Ecology & conservation of the Santa Cruz long-toed salamander (*Ambystoma macrodactylum croceum*)

A workshop on the natural history, ecology, and conservation of a critically-endangered species

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Workshop Goals

1. Explain key elements of SCLTS biology and life history
2. Review the regional landscape and areas where SCLTS is most likely to be found
3. Different life stages, timing of key life history events
4. Discuss effective sampling strategies
5. Discuss the complexities of conserving the species when habitat loss is increasing – *irony*
6. Provide an open forum for question and discussion
7. Conduct a field exercise in detection methods & mitigation design

In general, we will cover:

What a long-toed salamander is

How it got here, where it lives, and what it does

How to identify it

How to identify habitat and detect presence

Why it is endangered and how it is being managed, as well as prospects for recovery

Workshop Outline

I. Biogeographic history of the long-toed salamander and how the SC lineage arose

II. Ecology and life history

III. Surveying, monitoring, & management

IV. Threats, mitigation approaches

V. Practical conservation & recovery

I. History through biogeographic origins

Taxonomy and basic biology

Diversity, distribution, evolution, and rarity

Objective: understand why SCLTS is so rare *and* unique

The history of SCLTS begins with biogeography and long-range colonization followed by divergence in allopatry

It ends in restriction to a small chunk of the coastal terrace after long-range extinctions down the coast as habitat changed (Coast Redwoods)

Taxonomy of SCLTS

Amphibian: *amphi*- of both kinds, *bios*- life

- possess two modes of existence
- aquatic eggs, coated by polysaccharide gel
- aquatic larval stage
- thin, permeable skin for water balance (they do not drink) and gas exchange

Caudata: a tailed amphibian

- salamander, “legendary lizard-like creature that can live in fire,” "legendary fiery beast”
- four legs and a tail in all post-embryonic life stages, two habitats

Mole salamander: Ambystomatidae

- typically occupy small mammal burrows (e.g., mole tunnels, gopher burrows), costal grooves, unique to North America

Etymology – roots of SCLTS taxonomy

Genus *Ambystoma*: origin unclear; *anabystoma*- "to cram into the mouth," or possibly derived from *Ambly*- blunt, *stoma*- mouth (Greek)

– species *macrodactylum*: *makros*- long, *dactylos*- toe (Greek)

  - subspecies *croceum*: *crocus*- saffron colored, referring to the dull orange dorsal pattern coloration (Latin)

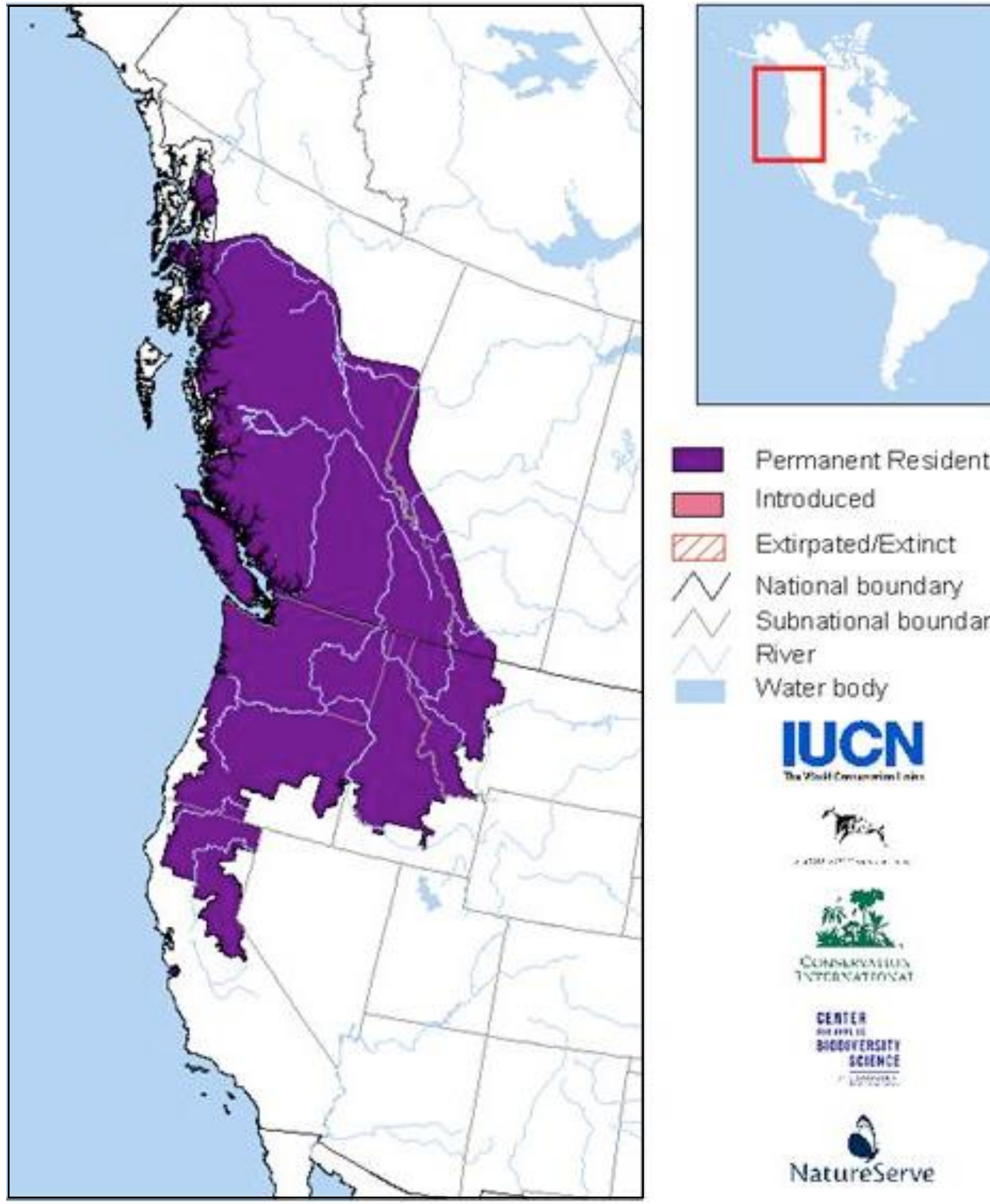
Long-toed salamander basics: *Ambystoma macrodactylum*

A smaller species of the mole salamanders (*Ambystoma*), dorsal surface is dark gray to black with a yellow, orange-to-red, tan or olive green dorsal stripe, which is broken up into pronounced blotches in two subspecies (modified from Stebbins 1951)

The sides have some white speckling/flecking – the ventral side is usually a translucent gray – black venter primarily only in one subspecies (modified from Petranka 1998)

They occupy forested landscapes associated with meadow wetlands, ranging from vernal pools near sea level to permanent fishless ponds and lakes at high elevation

North American range of the long-toed salamander (*Ambystoma macrodactylum*)



Diversity of long-toed salamanders, *Ambystoma macrodactylum*

- Five geographically variable subspecies (lineages)
- Recognizable different forms: genetics, morphology & geography
- Represent a widespread species that diversified into different evolutionary lineages due to long-term adaptation to regional environment and climate

Five types (subspecies) of long-toed salamanders:

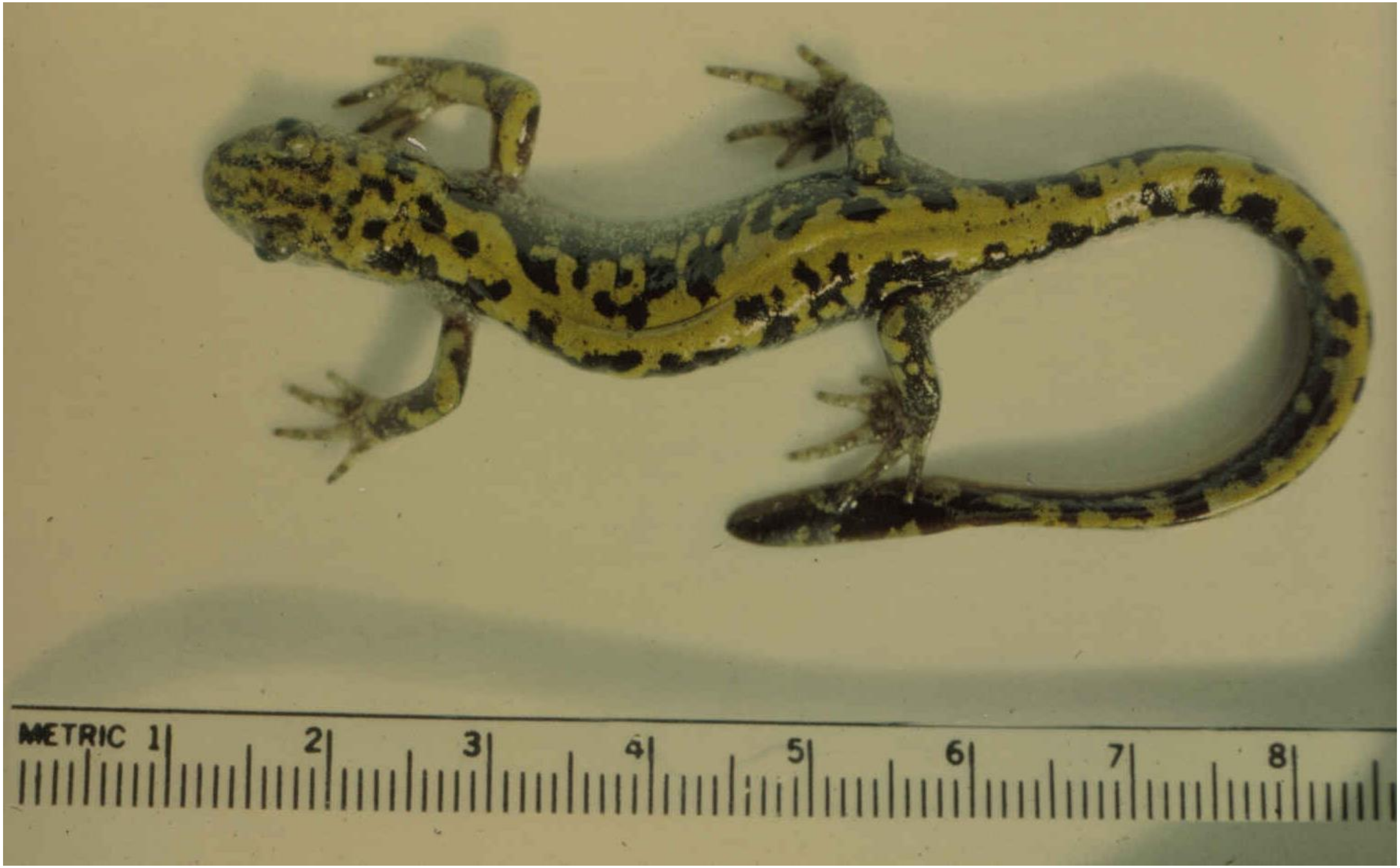
Three dorsal-banded forms:

1) Eastern: *A. m. krausei*
2) Northern/Central: *A. m. columbianum*
3) Western: *A. m. macrodactylum* (the typological form)

Two broken pattern forms:

4) Santa Cruz: *A. m. croceum*
5) Southern: *A. m. sigillatum*

A long-toed salamander from Alaska, the Central long-toed salamander (*A. m. columbianum*) – note the color pattern along the dorsum. SCLTS is a much smaller subspecies, and exhibits very different dorsal patterning.

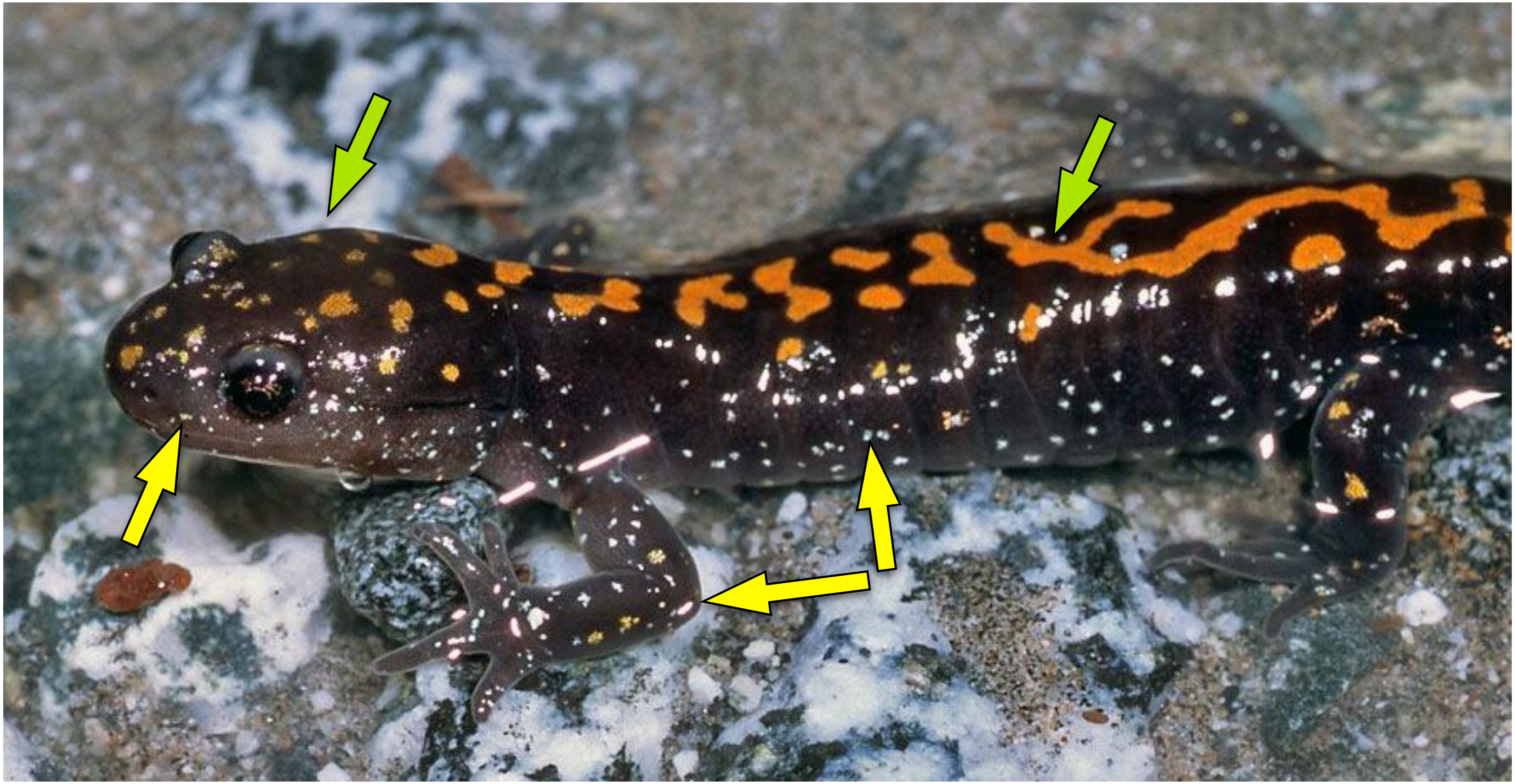



Another long-toed salamander from Alaska – SCLTS is smaller and darker along the flanks (here it is grey); the dorsal coloration is more connected than in SCLTS.

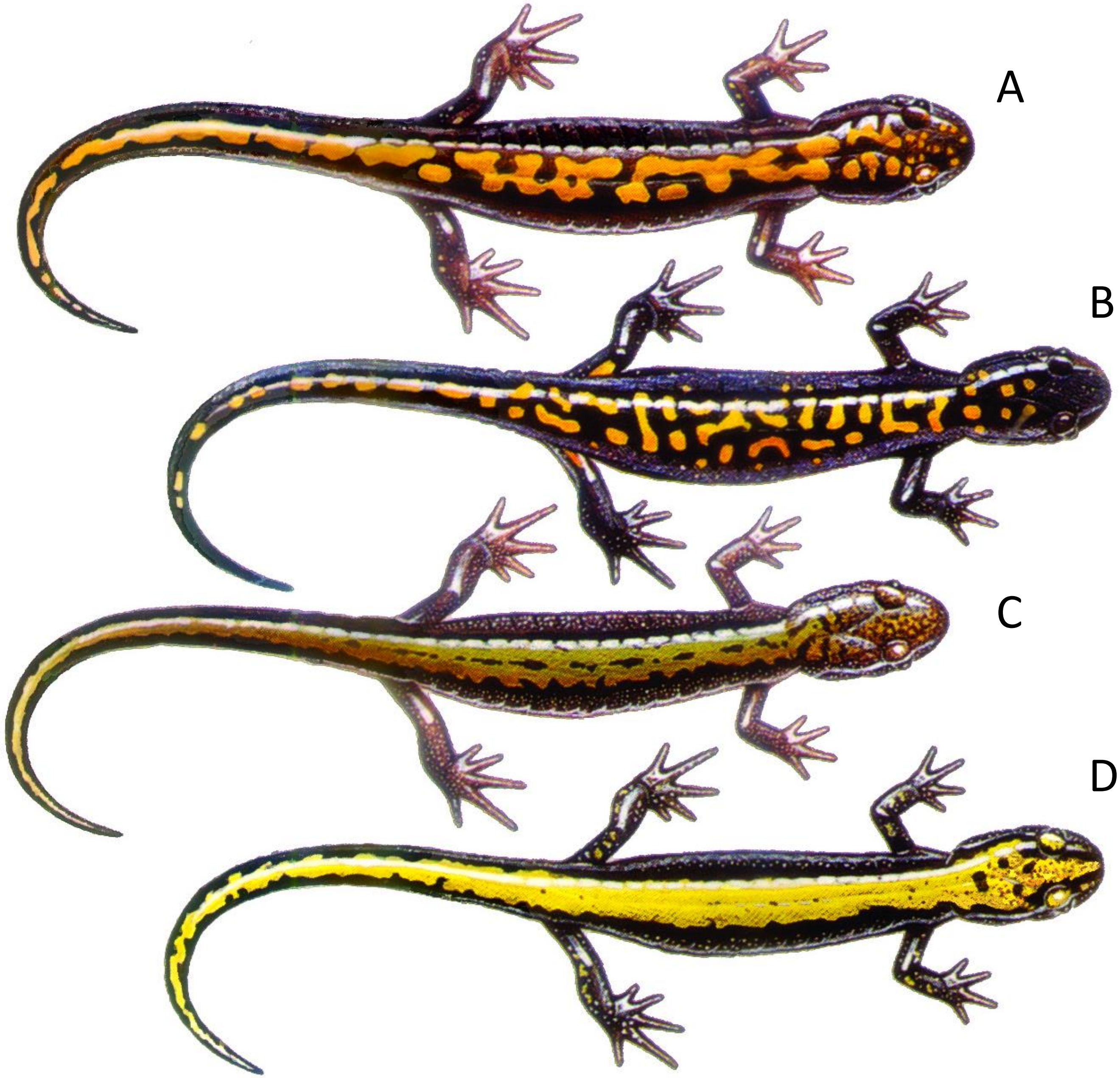
Santa Cruz long-toed salamander
(*Ambystoma macrodactylum croceum*)

croceus/croceum = saffron colored

Note the white flecking on the limbs, head, and along the costal grooves, and the discontinuous pattern along the dorsum, which is a saffron colored (yellow, golden). The base pattern is a dark gray-black and is somewhat lighter underneath – *pattern largley absent on head*.



Which of these is the Santa Cruz long-toed salamander?

