

# ENVIRONMENTAL RISK ECONOMICS

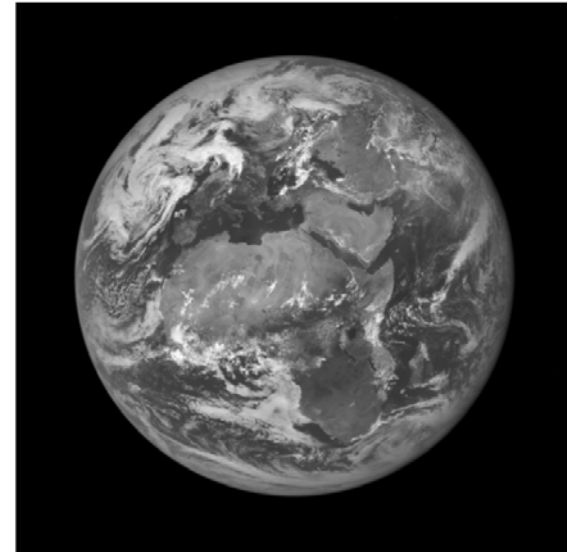
OCT. 2

INTRODUCTION

INSTRUCTOR  
NOBUYUKI ITO

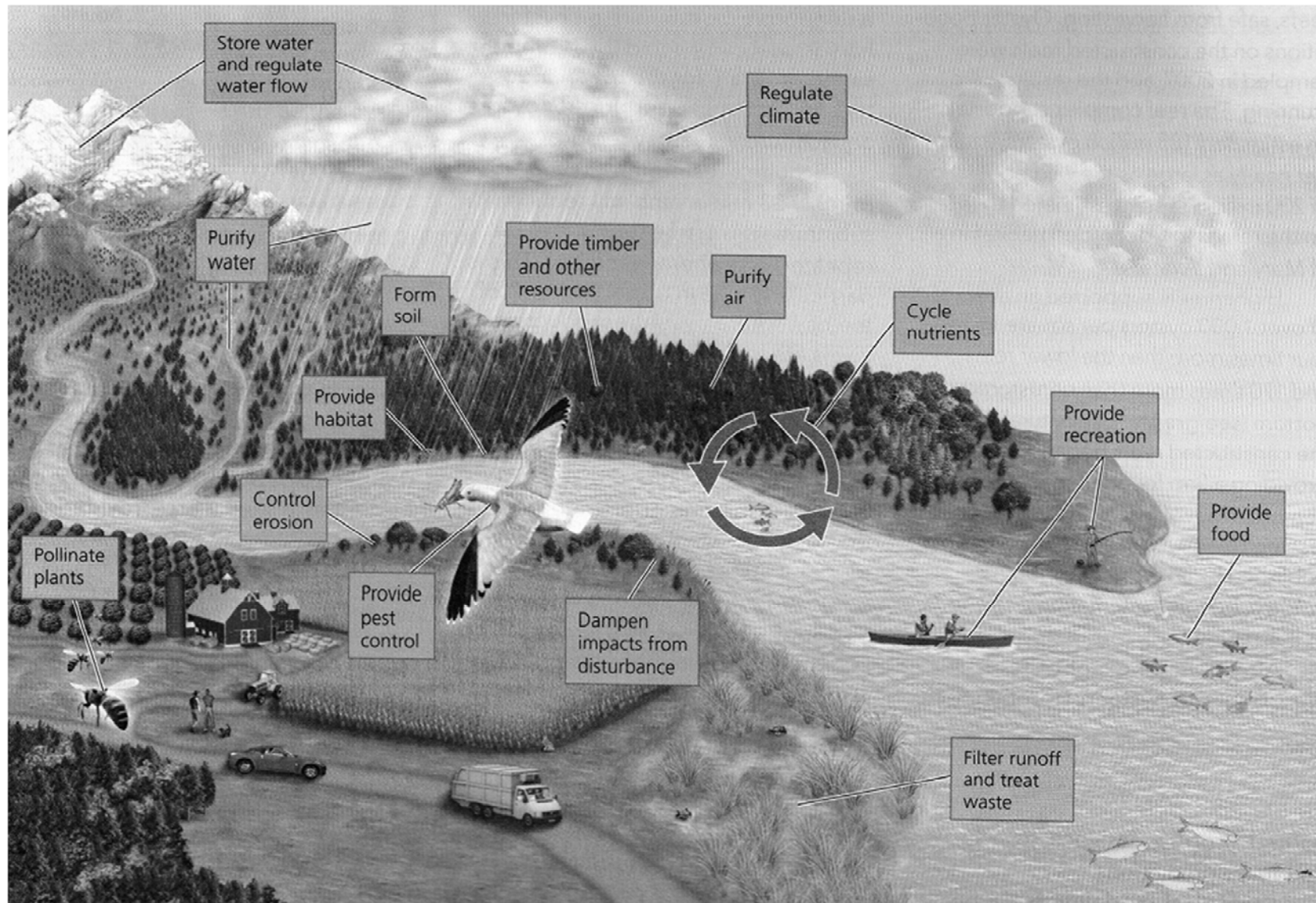
# What Is Environmental Science

- Earth
  - the continents, oceans, clouds, and ice caps
    - the animals, plants, forests, and farms compose the environment surrounding us
- Environmental science
  - people are part of the natural world
  - understanding our relationship with the natural world (“ecosystem services”)
    - how the natural world works
    - how our environment affects us
    - how we affect the environment



Source: <https://www.nasa.gov/>

# Ecological System (Ecosystem) Services



Source: Withgott and Laposata (2014)

# Natural Resources

- Two types of natural resources
  - nonrenewable natural resources
    - minerals (e.g. aluminum, tin, and copper)
    - fossil fuels (e.g. coal, oil, and natural gas)
      - it takes millions of years to form
    - limited supplies, depleted by use (natural process do not replenish nonrenewable resource within a reasonable period on the human time scale)
  - renewable natural resources
    - direct solar energy, energy of winds, tides flowing water
