4.10.5
Pilot Study: Assessors Parcel Based Landuse Analysis vs. Landsat 7 -

The Santa Barbara County Assessors office maintains a database of landuse classifications for all registered land parcels within the county. The "Use Codes" from the Assessors database were reclassified by Santa Barbara County personnel from 93 land use classes to 20 generalized classes by relating the described Assessors land use attribute to its relative affect on water quality (see Appendix B for Parcel Modified Use Codes). These 20 generalized land use classes were then reclassified to correspond as closely as possible to the Landsat 7 - ETM Landuse Classification described in previous sections. We compared the two land use classification schemes (*i.e.,* Assessors parcel land use data vs. ETM Land use classification) for three HGM reference sites (#29, #32, and #47) to discern differences in the resulting classifications (see Appendix B - Subwatershed Parcel Data).

This analysis revealed one major limitation of the Assessor's land use classification scheme. Specifically, the spatial resolution of the Assessor's land use classification is the area of the individually mapped parcel. Importantly, area varies considerably from parcel to parcel. This internal variability of map unit size affects the Assessor's classification scheme by allowing no internal variation of land use within a parcel because only one land use class is assigned to each parcel. As a consequence, large areas of the reference domain are classified as a single Assessor's land use class when in fact, there is one or more land use within each classified unit. Ultimately, this internal inconsistency results in a very coarse representation of land use within the reference domain (see Figure 4.29, Santa Barbara County Assessor's Parcel Land use Classification vs. Landsat 7 - ETM Landuse Classification).

For example, in the HGM reference site #29 sub-watershed (Arroyo Burro), approximately 47% of the sub-watershed is classified as "estates" under the Assessor's land use classification. In reality, only a small percentage of this area actually is occupied by buildings and structures that are, in fact, residential estates. Because the resolution of the Assessor's classification scheme is the entire parcel in which the "estate" is located, the additional areas not occupied by the estate structures also become similarly classified as "estate." Examination of the ETM land use classification data and imagery with a uniform spatial resolution of 30 m^2 reveals that the remainder of this area is dominated by native chaparral, riparian forest, and woodlands. Thus, a more accurate reflection of the true land use within these areas of the sub-watershed is achieved using the ETM land use classification protocol.

A second example of this "resolution effect" in the Assessor's parcel classification scheme is revealed through the land use classes that contain an "urban" component. The Assessor's land use classes "automobile, business, commercial, horses, hotel/motel, industrial, residential, roads, school, utilities, and DIF (*i.e.*, additional roads)" are aggregated to the land use class "urban" in the generalized land use classification scheme (see Appendix D). This class represents approximately 29% of the Arroyo Burro sub-watershed area under the generalized land use classification scheme, whereas the ETM land use classification data indicate that only 13% of the sub-watershed area is classified as "urban." This discrepancy in percent urban area is again attributed to the coarse resolution of the Assessor's parcel classification schemes in which the parcel represents the minimum mapping unit. As a result of this resolution phenomenon, the potential exists for over-estimating land use classes within the Assessor's parcel classification scheme.

Despite the previously mentioned problems, the Assessor's parcel land use classification database does provide valuable information regarding certain types of land use within the reference domain. For example, it is much more specific with respect to various anthropogenic land use activities, as compared to the ETM land use classification scheme. Also, the Assessor's land use data may be more applicable when trying to analyze specific water quality problems (*i.e.,* point and non-point sources) in urban areas of the reference domain due to this higher level of specificity. However, caution should be exercised in applying the Assessor's land use data in rainfall/runoff or pollutant/contaminant modeling, given the propensity to overestimate areas based upon the parcel as the minimum mapping unit

4.10.6 *Digital Elevation Model (DEM) Based Hydrologic/Genomorphic Analysis*

Stream gradients, drainage densities, and bifurication ratios were calculated based upon the USGS digital elevation model (hereafter "DEM") constructed for the reference domain. A stream network was derived from the DEM for each watershed and individual streams were attributed with Strahler based stream orders (Strahler 1957). Stream gradients were calculated from the DEM-derived drainage network and expressed in percent slope for all stream orders in the watershed in which each reference site was located (see Appendix B). The results of this analysis were then stratified by HGM subclass and mapped within the reference domain (Figure 1.2). Internal comparison of the individual slope values for the High, Medium and Low gradient subclasses and 6 stream orders is not particularly meaningful given the relative error (up to +/- 18 ft between pixels) and the resolution of the DEM (30 m^2 pixels). Site-specific slope calculations collected in the field are far more accurate (see Appendix B:13-14).

Drainage densities (*i.e.*, miles of stream channel/miles^2 of sub- or watershed area) were calculated for both the reference site sub-watersheds and the entire watersheds from both the DEM-derived drainage network and the USGS 1:100,000 DLG stream cover data (see Appendix B). For all reference sites, the DEM-derived drainage density values are on average 48% higher than the DLG stream network-derived data due to the coarser resolution of the 1:100,00 scale DLG stream network. While neither the DEM- nor the DLG-derived drainage networks accurately reflect the true drainage network of any given watershed, it is likely that the DEM-derived network is more accurate because of the finer spatial resolution of the source data. Table 4.2 summarizes the results of the drainage density analysis.

Table 4.2
Average DEM and DLG Derived Drainage Densities for Reference Site Sub-Watershed and Watershed Scales (miles/miles^2)

HGM SUBCLASS	Sub-Watershed DEM Drainage Density	Sub-Watershed DLG Drainage Density	Watershed DEM Drainage Density	Watershed DLG Drainage Density
Low gradient	3.59	1.89	3.63	1.78
Med gradient	3.33	1.80	3.58	1.78
High gradient	3.4	1.64	3.63	1.55

An average bifurcation ratio was calculated for each entire watershed using the DEM-derived drainage network. The number of streams of each stream order was calculated for each watershed that contained an HGM reference site. Bifurcation ratios were calculated by dividing the number of streams of a given stream order by the number of streams of the next highest stream order. Thus, watersheds with only first order streams have no bifurcation ratio calculated for them. The complete results of these analyses are documented in Appendix B. The average bifurcation ratio of all 29 watersheds in the reference domain that contained an HGM reference site was 2.03. The range in bifurcation ratios for the 29 watersheds was 1.58 to 3.56, slightly below the range of 3-5 typically expected for this geomorphic statistic, but not unusual given the strong geologic controls (*i.e.*, tectonic uplift) within the reference domain (Knighton 1998).

