



Introduction to Uncertainty and Risk

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Course Instructor

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You will NOT sleep the first time it rains ...

Introduction

- **Uncertainty**
 - Uncertainty IS NOT AN EXCUSE!
 - Uncertainty does NOT equal ignorance
 - Uncertainty is pervasive and unavoidable
 - Uncertainty is condition of being in doubt

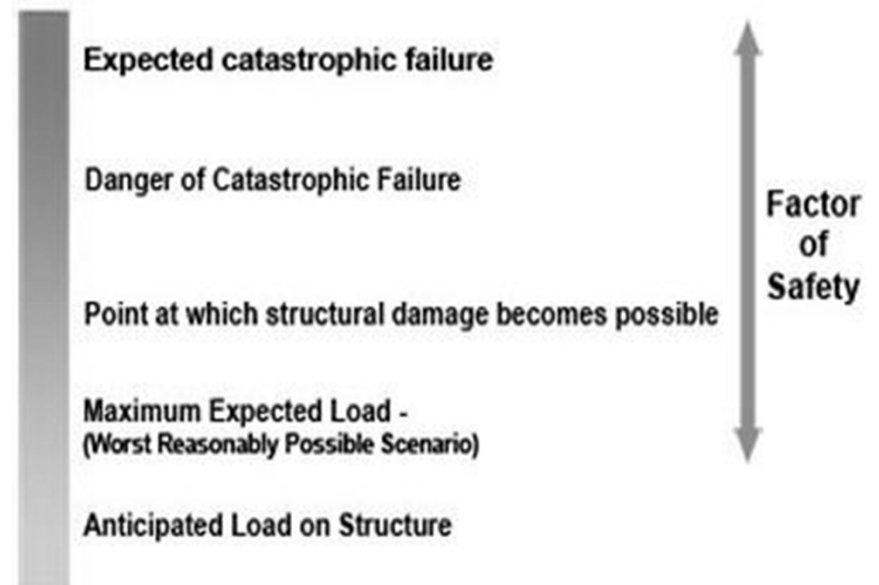


Two Certainties in Stream Rest. Design:

- We are certain that we are in doubt!
- And ...

Introduction

- Standard Engineering Design
 - Professional Certification (PE)
 - Clearly Defined Methods
 - Strict Standards (ASTM, ACI, IBC)
 - How do engineer's account for uncertainty?
 - Factor of Safety (FOS)
 - Overdesign/Conservative
 - Accuracy of Parameters
 - Life expectancy
 - Consequences of failure
 - Cost of Overdesign



Introduction

- Can we overdesign streams?
- Yes – In-Stream Structures tend to be our Factors of Safety!