    - trees, fishes, fertile agricultural soil, and fresh water
    - can be used forever as long as they are not overexploited in the short term
      - ecosystem services renew the resources

# What Is Economics?

- The word *economy* comes from the Greek word *oikonomos*, which means “one who manages a household”
  - a household faces many decisions:
    - Who cooks dinner?
    - Who does the laundry?
    - Who gets the extra dessert at dinner?
    - Who gets to choose what TV show to watch?
  - the household must allocate its scarce resources (income and time) among its various members, taking into account each member’s abilities, efforts, and desires

# Scarcity of Resources

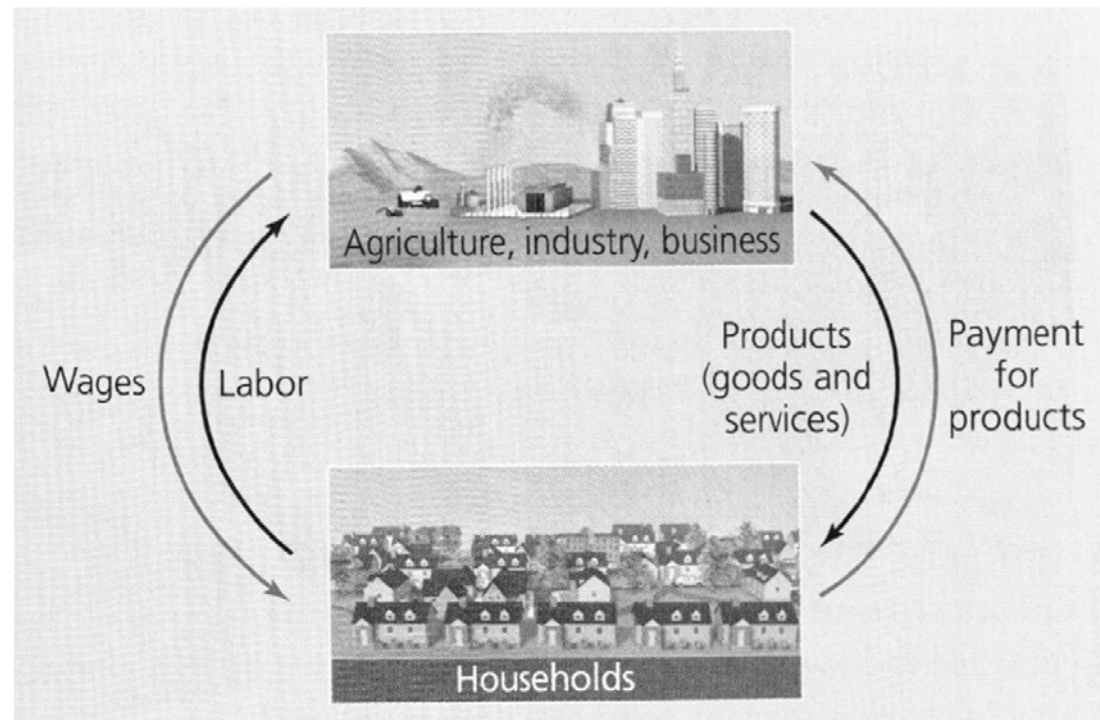
- Like a household, a society faces many decisions
  - a society must find some way to decide what jobs will be done (what goods or services will be produced) and who will do them
  - one society has allocated people as well as resources (e.g. land, materials, energy)
  - it must also allocate the output of goods and services they produce
  - it must decide who will eat rice, who will drive a car, and who will take the bus
- The management of society is important because our resources are limited

