AMPHIBIAN CONSERVATION STRATEGY FOR NORTHERN MONTEREY COUNTY

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EXECUTIVE SUMMARY

Northern Monterey County is a patchwork of residential areas, wetland and upland habitats, and agricultural production primarily on the floodplains and south facing slopes of the hillsides. While the county still hosts a number of habitats and diverse species, current and historic land use decision and management actions have directly affected the survival and fitness of endemic amphibians, particularly the Santa Cruz long-toed salamander (SCLTS) (*Ambystoma macrodactylum croceum*). Restricted to a highly constrained range in southern Santa Cruz and northern Monterey County (Figure 1), this Plan identifies key impediments to the species recovery, including the loss of functional breeding ponds due to salt water intrusion and mosquito abatement activities, habitat fragmentation and the severing of migration corridors. Through a two-year planning process with a Technical Advisory Committee, the recommendations of this Plan are actionable and adaptive strategies designed to address the goal of creating self-sustaining and connected SCLTS populations.

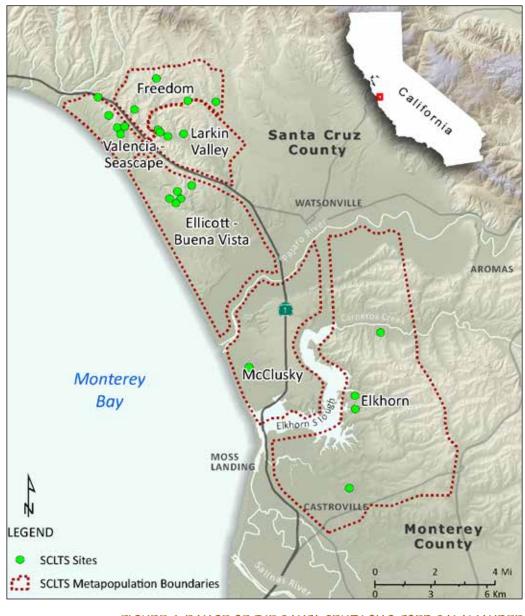


FIGURE 1. RANGE OF THE SANTA CRUZ LONG-TOED SALAMANDER

INTRODUCTION

The Santa Cruz long-toed salamander (SCLTS) (Ambystoma macrodactylum croceum) is an endemic amphibian species found only in southern Santa Cruz and northern Monterey Counties, California. The State and Federally endangered and State fully protected SCLTS inhabits ephemeral ponds for breeding and adjacent riparian, scrub, and woodland areas during the non-breeding season. These ponds occur in southern Santa Cruz and northern Monterey Counties, with a range roughly encompassing approximately 16 miles long (north to south) by 5 miles wide (east to west) (Figure 1). Approximately 32 confirmed breeding sites have been identified since the species was first detected in 1954, with approximately 23 of these sites having confirmed or assumed breeding as of 2015. Several factors have contributed to the species endangered status, including the loss and degradation of its aquatic breeding and upland over-summering habitats and the severing of historic migration corridors. Major waterbodies including Elkhorn Slough and the Pajaro River, as well as agriculture, residential, and industrial development act as barriers between the remaining populations, resulting in six isolated metapopulations (Figure 1). Importantly, threats from genetic isolation within each metapopulation are presumed to be increasingly severe and may represent a greater than anticipated threat. Other major factors impacting the species include invasive plant and animal species, pollution, climate change (more frequent and severe drought), salinization, road-kill, habitat degradation, and mosquito abatement activities.

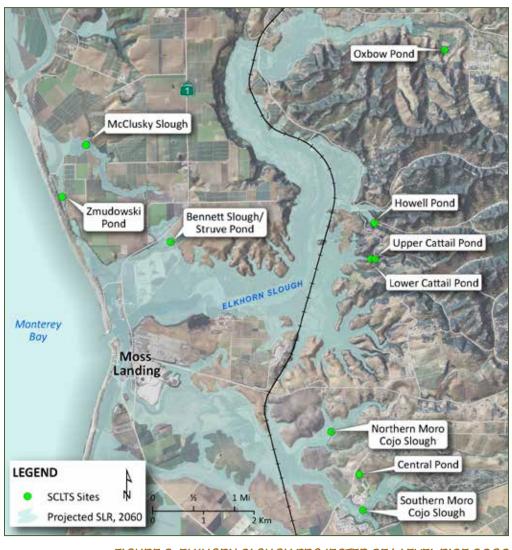


FIGURE 2. ELKHORN SLOUGH PROJECTED SEA LEVEL RISE 2060

As of 2015, the four metapopulations in Santa Cruz County and their associated functional or assumed functional breeding ponds include: Valencia-Seascape (five ponds), Ellicott-Buena Vista (five ponds), Freedom (three ponds), and Larkin Valley (four ponds). Since 2015, Monterey County has had confirmed breeding at five sites (Figure 1), all of which are located in the Elkhorn Metapopulation. It should be noted that two of these breeding ponds (Lower Cattail Pond and Southern Moro Cojo Slough) are currently non-functional due to tidal (marine) influence. However, restoration of these aquatic breeding habitats is anticipated to occur as soon as the winter of 2019-2020, resulting from the installation of a temporary weir within Moro Cojo Slough, and repairs to the tide-gate at Lower Cattail Pond. Additionally, Howell Pond is hydrologically connected to historic salt marsh and is also threatened by high salinity. The majority of the Elkhorn complex breeding sites are in historic salt marsh habitat managed as freshwater impoundments, and periodically revert to saline conditions when dikes deteriorate or tide gates leak, a threat that will only increase with rising sea levels (Figure 2). The remaining metapopulation in Monterey County, the McClusky Complex, may have already been lost due to an influx of saline water (Mitcham pers. comm. 2019).

As stated in the Recovery Plan (Service 1999), "The situation for the Monterey County populations is especially serious." The SCLTS has an extremely restricted range, currently breeding in approximately 23 ponds, with only five being located in Monterey County. The SCLTS at each of these sites are at high risk of continued declines or disappearing entirely within the next decade.

Genetic isolation is believed to be a factor in SCLTS population declines in Monterey County. A thorough review of available literature (Allentoft and O'Brien 2010) suggests that increasing genetic diversity is necessary to ensure increased fitness of declining amphibian populations in the modern age. It is well established that a decrease in genetic variation can lead to reduced fitness and lack of adaptability to a changing environment. Allentoft and O'Brien (2010) provide an overview of 34 studies that address a link between genetic variation and greater than 20 different fitness traits in amphibians. Although not all results are unequivocal, clear genetic-fitness-correlations are documented in the majority of the published investigations (Allentoft and O'Brien 2010). Over the past twenty years, the need to supplement declining Monterey County SCLTS populations through translocation has been discussed, and only recently formally proposed. The proposal includes the translocation of individuals from Santa Cruz County to Monterey County, with the short-term goal of stabilizing and increasing existing populations, while meeting the long-term goal of increasing genetic diversity and subsequently fitness.

Although this Strategic Plan (Plan) focuses on the SCLTS, the most critically endangered amphibian species in the region, the California red-legged frog (CRLF; *Rana draytonii*), which is a federally threatened and state species of concern, and the California tiger salamander (CTS, *Ambystoma californiense*), a federally and state threatened species, often co-occur with and use similar habitats as the SCLTS and may also significantly benefit from the implementation of actions identified in this planning effort.



ADULT SCLTS, IN-BOUND TO POND TO BREED (K. CAMARA)

BACKGROUND

A Technical Advisory Committee (TAC) comprised of species and technical experts including staff from the US Fish and Wildlife Service (Service), California Department of Fish and Wildlife (CDFW), Elkhorn Slough National Estuarine Research Reserve (ESNERR), Elkhorn Slough Foundation (ESF), Central Coast Wetlands Group (CCWG), the Resource Conservation Districts of Santa Cruz and Monterey counties (RCDs), University of California Santa Cruz (UCSC), and local biologists, have developed this strategy to guide recovery efforts for the aforementioned amphibian species. This plan provides a detailed implementation framework with the primary goals of stabilizing and increasing SCLTS populations in the face of a changing climate. To accomplish this, the Plan discusses the short-term goal of protecting existing breeding populations, with the long-term goal of protecting and enhancing suitable lands that are not vulnerable to anticipated sea-level rise. Of key importance is to ensure suitable dispersal corridors exist within this area, facilitating genetic exchange.

There are differing perspectives among regional stakeholders about whether historic salt marsh habitat that was diked in the past century, such as found in Moro Cojo or Lower Cattail Swale, can provide suitable amphibian breeding habitat in the long-term. Some favor use of water control structures in perpetuity to exclude tidal exchange from former estuarine habitat, while others are concerned that areas below sea level are likely to become sinks for amphibian populations, since they are already prone to saltwater leakage, and will be at even greater risk with rising seas.

As stated above, this Plan outlines priorities that have been identified by the TAC to ensure persistence of the species in the long-term within northern Monterey County. Specifically, these priorities are focused on the following: create a network of breeding habitats that are supported by adequate upland and dispersal habitat, ensure interbreeding among populations to increase genetic diversity and subsequently fitness, identify properties for acquisition, easements and/or enhancement to improve connectivity, and identification of research needs to further species recovery.

