Historical cases of vulnerability

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Outline

- Why undertake historical studies?
- Case studies
  - The Oak Ridge Moraine's dusty years
  - The Californian Pollination Crisis
  - Haiti compared to the Dominican Republic
- Ecosystem services and vulnerability
- Three causes of unsustainable management
- The role of environmental sciences
- Conclusions

Why do historical case studies?

- Vulnerability is the **likelihood of harm** – its study should be both **historical** and **prospective**
- Vulnerability assessments can only be **evaluated** in hindsight
- Historical analysis can inform us about what **types of information** and **action** could have **decreased vulnerability** in a particular place

Schröter, Polsky, Patt (2005), Miti. Ada. Stra. Glo. Cha.

Oak Ridges Moraine

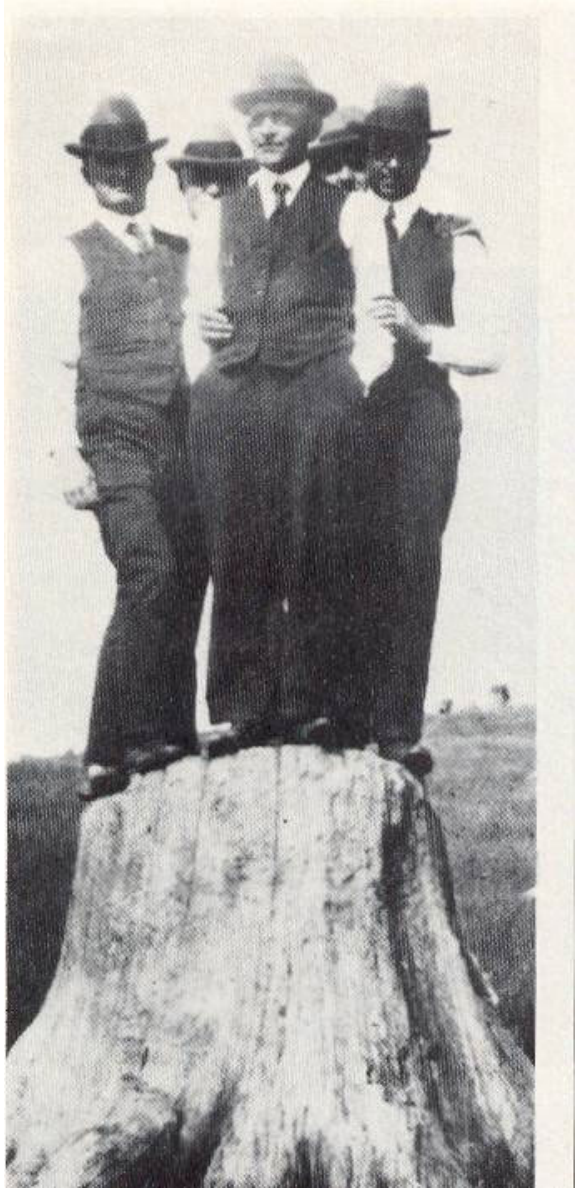
- southern Ontario, just North of the city of Toronto
- In the late 19th century, government of Ontario offered incentives to clear land and establish farms

Agricultural expansion and practice

- arrival of the **railway** (1890s) facilitated **settlement**
- high **wheat prices** during **World War I**
- **settlers** came mainly **from humid lands** in eastern North America and Europe
- sought to **preserve soil moisture** in summer **by leaving fields fallow** – an idea widely promoted by agronomists