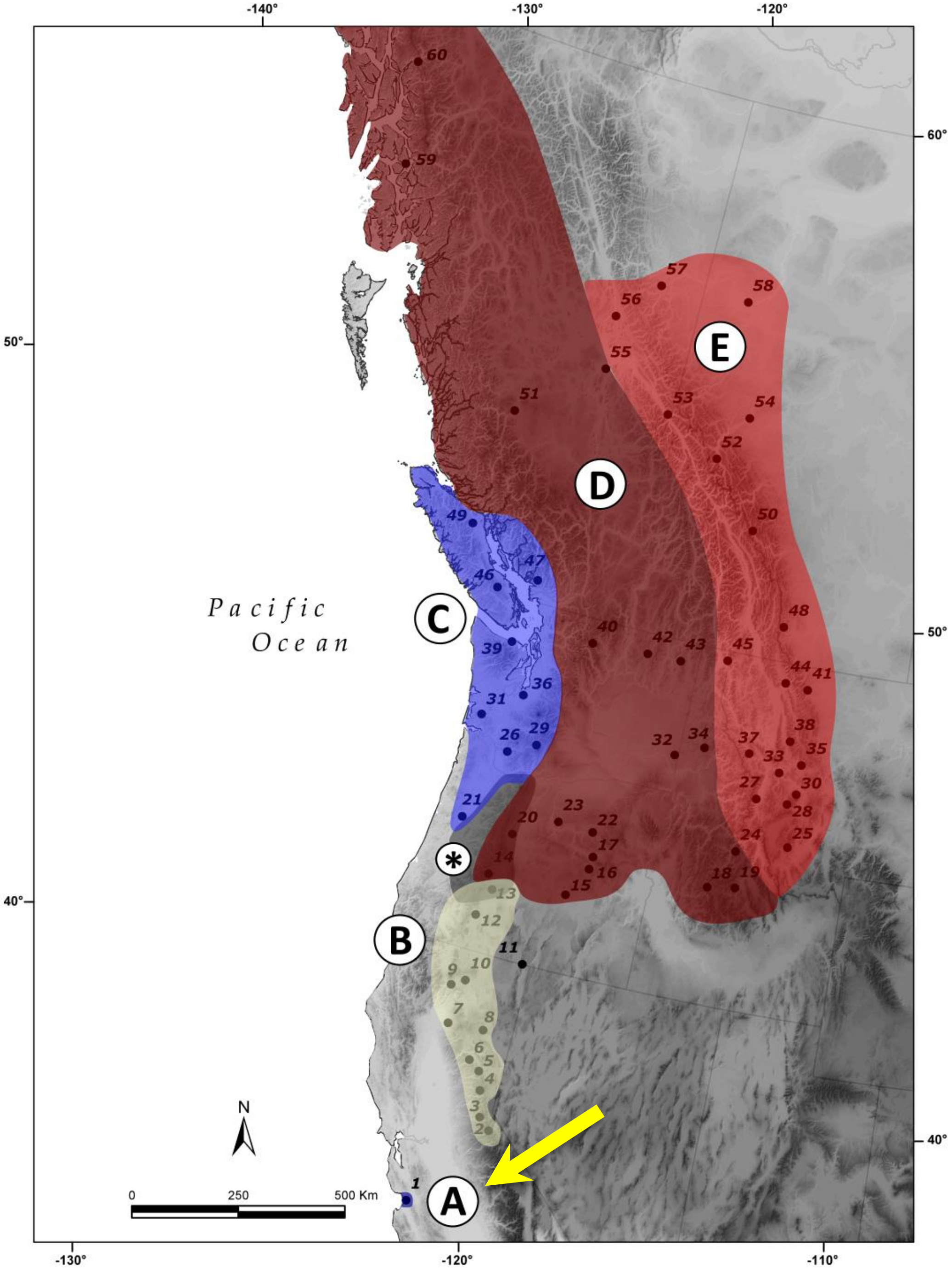


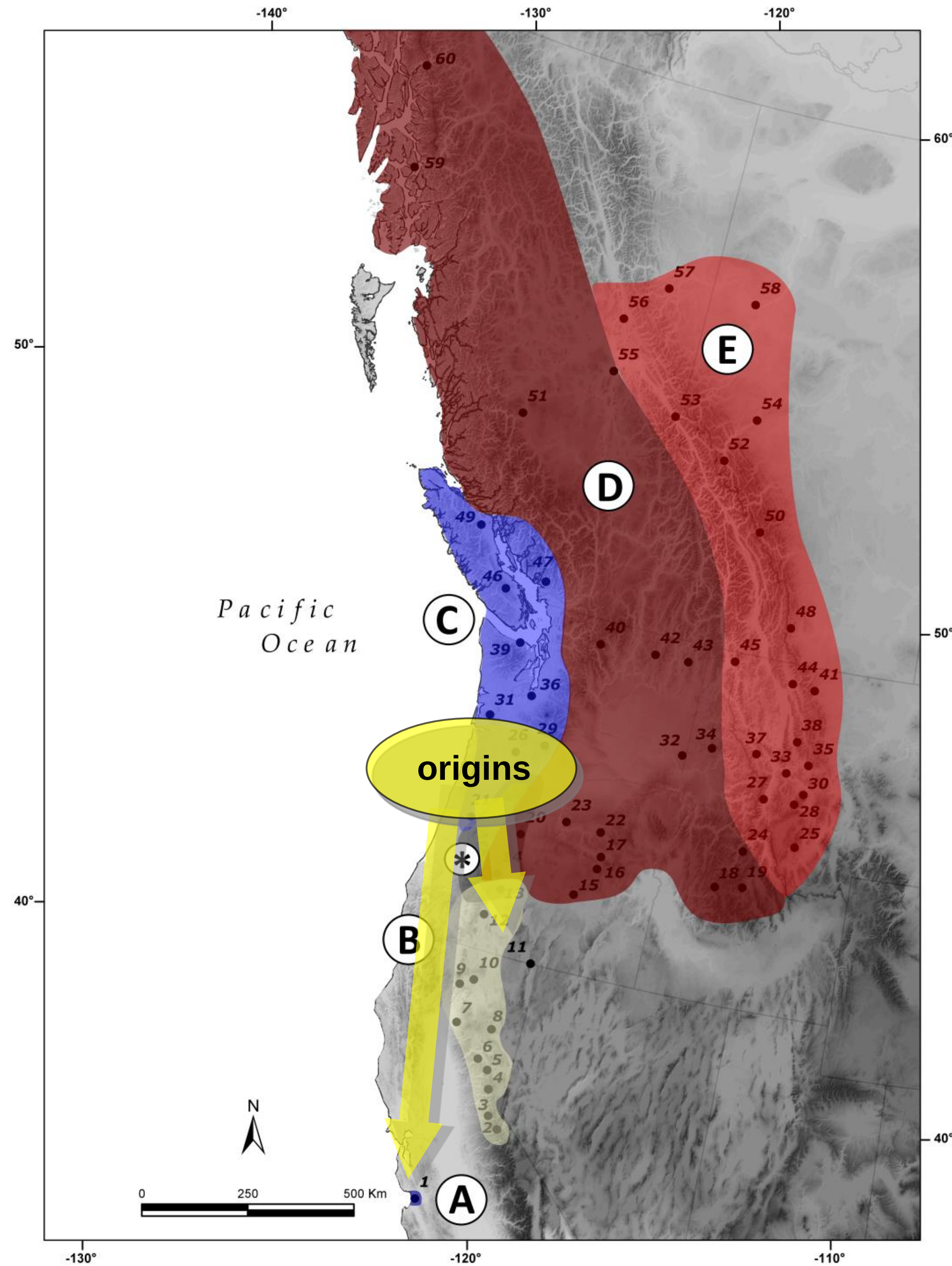
Distributions of long-toed salamander subspecies

The geographic range of long-toed salamanders spans a great diversity of ecological and elevational gradients.

…

Santa Cruz lineage is the exception.



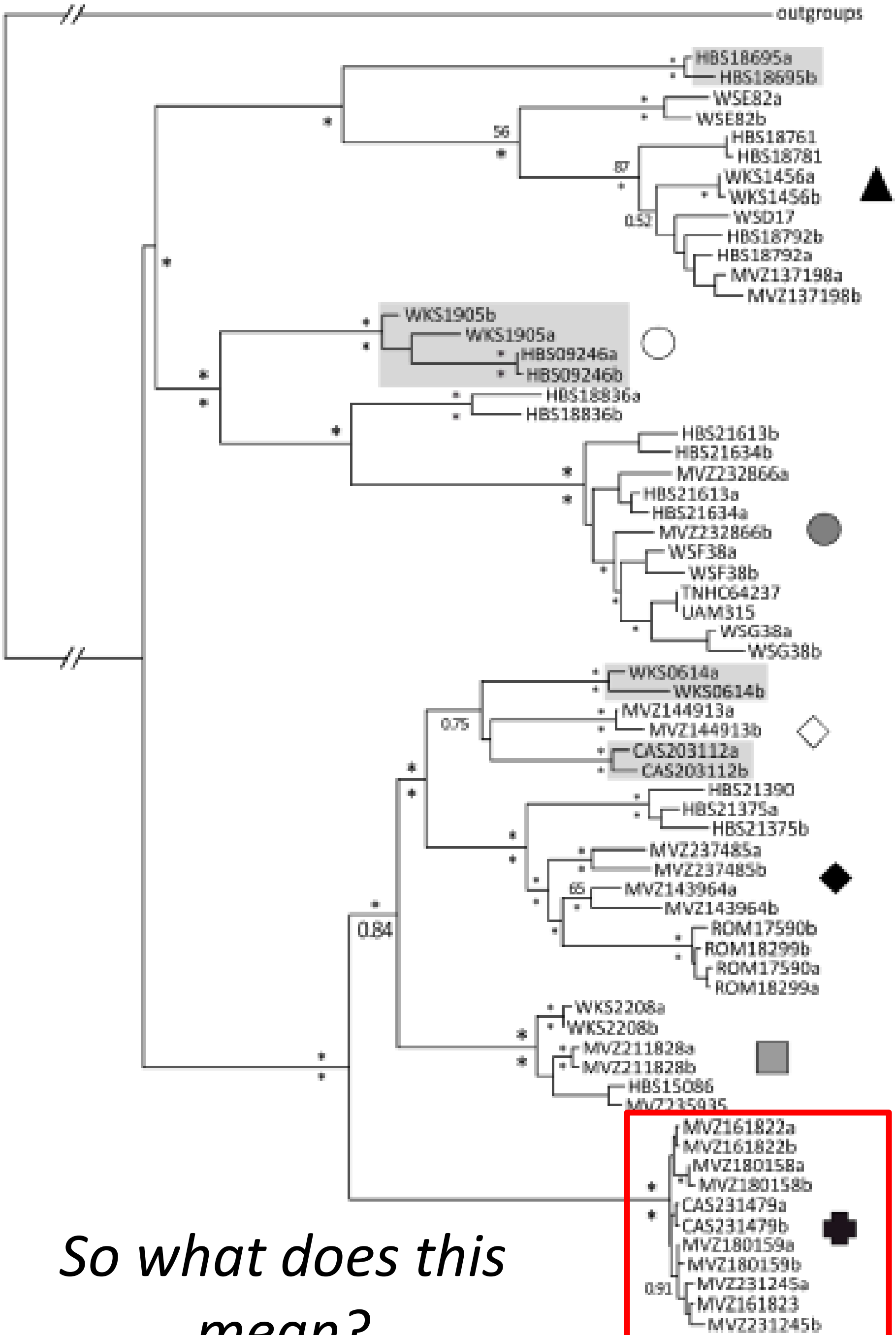


SCLTS descended from a northern, coastal lineage

A long-range change in coastal habitat left a relictual lineage in Santa Cruz

The closest relative to SCLTS is *not* in the Sierra Range

Ranges & relationships of long-toed salamanders

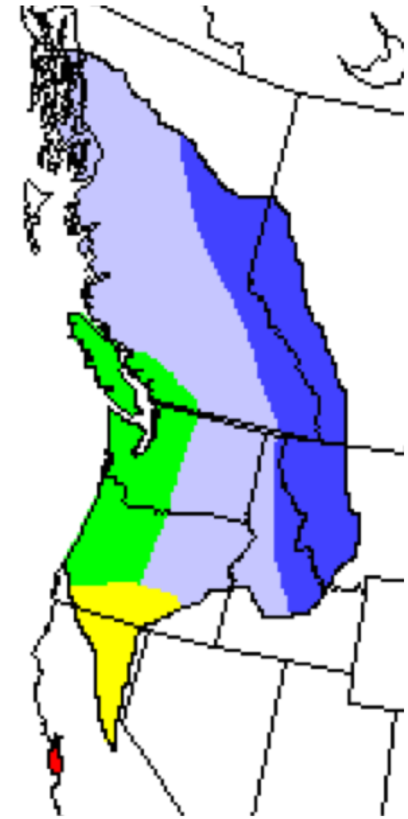


Eastern

Central

Western

Southern



So what does this mean?

SCLTS is a unique animal

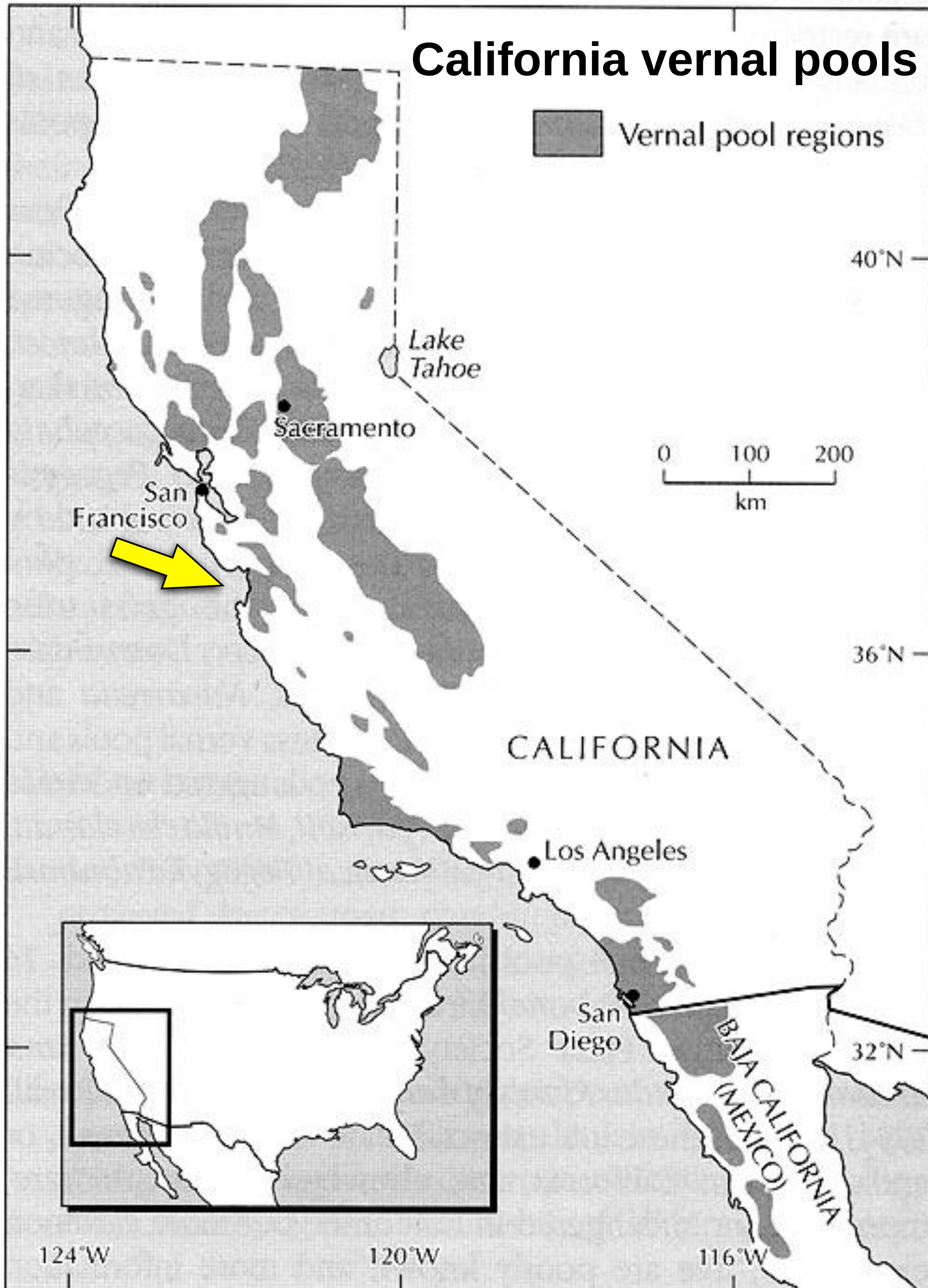
The Santa Cruz long-toed salamander is a genetically distinct taxon, an endemic and relictual lineage that was “left behind”

It is unique in color pattern, protein isozymes, genetics, where it is distributed, and critically low numbers of demes and total population size

This information, coupled with the reality of human development of remaining habitat, is the basis for recovery


Cabrillo Hwy
Monroe Ave
Jaunell Rd
433B
Valencia Lagoon
1
Bonita Dr
Vista Del Mar Dr

California vernal pools

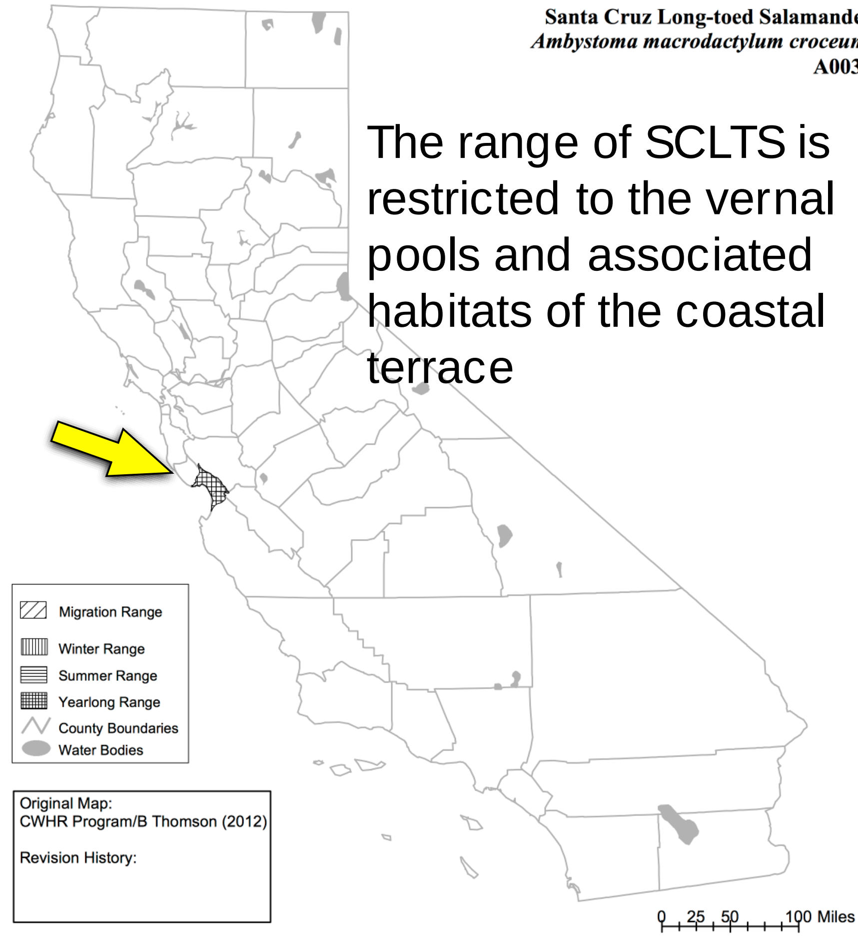


Current SCLTS distribution

California Wildlife Habitat Relationships System
California Department of Fish and Game
California Interagency Wildlife Task Group

Santa Cruz Long-toed Salamander
Ambystoma macrodactylum croceum
A003a

The range of SCLTS is restricted to the vernal pools and associated habitats of the coastal terrace



Range maps are based on available occurrence data and professional knowledge. They represent current, but not historic or potential, range. Unless otherwise noted above, maps were originally published in Zeiner, D.C., W.F. Laudenslayer, Jr., K.E. Mayer, and M. White, eds. 1988-1990. California's Wildlife. Vol. I-III. California Depart. of Fish and Game, Sacramento, California. Updates are noted in maps that have been added or edited since original publication.

