U.S. Fish and Wildlife Service and California Department of Fish and Wildlife

Draft Conservation Strategy and Mitigation Guidance for the California Tiger Salamander, Santa Barbara County Distinct Population Segment

Information in this document is presented in the following order:

1. Purpose
2. Conservation Strategy
3. Impacts to California tiger salamanders
4. Mitigation to Offset Impacts
5. Determining Mitigation
6. Providing Mitigation
7. Siting Mitigation
8. Translocation

This document is not meant to contain complete information regarding species biology, regulatory requirements, U.S. Fish and Wildlife Service policies, or compensatory mitigation procedures. Additional materials supporting this document and providing supplemental information relevant to this topic are indicated within this document. This document will be updated as needed to reflect new scientific information, species needs, or policy changes.

1. Purpose

The U.S. Fish and Wildlife Service (Service) provides this conservation strategy and mitigation guidance document in support of the conservation and recovery of the endangered Santa Barbara County distinct population segment (DPS) of the California tiger salamander. The main purpose of this document is to provide guidance when assessing land use and project development impacts to the Santa Barbara County DPS of the California tiger salamander and to strategically identify our preferred approaches to offset unavoidable impacts through compensatory mitigation when triggered under the Federal Endangered Species Act of 1973, as amended. The recommendations from this document should be assessed and, when appropriate, incorporated into all projects occurring within the known range of the DPS. We recommend that biologists, consultants, and project proponents use it to inform and facilitate their work with the Service in a regulatory context.

The Federal Endangered Species Act of 1973, as amended, is the primary Federal law providing protection for the Santa Barbara County DPS of the California tiger salamander. The listing of the DPS as endangered provided the full protection of Act. Sections 7, 9, and 10 of the Act have been the most relevant sections that have provided a conservation benefit to the species. Section 9 of the Act prohibits unauthorized taking of any federally listed endangered or threatened species. Section 3(18) defines "take" to mean "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct."

2. Conservation Strategy

The goal of this conservation strategy and mitigation guidance is to protect and manage sufficient habitat to support long-term viability of the Santa Barbara County DPS of the California tiger salamander. The species depends on a series of interconnected aquatic breeding habitats and upland habitats as a metapopulation, making it particularly sensitive to changes in the amount, configuration, and quality of these habitats. The loss and destruction of habitat represents the primary threat to the species. We believe that to ensure the long-term viability of California tiger salamander populations in Santa Barbara County, habitat loss needs to be reduced and that California tiger salamander habitat needs to be conserved and protected following strategic methodology. The recovery plan (Service 2016) lays out recovery criteria by which a minimum viable population can be conserved in each metapopulation area. This conservation strategy and mitigation guidance strives to conserve habitat in a strategic way through mitigation such that recovery criteria will be met in each metapopulation.

Aquatic breeding habitat for California tiger salamanders is characterized as ponds with seasonal, shallow wetlands that alternate between dry and wet periods. For regulatory purposes, ponds with a documented breeding California tiger salamander population are identified as known breeding ponds. Ponds with the appropriate hydroperiod to support California tiger salamander breeding (i.e., at least 10 weeks) and surrounding upland habitat, but in which

California tiger salamander breeding has not been documented, are identified as potential breeding ponds. Potential breeding ponds may have breeding California tiger salamander populations that have not been documented for a variety of reasons, including insufficient survey effort. Salamanders can forego breeding for 2 to 8 years, resulting in negative aquatic surveys despite the presence of the species in adjacent uplands (Trenham et al. 2000). For the purpose of this document, potential breeding ponds are treated the same as known breeding ponds. For project purposes, potential breeding ponds are presumed to be known breeding ponds unless a negative finding is achieved by correctly and completely following the Interim Guidance on Site Assessment and Field Surveys for Determining Presence or a Negative Finding of the California Tiger Salamander (Service and Department 2003).

