ECOREGION 31 – SOUTHERN TEXAS PLAINS

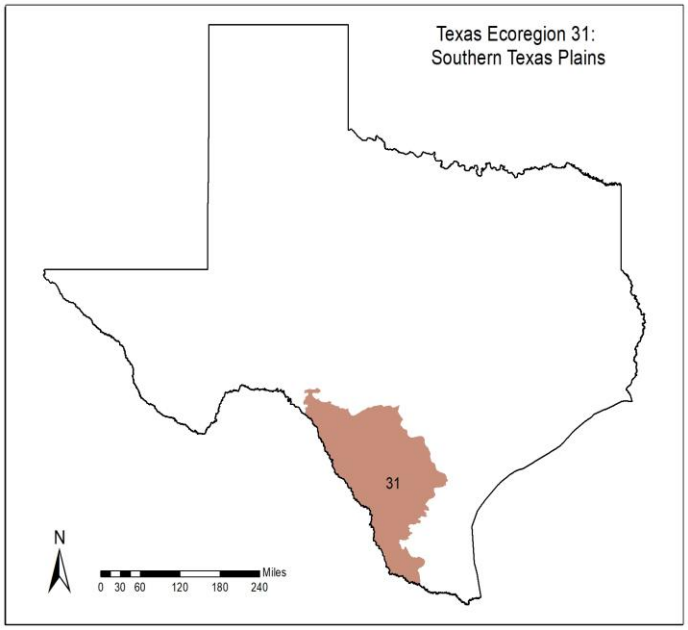

Figure 246. Map of Texas Ecoregion 31 – Southern Texas Plains.

Figure 247. Site photo from the Upper Nueces River.

Ecoregion 31 Characterization

The Southern Texas Plains ecoregion covers approximately 53,500 sq km of what is referred to as the "brush country" in southwest Texas (Figure 246) and contains a high diversity of plant and animal life (Griffith et al., 2007). This diversity is, to a great degree, a result of the convergence of the Chihuahuan Deserts to the west, the thornscrub and floodplain woodlands along the Rio Grande to the south, and coastal grasslands to the east. In Texas, the Rio Grande forms the western boundary of the ecoregion. To the north, the ecoregion is bounded by the Edwards Plateau ecoregion. The Texas Blackland Prairies, the East Central Texas Plains, and the Western Gulf Coastal Plain form the eastern boundary. The ecoregion includes portions of the Rio Grande, Nueces and Devil's River watersheds.

In general, the ecoregion was historically characterized as rolling to moderately dissected grassland plains. More recently, as a result of grazing and fire suppression, mesquite, and other thorny brush are now predominant. Currently, most of the ecoregion is used for rangeland, with only small areas of cultivated grain sorghum, cotton, and watermelons.

Climatically, the region is considered to be subtropical, having hot dry summers and mild winters. Typically, precipitation occurs bimodally with peaks in the spring and again in the fall. Extended droughts are not uncommon, and annual average precipitation varies from 48 – 71 cm.

Streams in the ecoregion may exhibit influences from the Edwards Plateau, either as a result of taking their origin from aquifers beneath the Edwards, or from having originated in the Edwards with resultant surficial flow from there into the South Texas Plains. Sycamore, Pinto, and San Felipe creeks are notable examples of this, each being characterized by relatively clear, cool, spring flow. The presence of these types of streams in such an arid region provides important relatively stable aquatic habitats.

Table 10. Streams sampled in Ecoregion 31.

Las Moras Creek	Nueces River	Sycamore Creek
Metate Creek	Pinto Creek	
Mud Creek	San Miguel Creek	

LAS MORAS CREEK

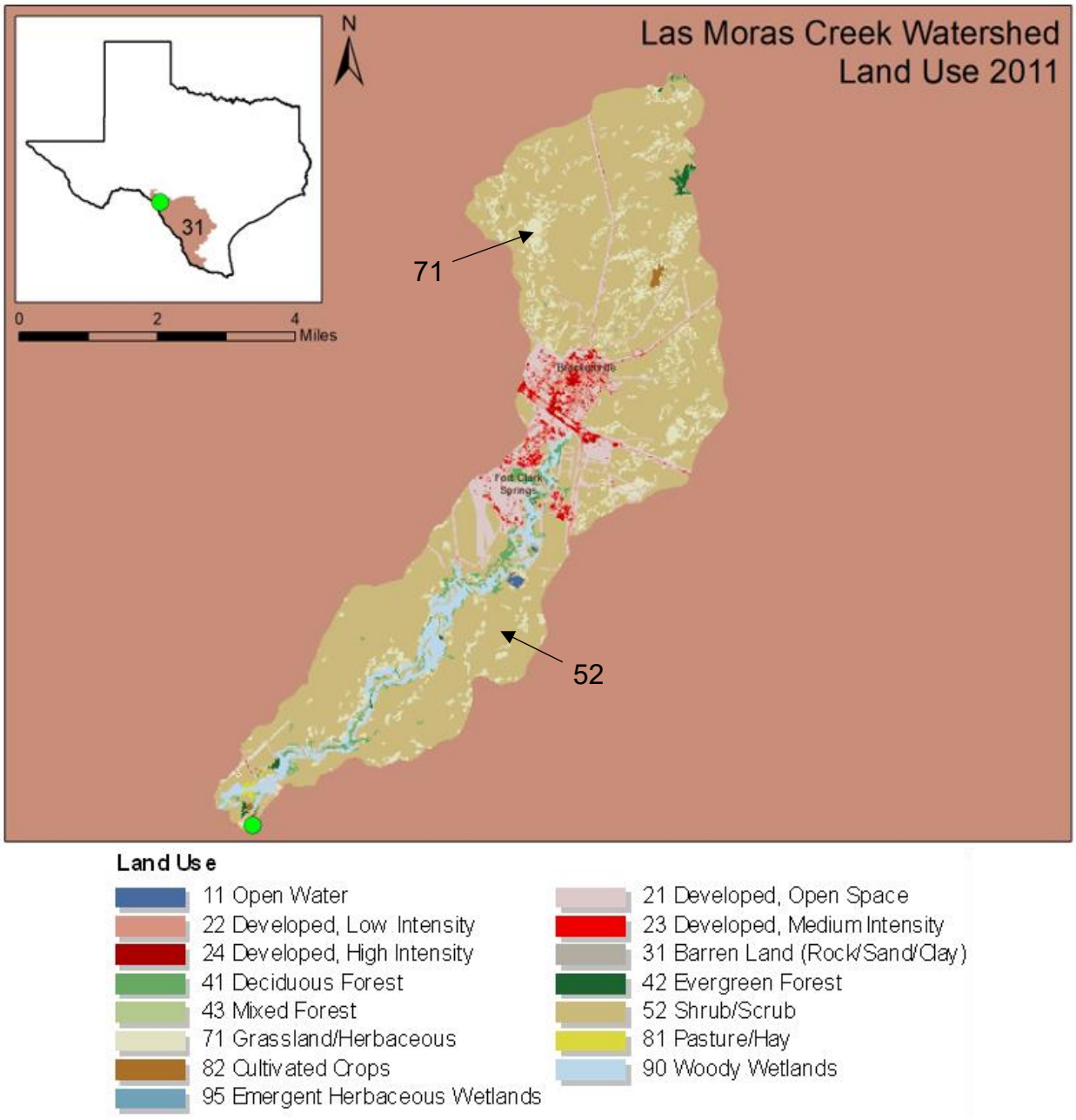

Figure 248. Map of Las Moras Creek watershed location and 2011 land use; shrub/scrub and grassland/herbaceous were the most common land uses.

Sampling Dates

Physical Habitat:	June 13, 1990
Water Quality:	3 sampling events
Fish:	June 13, 1990
Benthic Invertebrates:	June 13, 1990

Physical Characterization

Watershed and Land Use

Las Moras Creek lies within the Rio Grande Basin. Sample site 13130 is located near the Southern Pacific Railroad, approximately 12.9 km south of Brackettville in Kinney County (Figure 248).

The Las Moras Creek watershed at site 13130 is approximately 70.05 sq km. The entire watershed lies within Level IV Ecoregion 31c, the Texas-Tamaulipan Thornscrub. The dominant land cover in the watershed is shrub, which is present throughout 71.1% of the watershed (Homer et al. 2015; Figure 248 and Figure 249). Grassland/herbaceous is the second most prevalent land cover, encompassing 9.20%. The combined land cover for developed land use (open space and low, medium, and high intensity) totals 12.61%; and the total for cultivated crops is 0.22%.

From 1992-2011 there was a 6.38 sq km decrease in forest and a 3.20 sq km decrease in cultivated crops. There was a 5.24 sq km increase in shrub and a 4.84 sq km increase in open space development (Figure 250).

There is one domestic wastewater outfall (which discharges less than one million gallons per day) within the Las Moras Creek watershed permitted to the City of Brackettville. This facility discharges directly into Las Moras Creek.

In Channel and Riparian Physical Habitat

Physical habitat for Las Moras Creek was evaluated on June 13, 1990. Las Moras Creek is a spring fed stream that drains to the Rio Grande River. The riparian width was 42 meters. The riparian zone was dominated by trees, which made up an average of 50% of the total riparian species, followed by grasses (45%) then shrubs (5%). The average percentage of tree canopy cover was 88%. The dominant substrate was clay with some sand, and the average percent of substrate that was gravel size or larger was 0%. Average percent instream cover was 24%. Las Moras Creek had an average depth of 0.5 meters and a maximum depth of 0.9 meters. The average width was 4.4 meters and average stream bank slope was 22 degrees. Stream flow at the site was 35.1 cfs. Average stream bank erosion potential was 35%. One riffle was observed at the site and there were 10 poorly defined stream bends.

Water Quality

Water samples were collected at three stations on this segment: station 13129 over 3 sampling events from February 1993 to June 1988, station 14941 at 4 events from November 1995 through August 1996, and once at station 22310 in July 2021. Data were collected for temperature, flow, specific conductivity, dissolved oxygen, pH, alkalinity, ammonia, total Kjeldahl nitrogen, total nitrogen, phosphorus, total organic carbon, chloride, sulfate, and chlorophyll-a. Continuous 24 hour dissolved oxygen samples were only collected in July 2021 at station 22310 on this waterbody.

Biological Characterization

Fish

Nine species (five families) were collected from Las Moras Creek, with fairly even distribution among the families. Mexican Tetra, *Astyanx mexicanus,* was the most abundant species. Based upon the fish assemblage, the aquatic life use only rated as intermediate. The main reasons for the low aquatic life use rating were the small number of native cyprinid and sunfish species, low percentage of piscivorous individuals, and the high percentage of individuals as non-native species (3.1%, Common Carp).

Benthic Macroinvertebrates

Considering the single Surber sample from June 13, 1990, a total of 289 individuals representing 42 taxa from 12 orders of macroinvertebrates were collected from Las Moras Creek (Appendix E). Coleoptera, Ephemeroptera, Trichoptera, Oligochaeta, Odonata, and Diptera were the most collected orders, collectively accounting for 94.1percent of the total number of individuals collected. The Basommatophora and Lepidoptera were the only other orders collected which comprised greater than one percent of the collection. The Central Bioregion Surber BIBI for the 1990 Surber sample fell in the exceptional aquatic life use category.

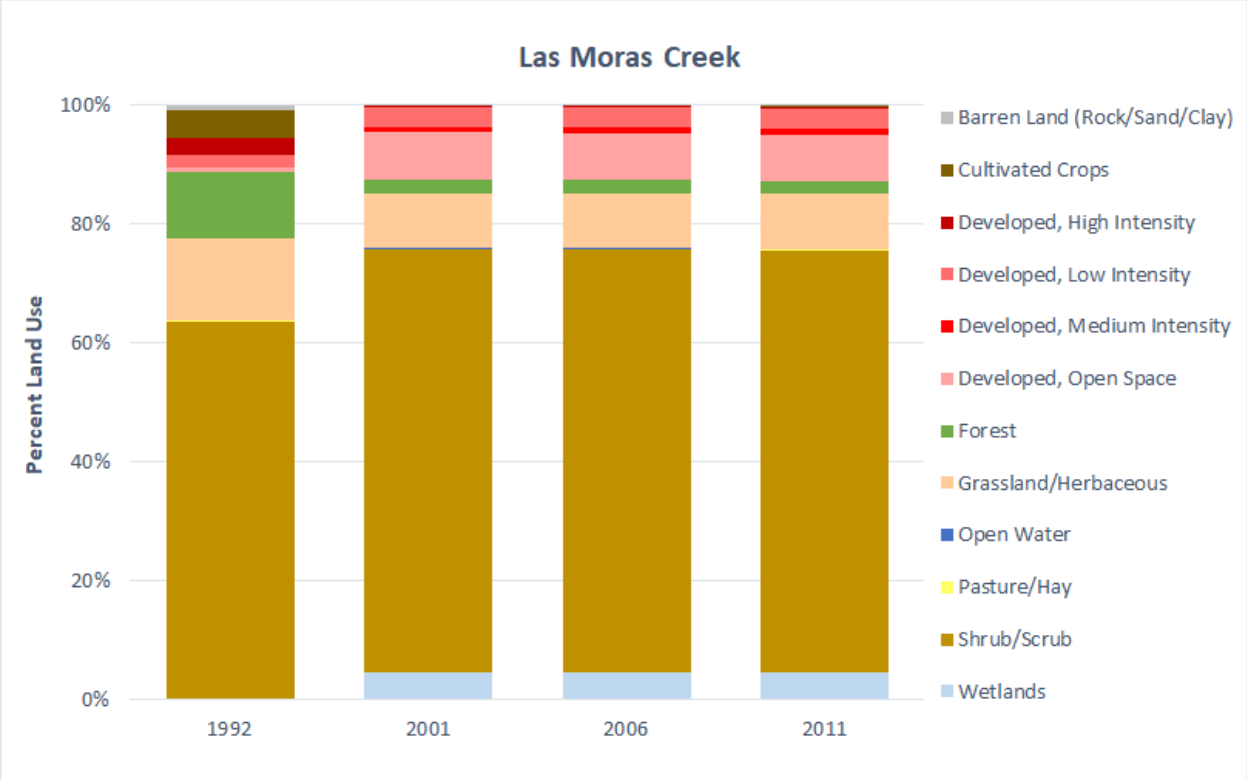

Figure 249. Percent land use in the Las Moras Creek watershed from 1992-2011.

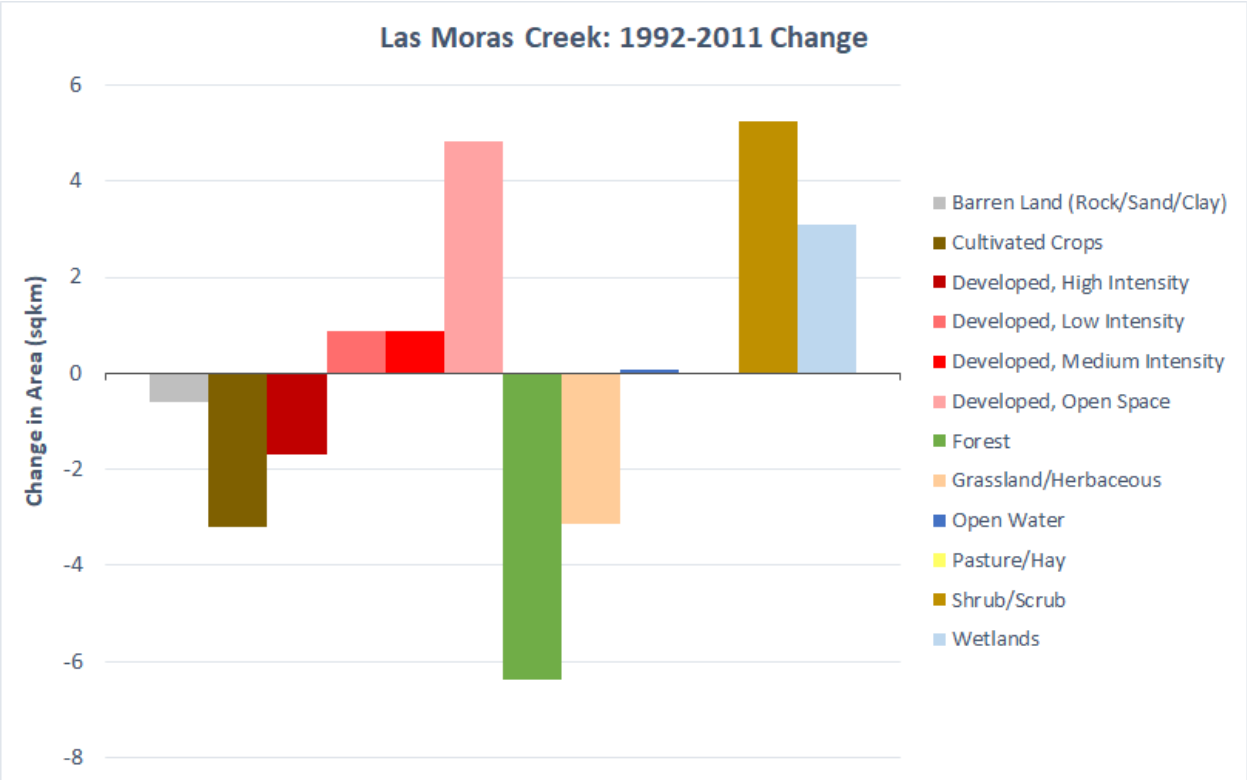

Figure 250. Land use change in area (sq km) from 1992-2011 for the Las Moras Creek watershed.