Introduction

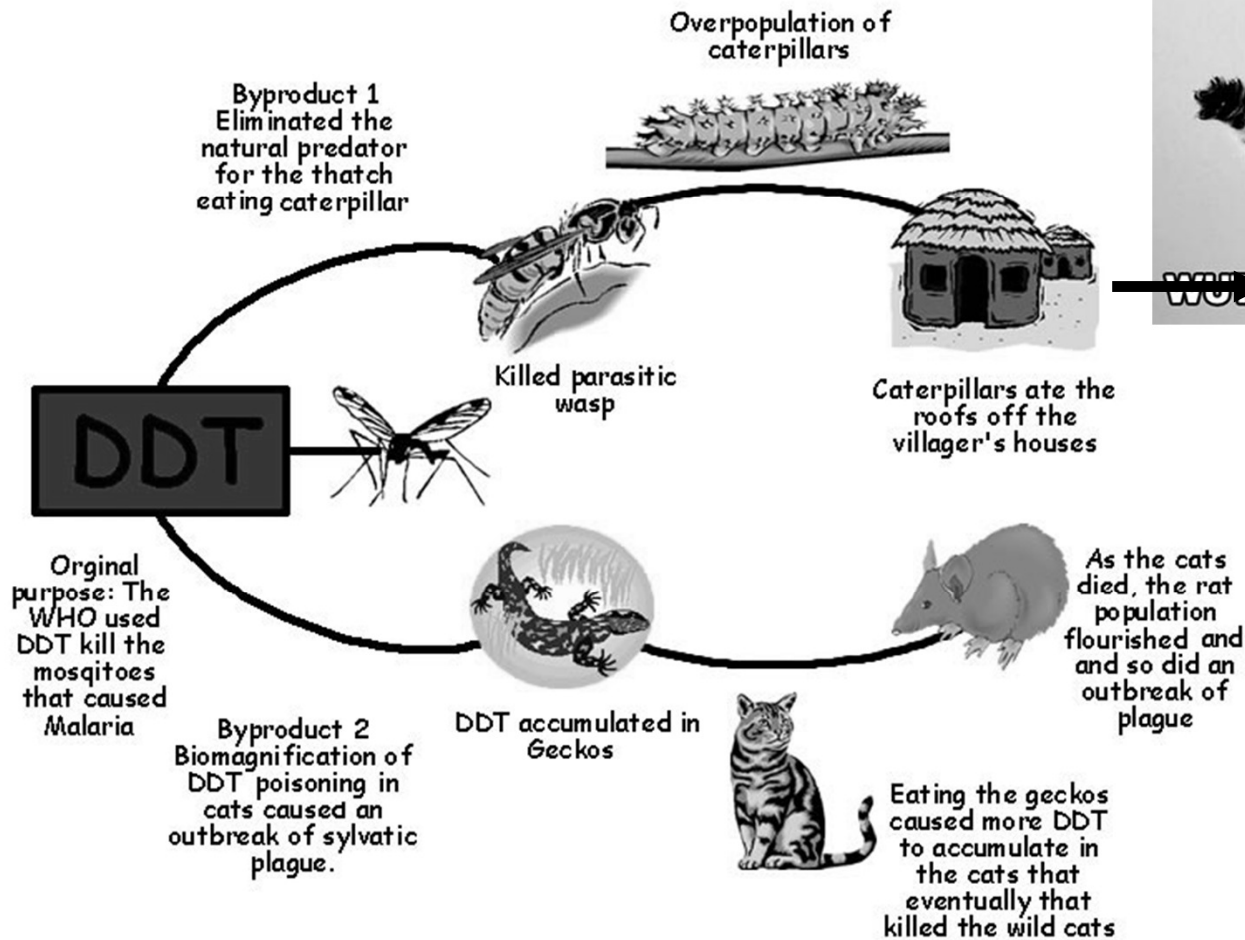
- Rigid structures used to:
 - Protect channel banks
 - Provide grade control
 - Promote flow deflection
 - Improve channel stability
 - Improve aquatic habitat
- Uncertainty
 - Vague design guidelines
 - Difficult to construct to spec
 - Localized
 - effect on rest of design and other stream reaches???



The high price of uncertainty ...

Effect of DDT Use in Borneo

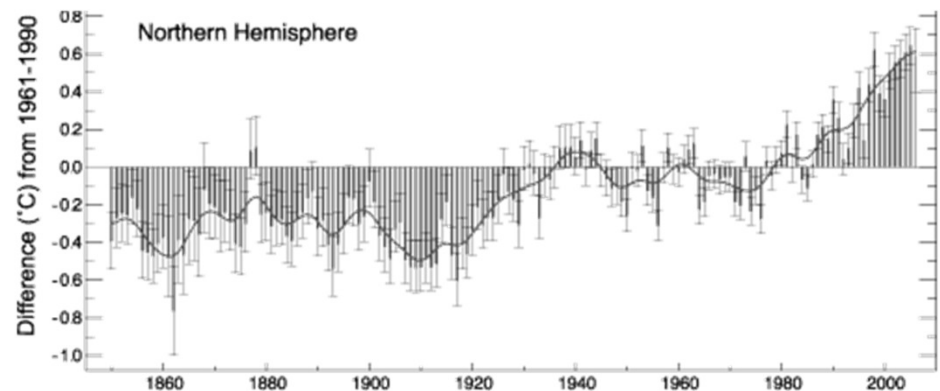
In the early 1950's the people in Borneo, suffered from Malaria the World Health Organization had a solution, kill the mosquitoes with DDT. This is what happened.



