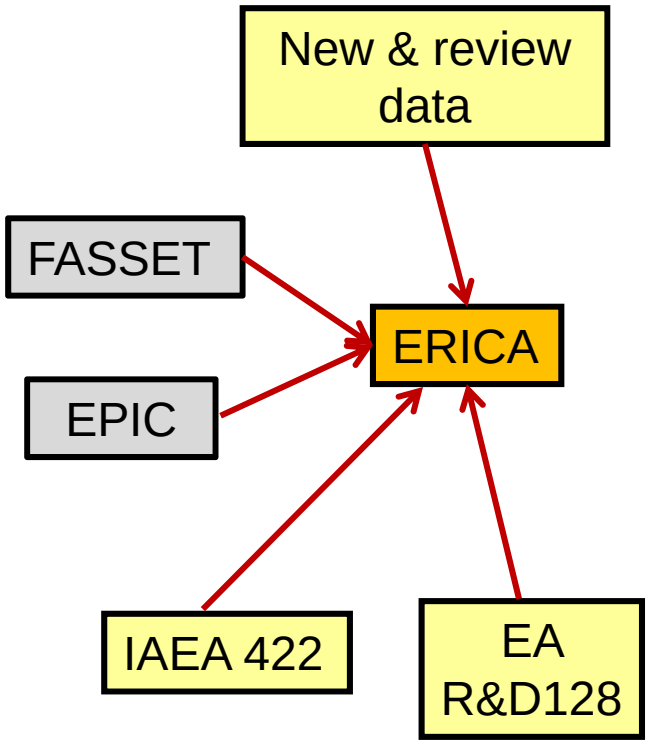
Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

Update on the derivation of the final CR data tables

N Beresford

Database evolution



ERICA database

What's in it?

Elements

- **Radionuclides to cover expected EIA scenarios, e.g. sources**
  - TENORM
  - Routine release (reprocessing, power production)
  - accidents
  - High level waste repository

- **31 radioelements (46 radioisotopes)**

Eleme

- **Radionuclides to cover expe scenarios, e.g. sources**
  - TENORM
  - Routine release (reprocessi production)
  - accidents
  - High level waste repository

- **31 radioelements (46 radioisc**

Ag	Silver
Am	Americium
C	Carbon
Cd	Cadmium
Ce	Cerium
Cl	Chlorine
Cm	Curium
Co	Cobalt
Cs	Caesium
Eu	Europium
H	Tritium
I	Iodine
Mn	Mangenese
Nb	Niobium
Ni	Nickel
Np	Neptunium
P	Phosphorus
Pb	Lead
Po	Polonium
Pu	Plutonium
Ra	Radium
Ru	Ruthenium
S	Sulphur
Sb	Antimony
Se	Selenium
Sr	Strontium
Tc	Technetium
Te	Tellurium
Th	Thorium
U	Uranium
Zr	Zirconium

Organisms

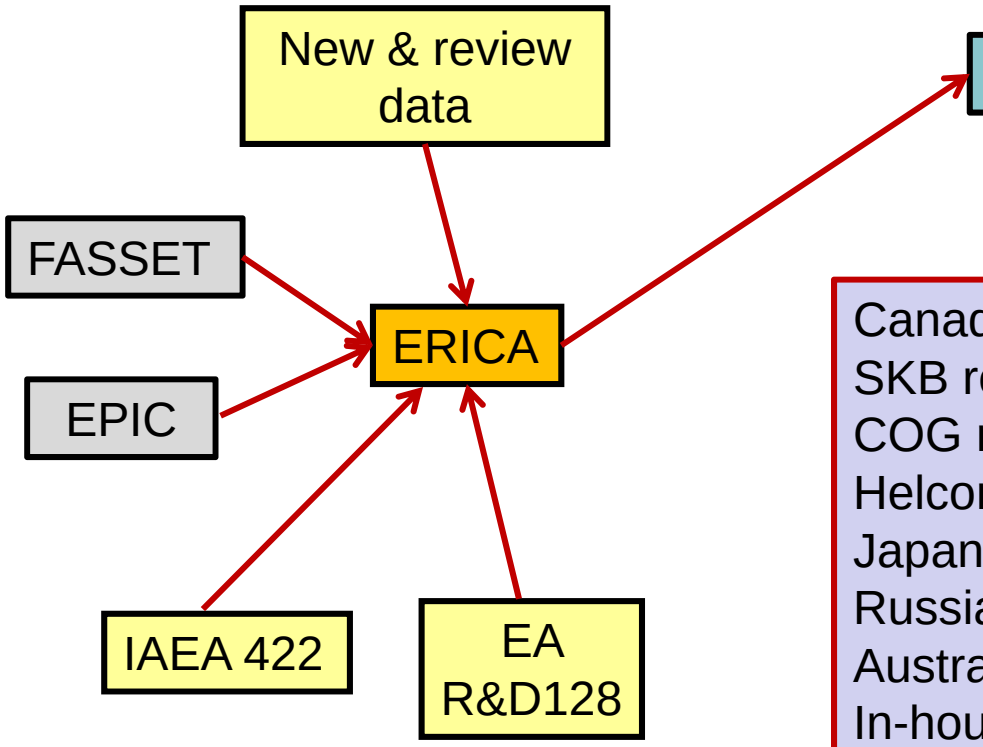
Selection criteria, reference organism list should encompass:

- Organisms likely to have comparatively high exposures
- Radiosensitive organisms
- Protected species
- Range of trophic levels
- Easy to sample

Organisms

Marine	***Freshwater***	***Terrestrial***
Phytoplankton	Phytoplankton	Grasses & Herbs
Macroalgae	Vascular plant	Shrub
Vascular plant	Zooplankton	Tree
Zooplankton	Insect larvae	Lichen & bryophyte
Polychaete worm	Bi-valve mollusc	Soil invertebrate (worm)
Bivalve mollusc	Gastropod	Gastropod
Crustacean	Crustacean	Flying insect
Benthic fish	Benthic fish	Mammal (deer)
Pelagic fish	Pelagic fish	Mammal (rat)
(Wading) bird	Bird	Bird
Mammal	Mammal	Bird egg
Reptile	Amphibian	Amphibian
Sea anemones/true corals		Reptile

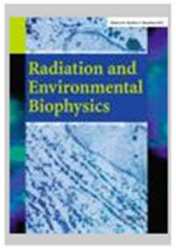
Database evolution



Wildlife TRS

Canadian U-mine industry (CNSC)
SKB reports (SSM, SU)
COG monitoring data (COG, TY)
Helcom Mors (STUK)
Japanese estuaries (NIRS)
Russian language literature (RIARAE, SF)
Australian data (ANSTO, SSD)
In-house databases (CEH, TY, SCK, MW)
Reptile review (MW)
Oregon Forest data (UoO)
Bird/rodent/bat data (IRL, CEH)
Post ERICA review (CEH, TY)

.... SENES, WSC, NRPA, KAERI, UoB .....