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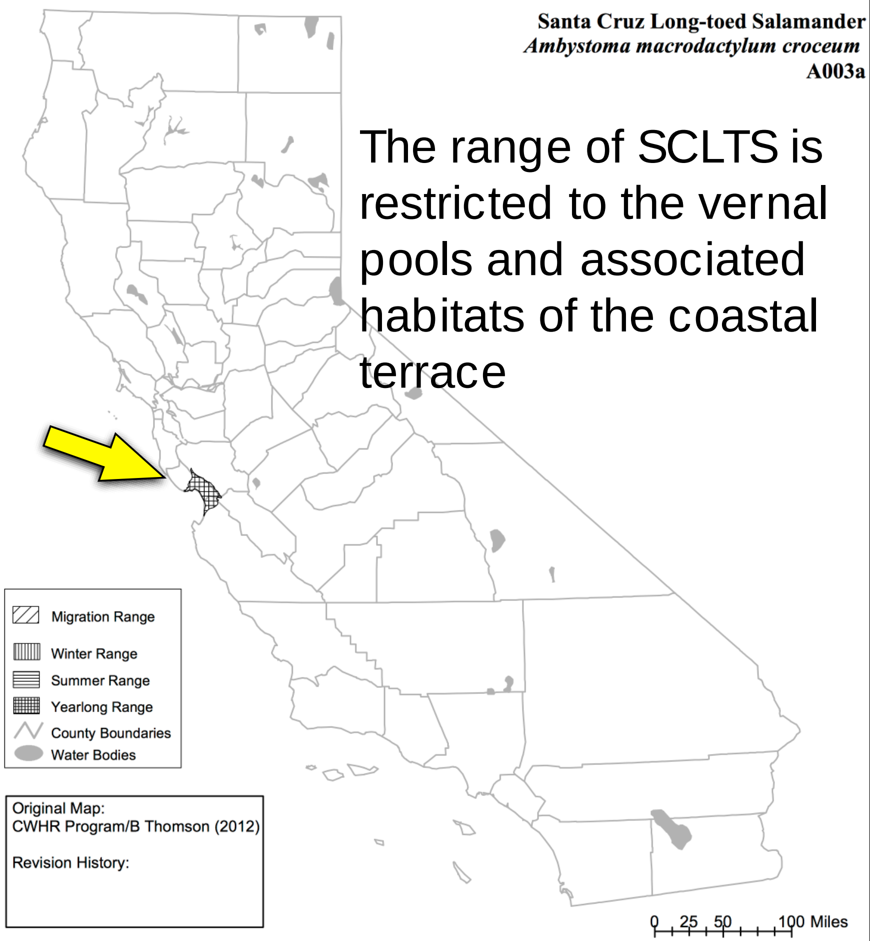

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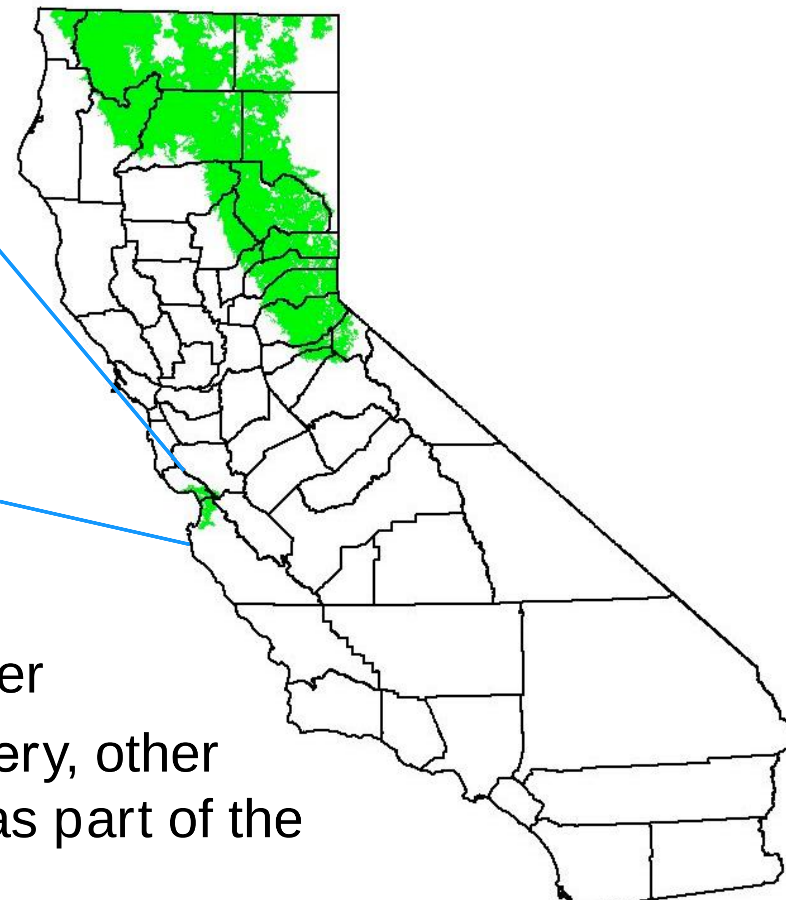
Major range of SCLTS is within the Pajaro Valley Watershed: a few populations exist to the north of Ellicott Slough and a few south of Elkhorn Slough (ESNERR)



Predicted distribution in California based on core habitat - the colored areas depict the predicted range for the long-toed salamander

Habitats were identified using satellite imagery, other datasets and experts throughout the state, as part of the California Gap Analysis Project

Summary of Part I: History

Appreciate the diversity of long-toed salamanders and why SCLTS is evolutionarily unique

Biogeographic origins: long-range colonization followed by divergence in allopatry through habitat change

SCLTS is restricted to a small chunk of the coastal terrace and is endangered because its habitat requirements make it unlikely they can persist in light of ever increasing human development

II. Life History & Ecology

i. Life cycle, identification and description of SCLTS eggs, larvae, adults, and sex

ii. Habitats and ecology

iii. Brief mention of demography and population dynamics, as well as predators and prey

iv. Movement (Allaback & Laabs), populations, metapopulations, and landscapes

v. Regional population relatedness – how this relates to recovery/management

Key features of the life cycle

1. Adults migrate to ponds with fall and winter rains
   - Present at ponds relatively briefly, only a few days
2. Embryos (potentially) detectable December-March
   - Eggs attached to vegetation singly or in small clumps
3. Larvae mainly detectable March-June
   - sometimes until August, depending on hydroperiod
   - too small to catch or identify prior to late April/May (?)
   - coloration is extremely variable (mottled, black, off white, but no true stripes)
4. Metamorphosis can begin as early as April, but
   - Metamorphs vary widely in color and size
   - Present in crevices created by pond drying and in habitat at pond edges through summer until fall rains

Santa Cruz long-toed salamander life cycle

Adult, 10 y (?)

courtship/
breeding

Eggs, ~15-35 d

hatching

Larva, 90-145 d

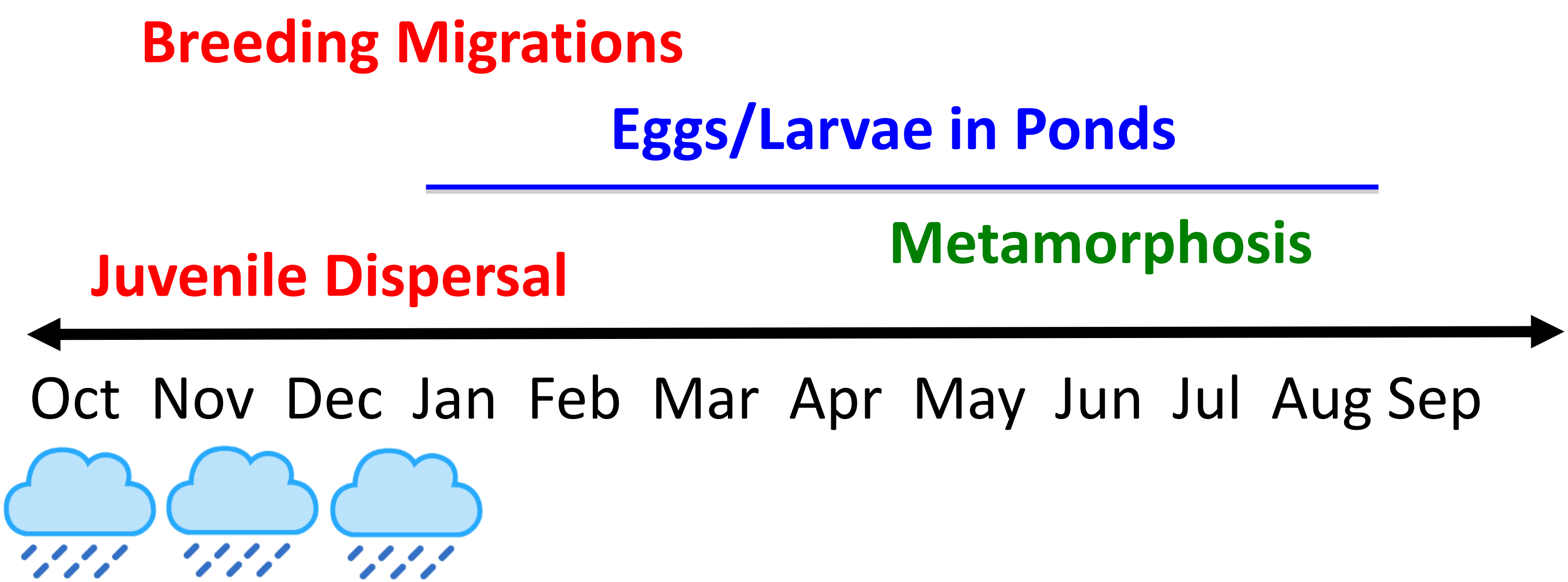
metamorphosis
26-48 mm

Juvenile, 1-3 y

growth

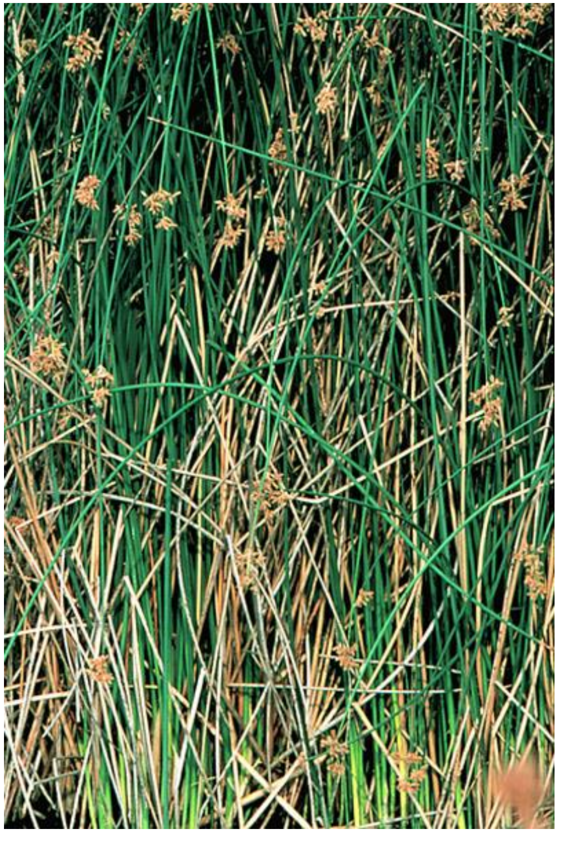
SCLTS life cycle is similar to CTS

Timing varies among sites due to pond duration and rain. Generally, the first fall rains involve outward bound movements of juveniles born the prior winter, and a relaxed inward bound movement of reproductive males, then females arrive as rains begin to fill temporary ponds.



Breeding habitat: wetlands

- Seasonal, and more recently, permanent ponds
  - Larvae use submerged root structures of California bulrush (*Schoenoplectus californicus*) and other emergent vegetation such as *Polygonum* and native wetland grasses for cover
- Wetlands: gulches, sloughs, swales, vernal pools, catchment basins
- Willow stands typically associated with breeding ponds – staging areas
- Breeding documented in ponds with predators
  - Sculpin, catfish, mosquito fish, bullfrog, crayfish, newt, garter snake (?), CTS (?)
  - Reduce recruitment levels



Ellicott Slough, inundated (high water year) - note the emergent vegetation, which is an indicator of good quality aquatic habitat

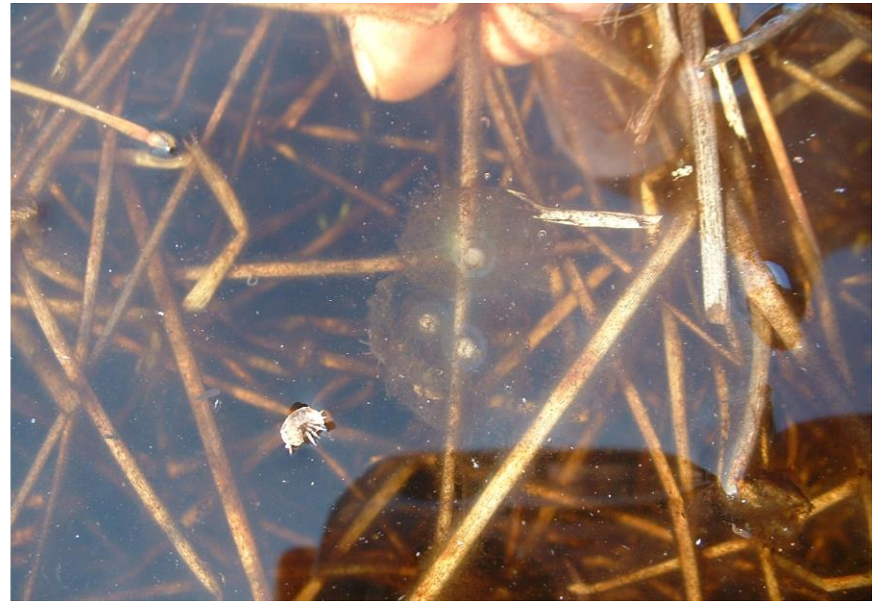
Seascape Uplands Mitigation Pond 2 - recently colonized by SCLTS

Identification/Morphology: Eggs

Eggs/Embryos

- tapioca-like
- Attached to vegetation or other submerged materials
- Attached singly or in small clusters
- Each enclosed in an individual membrane
- Mostly clear, but also grey
- Detectable mainly Dec-Jan
- Typically short period of time (a span of < ~3-5 weeks)

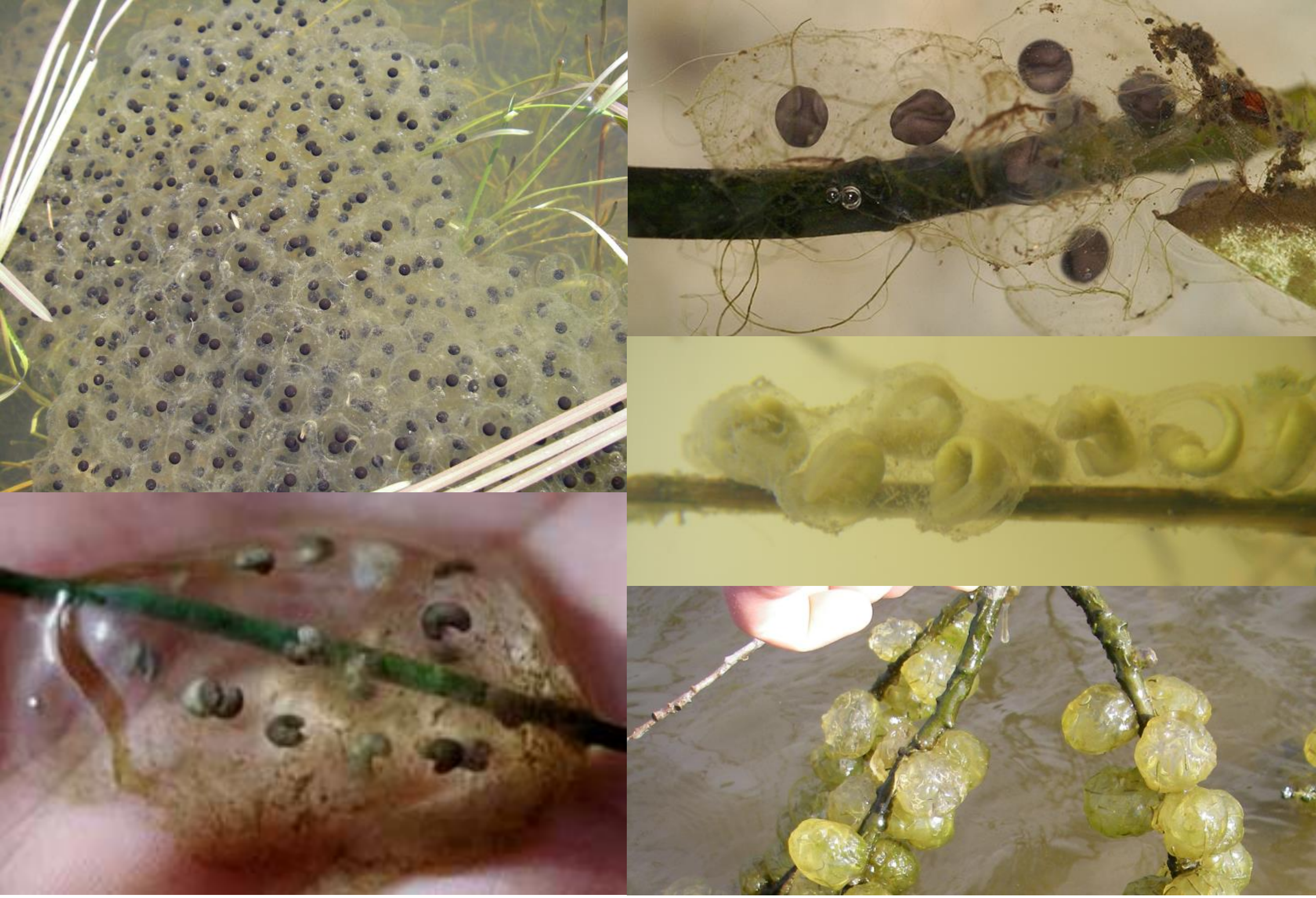
Identification: Eggs



Deposited in shallow water (< 0.5 m) either singly, or in small clusters of a few to > 20, sometimes more

Eggs are attached to vegetation (floating, emergent, standing, submerged, logs, branches)

Clutch size per female: ~ 215 – 411 (Anderson 1967)



- Hatch in 5–35 d, temperature dependent
- Not *easily* differentiated from CTS embryos
- Always photo-document and contact agencies/experts

Identification: Larvae

- Fish-like; four legs; feathery external gills;
  - ~12 - 90 mm (total length); color variable
- Somewhat challenging to identify due to confusion with larvae of other species
  - Especially at small sizes
  - Co-occur with California tiger salamanders in Harkin's Slough drainage, west of HWY 1
  - Co-occur with newts in Freedom area, east of HWY 1
- Larval period is variable in duration (~50-60 d)
  - Pond conditions may lengthen or shorten it
  - *What specific factors can influence the length of the larval period (and embryonic stage)?*

Embryonic and Larval Santa Cruz Long-Toed Salamander

Color patterns vary from mottled (above) to a uniformly-colored dark morph that is slate grey-blue with an iridescent blue belly, and even completely white (rare)

Identification: Larvae

Variation in larval phenotypes

The white, dark, and mottled larval phenotypes may be found in the same vernal pools

Larval Identification

Rough-skinned newt

- 5-7 gill rakers
- light spots (no mottling)
- Eye line
- <100mm

CTS

- Broad head
- 15-24 gill rakers
- Up to 150 mm *total length*
- Hideous, wedge-shaped toes, horribly ugly

SCLTS

- 9-13 gill rakers
- <100mm *total length*
- Small, cute, more endangered

Discriminating larval species: look for forelimbs, which emerge prior to hind limbs in larval salamanders whereas the opposite is true in tadpoles

Discriminating larval species: look at the digits of the hind limbs, which can be wedge-shaped in tiger salamanders – note also the coloration, the gill rami length, and the broad, shovel-nosed head in the unsophisticated salamander below

Larvae quiz ID slide:



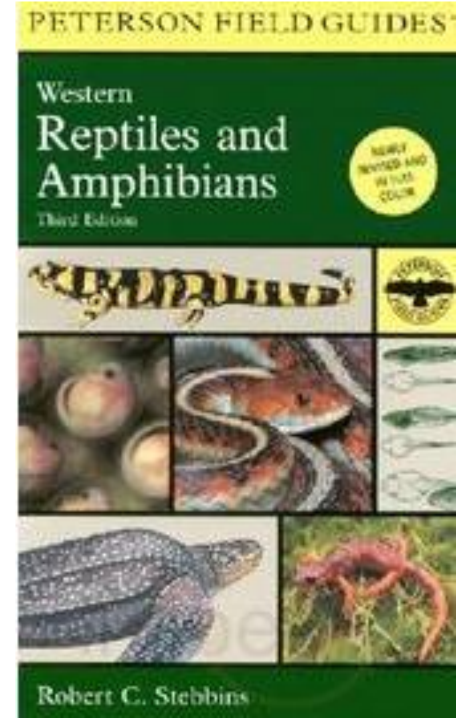


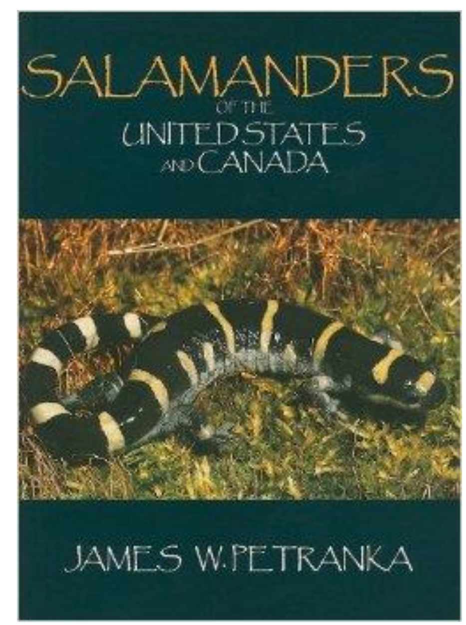

Identification/morphology: Terrestrial stages

Invest in a field guide and Petranka (1998) for a good background

Except in very rare and almost unimaginable circumstances, adult SCLTS are easily distinguishable from CTS, *Aneides*, and *Ensatina*

Juveniles, if lacking coloration, may present a bit of a challenge with juvenile *Ensatina* or *Aneides*





Rule out the obvious… It’s good to ask, ‘what other species co-occur?’