4.10.7
Additional GIS Data Sources

A variety of additional publicly available GIS data were analyzed within the reference domain. These included both Santa Barbara County and federally available GIS data sources.

Santa Barbara County Data Sources

Santa Barbara County Water Agency Groundwater Basin Data
Based upon Santa Barbara County Water Agency data, the percent of each reference site sub-watershed and entire watershed occurring within a mapped ground water basin was calculated. The complete results of these analyses are documented in Appendix B. For all reference sites at the watershed scale of analysis, an average of 24% of the watershed area was mapped within a groundwater basin. Analysis of the watershed data, stratified by subclass, indicates that the high and medium gradient reference sites averaged approximately 22% of the watershed mapped within a groundwater basin and the low gradient sites averaged slightly higher at 29% of the watershed area.

For all reference sites at the sub-watershed scale of analysis, an average of 15% of the sub-watershed area was mapped within a groundwater basin. Analysis of the reference site sub-watershed data, stratified by subclass, indicates that the High gradient subclass sites averaged less than 1%, the medium gradient sites averaged 7%, and the low gradient sites averaged 28% of the sub-watershed area mapped within a groundwater basin.

Santa Barbara County Environmental Health Services Septic Tank Data
Based upon Santa Barbara County Environmental Health Services septic tank data, the number of Assessors parcels using septic tanks within each 1000 ft assessment area ring, reference site sub-watershed, and entire watershed were calculated. The complete results of these analyses are documented in Appendix B: 84-85.

For all reference sites, the number of parcels using septic systems averaged 18, 14, and 31 parcels/miles^2 for the watershed, sub-watershed, and 1000 ft AA ring scales of analysis respectively. When the reference sites are stratified by subclass at the watershed scale, the averages for High, Medium and Low gradient subclasses were 23, 17, and 13 parcels/mile^2 respectively. At the sub-watershed scale, these averages were 22, 9, and 7 parcels/mile^2 for the High, Medium and Low gradient subclasses respectively. Lastly, at the 1000' AA ring scale, the averages were 29, 31, and 59 parcels/mile^2 for the High, Medium and Low gradient subclasses. It is important to remember that these data are based upon Assessors data with parcels that vary considerably in size and area and thus the parcels/mile^2 values do not represent true and comparable septic tank densities.

National Data Sources

US Fish & Wildlife Service National Wetlands Inventory (NWI) Data

The U.S. Fish and Wildlife Service National Wetlands Inventory (hereafter "NWI") is charged with creating and updating maps of the wetlands of the entire United States. Due to the continental scale of the mapping effort, the data set is insufficient for projects requiring detailed wetland and riparian maps at a local scale. Although NWI maps are distributed at the 1:24,000 mapping scale, they are generally drafted from aerial photos at a scale of 1:58,000 or coarser. Riverine wetlands often are completely absent in the NWI, which is especially true in the case of the NWI data in the SCSBC region. In some instances, Santa Barbara County has augmented the data set with additional site-specific wetland data from other projects and/or sources. As a result, the data set now represents a combination of wetland data generated from a variety of sources using multiple methodologies. Any utilization of this data must acknowledge this fact.

NWI data were assessed for the 1000 ft assessment area rings, the reference site sub-watersheds, and the entire watersheds in the reference domain. The number, total area, and density of wetlands for each wetland system (estuarine, lacustrine, marine, palustrine and riverine) were calculated for each assessment scale. The complete results of this analysis are included in Appendix B:86-88.

California Gap Analysis Program (GAP) Data

In 1993, the California Gap Analysis Program (hereafter "GAP") mapped vegetation and land use at a statewide scale. The extensive spatial scale of the effort required a coarse resolution of 100 hectares (25 acres) as the minimum mapping unit, a resolution unsuitable for detailed analysis of landuse with the reference domain. Nevertheless, the complete results of sub-watershed and watershed scale analyses for each reference site are included in Appendix B: 89-91.

Federal Emergency Management Agency (FEMA) Flood Zone Data

Federal Emergency Management Agency (hereafter "FEMA") data are based upon a large number of engineering assumptions and calculations regarding the potential for flooding during storm events of a certain magnitude and duration. The manner in which the magnitude and duration of the storm events used in these calculations are derived is subject to various interpretation. Furthermore, these data often are used to calculate flood insurance rates for particular regions. This represents an economic, rather than a hydrologic, application of the data.

As a result, FEMA data must be used conservatively in any analysis with these issues kept in mind. Within the reference domain, less than 7% of any given watershed is mapped as a State Flood Hazard Area (hereafter “SFHA”) and the data are of limited utility for accurate flood potential analyses.

Based upon the FEMA flood data, the percent of each reference site sub-watershed and entire watershed occurring within a mapped SFHA was calculated. The results of this analysis are documented in Appendix B:92.

National Resource and Conservation Service Soil Survey Geographic Data
The National Resource and Conservation Service (hereafter “NRCS”) mapped the soils of the SCSBC region at the 1:24,000 mapping scale. Hundreds of attributes are attributed to the soil map units; however, the map units and associated soil attributes often are incomplete for large portions of the reference domain. The Soil Survey Geographic (hereafter “SSURGO”) data set was examined to identify its utility as the best available digital soils map for the reference domain. This data set was used to identify and summarize hydric soils, soil drainage characteristic, soil hydrologic groups and suborder names for the reference site sub-watersheds and the entire watersheds. The complete results of this analysis are documented in Appendix B:93-96.

USGS 1:100,000 Scale Digital Line Graph (DLG) Roads Data
The presence of roads within the reference domain was assessed by measuring road density based upon the USGS 1:100,000 DLG roads theme. Hiking trails were queried out of the data set so that only roads were evaluated. Road density was calculated for 1000 AA rings, reference site sub-watersheds and entire watersheds, by measuring the total length of existing roads and dividing by the assessment scale area (*i.e.*, 1000 ft AA rings, sub-watershed, watershed). Road density was measured as miles of road/mile^2 and the complete results of this analysis are documented in Appendix B:98-100.