Short term priorities are primarily focused on ensuring stabilization of existing populations through a variety of actions. Some of these actions are in various stages of implementation and are anticipated to occur between 2019-2020; such as the repair of Lower Cattail Pond tide-gate, installation of a temporary weir within Moro Cojo Slough, the planning and construction of Hix Pond, and the planning of a SCLTS translocation and captive propagation program. The captive propagation program is of particular importance due to the low number of breeding sites, assumed low population numbers, and isolated nature of each of the existing breeding habitats in Monterey County. The forthcoming strategic translocation of captive propagated animals and translocation of individuals from drying or saline threatened breeding habitats would be utilized as a conservation tool to ensure persistence of key breeding locations in the short term, while enhancing genetic diversity and subsequently fitness over the long term. These conservation actions are based on recommendations identified during numerous TAC meetings, as well as Service, CDFW, and other organizational documentation, research reports, and strategic plans, which are included in Exhibit A. Funding for this effort has been provided by the Service and State Coastal Conservancy.

STRATEGIC PLAN GOAL AND OBJECTIVES

The goal and objectives articulated below were developed through an iterative process that included both internal consultation with staff from ESF, ESNERR, and CCWG (landowners), as well as discussions with the TAC. The goal is a broad, general statement reflecting the desired outcome. The objectives are conservation actions to achieve the long-term outcome.

GOAL: Create self-sustaining and connected SCLTS populations through the implementation of a landscape-scale conservation strategy that addresses climate change and other threats through utilization of suitable freshwater, riparian, and upland ecosystems in northern Monterey County.

OBJECTIVE 1: Create networks of new breeding habitats within areas not threatened by climate change (sea-level rise)

OBJECTIVE 2: Improve/maintain quality of existing breeding habitats

OBJECTIVE 3: Improve/maintain SCLTS upland habitat used by adults to support new or existing breeding sites

OBJECTIVE 4: Ensure species connectivity through the enhancement or creation of dispersal corridors

OBJECTIVE 5: Increase genetic diversity and subsequently genetic fitness through captive propagation and larval translocations

OBJECTIVE 6: Evaluate population recovery and inform adaptive management through research and monitoring, including eDNA

SCLTS OVERVIEW SCLTS DESCRIPTION AND RANGE

The SCLTS is a small salamander (2.5 to 5.5 inches total length) that differs from the other four subspecies of long-toed salamanders by a series of discrete, irregular patches of dull orange or metallic yellow markings on its dorsal side and by greatly reduced dorsal head markings of small scattered dots, which are often absent, anterior to the eyes (Service, 2013). This small ambystomatid salamander occupies a very small range in southern Santa Cruz County and northern Monterey County, between Castroville and Aptos in the vicinity of the coast (Figure 1). One of five subspecies of the long-toed salamander distributed throughout northeastern California and north into British Columbia, it is isolated from other subspecies by more than 150 miles. The Santa Cruz population is and completely isolated from Monterey County by urbanization and agriculture in the Pajaro Valley (Petranka 1998; Stebbins 2003).



MALE SCLTS IN-BOUND TO BREED (K. CAMARA)

SCLTS HABITAT REQUIREMENTS AND LIFE HISTORY

The SCLTS utilizes terrestrial and aquatic habitats during the course of its life cycle. Terrestrial habitats include upland coastal scrub and woodland areas comprised of coast live oak (*Quercus agrifolia*) and dense coastal scrub. The SCLTS spends most of its life underground in burrows of small mammals during the summer months and emerges during rainy nights in the fall and winter to migrate to shallow, freshwater ponds with sufficient emergent and submergent cover to breed. Leaf litter, rotten logs, fallen branches, and among the root systems of tree provide temporary cover especially for metamorphs and adults in transit during migration during the wet season. Single eggs are deposited on submergent vegetation, sometimes in small clusters. Larvae feed on a wide variety of aquatic organisms, including invertebrates and Pacific chorustree frog (Pseudacris regilla) tadpoles (Biosearch Associates, 2013). Single eggs are deposited on submergent vegetation, sometimes in small clusters. Larvae feed on a wide variety of aquatic organisms, including invertebrates and Pacific chorustree frog (*Pseudacris regilla*) tadpoles (Biosearch Associates, 2013).

SCLTS RECOVERY STATUS

The SCLTS is an endemic amphibian species whose decline is largely due to loss and degradation of upland habitats and severing of historic migration corridors. The species is classified as a 6C1 for recovery priority on a scale of 1 to 18 (one being the highest) due to the high degree of threat and high recovery potential (Service, 2009). The species is a top priority for recovery as it remains at risk of extirpation at a number of sites due to several threats (Mitcham, pers. comm. 2019). The naturally patchy distribution of the species renders it especially susceptible to random extinction events resulting from habitat loss and degradation (e.g. invasive species), parasite and fungal infections, predation, and changing rainfall patterns (climate change). The isolation of populations results in a reduction of the salamanders' effective gene pool, which makes the species more susceptible to diseases and ultimately extinction [draft Conceptual Area Protection Plan (CAPP), 2010]. Additionally, the presence of non-native invasive plants may reduce the numbers of invertebrates available as prey (Service, 2009). Furthermore, governmentally implemented mosquito abatement activities can have drastic unintended consequences on non-target insects and wildlife, with particularly negative effects on native amphibians (Service, 2019).

The Recovery Plan's (Service, 1999) Recovery Criteria requires that each complex (metapopulation) must contain at least two functional breeding ponds or sites, as well as sufficient upland habitat to support self-sustaining populations. Each site must be self-sustaining, not requiring human manipulation in years of average or above average rainfall. Evidence of continued breeding success, metamorphosis, and recruitment of adults must be documented over a 20-year period, which assumes sufficient time to monitor populations through at least one drought cycle. Upland scrub or woodland habitats must be adjacent to the breeding ponds or within migration distance, protected corridors for migration to non-breeding habitat must be established and maintained where necessary, and protected corridors for dispersal to other ponds in the complex must be established and maintained. The most effective way to achieve this goal is to protect the whole drainage surrounding the breeding pond, as well as protecting and enhancing existing ponds or creating one or more new breeding ponds within 0.6 miles of currently protected or managed breeding sites.

Delisting of the SCLTS can occur "when breeding populations are maintained with approximately equal sex ratios at or above 2,600 animals at Valencia Lagoon and 6,500 animals at Ellicott Slough for a minimum of 10 years, and "at least three additional sites are secured and adequately managed to support self-maintaining populations of at least 2,600 breeding animals..." (Service, 1999).

¹ Based on a 1-18 ranking system where 1 is the highest-ranked recovery priority and 18 is the lowest (Endangered and Threatened Species Listing and Recovery Priority Guidelines, 48 FR 43098, September 21, 1983). This number indicates that the taxon is a subspecies that faces a high degree of threat and has a low potential for recovery. The "C" indicates conflict with construction or other development projects or other forms of economic activity

SCLTS HABITAT IN MONTEREY COUNTY

Northern Monterey County is a patchwork of residential areas, wetland and upland habitats, and agricultural production on the flood-plains and south facing slopes of the hillsides. A number of current and historic land use decisions and management actions directly affect SCLTS recovery and are discussed below.

UPLAND AND DISPERSAL HABITAT

Land use changes and development have resulted in the loss of native grassland, riparian, and oak-woodland habitats, which formerly served as SCLTS upland habitat and migration corridors, although north-facing slopes remain largely intact. The SCLTS spends a substantial portion of its life underground in small mammal burrows. Examples of the small mammal burrows include Broad-footed mole (Scapanus latimanus), American shrew mole (Neurotrichus gibbsii), and Botta's pocket gopher (Thomomys bottae). California vole (Microtus californicus) burrows may also be used but only in grassland areas. This salamander is also found among the root systems of plants in upland chaparral and woodland areas of coast live oak or Monterey pine (*Pinus radiata*), and in strips of riparian vegetation such as arroyo willows (*Salix lasiolepis*), cattails (*Typha spp.*), and bulrush (*Scirpus spp.*). These areas are desirable because they are protected from heat and the drying rays of the sun (Reed 1979, 1981) (Service 1999). Additionally, over-summering SCLTS have been found in thick blackberry (*Rubus* spp.) thickets with no overstory (Mitcham pers. comm. 2019). Dispersal habitats consist of most terrestrial areas that provide barrier free movement for the species. Dispersal habitats can range from low to high quality, which can be evaluated in relation to the availability of forage and refugia, as well as the distance to and from suitable breeding and/or upland habitat.

FRESHWATER WETLAND HABITAT

In northern Monterey County, extensive historical freshwater wetlands have been lost due to groundwater overdraft, agriculture, and development. Additionally, a number of known SCLTS breeding sites are in freshwater impoundments behind tide gates and/or dikes, in areas that are below sea level. With climate models showing less frequent and more intense storm events and an increase in the rate of sea-level rise (SLR), these sites are vulnerable to watershed and tidal impacts.

Changing climate patterns may be also influencing the distribution of native predators, particularly rough-skinned newts (RSN; *Taricha granulosa*). Over a 10-year period (2007-2017), the capture frequency of RSN increased exponentially at a SCLTS pond (Biosearch 2017) and the species have been found further south in Santa Cruz County. RSN prey on amphibian eggs and larvae and the tendency of adult RSN to remain in the pond for much of the year may exert extreme predator pressure on other native pond-breeding amphibians, including the Sierran treefrog (*Pseudacris sierra*), a food source for both RSN and SCLTS.