We used the average size of known breeding ponds in Santa Barbara County (1.47 acres) to define the number of ponds needs in each metapopulation area to support a minimum viable population size of California tiger salamanders. Four ponds of this size are required to preserve a minimum viable population for each metapopulation based on calculations that are discussed in the Service's (2015) draft recovery plan. In metapopulation areas where ponds are smaller than 1.47 acres, more than 4 ponds may be needed to support the minimum viable population size because effective population size is related to pond area. For example, if ponds are 0.4 acres, then 5 ponds will be necessary to support a minimum viable population size.

To preserve the minimum viable population found in single pond, at least 623 acres of functional upland habitat around each pond is required. 623 acres of functional upland habitat encompasses approximately 75 percent of the individuals using that pond based on calculations that are discussed in the Service's 2016 recovery plan. The remaining 25 percent of the population is distributed across an additional 1,628 acres of functional upland habitat.

Compensatory mitigation should work to further meeting recovery criteria. The recovery plan (Service 2016) established the following recovery criteria to support long-term viability of the Santa Barbara County DPS of the California tiger salamander:

1. At least four functional breeding ponds are in fully preserved status per metapopulation area.

2. A minimum of 623 acres of functional upland habitat around each preserved pond is in fully preserved status.

3. Adjacent to the fully preserved ponds and fully preserved upland habitat, a minimum of 1,628 acres of additional contiguous, functional upland habitat is present, which is at least 50 percent unfragmented and partially preserved.

4. Effective population size in the metapopulation is, on average, increasing for 10 years.

5. Management is implemented to maintain the preserved ponds free of non-native predators and competitors (e.g., bullfrogs and fish).

6. Risk of introduction and spread of non-native genotypes is reduced to a level that does not inhibit normal recruitment and protects genetic diversity within and among metapopulations.

Given the different landscape context in each metapopulation area, the method in which recovery criteria will be met in each metapopulation will differ (see Table 1 below). The first priority is preservation of existing ponds, followed by restored or created ponds – metapopulations that are limited by the number of functional breeding ponds would likely require the creation of additional breeding ponds to meet the first recovery criteria as listed above.

Table 1. The six metapopulation areas of the Santa Barbara County DPS of the California Tiger Salamander and the actions the Service currently envisions are necessary to achieve recovery, including the number of breeding ponds needed to maintain a minimum viable population size (MVP). The average pond size was calculated using the geometric mean of all known breeding ponds in each metapopulation based on 2010 known California tiger salamander breeding pond data; number of breeding ponds needed to maintain an MVP was calculated as defined in Appendix A of the recovery plan (Service 2015). These calculations should be updated as new information about known breeding ponds is acquired.

Metapopulation	Number of Known Breeding Ponds	Average Size of Known Breeding Ponds (acres)	Number of Breeding Ponds Needed to Maintain an MVP	Upland habitat in fully preserved status needed (acres)	Current Recommended Recovery Actions
West Santa Maria/Orcutt	15	0.76	4	2,492	Preservation of existing ponds to conserve a minimum viable population
East Santa Maria	5	1.31	4	2,492	Prioritize preservation of existing ponds and restore those as identified in the draft recovery plan (Service 2015)
West Los Alamos	11	0.51	5	3,115	Preservation of existing ponds to conserve a minimum viable population
East Los Alamos	4	1.12	4	2,492	Pond creation will likely be necessary in this metapopulation to

					support a minimum viable population size
Purisima	19	0.42	5	3,115	Preservation of existing ponds to conserve a minimum viable population
Santa Rita	5	0.64	4	2,492	Prioritize preservation of existing ponds, restore or create ponds if necessary, and restore upland habitat as identified in the draft recovery plan (Service 2015)

3. Impacts to California tiger salamanders

For projects that have unavoidable adverse effects on California tiger salamanders and/or their habitats, compensatory mitigation is needed to conserve California tiger salamanders. The amount of compensatory mitigation to offset a proposed project's impacts should be determined by assessing a project's level of impacts to California tiger salamanders and their habitat. Impacts to California tiger salamanders result from direct mortality to individuals, loss or alteration of suitable breeding habitat, loss or alteration of suitable upland habitat, interference with breeding migration, or interference to dispersal and connectivity between metapopulations. Impacts may be permanent or temporary, direct or indirect, immediate or cumulative.