McNeill 2001 : An Environmental History of the Twentieth-Century World

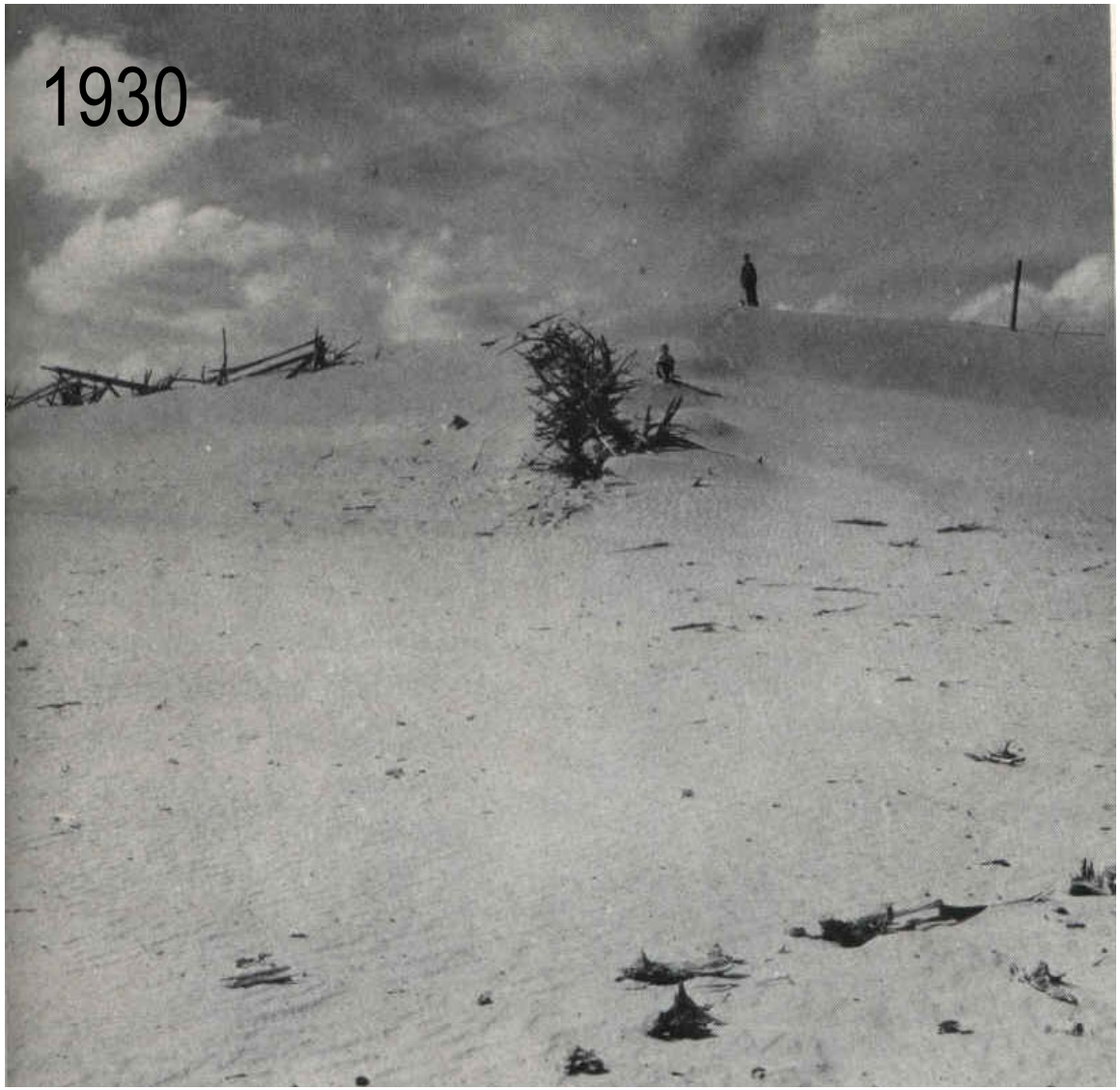
Forests were cleared for agriculture



The region is made up of glacial till, a mixture of clay, silt, sand, and stone: highly erosion-prone soil.

Pictures lent by Evan Fraser, Leeds University.

Farming community was vulnerable



- Once the vegetation was removed the area only supported agriculture for a few decades.
- When drought struck (due to natural variation in the hydrological cycle) the human-environment system failed.

Picture lent by Evan Fraser, Leeds University.

1930s: Fertility gone with the wind

- Massive erosion during the drought of the 1930s
- Snow ploughs were used to clear eroded sand from highways and roads.

Picture lent by Evan Fraser, Leeds University.

The crisis

- The ecosystem service **soil fertility maintenance** was compromised for the exploitation of the ecosystem service **food production**.
- The latter is the **obvious target** when farming, while the former, supporting service is **just as vital**.

