Forest economics

Overview of the field &

why it can be interesting

About Me

About you: learning objectives

Why is SE Asia being deforested?

Do carbon offsets really work?

Do we make 'good' conservation decisions?

Currently:
- Evolution of forest products sectors
- Productivity of managed forests
- Globalization & the 'anatomy' of modern forest markets
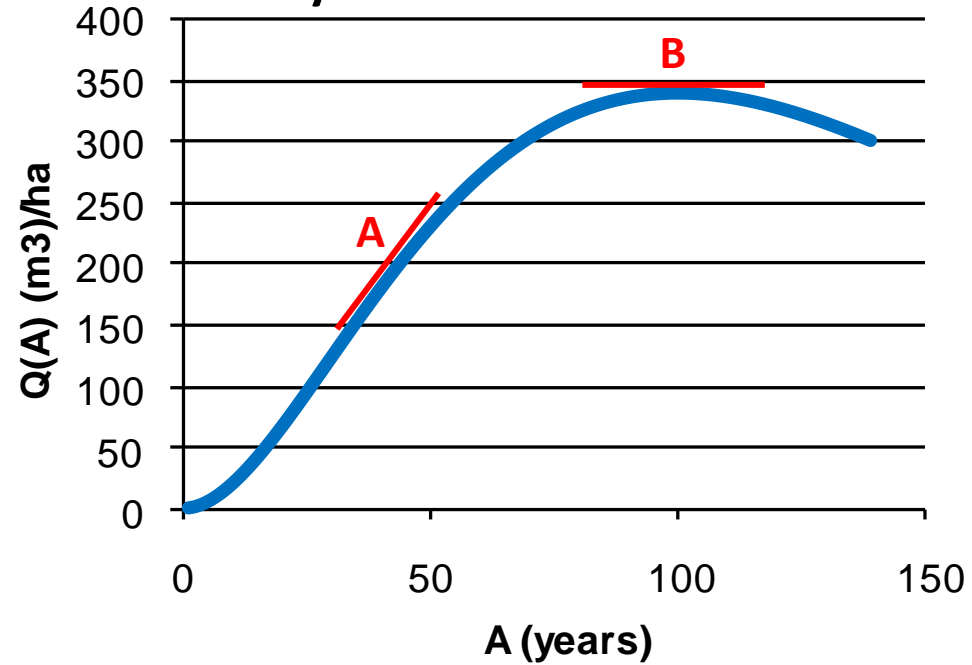- Behavioral economics of SAR

Classical Forest Economics

Physical world   Forestry   Human experience

Growth and yield curve for *Picea mariana*
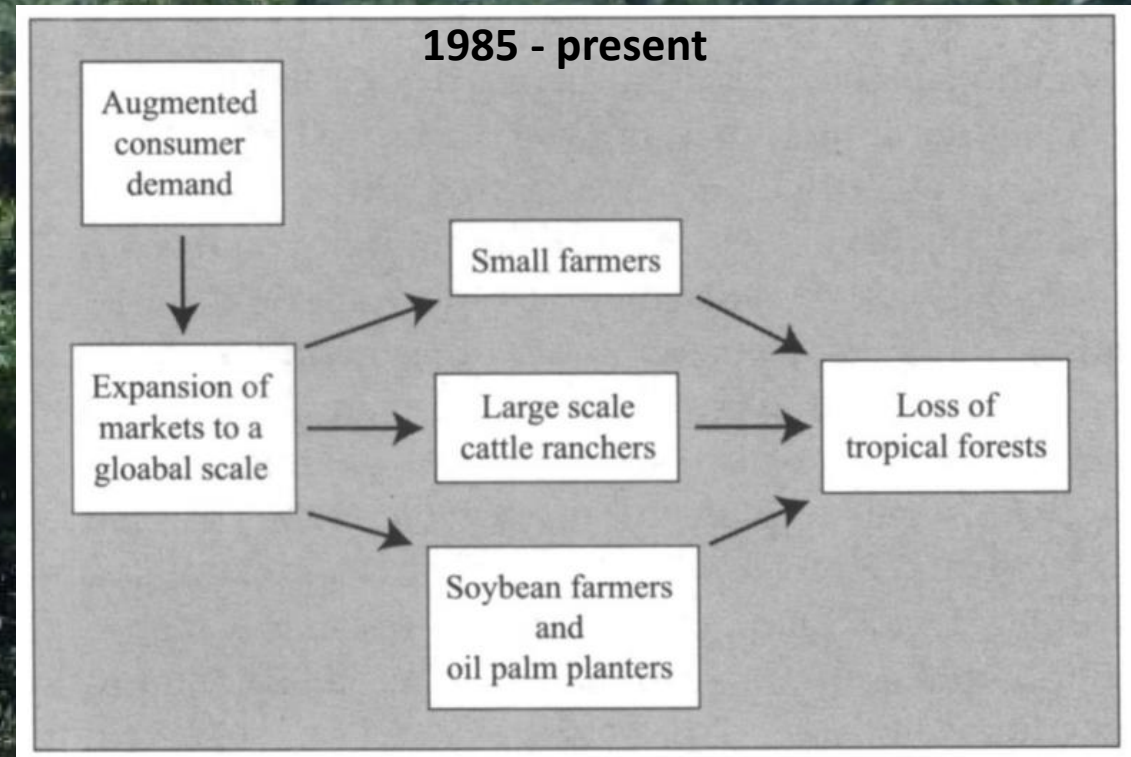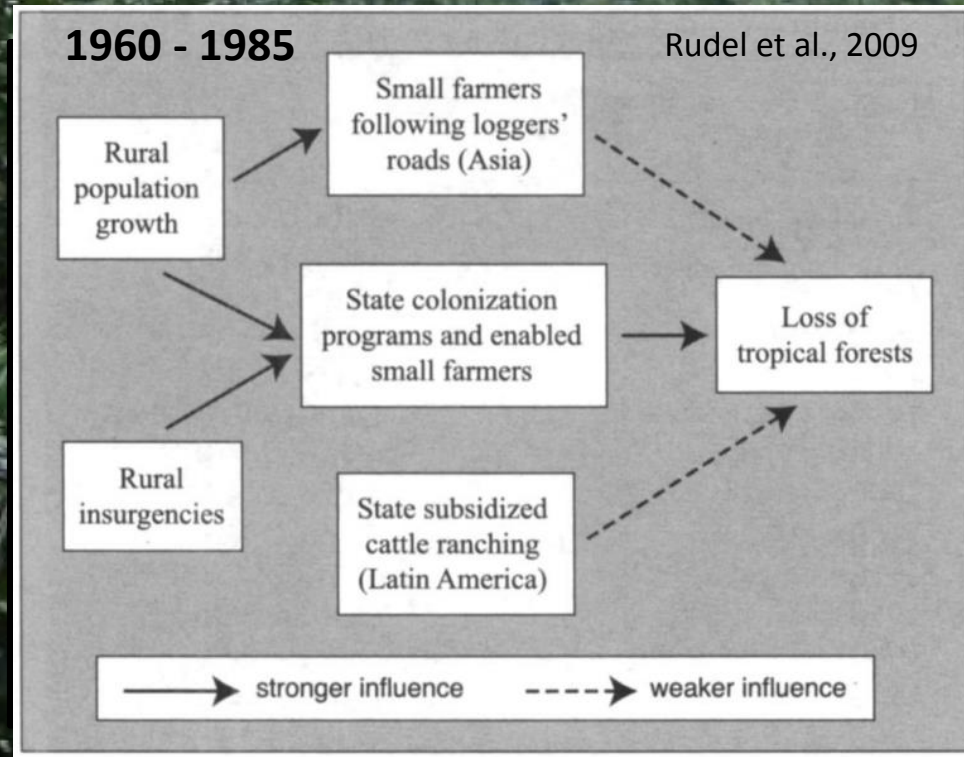
Results of optimization

