National Park Service
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Natural Resource Stewardship and Science

Vegetation Inventory Project

Rio Grande Wild and Scenic River

Natural Resource Report NPS/CHDN/NRR—2019/2048



ON THE COVER

View from Burro Bluff (Texas, USA) downstream toward Mesa El Tule (Coahuila, Mexico), in the Lower Canyons section of the Rio Grande Wild and Scenic River.

Photo Credit: Jeff Renfrow

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Natural Resource Report NPS/CHDN/NRR—2019/2048

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Executive Summary

The Rio Grande River is located on the United States border with Mexico. In 1978 Congress designated a 196-mile (315 kilometer) segment of this river on the U.S. side as a national wild and scenic river under the Wild and Scenic Rivers Act. With an authorized boundary of 0.25 miles from the center of the river, the resulting Rio Grande Wild and Scenic River (RIGR) unit covers approximately 35,000 acres (14,000 hectares) of both private and public lands in southwest Texas. The Rio Grande River flows through RIGR in an easterly direction starting above Mariscal Canyon in Big Bend National Park (BIBE) at river mile 853.2 and continues to the boundary of Terrell and Val Verde counties in Texas (river mile 657.5).

As the Rio Grande River flows through the surrounding desert lands, it has dramatically sculpted the topology at RIGR creating rugged canyons, scenic rapids, dynamic shorelines, and small alluvial islands. The river is also the primary source of water in these arid lands where it creates many unique upland and riparian environments. To better understand and document the vegetation diversity occurring on these formidable, yet fragile RIGR habitats, the National Park Service (NPS), the NPS National Vegetation Inventory Program (NVIP) and the NPS Chihuahuan Desert Inventory and Monitoring Network (CHDN) started a RIGR vegetation inventory effort in 2010.

An eight-year, six-phase project was begun in 2010 to complete the inventorying and mapping of the vegetation at RIGR. In phase one, Cogan Technology, Inc. (CTI) reviewed the existing vegetation data, summarized the previous classification efforts, and created a new sampling plan. In phase two, NPS, Rio Grande Institute (RGI), and Lady Bird Johnson Wildflower Center (LBJWC) ecologists collected vegetation data at 77 classification plot and 81 observation point locations. Field data was then entered into the NVIP-specific PLOTS database and reviewed by CHDN staff. In phase three, CTI analyzed the digital PLOTS data to classify 35 RIGR plant associations using the revised U.S. National Vegetation Classification (rUSNVC) standard. During phase four, CTI created the digital vegetation map layer. In the accuracy assessment (AA) phase, contracted field crews collected data at 169 AA point locations that were randomly placed throughout RIGR. In the final phase, CTI finalized the classification, reported the AA results, revised the final vegetation map, and delivered the final products to the NVIP.

The resulting spatial database and vegetation map layer for RIGR was created from high-resolution 2015 Texas Orthoimagery Program (TOP) imagery and ancillary data. By comparing the signatures on the imagery to field data, 47 map units (40 vegetated and 7 land-use/land-cover) were developed and used to delineate the vegetation. The interpreted vegetation polygons were then digitized into a Geographic Information System (GIS) layer that was field-tested, reviewed, and revised. The final RIGR vegetation map was assessed for overall thematic accuracy at 93.1% (88.9% raw accuracy) with a Kappa value of 89.0%.

Products developed for RIGR are described and presented in this report and stored in the accompanying project digital files. Project deliverables include the final RIGR Vegetation Inventory Report, the RIGR Spatial GIS Geodatabase, Digital Field Photos, Metadata, Vegetation Descriptions,

and the Field Key to the Vegetation Associations. For a full listing of the RIGR products available to download please visit the National Park Vegetation Inventory Product website.

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Introduction

National Vegetation Inventory Program

The National Vegetation Inventory Program (NVIP) was started as a cooperative effort between the National Park Service (NPS) and the United States Geological Survey (USGS) to classify, describe, and map existing vegetation communities in more than 270 national park units across the United States. The primary objective of the NVIP is to produce high-quality plant community classifications, standardized maps, and associated data sets of the vegetation. This information fills data gaps and complements a wide variety of resource assessments, park management, and conservation needs. Among its many uses, the NVIP products have helped park managers better identify and conserve plant biodiversity; manage non-native and rare species, monitor insect and disease effects; and provide a baseline to examine wildlife habitat relationships and the effects of wildland fires.

In 1999, the Director of the NPS approved the Natural Resource Challenge to encourage National Parks to focus on the preservation of the nation's natural heritage through science, natural resource inventories, and expanded resource monitoring. The Natural Resource Challenge provided funding for 12 baseline inventories to be completed in each of 270 park units that contain significant natural resources and the NVIP is considered one of these 12 baseline inventories.

The NVIP follows well-established procedures that are compatible with other agencies and organizations. The inventory uses the revised National Vegetation Classification Standard Version 2 (rUSNVC) (FGDC 2008), a system that is integrated with the major scientific efforts in the taxonomic classification of vegetation and is a Federal Geographic Data Committee (FGDC) standard (FGDC 1997 and FGDC 2008). In addition, stringent quality control procedures ensure the reliability of the vegetation data and encourage the use of resulting maps, reports, and databases at multiple scales.

A complete vegetation inventory and mapping project for an NPS unit follows a standard 12-step procedure (NPS 2009) and includes the following products:

- Detailed Vegetation Report
- Digital Vegetation Map
- Vegetation Plot Data
- Accuracy Assessment Data and Analysis
- Dichotomous Vegetation Key
- Photo-interpretation Key

Maps and other spatial data for the NPS units in the Continental U.S. are normally produced in the Universal Transverse Mercator (UTM) projection, the North America Datum (version 1983 = NAD 83), uses meters for map and distance units, and have a nominal 1:24,000-scale with a minimum mapping unit (MMU) of 0.5 hectare (1.2 acres). The vegetation maps must meet both the National Map Accuracy Standards for positional accuracy (TNC and ESRI 1994a & Lea and Curtis 2010) and the minimum map class accuracy goal of 60% percent (NPS 2009) for all vegetation classes.

National Vegetation Classification Standard

In 1994, the NPS formed the NVIP to catalog and map the vegetation within all of the 270 NPS units with a natural resource component. Shortly thereafter, the USGS joined this effort and formed a partnership. In the same year, the NVIP also adopted the U.S. National Vegetation Classification (USNVC) (Grossman et al. 1998) as a basis for the a priori definition of vegetation units to be inventoried. NatureServe has since revised the USNVC and in 2008, the FGDC formally endorsed the rUSNVC (FGDC 2008).

Use of a standardized vegetation classification system, such as the rUSNVC helps ensure data compatibility throughout the NPS and other agencies (FGDC 2008). A standard system is critical for a systematic inventory and classification of the nation's biological resources, assist with efficient stewardship, and help prioritize conservation efforts. The rUSNVC is being used for vegetation classification and mapping projects throughout the Chihuahuan Desert Inventory and Monitoring Network (CHDN) and all of the other 32 NPS inventory and monitoring networks in the U.S. The USNVC has been in existence for over two decades and has evolved from the original classification systems first developed jointly by The Nature Conservancy (TNC), NatureServe, and various other state Natural Heritage Programs (TNC and ESRI 1994a, Grossman et al. 1998).

The rUSNVC is a hierarchical system that allows for vegetation classification at multiple scales (FGDC 2008). There are eight levels with specific criteria set for each level (Table 1). The upper three levels are based on climate and physiognomic characteristics that reflect geographically widespread (global) topographic and edaphic factors. The middle three levels focus largely on broad sets of diagnostic plant species and habitat factors along regional-to-continental topographic, edaphic, and disturbance gradients. The lower two levels (as in the original USNVC) are the plant alliance and association (i.e. plant community) and are distinguished by differences in the local floristic composition (Grossman et al. 1998).

The broader alliances are physiognomically distinct groups (e.g. forests, woodlands, shrublands, herbaceous vegetation, etc.) of plant associations sharing one or more differential or diagnostic species (Mueller-Dombois and Ellenberg 1974). These are commonly the dominant(s) found in the uppermost strata of vegetation. The plant association is the base unit of the classification and following Jennings et al. (2009) is "a vegetation classification unit defined on the basis of a characteristic range of species composition, diagnostic species occurrence, habitat conditions, and physiognomy". In the winter of 2016, the NVC for the Conterminous United States was formally released. In the spring of 2017, version 2.01 was made available through the USNVC Explorer. Currently work is being done to revise the classification for plant communities found in Alaska, Hawai'i, and for the U.S. territories in the Caribbean and Pacific islands.

Content for the rUSNVC is currently maintained by NatureServe and is being peer reviewed through collaboration with federal agencies and the Ecological Society of America (ESA) (Faber-Langendoen et al. 2009). The content is available to the public and is regularly updated on the NatureServe Explorer website (2018) (http://explorer.natureserve.org/) and on the official USNVC website.

Table 1. Summary of rUSNVC Revised Hierarchy Levels and Criteria for Natural Vegetation.

Hierarchy Level	Description	Criteria
Upper: Physiognomy plays a predominant role.	L1 – Formation Class	Broad combinations of general dominant growth forms that are adapted to basic temperature (energy budget), moisture, and substrate/aquatic conditions.
	L2 – Formation Subclass	Combinations of general dominant and diagnostic growth forms that reflect global macroclimatic factors driven primarily by latitude and continental position, or that reflect overriding substrate/aquatic conditions.
	L3 – Formation	Combinations of dominant and diagnostic growth forms that reflect global macroclimatic factors as modified by altitude, seasonality of precipitation, substrates, and hydrologic conditions.
Middle: Floristics and physiognomy play predominant roles	L4 – Division	Combinations of dominant and diagnostic growth forms and a broad set of diagnostic plant species that reflect biogeographic differences in composition and continental differences in mesoclimate, geology, substrates, hydrology, and disturbance regimes.
	L5 – Macrogroup	Combinations of moderate sets of diagnostic plant species and diagnostic growth forms, that reflect biogeographic differences in composition and sub-continental to regional differences in mesoclimate, geology, substrates, hydrology, and disturbance regimes.
	L6 – Group	Combinations of relatively narrow sets of diagnostic plant species (including dominants and co-dominants), broadly similar composition, and diagnostic growth forms that reflect regional mesoclimate, geology, substrates, hydrology and disturbance regimes.
Lower: Floristics plays a predominant role	L7 – Alliance	Diagnostic species, including some from the dominant growth form or layer, and moderately similar composition that reflect regional to subregional climate, substrates, hydrology, moisture/nutrient factors, and disturbance regimes.
	L8 – Association	Diagnostic species, usually from multiple growth forms or layers, and more narrowly similar composition that reflect topo-edaphic climate, substrates, hydrology, and disturbance regimes.

All rUSNVC associations and alliances (or equivalents) are commonly used for map units or classes in the NVIP to insure compatibility throughout the NPS as well as with other federal and state agencies. Vegetation maps and supporting ecological information based on the rUSNVC allows for efficient comparisons of similar types in other areas and at the same location through time. Referencing the rUSNVC assures that map units are not based on confusing local (common) plant names or site-specific habitats. Future researchers using the vegetation map and data can always reference the rUSNVC descriptions for timely and accurate information on the common species and

habitat characteristics. Having the ability to cross-reference the vegetation map units with the rUSNVC types also allows for efficient comparison to other studies relating to a wide variety of resource assessment, park management, and planning needs.

Chihuahuan Desert Inventory and Monitoring Network

CHDN is composed of seven NPS park units in the desert and mountain landscapes of west Texas and southeastern New Mexico (Figure 1). CHDN park units include RIGR, Amistad National Recreation Area (AMIS), Big Bend National Park (BIBE), Carlsbad Caverns National Park (CAVE), Fort Davis National Historic Site (FODA), Guadalupe Mountains National Park (GUMO), and White Sands National Monument (WHSA). This network of park units occurs within the 230,000 square-mile Chihuahuan Desert Ecoregion that covers much of Northern Mexico and extends into Southwest Texas and Southern New Mexico. The biota contained in the CHDN park units is diverse and specialized, with many animal and plant species only found in this region of the world.

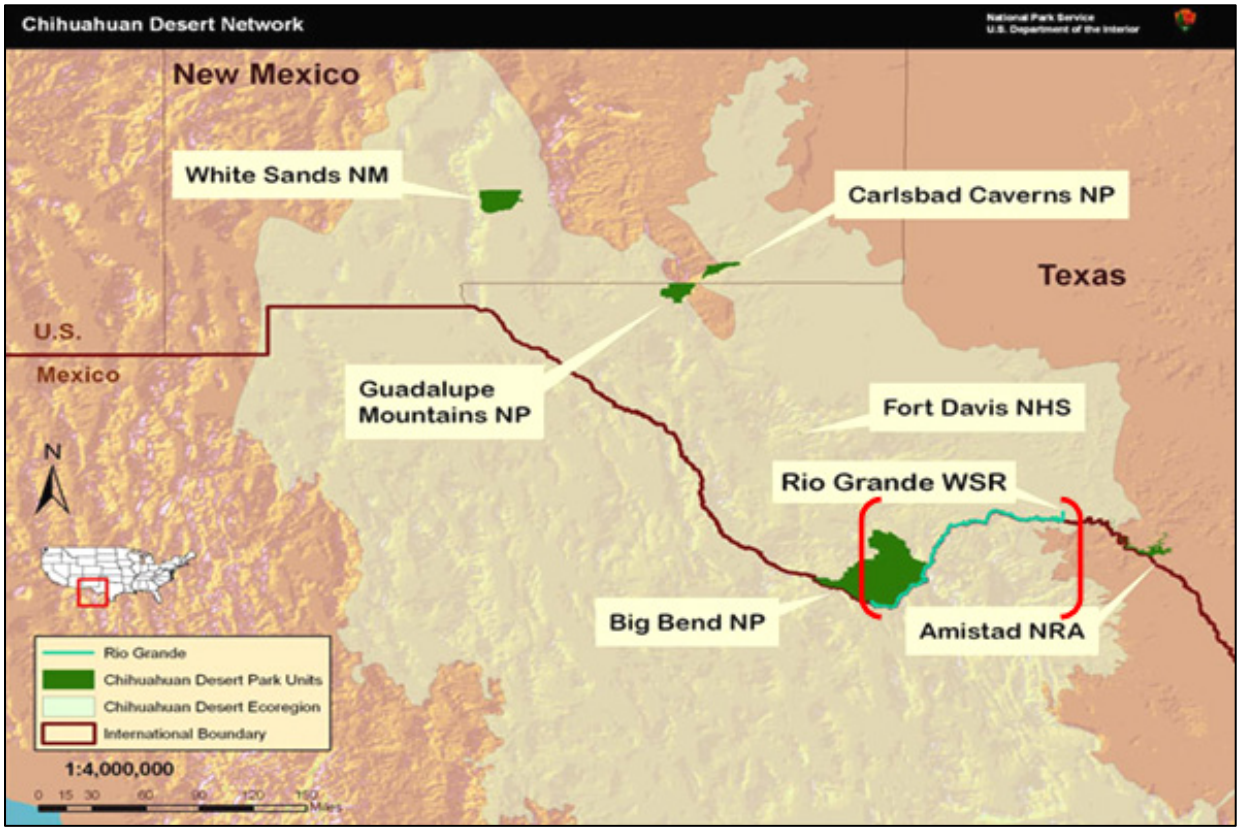


Figure 1. The Chihuahuan Desert Inventory and Monitoring Network Map (NPS/CHDN 2019).

Rio Grande Wild and Scenic River

The Rio Grande River (or the Rio Bravo River -its Mexican name) forms part of a natural boundary between the United States (U.S.) and Mexico. This important and historical river meanders southeast from the high Rocky and San Juan Mountains, through New Mexico and lower Texas before reaching its terminus at the Gulf of Mexico. Along its path, it cuts through the heart of the Chihuahuan Desert Ecoregion and for about 118 miles (190 km) it forms the southern border of

BIBE. After leaving BIBE, the Rio Grande River travels for another 131 miles (211 km) before entering into the reservoir behind the Amistad Dam near the town of Del Rio, Texas.

In 1978, Congress designated a portion of the Rio Grande River in Texas as a national wild and scenic river under the Wild and Scenic Rivers Act. Wild and Scenic Rivers are "designated to protect water quality and to preserve in a free-flowing condition, certain rivers with remarkable natural, cultural, or recreational values for the enjoyment of present and future generations" (NPS 2004). Under this designation, the Secretary of the Interior was instructed to create RIGR and administer this segment on the U.S. side from river mile marker 842.3 (1,356 km) above Mariscal Canyon (located in BIBE) downstream to river mile 641.1 (1,032 km) at the boundary between Terrell and Val Verde Counties in Texas (Figure 2). The International Boundary and Water Commission later revised the river miles on the Rio Grande River effectively changing the beginning and ending points of RIGR to 853.2 (1,373 km) and 657.5 (1,058 km), from west to east respectively. All RIGR administered lands are located on the U.S. side of the river.

The western boundary of RIGR starts near the Talley backcountry road and campsites in BIBE, opposite the boundary between the Mexican states of Chihuahua and Coahuila. As it travels downstream, the Rio Grande River exits BIBE jurisdiction and continues east flowing through a mix of private and state-owned Black Gap Wildlife Management Area (WMA) lands. On the Mexican side, the Maderas del Carmen and Cañon de Santa Elena sites are also two protected areas that help preserve wildlife habitat and migration corridors. Besides the Black Gap WMA, much of RIGR outside of BIBE is located on 17 parcels of private land all in the Lower Canyons or eastern section of RIGR (NPS 2004). According to the NPS website, ownership of land along RIGR (on the U.S. side) includes: Private Ownership = 101.1 river miles (162 km) (51%), Federal = 71.4 river miles (141 km) (36%), and the State of Texas = 26.7 river miles (42 km) (13%). Of the federal lands, BIBE and RIGR share jurisdiction along 69 river miles (111 km). The total length of RIGR is estimated at 196 miles (315 km) and it covers approximately 34,506 acres (13,971 ha) (NPS 2019).

The general course of RIGR is in a northeast direction with a straight-line distance of approximately 109 miles (175 km) from end to end. The width of RIGR varies along its path with the southern boundary officially recognized as the international boundary between the countries of U.S. and Mexico as defined by the midpoint of the deepest depth in the river channel (which can change depending on the direction and flow of the river). The northern boundary is set at 0.25 mile (0.4 km) from the ordinary high-water mark as dictated by federal legislation. A 1986 amendment to the Wild and Scenic Rivers Act specifies that the boundaries for all wild and scenic rivers with no permanent boundaries "shall generally comprise that area measured within one-quarter mile from the ordinary high-water mark" (NPS 2004). Although this legislation includes private lands within the current default boundary, management considerations and restrictions apply only to the federally owned public lands within RIGR.

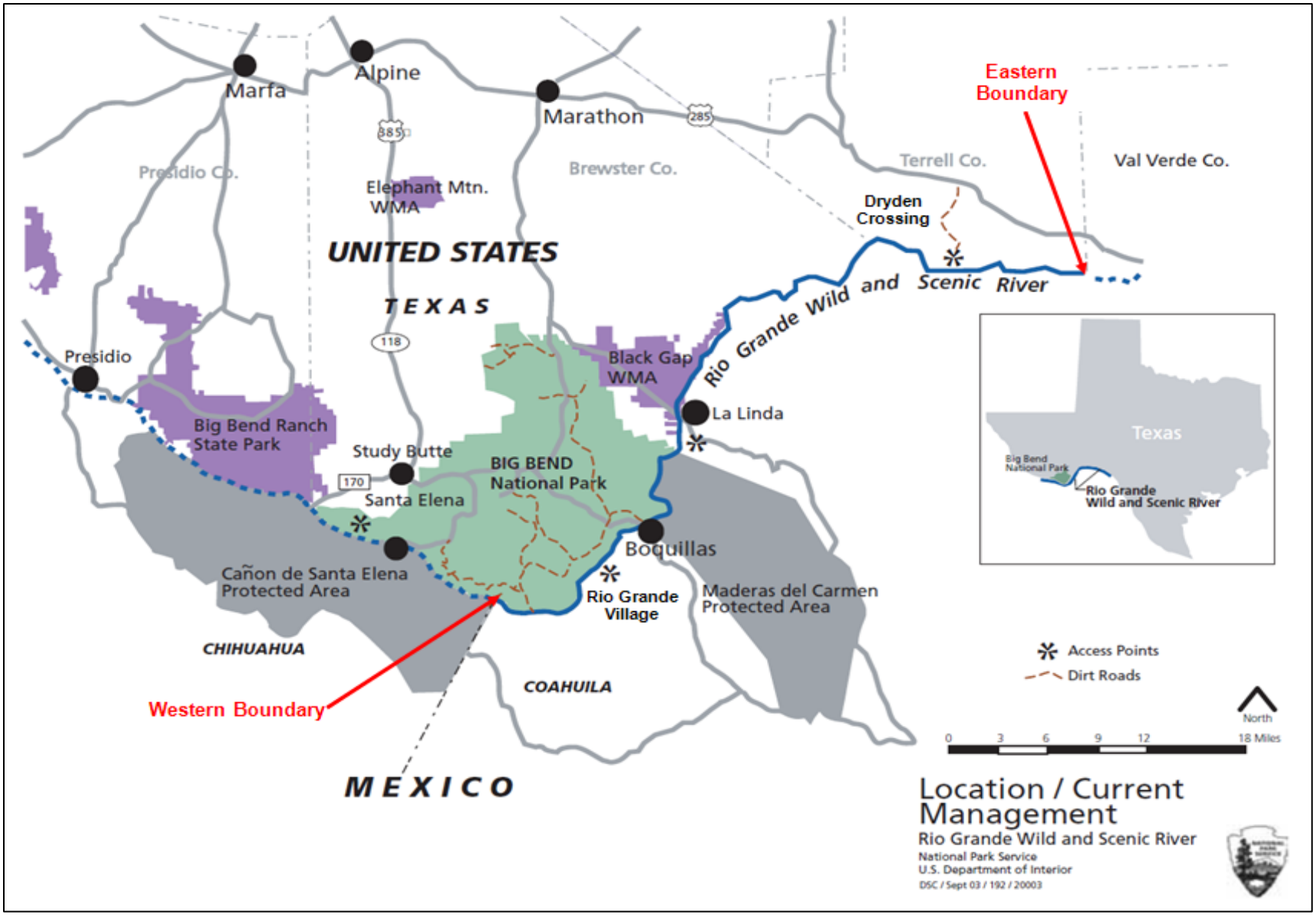


Figure 2. Rio Grande Wild and Scenic River Map (NPS).

RIGR has relatively few public access points. In BIBE, one paved road approaches the unit near the vicinity of the Rio Grande Village and the Mexican border town of Boquillas. Another, Ranch Road 2627, is located in the Black Gap WMA. The Ranch Road leaves U.S. Highway 90 and travels south 27 miles (43 km) before terminating at the Heath Canyon Ranch and the La Linda bridge (closed in 1997 for safety and security reasons). Directly across the Rio Grande River from the bridge is the abandoned town of La Linda in Mexico. About 20 miles (32 km) south on the 2627 Ranch Road is the turn off for Stillwell Crossing. This unpaved road also leads to the river and terminates at the confluence of Stillwell Creak and the Rio Grande River, a place commonly called Stillwell Crossing.

While the upper 43 miles (69 km) of RIGR contains unpaved roads, overland access outside of the Black Gap WMA in the lower 153 miles (246 km) is complicated by private land ownership and by rugged terrain. Accessing this part of RIGR usually requires traversing long stretches of river by boat, canoe, raft, or kayak. River trips can range from 30 to 80 miles (50 to 130 km) depending on access and often includes negotiating several whitewater hazards. Dryden Crossing is the only real take-out point for lower canyon trips. Dryden Crossing is located in Terrell County and is accessed off U.S. 90 near the town of Dryden, Texas. The Dryden Crossing or Shafter Crossing access road continues for over 20 miles (32 km) from Dryden before reaching the river. RIGR lands continue past Dryden/Shafter Crossing for about another 28 miles (45 km).

Natural Setting

Together RIGR and BIBE cover a vast landscape that has been described as the focal point for the Chihuahuan Desert, “one of three most biologically rich and diverse desert ecoregions in the world” (WWF 2019). As the primary water source, the Rio Grande River has been described as the lifeblood of the Chihuahuan Desert (NPS 2019). The natural processes of the Rio Grande River over the years has dramatically altered the topology of the area creating rugged canyons, lush riparian areas, scenic rapids, dynamic shorelines, and alluvial islands.

The canyons at RIGR are especially impressive as the river has cut through the surrounding rock formations to form many steep-walled valleys (Figure 3). Beginning in BIBE, RIGR starts at the Great Unknown Region that contains volcanic deposits (e.g. the Black Dike) and sedimentary rock formations and then travels through the smaller Mariscal, Vincente, and Hot Springs Canyons before entering the more dramatic and larger Mariscal and Boquillas Canyons. Downstream from these, the river flows across a relatively broad floodplain called the Vegas Meadows region. After the meadows, the Lower Canyons begin and continue northeast until reaching Reagan Canyon. Here the river turns in an easterly direction and flows through a continuous deeply cut canyon for almost 40 miles (64 km). Throughout the Lower Canyons, the river and its tributaries lie 500 to 1,500 feet (152 to 457 m) below the surrounding plateaus. Along the course of the river, numerous flash flood- prone dry washes and larger semi-annual tributaries such as the Maravillas, Stillwell and San Francisco Creeks occur and contribute to the rugged topography. Other significant natural features in the lower canyons include various smaller canyons (Big, Silber, and Palmas), river rapids (Hot Springs, Rodeo, Panther, Sanderson, and Agua Verde), waterfalls (Upper and Lower Madison Falls), and other cultural and natural features (Taylors Farm, Bullis Fold, and Bone Watering Hole).

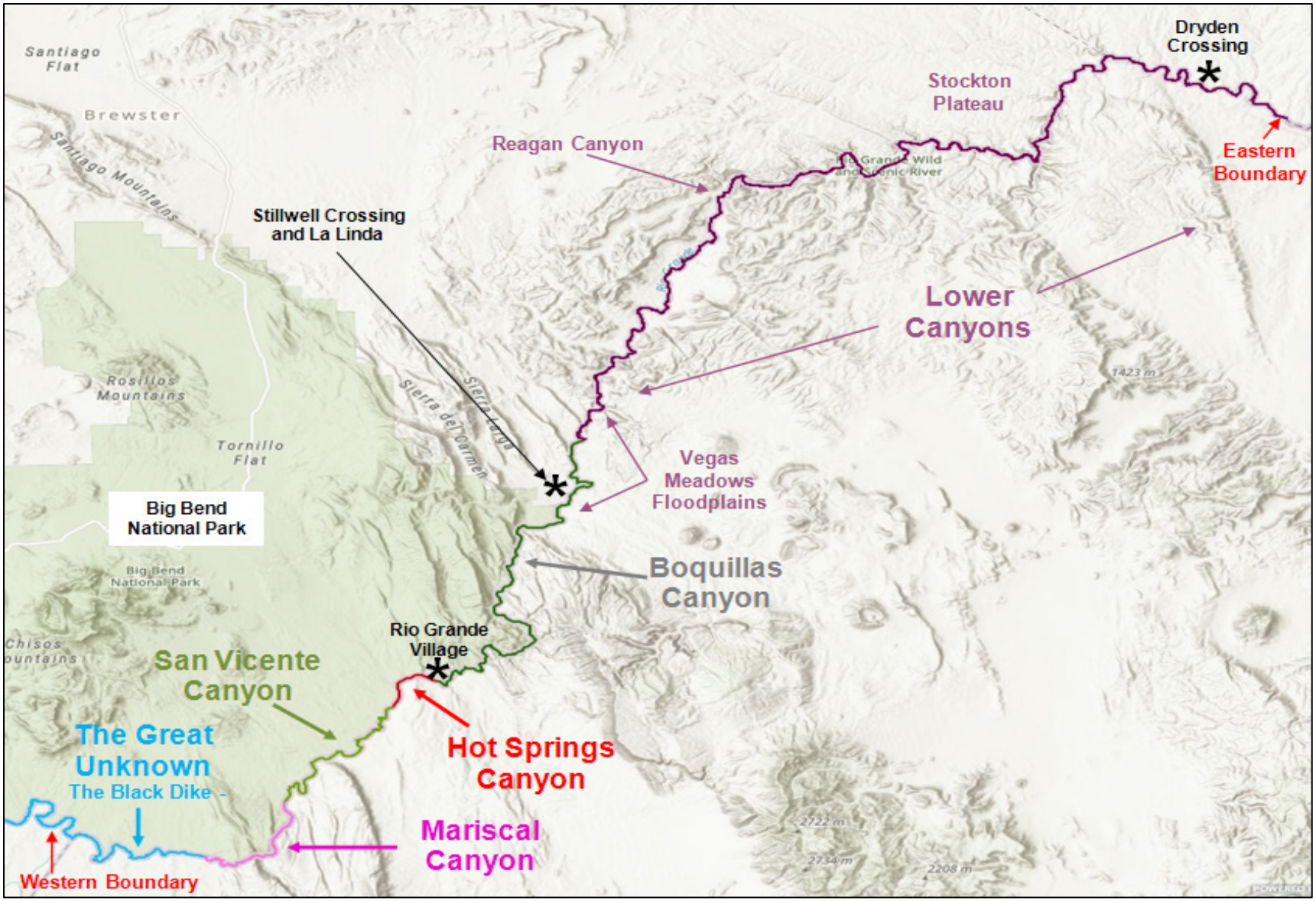


Figure 3. RIGR Canyons and General Location Map (NPS and CTI).

In the past, the dynamic Rio Grande River would flood and recede leaving behind many meandering floodplain channels and abandoned riverbeds. The river would also cut numerous riverbanks, form ever-changing large mud and alluvial flats, and deposit tons of sediment forming new alluvial plains and small islands. However, the Rio Grande River like most rivers in the Western U.S. has been altered due to a loss of water volume by dam construction, pumping, irrigation, and diversion projects. It is estimated that only 20% of all water in the river actually makes it to the Gulf of Mexico (NPS 2004). On most days, the river may only be knee deep and may be completely dried up in some locations. Because of the alterations, the Rio Grande River no longer seasonally floods as it did historically. The natural flooding events in the past would help maintain natural habitats by dispersing seeds and creating new habitats. Without the flooding, the streambanks have become more stable and entrenched allowing for the invasion and establishment of aggressive non-native plants that can diminish water flow and alter the composition of the natural riparian habitats (NPS 2019).

As part of the Chihuahuan Desert, RIGR has a hot and dry climate. Summers are usually hot, and temperatures can easily reach over 100 degrees Fahrenheit (F) or 38 degrees Celsius (C). Spring and fall are milder with average temperatures closer to 70°F (21°C). Winters are mild with 50°F (10°C) days and slightly colder nights. Freezing events at RIGR are rare but do occur. On average, the winter season also brings the most moisture to the region although spring and summer thunderstorms can be heavy (NPS 2019). Mean annual precipitation totals for RIGR vary from west to east. The western portion of RIGR receives less than 10 inches (250 mm) of rain whereas the eastern end gets about 16 inches (405 mm) of precipitation annually (Riskind and Diamond 1988).

RIGR's geology is comprised of various rock formations that occur along a west to east gradient. Starting in the west, the Rio Grande River travels east through BIBE regions containing lava and volcanics, igneous and non-calcareous formations, limestones in Boquillas Canyon, and broad alluvial floodplains (Vegas). Outside of BIBE, RIGR's Lower Canyons are formed from limestone bedrock and limestone derived formations. Numerous uplifting, folding, faulting, erosion, and other geologic processes can be found at RIGR (NPS 2004). Dramatic bare rock cliffs, overhangs, coves, large boulders, talus slopes, and exposed bedrock flats are common. Soils in RIGR are derived mostly from the various parent materials and are heavily influenced by wind and water erosion. Most soils in the Rio Grande River corridor consist of sediment and sand deposited by the river (alluvium). Upland slopes contain shallow soils that are derived from weathering of the exposed bedrock and colluviums (NPS 2004). Analyses of the USDA soils data for this region shows that the dominant soil types include the Blackgap - Rock Outcrop, Mariscal - Rock Outcrop and Ector - Rock Outcrop complexes and the Vicente, Lomapelona and Castolon Soils (USDA 2019).

Hiking, rafting, and canoeing are common recreational activities for visitors to RIGR. Livestock grazing and residential development represent the majority of the current land use practices on private lands. Ranching in this area has been prevalent for more than 100 years and continues to this day on both sides of the river. During low flow periods, livestock from the Mexican side often cross and graze on the lands on the U.S. side of the river (NPS 2004).

Vegetation

Together RIGR's arid climate, elevational gradient, hydrologic regimes, and varied geology coupled with its broad geographic span and current land use practices have created a wide variety of ecological niches and unique habitats. Broadly speaking, RIGR is situated at the eastern edge of the Chihuahuan Desert, where the vegetation progresses from a more strictly Chihuahuan Desert influence (as within BIBE) into a less arid zone with progressively more Balconian and Tamaulipan thornscrub elements also found further east at AMIS and near the town of Del Rio, Texas.

RIGR contains both unique upland and riparian habitats (Figure 4). The transition zone between these two broad habitats is located around the high-water mark of the river. Depending on slope, the transition can be minimal in steep canyons or more pronounced on flatter floodplains. The riparian habitat can be further split into a more established or upper riparian area and a more active lower riparian corridor. Together, these habitats contain many unique plant communities that are further influenced by geology, soils, moisture, topographic position, aspect (solar radiation), and the presence of non-native species. The wide geographic span of RIGR at over 100 miles (160 km) also greatly influences the regional diversity of the plant communities as they transition from sparse Chihuahuan Desert species in the west to slightly more mesic and thicker thornscrub species to the east.

