

# Teaching environmental risk analysis

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Tomas Öberg  
Kalmar Univ., Dept. Biol. Environ. Sci. Sweden.  
Email: [tomas.oberg@hik.se](mailto:tomas.oberg@hik.se)



# Introduction

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- Risk analysis courses and programs are offered at many universities in Europe, the US, and the rest of the world
- Literature on teaching, syllabi, etc. is missing
  - but a number of conference presentations (at the SRA Annual Meetings)



# Scope

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The aim with my presentation is to outline:

1. The present programme in environmental science at the University of Kalmar, with specialisation in environmental risk analysis
2. Describe the course modules
3. Our current supporting research
4. Planned future development of a masters programme in environmental risk analysis and communication



# The environmental science programme

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- ❑ Four years, with specialisation in:
  - environmental risk analysis
  - environmental protection
  - natural conservation
- ❑ First year, geosciences and chemistry
- ❑ Second year, biology
- ❑ Third and fourth year, specialisation.

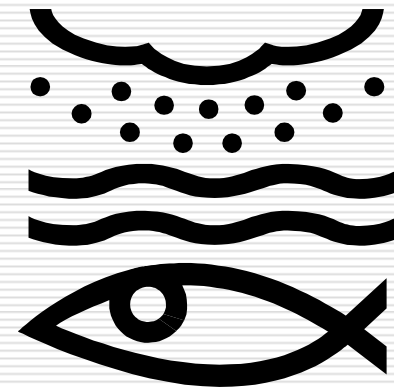


# Specialisation in environmental risk analysis, year 3-4

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## Courses:

- Environmental chemistry
- Ecotoxicology
- Hydrogeology
- **Environmental risk analysis**
- **Environmental risk communication**
- Natural resources management
- **Degree project**



# Environmental risk analysis 1

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- Credits:
  - Swedish system: 10 (=10 weeks full-time)
  - ECTS: 15
- Course objective:
  - knowledge about risk analysis and risk management of chemical substances and products
  - a focus on risks to environment and health
  - introduce a quantitative approach including statistical methods
  - provide a basis for further studies in environmental risk analysis

# Environmental risk analysis 1

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- Contents
    - Risk- and decision problems within the environmental field
    - Basic concepts in statistics and theory of probability
    - Transport processes and distribution of chemical substances
    - Risk identification
    - Exposure assessment
    - Risk characterization
    - Risk communication and risk management
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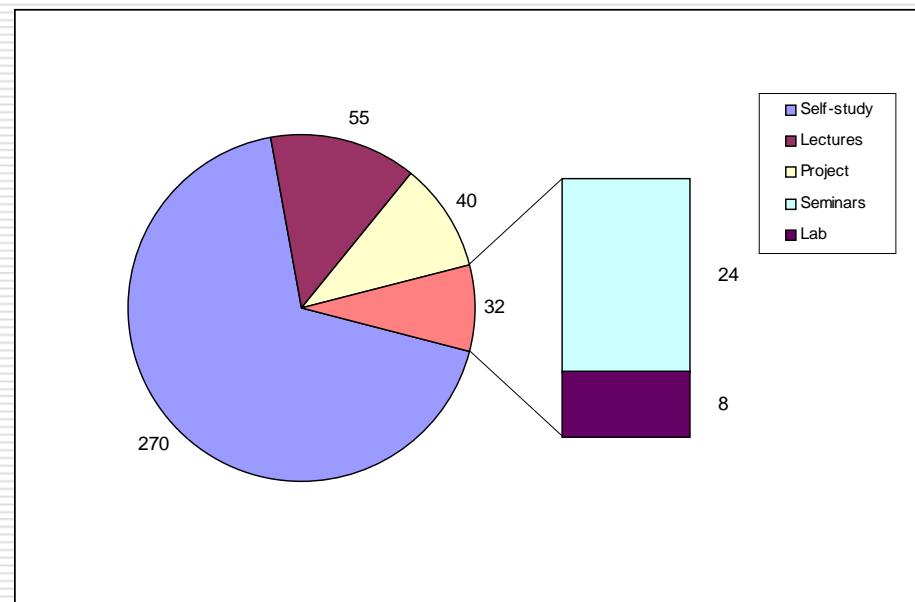
# Environmental risk analysis 1

## □ Teaching:

- Self-study (~270 h)
- Lectures (55 h)
- Project work (~40 h)
- Seminars (24 h)
- Computer lab (8 h)

## □ Examination:

- Written exam (fail, pass, pass with distinction)



# Environmental risk analysis 1

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- Main course reading:
  - Kammen DM, Hassenzahl DM (1999): *Should we risk it? Exploring environmental, health and technological problem solving*. Princeton University Press. 392 pp.
  - van Loon GW, Duffy SJ (2000): *Environmental chemistry. A global perspective*. Oxford University Press. 492 pp.
- Supplementary readings:
  - Various articles and reports