'Contemporary' forest economics

Journal of forest economics, Nov. 2019, Dec. 2019

- The net carbon emissions from historic land use and land use change
- Governance within a system of entangled political economy
- The effect of institution arrangements on economic performance among first nations: evidence from forestry in BC
- How does a biodiversity value impact optimal rotation length? An investigation using species richness and forest stand age
- Empirical analysis of the economic effect of tree species diversity based on the results of a forest accountancy data network
- The impact of green house gas mitigation policy for land use and the forestry sector in Indonesia: Applying the computable general equilibrium model

(tropical) Drivers of Deforestation

1960 - 1985 — Rudel et al., 2009

- Rural population growth → Small farmers following loggers' roads (Asia)
- Small farmers following loggers' roads (Asia) ⇢ Loss of tropical forests (weaker influence)
- Rural population growth → State colonization programs and enabled small farmers
- Rural insurgencies → State colonization programs and enabled small farmers
- State colonization programs and enabled small farmers → Loss of tropical forests
- State subsidized cattle ranching (Latin America) ⇢ Loss of tropical forests (weaker influence)

→ stronger influence   ⇢ weaker influence

1985 - present

- Augmented consumer demand → Expansion of markets to a gloabal scale
- Expansion of markets to a gloabal scale → Small farmers → Loss of tropical forests
- Expansion of markets to a gloabal scale → Large scale cattle ranchers → Loss of tropical forests
- Expansion of markets to a gloabal scale → Soybean farmers and oil palm planters → Loss of tropical forests

Conversion to oil palm - *Elaeis guineensis*
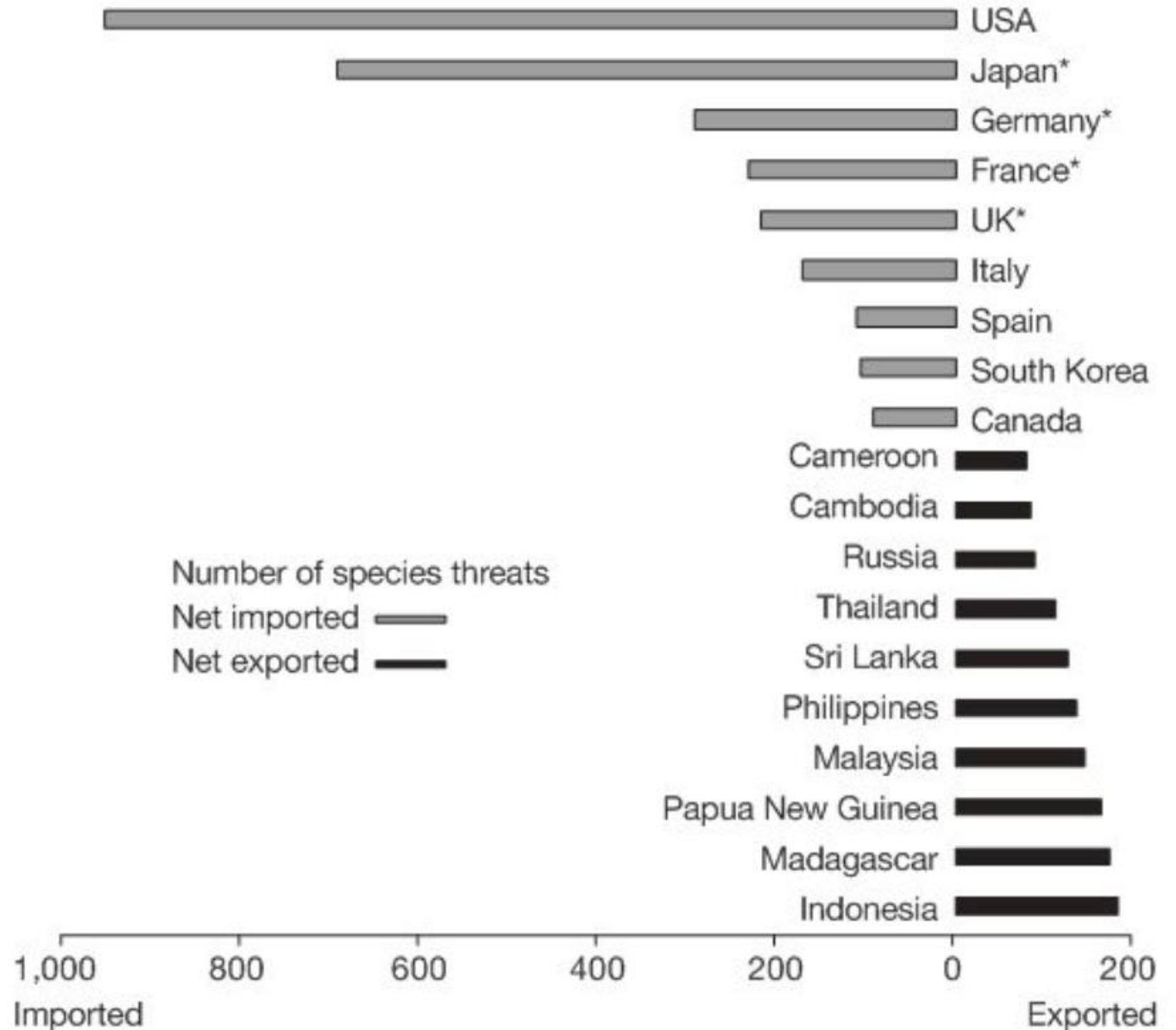
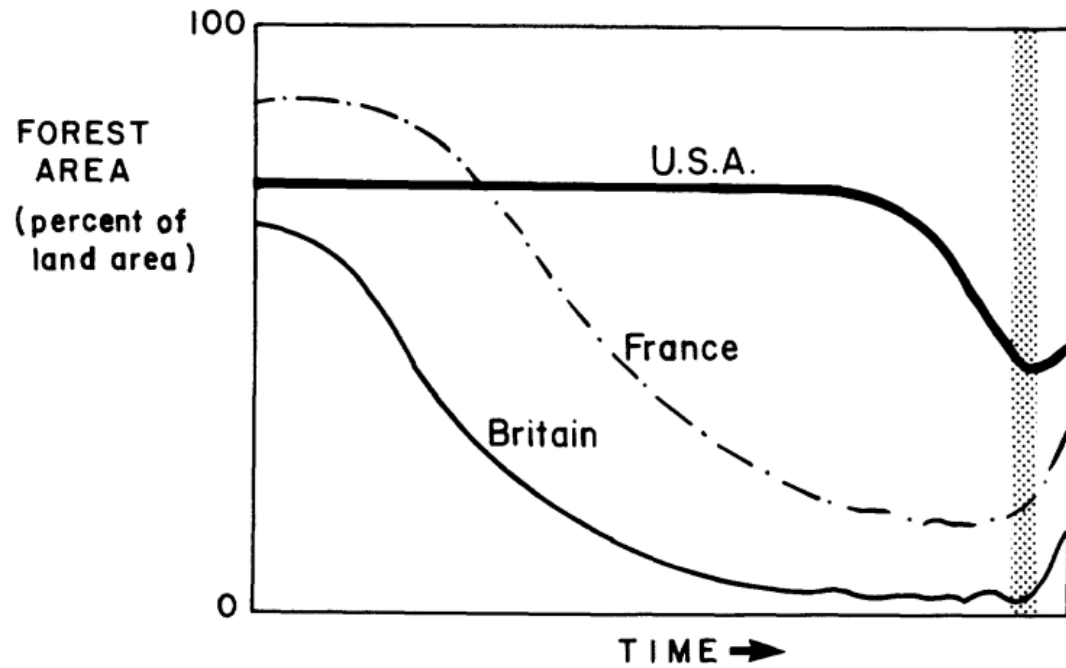# Tracing Globalization