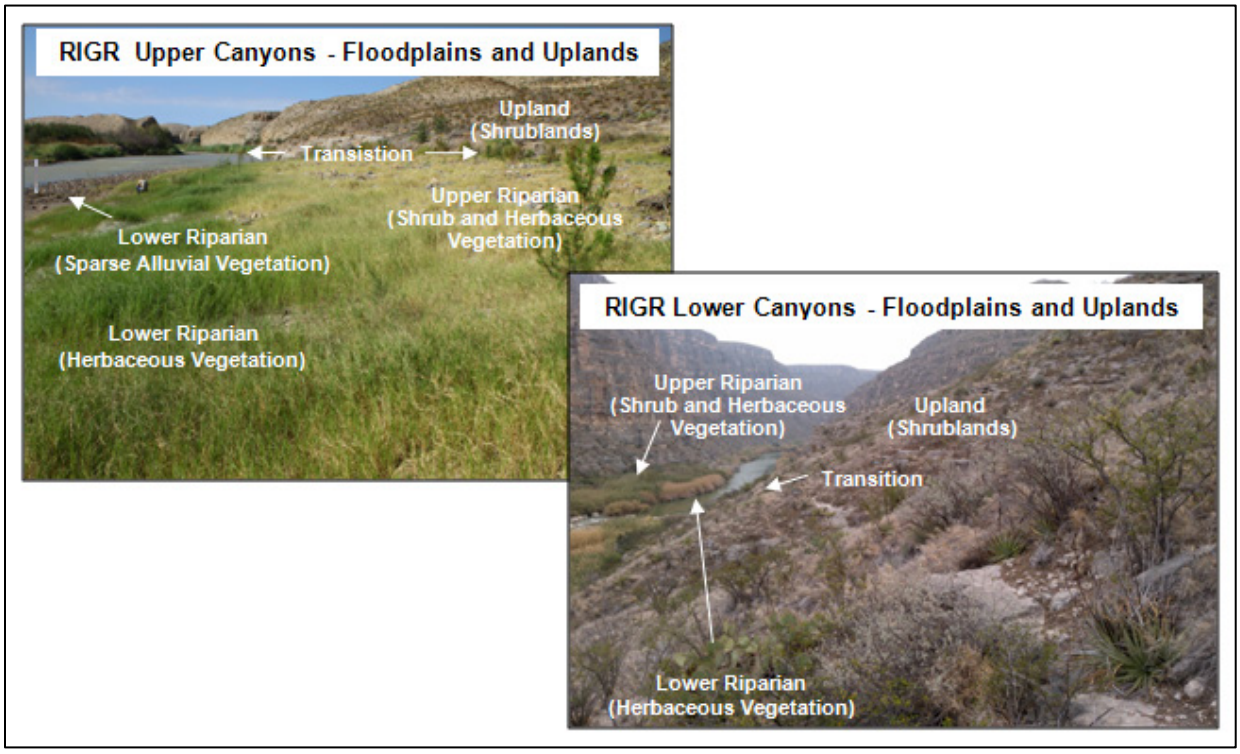


Figure 4. Examples of Unique Ecological Habitats at RIGR (CTI).

Building off the recent vegetation classification efforts at AMIS and BIBE, vegetative patterns emerge for RIGR based on both distance (river miles) and geologic formations. In summary, this is a progression that follows the flow of water from the west as it enters new environments moving east.

The vegetation gradient starts in BIBE on mixed geologic formations containing mostly native Chihuahuan upland shrub species, a mix of native and non-native riparian flora, and various early successional and weedy species on active floodplains. As the river flows east, it enters various limestone and calcareous canyons with limited riparian vegetation. Steep slopes supporting mixed upland shrubs and sparse vegetation types are common. As it exits BIBE, the river enters broad and dissected riparian meadows with rolling upland hills. Here the riparian vegetation is mostly non-native, and the upland hills support sparse Chihuahuan shrub communities. After leaving this flat area, the river again cuts through limestone formations as it enters the lower canyons. Habitats in the lower canyons include patches of low riparian herbaceous vegetation, non-native upper riparian vegetation communities (long strips/bands or small patches), and steep uplands with both Chihuahuan and Tamaulipan shrub species. The eastern-most portion of RIGR is located near the Southern Stockton Plateau and the Edward's Plateaus ecoregion. Here the upland and wash vegetation is strongly influenced by Tamaulipan thornscrub elements. The riparian zone near the Stockton Plateau is broader and more defined than in the preceding canyons. Non-native species with some widely spaced native plant communities including small woodlands are common. Based on this general vegetation model, the RIGR life zones are further summarized in Table 2 and elevational graphs and color infrared orthoimagery examples of these habitats are presented in Figures 5-7.

To understand RIGR's vegetation distribution and diversity each of the life zones can be examined individually using a combination of topographic position, elevation, and dominant plant species. The following are brief descriptions for each life zone at RIGR.

RIGR - BIBE Chihuahuan Desert - Western Region

The western portion of RIGR lays in BIBE and extends east to Boquillas Canyon. Included in this section are the Mariscal, Vicente, and Hot Springs Canyons and the developed Rio Grande Village. This section of RIGR contains primarily low desert shrubs in the upland regions. The desert scrub vegetation is primarily on non-calcareous substrates and creosotebush (*Larrea tridentata*) is constant and usually a dominant or co-dominant. Gentle slopes with finer-textured soils contain a combination of honey mesquite (*Prosopis glandulosa*) and creosotebush. The highest elevations support plant communities consisting of a mix of ocotillo (*Fouquieria splendens*), creosotebush, and/or lechuguilla (*Agave lechuguilla*) and Chino grama (*Bouteloua ramosa*) may be present. Sparse vegetation occurs on eroding clay badland formations and flat sites with high clay content and likely alkaline and gypseous substrates. Common species on these sparse sites include false grama (*Cathestecum erectum*), desert seepweed (*Suaeda suffrutescens*) and whorled dropseed (*Sporobolus pyramidatus*). Upland washes can be sparse (active channels), contain moderate amounts of creosotebush and honey mesquite, or have tall shrubs in the channels (especially in large washes). Common wash species include singlewhorl burrobrush (*Hymenoclea monogyra*), desert willow (*Chilopsis linearis*), and/or shrubby poreleaf (*Porophyllum scoparium*).

Table 2. General RIGR Vegetated Life Zones (from upstream/west to downstream/east).

General Life Zones	Distance in River Miles	Geology and Substrate	Dominant Vegetation Type and Species by Topographic Position
Chihuahuan Desert - West Region (BIBE)	853.2 - 784.5*	Volcanics, Igneous, and other Non-Limestone Formations	• Dry Uplands = Short Creosotebush and Mesquite Shrubs, Sparse Desert Scrublands, Badlands, and Flats • Upland Washes = Acacias, Mesquites, and Desert Willows • Upper Riparian = Thick Mesquite Bosque Stands, Willow Shrubs, Sparse Cottonwood and Willow Trees • Lower Riparian = Seepwillows, Wet Riverbank Herbaceous Vegetation, and Sparse Alluvial Vegetation • Non-native Riparian = Bermuda Grass, Johnson Grass, and Managed Giant Cane and Tamarisk.
Chihuahuan Desert - Boquillas Canyon Region (BIBE)	784.5 – 776*	Limestone and Calcareous Formations	• Dry Uplands = Yucca Shrublands, Calcareous Mixed Desert Scrub and Talus, Sparse Calcareous Outcrops, and Creosotebush Desert Scrub • Upland Washes = Yuccas, Acacias, and Mesquite Shrubs • Upper Riparian = Tall and Thick Mesquite/Willow Bosque Stands and Sparse Cottonwood and Willow Trees • Lower Riparian = Common Reed, Seepwillows, Wet Riverbank Vegetation, and Sparse Alluvial Vegetation • Non-native Riparian = Bermuda Grass, Giant Cane, and Tamarisk
Chihuahuan Desert - Black Gap WMA and Vegas Meadows Region	776 - 751* (#1 - #26)**	Limestone and Calcareous Formations	• Dry Uplands = Calcareous Mixed Desert Scrub and Talus, Sparse Calcareous Outcrops, and Creosotebush Desert Scrub • Upland Washes = Acacias, Mesquite, and Desert Willow • Upper Riparian = Thick Mesquite/Willow Bosque Stands and Sparse Mexican Ash and Huisache Trees • Lower Riparian = Common Reed, Seepwillows, Wet Riverbank Vegetation, and Sparse Alluvial Vegetation • Non-native Riparian = Spotty Bermuda Grass, Wide and Linear Giant Cane, and Tamarisk Bands

*Official Rio Grande River Miles from the International Boundary and Water Commission (Locations are Estimates Only)

**Unofficial Canoe Miles Start at La Linda and Increase Traveling East on the River

Table 2 (continued). General RIGR Vegetated Life Zones (from upstream/west to downstream/east).

General Life Zones	Distance in River Miles	Geology and Substrate	Dominant Vegetation Type and Species by Topographic Position
Chihuahuan Desert - Lower Canyons Region	751 - 707* (#26 - #70)**	Limestone and Calcareous Formations	• Dry Uplands = Northeastern Chihuahuan Canyon Desert Scrub, Sparse Calcareous Outcrops, and Creosotebush Desert Scrub • Upland Washes = Blackbrush and Mixed Shrubs • Upper Riparian = Mesquite, Bare Rock, Sparse Mixed Shrubs, and Mexican Ash and Huisache Trees • Lower Riparian = Common Reed, Seepwillows, Wet Riverbank Vegetation, and Sparse Alluvial Vegetation • Non-native Riparian = Spotty Bermuda Grass Patches, Linear Giant Cane, and Tamarisk Stands
Chihuahuan Desert and Tamaulipan Transition - Southern Stockton Plateau Region	707 - 657.5* (#70 - #120)**	Limestone and Calcareous Formations	• Dry Uplands = Southern Stockton Plateau Mixed Desert Scrub, Creosotebush Desert Scrub and Low Creosotebush Desert Scrub • Upland Washes = Tall Texas Persimmon, Blackbrush, and Guajillo • Upper Riparian = Blackbrush, Mesquite and Mixed Shrubs and Sparse Mexican Ash and Huisache Trees • Lower Riparian = Common Reed, Seepwillows, Wet Riverbank Vegetation, and Sparse Alluvial Vegetation • Non-native Riparian = Low Bermuda Grass Mats, Wide Giant Cane, and Tamarisk Stands

*Official Rio Grande River Miles from the International Boundary and Water Commission (Locations are Estimates Only)

**Unofficial Canoe Miles Start at La Linda and Increase Traveling East on the River

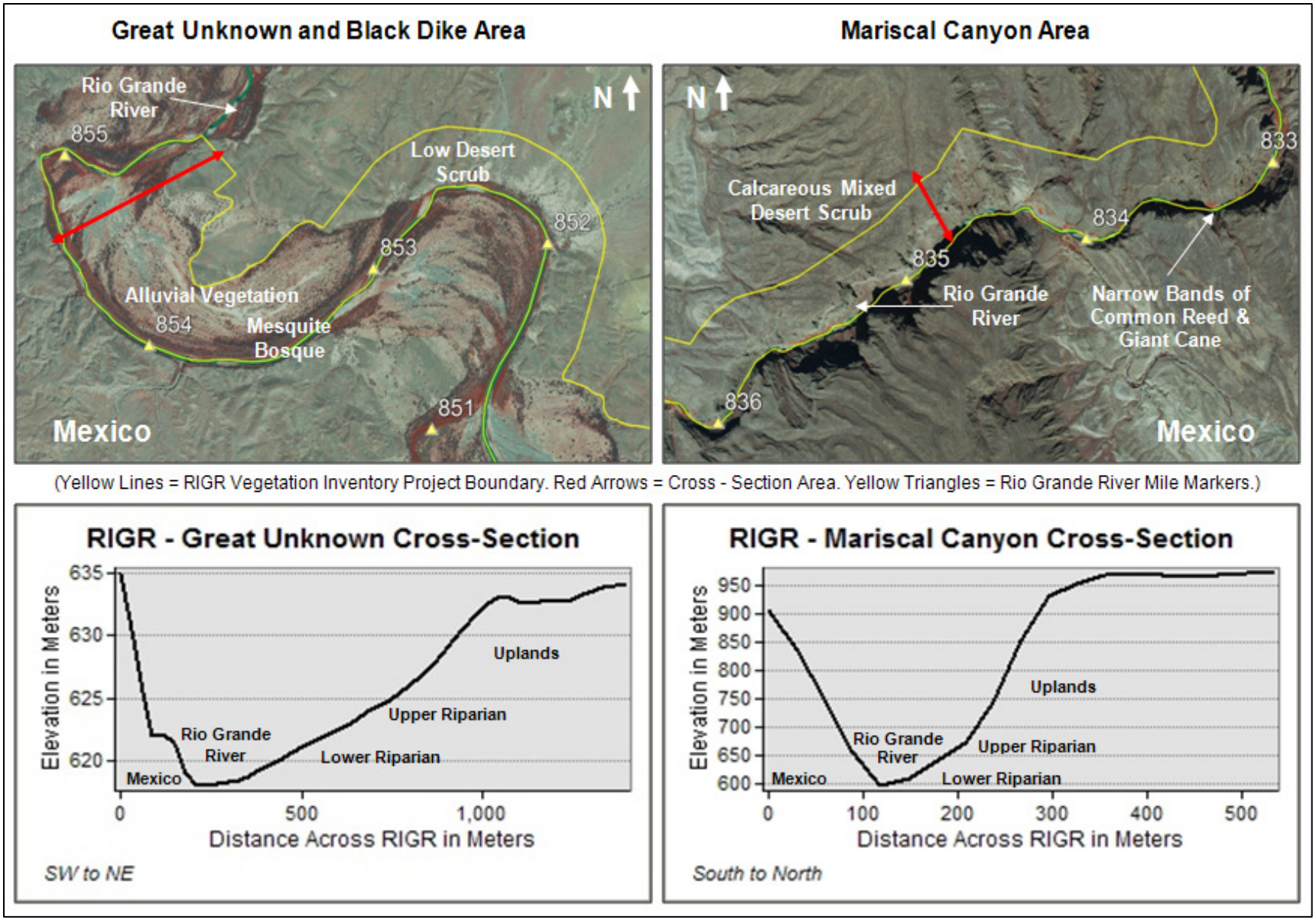


Figure 5. Western Region Image Examples and Elevation Profiles (CTI).

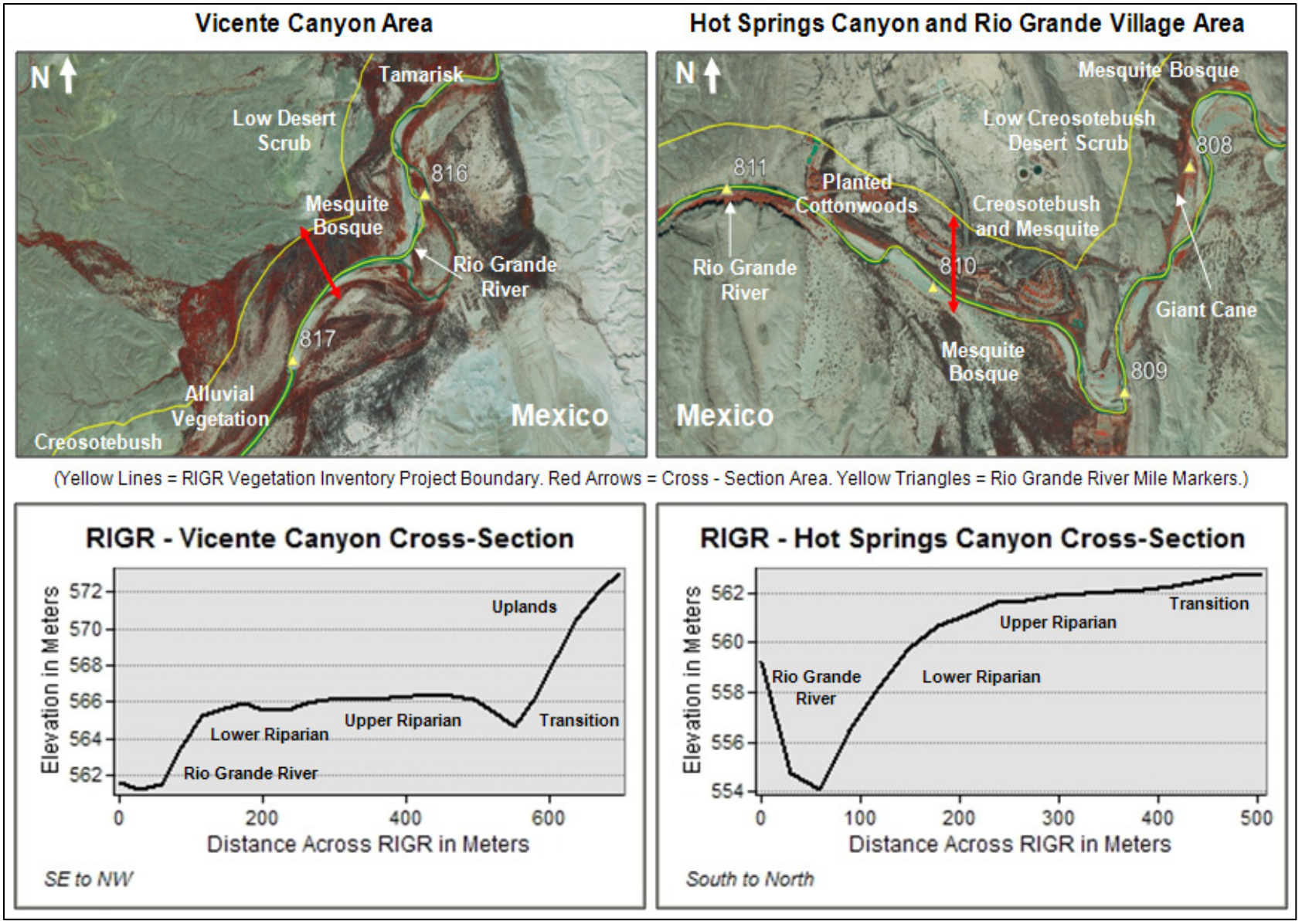


Figure 5 (continued). Western Region Image Examples and Elevation Profiles (CTI).

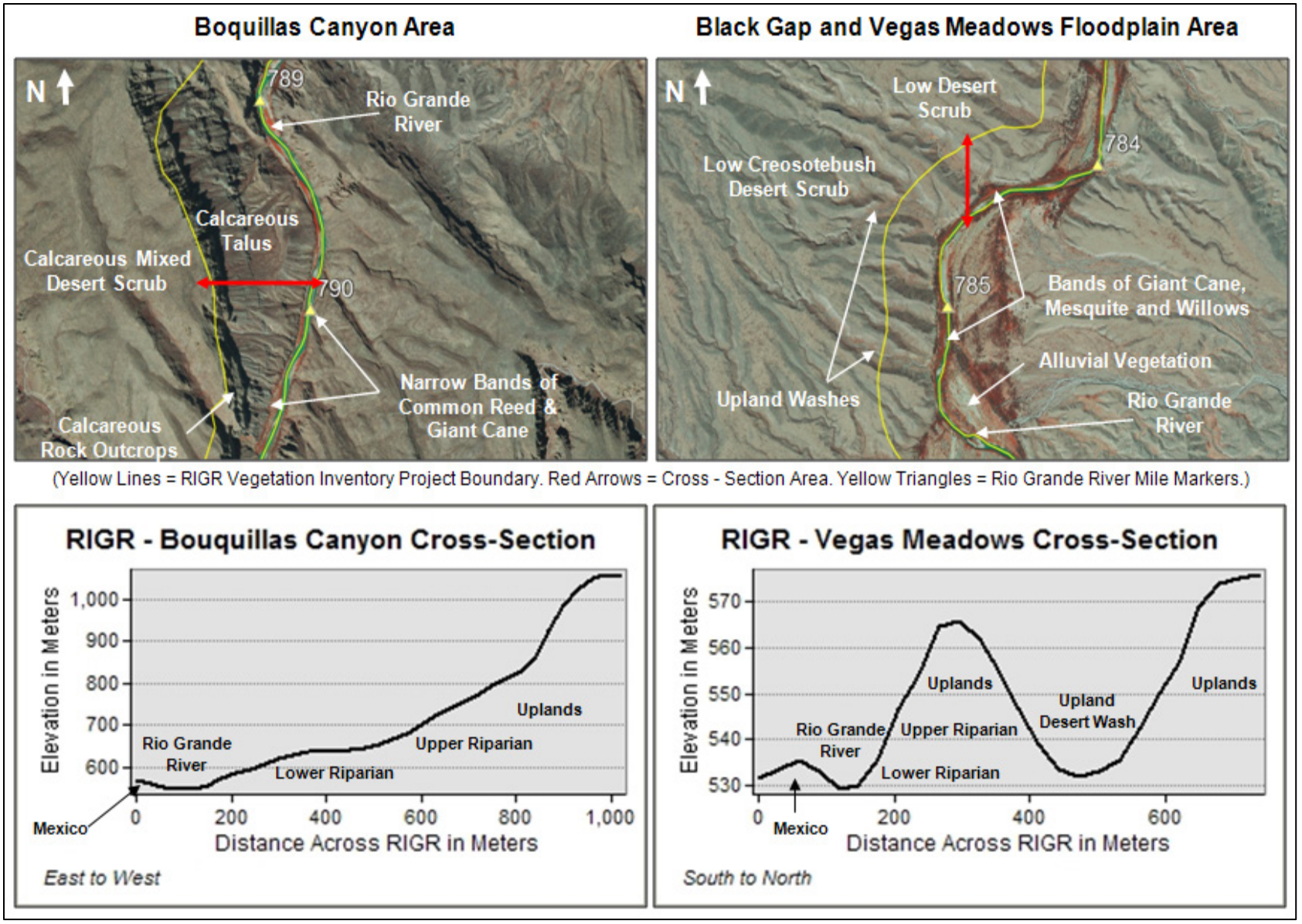


Figure 6. Boquillas Canyon and Vegas Meadows (Black Gap) Regions Image Examples and Elevation Profiles (CTI).

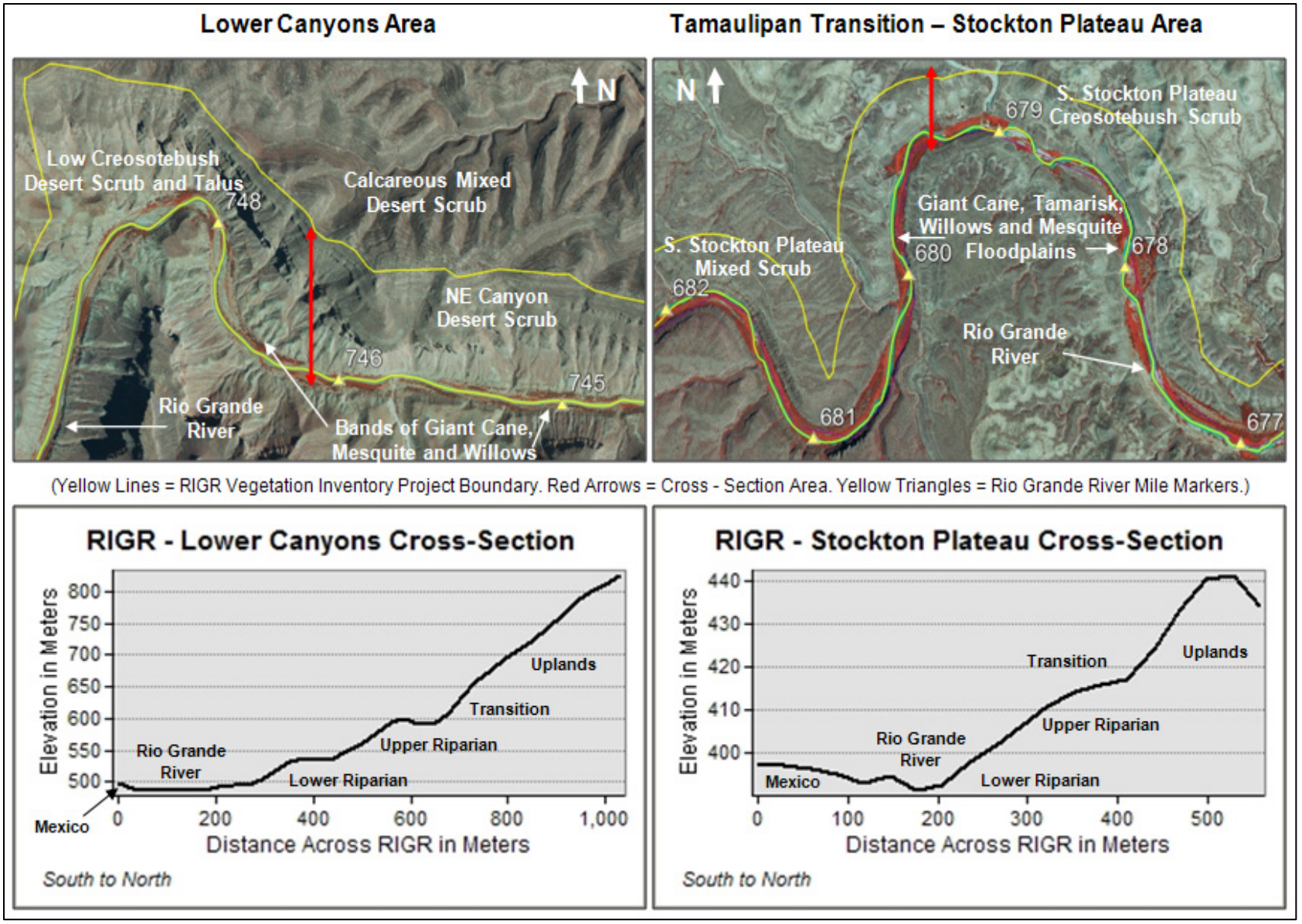


Figure 7. Lower Canyons and Southern Stockton Plateau Regions Image Examples and Elevation Profiles (CTI).

The transition zone is marked by the change from desert short shrubs to thick stands of tall shrubs and short trees. These upper riparian areas are usually stable and escape most of the flooding. Thick established shrubland stands or "bosques" consist of almost impenetrable stands of honey mesquite. Non-native tamarisk (*Tamarix ramosissima*) and athel tamarisk (*Tamarix aphylla*) shrubs can also form thick stands but most of these sites have been somewhat controlled or managed through eradication efforts by the NPS. Native trees including Arizona cottonwood (*Populus fremontii* ssp. *mesetae*), Goodding willow (*Salix gooddingii*), black willow (*Salix nigra*), Thuber's willow (*Salix thuberi*), and coyote/narrowleaf willow (*Salix exigua*) may occur in patches or form small bosque-like stands. Some of the steeper stream banks may be cut-banks with little vegetation. Areas around the Rio Grande Village are actively managed and contain mowed lawns and irrigated/planted cottonwoods and other trees.

The lower riparian zone is dynamic and can change depending on flooding events. Frequently inundated sites on alluvial islands and low floodplains usually contain early successional herbaceous vegetation with scattered short shrubs. Common species include tamarisk seedlings, singlewhorl burrobrush, Rooseveltweed (*Baccharis neglecta*), tree tobacco (*Nicotiana glauca*), buffelgrass (*Pennisetum ciliare*), Russian thistle (*Salsola tragus*), silverleaf nightshade (*Solanum elaeagnifolium*), and salt heliotrope (*Heliotropium curassavicum*). More stable low stream banks and alluvial stream bars often contain mixes of hydrophytic species such as threesquare bulrush (*Schoenoplectus pungens*), cattails (*Typha* spp.), and smartweeds (*Polygonum* spp.). Just above the lowest stream banks, tall linear stands of common reed (*Phragmites australis*) and taller thickets of dense river or giant cane (*Arundo donax*) maybe present. Low growing Bermuda grass (*Cynodon dactylon*) is usually present to some degree in these areas and can vary in cover from 5% in alluvial bar settings to nearly 100% on floodplains forming Bermuda grass meadows (Figure 8).

<u>RIGR - BIBE Chihuahuan Desert - Boquillas Canyon Region</u>

The Boquillas Canyon region of RIGR is characterized by dramatic limestone cliffs with steep upland slopes, a thin transitional area, and linear bands and pockets of riparian vegetation. The uplands include a few high limestone areas with shrub grassland (steppe) species that include giant dagger (*Yucca faxoniana*), Thompson's yucca (*Yucca thompsoniana*) and foothill beargrass (*Nolina erumpens*). Similar species may be found in the uplands washes at lower elevations as well due to higher moisture levels. Just below the yucca dominated upland steppe region are areas dominated by a mix of generalist desert scrub species that include several calcareous substrate indicator species such as candelilla (*Euphorbia antisyphilitica*). Also present are sparse limestone outcrops and rock cliffs with little vegetation. Below the rock outcrops, limestone talus slopes containing high amounts of boulders, rocks, and scree are often present. Vegetation on the talus slopes are similar to the higher areas but can be denser due to increased moisture levels. Buffelgrass can be prevalent and form dense understories. The lower elevation uplands, and areas with no talus contain creosotebush and a mix of calcareous indicator species such as spiny-fruited pricklypear cactus (*Opuntia ×spinosibacca*), Boquillas silverleaf (*Leucophyllum candidum*), and Texas false agave (*Hechtia texensis*).



Figure 8. Common RIGR Western Region Vegetation Types (CTI, CCB, and NPS).

The upper riparian areas in the Boquillas Canyons are narrow and linear. Honey mesquite shrubs, occasional tamarisk, isolated cottonwood, willows, and Mexican ash (*Fraxinus berlandieriana*) trees maybe present. Bermuda grass can be prevalent and form dense understories. Other weedy species such as giant cane and tree tobacco may encroach in some of the flatter areas. Sheer canyon cliffs and rock slopes offer no apparent transition zone.

The lower riparian zone in the Boquillas Canyon is also quite narrow, linear and patchy. Starting in the more established stream banks, thick giant cane and tamarisk stands are common. These give way to shorter common reed and Bermuda grass bands closer to the river. A few pockets of young Thuber's willows may also present. The active river channel includes small alluvial bars, islands, and low floodplains that support mixes of short and sparse riparian shrub seedlings and herbaceous vegetation such as seepwillow (*Baccharis salicifolia*), cattails, smartweeds, and other early successional species. Where the canyon is at its steepest, riparian vegetation maybe absent or only occur at the mouths of washes and drainages (Figure 9).

RIGR Chihuahuan Desert - Black Gap WMA and Vegas Meadows Region

After leaving the Boquillas Canyon and exiting BIBE, the Rio Grande River enters a region characterized by low rolling hills, large floodplains, and intricate drainages. The Black Gap WMA and Vegas Meadows region is similar in species composition to the western region of BIBE. Dominant upland species include creosotebush and to lesser extent ocotillo and lechuguilla shrubs at higher elevations. Taller creosotebush and honey mesquite shrubs and mixed desert scrub species are common on lower upland sites. Intermixed are dissected drainages supporting common tall wash shrubs such as desert willow and catclaw acacia (*Senegalia greggii*) and smaller washes with creosotebush, honey mesquite, and/or sparse vegetation.

The upper riparian zone in this segment of RIGR varies from broad floodplains to narrow strips. Some small honey mesquite bosque stands are present along with the occasional patch of tamarisk. Trees are mostly isolated and consist of cottonwood, willows, Mexican ash and sweet acacia or huisache (*Vachellia farnesiana*). Buffelgrass and Bermuda grass can be prevalent and form dense understories under shrubs and trees. Other weedy species such as giant cane and tree tobacco may encroach in flatter areas. Mesic sites may contain understories of buffelgrass and poison ivy (*Toxicodendron radicans*).

The lower and active riparian zone in the Black Gap WMA and Vegas Meadows Region is dynamic and is similar to the same areas co-located in BIBE. Frequently inundated sites on alluvial islands and low floodplains contain herbaceous vegetation with scattered short shrubs. Broad low floodplains may have short honey mesquite shrubs. Low stream banks and alluvial bars often contain mixes of bulrush, cattails, smartweeds, and other early successional species. Tall linear stands of common reed and taller bands of giant cane and young tamarisk maybe present. Bermuda grass is also often present and can form large mats in open areas and in the understory of trees and shrubs (Figure 10).



Figure 9. Common RIGR Boquillas Canyon Vegetation Types (CTI, CCB, and NPS).



Figure 10. Common RIGR Black Gap WMA and Vegas Meadows Region Vegetation Types (CCB and NPS).

RIGR Chihuahuan Desert - Lower Canyons Region

The long middle section of RIGR that occurs on private lands east of BIBE contain many limestone canyons, intermittent tributary streams, and smaller drainages and washes. The vegetation here is gradually shifting from western Chihuahuan Desert species to mixes of eastern Tamaulipan thornscrub species. Lower Canyon uplands contain northeastern desert scrub communities on limestone substrates usually dominated by the Chihuahuan succulent species candelilla, lechuguilla, Texas false agave, ocotillo, blind prickly pear, and creosotebush. To lesser degree, some Tamaulipan species such as blackbrush, (*Vachellia rigidula*) cenizo (*Leucophyllum frutescens*), Mexican oregano (*Lippia graveolens*), and coyotillo (*Karwinskia humboldtiana*) maybe present. Lower elevation uplands are sparser in nature and often contain more creosotebush shrubs with few associated species. Small, high-gradient upland tributary washes in this region contain combinations of blackbrush and/or splitleaf brickellbush (*Brickellia laciniata*) mixing with other tall shrubs including mesquite and catclaw acacia. Sparse limestone outcrops and rock cliff faces supporting little vegetation are also prevalent.

The upper riparian areas in the Lower Canyons are narrow and linear. Honey mesquite shrubs, occasional tamarisk, isolated cottonwood, willows, and Mexican ash (*Fraxinus berlandieriana*) trees maybe present. Buffelgrass and Bermuda grass can be prevalent and form dense mats. Some transition areas have mixed stands of linear upland shrubs that are larger and taller in appearance. These include mixes of blackbrush, honey mesquite, and other local dominant shrub species.

The lower riparian zone in the Lower Canyons is variable with narrow and linear features in steep canyons and larger floodplains occurring in open sections of the river. Stream banks can contain thick giant cane and tamarisk stands, along with pockets of young native willow saplings. Long linear bands of common reed and Bermuda grass may occur close to the river channel. The active river channel includes alluvial bars, islands, and low floodplains that support mixes of sparse riparian shrub seedlings and herbaceous vegetation such as catttails willows, young huisache saplings, catttails, smartweeds, and other early successional species. Bermuda grass may occur as thick mats in open areas. Very steep canyon slopes usually lack any riparian vegetation (Figure 11).