Operation Cat Drop

Sources of Uncertainty

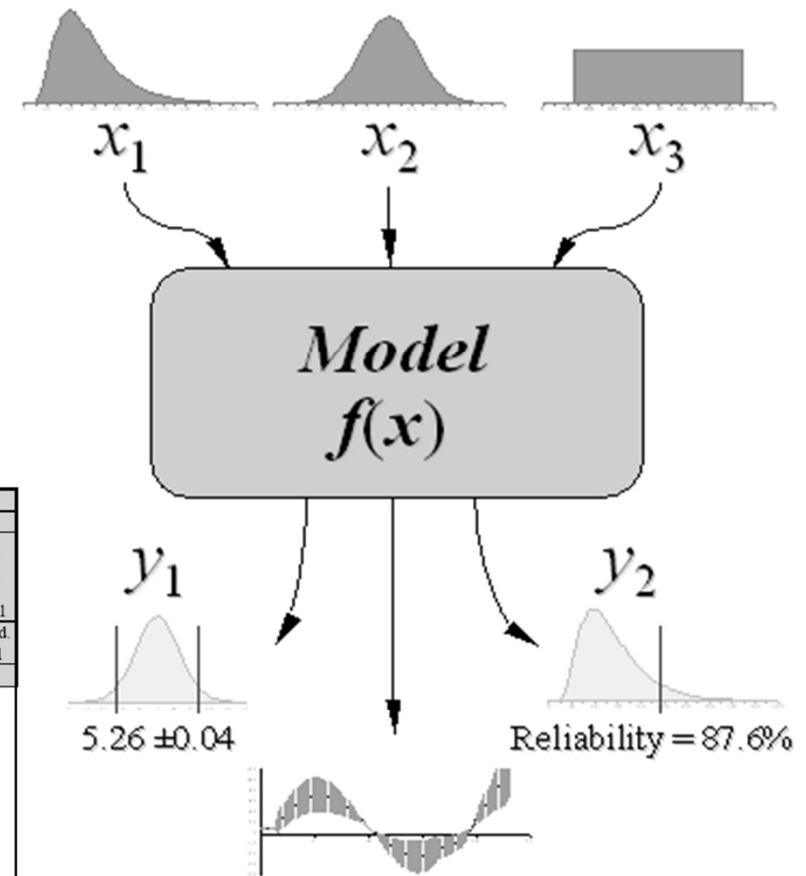
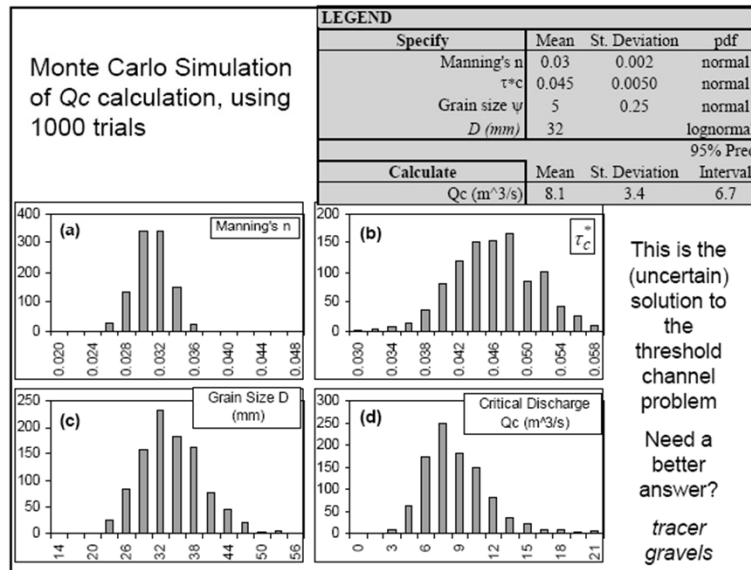
- Model uncertainty
 - Quantification of hydrologic and hydraulic parameters, shear stresses, sediment transport
- Project objectives (non-measurable objectives)
- Vague definitions
 - e.g. stability, water quality, project failure
- Parameter uncertainty
 - e.g., Bankfull, channel width, meander dimensions
- Monitoring
 - What, how long, ...
- Spatial extent
 - Local, reach-, system-wide
- Land use changes
 - Current and future impacts
- Construction and implementation practices
- Climate change



