Seminar

2

Theory of Ecosystem Services

Speaker

Dr. Stephen Polasky

2011 ECOSYSTEM SERVICES SEMINAR SERIES

GORDON AND BETTY MOORE FOUNDATION

Ecosystem Services Seminar 2: Theory of Ecosystem Services

Presentation and Discussion Notes From Speaker: Dr. Stephen Polasky

Seminar Series and Seminar 2 Goals:

The goal of the multi-session seminar is to educate the broader conservation community including practitioners and funders on the diverse aspects of ecosystem services – such as how to account for ecosystem services and to effectively measure, manage, and communicate them.

Seminar 2 focused on the following goals:

- *Describe basic economic theory behind ecosystem services*
- *Introduce different models of ecosystem services and basic economic analysis*
- *Discuss non-voluntary and voluntary markets*

This document is a product of the Gordon and Betty Moore Foundation's Ecosystem Services Seminar Series that took place between March and November 2011. For more information please visit www.moore.org or request "ES Course Info" from Heather Wright at info@moore.org.

Disclaimer:

This document is a summary that includes PowerPoint slides from the speaker, Dr. Stephen Polasky, and notes of his talking points. In addition, we provide a synthesis of important questions discussed during Seminar 2. Please keep in the mind that the following document is only a recap of Dr. Polasky's presentation and Blue Earth Consultants' notetakers have, to the best of their ability, captured the speaker's presentation. We hope that the following presentation and discussion notes will be used as resource to advance further discussions about ecosystem services.

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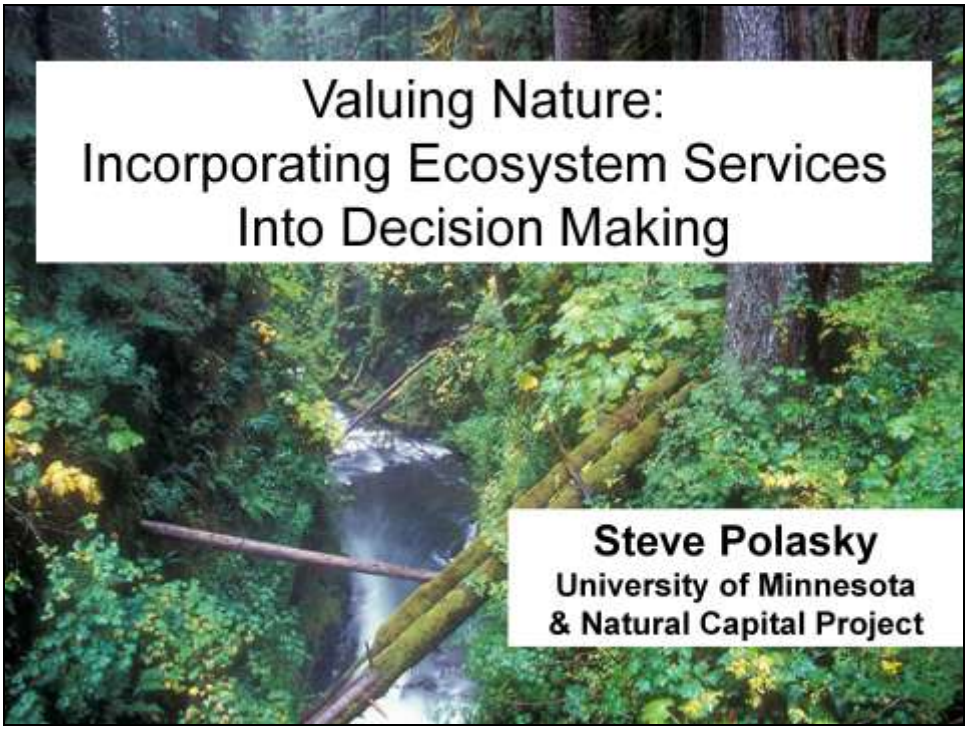
COASTAL QUEST

BLUE EARTH CONSULTANTS



Presentation Goal:

- To explore Ecosystem Services (ES) in the context of planning and decision-making. We recognize this is but a tool and that there are others.

- Humans are affecting the globe in profound ways.
- That effect is often invisible to the decision-maker.
  - How do we then get over the distortions and make ES visible?

Main Theme:

- How do we bring ES into everyday decisions of business, individuals, and government agencies?

Sub Theme:

- The concept of ES is mainstream or should be; ES is standard economics applied to an interesting set of questions.

- Economics systems are information systems. One thing the economic systems do well is provide signals of value, i.e., what do producers produce *well* and what do consumers *want*?
- The problem with ES is that we do not have clear signals of value for ecosystem services and there is no clear feedback loop. ES values are not fed back to agencies, etc…. THIS IS THE MAIN PROBLEM
    - We tend to think of ES as externalities and public goods. There is no direct feedback link.
    - So we undervalue these services.
- ES are rife with these market failures.

Clouded vision

- We lack the right set of measures and accounts to judge the full consequences of our actions
- Distorted views leads to distorted decisions

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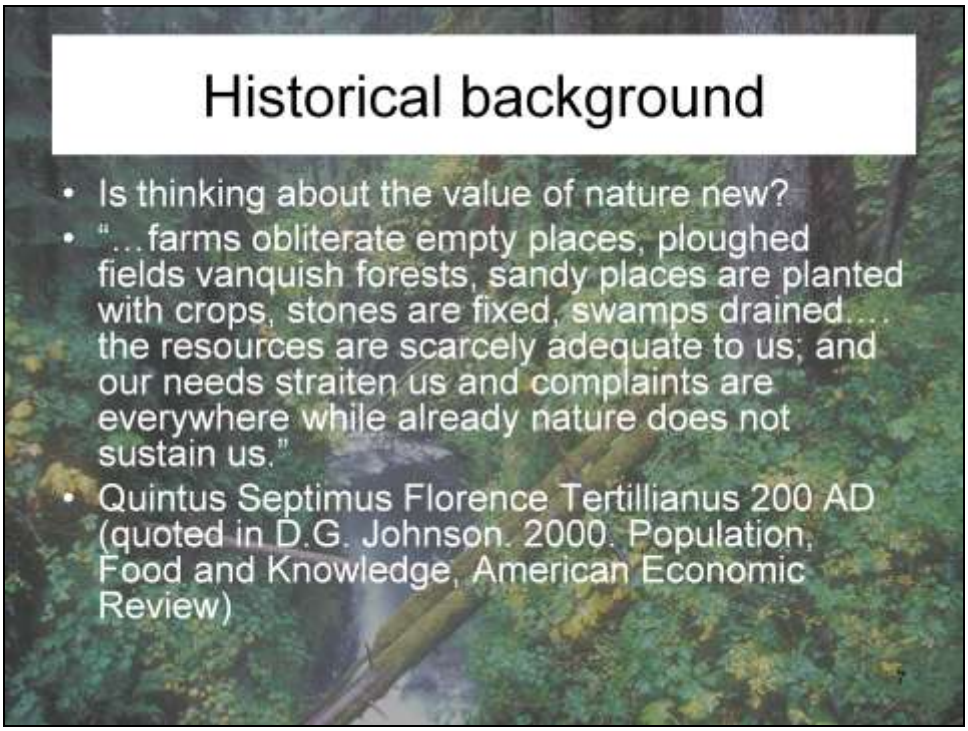
• Without the proper feedback, we have clouded visions. It's like you are driving a car with a malfunctioning speedometer, faulty brakes, or cloudy window…

• This clouded vision makes it hard to perceive the consequences of our actions.

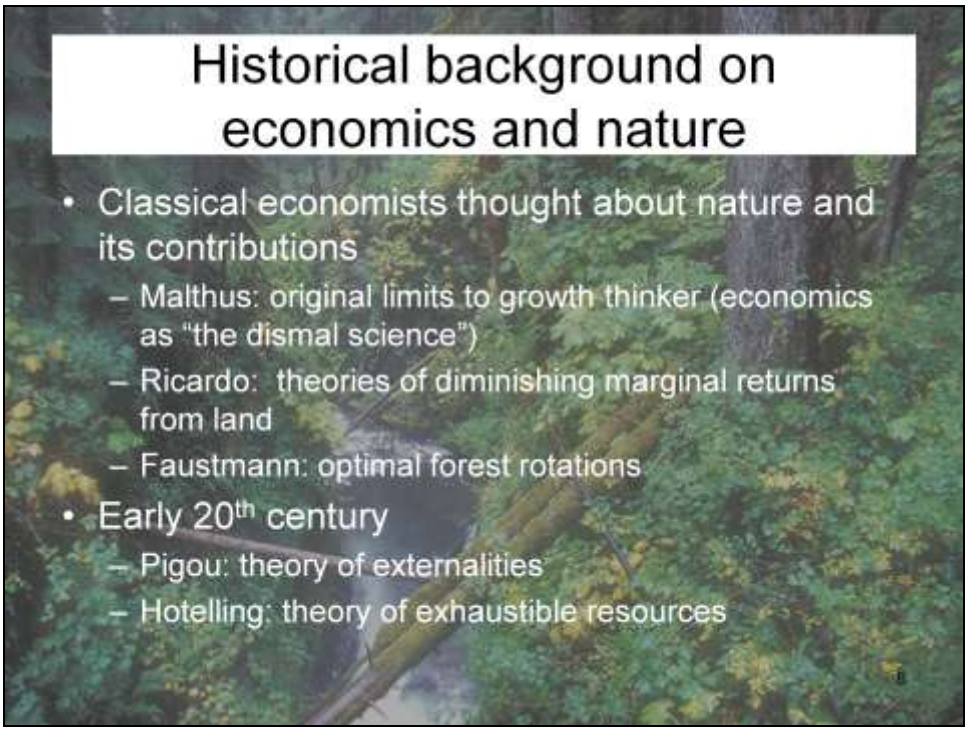
• Maybe not the best analogy because in reality, we can see really clearly out of half of the window. We see the market part well, but not the ES value part well.

- How then do we fix this distorted view a get a picture of the whole?

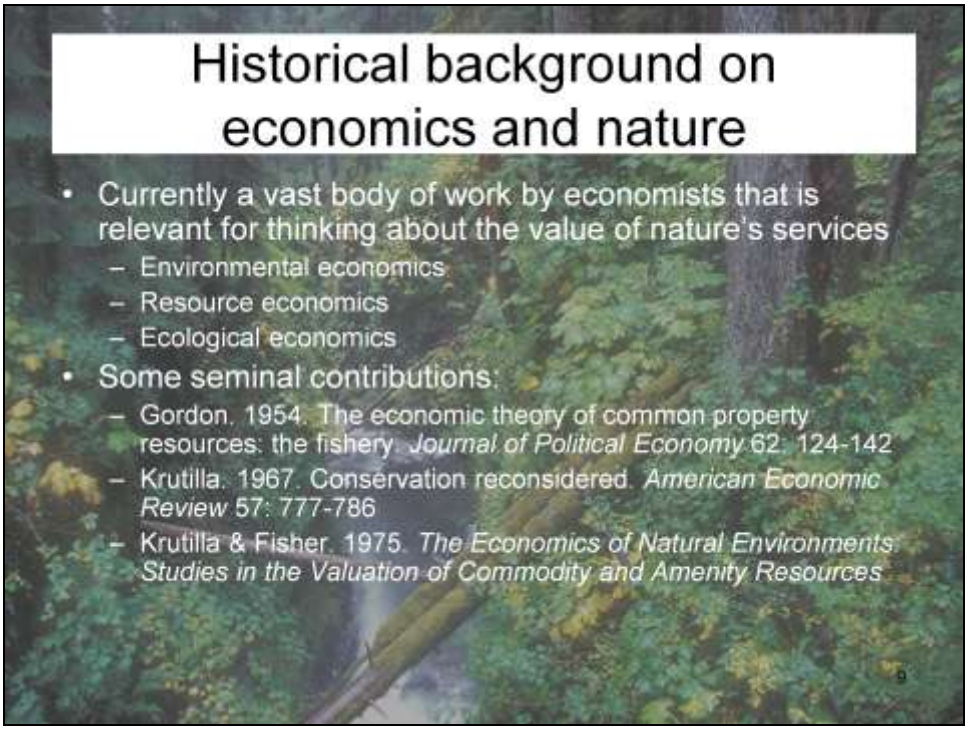
- How do we get accounting to provide the full spectrum?



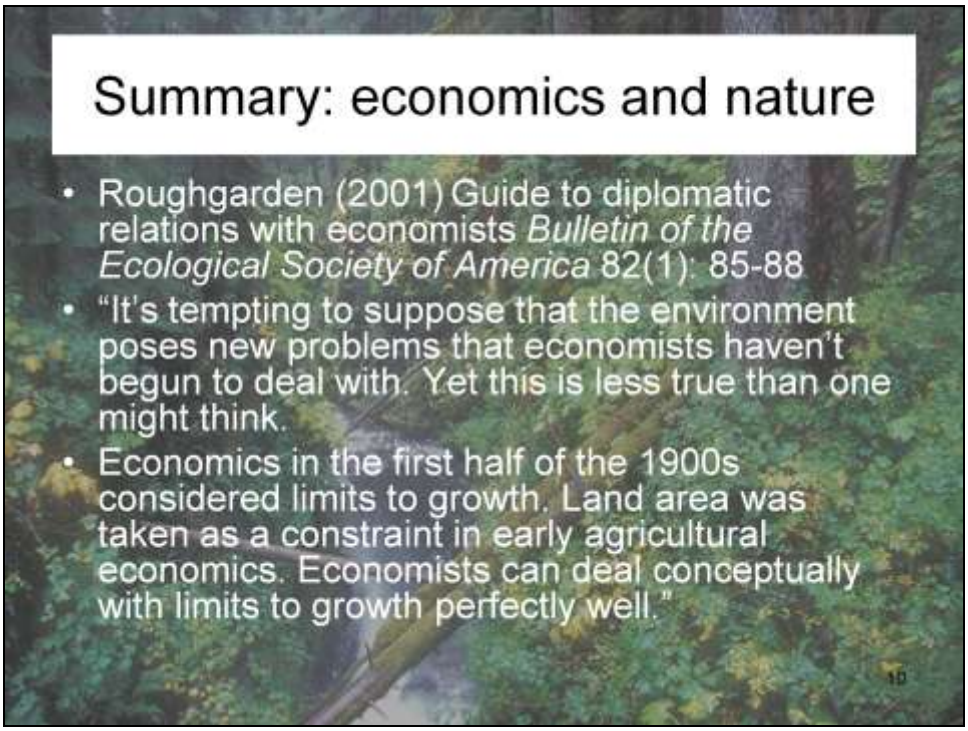
- Thinking about nature is not new! We have been doing it for a long time.



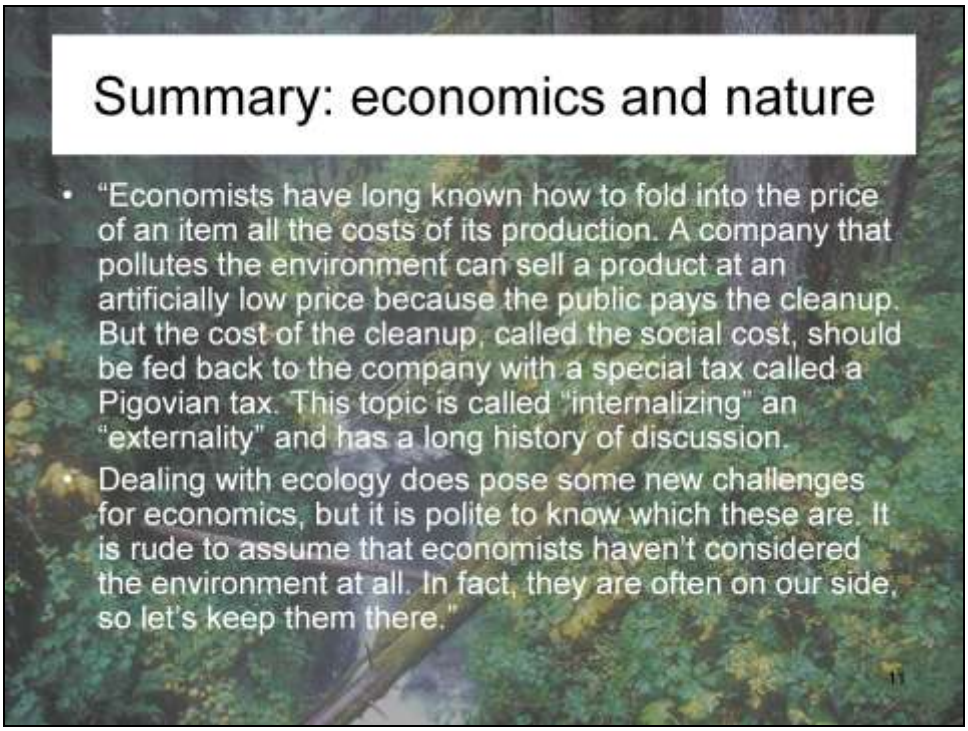
- In economics, the idea goes way back as well. Questions about the value of resources and the environment were very prominent.
    - Thomas Malthus: the dismal science
    - Ricardo: looked at fundamental economic concepts from agricultural background, diminishing marginal returns. The theory of rent stemmed from this as well.
    - Many early thoughts about optimal rotation age for crops.
        - ➢ What is the value of resources, the value of the environment etc?