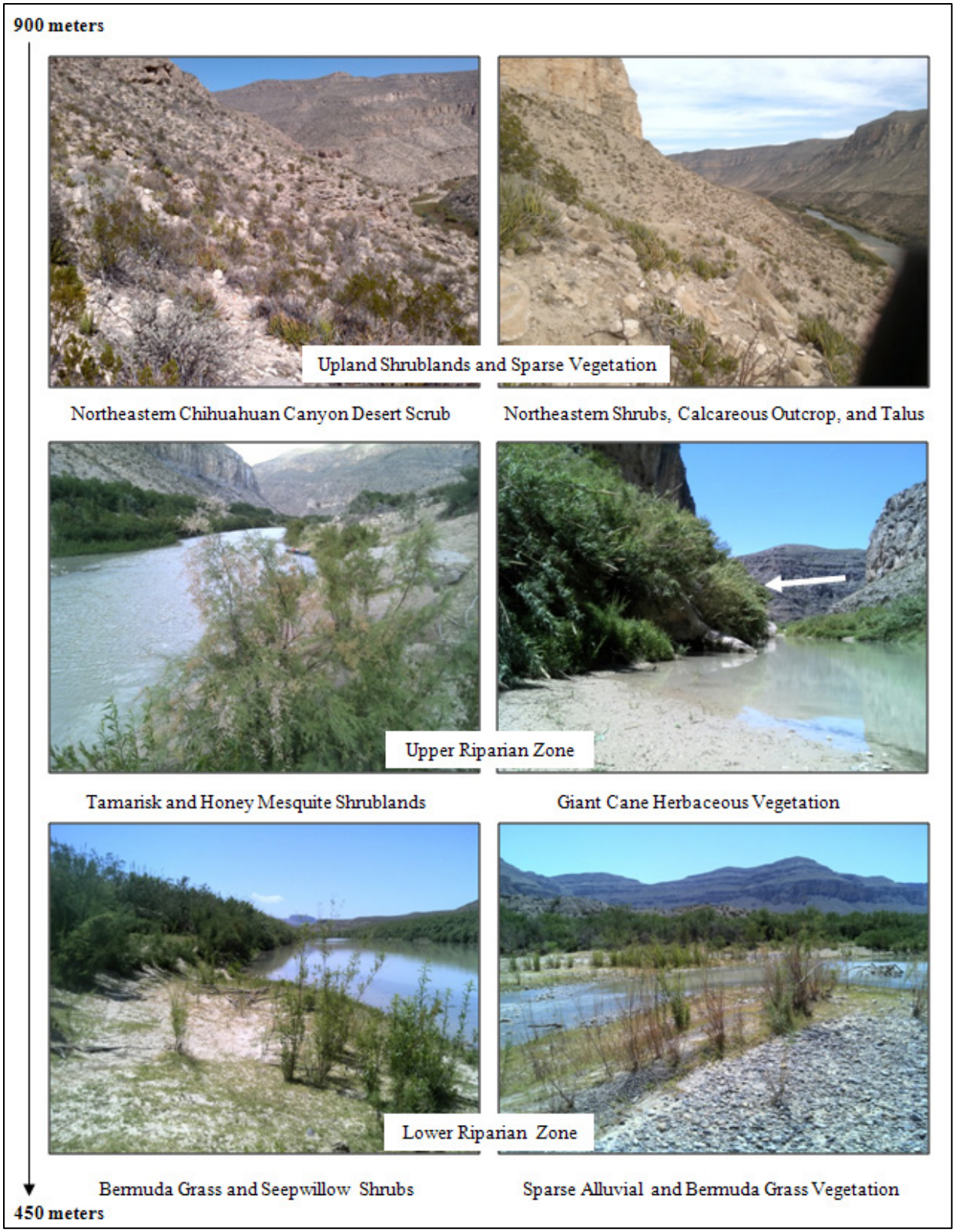


Figure 11. Common RIGR Lower Canyons Region Vegetation Types (CCB and NPS).

RIGR Chihuahuan Desert - Tamaulipan Transition - Southern Stockton Plateau Region

The eastern-most section of RIGR occurs in a true transition zone between the western Chihuahuan Desert and the eastern Tamaulipan Region of Texas. This area of RIGR is also located close to the Stockton Plateau portion of the Edward's Plateau ecoregion. Shrublands of mixed species dominate the upper moderate to steep slopes occurring on limestone substrates. On higher and more mesic upland areas, a mixed shrub type is common with a combination of honey mesquite, skeletonleaf goldeneye (*Viguiera stenoloba*), ocotillo, Christmas cactus (*Cylindropuntia leptocaulis*), Mexican oregano, and/or lechuguilla as co-dominant Chihuahuan species. Common Tamaulipan species include desert olive (*Forestiera angustifolia*), guajillo (*Senegalia berlandieri*), guayacan (*Guaiacum angustifolium*), lotebush (*Ziziphus obtusifolia*), Texas persimmon (*Diospyros texana*), and cenizo. Lower elevation uplands contain more creosotebush shrubs and are generally on gentler slopes or limestone flats. Upland washes and drainages are common with somewhat open to dense shrublands dominated by taller Texas persimmon, honey mesquite, guajillo, Texas kidneywood, (*Eysenhardtia texana*) and other thorny shrubs.

The upper riparian zone in the Southern Stockton Plateau Region is wider than then preceding canyons. Broad and long linear stands of giant cane, tall tamarisk, and honey mesquite bosque shrublands are common. Interspersed are pockets of Mexican ash, huisache, and willow trees. Open upper floodplain areas can have thick mats of Bermuda grass. At the transition between the riparian and upland zones, mixed stands of large statured upland species can occur including bushy creosotebush, blackbrush, and guajillo shrubs.

The lower riparian zone in the eastern section of RIGR is also wider than the canyon areas and contains long linear stands of common reed and seepwillows. Some patches of young willows may also occur. The alluvial bars, islands, and low floodplains contain sparse stands of early successional species and Bermuda grass. Young, short, and sparse shrub species such as tree tobacco, tamarisk, seepwillows, huisache, and mesquite maybe scattered over understories of bare rock, silt, and sparse Bermuda grass (Figure 12).



Figure 12. Common RIGR Southern Stockton Plateau Region Vegetation Types (CCB and NPS).

Non-native and Introduced Species

Like many areas in the West, water diversion, ranching, mining, and other human developments have removed or altered native plant communities and introduced non-native species into the environment. At RIGR, non-native and invasive species are common along the Rio Grande River and as understory components in the desert uplands. Although actively managed on NPS owned lands, large riparian areas at RIGR (especially outside of BIBE) contain thick stands of tamarisk or salt cedar shrubs/trees and giant/river cane or arundo grass thickets. Both species negatively affect the natural ecology by crowding out native vegetation, creating high salt concentrations, and consuming large amounts of water. Other, less pronounced introduced and somewhat invasive species such as Russian thistle (*Salsola tragus*), tree tobacco, and Bermuda grass can also occur in the riparian zones at RIGR. In and around the Rio Grande Village area, Bermuda grass is maintained as a lawn species and cottonwoods and other trees have been planted and irrigated. Buffelgrass (*Pennisetum cillare*), Johnson grass (*Sorghum halepense*) and Tobosa grass (*Pleuraphis mutica*) (all aggressive grass species) are also found extensively throughout RIGR as understory components in the various upland and riparian plant communities (Figure 13).

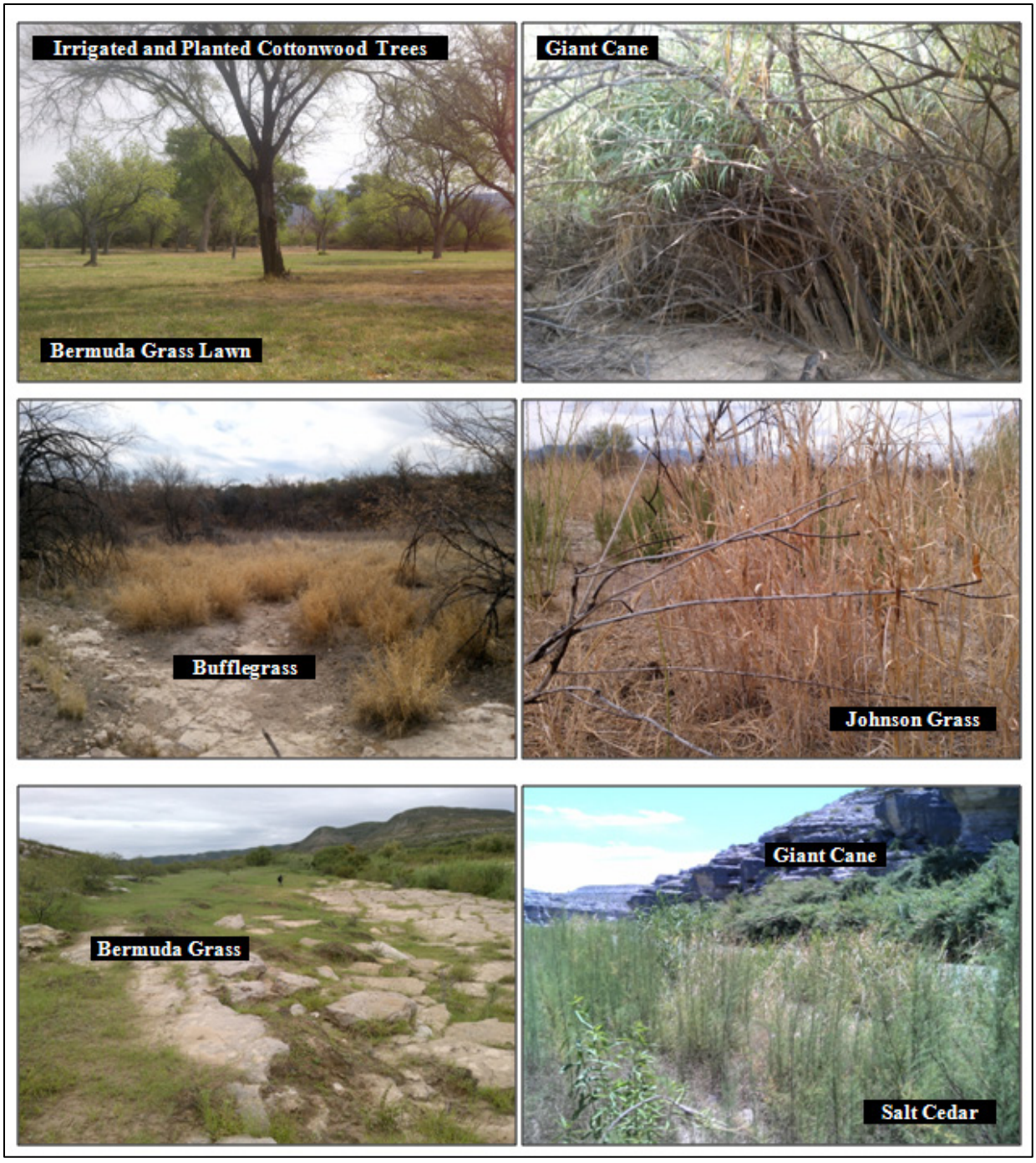


Figure 13. Examples of Introduced and Non-native Species at RIGR (CTI, CCB, and NPS).

Vegetation Inventory Project

The decision to inventory, classify, and map the vegetation at RIGR was made in response to guidelines set forth by the NVIP (NPS 2009) and the CHDN (NPS 2001). Work was started at RIGR in 2011, when CTI was contracted to complete three preliminary studies that included a review of the existing (legacy) vegetation data (Von Loh and Cogan 2011a), a summary of potential vegetation communities (Von Loh and Cogan 2011b), and a sampling approach for a plant community inventory

(Cogan and Von Loh 2011). Using the preliminary list of plant communities and the recommend sampling strategies found in these reports, the NVIP contracted with the Lady Bird Johnson Wildflower Center (LBJWC) to collect sample plot data in representative vegetation associations at RIGR starting in 2012.

After the plot data was collected at RIGR, CTI was again contracted to begin work on both the final vegetation classification (using the LBJWC data) and the vegetation map. CTI delivered the draft RIGR classification, field key, and vegetation map layer to the NVIP in 2016. CTI and sub-contracted field crews completed the accuracy assessment (AA) data collection in 2017. Data from the AA effort was then used to evaluate the draft products and the results were sent to the NVIP for review and approval in 2018-2019.

Overall the NVIP, CHDN, CTI, and LBJWC professionals (with critical support from BIBE/RIGR staff), worked together to meet all of the project objectives and ultimately produce all of the final products that met the NVIP's mandates as outlined in their 12 Step Guidance for NPS Vegetation Inventories (NPS 2009). Important directives from the NVIP that were addressed by the team include the following:

- Vegetation Information
    - The vegetation classification will be based on the rUSNVC;
    - A dichotomous field key of vegetation associations will be created;
    - Formal descriptions for each of the vegetation association will be included;
    - Representative ground photos will be attached for all vegetation associations;
    - All of the field data will be presented in the PLOTS database format.
- Spatial Data
    - The map classification will be based on the rUSNVC and will include RIGR-specific requirements;
    - Descriptions and a key will be created for each of the map units;
    - A spatial geodatabase will be created for all the vegetation data;
    - Digital and hardcopy maps of the vegetation will be created;
    - Metadata will be included for all spatial database layers;
    - An accuracy assessment of the vegetation spatial data will be performed and presented in a detailed final report.

Scope of Work

The NVIP instructed that all vegetation inventory work for RIGR occur within the administrative boundary of the unit. Various RIGR boundary layers were provided in digital form by the NPS and the NPS Land Resource Division. Since the southern boundary of RIGR changes periodically in relation to changes in the Rio Grande River some modifications were made to ensure that all lands within RIGR were inventoried and mapped. Specifically, the RIGR boundary was extended on both ends and a 0.25-mile (0.4 km) buffer was added. The 0.25-mile buffer was then examined against the

latest NPS boundary layers. Any additional RIGR lands not covered by the latest NPS boundary but previously contained in early boundary layers were included to create a larger and more encompassing project boundary (Figure 14). All mapping was done within the larger project boundary (compared to most of the fieldwork that was done closer to the river due to access issues). The final RIGR project boundary (Figure 15) contains 34,488 acres (13,957 hectares) and is comprised of 12,241 acres (4,954 hectares) of co-located BIBE lands, 13,378 acres (5,414 hectares) in Brewster County, 8,420 acres (3,407 hectares) in Terrell County, 22.2 acres (9 hectares) in Val Verde County and approximately 417 acres (169 hectares) of land falling on the U.S. - Mexican Boundary.

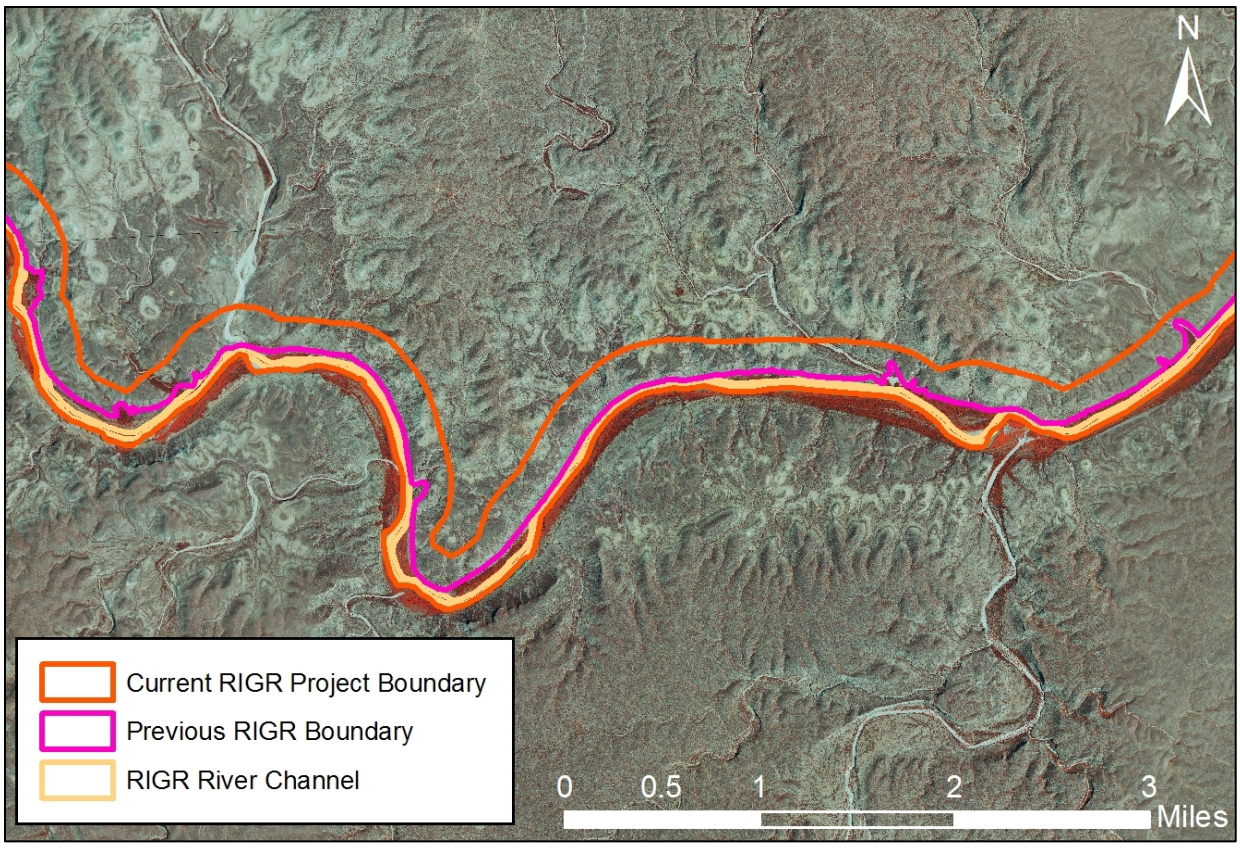


Figure 14. Example of the RIGR NPS and Project Boundaries Near Dryden Crossing (CTI).

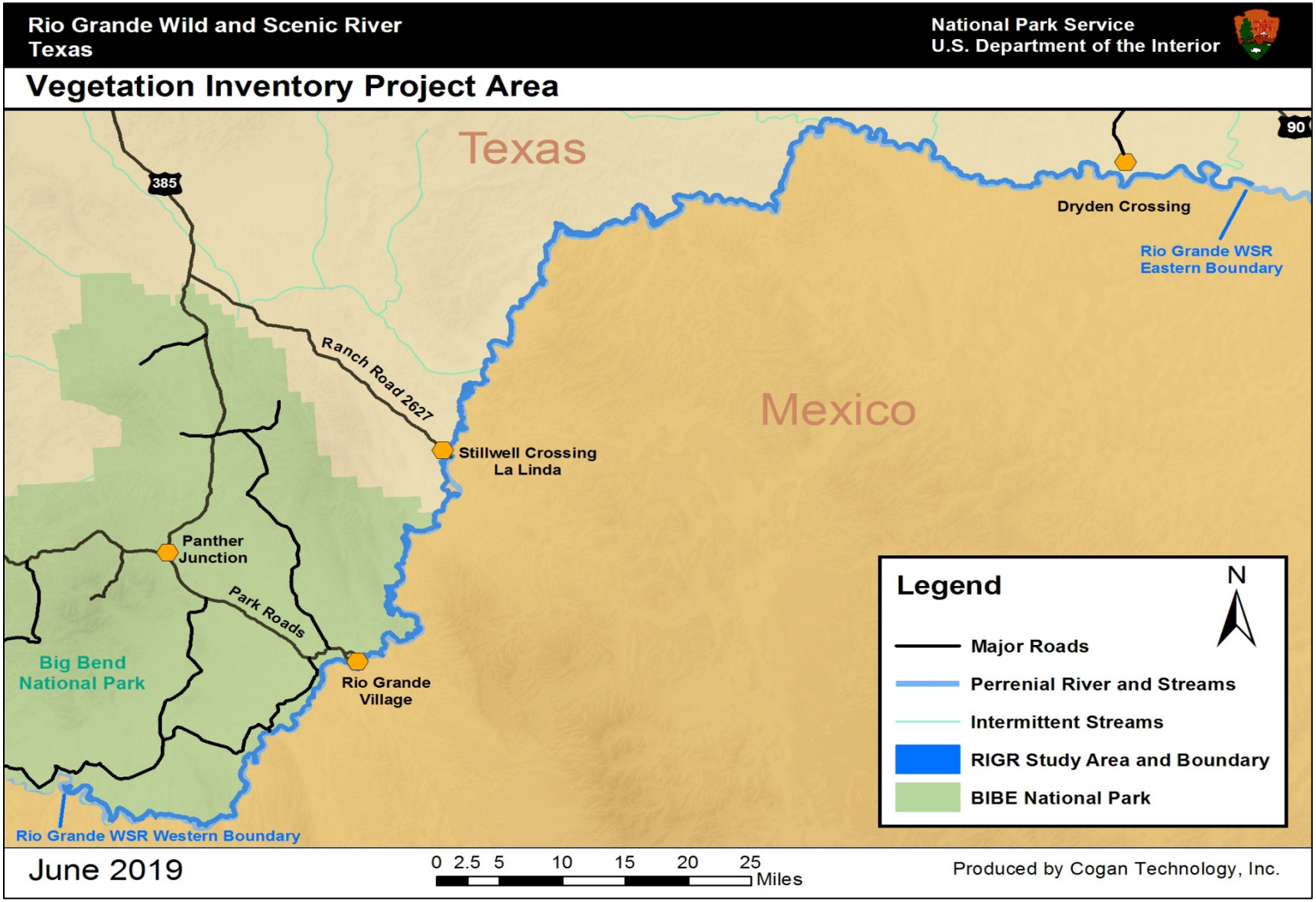


Figure 15. Map of the RIGR Vegetation Inventory Project Boundary (CTI).

Methods

All protocols and methods for this project as outlined in the following sections of this report can be found in the original program documents produced by The Nature Conservancy and Environmental Research Systems Institute (1994a, 1994b, and 1994c) and in later revisions (Lea 2011 and Lea and Curtis 2010). The standard vegetation inventory tasks were implemented for RIGR as outlined in the 12 Step Guidance for NPS Vegetation Inventories (NPS 2009). The five major project categories are summarized below, and the following report sections give detailed descriptions for each:

1) Plan, gather legacy and historical data, and coordinate tasks;
2) Survey RIGR to understand and inventory the vegetation using sample plots and observation points;
3) Classify the vegetation using the resulting field data to rUSNVC standard associations and alliances and crosswalk these to recognizable map units;
4) Acquire current digital imagery and interpret the vegetation from the imagery using the rUSNVC and a map unit crosswalk table;
5) Assess the accuracy of the final map product.
6) Summarize the project findings in a final report, create the final vegetation spatial database, and produce all the other standard deliverables.

All protocols for this project as outlined in the following sections can be found on the NVIP website.

Planning, Data Gathering, and Coordination

Planning for this project got underway in 2009 and numerous on-site meetings and conference calls were attended by representatives from CTI, NVIP, BIBE/RIGR, and LBJWC. The goals of these efforts were to

- Discuss the overall project and review the necessary requirements,
- Discuss availability of existing data,
- Learn about the management issues and concerns,
- Discuss procedural issues and data management,
- Develop a project scope of work and project timeline, n
- Discuss future project needs and funding.

After the initial meeting and calls, individual work responsibilities were assigned, tasked, or contracted with various entities to create an experienced vegetation inventory team. The participants in the vegetation inventory project and their responsibilities include the following:

NVIP Staff

- Provide project guidance, contract facilitation, oversight, and funding;
- Provide project management;

- Review draft and final products and finalize the project.

BIBE/RIGR and CHDN Staffs

- Provide copies of the existing data, provide local expertise, and other resources;
- Supply digital boundary files and ancillary spatial data files;
- Assist with all fieldwork and provide logistical support;
- Review and help develop the vegetation classification;
- Review draft and final products.

Rio Grande Institute (RGI) and Lady Bird Johnson Wildflower Center (LBJWC) (Contractors)

- Collect and manage plot and observation point data;
- Write the plot data collection report;
- Help develop the vegetation classification;
- Collect and manage the accuracy assessment (AA) data;
- Write the AA data collection report;
- Enter plots, observation point, and AA data into the PLOTS database and review for quality assurance purposes;
- Review draft and final products.

Cogan Technology, Inc. (CTI) and Coast to Coast Botany (CCB) (Contractor and Sub-contractor)

- Help with overall project planning, facilitation and coordination;
- Summarize the legacy data;
- Develop the vegetation classification (CCB);
- Write the field key and local descriptions for the vegetation types (CCB);
- Map and delineate the vegetation and land use types;
- Ground-truth vegetation and land use/land cover signatures on the imagery;
- Develop map units linked to the rUSNVC;
- Create the draft vegetation map for the AA;
- Collect and manage the AA data (CCB);
- Enter the AA data into the PLOTS database and review for quality (CCB);
- Write the AA data collection report (CCB);
- Review AA point field determinations, generate contingency tables, and suggest post-AA modifications to the vegetation layer;
- Finalize the vegetation layer;

- Create the final deliverables including a summary report, vegetation classification appendices, a spatial geo-database with all the new spatial layers, FGDC-compliant metadata, field and map guides, a vegetation map layout, graphics, and hyperlink all ground photos to the database.

Field Surveys

The field methods used for developing the classification at RIGR was based on the methodology outlined by the NVIP (TNC and ESRI 1994b and Lea 2011). Since RIGR is a unique NPS unit the standard methodology was modified for two reasons. First, the western half of RIGR (The Great Unknown and Boquillas Canyons) was sampled as part of the larger and co-located BIBE vegetation inventory effort. Second, since RIGR is a long corridor that is mainly only assessable by watercraft, no gradsect or sampling strategy was defined for the eastern half of the park. Instead unique stands of vegetation were targeted based on visual site assessments by the field ecologists as seen from the Rio Grande River.

Three field work sessions were used to sample the vegetation communities at RIGR. The first was conducted by a LBJWC ecology and botany team in April of 2013 within the co-located lands of BIBE and RIGR. They collected data at 39 vegetation sample plots that were placed in unique plant communities. The resulting data were labeled with the "BIBE" prefix in the classification database. The second effort occurred in the eastern half and Lower Canyons section of RIGR outside of BIBE in May of 2013. Sampling in this area was conducted by another LBJWC field team during a canoe-assisted river trip. During the river trip, the field team collected data at 81 sites using an observation point sampling strategy. Observation points by their nature are less comprehensive than a standard NVIP plot and are equivalent to an occurrence plot as defined by the FGDC (2008). Specifically, observation points are an efficient way to describe the vegetation over a very large area, in difficult terrain, and/or when funding and timing are limited. An observation point differs from a sample plot in that they only document or establish an occurrence of a previously described vegetation type, but do not contain detailed species, strata, and foliar data cover necessary for detailed classification analyses. The resulting data were labeled with the "RIGR" prefix in the classification database.

The third and last data collection effort at RIGR occurred in November of 2018 during a long river trip. This trip was deemed necessary to help fill-in the large eastern area of RIGR that was not sampled during the previous efforts. To maximize effectiveness, the 2018 river trip consisted of a combination of collecting sample plot and AA data. The data collection team consisted of a group of CTI sub-contracted CCB and RGI ecologists that were supported and aided by NPS guides and staff. The focus of their efforts was a 40 mile (64 km) stretch of RIGR between Dryden Crossing and the Terrell and Val Verde county line. In addition to collecting data at pre-selected AA sites, 38 new classification plots were sampled and recorded. The resulting data were also labeled with the "RIGR" prefix in the classification database. During this trip, NPS also requested that the field teams collect panoramic photos at 11 representative sites for inventory purposes.

During all three sampling sessions, the sampling plot size and shape requirements were consistent with NVIP guidelines (TNC and ESRI 1994b) and were determined by the physiognomy of the plant community being sampled (Table 3). Measuring tapes were used to establish the circular, square, or rectangle sampling area and the plot size and shape was adjusted as needed to sample linear bands of

vegetation in washes, riparian corridors, or other confined areas. In general, most of the RIGR plots were rectangular in shape, were 400 square meters in size, and were either 16 meters by 25 meters or 10 meters by 40 meters in dimension. In contrast, observation points were not delineated on the ground but were recorded around a single location. Geo-referenced coordinates were recorded as a waypoint in the center of each plot or observation point using Global Positioning System (GPS) receivers and then recorded by hand onto the field forms. Ground reference photographs of the sampling site were taken using digital cameras. The field ecologists took additional ground photos in the various cardinal directions (North, South, East, and West) or as the vegetation and landscape allowed. Ground photos were later labeled after each plot/observation point using a unique numbering system (e.g. RIGR_007N = RIGR plot number 7 with the ground photo taken in the northern direction).

Table 3. Plot Sizes Used for Classification Sampling at RIGR.

Dominant Physiognomy	Plot Size	Plot Area
Forest: trees have their crowns overlapping, usually forming 60-100% cover, and **Woodland**: open stands of trees with crowns usually not touching. Canopy tree cover 25-60%, OR exceeds shrub, dwarf-shrub, herb, and nonvascular cover.	• Circular: 11.28 m radius • Square: 20m x 20 m	400 m^2
Shrubland: shrubs greater than 0.5 m tall are dominant, usually forming more than 25% cover OR exceeding tree, dwarf-shrub, herb, and nonvascular cover, and **Dwarf-shrubland** (e.g., heath): Shrubs less than 0.5 m tall are dominant, usually forming more than 25% cover OR exceeds tree, shrub, herb, and nonvascular cover.	• Circular: 11.28 m radius • Square: 20m x 20 m	400 m^2
Herbaceous (e.g., grassland, meadow, marsh): Grasses or forbs dominant, usually forming more than 25% cover OR exceeds tree, shrub, dwarf-shrub, and nonvascular cover.	• Circular: 11.28 m radius • Square: 20m x 20 m	400 m^2 or 100 m^2
Nonvascular (e.g., fen, bog, cliff, scree slopes: nonvascular cover dominant, usually forming more than 25% cover.	• Circular: 11.28 m radius • Square: 20m x 20 m	400 m^2 or 100 m^2
Sparse vegetation (e.g., rock outcrops, talus slopes, and fell-fields): less than 10% total vegetation cover.	• Circular: 11.28 m radius • Square: 20m x 20 m	400 m^2 or 100 m^2

Each BIBE/RIGR plot or observation point was given a unique label/number and environmental data were recorded on the plot field forms (Appendix A). Environmental data included elevation, slope, aspect, landform, topographic position, soil texture and drainage, hydrologic (flooding) regime, and evidence of disturbance or wildlife use. The unvegetated surface was estimated and recorded as percent cover of bedrock, litter/duff, wood, bare soil, large rocks (>10 cm), small rocks (0.2 to10

cm), sand (0.1 to 2 mm), lichens, and mosses. Next, the vegetation was visually divided into strata, with the height and canopy cover of the dominant vegetation estimated for each stratum. Within each stratum, all taxa within the plot area (grid) or observed at a point location (no grid) were identified and the foliar cover of each taxon was estimated using cover classes (Table 4).

Table 4. Cover Classes and Vegetation Strata used at RIGR.

Physiognomic Classes	Vegetation Strata Code	Vegetation Strata	Cover Class Code	Cover Class
Forest (>60% Tree Cover)	T1	Emergent Canopy:	1	trace
Woodland (25-60% Tree Cover)	T2	Main Canopy	2	few (<1%)
Shrubland (> 25% Shrub Cover)	T3	Subcanopy	3	1-2%,
Shrubland with sparse (< 25%) tree layer	S1	Tall Shrubs	4	2-5%,
Dwarf shrubland (<25%) tree layer	S2	Short Shrubs	5	5-10%,
Herbaceous with sparse (< 25%) tree layer	S3	Dwarf-shrubs	6	10-25%,
Herbaceous with sparse (< 25%) shrub layer	H	Herbaceous Vegetation	7	25-50%,
Herbaceous	V	Vines	8	50-75%,
Nonvascular Bryophyte	E	Emergent	9	75-95%,
Nonvascular Lichen	N	Non-vascular	10	95-100%
Sparsely Vegetated (<10% cover) Vascular	–	–	–	–

Some additional common species that occurred outside of the sampled plots were listed to assist with the creation of the local association descriptions. Species that were not identifiable in the field were collected for identification and later destroyed. Plant species were recorded by their scientific name familiar at the time and were later updated to reflect any changes in nomenclature as dictated by the PLANTS Database (USDA-NRCS 2018). Appendix B contains a list of all of the plant species found during the RIGR fieldwork portion of this project.

Together the LBJWC and RGI field crews from 2010 through 2018 sampled vegetation at a total of 158 sites. These included 77 full releve-style sample plots and 81 observation points. Each sampled area was assigned a provisional community name from the preliminary plant associations list (Von Loh and Cogan 2011b). All data was then transferred from the field datasheets to the PLOTS database (version 3.2) and reviewed for content and quality assurance by LBJWC staff. LBJWC working with the CHDN certified the plant species data that was collected. Upon receipt of the final PLOTS database for RIGR, CTI extracted the geo-referenced coordinates for each unique plot and created a GIS spatial layer (Figure 16).



Plot Data Collection at Rio Grande Wild and Scenic River (CTI, CCB, RGI and LBJWC).

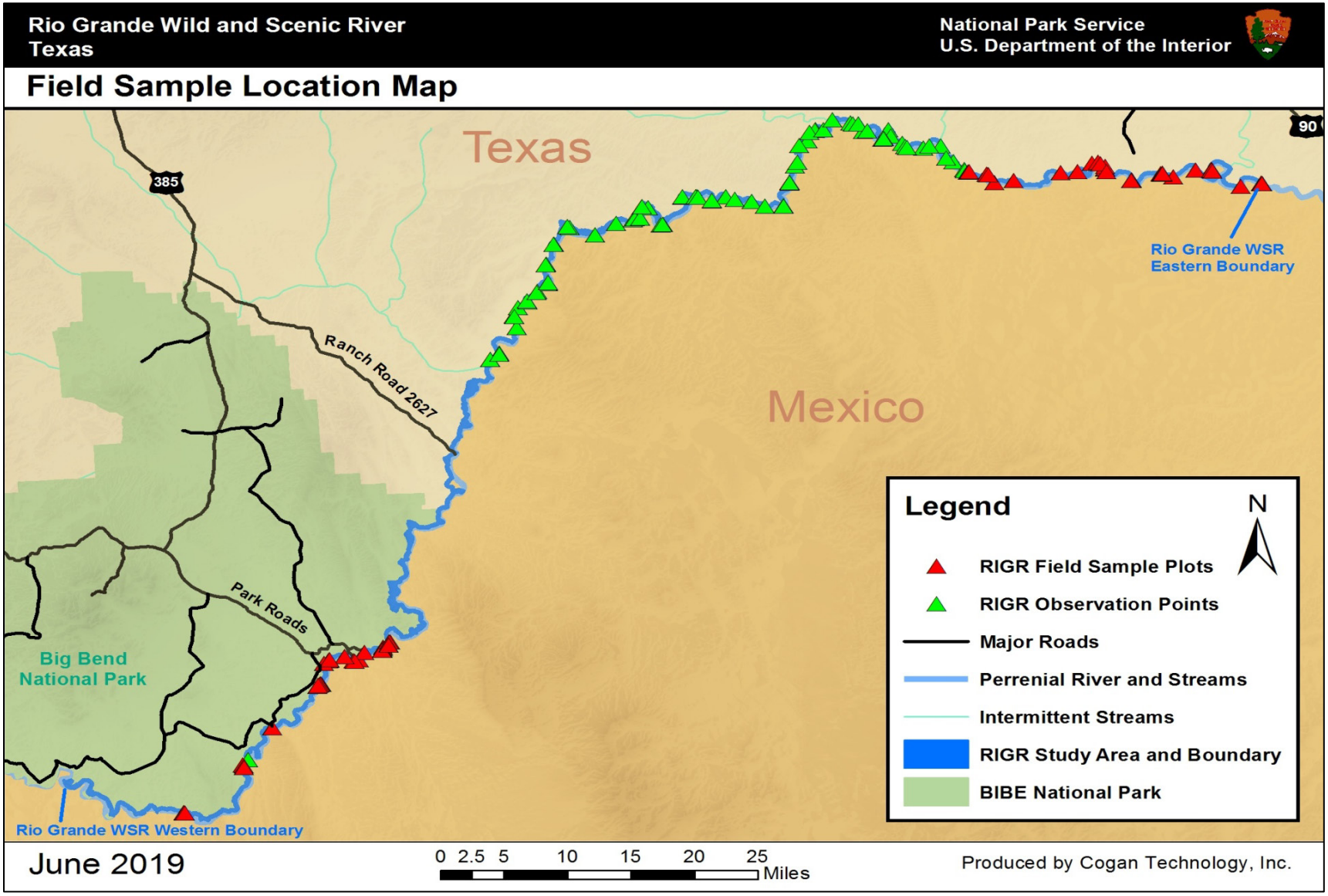


Figure 16. Map of the Vegetation Plots and Observation Points Collected at RIGR (CTI).