If we had done a vulnerability assessment…

- Vulnerability could have been lessened by an awareness and understanding of the **vital interplay between** these **ecosystem services**
  - **Soil conserving** farming methods, **suitable for the region** (e.g. no fallow land in summer)
  - **Awareness of hydrological regime** of the area (wet and dry cycles)

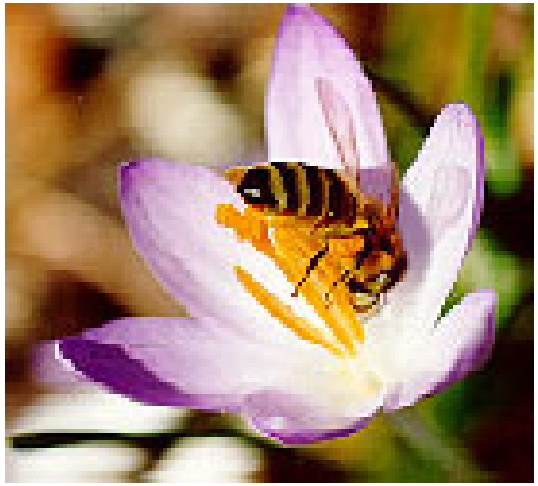
2000s: Reforested

- **Government reforestation programme**: planting red pine which is adapted for dry, sandy conditions.
- Today, mature plantations are breaking up, and an understorey of oak and white pine is established.
- **Adaptation** by change of land cover and land use. **Other ecosystem services are now provided.**

Picture lent by Evan Fraser, Leeds University.

What bugs and birds do when no one is looking – Pollination

Pollination



- Wild and farmed animals provide **pollination services** to over **3/4 of the staple* crop** plants.
- However, both wild and cultivated **populations of pollinators** are **declining.**
- Decline is attributed to **habitat loss, pesticide poisoning, diseases and pests.**

* Main source of nutrition consumed by people in a particular region.

Economic importance of pollination

- European honeybee alone adds **$ 14 billion a year** to US crops (US Department of Agriculture)
- California produces **80%** of the **world's almond supply** ($ 1.2 billion industry)

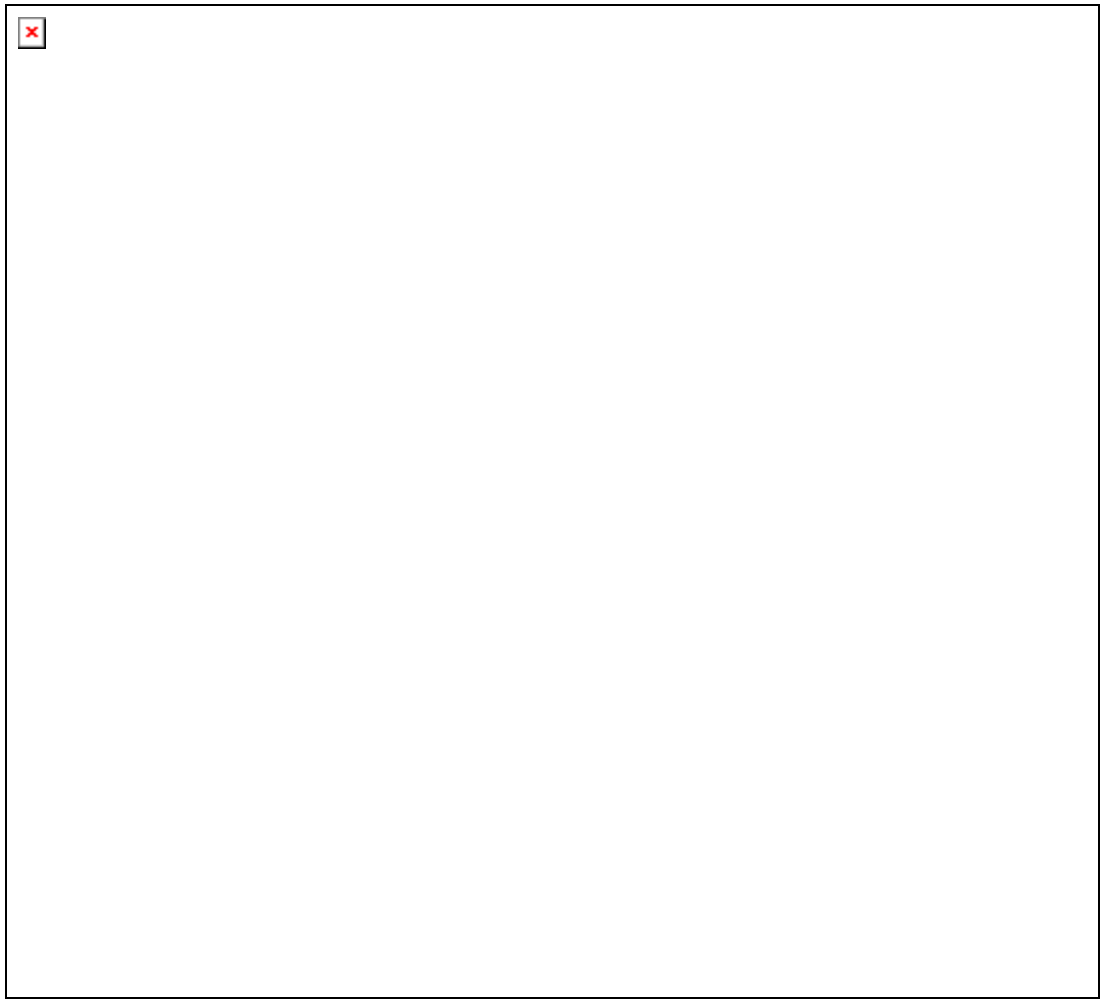
- Californian almond industry **relies on honeybee cultures**
- More than **1 million honeybee hives** are needed for the orchards in California's Central Valley alone