- Now, there are many schools of thought or many names for resources economics, *see slide*.
- Seminal contributions:
    - Only a few are listed to communicate that this is not a new idea from 2000.



- Roughgarden (Stanford) wrote a great piece about ES and how to think about it etc… Proceedings were put out in Wildlife Society Proceedings. The idea used to be that economics was the worst thing for environments. Joan Roughgarden challenged that idea, *see slide 10 and 11.*
- Economics is fundamentally about allocating scarce resources, and internalizing the externalities.

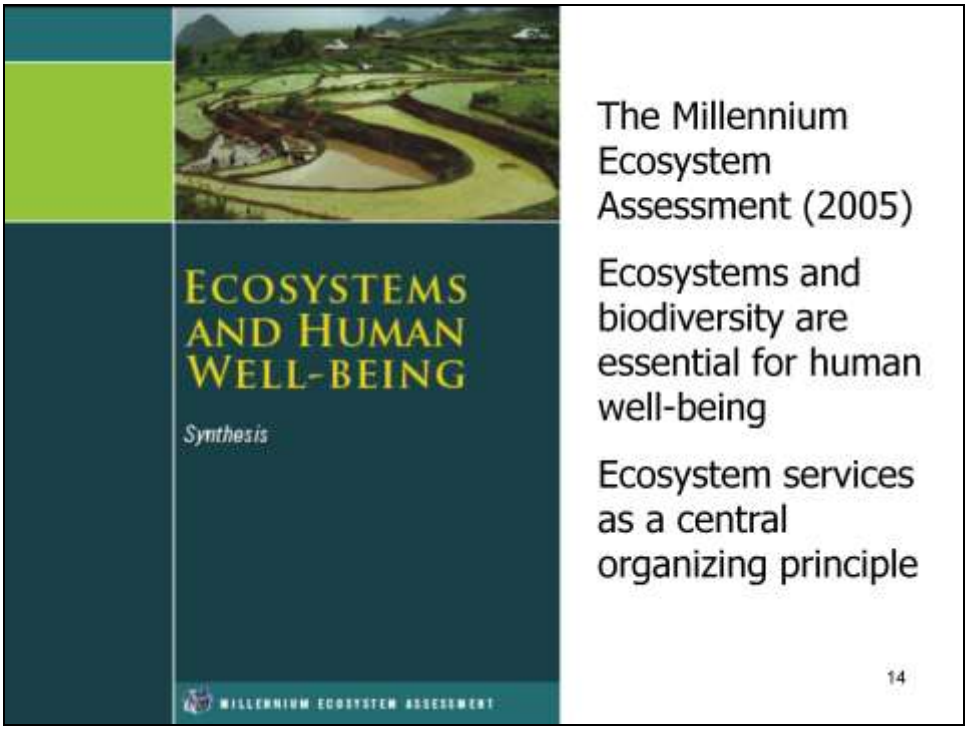


- Continued quotes from Joan Roughgarden.

What is new to ES?

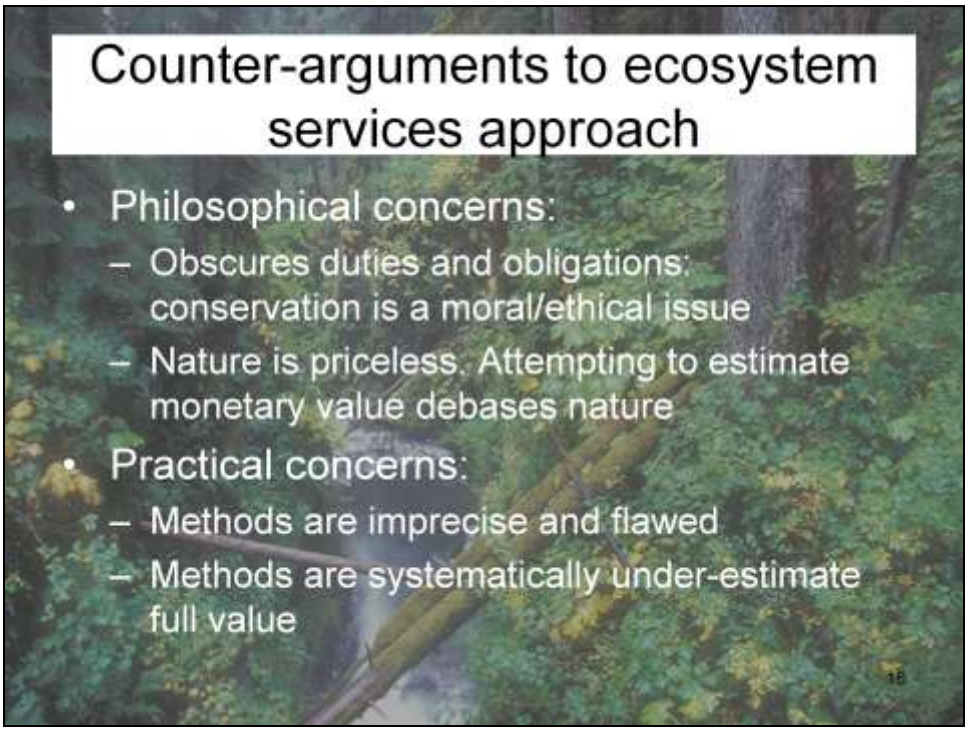
- The modern focus of ES can be traced to the 1980-90s to people like Hal Mooney, Paul Ehrlich, Gretchen Daily, and Robert Costanza.
- The late 1990s marked a time when a lot of work of ES began, in the modern sense. It is mostly defined by promoting the concept and less about the process.
- Now, ES is much more about understanding ecosystem processes and much more about an integrated systems view.

- There is a much closer linkage with ecologists now than before.
- Much more of an integrated system view now than in the 1970s.
- Not just the value of fish or oil, now thinking about the joint provision of multiple ecosystem services coupled with land use changes…



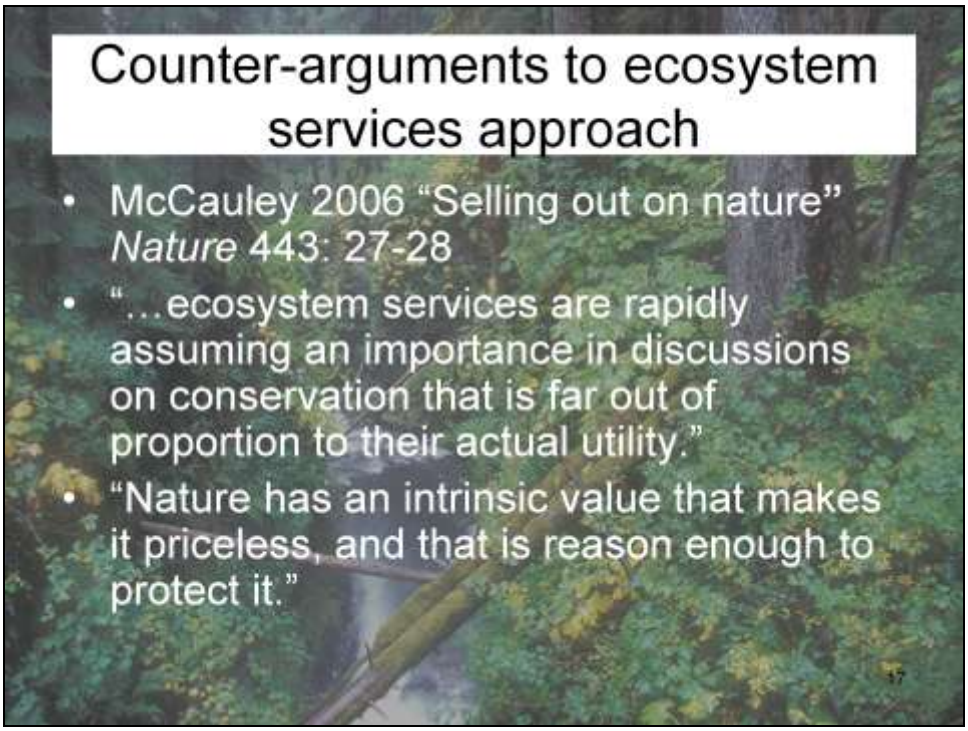
- Impetus for where we are now mostly comes from 2005 and the Millenium Ecosystem Assessment (MEA), *see above*. This made ecosystems central figures.
- Gave the necessary push to integrate ecology and economics.

- The field has begun to flower. List above shows the many government agencies and new studies. There is always a new commission and new reports etc…
- The theory of ES seems poised to take off.
  - What do we have to do to get beyond academic studies? *We will return to this later in the presentation.*

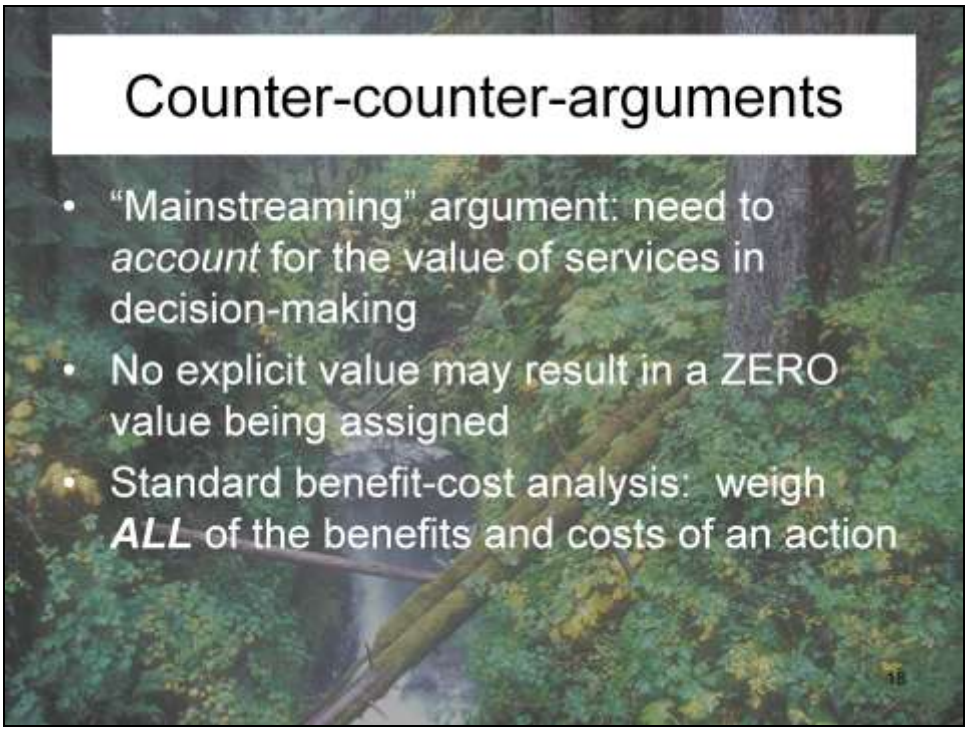


Some important things to note:

- Not everyone thinks this is the best way to approach these issues for 2 main reasons
    - Philosophical
        - Issues with viewing nature as an instrument for human well-being. Need to think about it on its own and not just what it does. Economists think about value and price and others think about rights and duty.
    - Practical Concerns
        - Can we do this? Can we do this <u>well</u> to actually inform and make better decisions? Or will it be very imprecise? It is hard to quantify it all…we will undervalue the services.



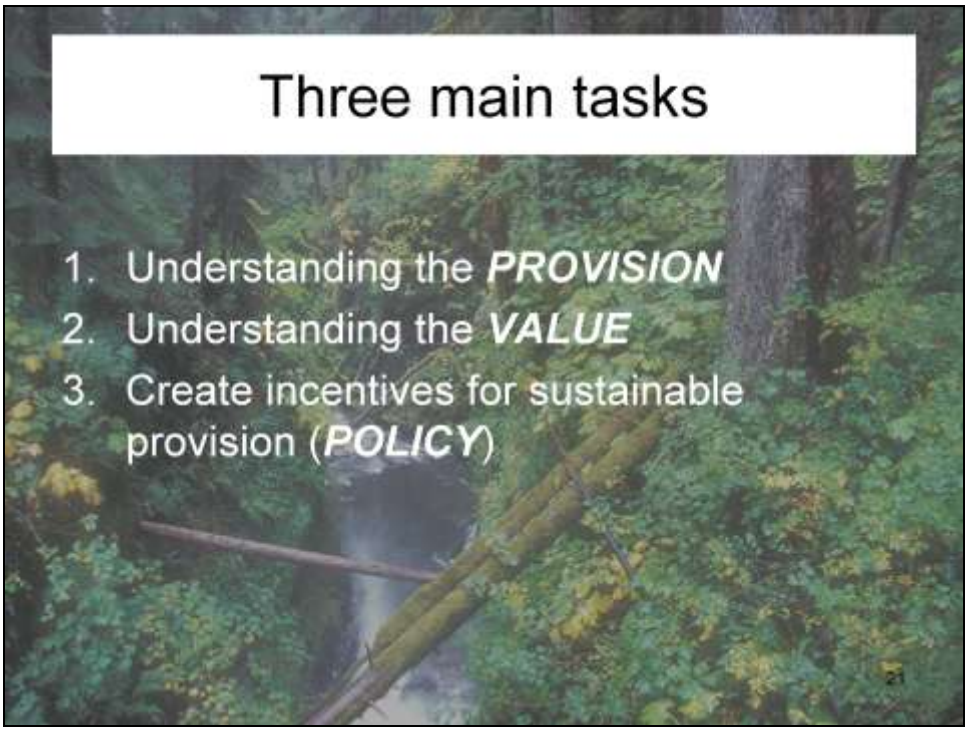
- McCauley quote, *see slide*, demonstrates the view that we will undervalue nature; it represents the notion that nature is priceless and we must protect it for that reason.



- We can argue philosophy, but that puts yourself on the sidelines. Real people are trying to do this and make it a good tool. Instead of arguing philosophy, get in the game and try to account and show how ES and actions people are taking will or won't cause harm/benefit.
- No explicit value may result in NO assigned value.
    - This has already happened in policy a lot. Other things without value, despite having known importance, get cast aside because people/policy makers tend to look at the bottom line. Things with no value are absent from the bottom line.
- In a benefit/cost analysis, we need to weigh ALL benefits and ALL costs, so let's try and do the best we can to bring all values to the table.

- People care about nature for a variety of reasons:
  - Material (ES category)
  - Spiritual/cultural
  - Ethical
- All of the reasons fit into the ES category!
  - ➢ What choices will people make when they think about the big picture? - This is an important question

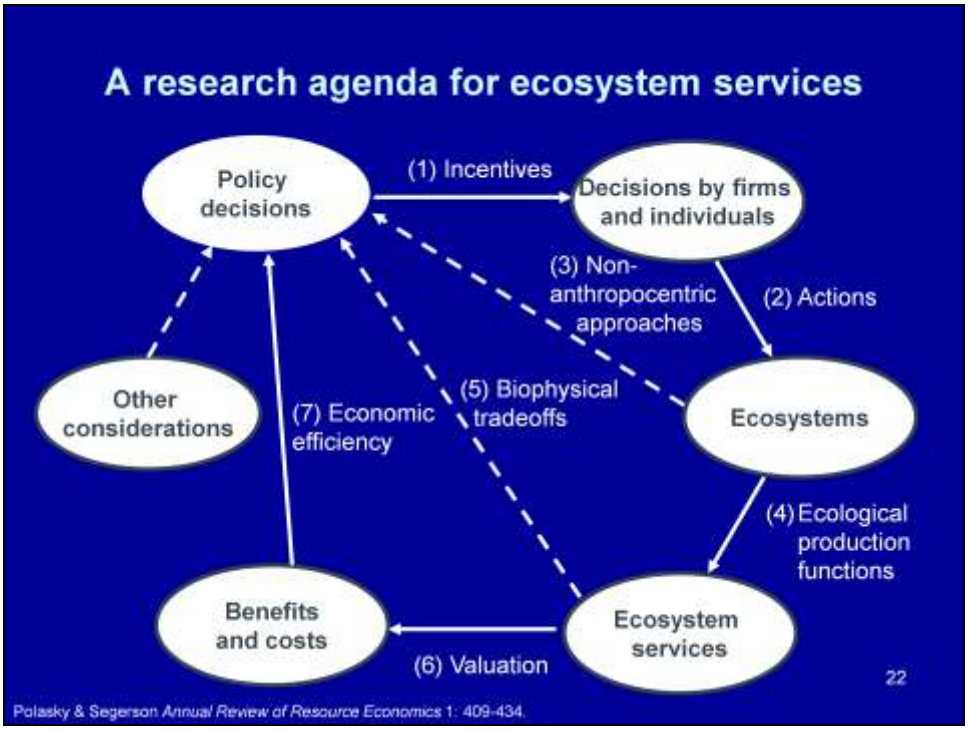
- Now, this presentation is about DOING the ES valuation, no longer concerned with the philosophy behind it.
- MEA has lots of lofty statements and "wish" science, but there is little evidence to complete the link.
- Frontiers in 2009 and show we can deliver the numbers and show the values.



