



Photo: FWS



Photo: National Wildlife Federation



Photo: FWS



Photo: Louisiana DWF



Photo: NRCS

# Quantification Tools for Biodiversity and Habitat Markets

Emily Pindilli

U.S. Geological Survey

Science & Decisions Center

ACES 2014

# Biodiversity and habitat loss in the U.S. is significant...

---



Photo: FWS



Photo: BLM



Photo: Pajaro Valley Water Management Agency



Photo: Sfgate.com



Photo: Univ. of North Texas



Photo: FWS

...market incentives to promote conservation are lacking.

---

**Laws and regulations are designed to address market failures...**

---



**...and incentivize internalization of social benefits in private decisions.**

---

# Approaches to protect biodiversity and habitat...

	Direct	Prescriptive	Market-Based		
Approach	Landowner Directed Conservation	Command and Control	Payments for Ecosystem Services	Market-Based Compensatory Mitigation	Alternative Incentives
Example	Land Trusts	Permitee-Responsible Mitigation	Environmental Quality Incentives Program	Conservation Bank	Habitat Exchange Eco-labeling
Parties	Private citizens, non-profits	Fed, state, or local gov, industry, developers	Fed, state, or local gov, landowners	Fed, state, or local gov, industry, developers, bankers, investors, entrepreneurs	Fed, state, nonprofits, industry, developers, bankers, entrepreneurs, consumers

...use different mechanisms to incentivize conservation.



## Market-based approaches can achieve environmental benefits...

---

- **Biodiversity benefits do not accrue to landowners**
  - Lack of compensation creates externality
  - Biodiversity and habitat undersupplied
- **Market-based mechanisms create incentives**
  - Incentives may be driven by regulation, or
  - Consumer preferences for 'green' products

...with greater efficiency and at lower cost than other strategies.

---

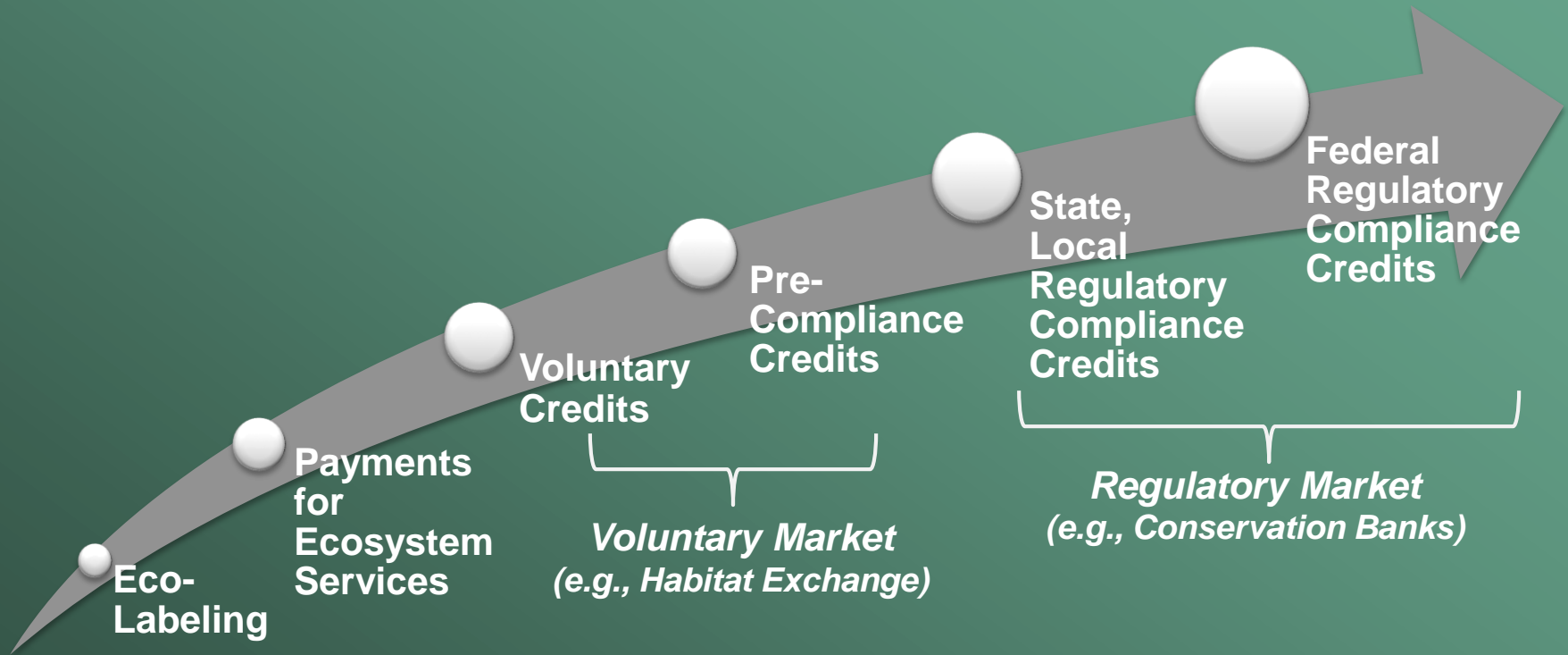
# What is traded in a biodiversity or habitat market?

