Chapter 8: Calculating Take from Land and Water Use Activities

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8.1 Analysis of Take from Proposed Land and Water Use Activities

The Habitat Conservation Plan (HCP) must contain an analysis of the impact which will likely result from the taking of the covered species. The impact of the taking may have population or species-level effects substantially greater than just the number of individuals or acres of species habitat. Ultimately the impacts of the taking must be minimized and mitigated to the maximum extent practicable. Nevertheless, quantifying the amount of take provides a key basis for evaluating project impacts. Furthermore, the amount and type of anticipated take must be described in the section 7 biological opinion for the HCP and identified on the incidental take permit.

To fully identify all sources of take that may result in an impact, it is necessary to consider each component of the proposed activity in detail. The following sections provide guidance on how to conduct this analysis.

8.2 Determining Take

Breaking down an applicant's proposed activities, as described in Chapter 5.3 and 5.4, will help to identify the type and amount of incidental take that could result. At this point of planning, we should be able to:

- identify the resources needed to fulfill the conservation needs (breeding, feeding, sheltering) of the species or ecosystems (e.g., predator-prey relations, dens re-used by other species) present in the project area;
- identify, isolate, and examine the components of ("deconstruct" as we often call it) the activities within your project area that potentially impact those resources; and
- identify and document the chain of logic needed for the development of the HCP's conservation program (i.e., biological goals and objectives, avoidance, minimization, and mitigation measures, etc.).

8.2.1 Sources and Types of Take

FWS has developed a conceptual model to guide the process of evaluating effects to individuals, called the "effect pathway model." As introduced in Chapter 5.3, the model is applied to effects identified as we break an activity into its components. Using the effect pathway model will help

identify how project activities may affect species, and this helps determine the source, amount and type of take (see the HCP Handbook Toolbox).

Information in current HCP planning efforts may be used to help populate the effect pathway model. Developing effect pathways and associated conservation measures to be delivered can be helpful to the public and FWS biologists alike. Effect pathways use source deconstructions, which are project activities that have been broken down into the individual steps that, in total, make up all the activities that may be needed to complete that kind of project. These source deconstructions, in conjunction with an effects analysis, can be used to help biologists understand the potential effects of various projects (in terms of both their construction and operation) on listed and proposed species. Using the effect pathway model to develop an effects analysis helps to clarify how and why projects might affect covered species, and creates a logical, transparent rationale for why conservation measures might be needed to avoid, minimize or mitigate these effects.

The primary purpose for quantifying take in the HCP is to provide a foundation for conducting the impact analysis. Take can be quantified in a number ways, such as numbers of affected individuals, nesting groups, or a surrogate measure like acres of habitat or stream miles. Net effects or impacts to the populations of covered species are addressed in Chapter 12.

Determining the amount of take requires the analysis of the proposed activities to identify ways the species or their habitats may be affected and whether those effects rise to the level of take. Identify all the "direct interactions" or "stressors" to resources required by covered species that may be associated with each activity. A direct interaction is an effect on the individual organism. A stressor is any agent capable of causing an adverse or beneficial change to a resource upon which an organism depends. Keep in mind a stressor might change, or new ones come into effect, as a result of the effects of climate change, such as increased wildfire frequency.

Here are the basic steps of an effect analysis, following the effects pathway model (Figure 8.2). First, identify the resources required by the species to fulfill their lifecycle needs that may be affected by a stressor. A stressor acts on a resource, which results in a response by the species. The resource could be the specific element of the habitat used by the species (e.g. water, gravel, old growth trees, etc.) or a circumstance (e.g., historic competition or predation rate, natural ambient lighting, cave microclimate, etc.). The effect can be both direct and indirect (e.g., destroying tree cavities used for hibernacula in the summer affects both hibernation habitat directly and hibernating bats indirectly).

- Identify the resource need affected (i.e., breeding, feeding, sheltering, or migrating) by a stressor acting on a resource. Resource needs are the basic lifecycle needs that a resources fulfills for a species (for survival and recovery). More than one resource need can be affected by a stressor (e.g., an increase in sedimentation stressor may affect breeding for adults and sheltering for young).