Invasive vegetation poses a concern in terms of fire hazard, water use, and the quality of upland and riparian habitat. In particular, some of the wetlands in this region are surrounded by eucalyptus trees, which are known to uptake greater amounts of fresh-water than do native oak trees. As a result of the water lost to eucalyptus, many of the regional wetlands dry down earlier in the season, preventing native amphibians from achieving metamorphosis. Eucalyptus also produce allelopathic chemicals which prevent adjacent herbaceous plant competition, reducing native understory diversity and potentially degrading water quality. Field studies performed in Santa Cruz showed that SCLTS were captured twice as frequently in oak woodland habitat than eucalyptus forest (Biosearch, 2016). That study noted eucalyptus groves that lack an understory found within oak woodland habitat had a negative affect and that fewer underground tunnels were available for SCLTS in eucalyptus groves than oak woodland habitat. However, it should also be noted that cover is a key component during SCLTS migration and in certain locations, eucalyptus may be preferable to open grasslands. Unlike eucalyptus groves to the south, eucalyptus groves in Monterey County increase over time. In a study by Fork et al. (2015) eucalyptus groves at Elkhorn Slough Reserve and Elkhorn Slough Foundation doubled or tripled in size from 1931-2001 (an average expansion of 271%). A more metered approach that first limits eucalyptus grove expansion into sensitive native habitat followed by slow removal and girdling working inward may be preferred in some instances.

COLLABORATION WITH THE NORTHERN SALINAS VALLEY MOSQUITO ABATEMENT DISTRICT

Concerns about public health and safety have resulted in broad treatment of most freshwater habitats in north Monterey County for the purpose of reducing or eliminating nuisance and health threats associated with mosquitos. Although we recognize the importance of addressing the threats that mosquitos present, we also recognize that mosquito abatement activities can have drastic unintended consequences on non-target insects and wildlife, with particularly negative effects on native amphibians. Larval amphibians depend entirely on the food web that healthy wetland habitats provide, and when this web is altered, reduced, or eliminated, breeding populations of our native amphibians cannot persist.

We provide the following paragraph, excerpted from Mazzacano and Black (2013), to provide an understanding of the unintended consequences that regional mosquito abatement activities can have on wetland habitats and their native occupants. "Mosquito control is done using agents that kill the adult (adulticides) or immature (larvacides) form of the insect. The most commonly used adulticides are organophosphate and pyrethroid insecticides. These compounds have broad spectrum toxicity and cause severe impacts to non-target invertebrates, fish, amphibians, and birds. They have been implicated in declines in both wetland and associated terrestrial wildlife, including endangered species that live near treated areas. Mosquito larvacides include compounds that disrupt larval development, such as methoprene and diflubenzuron; microbial agents such as Bacillus thuringiensis var. israelensis (Bti) and Bacillus sphaericus that are toxic to mosquito larvae when ingested; and surface oils such as Golden Bear that interfere with the larva's ability to breathe. These larvacides are recognized as being relatively nontoxic to non-target organisms (although methoprene and diflubenzuron have documented direct impacts on non-target invertebrates), but such direct toxicity studies rarely, if ever, address indirect effects. Biopesticides, such as Bti, are highly toxic to true flies (Diptera), which includes a variety of organisms that are an important food source in wetlands such as non-biting midges, shore flies, and gnats. Widespread and repeated Bti applications have the potential to severely disrupt local food webs and change wetland community composition. Chemical and biological pesticides are also formulated with adjuvants and carrier agents that may have additional negative effects on aquatic systems and non-target organisms; however, because these compounds are "inert ingredients," they are not examined in acute toxicity tests. Many fish, birds, and amphibians rely on aquatic flies as an important food resource in the water, and the winged forms of aquatic insects can provide 25-100% of the energy or carbon resources for terrestrial consumers such as bats, lizards, and birds. Aquatic macroinvertebrates that develop in pesticide-laden waters can act as "biotransporters" of contaminants because their accumulated pesticide load is taken up by the predators that consume them. Declines in aquatic invertebrate populations due to pesticide impacts also have serious implications for the energy budget of the aquatic and surrounding terrestrial ecosystems."

Based on the facts stated above, we believe it is critically important to ensure collaboration between the Northern Salinas Valley Mosquito Abatement District and landowners/managers of habitats that contain sensitive amphibian species. This goal is detailed in the Best Management Practices for Mosquito Control (CDPH and MVC 2010), a document jointly produced on recommendations from the California Department of Public Health and the Mosquito and Vector Control Association of California. Collaboration should be conducted with the ultimate goal being the reduction or elimination of chemical pollutant introductions into these ecosystems. This collaboration should focus on implementing a combination of the following activities: land managers should assist in minimizing mosquito breeding habitats, land managers should utilize mosquito biological control structures used to house predatory birds such as bats and swallows, mosquito abatement districts and land managers should investigate the use of novel techniques such as the introduction of sterile mosquitos, and most importantly, mosquito abatement districts should, only when absolutely necessary, utilize the minimum amount of larvacides that target only mosquitos that pose health threats. The Northern Salinas Valley Mosquito Abatement District should provide information, when requested, to landowners/managers regarding the type, amount, and date of pesticide utilized for each treatment activity.

SCLTS METAPOPULATIONS IN MONTEREY COUNTY

MCCLUSKY METAPOPULATION

The McClusky Metapopulation is a -7,500 acre area bounded by the Pajaro River to the north, the Pacific Ocean to the west and Elkhorn Slough to the east and south (Figure 3). The lowland area is predominantly farmed with limited available oak woodland and riparian habitats. On the east side of Highway 1, a large ranch (Packard Ranch) supports cattle and horses and hosts over 40 stockwater ponds, many of which have been documented to support CRLF breeding (D'Amore, 2007). Predominantly perennial, the ponds also support an abundance of bullfrogs, which are being controlled through an on-going bullfrog remove program (Mori pers. comm. 2019). The SCLTS historically bred at three locations (McClusky Slough, Struve Pond, and Bennett Slough) in this Metapopulation (Figure 3). The lack of native woodland and riparian (upland) habitat in the vicinity of these three wetlands were cited as presumably a major factor limiting the population size in the area (Talent, 1980) and in 2001, only 30 acres of highly fragmented upland habitat was estimated to remain (Biosearch Associates, 2003). Breeding was last confirmed at McClusky Slough and Zmudowski Pond in 2004, and at Bennett Slough/Struve Pond in 1985 (USFWS 2009). Following the 1989 Loma Prieta earthquake, larger culverts were placed under Jetty Road, increasing tidal exchange between the Moss Landing Harbor and Bennett/Struve Slough, resulting in salinities too high to support amphibians. In this Plan we identify a path forward to re-establish this Metapopulation.



SEEP AREAS ADJACENT TO UPLAND OAK WOODLAND HABITAT WITHIN MCCLUSKY METAPOPULATION THAT COULD BE DEVELOPED FOR SCLTS BREEDING(K. CAMARA)

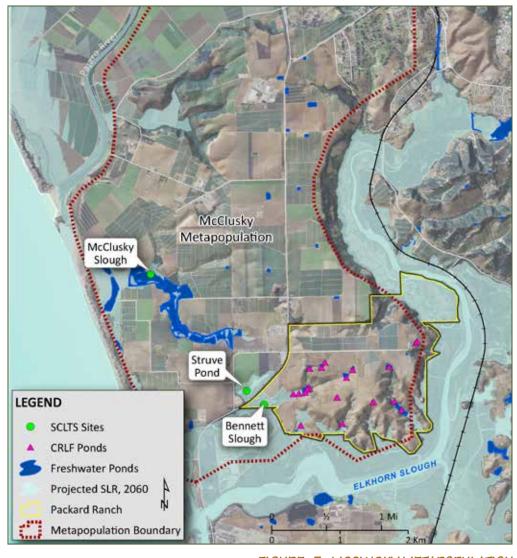


FIGURE 3. MCCLUSKY METAPOPULATION

ELKHORN METAPOPULATION

The Elkhorn Metapopulation inhabits a ~22,0000 acre area bound by the Pajaro River to the north, Elkhorn Slough to the west, Highway 156 to the south and San Miguel Canyon Road to the east (Figure 4). For planning purposes, this Plan divides the Elkhorn Metapopulation into three areas including Upper Elkhorn, Lower Elkhorn and Moro Cojo (Figure 4). It should be noted that the term "metapopulation" suggests that some level of interaction is occurring within spatially separated populations. However, based on existing barriers to dispersal and the distance between breeding sites, the term "metapopulation" may not be accurate as genetic exchange is likely not occurring between all breeding sites within the Elkhorn Metapopulation (Service, 2009). Therefore, we believe that dividing this Metapopulation into the three areas as stated above is a more accurate reflection of potential genetic exchange that may be occurring.