- Leontief 1949: applied math theorem to economies

$$\lim_{i \to \infty} \sum_{i=0}^{\infty} \mathbf{X}^i = (\mathbf{I} - \mathbf{X})^{-1}$$

- Lenzen et al., 2012: better databases!
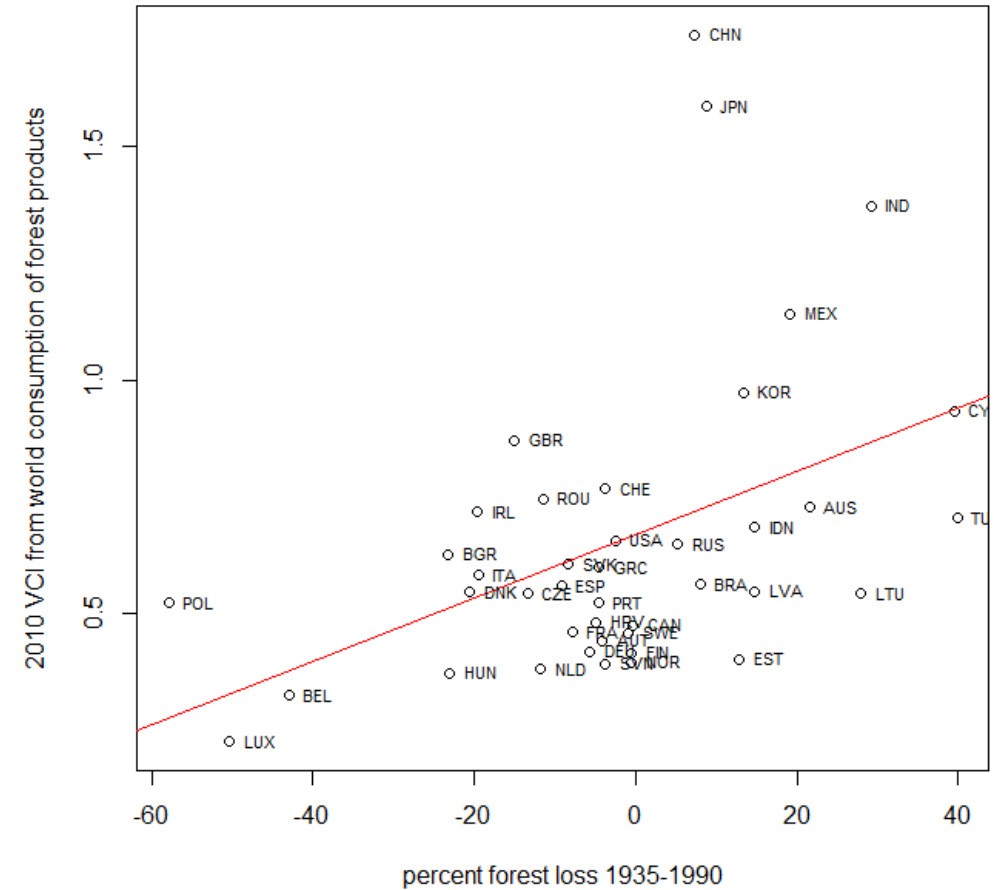
- www.worldmrio.com/biodivmap

Forests in the course of development

Mather, 1992: "The Forest Transition" *Area* 24(4)

Own calcs based on MRIO/EORA & Pongratz et al. 2008

Forests in Canadian history

- Imperial economy

- State expansion/consolidation

- Driver of modern growth

- ?Multi-use landscapes?

Ships loading timber, Quebec City, 1860-70
Forest History Society

Tenure & the bundle of rights

- 'relations between people' govern who has what rights

- The bundle of rights

- Should society lease or sell?