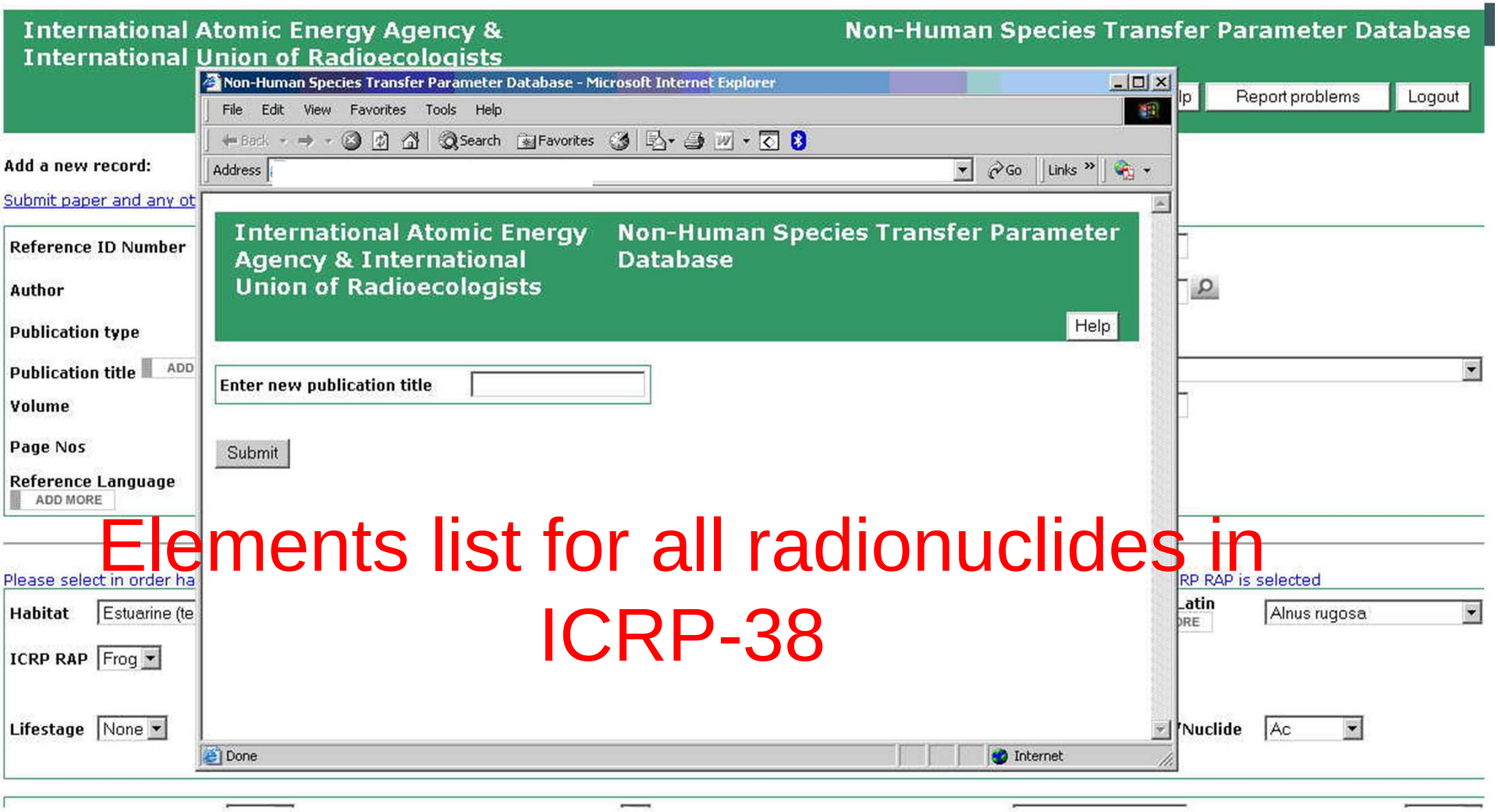
Radiation and Environmental Biophysics

Volume 1 / 1963 - Volume 49 / 2010

From Volume 1 (1963) to Volume 10 (1973), this journal was published as *Biophysik*.