# Focuses of Economics

- Economics is the study of
  - how society manages its scarce resources
    - in most societies, resources are allocated not by an all-powerful dictator (planned economy) but through the combined actions of millions of households and firms, a government, and municipalities (free-market)
  - how people make decisions: how much they work, what they buy, how much they save, and how they invest their savings
  - how people interact with others
    - how the price of a good is determined
  - how and to what extent government should intervene in the market to improve social welfare

# Conventional economics

- lack of awareness of ecosystem services
  - allocation problem of scarce resources among people
  - impacts of economic activities on the environment are ignored for simplification

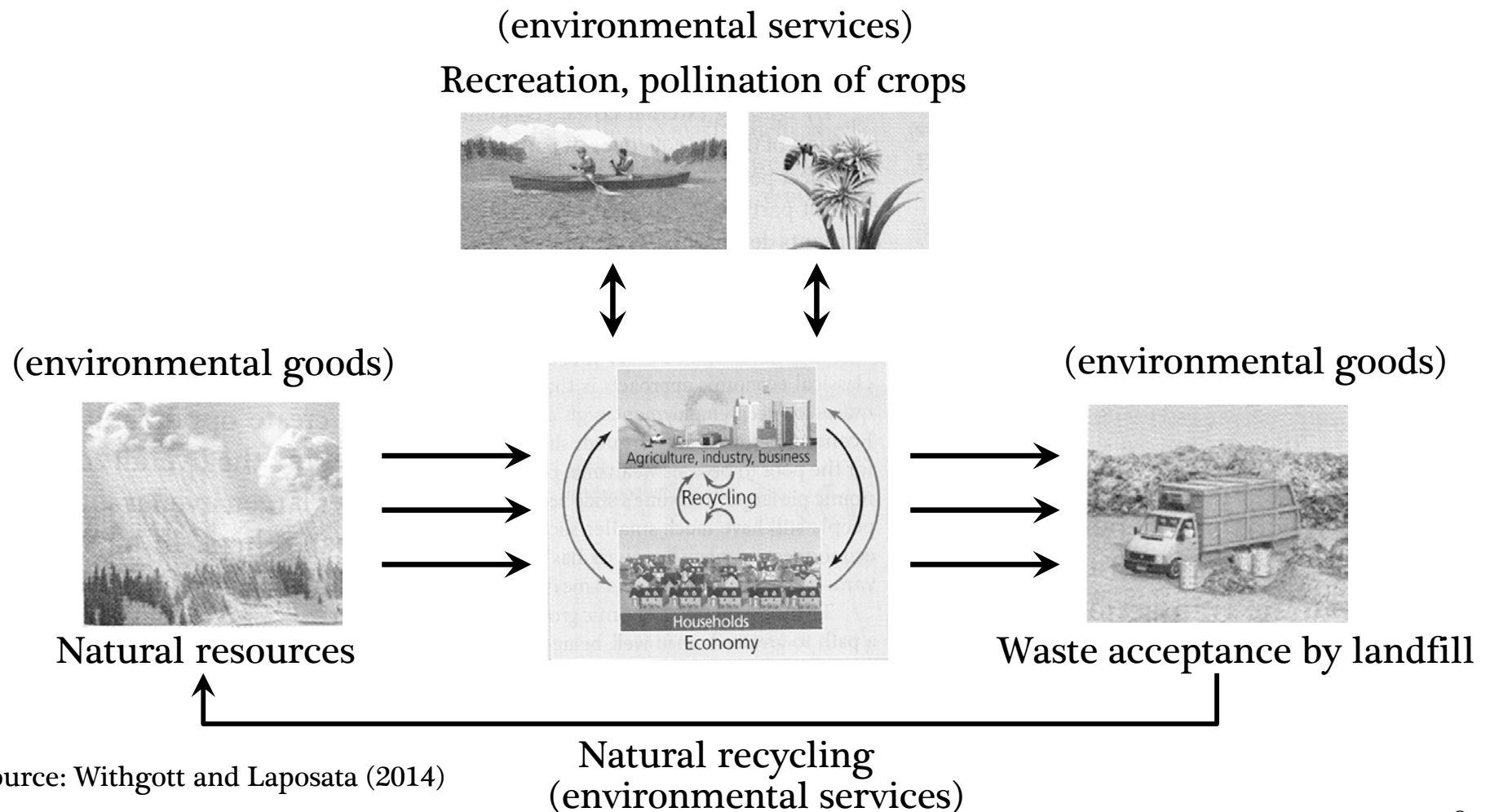


Source: Withgott and Laposata (2014)