But: Cultivated honeybee declines

- Commercially cultivated honeybees of the US **decreased by 50%** from 1947 to 2000
- Due to: diseases (bacterial foulbrood, fungal chalkbrood, nosema, parasitic mites), Africanized bees*
- In 1994, for the first time Californian almond farmers had to **import bees** from other states

*African bees escaped from a geneticist's laboratory in Brazil and interbred with local European honeybees, producing so-called *Africanized bees*. Since 1956, Africanized bees migrated steadily North and arrived in Texas in 1990. If Africanized bees interbreed with managed bees their offspring is too aggressive to handle.

Rental price of beehives



California Farm Bureau Association, 2005.

The pollination crisis

- The ecosystem service **pollination** was compromised for the short-term maximization of **food production**.
- Hedgerows and wild habitat were eradicated to farm more land  **habitat for pollinators lost**.
- **Pesticides** used to extent that their **intended effect is counteracted**: *No pollination, no fruit, poor pollination, poor fruit.*

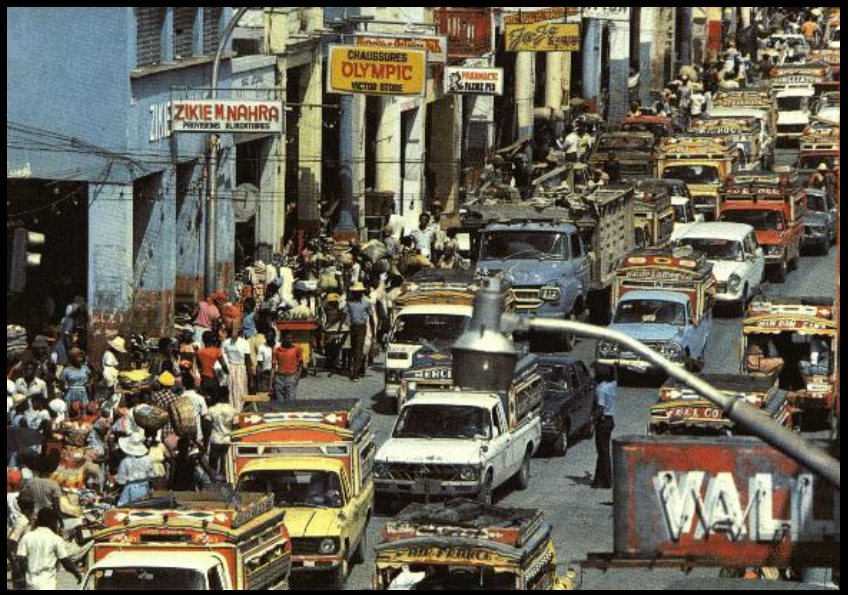
One visit is not enough…

E.g. a cucumber flower needs to be visited **15-20 times** to be sufficiently pollinated.