Volume 49, Number 4 / November 2010

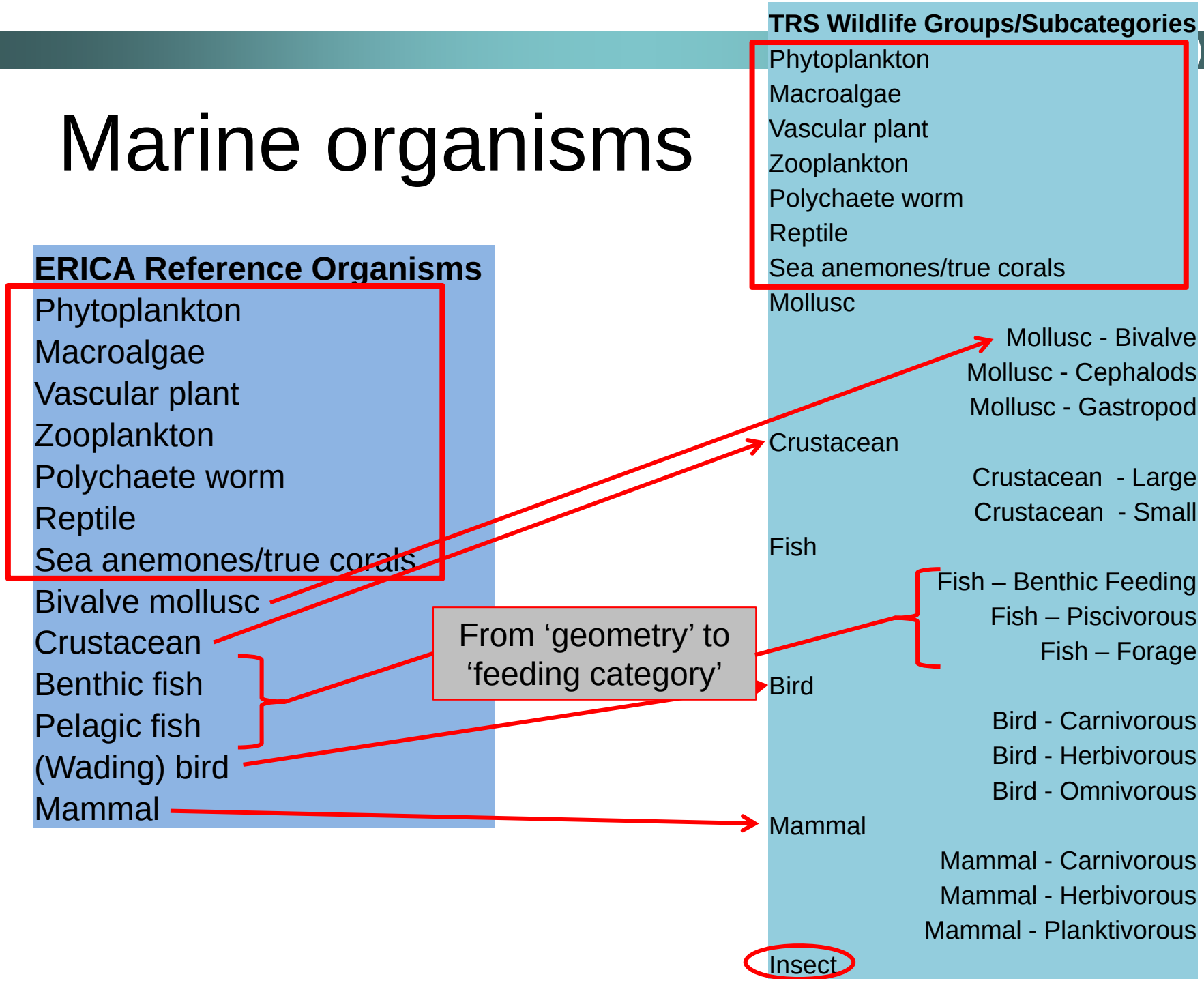
Viewing all 22 articles



Elements list for all radionuclides in ICRP-38

http://www.wildlifetransferdatabase.org/

Marine organisms



Freshwater organisms

ERICA Reference Organisms

Phytoplankton
Vascular plant
Zooplankton
Insect larvae
Gastropod
Bivalve mollusc
Crustacean
Benthic fish
Pelagic fish
Bird
Mammal
Amphibian

TRS Wildlife Groups/Subcategories

Phytoplankton
Algae
Vascular plant
Zooplankton
Reptile
Mollusc
Mollusc - Bivalve
Mollusc - Gastropod
Crustacean
Insect
Insect larvae
Fish
Fish - Benthic Feeding
Fish - Piscivorous
Fish - Forage
Bird
Bird - Carnivorous
Bird - Herbivorous
Bird - Omnivorous
Mammal
Mammal - Carnivorous
Mammal - Herbivorous
Mammal - Planktivorous
Amphibian

Terrestrial organisms

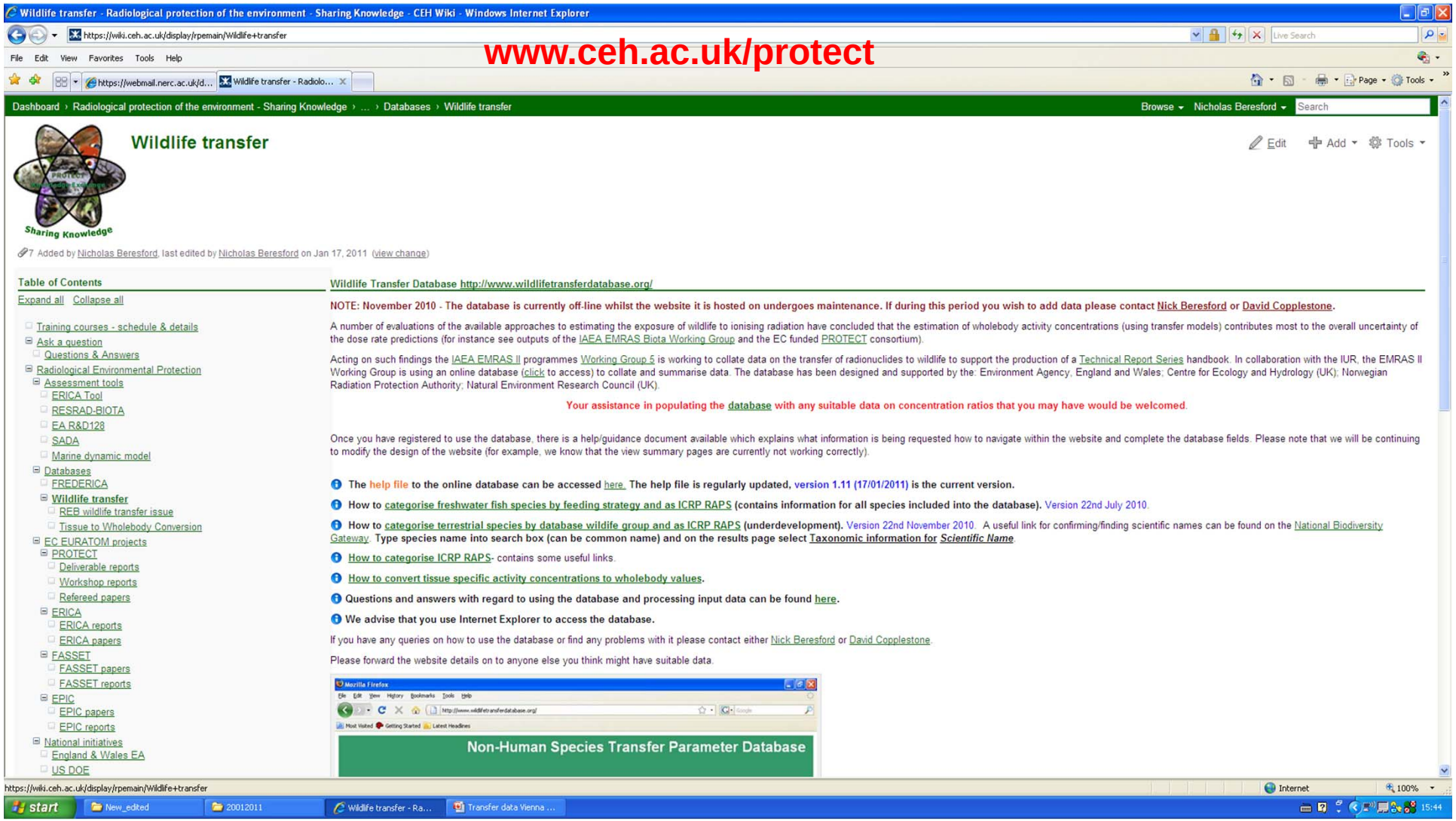
ERICA Reference Organisms

- Grasses & Herbs
- Shrub
- Tree
- Lichen & bryophytes
- Soil invertebrate (worm)
- Detritivorous invertebrate
- Gastropod
- Flying insects
- Mammal
- Bird
- Bird egg
- Reptile
- Amphibian

