

Identification of Potential Wildlife Corridors
Utilized by the North American Badger
(*Taxidea taxus*) in the
San Francisco Bay Area & Monterey County



**By Tanya Diamond
San Jose State University**

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Wildlife Connectivity Workshop
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Carnivores and Habitat Fragmentation

Carnivores are sensitive to the effects of
fragmentation because of their:

- Large home ranges (Beier 1995)
- Small population sizes (Hilty et al 2006)
- Juveniles typically disperse out of their parental home ranges (Woodroffe & Ginsberg 1998)



Corridors: a possible solution
to habitat fragmentation

To reduce the isolation of habitat fragments, many conservation biologists recommend maintaining landscape connectivity (Soule 1986; Walker and Craighead 1997; Penrod et al. 2005).



Photos: Critter Crossings (Dept. of Transportation)



Why are Corridors Important?

- provide a means for species to access necessary resources (Soule & Gilpin 1991)
- Provide access for juvenile dispersal (Beier 1995)
- Facilitate movement between habitat patches for wildlife to find viable mates (Hilty et al 2006)



Photos: Critter Crossings
(Dept. of Transportation)



Badgers and Corridor Success as a Conservation Tool

- Functioned in decreasing badger mortality from road kills (Federal Highway Administration 2000)
- Netherlands Badger Conservation: corridors has resulted in nearly doubling the badger populations (Hans and Canters 1995)



Photos: Critter Crossing, Department of Transportation

North American Badgers (*Taxidea taxus*) and Effects of Fragmentation

- Highly sensitive to fragmentation
 - with a lower probability of occurrence in small, isolated habitat patches (Crooks 2002)
- Badger populations in California have drastically declined primarily due to loss of habitat:
 - urban development
 - cultivation (Williams 1986)
- The badger's state status is a Species of Special Concern (Department of Fish & Game 1986)



Badger Ecology



- Large Home Ranges : - females: 1.6 km² to 2.4 km²
- males: up to 5.8 km² (Messick & Hornocker 1981)
- Dispersal: up to 110 km (Messick & Hornocker 1981)
- Carnivores: their prey consists of mainly ground squirrels (Goodrich and Buskirk 1998)
- Summer Months: may dig new burrows on a nightly basis (Sargeant & Warner 1972)

Badger Distribution in the San Francisco Bay Area and Monterey County

- Many of the populations are in State Parks, County Parks, and Preserves.
- The majority of the badgers exist in highly fragmented landscapes.
- Badgers locations:
 - grassland or oak woodland habitats
- Preferred soil types range from:
 - fine, sandy loam
 - coarse loam



Methods: Terminology for Badger Habitat Suitability Model with Least-Cost Paths

Badger Habitat Suitability Model: identifies highly suitable badger habitat to poor habitat using GIS

Least-Cost Path Analysis: indicates the optimum travel route based on badger habitat preferences

GIS database of habitat layers: allows the user to rapidly access data layers

Model Use: identify priority areas for wildlife management to preserve and to provide connectivity between core badger habitats

Badger Ecology in Relation to the Data Layers included in the Model



Layer	Source	Data type	Resolution/Cell Size
Soil types	NRCS ¹	Polygon	1.65 meters
Vegetation	USF FRAAP	Raster	100 meters
Elevation (slope)	USGS DEM	Raster	10 meters
Roads	Corvus TIGER Line Files ² 2000	Line	10 meters
Urban	Corvus TIGER Line Files ² 2000	Polygon	10 meters

¹ United States Department of Agriculture
² Corvus Inc. Department of Geography Data Management Program

Soils: badgers are fossorial creatures (Long, 1983)

Vegetation: grassland specialists (Lindzey 1982)

Slope: influences burrowing location (Apps et al. 2002)

Roads: - can act as barriers, such as highways
- one of the leading causes of badger mortality (Messick & Hornocker 1981; Dept. of Fish & Game 1986)

Urban Areas: - highly sensitive to human development
- tend to avoid densely populated areas (Crooks 2002; Lay thesis work in progress)

Reclassification of Habitat Layers

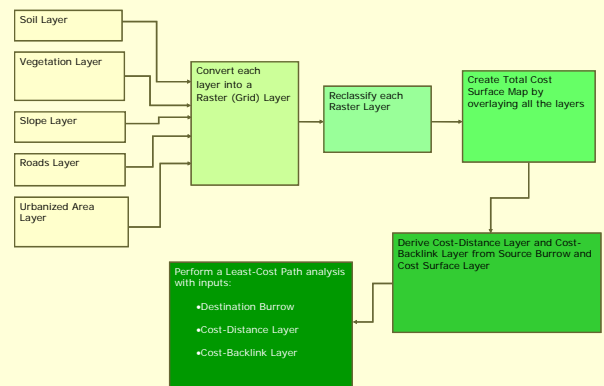
• Ranks were assigned to each data type that reflects the suitability of a habitat feature for the presence of badgers.

