Interim Approaches for National-Level Pesticide Endangered Species Act Assessments Based on the Recommendations of the National Academy of Sciences April 2013 Report

I. Introduction

In September 2010, the National Research Council, Division on Earth and Life Studies, Board on Environmental Studies and Toxicology convened the Committee on Ecological Risk Assessment pursuant to the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) and the Endangered Species Act (ESA) (Committee). The Committee was convened at the request of the U.S. Environmental Protection Agency (EPA); U.S. Fish and Wildlife Service, and the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (collectively, the Services); and the U. S. Department of Agriculture (referred to as the Agencies). The Agencies jointly requested the examination of scientific and technical issues associated with determining the risk of pesticide registration and use to threatened and endangered species protected by the ESA. The Agencies asked the National Academy of Sciences (NAS) to provide advice on a range of subjects related to risk assessment and the consultation process including best available data, consideration of sub-lethal, indirect and cumulative effects, assessing the effects of chemical mixtures and inert ingredients, the role and use of models, uncertainty, and the use of geospatial information and datasets.

On April 30, 2013, the Committee provided their recommendations to the Agencies in the form of a report entitled, *Assessing Risks to Endangered and Threatened Species from Pesticides* (National Research Council, 2013; http://www.nap.edu/catalog.php?record_id=18344). Since then, the Agencies have been working together to develop shared scientific approaches that reflect the advice provided by NAS, and have developed joint interim scientific approaches for assessing the risks of pesticides to endangered and threatened species (hereafter referred to as listed species), based on the NAS recommendations. The Agencies are also working on increasing the opportunities for stakeholder input during the review of pesticide registrations under FIFRA and associated consultations under the ESA.

The interim approaches for the pesticide ESA consultation process, which are based on shared assumptions, data, analytical processes and models, will be applied collaboratively as part of EPA's Registration Review program beginning in 2014. The Registration Review program, mandated under the Food Quality Protection Act (FQPA), makes sure that, as the ability to assess risk evolves and as policies and practices change, all registered pesticides continue to meet the FIFRA statutory standard of no unreasonable adverse effects to human health or the environment. The Agencies will work together to develop refined and improved techniques and approaches over time.

Described below in Section II are the general agreements reached by the EPA, FWS, NMFS and USDA. Section III outlines the interim processes that will be used for the initial pesticide consultations conducted under registration review.

II. General Agreements for Pesticide Consultation Process

The Agencies will generally use a three-step consultation process, as outlined in the NAS report (NRC, 2013) [*i.e.*, Step 1 ('No Effect/May Affect' determination), Step 2 ('Not Likely to

Adversely Affect (NLAA)/Likely to Adversely Affect (LAA)' determination), and Step 3 ('Jeopardy/No Jeopardy' determination and "adverse modification/no adverse modification" determination on effects to designated critical habitat(s)], with the understanding that the data and analyses for each step will be used, when possible, for the subsequent steps (see Figure 1). One goal of the interim approach is a streamlined consultation process that relies on best available data, data relevance, risk characterization, and robust quantitative and qualitative analyses.