4.11 Faunal Support/ Habitat

In the SCSBC region, we have identified important components of faunal habitat that facilitate movement of animals into, through and out of riverine ecosystems, and provide forms of food and cover resources for several types of activities (*e.g.,* resting, feeding, thermal, hiding, escape, *etc.*). Habitat components include those attributes of riverine hydrologic conditions, site micro and macro topography, vegetation structural complexity and species composition that are suitable for supporting terrestrial and aquatic faunal communities. Although all ecosystem attributes are important for maintenance of faunal habitat integrity, the horizontal and vertical structural complexity of habitats has repeatedly been shown to significantly impact faunal populations and community assemblages (*Birds*: MacArthur and MacArthur 1961, Parrish 1995; *Fish*: Werner and Hall, 1976, Crowder and Cooper 1982; *Reptiles*, Losos et al. 1996; *Mammals*: Price 1978, Ziv et al. 1995; *Insects*: Anholt 1990).

The taxa richness of the SCSBC region riverine ecosystems is largely dependent on the relatively open tracts of National Forest Service (NFS) land in the high gradient, mountain fronts of the Santa Ynez mountain front. While much of the NFS land is outside the SCSBC reference domain, it constitutes home range to many populations of wide ranging carnivores (*e.g.,* black bears, mountain lions) or ungulates that utilize lower elevation or Low gradient landscape positions. Specifically, it is riparian ecosystems (corridors) that allow relatively safe movement of these wide ranging animals from the high gradient landscape positions by providing continuous cover for resting, hiding, feeding, escape, and thermal regulation. (Figure 4.30). However, as human activities continue to increase throughout the SCSBC reference domain, habitat components necessary to support faunal populations become increasingly

Figure 4.30
Corridor through a fragmented landscape

fragmented. Continual fragmentation of the landscape through human activities significantly reduces levels of faunal movement and utilization of lower gradient landscape positions (Harris 1984, 1992). For the purposes of this *Draft Guidebook*, we have identified habitat components (variables) such as vegetative structural complexity (V_{STRATA}), buffer condition ($V_{BUFFCOND}$), buffer continuity ($V_{BUFFCONt}$), patch size ($V_{PATCHSIZE}$), patch contiguity ($V_{PATCHCONTIG}$), and patch number ($V_{PATCHNUMBEr}$) as indicators of faunal support/habitat functions.

Certain species within the faunal communities of the reference domain have been segregated or grouped for purposes of scaling the variable V_{SIGN} based on their sensitivity to anthropogenic disturbances and their populations dependence on specific habitat structure; we have identified these species as 'indicator species'. While the majority of species found within the reference domain are sensitive to fragmentation of the landscape, the type of disturbance and surrounding land uses can also have significant impacts on population structure. Canstrell and Cosner (1991) demonstrated that "it is not only the amount of favorable habitat but also its arrangement that determines the overall suitability of the environment."

4.11.1 *Characterization of Terrestrial and Aquatic Fauna and their Habitats*

The SCSBC region has a rich fauna of amphibian, reptilian, avian, mammalian, and fish species. Table 4.3 has been included which lists all species identified throughout the sixty reference sites. Given the scope and time constraints of this project, we recognize the difficulty in efficiently and effectively documenting all species that utilize a particular habitat. To compensate for these shortcomings, the following characterizations of faunal groups and their suitable habitats have been grouped taxonomically by Order, Family, and/or Genus.

Mammalia

Mammalian species can be found throughout the reference domain of the SCSBC region. Many of the larger, oftentimes "indicator species" (*e.g.*, Black bears, and Mountain lions), live primarily in the high gradient mountain front habitats of the Santa Ynez. They move into and through lower gradient landscape positions when the vegetative structure is continuous and complex (*i.e.*, multiple stratum). Riparian corridors are the frequent paths from the Santa Ynez to the Pacific Ocean coastline. On the other hand, many smaller, generalist predators utilize edge communities that are a direct resultant of landscape fragmentation. Thus, these species can be found in the majority of habitats including riparian ecosystems from the low gradient coastal plains to the high gradient mountain fronts, independent of the vegetative complexity and continuity.

Briefly, all the mammalian species we identified in our field work along the SCSBC region will be approached in terms of habitat and feeding requirements, as well as significant behavioral characteristics.

Black Bear (*Ursus americanus*): Currently, black bears are the largest terrestrial mammals in California. They are opportunistic omnivores that will forage for human refuse, berries, roots, and succulent stems of many plant species, carrion, or actively hunt fish, or other small to medium-sized prey. Black bears require numerous natural cavities in trees, snags, rock formations, talus slopes, *etc.* for cover and/or denning components of their life cycle. The previously mentioned habitat components must be found in mature, dense and continuous vegetation or on relatively sheltered mountain slopes.

Females especially are known to be territorial in southern California. (Bray and Barnes 1967, Herrero 1972, CDFG 2000). Males, on the other hand, are wide-ranging and opportunistic with respect to their food, cover, and reproductive opportunities. In addition, only females have the requirement for large, seasonal inputs of high-sugar foods (*e.g.*, berries, avocados, citrus) in order to ensure reproduction (*i.e.,* implantation of blastocysts to the ovary wall). In this regard, the riparian corridors on the Santa Ynez mountain front are critical components of essential black bear habitat, because they provide pathways for movement.

Mountain Lion (*Felis concolor*): Mountain lions are carnivores that can be found in a great diversity of habitats from sea level to the Santa Ynez. They are most abundant in riparian ecosystems and brushy stages of other habitats where they hunt primarily mule deer (60-80% of diet) as well as other smaller mammals. Mountain lions require large tracts of land with a complex vegetative structure, caves and/or natural cavities and/or brush thickets for denning, and are rarely permanent residents of any given location and/or habitat. Mountain lions are solitary animals that show few signs of defending particular territories (Maser *et al.* 1981, Currier 1983, CDFG 2000).