• A ranking scale from 1-4 was assigned:
1 = most suitable
4 = unsuitable

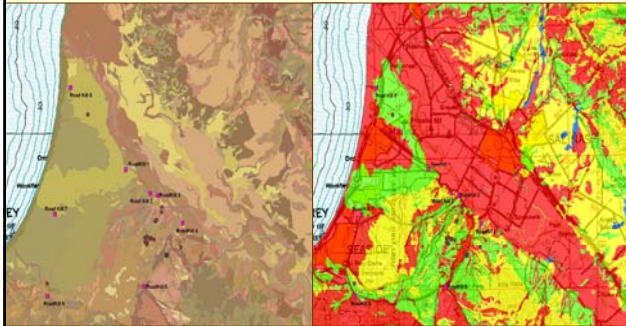
• Published findings, expert opinions, and ground truthing methods were used to reclassify the data.

Soils		Roads	
Soil type	Rank	Road class	Rank
Fine Sandy Loam	1	Trails	1
Gravelly Loam	2	Paths	1
Shaly Loam	2	Lanes	1
Coarse Loam	2	Terraces	1
Stony Loam	3	Bridges	1
Clay and clay composites	4	Walkways	1
Hydric soils (all types)	4	Ways	2
		Circles	2
		Highways	2
		Kings	2
		Passes	2
		Boulevards	2
		Places	2
		Courts	2
		Avenues	2
		Drives	2
		Canals	2
		Squares	2
		Loops	2
		Roads	3
		Streets	3
		Boys	3
		Malls	3
		Highways	3
		Stamps	4
		Expressways	4
		Freeways	4
			4

Least-Cost Path Model Development



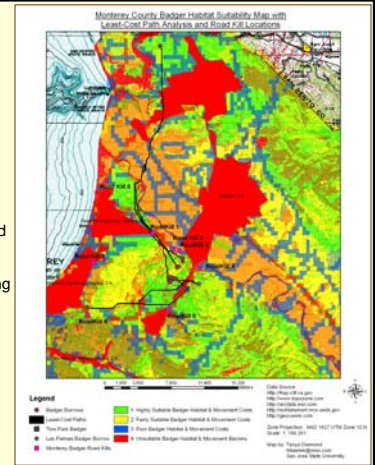
Results: Example of Monterey Soil Reclassification Map



Green (rank of 1) = highly suitable badger habitat and low movement costs, ex. fine sandy loam
 Yellow (rank of 2) = indicates fair badger habitat and movement costs, ex. shaly loam
 Blue (rank of 3) = poor badger habitat and movement costs, ex. stony loam
 Red (rank of 4) = unsuitable badger habitat and high movement costs ex. hard clay

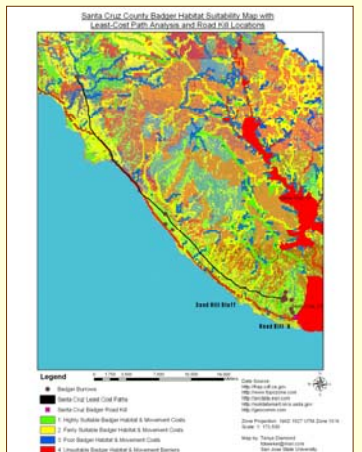
Monterey County Badger Habitat Suitability Map with Least-Cost paths

- Least-Cost path convergence indicates badger movement is being restricted.
- 3 road killed badgers were found along Highway 68
- 3 road killed badgers found along Reservation road. (Quinn unpublished data)
- Critical areas to implement corridors to facilitate badger movement across them



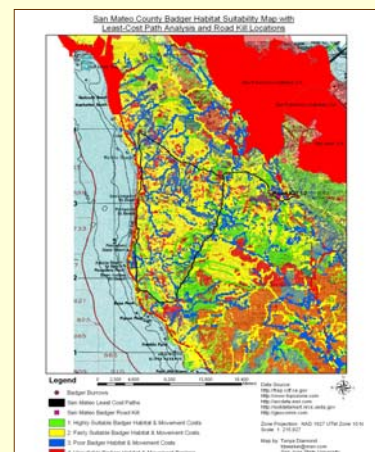
Santa Cruz County Badger Habitat Suitability Map with Least-Cost paths

- Badger are found along the Santa Cruz coast line in fragmented grassland habitats.
- Badger road kill located at Wilder Ranch Park



San Mateo County Badger Habitat Suitability Map with Least-Cost paths

- Most highly fragmented system
- Badgers exist in small, isolated habitat patches
- At Russian Ridge Open Space Preserve there was a badger road kill at Skyline blvd, located by a Least-Cost path



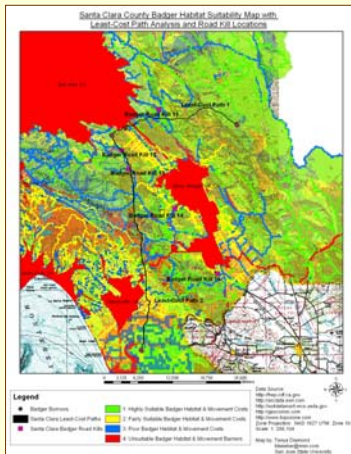
Santa Clara County Badger Habitat Suitability Map with Least-Cost paths

• Each badger location consists of highly suitable badger habitat

• Maintaining Viable Badger Populations: connectivity between

- Henry Coe park, Metcalf Canyon to Tulare Hill, Santa Teresa and Colaroe park must be implemented

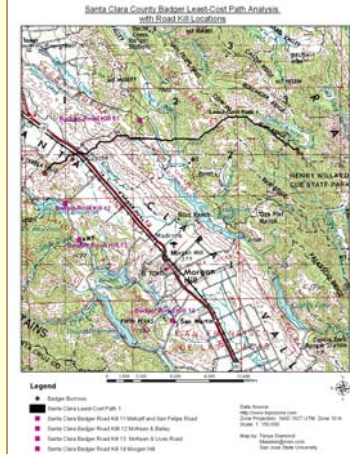
- grassland habitats ranging from Gilroy to Santa Clara must be preserved



Santa Clara County Badger Least-Cost Path 1 Analysis & Road Kill Locations

• Badger road kills were found at Metcalf and San Felipe road, close to the Least-Cost path.

• Several badger road kills have been located by Calero park, Santa Teresa Hills, and Morgan Hill

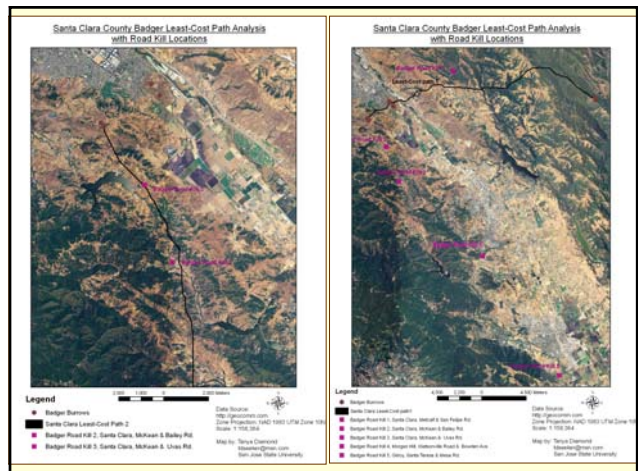


Santa Clara County Badger Least-Cost Path 2 Analysis & Road Kill Locations

• Least-Cost Path 2 analysis:
- runs from below Watsonville north to Santa Teresa Hills