4. Mitigation to Offset Impacts

Mitigation is typically defined as avoiding, minimizing, rectifying, reducing, and then compensating for unavoidable impacts that result from a project, to a species or its habitat. Projects should incorporate conservation measures that help to avoid, reduce, or minimize impacts. Under this conservation strategy and mitigation guidance, any remaining impacts to the California tiger salamander or its habitat should be offset through compensatory mitigation undertaken in a strategic way such that the mitigation contributes to meeting the recovery criteria in the affected metapopulation. Compensatory mitigation, in this document, means physical habitat that is permanently conserved, managed, maintained, and endowed in perpetuity to ensure conservation benefits for the California tiger salamander.

5. Determining Mitigation

The Service will consider a number of primary factors when determining how much mitigation should be provided to adequately offset impacts that will be incurred by a proposed project. These primary factors are:

1. The amount of breeding habitat and/or upland California tiger salamander habitat to be directly or indirectly impacted;

2. The quality of California tiger salamander habitat to be impacted as valued through Searcy and Shaffer (2008);

3. California tiger salamander occupancy and use of the site to be impacted;

4. Number of breeding ponds within dispersal distance (1.3 miles) of the impact area;

5. Location and landscape context of the site to be impacted.

Other factors that should be taken into account by both the Service and the project proponent include: how well the proposed mitigation site supports recovery of California tiger salamander; whether the impact is temporary or permanent; and whether the proposed mitigation to offset impacts provides immediate conservation and recovery benefits to California tiger salamanders

or if there will be a delay in such benefits. The Service prefers that lands to be used for mitigation already contain suitable habitat for the California tiger salamander, as opposed to lands that may need restoration or enhancement, to ensure immediate benefits to the species in exchange for proposed impacts.

6. Providing Mitigation

When a project's impact calls for compensatory mitigation, it can be provided by the project proponent by buying mitigation from a mitigation provider (mitigation bank), by paying a fee towards a Service-approved mitigation account for the California tiger salamander (mitigation account), or by establishing a mitigation site that meets the specification for approved mitigation (permittee-responsible mitigation).

Mitigation Bank

Applicants may purchase credits from an approved conservation bank commensurate with the required mitigation, to provide compensation for impacts to California tiger salamanders. Performance and success criteria for providing compensation for impacts to the California tiger salamander will be deemed to have been met upon purchase of such credits.

In order to determine how many credits an applicant must purchase, the applicant must calculate the loss of reproductive value that would result from their project. The Service has calculated the average reproductive value of one credit at approved conservation banks as a means to determine how many credits a project proponent must purchase to offset the loss in reproductive value resulting from a project. An applicant must purchase as many credits needed to reach a mitigation ratio of 1:1 for reproductive value. For example, if a credit at a conservation bank has a reproductive value of 100 and a project results in a reproductive loss of 200, that project proponent must purchase 2 credits from that bank to offset the loss in reproductive value. Project proponents that are proposing to purchase mitigation credits from a conservation bank should coordinate with the Service to ensure they are using the correct reproductive value of one credit from the conservation bank in which the project proponents proposes to purchase credits from.

For those pursuing compensatory mitigation for impacts occurring in the East and West Los Alamos, Purisima, or Santa Rita metapopulation areas, but unable or not interested in establishing and securing a mitigation site, it may be possible to pay an fee to or to purchase credits from a mitigation site or mitigation bank, each of which could result in providing California tiger salamander conservation benefits commensurate with project impacts. Paying a fee or purchasing credits both entail a payment of U.S. dollars by the entity needing to provide mitigation to a third party who will provide that mitigation. This payment is relatively simple and fast compared to permittee-responsible mitigation.