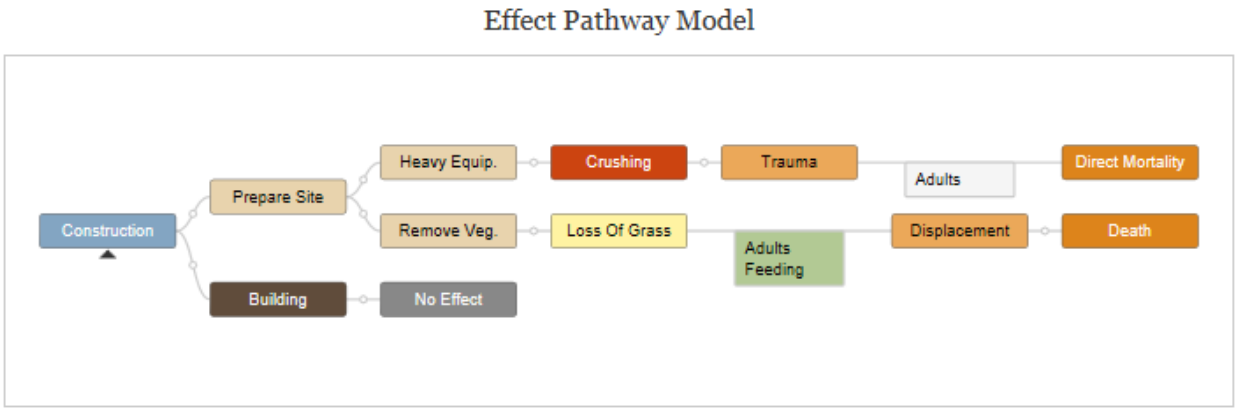
- Identify the behavioral or physical response associated with each stressor. A species' response is the direct or indirect effect of a stressor or direct interaction on a species, ranging from stress to system failure. Responses are usually measured on an individual

basis and then are expressed as a range of responses (e.g., stress, displacement, lack of foraging ability, mortality).

- Finally, once we have identified the responses of individuals, we must determine the demographic consequence at the population and species levels and how that may affect the population's or species' status as a whole. For example, loss of sagebrush may lead to a reduction in a species' forage base, which can translate into reduced growth that can delay age at sexual maturity (or reduce size at sexual maturity, or reduce fecundity), which in turn affects reproduction, which ultimately affects species conservation and recovery.

- Management options (conservation measures) include avoiding, minimizing, and mitigating the production of or exposure to a stressor. Ideally, conservation measures contribute to recovery actions (if a recovery plan has been developed).

Figure 8.2: Effect Pathway Model.



8.2.2 Units of Take

The HCP must identify the impacts likely to result from the proposed incidental take. It must include defined units to quantify impacts in terms of taking a number of affected individual animals or acceptable habitat surrogate units within the plan area. These same units are used on the permit to specify the authorized levels of incidental take.

Numbers of individuals, nesting territories, breeding pairs, etc. often come to mind first, but it is not always practical to survey and count affected wildlife populations directly. More often we use a surrogate measure, such as acres of habitat or a measurable ecological condition that we define and use to express incidental take authorized by a permit. To use a surrogate measure, we must:

- describe the causal link between the surrogate and take of the covered species,
- explain why it is not practical to express the amount or extent of anticipated take or to monitor take-related impacts in terms of number of individuals, and
- set a clear standard for determining when the level of anticipated take has been exceeded.

This justification for use of a surrogate can be in the intra-Service section 7 consultation, the HCP, or we can reference recovery planning documents, such as a recovery plan or species status assessment.

When identifying a surrogate measure, also take potential climate change effects into account. Causal links between the surrogate and take of the covered species may not necessarily remain valid due to various effects of climate change, such as:

- the emergence of novel species-to-species and species-to-habitat relationships,
- range shifts or other changes in the distribution and abundance of competitors or predators,
- increased spread of non-native invasive species, or
- differences between surrogate and the covered species in terms of vulnerability to the effects of climate change.

Incidental take has to be expressed in terms that are measurable and enforceable in the HCP and in the incidental take permit. The unit of take must be practicable, which means it can be monitored and the results of monitoring can be applied to adaptive management decisions. Conducting section 7 analyses concurrently with HCP development helps us better negotiate take levels in the HCP and identify appropriate units to enumerate take.