METATE CREEK

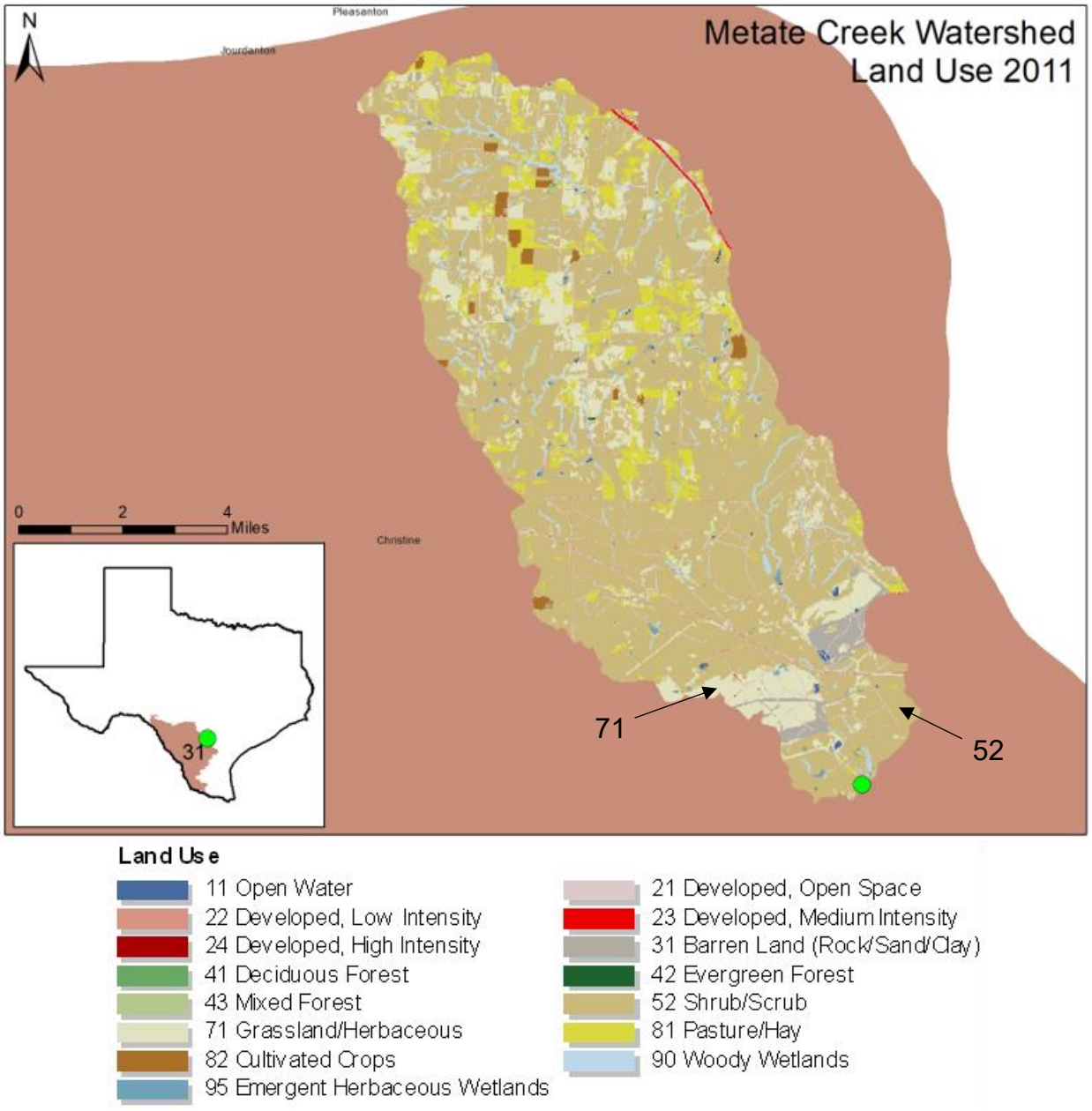

Figure 251. Map of Metate Creek watershed location and 2011 land use; shrub/scrub and grassland/herbaceous were the most common land uses.

Sampling Dates

Physical Habitat:	July 30, 1990
Water Quality:	2 sampling events
Fish:	July 30, 1990
Benthic Invertebrates:	July 30, 1990

Physical Characterization

Watershed and Land Use

Metate Creek lies within the Nueces River Basin. Sample site 12954 is located at FM 791, approximately 11.3 km southwest of Campbellton in Atascosa County (Figure 251).

The Metate Creek watershed at site 12954 is approximately 197.71 sq km. The entire watershed lies within Level IV Ecoregion 31c, the Texas-Tamaulipan Thornscrub. The dominant land cover in the watershed is shrub at 66.82% and is present throughout the watershed (Homer et al. 2015; Figure 251 and Figure 252). Grassland/herbaceous is the secondary land cover, encompassing 13.71%. The combined land cover for developed land use (open space and low, medium, and high intensity) totals 4.08% and the total for cultivated crops is 0.91%.

From 1992-2011 there was a 44.22 sq km decrease in forest and a 5.59 sq km decrease in cultivated crops. There was a 17.46 sq km increase in shrub and a 13.81 sq km increase in grassland (Figure 253).

There are no wastewater outfalls in the Metate Creek watershed.

In Channel and Riparian Physical Habitat

Physical habitat for Metate Creek was evaluated on July 30, 1990. The riparian width was 49 meters. The riparian zone was dominated by trees, which made up an average of 50% of the total riparian species, followed by shrubs (30%), then grasses (20%). The average percentage of tree canopy cover was 45%. The dominant substrate was clay/silt, and the average percent of substrate that was gravel size or larger was 0%. The average percent instream cover was 42%. Metate Creek had an average depth of 0.4 meter and a maximum depth of 0.7 meter. The average width was 5.1 meters, and the average stream bank slope was 48 degrees. Stream flow at the site was 0.04 cfs. Average stream bank erosion potential was 50%. Two riffles were observed at the site, and there was one poorly defined stream bend.

Water Quality

Water samples were collected at station 12954 over two sampling events, one in July 1990 and another in July 1999. Data were collected for temperature, flow, specific conductivity, dissolved oxygen, pH, alkalinity, ammonia, total Kjeldahl nitrogen, total nitrogen, phosphorus, chloride, sulfate, and chlorophyll-a. One 24-hour dissolved oxygen samples was collected on this segment in July 1990.

Biological Characterization

Fish

Eight species (five families) were collected from Metate Creek. Species were fairly evenly distributed among the families. Western Mosquitofish was the most abundant species. The aquatic life use (based upon the fish assemblage) rated as high.

Benthic Macroinvertebrates

Considering the single Surber sample from July 30, 1990, a total of 169 individuals representing 24 taxa from 8 orders of macroinvertebrates were collected from Metate Creek (Appendix E). Oligochaeta, Diptera, Basommatophora, and Coleoptera were the most commonly collected orders, collectively accounting for 94.1 percent of the total number of individuals collected. Ostracoda, Gastropoda, and Odonata were the only other orders collected which comprised greater than one percent of the collections. The Central Bioregion Surber BIBI for the 1990 Surber sample fell in the intermediate aquatic life use category.

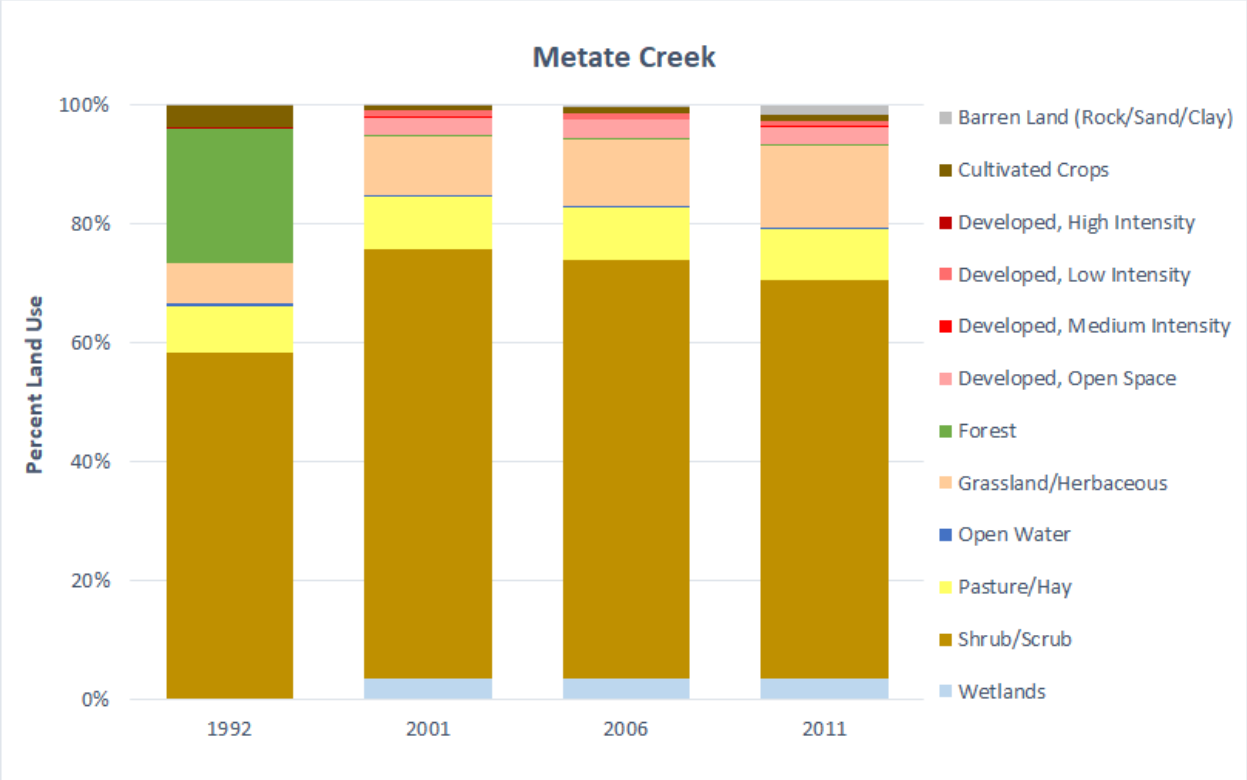

Figure 252. Percent land use in the Metate Creek watershed from 1992-2011.

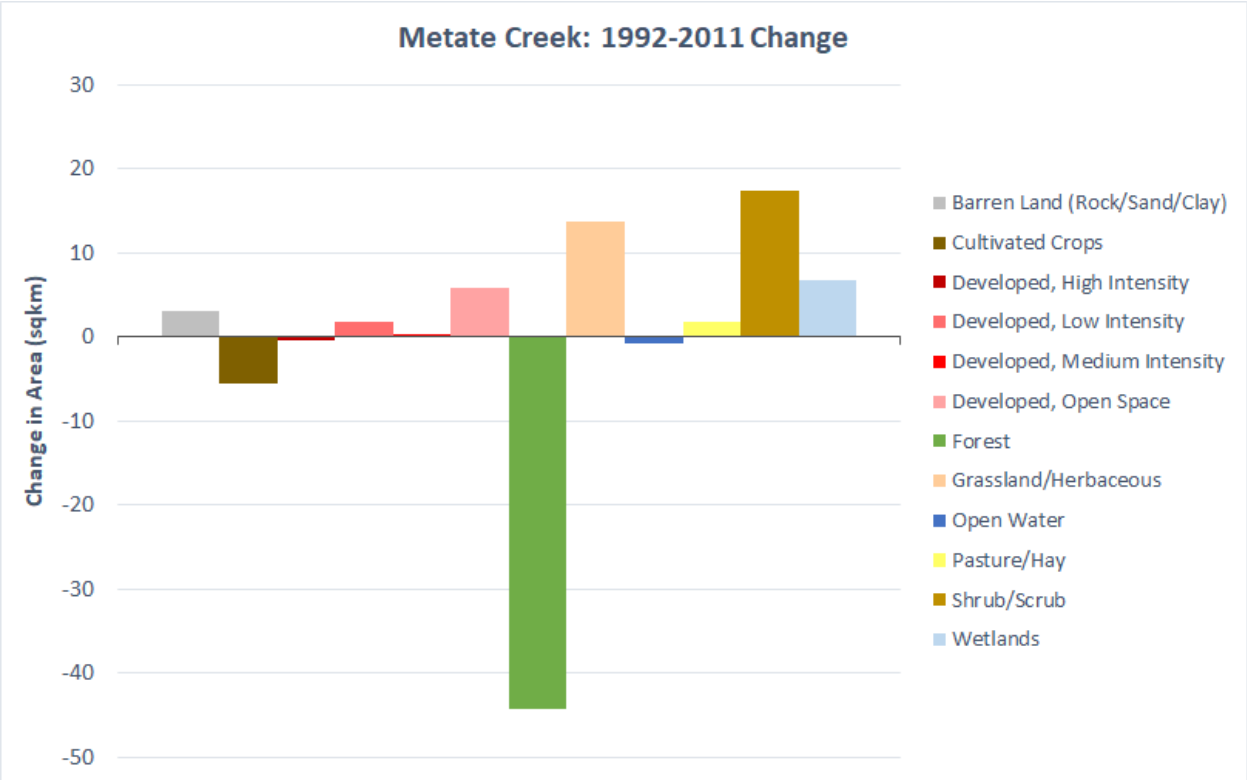

Figure 253. Land use change in area (sq km) from 1992-2011 for the Metate Creek watershed.

MUD CREEK

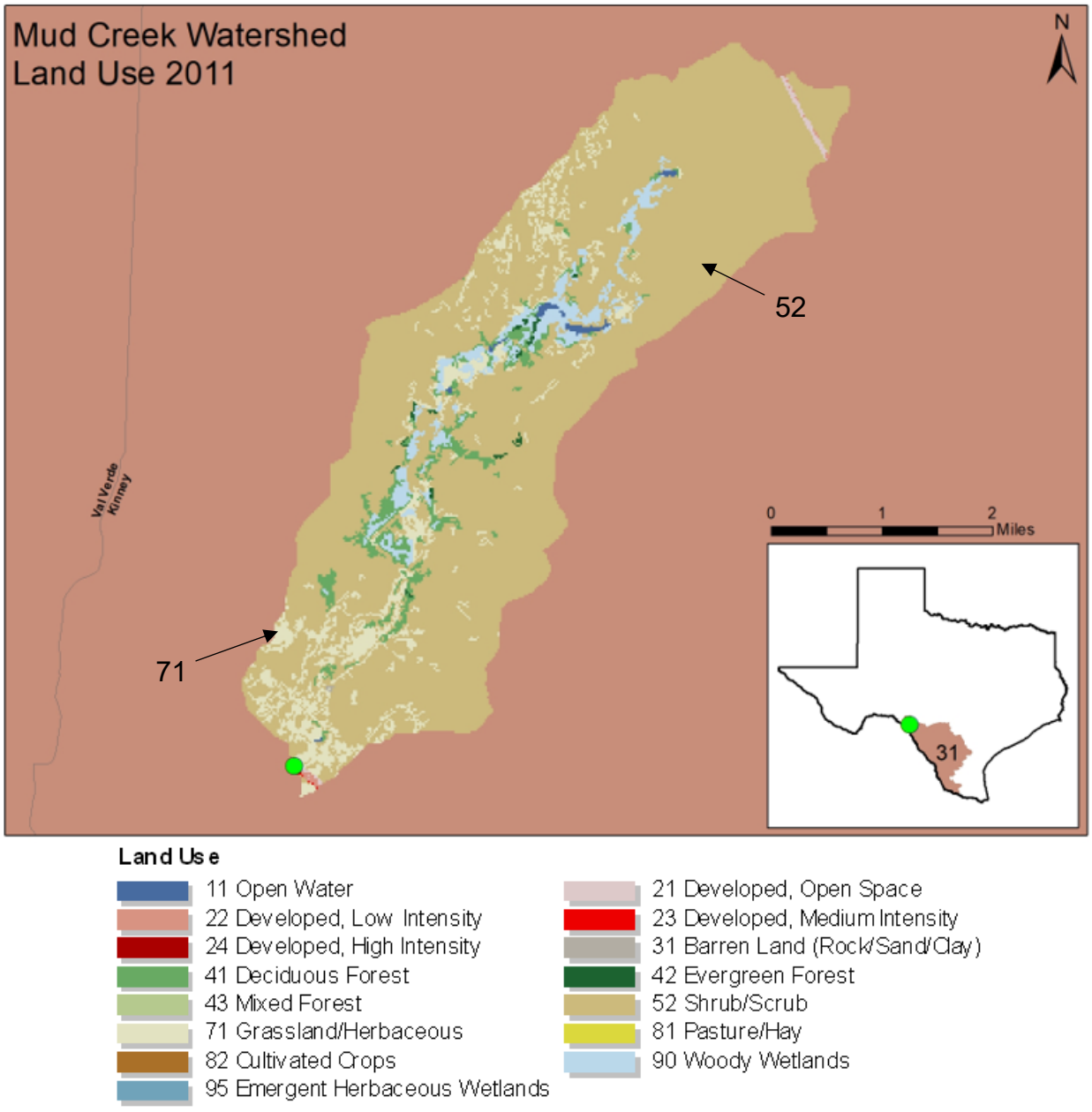

Figure 254. Map of Mud Creek watershed location and 2011 land use; shrub/scrub and grassland/herbaceous were the most common land uses.