Vegetation Classification

Due to challenges related to access and logistics, the classification for RIGR was performed in an uneven manner using both classification plot data and supplemental data (observation and AA points) to fill in the data holes for unsampled locations. The RIGR classification was started in 2013 using the co-located BIBE/RIGR plot data. The plot data represented both the original 39 plots co-located within the boundary of BIBE combined with the 81 RIGR observation points outside of BIBE. The plot data was used to create the BIBE vegetation classification and the observation data was used to verify these types at RIGR. Similarly, the observation data was also used to help identify two potentially new types not previously documented. Finally, both the vegetation classification for AMIS and the BIBE/RIGR AA data were examined to see if they could be used to serve as occurrence plots (FGDC 2008) in RIGR.

Early in the classification process it was noted that no field data was collected in the far eastern portions of RIGR. Since it was important that the RIGR classification include the full biogeographic gradient from upstream to downstream (southwest to northeast), a request was made to the NVIP and additional funding was provided to collect more data in this area. After this data collection trip, the additional plot data was added to the RIGR PLOTS database and the draft classification was updated using the 38 plots collected during this trip.

Overall, the vegetation data from a total of 268 classification plots, 81 observation points, and 250 AA points were examined for usefulness. These represented all of the RIGR data collected within the project boundary and also data collected during the nearby and identical BIBE and AMIS projects. Of these, 268 classification plots, 81 observation points, and 33 AA points were ultimately used to help classify the vegetation at RIGR (Table 5).

Table 5. Summary of the Field Data used in the RIGR Vegetation Classification.

Field Data Description	Field Data Location	Data Points Used for RIGR
AMIS Plots	West AMIS near the Eastern RIGR Boundary	62
BIBE Plots	East BIBE near the Western RIGR Boundary	129
BIBE/RIGR Plots	Co-Located in both BIBE and RIGR	39
RIGR Plots	Eastern Section of RIGR	38
RIGR Observation Points	Lower Canyons or RIGR	81
RIGR AA Points	Rio Grande Village to Dryden Crossing / Central RIGR	33
Total	–	382

Classification efforts at all stages included having a CCB NVC specialist (sub-contracted to CTI) first edit and review all of the field data located in the PLOTS database. The specialist then ran the data through a series of analytical steps to classify the potential plant associations. The first step was to convert all of the plot data by individual species and stratum abundance into a species by plot

abundance matrix using the data conversion formula given by Jennings et al. (2009). Individual species by plot abundance values were then scaled using the cover classes applied during the field data collection.

The second step involved taking the species by plots matrix and conducting a primary cluster analysis (McCune and Grace 2002) using a flexible beta value of - 0.5 (Bray and Curtis 1957). Dissimilarly distances were derived using PC-ORD version 6.0 software (McCune and Mefford 2011). The results were placed into a dendrogram that was inspected to determine an "average" level at which the individual clusters were ecologically interpretable. A level of clustering that left about 70% information remaining was selected. Additional clusters were also recognized if they were close to the threshold. This step provided 55 initial clusters to be considered as potential vegetation types.

The third classification step was to evaluate the initial clusters for common environmental conditions. Clusters that had common conditions and few floristic differences were merged and clusters that seemed overly heterogeneous were further split. At this time, the Bray-Curtis distance matrix was also converted to a plot-by-plot similarity matrix. The cells in this matrix that represented plot similarities were color-coded to better visualize tabular sorting. Finally, individual plots were moved and sorted from cluster to cluster to optimize the balance between (1) interpretability and ecological consistency of the clusters (particularly at mapping scales) with (2) maximizing within-cluster similarities and between-cluster dissimilarities

The effect of splitting, lumping, and sorting the individual plots between clusters provided initial interpretable fine-scale or provisional association types for RIGR. These were ultimately reduced when two draft associations were considered to be variants of more widespread types. Nineteen of these preliminary associations were previously described at BIBE including most of those known to occur below 2,000 feet (615 m) in elevation. Two additional associations were added from the RIGR AA data. Finally, three associations representing types of vegetation that are not normally sampled and analyzed (e.g. lichen vegetation on rock outcrops and managed area types) were added for mapping purposes.

Rio Grande riparian vegetation was assessed to be relatively homogeneous along the entire reach from BIBE to AMIS (320 river miles or 512 km). This meant that the plant association concepts and much of their descriptions previously developed for BIBE and/or AMIS could be assumed to be similar for RIGR, resulting in two preliminary riparian types. Two additional new riparian types were also included for small unique patch associations occurring in mesic RIGR side canyons that were not previously found in BIBE or AMIS.

In contrast to the riparian vegetation, RIGR's upland desert scrub communities were known to change considerably along a west to east (Chihuahuan to Tamaulipan/Balconian) gradient. To address the limited field data from the lower (eastern) 120 miles (192 km) in RIGR, a supplemental cluster analysis (using the same parameters described above) was performed on all upland classification plot data from BIBE, RIGR, and AMIS. Since the reach of RIGR from Rio Grande Village to Dryden Crossing had no classification plots in desert scrub vegetation (largely due to time and access constraints), 33 AA observations from this reach were also added to the analysis. The

final upland supplemental classification analysis yielded the presence of four previously undetected and previously undescribed associations due to the presence of more Tamaulipan flora. Additionally, one association previously known from AMIS was detected in the eastern part of RIGR and added to the classification.

Descriptions of each association, including synthesis (compositional) tables of species constancy and abundance, were created from the complete set of combined field plots for BIBE/RIGR/AMIS. While the synthesis tables are created from the classification plot data only, accuracy assessment and other observational data were used to augment or otherwise improve the written descriptions. For example, classification data was collected in 2011 during severe drought conditions so the subsequent AA data was used to reflect better the plant species diversity and abundance (foliar cover values) under more normal conditions at RIGR.

Plant Associations and Fine Scale Units

Based on the analyses described above, 35 associations were recognized for RIGR. In eight cases, an association had a reasonable match with a unit published by the rUSNVC (2017). The remaining types were not directly relatable to the rUSNVC at this time for one or more of the following reasons:

- General lack of detailed vegetation data from the Trans-Pecos region of Texas;
- Existing rUSNVC associations were too broad and were only defined at the state level;
- No similar rUSNVC association concept was found;
- A possible match was found, but the rUSNVC lacked sufficient data for comparison;
- The existing rUSNVC type matched in concept but did not match the dominant plant species at RIGR;
- The dominant plant species in one rUSNVC association occurred in multiple potential RIGR types;
- A partial match was found, but the published rUSNVC concept had significant conceptual conflicts with the RIGR type;
- A partial match was found, but the published rUSNVC association concept was placed in a higher level that left the potential RIGR type inappropriately distant in the hierarchy.

An attempt was made to match all of the unpublished and locally discovered rUSNVC association types to a published rUSNVC alliance (higher level). Of the 35 associations representing natural vegetation, 34 fit reasonably well within a recognized alliance. In some cases, the alliance level influenced the decision whether to treat an association as a new (local) type or as a previously recognized unit.

Those associations that were documented from RIGR with no certain rUSNVC counterpart were given a suitable Latin (floristic) name and NPS unique identifier (in lieu of a rUSNVC identifier), in accordance with the NPS classification guidelines (Lea 2011). Additionally, both the matched rUSNVC and new RIGR-specific associations were given a park or vernacular name. Alternative

names are useful in that they include the environmental context, helps with confusing Latin and scientific plant names, and makes them easier to understand.

Plant Alliances and Coarse Scale Units

At the higher levels in the rUSNVC, the 35 RIGR associations occurred with 17 rUSNVC alliances that were nested within 17 rUSNVC Groups and 14 rUSNVC Macrogroups (including one Cultural Vegetation unit at each of these levels) (rUSNVC 2018). These thematically and taxonomically coarser groupings of the associations represent broader levels in the hierarchy that might be more suitable for some management objectives. Despite their relatively new status, the rUSNVC Groups have fairly complete concept descriptions and unlike published rUSNVC associations seem to be more comprehensive for vegetation patterns that can be extracted from the RIGR PLOTS data.

The final products of the classification task include a field key and local plant association descriptions. The dichotomous field key to the RIGR plant associations was developed to assist users in identifying plant associations and their corresponding map units in the field, particularly during the AA portion of the project (Appendix C). The list of plant associations within the rUSNVC and their local descriptions provide a summary of the classification efforts at RIGR and include unique characteristics of each plant association (Appendix D). While the list follows the rUSNVC hierarchy, the field key and descriptions themselves are grouped and ordered more by their ecological setting including separating the riparian from the upland vegetation.

Digital Imagery and Vegetation Mapping

The overlap in coverage with BIBE and the long linear nature of the RIGR project boundary warranted the use of a modified vegetation mapping approach. Specifically, it was determined that the final vegetation map for BIBE (Cogan and Lea 2019) would be used as the basis for the western portion of RIGR. The remaining vegetation mapping in the eastern lower canyons and sites outside of BIBE would be done through standard vegetation signature interpretation and manual polygon delineation.

During the planning and coordination phase, CTI staff reviewed all available digital imagery for its potential use as the RIGR basemap. The most promising and easy to access was the data catalog found on the Texas Natural Resource Information System (TNRIS) website. Navigating to the orthoimagery-statewide web page, the list of existing imagery covering RIGR included multiple products produced annually by the U.S. Department of Agriculture's National Aerial Imagery Program (NAIP). The corresponding NAIP 2010 and 2012 1-meter (pixel resolution) quarter-quad datasets (Figure 17) for RIGR were downloaded and used during the preliminary planning and mapping stages.

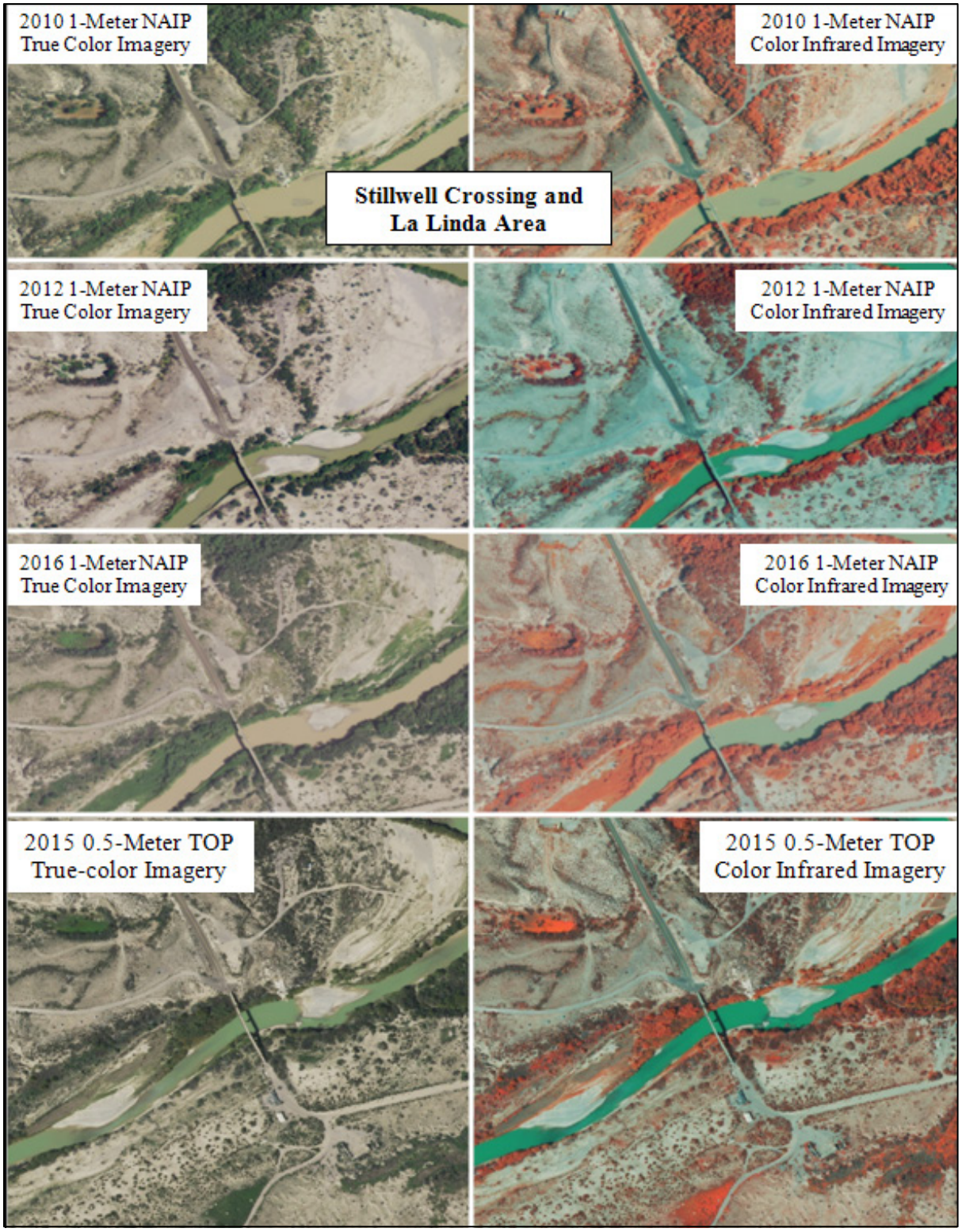


Figure 17. Examples of the Basemap Imagery for RIGR (NAIP and TOP).

Since 2012, other orthoimagery products covering RIGR were made available by TNRIS and were downloaded by CTI. This included the 2015 Texas Orthoimagery Program (TOP) 50-cm quarter

quads and the 2016 version of the NAIP products (Figure 17). Both datasets contained an infrared band that is useful for vegetation mapping as it highlights active growth patterns. However, after a thorough review, the 2015 TOP imagery was found to be superior to the 2016 NAIP product due to its finer resolution and sharper contrast. Based on this decision, the 2015 TOP imagery was selected as the primary basemap for this project and the NAIP 2016 product was used as ancillary data to back-up the 2015 TOP imagery (for mapping in shadows, at recent disturbed sites, etc.). Once digital copies of the imagery were acquired and compiled, interpretation and mapping of the vegetation began using a four-step process that included: (1) importing and updating the BIBE mapping, (2) photo-interpretation and digitizing, (3) ground-truthing the mapped data, and (4) map refinement and finalization. Figure 18 shows a summary of the mapping stages and spatial layers used or produced.

In the first step, all of the final BIBE vegetation polygons were clipped and imported into the RIGR project boundary layer. Next, existing RIGR roads, trails, and the Rio Grande River corridor (i.e. open water areas) were extended outwards from BIBE into the unmapped area. Once the preliminary polygon layer for the eastern portion of RIGR was digitally outlined, the BIBE RIGR boundaries were edge-matched and any small polygon slivers were removed. Based on the 2015 TOP imagery, new vegetation polygons were manually delineated for the eastern portions of RIGR. The existing RIGR plot and observation data were overlaid and consulted at this time. All vegetation delineations were visually inspected and manually moved, edited and updated as needed. Any obvious problems in the mapping were edited and resolved. Once the preliminary lines were completed, temporary map unit names and placeholder codes were used to attribute each vegetation polygon. Preliminary vegetation mapping was considered complete when all resulting polygons matched homogenous stands of vegetation apparent on the TOP 2015 imagery.

Ground-truthing or verifying the vegetation for the un-mapped portion of RIGR occurred during the November 2018 river trip. During this trip, the preliminary RIGR vegetation layer was reviewed by CCB and RGI field teams and verified that the map lines and labels matched the actual vegetation on the ground. Additional or missing vegetation polygons were noted, and more general observations were taken to help write the map unit descriptions and to ultimately create the final list of RIGR map units. A summary report containing map unit and mapping pattern suggestions was created by CCB and these suggestions were incorporated into the final RIGR vegetation map layer.

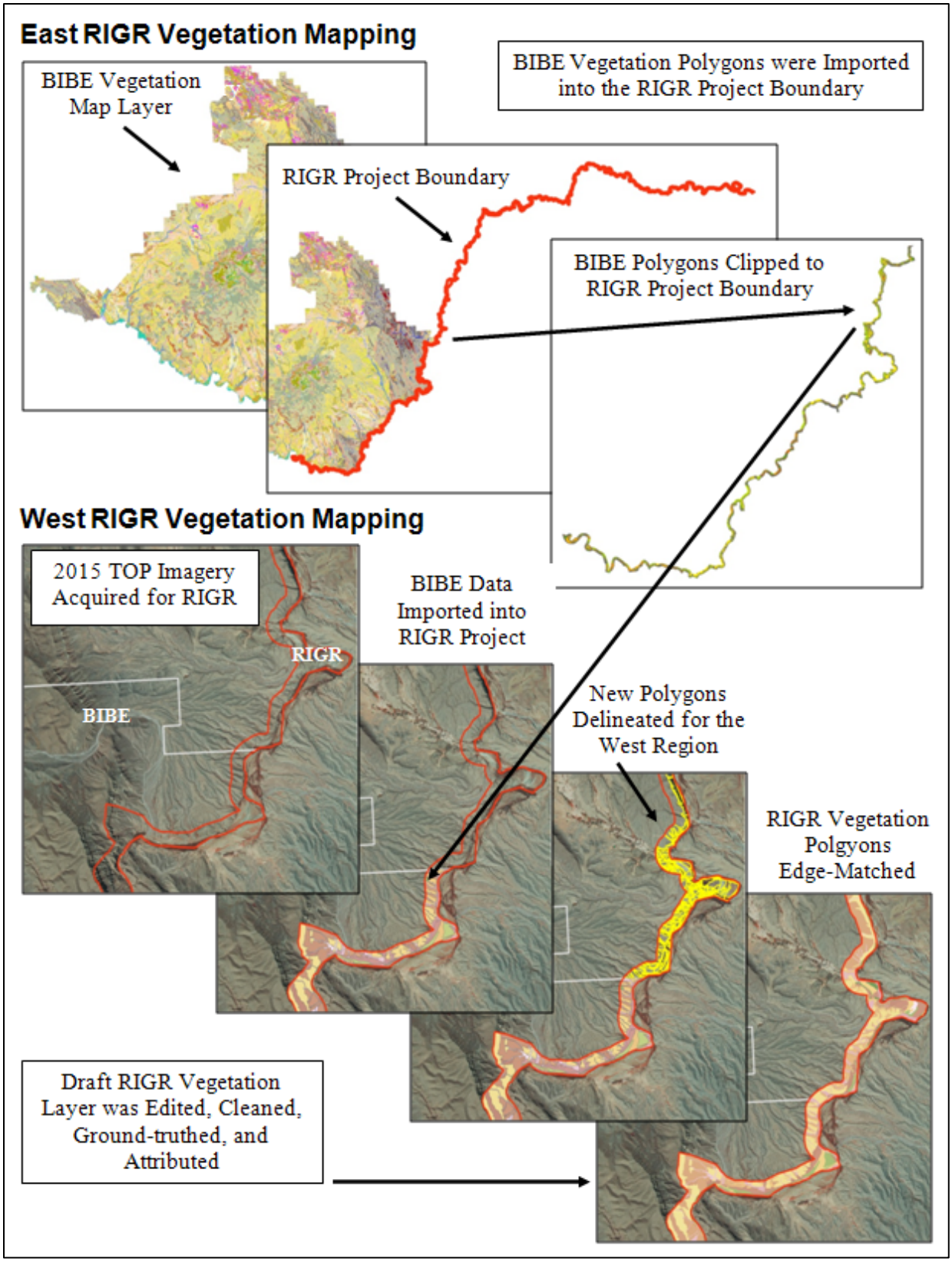


Figure 18. RIGR Vegetation Mapping Flow Diagram (CTI).

The RIGR vegetation map was considered ready for the AA analyses in 2019 when the final vegetation classification and final list of plant associations/alliances were used to replace the polygon attribute placeholder names. In most cases, the preliminary map unit names and labels were simply changed to reflect the current rUSNVC association or equivalent RIGR-specific name. Due to the limitations of the imagery and the complex mixing of the vegetation at RIGR some of the map units contained multiple associations from different alliances. This issue was addressed by grouping similar associations/alliances into one map unit. All of the resulting map units were then correlated or "cross-walked" by noting when plant associations were used as a map unit or when they were grouped. Some park special map units were also created especially for RIGR to define rare tree types, disturbed vegetation, and separate broad associations into finer scale units. At this time, it was determined that part of the vegetation at RIGR occurred in mixed settings or along ecotones. To better capture the full spectrum of the vegetation in these polygons a second set of vegetation attributes were added to capture the secondary or alternative vegetation type. To round-out the mapping scheme, additional map units were added for land use types based on a mapping system developed by Anderson et al. (1976). This included land-use and land-cover types not in the rUSNVC.

In addition to the final map unit names and codes other polygon specific information or modifiers were added to the vegetation layer (Table 6). Polygon modifiers included physical quantifiers such as average height of the vegetation, average density of the dominant vegetation strata, and the general pattern/shape of the vegetation in each polygon. Topographic and landscape modifiers (i.e. landform, biophysical location, geology, etc.) were also added for each vegetation polygon by extracting data from existing spatial datasets through GIS analysis routines (i.e. zonal statistics and spatial joining). BIBE/RIGR staff also requested that any areas with dead trees/shrubs and any areas with non-native grasses be flagged or attributed in the GIS layer. Finally, the vegetation layer was converted to a Geodatabase and all of the common rUSNVC data contained in the final RIGR classification was joined using relationship-classes.

Table 6. Polygon Attribute Items and Descriptions used in the RIGR GIS Vegetation Layer.

Attribute	Description
AREA*	Surface area of the polygon in meters squared
PERIMETER*	Perimeter of the polygon in meters
RIGRVEG*	Unique code for each polygon
RIGRVEG_ID*	Unique identification code for each polygon
MAP_CODE	Final Map Unit Codes - Project specific
MAP_DESC	Map Unit Scientific Description Name - Project Specific
MAP_CDESC	Map Unit Common Description Name - Project Specific
ALT_DESC	Map Unit Scientific Alternative Description Name - Project Specific

*Represent ArcGIS default attributes and values.

Table 6 (continued). Polygon Attribute Items and Descriptions used in the RIGR GIS Vegetation Layer.

Attribute	Description
ALT_CDESC	Map Unit Scientific Alternative Description Name - Project Specific
DENS_MOD	• Modifier - Percent Cover of the Upper Stratum Layer in the Polygon, • Sparse = < 10%, • Open = 10 - 25%, • Intermediate = 25 - 50%, • Discontinuous = 50 - 75%, • Closed = 75 - 100%
PTRN_MOD	• Modifier - Vegetation Pattern within the Polygon, • Evenly Dispersed = Homogeneous, • Grouped Stands of Vegetation = Bunched / Clumped, • String of Vegetation = Linear, • Varying densities and gradients of vegetation = Gradational
HT_MOD	• Modifier - Height Range of the Dominant Vegetation Layer, • Height classes: < 1, 1 - 3, 3 - 5, 5 - 15, and > 15 Meters
ASPECT	General Aspect (Direction) of the Polygon in Degrees
ASPECT_DIR	General Aspect Direction of the Polygon
SLOPE	General Slope of the Polygon in Degrees
ELEV_FT	Average Elevation in the Polygon (Feet)
ELEV_MTRS	Average Elevation in the Polygon (Meters)
LANDFORM	General Landforms
PHYS_VEG	General Physical Vegetation - Based on the Plumb 1993 Vegetation Map
BPS_VEG	General Biophysical Vegetation
GEOLOGY	Dominant Geological Formation for each Polygon (BIBE co-located lands only)
MORTALITY	Evidence of Mortality in the Polygon - Dead Trees and Shrubs
INTRO_GRSS	Common Non-native or Introduced Grass Species Name Present in the Polygon
PARK_NAME	Local or Common Name of the RIGR Plant Association
ASSN, ELMNT_CODE, ALLINACE, GROUP, MACROGROUP, DIVISION, FORMATION, SUBCLASS, CLASS	rUSNVC (or local equivalent) Hierarchy Names for the RIGR Vegetation Types (See Appendix D for more information on the rUSNVC)
ANDERSON_1 _2	Anderson Level One and Two Land-use and Land-cover Types (Anderson *et. al* 1976)

*Represent ArcGIS default attributes and values.

Table 6 (continued). Polygon Attribute Items and Descriptions used in the RIGR GIS Vegetation Layer.

Attribute	Description
COMMENTS	Additional Comments about the Vegetation for Individual Polygons
ACRES	Surface area of the polygon in acres
HECTARES	Surface area of the polygon in hectares

*Represent ArcGIS default attributes and values.

Accuracy Assessment

Once the vegetation layer was completed, the AA was conducted. Typically, in mapping exercises both thematic or attribute map accuracy as well as the positional or polygon line accuracy are considered. In the case of the NVIP however, the positional accuracy is usually omitted since rarely does vegetation split on discrete edges that can be positively located in the field. The subjectivity involved in this effort plus the high resolution and accuracy of TOP imagery allows for the assumption that all products derived from them are well within National Map Accuracy Standards for 1:12,000-scale maps (±30 feet).

The RIGR thematic AA was conducted for in stages. The first part included the field work for the western portion of RIGR that was conducted in 2017 as part of the BIBE NVIP project. In the second stage, AA data for the far eastern portion of RIGR was collected in 2018 during the Lower Canyons river trip. Data from both efforts were later combined and entered into the RIGR PLOTS database. The resulting data were labeled with the "BIBE or "RIGR" prefix in accordance with their location.

The thematic accuracy of the vegetation map was assessed using the methodology provided by the NVIP (TNC and ESRI 1994c and Lea and Curtis 2010). The revised protocols included a four step AA process consisting of a (1) sample design, (2) sample site selection, (3) data collection, and (4) data analysis. The design of the AA process followed the three possible scenarios provided in the field manual with stratified random targets placed in each map class based on their respective frequency and abundance (Table 7).

Table 7. Standard Sample Size Allocations for AA Points Based on Map Unit Area.

Map Class Total Area*	Number Of Observations Per Map Class
> 50 hectares	30**
8.33 to 50 hectares	0.6 per hectare**
< 8.33 hectares	5**

* - as measured before buffering for cost surface (access buffer) or for map class boundary buffer.

** - or as many spatially independent (non-overlapping) observation sites as map class area, MMU size and other considerations will allow

The AA sample size parameters were loaded into a custom GIS program along with the vegetation layer to perform the sample site selection. The program picked the random target locations and also

buffered them 10 meters (33 ft) away from any polygon boundary and 50 meters (165 ft) away from any other data point. Being able to choose minimum distance to polygon boundaries helped to minimize confusion and accounted for the horizontal error typically encountered in common GPS receivers (±5 m). To complete the sampling, additional target points were added to long linear riparian polygons and rare types that were missed. For the lower canyon areas outside of BIBE, the resulting target locations were restricted to those within the boundaries of RIGR. Potential AA targets were reviewed, edited, removed, and replaced if they were located too close to previously collected plots or observation points. At this time, an additional set of independent back-up AA targets were also created in case the original targets could not be reached while in the field. Difficult or hazardous target points were replaced with easier to reach backup targets for safety and economic reasons as determined by the field crews.

The RIGR AA data collection process was started once the draft vegetation layer, the AA target point locations, the key to the associations and their corresponding map units, and all associated digital GIS files were turned over to CCB on August of 2017. CCB used these materials to create a thorough AA study design with precise planning of field team deployments. For the section of RIGR co-located in BIBE the sampling was designed to maximize the use of NPS provided facilities, park roads, and lowland trails. For the eastern RIGR portion, the AA site selection included no AA targets farther than 200 meters from the ordinary high-water mark on the U.S. side of the Rio Grande River (as defined by USGS hydrologic data) and obvious steep dangerous areas were removed for safety reasons. CCB than created custom field maps, coordinated with RIGR staff for logistics and site access, and hired and trained field crews on the AA methodology.



Accuracy Assessment Data Collection at Rio Grande Wild and Scenic River (NPS, CBB, and RGI).

The AA fieldwork was split into three trips or rotations. The first one occurred between the Great Unknown and Boquillas Canyons (93 AA points), the second through the Vegas Meadows and the Lower Canyons up to Dryden Crossing (58 AA points), and a third from Dryden Crossing to the eastern boundary of RIGR (18 AA points). CCB and RGI field teams were made-up of local botanists, ecologists, and experienced field people who had done hiking and conducted river trips at RIGR in the past. The teams were divided into two person teams. Due to the overlapping of the BIBE and RIGR boundaries AA work was conducted in BIBE as well during the first two trips.

On average, each field crew sampled four or five target points each day in the field and attempted to access one or more additional target points if possible. After reaching a target site, the two observers completed a paper copy of the AA Form (Appendix A). The navigator recorded the waypoint indicated on a Garmin Oregon 650i (or similar) GPS receiver and photographed the vegetation in opposing directions and perpendicular to the major slope present at the site (for washes, an upstream and downstream photo are taken from the center point). At most AA points, the observation area was a circle with a radius of 40 meters (131 feet) that was equal to the MMU of 0.5 hectare. Smaller observation areas of 0.25 hectare or 0.1 hectare were used for smaller stands of vegetation as appropriate. The field crew recorded the dominant vegetation by cover class and used the vegetation key to determine the primary and secondary association, if needed. After determining the association(s), they noted the level of fitness for the type(s) in the vegetation key and collected supplemental data about the species composition. Appendix B contains all of the plant species identified during the AA point data collection. At the end of each field day, the field teams met to identify unknown plant species and checked the AA forms for completeness. NPS support was critical for all of the AA fieldwork. Park staff joined the AA teams when possible, provided housing and campsites, conducted shuttles for river trips, assisted with trip logistics, and secured permits.

During the three AA trips, the field crews sampled 169 total target points and all RIGR AA data was later entered into the PLOTS database. The AA data was then exported into a GIS point layer (Figure 19). The AA point layer was overlain on the RIGR vegetation map and the field call to the vegetation association was visually compared to its corresponding vegetation polygon map unit name during two stages of review.

In the first review stage, the original AA point data was matched by its rUSNVC association name to the corresponding map unit. If more than one association was listed on the AA form or the map unit contained more than one possible association the best map unit determination was made based on location, geology/substrate, dominant species, and foliar cover values. A preliminary contingency table was then generated to highlight any errors. Points that differed from the predicted polygon label were examined by reviewing the field forms in question. After the initial examination, many of the general errors in the data were corrected. Common errors included: (1) incorrect UTM coordinates (handwriting/transcription errors on the datasheet vs. the actual GPS waypoint location), (2) incomplete and/or incorrect field calls (corrected based on actual species and cover data), (3) discrepancies in the field key (i.e. wrong couplet was used), or (4) data was collected in a polygon that was obviously labeled incorrectly (e.g. a vegetated polygon labeled as a road). Changes were made and recorded in the comments field of the AA point layer.

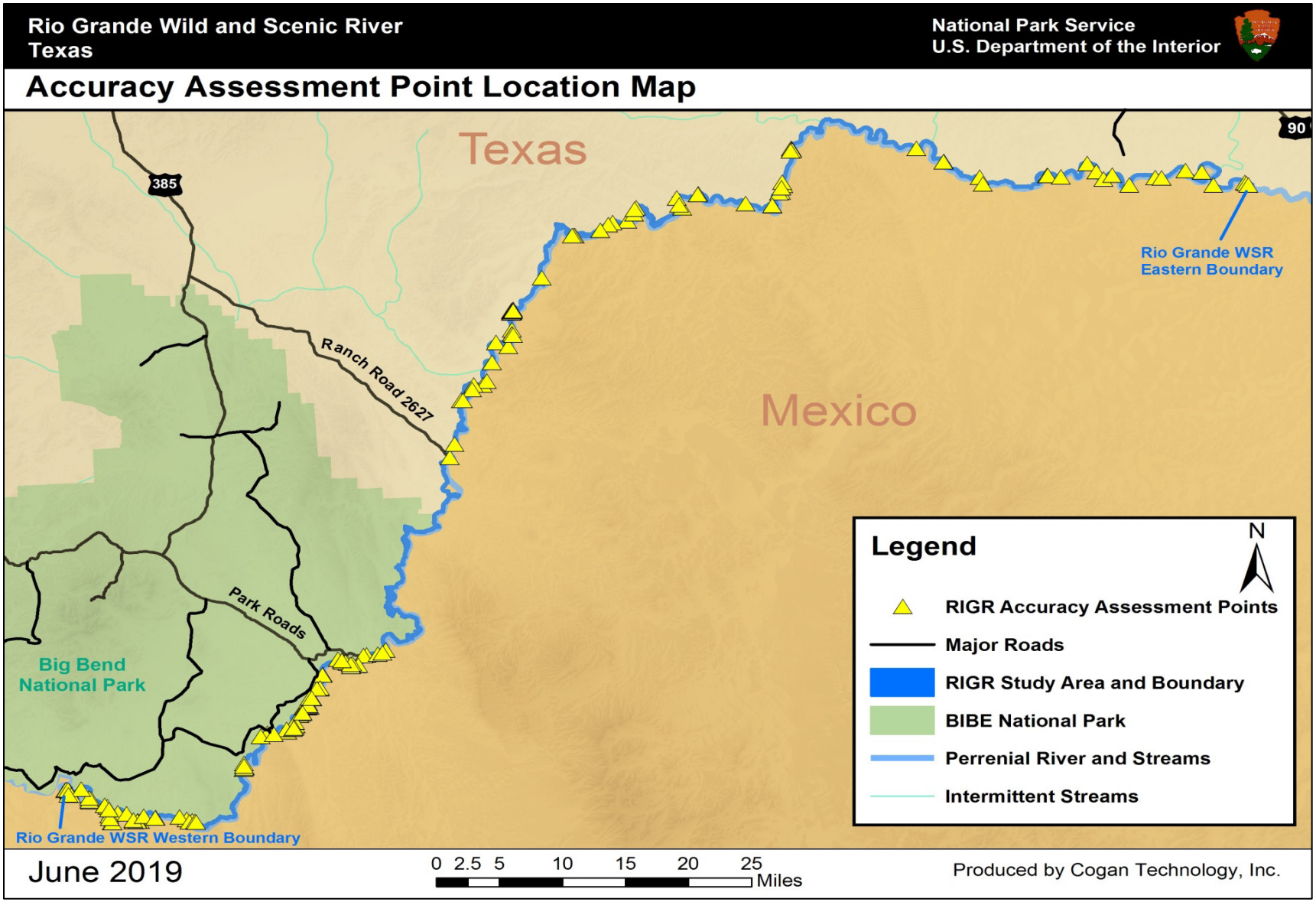


Figure 19. Map of the Accuracy Assessment Points Collected at RIGR (CTI).