Answer: Three easily distinguishable species (ignore most plethodontids)

SCLTS juvenile vs. CTS juvenile

SCLTS juvenile vs. SCLTS adult

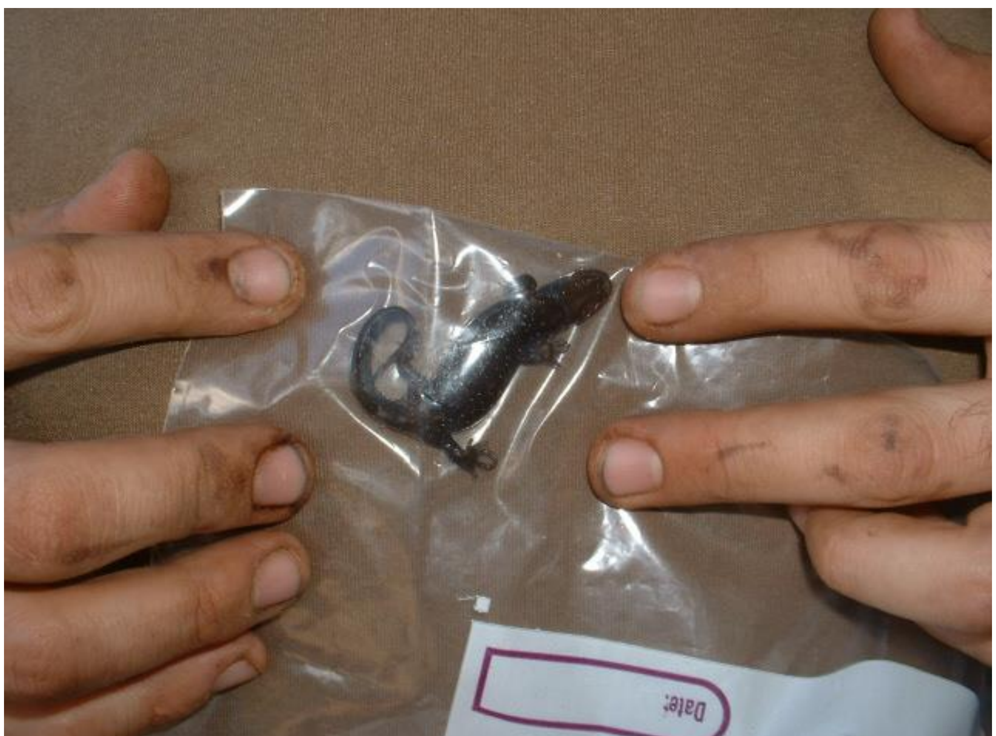
Large SCLTS adult (female) vs. CTS juvenile

SCLTS adult (male) vs. CTS adult

All terrestrial SCLTS possess a characteristic ventral coloring

Ventral surface (belly) is black/dark with white flecking

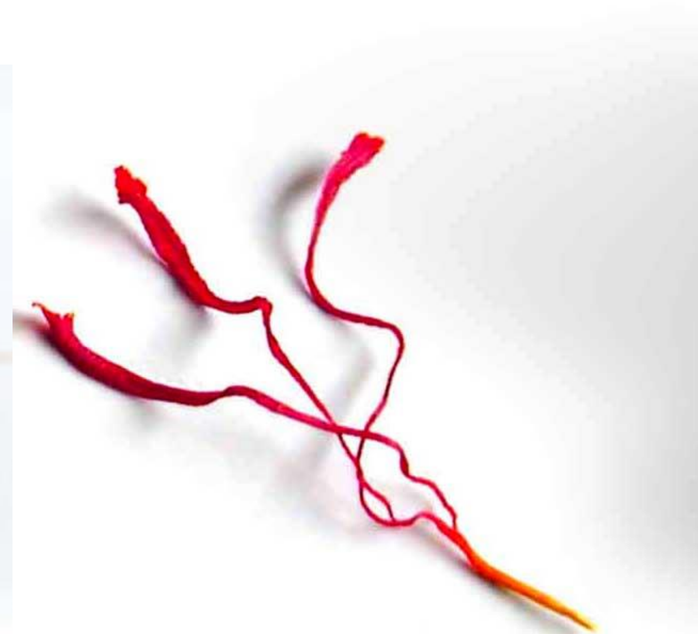
Flecking also on sides



Remember:

Dorsum is black with broken pattern of dull orange to saffron yellow blotches

- blotches are color of saffron flower threads
- brightest in juveniles, weakest in breeding males



Coloration may be adaptive because it affords crypsis

SCLTS dorsal pattern is a good a camouflage, particularly in willow habitat with the color & pattern of senescing willow leaves; also provides cover for protection against the elements



Background color, brightness, pattern and quantity of blotches varies


Hamilton Bell Co., Inc.
MONTVALE, N.J. 07645

Sex differences: they are not strongly sexually dimorphic in appearance

Three kinds:

- Male ♂
- Female ♀
- Undetermined (juveniles, etc.) ?

Breeding Adults: Males

♂

- Swollen vent
- Bladed, eel-like tail fin
- Body is slender and tail is elongate, often longer than females
- “Saffron” color patches are drab

Breeding Adults: Females

♀

- No, or only minor, swelling of the vent
- No prominent tail fin (dainty tail)
- Visibly swollen with egg masses = gravid
- Blotches appear brighter than males

Sex of non-breeding animals can be difficult if not next to impossible to assign with any accuracy

These individuals are usually encountered during outward-bound dispersal – they are asexual juveniles

Question: When might this kind of encounter occur?

Identification/Morphology

Metamorphs (recently transformed)

- Clearly distinguishable color pattern
- Remnant tail fin and gill stubs disappear rapidly, and gone on land
- 2.6-4.8 mm long (1.0-1.8 inches)
- Quite small and fragile

Juveniles (after 1st summer) (non-breeding)

- Resemble adults, but smaller
- Dorsal patterns vary in number of blotches and color becoming more prominent through growth
- 4-8.9 cm *snout-vent length* (1.6-3.5 inches)

Larva in early stages of metamorphosis

Recently transformed metamorphoses individual

Terrestrial species quiz slide

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SCLTS Habitat Basics

Aquatic Breeding Habitat

- Seasonal ponds and sloughs* (main historic habitats)
- Constructed ponds and converted wetlands (e.g., Valencia, Elkhorn, Tucker, Seascape, Buena Vista, etc.)
- Ditches (e.g., Shadow Mere Rd. area near Palmer Pond); these are unlikely to support population in the long term

Upland Habitat

- Willow stands identify moist soils which provide refuges for adults and juveniles (at ponded areas, edges)
- Oak woodlands, mostly
- Sometimes chaparral and shrublands, but likely only during migrations and not for home range

Cuesta Dr
ubhouse Dr
Greenbrier Ct
Pinehurst Dr
el Mar
Driftwood Ct
willow
pond
pond
oak woodlands
Bonita Dr

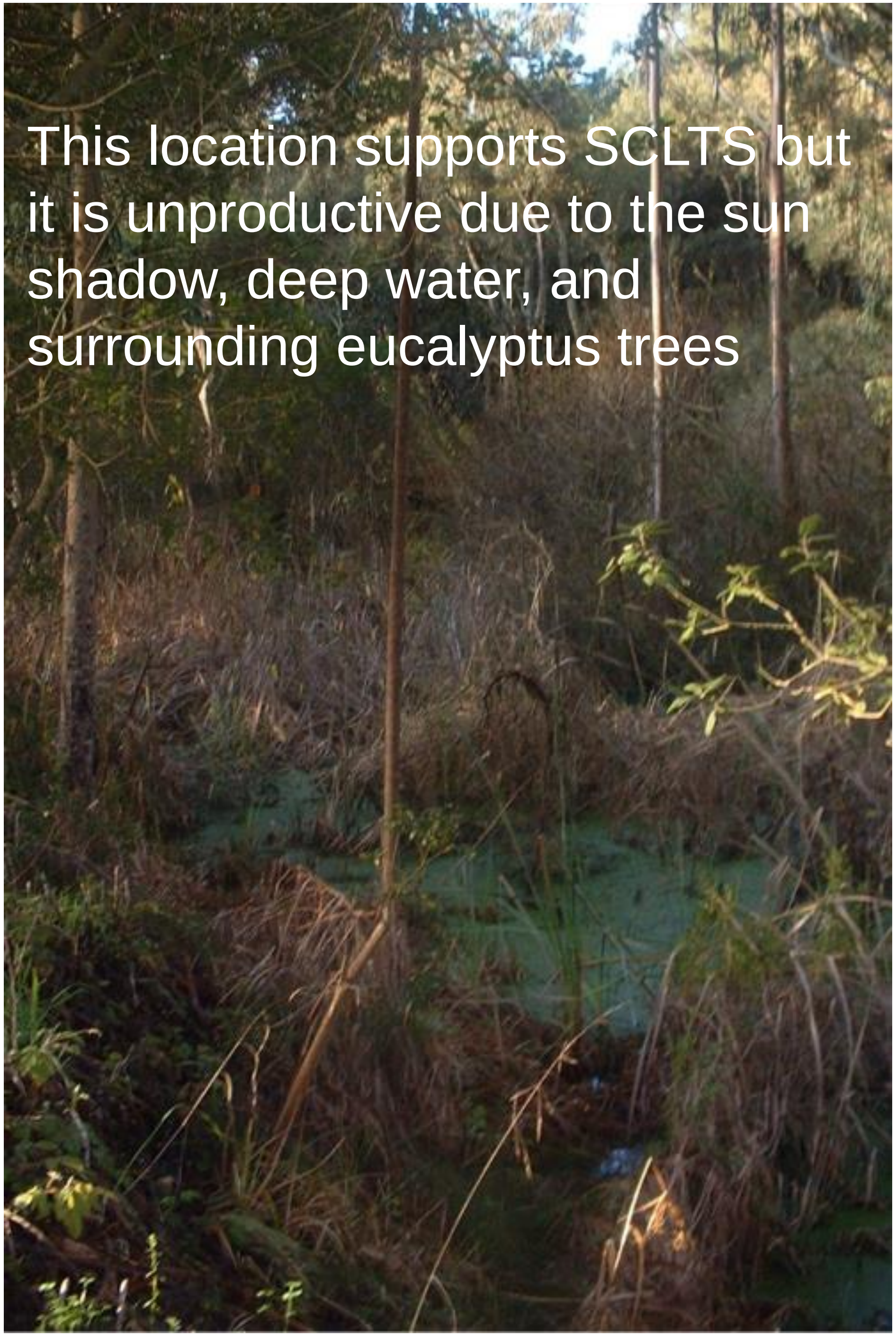
Wetland Breeding Habitats

Two types: permanent and seasonal

Most known breeding habitats are seasonal wetlands; but some permanent waters support breeding

Breeding habitats range from <0.1 to 65 acres (e.g. McCluskey)

Permanent ponds are inferior breeding habitat: they have more larval predators, competitors, agricultural runoff, and parasites


This location supports SCLTS but it is unproductive due to the sun shadow, deep water, and surrounding eucalyptus trees


all images are from the same pool (Mill Sap Pond)


A drainage ditch in Aptos that supports a very small
population of SCLTS


Note the flecking along the lateral flank - a diagnostic larval characteristic
Abdominal bloat is a cause of reproductive failure in some populations, often related to water quality issues

Upland Habitat Basics

After metamorphosis, SCLTS are rarely detected, & almost always underground

Occupy mainly ground crevices and other burrows

- Emerge to move to pond or another burrow
- Emerge only at night, usually when raining

Aestivation has not been observed (anecdotes)

Because little is known about this species we could make logical extensions from similar species (e.g., CTS), but only to gain an idea…

Upland Habitat: where?

This is still being discovered for SCLTS because not enough studies have focused on this particular issue

A number of breeding habitats have insufficient terrestrial habitat to support a stable population

No habitat corridors connect major breeding clusters

Oak & willow woodland

Habitat Main Points

Breeding habitat is ponds

- Ponds must hold water until at least June
- Permanent ponds are **not** good habitat (deformities)
- Small ponds produce fewer metamorphs & higher inbreeding because of competition for resources

Uplands are the primary SCLTS habitat

- Live underground in burrows, crevices, willow roots
- Come to surface rarely
- They do not *always* stay near the pond

FWS/DFW Sampling Protocols

If suitable breeding habitat exists on site…

- dipnetting to detect larvae
  - 2 yrs; 2x per yr (Mar 15 - Apr 1; Apr 15 – May 1)
  - ≤1/4 inch mesh nets
  - <1/2 acre = 1 hour; >1/2 acre = 2 hours
- drift fence sampling for adults and juveniles
  - if larvae not detected in year 1
  - Jan 1 – Feb 28 (or Mar 31); during periods of heavy rain
  - check every 12 hours
  - pitfalls non-galvanized #10 (or larger) cans

Sampling Approaches & Issues

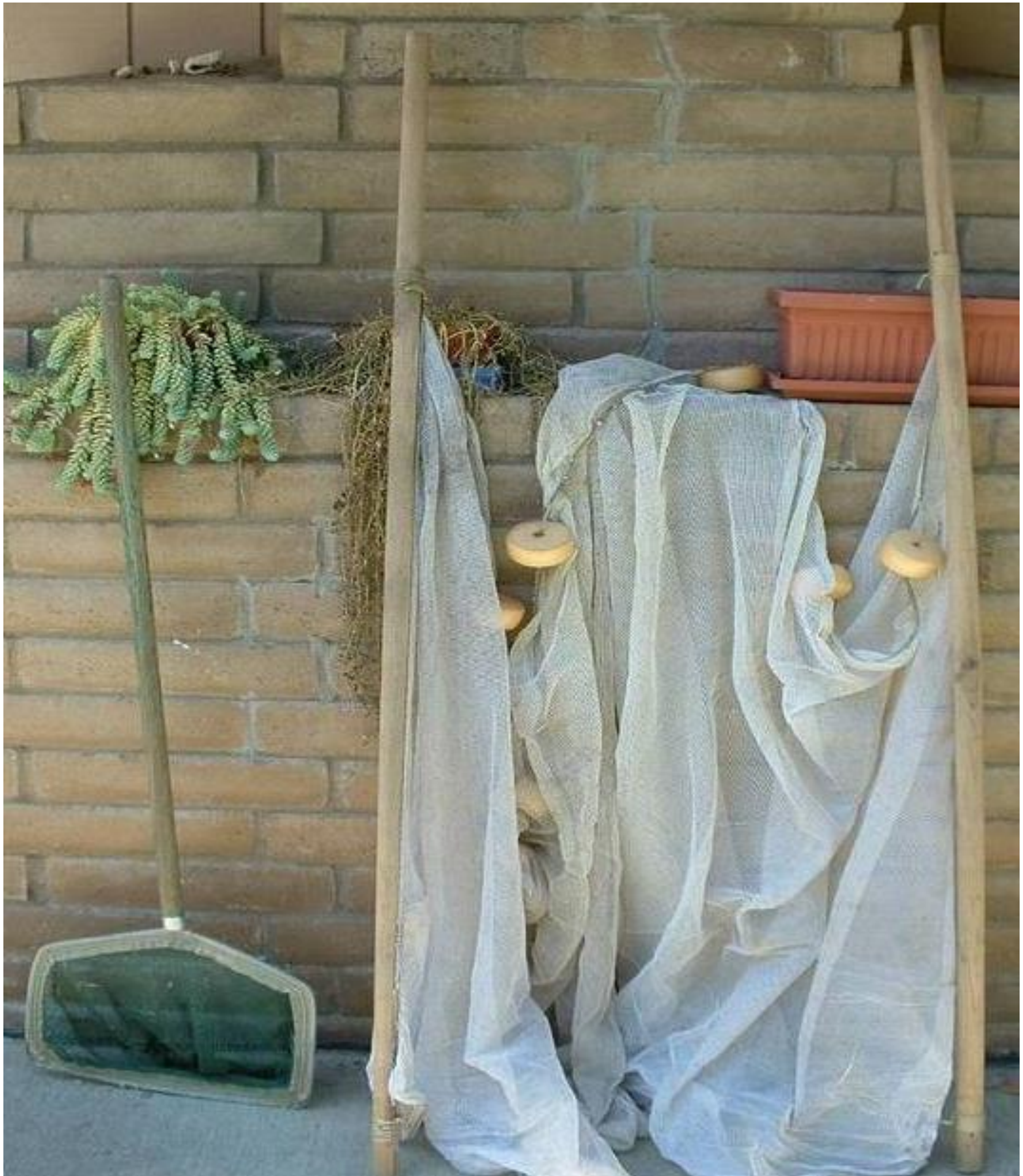
1) Suitable habitat – holds water to May 31
   - Sometimes a shorter hydroperiod may be sufficient
2) Dip netting
   - As long as survey dates are good (time of season)
   - 1/4 inch mesh (may be too large)
   - Dip netting may be ineffective (minnow traps)
3) Drift fence sampling
   - January start will most likely miss juveniles and even adults
   - Traps must be open on rainy nights
   - Location and amount of fencing is flexible
4) But what if there is no “suitable” breeding habitat?

Permit Requirements

- Need CDFW (scientific collecting permit plus protected species permission) – optimistically, this takes ~3-6 months, but it can take more time
- USFWS (10a1a recovery permit) permissions
- Develop/document your experience with SCLTS and other amphibians
- Local site permission from agencies and landowners

General Sampling Guidance

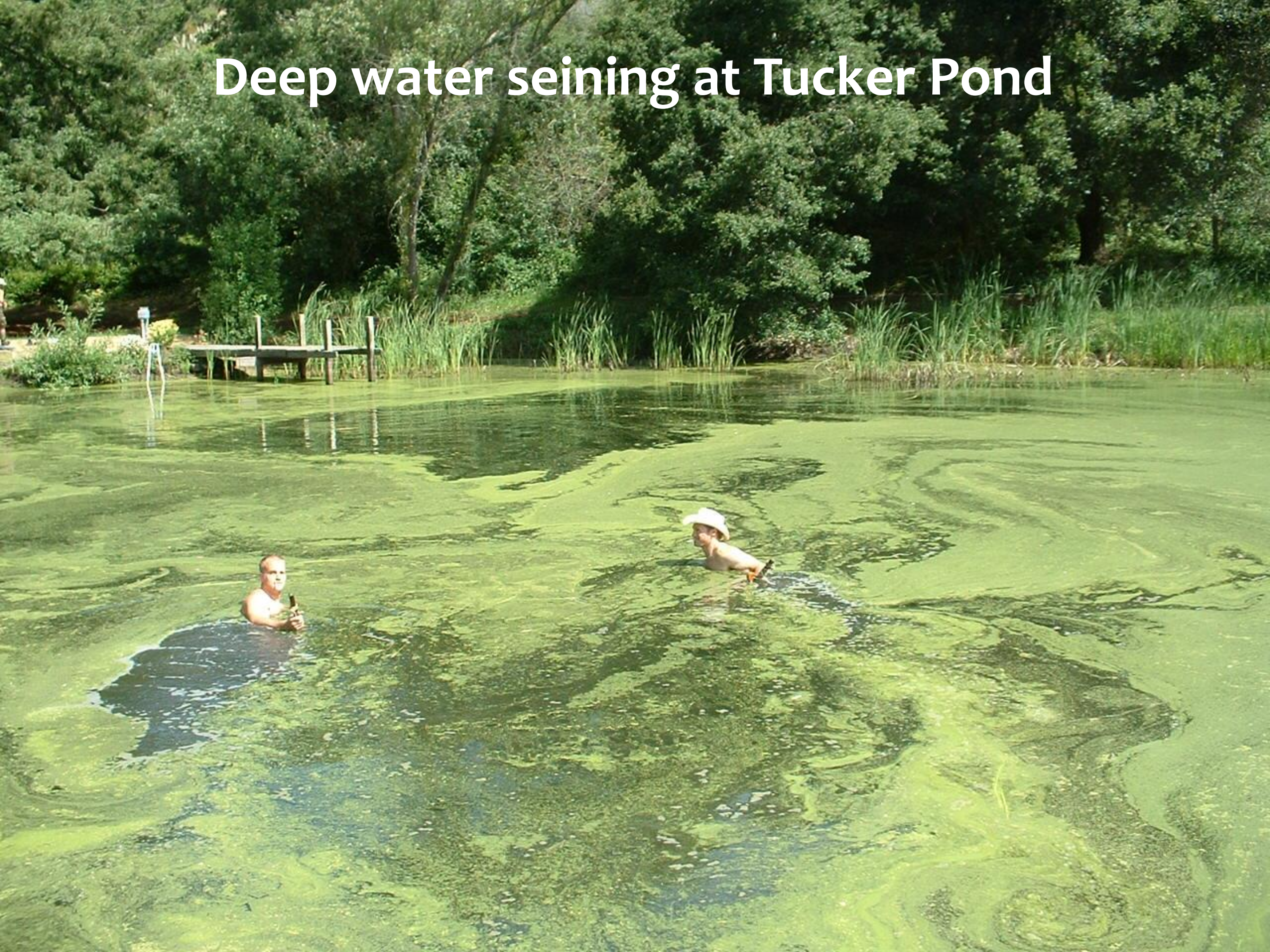
- Even at known occupied sites, SCLTS can be difficult to detect; failure to detect = elimination of habitat without compensation (*but absence of detection is not detection of absence*)
- Use additional methods to increase detection efficiency: surveys for embryos, night walking surveys & road cruising on rainy nights, deploy cover boards, drift fence installation



Standard aquatic sampling gear

- SCLTS breeding habitat is often complex and difficult to sample
- Dip nets
- Minnow seines (less useful due to habitat complexity)
- 1/8” mesh preferred

Deep water seining at Tucker Pond

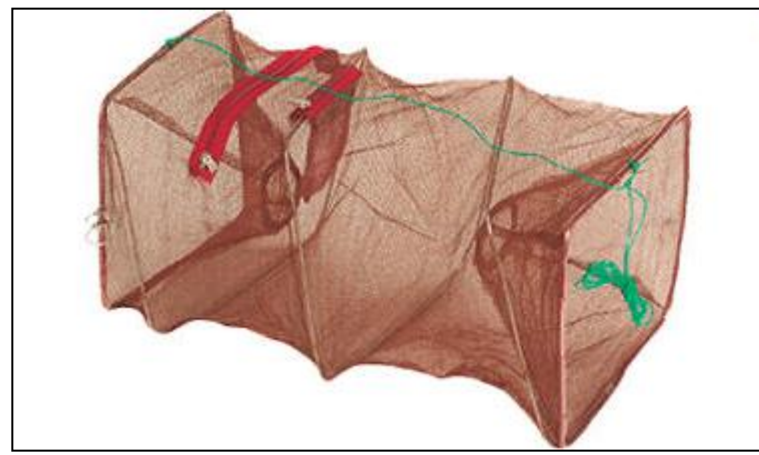


Minnow Traps

Use when you cannot reliably sample a pond with dip nets

- deep water, deep muck, heavily vegetated

Use many traps (*N* > 10)