Black-tailed or Mule Deer (*Odocoileus hemionus*): Black-tailed deer, otherwise known as Mule deer, can be found from the coastal plains to the Santa Ynez Mountain front in mosaic habitats that provide both open areas for grazing as well as a vegetative cover for foraging, escape, thermal regulation, reproduction, *etc.* Deer are herbivores that primarily feed on young shrubs, new shoots of trees, shrubs, and/or forbs, and succulent grasses and forbs. Their diet is relatively specific in order to provide the necessary amounts of protein, carbohydrates, and minerals. Deer can also be used as indicators of the effects of extensive fragmentation of a landscape (CDFG 2000).

Coyote (*Canis latrans*): Coyotes are known to be adaptable opportunistic omnivores and can be found in most habitats throughout the reference domain. Coyotes quickly adapt to anthropogenic disturbances, and are most frequently associated with early successional forests, scrub/shrub, and herbaceous communities. Coyote prefer relatively open habitats for foraging, with the interspersion of brush and or natural cavities for denning. Prey consists primarily of rodents, gophers, squirrels, and carrion (Ferrel *et al.* 1953, Bekoff 1977, CDFG 2000).

Fox species (Red or grey fox *Vulpes* spp.): Foxes can be found from the coastal plains to the Santa Ynez Mountains, below 3000 ft elevation. There is evidence that population numbers often fluctuate with numbers of coyotes when coexisting in the same landscape. Foxes prefer relatively open habitats for foraging, with the interspersion of brush and or natural cavities for denning. Their prey consists of small to medium sized mammals, as well as waterfowl, shorebirds, and upland game birds. A mated fox pair (and pups) shares a territory that is commonly defended by the male (Grinnell *et al.* 1937, Ables 1975, Gould 1980, CDFG 2000).

Rabbit species (*Sylvilagus* spp.): Rabbits are herbivores that proliferate in small areas of predominantly shrub/herb habitats, and/or early successional communities. Rabbits feed on a wide variety of grasses and forbs. They are always found close to cover for escape and/or protection from larger predators. Rabbits are commonly prey for a wide range of predators (CDFG 2000).

Striped skunk (*Mephitis mephitis*): Striped skunks are abundant from the coastline to the timber line. They prefer habitats with a mosaic of brush and open areas, including intermediate successional forests, riparian areas, meadows, and edge communities. Skunks are omnivores that primarily eat insects, small mammals, and other small vertebrates. They utilize cavities and crevices in rocky slopes, snags, coarse woody debris, and underneath buildings for cover. Skunks are considered opportunistic species as they have adapted to take advantage of landscapes fragmented by agriculture, residential and commercial developments, and other anthropogenic disturbances (Grinnell 1937, CDFG 2000).

Raccoon (*Procyon lotor*): Raccoons are abundant omnivores that can most frequently be found in riparian and wetland ecosystems from the coastal plains to the Santa Ynez. Raccoons are dependent upon a permanent water source for drinking. However, their feeding patterns are highly opportunistic and are oftentimes dependent on agriculture or urban areas. Raccoons use natural cavities in trees, snags, coarse woody debris, and other forms of cover. for denning (Grinnell 1937, CDFG 2000).

Squirrel species: We encountered the California ground squirrel (*Spermophilus beecheyi*), the Belding ground squirrel (*Spermophilus beldingi*), and the Eastern grey squirrel (*Sciurus carolinensis*) in the SCSBC region. These squirrels are omnivores that primarily feed on grasses, forbs, seeds, bulbs, fruits, insects, and/or carrion. Squirrels take cover in burrows dug in loose soil, often near water and beneath vegetative cover. Squirrels live singly, or in small colonies (Grinnell 1937, CDFG 2000).

Reptilia

The class of Reptilia in the SCSBC region can be found throughout the reference domain, generally at the extreme sides of the hydrologic gradient. Turtles, dependent on permanent bodies of water, are found in lacustrine and riparian ecosystems. Turtles are found primarily to use bodies of water for cover and the majority of their movement. Similar to terrestrial environments, vegetative structural complexity largely determines appropriate habitat and allows cover for movement, resting, feeding, reproduction, *etc.* Snakes and lizards are found in arid habitats with predominate scrub/shrub and chaparral vegetative community. Snakes and lizards are generally found in open terrestrial habitats with a mosaic of scrub/shrub vegetation. This allows for suitable basking and/or perching sites, with accessible cover close by. For all reptiles, a wide range of avian and mammalian predators is known. Thus, vegetative cover is an integral component of suitable habitat.

All the reptilian species identified in our fieldwork in the SCSBC region will be categorized in terms of habitat and feeding requirements, as well as significant behavioral characteristics.

Turtles: The only turtle identified within the reference domain was the Western Pond Turtle (*Clemmys marmorata*). The Western pond turtle ranges from sea level to 6000 ft above sea level along the coast of California and is almost exclusively associated with permanent bodies of water such as ponds, lakes, streams, and/or irrigation ditches. Turtles require basking sites just above water (*e.g..,* partially submerged logs, rocks, *etc.*) that allow for easy escape below the water surface. Western Pond turtles are known to lay eggs up to 100 ft from a body of water in soils that are at least 10 cm deep and have a high level of internal humidity to allow for the development and subsequent hatching of eggs. The Western Pond turtle is omnivorous and feeds on aquatic plant material, beetles, and other invertebrates.

Lizards: In the course of our study, we identified two lizards, the Western Fence lizard (*Sceloporus occidentalis*) and the Side-blotched lizard (*Uta stansburiana*), both in the family of *Phrynosomatidae*. The Western Fence lizard is California's most common lizard species and is found in almost every habitat. It feeds almost exclusively on terrestrial invertebrates and requires a vertical element (*e.g.*, coarse woody debris, snags, rock piles, fences, *etc.*) to provide suitable habitat for perching or basking (CDFG 2000).

The Side-blotched lizard is not as common as the Western fence lizard, but can be found in relative abundance in coastal scrub, chaparral, grasslands, and other open and arid to semi-arid habitats. The Side-blotched lizard feeds on a wide variety of insects and arthropods; however, it does not need a vertical component for suitable habitat because it rarely climbs. These lizards are an important food source for predators higher-up in the food web (CDFG 2000).