The second review step involved deciding between the primary or secondary field call for the plant association. This was done by first adding a "Final_Code" attribute to the AA point layer and then comparing the assigned field names of the point with its corresponding location on the digital imagery. In most cases, the primary association name assigned by the field crew was used. However, some points were assigned their secondary field call based on one of the following reasons: (1) it appeared that the second call was the better choice due to the overhead perspective (e.g. a stand judged to be a sparse shrubland on the imagery versus herbaceous vegetation in the field), (2) the data were actually recorded in a stand that was too small (i.e. inclusion below MMU size), or (3) the second call more appropriately matched the ecological context (e.g. riparian vegetation along a stream vs. dry, upland vegetation).

Once the data were reviewed, the final AA analysis was conducted using custom CTI GIS programs and AA templates supplied by the NVIP. Through this automated process, the final map units in the AA layer were compared to the map unit designations for their corresponding polygons. All of the statistics and calculations used to analyze these data are described at length in the program manuals (TNC and ESRI 1994c and Lea and Curtis 2010). Final percent accuracy for each of the map classes was recorded using contingency tables (error matrices).

Results

Vegetation Classification

The RIGR classification using a mix of plot, observation, and AA point data resulted in 35 plant associations. Eight of which matched an existing rUSNVC association and 27 did not fit a current rUSNVC type. Of the 27 new types, 21 were previously described in BIBE (labeled NPSBIBE) and six were new to RIGR (labeled as NPSRIGR). All of the new RIGR associations represent local plant communities that differ from existing rUSNVC associations. However, the new types were linked when possible to an Alliance or higher rUSNVC level. The new RIGR plant associations can be distinguished by their rUSNVC element codes as current rUSNVC associations begin with the CEGL prefix versus NPS for park specials. The new types can be considered park specials that represent local plant communities that differ slightly from existing rUSNVC association concepts or lack enough data to describe a new association. With additional data and analysis, some of the park special plant communities may become new associations or may be subsumed into existing rUSNVC associations. Others might be unique vegetation stands that remain as a locally independent type. All plant associations found at RIGR in this study are listed in Table 8 along with their common or park-specific name and element code.

Table 8. Summary of rUSNVC Plant Associations/Alliances for RIGR.

RIGR Plant Association Name [RIGR Plant Association Local Name(s)]	**rUSNVC Element Code**
***Fraxinus berlandieriana* / *Toxicodendron radicans* Alcove Woodland** [Mexican Ash / Poison-ivy Alcove Woodland]	NPSRIGR007
***Populus fremontii* - *Salix gooddingii* Woodland** [Cottonwood - Goodding Willow Spring Woodland]	CEGL000944
***Salix* (*gooddingii, thurberi*) Rio Grande Woodland** [Rio Grande Willow Riparian Bosque]	NPSBIBE019
***Vachellia farnesiana* - (*Prosopis glandulosa*) Woodland** [Huisache Riparian Bosque]	CEGL002131
***Populus* spp. - *Fraxinus* spp. Planted Woodland Cultural Type** [Cottonwood - Ash Planted Woodland] [Mixed Ornamental and Planted Woodland]	NPSBIBE045
***Tamarix* spp. Temporarily Flooded Semi-natural Shrubland** [Tamarisk - (Tree Tobacco) Riparian Shrubland]	CEGL003114
***Prosopis glandulosa* Wet Scrub** [Rio Grande Mesquite Riparian Bosque]	CEGL004934
***Baccharis salicifolia* / (*Phragmites australis*) Chihuahuan Riparian Shrubland** [Rio Grande Seepwillow Riparian Shrubland]	NPSBIBE047
***Arundo donax* Riverbank Herbaceous Vegetation** [Giant Cane Riparian Herbaceous Vegetation]	CEGL004101

Table 8 (continued). Summary of rUSNVC Plant Associations/Alliances for RIGR.

RIGR Plant Association Name [RIGR Plant Association Local Name(s)]	**rUSNVC Element Code**
***Phragmites australis* Chihuahuan Desert Riparian Herbaceous Vegetation** [Common Reed Riparian Herbaceous Vegetation]	NPSBIBE023
***Cynodon dactylon* Arid Southwest Herbaceous Vegetation** [Bermuda Grass Herbaceous Vegetation]	NPSBIBE017
***Schoenoplectus pungens* Herbaceous Vegetation** [Wet Riverbank Herbaceous Vegetation]	CEGL001587
Arid West Alluvial Shrub Herbaceous Vegetation [Rio Grande Alluvial Herbaceous Vegetation]	NPSBIBE024
***Atriplex canescens - Suaeda suffrutescens* / *Sporobolus airoides* Shrub Herbaceous Vegetation** [Alkali Sacaton Riparian Grassland]	NPSBIBE026
***Diospyros texana - Senegalia berlandieri - Prosopis glandulosa - Eysenhardtia texana* Shrubland** [Texas Persimmon - Thornscrub Limestone Wash Shrubland]	NPSRIGR008
***Vachellia rigidula - Brickellia laciniata* Shrubland** [Blackbrush - Brickellbush Wash Channel Shrubland]	NPSRIGR006
***Hymenoclea monogyra - Chilopsis linearis - Porophyllum scoparium* Shrubland** [Big Bend Lowlands Wash Channel Shrubland	NPSBIBE014
***Vachellia* spp. - *Senegalia greggii - Prosopis glandulosa - Yucca elata* Shrubland** [Acacia - Mesquite Wash Shrubland]	NPSBIBE043
***Larrea tridentata* / *Grusonia schottii* / *Tiquilia canescens* Shrubland** [Southern Stockton Plateau Creosotebush Desert Scrub]	NPSRIGR004
***Larrea tridentata - Cylindropuntia leptocaulis* / *Dasyochloa pulchella Cathestecum erectum* Shrubland** [Big Bend Lowlands Creosotebush Desert Scrub] [Creosotebush Desert Scrub]	NPSBIBE031
***Prosopis glandulosa - Larrea tridentata* - (*Flourensia cernua, Parthenium incanum*) Shrubland** [Mesquite - Creosotebush Desert Scrub]	NPSBIBE025
***Larrea tridentata - Agave lechuguilla - Hechtia texensis - Echinocactus horizonthalonius* Shrubland** [Boquillas Basin Calcareous Creosotebush Desert Scrub]	NPSBIBE011
***Euphorbia antisyphilitica - Agave lechuguilla - Hechtia texensis - Vachellia rigidula - Lippia graveolens* Shrubland** [Northeastern Chihuahuan Canyon Desert Scrub	NPSRIGR003
***Prosopis glandulosa - Viguiera stenoloba - Larrea tridentata - Leucophyllum frutescens* / *Bouteloua ramosa - Selaginella wrightii* Shrubland** [Southern Stockton Plateau Mixed Desert Scrub]	NPSRIGR005

Table 8 (continued). Summary of rUSNVC Plant Associations/Alliances for RIGR.

RIGR Plant Association Name [RIGR Plant Association Local Name(s)]	**rUSNVC Element Code**
***Agave lechuguilla - Euphorbia antisyphilitica - Ephedra aspera* / *Bouteloua ramosa* Shrubland** [Calcareous Mixed Desert Scrub	NPSBIBE010
***Yucca faxoniana -Yucca thompsoniana - Dasylirion leiophyllum - Nolina erumpens* / *Bouteloua curtipendula* Shrub Grassland** [Yucca - Sotol Calcareous Shrub Grassland]	NPSBIBE040
***Larrea tridentata - Fouquieria splendens - Agave lechuguilla - Leucophyllum frutescens* Shrubland** [Creosotebush - Ocotillo - Lechuguilla Mixed Desert Scrub]	NPSBIBE044
***Vachellia rigidula - Leucophyllum frutescens - Senegalia berlandieri* Shrubland** [Guajillo - Blackbrush - Torrey Yucca Shrubland]	CEGL007759
***Sorghum halepense* Chihuahuan Desert Herbaceous Vegetation** [Johnson Grass - Russian Thistle Desert Grassland]	NPSBIBE018
(*Heteropogon contortus, Pennisetum ciliare, Eragrostis lehmanniana*) - Mixed Forbs Chihuahuan Ruderal Herbaceous Vegetation [Upland Ruderal Herbaceous Vegetation]	NPSBIBE046
***Atriplex obovata* / *Tidestromia carnosa* Dwarf-shrubland** [Badlands Sparse Vegetation]	CEGL004575
***Suaeda suffrutescens* / *Sporobolus pyramidatus* Shrubland** [Alkaline Clay Flat Shrubland]	NPSBIBE027
***Jatropha dioica - Opuntia rufida* Sparse Vegetation Association** [Low Elevation Talus and Dune Sparse Vegetation]	NPSBIBE036
Chihuahuan Desert Non-calcareous Outcrop Lichen Vegetation Association [Low Elevation Non-calcareous Outcrop Lichen Vegetation]	NPSBIBE038
Chihuahuan Desert Calcareous Outcrop Lichen Vegetation [Calcareous Outcrop Lichen Vegetation]	NPSBIBE039

Summarized by physiognomic class and topographic locations, this study found five riparian woodland, three riparian bosque and shrubland, six riparian herbaceous vegetation, four upland wash shrublands, 10 upland shrubland, scrub, and shrub grasslands, two upland herbaceous vegetation, and five sparse vegetation types. The semi-natural or disturbed vegetation types represented mostly riparian types along the Rio Grande River or upland locations that were recently ranched, cleared, or otherwise disturbed.

In general, the rUSNVC nomenclature uses the current scientific species names as described by the USDA-NRCS (2018) for each association. However, the national classification occasionally lags in updating new plant names. For RIGR, the rUSNVC (2017) retains the older genus name *Acacia* for species that now are treated as *Vachellia* and *Senegalia* by the PLANTS database (USDA-NRCS

2018). For this project, the older *Acacia* genus is retained in some portions of the PLOTS database, but the new names are used in the mapping and in the classification documents (Appendices B and C). The rUSNVC naming methodology includes: using parentheses "( )" in the name to indicate that the species may or may not be present, a dash "-" between species to indicate species occurring in the same vegetation layer (i.e. stratum), a slash "/" to indicate species that occur in different vegetation layers (i.e. canopy/subcanopy/understory), and lower confidence associations are sometimes given a [Provisional] status.

Digital Imagery and Mapping

For RIGR, 47 map units (40 vegetated and 7 land-use/land-cover) were developed. The final list of map classes/units was directly cross-walked or matched to corresponding plant associations and land use classes. RIGR map classes represent a compromise between the detail of the rUSNVC, new types found in the park (not currently in the rUSNVC), the needs of the resource management staff (e.g. detailed mapping of riparian, wetland and non-native types), and the limitations of the imagery. An effort was made to crosswalk the final list of map classes/units to corresponding plant associations/alliances and land use classes. When a direct rUSNVC link to an association was not feasible, broader alliances or descriptive local map units (park specials) were created. In addition, some of the more widespread associations occurred across multiple map units. Table 9 contains the final list of map units and their crosswalk to associations/alliances or map unit descriptions and Appendix E contains descriptions and representative photographs for all the vegetation map units used at RIGR.

Table 9. RIGR Map Units and Relationships to the rUSNVC or Local Map Unit Description.

Map Code	RIGR Map Unit Name [RIGR Map Unit Local Name]	rUSNVC Element Name and Code or [Local Description]
W_CWD	***Populus fremontii - Salix gooddingii* Woodland** [Cottonwood - Goodding Willow Woodland]	*Populus fremontii - Salix gooddingii* Woodland CEGL000944
W_FOR	**Mixed Ornamental and Planted Woodland** [Cottonwood - Ash Planted Woodland]	*Populus* spp. - *Fraxinus* spp. Planted Woodland Cultural Type NPSBIBE045
W_HR	***Vachellia farnesiana* Riparian Bosque** [Huisache Riparian Bosque]	*Vachellia farnesiana* - (*Prosopis glandulosa*) Woodland CEGL002131
W_MA	***Fraxinus berlandieriana* / *Toxicodendron radicans* Alcove Woodland** [Mexican Ash / Poison-ivy Alcove Woodland]	*Fraxinus berlandieriana* / *Toxicodendron radicans* Alcove Woodland NPSRIGR007
S_ACAMEQ	***Vachellia spp. - Senegalia greggii - Prosopis glandulosa* Wash Shrubland** [Acacia - Mesquite Wash Shrubland]	*Vachellia spp. - Senegalia greggii - Prosopis glandulosa - Yucca elata* Shrubland NPSBIBE043
S_BBWASH	***Vachellia rigidula - Brickellia laciniata* Wash Channel Shrubland** [Blackbrush - Brickellbush Wash Channel Shrubland]	*Vachellia rigidula - Brickellia laciniata* Shrubland NPSRIGR006

Table 9 (continued). RIGR Map Units and Relationships to the rUSNVC or Local Map Unit Description.

Map Code	RIGR Map Unit Name [RIGR Map Unit Local Name]	rUSNVC Element Name and Code or [Local Description]
S_CB	***Larrea tridentata* Desert Scrub** [Creosotebush Desert Scrub]	*Larrea tridentata - Cylindropuntia leptocaulis / Dasyochloa pulchella - Cathestecum erectum* Shrubland NPSBIBE031
S_CBO	***Larrea tridentata - Fouquieria splendens - Agave lechuguilla* Mixed Desert Scrub** [Creosotebush - Ocotillo - Lechuguilla Mixed Desert Scrub]	*Larrea tridentata - Fouquieria splendens - Agave lechuguilla - Leucophyllum frutescens* Shrubland NPSBIBE044
S_CDS	**Calcareous Mixed Desert Scrub**	*Agave lechuguilla - Euphorbia antisyphilitica - Ephedra aspera* / *Bouteloua ramosa* Shrubland NPSBIBE010
S_CLAY	**Alkaline Clay Flat Shrubland**	*Suaeda suffrutescens / Sporobolus pyramidatus* Shrubland NPSBIBE027
S_CTAL	**Calcareous Talus Mixed Shrubland**	*Agave lechuguilla - Euphorbia antisyphilitica - Ephedra aspera* / *Bouteloua ramosa* Shrubland NPSBIBE010
S_GBTY	***Senegalia berlandieri - Vachellia rigidula - Yucca torreyi* Shrubland** [Guajillo - Blackbrush - Torrey Yucca Shrubland]	*Vachellia rigidula - Leucophyllum frutescens - Senegalia berlandieri* Shrubland CEGL007759
S_MEQ	***Prosopis glandulosa - Larrea tridentata* Desert Scrub** [Mesquite - Creosotebush Desert Scrub]	*Prosopis glandulosa - Larrea tridentata -* (*Flourensia cernua, Parthenium incanum*) Shrubland NPSBIBE025
S_MRIP	**Rio Grande *Prosopis glandulosa* Riparian Bosque** [Rio Grande Mesquite Riparian Bosque]	*Prosopis glandulosa* Wet Scrub CEGL004934
S_NECC	**Northeastern Chihuahuan Canyon Desert Scrub**	*Euphorbia antisyphilitica - Agave lechuguilla - Hechtia texensis - Vachellia rigidula - Lippia graveolens* Shrubland NPSRIGR003
S_PTWASH	***Diospyros texana* - Thornscrub Limestone Wash Shrubland** [Texas Persimmon - Thornscrub Limestone Wash Shrubland]	*Diospyros texana - Senegalia berlandieri - Prosopis glandulosa - Eysenhardtia texana* Shrubland NPSRIGR008
S_RWIL	**Rio Grande *Salix* spp. Riparian Bosque** [Rio Grande Willow Riparian Bosque]	*Salix* (*gooddingii, thurberi*) Rio Grande Shrubland NPSBIBE019
S_SSCB	**Southern Stockton Plateau *Larrea tridentata* Desert Scrub** [Southern Stockton Plateau Creosotebush Desert Scrub]	*Larrea tridentata* / *Grusonia schottii* / *Tiquilia canescens* Shrubland NPSRIGR004

Table 9 (continued). RIGR Map Units and Relationships to the rUSNVC or Local Map Unit Description.

Map Code	**RIGR Map Unit Name** [RIGR Map Unit Local Name]	**rUSNVC Element Name and Code or [Local Description]**
S_SSMS	**Southern Stockton Plateau Mixed Desert Scrub**	*Prosopis glandulosa - Viguiera stenoloba - Larrea tridentata - Leucophyllum frutescens* / *Bouteloua ramosa - Selaginella wrightii* Shrubland NPSRIGR005
S_TAM	***Tamarix* spp. - (*Nicotiana glauca*) Riparian Shrubland** [Tamarisk - (Tree Tobacco) Riparian Shrubland]	*Tamarix* spp. Temporarily Flooded Semi-natural Shrubland CEGL003114
S_WASH	**Big Bend Lowlands Wash Channel Shrubland**	*Hymenoclea monogyra - Chilopsis linearis - Porophyllum scoparium* Shrubland NPSBIBE014
S_YUC	***Yucca* spp. - *Dasylirion leiophyllum* Calcareous Shrub Grassland** [Yucca - Sotol Calcareous Shrub Grassland]	*Yucca faxoniana -Yucca thompsoniana - Dasylirion leiophyllum - Nolina erumpens* / *Bouteloua curtipendula* Shrub Grassland NPSBIBE040
S_YWASH	***Yucca* spp. Calcareous Wash Channel Shrubland** [Yucca Calcareous Wash Channel Shrubland]	*Yucca faxoniana -Yucca thompsoniana - Dasylirion leiophyllum - Nolina erumpens* / *Bouteloua curtipendula* Shrub Grassland NPSBIBE040
H_ASAC	***Sporobolus airoides* Riparian Grassland[** [Alkali Sacaton Riparian Grassland]	*Atriplex canescens - Suaeda suffrutescens / Sporobolus airoides* Shrub Herbaceous Vegetation NPSBIBE026
H_BERM	***Cynodon dactylon* Herbaceous Vegetation** [Bermuda Grass Herbaceous Vegetation]	*Cynodon dactylon* Arid Southwest Herbaceous Vegetation NPSBIBE017
H_CANE	***Arundo donax* Riverbank Herbaceous Vegetation** [Giant Cane Riverbank Herbaceous Vegetation]	*Arundo donax* Riverbank Herbaceous Vegetation CEGL004101
H_GRS	***Sorghum halepense - Salsola tragus* Desert Grassland** [Johnson Grass - Russian Thistle Desert Grassland]	*Sorghum halepense* Chihuahuan Desert Herbaceous Vegetation NPSBIBE018
H_REED	***Phragmites australis* Riparian Herbaceous Vegetation** [Common Reed Riparian Herbaceous Vegetation]	*Phragmites australis* Chihuahuan Desert Riparian Herbaceous Vegetation NPSBIBE023
H_RIO	**Rio Grande Alluvial Herbaceous Vegetation**	*Baccharis salicifolia / (Phragmites australis)* Chihuahuan Riparian Shrubland NPSBIBE047 *Schoenoplectus pungens* Herbaceous Vegetation CEGL001587

Table 9 (continued). RIGR Map Units and Relationships to the rUSNVC or Local Map Unit Description.

Map Code	RIGR Map Unit Name [RIGR Map Unit Local Name]	rUSNVC Element Name and Code or [Local Description]
H_UPG	**Upland Ruderal Herbaceous Vegetation**	(*Heteropogon contortus, Pennisetum ciliare, Eragrostis lehmanniana*) - Mixed Forbs Chihuahuan Ruderal Herbaceous Vegetation NPSBIBE046
SP_BAD	**Badlands Sparse Vegetation**	*Atriplex obovata / Tidestromia carnosa* Dwarf-shrubland CEGL004575
SP_CAL	**Calcareous Outcrop Lichen Vegetation**	Chihuahuan Desert Calcareous Outcrop Lichen Vegetation NPSBIBE039
SP_LCAL	**Boquillas Basin Calcareous *Larrea tridentata* Desert Scrub** [Boquillas Basin Calcareous Creosotebush Desert Scrub]	*Larrea tridentata -Agave lechuguilla - Hechtia texensis - Echinocactus horizonthalonius* Shrubland NPSBIBE011
SP_LDES1	**Big Bend Lowlands (Flats, Benches, and Plateaus)**	*Larrea tridentata - Cylindropuntia leptocaulis / Dasyochloa pulchella - Cathestecum erectum* Shrubland NPSBIBE031
SP_LDES2	**Big Bend Lowlands (Eroding Slopes, Hillsides, and Badlands)**	*Larrea tridentata - Cylindropuntia leptocaulis / Dasyochloa pulchella - Cathestecum erectum* Shrubland NPSBIBE031
SP_LDES3	**Big Bend Lowlands (Basalt, Lava, and Volcanic Rocks)**	*Larrea tridentata - Cylindropuntia leptocaulis / Dasyochloa pulchella - Cathestecum erectum* Shrubland NPSBIBE031
SP_NCAL	**Low Elevation Non-Calcareous Outcrop Lichen and Sparse Vegetation**	Chihuahuan Desert Non-calcareous Outcrop Lichen Vegetation NPSBIBE038
SP_RIO	**Rio Grande Alluvial Sparse Vegetation**	Arid West Alluvial Shrub Herbaceous Vegetation NPSBIBE024
SP_TAL	**Low Elevation Talus and Dune Sparse Vegetation**	*Jatropha dioica - Opuntia rufida* Sparse Vegetation NPSBIBE036
SP_WASH	**Big Bend Lowlands Sparsely Vegetated Wash Channel**	*Hymenoclea monogyra - Chilopsis linearis-Porophyllum scoparium* Shrubland NPSBIBE014
L_FACL	NPS and Other Facilities	[Visitor Center, Maintenance Yard, Picnic Areas, Boat Ramps, and Campgrounds]
L_POND	Small Lake / Pond	[Natural Catchments and Small Human-made Water Impoundments]
L_RESD	Residential Areas	[Housing and Residential Areas]
L_ROAD	Main Roads and Transportation Structures	[Paved and Gravel Roads]
L_STRM	Stream / River	[Perennial Streams and Rivers]

Table 9 (continued). RIGR Map Units and Relationships to the rUSNVC or Local Map Unit Description.

Map Code	RIGR Map Unit Name [RIGR Map Unit Local Name]	rUSNVC Element Name and Code or [Local Description]
L_TRAN	Transitional Area	[Recently Disturbed Area]
L_TRL	Trails and 2-Track Roads	[Dirt Roads, Hiking, and Social Trails]

The following rUSNVC type(s) to map unit(s) relationships represent the possible mapping scenarios encountered in the RIGR project:

1) **One-to-One Relationship** = When a plant association or a vegetation alliance had a unique photo signature and could be readily delineated on the imagery, the map unit adopted the unique plant association/alliance name or similar synonym. This was the most common scenario at RIGR occurring for 29 out of the 40 vegetated map classes.
2) **Many-to-One Relationship** = When related plant associations shared the same signature and could not be distinguished on the imagery, several plant associations were combined into a single complex. This scenario was especially true for several common map classes that were flooded and inundated on the imagery and therefore could not be distinguished from the drier upland variation of the same map unit.
   a) Map Unit = Rio Grande Alluvial Herbaceous Vegetation (H_RIO)

      Associations = *Baccharis salicifolia* / (*Phragmites australis*) Chihuahuan Riparian Shrubland (NPSRIGR047) and *Schoenoplectus pungens* Herbaceous Vegetation (CEGL001587)

      Reason = Riparian herbaceous vegetation along the Rio Grande River was patchy, small, intermixed, and could not be reliably separated and delineated.
3) **One-to-Many Relationship** = Some of the rUSNVC associations occurred in more than one map unit due to the separating of flooded and inundated areas from dry locations around the reservoir. These include the following:
   a) Agave lechuguilla - *Euphorbia antisyphilitica* - *Ephedra aspera* / *Bouteloua ramosa* Shrubland (NPSRIGR010).

      Map Units = S_CDS and S_CTAL.

      Reason = Calcareous areas with shrubs growing on talus and rocky slopes were split from the mixed Calcareous Scrub type in an effort to provide more detail.
   b) *Yucca faxoniana* -*Yucca thompsoniana* - *Dasylirion leiophyllum* - *Nolina erumpens* / *Bouteloua curtipendula* Shrub Grassland (NPSRIGR040)

      Map Units = S_YUC and S_YWASH

      Reason = Washes on limestone and calcareous geological formations were split from other wash map units and the upland shrub types to provide more detail.
   c) *Larrea tridentata* - *Cylindropuntia leptocaulis* / *Dasyochloa pulchella* - *Cathestecum erectum* Shrubland (NPSRIGR031)

Map Units = S_CB, SP_LDES1, SP_LDES2, and SP_LDES3

Reason = The widespread Creosotebush Desert Scrub type was split into four map units to provide more detail on low desert areas with high creosotebush cover (S_CB) and areas with sparse creosotebush cover that occurred on different soils and geologic formations (SP_LDES types).

d) *Hymenoclea monogyra* - *Chilopsis linearis* - *Porophyllum scoparium* Shrubland (NPSBIBE014)

Map Units = S_WASH and SP_WASH

Reason = Washes with little or no vegetation were split from vegetated washes to provide more detail.

4) **Land Use - Land Cover** = All 7 of the Land Use and Land Cover types (L_XX) that were not recognized by the rUSNVC received an Anderson et al. (1976, updated 2002) map unit designation.

Vegetation Map

The RIGR vegetation map consists of 7,284 polygons totaling 34,506 acres (13,971 hectares) (Appendix F) with an average polygon size of about 5 acres (2 hectares) (Table 10). The small polygons are due in part to the detailed mapping, the importance of delineating rare and non-native vegetation types, and the arbitrary splitting of continuous polygons into smaller areas due to RIGR's unique boundary that follows the active mid-channel of the river. The mapping is also finely detailed since the 2015 TOP imagery was of high resolution allowing for very small stands of vegetation to be accurately mapped. Figure 20 shows an example of the detailed RIGR vegetation mapping centered on the Stillwell and La Linda area.

Table 10. Summary Statistics for the RIGR Map Class Polygons.

Map Code	Map Unit Common Name	Number of Polygons	Acres	Hectares
W_CWD	Cottonwood - Goodding Willow Woodland	3	2.1	0.9
W_FOR	Mixed Ornamental and Planted Woodland [Cottonwood - Ash Planted Woodland]	24	28.5	11.6
W_HR	Huisache Riparian Bosque	74	104.1	42.2
W_MA	Mexican Ash / Poison-ivy Alcove Woodland	28	11.5	4.6
S_ACAMEQ	Acacia - Mesquite Wash Shrubland	161	324.0	131.1
S_BBWASH	Blackbrush - Brickellbush Wash Channel Shrubland	373	536.4	217.2
S_CB	Creosotebush Desert Scrub	83	410.9	166.4
S_CBO	Creosotebush - Ocotillo - Lechuguilla Mixed Desert Scrub	33	111.5	45.2

Table 10 (continued). Summary Statistics for the RIGR Map Class Polygons.

Map Code	Map Unit Common Name	Number of Polygons	Acres	Hectares
S_CDS	Calcareous Mixed Desert Scrub	268	5,244.9	2,123.7
S_CLAY	Alkaline Clay Flat Shrubland	32	168.4	68.2
S_CTAL	Calcareous Talus Mixed Shrubland	127	771.0	312.1
S_GBTY	Guajillo - Blackbrush - Torrey Yucca Shrubland	31	59.1	23.9
S_MEQ	Mesquite - Creosotebush Desert Scrub	104	1,019.3	412.7
S_MRIP	Rio Grande Mesquite Riparian Bosque	602	,3129.0	1,266.9
S_NECC	Northeastern Chihuahuan Canyon Desert Scrub	377	3,934.2	1,593.0
S_PTWASH	Texas Persimmon - Thornscrub Limestone Wash Shrubland	49	51.1	20.7
S_RWIL	Rio Grande Willow Riparian Bosque	36	69.3	28.1
S_SSCB	Southern Stockton Plateau Creosotebush Desert Scrub	553	2,563.3	1,037.8
S_SSMS	Southern Stockton Plateau Mixed Desert Scrub	567	2,386.8	966.6
S_TAM	Tamarisk - (Tree Tobacco) Riparian Shrubland	315	726.8	294.2
S_WASH	Big Bend Lowlands Wash Channel Shrubland	246	516.7	209.2
S_YUC	Yucca - Sotol Calcareous Shrub Grassland	13	104.2	42.2
S_YWASH	Yucca Calcareous Wash Channel Shrubland	55	179.1	72.5
H_ASAC	Alkali Sacaton Riparian Grassland	5	4.8	2.0
H_BERM	Bermuda Grass Herbaceous Vegetation	183	326.3	132.1
H_CANE	Giant Cane Riverbank Herbaceous Vegetation	407	1,063.8	430.8
H_GRS	Johnson Grass - Russian Thistle Desert Grassland	10	19.8	8.0
H_REED	Common Reed Riparian Herbaceous Vegetation	167	105.6	42.8
H_RIO	Rio Grande Alluvial Herbaceous Vegetation	240	633.6	256.6
H_UPG	Upland Ruderal Herbaceous Vegetation	1	0.5	0.2
SP_BAD	Badlands Sparse Vegetation	17	173.6	70.3
SP_CAL	Calcareous Outcrop Lichen Vegetation	435	2,981.4	1,207.1
SP_LCAL	Boquillas Basin Calcareous Creosotebush Desert Scrub	612	3,469.6	1,404.9
SP_LDES1	Big Bend Lowlands (Flats, Benches, and Plateaus)	145	673.9	272.9
SP_LDES2	Big Bend Lowlands (Eroding Slopes, Hillsides, and Badlands)	83	460.8	186.5

Table 10 (continued). Summary Statistics for the RIGR Map Class Polygons.

Map Code	Map Unit Common Name	Number of Polygons	Acres	Hectares
SP_LDES3	Big Bend Lowlands (Basalt, Lava, and Volcanic Rocks)	2	22.6	9.1
SP_NCAL	Low Elevation Non-calcareous Outcrop Lichen Vegetation	2	12.3	5.0
SP_RIO	Rio Grande Alluvial Sparse Vegetation	434	514.6	208.3
SP_TAL	Low Elevation Talus and Dune Sparse Vegetation	9	22.8	9.2
SP_WASH	Big Bend Lowlands Sparsely Vegetated Wash Channel	104	136.1	55.1
L_FACL	NPS and Other Facilities	15	3.7	1.5
L_POND	Small Lake / Pond / Watering Catchments	6	1.9	0.8
L_RESD	Residential Areas	40	11.6	4.7
L_ROAD	Main Roads and Transportation Structures	109	198.9	80.5
L_STRM	Stream / River	20	1,163.5	471.1
L_TRAN	Transitional Area	27	13.6	5.5
L_TRL	Trails and 2-Track Roads	57	38.5	15.6
–	Subtotal Woodlands	129	146	59
–	Subtotal Shrublands	4,025	22,306	9,032
–	Subtotal Herbaceous Vegetation	1,013	2,154	873
–	Subtotal Sparse Vegetation	1,843	8,468	3,428
–	Subtotal Land-Use and Land-Cover	274	1,432	580
–	Subtotal All Vegetation and Sparse Areas	7,010	33,074	13,391
–	**Total**	**7,284**	**34,506**	**13,971**

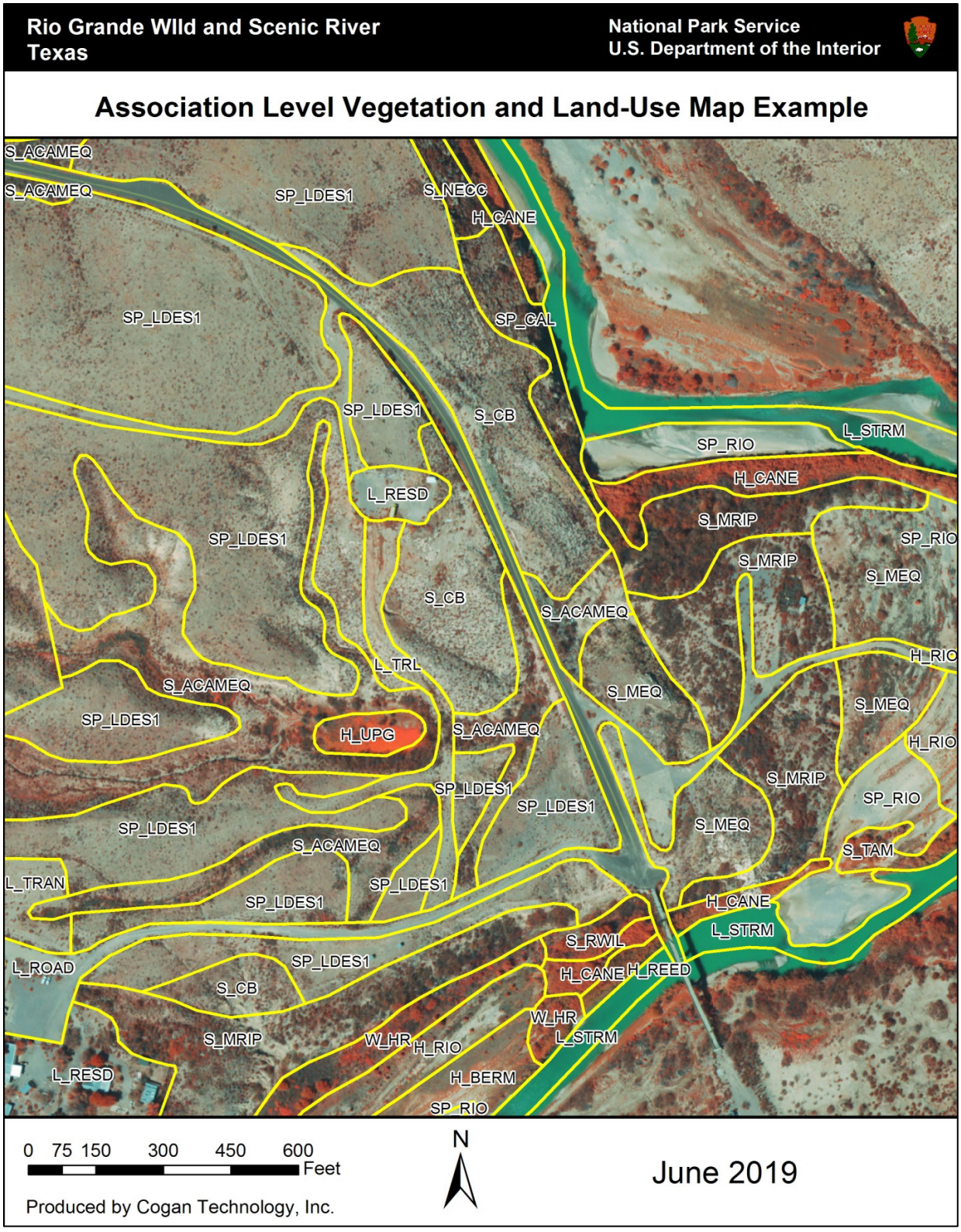


Figure 20. Example of the RIGR Fine-Scale Vegetation Map Layer (CTI).