Sampling Dates

Physical Habitat:	June 14, 1990
Water Quality:	6 sampling events
Fish:	June 14, 1990
Benthic Invertebrates:	June 14, 1990

Physical Characterization

Watershed and Land Use

Mud Creek lies within the Rio Grande Basin. Sample site 13136 is located at US 90, approximately 27.4 km west of Brackettville in Kinney County (Figure 254).

The Mud Creek watershed at site 13136 is approximately 36.16 sq km. The entire watershed lies within Level IV Ecoregion 31b, the Semiarid Edwards Bajada. The dominant land cover in the watershed is shrub at 82.51% and is present throughout the watershed (Homer et al. 2015; Figure 254 and Figure 255). Grassland/herbaceous is the secondary land cover, encompassing 8.66%. The combined land cover for developed land use (open space and low, medium, and high intensity) totals 0.45% and there is no cultivated crop cover present within the watershed.

From 1992-2011 there was a 2.14 sq km decrease in grassland and a 1.79 sq km decrease in forest. There was a 2.81 sq km increase in shrub and a 1.44 sq km increase in wetlands (Figure 256).

There are no wastewater outfalls in the Mud Creek watershed.

In Channel and Riparian Physical Habitat

Physical habitat for Mud Creek was evaluated on June 14, 1990. Mud Creek is a spring-fed stream that drains to Sycamore Creek, a tributary of the Rio Grande River. The riparian width was 36 meters. The riparian zone was dominated by grasses, which made up an average of 70% of the total riparian species, followed by shrubs (20%) then trees (10%). The average percentage of tree canopy cover was 0%. The dominant substrate was clay/silt, and the average percent of substrate that was gravel size or larger was 6%. Average percent instream cover was 39%. Mud Creek had an average depth of 0.2 meters and a maximum depth of 0.4 meters. The average width was 8.5 meters, and the average stream bank slope was 8 degrees. Stream flow at the site was 0.93 cfs. Average stream bank erosion potential was 22%. No riffles were observed at the site, and there was one moderately defined stream bend.

Water Quality

Water samples were collected at station 13136 over 6 sampling events from June 1993 to July 1999. Data were collected for temperature, flow, transparency, specific conductivity, dissolved oxygen, pH, alkalinity, ammonia, total Kjeldahl nitrogen, total nitrogen, phosphorus, total organic carbon, chloride, sulfate, and chlorophyll-a. One 24-hour dissolved oxygen sample was collected on this segment in June 1990.

Biological Characterization

Fish

Nine species (five families) were collected from Mud Creek. The Centrarchidae family had the greatest species richness, with four species present. Common Carp, a non-native species, was the most abundant species collected, making up over 50% of the individuals in the sample. The

aquatic life use only rated as intermediate. The only metric that did not receive a reduced score was the percentage of individuals with a disease or anomaly.

Benthic Macroinvertebrates

Considering the single Surber sample from June 14, 1990, a total of 258 individuals representing 45 taxa from 12 orders of macroinvertebrates were collected from Mud Creek (Appendix E). The Diptera, Coleoptera, Odonata, Ephemeroptera, Oligochaeta, and Trichoptera were the most commonly collected orders, collectively accounting for 91.5 percent of the total number of individuals collected. The Basommatophora, Hemiptera, and Veneroida were the only other orders which comprised at least one percent of the collections. The Central Bioregion Surber BIBI for the 1990 Surber sample fell in the high aquatic life use category.

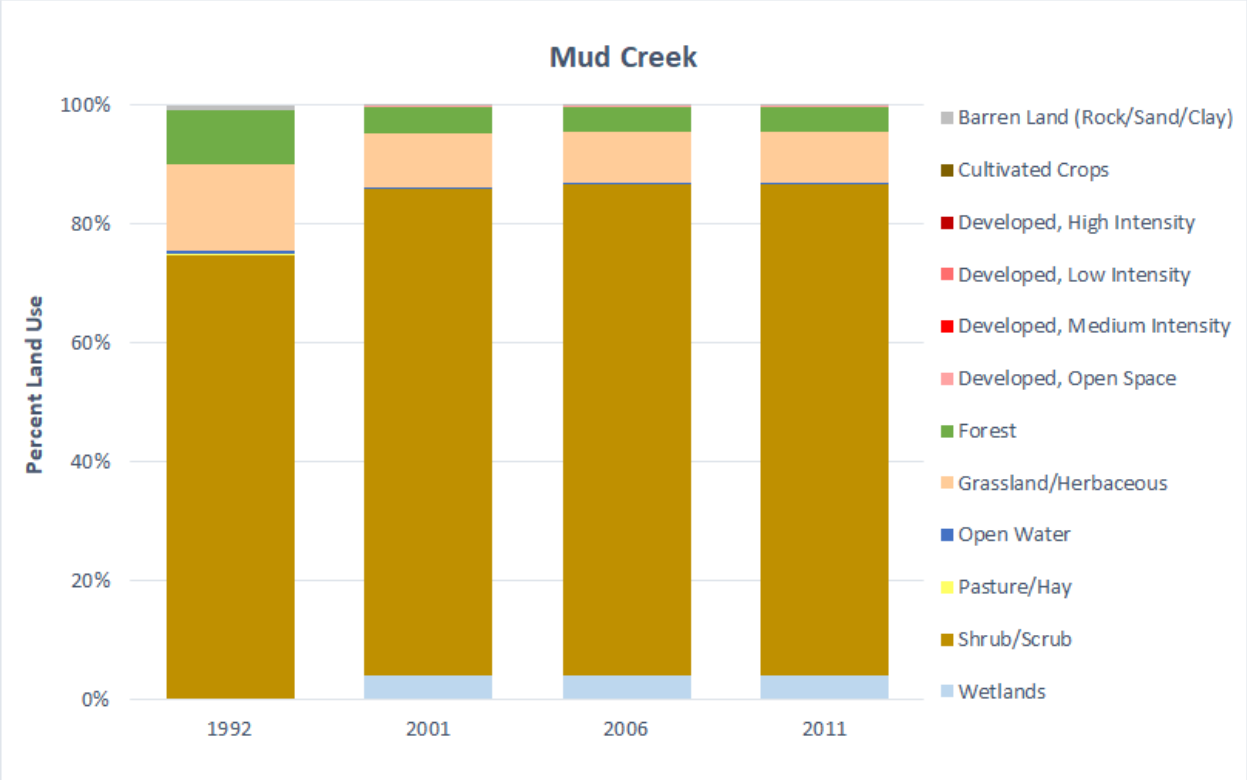

Figure 255. Percent land use in the Mud Creek watershed from 1992-2011.

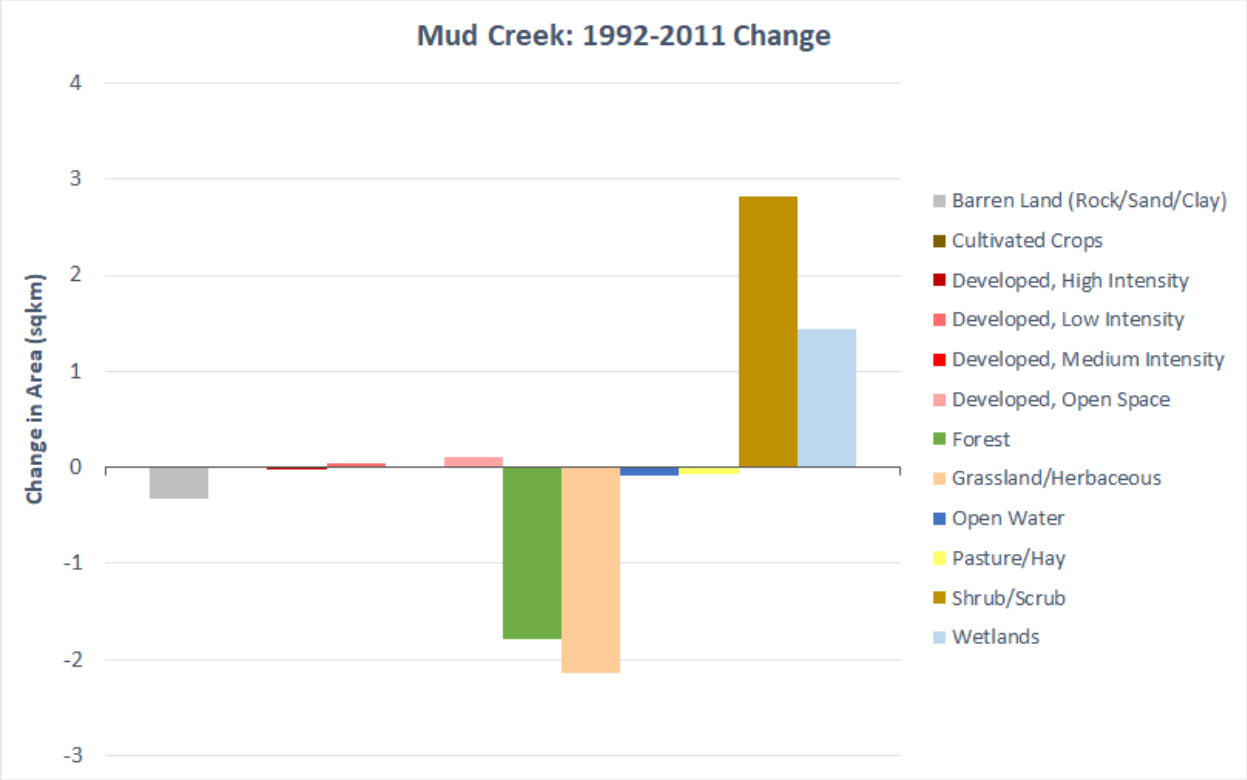

Figure 256. Land use change in area (sq km) from 1992-2011 for the Mud Creek watershed.

NUECES RIVER

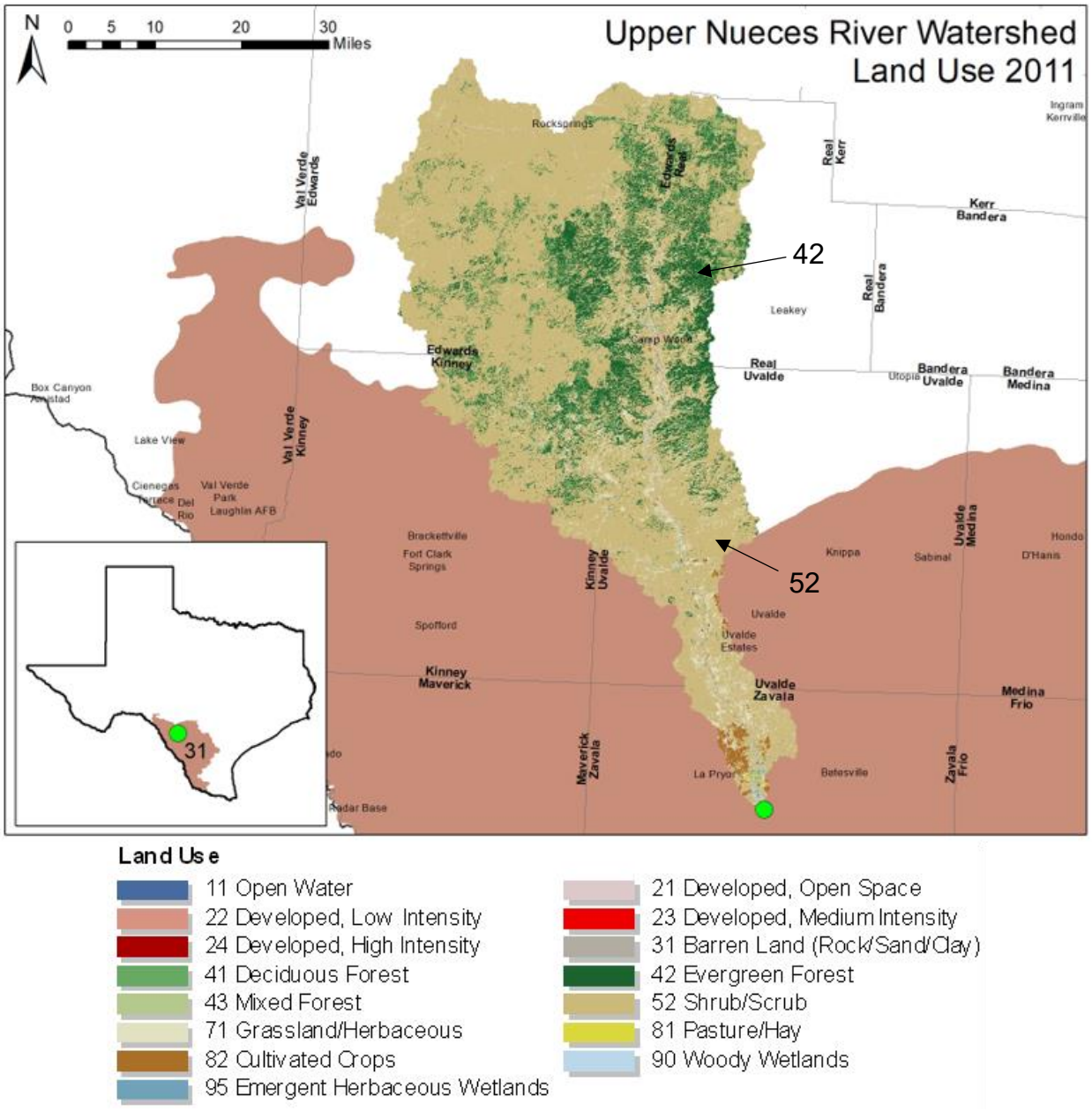

Figure 257. Map of Upper Nueces River watershed location and 2011 land use; shrub/scrub and forest were the most common land uses.

Sampling Dates

Physical Habitat:	April 18, 2002; September 18, 2002; October 2, 2017; June 12, 2018
Water Quality:	June 12, 2018
Fish:	April 16-18, 2002; September 17-18, 2002; October 2, 2017; June 12, 2018
Benthic Invertebrates:	October 2, 2017; June 12, 2018

Physical Characterization

Watershed and Land Use

Nueces River is the basin's namesake and is a major river basin in Texas. Sample site 22083 is located on La Pryor Ranch, approximately 8.85 river km downstream of SH 57 and 8.71 km southeast of La Pryor in Zavala County (Figure 257).

