The Limits to Growth: Sustainability and the Circular Economy

Lecture 5 – Bonus: Catabolic Collapse

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License

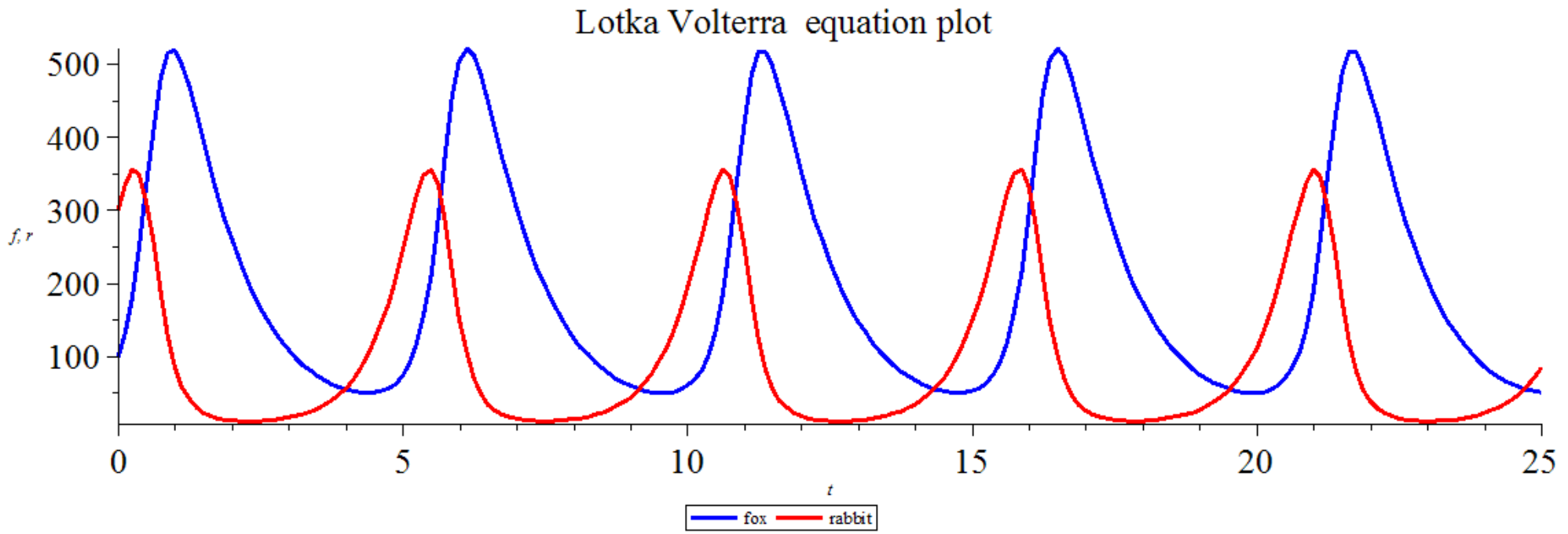
INTRODUCTION

Introduction

Finite Systems – Sandbox / Playground

