Indirect Effects of Pesticides to Listed Species: Key Statutory and Regulatory Considerations

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Listed Species

- More than 1900 listed under ESA
- USFWS manages terrestrial and freshwater species
- NMFS manages marine and anadromous species.
- NMFS currently has jurisdiction over 67 listed species.
Species Under NMFS Jurisdiction

- Marine Mammals (21)
- Marine Turtles (8)
- Marine and Anadromous Fish (34)
- Marine Invertebrates (3)
- Marine Plants (1)
NMFS/OPR Approach for Assessing Indirect Effects of Pesticides to Listed Species
Problem Formulation from US EPA 1998 Guidelines for Ecological Risk Assessment

- Integrate Available Information
- As Necessary: Acquire Data, Iterate Process, Monitor Results
- Planning (risk assessor/ risk manager/interested parties dialogue)
- Assessment Endpoints
- Conceptual Model
- Analysis Plan
Purpose of the Endangered Species Act

“"The purposes... are to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved, to provide a program for the conservation of such endangered species and threatened species, and to take such steps as may be appropriate to achieve the purposes of the treaties and conventions set forth in subsection (b) of this section”

Section 2(b) of the Endangered Species Act
Section 7 Requires:

All federal agencies to consult with the Services (USFWS, NMFS) to **insure any action** they authorize, fund, or carry out **is not likely to jeopardize** the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of designated critical habitat.
Risk Framework

**Action Stressors**
- Pesticide, metabolites, degradates, adjuvants

**Exposure Analysis**
- Co-occurrence: Stressors & listed resources
  - Distribution of individuals
  - Distribution of habitat

**Response Analysis**
- Effects of Stressors on ESA-listed Species and their habitat
  - Individual responses
  - Habitat responses

**Risk Characterization**
- Exposure Profile
- Response Profile
Risk Characterization

- Effects on individuals
- Effects on populations
  - Effects on species (ESU or DPS)
    - Can we insure that pesticide actions are not likely to jeopardize the continued existence of the species?
- Effects of habitat
  - Effects on primary constituent elements
    - Effects on conservation value of designated critical habitat
      - Can we insure that pesticide actions are not likely to adversely modify or destroy designated critical habitat?
Data Standards

- The data standard for consultation is “Best Scientific and Commercial Data Available”
- We have guidelines for what constitutes “Best Available” [59 FR 34271 (July 1, 1994)]
- We do not exclude any data from consideration including:
  - Toxicity tests that are not conducted according to standard protocols
  - Studies not conducted according to GLP
Use of Best Scientific and Commercial Data

![Diagram showing quality vs. relevance categories]

- High quality, high relevance
- High quality, low relevance
- Low quality, low relevance
- Low quality, high relevance
Stressors to Consider
Federal Action

“Authorization for use or uses described in labeling of a pesticide product containing a particular pesticide active ingredient.”

Understandings reached NMFS-USFWS-USEPA meeting 12/12/2007
Deconstruction of the Action

- Stressors associated with action based on review of EPA authorized labels
  - Active ingredient
    - Metabolites and degradates
  - Other ingredients
  - Recommended tank mixtures
  - Adjuvants
  - Application restrictions/ methods
Indirect Effects: Problem Formulation

- Develop risk hypotheses based on:
  - how the species interacts with its environment,
  - what is known about the pesticide
    - Mode/mechanism of action
    - Environmental fate
    - Adverse biological/ecological responses
Primary Constituent Elements (PCEs)

- Definition: physical and biological features that are essential to the conservation of the species
- How they are used
Southern Resident Orca Primary Constituent Elements

- Water quality – to support growth and development of the orca population
- Prey species – protecting quality, quantity, and availability of the orca’s food supply
- Passage conditions – ensuring room for migration, resting, and foraging.
Orcas from L pod, usually seen in Washington state waters, surface near Cypress Point, Calif. Scientists suggest the pod may be driven to swim hundreds of miles just to meet minimum nutritional requirements. (Photo: Nancy Black / Monterey Bay Whale Watch)
Are the orcas starving?

*Seattle Post Intelligencer* - 10/24/2008

- Orcas strong preference for Chinook salmon
- Many of the Chinook runs faltering
- Evidence Orcas starving
- Largest reduction in orca populations since series of bad Chinook seasons in 1990s
Influence on Orca Food Resources