Based on the final vegetation layer, about 3% (1,164 acres) consisted of open water, less than 1% (270 acres) was developed and 96% (33,074 acres) were vegetated. Of the vegetated total, less than 1% (146 acres) was forested or wooded, 65% (22,306 acres) were shrublands, 6% (2,154 acres) were dominated by herbaceous species, and 25% (8,468 acres) contained sparse vegetation. The largest single map unit was the Calcareous Mixed Desert Shrub (S_CDS) type covering 15% (5,245 acres) of the project area. General mapping trends include 71% (24,383 acres) of the project area was mapped as a dry upland scrub or shrubland type, 5% (1,802 acres) was mapped as an upland wash, drainage, or mesic shrub type, and 20% (6,889 acres) was mapped as a riparian type. Non-native vegetation map units were split between 4% (1,411 acres) for herbaceous vegetation and 2% (726 acres) for shrubs.

For more detailed analysis of the vegetation trends at RIGR, the full vegetation spatial database can be explored and manipulated using the additional linked databases and the additional polygon attributes such as density, height, pattern, landform, geology, soils, and biophysical settings in a GIS program. The extensive data created for RIGR in this project are difficult to convey in a table or on a two-dimensional map, but it should be understood that the different attributes can be combined in many ways and at different scales and resolutions to produce additional products. For example, coarse-scale maps can be produced by scaling up the NVCS hierarchy to the Alliance, Group, or Macrogroup level (Figure 21) or by selecting the General Physical Vegetation or General Biophysical Vegetation attributes. The selection of a broader vegetation class would produce a less-detailed vegetation map that might be more applicable for reports or project-wide assessments. Conversely, fine-scale mapping efforts can focus on individual associations by selecting the appropriate map unit in both the Map Description (primary) and the Alternative Description (secondary). This would produce a map highlighting all known areas for a specific vegetation type. Habitat studies can also be performed by querying the spatial database for various indicators such as canopy densities and heights of the vegetation, types in or close to washes/drainages, or map units that occur on certain geologic or soil formations.

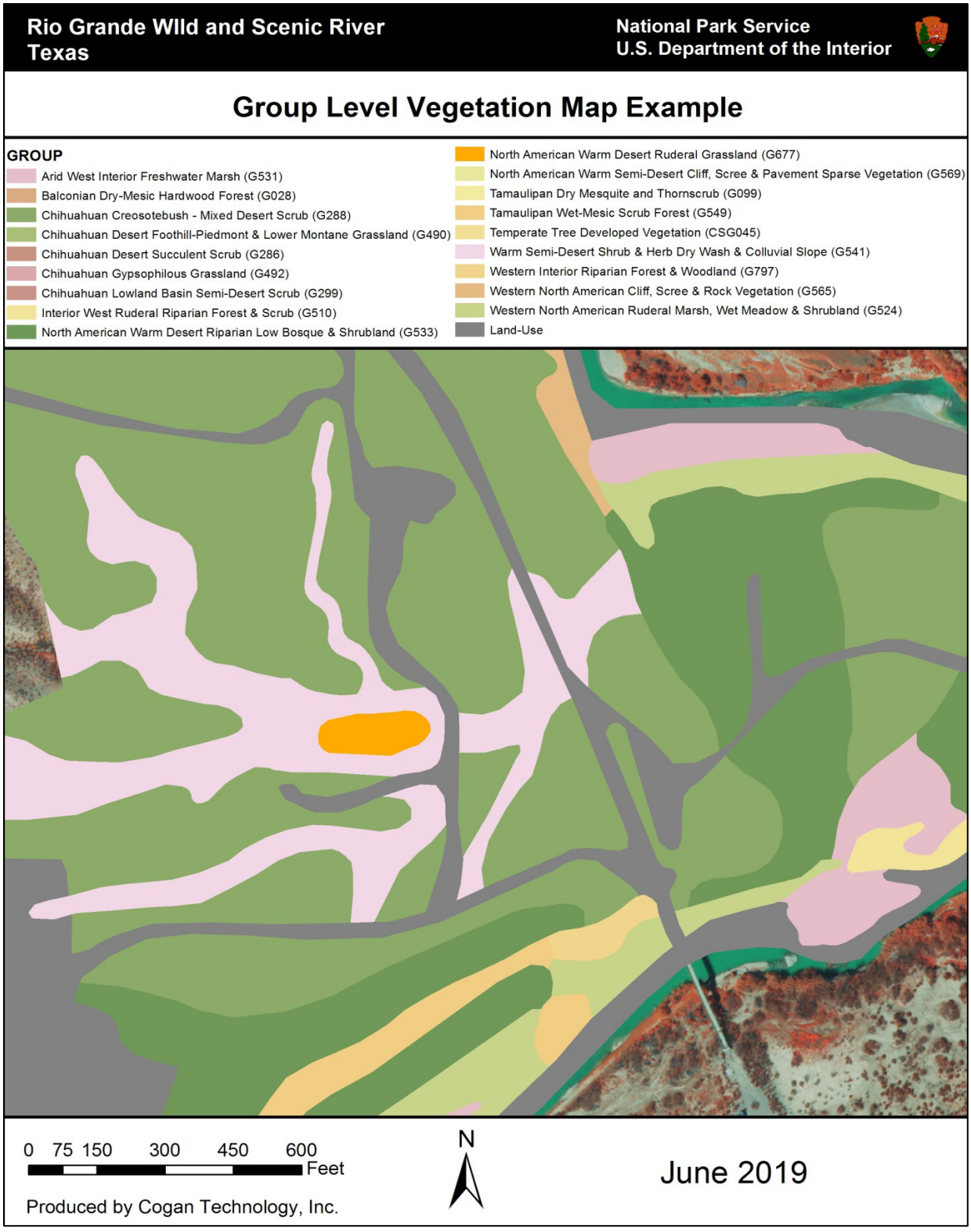


Figure 21. Example of the RIGR Coarse-Scale Vegetation Map Layer (CTI).

Accuracy Assessment

A total of 169 AA target points were sampled by the RGI and CCB field crews and distributed throughout the project area, including some co-located AA sites in BIBE. After the fieldwork, the resulting AA data was entered into the PLOTS database and reviewed. Based on the undescribed vegetation encountered at a few of the remote sites, the classification was updated and finalized to include the new plant associations found during the AA fieldwork. Final review of the AA data revealed seven points that were in the wrong location. These were removed from analysis yielding a final sample size of 162 AA points.

Thirteen of the map units were not assessed by the field crews for a variety of reasons as summarized in Table 11. These include 10 types that were previously assessed at BIBE or AMIS and were not targeted due to time and cost constraints (Table 12). The remaining map units that were not assessed at either RIGR, BIBE, or AMIS include: the S_PTWASH type that was extremely rare, the W_MA type that only occurred in small isolated stands, the S_CTAL type that was created after the AA fieldwork, and the SP_LDES map units that were combined for the AA since the field crews did not distinguish them apart in the field.

Table 11. Summary of the RIGR Map Classes not Accuracy Assessed.

Map Code	Polygons	Acres	% of Project	Reason
W_MA	28	12	< 0.1%	Rare polygons in RIGR. Most sites were already sampled with plots or observation points.
S_ACAMEQ	161	324	< 1%	More abundant in BIBE and polygons were not targeted as part of the RIGR AA field work.
S_CBO	33	112	< 1%	More abundant in BIBE and polygons were not targeted as part of the RIGR AA field work.
S_CTAL	127	771	2%	Was part of the S_CDS map unit during the time of the AA and was not targeted.
S_CLAY	32	168	< 1%	Most of the polygons were co-located in BIBE and were assessed as part of the BIBE project.
S_GBTY	31	59	< 1%	Rare polygons in RIGR. Most sites were already sampled with plots or observation points.
S_PTWASH	49	51	< 1%	Rare polygons in RIGR. Most were already sampled during the classification stage.
S_RWIL	36	69	< 1%	Most of the polygons were co-located in BIBE and were assessed as part of the BIBE project.
S_YUC	13	104	< 1%	Most of the polygons were outside of the original RIGR project boundary.
S_YWASH	55	179	< 1%	Most of the polygons were outside of the original RIGR project boundary.

Table 11. Summary of the RIGR Map Classes not Accuracy Assessed.

Map Code	Polygons	Acres	% of Project	Reason
S_WASH	246	516	1%	More abundant in BIBE and polygons were not targeted as part of the RIGR AA field work.
SP_NCAL	2	12	< 0.1%	Most of the polygons were co-located in BIBE and were assessed as part of the BIBE project.
SP_TAL	9	23	< 0.1%	Most of the polygons were outside of the original RIGR project boundary.
Totals	789	2,288	7%	–

Table 12. Summary of BIBE and AMIS Accuracy for Map Classes not Assessed at RIGR.

Map Code	Location	Correct AA Points	User's AA Points	User's Accuracy	Producer's AA Points	Producers Accuracy
S_ACAMEQ	BIBE	29	30	97%	36	81%
S_CBO	BIBE	55	64	86%	74	81%
S_CLAY	BIBE	12	20	60%	12	100%
S_GBTY	AMIS	27	36	75%	28	96%
S_RWIL	BIBE	1	4	25%	3	9%
S_YUC	BIBE	23	28	82%	25	92%
S_YWASH	BIBE	3	3	100%	3	100%
S_WASH	BIBE	21	27	78%	21	100%
SP_LDES	BIBE	67	61	91%	93	66%
SP_NCAL	BIBE	1	1	100%	1	100%
SP_TAL	BIBE	6	14	43%	6	100%

Analysis of the RIGR AA points involved a point-by-point review in two stages. In stage one, errors in the AA database were corrected, some of the wrong locations were fixed, ambiguous field calls were changed to the correct rUSNVC name, and the primary call was changed to the secondary call based on actual species abundance and cover values. Some AA points were also modified to better address the vegetation as seen from an overhead perspective. This included adding new second vegetation determinations for small inclusions that better reflected the larger mapping concept, addressing ecotones and transitional areas, and for areas were the field determination clearly did not match the field data.

Following the first AA point review, the results were presented to NVIP and BIBE/RIGR staffs. After their review, they requested that all of the map units currently in the vegetation map remain and they would accept any lower than expected accuracy values. The stated reasons for their request included high conservation value for the native types and the importance of knowing the locations of all the rare and non-native vegetation types.

Stage two of the analysis involved re-running the accuracy assessment using the corrected AA points. The resulting contingency tables (i.e. error matrices) include the observation counts with the predicted values (polygon map labels) as rows and the reference data values (AA field calls) as columns. The individual cell values represent the number of map units mapped in each class (row) that were found to be of a specific class (column) in the field. The values in the shaded cells along the diagonal represent correct map units, whereas those off the diagonal represent mismatched or incorrect types. The results of the sample contingency analysis are presented in Table 13 and are summarized in Table 14. The population contingency analysis is similar to the sample contingency, but the population values consider the proportion of the target area rather than just the raw count of observations. The results of the population table are summarized in Table 15. Due to space and page size limitations, the actual population contingency table can only be viewed directly from the project deliverable files (see RIGR_AA_Matrices.xls).

Table 13. Sample Contingency Table for RIGR. Cells wih and asterisk (*), also shaded in light gray, represent accurate map units, while all other cells represent miss-matched or incorrect units.

Map Unit	H_ASAC	H_BERM	H_CANE	H_GRS	H_REED	H_RIO	H_UPG	SP_BAD	SP_CAL	SP_LCAL	SP_LDES	SP_RIO	SP_WASH	S_BBWASH
H_ASAC	2*	0	0	0	0	0	0	0	0	0	0	0	0	0
H_BERM	0	8*	0	0	0	0	0	0	0	0	0	0	0	0
H_CANE	0	0	17*	0	0	0	0	0	0	0	0	0	0	0
H_GRS	0	0	0	1*	0	0	0	0	0	0	0	0	0	0
H_REED	0	0	0	0	1*	0	0	0	0	0	0	0	0	0
H_RIO	0	0	0	0	0	12*	0	0	0	0	0	5	1	0
H_UPG	0	0	0	0	0	0	1*	0	0	0	0	0	0	0
SP_BAD	0	0	0	0	0	0	0	2*	0	0	1	0	0	0
SP_CAL	0	0	0	0	0	0	0	0	1*	0	0	0	0	0
SP_LCAL	0	0	0	0	0	0	0	0	0	3*	0	0	0	0
SP_LDES	0	0	0	0	0	0	0	0	0	0	2*	0	0	0
SP_RIO	0	0	0	0	0	0	0	0	0	0	0	6*	0	0
SP_WASH	0	0	0	0	0	0	0	0	0	0	0	0	0*	0
S_BBWASH	0	0	0	0	0	0	0	0	0	0	0	0	0	1*
S_CB	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S_CDS	0	0	0	0	0	0	0	0	0	1	0	0	0	0
S_MEQ	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S_MRIP	0	0	2	0	0	0	0	0	0	0	0	0	0	0
S_NECC	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S_SSCB	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S_SSMS	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S_TAM	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 13 (continued). Sample Contingency Table for RIGR. Cells wih and asterisk (*), also shaded in light gray, represent accurate map units, while all other cells represent miss-matched or incorrect units.

Map Unit	H_ASAC	H_BERM	H_CANE	H_GRS	H_REED	H_RIO	H_UPG	SP_BAD	SP_CAL	SP_LCAL	SP_LDES	SP_RIO	SP_WASH	S_BBWASH
W_CWD	0	0	0	0	0	0	0	0	0	0	0	0	0	0
W_FOR	0	0	0	0	0	0	0	0	0	0	0	0	0	0
W_HR	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Column Total	2	8	19	1	1	12	1	2	1	4	3	11	1	1
Total Correct	2	8	17	1	1	12	1	2	1	3	2	5	0	1
Producer's Accuracy	100%	100%	89%	100%	100%	100%	100%	100%	100%	75%	67%	55%	0%	100%

Table 13 (continued). Sample Contingency Table for RIGR. Cells wih and asterisk (*), also shaded in light gray, represent accurate map units, while all other cells represent miss-matched or incorrect units.

Map Unit	SP_CB	S_CDS	S_MEQ	S_MRIP	S_NECC	S_SSCB	S_SSMS	S_TAM	W_CWD	W_FOR	W_HR	Row Total	Total Correct	User's Accuracy
H_ASAC	0	0	0	0	0	0	0	0	0	0	0	2	2	100%
H_BERM	0	0	0	0	0	0	0	0	0	0	0	8	8	100%
H_CANE	0	0	0	0	0	0	0	1	0	0	0	18	17	94%
H_GRS	0	0	0	0	0	0	0	0	0	0	0	1	1	100%
H_REED	0	0	0	0	0	0	0	0	0	0	0	1	1	100%
H_RIO	0	0	0	0	0	0	0	0	0	0	0	18	12	67%
H_UPG	0	0	0	0	0	0	0	0	0	0	0	1	1	100%
SP_BAD	0	0	0	0	0	0	0	0	0	0	0	3	2	67%
SP_CAL	0	0	0	0	0	0	0	0	0	0	0	1	1	100%
SP_LCAL	0	0	0	0	0	0	0	0	0	0	0	3	3	100%

Table 13 (continued). Sample Contingency Table for RIGR. Cells wih and asterisk (*), also shaded in light gray, represent accurate map units, while all other cells represent miss-matched or incorrect units.

Map Unit	SP_CB	S_CDS	S_MEQ	S_MRIP	S_NECC	S_SSCB	S_SSMS	S_TAM	W_CWD	W_FOR	W_HR	Row Total	Total Correct	User's Accuracy
SP_LDES	0	0	0	0	0	0	0	0	0	0	0	2	2	0%
SP_RIO	0	0	0	0	0	0	0	0	0	0	0	6	6	100%
SP_WASH	0	0	0	0	0	0	0	0	0	0	0	0	0	0%
S_BBWASH	0	0	0	0	0	0	0	0	0	0	0	1	1	100%
S_CB	**2***	0	0	0	0	0	0	0	0	0	0	2	2	100%
S_CDS	0	**2***	0	0	0	0	0	0	0	0	0	3	2	67%
S_MEQ	0	0	**5***	1	0	0	0	0	0	0	0	6	5	83%
S_MRIP	0	0	0	**26***	0	0	0	1	0	0	0	29	26	90%
S_NECC	0	0	0	0	**25***	0	0	0	0	0	0	25	25	100%
S_SSCB	0	0	0	0	0	**1***	0	0	0	0	0	1	1	100%
S_SSMS	0	0	0	0	0	0	**3***	0	0	0	0	3	3	100%
S_TAM	0	0	0	2	0	0	0	**12***	0	0	0	14	12	86%
W_CWD	0	0	0	0	0	0	0	0	**1**	0	0	1	1	100%
W_FOR	0	0	0	0	0	0	0	0	0	**2**	0	2	2	100%
W_HR	0	0	0	1	0	0	0	0	0	0	**10**	11	10	91%
Column Total	2	2	5	30	25	1	3	14	1	2	10	—	—	—
Total Correct	2	2	5	26	25	2	3	12	1	2	10	—	—	—
Producer's Accuracy	100%	100%	100%	87%	100%	100%	100%	86%	100%	100%	100%	—	—	—

Table 14. Sample Contingency Table Analysis Results for RIGR.

Map Code	Users Accuracy	90% Confidence Interval -	90% Confidence Interval +	Producers Accuracy	90% Confidence Interval -	90% Confidence Interval +
W_GOAK	100%	75%	100%	67%	55%	79%
H_ASAC	100%	75%	100%	100%	75%	100%
H_BERM	100%	94%	100%	100%	94%	100%
H_CANE	94%	82%	100%	89%	74%	100%
H_GRS	100%	50%	100%	100%	50%	100%
H_REED	100%	50%	100%	100%	50%	100%
H_RIO	67%	40%	93%	100%	96%	100%
H_UPG	100%	50%	100%	100%	50%	100%
SP_BAD	67%	0%	100%	100%	75%	100%
SP_CAL	100%	50%	100%	100%	50%	100%
SP_LCAL	100%	83%	100%	75%	17%	100%
SP_LDES	0%	0%	25%	67%	0%	100%
SP_RIO	100%	92%	100%	55%	8%	100%
SP_WASH	0%	N/A	N/A	0%	N/A	N/A
S_BBWASH	100%	50%	100%	100%	50%	100%
S_CB	100%	75%	100%	100%	75%	100%
S_CDS	67%	0%	100%	100%	75%	100%
S_MEQ	83%	46%	100%	100%	90%	100%
S_MRIP	90%	78%	100%	87%	74%	100%
S_NECC	100%	98%	100%	100%	98%	100%
S_SSCB	100%	50%	100%	100%	75%	100%
S_SSMS	100%	83%	100%	100%	83%	100%
S_TAM	86%	65%	100%	86%	65%	100%
W_CWD	100%	50%	100%	100%	50%	100%
W_FOR	100%	75%	100%	100%	75%	100%
W_HR	91%	71%	100%	100%	95%	100%

Table 15. Population Contingency Table Analysis Results for RIGR.

Map Code	Users Accuracy	90% Confidence Interval -	90% Confidence Interval +	Producers Accuracy	90% Confidence Interval -	90% Confidence Interval +
H_ASAC	100%	75.0%	100%	100%	100%	100%
H_BERM	100%	93.8%	100%	100%	100%	100%
H_CANE	94.4%	82.8%	100%	82.3%	82.0%	82.7%
H_GRS	100%	50.0%	100%	100%	100%	100%
H_REED	100%	50.0%	100%	100%	100%	100%
H_RIO	66.7%	45.6%	88%	100%	100%	100%
H_UPG	100%	50.0%	100%	100%	100%	100%
SP_BAD	66.7%	5.2%	100%	100%	100%	100%
SP_CAL	100%	50.0%	100%	100%	100%	100%
SP_LCAL	100%	83.3%	100%	91.1%	90.9%	91.3%
SP_LDES	100%	75.0%	100%	95.2%	95.2%	95.2%
SP_RIO	100%	91.7%	100%	74.5%	74.5%	74.5%
SP_WASH	0%	0%	0%	0%	0%	0%
S_BBWASH	100%	50.0%	100%	100%	100%	100%
S_CB	100%	75.0%	100%	100%	100%	100%
S_CDS	66.7%	5.2%	100%	100%	98.5%	100%
S_MEQ	83.3%	50.0%	100%	100%	96%	100%
S_MRIP	89.7%	78.6%	100%	74.0%	72.6%	75.3%
S_NECC	100%	98.0%	100%	100%	100%	100%
S_SSCB	100%	50.0%	100%	100%	100%	100%
S_SSMS	100%	83.3%	100%	100%	100%	100%
S_TAM	85.7%	66.8%	100%	79%	78%	79%
W_CWD	100%	50.0%	100%	100%	100%	100%
W_FOR	100%	75.0%	100%	100%	100%	100%
W_HR	90.9%	72.1%	100%	100%	100%	100%

By reading across the rows of the contingency tables, one can calculate the user's error or percent error of commission. This relates to how many polygons for each map unit were incorrectly labeled when compared to the field data. By reading down the columns, one can calculate the producer's error or the percent error of omission. This shows how many polygons for that type were left off the

map. Numbers on the diagonal tell the user how well the map unit was interpreted and how confident they can be in using it. Numbers off the diagonal yield important information about the deficiencies of the map including which types were either: (1) over- mapped - commission errors on the right - meaning more of this type was mapped than occurs at RIGR, or (2) under-mapped - omission errors on the bottom - meaning some of this type was mapped as other map units.

Based on the population accuracy analysis for RIGR the overall accuracy and Kappa values of the vegetation layer at the finest or association mapping level are as follows:

- Total AA Sites (Samples) = 162
- Sample Overall Accuracy = 88.9%
- Population Overall Accuracy (P_c) = 93.1%
- Lower Limit, 90% Confidence Interval = 88.4%
- Upper Limit, 90% Confidence Interval = 97.8%
- Kappa (K) = 89.0%
- Lower Limit, 90% Confidence Interval, K = 84.8%
- Upper Limit, 90% Confidence Interval, K = 93.3%

Reviewing the combined RIGR/BIBE/AMIS AA data shows that 28 of the 40 vegetated map units had both high user's and producer's accuracy of at least 80%. Eight map units had marginal accuracy between 79% - 60% (Table 16) and 4 map units had low accuracy of < 60% (Table 17). One source of error for the rare and infrequent types was the small number of AA points that fell below the NVIP standards (Lea and Curtis 2010). The low number of AA points was likely due to a combination of very few polygons to visit (i.e. rare types), most polygons were already sampled with plots or observation points, access limitations onto private lands, rugged terrain, safety considerations, and financial constraints limiting the amount of field time (river trips). Noticeably the AA results for these map units with limited sample sizes (1-3) present either a highly inflated or a highly deflated value when compared to other map units with more robust data. More sampling in these under-sampled types would better reflect the true individual map class accuracy and reduce the corresponding confidence intervals.

Other general sources of error can likely be explained by the difficulty in resolving the differences in scale and perspective between viewing the vegetation on the imagery and assessing it on the ground. For example, sampling could have occurred in large inclusions of shrubs or herbaceous vegetation that were actually part of a larger sparse desert scrub type. In addition, the fine delineation of closely related mapping units likely led to confusion, especially when map units shared the same dominant species. More thoughts on the accuracy of the RIGR vegetation map and recommendations on how to improve it are included in the discussion section of this report.

Table 16. Marginal Level Map Classes and Sources of Error.

Map Code	Producers Accuracy	Users Accuracy	Results and Likely Error Explanations
H_RIO	67%	100%	Over-mapped - Actually SP_RIO or S_WASH types in some cases (very similar map units with similar species and landscape characteristics, the dynamic nature of the vegetation on these types can change from year to year)
SP_BAD	67%	100%	Over-mapped - Actually SP_LDES type in some cases (occurs in very similar landscape positions)
SP_RIO	100%	75%	Under-mapped - Mapped as H_RIO instead in some cases (cover values of the vegetation on these types made it hard to access and map accurately from year to year)
S_CDS	67%	100%	Over-mapped - Actually SP_LCAL in some cases (very similar limestone shrub types with high species overlap)
S_CLAY*	60%	100%	Over-mapped - Actually SP_LDES or S_CB (species overlap and similar topographic position)
S_GBTY*	75%	96%	Over-mapped. High species overlap with the other thornscrub and wash types. (species overlap and similar topographic position)
S_MRIP	90%	74%	Under-mapped - Mapped as S_MEQ and W_HR in some cases. (high species overlap and similar tall shrub signatures)
S_WASH*	78%	100%	Over-mapped - Actually S_ACAMEQ or S_CBO (species overlap and similar topographic position)

*represents BIBE and AMIS AA data.

Table 17. Low Accuracy Level Map Classes and Sources of Error.

Map Code	Producers Accuracy	Users Accuracy	Results and Likely Error Explanations
SP_WASH	0%	0%	Under-mapped - Mapped as H_RIO (very similar map units with similar species and landscape characteristics, the dynamic nature of the vegetation on these types can change from year to year - SP_WASH was more thoroughly assessed during the BIBE NVIP project)
S_RWIL*	25%	9%	Under-mapped - Mapped as S_MRIP or H_CANE – and - Over-mapped - Actually H_CANE or S_TAM (rare riparian type with high species overlap)
SP_TAL*	43%	100%	Over-mapped - Actually S_CBO or SP_LDES (common desert types that can grow on talus)

*represents BIBE and AMIS AA data.

Table 17 (continued). Low Accuracy Level Map Classes and Sources of Error.

Map Code	Producers Accuracy	Users Accuracy	Results and Likely Error Explanations
SP_WASH	0%	0%	Under-mapped - Mapped as H_RIO (very similar map units with similar species and landscape characteristics, the dynamic nature of the vegetation on these types can change from year to year - SP_WASH was more thoroughly assessed during the BIBE NVIP project)

*represents BIBE and AMIS AA data.

Discussion

The long linear and rugged landscape at RIGR supports a wide range of plant communities that are adapted to both riparian and upland environments. RIGR spans many unique ecoregions that gradually transition from western arid desert to more eastern semi-arid thornscrub habitats. These harsh and remote locations made for many unique challenges to the vegetation inventory project. Challenges included many logistical considerations due to travel distances, heat exposure, abbreviated growing seasons, working on steep slopes, negotiating routes through thick vegetation, and working on foot from limited roads, trails, and other access points. In addition to the difficulty of doing fieldwork at RIGR, the natural mixing of the vegetation and the overlap of similar dominant species made for both a challenging classification process and a complex mapping effort. The inventory and mapping processes described in this report although largely successful revealed opportunities for improvement and new approaches for future efforts that are discussed herein.

Approaches that Worked Well

Having access to the BIBE and AMIS existing vegetation data helped speed-up the classification process for RIGR. The BIBE/AMIS data formed the basis for the RIGR classification and allowed for more emphasis to be placed on getting more data outside of the co-located BIBE/RIGR lands. This approach recognized the large gap in the data collection for the lower canyons and allowed for an additional effort to be conducted there. The subsequent field sampling in the lower canyons was greatly aided by the use of NPS-provided boats, canoes, guides, and vehicle support. BIBE/RIGR staff also provided invaluable guidance on logistics and imparted local knowledge about possible unique stands of vegetation. Both spring and fall field efforts helped minimize the dangers from heat exposure while still allowing for accurate plant identification. Timely and high-resolution base imagery was essential to produce the detailed and accurate maps and the 2015 TOP imagery was of superior quality and resolution when compared to similar NAIP or other existing imagery sources. Further, having imagery with 4-bands and the ability to view the vegetation in color infrared format was essential to the detailed and accurate mapping of the vegetation at RIGR.

Areas for Improvement

NPS vegetation inventory projects are by design lengthy projects that incorporate numerous cooperators and partners. Having more than one group working on the project can lead to a loss of intuitional knowledge and an overlap in responsibilities. Stream-lining the number of people working on the project, creating clear roles for each partner, mandating project reports, standardized interim products, and having designated project leads would help economize and make the project more efficient. Inherent to all vegetation mapping projects is also the need to produce both a complete and up-to-date vegetation classification and a rUSNVC-relatable set of map units. In the future, it may be possible to supplement the RIGR classification by collecting additional field data that may help remove the provisional or local status of the non-rUSNVC plant associations. Similarly, more fieldwork may also allow for more detailed ground-truthing and/or create new or refined map classes. More targeted sampling in unvisited areas in the Boquillas and Lower Canyons may also help find potentially new types and/or complete the range of variation for existing types. Finally, new advances in aerial imagery acquisition (e.g. drones, new sensors, higher resolutions, etc.) and other

remotely sensed data (e.g. LIDAR, hyperspectral, etc.) may allow for more precise mapping of the vegetation.

Field Surveys

The long linear nature of RIGR (196 river miles - 315 km) represents a large geographic span with significant regional and local plant diversity differences influenced by geology, moisture levels, topographic position, and other factors. RIGR is situated at the eastern edge of the Chihuahuan Desert, where the vegetation progresses from more strictly Chihuahuan Desert species (as within BIBE) to a less arid zone with progressively more Balconian and Tamaulipan floristic elements (as within AMIS). This biogeographic gradient imposed a requirement of repetitive sampling (especially in the rugged uplands) from upstream to downstream (southwest to northeast) to recognize the subtle changes in plant composition and to produce a reasonably complete description of the vegetation.

The field work of this project was strenuous and three work rotations on the river were used. The focus of the initial field work (first and second field work rotations) was in the western section of RIGR and co-located lands within BIBE. Data collected in this region of RIGR was robust and well defined. Collecting data in the eastern section of RIGR outside of BIBE (east of La Linda) proved to be more difficult due to the privately-owned lands, rugged approach terrain, and the long distances between river access points. To maximize efficiency, observation and AA points were also collected during this lower canyon trip (third field work rotation). Future classification work would likely benefit from more sampling of the vegetation in these remote and hard to access areas of the Lower Canyons. The Rio Grande River and its larger tributaries should also be monitored for any changes after flooding or when non-native species are removed.

Vegetation Classification

Due to challenges related to access, the classification for RIGR was performed in a fragmented manner using various methodologies. As a result, the RIGR plant associations can roughly be separated into three categories. The first includes the western BIBE Chihuahuan Desert types that have been thoroughly sampled and defined. The second are Chihuahuan Desert species in the middle section of RIGR that are influenced by the presence of eastern plants. Finally, the easternmost section represents a true transition from Chihuahuan Desert associations to the less arid Balconian and Tamaulipan types. Both the middle and eastern sections were not as vigorously sampled as those in BIBE due to access and logistics. Future classification work should concentrate on the eastern sections of RIGR as more field data becomes available. Having more data in these remote areas would allow for a better understanding of the vegetation diversity and how it transitions along the Rio Grande River from BIBE through RIGR and onto AMIS.

The vegetation at RIGR was classified using the NVIP National Vegetation Standard, Version 2 (rUSNVC) (FGDC 2008). There exists some confusion over how physiognomy is used in classifying existing vegetation in the rUSNVC compared to how it was used in the previous version (FGDC 1997). To clarify, the physiognomy of a plant community (i.e. forest, woodland, shrubland, shrub steppe, herbaceous or sparse vegetation) does not trump floristic composition or ecology when classifying vegetation. Further, the strict and detailed physiognomic hierarchy of the USNVC version 1 is not maintained in the rUSNVC. Rather, very broad physiognomic criteria are applied at higher

levels, with floristics playing an increasingly stronger role at the mid and lower levels. As a result, the association and alliance levels only have fine-scale physiognomic criteria when they are supported by floristics and ecology. Thus “forest to open woodland” is separated from “shrubland and grassland” at the highest levels, based on the 10% or more cover of trees and finer scale splits are only made at lower levels as needed.

The use of the new rUSNVC at RIGR likely helped reduce the number of potentially confusing plant associations resulting from mixed stands of vegetation. For example, shrub dominated vegetation with scattered trees (up to 9% cover of trees) is now classified as a shrubland and if there is 10% or more cover of trees, then the stand is classified as a woodland or forest. This discourages the classification of transitional vegetation (either spatial transitions such as in ecotones, or temporal transitions when trees colonize/invade shrublands) to rUSNVC associations, reducing the proliferation of associations based solely on physiognomy and reducing the complexity of the classification in general. The 10% or more tree cover break for woodlands and forests is applied globally in the rUSNVC with few exceptions. One significant exception may occur in sparse woodlands (such as emergent riparian trees) were the total vegetation cover only equals 10-15% and the trees dominate with slightly less than 10% cover.

Digital Imagery and Mapping

The vegetation map for RIGR was based primarily on the 2015 TOP orthoimagery. However, both the 2012 and 2016 NAIP products were used to help delineate confusing upland areas, areas with dark shadows, and rapidly changing areas along the Rio Grande River. In general, the RIGR vegetation map should be considered a snapshot in time directly relating to the 2015 TOP imagery. As the data are used, it should be remembered that floods, sediment accumulation/removal, invasive species control, and other changes to the landscape since 2015 are not included in this product. In the future, it might be beneficial to update the map with newer imagery and use GPS receivers to collect coordinates in the field after major events (e.g. fire perimeters, insect infestations, flooding impacts, and changes to the river channel).

It is also important to understand that the mapping portion of this project is primarily a remotely sensed exercise and the field work was conducted on site, therefore all resulting products are scale dependent. As a rule, the mapping portions should be considered as a broad overview and the field data as site-specific. An analyst can enlarge the imagery beyond the 1:12,000-scale using GIS software to see more detail. However, it should be remembered that the actual interpretation/mapping was conducted at 1:12,000-scale. As such, any work performed with this product at a finer scale (enlarged image) could lead to some uncertainty. In contrast, the fieldwork was conducted at individual locations at one specific time and any extrapolation using these locations to represent outlying areas or using them to determine species presence at different times/seasons is less reliable. Database users should recognize scale limitations and balance research and modeling projects accordingly.