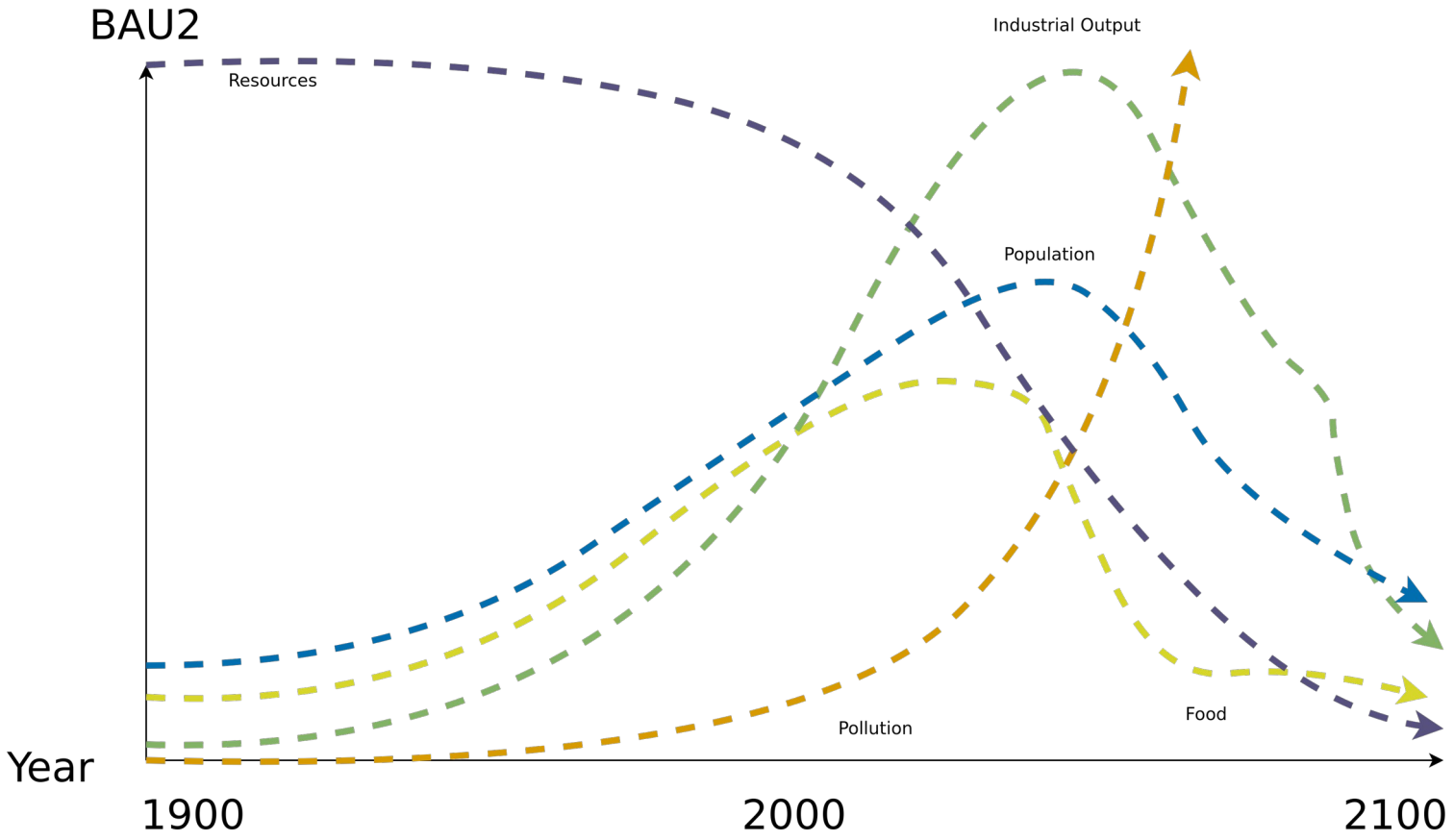
Introduction

Lotka–Volterra Equations (Predator–Prey Equations)



Introduction

World3 Standard Run – Business-as-Usual2 (BAU2)

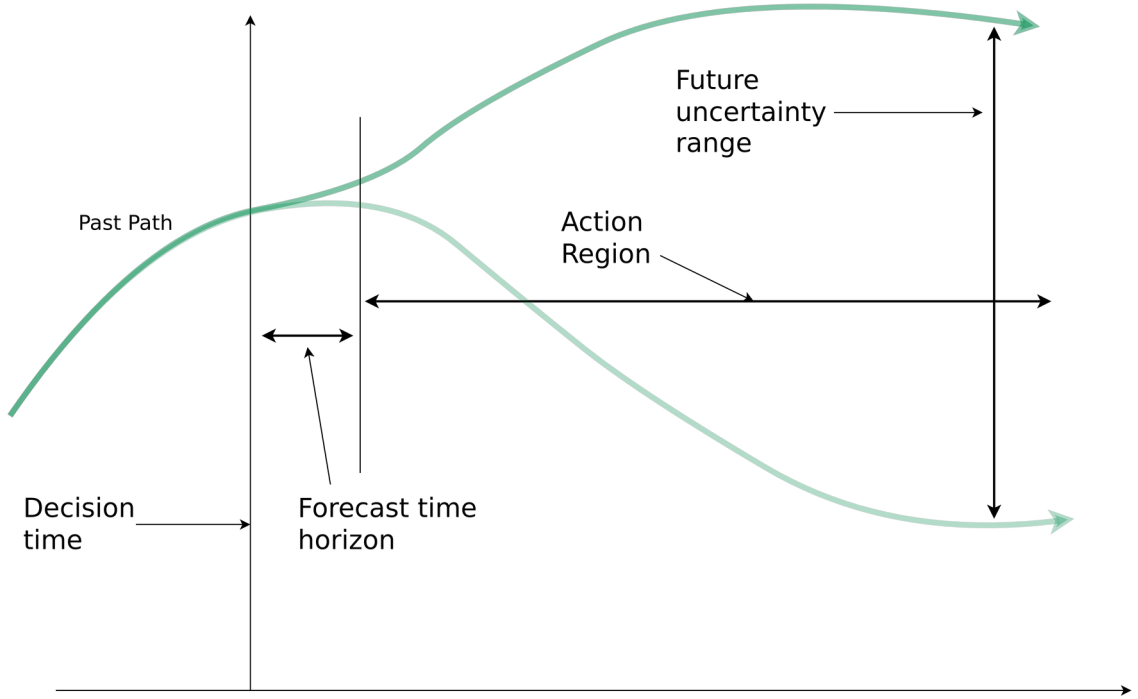


→ Collapse due to pollution (climate change equivalent)

