

# Expert judgment of unpredictable and/or low probability environmental health risks:

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## Chemical micropollutants in recycled water

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# Uncertainties in recycled water risk analysis

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- Many categories and mixes of endocrine disrupting chemicals, pharmaceuticals, personal care products
- Exposures from recycled water from many sources for many uses, now under regulatory review (from IPR to irrigation)
- Long-term low-dose exposures with known mutagenic or carcinogenic effects (no human data)

# Uncertainty analysis

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- When experts are uncertain, cognitive biases influence their estimates
- Informative estimates under uncertainty can be constructed by ruling out what is definitely known to be untrue

# Uncertainty analysis

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- These methods can be used for RA problems that may not (ever) have quantitative solutions, but do require policy decisions

# Probability bounds analysis

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- Using uncertain numbers (or intervals) that represent lack of knowledge *and* variability
- Can be used to elicit quantitative visual models of expert uncertainty
- Can be aggregated across experts for decision-makers, preserving ambiguities in expert judgment

# Issues addressed in developing methods

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I will discuss how we resolved these challenges:

- How to answer the question “Who is an expert?”
- What different elicitation method will work best?
- Using p-box software for elicitation

# “Who is an expert?”

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On a scale of 1- 10 (with 10 being the highest), how would you rate your expertise in your chosen discipline?	1 2 3 4 5 6 7 8 9 10
Do you have a minimum 5 years work experience or postgraduate study in this area?	Yes No
Are you currently working in a related job?	Yes No
Age Group	18- 25 25- 30 30- 35 35- 40 40- 50 50- 60 60+
Gender	Male Female

# “Who is an expert?”

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- *“That depends on who you are comparing me to”*
- *“Do you mean, how long have I been in this job”*
- *“No one is an expert in this”*

# Protocol to elicit probability distributions: Hypothetical scenario

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- Recycled water used by market gardeners for irrigation,
- Growers concerned about the growth and development of market-quality lettuce.
- Water comes from recycled sewage, subjected to standard water treatment processes, but not drinking water quality.
- You suspect a by-product of the sewage treatment process used to disinfect the water, but it may be having an effect at some quantity below the detectable limit of your testing.

*What is your estimate of the level of this chemical (mg or ng/litre) in the recycled water product?*