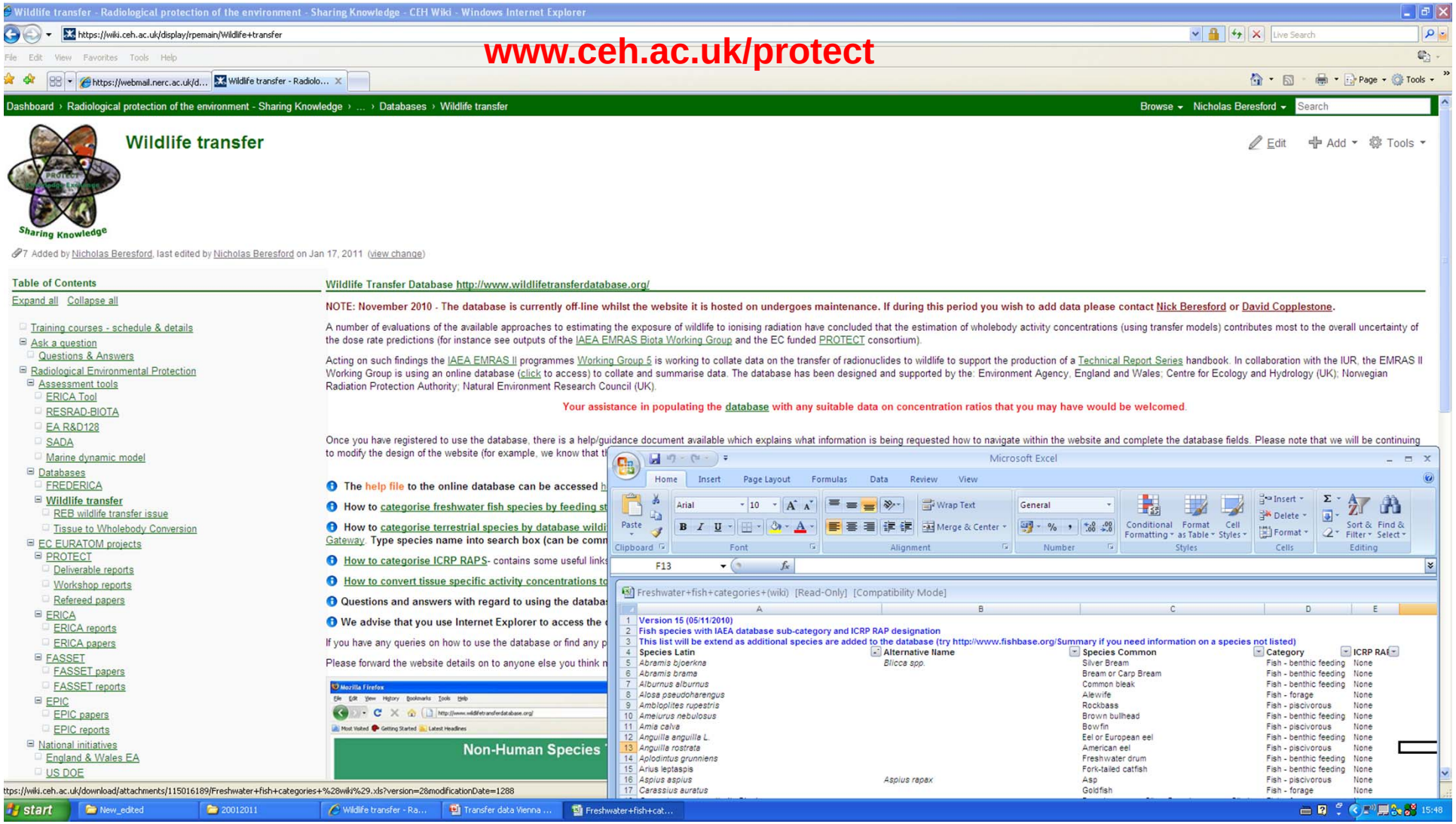
TRS Wildlife Groups/Subcategories

- Grasses & Herbs
  - Grassess
  - Herbs
- Shrub
- Tree
  - Tree - Coniferous
  - Tree - Broadleaf
- Annelid
- Arachnid
- Arthropod
  - Arthropod - Herbivorous
  - Arthropod - Carnivorous
  - Arthropod - Detritivorous
- Gastropod
- Bird
  - Bird - Herbivorous
  - Bird - Carnivorous
  - Bird - Omivorous
- Mammal
  - Mammal - Herbivorous
  - Mammal - Carnivorous
  - Mammal - Omivorous
  - Mammal - Marsupial
  - [Mammal - Rangifer spp.]
- Reptile
  - Reptile - Herbivorous
  - Reptile - Carnivorous
- Amphibian
- Fern
- Fungi