Carbon storage
Water use
Plant harvesting
Fuelwood gathering
Timber rights   gazing rights

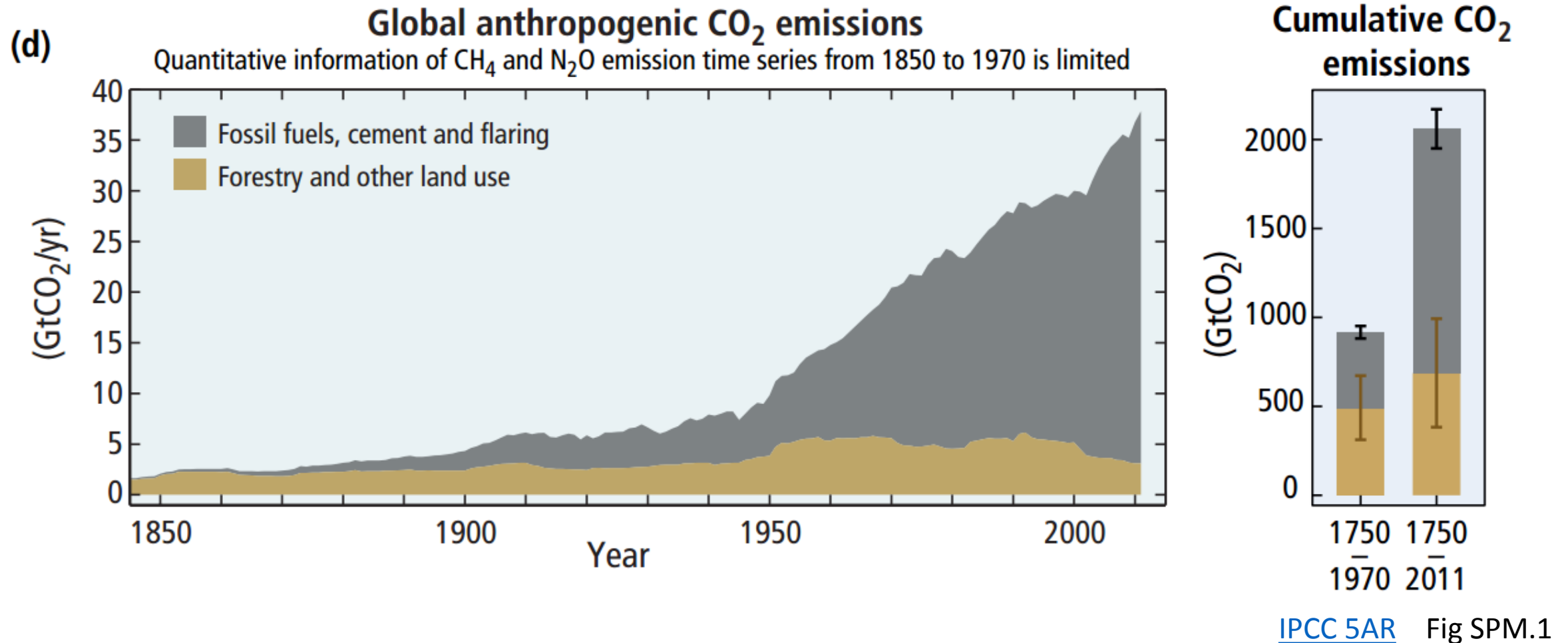| Variable	Coefficient	T-ratio
Form of tenure		
PFL	0.5134	3.101*
TFL	0.2135	3.848*
TL	0.1288	1.658**

Dependent variable: silvicultural investment
* Significant at 99% level, ** significant at 90% level
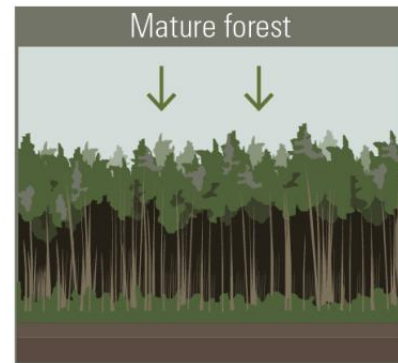
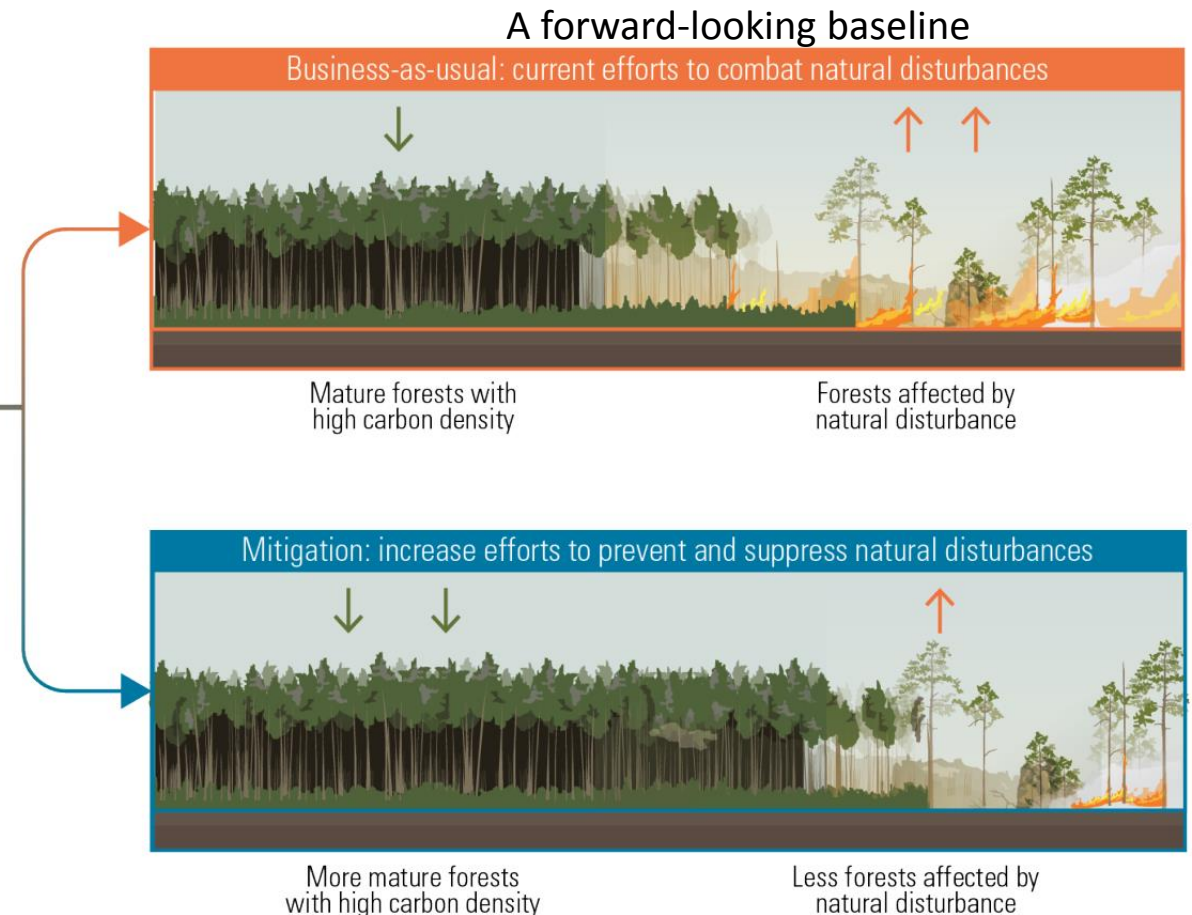(Zhang and Pearce, 1996)