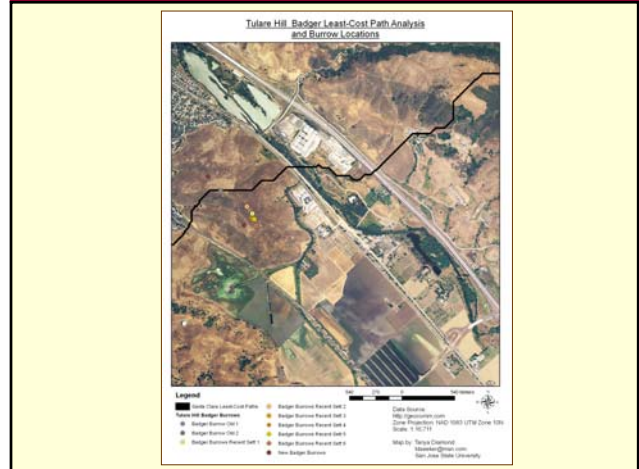
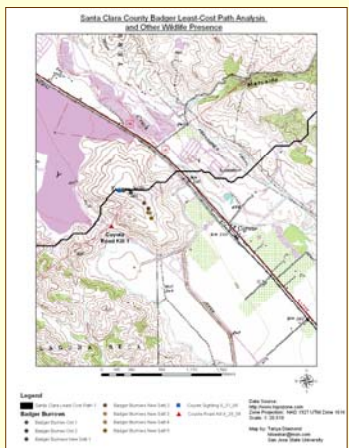
• runs through 2 Road Kill Badger Locations:
- both at McKean road
- which runs parallel to Coyote Valley

• These road kill sites are critical areas to implement corridors to facilitate badger movement across them



Coyote Valley Badger Least-Cost Path Analysis

- Tulare Hill is located next to Coyote Valley
- Tulare Hill is being recommended as important habitat for providing connectivity (Santa Clara HCP/NCCP scientific advisory board, Wayne Spencer)
- The Least-Cost path crosses over badger burrows locations
- Other wildlife presence has been recorded



Badger Burrow Locations and Sign at Tulare Hill 8/31/06

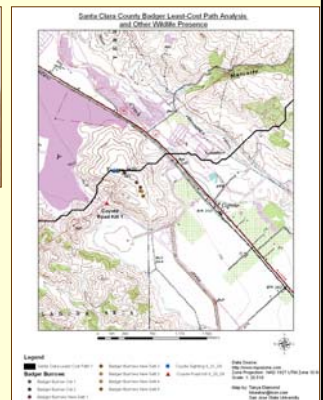


Badger Burrow Sett 3

Badger Burrow New Sett 8

- Burrows are often wider than tall with an oval shape 16-30 cm wide (Lindzey 1971).
- Often deep by more than 50 cm (Neal 1986).

Coyote Sightings at Tulare Hill and Santa Teresa Road



Ground Squirrels, badger prey



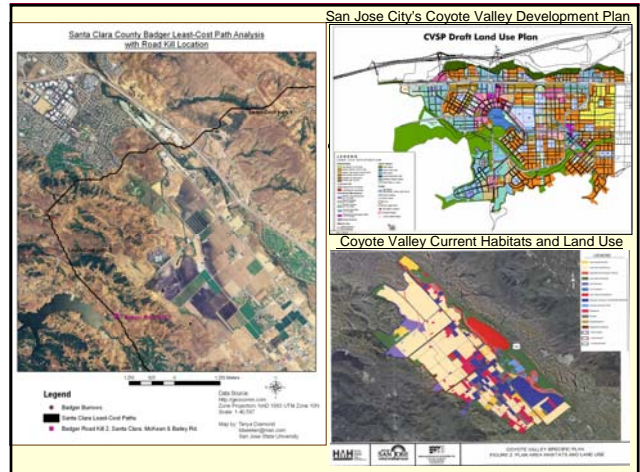
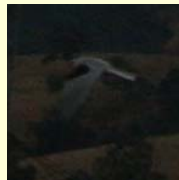
Jack Rabbit Skull 8/29/06



Burrowing Owl Sighting 9/08/06



Kite Flying 10/1/06 at Tulare Hill



Badger Least-Cost Path at Tulare Hill facing Santa Teresa Road and Sierra Azul



Badger Least-Cost Path at Tulare Hill facing Monterey road and Highway 101



Continuing Urban Development towards Highway 101 Overpass and Metcalf Road



Recommendations for Badger Corridors for Coyote Valley

Preserving Tulare Hill as critical habitat for providing connectivity between Henry Coe park, Metcalf Canyon, Santa Teresa Park, and Calero park.



Provide connectivity for badgers between Metcalf Canyon and Tulare Hill by:

- identifying culverts under Highway 101 for badgers
- using fencing to guide badgers to culverts



Recommendations for Badger Corridors

Provide culverts at roads impeding badger movement:
-Santa Teresa Blvd, Monterey road, and McKean road



Monterey road where Least-Cost path crosses



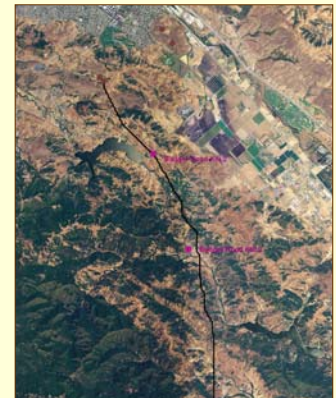
Santa Teresa road where Least-Cost path crosses



Recommendations for Badger Corridors from Watsonville to Santa Teresa Hills

- Preserving grassland habitats from Watsonville, up through Gilroy, to Santa Teresa Hills

- Provide connectivity for badgers across roads where the Least-Cost path traverses & road killed badgers have been found:
 - McKean road
 - Watsonville road

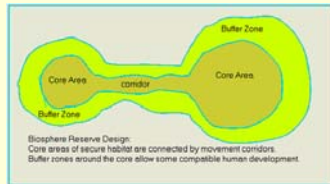


Recommendations for Badger Corridor Design

Badger corridors should include not only habitat preferences but the dimensions need to be able to support and allow for badgers to utilize and reside within the corridor (Hilty et al 2006; Noss 1986).

Corridor design must take into consideration that badgers have relatively large home ranges (Messick & Hornocker 1981; Lindzey 1978).

Since badgers are fossorial creatures, culverts would be the optimum crossing structure for roads. (Messick & Hornocker 1981).



Culvert Design



Highway 101 Access for Wildlife Crossing

Data and Pictures by Dave Johnston, Department of Fish and Game

Station 2

Coyote Creek overpass

101 bridge of Coyote Creek

CalTrans bridge # 37349R, MP 19.21.

Width of span: 125' Height of span: At least 20'



Upstream (eastern) side of bridge, looking NE



View looking NW

Station 2: Coyote Creek overpass

101 bridge of Coyote Creek

CalTrans bridge # 37349R, MP 19.21.

Width of span: 125' Height of span: At least 20'



Upstream view, showing parallel ditch and fencing, looking NE



Upstream view, looking SE from north bank

Station 14

Station 14 consists of two elements, a golf cart underpass beneath Highway 101 and a culvert to the north.

The culvert is a 54" RCP. This is a probable passage point for wild pigs.



View from highway shoulder, looking SE



Underpass

Station 16

72" RCP, wet at time of site visit.



Crossing 12



60" RCP?

View to east



Station 13 (Scheller Avenue)

- Station 13 consists of two elements, the Highway 101 crossing over Scheller Avenue and a minor culvert to the south that crosses under the off ramp and freeway, daylighting on the far side. The culvert is a 30" RCP. The overpass is approximately 180' wide.

- Scheller Avenue is the location of one confirmed crossing attempt by a young mountain lion in 2005. Another mountain lion was taken with a depredation permit just south of this location in August 2006.

- This location is also thought to be the probable crossing of at least 6 tule elk sighted on the west side of the valley in 2004.



View of Overpass, looking west



View from eastern side of 101 to NE

Station 18

36" RCP, dry at time of site visit



Station 19

36 RCP, damp at time of site visit



Station 22

- 36" RCP, wet at time of site visit. Station 22 is a recent construct and is part of the drainage system for the just completed Bailey Avenue interchange.
- This project constructed an entirely new crossing over Highway 101.
- This culvert is located at the SE corner of the project area.
- Two medium sized frogs were heard to jump into the water on approach.



View from highway shoulder to SE

Station 24

48" CMP, dry at time of site visit



View to east



Station 25 Metcalf Road

- Metcalf Road is probably the point furthest north from which a crossing can reasonably be attempted.
- Development to the north is fairly dense and fencing is more common. The tule elk herd has been noted in the vicinity.
- Metcalf Road crosses over Highway 101. This is a two lane road with no on-ramps or off-ramps.
- It terminates at Monterey Road, to the west, near the base of Tulare Hill, a potential passage area to the west.
- It is constrained by the settling basins to the north and a PG&E corp. yard to the south.



Station 3



RCP, dry at date of site visit. MP 19.2



View to east

Thank-you



Photos: Critter Crossing, Department of Transportation