For project proponents intending to provide compensatory mitigation for impacts occurring in the East and West Los Alamos, Purisima, or Santa Rita metapopulation areas by purchasing credits from a bank, the Service will determine the quality of California tiger salamander habitat as valued through Searcy and Shaffer (2008) for each credit within the bank. The Service and Department will then use that to set the appropriate number of credits for perspective projects to purchase the required mitigation ratio (defined below under *Methodology on How to Determine Mitigation*).

California Tiger Salamander Mitigation and Conservation Account

The Service created a California tiger salamander Mitigation and Conservation Account that is intended to collect mitigation fees for impacts to the California tiger salamander that occur in the East and West Santa Maria metapopulation areas. While there are six metapopulations of the Santa Barbara County distinct population segment of the California tiger salamander, the East and West Santa Maria metapopulation areas are under the greatest threat from land conversion and habitat loss. In order to avoid precluding recovery in these metapopulation areas, mitigation for impacts in West Santa Maria and East Santa Maria should occur within these metapopulations areas. Therefore, the mitigation account pertains only to mitigation fees resulting from impacts occurring in the East and West Santa Maria Metapopulation areas and will be used for mitigation within these metapopulations. With the current prices of property, single applicants are unable to purchase land as mitigation for their projects. Therefore, a mitigation account is necessary to compile funds from multiple projects to be able to purchase parcels of land to put into conservation easements for the California tiger salamander in the Santa Maria metapopulation areas.

The Account is held, managed and administered by the National Fish and Wildlife Foundation to receive monies paid by project applicants in connection with offsetting impacts to the California tiger salamander occurring in the East and West Santa Maria metapopulations. These monies will be received as compensation for unavoidable impacts to the California tiger salamander. The types of activities for which the Account will be used include, but are not necessarily limited to: habitat restoration and enhancement; long-term protection of habitat, including establishment of conservation easements on habitat lands and/or long-term management and monitoring of habitat lands; and recovery activities. These activities will only be implemented in the East and West metapopulations for the California tiger salamander, Santa Barbara distinct population. The Service recognizes that a temporal loss may occur between a project's impacts and implementation of compensatory mitigation. In order to minimize the extent of the temporal loss, funds should be used to implement the aforementioned activities within 5 years of the date of deposit.

In 2017, the Service calculated the reproductive value of one mitigation credit from the La Purisima Conservation Bank. At the time, one credit had a reproductive value of 850. The

Service used that number to establish a mitigation fund fee calculator to determine the mitigation fee needed to offset the loss in reproductive value resulting from a project. The Service consulted with the National Fish and Wildlife Foundation to develop a mitigation fund fee calculator (Service 2017) to account for various fees associated with establishing a conservation easement. The Service anticipates revisiting the fund fee calculator every 5 years to ensure the accuracy of the fee calculator. The calculator is based on the loss of reproductive value resulting from a project to ensure a mitigation ratio of 1:1 [as calculated in Searcy and Shaffer (2008)] is met for the impacts to California tiger salamanders and their habitats. The mitigation fund fee calculator (Service 2017) has detailed information about how mitigation fees are calculated.

Permittee-Responsible Mitigation

Applicants may acquire compensation land to satisfy compensation requirements for impacts to the California tiger salamander. Compensation land must be acquired prior to initiating ground-disturbing activities within the Planning Area and financial assurances must be provided to ensure funding for the long-term management of the compensation lands. All compensation land must be recorded, managed and maintained and endowed in perpetuity prior to the onset of ground-disturbing activities. The compensation land will conserve sufficient reproductive value, as addressed in the Conservation Strategy and Mitigation Guidance for the California tiger salamander (Service 2016), to offset the impacts to the California tiger salamander. As stated above, a mitigation ratio of 1:1 [as calculated in Searcy and Shaffer (2008)] will be required for impacts to California tiger salamanders and their habitats. In other words, the reproductive value of habitat proposed for mitigation should equal the calculated reproductive value of the impacted habitat. When potentially suitable compensation land is identified, the applicant will prepare and submit a report to the Service outlining the suitability of the land for compensatory purposes. Once the Service agrees to the suitability of the compensatory land and the land is placed into conserved status, the performance and success criteria for the provision of onsite compensation lands will be deemed to have been met.