The Nueces River watershed at site 22083 is approximately 5160.44 sq km. The station and lower watershed lie within Level IV Ecoregion 31a, the Northern Nueces Alluvial Plains. A small portion of the watershed lies within Level IV Ecoregion 31c, the Texas-Tamaulipan Thornscrub, while the middle and upper watershed lie within Ecoregion 30. The dominant land cover is shrub, which is present throughout 71.90% of the watershed (Homer et al. 2015; Figure 257 and Figure 258). Forest is the secondary land cover encompassing 20.19% of the watershed. The combined land cover for developed land use (open space and low, medium, and high intensity) totals 1.73%, and total for cultivated crop is 0.82%.

From 1992-2011 there was an 805.94 sq km decrease in forest and a 539.77 sq km decrease in grassland. There was a 1407.05 sq km increase in shrub and a 79.07 sq km increase in open space development (Figure 259).

There are no wastewater outfalls in the Nueces River watershed.

In Channel and Riparian Physical Habitat

Physical habitat for the Nueces River was evaluated at two sites across four sampling events. One site, located at the intersection of US 83, was sampled on April 18, 2002, September 18, 2002, and October 2, 2017. The second site, located on La Pryor Ranch, was sampled on June 12, 2018. Habitat Quality Index scores in April and September 2002 were 18.5 and 20, respectively and indicate an intermediate to high aquatic life use, while scores in 2017 and 2018 (25 and 28, respectively) indicate a high to exceptional aquatic life use rating. The riparian buffer ranged from 0 meters in 2002 to greater than 20 meters in 2017 and 2018. The riparian zone was primarily dominated by trees, followed by shrubs, then grasses. The average percentage of tree canopy cover ranged from 18% to 77%. The dominant substrate was cobble/gravel in 2002 and 2017, and silt in 2018. The average percent of substrate that was gravel size or larger ranged from 60% to 87%. Average percent instream cover varied from 34% to 86%, and instream cover types include macrophytes, cobble/gravel, woody debris, algae, overhanging vegetation, and undercut banks. The Nueces River ranges from 0.3-0.6 meters deep on average and 11-39 meters wide. Average stream bank slope was between 24 and 39 degrees. Stream flow at the site was measured at a minimum value of 10 cfs in 2018 and a maximum of 80 cfs in September 2002. Average stream bank erosion potential was 31% to 79%. The deepest pool was 2.4 meters in 2018. The maximum number of riffles observed was six in September 2002 and the maximum number of stream bends was four in 2018.

Water Quality

Water samples were collected during one event at station 22083 in June 2018. Data were collected for temperature, flow, transparency, specific conductivity, dissolved oxygen, pH, alkalinity, ammonia, total Kjeldahl nitrogen, total nitrogen, phosphorus, total organic carbon, chloride, sulfate, and chlorophyll-a. One 24-hour dissolved oxygen sample was collected on this segment during the June 2018 sampling event.

Biological Characterization

Fish

Data from five sampling stations located from upstream of FM 481 to US 57 (about 35 kilometers), were used to evaluate aquatic life use. 29 species (nine families) were collected over the course of 10 sampling events. The Centrarchidae family had the greatest species richness, with nine species present. Of the twenty-nine species, six were present in every sample. These six species were Blacktail Shiner, Western Mosquitofish, Rio Grande Cichlid (*Herichthys cyanoguttatus)*, Channel Catfish, Green Sunfish, and Longear Sunfish. Seven of the ten fish collections rated as exceptional, three as high. Two of the high ratings were from the most recent collections (from two different sampling locations). Both recent collections remained as high when the coefficient of variability was applied; however, the April 2002 collection rose to exceptional.

Benthic Macroinvertebrates

Considering the two RBP samples (October 2, 2017 and June 12, 2018) together, a total of 584 individuals representing 55 taxa from 17 orders of macroinvertebrates were collected from the Nueces River (Appendix E). Ephemeroptera, Trichoptera, Diptera, Coleoptera, Odonata, Hemiptera, and Neoophora were the most commonly collected orders, collectively accounting for 91.6 percent of the total number of individuals collected. Neotaenioglossa, Veneroida, Oligochaeta, and Lepidoptera were the only other orders which comprised at least 1% of the collections. The Statewide BIBI for both RBP samples fell in the exceptional aquatic life use category.

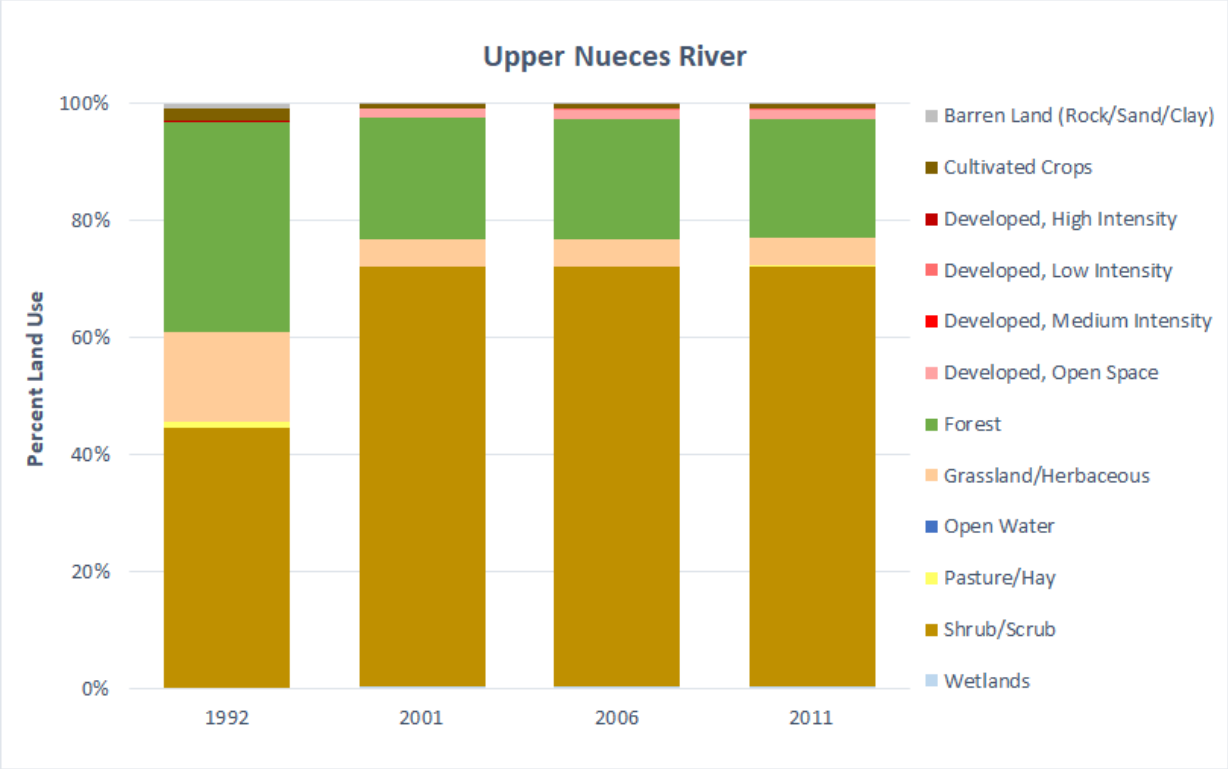

Figure 258. Percent land use in the Upper Nueces River watershed from 1992-2011.

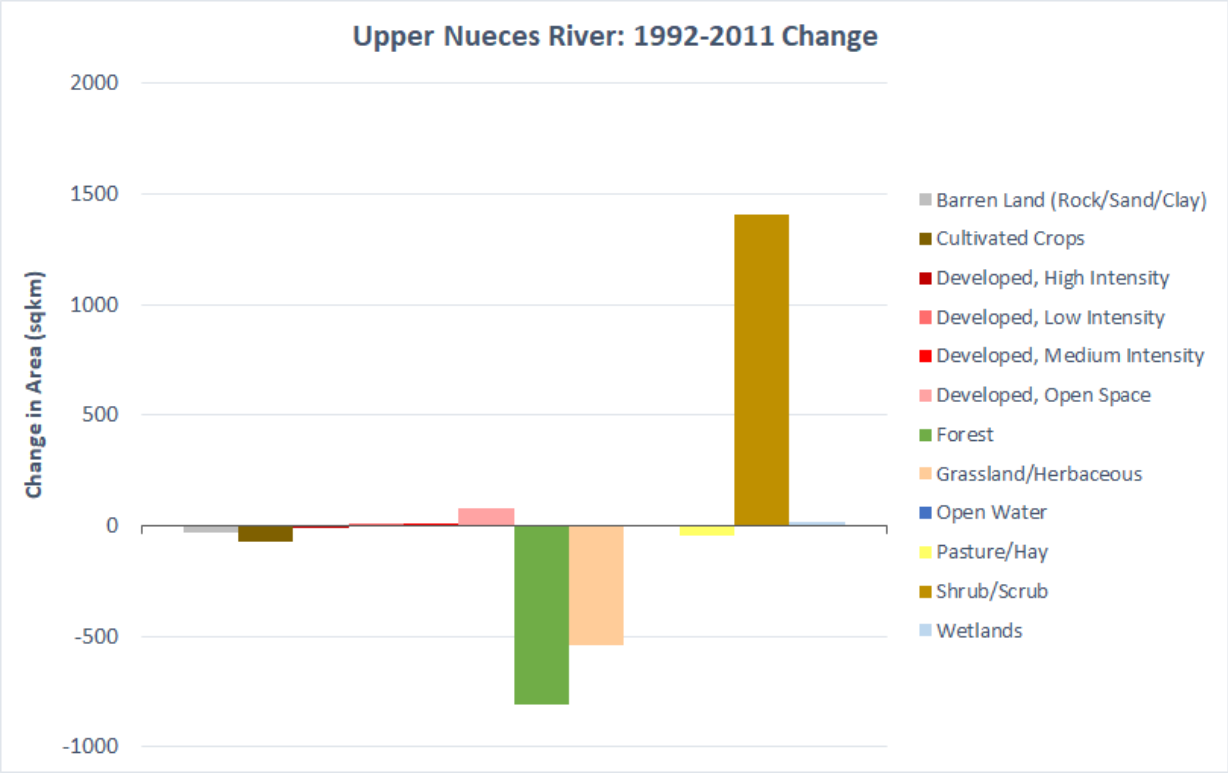

Figure 259. Land use change in area (sq km) from 1992-2011 for the Upper Nueces River watershed.

PINTO CREEK

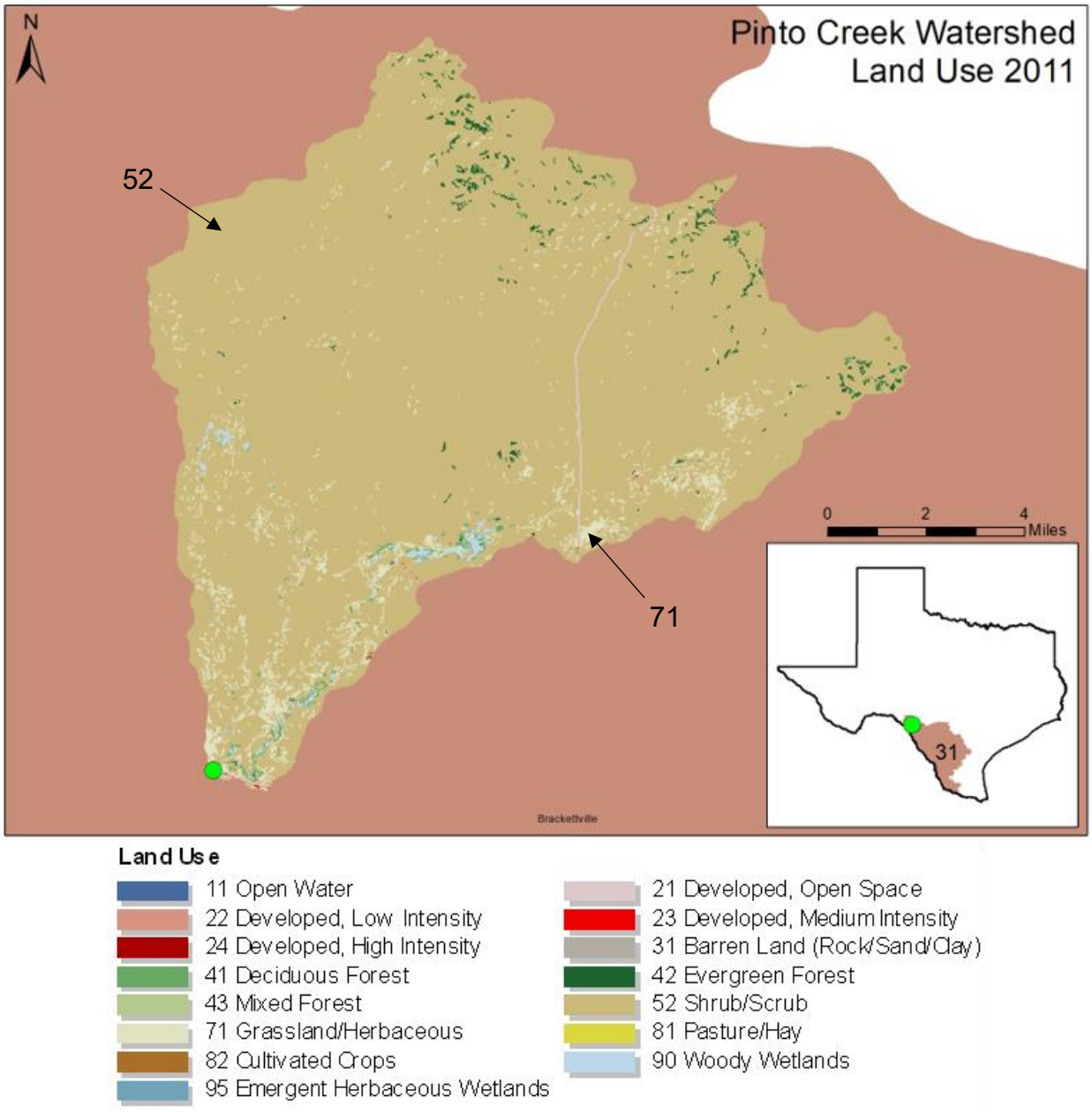

Figure 260. Map of Pinto Creek watershed location and 2011 land use; shrub/scrub and grassland/herbaceous were the most common land uses.

Sampling Dates

Physical Habitat:	June 13, 1990; July 7, 2016; February 28, 2017
Water Quality:	July 2016; February 2017
Fish:	June 13, 1990; July 7, 2016; February 28, 2017
Benthic Invertebrates:	June 13, 1990; July 7, 2016; February 28, 2017

Physical Characterization

Watershed and Land Use

Pinto Creek lies within the Rio Grande Basin. Sample site 13137 is located on US 90, 12.9 kilometers west of Brackettville in Kinney County (Figure 260).

The Pinto Creek watershed at site 13137 is approximately 309.39 sq km. The station and majority of the watershed lie within Level IV Ecoregion 31b, the Semiarid Edwards Bajada. A small portion of the upper watershed lies within Level IV Ecoregion 31c, the Texas-Tamaulipan Thornscrub. The dominant land cover is shrub, present throughout 93.48% of the watershed (Homer et al. 2015; Figure 260 and Figure 261). Grassland/herbaceous is the secondary land cover encompassing 4.17%. The combined land cover for developed land use (open space and low, medium, and high intensity) totals 0.35%, and the total for cultivated crop is 0.01%.

From 1992-2011 there was a 57.56 sq km decrease in grassland and a 24.50 sq km decrease in forest. There was a 98.44 sq km increase in shrub and a 1.64 sq km increase in wetlands (Figure 262).

There are no wastewater outfalls in the Pinto Creek watershed.

In Channel and Riparian Physical Habitat

Pinto Creek is a spring-fed stream that drains to the Rio Grande River. Physical habitat for Pinto Creek was evaluated at three sites within an 8-kilometer stretch north of US 90. One site was sampled on June 13, 1990, the second on July 7, 2016, and the third site on February 28, 2017. Habitat Quality Index scores in 2016 and 2017 were 23 and 23.5, respectively, and both indicate a high aquatic life use rating. The riparian buffer was wide and ranged from 12 meters on average to greater than 20 meters. The riparian zone was dominated by trees, followed by shrubs and grasses; and the average percentage of tree canopy cover ranged from 39% to 41%. The dominant substrate was silt, but cobble and gravel were common in riffle/run habitats, and the average percent of substrate gravel size or larger ranged from 16% to 28%. Average percent instream cover varied from 47% to 54%, and instream cover types included abundant macrophytes, algae, woody debris, overhanging vegetation, undercut banks, root mats, cobble/gravel, and boulders. Pinto Creek was 0.7-1.1 meters deep on average and 17 to 22 meters wide. The deepest pool at Pinto Creek was 3 meters. Average stream bank slope ranged from 22-28 degrees, and stream bank erosion potential was 15% to 23% on average. Stream flow at the site was measured at a minimum value of 9.3 cfs in 2016 and a maximum of 29 cfs in 2017. At least one riffle was observed for each sampling event, and the maximum number of stream bends recorded was four in 2017.