Units of take or their surrogates can take many forms:

- In the simplest case, we can identify individual animals, such as desert or gopher tortoises, likely to be affected by a project.
- Breeding pairs or nesting territories might be readily identified and treated as the unit of take. However, the actual number of individuals affected becomes less certain, as the species territory may include the current and previous year's offspring. Although we might count nesting territories, the population numbers affected become less certain.
- Species that aggregate into roosting, hibernation, or maternity colonies test our ability to tie a "territory" to numbers of individuals. We may be able to measure only relative sizes of the colony and numbers of colonies.
- In cases where a colony or breeding territory is used as the take unit, habitat acres, such as foraging area or a buffer, will also often need to be quantified.
- Presence of wide-ranging, secretive species becomes more difficult to measure directly. Sand skinks, Houston toads, or American burying beetles are difficult to census, and surveys are often inconclusive. For species like these, we often need to rely on surrogate units. Usually, the surrogate we use will have resulted from recovery planning or conservation strategies that emerge from our efforts independent of any HCP. Nevertheless, an applicant may be able to develop a new surrogate measure or one tailored to their situation.
- Recovery planning for the Florida panther has resulted in a delineated consultation area. Take within this area is measured in acres and adjusted by weighted habitat value factors. This results in a relative measure of impact that integrates habitat acres and habitat values.

- For conservation plans addressing coastal or estuarine fishery bycatch of listed species, applicants quantify expected take from fisheries observer programs in combination with statistical modeling methods. Typically, the applicant (usually a State fisheries management agency) will either have a fisheries observer program in place, or will develop one as part of their conservation plan and use Federal fisheries observer data. Within these observer programs, observers on vessels make direct observations of bycatch in certain bodies of water or habitats. These observations are quantified, described, and logged as data. Data collected from observer program direct observations are then used to develop models for estimating covered species interactions. The information gathered from these direct observations in combination with modeling allows the applicant to generate estimated take numbers for observed fisheries and build a functional conservation plan.
- At least one watershed has been modeled to determine the effect of construction on fish species in the streams. This modeling identifies the additional impervious surface resulting from new construction as the surrogate measure of take. Though no HCPs have used this approach, section 7 consultations in this basin use the surrogate to quantify take resulting from proposed projects.

Whatever surrogate measures are used, we must link them to expected population responses by the covered species (i.e., stressors and effects). If not provided by practices established in existing conservation strategies, the applicant may need to develop and explain surrogate measures in the HCP. The Services must work closely with an applicant who develops novel surrogates. The surrogate measures of take used in the HCP and incidental take permit usually are translated to population effects in the intra-Service consultation on the application. This is a crucial area of HCP development where we need section 7 staff involved early.

The Services and an applicant may not always reach agreement on every aspect of measuring the take. We may be able to avoid conflict about such issues if we find that the disagreement in certain intermediate numbers does not affect the impact or mitigation calculations. Determining this will require looking ahead at the net effects, as we describe in Chapter 12.

8.2.3 Quantity of Take

The amount of take the permit authorizes should be commensurate with the effects of the incidental take caused by the project throughout the analysis area (see Chapter 6.3.1), plus any take that results from mitigation activities. There may be additional, separately authorized take as described in section 8.2.4 below.

8.2.4 Take That May Be Accounted for in Another Permitting Process

As we discuss in Chapter 3.5.5, mitigation and monitoring may cause take in addition to what the project causes. We need to quantify and consider these sources of take in our biological opinion and permit findings. The incidental take permit authorizes a permittee to implement the conservation measures in the HCP, including those that result in take, whenever the permittee is responsible for implementing the conservation. Often, the permittee will hire contractors with their own section 10(a)(1)(A) recovery permits to conduct the conservation activities (Chapter

5.1.2). In this arrangement, the take authority for the conservation activities originates with the incidental take permit. There often will be continuing management area obligations into perpetuity or for extended periods. Chapter 9.4 describes the common approaches used to assure implementation of long-term conservation obligations. In many of these arrangements, the third-party managers of conservation banks or in-lieu fee lands, should hold their own recovery permits for any take required to manage the conservation area.