For permittee-responsible onsite or offsite mitigation, applicants will provide for the long-term monitoring and management of the compensation lands by providing initial funding for a long-term, non-wasting endowment. All compensation land must be protected under a perpetual Conservation Easement and be recorded, managed and maintained and endowed in perpetuity prior to the onset of ground-disturbing activities. Applicants must develop a management plan for mitigation lands to be included in a Conservation Easement. The management plan provides for: 1) annual easement inspections, which will generate up-to-date information on the Easement Area's overall condition and biological resources; 2) periodic biological monitoring, which will generate detailed data describing onsite species: including population abundance, condition of habitat and condition of related human infrastructure, particularly water impoundment structures; 3) management, maintenance and enhancement tasks, which will ensure the sustainability of these resources and the health of the species' habitat; and 4) annual reports, which will

summarize maintenance and management activities undertaken during the previous year, and provide an opportunity to creatively consider future needs and adaptive responses.

For those establishing a mitigation site to provide their own mitigation or to establish a bank, it will be necessary to work with the Service to ensure approval of key elements needed to authorize the mitigation site. The Service will provide detailed guidance and feedback on each of the following key elements:

1. Identifying a land parcel(s) adequate for providing compensatory mitigation.
2. Recording a permanent conservation easement on the property.
3. Developing a management plan for the property that documents baseline conditions. A management plan will establish biological goals, objectives, and performance standards, prescribe monitoring and reporting, and provide for adaptive management.
4. Providing financial assurances (specifically, an endowment) for the interim and perpetual maintenance, management, and monitoring of the mitigation site property.
5. Private parties must obtain an Incidental Take Permit (i.e., Section 10 permit pursuant to the Act) or otherwise be covered by an existing permit. This occurs in part by developing a Habitat Conservation Plan (HCP) or being covered by an existing conservation plan. For additional information on HCPs, see: http://www.fws.gov/endangered/what-we-do/hcp-overview.html
6. Federal agencies should complete a consultation (pursuant to section 7 of the Act) in which the proposed project action includes compensatory mitigation to offset impacts California tiger salamanders or their habitat.

7. Siting Mitigation

For all circumstances, mitigation for impacts to California tiger salamanders and its habitat should occur at a location within the affected California tiger salamander metapopulation unless otherwise determined by the Service. In general, large sites functionally connected to other permanently conserved lands are preferred for mitigation as they would likely contribute the greatest toward meeting recovery criteria. Within each metapopulation, compensatory mitigation should be directed to areas encompassing known breeding ponds and their associated upland habitat that contribute in the greatest extent to meeting the aforementioned recovery criteria. Mitigation should be steered away from ponds that are isolated from other ponds in a metapopulation area and/or that do not have sufficient functional upland habitat to support long-term viability of a metapopulation. Proposed mitigation areas should be located within areas that are capable of supporting a minimum viable population of California tiger salamanders. As specified in the Service's 2016 recovery plan, a minimum of 623 acres of functional upland habitat around a preserved pond is necessary to support a minimum viable population. Mitigation

areas must be evaluated and approved by the Service to qualify as mitigation for proposed impacts to California tiger salamanders.

All areas approved for mitigation must be placed into fully preserved status. Fully preserved status is either: (1) owned in fee title by an agency or conservation organization; or, (2) privately-owned lands protected in perpetuity with conservation easements. These lands must have funding secured for long-term management and monitoring. Parcels will be legally and permanently conserved, managed, and endowed to help ensure their long-term ecological value, in a manner consistent with the Service's 2003 Conservation Banking guidance and the Service's most current recommendations for implementing that guidance specific to federally-listed species conservation.