Categorising organisms



Categorising organisms



ERICA database review

- Started with ERICA databases for generic freshwater, marine and terrestrial ecosystems:
  - Re-categorised to 'IAEA' wildlife groupings and sub-categories and also by ICRP RAP
  - QC:
    - marine - resulted in some reductions in data (tissue specific data)
    - freshwater - identified that considerable number of values originated from review publications
    - freshwater - some instances where tissue specific data and not wholebody had been used

New data treatment

www.ceh.ac.uk/protect

- Yankovich et al. (2010) used to convert tissue to wholebody data (for new entries) if information not available in source

New data treatment

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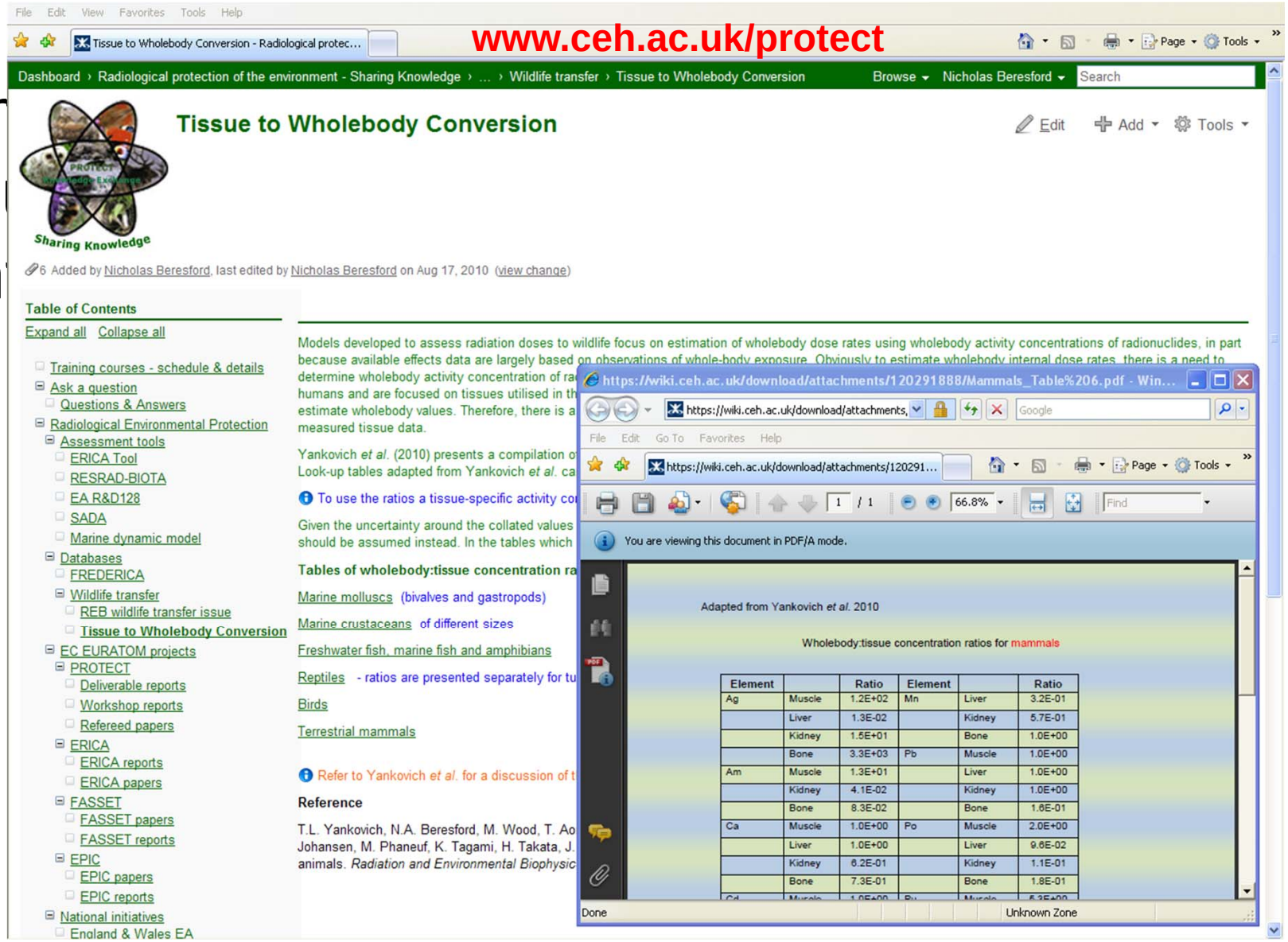