Snakes: We identified three snakes within the reference domain: the Common garter snake (*Thamnophis sirtalis*); the Common kingsnake (*Lampropeltis getula*); and the Western rattlesnake (*Crotalis viridis*). The Common garter snake is abundant throughout California and most of the lower 48 contiguous states. In the SCSBC region, they can be found from sea level to the Santa Ynez in mosaic habitats, which provide both significant cover opportunities as well as open areas for basking and foraging. The Common garter snake is associated with permanent to semi-permanent bodies of water where they can forage in quiet, slow moving pools. Common prey includes tree frogs, mice, leeches, and earthworms.

The Common kingsnake is found throughout most of California, commonly in riparian ecosystems and near irrigated agriculture. They require rock outcrops and/or clumps of vegetation for cover. Common kingsnakes often feed on lizards, small rodents, and other species of snakes. The Western Rattlesnake is also abundant throughout most habitats in California. They require rock outcrops, clumped vegetation, and/or mammal burrows for foraging and cover. The Western Rattlesnake's primary sources of food are small rodents (especially ground squirrels), rabbits, birds, and even carrion (CDFG 2000, Stebbins 1954, 1972, White & Knob 1974). All three species of snakes identified are also prey for other predators higher in the food web.

Amphibia

The majority of species within *Amphibia* fall into two Orders: *Caudata*, consisting of newts and salamanders; and *Anura*, consisting of frogs and toads. Within both orders, identified species were found from the low gradient coastal plains to the Santa Ynez Mountains, primarily associated with pools, and/or slow moving perennial bodies of water. Bodies of water provide cover for foraging, hiding, hibernation, *etc.*, and are necessary for all amphibians to complete their life cycle. Due to the time of year (spring) and the time allotted for identification of reptiles and amphibians, we were not able to effectively catalogue many of the amphibian species observed throughout the sixty reference sites. Therefore, habitat and feeding requirements for the two orders of species are generalized to represent the range of necessary habitat components for faunal support/habitat.

It is important to note that a general decline of amphibians across the globe has recently been identified and their decline is hypothesized to be directly correlated with certain human activities, such as loss and degradation of habitat, the transfer of pathogenic fungi by hikers' boots, and the increase in ultraviolet radiation through the thinning of the ozone layer, *etc*. Therefore, the success of amphibian populations is often used as an indicator of the impacts from anthropogenic disturbances and the fragmentation of a landscape.

Frogs (order *Anura*): Frogs are the most diverse group of amphibians, found in almost all habitats associated with seasonal and/or perennial bodies of water. Frogs are known to be aquatic, terrestrial, sub-terrestrial, or various combinations of all three. Unlike Salamanders, frogs fertilize their eggs externally and commonly deposit them in leaf litter and/or wet moss or other vegetation. An important part of a frogs life cycle, is the metamorphosis from aquatic tadpoles into a terrestrial frog. Frog tadpoles are extremely susceptible to predation, having minimal defense mechanisms.

Unfortunately, we were unable to identify many of the frogs found throughout the reference domain because individuals were predominantly found in the tadpole stage. However, we did identify two species: the federally listed Red-legged frog (*Rana aurora*) and the abundant Pacific Chorus frog (*Pseudacris regilla*). The Red-legged frog is highly aquatic, and prefers shorelines with dense vegetation for cover. Underneath this dense vegetation in quiet, permanent pools, the Red-legged frog is known to deposit its eggs. In contrast, the Pacific Chorus frog can often times be found out of water in wetland type habitats in moist niches such as decayed woody material, snags, wells, *etc.* For reproduction, they require permanent pools with a complex aquatic vegetative structure where eggs can be anchored to the stems (Leonard *et al.* 1993, Heyer *et al.* 1994, CDFG 2000).

Salamanders and Newts (*Rhyacotritonidae* and *Salamandridae*): Salamanders and Newts in the SCSBC region require a body of water (*i.e.*, lake, either seasonal or perennial stream, etc), thick vegetation along the body of water, and a variety of earthworms, leeches, snails and aquatic invertebrates to eat. Adult salamanders are terrestrial, aquatic, sub-terrainian, or various combinations of the three. Salamanders commonly internally fertilize, and eggs, which are laid singly, in chains, or in clumps in aquatic vegetation. Similar to frogs, salamanders and newts metamorphose from aquatic larvae into terrestrial adults (CDFG 2000, Leonard *et al.*1993, Heyer *et al.* 1994).

Aves The Class Aves was by far the most diverse class of species identified in the SCSBC region. The 45 identified species will be grouped and addressed by Order. We believe that this will most effectively and efficiently capture the necessary habitat components of avian support/habitat for all avian species.

Throughout the reference domain, we observed multiple bird species at each site. While overlaps of habitat utilization can be identified, generalizations between Orders can often times be effective. For example, Pelecaniformes are frequently found in coastal areas, in contrast to Falconiformes, which are predominantly found in the Santa Ynez mountains. For the purposes of this guidebook, generalizations at this scale should be sufficient.

Increased human activities can have both negative and positive effects on bird species. Fragmentation of a landscape and the reduction of suitable habitat will have negative effects on many bird species. For example, the Great Blue Heron have been shown to be extremely sensitive to human activities in the near vicinity of nesting sites. Nests are frequently abandoned at any indication of human activities around the nesting site. In contrast, a fragmented landscape can be shown to have positive effects on populations of bird species. The creation of open space can be shown as a positive habitat component for species such red-tailed hawks that forage for small mammals in open areas.

We have done our best to briefly develop necessary components of avian support/habitat for the ten orders listed below. We realize that the 45 identified species in the SCSBC region do not adequately describe the actual diversity of bird species. However, we hope that these general groupings adequately account for the large diversity of birds.

Falconiformes (Vultures, Hawks and Falcons): Falconiformes are permanent residents within certain habitats and migrants in others. The distribution of Falconiformes in California ranges from the coast to the Santa Ynez Mountains. Falconiformes are commonly found in edge communities with dense vegetation borders and open areas such as grasslands, chaparral communities, *etc.* However, nesting is predominantly done in late successional forest communities. We identified four species: the Northern Harrier (*Circus cyaneus*); the Red-tailed Hawk (*Buteo jamaicensis*); the Red-shouldered Hawk (*Buteo lineatus*) ; and American Kestrel (*Falco sparverius*). Commonly, these species have shown to compete for the same food resources, such as small mammals, birds, frogs, reptiles, amphibians, and occasionally carrion.