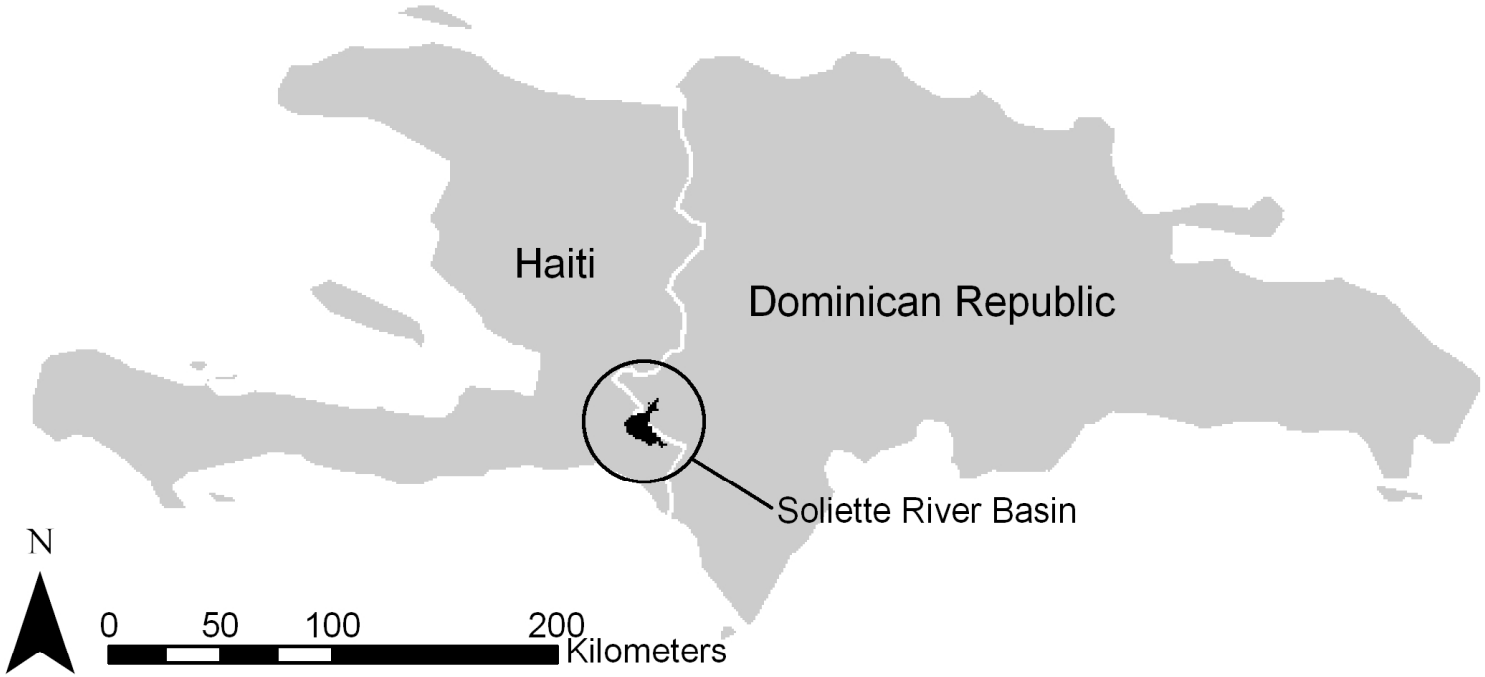
If we had done a vulnerability assessment…

- **Awareness** of the **sensitivity of pollinators**, wild and cultivated, could have prevented the “pollinator crisis”.
- Some **organic farmers** use no pesticides, but maintain **hedgerows and wild habitat** so successfully that they do not have to rent cultivated pollinators (Daily and Ellison 2002).
- However, knowledge is sparse: **How much land is needed to maintain a sufficient wild pollinator community?** (working on that: applied ecologist Claire Kremen, Uni. California)
- **Growing awareness** that pollination is an essential ecosystem service **facilitates research** that can increase the **adaptive capacity of farmers**.