Check 2x daily (to minimize mortality)

Use floats to prevent mortality

- e.g., of red-legged frogs, newts

Stake traps in place and attach flagging with ID cards & permit #

Drift fence study planning

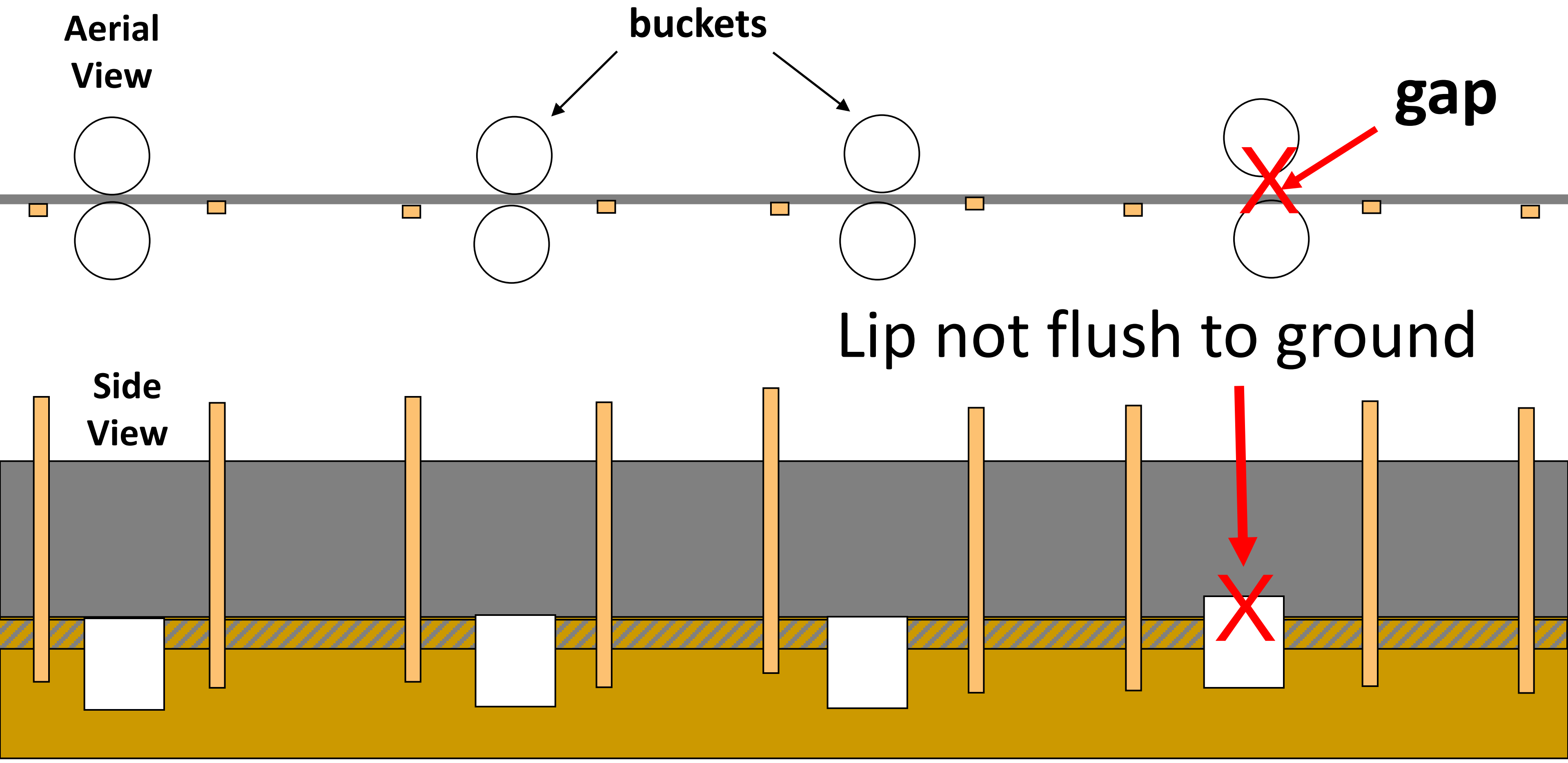
What is the goal of installing drift fences?

- Maximize captures with “least effort”?
  - Target specific areas around key features
- Detecting presence/movement patterns?
  - Needs of most consulting/agency biologists

When planning, plan for the worst…

- Think about worst case scenarios, like flooding or other species that may be affected
- It doesn’t hurt to consider poison oak or stinging nettle in locating fences
- Vandalism or inviting curiosity
- Traps can be death traps

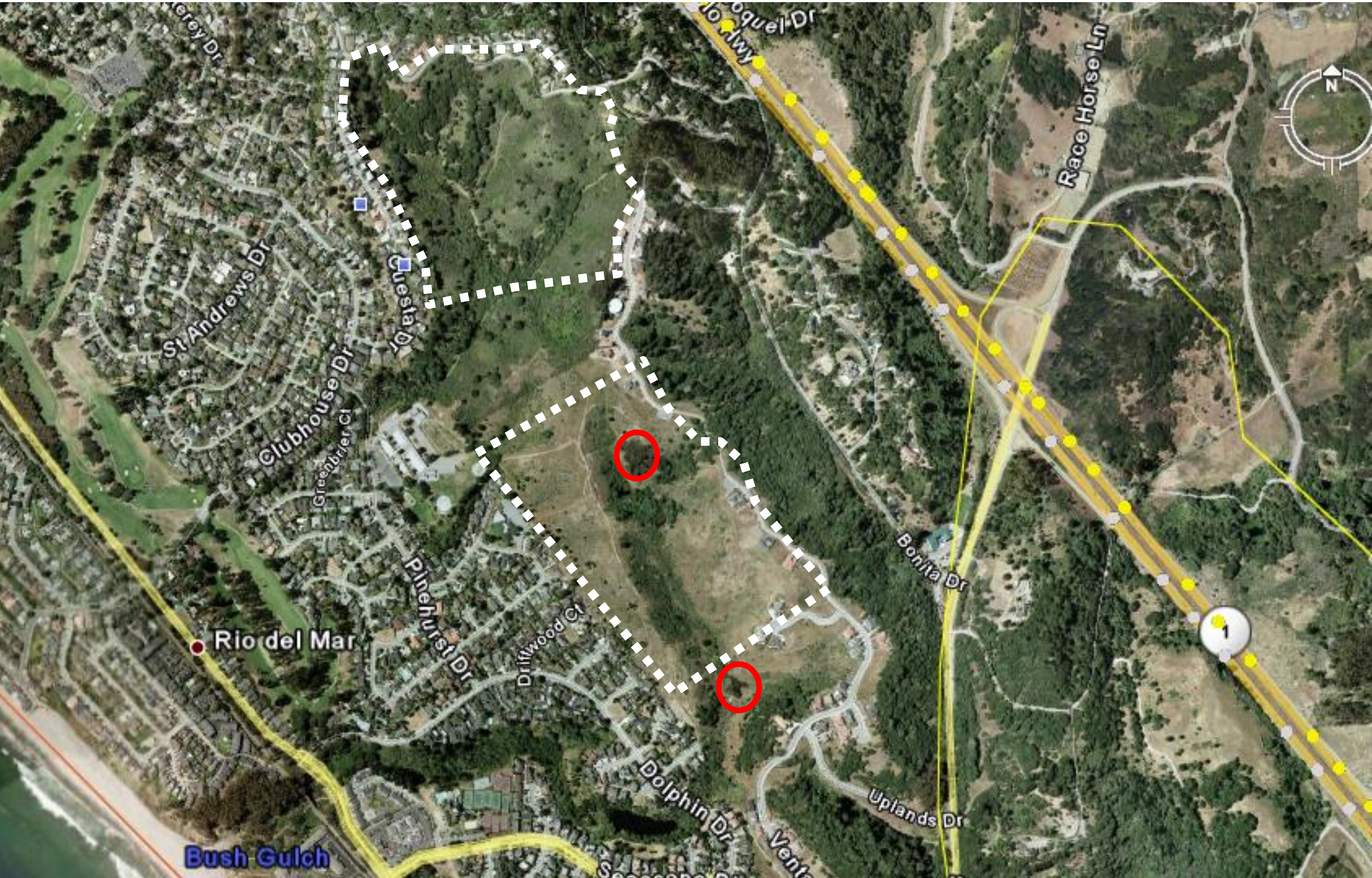
Upland sampling – drift fences with pitfall traps





- Information tags
- Bucket divider
- Buried bottom edge
- Protective cover over bucket lid to deter predation
- Handling with hypoallergenic latex gloves (rinsed in pond water)
- Small PVC pipe for cover
- Not shown: foam pieces for moisture, rope tassels for small mammal escapes, small perforations for drainage

Discuss survey designs for these two parcels



II. Life History & Ecology

i. Life cycle, identification and description of SCLTS eggs, larvae, adults, and sex

ii. Habitats and ecology

iii. Brief mention of demography and population dynamics, as well as predators and prey

iv. Movement (Allaback & Laabs), populations, metapopulations, and landscapes

v. Regional population relatedness – how this relates to recovery/management

Population Basics

~22 known breeding ponds

Valencia Lagoon (1978)

- ~2500 adults bred
- *2200 juveniles emerged*

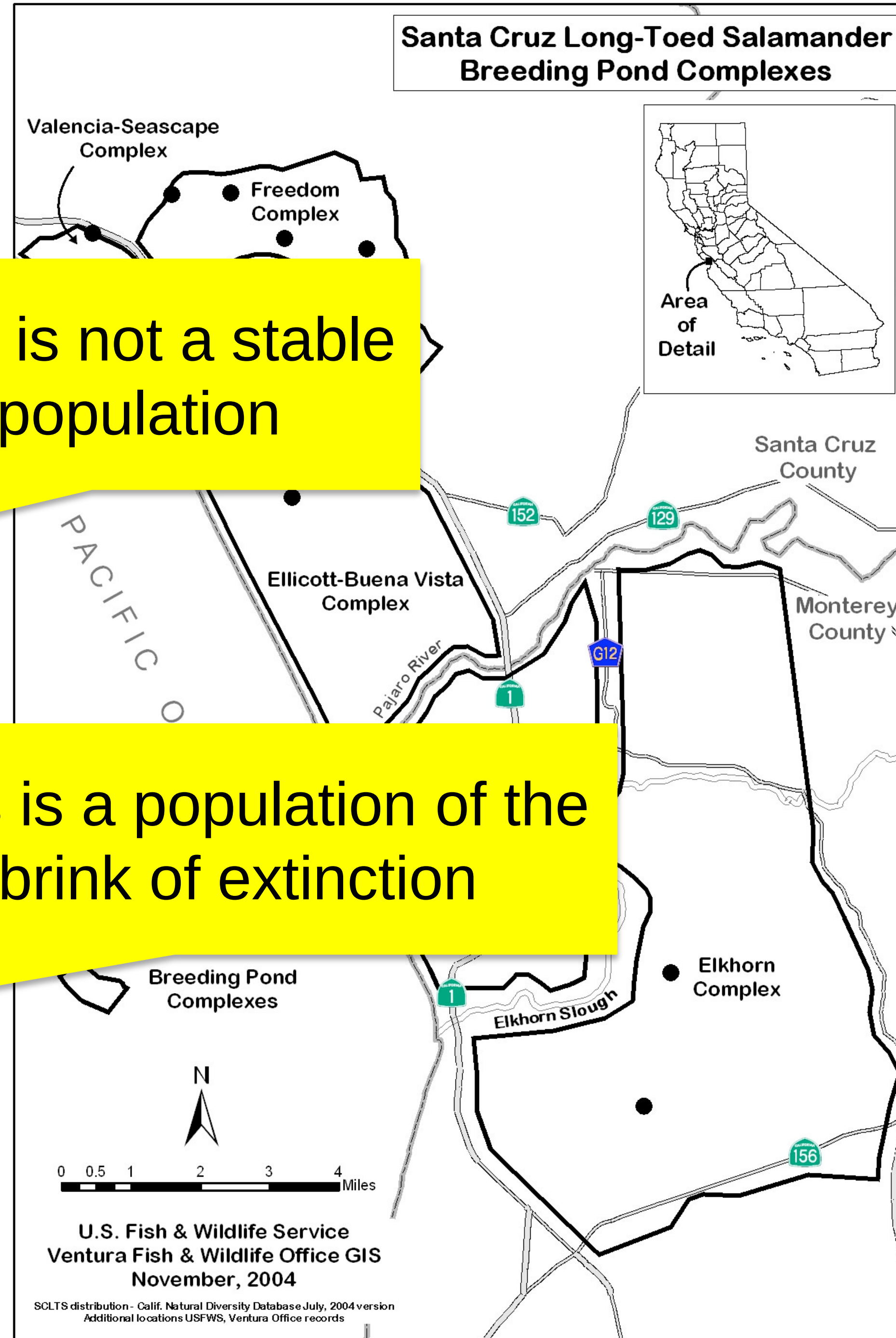
Seascape 1 (1999-2003)

- ~2000-3000 adults bred
- 288-4330 juveniles emer

Zmudowski Pond

- ~19 adults bred (2002)
- ~13 captures (2003)

Typically 0-5% of embryos survive to metamorphosis!



This is not a stable population

This is a population of the brink of extinction

Demography

Embryos = ~300 per female (Anderson 1967)

Emerging juveniles = 0-6 per female, $\mu = 3$

Survival to metamorphosis = ~0-5%, $\mu = 1\%$

- Can be limited by pond size (density dependence)
- Can result in reproductive skew for some pairs

Post-metamorphic survival

- Little, if any data available, only by adult census

If each female produces two adults during her lifetime, population size will not change

- Says little about breeding success & the next generation

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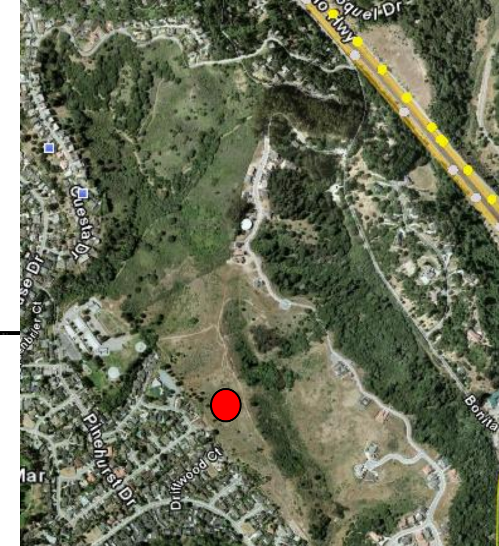
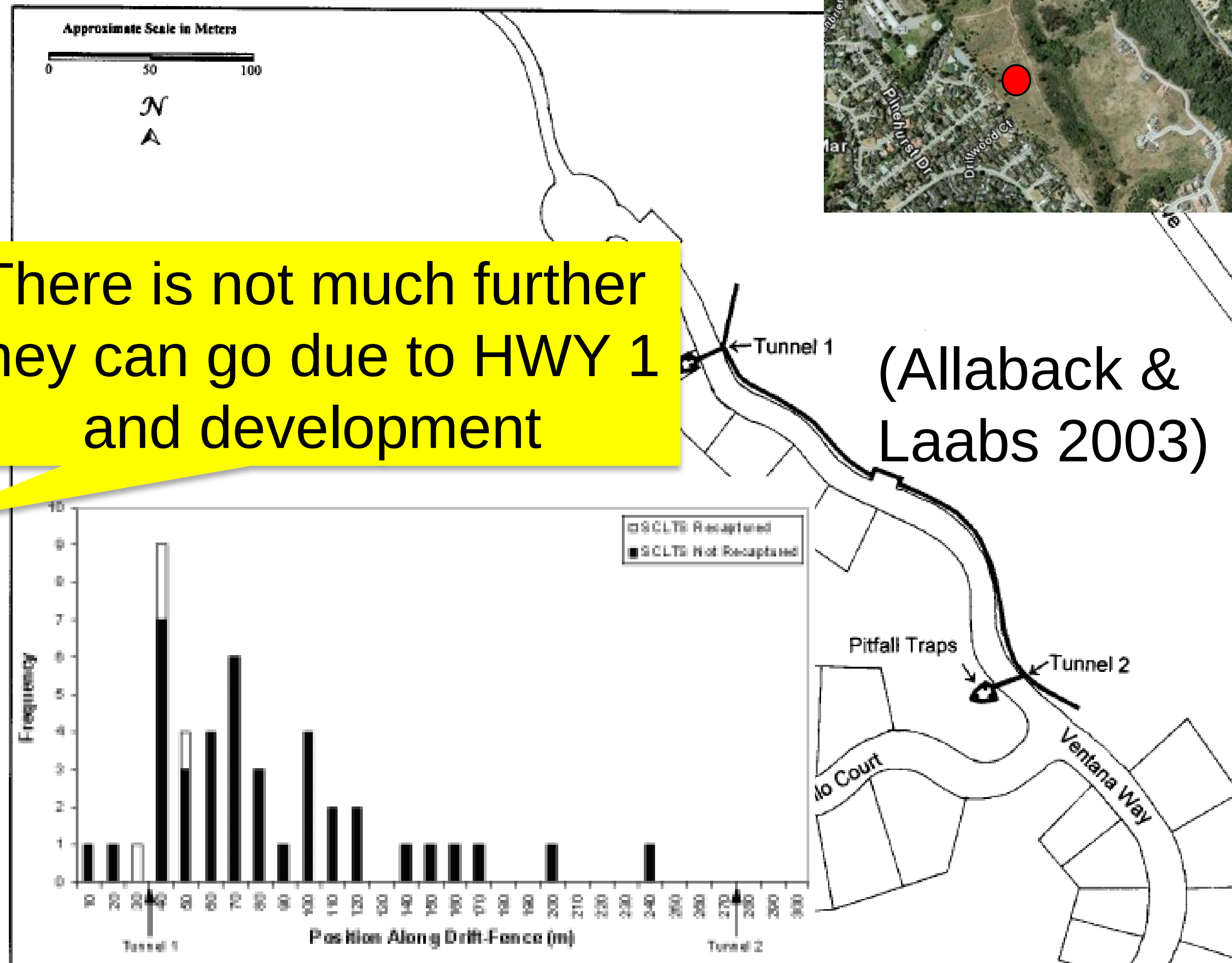
How far do they move?
Farther than you might think…



- Seascape: 26-36 % went > 335m
- Willow Canyon: up to 800 m
- Valencia: 90 % went <125 m
- Likely depends on multiple factors, including weather and density

There is not much further they can go due to HWY 1 and development



(Allaback & Laabs 2003)

Figure 1. Locations of road tunnels and drift fencing at Seascape Uplands, Santa Cruz County, CA.