# Environmental risk analysis 2, advanced course

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- Credits:
    - Swedish system: 5 (=5 weeks full-time)
    - ECTS: 7.5
  - Course objective:
    - provide advanced knowledge in environmental risk analysis
    - emphasizes the subject areas of exposure assessment, probabilistic methods and contaminated soil
    - provide a basis for a professional career within research, environmental and health protection
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# Environmental risk analysis 2, advanced course

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- Contents
    - Basic concepts and models in exposure assessment
    - Exposure data and intake
    - Characterization of uncertainty and variability
    - Methods for probabilistic exposure assessment
    - Data and frequency distributions
    - Presentation and evaluation of results from Monte Carlo simulations
    - Generic and site specific guideline values for contaminated land
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# Environmental risk analysis 2, advanced course

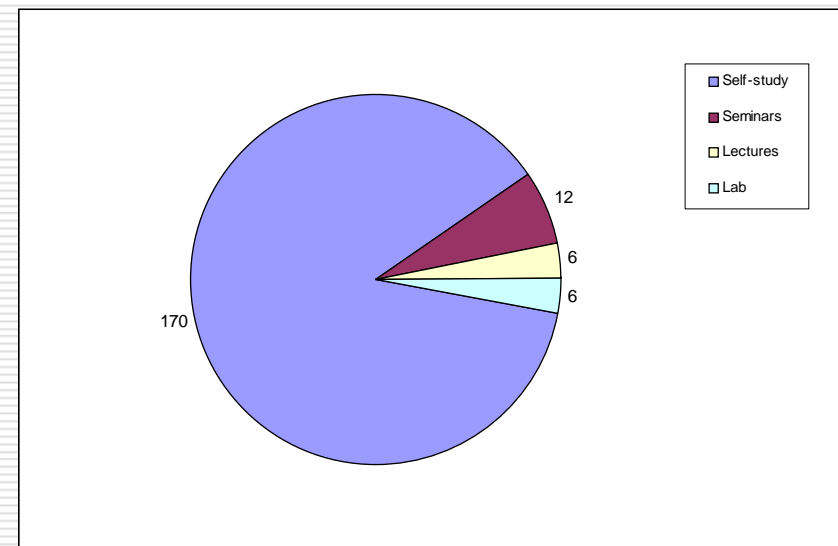
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## □ Teaching:

- Self-study (~170 h)
- Seminars (12 h)
- Lectures (6 h)
- Computer lab (6 h)
- Hand-in papers weekly
- Hand-in calculation exercises weekly

## □ Examination:

- Hand-in materials and oral exam (fail, pass, pass with distinction)





# Environmental risk analysis 2, advanced course

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- Main course reading:
  - Cullen AC, Frey HC (1999): *Probabilistic techniques in exposure assessment: A handbook for dealing with variability and uncertainty in models and inputs*. Plenum Publishing Corporation. 352 pp.
  - Paustenbach DJ (2000): *The practice of exposure assessment: A state-of-the-art review*. Journal of Toxicology and Environmental Health Part B: Critical Reviews 3, 179-291. 113 pp.
- Supplementary readings:
  - Elert M, Jones C, Norman F (1997): *Development of generic guideline values - Model and data used for generic guideline values for contaminated soil in Sweden*. Swedish Environmental Protection Agency, Stockholm, report 4639. 49 pp.
  - USEPA (2001): *Risk assessment guidance for Superfund: Volume III - Part A, Process for conducting probabilistic risk assessment*. US Environmental Protection Agency, Washington DC, report EPA/540/R-02/002, 219 pp.
  - Various articles and reports

# Environmental risk communication

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□ Credits:

- Swedish system: 5 (=5 weeks full-time)
- ECTS: 7.5

□ Course objective:

- develop an advanced knowledge in risk communication
- focus on chemical risks to the environment and the communication of results from advanced risk analyses
- introduce concepts and theories and describes the role of media in communicative processes
- provide a basis for a professional career within research, environmental and health protection

# Environmental risk communication

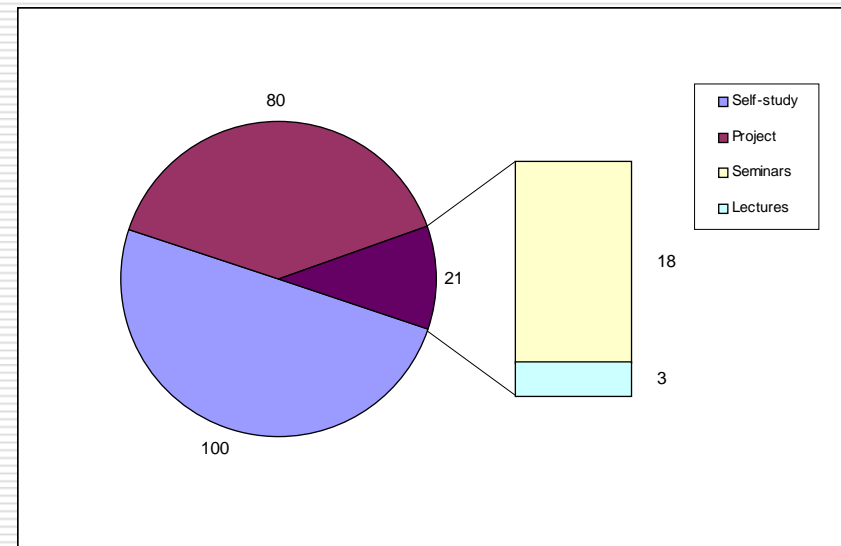
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## □ Contents