Hispaniola: Haiti and the Dom. Republic

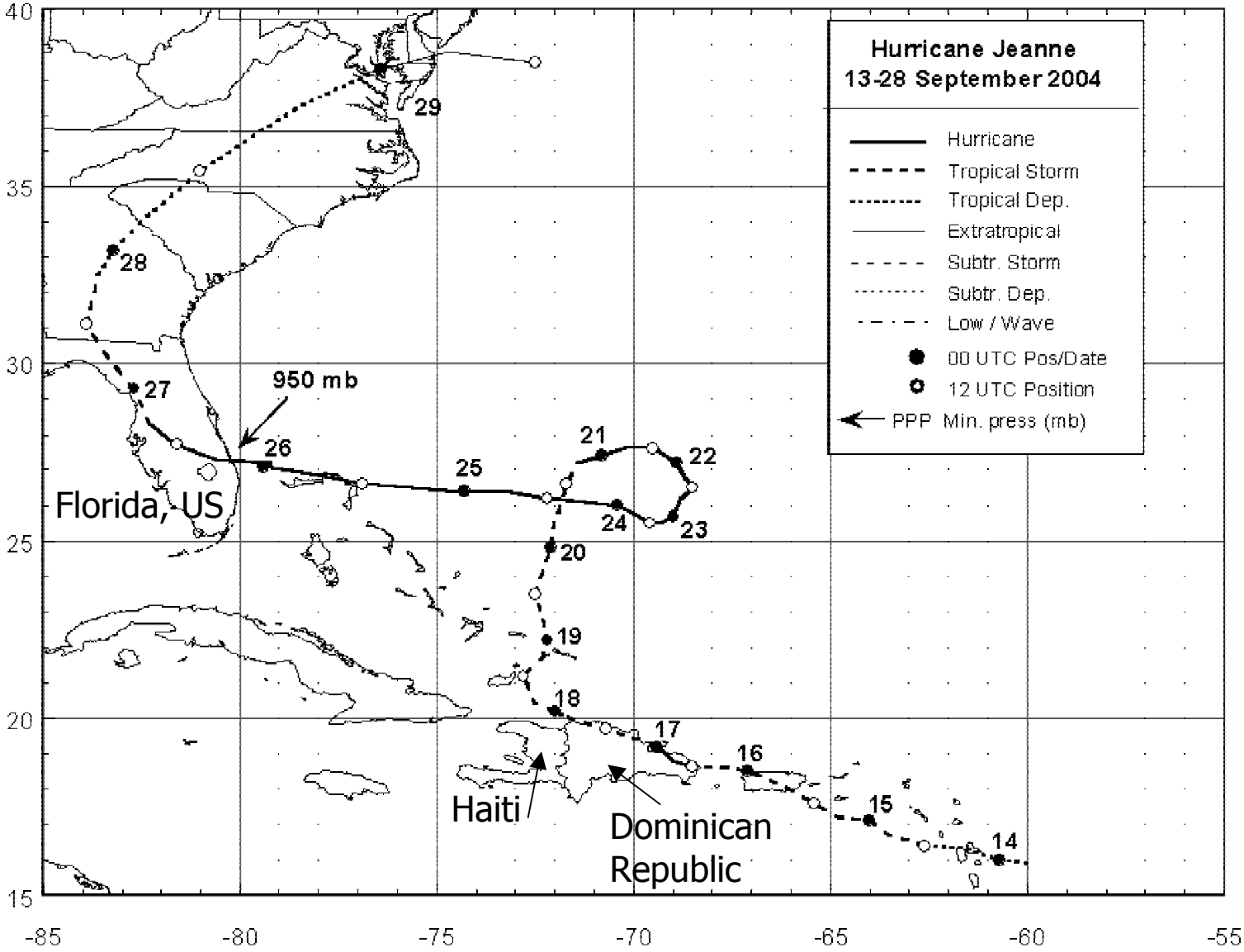


Hispaniola



Map provided by Anna Versluis, 2005.

Hurricane Jeanne's Path



National Hurricane Center, NOAA.

Hurricane Jeanne, 2004

- **Similar exposure**, **different vulnerability**
- Jeanne brought **torrential rainfall** to Hispaniola
- In **Haiti** this resulted in **flooding and mudslides**

	Haiti	Dominican Republic	Florida
Direct casualties	2 745	11	6
Injured	2 620	9	0
Lost homes	14 048	0	0
Resulting homeless	200 000	0	0
Total affected	315 594	14 009	40 000
Damage (US$)	21 Million	206 Million	7 Billion

EM-DAT, Emergency Disasters Data Base, Université Catholique de Louvain; and National Hurricane Center, NOAA

Why was Haiti so vulnerable?

	Haiti	Dominican Republic
Economy	Poorest country outside Africa	Poor, but booming economy
Agriculture	Subsistence	Exports
Tourism	Few enclaves	Large industry
Population (Millions)	~10	~5
Land area	~1/3	~2/3
Population growth rate	High (3%)	Low (1.6%)
Forest area (%)	1	28
National Parks	4	74

Diamond, *Collapse*, 2005.