II. Life History & Ecology

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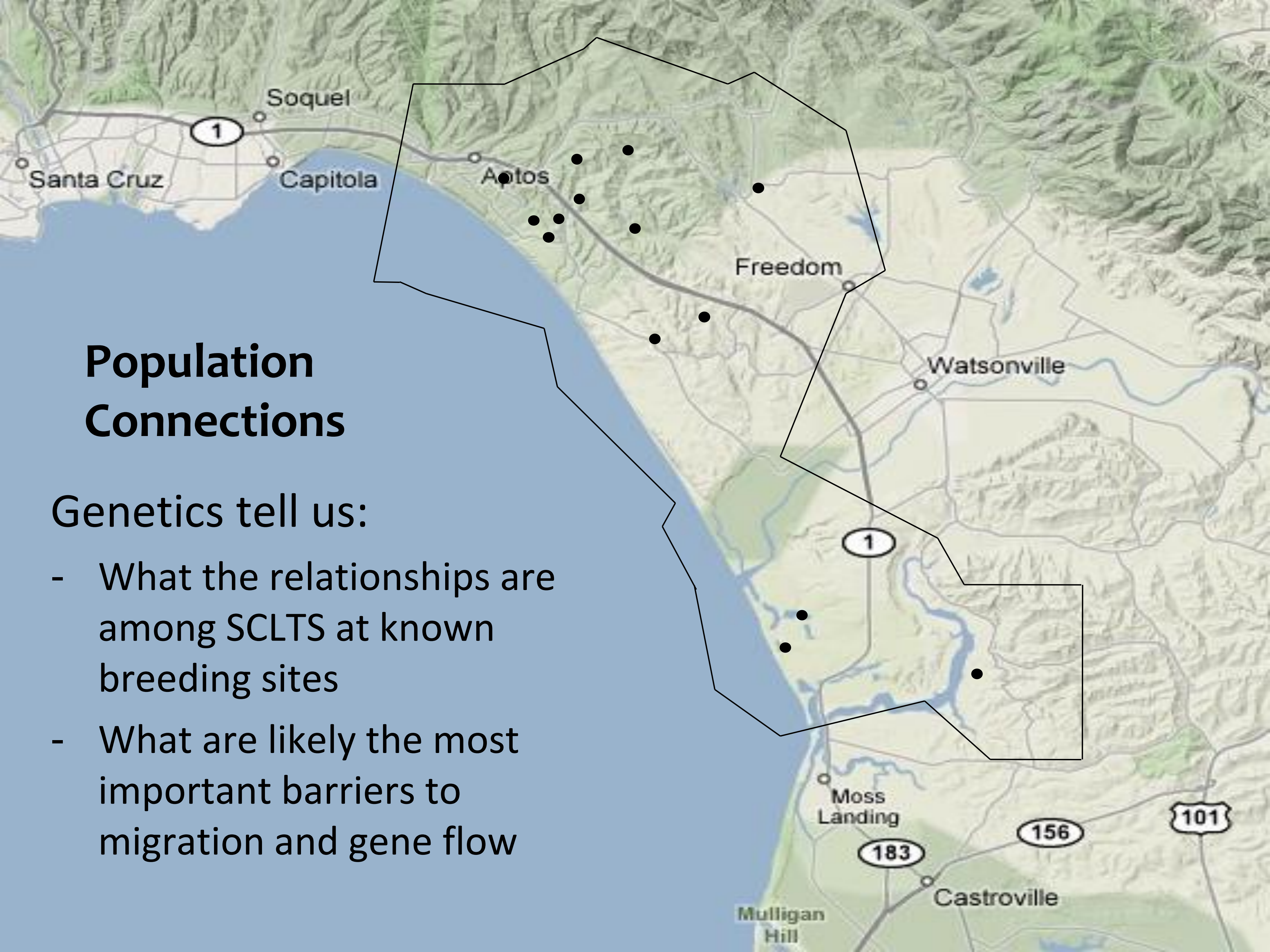


Population Connections

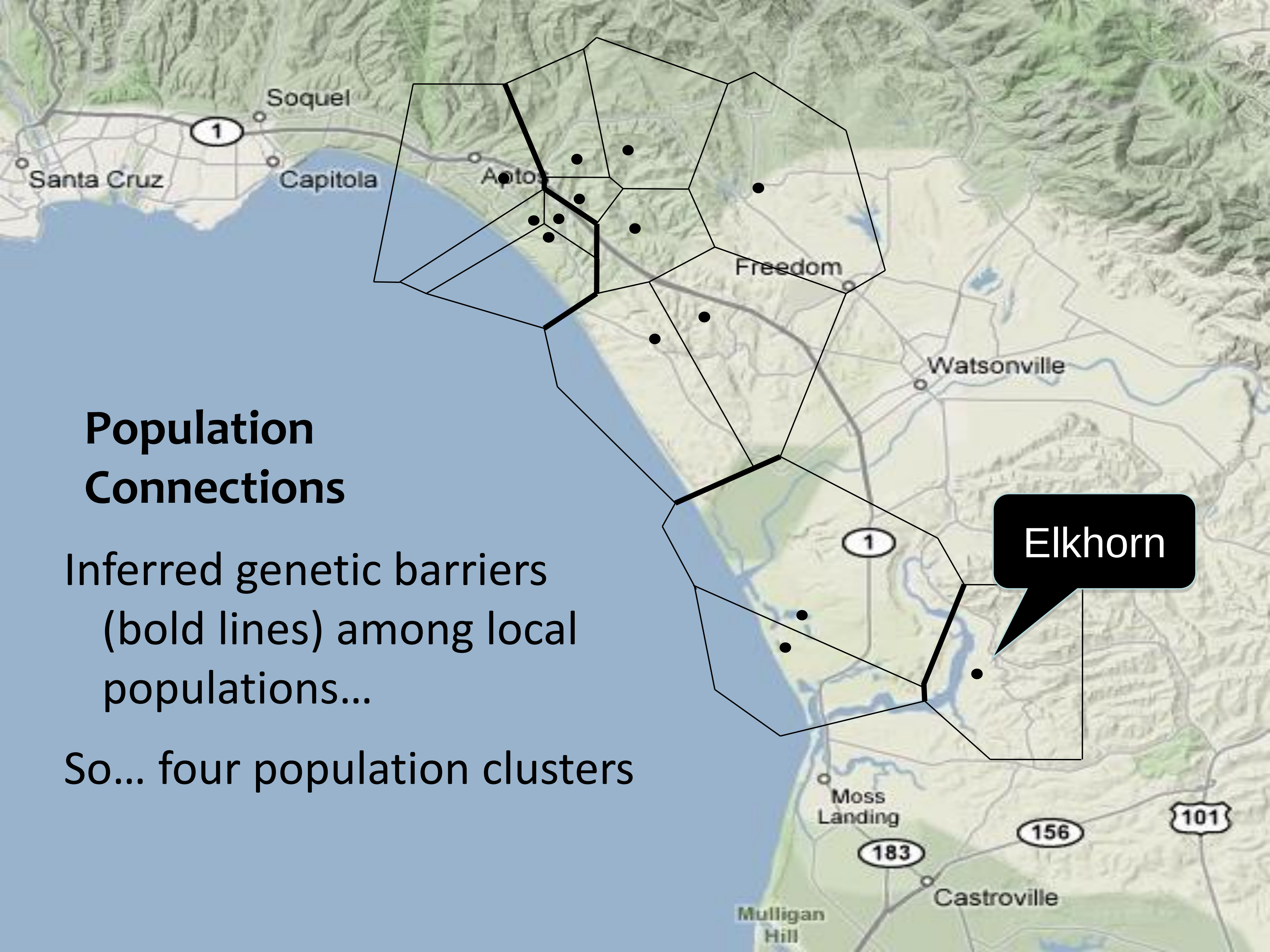
Genetics tell us:

- What the relationships are among SCLTS at known breeding sites
- What are likely the most important barriers to migration and gene flow

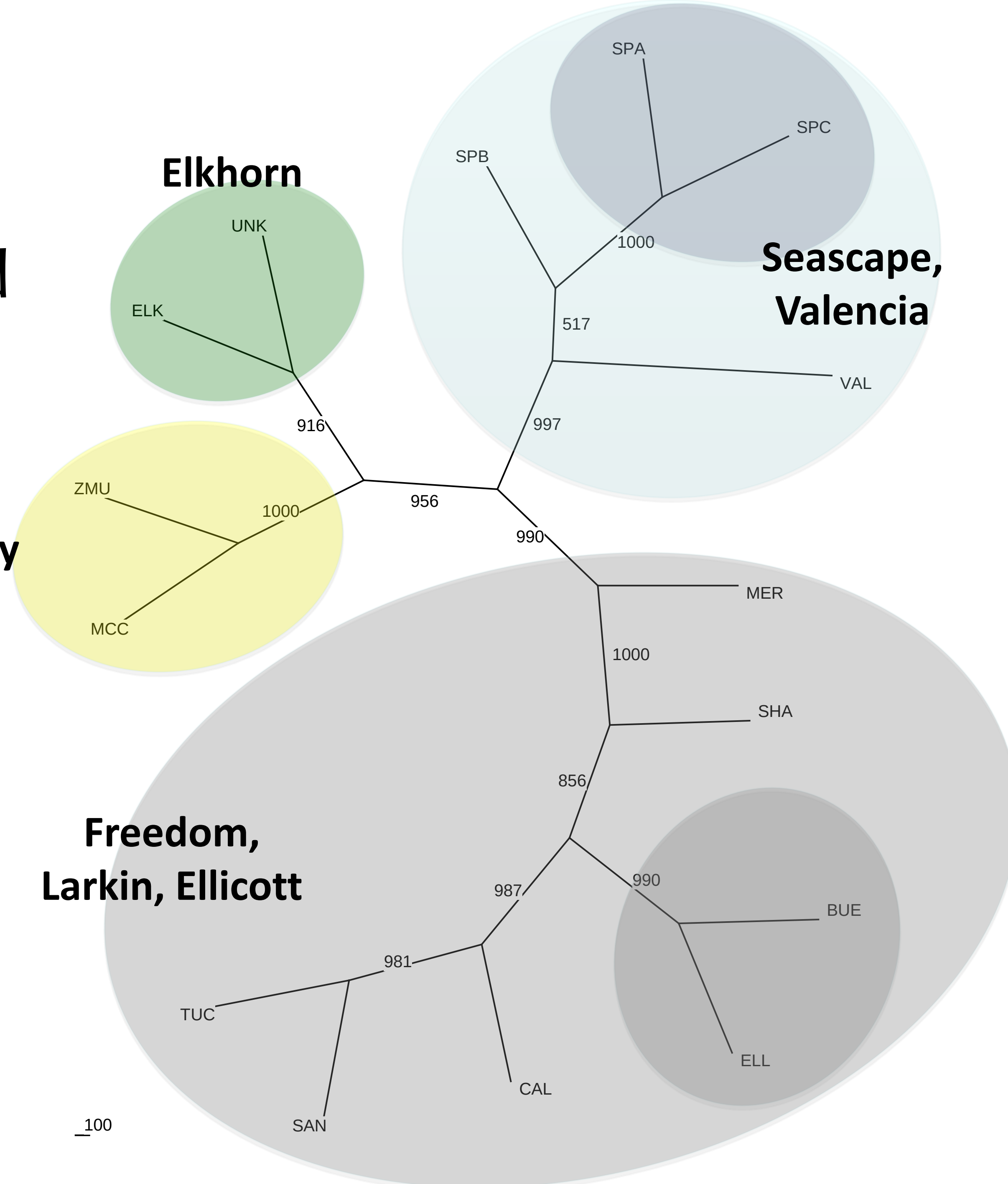
Population Connections

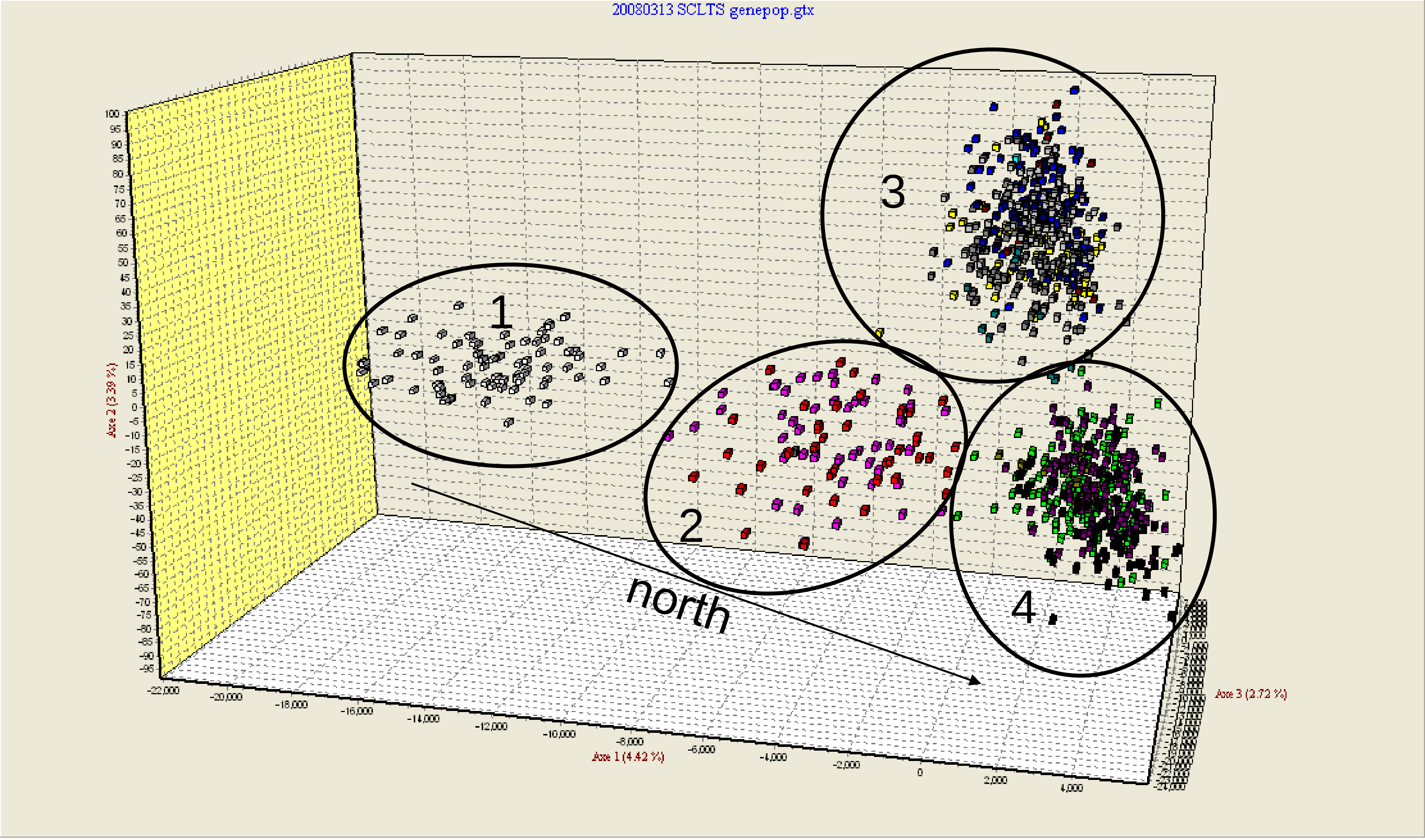
Inferred genetic barriers (bold lines) among local populations…

So… four population clusters



Relationships among SCLTS ponds and pond complexes



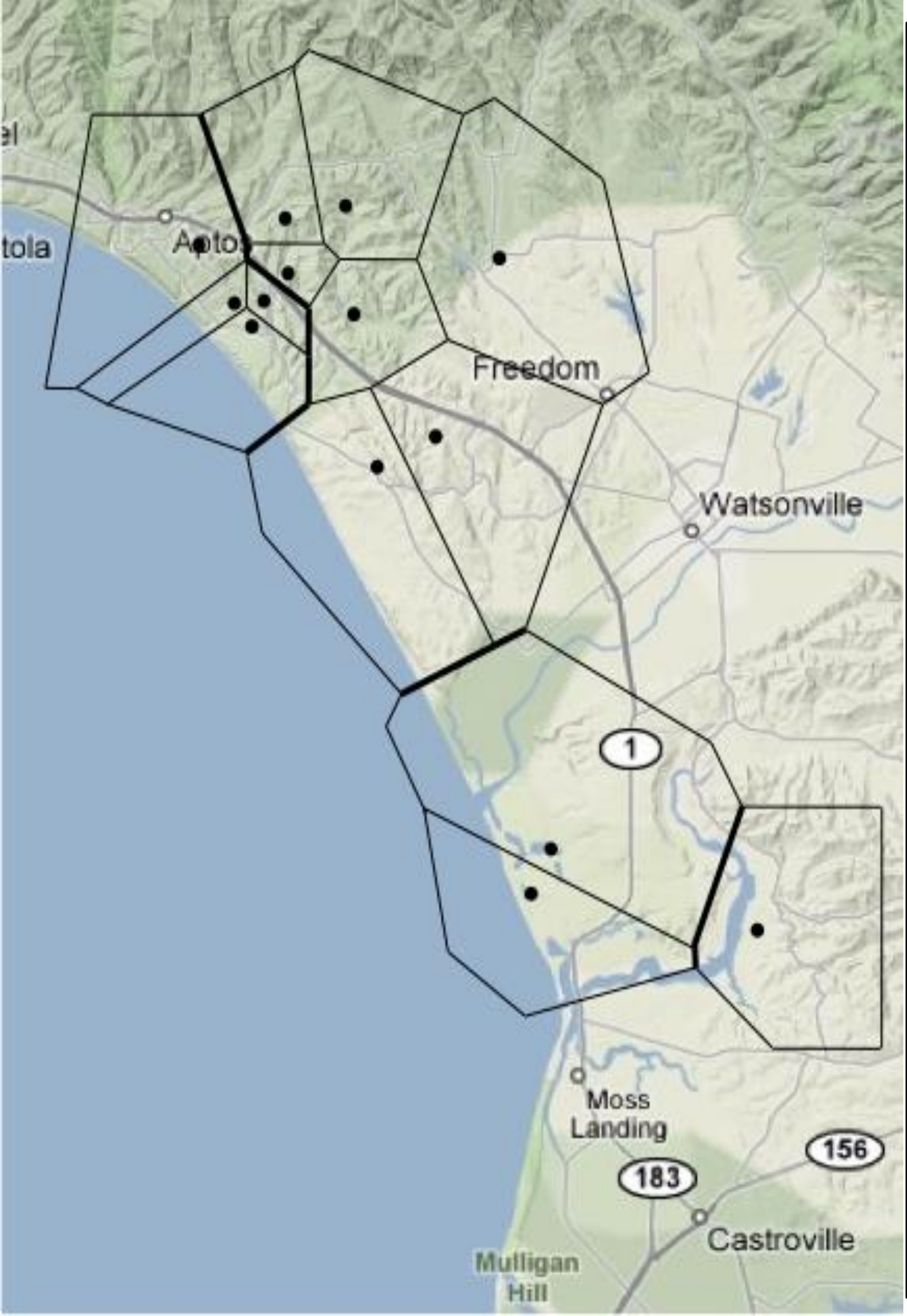


1: ELK

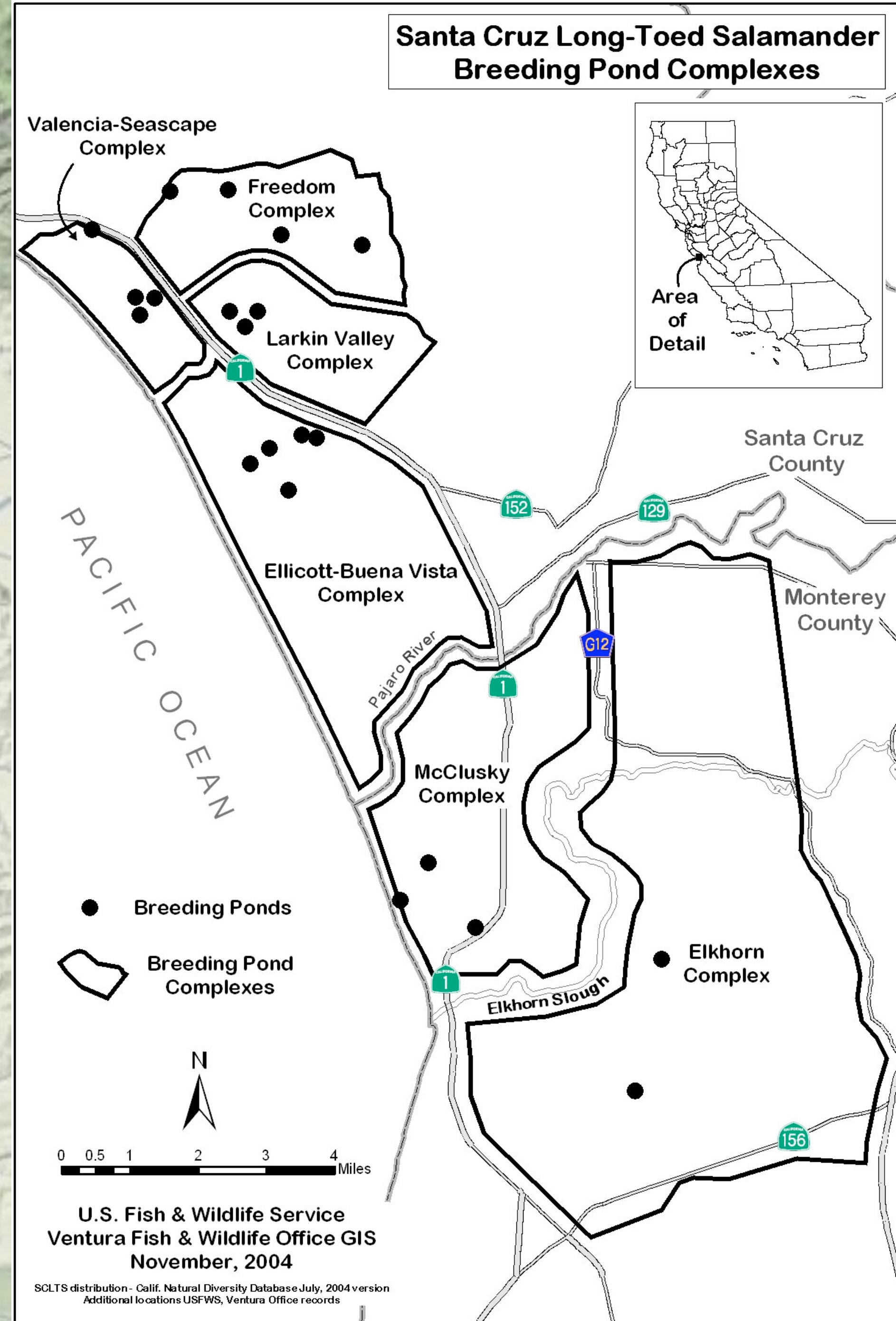
2: MCC, ZMU

3: ELL, TUC, BUE, MER, SHA, CAL, SAN

4: SPA, SPB, SPC, VAL



Aptos
Freedom
Watsonville
1
Moss Landing
156
183
Castroville
Mulligan Hill



Santa Cruz Long-Toed Salamander Breeding Pond Complexes
Valencia-Seascape Complex
Freedom Complex
Larkin Valley Complex
Ellicott-Buena Vista Complex
McClusky Complex
Elkhorn Complex
PACIFIC OCEAN
Pajaro River
Elkhorn Slough
Santa Cruz County
Monterey County
Area of Detail
1
152
129
G12
156
Breeding Ponds
Breeding Pond Complexes
N
0 0.5 1 2 3 4 Miles
U.S. Fish & Wildlife Service
Ventura Fish & Wildlife Office GIS
November, 2004
SCLTS distribution - Calif. Natural Diversity Database July, 2004 version
Additional locations USFWS, Ventura Office records

Population and Landscape Summary

SCLTS are capable of producing impressive numbers of offspring, given the right habitat conditions

Some individuals can live 10 (?) years (unk.)