Incorporating Uncertainty

- Monte Carlo Simulation

- Mathematical model needed
- Quantify statistics, probability distributions



Introduction

- Risk

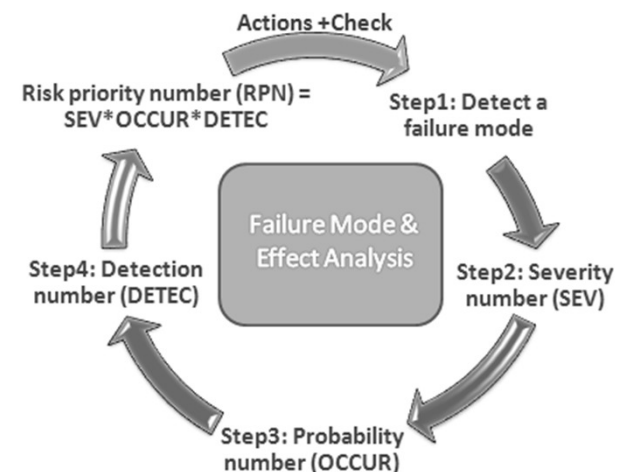
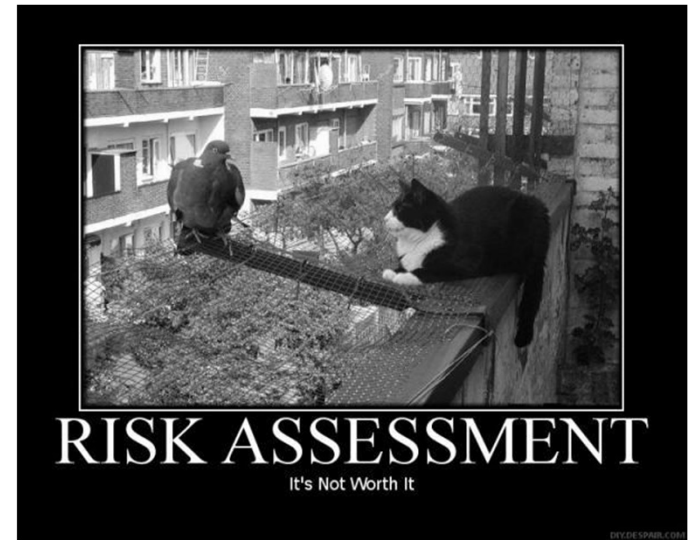
- Def 1 - The possibility of suffering harm or loss; danger.
- Def 2 - A factor, thing, element, or course involving uncertain danger; a hazard
- Do you often understand your projects risks?



- **Risk** - *If one has to jump a stream and knows how wide it is, he will not jump. If he doesn't know how wide it is, he'll jump and six times out of ten he'll make it. ~ Persian Proverb ~*

Risk Assessment

- Qualitative RA
 - Failure Modes and Effects Analysis (FMEA)
 - Procedure to systematically identify potential component failure modes and assess the effects of associated failures on operational status of the system
- Quantitative RA
 - Total project risk in terms of cost of implementation
 - Probability of Failure
 - Consequences of Failure



$$Risk = C_o + \sum_{i=1}^n (p_i C_i)$$



Incorporating Uncertainty in Design

- **Summary**

- Uncertainty and risk prevalent in restoration
- Embrace as integral to design

- **Objectives of this course**

- Identify sources of uncertainty in restoration design
- Apply methods to incorporate and reduce uncertainty
- Analyze a design to identify components with highest risk/uncertainty
- Re-design the project to minimize uncertainty/risk

Get Ready for a Risky Rollercoaster Ride!



Eric Petersen / The Livingston Enterprise