New data treatment

- Yankovich et al. (2010) used to convert tissue to wholebody data (for new entries) if information not available in source
- QC on entry, exclude if unclear:
  - DW or FW, tissue or wholebody, co-location of biota and water …
  - Duplicate data
  - Laboratory data (other than for freshwater algae, phyto/zoo-plankton, sea anemone)

Data entries

In total approximately 50,000 entries comprising 87,000 CR_{wo} values from 520 sources:

Ecosystem	Entries	Values
Estuarine (water)	3259	4190
Estuarine (terrestrial)	119	141
Freshwater $CR_{wo\text{-}water}$	30825 10441	42878 16814
Marine	3441	10229
Terrestrial	12276	29848

- There is bias in some datasets, e.g.
  - Lots of data from Canada for freshwaters
  - All terrestrial Tc data from UK sand dunes
  - Terrestrial bird/mammal Pu/Am signif. amount of data from Chernobyl zone
  - Estuarine is either Baltic or Japanese estuaries

Derivation of values in tables

$$CR_{wo\text{-}soil} = \frac{\text{Activity concentration in whole organism (Bq kg}^{-1}\text{ fresh weight)}}{\text{Activity concentration in soil (Bq kg}^{-1}\text{ dry weight)}}$$

$$CR_{wo\text{-}water} = \frac{\text{Activity concentration in whole organism (Bq kg}^{-1}\text{ fresh weight)}}{\text{Activity concentration in water (Bq l}^{-1}\text{)}}$$

Derivation of values in tables

- Weighted arithmetic means and SD calculated (i.e. taking into account ‘n’ for each entry)
- Geometric means and GSD approximated from the arithmetic values
- Minimum and maximum entry reported together with N
  - the min. and max. may be for individual samples or may be for a mean value (with associated SD)

GM v's minimum

In some instances GM < minimum

Wildlife	Radionuclide	AM	AMSD	GM	GSD	Min	Max	n
Vascular Plant	Hf	1.2E+1	2.2E+1	5.4E+0	3.4E+0	1.1E+1	1.3E+1	6
Mollusc	I	8.3E+1	2.6E+1	7.9E+1	1.4E+0	8.0E+1	1.0E+2	7
Fish	Sc	6.9E+0	3.4E+0	6.2E+0	1.6E+0	6.3E+0	7.4E+0	6
Vascular Plant	Zr	4.1E+1	3.5E+1	3.1E+1	2.1E+0	4.0E+1	4.2E+1	6

CRN	CR	CRSD
6	80	27
1	102	

$$GM = \exp\left(-0.5\ln\left(\frac{AMSD^2 + AM^2}{AM^4}\right)\right)$$

Wildlife subcategories

- In addition wildlife group values for CR_{wo} for subcategories have been presented where possible
  - Sub-category not considered for inclusion if the number of data were <10
  - Number of references also taken into account
- Major wildlife group data include sub-category data
- Some instances where one sub-category contributes all the data for a wildlife group
  - Identified in tables

Wildlife subcategories

DRAFT – DO NOT QUOTE OR USE VALUES

Vanadium (V)								
Lichens and bryophytes	2.0E-01	2.9E-01	1.1E-01	2.9E+00	2.2E-02	1.2E+00	32	348, 355
Shrub	4.7E-02	6.9E-02	2.6E-02	2.9E+00	7.5E-03	3.4E-01	64	347, 348
Tungsten (W)								
Tree - coniferous*	4.7E-01						1	467
Ytterbium (Yb)								
Grasses and herbs	5.7E-03	8.5E-03	3.1E-03	3.0E+00	2.6E-04	7.5E-03	4	467
Lichens and bryophytes	9.8E-03	1.2E-02	6.3E-03	2.6E+00	3.3E-03	3.1E-02	5	467
Shrub	8.4E-03	3.4E-03	7.8E-03	1.5E+00	6.0E-03	1.0E-02	5	467
Tree - coniferous*	3.2E-03						2	467
Zinc (Zn)								
Annelid	4.0E+00	1.6E+00	3.7E+00	1.5E+00	1.9E+00	7.0E+00	383	344
Arthropod	1.1E+00	6.1E-01	9.7E-01	1.7E+00	3.0E-01	3.6E+00	257	344
Arthropod - Detritivorous	1.7E+00	1.2E+00	1.4E+00	1.9E+00	3.0E-01	3.6E+00	38	344
Grasses and herbs	1.8E+00	2.8E+00	9.6E-01	3.1E+00	1.8E-02	8.7E+00	12	334, 467
Lichens and bryophytes	1.8E+00	1.7E+00	1.3E+00	2.2E+00	2.9E-02	7.6E+00	100	334, 342, 345, 348, 355, 467
Reptile - Carnivorous*	2.0E-01	3.9E-01	9.2E-02	3.5E+00	1.6E-01	2.4E-01	30	487
Shrub	4.5E+00	3.5E+00	3.5E+00	2.0E+00	4.0E-02	1.6E+01	250	342, 345, 347, 348, 467
Tree	3.1E-02	2.0E-02	2.6E-02	1.8E+00	8.4E-03	4.7E-02	4	467
Zirconium (Zr)								
Shrub	9.4E-05	8.1E-05	7.2E-05	2.1E+00			64	249