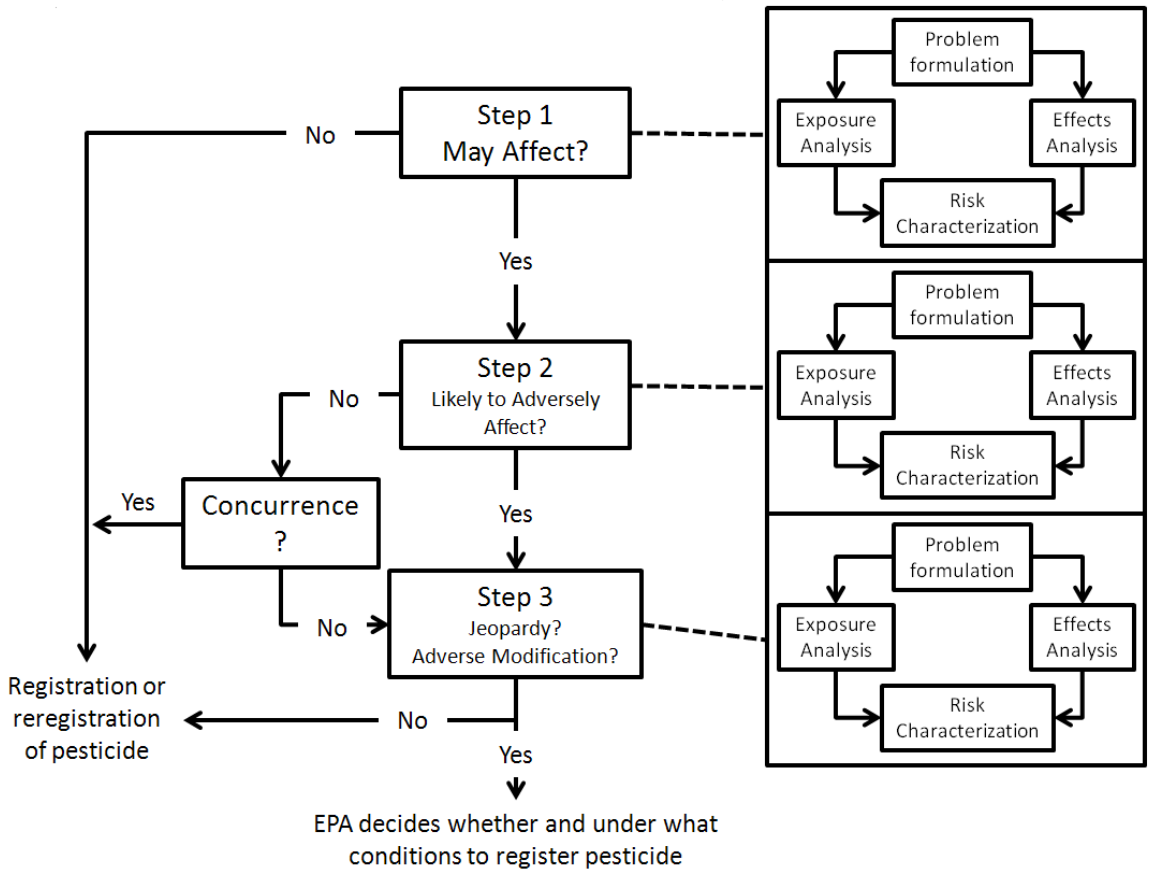

FIGURE 1. Relationship between the ESA process and the ecological risk assessment (ERA) process. Each step answers the question that appears in the box (revised from NRC, 2013, p. 6).

At each step the same four elements – problem formulation, exposure analysis, effects analysis, and risk characterization – should be applied and given the appropriate level of effort needed to address the questions at hand. For example, listed species risk hypotheses are developed during problem formulation for Steps 2 and 3.

The Use of Quantitative and Qualitative Data

In order to address consideration of quantitative and qualitative data as part of the consultation process, the Agencies have agreed to work together to develop criteria for weighing quantitative and qualitative data based on the following guiding principles:

1. Agencies will conduct analyses in a quantitative manner whenever possible.

2. Where information does not meet the criteria for quantitative analyses, the Agencies will utilize the best available science in a qualitative manner, and will be clear as to why qualitative information is being used.

3. The Agencies will jointly develop and apply a systematic approach for using and classifying quantitative and qualitative information.

4. Agency conclusions will be based on a weight-of-evidence approach that includes all the evidence, both qualitative and quantitative, including an explanation of how all of the information was used to draw and support conclusions.

5. As all evidence is being weighed, deference will be given to robust quantitative analyses of relevant data, when available.

6. The Agencies commit to work collaboratively and to share perspectives on judgments being made from the evidence.

"Certainties" and "uncertainties" for quantitative and qualitative approaches will be described. The Agencies will evaluate risk using all of the best available data (quantitative and qualitative) using a weight-of-evidence approach. Where there is no evidence to suggest the existence of a particular effect, the Agencies will not be obligated to produce or create data regarding that effect, although care will be taken to avoid Type 2 errors (*i.e.*, incorrectly concluding no risk) with data-poor species or effects pathways. Risk will not necessarily be assumed in the absence of information nor will the absence of information necessarily be construed as evidence of no risk; rather, professional judgment will be used by considering the significance, quality, and relevance of the available information (including uncertainties) consistent with the Agencies' jointly developed approach for qualitative and quantitative information.

Best Available Data:

In addition to data submitted by pesticide registrants to the EPA as part of the pesticide registration process, the ECOTOXicology database (ECOTOX) (with potential supplementation by the Services) will be used as a source for 'best available' toxicity data. The bibliographies of all of the studies returned by ECOTOX (both those that pass the screening filters and those that do not) will be provided as part of the Biological Evaluation (BE) and all relevant data/information will be used in the effects determination. For example, studies that have not been included in the past because they do not pass the ECOTOX screening filters such as studies having the rejection codes 'Mixture,' 'Incident,' 'Fate,' plus targeted monitoring studies, will be retrieved from the ECOTOX bibliography and considered for use in the weight of evidence analysis. For additional information on ECOTOX and the screening filters see: http://cfpub.epa.gov/ecotox/. Additional information, if available, may be provided by the Services to supplement information gathered from ECOTOX.