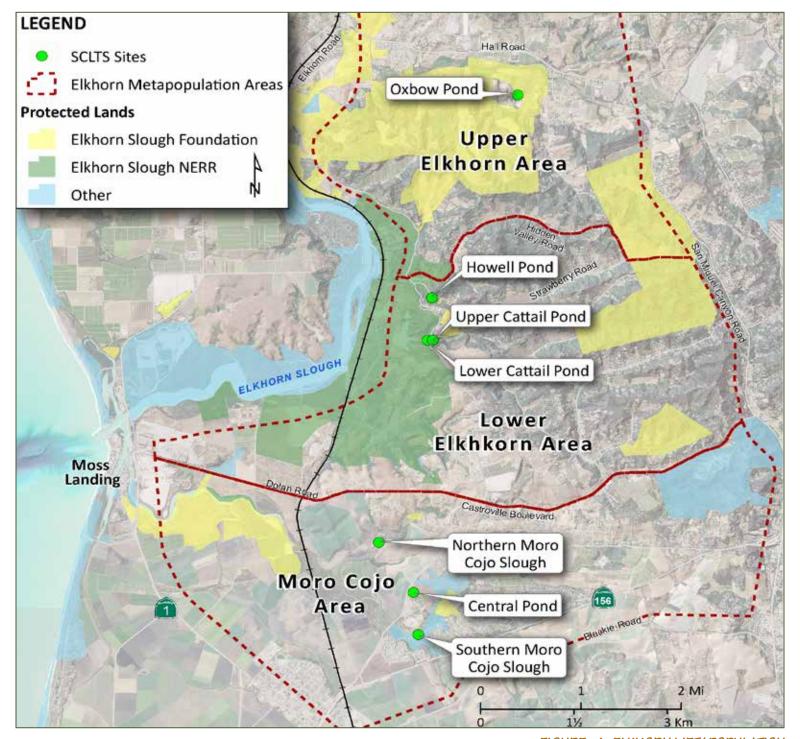


FIGURE 4. ELKHORN METAPOPULATION

UPPER ELKHORN AREA

The Upper Elkhorn Area (Figure 5) is concentrated in the northern portion of the metapopulation between Hall Road to the north and Hidden Valley Road to the south. The sandy, steep, south facing slopes in this area were largely used for strawberry production in the 1990s and early 2000s. However, a majority of this highly erodible land has been retired and is currently owned or managed by a planning team partner, the ESF. The valleys and north facing slopes remain largely intact and provide functional dispersal corridors for SCLTS migration.

SCLTS were discovered at Oxbow Pond in 2007 and breeding was confirmed in 2008 (Service 2009) and 2019. Oxbow Pond is the only known SCLTS breeding site in the Upper Elkhorn Area. Oxbow Pond is located near Carneros Creek, which is known to overflow its banks resulting in the deposition of invasive species such as bullfrogs, catfish, and crayfish in and around adjacent wetland habitat. Oxbow Pond is located within a conservation easement which is managed by the ESF.

LOWER ELKHORN AREA

The Lower Elkhorn Area is concentrated in the center portion of the metapopulation with estuarine habitats of Elkhorn Slough located to the west and south (Figure 6). This area, predominantly owned and managed by ESNERR, supports several freshwater ponds, although many of them are subject to sea level rise and increasing levels of salinity. This includes Lower Cattail Pond, which was considered the only historically consistent breeding site for the SCLTS. Lower Cattail Pond was functionally lost in the winter of 2017, as a tide-gate failure resulted in tidal (marine) water infiltrating the pond. Planning efforts are currently underway to repair this failed tidegate. Salamander larvae (assumed to have been SCLTS) were also detected in 2002 in Rookery Pond, another freshwater impoundment which is currently saline. In 2019, SCLTS were detected at two new sites within this Area. SCLTS adults were observed in and around Upper Cattail Pond, an aquatic feature that was recently deepened for the purpose of providing freshwater breeding habitat for amphibians. Additionally, SCLTS larvae were detected in Howell Pond for the first time, an extension of the North Marsh-Strawberry Marsh estuarine complex, with limited tidal exchange through culverts under Elkhorn and Strawberry roads, resulting in variable but often brackish salinities. Suitable upland habitat exists in this area, consisting primarily of native oak woodland, non-native grasslands, and eucalyptus stands, as well as willow riparian corridors. Most of the agricultural production on the sandy, steep, south facing slopes to the east of Elkhorn Road has been retired and is owned and managed by ESF or ESNERR. Intact and expansive oak woodland habitat and riparian corridors exist in this area.

MORO COJO AREA

The Moro Cojo Area represents the southern extent of the range, with Elkhorn Slough to the north, Highway 1 to the west, Blackie Road to the south and Highway 101 to the east (Figure 7). This area is dominated by agricultural production with small remnants of the fresh and brackish water wetlands, non-native grasslands, oak woodland habitat and a few protected parcels owned by CDFW, CC&R, and ESF. SCLTS were discovered breeding in Upper Moro Cojo Slough (above Castroville Boulevard) in 1978 and were last documented breeding in Lower Moro Cojo Slough in 2007 (Mori 2007) (Figure 5). Both SCLTS and CTS were captured during a 2006-7 and 2007-8 winter drift fence study at the North Monterey County High School (NMHCS) (Lower Moro Cojo Slough) (Mori, 2007, 2008). However, no larvae were found during spring aquatic surveys of construction-related ponds on the school site in either year. In 2019 SCLTS were confirmed to have bred in Central Pond at NMHCS. Efforts are currently underway at NMCHS for the purpose of restoring native oak woodlands and riparian habitat for the SCLTS.

In 2015, tidal (marine) flows reached the known SCLTS breeding site located adjacent, south of NMCHS in Lower Moro Cojo Slough. This was the result of a tide-gate failure at the Moss Landing Harbor. Long-term monitoring data show that this sort of event has happened periodically over the past decades, due to intermittent leakage of the tide-gates that are intended to restrict saltwater from moving upstream. Saltwater infiltration events result in the die off of freshwater marsh and riparian vegetation and the loss of breeding habitat for amphibians. Then, in years of high rainfall, freshwater vegetation and amphibian breeding habitats return. This dynamic is common in many impounded freshwater/former estuarine habitats in the region, including Strawberry Marsh and south Azevedo Marsh. Planning efforts are currently underway to repair the failed tide-gates at the Moss Landing Harbor, presumably resulting in the return of functional breeding habitat within Upper Moro Cojo Slough adjacent to the NMCHS.

Although saltwater intrusion negatively impacted SCLTS breeding habitat in Upper Moro Cojo in 2015, the southermost breeding site, south of Hwy 156, was likely spared, as the culvert that connects the fragmented slough arm through Hwy 156 is elevated at the downstream end, preventing flows from reaching the southernmost breeding site. Like many other SCLTS breeding ponds in Monterey County, this site is imperiled due to lack of upland habitat, adjacent agriculture and small population size (B. Mori, pers. comm.).

PRIORITY CONSERVATION ACTIONS FOR SCLTS

Through this extensive planning effort, we developed a detailed list of priority conservation actions that are needed to ensure the persistence of the species in north Monterey County. Priority actions include the identification of breeding habitat enhancement and creation sites, land conservation (easement/acquisition) candidates, upland and dispersal habitat enhancement areas, invasive animal and plant management actions, captive propagation and translocation actions, and research priorities. Pond enhancement and creation locations were selected based on their proximity to existing/historical occurrences, suitability of existing and potential upland and dispersal habitats, availability of water, and absence of predation threats from both non- native species, such as bullfrogs and fish, as well as native species, including CTS and RSN. Upland and dispersal enhancement areas were selected based on their proximity to existing or planned breeding areas, and dispersal corridors through which the species utilizes, or must utilize, to ensure genetic exchange between populations. Of key importance is that the high priority actions identified in this document would primarily occur on lands that are owned or managed by key planning partners and are protected in perpetuity.



(K. CAMARA)

High priority actions for all Metapopulations, include:

- Conduct research to determine presence/absence and to aid in the prioritization of new pond creation and enhancement of existing breeding sites, upland and dispersal habitat based on migration studies through field surveys and eDNA.
- Coordinate with mosquito abatement districts to limit prey reduction activities in breeding habitat to protect prey base and breeding amphibians. Mosquito fish (Gambusia) should not be added to ponds. An annual meeting should occur to identify ponds used by listed species and to discuss management options.
- Conduct regular monitoring and maintenance of new potential breeding sites, existing ponds, and upland and dispersal habitats.
- Ensure existing pond infrastructure remains functional and intact, including inlet and outlet structures, berms, and water supply (tanks/pipes), where applicable.
- Inspect and maintain existing lined ponds before 1st rainfall to ensure that they continue to maintain an acceptable hydroperiod, including but not limited to Upper Cattail, Swimming Pool Pond, and Visitor Center Pond.
- Supplement water from wells to maintain hydroperiod in years of drought, including but not limited to, Visitor Center Pond, Upper Cattail Pond, Swimming Pool Pond, even if no listed amphibians are detected, to provide breeding habitat for adults as well as support for other wildlife. Ideally, keep these wetlands wet at least through August, and fill them again by December if rain has not done so, to attract breeding by amphibians.
- Add additional tanks, as needed, to allow for hydroperiod management.
- Continue maintenance of existing rainwater-fed guzzlers to provide support for wild-life including amphibians.
- Add or maintain large branches within ponds for structure and cover.
- Plant aquatic vegetation to provide an egg laying medium.
- Manage non-native invasive species, such as bullfrogs/ predatory fish, if they are detected.
- Identify key locations for undercrossing to support SCLTS migration and dispersal.
- Manage high priority, non-native plant species to improve food and cover.



