

Secondary Poisoning Assessment of Nickel to Aquatic and Terrestrial Organisms

Secondary Poisoning Assessment of Ni

Regulatory context

Nickel and selective Nickel compounds reviewed under **EU-ESR system**

EU Technical Guidance Document (TGD):

- 2° poisoning needs to be assessed for:
 - Avian and mammalian consumer organisms
 - Terrestrial and aquatic food chains
 - Marine and freshwater systems
- Applying TGD **default assumptions** led to unreasonable conclusions of risk:
 - Birds and mammals at risk at *natural background soil Ni* concentrations
- **Tiered approach developed** to provide a series of refinements to default assumptions
 - Discussed at Technical Committee for New and Existing Substances
 - Published in peer-reviewed literature (De Forest et al. 2011)

Food Chains Modeled in Secondary Poisoning Assessment

Aquatic:

seawater → fish / octopus / squid → mammal (harbor seal)

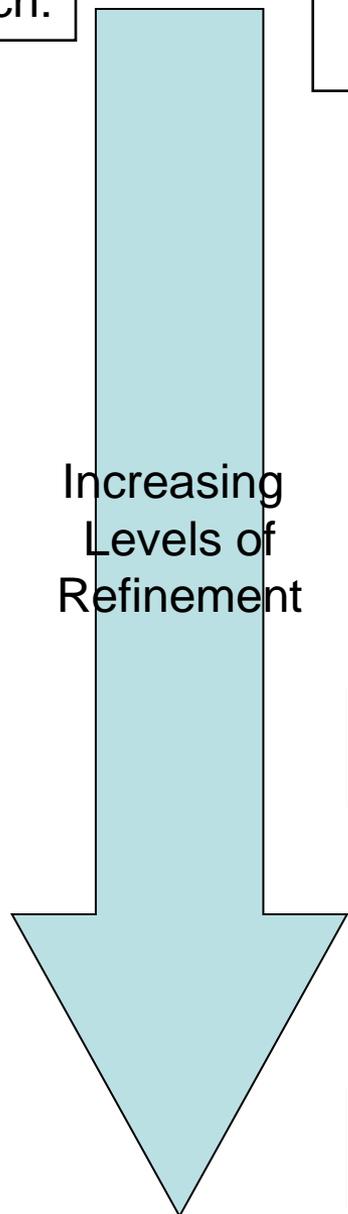
seawater → mollusc → bird (oystercatcher)

Terrestrial:

soil → earthworm → worm-eating bird / mammal
(robin or starling / shrew)

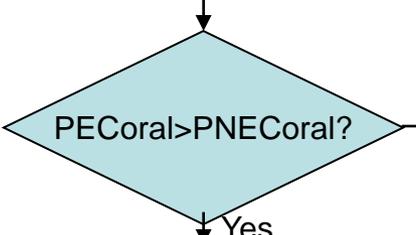
- Top predator not assessed because Ni exhibits biodilution, and top predators would therefore be exposed to lower Ni doses

Tiered Approach:



Tier 1: Generic TGD approach

- no consideration of bioavailability
- generic “consumer” PNEC_{coral}



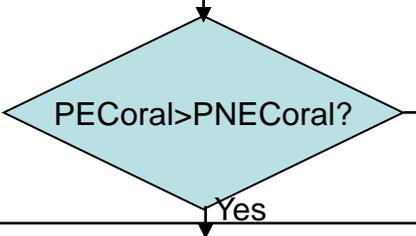
No

No further action

Yes

Tier 2: Refine to account for

- Species-specific PNEC_{coral}



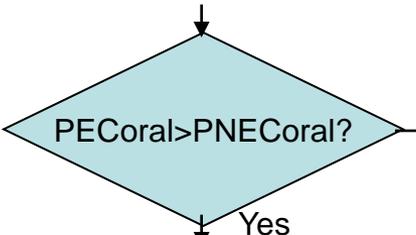
No

No further action

Yes

Tier 3: Refine to account for

- Bioavailability of dietborne Ni



No

No further action

Yes

Tier 4: Refine to account for

- Relevant dietary composition

Tier 1: Default Approach

- Default assumptions include:
 - “standard” consumer organism
 - PNEC_{oral} derived by applying 30-fold assessment factor to lowest NOAEL
 - 100% absorption of ingested metal
 - 100% of the diets of consumer organisms consist of worst case diet (prey showing highest BAF)
- When applied to Ni, ***risk at background concentrations*** was concluded for several scenarios
 - Terrestrial mammals, aquatic and terrestrial birds