Additionally, the Northern Harrier has been shown to be sensitive to the destruction or fragmentation of wetland habitats, native grasslands, and similar type of open habitats by anthropogenic disturbances. However, the Red-tailed hawk can often adapt to anthropogenic disturbances, such as intensive agriculture.

Plecaniformes (Tropical Birds, Pelicans and relatives): We identified one pelecaniform in the SCSBC region, the Brown Pelican (*Pelecanus occidentalis*). The Brown Pelican is a large, marine bird known to migrate up and down the California coast. They primarily feed on fish and roost in undisturbed estuaries and other tidally-influenced areas on land. Brown Pelicans have commonly been associated with undisturbed islands such as the Channel Islands.

Ciconiformes (Herons, Storks, Ibises, and relatives): We observed this order, consisting of two distinct families, in the SCSBC region: the *Ardeidae*, or Heronsand Egrets; and the *Cathartidae*, or New World Vultures. Each will be addressed separately due to their ecological and behavioral differences. We observed two highly representative species in the Ardeidae, the Great Blue Heron (*Ardea herodias*) and an Egret species (*Egretta* sp.). Both species are dependant on permanent shallow bodies of water (*i.e.*, estuaries, emergent wetlands, ponds, *etc.*) for feeding; the Great Blue Heron's diet consists of 75% fish. The Great Blue Heron roosts in secluded, tall trees or snags that are a significant distance from human activities. As mentioned previously, human activities have commonly led Great Blue Herons to abandon their nests. On the other hand, human activities can have favorable effects on New World Vultures, or the Turkey Vulture (*Cathartes aura*). This species is abundant in areas of high human activities, and is known to primarily eat carrion (Jackman and Scott 1975, Cogswell 1977, CDFG 2000).

Anseriformes (Screamers, Ducks, and relatives): We observed California's most abundant breeding duck, the Mallard (*Anas platyrhynchos*). This Order of birds is predominantly water dependent and can be found in a wide range of habitats including estuaries, emergent wetlands, to riverine habitats, and urban parks. The feeding patterns range throughout this Order from primarily vegetative material to a predominant fish diet. The Mallard is known to nest on fairlydry sights in thick vegetation, which provides cover from predators. Human activities, in addition, can frequently have negative affects on nesting sights and the rearing of young (CDFG 2000, Bellrose 1976).

Galliformes (Megapodes, Curassows, and Pheasants): The only *Galliformes* we identified were the California Quail (*Callipepla californica*) and the Ring-necked Pheasant (*Phasianus colchicus*). The California Quail is found throughout California in the Low to Medium elevations. It requires a mosaic of shrubby vegetation with grass/forb communities. It is highly dependent on the level of seasonal rainfall and the production of its primary food source, legumes and other seeds. The Ring-necked pheasant are frequently associated with agriculture, especially grain crops, for suitable habitat. They are known to forage, predominantly on the ground, for grain, seeds, and other vegetative material. However, the Ring-necked pheasant also requires dense vegetation for nesting and other forms of cover.

Charadriformes (Shorebirds, Gulls, and Relatives): The majority of species in the Charadriformes are dependent on permanent bodies of water. However, there are distinct differences in how species utilize these bodies of water. For example, the Black-necked Stilt (*Himantopus mexicanus*) forages in shallow water for insects, crustaceans, and other aquatic invertebrates, whereas, the Western Gull (*Larus occidentalis*) more often forages in the deep, open water by diving for fish. The Black-necked Stilt is known to rest and roost in dikes, mud flats, islands in shallow water, and lake shores. The Western Gull requires protected areas (*i.e.,* off-shore rocks, islands, and remote beaches) for roosting.

Columbiformes (Pigeons and Doves): The two species we identified in the *Columbiforme*s were the Mourning Dove (*Zedaida macroura*) and the common Pigeon (*Columba* sp.). Both species are known to commonly occur in areas of high human activity and throughout a wide range of habitats.

Apodiformes (Swifts and Hummingbirds): An important Apodiformes we identified was Anna's hummingbird (*Calypte anna*). It commonly occurs in most woodland and forest communities. Recently, populations have been dramatically increasing as a result of the number of exotic flowers introduced throughout the State. This may also have effects on the range of suitable habitat. In addition, there are many native flowers that are directly dependent on hummingbirds for pollination. Anna's hummingbird in addition to nectar, is known to feed on small insects and spiders (CDFG 2000).

Piciformes (Woodpeckers and relatives): We identified four species of the family Picidae: Northern Flicker, *Colaptes auratus*; Hairy Woodpecker, *Picoides villosus*; Downy Woodpecker, *Picoides pubescens*; and Acorn Woodpecker, *Melanerpes formicivorus*. All four species are found in hardwood and conifer habitats or riparian deciduous habitats under 7000 ft above sea level. Suitable habitat is a relatively open woodland and forest communities, with abundant snags. Feeding behaviors within this Order ranges from a predominantly acorn diet to approximately 80% of animal matter. Competition exists between many of the Piciformes due to similarities in behavioral and feeding patterns (Grinnell and Miller 1944, Kiseil 1972, CDFG 2000).

Passeriformes (Perching Birds): The Passeriformes is the largest Order of species we identified in the SCSBC region. The 26 species identified ranged from the common, permanent resident house finches (*Carpodacus mexicanus*) and the American Crows (*Corvus brachyrynchos*), to the relatively transient, migratory Orange-crowned Warbler (*Vermicora chrysoptera*). Suitable habitat ranges from open areas of high human activity (*e.g.,* House Finch; European Starling, *Sturnus vulgaris*, *etc.*) to forested habitats with minimal human activities (*e.g.,* Dark-eyed Junco, *Junco hyemalis*). Species feed on anything from seeds and vegetative material, to small insects, spiders, arthropods, *etc.* *Passeriformes* were identified at every site by direct sightings and/or calls (CDFG 2000).

Fish

There are three stream characteristics that provide suitable habitat for fish: pools, riffles and flatwaters. In general, pool habitats are the areas of calm water, which provide cover for large and small fish. Riffle habitats are swiftly flowing stretches of water with exposed rocks and high rates of oxygen mixing that provide a niche for small fish. Flatwater habitat is moderately flowing stretches of water with little or no flow obstructions that can provide territory for larger fish.