# Environmental Economics

- an extended model based on understanding our relationship with the natural world



# What Are Environmental Risks?

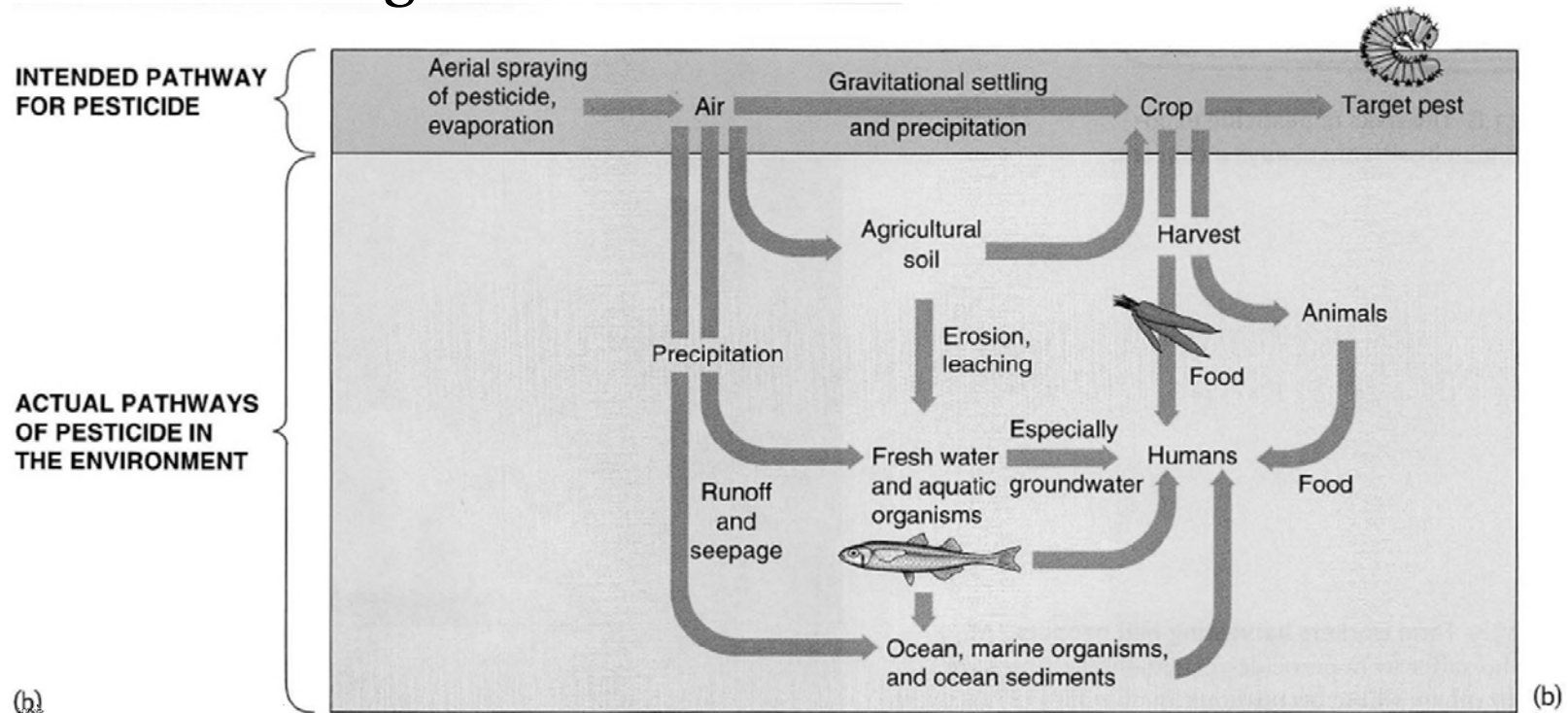
- “Environmental risks” are:
  - uncertain consequences of environmental changes with known or unknown distribution of probabilities that these consequences happen
    - air/water/soil pollution
      - SO<sub>x</sub>, NO<sub>x</sub>, pesticide (農薬), phosphorus (リン), nitrogen (窒素), heavy metal (重金属), and organic solvents (有機溶剤)
    - climate change
      - emissions of green house gasses (e.g. CO<sub>2</sub> and CH<sub>4</sub>)
    - loss of biodiversity
      - housing/agricultural/industrial land developments
    - natural disasters
      - earthquakes, volcanic eruptions, landslides, tsunamis, floods, droughts, heavy rains, typhoons, and heavy snowfalls
    - infectious disease
      - malaria and cholera