Water Quality

Water samples were collected at two stations along Pinto Creek: at station 21921 in July 2016 and at station 21987 in February 2017. Data were collected for temperature, flow, transparency, specific conductivity, dissolved oxygen, pH, alkalinity, ammonia, total Kjeldahl nitrogen, total

nitrogen, phosphorus, total organic carbon, chloride, sulfate, and chlorophyll-a. One 24-hour dissolved oxygen sample was collected on this segment in June 1990.

Biological Characterization

Fish

Eighteen species (seven families) were collected over the course of the three sampling events. Centrarchidae was the most species-rich family, with seven species. The two most recent collections (which were conducted in a reach upstream of the 1990 collection) yielded Devils River Minnow (a federally listed threatened species) and Headwater Catfish, *Ictalurus lupus* (a state listed threatened species). Each of the three collections had a different dominant species. Red Shiner was the most abundant species in 1990 (it was not collected in the other two samples), Texas Shiner was the most abundant in 2016, and Western Mosquitofish was the most abundant in 2017. All three fish assemblages rated as having a high aquatic life use.

Benthic Macroinvertebrates

Considering the single Surber sample from June 13, 1990 and the two RBP samples (July 7, 2016 and February 28, 2017) collectively, a total of 2,534 individuals representing 124 taxa from 18 orders of macroinvertebrates were collected from Pinto Creek (Appendix E). Trichoptera, Ephemeroptera, Veneroida, Diptera, Odonata, Coleoptera, Oligochaeta, Neoophora, and Amphipoda were the most commonly collected orders, collectively accounting for 93.4 percent of the total number of individuals collected. Basommatophora, Hoplonemertea, and Hemiptera were the only other orders which comprised at least one percent of the collections.

The Central Bioregion Surber BIBI for the 1990 Surber sample fell in the exceptional aquatic life use category. The statewide BIBI for the February 2017 and July 2016 RBP samples fell in the exceptional and high aquatic life use categories, respectively.

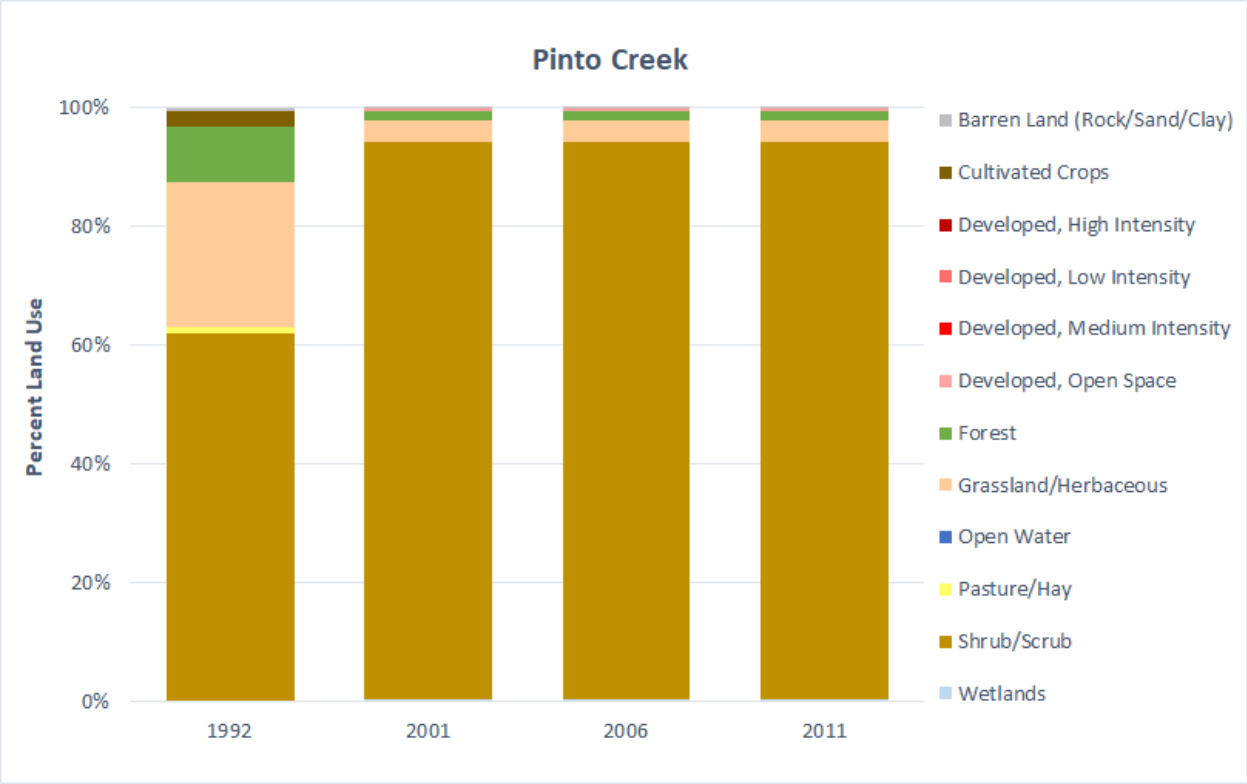

Figure 261. Percent land use in the Pinto Creek watershed from 1992-2011.

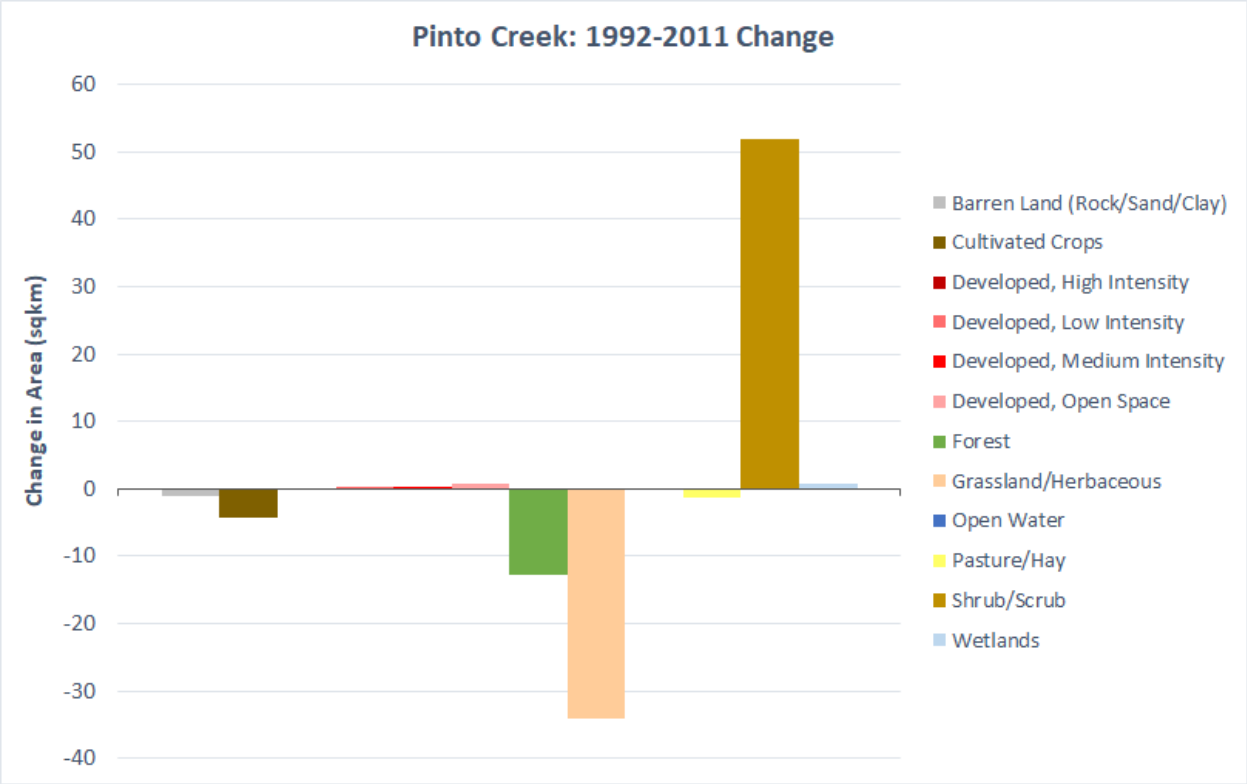

Figure 262. Land use change in area (sq km) from 1992-2011 for the Pinto Creek watershed.

SAN MIGUEL CREEK

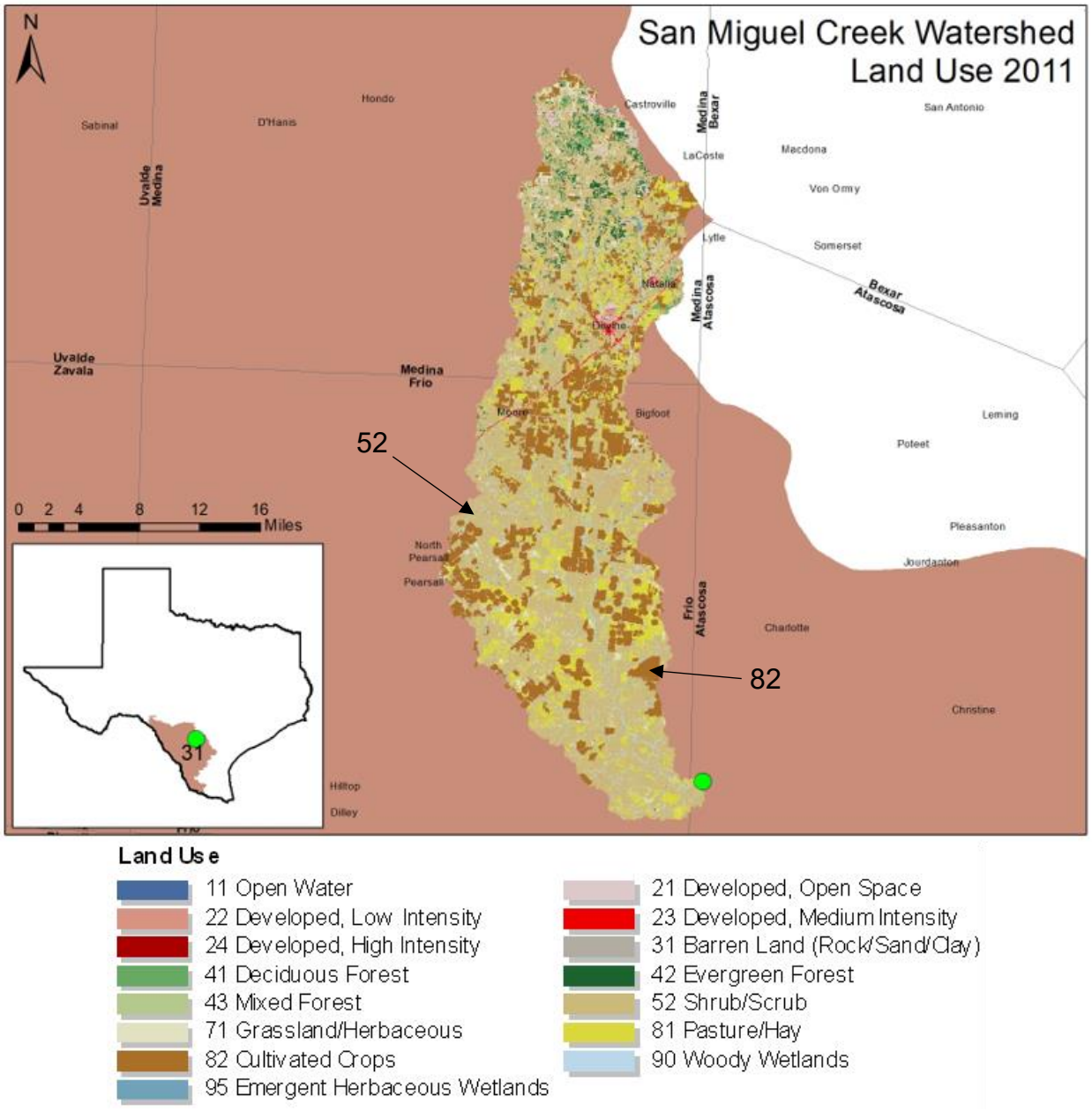

Figure 263. Map of San Miguel Creek watershed location and 2011 land use; shrub/scrub and cultivated crops were the most common land uses.

Sampling Dates

Physical Habitat:	July 31, 1990; June 13, 2018
Water Quality:	July 1990; July 1999; July 2018
Fish:	July 31, 1990; June 13, 2018
Benthic Invertebrates:	July 31, 1990; June 13, 2018

Physical Characterization

Watershed and Land Use

San Miguel Creek lies within the Nueces River Basin. Sample site 12984 is located at SH 97, approximately 19.31 km south of Charlotte in Atascosa County (Figure 263).

The San Miguel Creek watershed at site 12984 is approximately 1275.26 sq km. The station and lower watershed lie within Level IV Ecoregion 31c, the Texas-Tamaulipan Thornscrub, while the upper watershed lies in Level IV Ecoregion 31a, the Northern Nueces Alluvial Plains. The dominant land cover is shrub, present throughout 47.88% of the watershed (Homer et al. 2015; Figure 263 and Figure 264). Cultivated crop is the secondary land cover, encompassing 20.26%. The combined land cover for developed land use (open space and low, medium, and high intensity) totals 7.42%.

From 1992-2011 there was a 283.89 sq km decrease in pasture/hay and a 104.94 sq km decrease in forest. There was a 168.71 sq km increase in shrub and a 110.64 sq km increase in cultivated crops (Figure 265).

There are three domestic wastewater outfalls (discharging less than one million gallons per day) within the San Miguel Creek watershed. The domestic wastewater facilities are permitted to Moore Water Supply Company and the cities of Natalia and Devine. None of these facilities discharge directly into San Miguel Creek.

In Channel and Riparian Physical Habitat

Physical habitat for San Miguel Creek was evaluated on July 31, 1990, and again on June 13, 2018. San Miguel Creek is a perennial stream that drains to Choke Canyon Reservoir. The following summary information is based on data collected during the most recent sampling event in 2018. The Habitat Quality Index score of 17 indicates an intermediate aquatic life use rating. Riparian areas were well vegetated throughout the reach with an average riparian buffer measured at greater than 20 meters. The riparian zone was dominated by grasses, which make up an average of 70% of the total riparian species, followed by trees and shrubs (15% each). The average percentage of tree canopy cover was 66%. The dominant substrate was silt, and the average percent of substrate that was gravel size or larger was 29%. Average percent instream cover was 25%, and instream cover types included woody debris, boulders, and cobble. San Miguel Creek was 0.4 meters deep and 6.2 meters wide on average. The average stream bank slope was 44 degrees, and the average stream bank erosion potential was 74%. The deepest pool measured at San Miguel Creek was 1.07 meters. Stream flow at the site was measured at a minimum value of 0 cfs in 2018 and a maximum of 3.9 cfs in 1990. No riffles were observed at the site in 2018 due to low flow conditions, and there were three total stream bends.

Water Quality

Water samples were collected at both stations 12984 and 22085 on San Miguel Creek. Water samples were collected at station 12984 over two events: July 1990 and July 1999. Additionally, one set of water samples were collected in July 2018 at station 22085. Data were collected for

temperature, flow, specific conductivity, dissolved oxygen, pH, alkalinity, ammonia, total Kjeldahl nitrogen, total nitrogen, phosphorus, chloride, sulfate, and chlorophyll-a. One 24 hour dissolved oxygen sample was collected on this segment during the June 2018 sampling event.

Routine monitoring data at other stations along this segment in 2017 found portions of the segment to be intermittent with pools.

Biological Characterization

Fish

Sixteen species (six families) were collected between the two sampling events. Centrarchidae had the most species of any family with eight species represented. Three species were unique to the 1990 collection - Black Bullhead *Ameiurus melas*, Red Shiner, and Bullhead Minnow. Their absence from the 2018 collection is likely a function of their relatively low abundance rather than a change in water quality or habitat. The same can be said of Golden Shiner, Redbreast Sunfish, and Sailfin Molly *Poecilia latipinna,* which were only collected in 2018. Western Mosquitofish was the most abundant species in both collections. The aquatic life use for the 1990 and 2018 fish collections were exceptional and high, respectively.