Tier 2: Species-specific PNEC_{Coral} values

Food chains examined:

Aquatic:

seawater → fish / octopus / squid → **mammal (harbor seal)**

seawater → mollusc → **bird (oystercatcher)**

Terrestrial:

soil → earthworm → **worm-eating bird / mammal
(robin or starling / shrew)**

PNEC_{Coral} values calculated using *ingestion rate-to-body weight ratios* between test organism (e.g., rat) and selected consumer (e.g., harbor seal)

Tier 3: Correction for bioavailability of the dietborne fraction

- **Bioavailability** accounted for by *relative absorption factors* (RAF)
 - Compare absorption between test compound (e.g., NiSO₄) and relevant matrix (e.g., soil, food)
- For mammals, RAFs were:
 - Soil: 2.4%
 - Diet (e.g., earthworm): 10%
- No data available for birds
 - No bioavailability correction possible

Conclusion : still risk scenarios identified for certain food chain transfers

Tiered Approach for Terrestrial Mammals

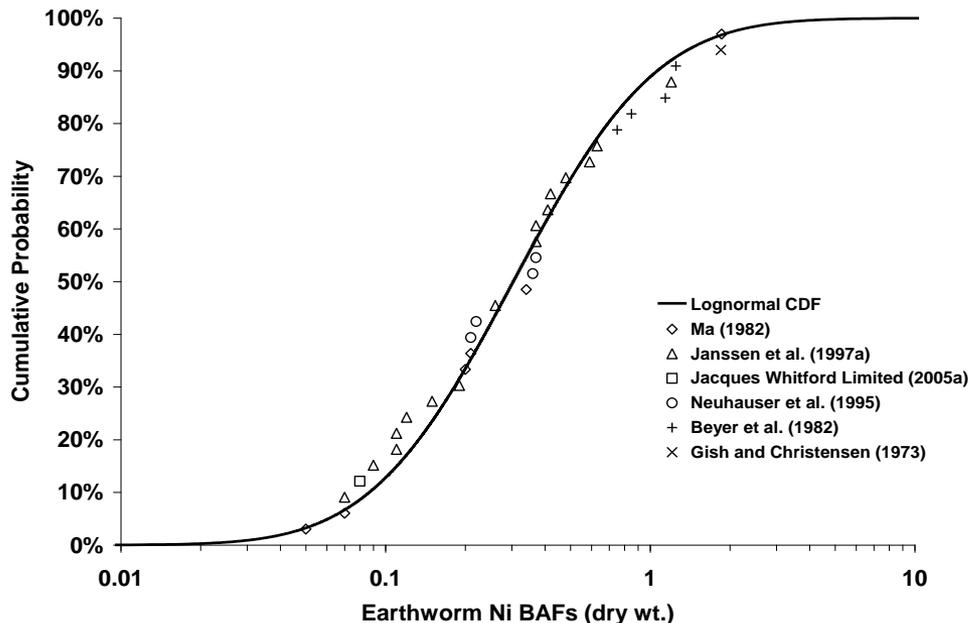
	Basis for PEC _{Coral}	RAF	Basis for PNEC _{Coral}	PEC / PNEC Ratio
Tier 1	Multiple scenarios based on different soil types	1	Generic ¹ PNEC = 0.73 mg kg ⁻¹	PEC _{reg} = 0.2-16 PEC _{loc} = 6.0
Tier 2	Multiple scenarios based on different soil types	1	Shrew ² PNEC = 0.12 mg kg ⁻¹	PEC _{reg} = 1.3-100 PEC _{loc} = 37
Tier 3	Multiple scenarios based on different soil types	0.015	Shrew ² PNEC = 0.12 mg kg ⁻¹	PEC _{reg} = 0.02-1.5 PEC _{loc} = 0.6

¹ Generic PNEC not adjusted for species-specific relative ingestion rate-to-body weight differences.

² Based on shrew-specific ingestion rate and body weight.

Tier 4: Correction for diet composition

- Diets of organisms are not uniform, nor are their capacities for accumulating metals
- Dietary compositions for consumer species were identified from the literature
 - e.g., diet of shrews is 30% earthworms, 70% other invertebrates (isopods)
- Species-specific BAFs used to estimate tissue concentrations of prey organisms



Summary

- Generic default assumptions often leads to Risk at background soil level (for metals)
- Tiered framework developed to assess (Ni) secondary poisoning
- Important refinements include:
 - bioavailability of dietborne Ni (for mammals)
 - species-specific PNEC
- Conclusion after refinements is that risk of Ni secondary poisoning is low