Most don’t survive (hatching, metamorphosis)

Population size is more sensitive to upland survival than to larval survival (adults make babies)

Given good habitat, even single breeding ponds may be able to support viable populations…

- *but is this a viable approach for long term management/recover goals?*

Main Conservation Issues

Few sites (~22 known historical breeding sites, perhaps less now)

Breeding habitat degradation: *siltation, water quality, water supply, pollution, conversion*

Extreme conversion and elimination of upland habitat

Habitat fragmentation/isolation: *development continues*

Roads fragment habitat and increase mortality – HWY 1

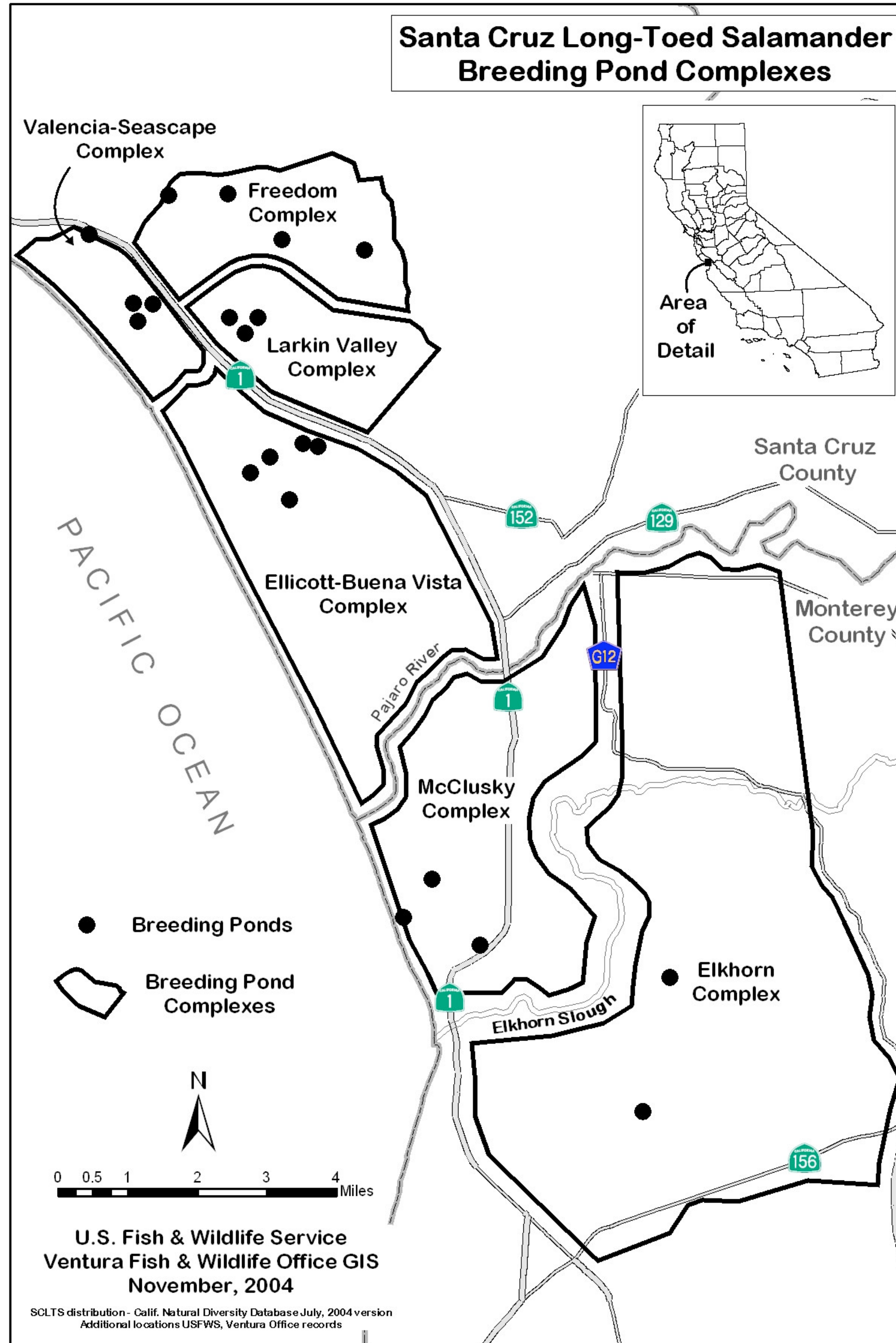
Other issues:

- Predators (fishes, bullfrogs, crayfish)
- Malformations
- Bd (chytrid fungus)
- Contaminants (pesticides, runoff from roads)

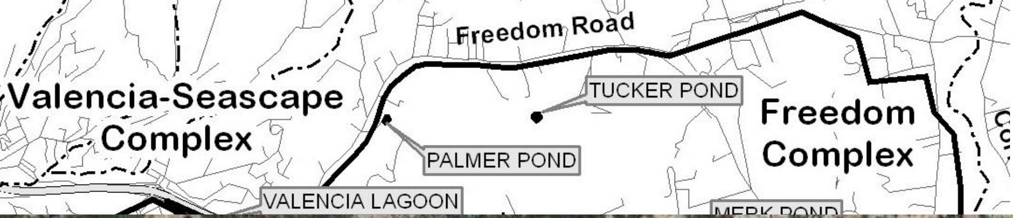

SCLTS
Limb deformities resulting in multiple limbs (polymelia)
Pacific chorus/tree frog

Discussion of local and regional issues and opportunities

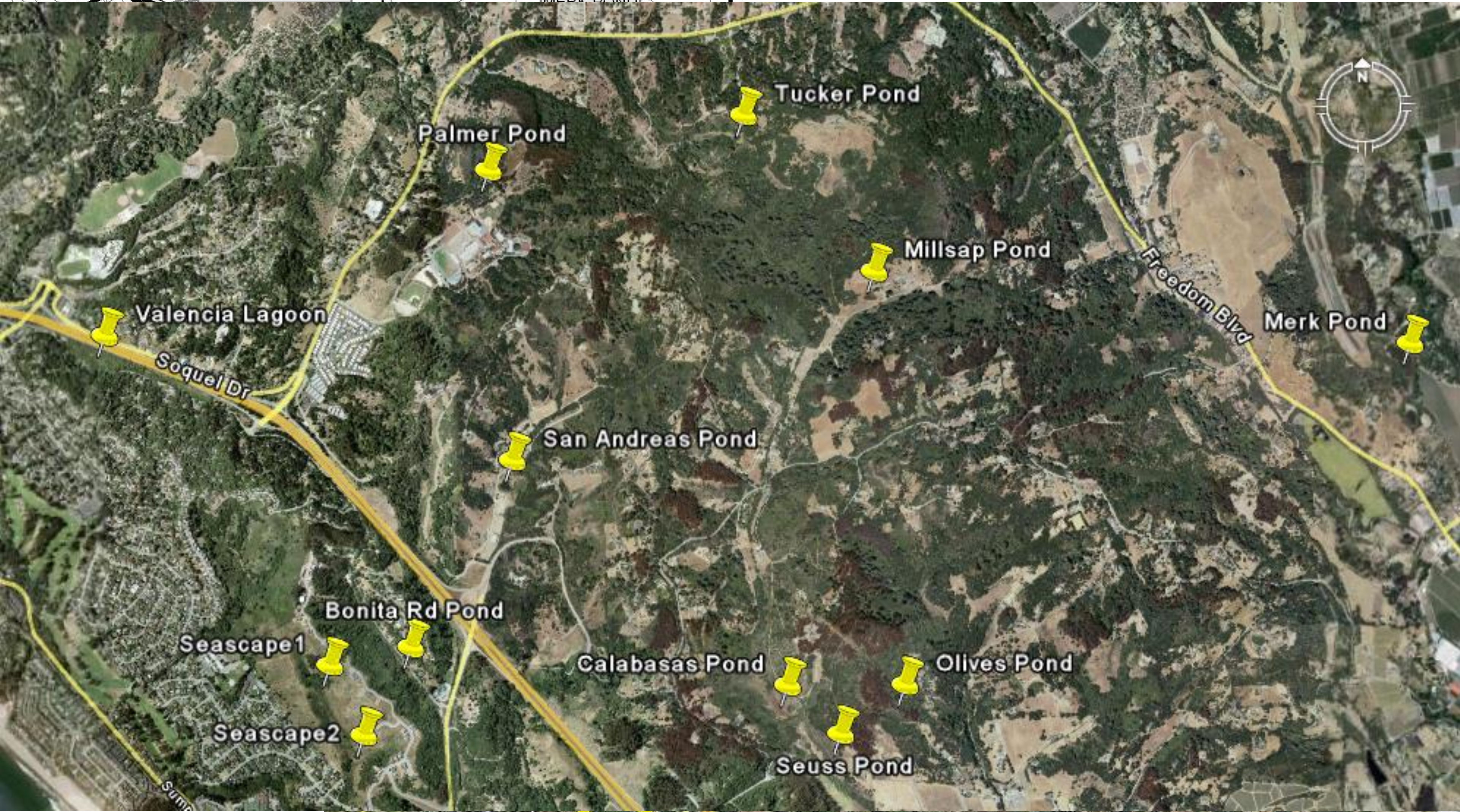
- What can be done to recover the species?
- Is recovery even possible, or is the species entering an extinction vortex, both demographic and genetic?

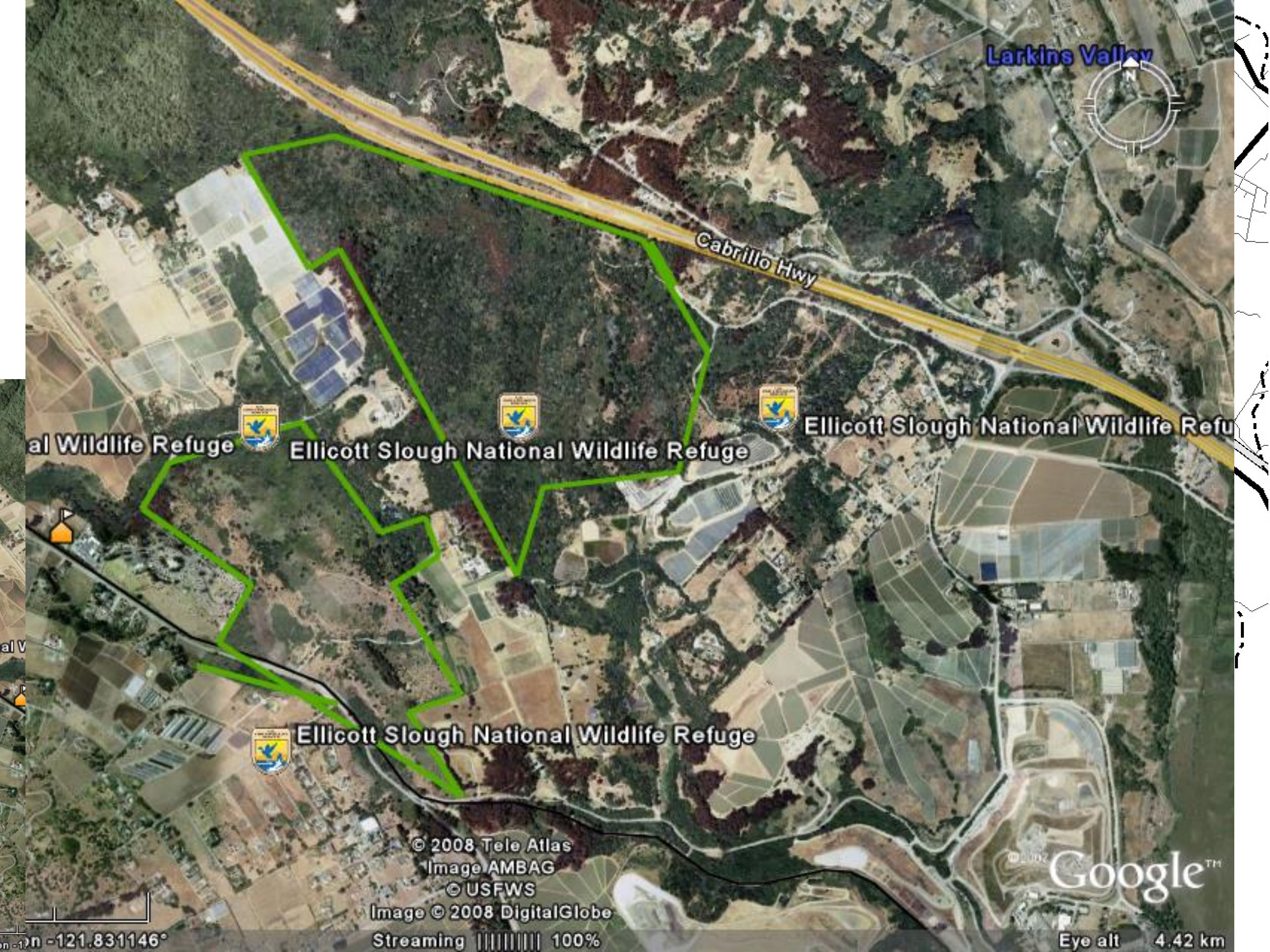



Valencia Lagoon
CALIFORNIA HIGHWAY 1
Bonita Rd.
BONITA ROAD POND
SEASCAPE POND 1
Seascape1
= WILLOW CANYON
= SEASCAPE UPLANDS PRESERVE
Seascape2

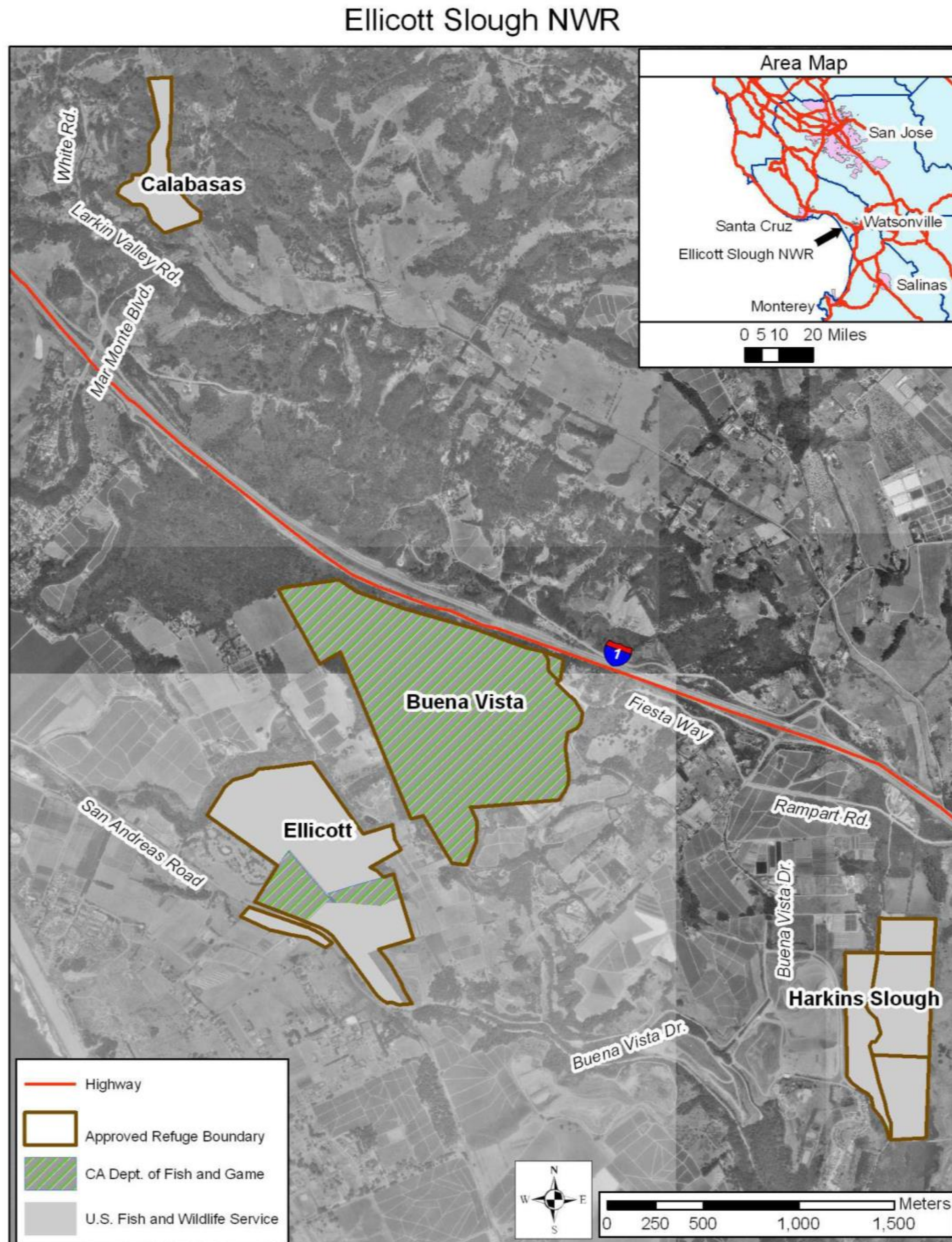


Freedom & Larkin Valley areas




Larkins Valley
Cabrillo Hwy
Ellicott Slough National Wildlife Refuge
Ellicott Slough National Wildlife Refuge
Ellicott Slough National Wildlife Refu
al Wildlife Refuge
© 2008 Tele Atlas
Image AMBAG
© USFWS
Image © 2008 DigitalGlobe
Google™
on -121.831146°
Streaming 100%
Eye alt 4.42 km

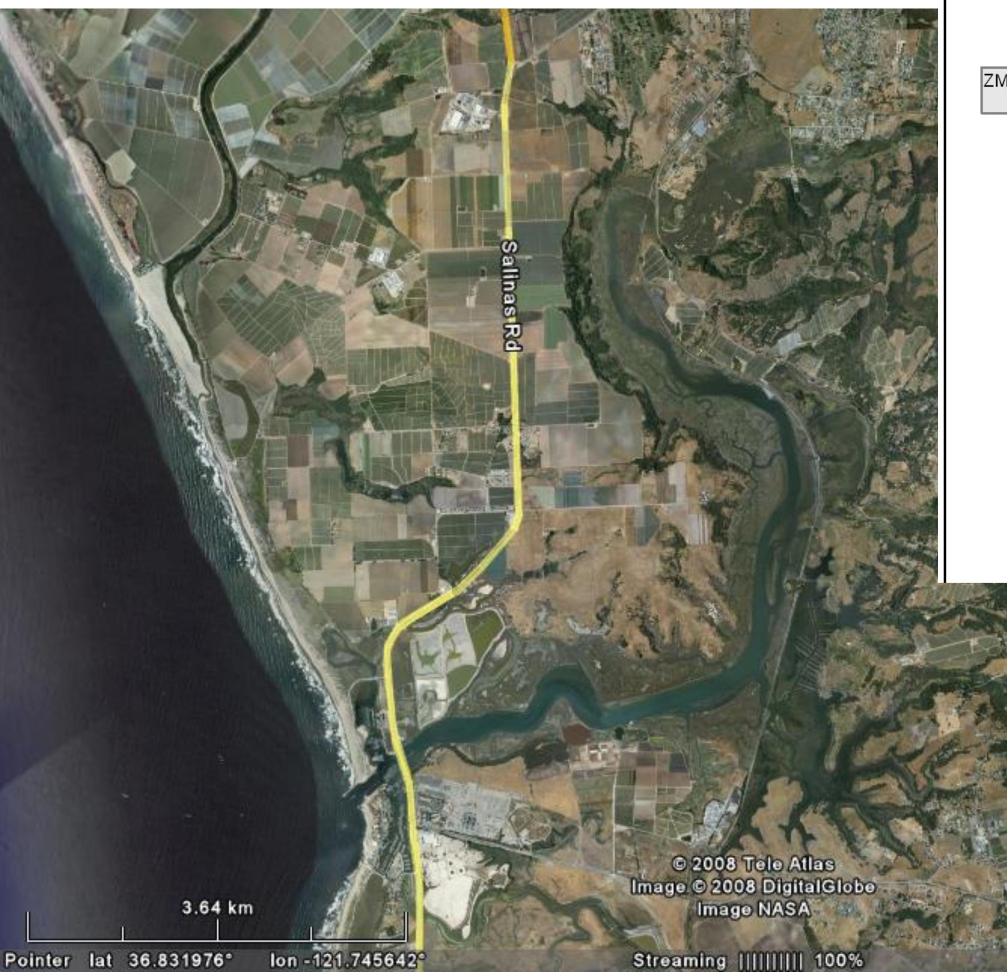
Ellicott Slough Santa Cruz long-toed salamander Ecological Preserve