Benthic Macroinvertebrates

Considering the single Surber sample from July 31, 1990 and single RBP sample from June 13, 2018 together, a total of 217 individuals representing 41 taxa from 12 orders of macroinvertebrates were collected from San Miguel Creek (Appendix E). Ephemeroptera, Diptera, Coleoptera, Decapoda, Odonata, and Amphipoda were the most commonly collected orders, collectively accounting for 92.3 percent of the total number of individuals collected. Hemiptera, Oligochaeta, and Basommatophora were the only other orders which comprised at least one percent of the collections.

The Central Bioregion Surber BIBI for the 1990 Surber sample fell in the high aquatic life use category. The statewide BIBI for the 2018 RBP sample fell in the intermediate aquatic life use category.

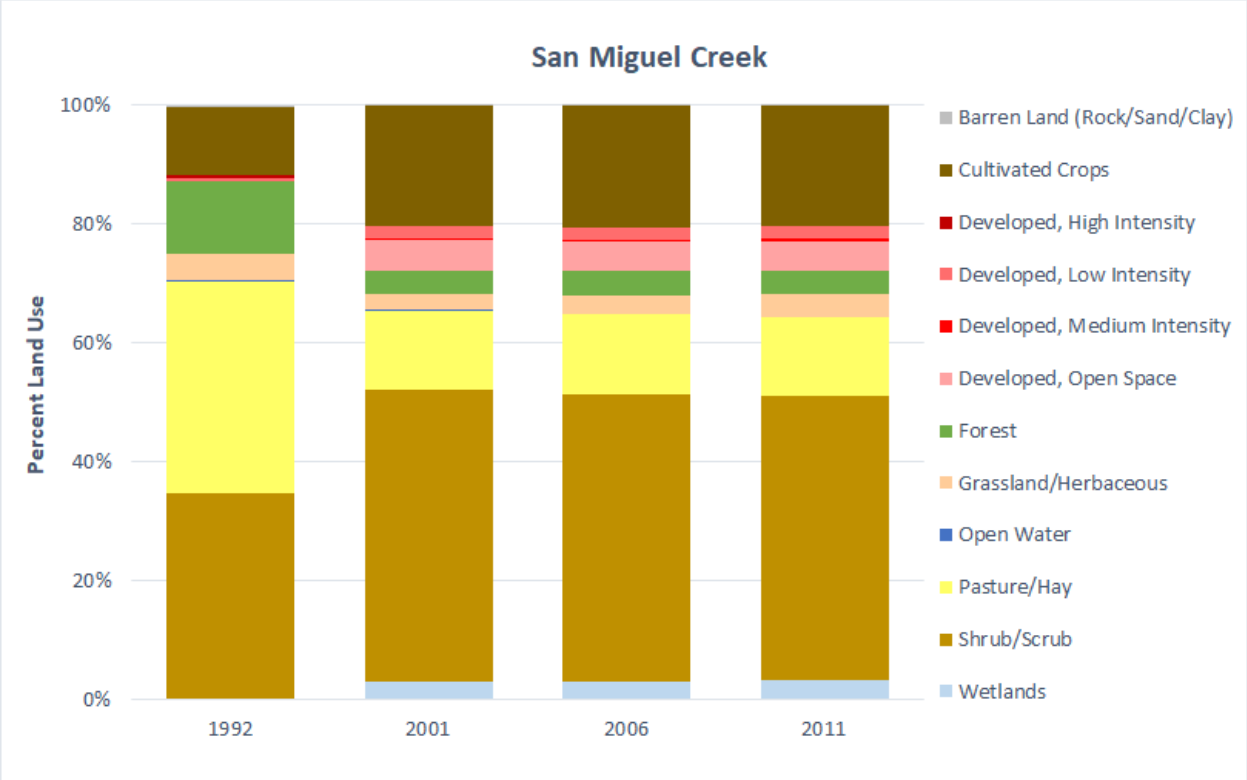

Figure 264. Percent land use in the San Miguel Creek watershed from 1992-2011.

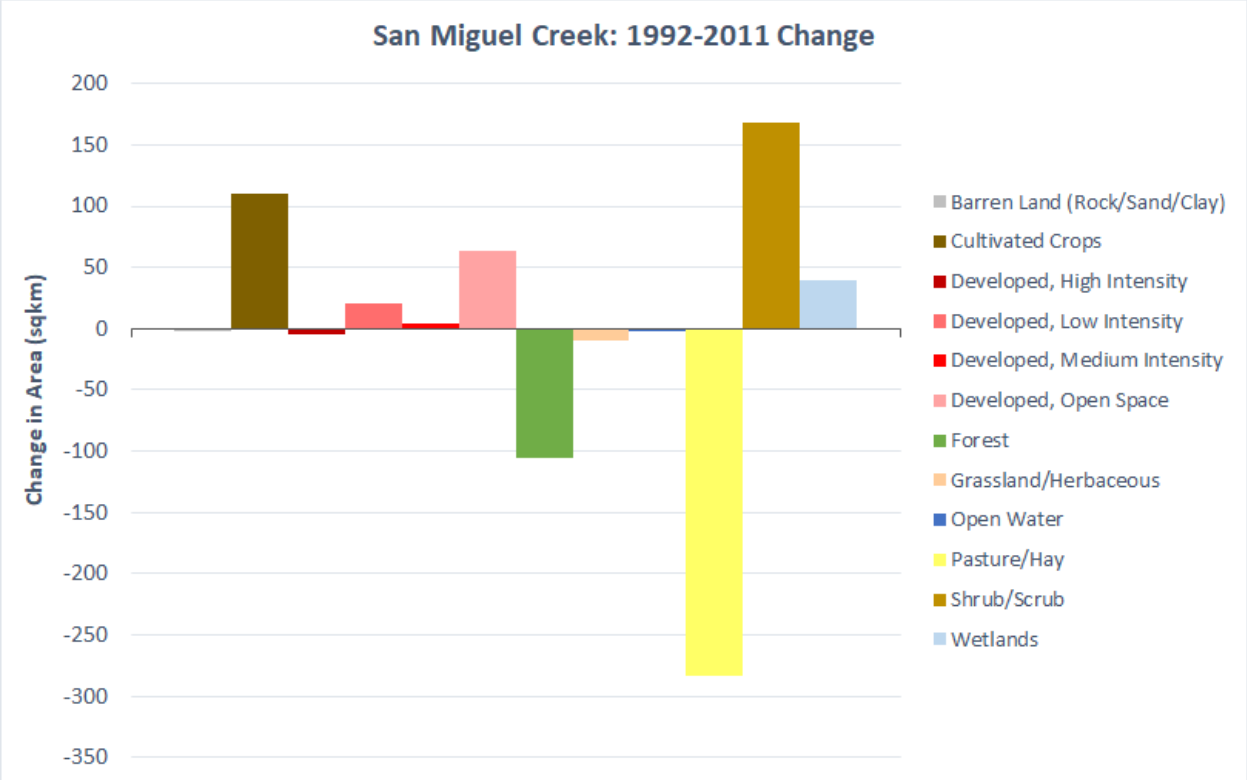

Figure 265. Land use change in area (sq km) from 1992-2011 for the San Miguel Creek watershed.

SYCAMORE CREEK

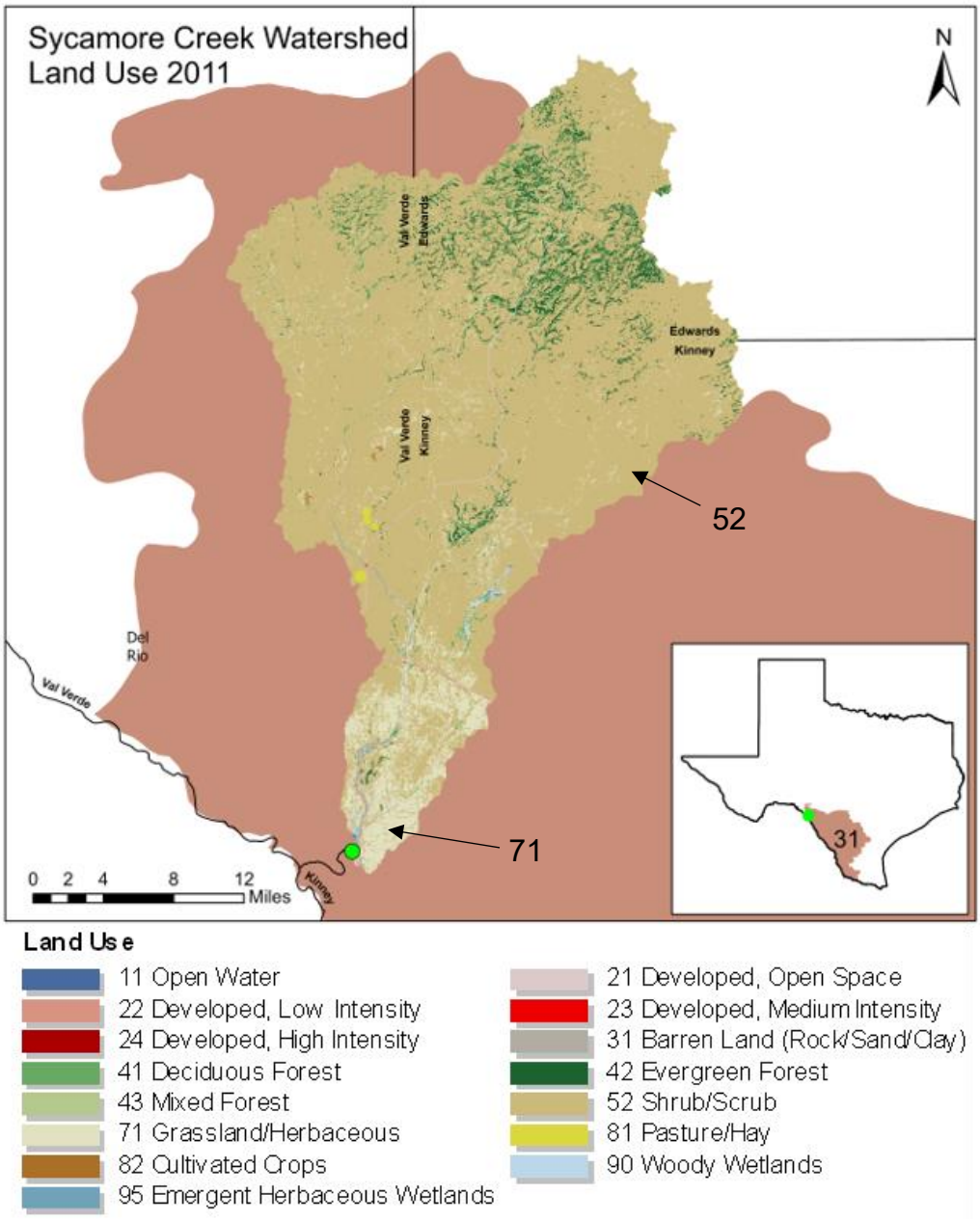

Figure 266. Map of Sycamore Creek watershed location and 2011 land use; shrub/scrub and grassland/herbaceous were the most common land uses.

Sampling Dates

Physical Habitat:	June 12, 1990; August 3, 2017
Water Quality:	12 sampling events
Fish:	June 12, 1990; August 3, 2017
Benthic Invertebrates:	June 12, 1990; August 3, 2017

Physical Characterization

Watershed and Land Use

Sycamore Creek lies within the Rio Grande Basin. Sample site 13135 is located upstream of US 277 approximately 18.5 km southeast of Del Rio in Val Verde County (Figure 266).

The Sycamore Creek watershed at site 13135 is approximately 1283.61 sq km. The station and a small portion of the lower watershed lie within Level IV Ecoregion 31c, the Texas-Tamaulipan Thornscrub. The middle portion of the watershed lies within Level IV Ecoregion 31b, the Semiarid Edwards Bajada, and the upper portion of the watershed lies within Ecoregion 30. The dominant land cover in the watershed is shrub at 83.87% and is present throughout the watershed (Homer et al. 2015; Figure 266 and Figure 267). Grassland/herbaceous is the secondary land cover encompassing 7.69%. The combined land cover for developed land use (open space and low, medium, and high intensity) totals 0.57% and total for cultivated crop is 0.05%.

From 1992-2011 there was a 304.13 sq km decrease in grassland and a 25.90 sq km decrease in pasture/hay. There was a 351.15 sq km increase in shrub and a 5.95 sq km increase in open space development (Figure 268).

There are no wastewater outfalls in the Sycamore Creek watershed.

In Channel and Riparian Physical Habitat

Physical habitat for Sycamore Creek was evaluated on June 12, 1990, and again on August 3, 2017. Sycamore Creek is a spring-fed perennial stream that drains to the Rio Grande River. The following summary information is based on data collected during the most recent sampling event in 2017. The Habitat Quality Index score of 25.5 indicates a high to exceptional aquatic life use rating. Riparian areas were well vegetated throughout the reach with an average riparian buffer measured at greater than 20 meters. The riparian zone was dominated by grasses, which make up an average of 40% of the total riparian species, followed by shrubs (35%) then trees (25%). The average percentage of tree canopy cover was 33%. The dominant substrate was gravel, and the average percent of substrate that was gravel size or larger was 69%. Average percent instream cover was 63% and instream cover types included undercut banks, macrophytes, algae, cobble/gravel, overhanging vegetation, root mats, woody debris, and bedrock ledges. Sycamore Creek was 0.5 meters deep on and 34.5 meters wide on average. Average stream bank slope was 21.5 degrees, and average stream bank erosion potential was 24%. The deepest pool measured at Sycamore Creek was 2 meters. Stream flow at the site was measured at a minimum value of 2.4 cfs in 1990 and a maximum of 13 cfs in 2017. Three riffles were observed at the site in 2017 and there were three total stream bends.

Water Quality

Water samples were collected at station 13135 over 12 sampling events from June 1990 to February 1993. Data were collected for temperature, flow, transparency, specific conductivity, dissolved oxygen, pH, alkalinity, ammonia, total Kjeldahl nitrogen, total nitrogen, phosphorus,

total organic carbon, chloride, sulfate, and chlorophyll-a. No 24-hour dissolved oxygen samples were collected on this segment.

Biological Characterization

Fish

Twenty-two species (seven families) were collected between the two sampling events. The family yielding the most species was Cyprinidae, with nine species present. Manantial Roundnose Minnow was the most abundant species in 1990 but was absent from the 2017 collection. The most abundant species in 2017 was Blacktail Shiner, which was only collected in relatively low numbers in 1990. Three state listed threatened species were collected in 1990 - Proserpine Shiner, Rio Grande Darter, and Headwater Catfish. Despite the 1990 sample yielding twice the number of species, both fish assemblages rated as having a high aquatic life use.

Benthic Macroinvertebrates

Considering the single Surber sample from June 12, 1990 and single RBP sample from August 3, 2017 together, a total of 2,826 individuals representing 84 taxa from 20 orders of macroinvertebrates were collected from Sycamore Creek (Appendix E). Diptera, Ephemeroptera, Neoophora, Trichoptera, Odonata, Neotaenioglossa, and Coleoptera were the most commonly collected orders, collectively accounting for 90.3 percent of the total number of individuals collected. Trombidiformes, Ostracoda, Oligochaeta, and Hirudinida were the only other orders which comprised at least one percent of the collections.

The Central Bioregion Surber BIBI for the 1990 Surber sample fell in the high aquatic life use category. The statewide BIBI for the 2017 RBP sample fell in the exceptional aquatic life use category.