Exposure models will be used for estimating aquatic environmental concentrations. Targeted monitoring studies may be used for evaluating site-specific exposure estimates. Ambient (general) monitoring results (those studies not coordinated with applications of pesticides at the field scale) will not be used to quantify exposure or to evaluate exposure model performance, but may be used to identify the occurrence of multiple stressors at specific locations for assessing exposure to mixtures. Given the importance of targeted field data to provide an accurate representation of measured aquatic exposures, during the focus meetings with stakeholders, EPA will ask for available targeted field studies and will search the literature (*e.g.*, through ECOTOX) to identify these studies. Information from targeted monitoring studies may be used to inform problem formulation and refine exposure modeling analyses.

Inerts and Mixtures:

For assessments conducted using the interim approach, inerts and mixtures (*i.e.*, formulated products with more than one active ingredient, tank mixes, and environmental mixtures) will largely be considered qualitatively. Quantitative analyses of formulated pesticide products will be conducted by considering spray drift and direct application to water exposure routes. Field dissipation studies will be used, when possible, to determine the potential impact of inerts on the fate of active ingredients. As part of the interim approach, the environmental fate and toxicity of inerts themselves will be addressed to the extent possible through literature searches, European Union data, Quantitative Structure Activity Relationship (QSARs), and submitted formulated product toxicity data [*i.e.*, available toxicity data submitted on formulated products (*e.g.*, the acute rat toxicity data using formulated product) to compare with toxicity data available for the technical grade active ingredient].

Addressing Changes to the Federal Action:

To address future changes to labeled uses that could affect the action area considered in any final Biological Opinion or letter of concurrence, EPA will use its risk assessment process for Section 3, 18 and 24c registration decisions, for chemicals that have already gone through the registration review process, to determine if the risks have changed since completion of consultation such that exposure is higher or the geographical extent of the action area has expanded. EPA will determine whether risk remains the same, is decreased or increased and will re-initiate consultation if risk increases[1] but not if risk is the same or decreased.

III. Interim Approach:

A. Step 1 (No Effect/May Affect Determination and Action Area):

The 'No Effect/May Affect' determination (NAS' Step 1) will largely be based on the overlap of the action area with the species' ranges and designated critical habitats (*i.e.*, any species or critical habitat that overlaps with the action area will be considered a 'May Affect'). The action

[1] Or if other reinitiation triggers are met [e.g., new species listing/critical habitat designation, new toxicity information, label changes that result in new locations for pesticide use, etc.]

area will be based on potential use sites combined with the range of off-site transport to identify the area of potential effects in and around the use sites.

Readily available geospatial data sets will be used to establish agricultural and non-agricultural pesticide use areas. The Agencies will develop a proposal to aggregate data over multiple time periods to more fully account for past, present and reasonable future use area changes. To determine the area of the potential agricultural use sites, sources of information, including but not limited to the following, may be used to determine potential use sites:

- USDA National Agricultural Statistics Service (NASS) Census of Agriculture data (county level)
- The National Land Cover Database (NLCD)
- The Cropland Data Layer (CDL) and/or CDL aggregated by years

For species range and designated critical habitat geospatial information, priority and weight will be given to spatial data provided by the Services. If sub-county spatial data are not available from the Services for particular species and/or designated critical habitats, an interim approach for supplementing listed species locations will be used. Although the interim approach is still being determined, potential sources of species range data include, but are not limited to the FWS' Environmental Conservation Online System (ECOS) [including the Information, Planning, and Conservation System (IPaC), and the Critical Habitat Portal]; the FIFRA Endangered Species Task Force (FESTF) database; and NatureServe.

Estimated environmental concentrations (EECs) will be based largely on modeled estimates. For aquatic concentrations, existing fate and transport models including the Pesticide Root Zone Model and the Exposure Analysis Modeling System (PRZM-EXAMS), the Agricultural Drift Model (AgDRIFT), the Agricultural Dispersal Model (AGDISP), and the Variable Volume Pond Model will be used to evaluate off-site pesticide transport. In addition to the PRZM-EXAMS farm pond, EECs will be derived for different aquatic habitat bins (to be defined) to more accurately reflect the range of exposure that may occur to aquatic species. For terrestrial exposures, the Terrestrial Residue Exposure Model (T-REX), TerrPlant, AgDRIFT and AGDISP will be used. For more information on these models, see: http://www.epa.gov/pesticides/science/models_db.htm.