(K. CAMARA)



(K. CAMARA)

MCCLUSKY METAPOPULATION

As stated above, the historic McClusky Metapopulation may have been permanently lost due to degradation of upland habitat resulting from intensive agriculture and infrastructure, and the degradation of freshwater aquatic habitat from tidal (marine) flows. Although suitable habitat is limited, the re-establishment of this metapopulation can be achieved. Planning team members have been and are currently coordinating with landowners in this area for the long-term objective of enhancing key areas in order to provide suitable conditions for the potential translocation of SCLTS larvae into one or more suitable freshwater habitats. Additionally, planning partners are continuing to work with agricultural landowners in this area for the purpose of retiring degraded farmable lands for conversion into suitable habitats for the SCLTS. Priority actions include:

- Conduct research to determine if population is extirpated through field surveys and eDNA.
- Retire agricultural land and convert to suitable upland habitat for adults, adjacent to or within dispersal distance of existing or potential breeding habitat.
- Investigate opportunities and secure conservation easements or land acquisition on historica or potential breeding and upland habitats.
- Implement upland and aquatic habitat restoration on Packard Ranch and/or other adjacent properties.
- Conduct predator management and habitat enhancement actions on Packard Ranch and/or other nearby habitats for the goal of decreasing or eliminating bullfrog populations and/or breeding habitat.
- Create new breeding ponds outside anticipated sea level rise which are supported by suitable, or potentially suitable upland habitat.
- Enhance upland habitat and dispersal corridors through removal of invasive plant species and revegetation with appropriate native species within dispersal distance of aquatic breeding habitat. Priority non-native species include Eucalyptus spp., Acacia spp., pampas/jubata grass, broom spp.
- Conduct SCLTS larval translocations to suitable breeding ponds.



POTENTIAL NEW BREEDING SITE WITHIN MCCLUSKY METAPOPULATION (K. CAMARA)

UPPER ELKHORN AREA

The Upper Elkhorn Area contains extensive amounts of high-quality upland and dispersal habitats. The key factor limiting SCLTS persistence in this Area is the lack of suitable freshwater breeding habitats that are in close proximity to upland habitats. Thankfully, a key planning partner (ESF) owns or manages large swaths of high quality habitat in this Area. Through several site visits and preliminary studies, we have identified key locations for pond creation. This network of pond creation sites is intended to establish self-sustaining populations of the species and would enable the reconnection of breeding populations within the historic Elkhorn Metapopulation.

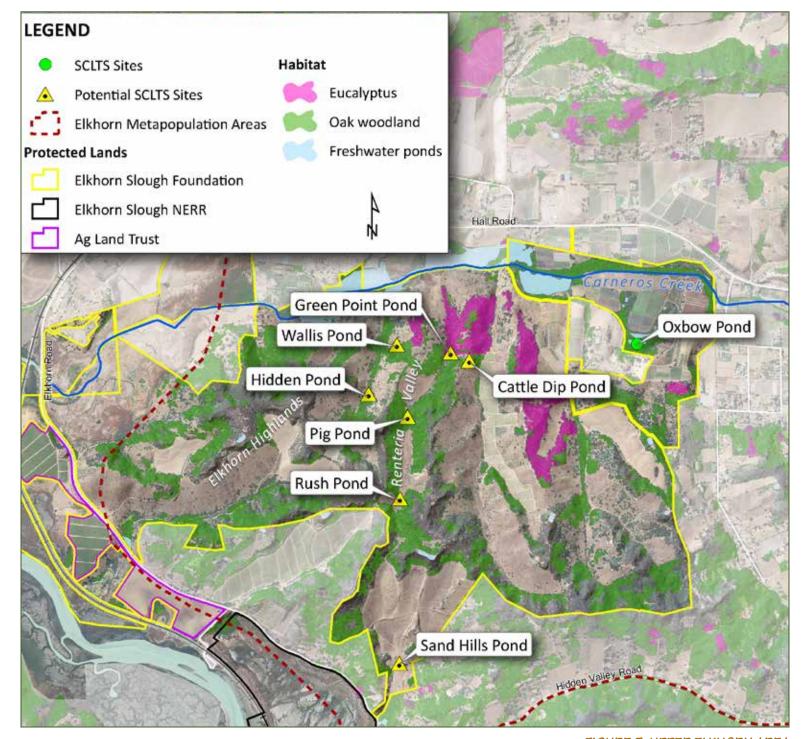


FIGURE 5. UPPER ELKHORN AREA

1. CREATE NETWORK OF NEW BREEDING HABITATS (FIGURE 5)

A high priority for this region is to create a series of ponds on protected lands that are within dispersal distance from Oxbow Pond (aka Carneros Floodplain). The only, presumably reliable SCLTS breeding site in the Upper Elkhorn Area, Oxbow Pond, which is impacted by invasive predators due to flooding from Carneros Creek, could be supplemented by the creation of ponds in Renteria Valley and the adjacent El Chamisal property (Elkhorn Highlands) to the west. The establishment of breeding sites within Renteria Valley and the Elkhorn Highlands will provide long-term sustainability of the species in this Area. Additionally, this network of ponds will facilitate the dispersal of the species towards the Moro Cojo and Lower Elkhorn Areas. Priority sites on lands owned or managed by ESF include but are not limited to:

RENTERIA VALLEY

CATTLE DIP POND

Located 0.8 miles to the west of Oxbow Pond. This existing concrete cattle trough should be modified through partial filling and adding a synthetic liner to provide breeding habitat.

GREEN POINT POND

Create a pond approximately 4,000' to the west of Cattle Dip Pond. This site is adjacent to pristine oak woodland habitat and will ensure the sustainability of the Upper Elkhorn Area population. A small lined pond, with an embankment and structures to manage hydroperiod, should be created in a mesic clearing adjacent to an existing high-quality oak woodland corridor that extends parallel to Renteria Valley.

RUSH POND

Located 2,000 ft south of Cattle Trough and Green Point ponds, a small lined pond along the Renteria Valley drainage should be constructed. This pond should be created below existing high-quality wetland vegetation to avoid impacting native species.

PIG POND

Located 2,000 ft south of Rush Pond, Pig pond was likely a historic sediment basin that is vegetated predominantly with willows. Below the basin embankment, wetland vegetation has become well-established and the groundwater level is just below the soil surface, providing optimum conditions for pond creation.

SANDHILL POND

Approximately 3,000 feet to the south, ESF has been working to reduce erosion and stabilize the Sandhills property, which had been historically farmed. As part of their efforts, a ditch has been installed across the middle of the property to capture surface flows. This ditch could be re-configured to create a lined pond for breeding. If an additional pond could be sited south of the Sandhills property (site TBD), it is possible that the Upper Elkhorn and Lower Elkhorn SCLTS populations could be re-connected.



PIG POND (K. CAMARA)



GOOD UNDERSTORY (K. CAMARA)



GREEN POINT POND. (K. CAMARA)

ELHORN HIGHLANDS

HIDDEN POND

Located on the El Chamisal property, this pond appears to currently provide suitable conditions for freshwater amphibian breeding. The valley in which this pond is located (Renteria Valley), occurs within an area known as the Elkhorn Highlands, and is surrounded by high quality upland and dispersal habitats for the SCLTS. This pond is located in a prime location in terms of potentially facilitating movement of SCLTS among several of the ponds discussed in this document. This pond's suitable water conditions in combination with supporting high quality upland habitat makes this site a key location to introduce SCLTS.

WALLIS POND

Approximately 0. 22-mile north of Hidden Pond is a site that is fed hydraulically by surface flows from an existing drainage. The creation of Wallis Pond at this site would facilitate use of expansive, high-quality habitat by the SCLTS in this area.

2. IMPROVE/MAINTAIN QUALITY OF EXISTING BREEDING HABITATS

As mentioned above, the only known SCLTS breeding site in the Upper Elkhorn Area is Oxbow Pond, which is threatened by invasive predators resulting from regular flooding events emanating from Carneros Creek. At this site, land management or infrastructure to protect Oxbow Pond from Carneros Creek flood flows may be needed.

- Retain engineering firm, specializing in ecological restoration, to provide hydrologic analysis to determine flood level threats and evaluate alternative infrastructure to protect existing breeding habitat.
- Install or other devices to protect breeding habitat from invasive predators, while a long-term solution is developed.
- Conduct land management activities to enhance existing on-site wetlands for the purpose of retaining suitable hydrology for SCLTS breeding.
- Address off-site sediment and nutrient sources through property acquisition or landowner coordination to improve water quality of Oxbox Pond.
- Investigate opportunities and secure conservation easements or land acquisition on existing breeding sites and implement restoration activities, as appropriate.

3. IMPROVE/MAINTAIN UPLAND HABITAT USED BY ADULTS TO SUPPORT NEW OR EXISTING BREEDING SITES.

- Control and/or eradicate non-native invasive plant species within dispersal distance (1 mile) of aquatic breeding habitat. Priority non-native species include Eucalyptus spp., Acacia spp., pampas/jubata grass, broom spp. Although the majority of pond creation sites have been identified by their locations as being supported by suitable upland habitat; an existing Eucalyptus grove near Green Point Pond should be prioritized for removal. This action would greatly assist in ceasing the spread of Eucalyptus further into Renteria Valley.
- As agricultural fields lack the temporary cover needed for migration and dispersal, retirement of marginal or abandoned agricultural land and conversion to upland habitat is recommended. In cases, where retirement is not feasible, best management practices (BMPs) should be employed. BMPs inlcude not farming steep slopes to reduce sediment loss, creating vegetative buffers to protect sensi-

tive habitat, and supporting organic production to limit the use of herbicides and pesticides.

Identify lands that are within the dispersal range of existing or potential breeding
ponds for protection and restoration. Communicate with willing sellers for both
easements and fee acquisition and identify funding sources to complete transactions.