In some areas, we are working to develop the link and show the numbers and deliver them as scientists.

Three main tasks to obtaining numbers:

1. Provision – This is a natural science task; change function and process to see how it changes provision. The physical quantities of goods and services being produced.
2. Value – This is an economic task. What is water quality worth vs. more agricultural production?
3. Policy – Can we align incentives for sustainable provisions for ES? This is an implementation provision.



- This slide represents a schematic of how things fit together. Again this is all about decision-making. This could be government or business. They provide framework and incentive for individuals and/PR firms that then take action on the ground and affect ecosystems function and process.
- (3) Involves more ecology based notions.
- (4) Going further - think about human action and the affect they have on ecosystems, and how does it affect provisioning?
- (5) Biophysical Tradeoffs
- (6) Going further with monetary terms, sometimes it stops here.
- (7) This is the last possible step; deciding where to stop is different and difficult, don't always have to put things in the same metric value. Sometimes dollar values are helpful, but maybe reporting in terms of tradeoffs is more advantageous for a given situation/decision-making process.

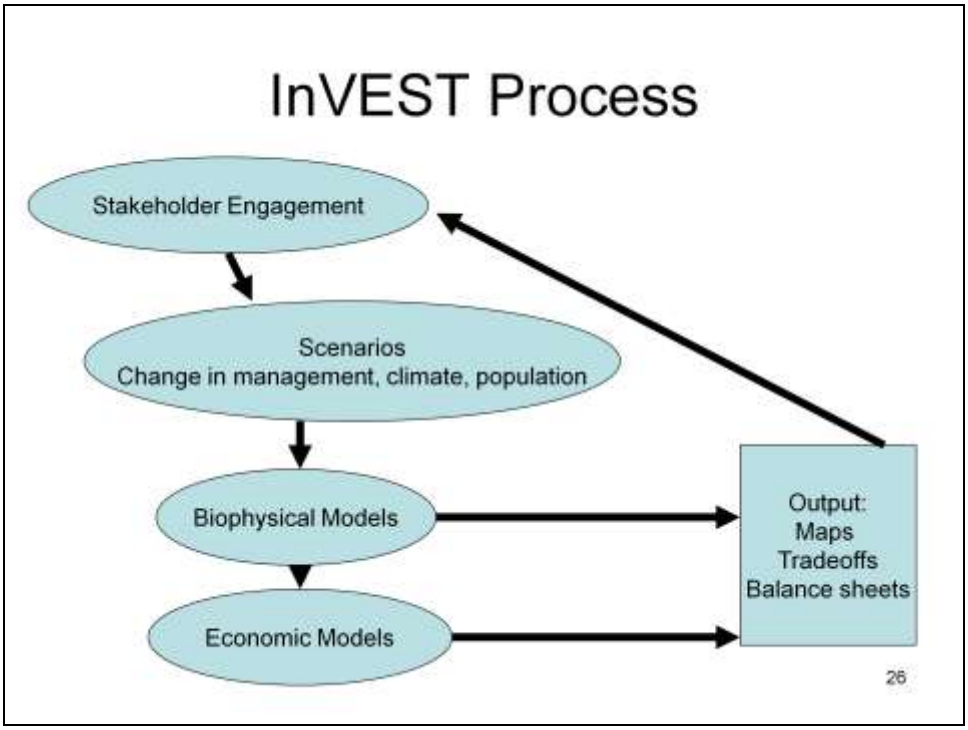
Again, this is a loop and each steps provides feedback to another.

- Lots of work on this and is happening through partnerships listed above. We've been working together to do a set of models in InVEST. Models are downloadable from the web with good users guide.

- InVEST – freely downloadable on the web, *see link above.*
- People who pick it up are from all over the world.

What is InVEST?

- The whole point of it is to think about the joint provisions of ES and what you do to a landscape.
- It is comparative.
- It is spatially explicit because it matters where things happen.
- Data use is tailored to the place and application.
- We want it to be flexible and transferable.



Stakeholder engagement

- First and foremost: what are the problems, concerns and policies? What is motivating the study of the issue? Here you need to talk to people on the ground.

Scenarios

- Must think about all the scenarios to consider.

Biophysical

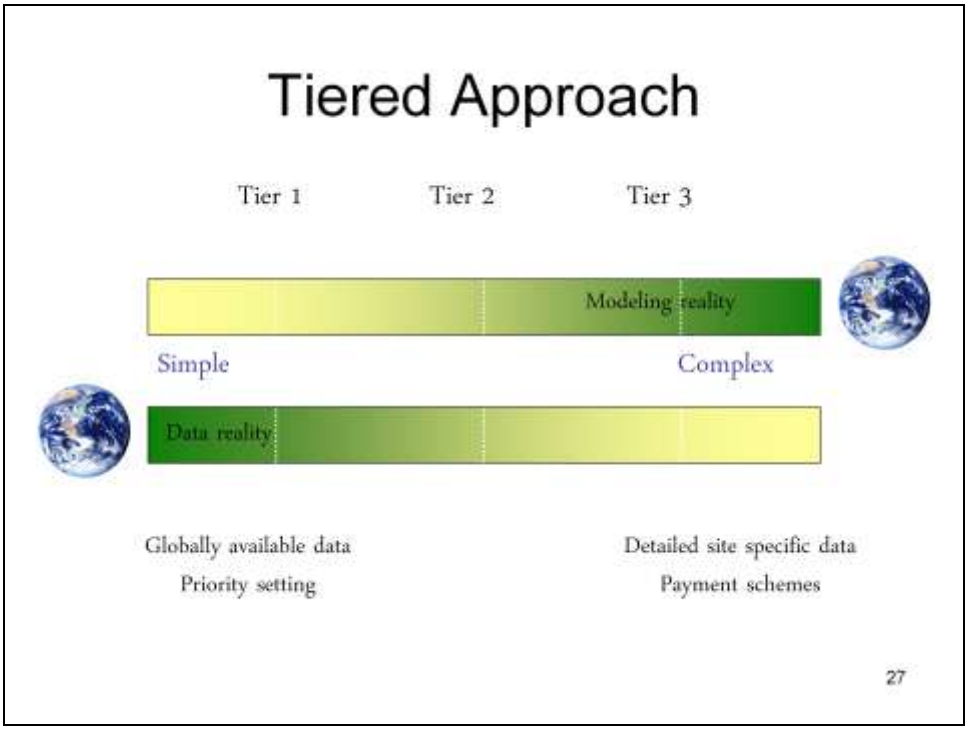
- Models a function of what you decide to do according to scenario.

Economic

- Models utilize more traditional economic outputs and valuation.

Output

- Can either be in biophysical or economic terms depending on the models.

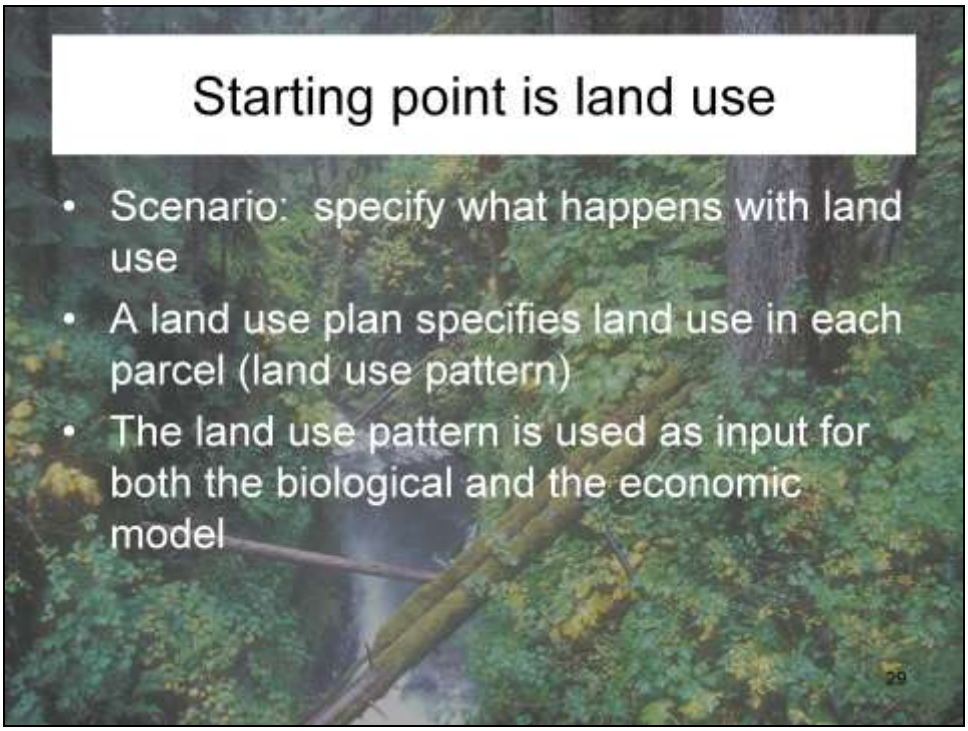


- These models aren't parameterized with some standard data. You have to pull together the data from your area of interest to run them. This presents a challenge that many of you are familiar with.
- A tiered approach exists which describes the complexity of the models.
    - Tier 1 is simple – maybe be best for policy comparisons
    - Tiers 2 & 3 are more complex –maybe best for assessing service payments

Where to put things? Spatial land management with biological and economic objectives

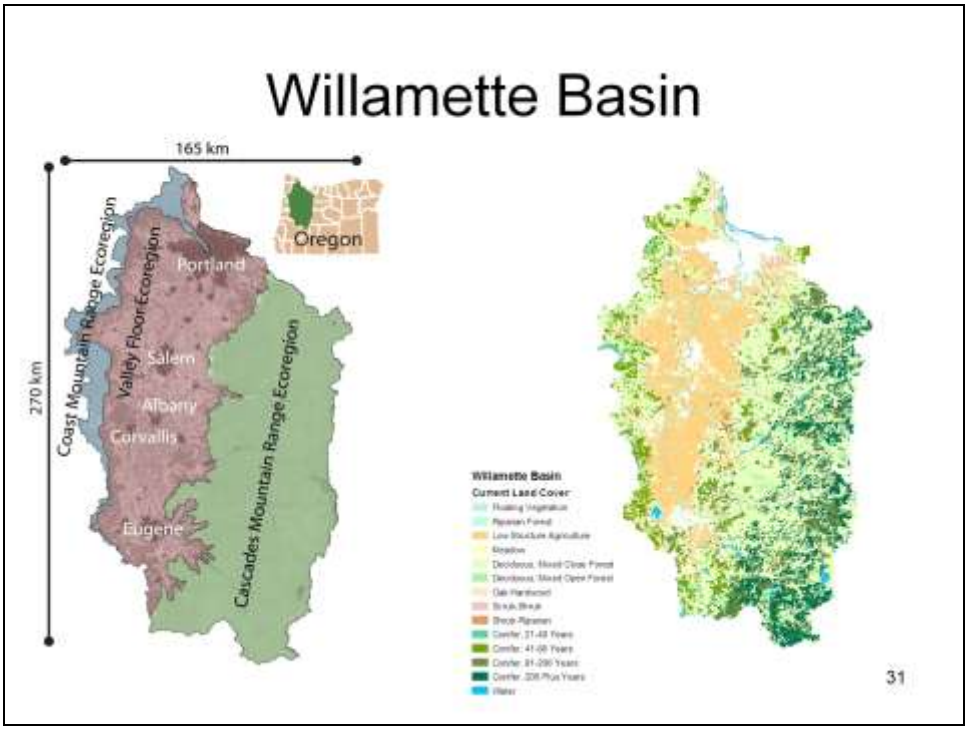
Polasky et al. 2008. Biological Conservation 141(6): 1505-1524. 28

- No we will run through a couple of examples that deal with the question:
  - What are key methods and results and kinds of things you get out of the valuation?
- Important to note that this example predates InVEST.

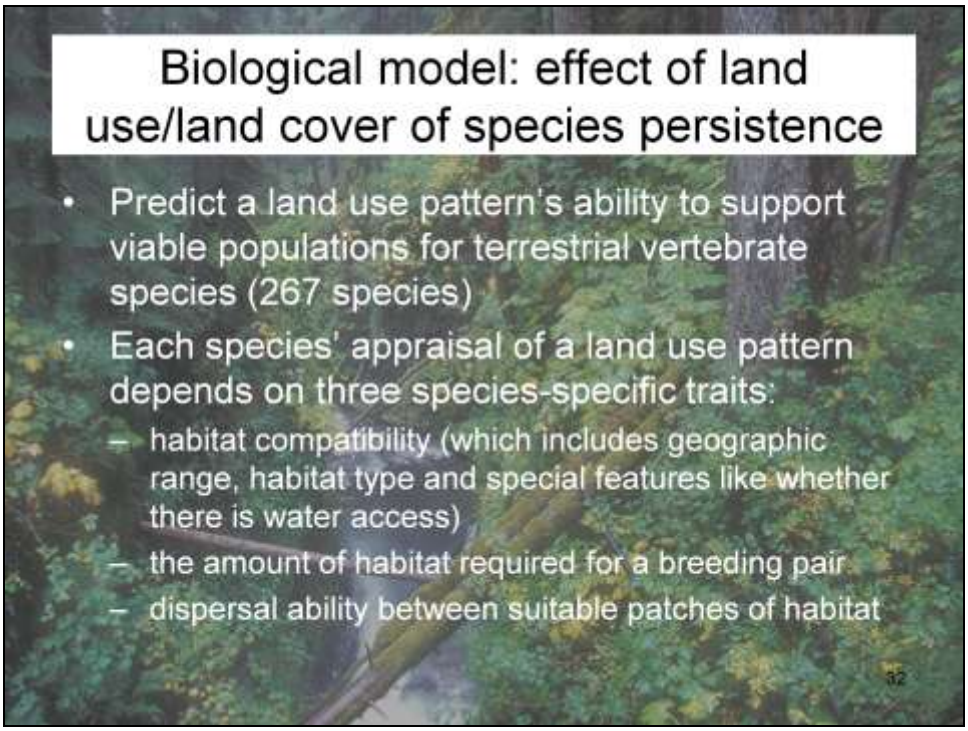


- Scenarios are the starting point.
- We use land use plans because they tell you what is happening across a large scale. It can be more broad than land use such as including climate change etc., but this scenario is only after land use changes.
- In this case we are concerned with land uses in the Willamette Basin. This is the input for all service provisions.
- Biologic – what are the biologic returns?
- Economic – what are the returns to landowners under different scenarios?

- We looked at 9 land uses, *see slide*.
- Oregon is unique that development has to happen in urban growth boundaries; this study is outside of those areas.
    - ➢ What are the land use alternatives in the Willamette Basin?