The action area will be based on the lowest relevant toxicity value for the most sensitive species in the environment that results in the farthest distance from the use site(s) based on the effects thresholds described below. The aquatic portions of the action area will incorporate/characterize downstream transport. All effects/endpoints considered relevant to the 'No Effect' – 'May Affect' determination will be included in Step 1. The effects/endpoints for all species will be listed and arrayed along an exposure concentration gradient. The effects/endpoints that occur at the lowest concentration or at the 5% level of a species sensitivity distribution (SSD) will be used to establish the off-site portion of the action area; these may include, but are not limited to the following (see Table 1):

- For direct effects to animals based on acute lethality endpoints (LC_{50}/LD_{50}):

- For animals with robust data sets, exposure that results in a one in a million chance of mortality based on the 5th percentile (HC_{05}) species from a species sensitivity distribution (SSD).
- If there are not enough data for a SSD, the exposure that results in a one in a million chance of mortality based on the most sensitive species tested for each taxon will be used.

- For direct effects with sublethal endpoints (only sublethal effects that can be linked to environmental exposures will be considered):

  - For plants, endpoints that can be quantitatively or strongly qualitatively linked to effects on growth, the level corresponding to a reproduction/growth no observed adverse effect concentration or level (*i.e.*, NOAEC/NOAEL) for the most sensitive species will be used.
  - For animals, the lowest available NOEC or other scientifically defensible effect threshold (EC_x) will be used.
    - Endpoints generally will be: a) from *in vivo* studies that are conducted with whole organisms and b) linked to environmentally relevant exposures.
    - Decisions on the use of effects levels other than NOEC values (*i.e.*, EC_x) would involve a consideration of the power of the concurrent NOEC from that study and whether there is sufficient information regarding dose response to establish a different threshold with a reasonable degree of confidence.
    - Establishing "may effect" thresholds for given taxa may also, when supported by professional judgment, be based on toxicity studies that are conducted at the sub-organism level (*e.g.*, on organs or cells), provided they can be linked to environmentally relevant exposures that can influence survival, growth, or reproduction.

TABLE 1. Endpoints to be used in Step 1 (the most sensitive of these thresholds will be used in Step 1 to establish the action area) (these are the same thresholds to be used to assess the potential for direct effects in Step 2).

Taxa (of listed species or obligate species)	Mortality	Sublethal Effects
Birds Mammals Reptiles Terrestrial-phase amphibians Aquatic-phase amphibians Fish Aquatic invertebrates Terrestrial invertebrates	Concentration (or dose) that would result in a chance of 1 in a million of causing mortality to an individual. This is calculated by using HC_{05} of species sensitivity distribution (SSD) of LC_{50} or EC_{50} values for taxa and representative slope. If SSD cannot be derived, most sensitive LC_{50} or EC_{50} will be used.	The lowest available NOEC or other scientifically defensible effect threshold (EC_x) will be used. Endpoints generally will be a) from *in vivo* studies that are conducted with whole organisms and b) linked to environmentally relevant exposures (see text for details)
Aquatic plants Terrestrial plants	None	Aquatic plants: *Non-vascular* - Concentration equal to the lowest value among the available NOAEC and

Wetland plants		EC_{05} values for non-vascular aquatic plants *Vascular* - Concentration equal to the lowest value among the available NOAEC and EC_{05} values for vascular aquatic plants Terrestrial and wetland plants: *Monocots* - Concentration equal to the lowest value among the monocot NOAEC and EC_{05} values from the available seedling emergence and vegetative vigor studies *Dicots* - Concentration equal to the lowest of the dicot NOAEC and EC_{05} values from the available seedling emergence and vegetative vigor studies *Non-angiosperm* - Concentration equal to the lowest of the NOAEC and EC_{05} values from the available seedling emergence and vegetative vigor studies

For species/critical habitats that do not overlap with the action area (as determined by the process described above), the call will be 'No Effect' and no further analyses will be required (*i.e.*, there is no need for Steps 2 and 3). For species and critical habitats that do overlap with the action area, the call will be "May Affect," and the analysis will proceed with Step 2. This process will be iterative [*i.e.*, if additional information becomes available during the course of conducting Step 2 that indicates that the action area was not adequate for the action(s) being assessed, the action area can be revisited].