Osteichthyes

The habitat needs of trout are relatively specific. Trout require clean gravel for spawning, deep cool pools to survive the heat of summer, instream shelter to hide from predators, active riffles to provide an insect food source, and overhead vegetation/canopy. Human alteration of waters, stream banks, and surrounding landscape can have profound impacts on these species. The removal of side bank vegetation eliminates overhead canopy cover and increases erosion and sediment deposition. This in turn minimizes shaded areas (food, protection, rest *etc.*) within the stream channel, and then reduces vegetative detritus that is a limiting factor for insect populations. By decreasing population number of insects, human alteration impacts the amount of prey available to the trout. In addition, these perturbations can impact sediments sources and amounts in the water column and gravel beds that degrade reproduction gravel sites. Fish migration , habitat, and spawning sites are also impacted by hardened engineered structures such as concrete culverts, weirs, dams that can significantly alter water level, flow, turbidity, dissolved oxygen content, and pH concentrations. The fish species identified in the field will be approached in terms of habitat, breeding, and feeding requirements.

Rainbow Trout (*Oncorhynchus mykiss*): Rainbow trout is the most abundant species of trout in California. Adult rainbow trout favor cool, clear, moderately flowing streams with abundant cover and deep pools. Spawning occurs in shallow riffles with gravel bottoms within small tributaries of rivers. Rainbow trout eat a wide variety of foods, mainly consisting of insects, crustaceans, snails, leeches, and other available fish.

Rainbow Steelhead Trout (*Onchorynchus mykiss*): Steelhead trout are listed as a species of "special concern" by California Department of Fish and Game and as a "threatened" species under the Federal Endangered Species Act. Steelhead trout are Rainbow trout that migrate to sea and spend a portion of their life cycle in open ocean waters. Like Rainbows, Steelheads live similar lives while residing in stream systems. Steelhead can spend between 1 and 4 years in a fresh water system before migrating to sea. When they migrate to sea they can spend a few months to several years there before returning to fresh water to spawn. At sea they eat mainly fish, crustaceans and squid.

Threespined Stickleback (*Gasterosteus aculeatus*) Sticklebacks prefer areas of moderate flow with vegetation for cover. Riffles and ponds are their major habitats, and they tend to be most numerous in small ponds with moderate flow. Natural cover includes stream banks, rocks, sunken logs and, most importantly, vegetation. Sticklebacks have a high reproductive capacity but appear to be limited by available breeding habitat. Natural pools or impoundments with maintained flow enhance habitat quality for sticklebacks. Sticklebacks subsist on detritus, worms, fish, zooplankton, crustaceans and mollusks.

Table 4.3
All species identified throughout the sixty reference sites

AMPHIBIANS	
Anura Salientia (Frogs and Toads)	
Hylidae (Treefrogs and relatives)	
Pacific Tree Frog	*Pseudocris regilla*
Pacific Tree Frog	*Pseudocris cadaverina*
Ranidae (True Frogs)	
Red Legged Frog	*Rana aurora*
Caudata (Salamaders)	
Salamandridae (Newts)	
California Newt	*Taricha torosa*
REPTILES	
Testudines (Turtles)	
Emydidae (Box and Water Turtles)	
Western Pond Turtle	*Clemmys marmorata*
Squamata (Lizards and Snakes)	
Phrynosomatidae	
Western Fence Lizard	*Sceloporus occidentalis*
Side-blothced Lizard	*Uta stansburianna*
Anguidae (Alligator Lizards and Relatives)	
Alligator Lizard	*Elgaria sp.*
MAMMALS	
Lagomorpha (Rabbits, Hares and Pikas)	
Leporidae (Rabitts and Hares)	
Brush Rabbit	*Sylvilagus bachmani*
Rodentia (Squirrels, Rats, Mice and relatives)	
Sciuridae (Squirrels, Chipmunks and Marmots)	
Western gray squirrel	Sciurus griseus
California Ground Squirrel	*Spermophilus beecheyi*
Muridae	
Bushy-tailed Woodrat	*Neotoma cinerea*
Mephitidae (Skunks)	
Striped Skunk	*Mephitis mephitis*
Artiodactyla (Even-toed Ungulates)	
Suidae (Pigs)	
Wild Pig (Feral Boar)	*Sus scrofa*
Cervidae (Deer, Elk and relatives)	
Mule Deer (Black-tail deer)	*Odocoileus hemionus*

Table 4.3
All species identified throughout the sixty reference sites (con't)

MAMMALS (cont.)	
Carnivora (Carnivores)	
Canidae (Foxes, Wolves and relatives)	
Coyote	*Canis latrans*
Red Fox	*Vulpes vulpes*
Ursidae (Bears)	
Black bear	*Ursus americanus*
Procyonidae (Racoons and relatives)	
Raccoon	*Procyon lotor*
Felidae	
Mountain Lion	*Puma concolor*
FISH	
Salmoniformes (Salmon, Trout, Char and Smelt)	
Salmonidae (Salmon, Trout and Char)	
Rainbow Trout	*Salmo gairdnerii*
Cutthroat	*Salmo sp.*
Steelhead	*Salmo gairdnerii gairdnerii*
Gasterosteiformes (Sticklebacks)	
Gasterosteidae (Sticklebacks)	
Threespined Stickleback	*Gasterosteus aculeatus*
BIRDS	
Falconiformes (Vultures, Hawks and Falcons)	
Accipitridae (Hawks, Old World Vultures, and Harriers)	
Northern Harrier	*Cirus cyaneus*
Red Shouldered Hawk	*Buteo lineatus*
Red Tailed Hawk	*Buteo jamaicensis*
Falconidae (Caracaras and Falcons)	
American Kestrel	*Falco sparverius*
Pelecaniiformes (Tropic Birds, Pelicans and relatives)	
Pelecanidae (Pelicans)	
Brown Pelican	*Pelecanus occidentalis*
Exotic Parrot	*Amazona sp.*
Ciconiiformes (Herons, Storks, Ibises and relatives)	
Ardeidae (Herons and Bitterns)	
Great Blue Heron	*Ardea herodius*
Egret	*Egretta spp*
Cathartidae (New World Vultures)	
Turkey Vulture	*Cathartes aura*