For impacts occurring outside the six metapopulations, mitigation efforts should be directed to the closest defined metapopulation. The Service will evaluate impacts occurring outside of the six metapopulations and provide recommendations and guidance on where compensatory mitigation should be directed on a case-by-case basis. The different metapopulations within Santa Barbara County are shown by different colors on the map located on the following page. These six metapopulations were delineated by the Service upon consideration of the range of the Santa Barbara County DPS of California tiger salamander and are defined by a series of interconnected breeding and upland habitat. These metapopulations could be refined in the future as biological information, recovery needs, and land uses change. We believe that siting mitigation in and adjacent to other parcels that are conserved and managed for similar upland ecosystem functions and values can be advantageous both ecologically and economically.

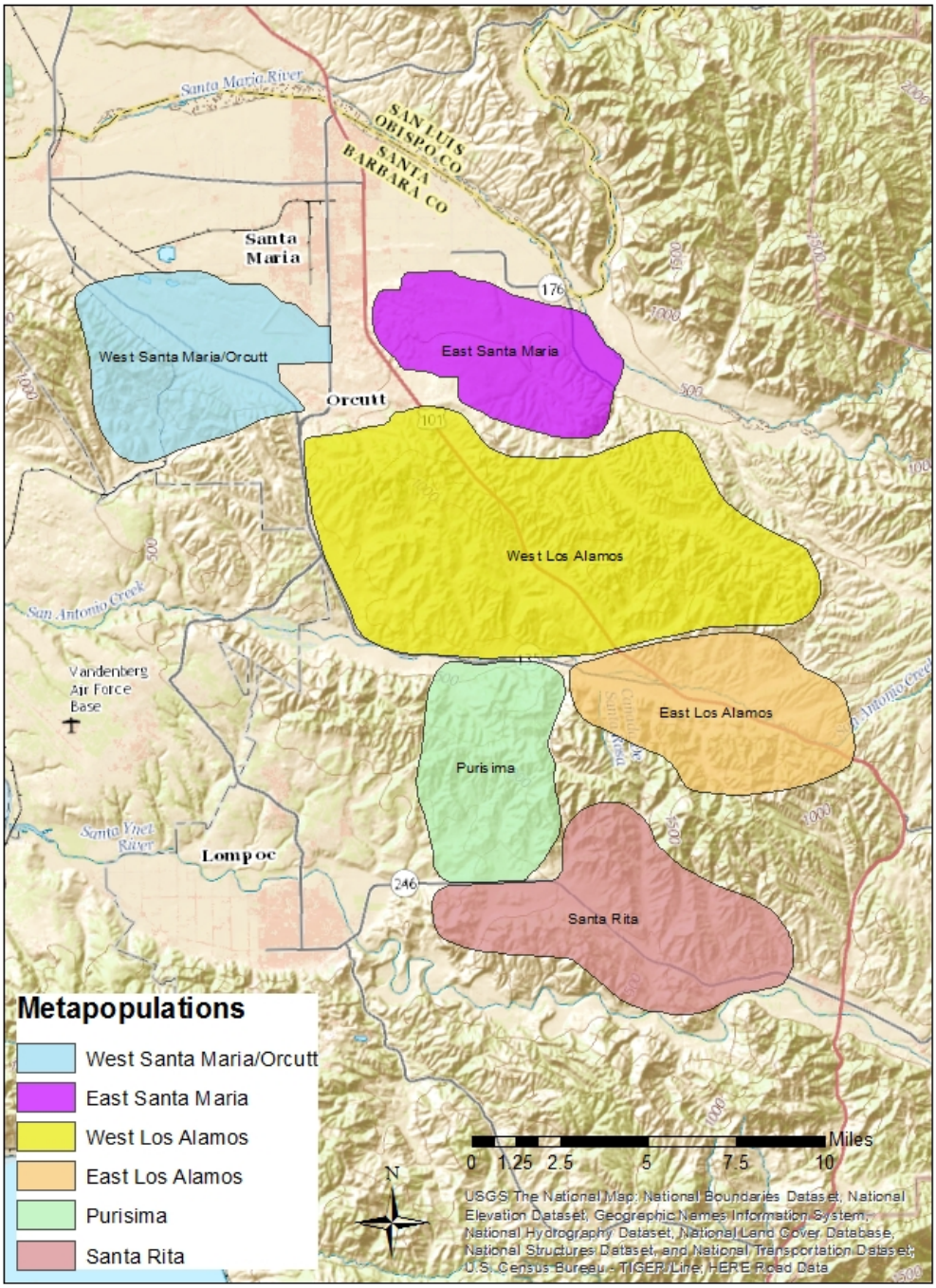
Proposed mitigation areas outside the areas that are capable of supporting a minimum viable population of California tiger salamanders will be considered on a case-by-case basis. Under this scenario, mitigation proposals would likely incur a longer review process and may be subjected to additional requirements, including greater mitigation ratios.