# Uncertain Consequences: Pesticide Spraying

- factors and results
  - economic activity: agriculture
  - consequences in the environment: pesticide residue in the soil, water, air, food, etc. and influences on ecosystem
  - damages: adverse reaction (薬害反応) and the environmental degradation
- randomness of
  - how farmers distribute pesticides in their agricultural lands,
  - the pathway of the contaminated water,
  - weather, and
  - rate of cancer from ingesting specific amounts of pesticides through drinking water (ex. age and other characteristics of the consumer)

# Unintended Pathways

- the actual pathway of pesticides in the environment is quite different from the intended pathway
  - if the pesticide level in the aquatic ecosystem is high enough, fishes may die
  - humans also can exposure to pesticides by drinking contaminated water and eating contaminated foods



# Environmental Risks of Pesticide Usage

- pesticides do not stay where they are applied but tend to travel into the soil, water, and air, sometimes long distances
- uncertainties of
  - the impacts of the economic activity on the consequences in the environment, and
  - the impacts of the consequences on humans

# Lectures in the Course (1)

## 1. Fundamental Economic Theory:

- consumers behaviors and demand for goods
- firms behaviors and supply of goods
- market mechanism and sources of price changes
  - the impact of a price change in another market
  - what are “short- and long-run” economists say
  - government intervention in the market

## 2. Social Choice and Welfare:

- collective choice on a government policy or a public work
- what is “efficiency” economists say
- social decision-making on public policies
  - heterogenous individual preferences and an social preference
  - “Pareto criterion” and social welfare functions

# How Should We Make a Social Decision?

- Malaysia's largest state, Sarawak
  - a dam construction plan
  - aims to promote growth of aluminum smelters, steelmakers, and other energy-intensive heavy industries with the cheap hydroelectric power
- One of Sarawak's plans for economic development by 2030:
  - growth in economy by 5 times
  - increase in the population by 4.6 million



Rendering of Baram dam.  
Source: Website of Sarawak Energy



Source: Website of International Rivers

# Conflicts between People

- Construction of dam will
  - submerge 412 square kilometers of rain forest in water, displacing 20,000 indigenous people
- Endangered species:
  - Bornean bay cat, Borneo gibbon, Hose's civet, Rajah Brooke Birdwing (one of the world's largest butterflies)
- Indigenous people:
  - difficulty finding employment for indigenous people
  - the tribes of *Penan*, *Kenyah*, and *Kayan* have strongly opposed to the plan.
- Conflict of interest between people in the urban area and indigenous people



Photo: Bornean Bay Cat.