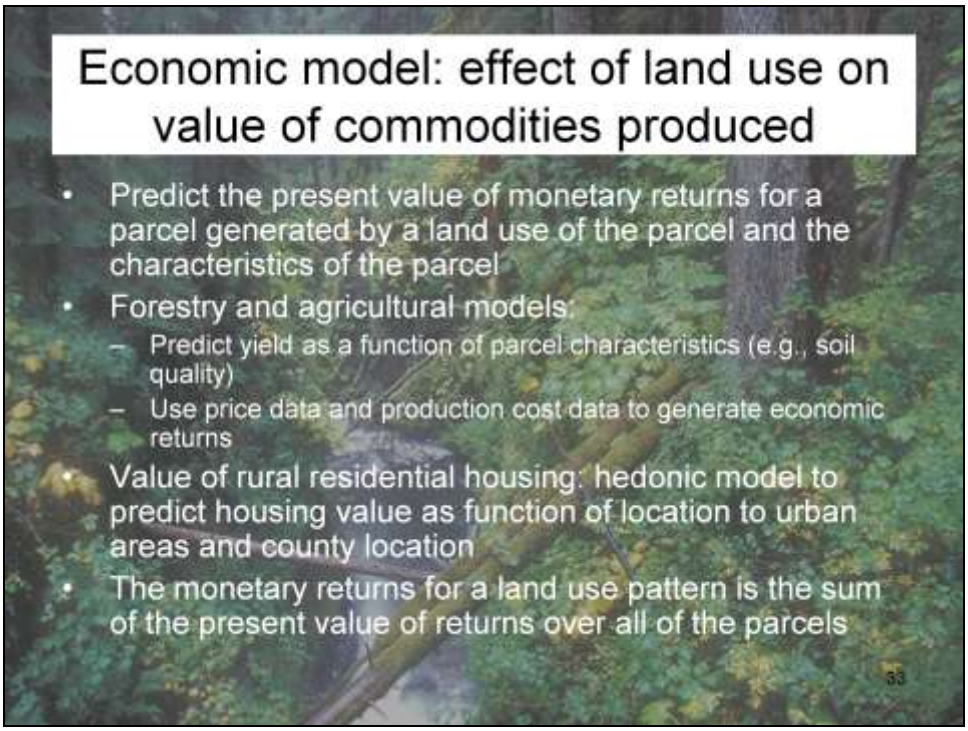


- Western Oregon
  - Small coastal range to the West
  - Valley floor contains cities and agriculture
  - Cascade Mountains to the East
- Cities are in white, study does not look at those areas
- Forestry is in green



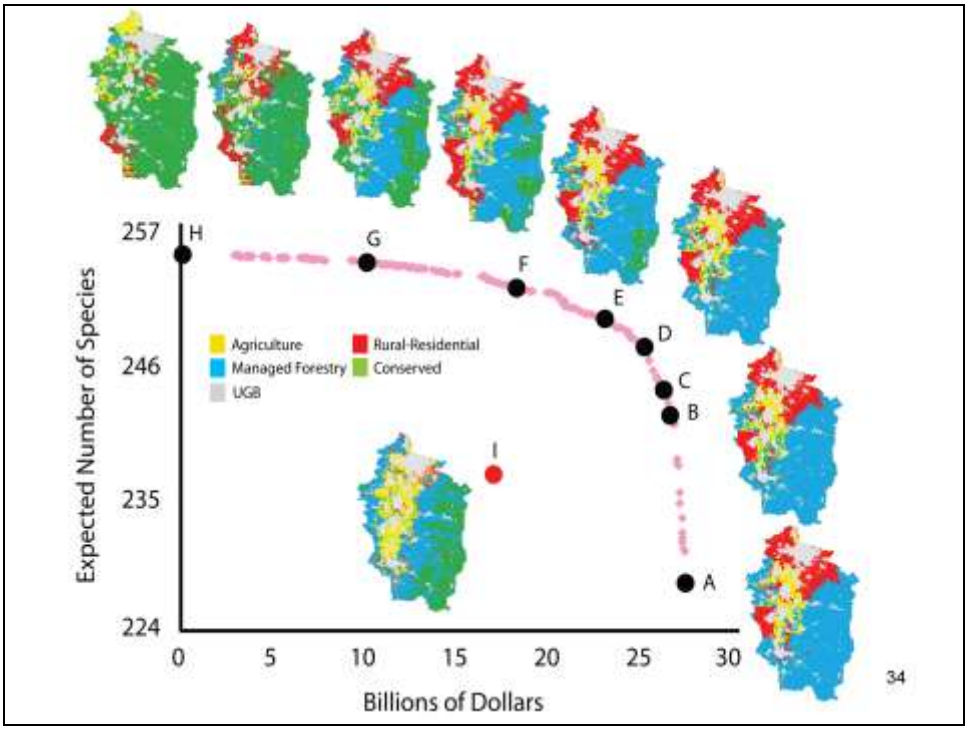
Biologic Model:

- This example was concerned with terrestrial species. It didn't look at each one, that would have taken forever so they developed three elements required to evaluate benefits to species as a function of land use
    - What counts as habitat?
    - How much do you need for a breeding pair?
    - What about dispersal considerations?



Economic Model:

- Land type will affect yield for each
- Agriculture: function of soil quality, slope, distance to market
- Forest production
- Combined the previous factors with price and market data and you get a economic value for services



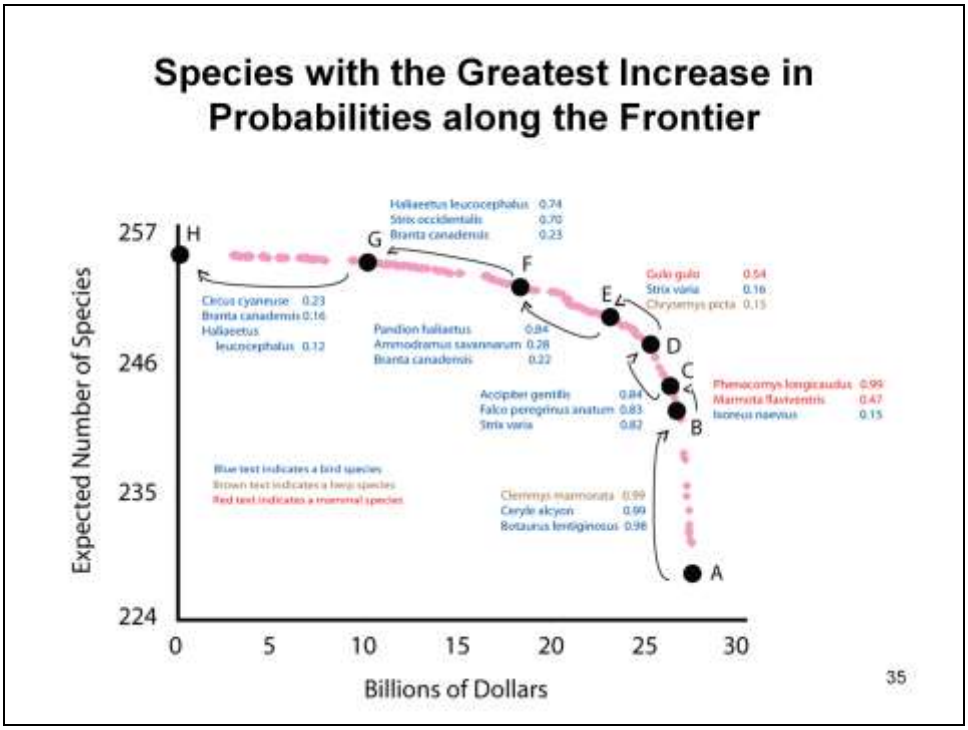
- This graph is a depiction of economic returns for agriculture and timber.
- It uses present value for ALL economic returns for the basin.
- Y-axis, how well species do, as you see not all will survive in the basin no matter what we do.
    - If we fix the biological score, what is the max economic score?
    - If we fix the economic score, what is the max biologic score?
- Production Possibility Frontier, standard economic theory
    - At spot B – there are very rare habitat types, many species respond very quickly. The difference between A and B is the large biologic benefit at a very small economic cost.
- Optimization people indicated that this is a nonlinear integer programming problem so to simplify it they made it linear which means prices were held constant.
    - Timber is one item where the price would not be the same because it is so special to this area.
    - In a later study where they were interested in scoring the landscape they include models of price changes.
- Point I is the current score. The debate is between jobs and environment but as we can see from the graph, we are not even at that point yet. They can still get a lot

out of the land and produce the same amount of biologic and/or economic score. Lesson is that we can do better on both dimensions.

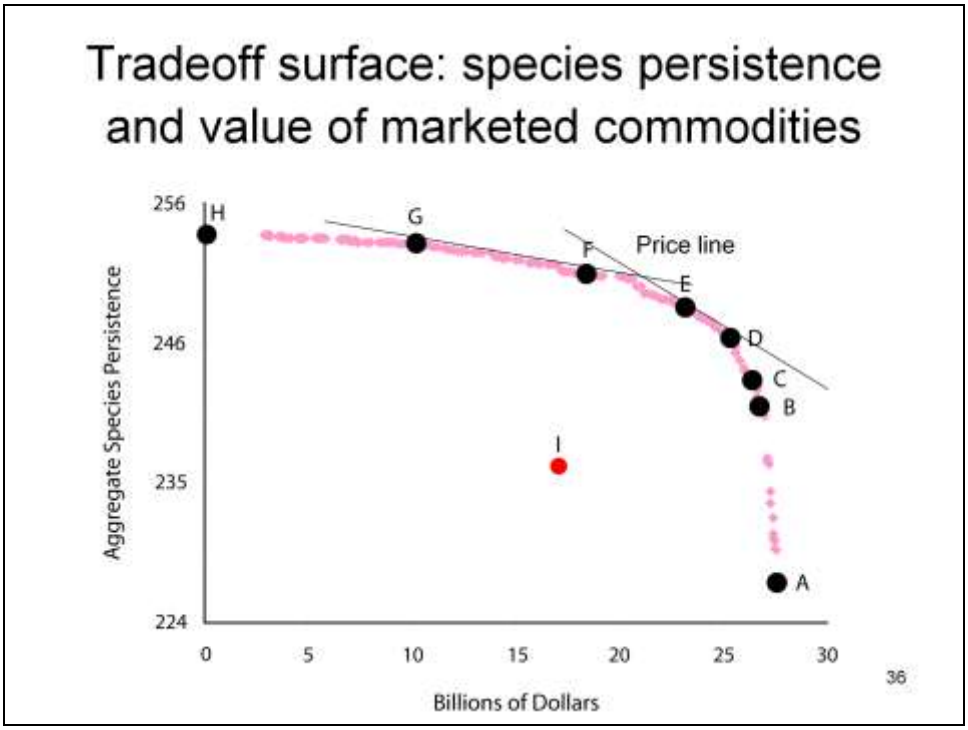
- Points E, F, G, to H are for species that need lots of space to thrive, i.e., spotted owl.

Note:

- They are analyzing this basin as an island, but it is not in reality.
- From this, we see the motivation to care about the services. In this model, it isn't just about the species count, we do care about other services like pollination and soil etc… they are all responsible for production of ecosystem and should be considered.



- Besides doing the aggregate, this shows the biological side.
- This graph list some species that changed the most at various points.
- Change from F – G is the most important for the spotted owl.
- Other species A – B can be saved more cheaply.



- Here's where tradeoffs come in – horizontal is in monetary terms, vertical is not – so how do we look at tradeoffs?
- What's it worth to you to save spotted owl? Most of these consideration are going to be political decisions, so let's bring the best info to the table to do this.

The Impact of Land Use Change on Ecosystem Services, Biodiversity and Returns to Landowners: A Case Study in the State of Minnesota

Polasky, Nelson, Pennington, Johnson. *Environmental and Resource Economics* 2011

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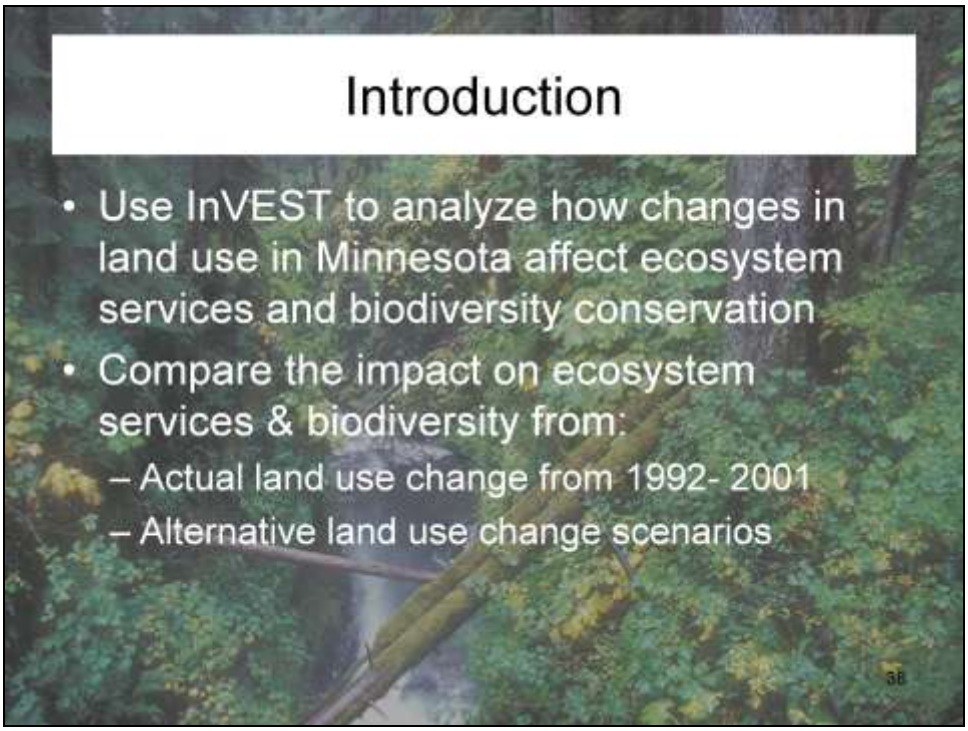
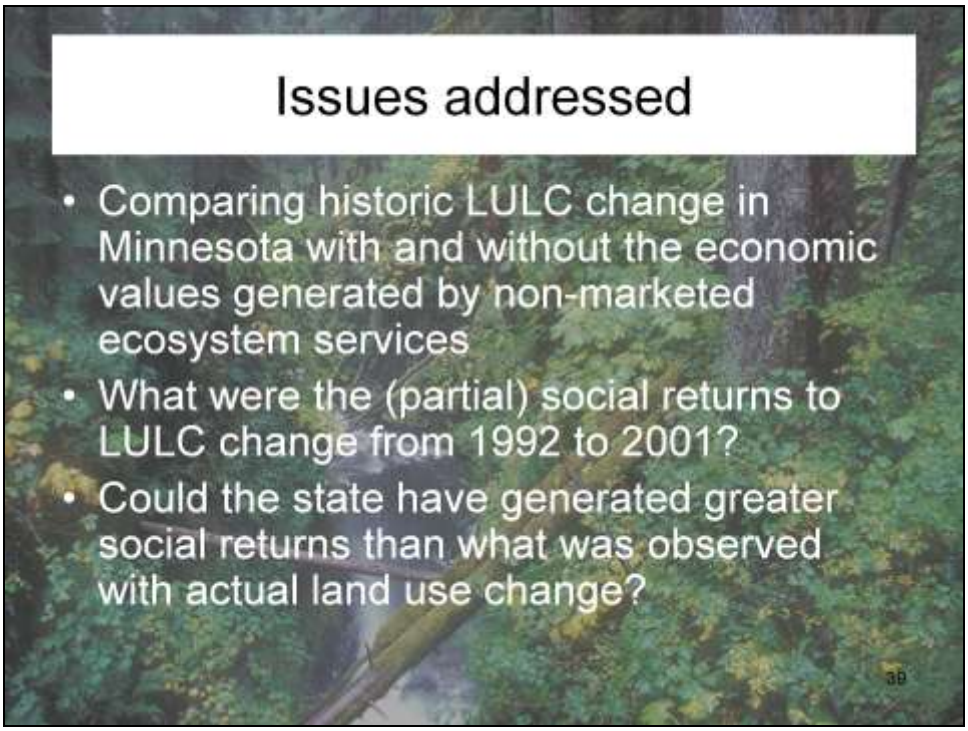


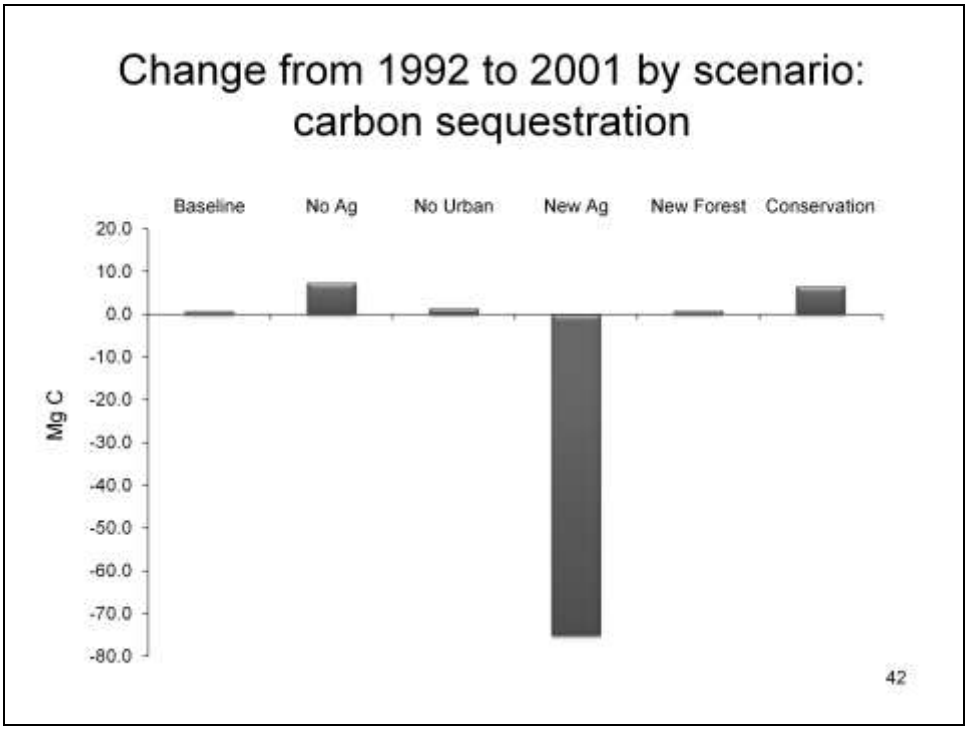
- This is set in Minnesota not Oregon.
- Still does not have full set of services in here; they are gradually adding them in. Pollination is one that is not included.



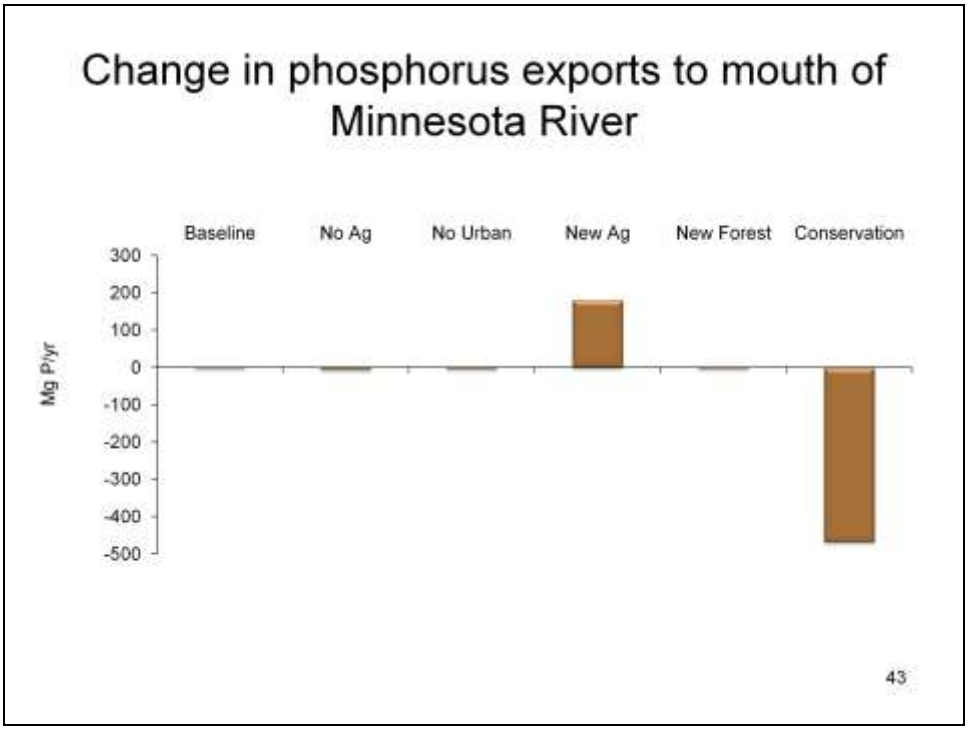
- Both market and nonmarket (carbon sequestration and water quality) addressed and how it relates to biodiversity conservation.

- This slide lists out some of the methods.

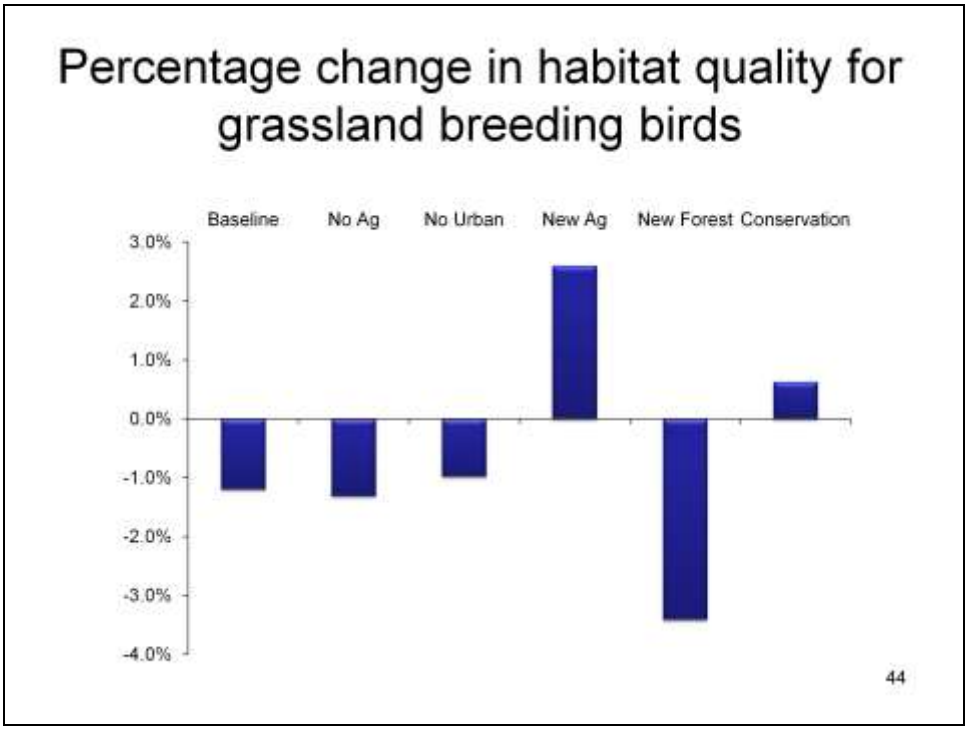
- The list of outputs that were examined, *see slide.*
- These are much simpler than before. It is a function of area as opposed to species. Not very nuanced; rather basic, i.e., is it grassland, yes or no? Etc.
- Non market services.



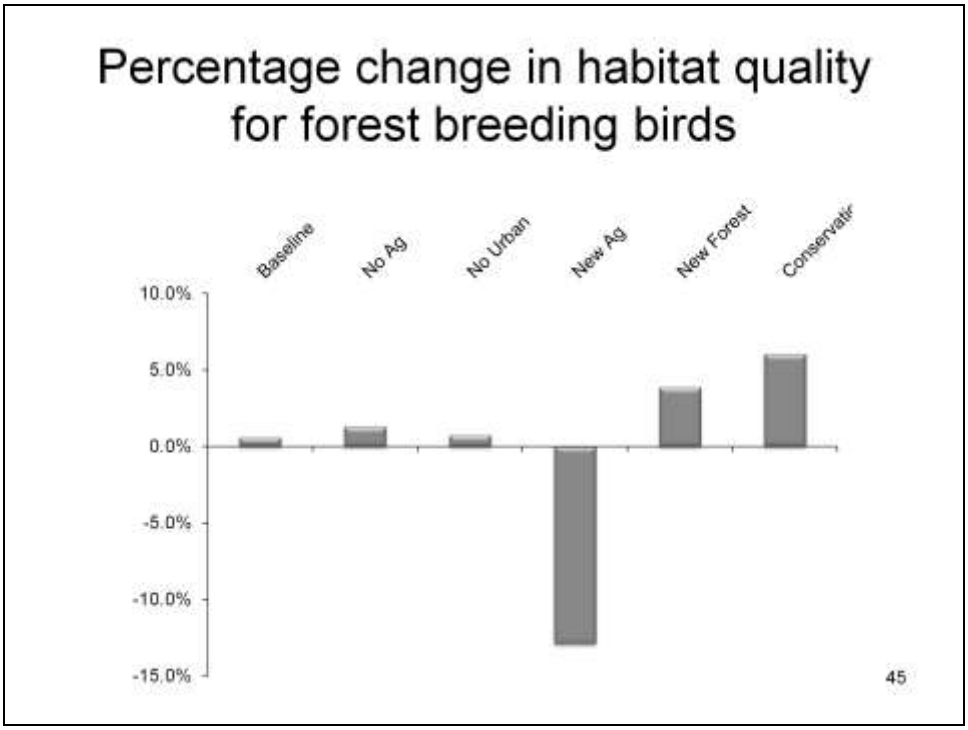
- This slide examines how carbon sequestration changes over time. Lots of forests maturing so if there is a big pulse of new agriculture then there is a new pulse out of carbon, *see slide*.
- Should you get rid of one of these? Answer is confusing; it does not change relative ranking across scenarios.



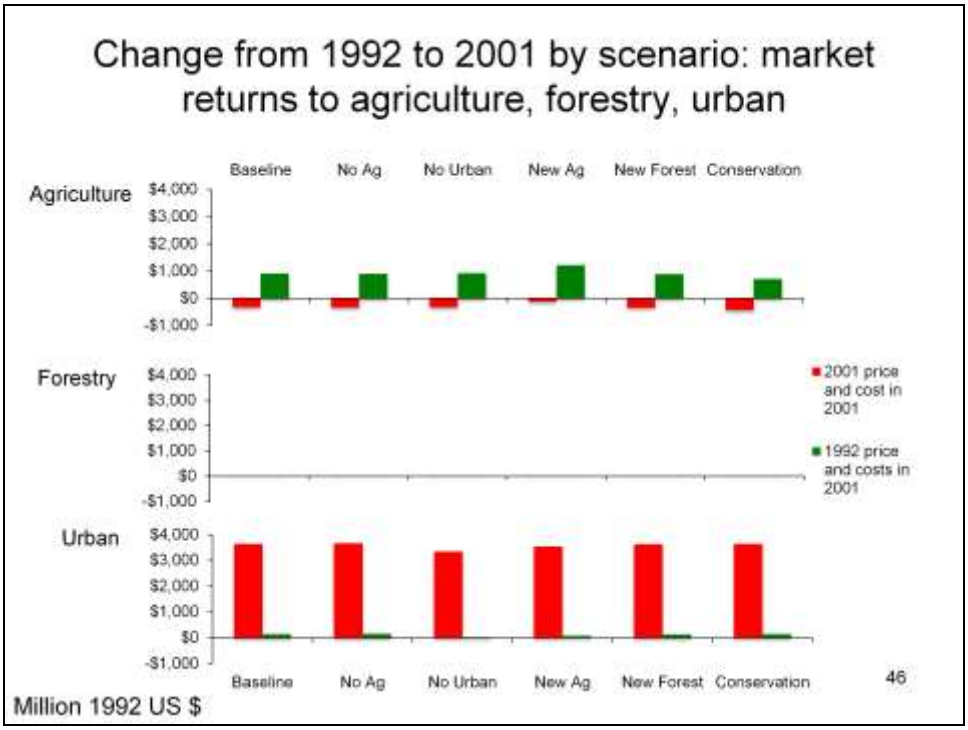
- This is the measure of water quality via phosphorous output.
- If you expand agriculture, then you get more phosphorous output.
- Not much change in others besides conservation, which creates a large surplus.



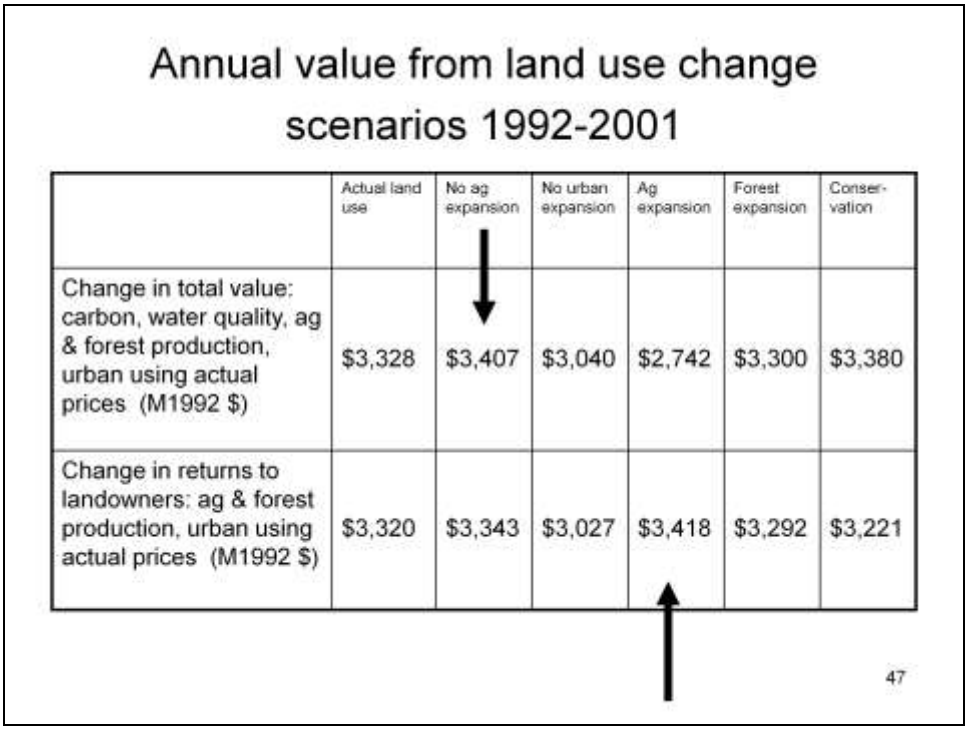
- One place where expansion of agriculture is good: pasture birds.



- Opposite is true when you look at forest birds.



- Actual prices in red versus no price change in green. No price change reflects the change from land use.
- Prices dropped and cost rose between 96-01 for agriculture products. Urban and forestry prices rose.
- Values of houses went up; they kept 1992 prices and saw smaller outputs.



- Top row looks at change in total value as value of water quality and carbon changes.
- To get valuation:
    - **Carbon**:
        i. Could look at prices for carbon markets, but that has its limitations. Chicago Climate Exchange was functioning, now it no longer exists. In 2008, the US voluntary market was trading for $2/ton; in Europe was more like $30/ton. Carbon is global, does not matter where it is emitted. The institutional details are affecting price so instead, this study looked at "social cost of carbon." What do we think an increase will do in terms of climate change and other social damages? IPCC and others have looked at this. This study used mean value which at the time was $43/ton for carbon and $14/ton for CO2
    - **Water**:
        i. This study used a prior study that asked people what they would pay. Recognize that the question is not the best, but it was "convenient" for the study.
- Real Values – there is a real value according to people living in society, but how do you get it?

- The difficulties come with the aggregation of perceptions. There are lots of fairness and equity issues, good discussion topic because there is no quick answer.
- If you expanded agriculture, landowners are happy because of market return but give you the worse value for biologic component.

Modeling multiple ecosystem services and tradeoffs at landscape scales

Nelson et al. 2009. Frontiers in Ecology and Environment 7(1): 4–11.