B. Step 2 (NLAA/LAA Determination):

The purpose of Step 2 is to conclude a determination of either "Not Likely to Adversely Affect" (NLAA) or "Likely to Adversely Affect" (LAA) for listed species and/or designated critical habitats within the action area. To determine whether the call for a species is an NLAA or LAA, a similar process as described above for Step 1 will be used with the exception that only endpoints relevant to the specific listed species being assessed and their habitats will be considered. Exposure values will be based primarily on fate and transport model results that assess the range of labeled uses of the pesticide (rates, methods). For aquatic exposures, PRZM/EXAMS, AgDRIFT and AGDISP will be used to predict exposure in generic habitats, referred to as bins, relevant to groups of listed species with similar habitat preferences. Exposure results for the bin most appropriate for the species being assessed will be used. For terrestrial exposures, TerrPlant, AgDRIFT, AGDISP and T-REX will be used. In this step (*i.e.*, Step 2), a refined version of T-REX that accounts for species-specific characteristics (*e.g.*, body size, diet, *etc.*), will be used.

Direct Effects (Based on Lethality):

The potential for direct effects will largely be based on those effects and endpoints that were identified in Step 1 (see Table 1) and are determined to be relevant for species and their habitats. Effects will be analyzed using a weight-of-evidence approach to make NLAA/LAA determinations. For lethality endpoints, a one in a million chance of mortality – using the most

appropriate surrogate (*e.g.*, trout data for a listed salmonid) – will be used. For example, if the range, including critical habitat, of a listed salmonid overlaps with a 'May Affect' area (based on the most appropriate exposure and effects data for that particular species) where there is an estimated chance of at least one salmonid in one million dying from that exposure, this would result in a 'LAA' call. If enough data from appropriate surrogates are available to create a SSD for the surrogates (*e.g.*, for example, data for several salmonid species are available to assess risks to listed salmonids), the 5th percentile of the surrogate species on the SSD will be used. If a specific surrogate is not available (*e.g.*, only data from trout and sunfish are available to assess risks to a listed sturgeon), the most sensitive species tested in a taxon (*e.g.*, all freshwater fish) will be used.

Indirect Effects (Based on Lethality):

The potential for indirect effects (see Table 2) will be based on the taxa that are relevant to the specific species being assessed. For potential indirect effects based on prey lethality for those species without obligate relationships, the exposure that results in a 10% effect for the 5th percentile species on a SSD will be used. If not enough data are available for a SSD, the 10% effect for the most sensitive species tested in that taxon will be used to determine the potential for indirect effects based on prey lethality.

Direct and Indirect Effects (Based on Sublethal Endpoints):

For sublethal effects to plants, the level that corresponds to the reproduction/growth NOAEC/EC_{05} for the most appropriate surrogate species will be used to make the NLAA/LAA call. If data on a specific surrogate is not available, the most sensitive species tested in a taxon will be used (as described above). For indirect effects related to terrestrial and wetland plants (*e.g.*, impacts to the diet or habitat of listed species based on potential effects to plants), the lowest available LOAEC or EC_{25} from the available terrestrial plant studies will be used. The lowest available LOAEC or EC_{25} from the available aquatic plant studies will be used to assess indirect effects associated with potential impacts to aquatic plants. Other data (*e.g.*, incident data and other data on sublethal effects) will be qualitatively considered. For species with obligate relationships, the potential for indirect effects to the obligate species will be based on the effects endpoints identified for assessing the potential for direct effects to a species as described above (see Table 1).

For making an LAA determination based on direct effects to listed animals, the lowest available NOEC or other scientifically defensible effect threshold (EC_x) that can be linked to survival or reproduction of a listed individual will be used. For making a LAA determination for <u>indirect</u> effects, the LOEC or other scientifically defensible effect threshold (EC_x) for growth or reproduction will be used.

- The goal of this step is to evaluate whether an individual's fitness (survival or reproduction) is likely compromised and whether habitat attributes are likely adversely affected for listed species.
- The NOEC and LOEC values are selected as endpoints to represent sublethal effects following chronic exposures because 1) standard chronic toxicity studies are designed to generate these values and 2) they are consistent with the goal of this step.