Source: Jim Sanderson, Mongbay.com



Photo: Borneo Gibbon

Source: Website of ARKive



# Lectures in the Course (2)

## 3. Cost-Benefit Analysis:

- applying the value judgment of “efficiency”
- the benefits and costs generated over a long time
  - time discounting
- uncertainty
  - expected value analysis

## 4. Environmental Valuation:

- how to measure the demand for the environment
  - no price and the market for exchanging the environment
- four pathways of impacts of the environmental change
- use value and nonuse value

# Does the Environment Have No Value?

- Alaska's Prince William Sound, US, in March 1989
  - Exxon (the present Exxon Mobil Corp.) *Valdez* dashed against rocks and spilled 11 million gallons of oil into the shoreline
  - the massive death of wildlife, including salmon, 2,800 sea otters, 250,000 birds, and over 250 seals
  - a majority of the species affected by the spill have not yet been fully recovered even in 2011
  - environmental valuation became widely recognized after the accident

Source: William Yardley, (March 3, 2011. *The New York Times*; Kling et al. (2012, *J. Econ. Persp.*)



Photo taken in 1989 by Erik Hill, *Anchorage Daily News* (2010)



Photo taken in Jul. 1989 by Jim Lavrakas, *Anchorage Daily News* (2008)

# Can We Measure the Environmental Value?

- Environmental valuation
  - environmental valuation in 1992 by economists who were asked to study by the state of Alaska and the Federal Government
    - environmental damage of \$2.8 billion
- Exxon Corporation
  - more than \$1 billion spent on correcting the environmental damage
  - more than \$2 billion spent on trying to limit the extent of damage



Photo by Bob Hallinen, Anchorage Daily News  
Archive 1989

Source: Stiglitz, J., (2000) *Economics of the Public Sector*, p.220-221); Carson et al. (1992)

# Lectures in the Course (3)

## 5. Market Failure:

- public goods and externality
  - the market fails in efficient resource allocation

## 6. Property Rights:

- property rights to emit pollution vs to enjoy a clean environment
- government's granting property rights and "Coarse theorem"
- regulation
  - conventional way to reduce pollution

## 7. Economic Incentive Mechanisms:

- taxes or emission fees (e.g. carbon taxes)
- subsidies
- tradable permits (e.g. EU Emission Trading System, water quality trading)

# The Goal of This Course

- The goal of this course is:
  - to acquire the view point of economists
    - how society manages its scarce resources
    - how people make decisions
    - how people interact with others
    - how and to what extent government should intervene in the market to improve social welfare
  - so that you can consider issues related to environmental risks like an economist

# Schedule of Lectures

Period	Date	Topic
Lesson 1	October 2	Introduction of the Course
Lesson 2	October 9	Fundamental Economic Theory
Lesson 3	October 16	
Lesson 4	October 23	Social Choice and Welfare
Lesson 5	October 30	
Lesson 6	November 6	Cost-Benefit Analysis
Lesson 7	November 13	
Lesson 8	December 4	Environmental Valuation
Lesson 9	December 11	
Lesson 10	December 18	Market Failure
Lesson 11	December 25	
Lesson 12	January 8	Property Rights and Regulation
	January 15	<i>No Class for the National Center Test</i>
Lesson 13	January 22	Economic Incentive Mechanisms

Note: The lecture schedule may slightly change due to the progress of lectures.

# Grading

- we will give an assignment in the last lecture of each topic except the last topic.
- 6 assignments and final report will be given
- each assignment and final report will be evaluated on 10 and 40 point scale, respectively (this may be changed due to the progress of lectures)

	Score
Assignments	60
Final Report	40

- you can download all handouts and assignments from a page of “Courses” in my website (<http://www.ecn-ito.com/> or google “nobuyuki ito”)
  - password to open files is: