

Importance of connectivity for wildlife

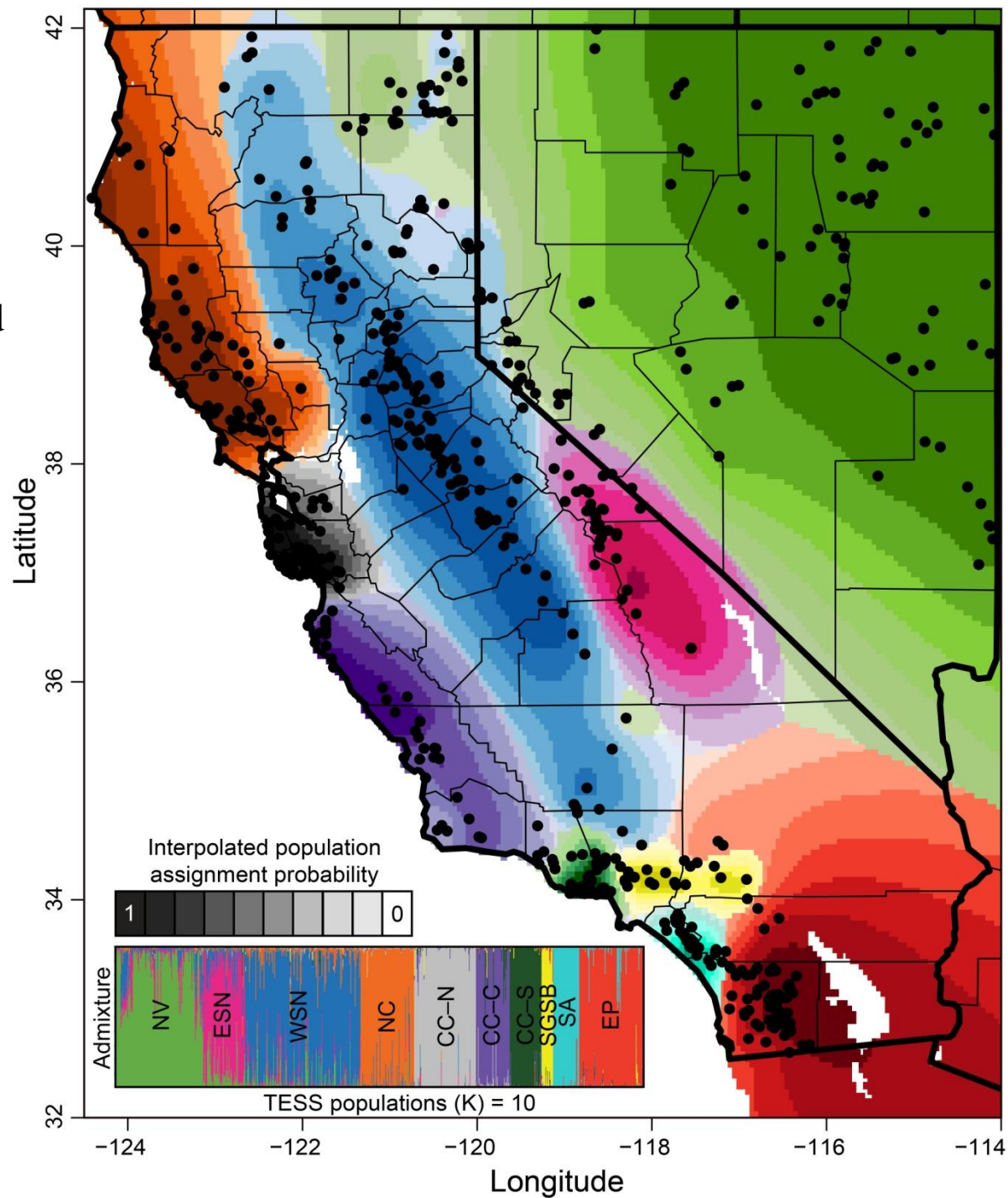


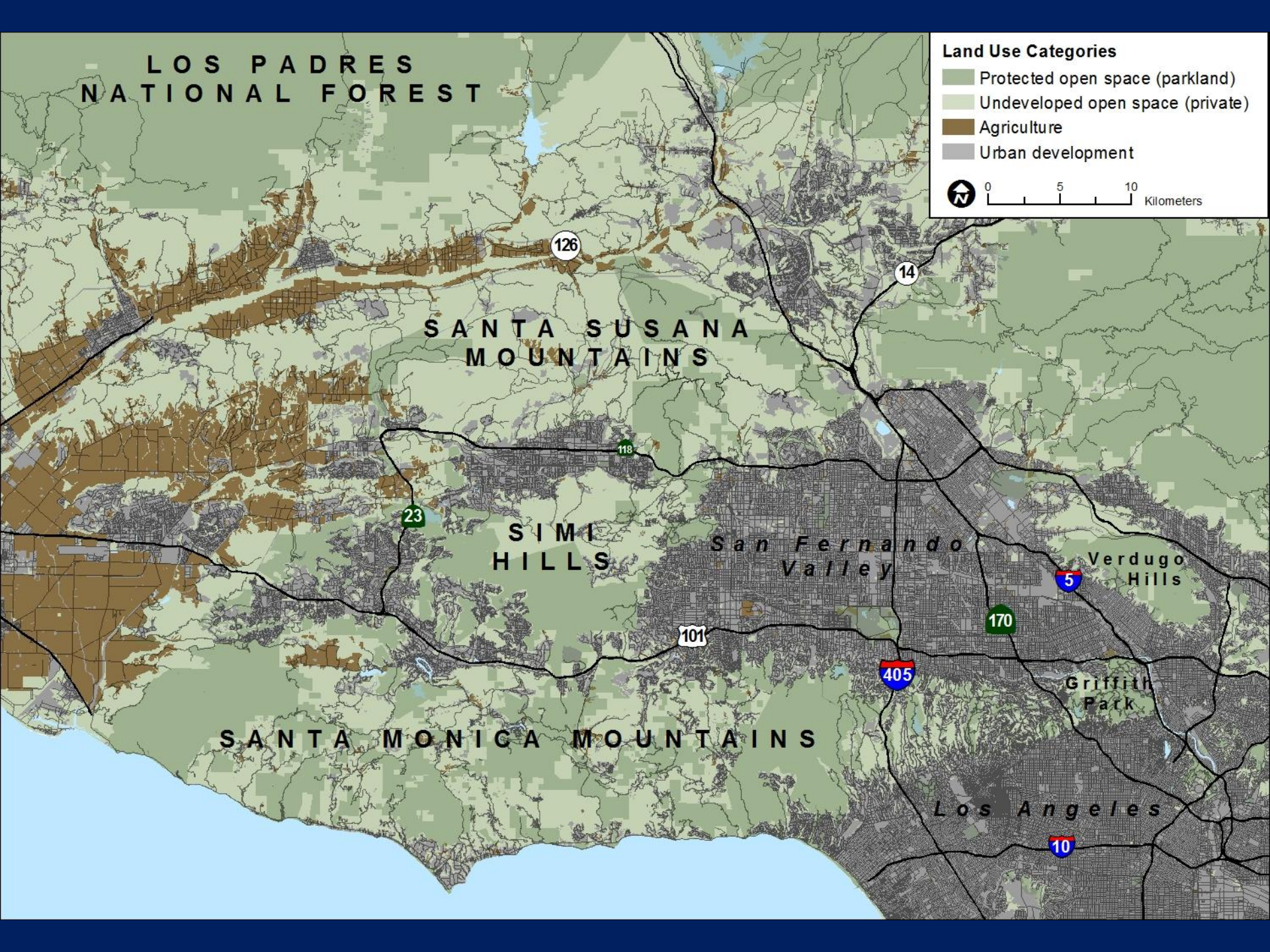
Seth Riley
National Park Service
Santa Monica Mountains Nat Rec Area
and UCLA, Dept of Ecology and Evolution

Population genetic structure of mountain lions in California and Nevada

-- Nevada, other states in the west, little or no genetic structure

-- California – 10 different genetic clusters, particularly in southern California.





LOS PADRES
NATIONAL FOREST

Land Use Categories

- Protected open space (parkland)
- Undeveloped open space (private)
- Agriculture
- Urban development



0 5 10
Kilometers

SANTA SUSANA
MOUNTAINS

23

SIMI
HILLS

118

San Fernando
Valley

101

405

5

Verdugo
Hills

170

Griffith
Park

SANTA MONICA MOUNTAINS

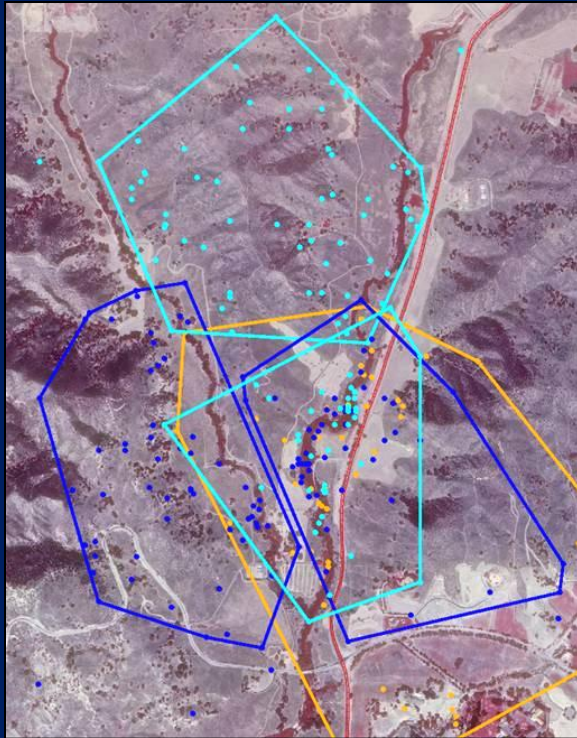
Los Angeles

10

Bobcat study: 1996 – 2018, 362 bobcats studied

Coyote study: 1996 – 2004, 2010-2018, 149 coyotes studied

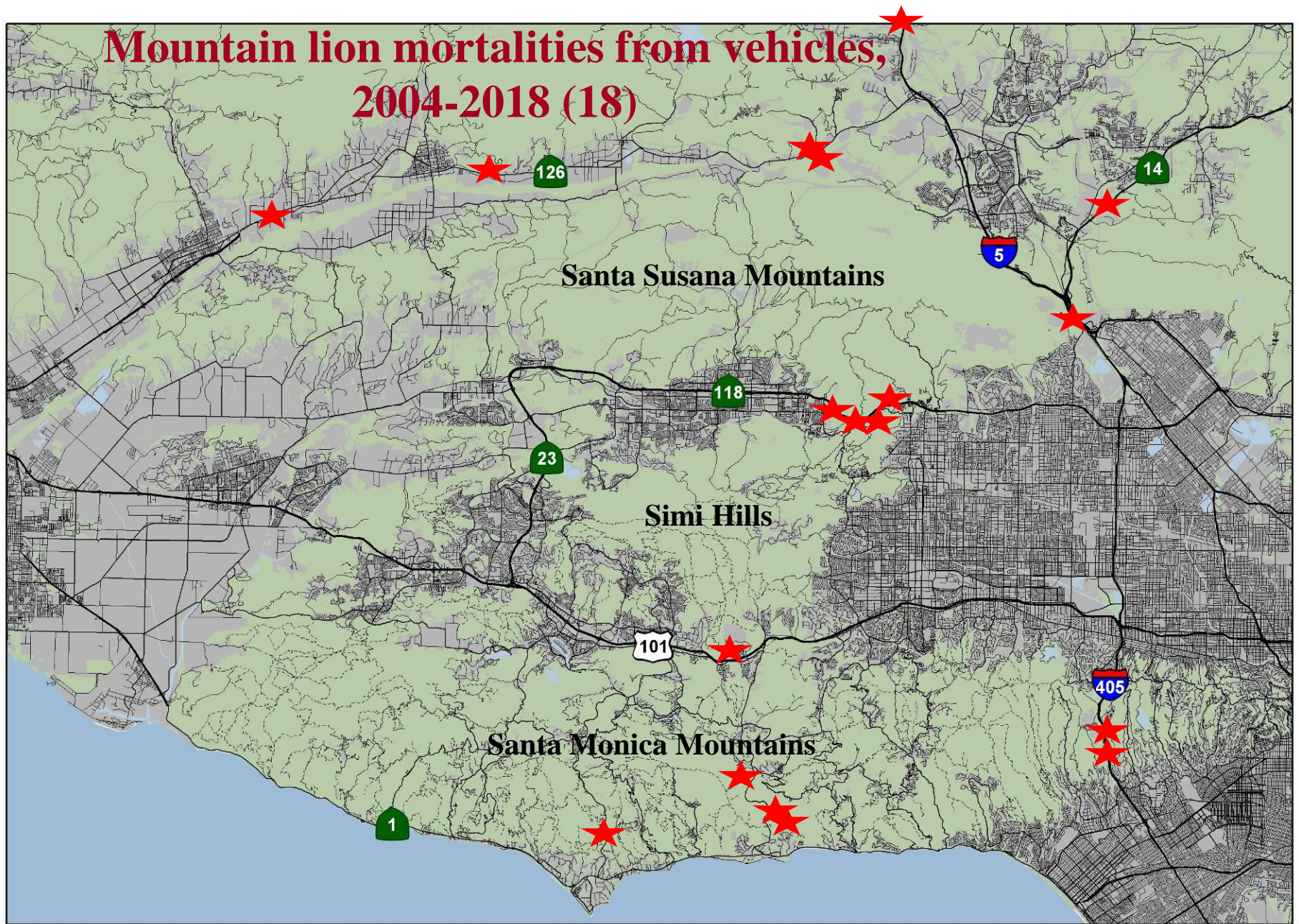
Vehicles –significant source of mortality for coyotes (#1 cause), and for bobcats

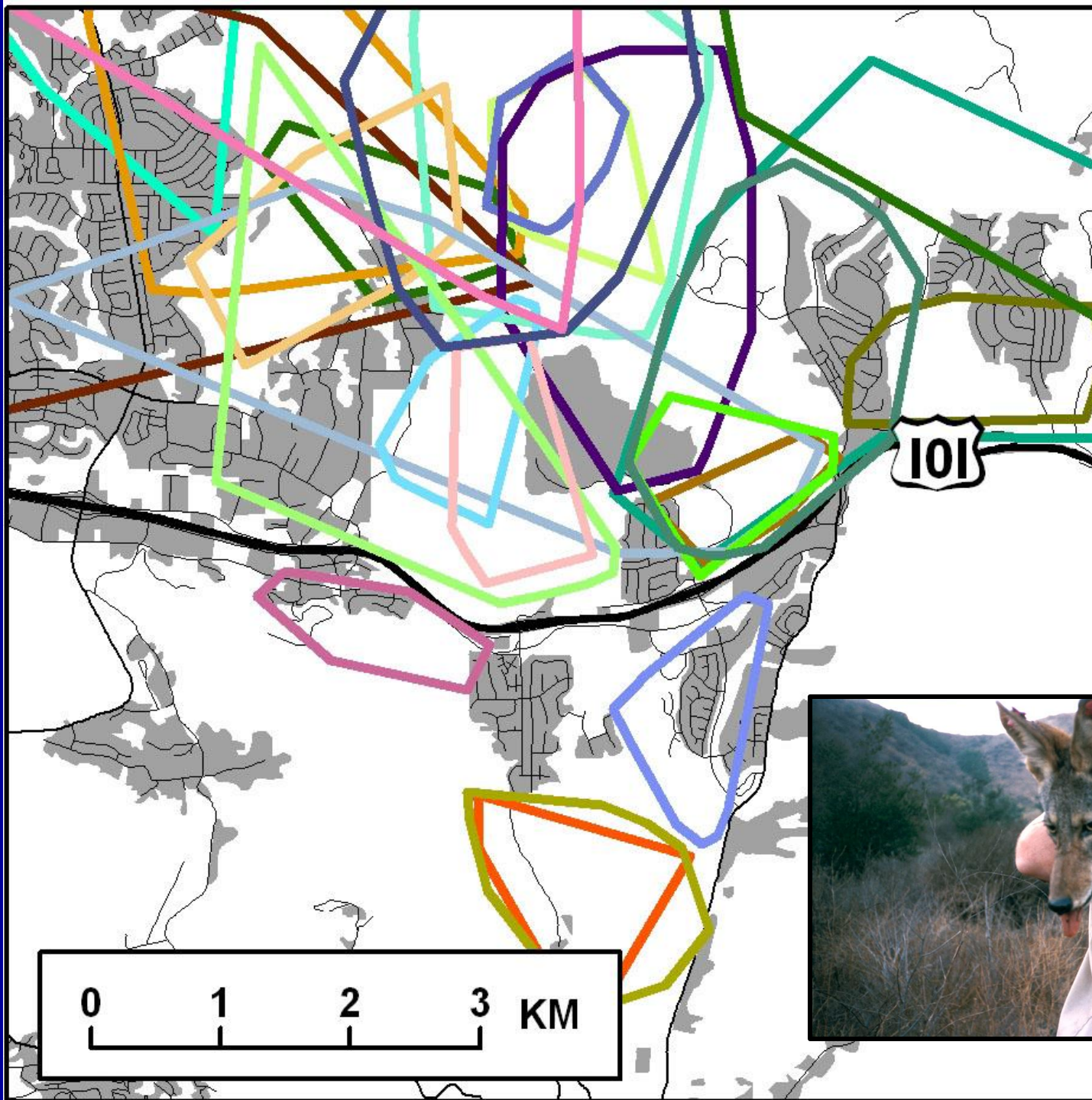


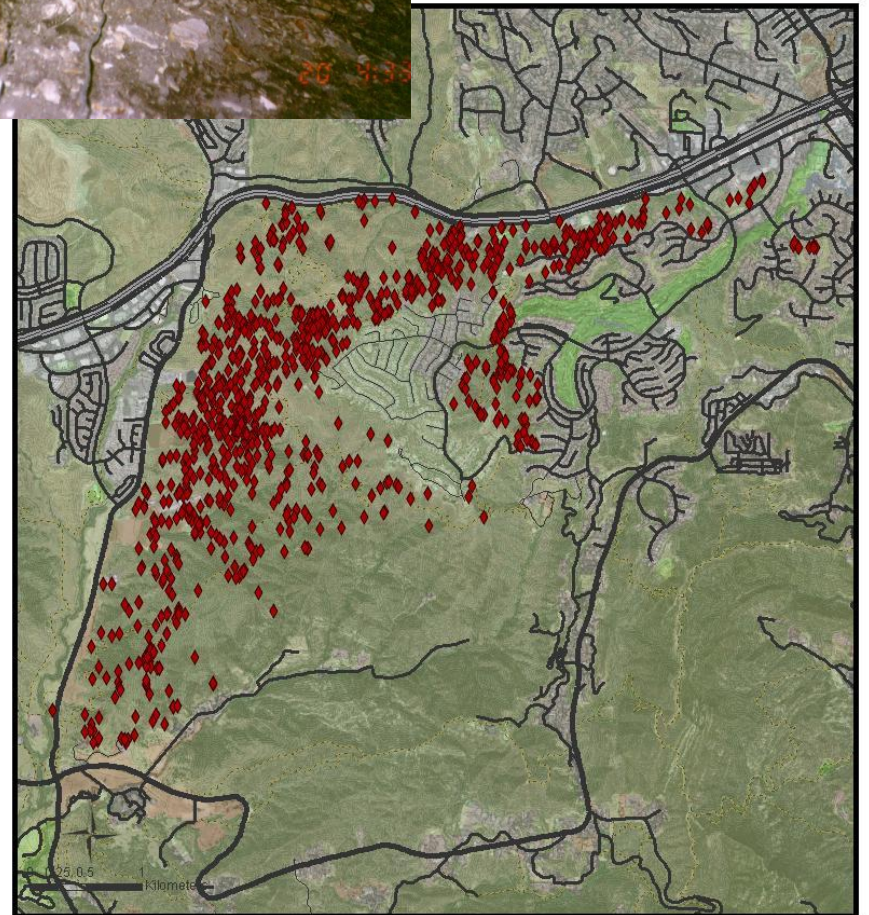
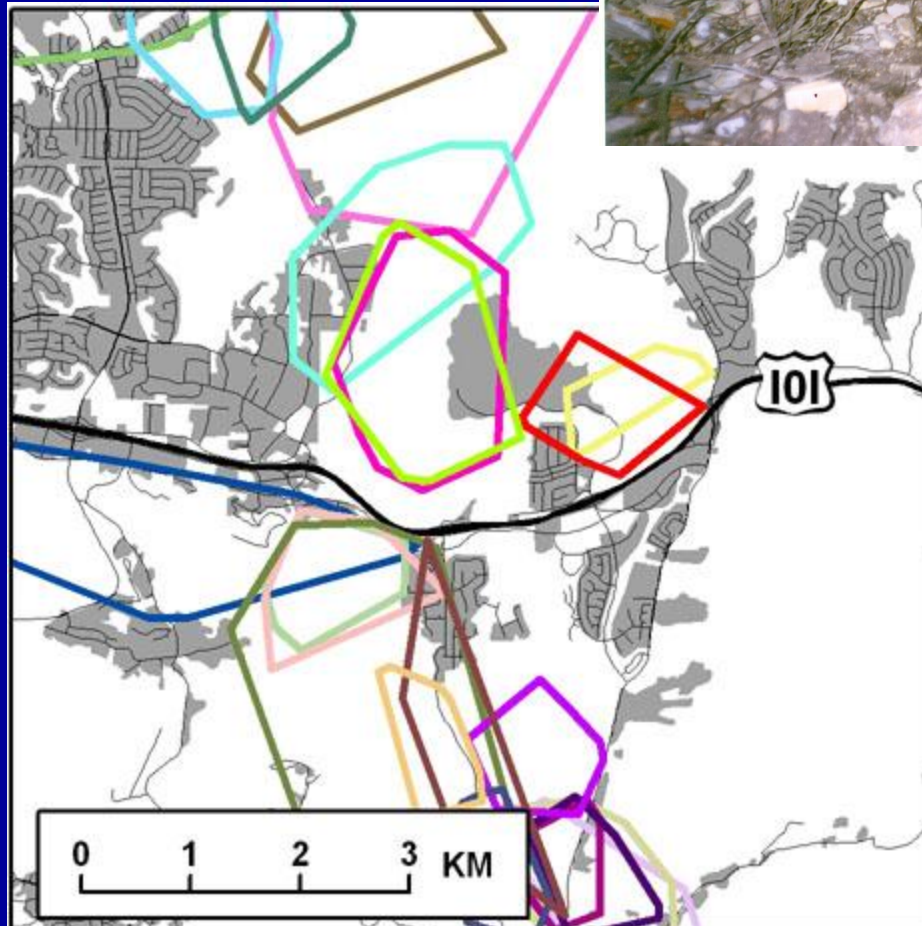
Roadway mortality in mountain lions

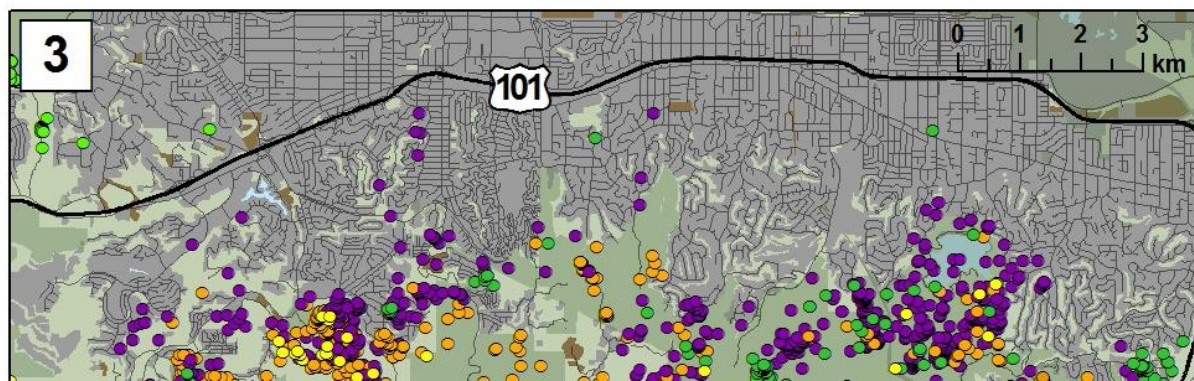
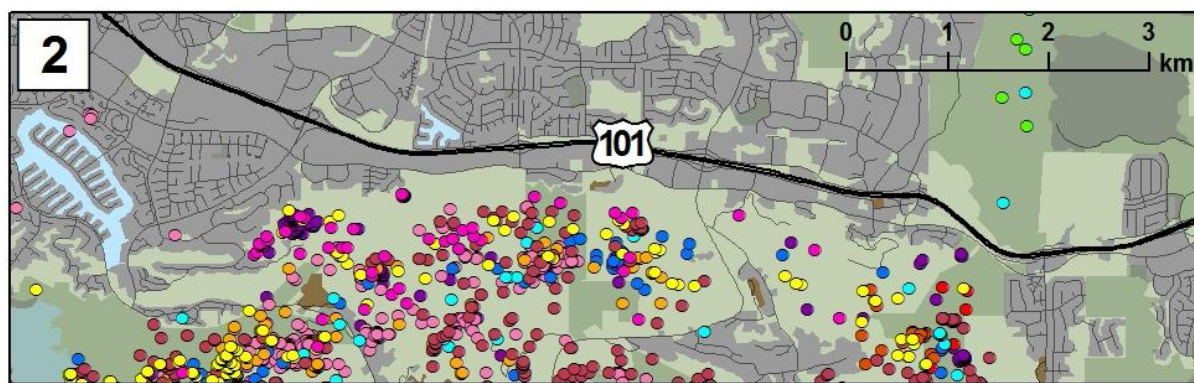
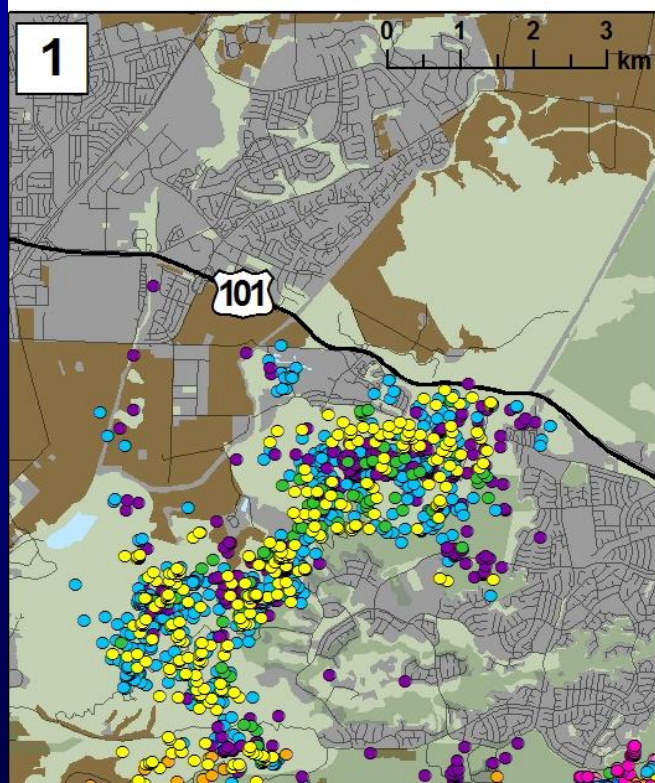
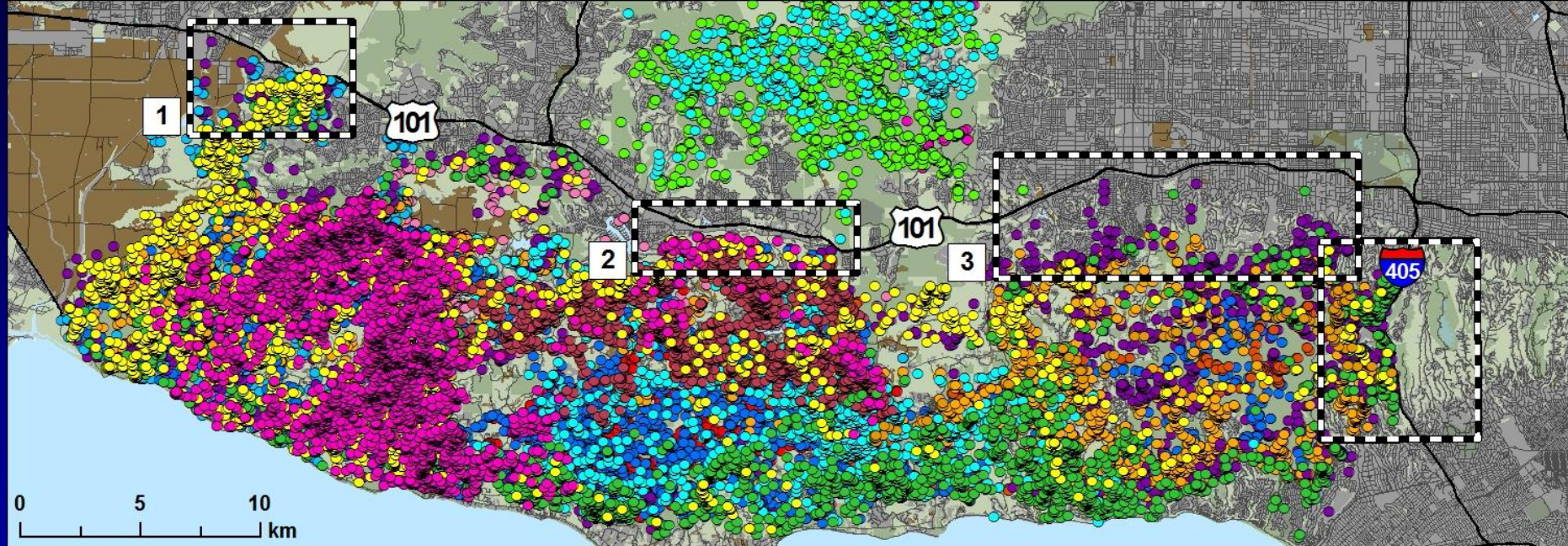


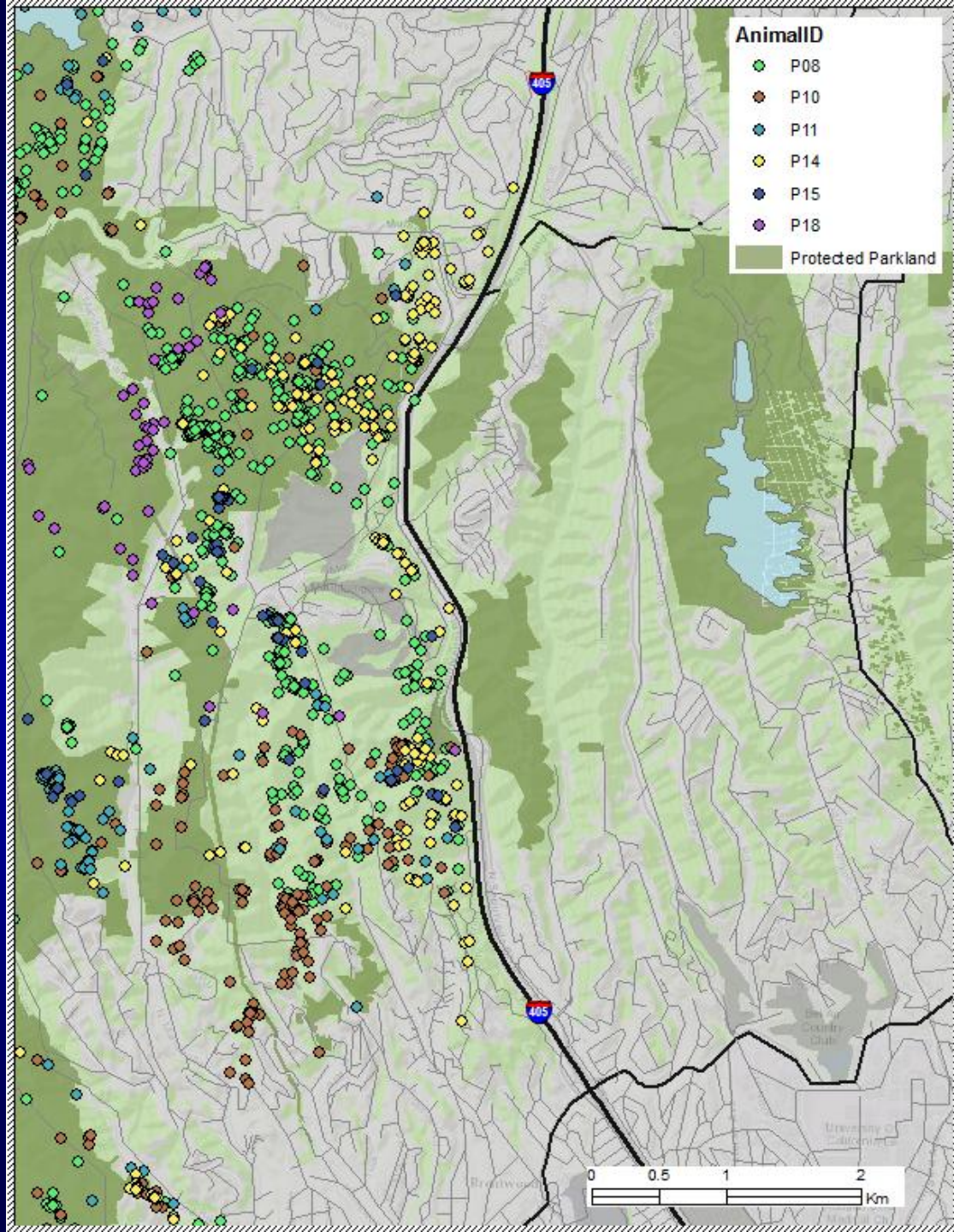
Mountain lion mortalities from vehicles, 2004-2018 (18)

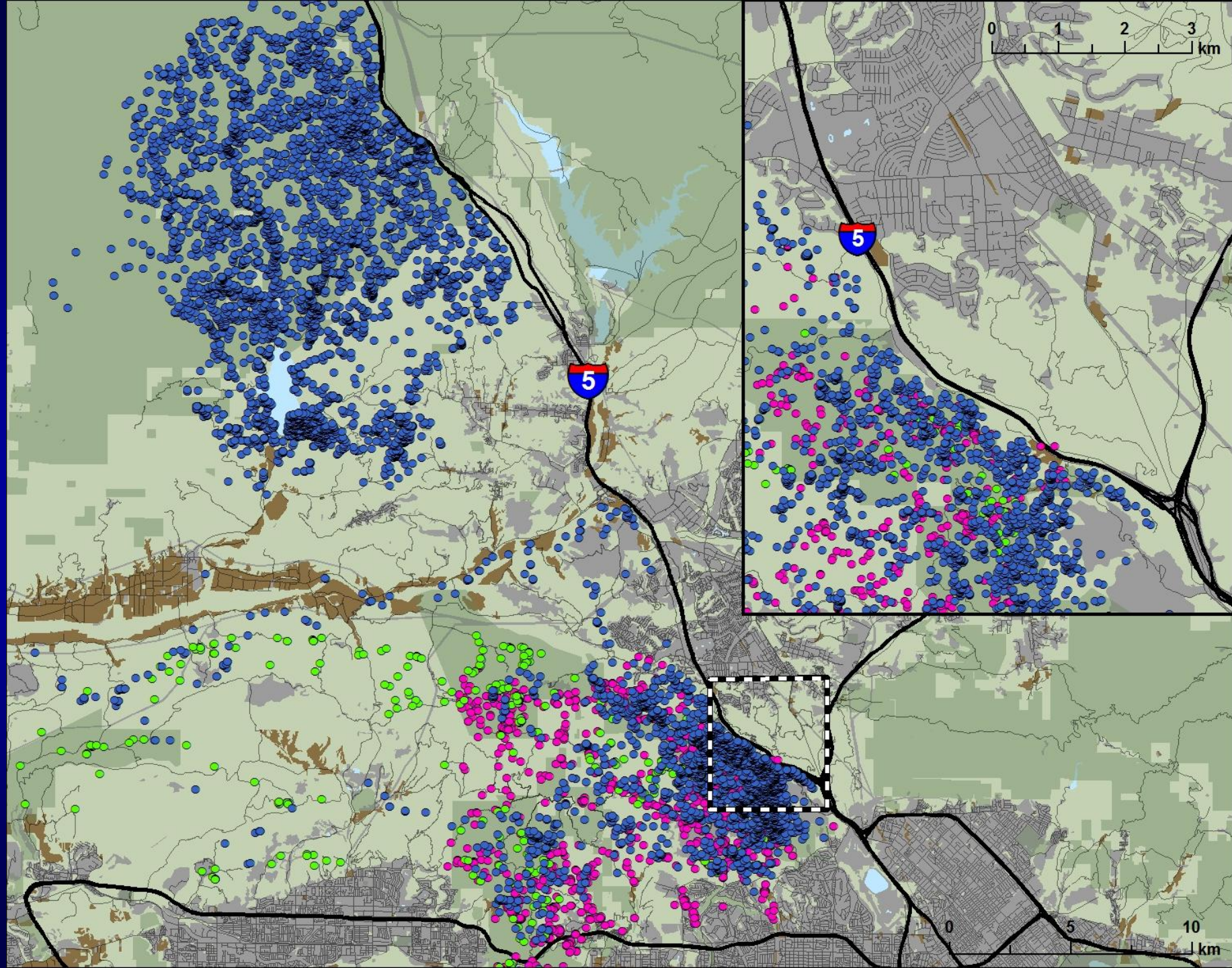










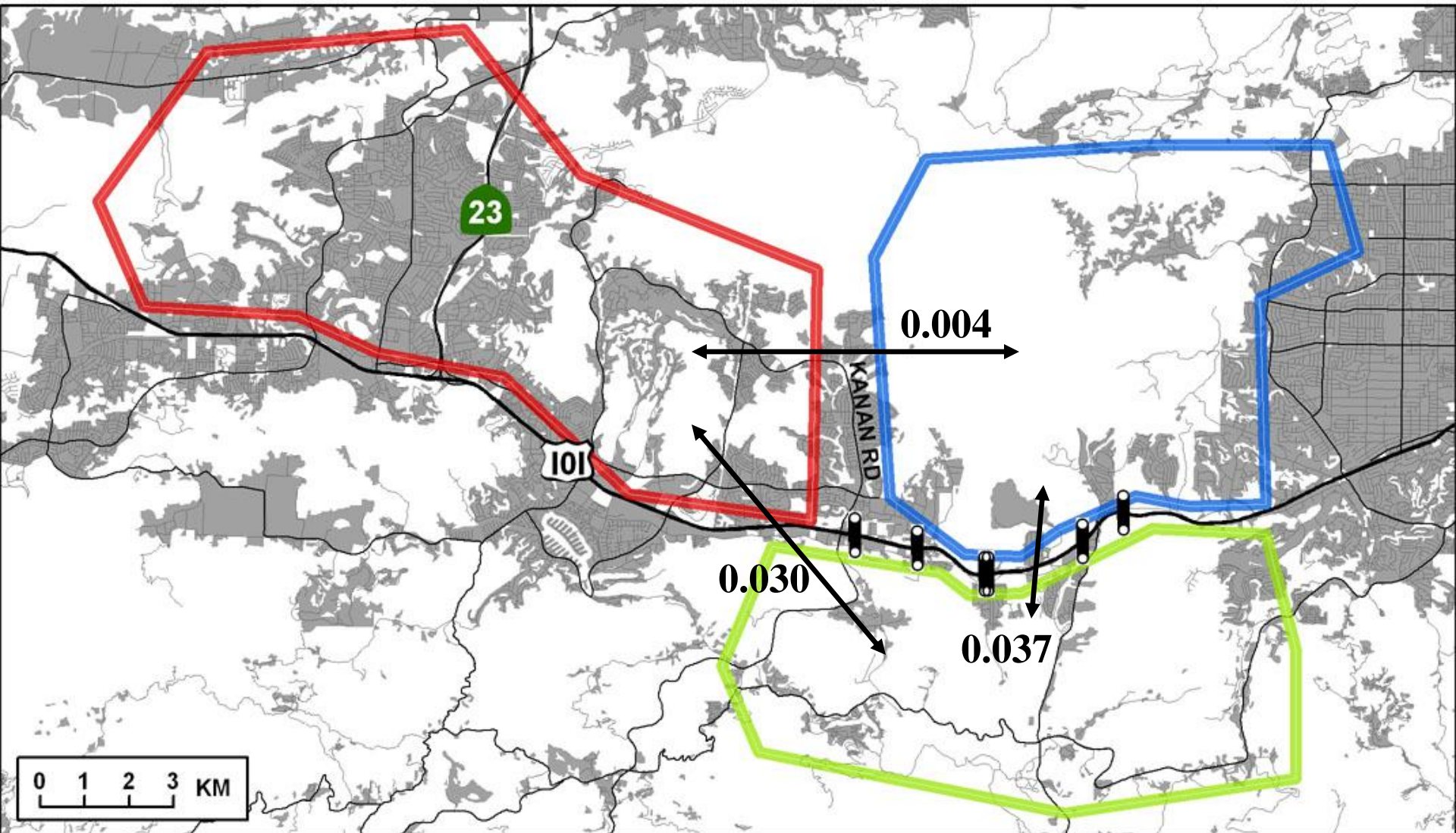


Highway 118 between Moorpark and Ventura



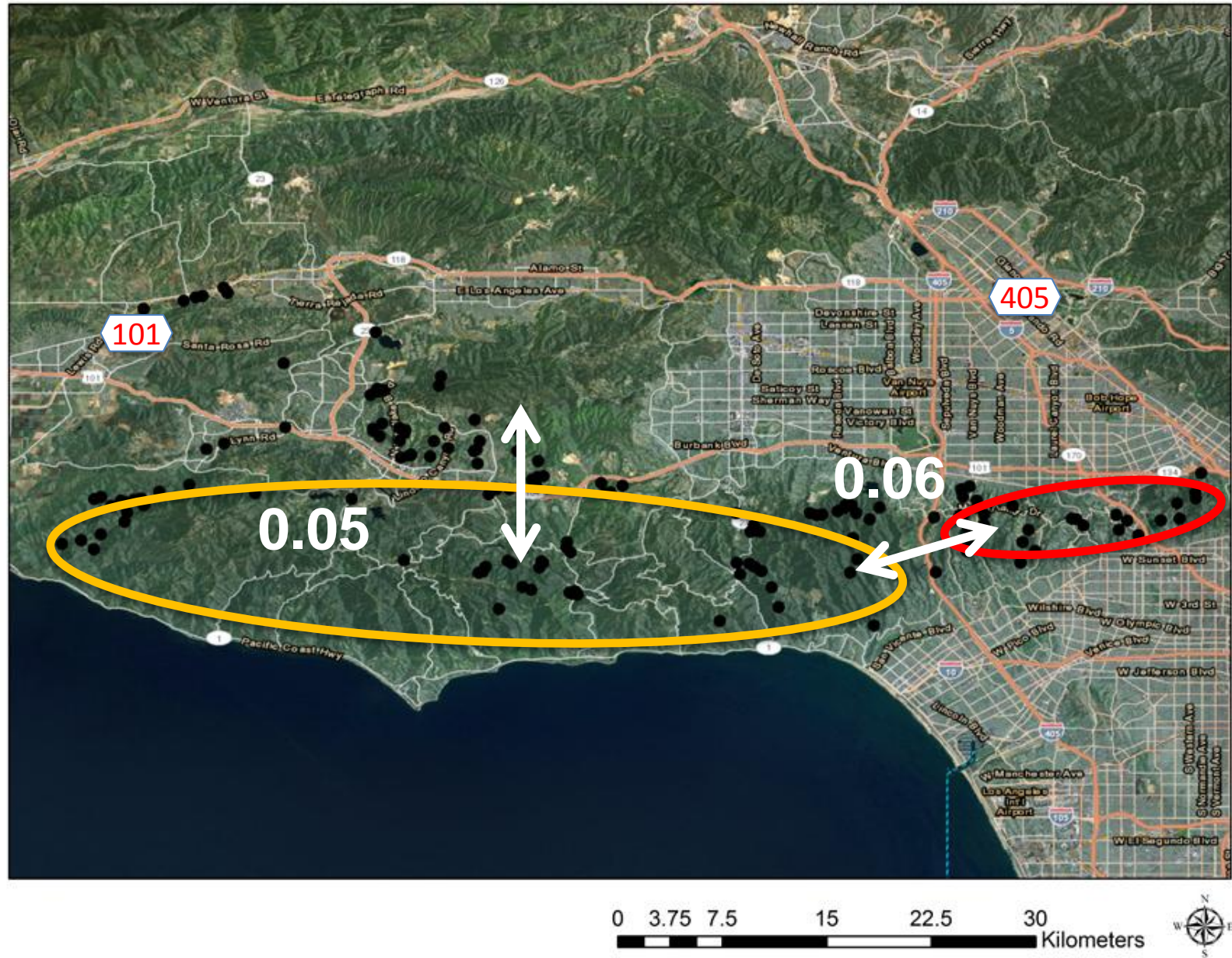
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- B267 Locations
 - ◆ B268 Locations
 - ◆ B269 Locations
 - ▲ B270 Locations
 - B278 Locations
 - B282 Locations
 - B283 Locations
 - B284 Locations
 - B286 Locations





Genetic differentiation (F_{ST} values) between coyote populations along and across the 101 Freeway

Genetic Differentiation (D_{EST}) across freeways in bobcats



© G. Nafis



Western Fence Lizard
(*Sceloporus occidentalis*)

- Abundant
- Widespread distributions
- Small dispersal distances



Western Skink
(*Eumeces skiltonianus*)

Side-Blotched Lizard
(*Uta stansburiana*)

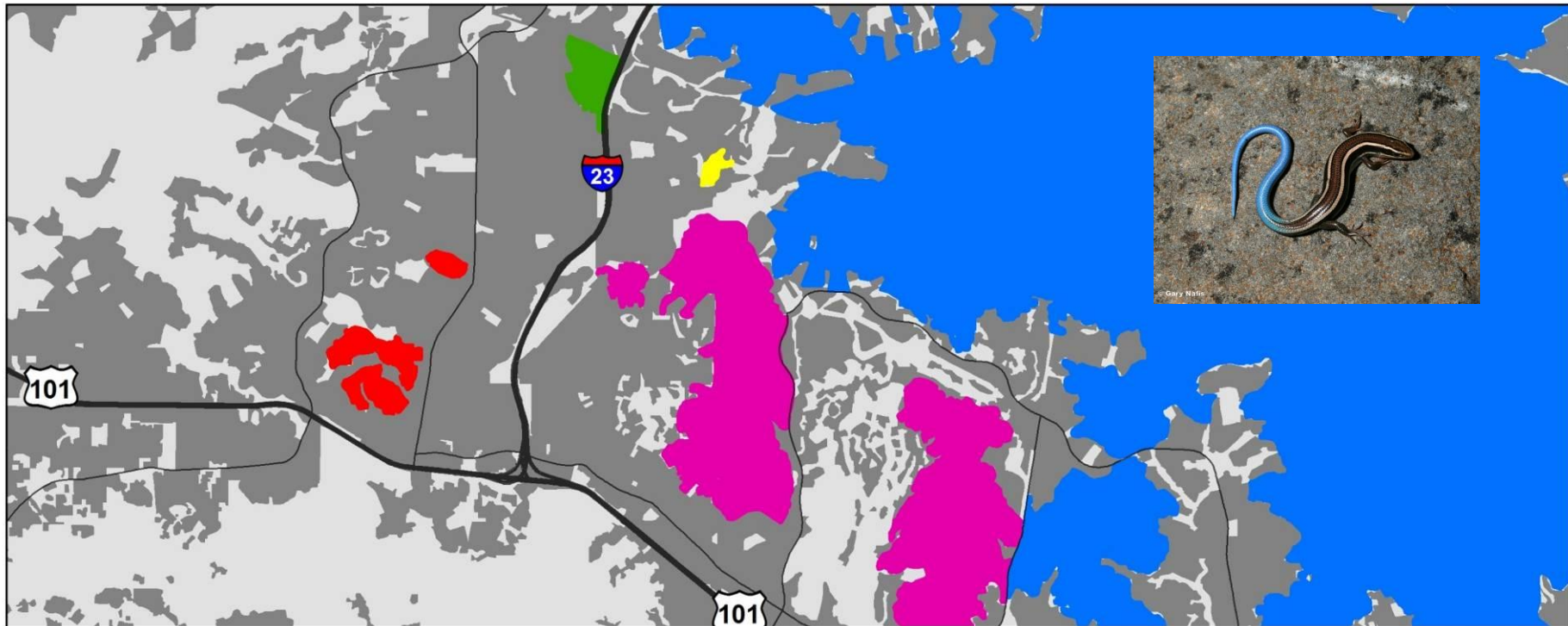
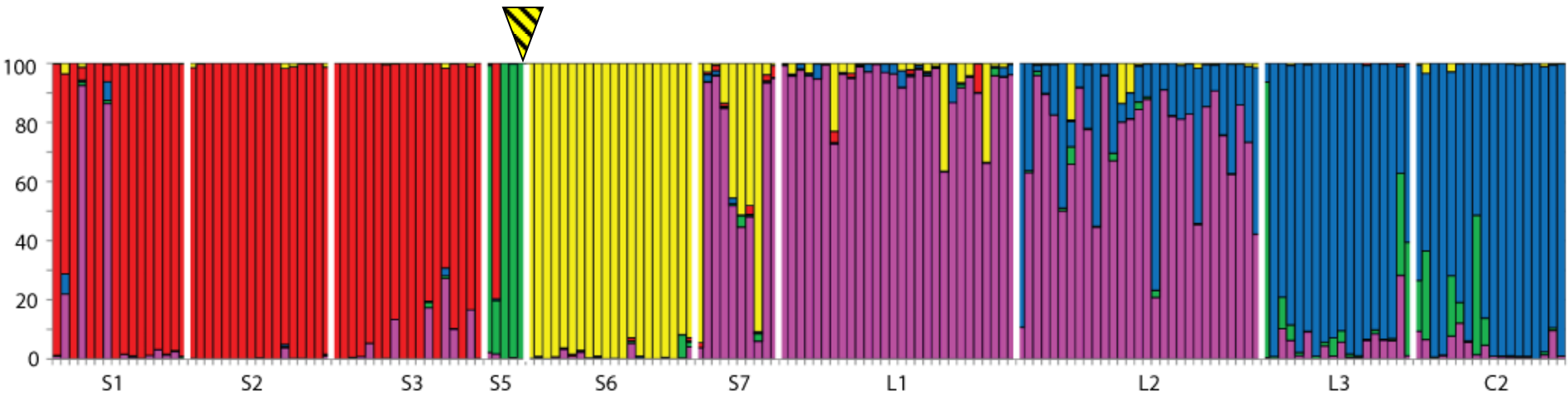


© G. Nafis



Wrentit
(*Chamaea fasciata*)

Skink – 5 clusters





- Significant genetic divergence relative to habitat fragmentation
 - Related to patch age, patch isolation, **presence of roads and the freeway (23)**
- Decreased genetic variability
- Concordance among four species despite taxonomic differences.



Mountain lion genetics

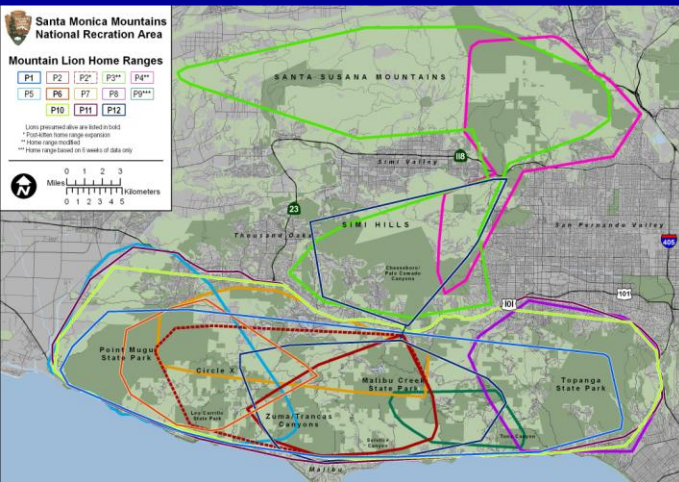
with Univ. Wyo. and UCLA

Reduced genetic diversity S. of 101, $F_{ST} = 0.12$ across 101

North of 101 have significantly higher expected heterozygosity (H_e), number of effective alleles per locus (N_e), % genetic loci variable

North 101: $H_e = 0.48$ $N_e = 2.1$ **100%** loci variable

South 101: $H_e = 0.31$ $N_e = 1.6$ **72%** loci variable

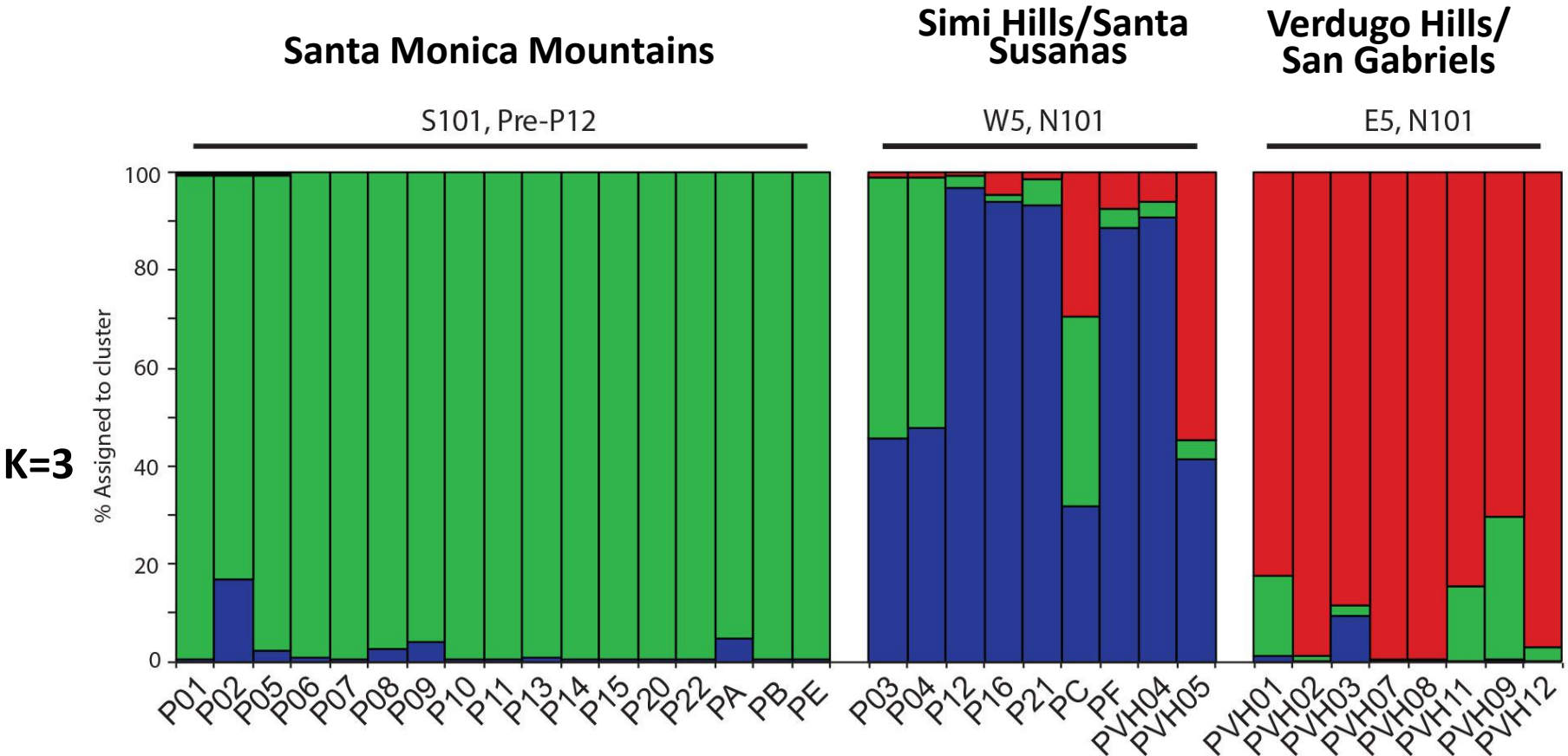


-- **Santa Monicas (S of 101), lower genetic diversity than all other populations in California** (similar to Santa Anas, South of LA)

-- **lower than all other populations measured in other parts of west** – only endangered FL panthers lower

STRUCTURE Genetic Cluster Analysis Results

(54 microsatellite markers)



- Three genetic clusters are resolved – Santa Monica Mountains, Simi Hills/Santa Susana Mountains, and Verdugo Hills/San Gabriel Mountains
- Green and red clusters very consistent (16 of 17 > 95% assignment to green, all > 80%; 7 of 8 > 80% assignment to red, all > 70%)

Protected Parkland

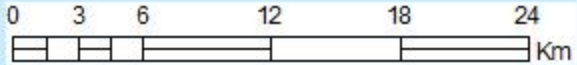
**Los Padres National
Forest**

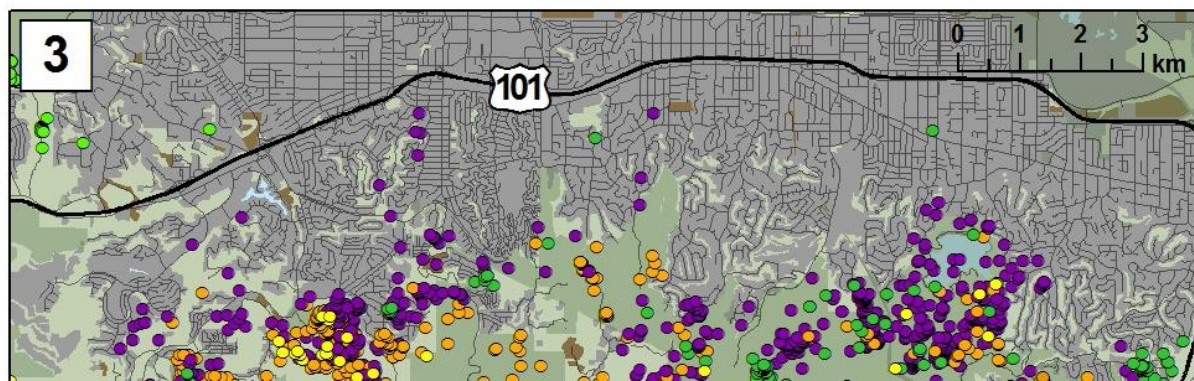
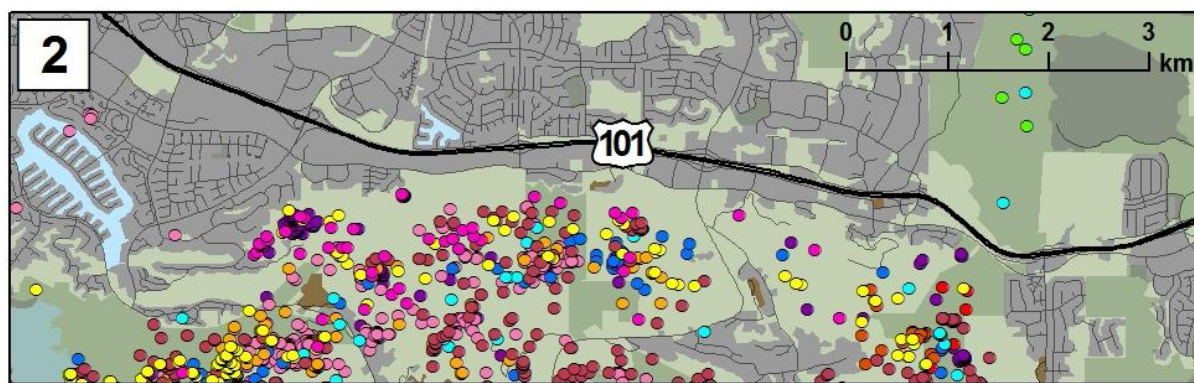
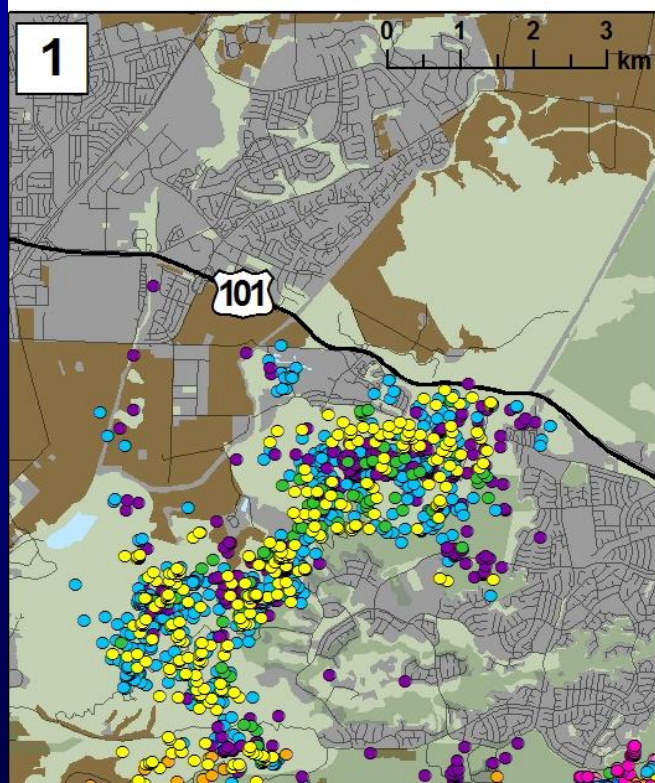
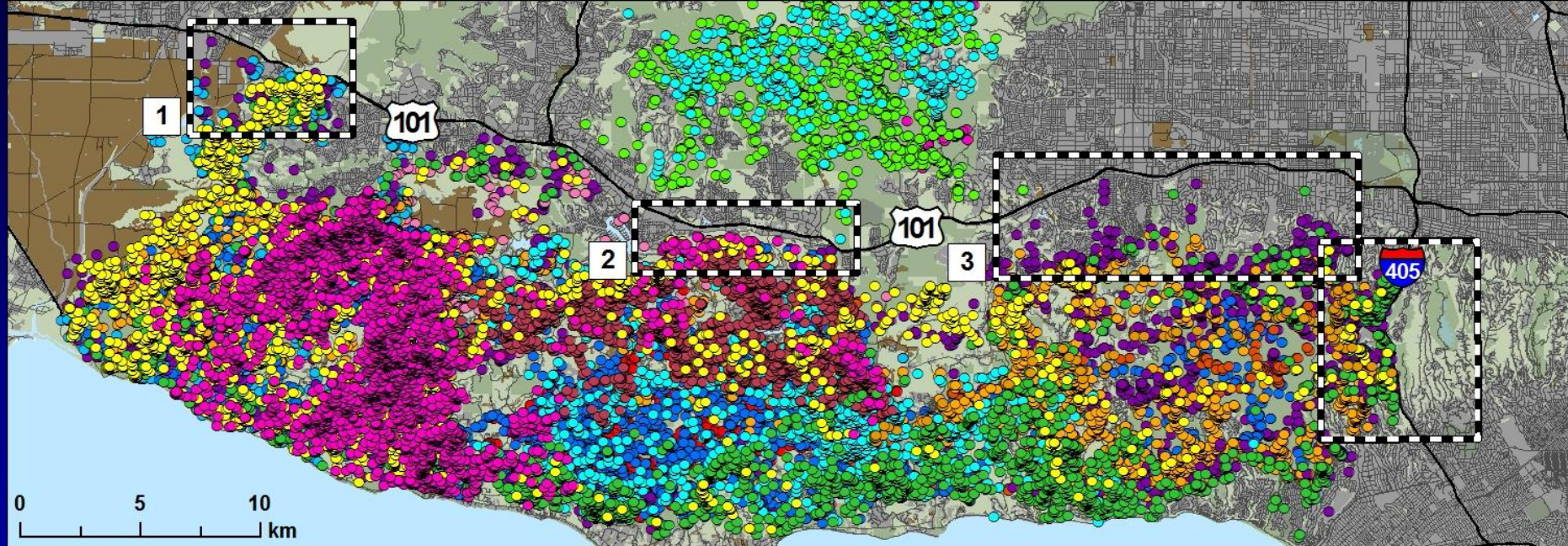
Santa Susana Mountains

Simi Hills

**Angeles National
Forest**

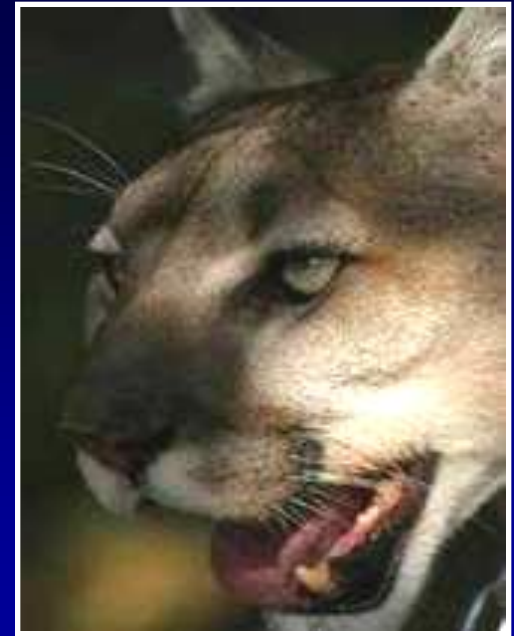
Santa Monica Mountains





Increased social interactions,
aggression and reproduction:

- 8 lions have been killed by other mountain lions, most common mortality source in our population
- Especially young males trying to disperse (also killed on roads, by police).



Close inbreeding – have documented at least four cases of father-daughter matings



P5,6,7,8 – August 2004, parents P1 (male) and P2



P1 and P6 then mated, resulted in P13

P17,18,19 – April 2010, parents P12 (male) and P13



P12 and P19 mated, resulted in P23 and P24

P12 and P19 mated, resulted in P32, P33, P34

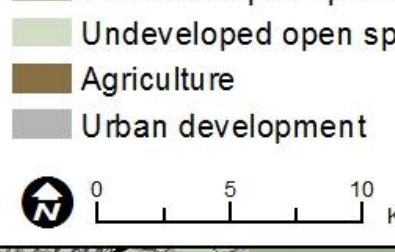
P12 and P23 mated, resulted in P36, P37



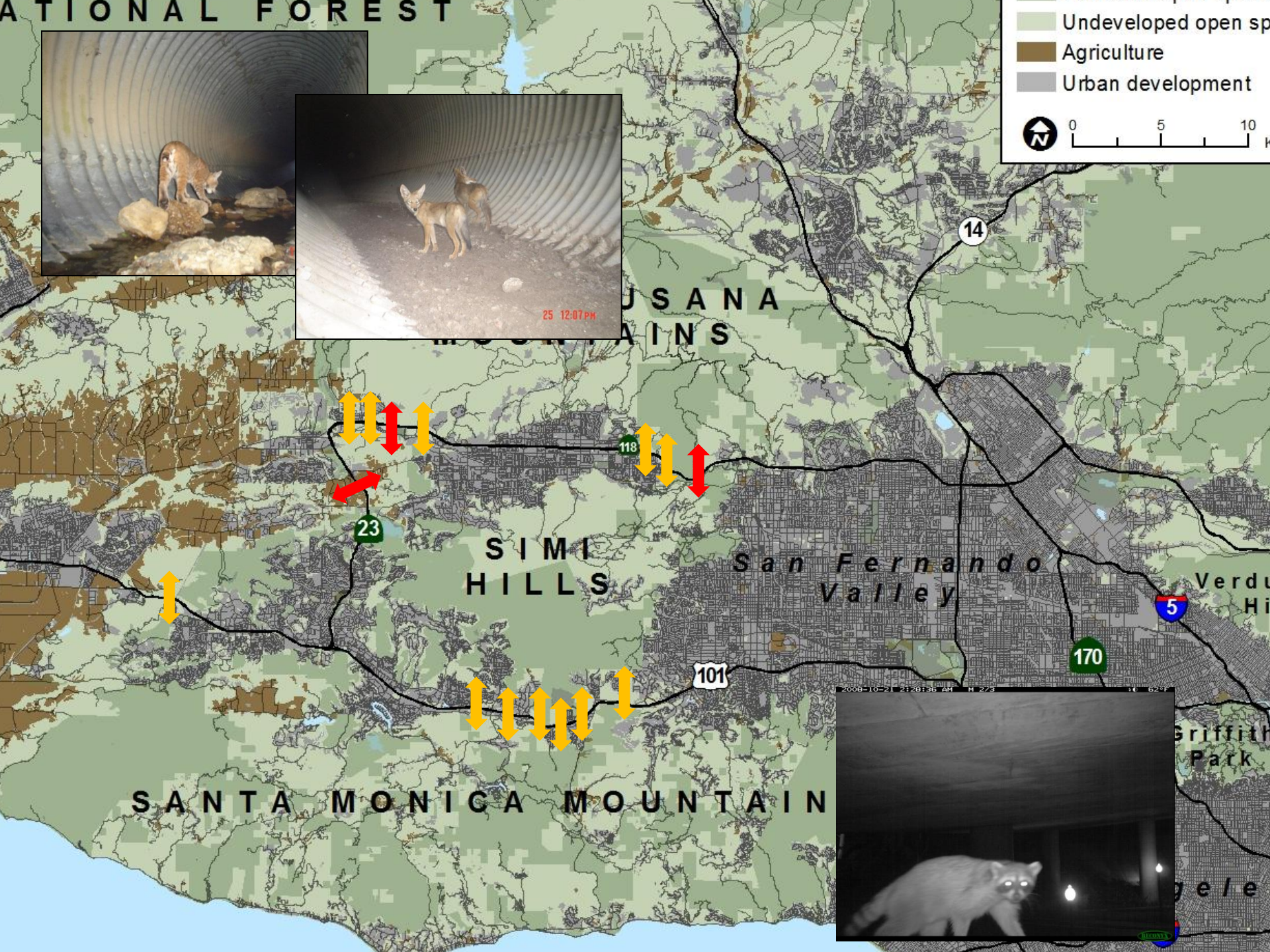
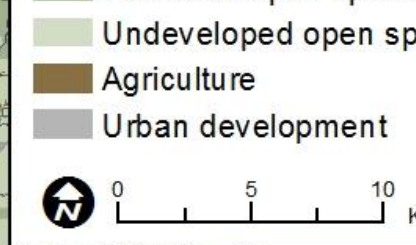
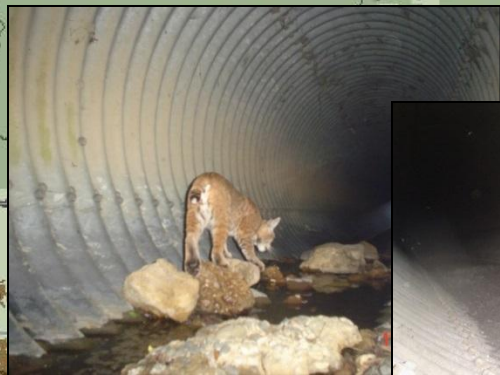
- Use of freeway culverts and underpasses



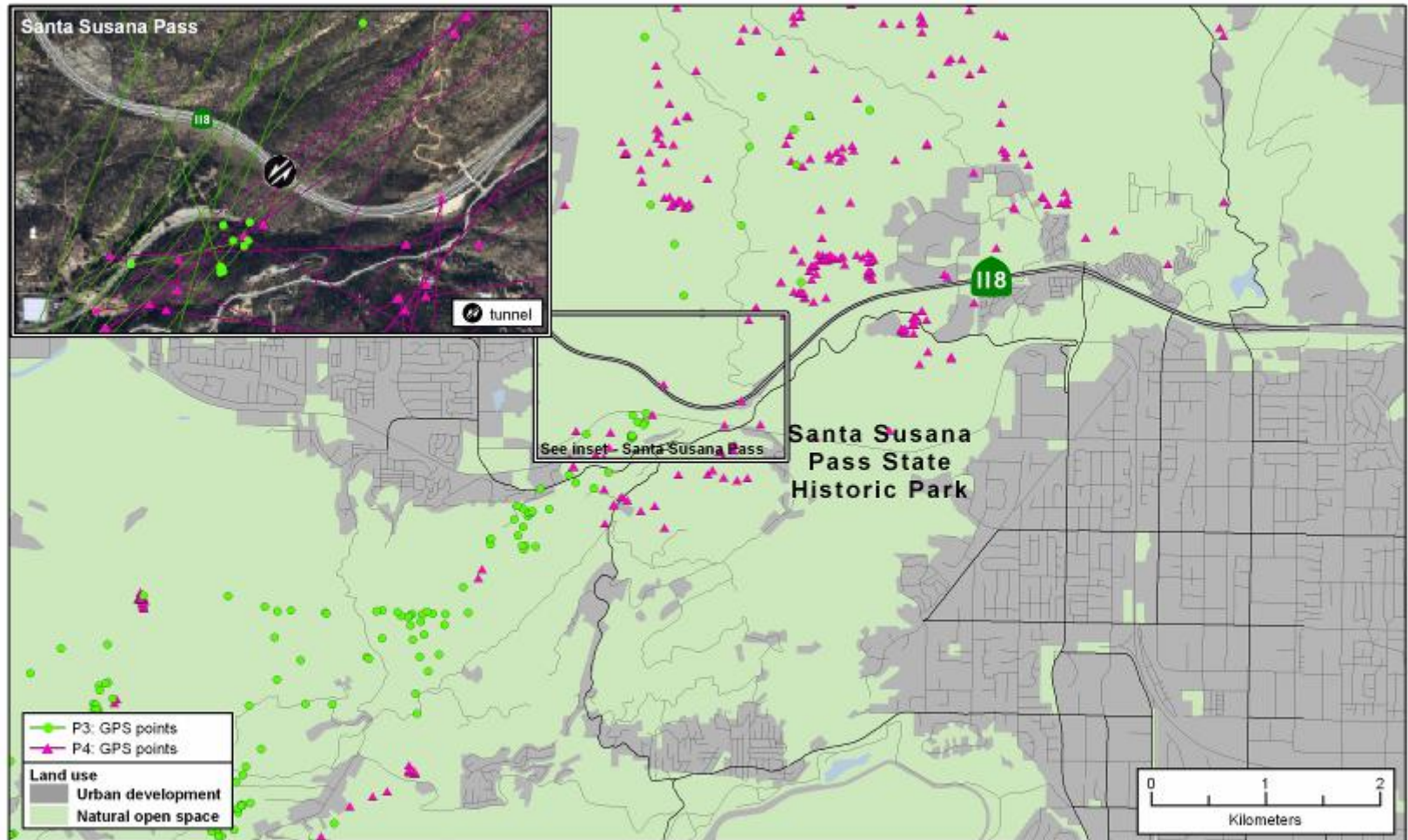
NATIONAL FOREST



NATIONAL FOREST

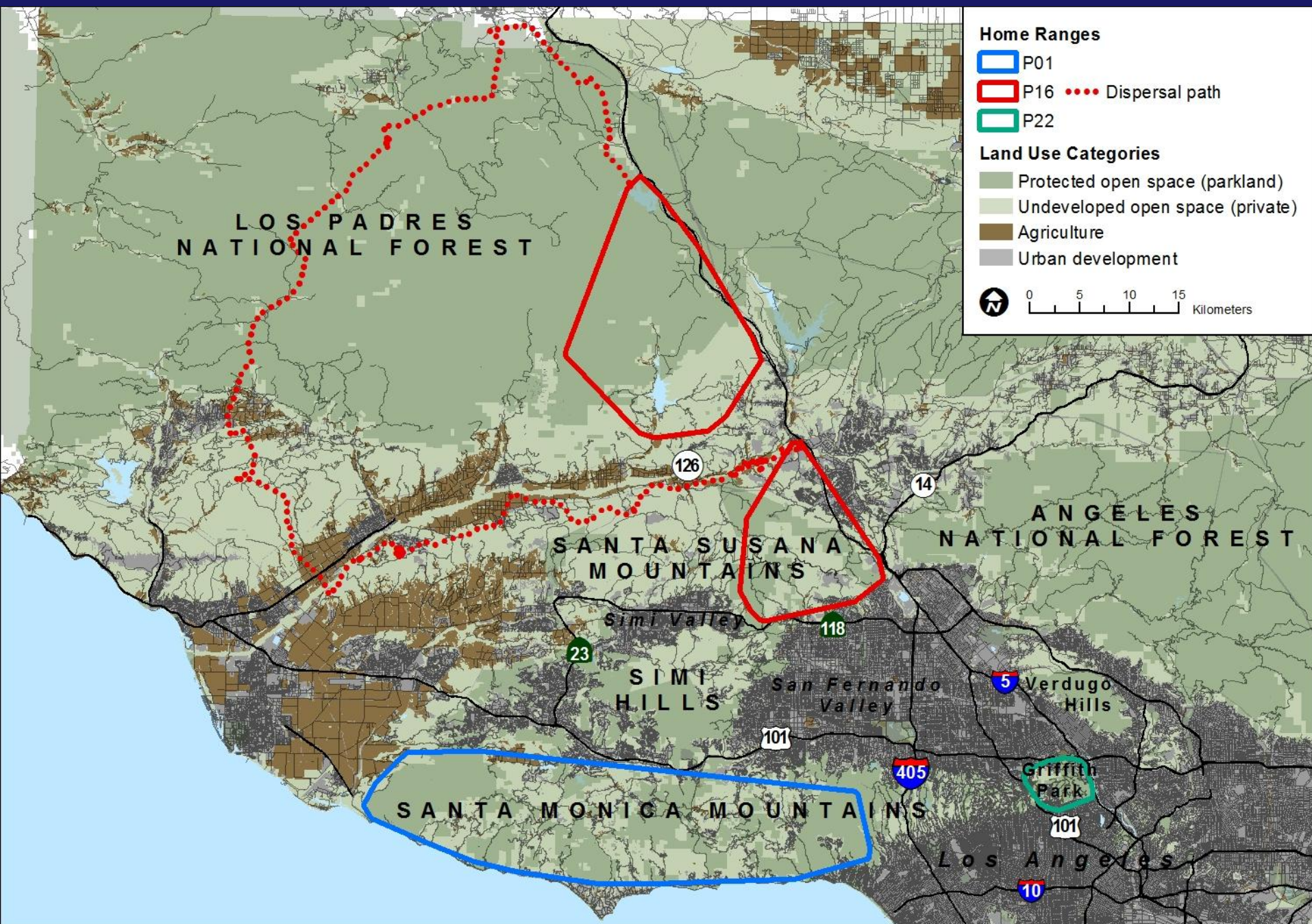


P3+P4 crossing 118 at Santa Susana Pass

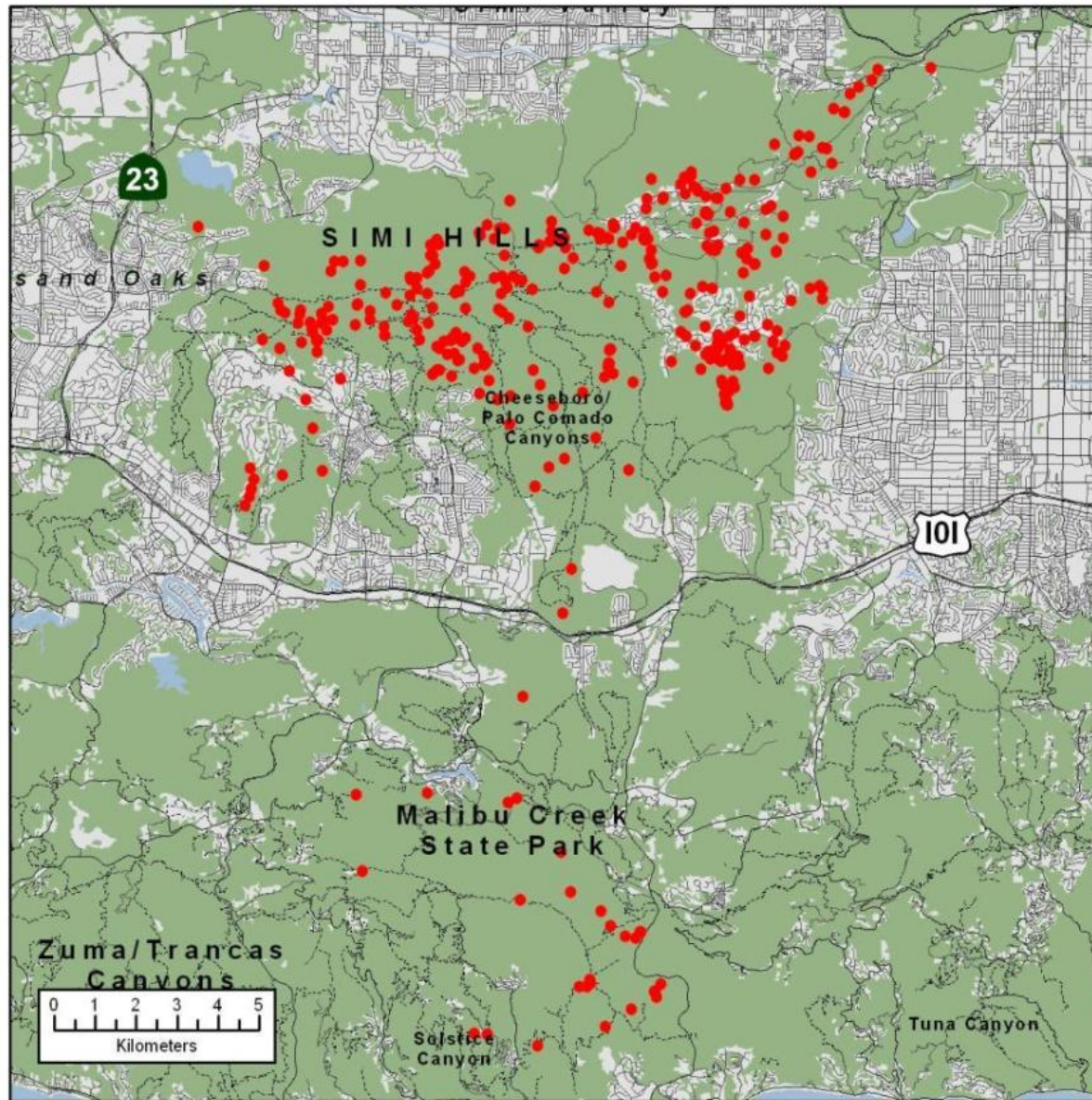


P3 crossing Highway 118 – 14 crossings (7 roundtrips)



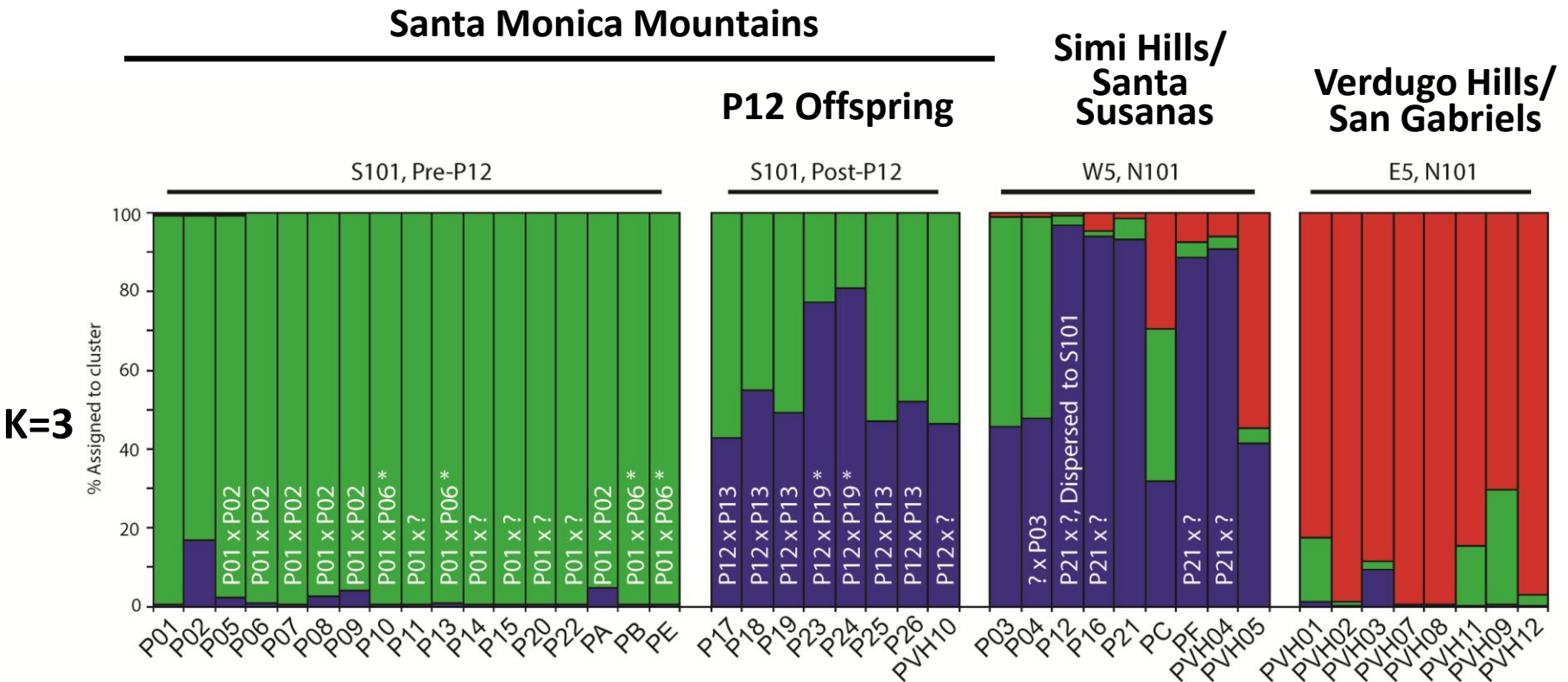


P12 crossed the 101 Freeway – Feb. 2009



STRUCTURE Genetic Cluster Analysis Results

(54 microsatellite markers)



- Three genetic clusters are resolved – Santa Monica Mountains, Simi Hills/Santa Susana Mountains, and Verdugo Hills/San Gabriel Mountains
- P12 has significantly impacted the genetic composition of the SAMO lion population

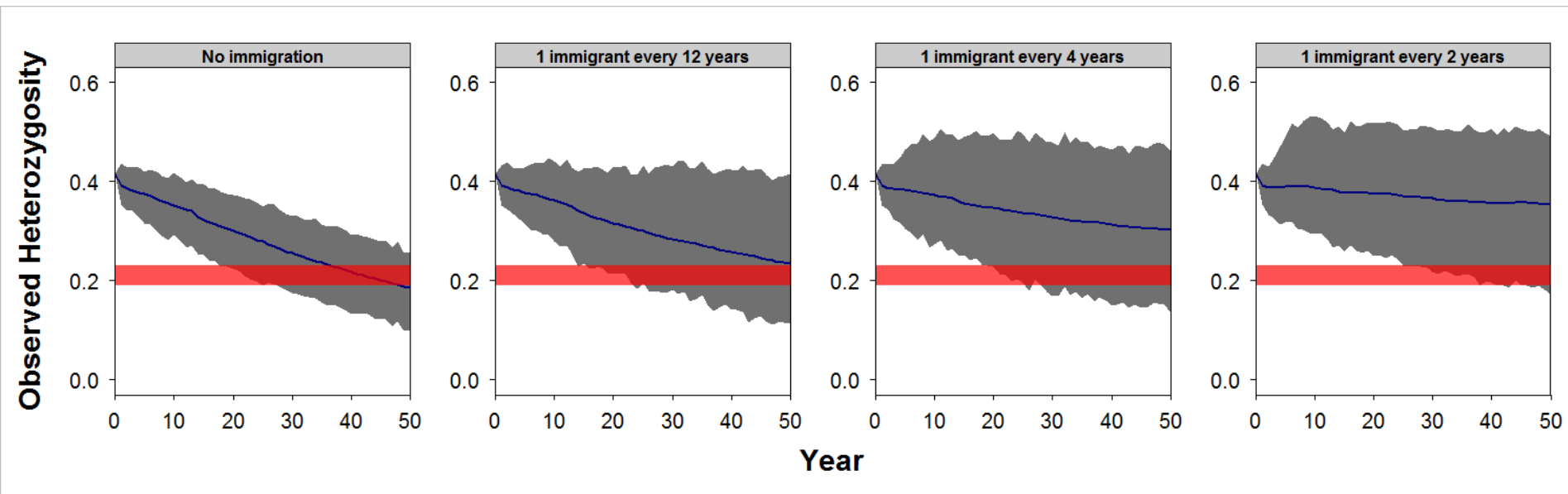
Simulation modeling results for genetic diversity of Santa Monica Mountains mountain lions under 4 scenarios:

No Immigration

Current levels
(1 per 12 years)

1 per 4 years

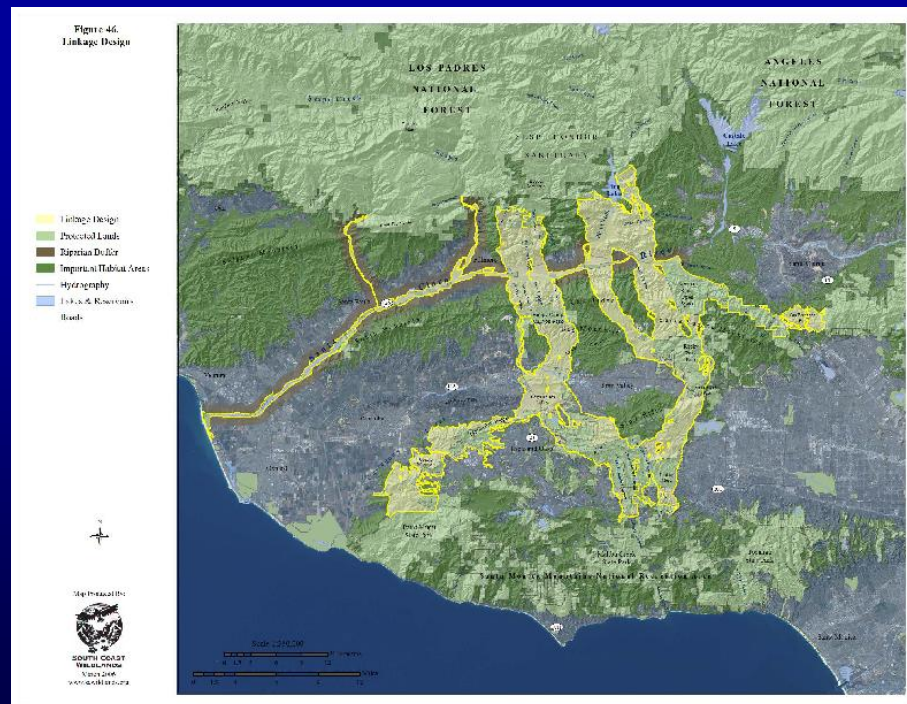
1 per 2 years



Red line: approximate levels of genetic diversity in Florida panthers before 1995, with severe genetic defects

Landscape level connectivity efforts

1. Focus on connectivity in **park's** land protection plan (**1998**)
2. Missing Linkages workshop for whole **state of CA** (**2000**)
3. More focused look at the **South Coast Ecoregion** – 55 linkages, with 15 selected as most critical (**early 2000s**)
4. Specific plan, or **Linkage Design** for one of the 15, the Santa Monica Mountains to Sierra Madre Linkage (**2006**)



South Coast
Wildlands

Use of natural, altered, and urban areas of radio-collared carnivores in the Santa Monica Mountains National Recreation Area study area.

Land Use Category	Mountain lions	Bobcats (female)	Coyotes
Natural	96.5	94.6	79.5
Altered	2.6	4.5	9.5
Urban	0.9	0.9	10.9

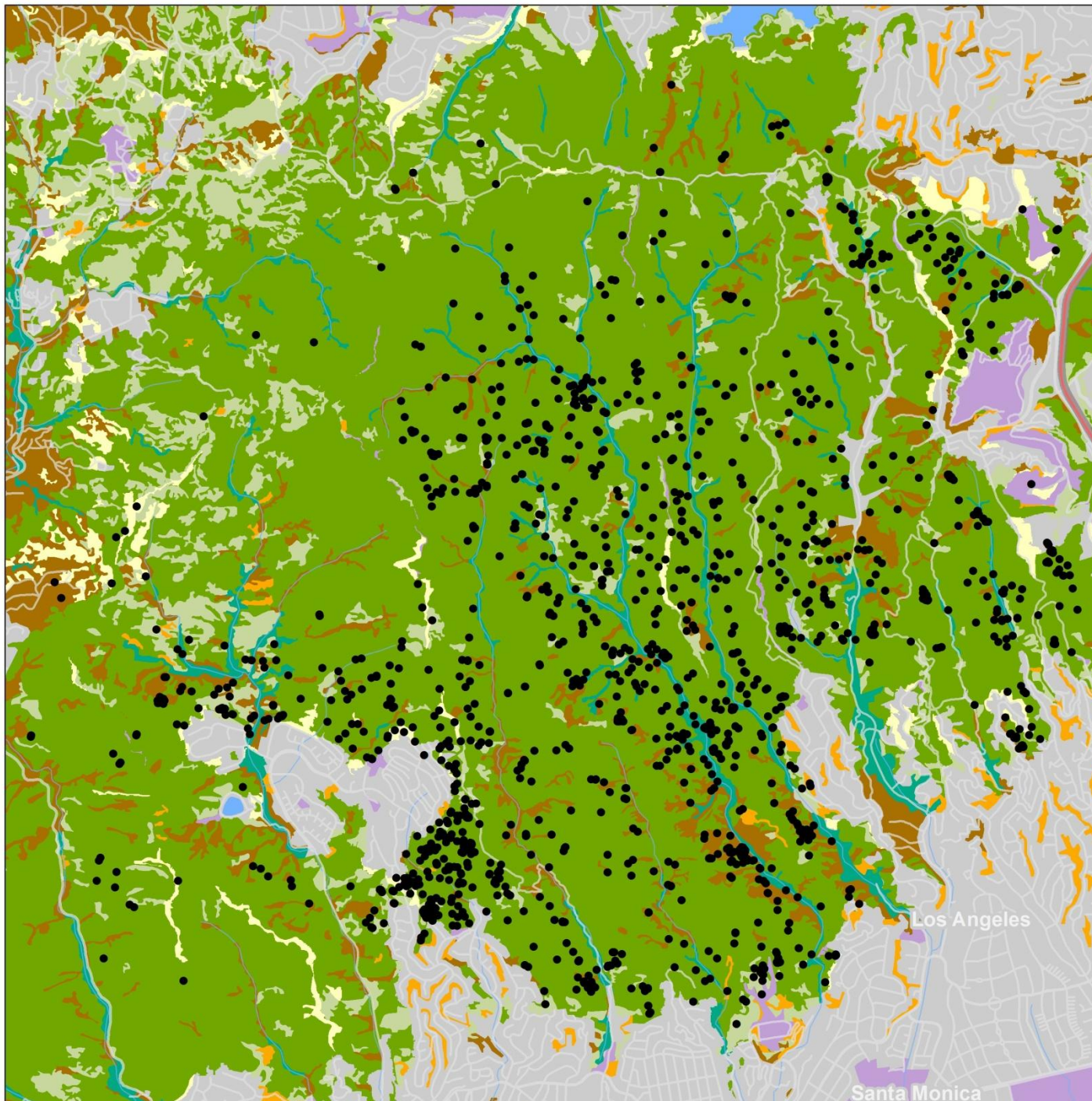
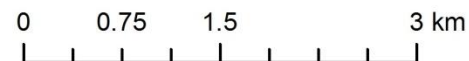
P42 Locations

4/8/2016 - 2/28/2017

- GPS Locations

Habitat Classes

- Prairie Meadow
- Coastal Sage Scrub
- Chaparral
- Upland Woodland
- Riparian Woodland
- Altered Open
- Other
- Water
- Urban

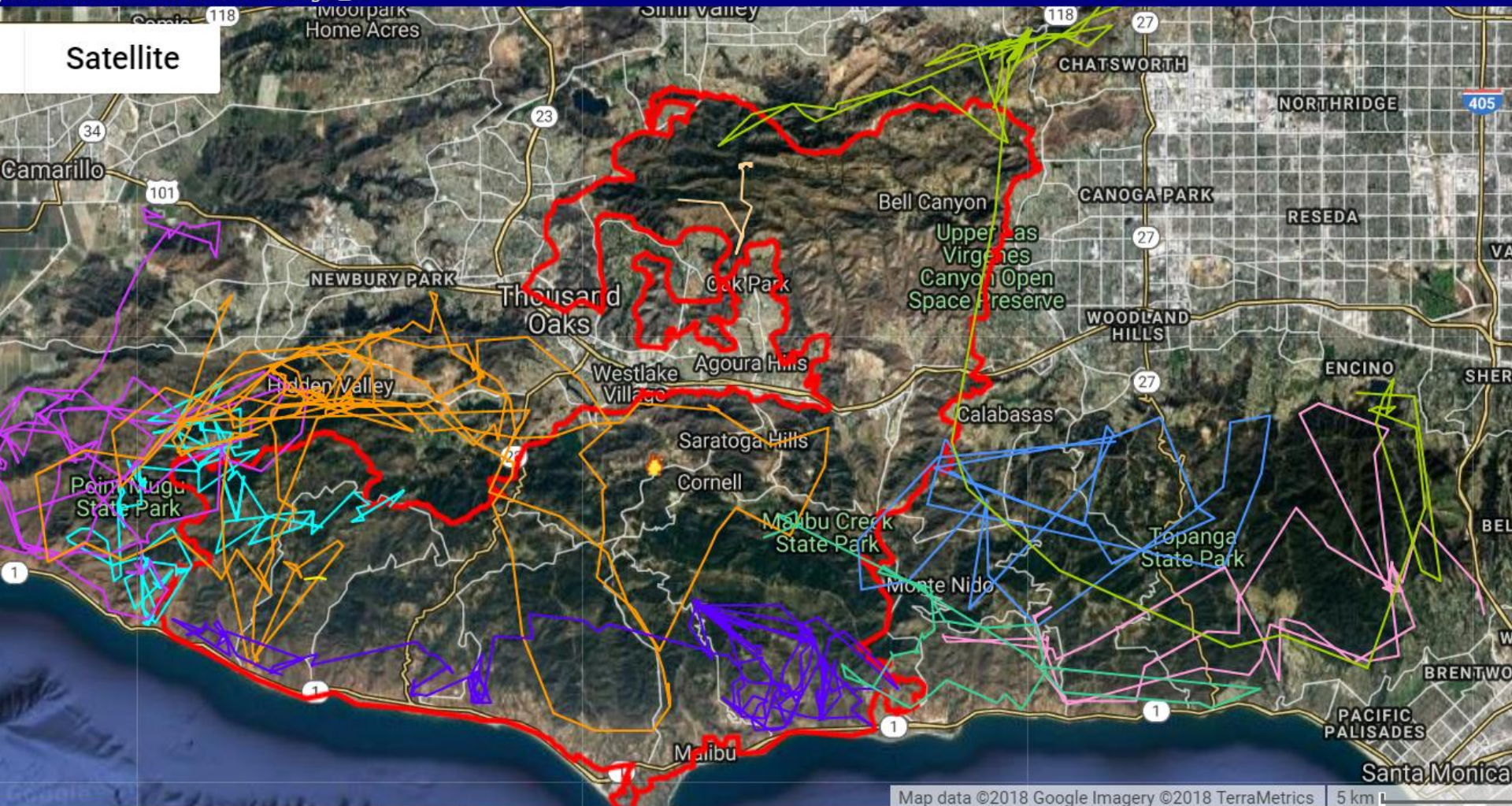


CTRONIC Aerospace

ative technology for science and research

you are connected to database "cougar_ca".

Satellite



Map data ©2018 Google Imagery ©2018 TerraMetrics 5 km



The effects of roads, lack of connectivity on wildlife populations



- Important **source of mortality**, especially in urban landscapes where roads are common.
- **Barrier to movement**, especially large freeways with high traffic volumes, but even smaller roads as well.
- If movement, including dispersal, is reduced enough, can cause **genetic differentiation** across roads.
- roads and development can cause **habitat fragmentation**, resulting in small, isolated populations.
- with both genetic differences and fragmentation, can get **low genetic diversity**, genetic defects.

Mountain Lion Freeway Crossings (# of crossings)

- P03 (14)
- P04 (8)
- P12 (1)
- P16 (3)
- P21 (15)
- P32 (10)
- P33 (20)
- P38 (74)
- P55 (4)
- P63 (6)
- P64 (42)

- Santa Monica Mountains to Sierra Madre Linkage
- Parkland
- Land Use
- Natural Habitat
- Agriculture
- Developed