**Stressors**
- A.I.s
- metabolites
- degradates
- others
- +

**Matrices**
- terrestrial environment
- water column
- sediment/pore water
- aquatic biota

**Exposure**
- terrestrial inverts
- aquatic inverts

**Responses**
- habitat effects
- health effects

**Life stages**
- egg
- alevine
- fry/ juvenile/ smolt
- adult

Chinook salmon

Stressors in baseline
Scope of Effects

**Informal consultations**

Purpose: Insure no jeopardy / adverse modification

Product: NLAA concurrence / non-concurrence

Scale: individual organisms, critical habitat, duration of project

Screening assessment: If NLAA then no jeopardy
<table>
<thead>
<tr>
<th><strong>Informal consultations</strong></th>
<th><strong>Formal consultations</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Purpose:</strong> Insure no jeopardy / adverse modification</td>
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<tr>
<td><strong>Product:</strong> NLAA concurrence / non-concurrence</td>
<td><strong>Product:</strong> Biological Opinion</td>
</tr>
<tr>
<td><strong>Scale:</strong> individual organisms, critical habitat, duration of project</td>
<td><strong>Scale:</strong> individual organisms, critical habitat, population, species</td>
</tr>
<tr>
<td><strong>Screening evaluation:</strong> If NLAA then no jeopardy</td>
<td><strong>Comprehensive evaluation:</strong> includes quantification of amount and extent of take</td>
</tr>
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Endangered Species Act definitions

ESA Consultation Handbook

- **Not likely to adversely affect (NLAA)** – effects on listed species are expected to be *discountable*, or *insignificant*, or *completely beneficial*.

- **Discountable** – Extremely unlikely to occur... can’t measure or detect

- **Insignificant** – should never reach the scale where *take* occurs.
Endangered Species Act definitions
ESA Consultation Handbook

- **Take** – “to harass, harm, pursue…”

- **Harm** – “any significant habitat modification or degradation that results in death or injury... significantly impairing behavioral patterns such as breeding, feeding, or sheltering”

- **Harass** – “…to significantly disrupt normal behavior patterns which include but are not limited to, breeding, feeding or sheltering”
How does NMFS reach conclusions in a biological opinion?

- Our process is defined in the USFWS/NMFS Consultation Handbook (1998)
- Major Components:
  - Status of Species
  - Baseline
  - Effects of Action
  - Cumulative Effects
Environmental Baseline

By regulation, environmental baselines for biological opinions include the past and present impacts of all state, Federal or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process (50 CFR §402.02).
Snake River Spring/Summer-run Chinook
## Contaminants detected in Puget Sound

<table>
<thead>
<tr>
<th>Contaminant groups</th>
<th>Select example(s)</th>
<th>Source and Use Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fertilizers</td>
<td>Phosphorus, Nitrogen</td>
<td>lawns, golf courses, urban landscaping</td>
</tr>
<tr>
<td>Pesticide ingredients</td>
<td>Chlorpyrifos, Diazinon, Carbaryl, Atrazine, Esfenvalerate, Creosote, DDT, Copper sulfate, Metalaxyl, Nonylphenol</td>
<td>golf courses, right of ways, lawn and plant care products, pilings, bulkheads, fences</td>
</tr>
<tr>
<td>Pharmaceuticals, personal care products</td>
<td>Ethinyl estradiol, Nonylphenol</td>
<td>municipal and industrial waste discharges</td>
</tr>
<tr>
<td>PAHs</td>
<td>Tricylic PAHs</td>
<td>fossil fuel combustion, creosote treated wood</td>
</tr>
<tr>
<td>Industrial chemicals</td>
<td>PCBs, PBDEs, Dioxins</td>
<td>utility infrastructure, flame retardants, electronic equipment</td>
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</table>
Pesticide Mixtures

- Two or more pesticides are detected in agricultural, urban, and mixed use watersheds more than 90% of the time*
- Monitoring in urban streams across U.S.**
  - Two or more herbicides in 85% samples
  - Two or more insecticides in 54% samples
  - Four or more herbicides were detected in 61% of the water samples.
- Monitoring by WSDA in listed salmonid habitats***
  - Urban sites: Averaged 3 pesticides/sample, found up to 9 pesticides in a single sample.
  - Agricultural sites: Averaged 3-5 pesticides/sample, found up to 14 pesticides in a single sample.

Source:


Conceptual Framework for Assessing Risk to Listed Species

Exposure Profile

- Effects on individuals
- Effects on populations
- Effects on species

Response Profile

- Effects on habitat
- Effects on PCEs
- Effects on conservation value of designated habitat

Can we insure that pesticide actions are not likely to jeopardize the continued existence of the species?

Can we insure that pesticide actions are not likely to adversely modify or destroy the designated critical habitat?

Analyzed within the context of the Environmental Baseline (including multiple stressors such as temperature and environmental mixtures of pesticides); the Status of the Species; and Cumulative Effects
## Handling Uncertainty

<table>
<thead>
<tr>
<th>Type 1 Error</th>
<th>Type 2 Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reject true null hypothesis - Claim an effect when none exists</td>
<td>Accept false null hypothesis - Claim no effect when one exists</td>
</tr>
<tr>
<td>Protect Species more than necessary</td>
<td>Protect species less than necessary, even lose species</td>
</tr>
<tr>
<td>Lose scientific credibility</td>
<td>Lose practical and scientific credibility</td>
</tr>
<tr>
<td>Increase socioeconomic costs more than necessary</td>
<td>Permit activities that should not have been approved</td>
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Concluding Remarks