Accuracy Assessment

A formal accuracy assessment is critical to determining the overall usefulness of the vegetation map and its ability to predict the size, shape, and location of individual map units on the landscape. As

such, users of the vegetation mapping product should remember that the AA results were directly dependent on many key factors including:

- Field Surveys - thoroughness of the sampling to reach all areas of RIGR;
- Field Crews - level of expertise to consistently identify and record species and cover values;
- Classification - ability to describe ecotones and the full variation of each association;
- Field Key - its ability to reliably and consistently identify and separate unique associations;
- Date Entry - consistent maintenance of data with minimal errors;
- Orthoimagery - ability to provide consistent vegetation signatures that repeat across the landscape;
- Vegetation Stability - little if any changes occurred between the timing of the orthoimagery to when the AA fieldwork occurred.

Although the accuracy for RIGR was high, improvements can be made, and users should fully explore and understand the sources of error in the contingency tables and the factors stated above. Specific areas at RIGR that could benefit from more investigation or future efforts to improve the accuracy include the following regions of RIGR:

1) **Low Desert:** Mapping in the low desert regions of RIGR was largely based on the amount, diversity, and species associated with creosotebush and to a lesser degree with honey mesquite. To provide more detail, two main creosotebush map units were created, (1) one on slightly higher elevations that contains ocotillo and lechuguilla (S_CBO) and (2) for lower elevations (S_CB) that mainly lacks any other associated shrubs. The remaining areas were typically devoid of any one dominant species but contained low amounts of creosotebush, cacti, and other desert species (SP_LDES). The SP_LDES types were further separated into three variants to describe their unique substrates and locations. In addition, more detail was provided by separating sparse species compositions that occurred on clay fans and flats (S_CLAY) and in badland formations (SP_BAD). As requested during the mapping, low desert and high desert areas containing significant amounts of introduced grasses were noted by species in the GIS layer using the INTRO_GRSS attribute. The SP_LDES is widespread and could easily be fully merged and combined with the S_CLAY, SP_BAD, and S_CB types. This would reduce the mapping detail, slightly increase the accuracy, and would combine different landforms that may or may not be significant to resource management.
2) **Limestone Mountains and Low Elevation:** During the classification stage, a large break in the plant associations occurred for those growing on limestone (calcareous) versus those on non-limestone geology. This was carried over into the mapping scheme by creating various calcareous map units such as S_CDS, S_YUC, and S_YWASH. To capture fully the variation on the limestone formations, unique map units were also created, especially for those supporting sparse vegetation such as high rock outcrops (SP_CAL) and lower scrub communities (SP_LCAL). In addition, the S_CTAL type was created for vegetation occurring on talus where more mesic conditions support higher vegetation concentrations. Similarly, the S_YWASH map unit was used to label similar vegetation occurring in limestone washes. All of the

limestone/calcareous map units have similar species and can be easily combined into larger groupings if needed.

3) **Washes and Upland Riparian:** The importance of understanding the hydrology at RIGR resulted in the detailed mapping of the drainages and washes in the project area (down to about 1-2 meters wide). The map attribution of the wash drainages proved challenging since similar species occur in both the upland shrublands and in washes. Some of the confusion was alleviated by creating an alternate or secondary map unit label. For example, a wide wash area would be a linear feature with the primary label of S_WASH. Alternatively, large pockets within the drainage may support S_CB species. Thus, the secondary label would be S_CB. In addition, other map units were created specifically for sites containing high and tall mesquite and acacia shrubs (S_ACAMEQ), washes dominated by blackbrush (S_BBWASH) and others containing Texas persimmon trees (S_PTWASH). Wide drainages devoid of vegetation were mapped as SP_WASH. On limestone formations, the washes were given a park special designation of S_YWASH to indicate the presence of yucca and other calcareous shrub species. Deciduous trees were given a high priority in the mapping due to their rarity. Most of the trees were either cottonwood (W_CWD), Mexican ash (W_MA), huisache (W_HR), or tall willows (S_RWIL). In addition, some of the trees in the BIBE campgrounds were found to be planted and irrigated (W_FOR). Various groupings of the woodland types could be made, such as combining the W_CWD and W_FOR types to better indicate all of the cottonwood trees in RIGR.

4) **Lower Canyons:** Due to the remote and difficult access in the Lower Canyons, the unique map classes for this region are not as well defined as those found in the western sections of RIGR. As a result, future work may prove that the S_NECC type is actually quite similar to both the S_CDS and S_CBO map units due to the high amount of creosotebush and may need to be re-defined. Similarly, the S_SSCB and S_SSMS types may be more like each other or like similar thornscrub map units found in nearby AMIS.

5) **Rio Grande River Corridor:** The river corridor was mapped twice during our efforts, once with the old boundary and once after receiving a new boundary from the NPS Lands Office. In both cases, the honey mesquite bosque stands (S_MRIP) were easily to distinguish except when they integrated with tamarisk (salt cedar) stands. Some difficulties were also encountered trying to map the native willow and reed types from the giant cane (H_CANE) and tamarisk (S_TAM) map units. Bermuda grass was also common throughout RIGR and may change in frequency and abundance from year to year. The dynamic nature of the river also created some early successional herbaceous and bare alluvial bars that were labeled with the H_RIO and SP_RIO designations. Both of which, could easily be combined to greatly improve the accuracy of these types.

6) **Map Units with Limited AA Sample Points:** For various reasons described in this report, some of the map units had lower than expected AA sample sizes or were not sampled during the AA portion of this project. Users of this data should keep these limitations in mind while working with the data and factor them into any future planning or monitoring activities. More sampling in the under-sampled types would likely improve the individual map class accuracy and reduce the

corresponding confidence intervals. With new data, the contingency tables could be updated, and the entire project improved and made more reliable.

Future Recommendations

The vegetation inventory project for RIGR represents the best efforts put forth by many dedicated experts over a relatively short period of time. In order to create the best possible "long-term" product, this project should not be viewed as final, but rather as the starting point for an on-going effort. RIGR staff and researchers should continue to explore the river corridor and observe the vegetation. Improvements and up-dates to the products presented in this report should be made as needed and on a periodic basis. Present and future researchers should be encouraged to scrutinize the vegetation at RIGR, sample more of the rare and under-represented types, modify the classification and field key to better document the full range of vegetation variation, update and improve the GIS layers, and be ever vigilant to record any recent changes or new types that may have been overlooked.

In summary, the products produced as part of this project can assist and direct future vegetation and land-use monitoring and management, as follows:

1) The diversity of plant species and dynamic nature of RIGR with respect to the Rio Grande River, non-native species encroachment/eradication, native plant restorations, wildfires, water diversions, climate change, and other vegetation altering influences warrants periodic **field surveys** by experienced ecologists. Sampling more of the plant communities (especially in the Lower Canyons and eastern sections of RIGR) would allow for the possibility of discovering new associations, updating the descriptions of the current plant associations, and devising better landscape management strategies. All new information could be used to update both the GIS map layer and the classification.
2) Remote sensing does not replace on-the-ground knowledge provided by GPS-linked plots, observations, site photographs, and verification/ground-truthing work. Time, access, and funding limitations curtailed the amount of **ground-truthing** performed at RIGR. As research opportunities arise, maps should be examined in the field by experienced personnel. In addition, GPS receiver data and other GIS layers (such as soils and geology) should be used to improve and update the spatial data. Data could be collected on a standard field form, stored, and then used to update the GIS layer on an annual basis. The vegetation map layer should not be viewed as static but should be updated with more current and accurate information as it becomes available.
3) To understand better the limitations of the map layer, the **accuracy assessment** data as presented in the error matrices should be thoroughly reviewed by all users. Map classes with low accuracy or zero to few data points should be examined to determine if they could be improved with future studies using ground-truthing or other remote-sensing formats (e.g. LIDAR, hyperspectral imagery, etc.). Landscape modeling may help to tease out the locations of rare types based on specific habitat information such as deep soil types, unique geologic formations, and distance from water sources. For some applications, it may make sense to combine map classes into higher units, such as rUSNVC Groups or biophysical types to improve accuracy and present a broader perspective**.**

4) For monitoring purposes, **change over time** could be addressed by similar remote sensing projects. New imagery as it becomes available could be analyzed to create up-to-date vegetation layers that could be overlain for comparison purposes. Also, periodically, and immediately following vegetation altering events, new data should be collected, and any changes noted in a new vegetation layer. Through this process, new RIGR vegetation map layers can be prepared on a regular basis to prevent the vegetation map from becoming outdated.
5) In the future, resource management personnel could link the habitat for **species of concern** to specific associations and map units. These map units could be used to help locate potential sites of rare, endangered, or threatened species or identify areas for non-native plant removal or treatment. Known populations of threatened, endangered, or non-native species could be overlain on the vegetation map using point or small polygon layers to extract helpful plant community indicator data such as soil type, slope, aspect, hydrology, etc.

Research Opportunities

The wide array of final products produced for this project lends themselves for future research opportunities. On the inventory and classification side, research could include setting up a photo-monitoring project that periodically retakes plot photographs. This would help to document vegetation change over time. Another option would be mine the PLOTS database for locations of species of concern for both rare plants and problematic invasive species. For example, several plant species of conservation concern and that are endemic to Texas were documented in the plot data collection. These locations could be used as the basis for more rare plant surveys, the start of mapping their distributions, and/or analyzing their habitats for vulnerabilities (flooding, erosion, non-native species invasion, etc.).

On the mapping side, having an accurate and current vegetation map in a geodatabase presents many new and exciting opportunities including expanding or linking the GIS layer to derive other information such as fire models, wildlife habitat monitoring locations, habitat structural analyses, and inventorying areas that are likely vectors for invasive species. The map could also be enhanced by overlaying other existing GIS layers including geology, hydrology, elevation, and soils. In this manner complex interactions between these layers could be examined and yield important information about growth rates, regeneration after disturbance, biomass distribution, and stream morphology. Through innovative analyses the vegetation layer could be used as a baseline for other ecological and climate-related studies including examining how the vegetation is impacted by global warming events and how it interacts with soil chemistry, pollution, paleontological/archeological sites, insect infestations, weather patterns, etc.

Having consistent ecological and digital map data for plant associations across a large geographical span (BIBE to RIGR to AMIS) could create some exciting opportunities for ecoregion analysis. Plant communities could be examined against other GIS layers to see when dominant species occur or drop-out and what are the driving factors behind this. Investigations examine the distribution, health, and vigor of common species (such as creosotebush) overtime as it relates to drought, flooding, or human activities. For example, are desert adapted plants spreading east and closer to the river after drought events or are more mesic thornscrub and riparian species moving west and into the uplands

due to changes in weather patterns? Finally, the active control of non-native species upriver could also be examined in relation to the amount, or rate of recovery of these same types further down the Rio Grande River and around the Amistad Reservoir. Are the seed sources being reduced allowing more native riparian vegetation to occur after flooding or draw-down events? These and other research opportunities could result from linking all of the regional vegetation data for these neighboring NPS units (and possibly other lands) into a seamless classification and related geo-database.

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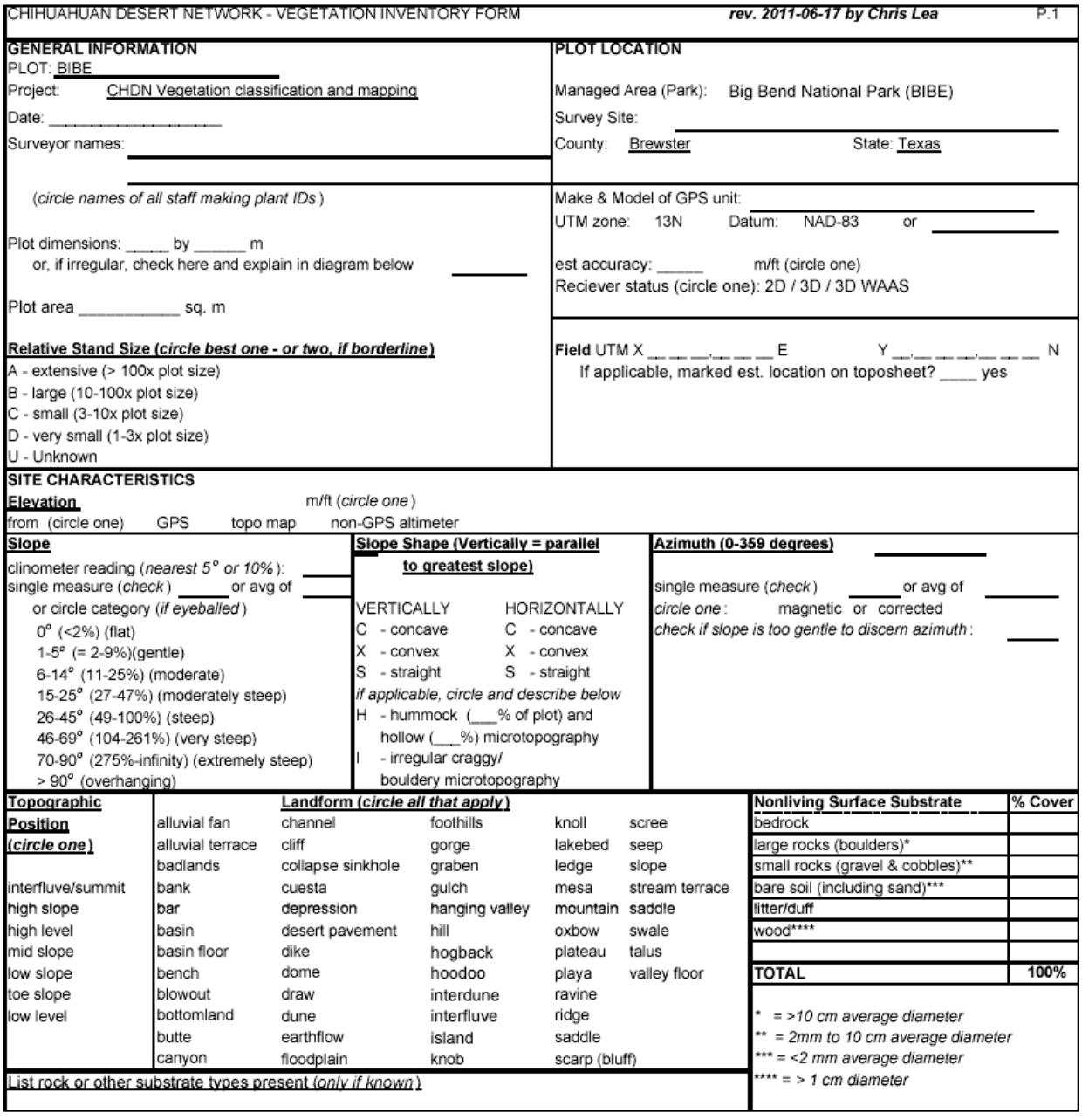
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Appendix A. RIGR Data Forms



CHIHUAHUAN DESERT NETWORK - VEGETATION INVENTORY FORM *rev. 2011-06-17 by Chris Lea* P.1

GENERAL INFORMATION

PLOT: BIBE

Project: CHDN Vegetation classification and mapping

Date: _____

Surveyor names: _____

(*circle names of all staff making plant IDs*)

Plot dimensions: _____ by _____ m

or, if irregular, check here and explain in diagram below _____

Plot area _____ sq. m

Relative Stand Size (*circle best one - or two, if borderline*)

A - extensive (> 100x plot size)
B - large (10-100x plot size)
C - small (3-10x plot size)
D - very small (1-3x plot size)
U - Unknown

PLOT LOCATION

Managed Area (Park): Big Bend National Park (BIBE)

Survey Site: _____

County: Brewster State: Texas

Make & Model of GPS unit: _____

UTM zone: 13N Datum: NAD-83 or _____

est accuracy: _____ m/ft (circle one)

Reciever status (circle one): 2D / 3D / 3D WAAS

Field UTM X __ __ __,__ __ __ E Y __,__ __ __,__ __ __ N

If applicable, marked est. location on toposheet? ____ yes

SITE CHARACTERISTICS

Elevation m/ft (*circle one*)

from (circle one) GPS topo map non-GPS altimeter

Slope

clinometer reading (*nearest 5° or 10%*): _____

single measure (*check*) _____ or avg of _____

or circle category (*if eyeballed*)

0° (<2%) (flat)
1-5° (= 2-9%)(gentle)
6-14° (11-25%) (moderate)
15-25° (27-47%) (moderately steep)
26-45° (49-100%) (steep)
46-69° (104-261%) (very steep)
70-90° (275%-infinity) (extremely steep)
> 90° (overhanging)

Slope Shape (Vertically = parallel to greatest slope)

VERTICALLY	HORIZONTALLY
C - concave	C - concave
X - convex	X - convex
S - straight	S - straight

if applicable, circle and describe below

H - hummock (___% of plot) and hollow (___%) microtopography
I - irregular craggy/ bouldery microtopography

Azimuth (0-359 degrees) _____

single measure (*check*) _____ or avg of _____

circle one: magnetic or corrected

check if slope is too gentle to discern azimuth: _____

Topographic Position (*circle one*)	**Landform (*circle all that apply*)**				
	alluvial fan	channel	foothills	knoll	scree
	alluvial terrace	cliff	gorge	lakebed	seep
	badlands	collapse sinkhole	graben	ledge	slope
interfluve/summit	bank	cuesta	gulch	mesa	stream terrace
high slope	bar	depression	hanging valley	mountain	saddle
high level	basin	desert pavement	hill	oxbow	swale
mid slope	basin floor	dike	hogback	plateau	talus
low slope	bench	dome	hoodoo	playa	valley floor
toe slope	blowout	draw	interdune	ravine	
low level	bottomland	dune	interfluve	ridge	
	butte	earthflow	island	saddle	
	canyon	floodplain	knob	scarp (bluff)	

List rock or other substrate types present (*only if known*)

Nonliving Surface Substrate	**% Cover**
bedrock	
large rocks (boulders)*	
small rocks (gravel & cobbles)**	
bare soil (including sand)***	
litter/duff	
wood****	
TOTAL	**100%**

* = >10 cm average diameter
** = 2mm to 10 cm average diameter
*** = <2 mm average diameter
**** = > 1 cm diameter

Figure A-1. RIGR/CHDN Plot Form Example (blank).

Soil Drainage Class (*circle one*)	Soil Texture (*circle one*)	Moisture or Floodin	Moisture or Flooding Regime (circle one)
A - very poorly drained	A -clay	A - Xeric	I -Saturated (e.g., ground water seep or spring)
B - poorly drained	B -loam (any)	B - Dry-mesic (intermediate)	
C - somewhat poorly drained	C -sand	C - Mesic	
D - moderately well drained	**Cowardin System (*circle one*)**	D -Intermittently flooded (e.g., playa)	
E - well drained	A - Upland	E -Temporarily flooded (e.g., wash)	
F - rapidly drained	B - Lacustrine	F -Seasonally flooded (e.g., tinaja)	
	C - Riverine	G -Semipermanently flooded	
	D - Palustrine	H -Permanently flooded	

Environmental Comments (optional):

Landscape Comments (optional):

Hydrology evidence (optional)

Provisional vegetation type name:

Sketch plot configuration, indicate the plot shape, orientation (azimuth), sub-plots (if used),landscape position, and directions and distances to landmarks. Use the symbols in the key below to indicate positions of GPS points, photos, and permanent markers (if any), relative to the plot sides.

⊗	GPS position
○→	Photo # and direction
●	Permanent Marker

Driving and walking directions to plot:

II. VEGETATION STRUCTURE AND PHYSIOGNOMY PLOT BIBE_____, P.2

Stratum	T1	T2	T3	S1	S2	S3	H	NB	NL	NAC
% COVER*										
Max Height (meters)			10	5	2	0.5		N/A	N/A	N/A

* - if < 5%: estimate to nearest 1% (or as <1%)
if 5-15%, estimate to nearest 5%
If > 15%, estimate to nearest 10%
_____ total vegetation cover of stand, if different from plot (for sparse vegetation only)

T1 = Emergent trees
T2 = Trees, > 10 meters
T3 = Trees, 5-10 meters
S1 = Shrubs, 2-5 meters
S2 = Shrubs, 0.5-2.0 meters
S3 = Shrubs, 0-0.5 m
H = Herbaceous
NB = Nonvascular, bryophytes
NL = Nonvascular, lichens
NAC = Nonvascular (algae, and cyanobacteria)

PHYSIOGNOMIC CLASS	LEAF PHENOLOGY(dominant stratum)	LEAF TYPE (dominant stratum)
Forest (>60% Tree Cover)*	Deciduous (< 25% evergreen)	**(may select more than one)**
Woodland (25-60% Tree Cover)*	Mixed deciduous (25-49% evergreen)	Broadleaf (including xeromorphic)
Shrubland (> 25% Shrub Cover)**	Mixed evergreen (25-49% deciduous)	Needleleaf
Shrubland with sparse (< 25%) tree layer	Evergreen (< 25% deciduous)	Mixed
Herbaceous with sparse (< 25%) tree layer	Perennial graminoid*	Broadleaf Herbaceous
Herbaceous with sparse (< 25%) shrub layer	Perennial forb*	Graminoid
Herbaceous	Annual graminoid*	Pteridophyte
Nonvascular Bryophyte	Annual herbaceous*	Bryophyte
* -or, cover trees > cover shrubs & > cover herbs	Not applicable	Lichen
** - or, cover shrubs > cover herbs	* = may select more than one, if mixed	Algae/Cyanobacteria

Figure A-1 (continued). RIGR/CHDN Plot Form Example (blank).

III. SPECIES COMPOSITION AND COVER CLASS BY STRATUM. Record species cover in the following cover classes:

1=trace, 2=a few to frequent, but scattered (<1%), 3=1-2%, 4=2-5%, 5=5-10%, 6=10-25%, 7=25-50%, 8=50-75%, 9=75-95%, 10=95-100%

Record cover values for each stratum AND for total cover in entire sample. Optional: Check "C" for collection, # for unique identifier assi

T1	T2	T3	S1	S2	S3	H	N		TAXON NAME	C	#	D

Figure A-1 (continued). RIGR/CHDN Plot Form Example (blank).

NATIONAL PARK VEGETATION MAPPING PROGRAM: OBSERVATION POINT FORM (1997)

IDENTIFIERS/LOCATORS

Plot Code_____ Polygon Code_____

Provisional Community Name_____

State ___ Park Name _____ Park Site Name _____

Quad Name_____ Quad Code_____

GPS file name_____ Field UTM X___ ___ ___ ___ ___ ___ m E Field UTM Y___ ___ ___ ___ ___ ___ ___ m N

please do not complete the following information when in the field
Corrected UTM X___ ___ ___ ___ ___ ___ m E Corrected UTM Y___ ___ ___ ___ ___ ___ ___ m N UTM Zone_____

Survey Date_____ Surveyors_____

ENVIRONMENTAL DESCRIPTION

Elevation _____ Slope _____ Aspect_____

Topographic Position

Landform

Cowardian System	Hydrologic Regime		Salinity Modifiers
___Upland	Non-Tidal		___Saltwater
___Riverine	___Permanently Flooded	___Saturated	___Brackish
___Palustrine	___Semipermanetly Flooded	___Temporarily Flooded/Saturated	___Freshwater
___Lacustrine	___Seasonally Flooded	___Intermittently Flooded	

Environmental Comments:	Unvegetated Surface: (please use the cover scale below)
	___ Bedrock ___ Litter, duff ___ Wood (> 1 cm)
	___ Large rocks (cobbles, boulders > 10 cm)
	___ Small rocks (gravel, 0.2-10 cm)
	___ Sand (0.1-2 mm) ___ Bare soil
	___ Other:_____

VEGETATION DESCRIPTION

Leaf phenology (of dominant stratum)	Leaf Type (of dominant stratum)	Physiognomic class	Cover Scale for Strata & Unvegetated Surface		Height Scale for Strata	
Trees and Shrubs		___Forest				
___Evergreen	___Broad-leaved	___Woodland	01	5%	01	<0.5 m
___Cold-deciduous	___Needle-leaved	___Shrubland	02	10%	02	0.5-1m
___Drought-deciduous	___Mixed broad-leaved/Needle leaved	___Dwarf Shrubland	03	20%	03	1-2 m
___Mixed evergreen - cold-deciduous	___Microphyllous	___Herbaceous	04	30%	04	2-5 m
___Mixed evergreen - drought-deciduous	___Graminoid	___Nonvascular	05	40%	05	5-10 m
	___Forb	___Sparsely Vegetated	06	50%	06	10-15 m
Herbs	___Pteridophyte		07	60%	07	15-20 m
___Annual			08	70%	08	20-35 m
___Perennial			09	80%	09	35 - 50 m
			10	90%	10	>50 m
			11	100%		

Figure A-2. NPS Observation Point Form.

Strata	Height	Cover Class	Dominant species (mark any known diagnostic species with a *)	Cover Class
T1 Emergent	____	____		
T2 Canopy	____	____		
T3 Sub-canopy	____	____		
S1 Tall shrub	____	____		
S2 Short Shrub	____	____		
S3 Dwarf-shrub H Herbaceous	____	____		
N Non-vascular	____	____		
V Vine/liana	____	____		
E Epiphyte	____	____		

please see the table on the previous page for height and cover scales for strata

Other Comments

Cover Scale for Species

01 <1%
02 1-5%
03 5-25%
04 25-50%
05 50-75%
06 75-100%

Figure A-2 (continued). NPS Observation Point Form.

GEOGRAPHY/ENVIRONMENT FORM v 2 **BIBE or RIGR _AA_____**

DATE:_____ ECOLOGIST:_____ ASSISTANT:_____

GPS MODEL: Garmin Oregon 650t **GPS ERROR (m):** _____ **GPS SATELLITES:** _____

UTM EASTING: _____ **UTM NORTHING:** _____

PLOT SHAPE (CIRCLE ONE): **CIRCLE:** 30 m RADIUS _____m RADIUS

RECTANGLE: 40m × 62m, 25m × 100m, 20m × 125m, 15m × 167m, 10m × 250m, 5m × 500m, ____m × ____m

GROUND SUBSTRATE COVER (%):

SOIL/SEDIMENT: _____%

TALUS/SCREE: _____%

BEDROCK _____%

OTHER: _____% DESCRIBE: _____

IF A WASH, CIRCLE PLOT LOCATION: CHANNEL/BED BANK/FLOODPLAIN/TERRACE

PHOTOS:

FILE NUMBER	**PHOTO DIRECTION**	**COMMENTS (if needed)**

PLOT SETUP AND SETTING COMMENTS (if needed): _____

_____

_____

_____

_____

_____

_____

_____

_____

Figure A-3. RIGR Accuracy Assessment Form.

VEGETATION FORM ver 2 **RIGR or RIGR _AA**_____

DATE:_____ **ECOLOGIST:**_____ **ASSISTANT:**_____

BEST ASSOCIATION CHOICE: _____ **%**_____

2ND POSSIBILITY: _____ **%**_____

3RD POSSIBILITY: _____ **%**_____

PLOT COMMENTS (if needed): _____

_____

_____

DOMINANT OR CHARACTERISTIC VEGETATION BY STRATUM:			
T1 (20-35m) T. STRATUM COVER: _____ **%**		**VINE TOTAL STRATUM COVER:** _____ **%**	
1.	%	1.	%
T2 (10-20m)		**TOTAL STRATUM COVER (ALL SPECIES):** _____ **%**	
1.	%	3.	%
2.	%	4.	%
T3 (5-10m)		**TOTAL STRATUM COVER (ALL SPECIES):** _____ **%**	
1.	%	3.	%
2.	%	4.	%
S1 (2-5m)		**TOTAL STRATUM COVER (ALL SPECIES):** _____ **%**	
1.	%	3.	%
2.	%	4.	%
5.	%	6.	%
S2 (0.5-2m)		**TOTAL STRATUM COVER (ALL SPECIES):** _____ **%**	
1.	%	3.	%
2.	%	4.	%
5.	%	6.	%
S3 (< 0.5m)		**TOTAL STRATUM COVER (ALL SPECIES):** _____ **%**	
1.	%	3.	%
2.	%	4.	%
5.	%	6.	%
HERB (all non-vine herbaceous plants)		**TOTAL STRATUM COVER (ALL SPECIES):** _____ **%**	
1.	%	3.	%
2.	%	4.	%
5.	%	6.	%

Figure A-3 (continued). RIGR Accuracy Assessment Form.

Appendix B. RIGR List of Plant Species

Plant Species Found During the RIGR Field Sampling

This appendix contains a list of the vascular plant taxa observed at RIGR during the vegetation classification plot, observation point, and accuracy assessment sampling (Table B-1). Genera, species, and infraspecific taxa are sorted alphabetically within families. The families are sorted alphabetically within the following order of Class/Division: Pteridophytes, Gymnosperms, Dicots, and Monocots. See end of table for reference code legend and nomenclature footnotes.

Table B-1. RIGR Plant Species

Family	Scientific (Latin) Name and Author	Common name	Ref.
Pteridaceae	*Astrolepis cochisensis (Goodding) Benham & Windham*	Cochise scaly cloakfern	Tndd
	Astrolepis integerrima (Hook.) Benham & Windham	hybrid cloakfern	Tndd
	Astrolepis sinuata (Lag. ex Sw.) Benham & Windham	wavy scaly cloakfern	Tndd
	Astrolepis windhamii Benham	Windham's scaly cloakfern	Tndd
	Cheilanthes horridula Maxon	rough lipfern	Tndd
	Notholaena standleyi Maxon	star cloak fern	Tndd
Selaginellaceae	*Selaginella lepidophylla (Hook. & Grev.) Spring*	resurrection plant	Tndd
	Selaginella wrightii Hieron.	Wright's spikemoss	Tndd
Cupressaceae	*Taxodium mucronatum Ten.*	Montezuma bald cypress	Tndd
Ephedraceae	*Ephedra antisyphilitica Berl. ex C.A. Mey.*	clapweed	PW
	Ephedra aspera Engelm. ex S. Watson	rough jointfir	Tndd
Acanthaceae	*Ruellia parryi A. Gray*	Parry's wild petunia	PW
Aizoaceae	*Sesuvium verrucosum Raf.*	verrucose seapurslane	PW
Amaranthaceae	*Amaranthus L. sp.*	pigweed	PW
	Tidestromia lanuginosa (Nutt.) Standl.	woolly tidestromia	PW
Anacardiaceae	*Pistacia mexicana Kunth*	Mexican pistachio	PW
	Rhus microphylla Engelm. ex A. Gray	littleleaf sumac	PW
	Rhus virens Lindh. ex A. Gray	evergreen sumac	PW
	Toxicodendron radicans (L.) Kuntze	eastern poison-ivy	PW

Table B-1 (continued). RIGR Plant Species

Family	Scientific (Latin) Name and Author	Common name	Ref.
Apocynaceae	*Cynanchum L. sp.*	swallow-wort	PW
	Funastrum cynanchoides (Decne.) Schltr.	fringed twinevine	PW
	Matelea parvifolia (Torr.) Woodson	spearleaf	PW
Asteraceae	*Acourtia runcinata (Lag. ex D. Don) B.L. Turner*	featherleaf desertpeony	PW
	Ambrosia artemisiifolia L.	annual ragweed	PW
	Ambrosia psilostachya DC.	Cuman ragweed	PW
	Aphanostephus riddellii Torr. & A. Gray	Riddell's dozedaisy	PW
	Baccharis havardii A. Gray	Havard's false willow	PW
	Baccharis neglecta Britton	Rooseveltweed	PW
	Baccharis salicifolia (Ruiz & Pav.) Pers.	seepwillow	PW
	Baccharis wrightii A. Gray	Wright's baccharis	PW
	Bahia absinthifolia Benth.	hairyseed bahia	Tndd
	Bahia pedata A. Gray	bluntscale bahia	Tndd
	Baileya multiradiata Harv. & A. Gray ex A. Gray	desert marigold	PW
	Brickellia laciniata A. Gray	splitleaf brickellbush	PW
	Calyptocarpus vialis Less.	straggler daisy	PW
	Chloracantha spinosa (Benth.) G.L. Nesom	devilweed	PW
	Chrysactinia mexicana A. Gray	damianita	PW
	Chrysothamnus baileyi Woot. & Standl.	Bailey's rabbitbrush	Tndd
	Cirsium texanum Buckley	Texas thistle	PW
	Eclipta prostrata (L.) L.	false daisy	PW
	Erigeron L. sp.	fleabane	PW
	Gaillardia Foug. sp.	blanketflower	PW
	Grindelia arizonica A. Gray	Arizona gumweed	PW
	Gutierrezia sarothrae (Pursh) Britton & Rusby	broom snakeweed	PW
	Helenium amarum (Raf.) H. Rock	yellowdicks	PW
	Helenium elegans DC.	pretty sneezeweed	PW
	Helenium microcephalum DC. var. microcephalum	smallhead sneezeweed	PW
	Helianthus annuus L.	common sunflower	PW

Table B-1 (continued). RIGR Plant Species

Family	Scientific (Latin) Name and Author	Common name	Ref.
Asteraceae (continued)	*Hymenoclea monogyra Torr. & A. Gray*	singlewhorl burrobrush	Tndd
	Jefea brevifolia (A. Gray) Strother	shortleaf jefea	PW
	Lactuca L. sp.	lettuce	PW
	Machaeranthera tanacetifolia (Kunth) Nees	tanseyleaf tansyaster	PW
	Melampodium leucanthum Torr. & A. Gray	plains blackfoot	PW
	Palafoxia Lag. sp.	palafox	PW
	Parthenium confertum A. Gray	Gray's feverfew	PW
	Parthenium incanum Kunth	mariola	PW
	Pectis angustifolia Torr.	lemonscent	PW
	Perityle vaseyi J.M. Coult.	Vasey's rockdaisy	PW
	Pinaropappus roseus (Less.) Less. var. roseus	white rocklettuce	1
	Porophyllum scoparium A. Gray	Trans-Pecos poreleaf	PW
	Psathyrotopsis scaposa (A. Gray) H. Rob.	naked turtleback	PW
	Psilostrophe tagetina (Nutt.) Greene	woolly paperflower	PW
	Sonchus asper (L.) Hill	spiny sowthistle	PW
	Sonchus oleraceus L.	common sowthistle	PW
	Symphyotrichum expansum (Poepp. ex Spreng.) G.L. Nesom	southwestern annual saltmarsh aster	PW
	Thelesperma megapotamicum (Spreng.) Kuntze	Hopi tea greenthread	Sta
	Thelesperma simplicifolium A. Gray	slender greenthread	PW
	Thymophylla acerosa (DC.) Strother	pricklyleaf dogweed	PW
	Thymophylla aurea (A. Gray) Greene ex Britton var. aurea	manyawn pricklyleaf	PW
	Thymophylla micropoides (DC.) Strother	woolly pricklyleaf	PW
	Thymophylla pentachaeta (DC.) Small var. belenidium (DC.) Strother	fiveneedle pricklyleaf	Stb
	Thymophylla pentachaeta (DC.) Small var. pentachaeta	fiveneedle pricklyleaf	Stb
	Thymophylla pentachaeta (DC.) Small var. puberula (Rydb.) Strother	fiveneedle pricklyleaf	Stb
	Trixis californica Kellogg	American threefold	PW