- Concepts in risk communication
- Risk perception and preferences
- Trust and credibility
- Role of media
- Risk communication within agencies, companies and organisations
- Catastrophes and crisis management
- Communication of uncertainty and risk estimates from probabilistic assessments

# Environmental risk communication

- Teaching:
  - Self-study (~100 h)
  - Project work (~80 h)
  - Seminars (18 h)
  - Lectures (3 h)
  - Hand-in papers weekly
- Examination:
  - Hand-in materials and oral exam (fail, pass, pass with distinction)



# Environmental risk communication

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- Main course reading:
  - Allan S, Adam B, Carter C (2000): *Environmental risks and the media*. Routledge. 278 pp.
  - Various reports from Swedish organisations/agencies
- Supplementary readings:
  - Bier VM (2001): *On the state of the art: risk communication to the public*. Reliability Engineering & System Safety 71, 139-150. 12 pp.
  - Bier VM (2001): *On the state of the art: risk communication to decision-makers*. Reliability Engineering & System Safety 71, 151-157. 7 pp.
  - Maher ST (2001): *Risk communication guide for state and local agencies*. State of California, Governor's Office of Emergency Services. 94 pp.
  - USEPA (2001): *Risk assessment guidance for Superfund: Volume III - Part A, Process for conducting probabilistic risk assessment*. US Environmental Protection Agency, Washington DC, report EPA/540/R-02/002, 219 pp.

# Student evaluation of courses

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- ❑ Teaching and literature were rated as acceptable-good, except the risk communication textbook
- ❑ A statistics course would be needed from the previous education
- ❑ Difficult literature, too much work
- ❑ Project work and computer exercises were highly rated and more of this was requested

# Lecturer evaluation of courses

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- The problem-based and self-study approach worked well
- The results from the examination show that the aims of each course were fulfilled
- More basic statistics in previous education would be helpful
- These courses could probably be adapted into an online Internet education programme

# Degree projects

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## □ Credits:

- Swedish system: 20 (=20 weeks full-time)
- ECTS: 30

## □ Course objective:

- provide advanced theoretical and practical knowledge within a topic incorporated in the subject Environmental Science
- understand how to plan, carry out and present a scientific investigation

# Degree projects

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## Teaching:

- Independent project based in part on reference literature and data collections
- Supervised by a specially appointed supervisor

## Examination:

- Written report presented at the end of the course in the form of a seminar at which opponents appointed by the examiner are present (fail, pass, pass with distinction)
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# Degree projects

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- Examples of degree projects in environmental risk analysis
  - Probabilistic risk assessment of contaminated land at a closed steel mill
  - Comparison of the Swedish and the US methodology for preliminary assessment of contaminated land
  - Environmental risks from nanotechnology

# Linking teaching and research

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- Strong research in biology and environmental science
- Research in environmental risk analysis is now being initiated
  - Hazard identification (QSAR/QSPR)
  - Exposure assessment (probabilistic methods, contaminated land)
  - Risk communication (conjoint analysis)



# Structure-activity relationships

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- Quality assurance
  - Validation
  - Domain of applicability
- QSARs for baseline toxicity
- QSPRs for partitioning constants
- QSPRs for reactivity
- Virtual screening

Funded by the Faculty Board

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# Probabilistic risk assessment contaminated land

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- Quality assurance
  - Guideline
- Tools and software
- Communication
- Case studies



Funded by the Swedish EPA

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# Conjoint analysis

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- To provide tools for evaluation and ranking of environmental preferences among:
  - Environmental experts
  - Product designers
  - Consumers and other stakeholders
- Method development for environmental applications
  - Data collection and multivariate analysis
  - Graphical presentation and communication
- Case studies in the steel industry

Funded by the Foundation for Strategic Environmental Research and the steel industry

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# Future developments

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- Continued funding for research projects on probabilistic assessment methods and conjoint analysis
- The Bologna process
  - The basic environmental science programme will encompass three years and result in a bachelor degree
  - Master programmes of two years each will be initiated



# A new masters programme

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## Outline of a masters programme in Environmental Risk Analysis and Communication

Background in social sciences	Background in science
Environmental science, basic level 30 ECTS	Environmental science, advanced level 30 ECTS
Media and communication 15 ECTS	
Research methodology and statistics 15 ECTS	
Environmental risk analysis 20 ECTS	
Environmental risk communication 10 ECTS	
Master thesis work 30 ECTS	



# Conclusions

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- ❑ It is important to regard environmental risk analysis as a subject of its own
- ❑ Teaching of risk analysis should ideally also be linked to active research
- ❑ We are trying to build our resources gradually and so far with support from both our university and the outside community

# Acknowledgements

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- Support from the Swedish EPA and the project 'Hållbar Sanering', is gratefully acknowledged