Carbon storage: a new stick in the bundle

(d) Global anthropogenic CO$_2$ emissions
Quantitative information of CH$_4$ and N$_2$O emission time series from 1850 to 1970 is limited

Cumulative CO$_2$ emissions

Managing forest carbon

- INDCs are statements of ambition, framed in terms of emissions reductions
- Reductions vs. what?

- Offsets: reductions are sold to another liable party

(St-Laurent and Hoberg, 2016)

A forward-looking baseline

Business-as-usual: current efforts to combat natural disturbances

Mature forest

Mature forests with high carbon density

Forests affected by natural disturbance

Mitigation: increase efforts to prevent and suppress natural disturbances

More mature forests with high carbon density

Less forests affected by natural disturbance

Problems with offsets

Liberal | Justin Trudeau | 2019 Candidates | Liberal MPs | Your Riding

LIBERALS MOVE FORWARD TO PLANT TWO BILLION TREES

September 27, 2019

"Nature isn't just part of our identity as Canadians. It's part of the solution to climate change. And it's a solution we can start using today," said the Leader of the Liberal Party, Justin Trudeau. "Trees are a fundamental part of a cleaner future. They're renewable. They're sustainable. And, eventually, they recycle themselves. All we have to do is plant the first one."

Problems:

- Additionality vs. permanence (ecological system)
- Additionality vs. leakage (economic system)

Managing it all: modern SFM

Montreal Process C&I

Criterion 1: Conservation of biological diversity
Criterion 2: Maintenance of productive capacity of forest ecosystems
Criterion 3: Maintenance of forest ecosystem health and vitality
Criterion 4: Conservation and maintenance of soil and water resources
Criterion 5: Maintenance of forest contribution to global carbon cycles
Criterion 6: Maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of societies
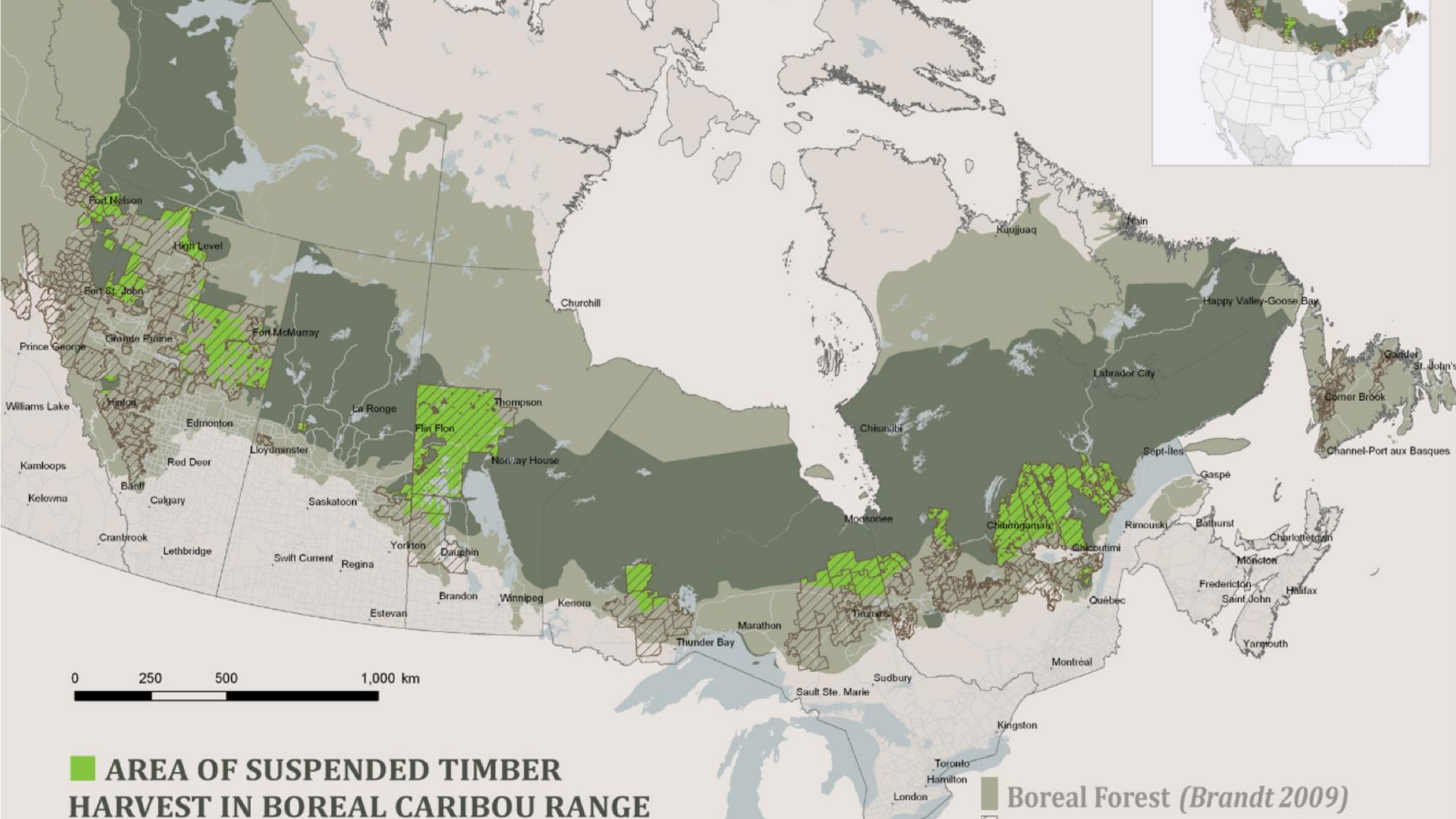*Criterion 7*: Legal, institutional and economic framework for forest conservation and sustainable management