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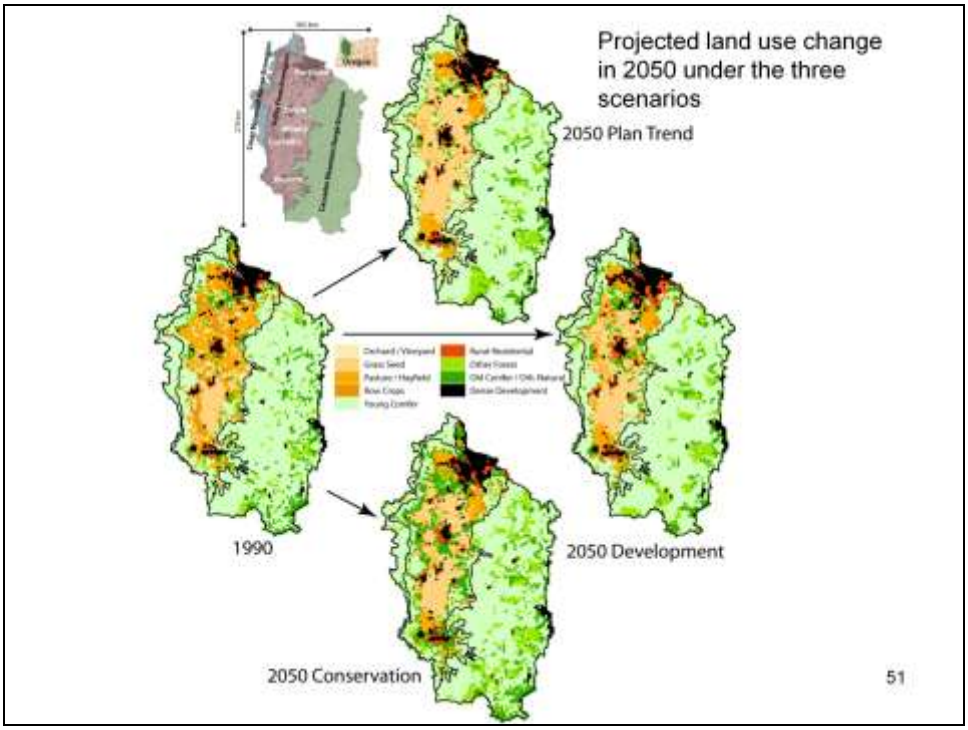
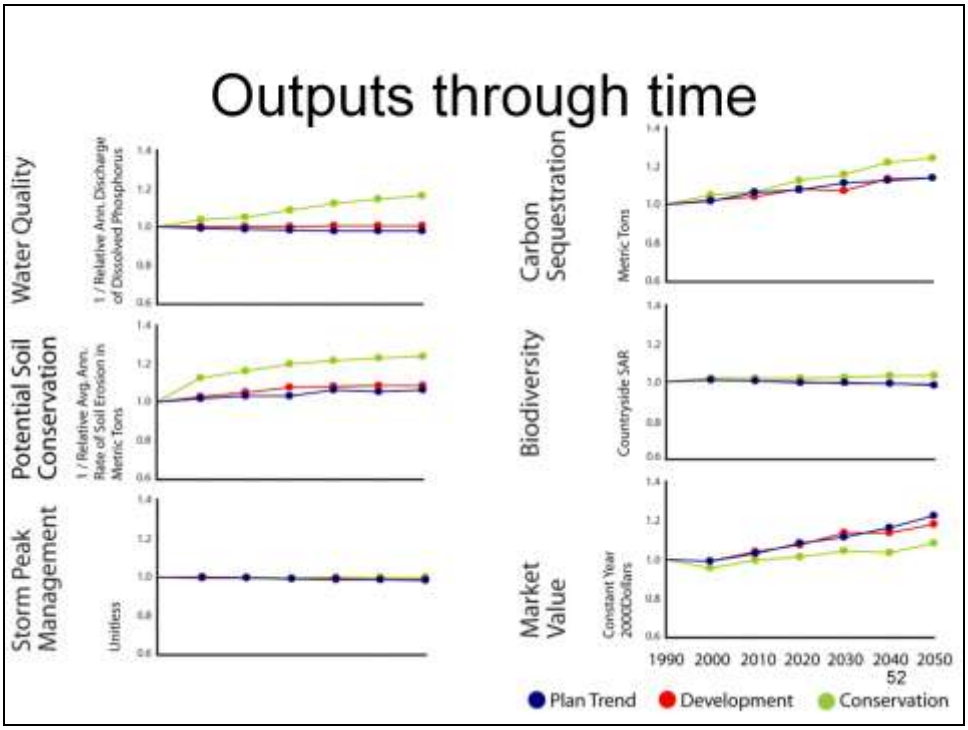
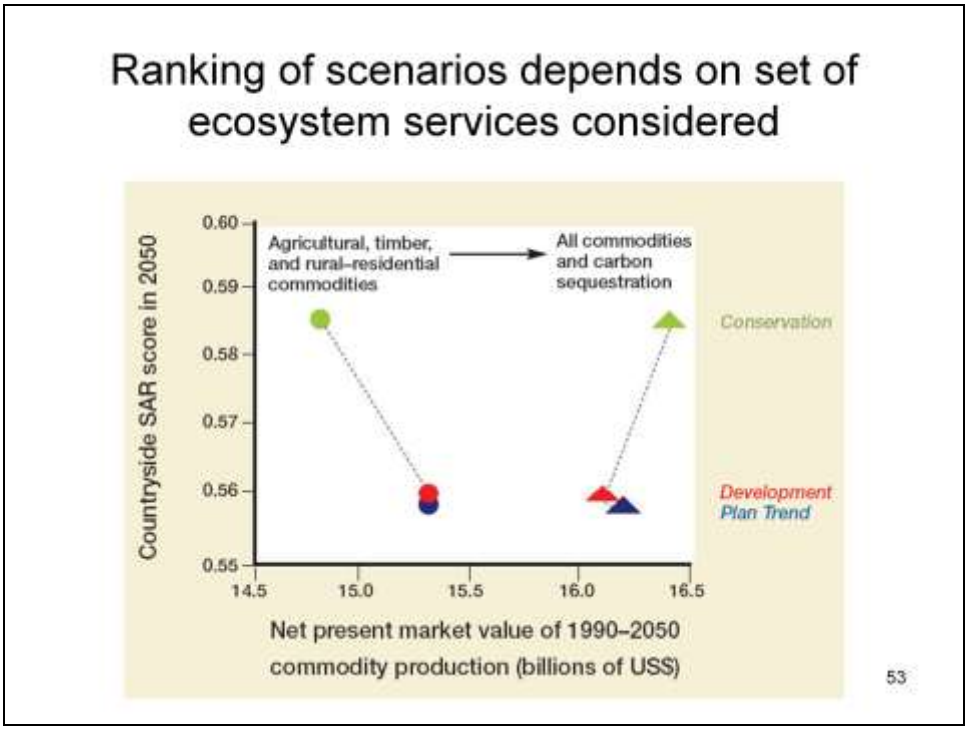
- Study takes place in Oregon.


Modeling multiple services under alternative scenarios
• Model outputs: service provision and biodiversity
– Water quality
– Storm peak mitigation
– Soil conservation (sediment retention)
– Climate stabilization (carbon sequestration)
– Biodiversity (species conservation)
– Market returns to landowners (agricultural crop production, timber harvest and housing values)
60



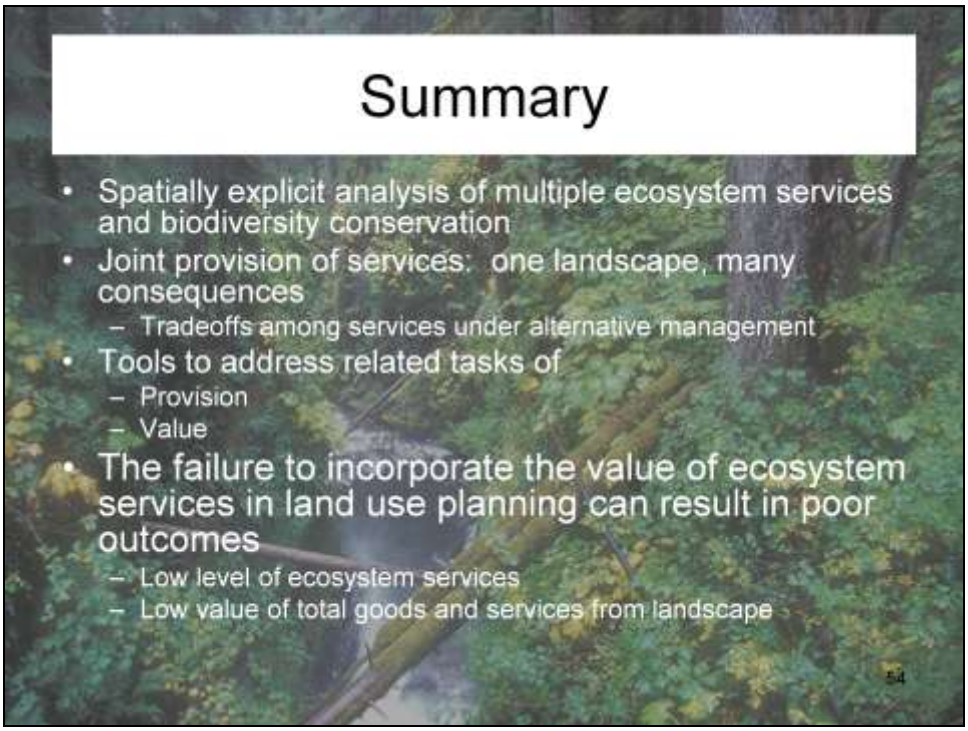
- Looked at scenarios discussed with people in the area.
- These are the consequences through time for a number of services.


Outputs through time
Water Quality
1 / Relative Ann. Discharge of Dissolved Phosphorus
Potential Soil Conservation
1 / Relative Avg. Ann. Rate of Soil Erosion in Metric Tons
Storm Peak Management
Unitless
Carbon Sequestration
Metric Tons
Biodiversity
Countryside SAR
Market Value
Constant Year 2000Dollars
1990 2000 2010 2020 2030 2040 2050
52
Plan Trend
Development
Conservation



- What is viewed as a good outcome for society? The services you include and the services you ignore have an effect.

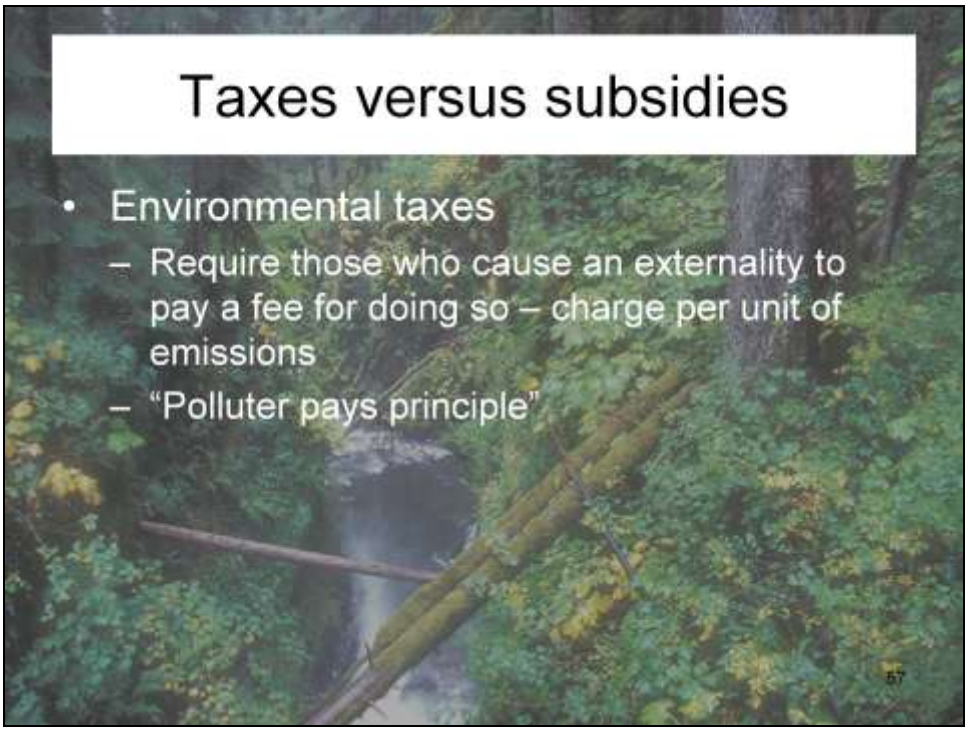
- What if you could pay for ES, pay for carbon?
- Second line depicts what happens: there are no longer the classic tradeoffs.
- Lesson:
  - The rules of the game and/or incentives (paying for carbon) really change the scenarios.



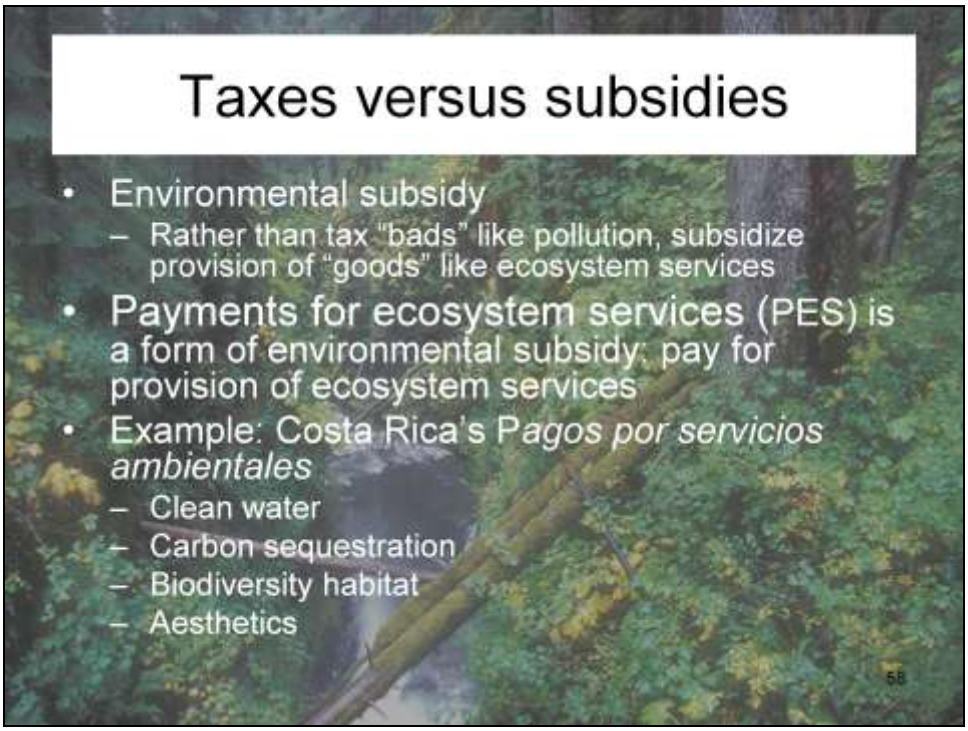
- Even InVEST is guilty of looking at an incomplete list of services.
- Carbon and water quality are very important to include. In certain areas recreation are more important to include.
- Lesson:
    - We get ourselves in trouble when we do not look at the full list.

- How do we fix the problem and provide proper incentives for ES?

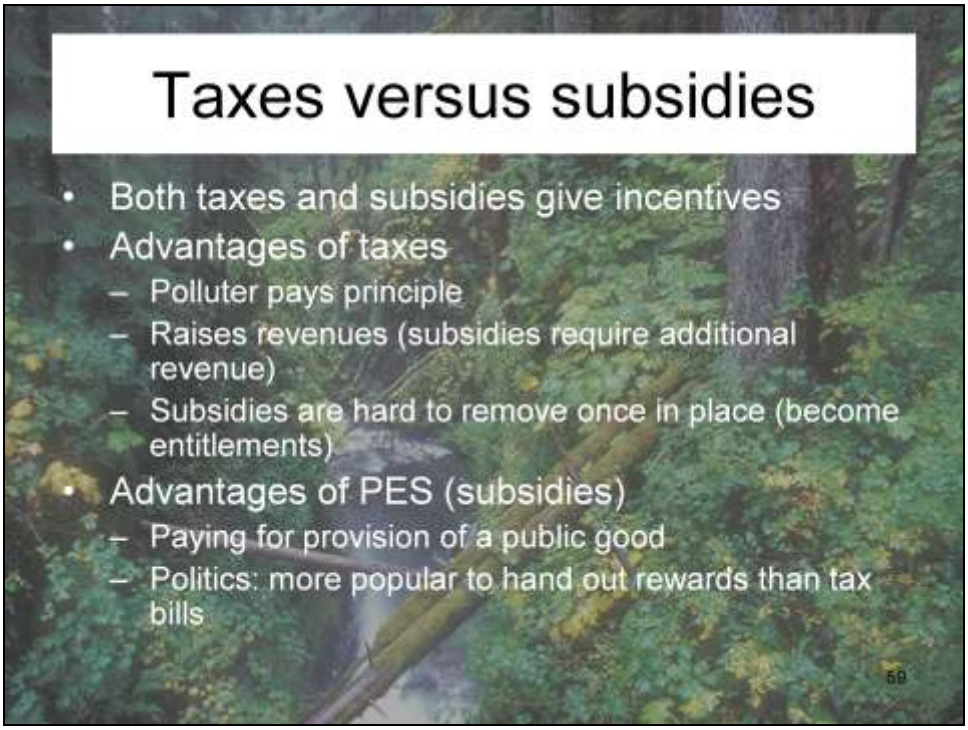
- This has been well-studied for a while. Focus has been on how to deal with externalities and public goods.



- Payment for ES (PES) dominates a lot of conversations of ES.
    - Makes sense to charge a person; that is what we do for pollution.



- In ES, we have not used the taxation approach.
- We think that ES are public goods, if they want them, we must pay land users to keep them instead of charging landowner for destroying them.
- There are lots of examples of subsidies being used: Conservation Reserve Program and Wetland Reserve Program – PES; Costa Rica PES pays landowners for four types of services, *see slide*.



- Do you think of this more as a land-owner responsibility or is it a public good?
    - This brings up a philosophic question about what is fair? Who takes on the responsibility for ecosystem services?
- In the case of pollution, the polluter pays penalties which then creates revenue that is available for later use.
- Subsidies are really hard to remove once in place, they become entitlements.
- There are advantages of PES:
    - If it is public good, and not fair for land-owner to have burden, then this is the way to go.
    - Politically more popular to have rewards than penalties.

Efficiency of incentives to jointly increase carbon sequestration and species conservation on a landscape

Nelson, Polasky et al. 2008. *Proceedings of the National Academy of Sciences* 105(28): 9471-9476.