---



Photo: FWS

# What are the different markets?



# How are credits and debits quantified?

## Expert Opinion

- Often used for simple credit acre assessment
- May incorporate ratios to account for habitat types
- Lacks standardization between projects and species/habitat types
- Doesn't provide certainty in credit/debit estimate
- Highly subject to bias of assessor

## Habitat Metric

- Often used to assess functional acre
- Varying levels of sophistication
- Used to evaluate habitat quality via attributes
- May be a one-off metric or developed and used in multiple projects
- Increases certainty in credit/debit estimate
- Subject to bias of assessor

## Quantification Tool

- Tool-based metric
- Varying levels of sophistication and user friendliness
- Considers habitat attributes, scoring criteria, damage and recovery functions to quantify credits/debits
- Used in multiple projects
- Greatly increase certainty in credit/debit estimate
- Less subjective to bias



# Why are quantification tools needed?

---

- **Measuring biodiversity outcomes is challenging**
- **Benefits depend on source, location, habitat size, ecological context, and initial conditions of a site**
- **Transparency and standardization in the credit and debit quantification process is important**
- **Landowner ability to assess potential credits increases rate of participation in markets**

# Examples of Quantification Tools

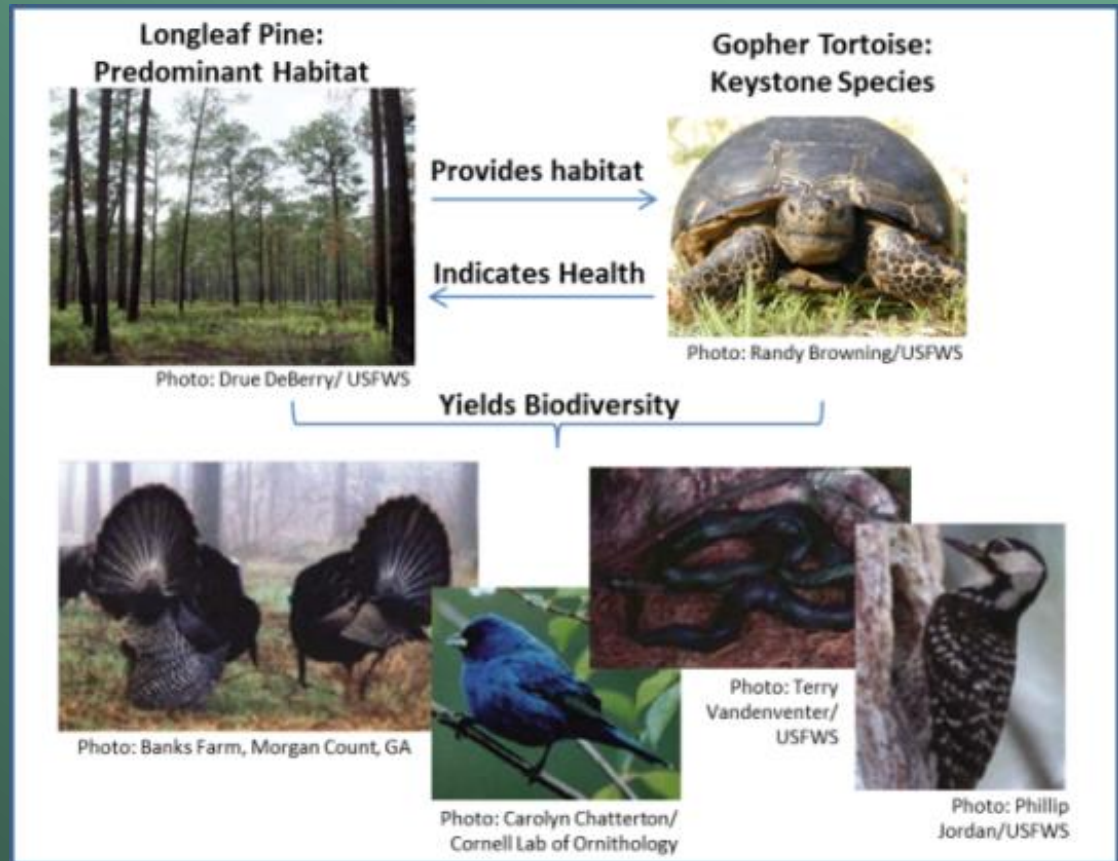


# Conservation Banks: Ad-Hoc Quantification

Species	Location	Credit Type	Credit Quantification Methodology
Vernal pool, CA tiger salamander	Merced, CA	Simple acre	All species/habitat credited at 1:1 ratio.
Vernal pool fairy shrimp, CA tiger salamander	San Joaquin, CA	Functional acre	Vernal pool habitat credits depend on preserve size, rare unique vernal pool type, listed species, rare species, site conditions, and defensibility of site. Upland habitat credits 1:1 acre to credit ratio.