8. Translocation

Translocation involves the human-mediated movement of animals from one area, with release in another. Techniques for successful California tiger salamander translocation are not refined at this time, and there is currently little data on the conservation value of California tiger salamander translocation to the species. In general, we do not consider the translocation of California tiger salamanders for the purposes of removing an individual out of harm's way appropriate mitigation at this time. Since California tiger salamander translocation is not presently viewed as a viable mitigation option by the Service, translocation will occur at the discretion and authorization of the Service on a case-by-case basis. Translocation may be appropriate when recovery or research objectives are likely to be met (i.e., when reestablishing a local population or restocking a breeding pond). A translocation proposal must be submitted to

the Service for evaluation and approval prior to any potential translocation of California tiger salamanders.

Santa Barbara County Disting Population Segment of the California Tiger Salamander



Methodology on How to Determine Mitigation

This section describes the methodology on how to determine the estimated impacts to the Santa Barbara County DPS of the California tiger salamander and amount of compensatory mitigation needed so that project development can move forward where appropriate. Our application of these methods will depend on our evaluation of project-specific conditions. We have considered these methods specifically for use in projects impacting the Santa Barbara County DPS of the California tiger salamander; however, they may have applicability elsewhere.

- The value of the impacted habitat should be calculated using the methodology outlined in Searcy and Shaffer (2008), incorporating the amount of California tiger salamander aquatic breeding habit and upland habitat covering the site to be impacted.

- The value of the land proposed for mitigation habitat should be calculated using Searcy and Shaffer (2008). Typically, a mitigation ratio of 1:1 will be required for impacts to California tiger salamanders and their habitats. Habitat proposed for mitigation should have an equal calculated value of the reproductive value of the impacted habitat. Additionally, habitat proposed for mitigation should be placed into a permanent conservation status.

The method described in Searcy and Shaffer (2008) attaches a value to habitat that scales with the reproductive value of the individuals estimated to be occupying an area.

According to Searcy and Shaffer (2008) the reproductive value of a site is a function of:

a. Distance from each breeding pond within dispersal distance of the site, and
b. Land-use in the surrounding areas.

The density distribution of reproductive value decreases exponentially with increasing distance from a breeding site and decreases with increasing habitat loss in the surrounding uplands. For example, parcels close to a breeding pond, or several ponds, with intact upland habitat in the surrounding area will have a higher reproductive value than those with one pond where upland habitat has been converted to a use that is incompatible with California tiger salamanders.