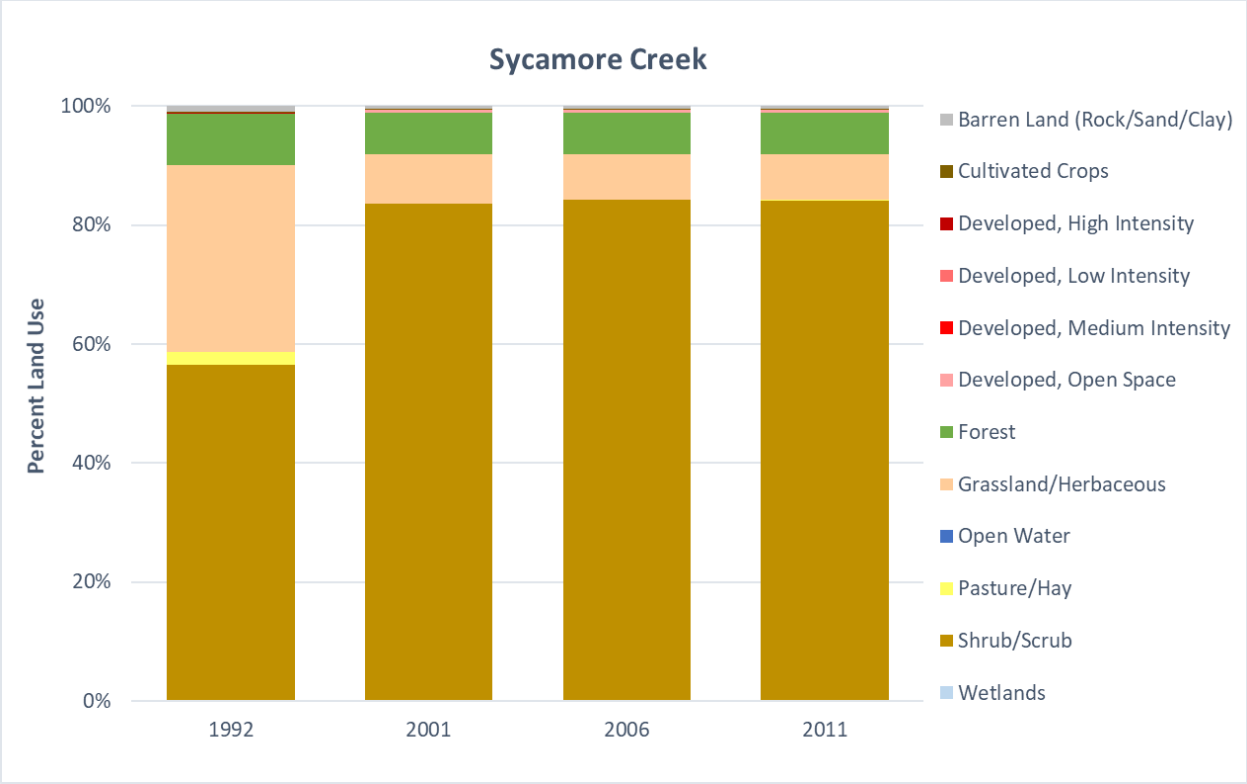

Figure 267. Percent land use in the Sycamore Creek watershed from 1992-2011.

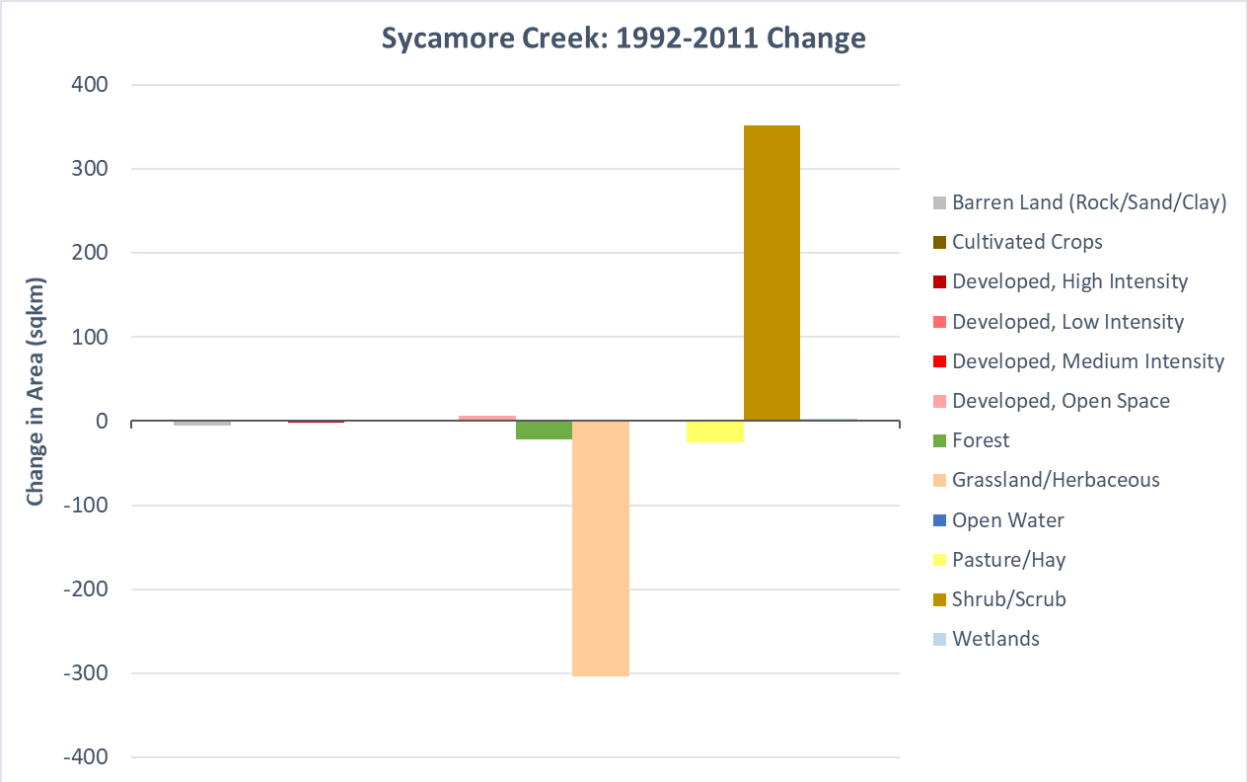

Figure 268. Land use change in area (sq km) from 1992-2011 for the Sycamore Creek watershed.

Ecoregion 31 Summary and Historical Characterization

Watershed and Land Use

Ecoregion 31 was historically covered by grassland and savanna vegetation; however, due to long continued grazing and fire suppression, this area is now predominantly thorny brush vegetation. The area contains a high diversity of animal life, and oil and gas production activities are widespread (Griffith et al. 2007). In 2011 the overall primary land cover in the study watersheds was shrub, and the secondary land cover was grassland. Between 1992-2011, forest experienced the largest decrease in combined land cover area across all watersheds (~856.54 sq km) and shrub experienced the largest increase (~2,050.86 sq km).

In Channel and Riparian Physical Habitat

Physical habitat for the Southern Texas Plains was evaluated at seven stream sites over 14 sampling events from 1990 to 2018. Watershed area varied from a minimum of 36 sq km at Mud Creek to a maximum of 5,160 sq km at the Upper Nueces River. The sites generally had well vegetated riparian zones, and the riparian buffer was 38 meters on average, with a minimum of 0 meters and maximum of 91 meters. Trees were the dominant riparian species (35% on average), followed by grasses (31%) and shrubs (31%), and average percent tree canopy coverage was 40%. Dominant substrate at the sites was generally silt or cobble/gravel. Average percentage of substrate gravel sized or larger was 44% and varied from a minimum of 0% to a maximum of 87%. Average percent instream cover was 42% and common instream cover types include macrophytes, cobble/gravel, woody debris, algae, overhanging vegetation, undercut banks, root mats, boulders and bedrock ledges. Average stream depth and width measurements were 0.5 meters and 16 meters, respectively. Average stream bank slope was 31 degrees and erosion potential was moderate, with an average of 41% which was reflected in the average bank stability HQI score (1.7) indicating moderately stable to moderately unstable stream banks. Maximum pool depth ranged from a minimum of 0.4 meters to a maximum of 3 meters. Total number of riffles varied from zero to six, and total number of stream bends ranged from one to ten. Additional in-channel and riparian physical habitat attributes are summarized in Appendix B.

HQI scores are available for eight events and range from a maximum score of 28 (exceptional) at the Upper Nueces River on La Pryor Ranch to a minimum score of 17 (intermediate) at San Miguel Creek on Las Lomas Ranch. Of the eight sampling events with an HQI score, two (25%) received a habitat assessment rating of exceptional, four (50%) received a rating of high, and the remaining two (25%) received a rating of intermediate. The highest scoring HQI metrics for the Southern Texas Plains were the dimensions of largest pool metric and the available instream cover metric. The lowest scoring HQI metrics on average were the channel sinuosity metric and the bank stability metric.

Water Quality

Water quality data from ecoregion 31 was similar between stations. Specific conductivity ranged between 315 and 1,810, with a median value of 488 microsiemens per centimeter (uS/cm) at 25° C. The transparency in the water column was higher than in the eastern part of the state, as indicated by the median Secchi value of one meter. The total organic carbon in ecoregion 31 was lower than other parts of the state and similar to concentrations in ecoregions 30 and 34. The pH values ranged from 7.09 to 8.4, with a median of 7.7. Nutrient concentrations in the streams were higher for nitrogen species than for total phosphorus. The median total phosphorus concentration of 0.03 mg/L and the median TKN concentration was 0.31 mg/L. Additional water quality variables are summarized in appendix C of the report.

Fish

A total of 9,345 individuals consisting of 10 families and 43 species have been documented in 20 sampling events across seven streams in the Southern Texas Plains from 1990 to 2018 (Appendix D - 5). For individual sites, taxa richness ranged from a high of 30 species at the Nueces River across 10 sampling events from 2002 to 2018, to a low of nine species at Las Moras, Metate, and Mud creeks from one sampling event each in 1990. The most abundant species collected across all sites and sampling events were Texas Shiner (n = 1,887), Longear Sunfish (n = 1,724), Western Mosquitofish (n = 1,266), Blacktail Shiner (n = 917), and Mexican Tetra (n = 588).

Index of biotic integrity scores across all sites and sampling events ranged from 25 to 47, resulting in aquatic life use categories of intermediate (n = 2), high (n = 10), and exceptional (n = 8; Figure 269). Of the 20 sampling events in this ecoregion, 90% received an ALU rating of high or exceptional; 10% received an ALU of intermediate. All sites received one ALU score of high or better except for Las Moras and Mud creeks which both received an ALU score of intermediate only.

Overall, IBI scores and individual metrics did not significantly change through time (Figure 270; Figure 271; Figure 272).

Benthic Macroinvertebrates

A total of 6,877 individuals representing 25 orders of aquatic macroinvertebrates were collected in the six Surber samples and six RBP samples collected at seven streams in the Southern Texas Plains ecoregion from June 1990 to June 2018 (Appendix E). Five orders (Basommatophora, Coleoptera, Diptera, Ephemeroptera and Odonata) were represented at all seven streams, which collectively represented 58 percent of the total number of individuals collected.

In terms of relative abundance, *Fallceon quilleri* (Ephemeroptera, Baetidae) was the most abundant taxon, representing almost 9 percent of the total number of individuals collected at all sites. Other relatively abundant taxa include the flatworm *Dugesia* sp., the black fly *Simulium* sp., the Asian clam *Corbicula fluminea*, the damselfly *Argia* sp., the caddisfly *Chimarra* sp., the microcaddisfly *Hydroptila* sp., the chironomid *Rheotanytarsus* sp., and the mayfly *Tricorythodes* sp.

The damselfly *Argia* sp. was the most widely distributed genus, and it was the only taxa collected at all seven streams. *Corbicula fluminea*, *Fallceon quilleri*, and *Simulium* sp. were also widely distributed genera/species, occurring in collections from six of the seven streams.

The BIBI scores for the Surber samples collected at Las Moras Creek and Pinto Creek in 1990 both fell in the exceptional aquatic life use category, while the BIBI scores for Surber samples from Mud Creek, San Miguel Creek, and Sycamore Creek fell in the high aquatic life use category, and the Surber sample from Metate Creek fell in the intermediate aquatic life use category (Figure 273). Results for the RBP IBI for the kicknet samples collected at Pinto Creek in 2017, Sycamore Creek in 2017, and the Upper Nueces River in 2017 and 2018 fell in the exceptional ALU category. The RBP IBI score for the Pinto Creek RBP sample collected in 2016 fell in the high aquatic life use category, while the results for San Miguel Creek in 2018 fell in the intermediate category. As was noted for fish, benthic macroinvertebrate biotic integrity, as indicated by the benthic IBI's, appeared to remain relatively constant over the interval from 1990 to 2018 (Figure 274).

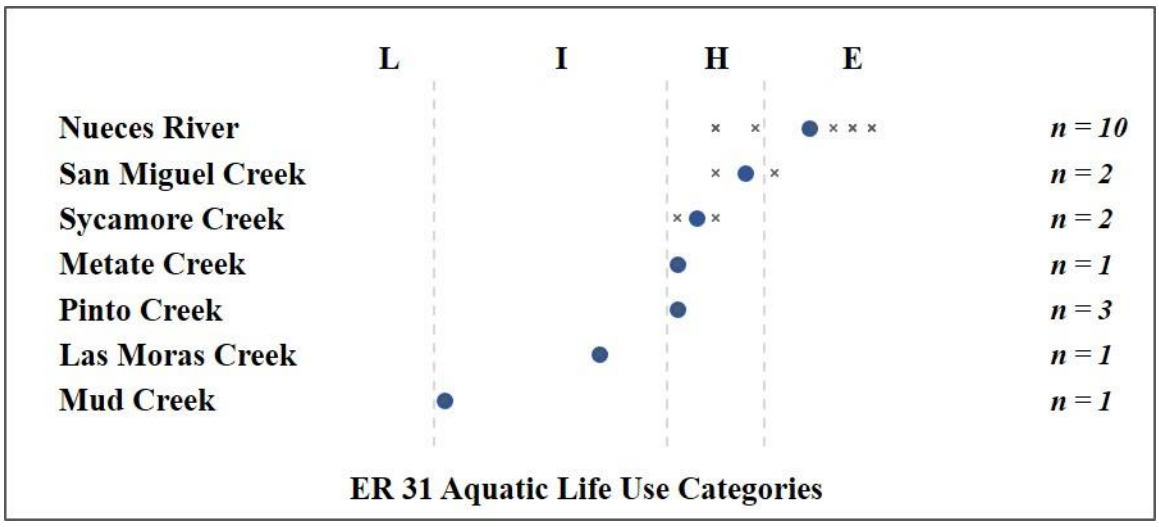

Figure 269. Aquatic life use categories (L – limited; I – intermediate; H – high; E – exceptional) for all fish sampling events in Ecoregion 31 grouped by site and ranked by mean ALU score (blue dot); number of sampling events per site noted on right.

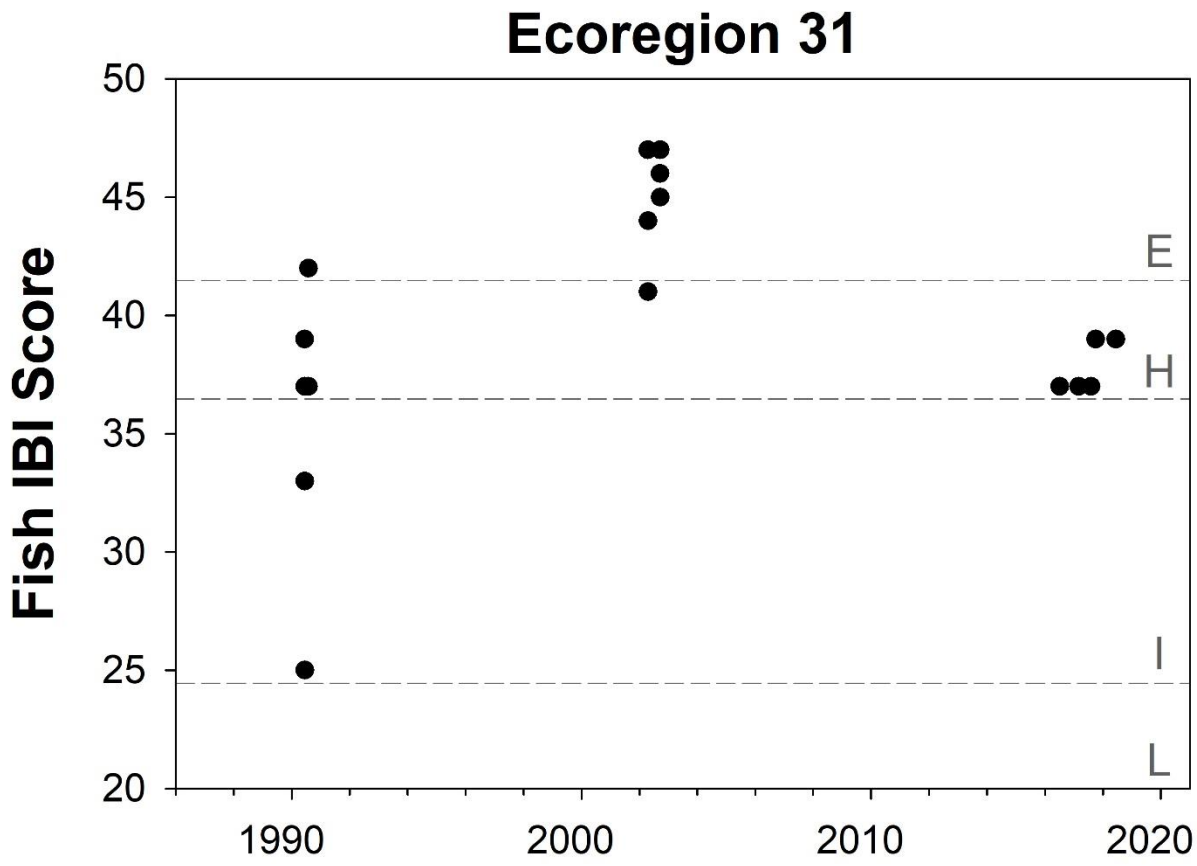

Figure 270. Fish index of biotic integrity scores through time for all sampling events in Ecoregion 31; break lines for aquatic life use categories (i.e., limited, intermediate, high, and exceptional) shown on each graph for reference (see Linam et al. 2002).