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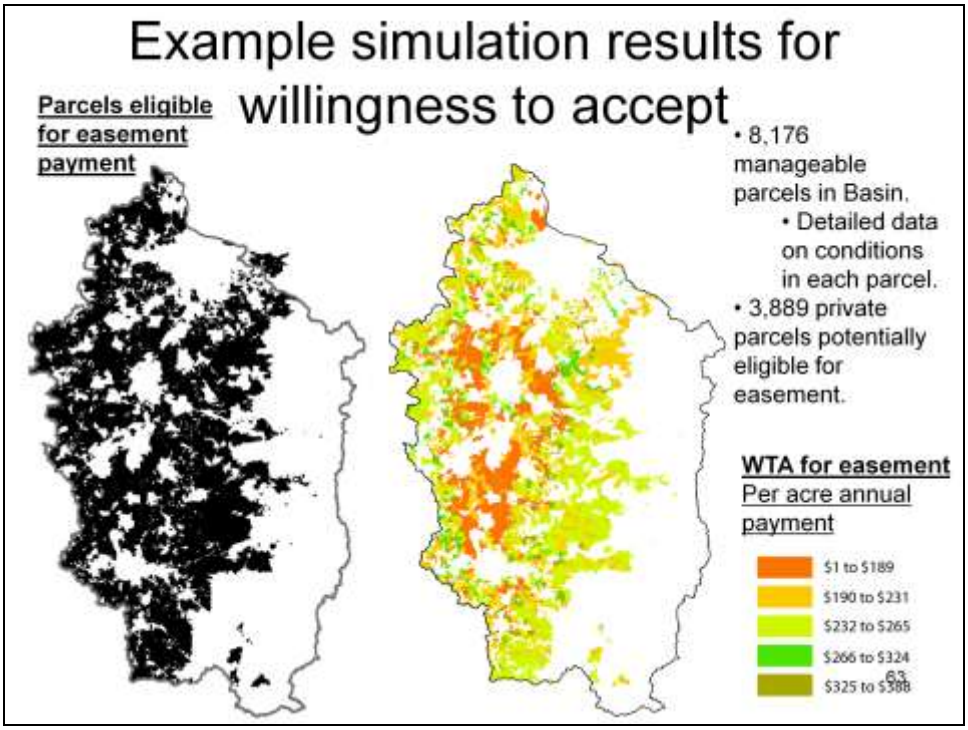
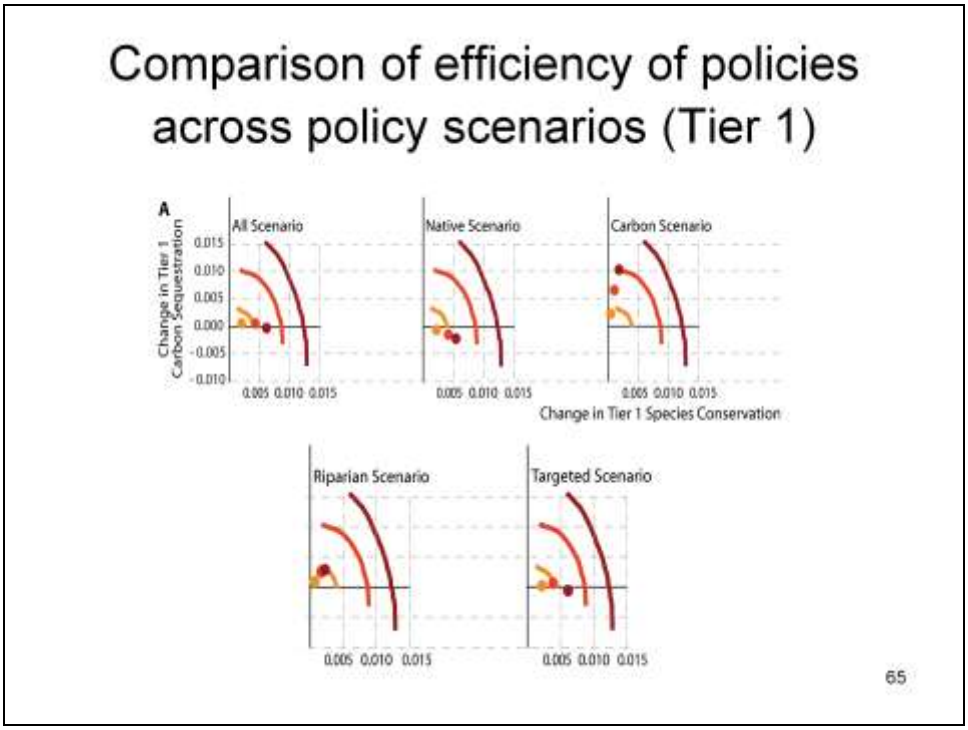
Efficiency of incentives to provide services
Analysis of incentive programs that pay for enrolling in conservation
How well do voluntary payment programs work?
Use data to built a statistical model of land-use change (NRI land use data 1982, 1987, 1992, 1997)
Use the statistical model to estimate parcel-level willingness-to-accept a conservation payment to enroll
Simulating the spatial pattern of conservation for a given policy
Score the landscape for species conservation and carbon sequestration
Compare outcome with the optimal spatial arrangement of conservation (efficiency frontier)
61


Efficiency of incentives to provide services
• Data on land-use change (NRI land use data 1982, 1987, 1992, 1997)
• Estimate relationship between economic returns in various activities and probability of land use conversion
• Use the statistical model to estimate parcel-level willingness-to-accept a conservation payment
• Simulating the spatial pattern of conservation for a given policy
• Score the landscape for species conservation and carbon sequestration
62

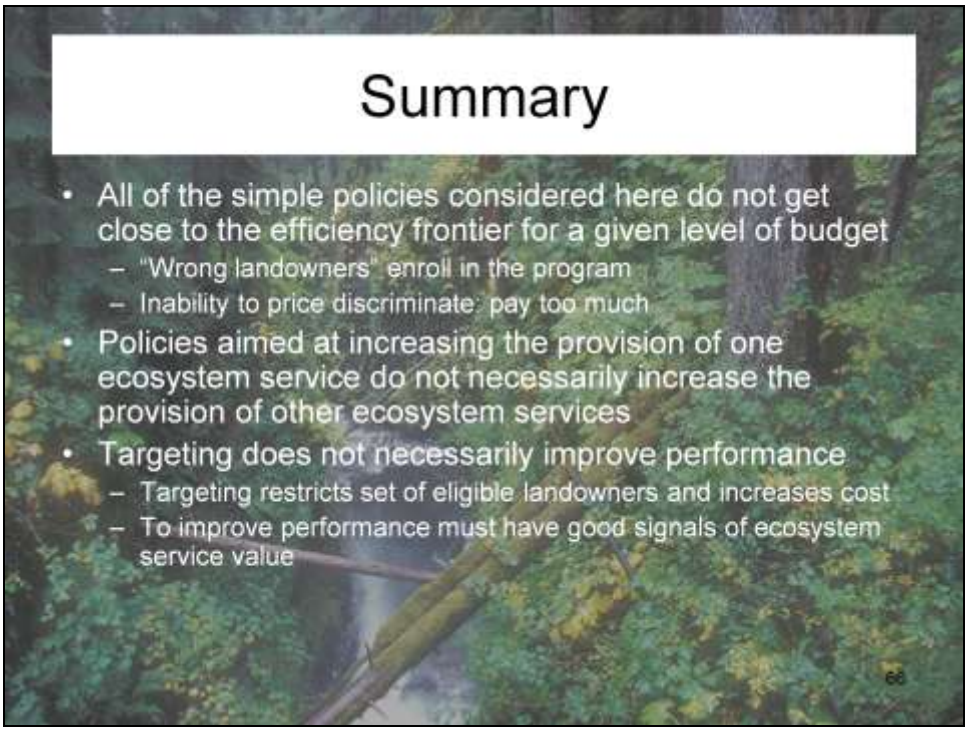


- How much can you pay someone to get into a conservation program?


Policy simulations
• If conservation payment offered to landowner exceeds WTA then landowner enrolls in the conservation program
• Policy scenarios:
– All: all landowners eligible for payments
– Native: restrict to land in certain habitat types
– Carbon: restrict to land that could convert to forest
– Riparian: restrict to land along riparian corridors
– Targeted: restrict to land shown by prior analysis to be important habitat for species of concern
• Run simulations with various budget levels ($1 million, $5 million, $10, million)
64



- Dots are voluntary frontiers and show that we are not close to the frontier and not where we want to be.
- This was a targeted scenario, meaning that the study picked out important habitat types. Shows that scenarios did okay for conservation, but not for carbon.



- <u>Targeting:</u>
    - If you restrict eligibility to those land-owners that have land with the highest ecological value, i.e., riparian buffer, it is beneficial in the sense you increase biological benefits, but you also restrict acreage and increase the cost of the program.
- Need a good measure of ecological performance for targeted approaches.

Implementing Optimal Conservation

Polasky, Lewis, Nelson, Plantinga, Working Paper

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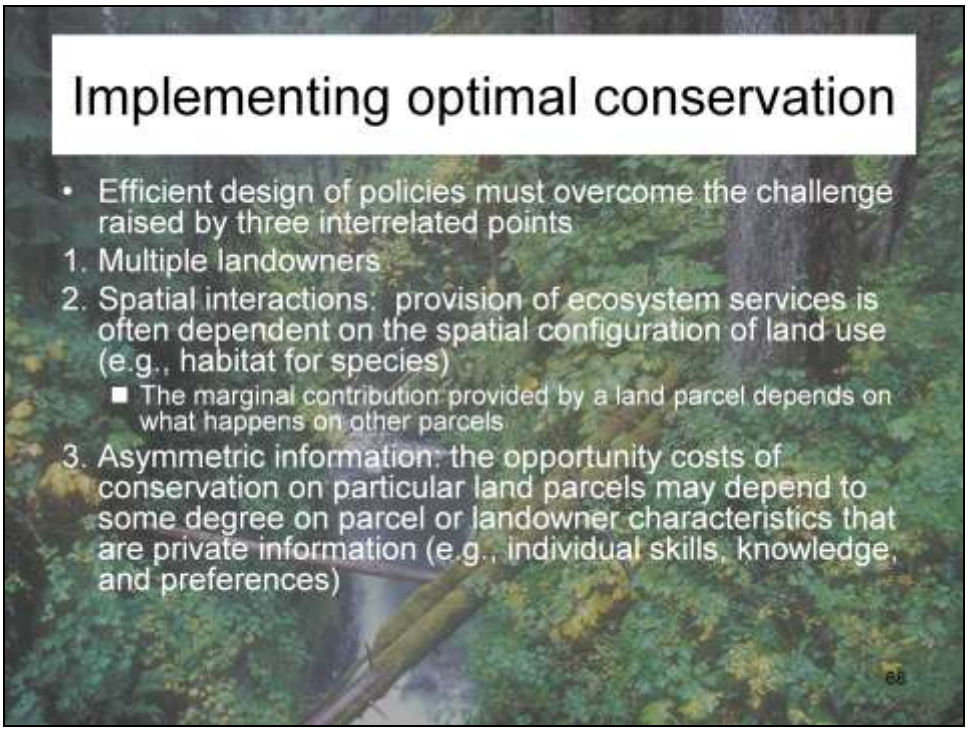
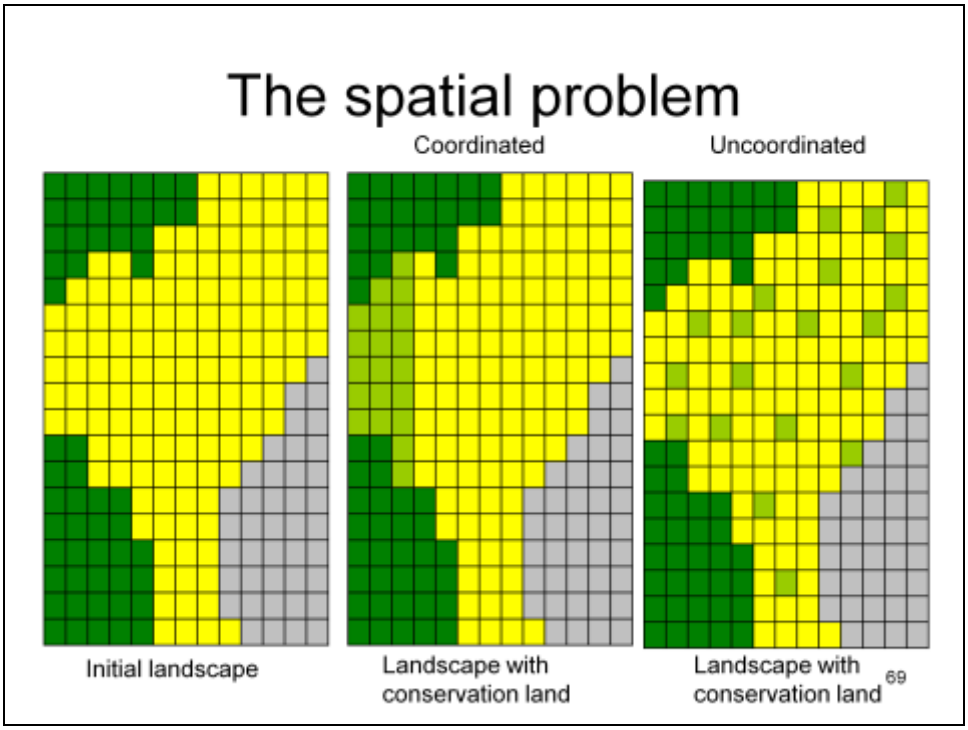
- There are some slightly less simple policies that work really well.



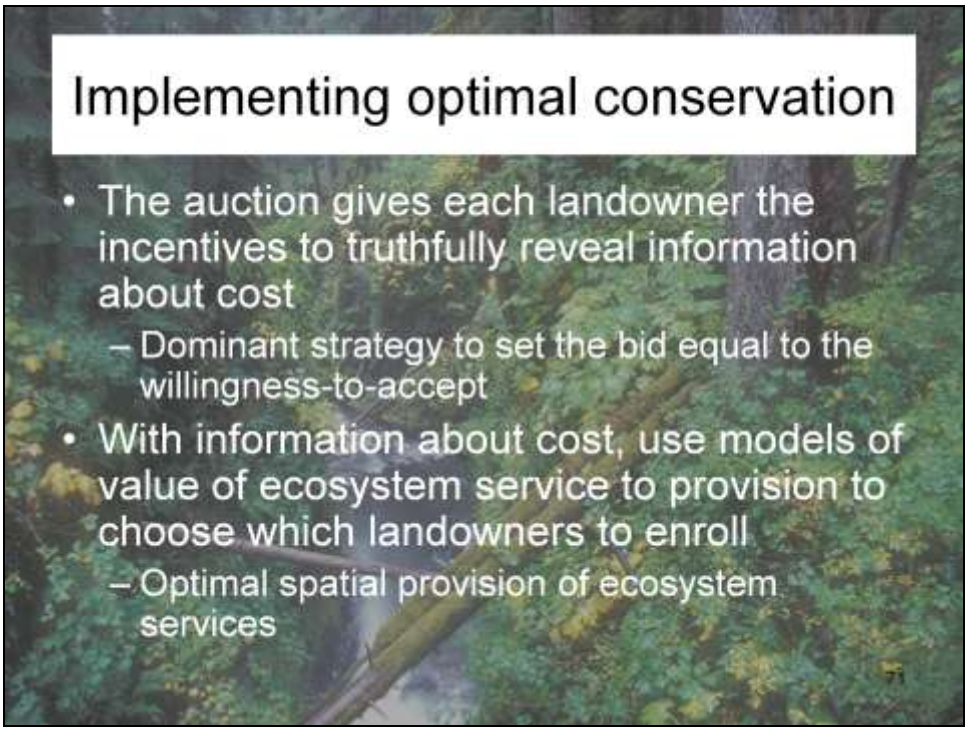
- There are some less simple policies that have more optimal outcomes.
- Landowners have different values (personal or otherwise). One might value the identity of being a farmer while others may be happy to enroll for any reason.

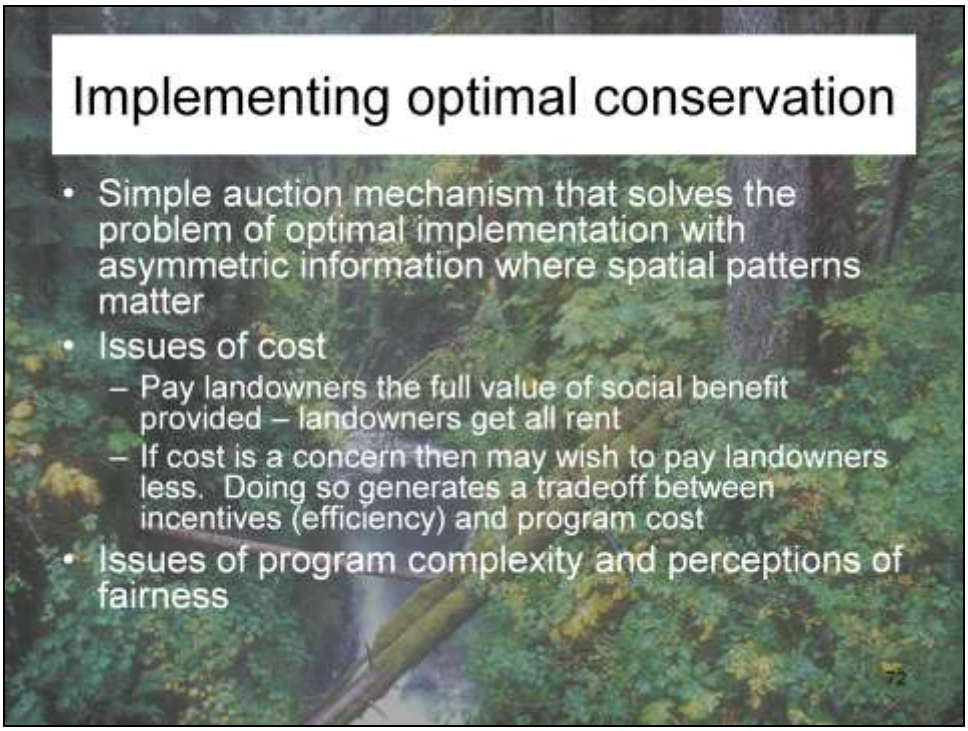


- This helps people to answer honestly regarding cost info.
- Then you can use that to decide which landowners should be enrolled.