Caribou conservation: *Rangifer tarandus*

- Generalist herbivore
  - Lichens, forbs, sedges, grasses, shrubs
  - Unusual winter diet: lichens
  - "…forests 150 – 250 years after fires."
- Migrant
  - Large ranges
  - Range fidelity (calving grounds)
- Sensitive to 'disturbance'
  - Wolf predation pressure
- Human values
  - Livelihoods (+ culture)
  - Existence value
  - ('umbrella' species)

Alexandre Buisse © CC BY-SA 3.0

AREA OF SUSPENDED TIMBER HARVEST IN BOREAL CARIBOU RANGE

Boreal Forest *(Brandt 2009)*

What could behavioral economics tell us?

Do 'latent goals' (aka reference points) differ among stakeholders?

Do these goals determine observed choices under risk?

Do stakeholders prioritize and make tradeoffs in different ways?

Do people think about money-valued and 'intrinsically-valued' things in the same way?

Kahneman and Tversky (1979): Prospect Theory

- Defined in deviations from a reference point

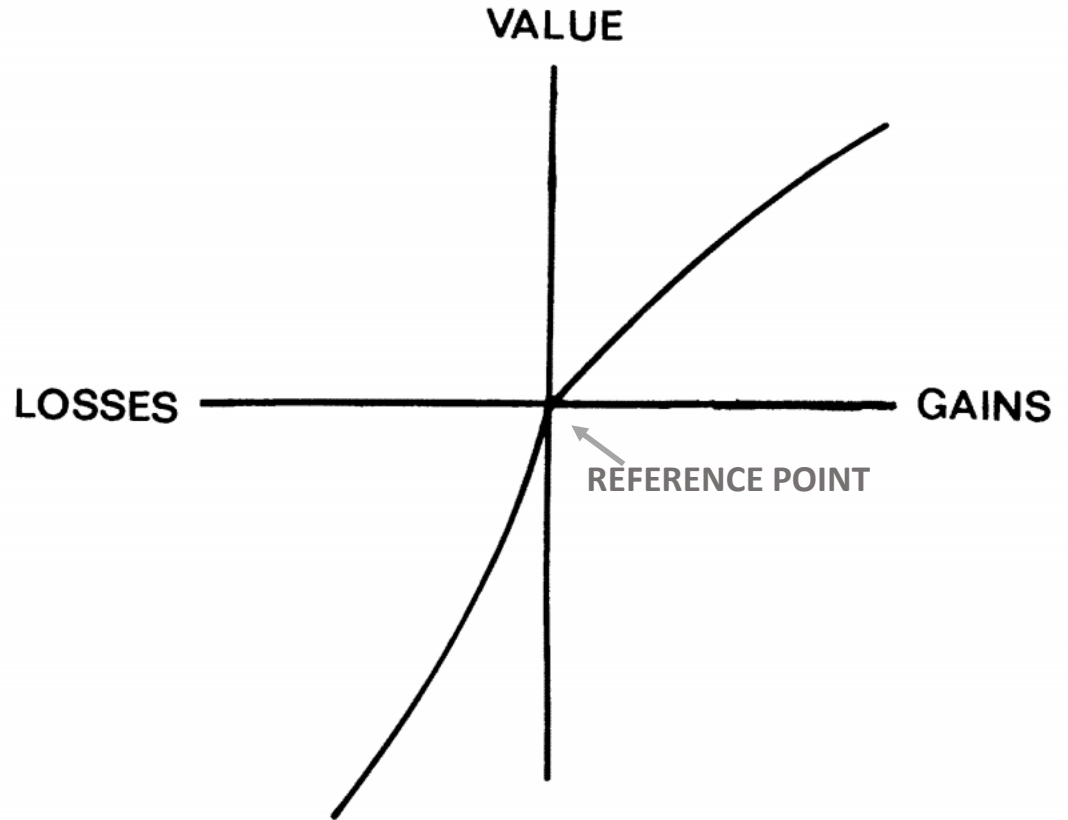- "S-shaped": Concave for gains, convex for losses

- Steeper for losses than gains

FIGURE 3.—A hypothetical value function.

Some evidence: WTA vs. WTP

How much is the tree on your front lawn worth?

- **WTA**: If you gave me $ ___ , I'd be OK if you cut the tree down.
- **WTP**: If I didn't have the tree, I'd pay $ ___ for it.

Tuncell & Hammitt, 2014:

- Meta-analysis of 76 published studies
- Values diverge by a factor of about 6!
- Why? Income effects, transaction costs, *"psychological explanations such as framing and endowment effects"* (175)
- No consensus yet

The behavioural economics of species conservation

- Reference points
  - Are policies making a gain or reducing a loss?

- Prioritization
  - Do notions of 'fairness' change outcomes?
  - Are there 'lines we won't cross'?

- Policy failures
  - Do we accept worse gambles when dealing with species-at-risk?

Compared Across groups

Are respondents prospect-theory reasoners?

- We equate this with "are respondents risk-averse for gains and risk-loving for losses"
- **(M1) Kahneman and Tverksy's 1974 question**
  - 76.7% preferred a sure gain of $250.
  - 67.4% preferred a 25% chance to lose $1000 and a 75% chance to lose nothing.
- **(M2) Same question, but non-monetary**
  - 86.0% preferred a sure gain of endangered species, and 74.4% preferred to gamble on chance of loss.
  - Consistent across framings: imaginary animal, vague caribou, specific tigers

Interpretation: we can assume prospect theory reasoning in order to interpret our other questions

"Failures of rationality"