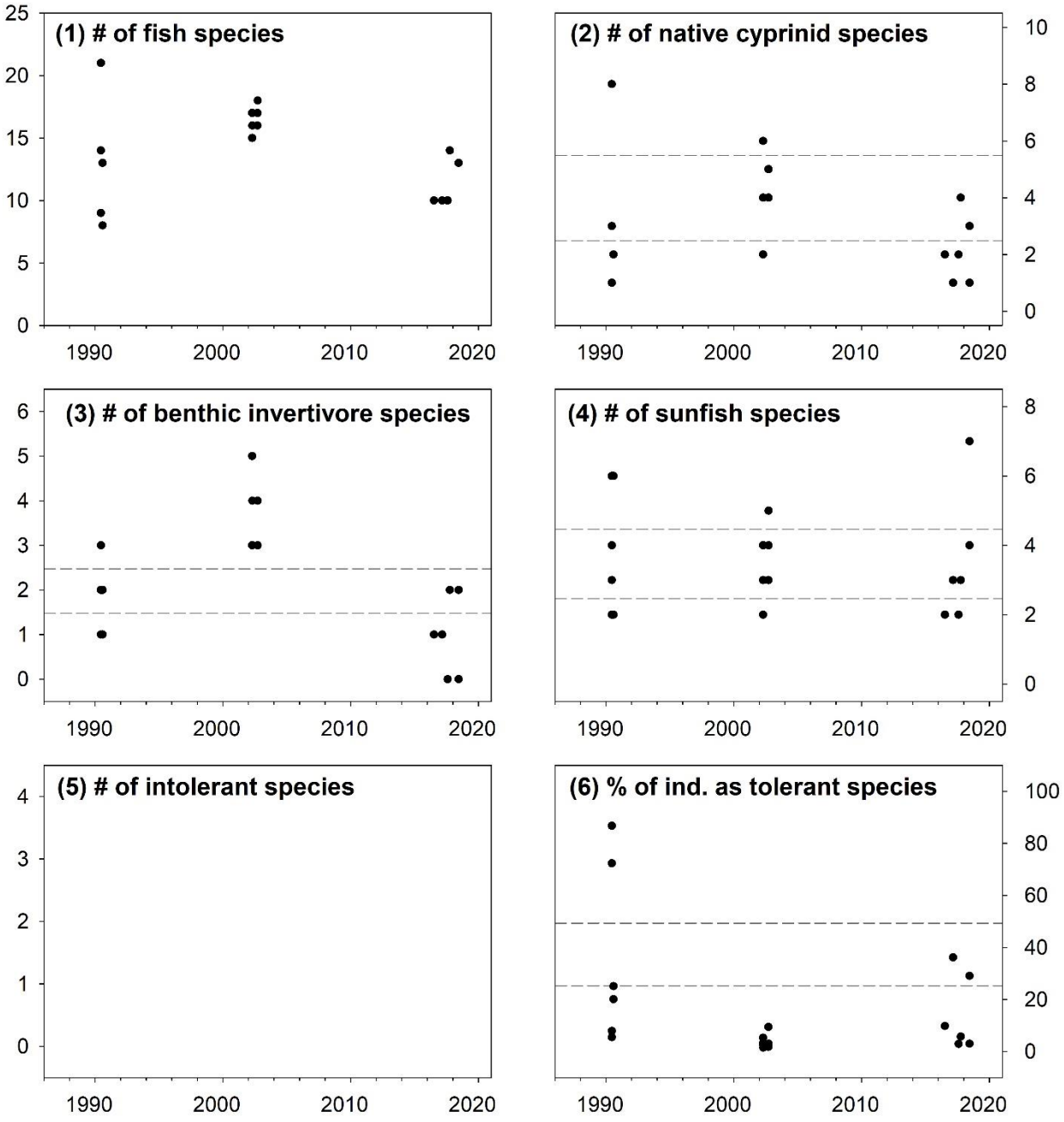

Figure 271. Raw values for fish index of biotic integrity metrics 1-6 through time for all sampling events in Ecoregion 31; break lines for scoring criteria (i.e., 1, 3, and 5) shown on each graph for reference (see Linam et al. 2002); metrics that are not included in the IBI for this ecoregion are blank.

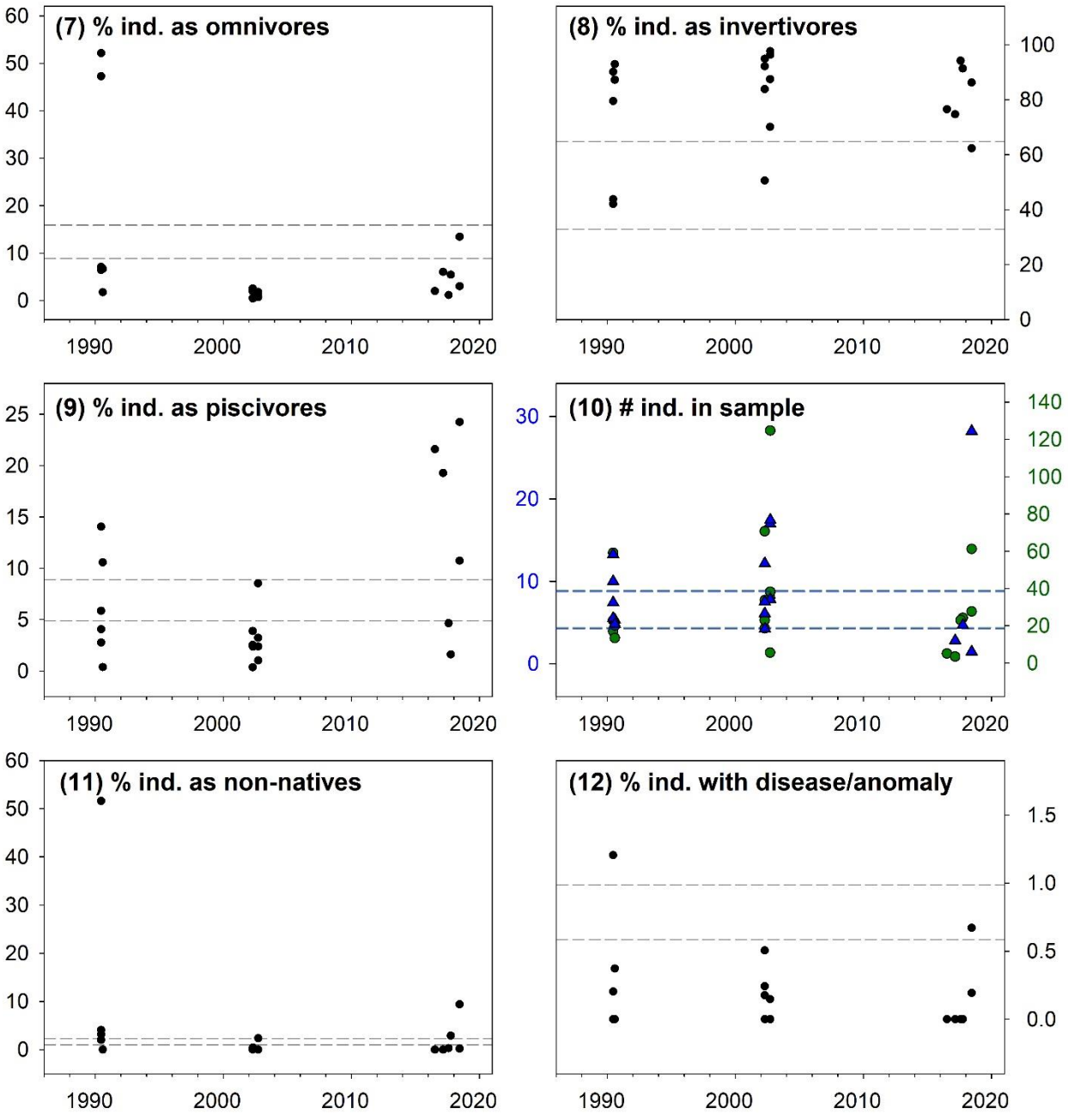

Figure 272. Raw values for fish index of biotic integrity metrics 7-12 through time for all sampling events in Ecoregion 31; break lines for scoring criteria (i.e., 1, 3, and 5) shown on each graph for reference (see Linam et al. 2002); number of ind./seine haul represented by green circles and number of ind./min electrofishing represented by blue triangles for metric number 10.

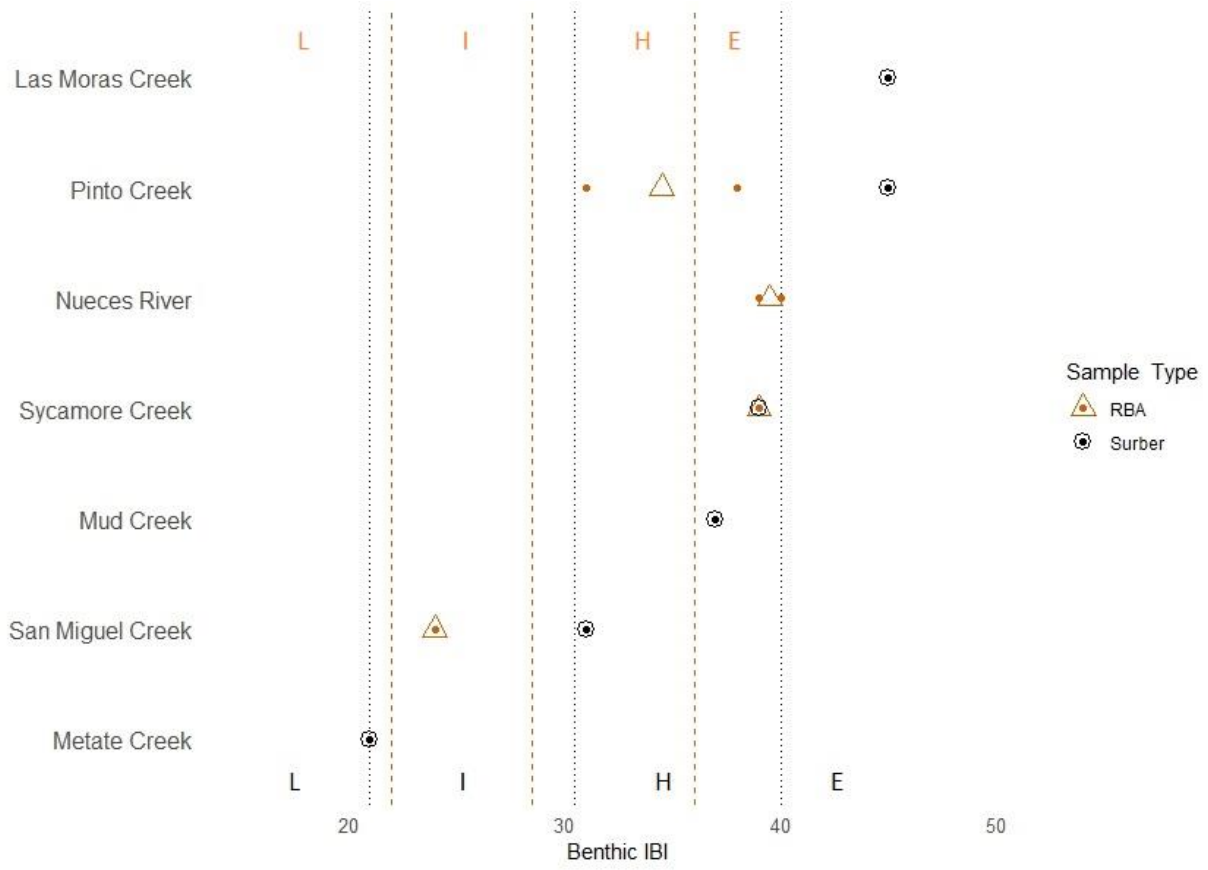

Figure 273. Benthic IBIs and aquatic life use categories (L – limited; I – intermediate; H – high; E – exceptional) for all benthic sampling events in Ecoregion 31 grouped by site and ranked by mean IBI score. Site scores are solid circles, and mean scores are hollow circles for Surber IBI sample and hollow triangles for RBP IBI samples. RBP IBI ALU cut offs are red dashed lines and Surber ALU cutoffs are in black dotted lines.

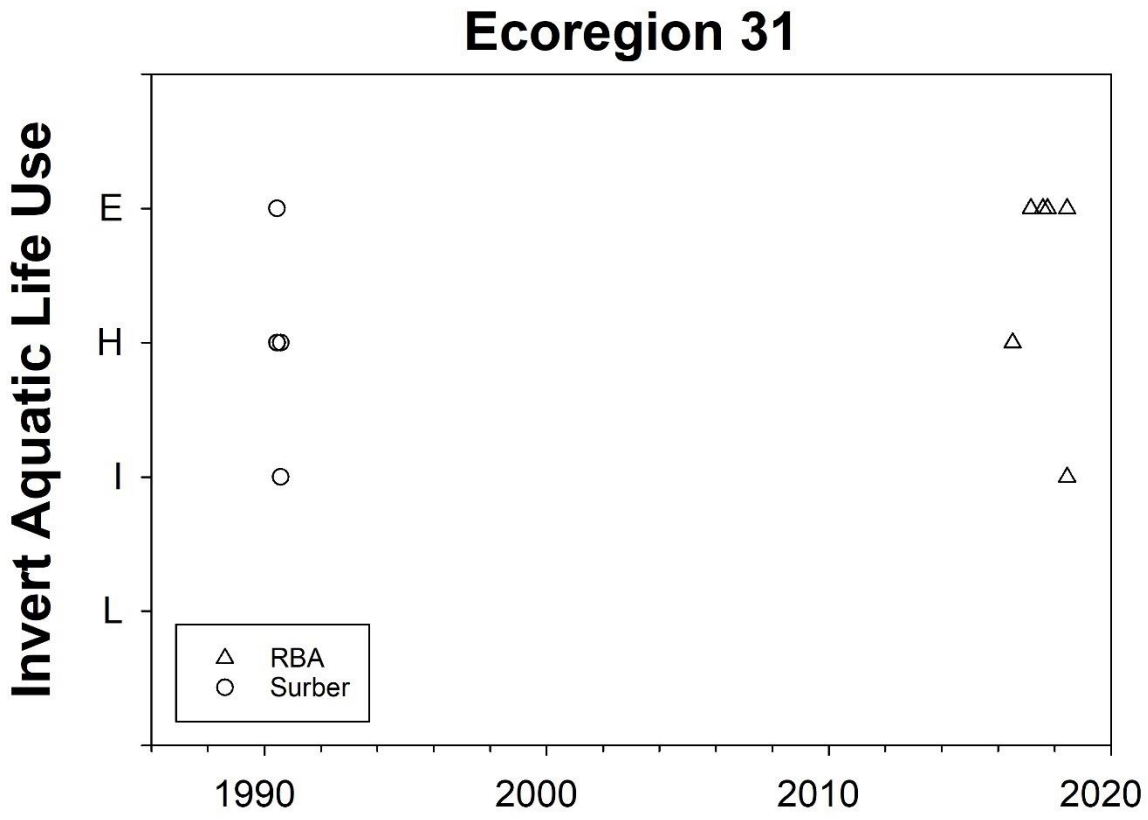

Figure 274. Benthic aquatic life use (ALU) categories through time for all sampling events in Ecoregion 31; Surber ALUs are noted by circles and RBP ALUs are noted by triangles.