4. ENSURE SPECIES CONNECTIVITY THROUGH THE ENHANCEMENT OR CREATION OF DISPERSAL CORRIDORS

- Improve oak woodland and riparian habitat between Oxbow Pond and Cattle Dip Pond to increase connectivity for SCLTS migration.
- Improve oak woodland and riparian habitat between Sandhills Pond and Pig Pond to increase connectivity for SCLTS migration.
- Seek property acquisition opportunities outside of the anticipated tidal influence to improve the oak woodland and riparian habitat south of the Sandhill Property and north of the Rookery Pond complex, to encourage migration and genetic exchange between the Upper and Lower Elkhorn populations.
- Build a long-term stewardship fund for the perpetual care of the acquired habitats.

5. INCREASE GENETIC DIVERSITY AND SUBSEQUENTLY GENETIC FITNESS THROUGH CAPTIVE PROPAGATION AND LARVAL TRANSLOCATIONS

The Service and CDFW are currently working on a plan to authorize the translocation of SCLTS larvae between known and potential breeding sites throughout Monterey and Santa Cruz Counties. It will likely be necessary to translocate individuals to new ponds in this area, not only to establish populations, but to also ensure high genetic diversity and subsequently increased fitness of these populations. Once the translocation plan is approved translocations will be conducted in accordance with stated priorities.

Prior to translocation plan approval there will likely be cases where SCLTS larvae are imperiled due to lack of appropriate hydrology or salinity threats. These individuals would be moved on a case by case basis to suitable locations as determined by the Service and CDFW.

A formal translocation plan has been drafted by the Service and CDFW to support the introduction of larvae into Monterey County Ponds.

6. EVALUATE POPULATION RECOVERY AND INFORM ADAPTIVE MANAGE-MENT THROUGH RESEARCH AND MONITORING, INCLUDING eDNA.

While it will be important to monitor all existing and created ponds to determine species presence/ absence, it is particularly critical to conduct aquatic monitoring and terrestrial surveys at Oxbow Pond. Aquatic sampling surveys in 2019 have demonstrated that a SCLTS population persists. Last noted in 2013, larvae were not detected during sampling in 2015 and 2016. Pit trapping can also provide information on species dispersal patterns, which assists with siting ponds and dispersal and upland habitat locations.

LOWER ELKHORN AREA

The Lower Elkhorn Area contains a variety of high- and low-quality upland and dispersal habitats for the species. As in the Upper Elkhorn Area, the key factor limiting SCLTS persistence in this Area is the lack of suitable freshwater breeding habitats that are supported by suitable upland habitats. Thankfully, key planning partners (ESF and ESNERR) owns or manages large swaths of habitat in this Area. Through several site visits and preliminary studies, we have identified key locations for pond creation and upland habitat enhancement. This network of pond creation sites would establish self-sustaining populations of the species and would enable the reconnection of breeding populations within the historic Elkhorn Metapopulation.

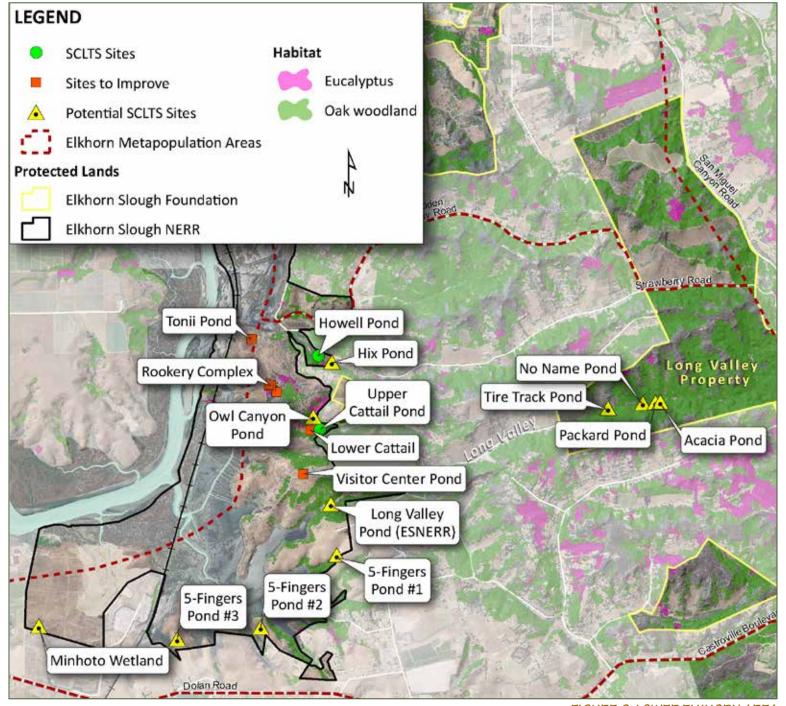


FIGURE 6. LOWER ELKHORN AREA

1. CREATE NETWORK OF NEW BREEDING HABITATS (FIGURE 6)

A high priority for this region is to create a network of ponds on protected lands that are within dispersal distance of existing breeding sites, including Lower Cattail Pond. Lower Cattail Pond has historically been one of a few presumably consistent breeding locations for the SCLTS in Monterey County. Regrettably, during the winter 2017-2018, a tide-gate failure resulted in the loss of this site, as tidal (marine) water infiltrated the pond. ESNERR is currently seeking funds to address the tide-gate failure and are prepared to implement the planned repairs in 2019. If repairs are implemented in 2019, Lower Cattail Pond is likely to become suitable breeding habitat for the species again within 1 to 3 years. Continued maintenance and repairs may allow this historical salt marsh to be managed as a freshwater impoundment indefinitely, but given the cost of such efforts and the risk of periodic failure, especially in the face of sea level rise, we cannot depend on the reliability of this site. Priority pond creation sites on lands owned or managed by ESNERR and ESF include but are not limited to:



INIQUEZ PROPERTY. (K. CAMARA)

OWL CANYON POND

Approximately 400 ft north of Lower Cattail Pond, an adult SCLTS was observed in Owl Canyon in 2013. Once the eucalyptus has been removed from this area and restored with native vegetation, a pond in Owl Canyon would create a stepping stone between the Cattail Complex and the Rookery Complex.

LONG VALLEY POND

The pond creation site is located within dispersal distance (0.6 mile) south of Upper and Lower Cattail Ponds, on lands that are owned and managed by ESNERR. A pond at this location would be free from salinity threats and would further assist in supporting the Lower Elkhorn population at ESNERR over the long term. An abundance of high quality upland habitat exists at this location and prime recruitment conditions are anticipated upon the creation of a suitable pond at this location.

"FIVE FINGERS" POND(S)

Migrating individuals from Long Valley Pond(s) would be in dispersal distance to an area known as the "Five Fingers" area, owned by ESNERR. Breeding habitats could be created in this area (Springer, Yazwin and Avila parcels) by creating small blockages in existing drainages to create a series of wetland habitats that presumably occurred here in the past. The creation of one or more breeding habitats in this area would facilitate the reconnection of the Lower Elkhorn and Moro Cojo populations.

UNNAMED MINHOTO WETLAND OWNED BY ESNERR

A new pond could be created in the saddle between Elkhorn and Moro Cojo on Minhoto property, near where the wetland complex crosses under Moonglow driveway. The pond would immediately benefit both CTS and CRLF, as well and would facilitate the reconnection of the Lower Elkhorn and Moro Cojo populations.

HIX POND

Currently located on ESF owned land, the proposed Hix Pond site would provide reliable breeding habitat for the SCLTS and CTS populations that are currently utilizing Howell Pond for breeding. This pond would be located 450 ft upstream of Howell Pond, outside of tidal influence. This small pond would be constructed in a low-lying drainage swale, adjacent to pristine oak woodland habitat to the south.



HIX PROPERTY (K. CAMARA)



LONG VALLEY. (K. CAMARA)

LONG VALLEY

Reconnaissance surveys of ESF owned and managed properties located 1.6 miles east of ESNERR resulted in the identification of potentially four pond creation sites within an area known as Long Valley, which is distinct from the Long Valley Pond site referred to above. This large swath of land (1600 acres) is bisected by a natural drainage and contains abundant and high-quality oak woodland habitat. The creation of suitable breeding habitat in this area would provide sustainability reassurances for the SCLTS and other sensitive amphibians by facilitating the utilization of this prime habitat.

NO NAME, TIRE TRACK, ACACIA, AND PACKARD PONDS

These four pond sites were identified along the existing drainage within Long Valley. These areas are bounded by high-quality upland habitat and provide open areas for prime pond creation sites. Further investigation of these sites to determine existing hydrological conditions is needed; although, it is presumed that these ponds would require artificial lining to retain suitable hydrology to facilitate amphibian breeding.



LONG VALLEY PROPERTY (K. CAMARA)

2. IMPROVE/MAINTAIN QUALITY OF EXISTING BREEDING HABITATS

Improving existing breeding sites, in conjunction with creating new breeding sites, is key to SCLTS recovery. A number of existing ponds on ESF and ESNERR land can be improved to encourage and improve amphibian breeding, including:

LOWER CATTAIL POND

As mentioned above, as the only historically consistent breeding site for SCLTS in the Lower Elkhorn Area, repair of the outlet structure is a high priority to prevent continued salt water intrusion. As the source population, this pond should be maintained until SCLTS are documented breeding for at least 2 consecutive years in one or more ponds within dispersal distance.