8.3 Describe the Impact That Will Result from Such Taking

The Endangered Species Act (ESA) and its regulations require that HCPs specify the impact that will likely result from the taking [ESA section 10(a)(2)(A)(i), 50 CFR 17.22(b)(1)(iii)(A), 50 CFR 17.32(b)(1)(iii)(C)(1) for FWS and 50 CFR 222.307(b)(5)(i) for NMFS (see HCP Handbook Toolbox)]. Once the initial causes, types, and amounts of take have been identified, then its impact can be assessed. While take occurs to individuals, the impact of taking occurs at levels above the individual, such as to the population and the species. Covered activities cause take of individuals, which in turn impacts the population.

covered activities → take of individuals → impact of the taking on populations and the species

The HCP must specify the impact of the taking on a meaningful, distinct, or relevant population of the covered species. This is usually the population that is local to the plan area, but might encompass the species rangewide or a designated population segment. This analysis forms the basis for determining appropriate avoidance, minimization, and mitigation actions needed to offset these impacts. When assessing the impact of the taking, it is important to consider context, intensity, and duration of the impact (we use these terms here independently of the National Environmental Policy Act definitions, Chapter 13.5.2).

Context is the setting in which the impact of the take analysis occurs. It usually includes geographic and temporal scales. For example, we might analyze the impact of take on species numbers, reproduction, and distribution at the covered land scale, recovery unit scale, and range-wide scale. It includes such things as understanding the conservation role of the permit area to the covered species. Effects to pristine areas that are important to a species may be greater than effects to already degraded areas that are less important or marginal habitat. Alternatively, degraded habitats may have considerable relative value if that is all that remains. A site's location on the landscape may make it important at certain times of the year or for certain purposes so that its apparent quality as habitat masks its real importance to a covered species. We must also assess the impact of the taking in the context of other threats to covered species in the plan area. For permits that cover a long duration, it is important to consider how the context of the effects might change over time. For example, there may be other ongoing threats, such as effects related to climate change, that will affect environmental conditions and the context in which the impact of the taking occurs.

Intensity is the severity of the impact; for example, the percent of the population impacted or the quantity and degree to which habitat is affected. We sometimes use population viability analysis to try to estimate or better understand the possible severity of impacts at various scales, although the data needed for such analysis often is not available, so many assumptions are made. Consequently, the outcomes need to be interpreted with care.

Duration of the permit is at least as long as the duration of the taking. Therefore, effects analyses for a permit must correspond to at least the duration of the permit, but it may be longer if the impact is expected to last longer.

The ideal units of take (see section 8.2.2) to use in describing the impacts of the taking on the covered species are those that are closely associated with reproduction, numbers, and distribution. This is because reproduction, numbers, and distribution are explicitly associated with survival and recovery of the species in the wild as well as one of the incidental take permit issuance criteria [50 CFR 17.22 (b)(2)(i)(D) and 50 CFR 222.307(c)(1)(ii) for NMFS] and the required section 7 analysis.

Some examples of effect variables related to reproduction are:

- percent decrease in loss or increase of breeding habitat,
- percent decrease of loss of habitat that provides a climate refugia and results in reduced survivorship or lower reproduction,
- increased disturbance to breeding areas,
- increased predation of juveniles,
- decrease or increase in survivorship,
- decrease in breeding activities due to disturbance,
- loss of spawning grounds, nest trees, etc.

Some examples of negative effects related to species numbers are:

- decrease in the numbers of individuals, breeding pairs, or average population size,
- loss of an age cohort,
- changes in demographics,
- loss of recruitment,
- changes in age distribution,
- creation of a habitat sink (road crossing)

Some examples of negative effects related to distribution are:

- loss or increase of habitat that affects species distribution fragmentation,
- decrease in range,
- loss of stepping stone habitat

The process of determining anticipated incidental take and the development of the mitigation program are a dynamic and iterative process which is best performed when there is close coordination between the applicant and the Services.

8.4 Section 7 Tasks

As stated previously, we should anticipate our section 7 analysis throughout the HCP development process. At this stage, while the applicant is calculating the take levels and impact of the taking, it is prudent to coordinate with the section 7 staff to come to agreement on the

causes and forms of take associated with covered activities and on the methods and metrics for calculating take.