Florida panther	Hendry, FL	Functional acre	Dubbed Panther Habitat Units, credits based on a Habitat Suitability Value depending on habitat type (e.g. basin swamp or mesic hammock).
Delmarva fox squirrel	Dorchester, MD	Simple acre	Credits generated through habitat preservation. One acre of habitat equals one credit.
Houston toad	Bastrop, TX	Simple acre	Credits are generated through habitat preservation on a one to one basis.
Utah prairie dog	Iron, UT	Species	2 credits per prairie dog observed in 2 most recent spring counts; additional credits in increments of 50 for every additional 25 prairie dogs sustained for 2 years. Maximum credits equal to number of acres preserved.

# Pre-compliance Markets: Gopher Tortoise Metric

- American Forest Foundation and World Resources Institute partnered to develop a voluntary conservation banking system for eastern gopher tortoises
- Driven by demand from Fort Benning
- Conserving longleaf pine habitat to benefit gopher tortoise also yields benefits for other pictured species



# Colorado Habitat Quantification Tool

## Colorado Habitat Quantification Tool

- Concept under development; may be tested winter/spring 2015
- Will provide a market for sage-grouse credits sold by ranchers to energy developers (and others) to offset their impacts on sage grouse, pre-listing

Source: Environmental Defense Fund

## Greater Sage Grouse





# Salmon Habitat Credit Tool

## Salmon Habitat Credit Calculation Method

- Excel-based scoring tool
- Methodology scores sites/projects based on six ecological functions that support salmonid species habitat
- Biotic support groups and functions considered include:
  - cover/refuge,
  - forage,
  - nesting/spawning sites,
  - connectivity, cover/refuge, and nesting for insect/invertebrates.
  - Habitat formation,
  - temperature regulation,
  - spatial separation,
  - variable velocity, and
  - channel diversity