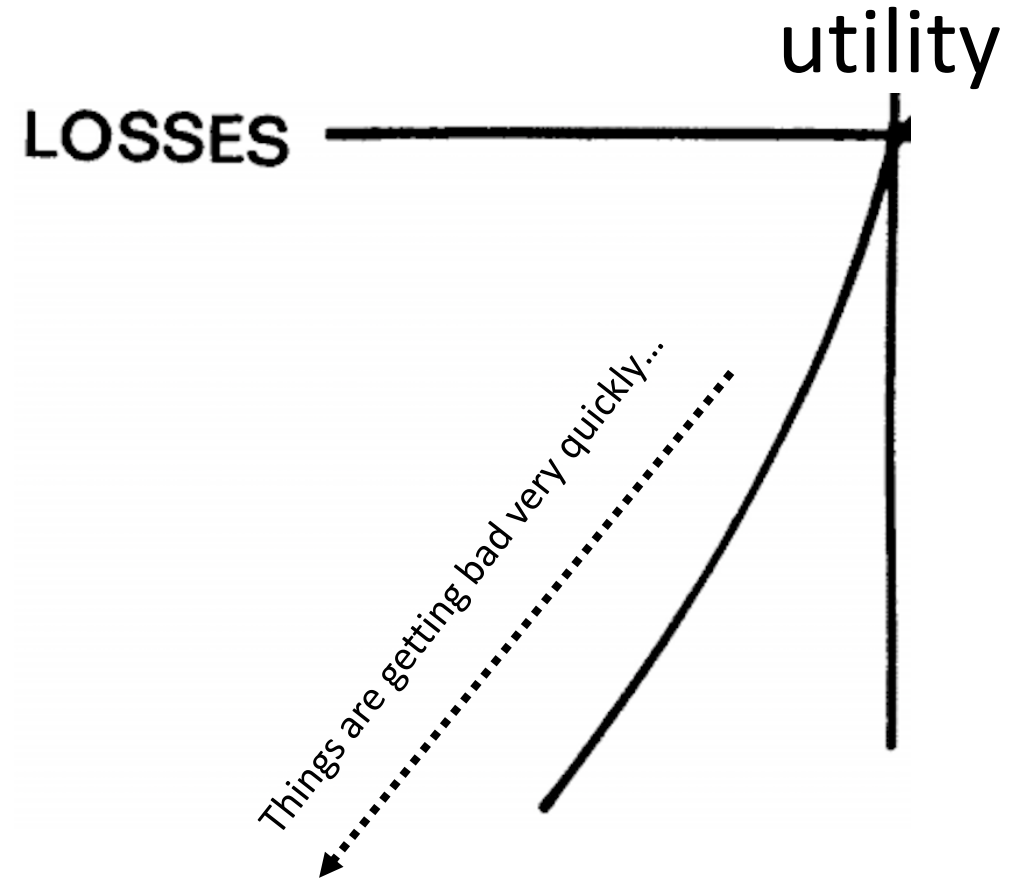Behavior when faced with high probability of loss
- Risk seeking
- 'certainty' effect

⇒ take (bad) gambles

e.g. Choose between:
a) -45
b) 0.5*-20 + 0.5*-80
= -10 + -40 = -50

utility

LOSSES

Things are getting bad very quickly...

Are respondents prospect-theory reasoners?

- When facing large losses, risk-loving preference in the domain of gains leads people to take bad gambles (Kahneman's 'fourfold pattern')
- Test if this varies btw. money-valued and intrinsically-valued things (n=43):
  - **(P2)** Framed in terms of money: 63% showed risk-loving preference when facing a loss
  - **(P1)** Framed in terms of biodiversity: 45% preferred showed risk-loving preference when facing a loss
  - **(P3)** Framed in terms of money, with a third option added (refuse to choose): 40% took the sure loss, 32% took the risky loss, and 28% refused to choose

Are people risk-averse in domain of losses when dealing with 'intrinsically valued things'?

In this case, since the gamble as slightly worse expected value, does this make people more 'rational' when dealing with intrinsically valued things?

If any of this interests you…

The language of economics is still math
More ecology = better grasp of physical systems
There are other routes to policy work

Thank you

The standard model: expected utility

c_n are events
π_n are the probabilities that they occur
u( ) is a utility function

Expected value:

$$\pi_1 c_1 + \pi_2 c_2$$

Expected utility:

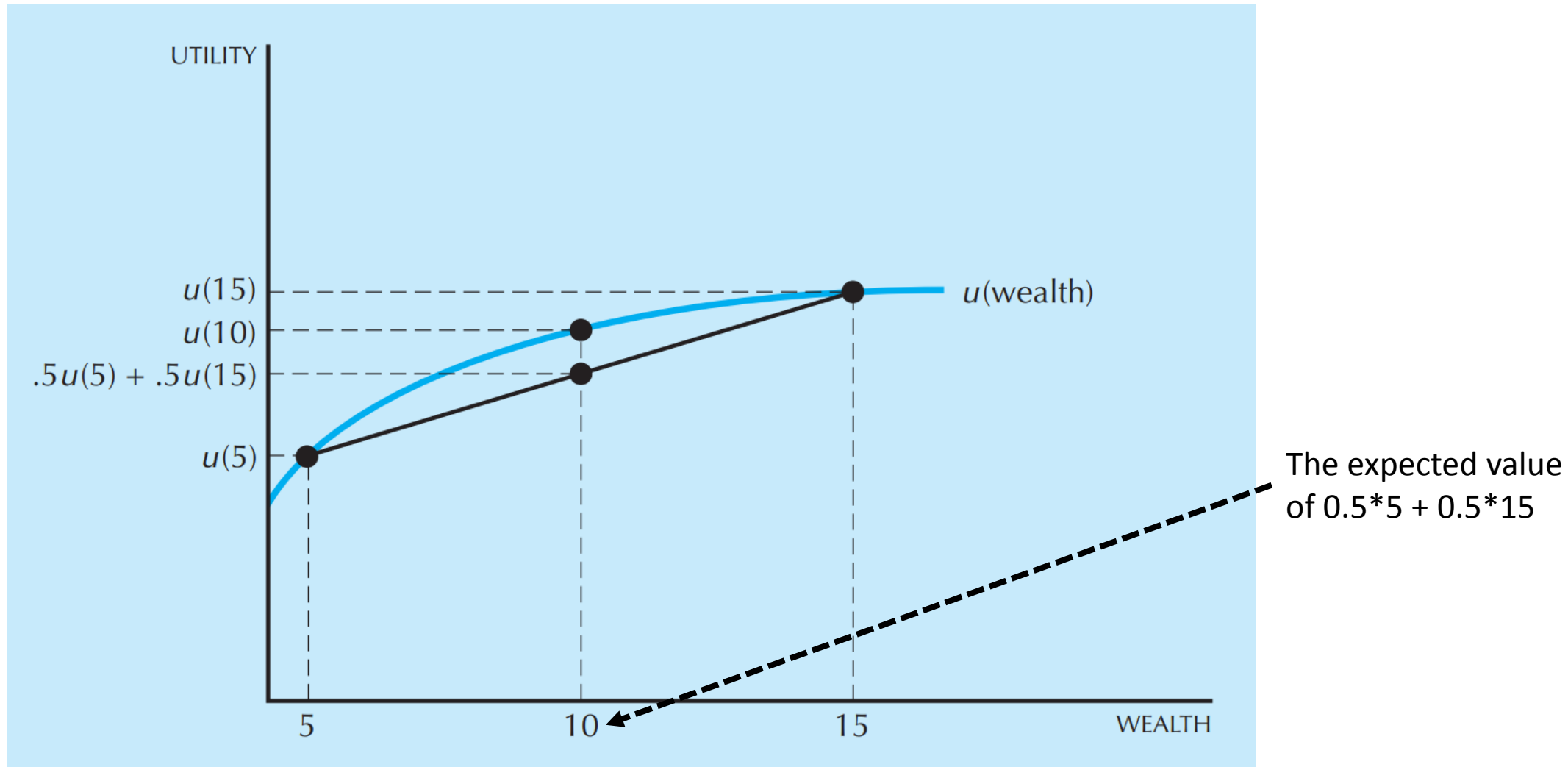$$\pi_1 u(c_1) + \pi_2 u(c_2)$$

Utility of the expected value:

$$u(\pi_1 c_1 + \pi_2 u c_2)$$

Risk aversion in the standard model

The expected value of 0.5*5 + 0.5*15

Varian *Intermediate Microeconomics* (8th ed.): Fig 12.2

Reference points

- Prefer the sure thing over the gamble ⇒ risk averse ⇒ this is viewed as a gain

- Prefer the gamble thing over the sure thing ⇒ risk loving ⇒ this is viewed as a reduction of a loss

VALUE   Prefer the sure thing
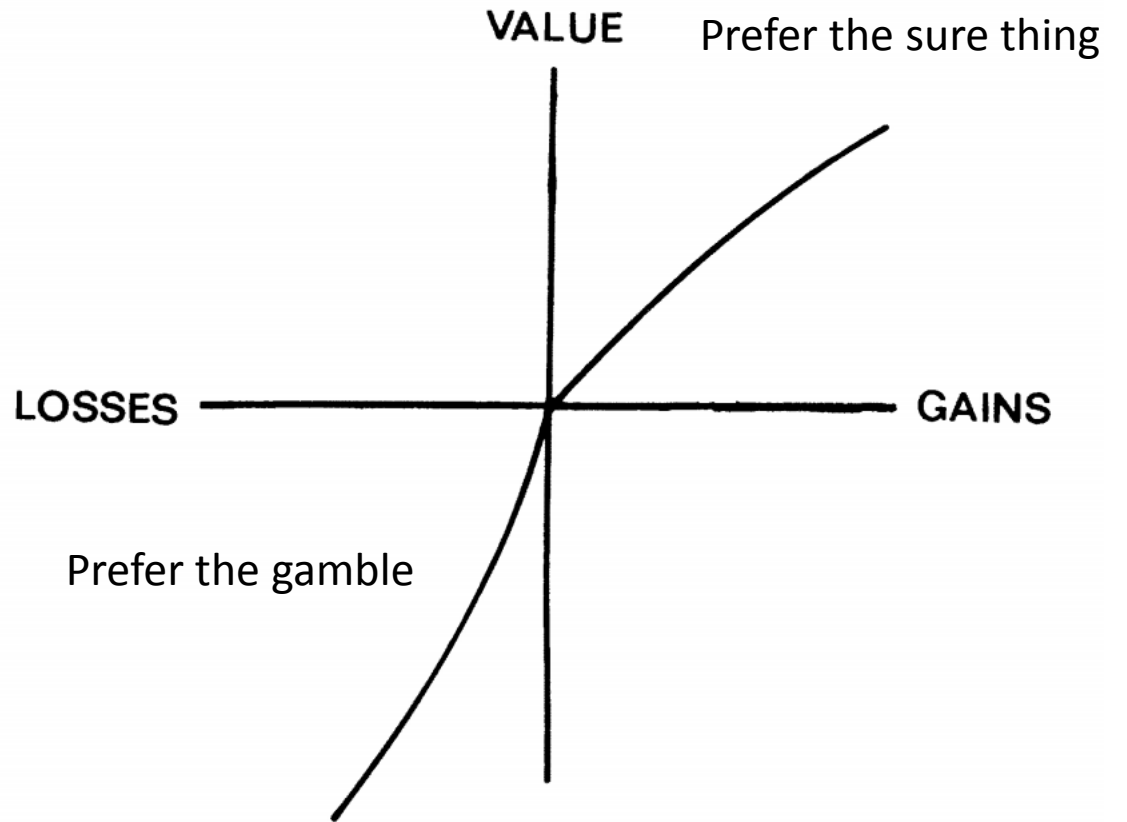
LOSSES   GAINS

Prefer the gamble

FIGURE 3.—A hypothetical value function.

Prioritization

You have a budget of $10 million that you must allocate entirely. Herd A has a 50% chance of survival and Herd B has a 10% chance of survival.

- Allocate the entire $10 million to conservation programs for Herd A, raising its chance of survival from 50% to 90%.

    You buy 0.40(herd survival)*

- Allocate $5 million to conservation programs for Herd A, raising its chance of survival from 50% to 60%, and $5 million to conservation programs for Herd B, raising its chance of survival from 10% to 20%.

    You buy 0.10(herd A survival) + 0.1(herd B survival)*

- Allocate the entire $10 million to conservation programs for Herd B, raising its chance of survival from 10% to 40%.

    You buy 0.3(herd B survival)*

Prioritization

- (**PR1**) asked respondents to allocate a fixed budget among two herds. Variants (v3) control for framing effects. The expected value ranking of the options is: allocate entirely to better-off herd > allocate entirely to worse-off herd > split evenly between herds

	Allocate to better-off herd	Allocate to worse-off herd	Split between herds
V1 – money is not allocated to start	6	2	6
V2 – money starts allocated to better-off herd	4	6	8
V3 – money starts allocated to worse-off herd	2	2	7
Total	*12*	*10*	*21*

Notions of fairness appear to be at play, leading to bad decisions.