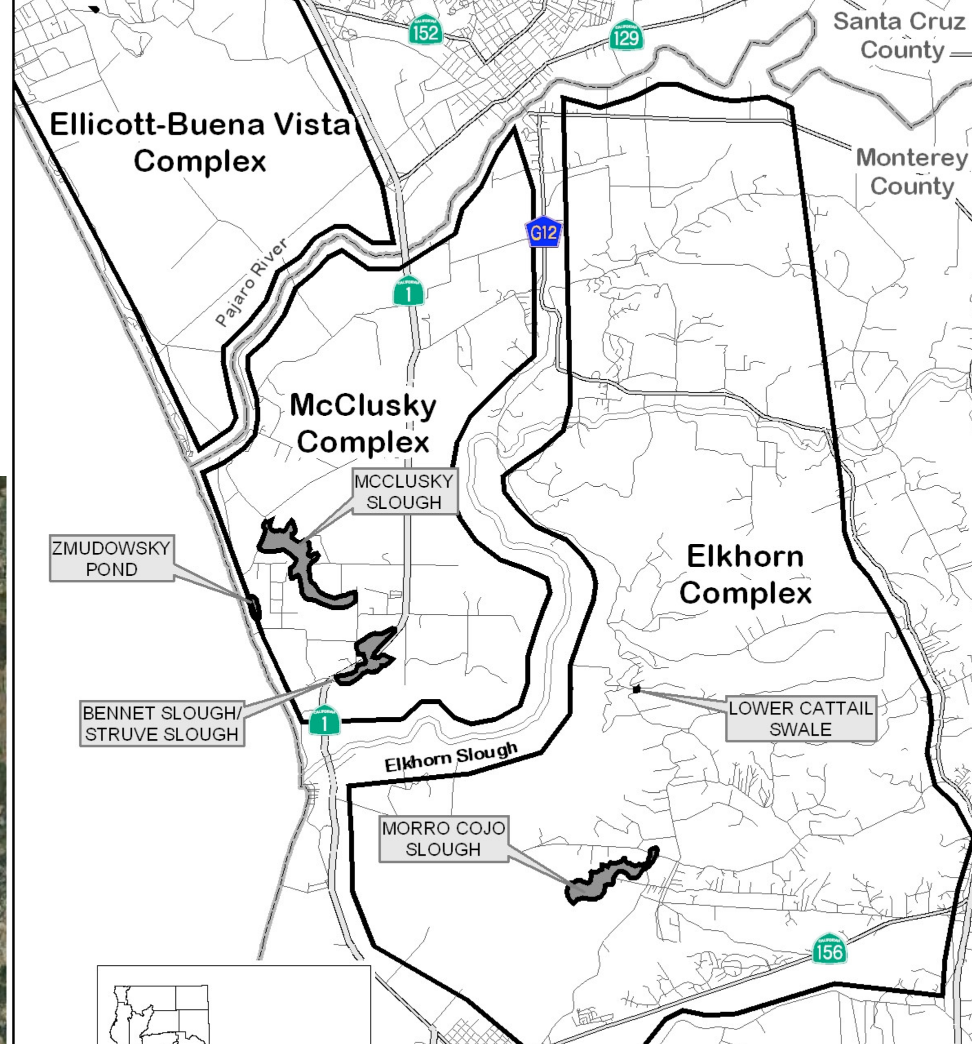



Buena Vista Pond (dried up)
Ellicott Slough Pond (dried up)

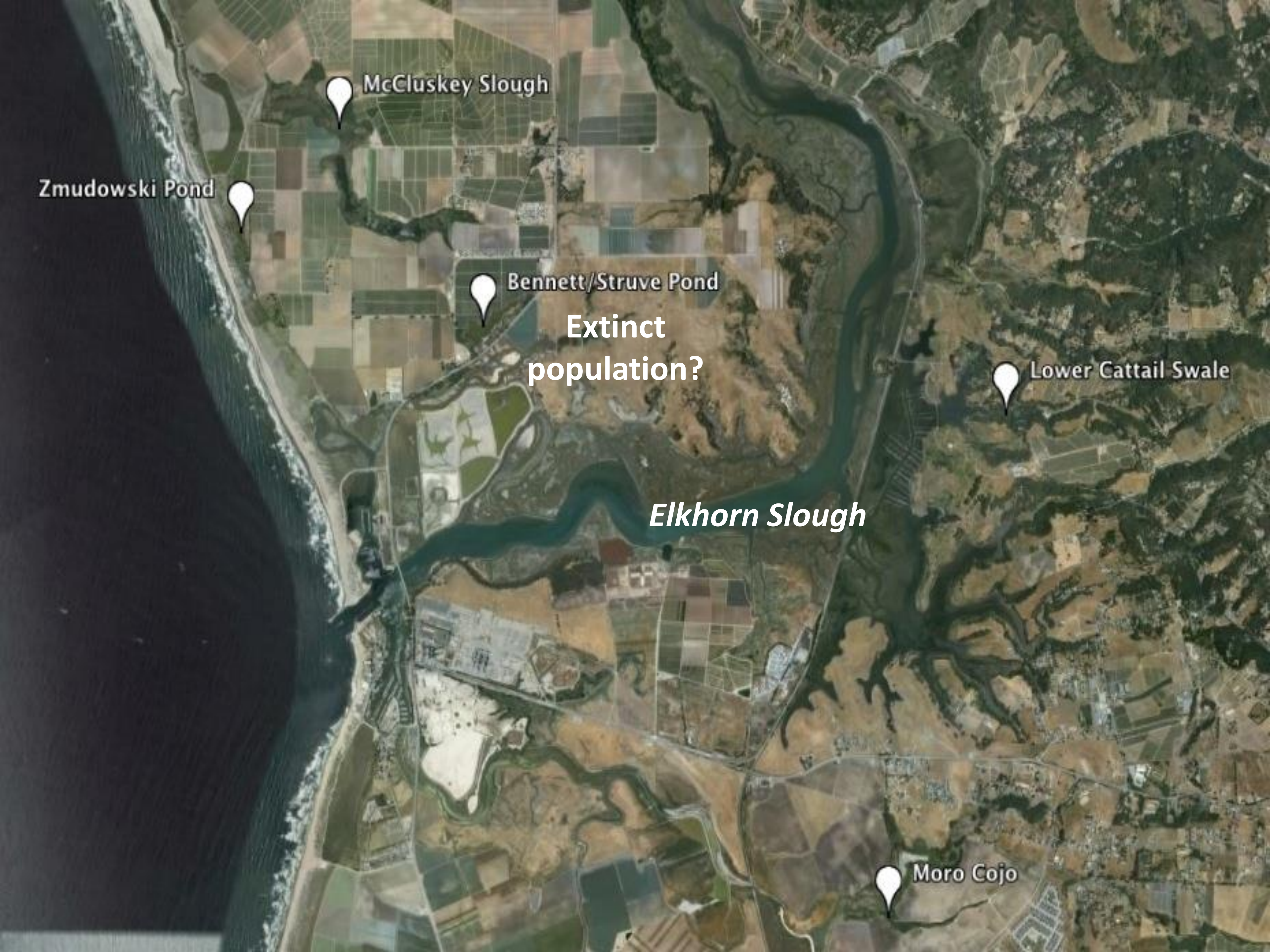
McClusky and Elkhorn

- extreme habitat modification and elimination
- salinity of aquifers

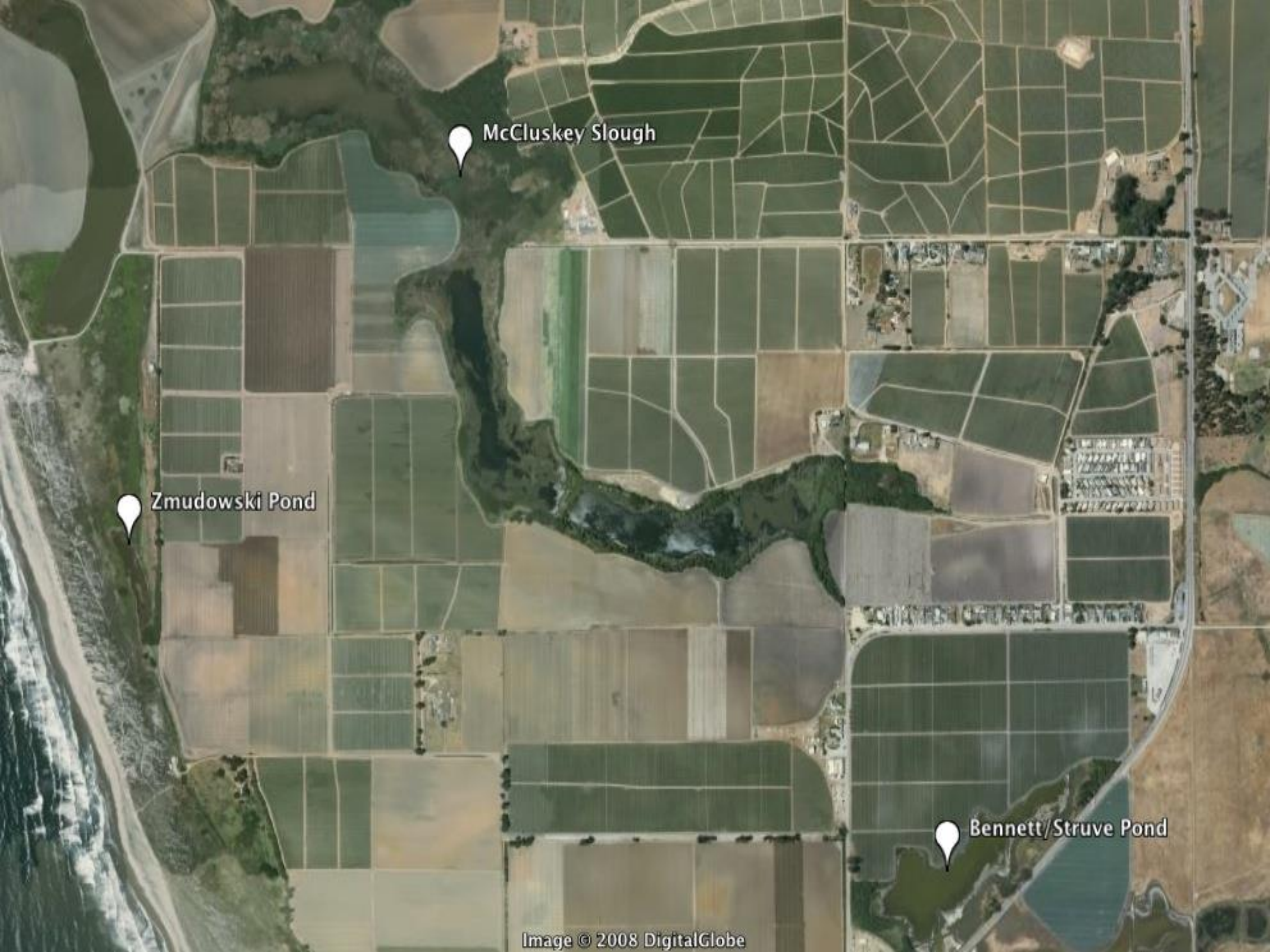


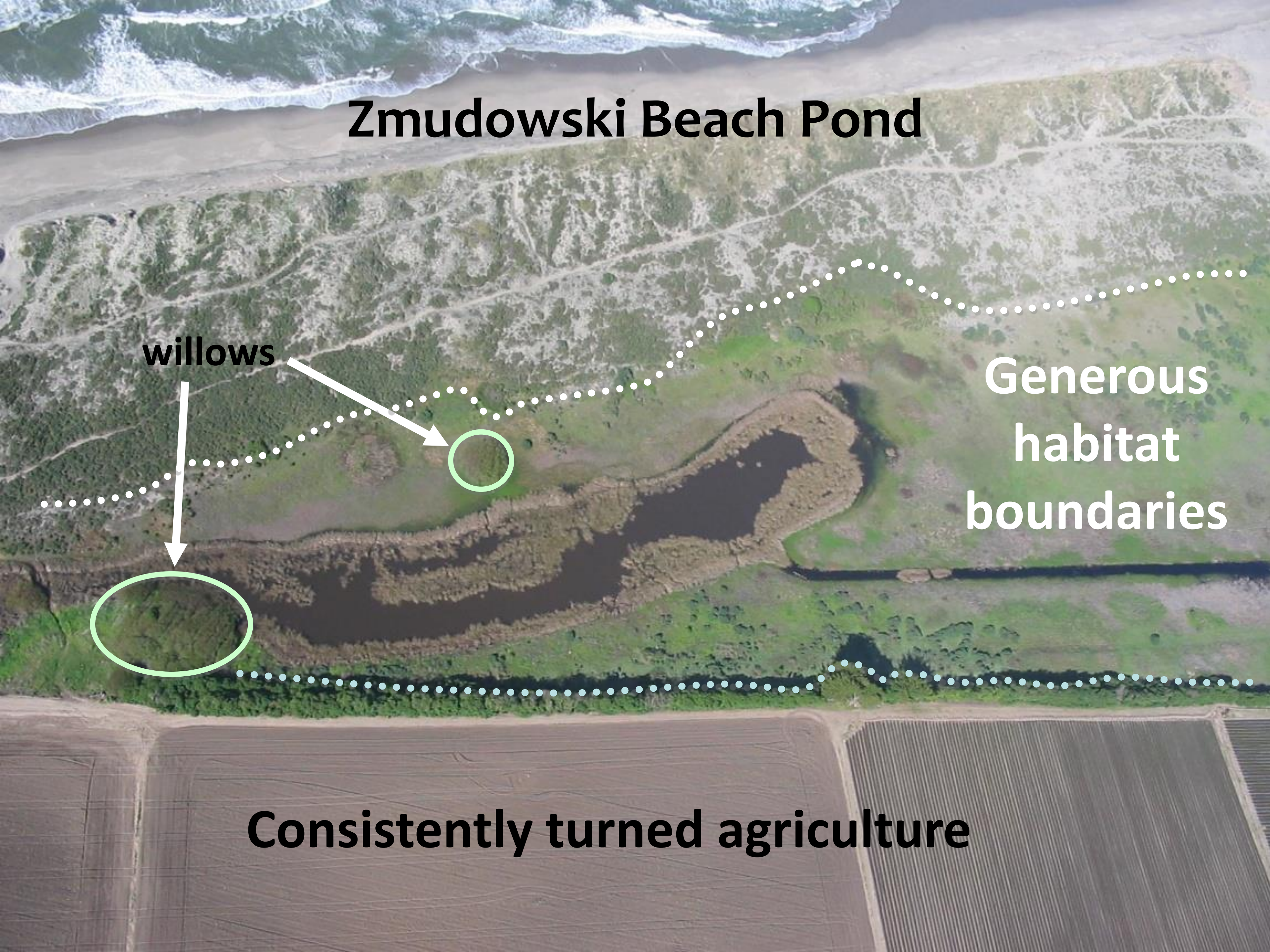


- extreme habitat isolation and water quality problems (ag runoff and salinity)


McCluskey Slough
Zmudowski Pond
Bennett/Struve Pond
Extinct population?
Lower Cattail Swale
Elkhorn Slough
Moro Cojo


The extent of upland habitat at McCluskey-Zmudowski complex is restricted to the perimeter of the wetland area at the edge of the agriculture fields


McCluskey Slough
Zmudowski Pond
Bennett/Struve Pond
Image © 2008 DigitalGlobe


Zmudowski Beach Pond
willows
Generous
habitat
boundaries
Consistently turned agriculture


Agricultural runoff drains into
Cattail Swale
Elkhorn Slough
We are here
Salt water estuary is
separated by an
impoundment

Avoidance and Minimization

Habitat management issues: *discing, mowing, burning, trenching, herbicides, agriculture, pond repair, road maintenance, irrigation, invasive plants, runoff, etc. make ag-edge sites a problem*

Upland habitats

- *Avoid collapsing burrows and any cracks/crevices if possible*
- *Limit activities to daylight hours*
- *Limit activities to the dry season (Aug-Sept until the rains)*
- *Disturb only part of site at a time, including the pond area*

Aquatic habitats

- *Only conduct work after pond has dried (not a guarantee)*

Help develop beneficial effects of human-centric projects

- *Could the habitat be improved as a result of the project?*

Conservation & Recovery Strategies

Protect/enhance occupied landscapes

- *As large as possible, given restricted range of SCLTS*
- *Consider the benefits of additional breeding habitat*

Maintain and enhance habitat connectivity

- *Minimize effects of new or improved roads*
- *Minimize barriers: agricultural canals/ponds/fields, train tracks (e.g., Ellicott); large-scale development that consumes natural habitat*

Create new corridors

- *Enhance potential for movement*
- *Native plant revegetation projects*

Ecoducts and wildlife tunnels – why not?

Ecoducts and tunnels

If it can be done in New Jersey!

Improving/Managing Aquatic Habitat for SCLTS

Create additional ponds – safety net (e.g., Seascape, ALBA)

Eliminate predators by drying (e.g., Tucker Pond)

Modify/manage pond hydroperiod to make longer lasting, but still ephemeral wetlands (all breeding ponds now)

Maintain existing berms/remove excessive siltation (e.g, Ellicott drying)

Allow modest livestock grazing (esp. vernal pools) to remove vegetation *in* ponds – *Tule elk once served this role*

SCLTS Basics - Review

Aquatic Habitat – breeding

- Ponds *should* be temporary, but not too temporary
- Larger, longer lasting ponds are better

Upland Habitat – *the rest of their lives*

- On land occupy terrestrial burrows & crevices
- ~3 year sub-adult phase
- Move hundreds of meters from ponds

Landscape Considerations

- More ponds = more security against local extinction
- Ideally want ponds separated by <<2 km for movement
- Eliminate and/or minimize barriers

Weather/Rainfall drives migrations and population dynamics

Summary I

Due to restricted range and the small number of sites, impacts to populations are likely to reduce recovery potential

Maintaining large areas of continuous or interconnected habitat is critical – as large as possible given the reaction to protection

SCLTS is primarily terrestrial, but breeding ponds are obviously essential

SCLTS are present in uplands year-round, and disperse across regional uplands

Summary II

At least a 0.25 mile buffer around breeding habitats is a starting point for population protection (not avoidance) (Trenham; Allaback & Laabs)

Upland habitat is not simply aestivation habitat – they *live* there

Ponds should regularly hold water minimally *through June*, but should be later (end of July)

Large ponds are critically important for population sustainability – small ponds, small populations

Permanent ponds are not usually good (fish & non-natives)

Habitat loss and fragmentation are the main threats, and these are not subsiding

Conservation needs and goals for recovery of SCLTS

Only achieved by maximizing:

- The greatest number of breeding habitats
- The greatest connectivity among populations through reduction in barriers
- The greatest number of individuals at each location
- The quality and size of upland habitat:
  - Essential for breeding pond water quality
  - Maximizing larval → juvenile recruitment
  - Terrestrial life stages

Reality

The Santa Cruz long-toed salamander will probably go extinct

This is tragic from the perspective of environmental stewardship, because it means that our landscape and water quality are declining in the long run, but for short term gains

It is also tragic because extinction is irreversible, and from the perspective of interest in and appreciation of biodiversity, declines of species inevitably result in declining ecosystem services for us (clean air, clean water, clean soil)

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5 June 2014 Last updated at 01:50 ET

Risk posed by China mountain removal

By Rebecca Morelle
Science correspondent, BBC News

Satellite images of western Shiyan between 2010 (L) and 2012 (R) show that several peaks have been flattened

China's campaign to bulldoze mountains to create land to build on could cause extensive environmental problems, scientists say.

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NATURE | COMMENT

Environment: Accelerate research on land creation

Peiyue Li, Hui Qian & Jianhua Wu

04 June 2014

China's campaign to bulldoze mountains to build cities needs expertise to avert geoengineering problems, warn Peiyue Li, Hui Qian and Jianhua Wu.

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"Dozens of mountains have already been flattened – and this is causing air and water pollution, soil erosion and flooding." -- Peiyue Li HQ, Jianhua W (2014) Environment: Accelerate research on land creation. *Nature* **510**, 29–31

Additional Issues – Discussion Topics

Monitoring *& discovering* SCLTS populations

Metapopulation dynamics – do they exist?

Mosquitofish (catfish, other spp.), road/development

Decontamination protocols

Climate change

Species range

CNDDB records

QUESTIONS?

Acknowledgements

Virginia Guhin, Grey Hayes, Elkhorn Slough Foundation, ESNERR, David Laabs, Mark Allaback, Dana Bland, Pete Trenham, Brian Mori, Kaley Grimland, Nina D'Amore, *many* DFW and FWS personnel, you (workshop participants), ESA 1973, CA ESA

Advice for FWS & CA DFW Reports, CNDDB

Complete information:

- Dates, times, and coordinates of sampled site
- Rainfall/temperature data for area during study period
- Records of all animals (& life stages) captured/observed
- Photographs of representative specimens
- Photographs of sampling apparatus
- Records of all communications with FWS, DFW
- For aquatic sampling calculations of the total effort expended/area covered each time