Studies have recorded migration and dispersal distances by adult and juvenile California tiger salamanders, both through radio-tracking (Loredo et al. 1996, Trenham 2001) and upland drift fence capture (Trenham and Shaffer 2005, Orloff 2007, Orloff 2011). None of these studies were conducted within the range of the Santa Barbara County DPS of the California tiger salamander but are considered to be the best available scientific information on the species. Movement of California tiger salamanders is reviewed in Service (2009) and Searcy et al. (2013). In general, adults may migrate up to 1.2 miles (6,336 feet; 2 kilometers) from upland habitats to aquatic breeding sites (Service 2000). Orloff (2011) found that a considerable number of adult and juvenile California tiger salamanders moved more than 2,625 feet (800 meters) from their

breeding pond, and some more than 1.4 miles (7,392 feet; 2.2 kilometers). Based on studies at Jepson Prairie (Central DPS), researchers estimated that California tiger salamanders use a much greater area around the pond, as compared to Trenham and Shaffer's (2005) original 2,200-foot (670-meter) estimate, with 95 percent of salamanders found within 1.1 miles (5,587 feet; 1.7 kilometers) of a breeding pond from the most outlying pool edge (Searcy and Shaffer 2008, 2011, Searcy et al. 2013, Service 2015).

The location of a site within, or outside, a metapopulation area affects the site's relative importance to the persistence and recovery of California tiger salamanders. Areas capable of supporting a minimum viable population are those geographies with potential for conservation of upland habitat of at least 623 acres around known breeding ponds. Thus, mitigation should be steered away from ponds that are isolated from other ponds in the metapopulation area and/or that do not have sufficient functional upland habitat to support long-term viability of the population. Mitigation should be applied in a strategic way such that it contributes toward meeting recovery criteria in the metapopulation area where the project occurs.

Methodology for Calculating Permanent vs. Temporary Impacts

In general, Searcy and Shaffer (2008) demonstrate that there are two components of habitat loss for California tiger salamanders: (1) project footprint plus (2) "deficit wedge." The project footprint is the direct loss of habitat where the impact occurs, which is straight-forward in concept. More complex is the "deficit wedge" that results from the impact to habitat. The deficit wedge is the habitat that becomes isolated from a given breeding pond as a consequence of the impact and is rendered inaccessible to a California tiger salamander migrating in a straight line away from the center of a pond. The total impact of the project includes a sum of the footprint and the deficit wedges (or shadows) where habitat has become inaccessible to salamanders from ponds within dispersal distance of the project.

In calculating mitigation owed for impacts to listed species and/or the habitat that supports them, temporary impacts are of a different nature than permanent impacts. Therefore, mitigation for permanent and temporary should be calculated differently. Permanent impacts should be calculated using the methodology outlined in Searcy and Shaffer (2008), as described above. The deficit wedge (shadow) described above is only created by permanent or long-term impacts that impede California tiger salamander that are dispersing across the landscape. For temporary impacts occurring over one dry season (approximately May to October), there is no shadow because there is no habitat that becomes isolated during migration or dispersal. Calculating mitigation owed for temporary impacts only includes the direct loss of habitat within the project footprint where the impact to habitat occurs.

Not all temporary impacts occur over one dry season. For temporary impacts spanning more than one dry season, the aforementioned methodology does not account for impacts that could occur to migrating California tiger salamanders over a rainy season. While the effects are still

temporary, there is a temporary deficit wedge that is created over the rainy season. The lifetime reproductive success of California tiger salamanders is typically low because metamorphs have low survivorship; in some populations, less than 5 percent survive to breed (Trenham 1998). In addition, metamorphs require an extended amount of time before they reach sexual maturity (4 to 5 years) (Trenham et al. 2000). Less than 50 percent of first-time breeding California tiger salamanders typically survive to breed more than once (Trenham et al. 2000). Therefore, we assume that a temporary impact lasting more than 5 years could affect the entire reproductive output of an individual California tiger salamander, such that a temporary impact has the same impact as a permanent impact. Thus, any temporary impact lasting 5 or more years will be treated as a permanent impact as described above. If a temporary impact occurs over one rainy season, we assume that 1/5 of the entire population is potentially permanently affected during that rainy season and we calculate the temporary impact of the deficit wedge as 1/5 of the total reproductive value of the wedge. The following table shows the percentage of the population and the associated percentage of the deficit wedge that would be mitigated for.

Years of Disturbance	Percent of Deficit Wedge to Mitigate
1	20
2	40
3	60
4	80
5	100

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