➢ How do you solve the spatial problem optimally?

- This helps people to answer honestly regarding cost info.
- Then you can use that to decide which land-owners should be enrolled.


Implementing optimal conservation
• The auction gives each landowner the incentives to truthfully reveal information about cost
– Dominant strategy to set the bid equal to the willingness-to-accept
• With information about cost, use models of value of ecosystem service to provision to choose which landowners to enroll
– Optimal spatial provision of ecosystem services



- Simple auction mechanism solves the problem.
- This is not an insurmountable problem, it can be tackled.


Valuing nature: Summary, current status, and what needs to be done
73

- Good news: We know a lot already. Through thoughtful valuation, we can do a fair amount

- Bad news: We do not pay attention, i.e., we know a lot and we do not do anything about it.

Two sets of challenges:

- Knowledge: modeling, etc…
- We need to try things; we should put things out there and see what happens. Also, we should see what works and what impacts those actions might have.

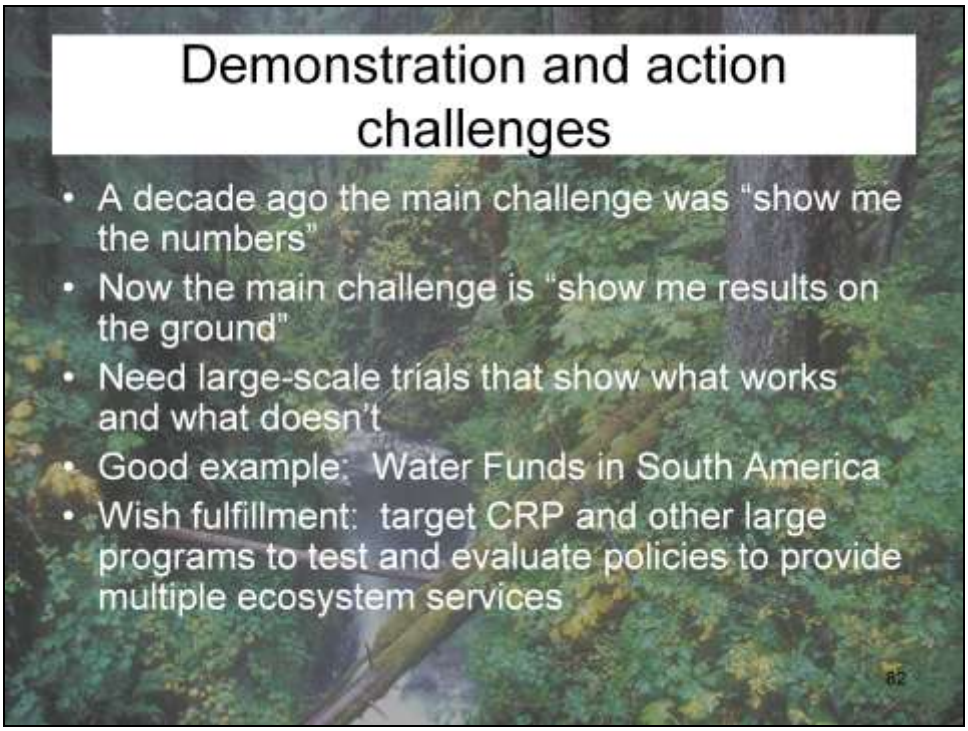

Technical and modeling challenges (1): quantification
• Social-ecological systems: dynamic and interconnected
• Do we understand systems well enough to predict short-term and long-term consequences of management actions on services?
• Particular challenges
– Incorporating variability and uncertainty
– Thresholds and regime shifts

- Carbon and tilling – different studies about what sequestered more carbon. Once they figured out that it does not affect carbon, it was hard to take away mechanism that already begun paying farmers not to till.

- It is hard for economists to assign a value to this.

- Interesting work at a macro scale, *see slide*.
  - ➢ What is a good set of sustainability metrics?

- There are important questions about distribution and equity.
  - ➢ How do we weigh these tradeoffs?



- Fundamentally it is a question of demonstration.
- A decade ago it was about the numbers, now we need large scale trials to show what works and what does not.
- CRP – conservation reserve program.


Moving ahead
• We do not know enough BUT…
• We know enough to improve on current performance
• Pressing need to begin to mainstream ecosystem services into societal decisions
• The long road rather than the quick fix:
– Better science to improve understanding
– Better institutions/policy that reflect values
– Adaptive process that learns through time
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Thank you

Seminar 2 Discussion Synthesis

May 5, 2011

This document is a synthesis of important topics and questions discussed during the question and answer period immediately following Dr. Stephen Polasky's presentation. Please keep in the mind that the following is only a recap and speaker identities have been removed, except for Dr. Polasky. We hope that the following notes and discussion questions will be used as resource to advance further discussions about ecosystem services.

Below you will find a summary of specific key questions and topics that were covered during the Seminar discussion.

Question 1

Going back to the auction example to get landowners involved in conservation programs – How could you bridge the gap between what landowners want for ecosystem services and how much existing programs pay for stewardship?

DR. POLASKY

- Trials are often theoretical, but there are some examples e.g. Australia. This is a hard question to answer because there may be critical landowners that aren't currently enrolled so how much more would you need to pay them? If you want truthful revelation, then the auction method is a good way to know range rather than just if it is worth $X.

Question 2

Do InVEST models include social elements or just ecological elements?

DR. POLASKY

- For the most part, they are economic and environmental only. They are really based on what the market return would be. One way to get at this is to use observed decisions of what people actually do. I'd love to bring social components into it and I think we're at a point where this in now needed.
- National Center for Ecological Analysis and Synthesis (NCEAS) is working on cultural services now, but do not know the outcome has been. There are other examples of those that have added in social services that are outside of InVEST, but parallel and on equal footing.

Question 3

I am surprised by the notion that we do not have to do much more research. Would you say the same thing about the marine environment?

DR. POLASKY

- NO – the statement about implementation vs. science is relative. We do not know everything about science, but on a general level, we know things that are going to be better or worse for the environment, for ecosystem services. What I mean to say is that it is not a big jump to say nutrient management will improve downstream quality. Maybe not the exact amount, but the rough amount we know. So let's take what we know and start putting it into action – that is why I say implementation is the more urgent need right now.

Question 4

Oregon and Minnesota both have huge recreation industries, is it worthwhile to add this into the models?

DR. POLASKY

- Yes, it is very important. In some ways, we should be further along because there is well developed recreation literature for non-market values. The problem for InVEST, is that they are all tier 3 models or beyond. They require careful analysis of who is visiting sites, where they come from, etc. which is data we do not have yet. So we can do a simpler model to get a base value and then incorporate the new data once it is available.

Question 5

What has the reception been of this type of framework, the ecosystem framework, by decision-makers? Is it different depending on scale e.g. local, regional, marine or terrestrial?

DR. POLASKY

- My sense right now (I am biased); I am overrun by people who are interested right now. The interest is in finding more about it, there is a lot left in translation to doing it on the ground. People are into finding out what it means and what it means for their program from all scales, i.e. county commissioners to international level.
- I tend to be well-versed on domestic. The Natural Capitol Project is international; they have demonstration projects on certainly every continent: projects in Ecuador, Tanzania, South Africa, Brazil, USA, and South Africa. South Africans have great capacity for ecosystem services. One program, I think it is called Work for Water, is a great example.
- In Costa Rica, I gave a seminar for economists. They are the ones who pioneered this program for ecosystem services and are way further ahead than we are.
- Australia has a lot of programs. Lots of activity everywhere. China Indonesia.

PARTICIPANT

- My experience is with California Assembly Bill 32 Climate Program. We see benefits to the atmosphere through emission capture. In that context, officials have had enough confidence in regulatory design that they accepted it at the State scale while the federal level is less confident. I think we will see a watershed event with the launch of the cap and trade program.

Question 5, part B

In terms of receptivity for decision-makers, what are the key ingredients of success? What has been challenging to this? What helps policy makers accept this ecosystem services approach?

DR. POLASKY

- A lot of this starts with the recognition that this is important. It has to come from the people in the system, whichever system that might be. I work with EPA and now they want to transition from the risk paradigm to a sustainability paradigm. Their science advisory board put together a document about this. This is an example of an internal change largely bubbling up from regional offices. They want to move beyond human health to ecosystem services and ecosystem health. There was recognition internally that this was important and now it is moving in that direction.
- The national program right now is facing some serious headwind with carbon skepticism. The downside is that I think it has gotten harder because of the politics surrounding climate change. This isn't true in a lot of other countries; Europe is full speed ahead.

PARTICIPANT

- I want to tell the story of not exactly a failure but not exactly a success either. We have been working with the government of Rio de Janeiro about having water users in a small area and subsidizing water uses in headwater. Did a lot of work on it, and gave them a few simple options and it has not happened yet. Not because it isn't a good idea but because of government inertia. Having the technical advisors available for 5-10 years for government makers is difficult. We need to look for enough champions to get issues through. There are so many other priorities in government that we are not only victims of opposition but also just of being too low of a priority.

PARTICIPANT

- Coming from the non-public sector approach, it seems like in several cases where there is something mandated and then people have to respond. For example, in Mongolia, the World Bank mandated that they write a payment for ecosystem services (PES) law. This may not be scientifically driven, but it sets up movement to do this.
- There are other social drivers at play. Val Chemical gave $10 million to TNC to develop ecosystem services for their own practices – this probably was not scientifically informed but based off of their own interests.

DR. POLASKY

- The classic model used to be that the private sector has to be dragged kicking and screaming and the public sector has to regulate; increasingly this is not what I see. Some of it is bottom line, i.e. with prices going up we will do X. But some of it isn't scientific or bottom line, it is more "this is the right way to do business." Corporations like the Dow Chemical Company (Dow) or even countries like China where if they decide they want to do something, it happens quickly. May be good, may be bad but it is QUICK, not like democracy.

PARTICIPANT

- Socio-Bosque in Ecuador, another example where the President mandated to set up Reducing Emission for Deforestation and Forest Degradation (REDD) for international community. It is in place and doubling in size, may not be good or bad but it is an example of democratic country where a strong leader got something done.

Question 6

That describes a common issue. I would be interested in exploring the tradeoffs that need to be considered, particularly in the Klamath. Do you think the watershed, basin management and the different organizations working in the Klamath are good vehicles for policy?

DR. POLASKY

- Well I work mostly in the Willamette, but I can speak to the Klamath a bit. It is interesting because they have had the water fights and it is very polarized.
- When I worked at the Council of Economic Advisors, I noticed that there are two explanation for why certain topics getting lost in the shuffle, either:
    - The issues is cold, not as important or
    - The issue is important, but not white hot.
- The Klamath is too polarized to do anything. It got so emotional that you couldn't have a conversation about tradeoffs. It is really important to have conversations then, but it is the hardest time to do that. In the Willamette, it wasn't so polarized. You have a bigger population base and livelihoods are fundamentally tied to one thing like the farmers. When talking about water in the Klamath, you were talking about a direct threat to their livelihood. In Willamette people were interested and knew it was important.

Question 7

Is there a way to include services from built capital vs. natural capital and consider the tradeoffs to get an overall portfolio of use that maximizes value? Who captures the wealth?

DR. POLASKY

- Speaking to the first part, on built capitol vs. natural capital: In principle, this is an economic framework so it does not matter what you call it (human, social, natural….); it all fits into the same framework.
- With climate change, there may be changes to sea level, storm risk etc…so you think about flood mitigation and storm protection – can do it through natural capital (protect wetland) or you can approach it with built capital (levees). One can think about each separately or one can think of the system as a whole. My preferred option is to think about the whole system, not just one part of it. Think about outcomes and whole set of ecosystem services involved.
- Another component is to think in terms of capital assets; not just flow of services now but the future? Are we getting to s sustainable area where future generations can exist? (Larry Goulder and Ken Arrow (Stanford) working on notion of inclusive wealth).

Question 8

Is this an exhaustive set? Is there a way to do comparisons so that we can looks at portfolio and make those decisions based on what would be best for now and for the future? Are there examples?

DR. POLASKY

- Though I hate to use it, the New York City example is one.
- I would rather think about bottom line and human well-being and whether that's better served by human or natural capital. There is no reason we cannot do this now. The focus is on ecosystem services now because there is a view that these things were left out before, so in a way it is a response to that, but what we want to think about is the social and ecological systems and how both contribute to human well-being and non-human well-being (intrinsic value).

Question 9

What are the underlying assumptions in valuation? For example: underlying science is accurate.

DR. POLASKY

- It is based off of individuals and the choices that they would make. Economists talk about utility functions - preference functions, where the choice is between A and B. If you have a complete ranking based on alternative of an individual then you can ask them about tradeoffs, i.e. are you willing to trade additional money for less water quality? Etc..
- But there are a lot of critics of the way economists do valuation. It is based upon its individual that they know what they want and they can rank alternatives. There are lots of critics….I shy away from it. I do not want to do the valuation for species. Some economists do these kinds of surveys. There are many critics of the particulars and survey methods. Many practical questions remain to be answered.
- I was talking about public good and value to society - How do you go from the individual to society as a whole? On what basis do you do that aggregation?
    - Pareto principle - You can judge socially if it is unanimous…Could winners compensate looser to make it equal?
    - Cost/Benefit analysis…you just aggregate it and sum it and look at the net. But the individuals with greater income get more votes, so is that the right way to do social policy?

Question 10

How much is decision theory and behavior theory playing into ecological economics?

DR. POLASKY

- Behavioral economics has been on the rise for a decade or more. It is not about idealized values, but about how people actually make decisions. Frankly, it has been slow getting into ecological economics. It is problematic; especially when you ask people things they do not have much experience with or do not know anything about. Has not come to grips with new learning coming out of physiologic and behavioral econ.

Question 11

How are models like InVEST and land use scenarios communicated to decision-makers?

DR. POLASKY

- One way is the "black box" approach, or you can get into gory detail of models, which is when you lose people. Opposite is to present with basic idea. If you capture people with the straight forward idea, they get it. Willamette experiment is a clear and easy way people understand. Once they are interested, then people get into the details of how you did it. If you can present compelling questions at the beginning then people are willing to dive into the detail secondarily and get into with you. Be explicit about the motivation and kinds of analysis one could get and the results one could use.

Question 12

There are many economic benefit models for parks and open space, how do they differ from an InVEST model? What are they showing decision-makers as a product?

DR. POLASKY

- Most of the studies that value open space are from what an economist would call a hedonic or property approach, i.e. if a property is near a park, how much does that increase value? Roughly 2/3 – 3/4 of studies are of that mold which is not about ecosystem services as much as it is about looking at how property owners and their property value changes. Not why it changes, just how it changes.

Question 13

What are some opportunities and low hanging fruit that you see to implement an ecosystem services approach?

PARTICIPANT

- There seems to be opportunity to move into making a close link between land and biodiversity with clean water provision for water districts. If we could get that across to decision-makers it would come across as better spending, etc…

PARTICIPANT

- We are seeing evolution with REDD and avoided deforestations. Programs are now addressing social and environmental benefits and safeguards.

PARTICIPANT

- Changing commodity price and structure – areas where opportunity costs are low but changing as a function of changing commodity price and structure. Places like Ecuador and Costa Rica and subsidies are examples of successes.
- Those programs might not need to be based on valuation, in the traditional sense. Valuation is expense and has inherent problems. You do not need it; there are models of auctions that work and may help to get this going. The commodity moves going on are piling up public money.

PARTICIPANT

- There is a big opportunity for supply chains. Many unexpected companies are seeing this and looking for ways to use it; for a lot of people, it is vague. Companies are doing life cycle analyses of products, i.e. Nissan did examined their supply chain with WRI and were astonished to realized that their product relied heavily on water. Dow and Coca Cola are doing the same. They are all starting to be very active which opens a huge arena and is just starting to be recognized.

DR. POLASKY

- A real opportunity to develop some quick rapid response tools as opposed to in depth surveys, i.e. develop the ability to denote the change in carbon and water quickly. As academics, we always want to get it right, but let us get it right now so county commissioners and companies can use it. It is a promising place, particularly when tied to the land and to water quality.
- We focus on value in dollars, but can we use certain flash points? Can we just tell people the impacts on water quality? What about the probability of floods? Do not have to weigh in on value but give them the other powerful options which are relevant for decision-makers too.