricolored Blackbird	Other Potential Foraging	41,972	16,789	40,922	100%	36,307	100%
Yellow-headed blackbird	Breeding Season Foraging	7,688	6,151	5,527	13%	6,800	73%
Western red bat	Secondary Roosting and Foraging	27,206	16,323	24,487	100%	26,125	100%
Townsend's western big-eared	Secondary Foraging	65,714	19,714	63,933	100%	61,940	100%
Pallid bat	Foraging	54,694	21,877	42,103	100%	41,068	100%

Notes:

[a] Is the habitat units as estimated by the biologists

[b] Is the agricultural habitat target established by the biologists

[c] This is the estimated habitat units as simulated from the ML model

[d] This is the simulated estimation of [c] achieving [b] accounting only for time varying and exogenous variables

[e] Long Run simulated Habitat Values

[f] This is the simulated estimation of [e] achieving [b] accounting for incidence of crops types occuring on a particular parcel in all years of observation

Key Modeling Results

- Generally, improved the likelihood of meeting covered species goals
  - Most goals reached in all years
  - 50% of each species-habitat goal is reached every year for 88% of species
  - Habitat goals are exceed by 25% for >90% of time for two thirds of species
- Certain species goals remain a focus.
  - Giant garter snake
  - Swainson's hawk (secondary and other medium value foraging)
  - Yellow-headed blackbird

Simulations of Changed Targets

- Simulated the effect of 50% reduction and 25% increase in covered species habitats.
- 50% reduction results in all species achieving target with certainty or near certainty.
- 25% increase *without any intervention* decreases likelihood of achieving target for many species.
  - Again, asymmetric risk arises as an issue.

Species	Habitat Element	Existing Agriculture (HU)	Agricultural Target (HU)	Long Run Simulation (HU)	Probability of Achieving Target	Probability of Achieving 50% of Targets	Probability of Achieving 25% Increase in Targets
		[a]	[b]	[c]	[d]	[e]	[f]
Giant garter snake	Active Season Aquatic	33,825	27,060	29,914	70%	100%	20%
Northwestern pond turtle	Aquatic Habitat	22,564	15,795	19,955	91%	100%	50%
White-tailed kite	Primary Foraging	66,217	46,352	74,637	100%	100%	100%
White-tailed kite	Secondary Foraging	55,897	27,948	34,025	100%	100%	15%
Bald Eagle	Secondary Foraging (Winter)	22,564	11,282	19,955	100%	100%	98%
Northern Harrier	Secondary Breeding	38,382	20,364	28,837	100%	100%	100%
Northern Harrier	Primary Foraging	120,878	96,702	107,184	100%	100%	0%
Northern Harrier	Secondary Foraging	34,828	16,636	24,151	100%	100%	98%
Swainson’s Hawk	Primary Foraging	65,297	58,767	72,813	100%	100%	41%
Swainson's Hawk	Secondary Foraging	56,353	33,429	34,144	75%	100%	0%
Swainson's Hawk	Other Medium Value Foraging	1,275	637	929	71%	94%	56%
Swainson's Hawk	Other Low Value Foraging	2,680	0	2,415	100%	100%	100%
Golden Eagle	Secondary Foraging	845	338	787	100%	100%	100%
American Peregrine Falcon	Agricultural Foraging	51,619	30,972	50,390	100%	100%	100%
Prairie Falcon	Secondary Foraging	34,809	17,404	30,241	100%	100%	100%
Mountain Plover	Wintering	85,429	8,543	60,800	100%	100%	100%
Black Tern	Rice Field Complex or Isolated Patch	45,099	31,570	39,886	91%	100%	50%
Burrowing Owl	Primary Habitat	1,249	749	1,512	100%	100%	100%
Burrowing Owl	Other Potential Habitat	16,491	9,895	18,143	100%	100%	100%
Short-eared Owl	Secondary Foraging	8,315	5,821	8,837	100%	100%	92%
Loggerhead Shrike	Primary Foraging	21,246	14,872	25,641	100%	100%	100%
Loggerhead Shrike	Secondary Foraging	19,176	11,506	20,152	100%	100%	95%
Yellow-billed magpie	Secondary Breeding	18,212	9,106	16,162	100%	100%	100%
Yellow-billed magpie	Primary Foraging	191,673	134,171	163,257	100%	100%	23%
Yellow-billed magpie	Secondary Foraging	17,032	8,516	14,637	100%	100%	100%
Tricolored Blackbird	Primary Foraging	78,353	54,847	78,700	100%	100%	97%
Tricolored Blackbird	Secondary Foraging	48,046	19,218	33,866	100%	100%	100%
Tricolored Blackbird	Other Potential Foraging	41,972	16,789	36,307	100%	100%	100%
Yellow-headed blackbird	Breeding Season Foraging	7,688	6,151	6,800	73%	100%	18%
Western red bat	Secondary Roosting and Foraging	27,206	16,323	26,125	100%	100%	99%
Townsend's western big-eared bat	Secondary Foraging	65,714	19,714	61,940	100%	100%	100%
Pallid bat	Foraging	54,694	21,877	41,068	100%	100%	100%

Notes:

[a] Is the habitat units as estimated by the biologists

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[c] Long Run simulated Habitat Values

[d] This is the simulated estimation of [c] achieving [b] accounting for incidence of crops types occuring on a particular parcel in all years of observation

[e] This is the simulated estimation of [c] achieving 50% of [b] accounting for incidence of crops types occuring on a particular parcel in all years of observation

Key Modeling Results

- Results
- Most goals reached in all years
- All goals reached in at least 50% of years
- Many goals exceeded by 25% in all or majority of years
- Certain goals remain a focus.
  - Giant garter snake,
  - Swainson's hawk (secondary and other medium value foraging),
  - Yellow-headed blackbird.

Key Ag Modeling Implications

- Habitat availability fluctuates, as it always has
- Goals are generally met without intervention
- Fluctuations cause goals to not be met in some years, exceeded in others
  - Species have tolerated fluctuations in past
  - Need to define tolerable fluctuations

Key Ag Modeling Implications

- Options for species whose goals are not met within ag lands:
  - Incorporate substitutions
    - Primary agricultural habitats can replace secondary habitats
    - Determine if "excess" values are produced in Riparian/Wetland or Upland habitats that can replace ag values
  - Develop land management strategies to increase per-acre habitat value (in ag or other habitats). Examples:
    - Reconfigure ditches for Giant Garter Snake
    - Provide residual cover for raptor prey
    - Specify certain crop use near Yellow-headed Blackbird nesting areas