- Decisions on the use of EC_x values instead of NOEC and LOEC values would involve consideration of the power of the concurrent NOEC and whether there is sufficient information regarding dose-response to establish an alternative threshold with reasonable degree of confidence.
- Effect concentrations (thresholds) from growth or other sublethal endpoints will stem from studies that are relevant to environmental exposures.
- Some best professional judgment should be used to ensure selection of appropriate studies and endpoints that are relevant to the "survival and reproduction of the species in the wild" (*NAS recommendation*).
- When considering both direct and indirect effects to a listed species, sublethal effects for which quantitative linkages to apical responses have not yet been established will be incorporated as part of the weight-of evidence approach for making NLAA/LAA determinations. This weight of evidence approach may also consider toxicity studies that are conducted at the sub-organism level (*e.g.*, on organs or cells) and that can be linked to environmentally relevant exposures. Sublethal effects data will be reviewed for relevance and data quality. The adverse outcome pathway framework can be used to structure sublethal effects data along causal pathways. Species and habitat risk hypotheses will be considered when determining relevance of data.

An overarching goal of the interim approach (Steps 1 and 2) is to collaboratively develop a streamlined consultation process that meets the needs of the FIFRA/ESA workload and integrates seamlessly into Step 3. For all of the species/critical habitats that are found to warrant NLAA determinations, based on the process described above, a streamlined consultation process will be developed, contingent on successful implementation of the other interim approach measures.

TABLE 2. Endpoints to be used in Step 2 [these values will be used to make NLAA and LAA determinations for direct and indirect effects to listed species (*e.g.*, diet, habitat) and for making adverse modification/no adverse modification determinations related to critical habitat].

<table>
<tr><th>Taxa on which a listed species depends</th><th>Mortality</th><th>Sublethal Effects</th></tr>
<tr><td>Birds
Mammals
Reptiles
Terrestrial-phase amphibians
Aquatic-phase amphibians
Fish
Aquatic invertebrates
Terrestrial invertebrates</td><td><u>Direct Effects</u>: Same as those identified in Table 1.

<u>Indirect Effects</u>: Concentration (or dose) that would result in a decrease of 10% of individuals (i.e. the EC_{10}). This is calculated by using HC_{05} of SSD of LC_{50} or EC_{50} values and representative slope. If SSD cannot be derived, most sensitive LC_{50} or EC_{50} will be used.</td><td rowspan="2">For making an LAA determination based on direct effects to listed animals, the lowest available NOEC or other scientifically defensible effect threshold (EC_x) that can be linked to survival or reproduction of a listed individual will be used. For making a LAA determination for <u>indirect</u> effects, the LOEC for growth or reproduction will be used (see text for details)</td></tr>
<tr><td>Aquatic plants
Terrestrial plants
Wetland plants</td><td>None</td><td>Direct Effects: Same as those identified in Table 1.

<u>Indirect Effects:</u>
<u>Aquatic plants</u>: Concentration equal to the</td></tr>
</table>

		lowest available LOAEC and EC_{25} value for aquatic plants Terrestrial and wetland plants: Concentration equal to the lowest LOAEC and EC_{25} value from the available seedling emergence and vegetative vigor studies

C. Step 3 (Jeopardy/No Jeopardy Opinion):

For all of those species/critical habitat designations found to warrant determinations of LAA, the relevant Service(s) will determine 'jeopardy' or 'no jeopardy' for species and 'adverse modification' or 'no adverse modification' for designated critical habitat (NAS' Step 3). These determinations will be based on, but not limited to, the following:

- Population models (when appropriate and available) using the same SSDs, dose-response slopes, estimates of the likely adverse impacts on a specific number of individuals within the population and other information provided in Steps 1 and 2;
- Duration of potential exposures exceeding effects thresholds; and
- Weight-of-evidence approach.

Summary of Follow up Tasks

1. Develop a common approach to weight of evidence analyses, using qualitative information for making the NLAA/LAA (and jeopardy) decisions.
2. Share information about the FESTF database and ECOS (IPaC, Critical Habitat Portal), and discuss whether/how these tools can be used as part of the interim approach to identify species and define species' ranges and critical habitats.
3. Define bins for aquatic species for use in Steps 2/3 for exposure modeling.
4. Develop guidance on the construction and use of SSDs.
5. Discuss proposal for defining agricultural pesticide use areas by aggregation of crop categories in the Cropland Data Layer (CDL) produced by USDA.

References:

National Research Council (2013). Assessing Risks to Endangered and Threatened Species from Pesticides. Committee on Ecological Risk Assessment under FIFRA and ESA, Board on Environmental Studies and Toxicology, Division on Earth and Life Studies, National Research Council of the National Academies. The National Academies Press, Washington, DC.