Image recreated from: Gaya Herrington (2020) – Update to limits to growth: Comparing the World3 model with empirical data – Link

Introduction

Forrester's Dilemma



"One can forecast future conditions in the region where action is not effective, and one can have influence in the region where forecasting is not reliable." – Forrester, 2007

Image recreated from: Brian Hayes (2012) – Computation and the Human Condition (Harvard SEAS) – Link

TASK 1 – WHAT IS COLLAPSE GONNA LOOK LIKE? (10MIN)

CATABOLIC COLLAPSE

Catabolic Collapse

Collapse

“A society has collapsed when it displays a rapid, significant loss of an established level of sociopolitical complexity”

Joseph Tainter (1988) – The Collapse of Complex Societies. Cambridge University Press.

Catabolic Collapse

Definition

*"Relationships among **resources**, **capital**, **waste**, and **production** form the basis for an ecological model of **collapse** in which production fails to meet maintenance requirements for existing capital. **Societies** facing such crises after **having depleted essential resources risk catabolic collapse**, a self-reinforcing cycle of contraction converting most capital to waste."*

John Michael Greer (2015) – How Civilizations Fall: A Theory of Catabolic Collapse

Catabolic Collapse

Theory – Resources and Capital

- **Resources (R)**
  - Naturally occurring exploitable factors in the environment
  - Not (yet) extracted/incorporated into the society's flows of energy and material
  - E.g., not yet mined minerals, soil fertility, human resources (not yet working), etc.

- **Capital**
  - All factors from whatever source that have been incorporated into the society's flows of energy and material but are capable of further use.
  - E.g., food, tools, buildings, human capital (labourers), etc.

Catabolic Collapse

Theory – Waste and Production

- **Waste (W)**
  - Energy and material that have been incorporated into society but are now exploited to the point that they are incapable of further use.
  - Also → pollution

- **Production (P)** is the process by which existing capital and resources are combined to create new capital and waste.

John Michael Greer (2015) – How Civilizations Fall: A Theory of Catabolic Collapse

Catabolic Collapse

Theory – Production vs. Maintenance

- C(p) = M(p)
  - C(p) is new capital produced
  - M(p) is maintenance of production

Catabolic Collapse

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- C(p) = M(p) = W(p) + W(c) == steady state
  - W(p) is existing capital converted to waste in the production of new capital
  - W(c) is existing capital converted to waste outside of production

Catabolic Collapse

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Catabolic Collapse

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- C(p) > M(p) == expansion
- C(p) < M(p) == contraction

Catabolic Collapse

Theory – Replenishment vs. Depletion

- r(R) → replenishment rate
- d(R) → depletion rate

- d(R) / r(R) > 1 → resources become depleted

Catabolic Collapse

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- Liebig's law of the minimum:
  - Essential resource with the highest value for d(R)/r(R) may be used as a working value of d(R)/r(R) for resources as a whole

Catabolic Collapse
Theory

- C(p) < M(p) → contraction, but also **maintenance crisis**
- d(R) / r(R) > 1 → contraction, but also **depletion crisis**

Catabolic Collapse

Theory – Catabolic Cycle

*"**A self-reinforcing process in which C(p) stays below M(p) while both decline**. Catabolic cycles may occur in maintenance crises if the gap between C(p) and M(p) is large enough, but tend to be self-limiting in such cases. **In depletion crises, by contrast, catabolic cycles can proceed to catabolic collapse**, in which C(p) approaches zero and most of a society's capital is converted to waste."*

John Michael Greer (2015) – How Civilizations Fall: A Theory of Catabolic Collapse

TASK 2 – LESSONS LEARNED? (5 MIN)

Catabolic Collapse

Lessons Learned / Implications

- “Technology is gonna safe us” vs. maintenance cost/crisis
- Minimize use of resources
  - Sufficiency
  - Consume less
- Less complex societies → The earlier we adapt, the better
- What else?