Historical comparison

	Haiti	Dominican Republic
Colonization	French	Spanish
Imported slaves in 1785	700 000	30 000
Non-slave population (%)	10	85
Status end of 18th century	Richest colony in New World	Spanish cede colony to French
Revolution	1804: Independence; infrastructure destroyed	1809: settlers reassume status as colony of Spain
mid 19th - start of 20th century: political instability, US military occupation		
Violent dictators (until ca. 1970)	Francois Duvalier: Exploitation.	Rafael Trujillo: Innovation and exploitation.
Important presidents	Aristide: Never really able to govern.	Balaguer: Violent. Strong environmentalist

Haiti‘s crisis – an environmental dimension

- **Deforestation** started with coffee plantation in 1730.
  - In 1780, ca. 75% of total land area was forest.
    In 1940, 30%, in 1970, 10%, in 1990, less than 2%.
  - **Exported timber** to pay off debt that was claimed by France (1825).
  - Population relies entirely on **charcoal as cooking fuel**.
  - Peasants granted access only to **marginal lands** (above the fertile, below the coffee, at 200-600 m). **Steep slopes**. Only **20 %** of land is **considered** arable, while **50 %** is under agricultural production (FAO 2001).
- Soil erosion, river silting, desertification, loss of hydropower option 🎭 **water shortages, floods, mudslides.**
- The **exploitation of some ecosystem services** to the expense of others contributes to Haiti’s **vulnerability**:
  - crop production vs. soil fertility maintenance
  - timber/charcoal production vs. slope stability, water retention and fresh water production

Farming marginal lands

Deforestation seen from space

From space: clear divide between Haiti and the Dominican Republic. Both have similar water resources. (Photo: NASA.)

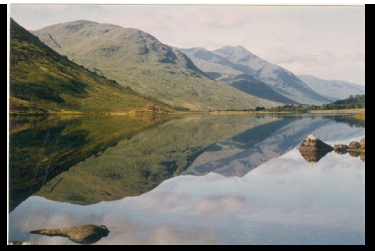
Solutions…?

- Most people have **little hope for Haiti**. HIV/AIDS, civil unrest, poverty…
- Part of the solution could be a **reforestation** of parts of Haiti starting from the National Parks. Efforts are ongoing. **Energy system** needs to be **reformed** (away from charcoal as main fuel). Farming of marginal lands needs alternatives. Tourism could be developed.
- Also, many **people worry** about the **Dominican Republic**, some expect a steep decline of its environment and economy.
- Dom. Rep. has a **"home-grown" environmental movement**. Part of the country's fate might depend on sustaining that movement.
- **Both countries** would best **work together**. But…. history.

food production

slope stability

fire prevention



water storage

fibre production

biodiversity

Human vulnerability has an environmental dimension.

Ecosystem services form a **vital link** between **humans** and their **environment.**

E.g. Mississippi dynamics, sedimentation, coastal vulnerability, New Orleans disaster, Hurricane Katrina

pollination

fodder production

carbon sequestration

flood protection

tourist attraction

recreation

stabilising micro-climate

game reserve

shelter for life stock

beauty

Three causes of unsustainable management of ecosystem services

1. An ecosystem service is **not recognized**.
2. An ecosystem service is compromised to **maximize profits at the cost of the public**, because regulation and taxation set no limits.
3. An ecosystem service is used unsustainably, because of an **immediate vital need** and no alternatives.

The role of environmental sciences

- **Identify and raise awareness** of the importance and complexity of ecosystems and the services they provide (MA)
- **Specify and quantify** the supply of ecosystem services under different management options (ATEAM* was a pioneer)
- If ecosystem services are compromised to maximize profits at the cost of the public, env. scientists can **sound the alarm and shed light on the causality**
- If ecosystem services are compromised to fulfil an immediate vital need, env. scientists can **offer alternative and more sustainable technologies based on an understanding of the ecosystem**

* www.pik-potsdam.de/ATEAM

Conclusions

- **Human well-being** depends on the sustained supply of **ecosystem services –** unsustainable use of ecosystem services increases **vulnerability**.
- **Environmental scientists alone cannot** provide the information and the tools that are needed to **lessen** the **vulnerability** of a region.
- However, they can make **essential contributions**:
  Identify, raise awareness, specify, quantify, understand causality and trade-offs, offer alternatives.
  Observations, experiments, models, stakeholder dialogue, contributions to interdisciplinary teams.


Thank you !