UPPER CATTAIL POND

Out of the influence of sea level rise, Upper Cattail Pond has been a consistent breeding site for CRLF and is located just upstream of Lower Cattail Pond. We believe that this pond is critically important to maintain the existing population of SCLTS in this area. Upper Cattail Pond should be inspected and maintained annually to ensure that existing infrastructure remains functional. In addition, the liner should be inspected before the first rainfall, water levels monitored during dry down and supplemental water added, as needed, to allow for successful metamorphosis. Additional plantings or the placement of large wood in the pond will help provide cover for breeding amphibians.



UPPER CATTAIL POND (K. CAMARA)



LOWER CATTAIL.POND (K. CAMARA)

VISITOR CENTER POND

Located 0.3 mile south of the Cattail Complex of ponds, Visitor Center Pond provides suitable breeding habitat for SCLTS, although the species has not been found here. Successful utilization of Visitor Center Pond for breeding SCLTS would facilitate dispersal to other locations at ESNERR. Thick native vegetation, such as California blackberry, California wildrose, and poison oak should be planted within the native and non-native grasslands adjacent, south of this pond. Additionally, the addition of herbaceous vegetation and/or downed wood or other refugia should be installed in the adjacent oak woodland that is located immediately north of the pond.

ROOKERY COMPLEX

The Rookery Complex includes Main Rookery Pond, Middle Rookery Pond, and Swimming Pool Pond. SCLTS breeding was noted in Main Rookery in 2002. However, successful breeding has not been noted since then and CRLF breeding ceased in 2006, although CRLF larvae were found in Swimming Pool Pond during sampling efforts in 2019. This is likely due to tidal seepage through the earthen berm. Measures to arrest tidal influence, such as repairing the berm, replacing the culvert and/or construction a new berm to impound freshwater in the upper portion of the pond, should be employed. Water quality conditions may be limiting successful amphibian breeding at Main Rookery and Swimming Pool Ponds. Practices to address the low pH should be implemented to improve habitat for amphibian breeding.

HOWELL POND

Aquatic sampling in 2019 resulted in the discovery of SCLTS larvae at Howell Pond. Howell Pond is known to support CTS breeding with documented occurrences in 2015 and 2016. This pond is currently subject to tidal influence, with varying salinity levels. Due the tenuous nature of this habitat, and the recent confirmation of SCLTS breeding, it is apparent that an additional pond should be created near Howell Pond, but outside of salinity threats, at the earliest available opportunity. Of additional importance regarding the retention of suitable breeding habitat at this location is the existence of abundant, high-quality upland habitat that supports this area. The north-facing slope of this valley is approximately 3000 ft of contiguous oak woodland habitat.

TONII POND

Located 1500 LF north of the Rookery Complex, Tonii Pond could be enhanced to extend the hydroperiod by improving the pond lining and establishing native cover, such as willows. This would extend the breeding range of SCLTS north.



HOWELL POND (K. CAMARA)

3. IMPROVE/MAINTAIN UPLAND HABITAT USED BY ADULTS TO SUPPORT NEW OR EXISTING BREEDING SITES

- Remove key non-native invasive plant species within dispersal distance (1 mile) of
 aquatic breeding habitat. Priority non-native species include Eucalyptus spp., Acacia
 spp., pampas/jubata grass, broom spp. Other species in and near freshwater wetlands
 include velvet grass, tall fescue, hemlock, and Cape ivy and jubuta grass from riparian
 habitats.
- Provide additional refugia, including snags and downed wood, in degraded oak woodland habitat, until adequate understory can be established and maintained.
- As agricultural fields lack the temporary cover needed for migration and dispersal, retirement of marginal or abandoned agricultural land and conversion to upland habitat is recommended. In cases, where retirement is not feasible, best management practices (BMPs) should be employed. BMPs inleude not farming steep slopes to reduce sediment loss, creating vegetative buffers to protect sensitive habitat, and supporting organic production to limit the use of herbicides and pesticides.

CATTAIL COMPLEX

As a priority breeding area that should be protected, the existing stand of Eucalyptus to the north of the Cattail Complex should be removed. This area should be revegetated with oak woodland species. In addition, the existing oak woodland habitat understory to the south should be enhanced with appropriate native understory.

OWL CANYON

The existing stand of Eucalyptus in Owl Canyon should be removed prior to creation of a new breeding pond. This area should be revegetated with oak woodland species.

ROOKERY COMPLEX

Restore oak woodland habitat where eucalyptus were recently removed.

LONG VALLEY PONDS

Control hemlock in Long Valley, adjacent to the new ponds to enhance upland habitat.

4. ENSURE SPECIES CONNECTIVITY THROUGH THE ENHANCEMENT OR CREATION OF DISPERSAL CORRIDORS

- Improve oak woodland and riparian habitat between the Five fingers Pond(s) and increase connectivity for SCLTS migration from Moro Cojo Area.
- Protect existing oak woodland habitat on the south side of Long Valley, along
 with the creation of additional breeding ponds, which will be necessary in order
 to facilitate SCLTS movement from ESNERR to the Long Valley Area.
- Seek property acquisition opportunities outside of the anticipated tidal influence to protect known or potential SCLTS habitats. ESF has an active land acquisition program that supports amphibian recovery and protect from development pressure, particularly adjoining uplands.

5. INCREASE GENETIC DIVERSITY AND SUBSEQUENTLY GENETIC FITNESS THROUGH CAPTIVE PROPAGATION AND LARVAL TRANSLOCATIONS

A formal translocation plan is currently being drafted by the Service and CDFW to support the introduction of larvae into Monterey County Ponds, and will be utilized in combination with this document at the time of its release.

6. EVALUATE POPULATION RECOVERY AND INFORM ADAPTIVE MANAGE-MENT THROUGH RESEARCH AND MONITORING, INCLUDING eDNA.

Track amphibian breeding and water quality conditions to inform adaptive management of Reserve wetlands, including:

- Conduct spring dipnet surveys of all accessible freshwater wetlands in the Elkhorn Metapopulation.
- Conduct water quality monitoring at all Reserve ponds, as needed.
- Deploy and check coverboard opportunistically to detect the presence of the species.
- Maintain master database of north Monterey County listed species sightings in Excel and GIS and annually upload new ones to CNDBB.
- Develop and test eDNA protocols to enhance detection of SCLTS presence in regional ponds.
- Conduct upland pitfall surveys to determine movement patterns, migration corridors and identification of critical occupied upland areas.

MORO COJO AREA

As stated above, the Moro Cojo Area is highly impacted as a result of intensive agriculture, residential and industrial development, infrastructure, and hydrologic alterations. Although this area is highly impacted, remaining habitat in the area provides opportunities for SCLTS persistence. This is particularly due to the efforts of partners including CDFW, ESF, and Coastal Conservation and Research, Inc (CCR), who have acquired properties in the watershed and CCWG, who has worked with private landowners to retire marginal farmland and restored wetland, upland and riparian habitat. At present, there are relatively few available options in terms of the creation of additional breeding sites, which is primarily due to the absence of supporting upland habitat and perpetually protected lands. We believe that the highest priority in this Area is to continue to enhance breeding and upland habitat at NMCHS and within the neighboring Moro Cojo Slough adjacent to the NMCHS.

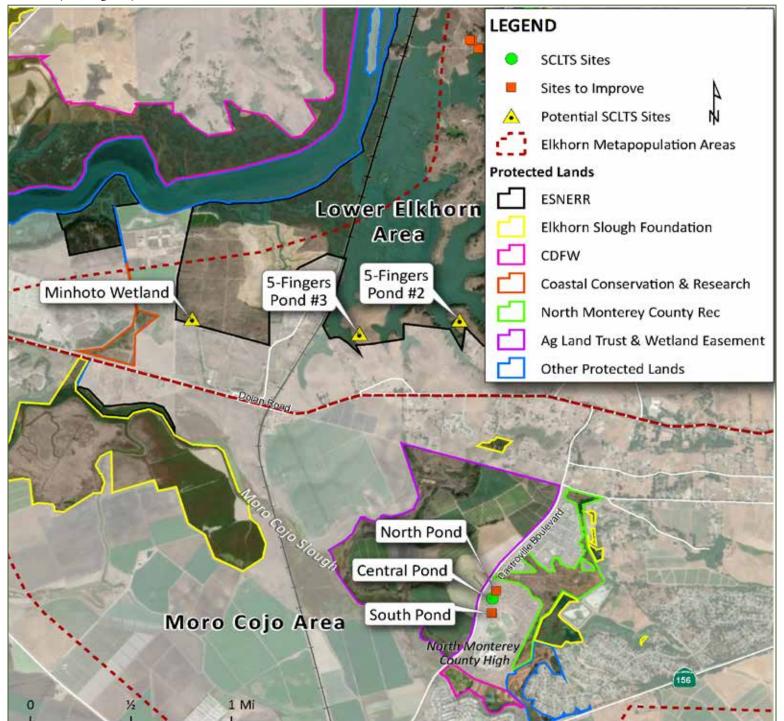


FIGURE 7. MORO COJO AREA

1. CREATE NETWORKS FOR NEW BREEDING HABITAT (FIGURE 7)

A high priority for this region is to create a network of ponds on protected lands that are within dispersal distance of existing breeding sites. The lone, presumably consistent breeding site in this area is the Moro Cojo Slough, adjacent to and south of NMCHS, on both sides of Highway 156. The area north of Hwy 156 periodically faces high levels of salinity as a result of tidal influence and evaporation. In the short term, we believe it is important to work to sustain freshwater conditions at this site. Long-term sustainability efforts are currently underway at this location, consisting of the restoration of upland habitat at NMCHS and other upland areas in the Upper Slough, downstream of Castroville Blvd. The restoration of upland habitat at the NMCHS site would support Central Pond, which is the location that breeding was confirmed for the first time in 2019. Priority pond creation sites include but are not limited to:

NORTH MONTEREY COUNTY PARKS PROPERTY NEAR NMCHS

Investigate opportunities to develop breeding habitat on properties adjacent to the high school, particularly the county parks parcel to encourage SCLTS movement to the north rather than south toward tidally influenced areas.