Table 4.3
All species identified throughout the sixty reference sites (con't)

BIRDS (cont.)	
Anseriformes (Screamers, Ducks, and relatives)	
Anatidae (Swans, Geese and Ducks)	
Malard	*Anas platyrynchos*
Galliformes (Megapodes, Curassows, Pheasants)	
Odontophoridae (New World Quail)	
California Quail	*Cillipepla californica*
Charadriiformes (Shorebirds, Gulls and relatives)	
Recurvirostridae (Avocets and Stilts)	
Black-necked stilt	*Himanoptus palliatus*
Laridae (Skuas, Gulls, Terns and Skimmers)	
Western Gull	*Larus occidentalis*
Columbiformes (Pigeons and Doves)	
Columbidae (Pigeons and Doves)	
Mourning Dove	*Zenaida macroura*
Pigeon	*Columba sp.*
Apodiformes (Swifts and Hummingbirds)	
Trochilidae (Hummingbirds)	
Anna's Hummingbird	*Calypte anna*
Piciformes (Woodpeckers and relatives)	
Picidae (Woodpeckers and Wrynecks)	
Acorn Woodpecker	*Melanerpes erythrocephalus*
Downy Woodpecker	*Picoides pubescens*
Hairy Woodpecker	*Picoides villosus*
Northern Flicker	*Colaptes auratus*
Passeriformes (Perching Birds)	
Tyrannidae (Tyrant Flycatchers)	
Black Phoebe	*Sayornis nigicans*
Pacific Slope flycatcher	*Empidonax difficilus*
Passeriformes (Perching Birds) (cont.)	
Lannidae (Shrikes)	
Loogerhead Shrike	*vermivora chrysoptera*
Corvidae (Jays, Magpies, Crows)	
Western Scrub Jay	*Aphelocoma insularis*
American Crow	*Corvus brachyrynchos*
Alaudidae (Larks)	
Lark sp.	*Eremophila sp*
Hirundinidae (Swallows)	
Barn Swallow	*Hirundo rustica*
Cliff Swallow	*Petrochelidon pyrrhonota*

Table 4.3
All species identified throughout the sixty reference sites (con't)

BIRDS (cont.)	
Troglodytidae (Wrens)	
Rock Wren	*Salpinctes obsoletus*
Turdidae	
American Robin	*Turdus migratorius*
Hermit Thrush	*Catharus guttatus*
Timaliidae (Wrentit)	
Wrentit	*Chamaea fasciata*
Mimidae (Mockingbirds and Thrashers)	
Northern Mockingbird	*Mimus polyglottos*
Sturnidae (Starlings and Allies)	
European Starling	*Sturnus vulgaris*
Parulidae (Wood Warblers and relatives)	
Common Yellowthroat	*Geothlypis trichas*
Orange-crowned Warbler	*Vermivora chrysoptera*
Emberizines	
Rufous-crowned Sparrow	*Aimophyla cassinii*
Savannah Sparrow	*Passerculus sandwichensis*
White-crowned Sparrow	*Zonotrichia leucophrys*
Dark-eyed Junco	*Junco hyemalis*
Towhee	*Pipilo sp.*
Cardinalidae (Cardinals, Grosbeaks and Allies)	
Black-headed Grosbeak	*Pheucticus melanocephalus*
Icteridae (Blackbirds, Orioles and Allies)	
Red-winged Blackbird	*Agelaius phoeniceus*
Brewer's Blackbird	*Euphagus cyanocephalus*
Hooded Oriole	*Icterus cucullatus*
Fringillidae (Finches)	
House Finch	*Carpodacus mexicanus*
American Goldfinch	*Carduelis tristis*

Range of Variation in Faunal Support/Habitat Structure and Use

Structure in the plant community types within the regional subclasses is discussed in the Vegetation section (4.9) of this profile. Although all ecosystem attributes are important for maintenance of habitat integrity, vegetative structural complexity has repeatedly been found to be one of the most significant attributes that contribute to defining suitable habitat for resident and non-resident animals. Composition of faunal communities and their use of a particular habitat will vary between community types based on plant species composition and subsequent structure of the vegetative community. Additionally, components of vegetative structural complexity such as tree basal area, abundance of snags, and cover class of the four vegetative strata will vary between sites and within subclasses. A thorough review of the literature on species known to exist within the reference domain will provide additional information.

At every reference site, we recorded specific indicators of animal use that included tracks, trails, feeding evidence, squirrel middens, feathers, bird nests, nesting cavities, bedding, fur, scrapes and rubs, browse, scat – avian and mammal, and calls (see Figure 4.31). The number of different indicators found at every site demonstrates the level of animal use. The implication of these data is that faunal communities continue to utilize habitats that have been altered by anthropogenic disturbances. In fact, we can expect the abundance and distribution patterns of generalist predators to increase with an increase in human activities. However, for simplification, animal sign data has been analyzed based on the presence/absence of the five major groups of animals as identified by us: mammals, birds, reptiles, amphibians, and fish.

We concluded that evidence of animal use, while useful, is subject to large uncertainties related to timing and duration of site visits, cyclical fluctuations of animal populations, and skill of observers in identifying species from direct sightings as well as recognizing signs of animal use. In this regard, the structure and composition of the plant community may be a good proxy for animal use (*i.e.*, habitat potential), although it still cannot account for characteristics of the physical (*e.g.,* climate) or trophic (*e.g.*, predator density) environments that also influence the distribution and abundance of animal populations. Therefore, the variables used to define functions of faunal support/habitat are based on both direct and indirect methods of data collection. Direct methods are the field-collected data related to direct sightings and indicators of animal use. Indirect methods include those data on vegetative structure, area, and contiguity extracted from GIS data coverages.

It should be clear that faunal support/habitat results reported herein are not intended to replace more intensive studies of wildlife and animal communities, such as those completed by the U.S. Fish and Wildlife Service.

Figure 4.31 Photograph of a black bear (*Ursus americanus*) track found at a reference site. This is an example of an indirect indicator of animal utilization within a reference site.