Source: Willamette, 2009

## Columbia River Salmon



Photo: National Wildlife Federation

# Prairie Habitat Credit Tool

## Prairie Credit Calculation Method

- Excel-based scoring tool to determine functional acres of upland prairie habitat
- Score is 0 to 10 and that value divided by 10 is applied to the number of acres to yield functional acres
- For example a score of 5 would be divided by 10 for .5 and multiplied by number of acres (10) to derive 5 functional acres or credits
- Scoring tool criteria include:
  - connectivity,
  - vegetation,
  - rare species, and
  - invasive species

Source: Adamus, 2009

## Upland Prairie



Photo: Willamette Partnership

# Wetlands Habitat Credit Tool

## Oregon Rapid Wetland Assessment Protocol

- Excel-based scoring tool for Oregon wetlands
- Scores generated for:
  - Aquatic Invertebrate Habitat,
  - Fish Habitat,
  - Amphibian & Reptile Habitat,
  - Waterbird Feeding Habitat,
  - Waterbird Nesting Habitat,
  - Songbird,
  - Raptor and Mammal Habitat,
  - Pollinator Habitat, and
  - Native Plant Diversity
- Takes 3 to 6 hours to complete
- Requires:
  - aerial photography,
  - topographic maps,
  - wetland delineation, and
  - a field survey to assess vegetation.

Source: Adamus, 2010

## Wetlands



Photo: Adamus, 2009

# Floodplain Habitat Metric

## Floodplain Habitat Metric

- Floodplain Habitat Quality Score assesses floodplain quality in Oregon
- Considers habitat quality indicators including:
  - landscape context,
  - flooding regime,
  - risk/stressors,
  - vegetation structure
  - distribution,
  - non-invasive species of vegetation, and
  - sensitive/rare species
- Indicators are aggregated into 6 composite indicators
- Composite indicators are weighted based on significance as determined by expert opinion

Source: Defenders of Wildlife, 2012a

## Sandy River Delta



Photo: Oregon Habitat Joint Venture, Bruce Taylor, 1992

# Sagebrush/Sage Grouse Habitat Metric

## Sagebrush/Sage Grouse Habitat Metric

- Habitat metric used to assess sagebrush habitat quality for sage grouse
- Factors considered in the scoring include:
  - juniper invasion in the overstory,
  - sagebrush cover,
  - functional vegetative diversity,
  - patch size,
  - distance to sage grouse lek (mating area),
  - proximity to maintained roads, inhabited human structures, trees, buildings, or other raptor structures greater than 5' tall, and
  - distance to persistent water
- Factors are aggregated into a weighted total score
- Estimated to take 1 to 2 days including field data collection

Source: Defenders of Wildlife, 2012c

## Greater Sage Grouse



Photo: FWS



# Oak Woodland Habitat Metric

## Oak Woodland Habitat Metric

- Metric for assessing oak woodland habitat used to assess functional acres
- Excel-based scoring tool used to assess indicators of habitat quality
- Indicators are categorized into the following 6 weighted composite indicators:
  - landscape context,
  - invasive species of vegetation,
  - risks/stressors,
  - management practices,
  - vegetation structure, and
  - sensitive/rare species

Source: Defenders of Wildlife, 2012b

## Oak Savannah



Photo: FWS

# There is a gap in the availability of quantification tools...

---



...and the need for standardized, simple approaches to assess biodiversity and habitat.

---



*Photo: Oregon DFW*

# Thank You!

For more information contact:

Emily Pindilli

Phone: 703-648-5732

Email: [epindilli@usgs.gov](mailto:epindilli@usgs.gov)

This work could not have been completed without the guidance of Dr. Frank Casey (USGS) and the support of Dr. Chris Hartley (USDA OEM)