OPPORTUNISTIC ACQUISTION/EASEMENT/ENHANCEMENT

Explore future opportunities to acquire, dedicate conservation easements, or conduct habitat enhancement within parcels north of NMCHS, between the Moro Cojo Area and the Lower Elkhorn Area.

2. IMPROVE/MAINTAIN QUALITY OF EXISTING BREEDING HABITATS

NORTH POND AND SOUTH POND@ NMCHS

In 2019, during aquatic sampling, SCLTS larvae were detected at Central Pond at the NMCHS. While SCLTS and CTS were documented on-site during winter drift fence studies in 2006-07 and 2007-08, spring aquatic surveys of the ponds in 2010 and 2018 did not document breeding. With SCLTS known to be on the property and with a supportive landowner (North Monterey County Unified School District), South Pond should be lined to extend the hydroperiod. North Pond should be excavated to create a larger depression and the bulrush and cattails removed to increase open water habitat.

CDFW PONDS

The existing CDFW owned ponds, southwest of NMCHS, should be managed to encourage use by native amphibians. Predatory fish, bullfrogs, and other non-native predators should be eradicated. Hydro-period manipulation should also be investigated to encourage utilization by native amphibians.

Investigate opportunities to enhance breeding habitats to encourage the migration of SCLTS to the north, outside of the current prediction of tidal influence. Support efforts by CCWG to enhance freshwater resources that are located outside of anticipated sea level rise.



NORTH MONTEREY COUNTY HIGH SCHOOL (K. CAMARA)



NORTH MONTEREY COUNTY HIGH SCHOOL (K. CAMARA)



CENTRAL POND. (K. CAMARA)

HWY 156 SOUTH POND

While no upland habitat exists and despite it's isolation, the pond south of Hwy 156 may bring important genetic material to the SCLTS population, as pit trap studies documented the animal in 2010/2011 (Mori 2017). An easement or acquisition of the site would protect the pond and installing an undercrossing would be important for biological connectivity with NMCHS.

3. IMPROVE/MAINTAIN UPLAND HABITAT USED BY ADULTS TO SUPPORT NEW OR EXISTING BREEDING SITES

- Remove key non-native invasive plant species within dispersal distance (1 mile) of aquatic breeding habitat. Priority non-native species include Eucalyptus spp., Acacia spp., pampas/jubata grass, broom spp. Other species in and near freshwater wetlands include velvet grass, tall fescue, hemlock, and Cape ivy and jubuta grass from riparian habitats.
- Investigate opportunities to collaborate with Monterey County Parks to restore upland habitat at their property located adjacent, east of NMCHS.
- Plant poison oak and other trespass reducing plants on properties subject to trespass and vandalism including the County Parks property.

4. ENSURE SPECIES CONNECTIVITY THROUGH THE ENHANCEMENT OR CREATION OF DISPERSAL CORRIDORS

NORTH MONTEREY COUNTY HIGH SCHOOL

- Install a low barrier fence along Castroville Boulevard to direct SCLTS to North Monterey County Parks Property.
- Investigate opportunities to acquire or retire agricultural land and rural properties within Moro Cojo Slough, with a particular focus on the area north of NMCHS, in order to provide breeding habitat and/or dispersal corridors that facilitate connectivity with the Lower Elkhorn Area.
- Support efforts by CCWG to enhance dispersal habitats within Moro Cojo Slough.
- Identify potential dispersal corridors to Five Fingers.

5. INCREASE GENETIC DIVERSITY AND SUBSEQUENTLY GENETIC FITNESS THROUGH CAPTIVE PROPAGATION AND LARVAL TRANSLOCATIONS

A formal translocation plan is currently being drafted by the Service and CDFW to support the introduction of larvae into Monterey County Ponds. This Plan will be used concurrently to idenfity appropriate sites for larval translocation.

EVALUATE POPULATION RECOVERY AND INFORM ADAPTIVE MANAGEMENT THROUGH RESEARCH AND MONI-TORING, INCLUDING EDNA.

Track amphibian breeding and water quality conditions to inform adaptive management of moro cojo wetlands, including:

- Conduct spring dipnet surveys of all accessible freshwater wetlands in the moro cojo Metapopulation
- Conduct water quality monitoring at all ponds
 - Deploy and check cover boards opportunistically to confirm the presence of the species
 - Maintain master database of moro cojo area listed species sightings in Excel and GIS and annually upload new ones to CNDBB
 - Develop and test eDNA protocols to enhance detection of SCLTS presence in regional ponds

PRIORITY CONSERVATION ACTIONS FOR CTS AND CRLF

UPPER ELKHORN AREA

Explore restoration opportunities at Werner Lake, such as conducting dredging and vegetation management, to restore this major historic freshwater wetland and encourage amphibian breeding. Retain engineering firm, specializing in ecological restoration, to identify sediment sources and evaluate sediment delivery rates to determine the feasibility of creating breeding habitat.

Examine Porter Ranch uplands as potential habitat and mitigation lands for CTS.

LOWER ELKHORN AREA

Due to steep slopes and high rates of erosion, agricultural production was retired upon acquisition of the Iniguez Property by ESF and the parcel was restored with native grasses and oak trees. Located within dispersal distance of the Cattail Complex, Owl Canyon, and Howell Pond, this property along with adjacent properties that could be acquired in the future would provide valuable oak woodland habitat for SCLTS recovery. In addition, on-going observations of adult CTS make this area a prime location to construct future wetland habitat.

RANA POND

Rana Pond could be improved to provide habitat for CTS and CRLF.

MIDDEN POND

Midden Pond could be improved to provide habitat for CTS and CRLF.

MINHOTO FRESHWATER WETLAND SITE

Owned by ESNERR, a new pond could be created in the saddle between Elkhorn and Moro Cojo on Minhoto property, near where the wetland complex crosses under Moonglow driveway. The pond would immediately benefit both CTS and CRLF within grassland, and could maybe facilitate the reconnection of the Lower Elkhorn and Moro Cojo populations.

GRANITE ROCK POND

Located north of Dolan Road and owned by CC&R, the berm around Granite Rock Pond could be raised to pond additional water to support amphibian. Currently the pond is drained through an existing pipe before successful breeding could occur.

MORO COJO

While no upland habitat exists and despite it's isolation, hybridized CTS have been documented in the pond south of Hwy 156 (Mori 2017). An easement or acquisition of the site would protect the pond.



CALIFORNIA TIGER SALAMANDER (K. CAMARA)



CALIFORNIA RED-LEGGED FROG (K. CAMARA)



CALIFORNIA RED-LEGGED FROG (K. CAMARA)

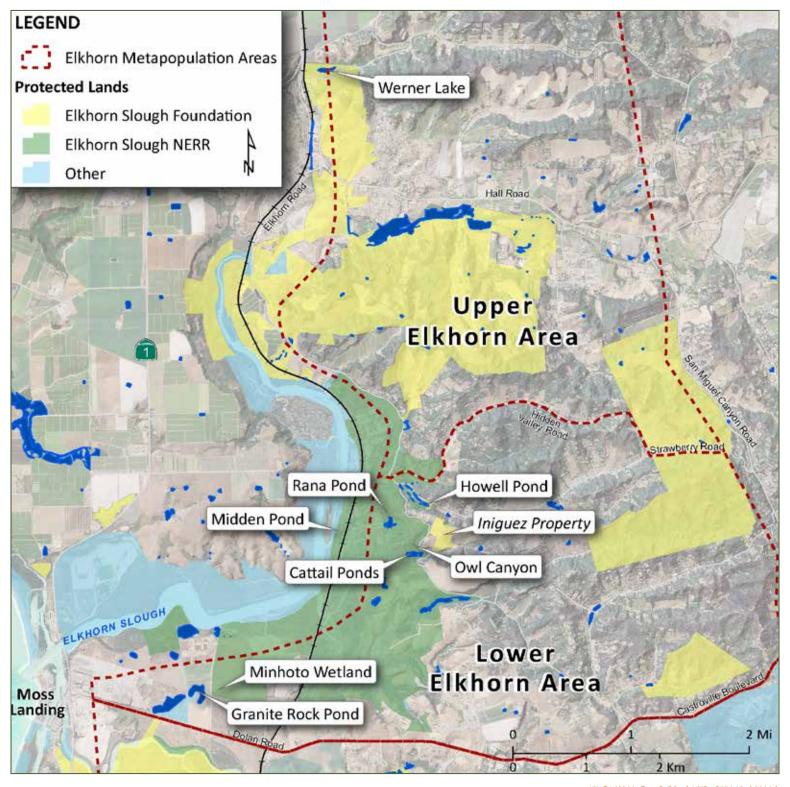


FIGURE 8. CTS AND CRLF AREA

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