# Protocol to elicit belief function: Interview checklist

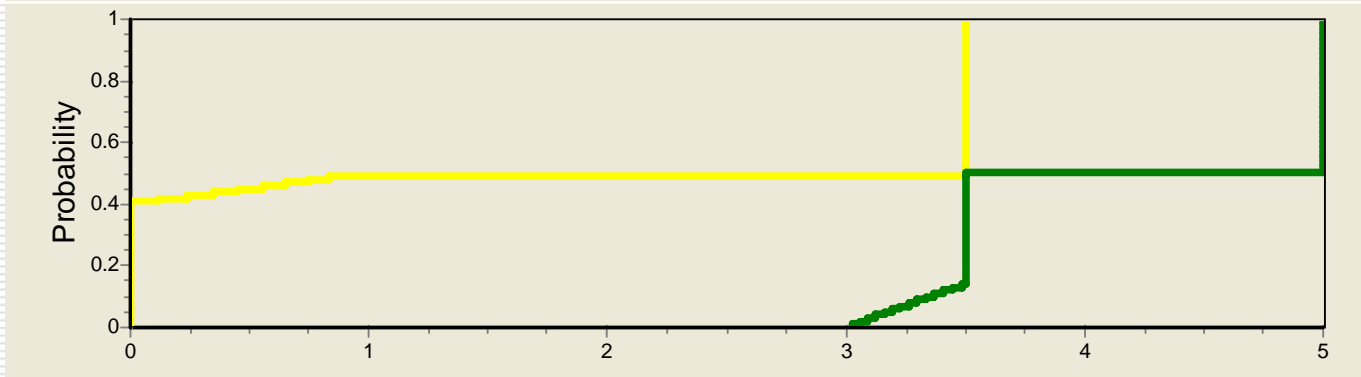
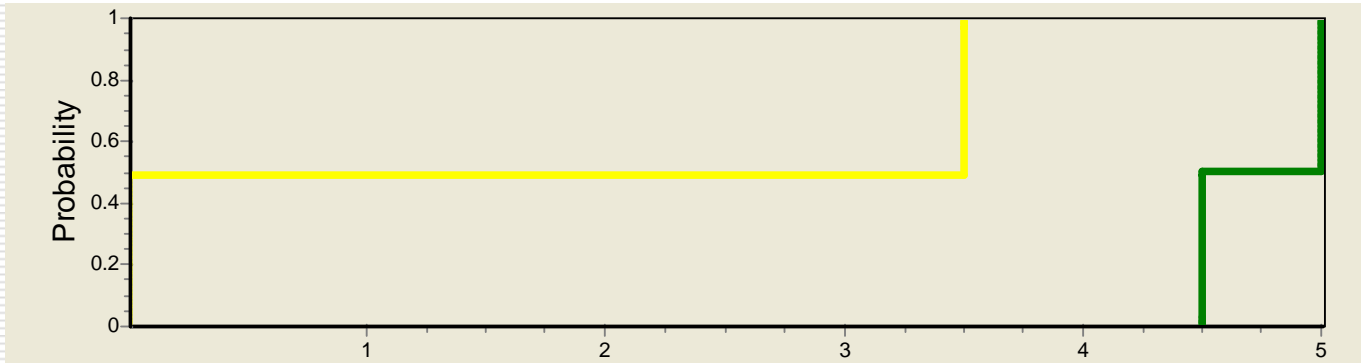
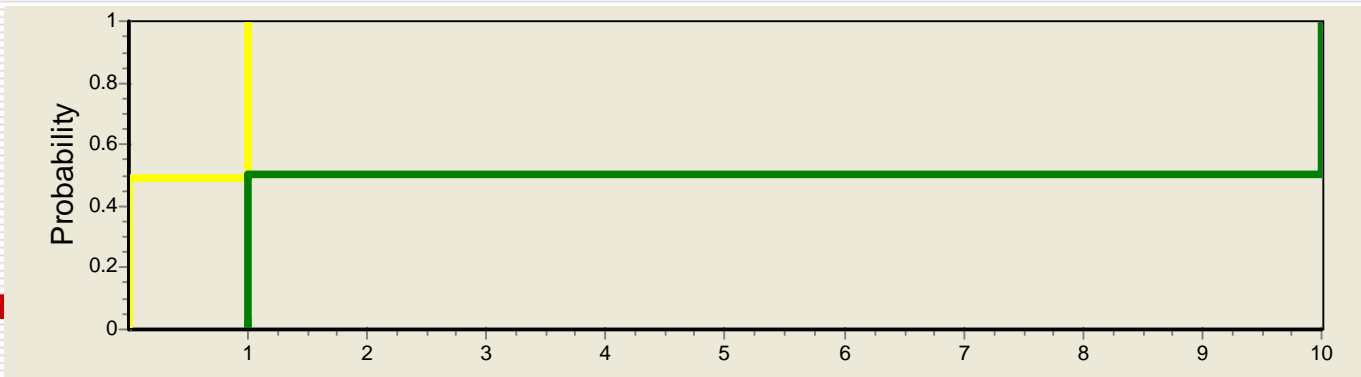
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Knowledge elements	Risk analyst query	<i>Expert response</i>
Conceptual model	What do you think is causing this problem?	
Conditioning	What are all the possible factors that influence detecting? What are the all conditions that you think are important to consider in describing the effect of this exposure on crops? If it were possible to have a constant level of exposure, what would you expect under different conditions?	
Type(s) of uncertainty	Is this uncertainty due to a lack of knowledge? Is it due to natural variation in the outcome (under which conditions)? (Specify conditions for predictions; specify remaining areas of uncertainty; assign types of uncertainty)	
Parameters	What concentrations do you see typically? How often do you see this? What are the <b>lowest/highest/typical</b> concentrations you have (ever) seen? What do you know about this range from the literature? From other experts? From your own observations?	

## *“...just my gut feeling”*

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- Three experts, three p-boxes, three different distributions
- These can be aggregated statistically, or they can be used to demonstrate expert uncertainty visually
- Further work will focus on standardising the protocol to improve the elicitation



Experts' P-boxes showing distributions of chloramine in recycled water used for irrigation

# A useful new tool to supplement environmental health risk analysis

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- Our experts agreed on only one thing: *that this exercise was very useful for them!*
- Our next steps are to refine the interview protocol,
- And to trial these methods with other environmental health risk scenarios with low probability and extreme consequences

# Acknowledgements

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