You Are What You Eat:
Evaluating Exposures by Subsistence Exposure Scenarios

Barbara Harper & Stuart Harris,
CTUIR Dept. of Science & Engineering
Santa Ana Pueblo and EPA Region 6
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Exposure scenarios are narrative and numerical descriptions of how a person interacts with the environment. Any risk-based decision uses exposure factors.

**Exposure scenarios used to:**

- Evaluate multipathway exposure and risk (Superfund site);
- Evaluate single exposure pathways (water);
- Develop environmental codes and standards (Cleanup goals, Water quality standards)
Scenario =  
- Where you go
- What you do
- What you eat

Exposure =  
What contaminants are in each medium – air, water, soil, food…
(Sampled or modeled)

DOSE =  
How toxic is each chemical

RISK =  
The Risk Assessment Process
Typical Exposure Assessment Model
- Suburban lifestyle

- Air release
- Groundwater release

Little environmental contact.
Few exposure pathways.

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Defining temporal scope of the scenario

Past
What were past doses?
Past ingestion rates
Original conditions

Present
What are the risks now?
Current ingestion rates
Current (contaminated)

Future
What could risks be in the future?
Future ingestion rates
Restored (residual)
EPA (Omernick) Ecoregions

- Scenarios – EPA Star Grant (OSU; Harper) and/or mixed funding
- Scenarios – other funding sources
Data Needs

- What types of information and what level of detail?
  - Team – toxicologist, ethnohistorian/anthro, ecologist, tribal cultural/nat. resources.
  - Ecological description. Scenarios are habitat-based, first and foremost.
  - Tribal lifestyle, general resource use
  - TEK, interviews, ethnobotany
  - Literature – biomedical, anthro, historical, other.
  - Specific dietary studies, foraging theory.
Tribal Scenarios or Exposure Factors are at the intersection of three areas:

- **Anthropology or Ethnography**
  - Describing Traditional Lifeways With Natural Resource uses.
  - Foraging Theory.

- **Ecology**
  - What natural resources are present in the local Environment.
  - Eco-Cultural Ecology through a Cultural lens; what is Useful, edible, important.

- **Toxicology or Risk Assessment**
  - How are people exposed, What is the diet, what is the frequency, duration, and Intensity of environmental contact.

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XX Tribe’s Food Pyramid
2500 kcal/day –
(Quantities of each food group by %)

Risk Assessment can handle only limited detail, so we must be complete but low precision.

Not an exhaustive species list. Probably proprietary. Only major staples and most important foods and medicines as surrogates for entire food categories and genera.
Columbia River Tribes

500 pounds of fish per capita per year (620 grams per day).

Boldt decision and extensive documentation

NOT
6.5, 17.5, or 142 gpd.
The Diet – Multiple Lines of Evidence

1. Direct Observation (early explorers and naturalists)
2. Early Records (e.g. traders, fish buying records)
3. Foraging Theories –
   • Return rates of calories expended vs calories obtained
   • Ecological-based data – patch choice etc.
4. Ecology and ecoregions, habitat types, potential natural veg.
5. Archaeology – hard vs soft remains, excreta microscopy
6. Paleomedicine – skeletal evidence, bone isotopes
7. Traditional Environmental Knowledge, language, oral history and current use by a subset of tribal members.
8. Ethnobotany
### Hunting

- Learn skills, TEK
- Making tools
- Sweat Purify
- Vigorous activity in hunting
- Pack meat out
- Process
- Scrape hides
- Tan, use other parts
- Cook, smoke, dry, eat meat and organs

### Sweatlodge

- Learn skills, songs
- Build lodge from natural materials
- Gather rocks
- Chop firewood
- Prepare for use, get water
- Use Lodge, sing, drink water, inhale steam and smudges
- Close area & fire

### Gathering

- Learn skills, TEK
- Previous gathering
- Make baskets, bags
- Hike to areas
- Cut, dig, harvest
- Carry out items
- Wash, peel, process, split, spin, dye
- Cook and eat or make product or make medicine
- Return carcasses to ecosystem, use as fertilizer

### Fishing

- Learn skills, TEK
- Make nets, poles, platforms, tools
- Travel to location
- Catch fish, haul out
- Clean, can, hard dry, soft dry, smoke, eat whole fish or fillet or liver or soup

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**Soil Ingestion**

**Sediment Ingestion**

**Water Ingestion**

**Inhalation**

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### Examples of Exposure Factors

<table>
<thead>
<tr>
<th>Exposure Factor</th>
<th>Suburban</th>
<th>Subsistence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drinking water</td>
<td>2 liters/day</td>
<td>2+ L/d</td>
</tr>
<tr>
<td>Fish ingestion</td>
<td>17.5 grams/d</td>
<td>up to 2-3 lbs/d</td>
</tr>
<tr>
<td>Soil ingestion</td>
<td>50/100 (adult)</td>
<td>400 mg/d</td>
</tr>
<tr>
<td></td>
<td>200 mg/d (child)</td>
<td>(all ages)</td>
</tr>
<tr>
<td>Inhalation rate</td>
<td>20 m$^3$/d</td>
<td>30 m$^3$/d</td>
</tr>
<tr>
<td>Frequency of exposure</td>
<td>varies</td>
<td>continual</td>
</tr>
<tr>
<td>Duration of exposure</td>
<td>24-30 yrs</td>
<td>lifetime</td>
</tr>
<tr>
<td>Sweat lodge use</td>
<td>NO (showering)</td>
<td>YES</td>
</tr>
</tbody>
</table>

**RESULT:** Subsistence lifestyles result in 10 to 1000 times more exposure than suburban lifestyles.
Barbara Harper
509-967-5174
bharper@amerion.com

Stuart Harris
541-966-2400
stuartharris@ctuir.com