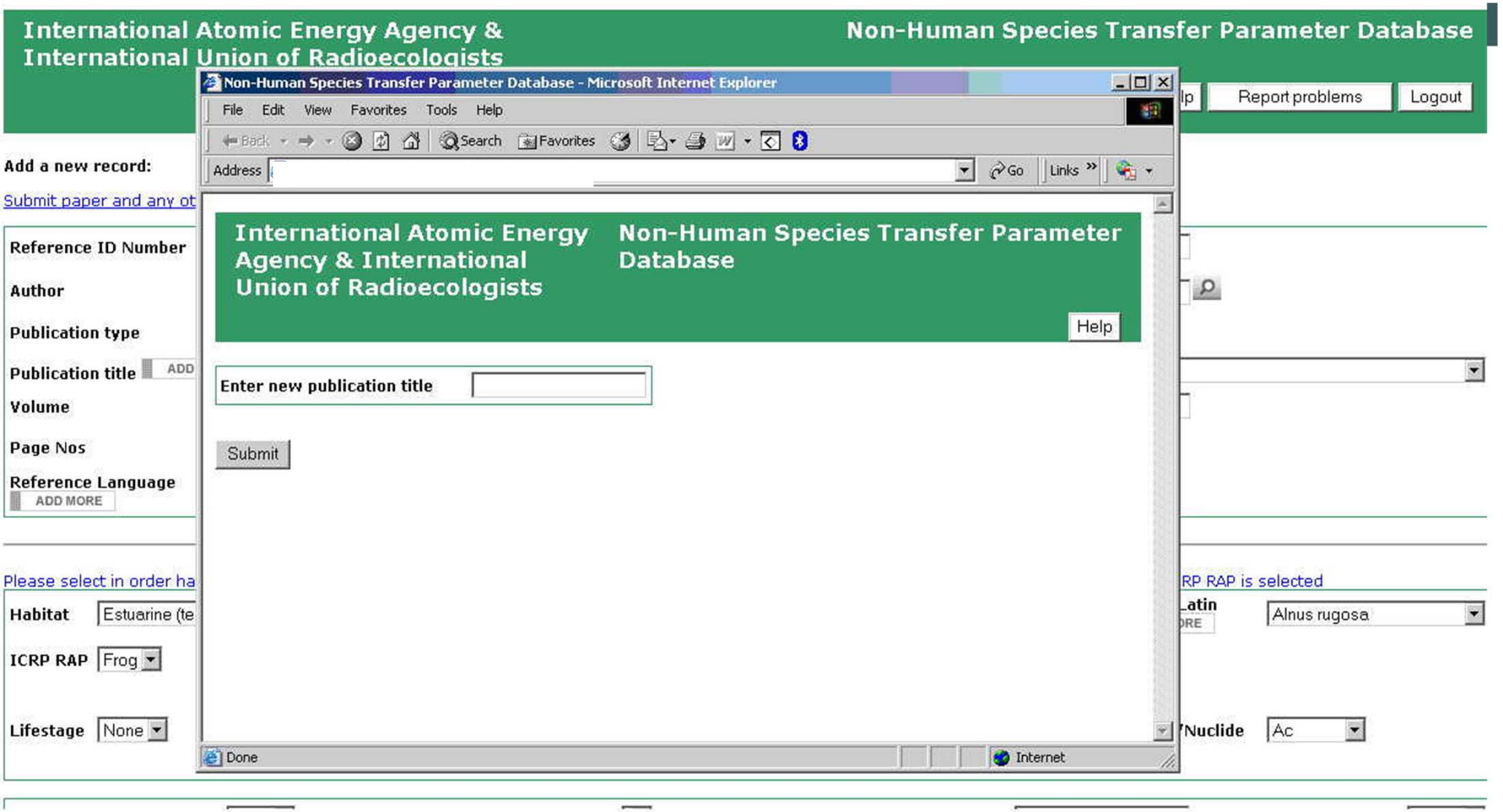
*All data for wildlife group are for subcategory presented; + not included in the mammal wildlife group value

t

– Identified in tables

What's not presented

- No $CR_{wo\text{-}sed}$ values – virtually only Canadian fish data & not (to our knowledge) being routinely used
- New wildlife groups where very little data entered – fungi, fern
- Any consideration of habitat sub-category (e.g. freshwater-flowing, freshwater-lake)



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