Table B-1 (continued). RIGR Plant Species

Family	Scientific (Latin) Name and Author	Common name	Ref.
Asteraceae (continued)	*Verbesina encelioides (Cav.) Benth. & Hook. f. ex A. Gray*	golden crownbeard	PW
	Viguiera stenoloba S.F. Blake	skeletonleaf goldeneye	Tndd
	Xanthisma texanum DC.	Texas sleepydaisy	Tndd
	Xanthium strumarium L.	rough cocklebur	PW
	Wedelia acapulcensis Kunth var. hispida (Kunth) Strother	hairy wedelia	Stc
Berberidaceae	*Mahonia trifoliolata (Moric.) Fedde*	algerita	2
Bignoniaceae	*Chilopsis linearis (Cav.) Sweet*	desert willow	PW
Boraginaceae	*Heliotropium confertifolium (Torr.) Torr. ex A. Gray*	leafy heliotrope	Tndd
	Heliotropium curassavicum L. var. curassavicum	salt heliotrope	Tndd
	Heliotropium torreyi I.M. Johnst.	slimleaf heliotrope	Tndd
	Nama havardii A. Gray	Havard's fiddleleaf	PW
	Nama hispidum A. Gray	bristly nama	PW
	Phacelia congesta Hook.	caterpillar phacelia	PW
	Tiquilia canescens (DC.) A.T. Richardson var. canescens	woody crinklemat	PW
	Tiquilia gossypina (Woot. & Standl.) A.T. Richardson	Texas crinklemat	PW
	Tiquilia greggii (Torr. & A. Gray) A.T. Richardson	plumed crinklemat	PW
	Tiquilia hispidissima (Torr. & A. Gray) A.T. Richardson	hairy crinklemat	PW
	Tiquilia mexicana (S. Watson) A.T. Richardson	Mexican crinklemat	PW
Brassicaceae	*Descurainia pinnata (Walter) Britton*	western tansymustard	PW
	Draba cuneifolia Nutt. ex Torr. & A. Gray	wedgeleaf draba	Tndd
	Eruca vesicaria (L.) Cav. ssp. sativa (Mill.) Thell.	rocketsalad	PW
	Nerisyrenia camporum (A. Gray) Greene	bicolor fanmustard	PW
	Sisymbrium irio L.	London rocket	PW
	Streptanthus platycarpus A. Gray	broadpod jewelflower	PW
Cactaceae	*Ariocarpus fissuratus (Engelm.) K. Schum.*	chautle livingrock	PW
	Coryphantha echinus (Engelm.) Britton & Rose	rhinoceros cactus	PW

Table B-1 (continued). RIGR Plant Species

Family	Scientific (Latin) Name and Author	Common name	Ref.
Cactaceae (continued)	*Cylindropuntia kleiniae (DC.) F.M. Knuth*	candle cholla	PW
	Cylindropuntia leptocaulis (DC.) F.M. Knuth	Christmas cactus	PW
	Echinocactus horizonthalonius Lem.	eagle-claw cactus	PW
	Echinocereus dasyacanthus Engelm.	spiny hedgehog cactus	PW
	Echinocereus enneacanthus Engelm. var. enneacanthus	pitaya cactus	PW
	Echinocereus enneacanthus Engelm. var. brevispinus (W.O. Moore) L.D. Benson	pitaya cactus	PW
	Echinocereus stramineus (Engelm.) F. Seitz	strawberry hedgehog cactus	PW
	Escobaria tuberculosa (Engelm.) Britton & Rose var. tuberculosa	whitecolumn foxtail cactus	PW
	Ferocactus hamatacanthus (Muehlenpf.) Britton & Rose	turk's head	PW
	Grusonia aggeria (B.E. Ralston & Hilsenb.) E.F. Anderson	Big Bend dog cholla	Pi
	Grusonia densispina (Ralston & Hilsenbeck) Pinkava[A]	dense-spined dog cholla	Prb
	Grusonia schottii (Engelm.) H. Rob.	Schott's dog cholla	Pi
	Mammillaria heyderi Muehlenpf.	little nipple cactus	PW
	Mammillaria lasiacantha Engelm.	lacespine nipple cactus	PW
	Opuntia aureispina (Brack & K.D. Heil) Pinkava & Parfitt	Rio Grande pricklypear	Tndd
	Opuntia azurea Rose var. parva A.M. Powell & Weedin[B]	Big Bend purplish pricklypear	PW
	Opuntia camanchica Engelm. & J.M. Bigelow	tulip pricklypear	PW
	Opuntia engelmannii Salm-Dyck ex Engelm. var. engelmannii	Engelmann’s pricklypear	PW
	Opuntia engelmannii Salm-Dyck ex Engelm. var. lindheimeri (Engelm.) Parfitt & Pinkava	Texas pricklypear	PW
	Opuntia macrocentra Engelm.	purple pricklypear	PW
	Opuntia rufida Engelm.	blind pricklypear	PW
	Opuntia ×spinosibacca Anthony (pro sp.)	spiny-fruit pricklypear	PW

Table B-1 (continued). RIGR Plant Species

Family	Scientific (Latin) Name and Author	Common name	Ref.
Cannabaceae	*Celtis ehrenbergiana (Klotzsch) Liebm.*	spiny hackberry	3
	Celtis laevigata Willd. var. reticulata (Torr.) L.D. Benson	netleaf hackberry	Po
Celastraceae	*Schaefferia cuneifolia A. Gray*	desert yaupon	PW
Chenopodiaceae	*Atriplex canescens (Pursh) Nutt.*	fourwing saltbush	PW
	Chenopodium album L.	lambsquarters	PW
	Salsola tragus L.	Russian thistle	PW
	Suaeda suffrutescens S. Watson	desert seepweed	Tndd
Convolvulaceae	*Convolvulus arvensis L.*	field bindweed	PW
	Convolvulus equitans Benth.	Texas bindweed	PW
	Ipomoea cordatotriloba Dennst. var. torreyana (A. Gray) D. Austin	Torrey's tievine	PW
Cucurbitaceae	*Ibervillea lindheimeri (A. Gray) Greene*	Lindheimer's globeberry	PW
	Ibervillea tenuisecta (A. Gray) Small	slimlobe globeberry	PW
Ebenaceae	*Diospyros texana Scheele*	Texas persimmon	PW
Euphorbiaceae	*Argythamnia humilis (Engelm. & A. Gray) Müll. Arg.*	low silverbush	PW
	Argythamnia serrata (Torr.) Müll. Arg.	Yuma silverbush	PW
	Bernardia myricifolia (Scheele) S. Watson	mouse's eye	PW
	Bernardia obovata I.M. Johnst.	desert myrtlecroton	PW
	Chamaesyce serpens (Kunth) Small	matted sandmat	Tndd
	Croton bigbendensis B.L. Turner[C]	Big Bend croton	PW
	Croton dioicus Cav.	grassland croton	PW
	Croton fruticulosus Engelm. ex Torr.	bush croton	PW
	Croton incanus Kunth	Torrey's croton	PW
	Croton monanthogynus Michx.	prairie tea	PW
	Croton pottsii (Klotzsch) Müll. Arg. var. pottsii	leatherweed	vEB
	Euphorbia antisyphilitica Zucc.	candelilla	PW
	Jatropha dioica Cerv.	leatherstem	PW
Fabaceae	*Astragalus mollissimus Torr.*	woolly locoweed	PW
	Calliandra Benth. sp.	stickpea	PW

Table B-1 (continued). RIGR Plant Species

Family	Scientific (Latin) Name and Author	Common name	Ref.
Fabaceae (continued)	*Dalea formosa Torr.*	featherplume	PW
	Dalea jamesii (Torr.) Torr. & A. Gray	James' prairie clover	PW
	Dalea neomexicana (A. Gray) Cory	downy prairie clover	PW
	Dalea pogonathera A. Gray	bearded prairie clover	PW
	Dalea wrightii A. Gray	Wright's prairie clover	PW
	Eysenhardtia texana Scheele	Texas kidneywood	PW
	Gleditsia triacanthos L.	honeylocust	Tndd
	Indigofera lindheimeriana Scheele	Lindheimer's indigo	PW
	Leucaena retusa Benth.	littleleaf leadtree	PW
	Lupinus havardii S. Watson	Big Bend bluebonnet	PW
	Mimosa aculeaticarpa Ortega var. biuncifera (Benth.) Barneby	catclaw mimosa	PW
	Mimosa borealis A. Gray	fragrant mimosa	PW
	Parkinsonia aculeata L.	retama	PW
	Prosopis glandulosa Torr. var. torreyana (L.D. Benson) M.C. Johnst.	western honey mesquite	PW
	Prosopis pubescens Benth.	screwbean mesquite	PW
	Senegalia berlandieri Britton & Rose	guajillo	PW
	Senegalia greggii (A. Gray) Britton & Rose	Gregg’s catclaw	PW
	Senegalia roemeriana (Scheele) Britton & Rose	Roemer’s acacia	PW
	Senna bauhinioides (A. Gray) Irwin & Barneby	twinleaf senna	PW
	Senna durangensis (Rose) Irwin & Barneby	Durango senna	PW
	Senna lindheimeriana (Scheele) Irwin & Barneby	velvet leaf senna	PW
	Vachellia constricta (Benth.) Seigler & Ebinger	whitethorn acacia	PW
	Vachellia farnesiana (L.) Wight & Arn.	huisache	PW
	Vachellia rigidula (Benth.) Seigler & Ebinger	blackbrush acacia	PW
	Vachellia vernicosa (Britton & Rose) Seigler & Ebinger	viscid acacia	PW
Fouquieriaceae	*Fouquieria splendens Engelm.*	ocotillo	PW
Gentianaceae	*Centaurium calycosum (Buckley) Fernald*	Arizona centaury	Tndd
	Eustoma exaltatum (L.) Salisb. ex G. Don	catchfly prairie gentian	PW
Juglandaceae	*Juglans microcarpa Berl.*	little walnut	PW

Table B-1 (continued). RIGR Plant Species

Family	Scientific (Latin) Name and Author	Common name	Ref.
Krameriaceae	*Krameria L. sp.*	ratany	PW
Lamiaceae	*Hedeoma drummondii Benth.*	Drummond's false pennyroyal	PW
Linaceae	*Linum L. sp.*	flax	PW
Loasaceae	*Cevallia sinuata Lag.*	stinging serpent	PW
	Eucnide bartonioides Zucc.	yellow stingbush	PW
	Mentzelia multiflora (Nutt.) A. Gray	Adonis blazingstar	Tndd
Lythraceae	*Lythrum californicum Torr. & A. Gray*	California loosestrife	PW
Malvaceae	*Hibiscus coulteri Harv. ex A. Gray*	desert rosemallow	PW
	Hibiscus denudatus Benth.	paleface	PW
	Sida abutifolia Mill.	spreading fanpetals	Tndd
	Sida neomexicana A. Gray	New Mexico fanpetals	PW
	Sphaeralcea angustifolia (Cav.) G. Don	copper globemallow	PW
Menispermaceae	*Cocculus carolinus (L.) DC.*	Carolina coralbead	PW
Nyctaginaceae	*Acleisanthes longiflora A. Gray*	angel's trumpets	PW
	Allionia incarnata L.	trailing windmills	PW
	Anulocaulis eriosolenus (A. Gray) Standl.	Big Bend ringstem	PW
	Boerhavia coccinea Mill.	scarlet spiderling	PW
	Boerhavia diffusa L.	red spiderling	Tndd
	Selinocarpus angustifolius Torr.	narrowleaf moonpod	Tndd
Oleaceae	*Forestiera angustifolia Torr.*	desert olive	PW
	Forestiera pubescens Nutt.	stretchberry	PW
	Fraxinus berlandieriana DC.	Mexican ash	PW
	Fraxinus greggii A. Gray	littleleaf ash	PW
	Fraxinus velutina Torr.	velvet ash	PW
	Menodora longiflora A. Gray	showy menodora	PW
	Menodora scabra A. Gray	rough menodora	PW
Onagraceae	*Ludwigia L. sp.*	primrose-willow	PW
	Oenothera curtiflora W.L. Wagner & Hoch	velvetweed	PW
	Oenothera primiveris A. Gray	desert evening primrose	PW
	Oenothera rosea L'Hér. ex Aiton	rose evening primrose	PW

Table B-1 (continued). RIGR Plant Species

Family	Scientific (Latin) Name and Author	Common name	Ref.
Orobanchaceae	*Orobanche L. sp.*	broomrape	PW
Papaveraceae	*Argemone albiflora Hornem. ssp. texana G.B. Ownbey*	bluestem pricklypoppy	Tndd
	Argemone sanguinea Greene	red pricklypoppy	PW
Passifloraceae	*Passiflora tenuiloba Engelm.*	birdwing passionflower	PW
Plantaginaceae	*Bacopa monnieri (L.) Pennell*	herb of grace	PW
	Maurandella antirrhiniflora (Humb. & Bonpl. ex Willd.) Rothm.	climbing snapdragon	PW
	Penstemon baccharifolius Hook.	baccharisleaf beardtongue	PW
	Plantago L. sp.	plantain	PW
Polygalaceae	*Polygala macradenia A. Gray*	glandleaf milkwort	PW
Polygonaceae	*Polygonum lapathifolium L.*	curlytop knotweed	Tndd
	Polygonum persicaria L.	spotted ladysthumb	Dlo
	Rumex crispus L.	curly dock	PW
	Rumex maritimus L.	golden dock	PW
	Rumex salicifolius Weinm. var. mexicanus (Meisn.) C.L. Hitchc.	Mexican dock	4
Portulacaceae	*Portulaca pilosa L.*	kiss me quick	PW
Ranunculaceae	*Clematis drummondii Torr. & A. Gray*	Drummond's clematis	PW
	Clematis pitcheri Torr. & A. Gray	bluebill	PW
Resedaceae	*Oligomeris linifolia (Vahl) J.F. Macbr.*	lineleaf whitepuff	PW
Rhamnaceae	*Colubrina texensis (Torr. & A. Gray) A. Gray*	Texan hogplum	PW
	Condalia ericoides (A. Gray) M.C. Johnst.	javelina bush	PW
	Condalia viridis I.M. Johnst.	green snakewood	PW
	Karwinskia humboldtiana (Schult.) Zucc.	coyotillo	PW
	Ziziphus obtusifolia (Hook. ex Torr. & A. Gray) A. Gray var. obtusifolia	lotebush	PW
Rubiaceae	*Cephalanthus occidentalis L.*	common buttonbush	PW
	Stenaria nigricans (Lam.) Terrell	diamond-flowers	PW
Rutaceae	*Thamnosma texana (A. Gray) Torr.*	rue of the mountains	PW

Table B-1 (continued). RIGR Plant Species

Family	Scientific (Latin) Name and Author	Common name	Ref.
Salicaceae	*Populus fremontii S. Watson ssp. mesetae Eckenwalder*	Arizona cottonwood	E
	Salix gooddingii C.R. Ball	Goodding willow	PW
	Salix thurberi Rowlee[D]	Thurber's willow	PW
Sapindaceae	*Sapindus saponaria L. var. drummondii (Hook. & Arn.) L.D. Benson*	western soapberry	Tndd
	Ungnadia speciosa Endl.	Mexican buckeye	PW
Sapotaceae	*Sideroxylon lanuginosum Michx.*	gum bully	PW
Scrophulariaceae	*Leucophyllum candidum I.M. Johnst.*	Boquillas silverleaf	PW
	Leucophyllum frutescens (Berl.) I.M. Johnst.	cenizo	PW
Simaroubaceae	*Castela erecta Turp. ssp. texana (Torr. & A. Gray) Cronquist*	Texan goatbush	PW
Solanaceae	*Chamaesaracha (A. Gray) Benth. sp.*	five eyes	PW
	Datura wrightii Regel	sacred thorn-apple	PW
	Lycium berlandieri Dunal	Berlandier's wolfberry	PW
	Nicotiana glauca Graham	tree tobacco	PW
	Nicotiana obtusifolia M. Martens & Galeotti	desert tobacco	PW
	Nicotiana repanda Willd. ex Lehm.	fiddleleaf tobacco	PW
	Physalis L. sp.	groundcherry	PW
	Quincula lobata (Torr.) Raf.	Chinese lantern	PW
	Solanum elaeagnifolium Cav.	silverleaf nightshade	PW
	Solanum ptycanthum Dunal	West Indian nightshade	PW
Sterculiaceae	*Melochia pyramidata L.*	pyramidflower	PW
Tamaricaceae	*Tamarix aphylla (L.) Karst.*	athel tamarisk	PW
	Tamarix ramosissima Ledeb.	saltcedar	Tndd
Theophrastaceae	*Samolus ebracteatus Kunth ssp. cuneatus (Small) R. Knuth*	limewater brookweed	Dlo
Urticaceae	*Parietaria pensylvanica Muhl. ex Willd.*	Pennsylvania pellitory	PW
Verbenaceae	*Aloysia gratissima (Gillies & Hook.) Troncoso*	whitebrush	PW
	Aloysia wrightii (A. Gray) A. Heller	Wright's beebrush	PW
	Glandularia J.F. Gmel.	mock vervain	PW

Table B-1 (continued). RIGR Plant Species

Family	Scientific (Latin) Name and Author	Common name	Ref.
Verbenaceae (continued)	*Glandularia pumila (Rydb.) Umber*	pink mock vervain	PW
	Lantana achyranthifolia Desf.	brushland shrubverbena	PW
	Lippia graveolens Kunth	Mexican oregano	PW
	Phyla nodiflora (L.) Greene	turkey tangle fogfruit	PW
	Verbena neomexicana (A. Gray) Small var. hirtella L.M. Perry	hillside vervain	5
	Verbena plicata Greene	fanleaf vervain	PW
Viscaceae	*Phoradendron tomentosum (DC.) Engelm. ex A. Gray*	Christmas mistletoe	Tndd
Vitaceae	*Cissus trifoliata (L.) L.*	sorrelvine	PW
	Vitis arizonica Engelm.	canyon grape	Tndd
	Vitis monticola Buckley	sweet mountain grape	PW
Zygophyllaceae	*Guaiacum angustifolium Engelm.*	Texas lignum-vitae	PW
	Larrea tridentata (DC.) Coville	creosotebush	PW
	Tribulus terrestris L.	puncturevine	PW
Alismataceae	*Sagittaria L. sp.*	arrowhead	PW
Amaryllidaceae	*Allium kunthii G. Don*	Kunth's onion	PW
Asparagaceae	*Agave lechuguilla Torr.*	lechuguilla	PW
	Dasylirion leiophyllum Engelm. ex Trel.	green sotol	PW
	Dasylirion texanum Scheele	Texas sotol	PW
	Yucca elata (Engelm.) Engelm.	soaptree yucca	Tndd
	Yucca thompsoniana Trel.	Thompson's yucca	PW
	Yucca torreyi Shafer	Torrey's yucca	PW
Bromeliaceae	*Hechtia texensis S. Watson*	Texas false agave	PW
Cyperaceae	*Cyperus laevigatus L.*	smooth flatsedge	PW
	Cyperus odoratus L.	fragrant flatsedge	PW
	Eleocharis R. Br. Sp.	spikerush	PW
	Fuirena simplex Vahl var. simplex	western umbrella-sedge	PW
	Schoenoplectus pungens (Vahl) Palla var. longispicatus (Britton) S.G. Sm.	threesquare bulrush	PW
Juncaceae	*Juncus torreyi Coville*	Torrey's rush	PW

Table B-1 (continued). RIGR Plant Species

Family	Scientific (Latin) Name and Author	Common name	Ref.
Poaceae	*Aristida purpurea Nutt.*	purple threeawn	PW
	Arundo donax L.	giant reed	PW
	Bothriochloa alta (Hitchc.) Henr.	tall beardgrass	PW
	Bothriochloa ischaemum (L.) Keng	yellow bluestem	PW
	Bothriochloa laguroides (DC.) Herter	silver beardgrass	PW
	Bouteloua barbata Lag.	sixweeks grama	PW
	Bouteloua curtipendula (Michx.) Torr.	sideoats grama	PW
	Bouteloua ramosa Scribn. ex Vasey	Chino grama	PW
	Bouteloua trifida Thurb.	red grama	PW
	Cathestecum erectum Vasey & Hack.	false grama	Tndd
	Cenchrus spinifex Cav.	coastal sandbur	PW
	Chloris cucullata Bisch.	hooded windmill grass	PW
	Cynodon dactylon (L.) Pers.	Bermuda grass	PW
	Dasyochloa pulchella (Kunth) Willd. ex Rydb.	low woollygrass	PW
	Digitaria californica (Benth.) Henr.	Arizona cottontop	PW
	Digitaria cognata (Schult.) Pilg.	fall witchgrass	Tndd
	Enneapogon desvauxii Desv. ex P. Beauv.	nineawn pappusgrass	PW
	Eragrostis intermedia Hitchc.	plains lovegrass	PW
	Eragrostis lehmanniana Nees	Lehmann lovegrass	PW
	Erioneuron pilosum (Buckley) Nash	hairy woollygrass	PW
	Heteropogon contortus (L.) P. Beauv. ex Roem. & Schult.	tanglehead	PW
	Leptochloa fusca (L.) Kunth ssp. uninervia (J. Presl) N. Snow	Mexican sprangletop	Sn
	Panicum antidotale Retz.	blue panicum	PW
	Panicum hallii Vasey	Hall's panicgrass	PW
	Panicum virgatum L.	switchgrass	PW
	Paspalum distichum L.	knotgrass	PW
	Pennisetum ciliare (L.) Link	buffelgrass	PW
	Phragmites australis (Cav.) Trin. ex Steud.	common reed	PW

Table B-1 (continued). RIGR Plant Species

Family	Scientific (Latin) Name and Author	Common name	Ref.
Poaceae (continued)	*Poa L. sp.*	bluegrass	PW
	Polypogon monspeliensis (L.) Desf.	annual rabbitsfoot grass	PW
	Setaria leucopila (Scribn. & Merr.) K. Schum.	streambed bristlegrass	PW
	Setaria reverchonii (Vasey) Pilg. ssp. ramiseta (Scribn.) W.E. Fox	Rio Grande bristlegrass	R
	Sorghum halepense (L.) Pers.	Johnsongrass	PW
	Sporobolus airoides (Torr.) Torr.	alkali sacaton	PW
	Sporobolus cryptandrus (Torr.) A. Gray	sand dropseed	PW
	Sporobolus flexuosus (Thurb. ex Vasey) Rydb.	mesa dropseed	PW
	Sporobolus pyramidatus (Lam.) Hitchc.	whorled dropseed	PW
	Tridens muticus (Torr.) Nash	slim tridens	PW
Typhaceae	*Typha domingensis Pers.*	southern cattail	PW
	Typha latifolia L.	broadleaf cattail	PW

In the "Ref." (reference) column, the following codes denote literature sources are used as the stable source of the taxonomic concept that is associated with the Scientific (Latin) name that is used by USDA-NRCS (2018). While use of USDA-NRCS (2018) generally is required for many federal projects, the content lacks stability as a concept source, since the taxonomic concepts behind unique names are sometimes revised without notification to users.

A = Ackerfield (2015).
AI = Allred and Ivey (2012).
Dlo = Diggs et al. (1999).
E = Eckenwalder (1996).
Is = Isely(1998).
K = Kiger (2003).
Pi = Pinkava (2003).
Prb = Pinkava et al. (2001).
Po = Powell (1998).
PW = Powell and Worthington (2018)
Sc = Schilling (2006).
Sm = Smith (1993).
Sn = Snow (2003).
St1 = Strother (2006a).
St2 = Strother (2006b).
Tndd = Turner et al. (2003).

Veb = van Ee and Berry (2016).

In the "Ref." column, the following numeric designation is used to denote a synonym or equivalent concept for USDA-NRCS (2018) Latin names that could not be located in a published source.

1 = *Cupressus arizonica* Greene of Powell (1998).
2 = *Conoclinium dissectum* A. Gray of Powell and Worthington (2018).
3 = *Xanthisma spinulosum* (Pursh) D.R. Morgan & R.L. Hartm. var. *chihuahuanum* (B.L. Turner & R.L. Hartm.) D.R. Morgan & R.L. Hartm. of Powell and Worthington (2018).
4 = *Berberis trifoliolata* Moric. of Powell and Worthington (2018).
5 = *Coelophragmus auriculatus* (A. Gray) O.E. Schulz of Turner et al. (2003).
6 = *Echinocereus viridiflorus* Engelm. var. *russanthus* (Weniger) A.D. Zimmerman of Powell and Worthington (2018).
7 = *Escobaria sneedii* Britton & Rose var. *albocolumnaria* (Hester) A.M. Powell of Powell and Worthington (2018).
8 = *Escobaria dasyacantha* Britton & Rose of Powell and Worthington (2018).
9 = *Escobaria chaffeyi* Britton & Rose of Powell and Worthington (2018).
10 = *Celtis pallida* Torr. of Powell and Worthington (2018).
11 = *Ditaxis humilis* (Engelm. & A. Gray) Pax var. *humilis* of Diggs et al. (1999).
12 = *Chamaesyce chaetocalyx* (Boiss.) Wooton & Standl. of Turner et al. (2003).
13 = *Commicarpus scandens* (L.) Standl. of Powell and Worthington (2018).
14 = *Nicotiana obtusifolia* M. Martens & Galeotti of Powell and Worthington (2018).
15 = *Verbena hirtella* (L.M. Perry) G.L. Nesom of Powell and Worthington (2018).

In the "Scientific (Latin) Name and Author" column, the following alphabetic designations are used to denote USDA-NRCS (2018) names that include or probably include a named taxonomic concept on this list that is not recognized by USDA-NRCS (2018). These are often recently described taxa not yet recognized by USDA-NRCS (2018).

A: *Grusonia densispina* (Ralston & Hilsenbeck) Pinkava (of this report) is part of *Grusonia schottii* (Engelm.) H. Rob. (of USDA-NRCS 2018).
B: *Opuntia azurea* Rose var. *parva* A.M. Powell & Weedin (of this report) is part of *Opuntia macrocentra* Engelm. (of USDA-NRCS 2018).
C: *Opuntia dulcis* Engelm. (of this report) is part of *Opuntia phaeacantha* Engelm. (of USDA-NRCS 2018).
D: *Croton bigbendensis* B.L. Turner (of this report) is part of *Croton dioicus* Cav. (of USDA-NRCS 2018).
E: *Salix thurberi* Rowlee (of this report) is part of *Salix exigua* Nutt. (of USDA-NRCS 2018).

Appendix C. RIGR Plant Association Field Keys

Field Key to the Vegetation Associations of RIGR

The purpose of this key is to allow an observer to identify a vegetation association (i.e. plant community) at Rio Grande Wild and Scenic River (RIGR) both accurately and efficiently and to set relatively firm (if sometimes arbitrary) boundaries on the conceptual limits of the classified associations. As a companion to this key, all associations are also fully described in the individual association descriptions (Appendix D) as they occur in both their most common forms and across possible variations.

Requirements

The user of this key should have a familiarity with most common vascular plant species at RIGR, including those that can dominate plant communities, and any potential "look-alikes". Minimally, the user should be familiar with the riparian indicator species in Table C-1 and the dominant species listed in each of the plant association names. The user should also know how to measure canopy cover for trees, shrubs, grasses, and forbs by ocular estimation with the following precision: (1) 10% error for cover levels above 20% cover, (2) 5% error for 10% to 20% cover, and (3) 1% error for up to 10% cover. Finally, the user should be able to estimate the height of vegetation with the following precision: (1) 5 meters of error for heights above 10 meters, (2) within 1 meter of error from 1 to 10 meters of height, and (3) within 0.1 meter for less than 1 meter in height.

Table C-1. List of Riparian Indicator Taxa.

Scientific Name	Common Name
Arundo donax	giant cane
Baccharis salicifolia	seepwillow
Bacopa monnieri	water hyssop
Bothriochloa ischaemum	yellow bluestem
Cephalanthus occidentalis	common buttonbush
Chilopsis linearis	desert willow
Cynodon dactylon	Bermuda grass
Fraxinus berlandieriana	Mexican ash
Fraxinus velutina	velvet ash
Heliotropium curassavicum	salt heliotrope
Hymenoclea monogyra	singlewhorl burrobrush
Nicotiana glauca	tree-tobacco
Phragmites australis	common reed
Phyla nodiflora	turkey tangle fogfruit

Table C-1 (continued). List of Riparian Indicator Taxa.

Scientific Name	Common Name
Polygonum spp.	smartweeds*
Polypogon monspeliensis	annual rabbitsfoot grass
Populus fremontii ssp. *mesetae*	Arizona cottonwood
Porophyllum scoparium	shrubby poreleaf
Prosopis pubescens	screwbean mesquite
Salix spp.	willows*
Schoenoplectus spp.	bulrushes*
Sorghum halepense	Johnson grass
Sporobolus airoides	alkali sacaton
Sporobolus wrightii	big sacaton
Tamarix aphylla	athel tamarisk
Tamarix ramosissima	tamarisk
Taxodium spp.	bald-cypresses*
Toxicodendron radicans	Eastern poison-ivy
Typha spp.	cattails*
Vachellia farnesiana	huisache
Verbesina encelioides	alkali sacaton

* Treat these genera as single taxa (equivalent to a single species)

How to Use the Key

The key starts with all possible associations identified at RIGR during this project and then walks the user through a progressive series of couplets. Each couplet (designated by a number) consists of two mutually exclusive (contrasting) and mutually comprehensive statements (designated by the letters A and B) about selected vegetation conditions. The user then selects the statement that better satisfies the condition of the vegetation and follows the directions at the end of the statement. These directions will direct the user to a new couplet or (eventually) to the name of the association that best describes all the conditions encountered. The most significant gradient affecting vegetation composition within RIGR is that representing the differences between the zone of influence of the Rio Grande River (riparian) and the zone outside that influence (uplands). Because the composition of vegetation between these two zones involves a largely different pool of species, it is convenient to divide the entire key of many couplets into a riparian vegetation key and an uplands vegetation key.

User Recommendations and Suggestions

The user starts by reading through a pair of couplets in the Master Key that directs them to either the Riparian Vegetation Key or the Uplands Vegetation Key. The criteria that are used by the master key

involve evaluating the presence and/or abundance of a pool of possibly present riparian indicator plant taxa from a list that immediately follows the couplets of the master key.

After some practice working through the master key by evaluating indicator taxa, the user will come to understand the most commonly encountered of the potential indicators species without working through the master key. Familiarity of common species and their locations will allow a user to determine quickly which subkey to use.

> **Example 1:** An observation site with *Arundo donax*, *Tamarix ramosissima*, or *Salix gooddingii* are all nearly equal in abundance (cover), the experienced user will quickly turn to the Riparian Vegetation Key, since all three species are riparian indicators.
>
> **Example 2:** An observation site with *Prosopis glandulosa* along other dominant species would require more careful estimation to determine whether *P. glandulosa* might be the most abundant species. This is because *P. glandulosa*, while often dominant in riparian settings, frequently is also abundant in many non-riparian settings. With experience, the user will understand that *P. glandulosa* is not one of the indicator taxa that necessarily prescribes use of the Riparian Vegetation Key.

When the user has arrived at a final answer (i.e. the name of an association), it is always advisable to read the description and synthesis (floristic composition) tables for that association (**Appendix D**). If the description and synthesis of that association do not match reasonably well with the vegetation being evaluated, it is possible that a keying error has occurred. Either the user may have made a mistake or there is an error in the key's logic that has been uncovered. In these cases, it is advisable to key the vegetation again, paying close attention to steps in the key were the vegetation is close to a stated threshold condition between the couplet statements. For individual couplets where these thresholds are approached, the user may wish to check both paths through the key from that point and select the best answer from these two (or more) choices.

> **Example 3**: Couplet 4 of the Riparian Vegetation Key:
>
> **4A.** *Prosopis pubescens* (screwbean mesquite) has the highest (or equal to highest) cover of any woody species..... **Cottonwood - Goodding Willow (Spring) Woodland**
>
> **4B.** A species other than *Prosopis pubescens* (screwbean mesquite) has the highest cover of any woody species..... go to **5**
>
> The user estimates the cover of *Prosopis pubescens* to be 8%, the more likely path would be through statement 5B. However, the observed value (8%) is so close to the threshold for this couplet (10%) that error cannot be ruled out. In this case, it may be advisable to follow the results of both statements (5A and 5B) and choose the result whose description and synthesis table better fits the observed stand.

Users of the key should also remember that the vegetation at RIGR is transitional and can change along ecotones and contain inclusions of other associations. The RIGR classification descriptions try

to address some of this variation, whereas the key only describes the best or most common representation of the type. It is therefore likely that multiple associations may occur in close proximity and more than one answer may be applicable. Some areas may be best keyed-out to a primary type (user's best estimate) and a secondary or tertiary plant association(s) representing inclusions or a gradation of types. Reading the descriptions of these types after keying them out may help refine the initial determination.

With practice, the user will observe that some associations can be reached from multiple paths or from both couplets in the key. This was intended to account for associations occurring in multiple locations and cases that are best reached using the explanations of both couplets instead of either/or paths (i.e. both A and B = C vs. A and not B = C). These associations may span the threshold condition stated by the couplet and can only be addressed through both pathways in the key.

Finally, it is possible that the classification or the key does not address the vegetation association under consideration. In such a case, it is possible that no path through the key is likely to produce a reasonable answer. In these cases, it is important to remember that the classified and described associations are intended to be broad and flexible. A vegetation type that deviates from a described association by just a single or very few factors does not necessarily mean it is a new or undocumented type. Careful examination of the associated species and cover value cut-offs may help identify it as a variant of a common type. New associations would most likely be either of small and limited extent and/or in remote or otherwise seldom-visited areas of RIGR.

Master Key to Vegetation Associations of Rio Grande Wild and Scenic River

1A. Discounting the cover of *Pennisetum ciliare* (buffelgrass) (if present), the individual vascular plant taxon with the highest cover is one of the riparian indicator taxa listed below. If two or more vascular plant taxa have equal or near equal cover, then at least two of those taxa with the highest cover are a riparian indicator (Generally, vegetation along Rio Grande floodplain, banks, or alluvial bars, in the channels of desert washes, or associated with springs) use..... **Riparian Vegetation Key**

1B. Discounting the cover of *Pennisetum ciliare* (buffelgrass) (if present), the individual vascular plant taxon with the highest cover is a taxon OTHER THAN one of the riparian indicator taxa listed below, or no vascular plants are evident. If two or more vascular plant taxa have equal or near equal cover, then no more than one of those taxa that have the highest cover is a riparian indicator (Generally, vegetation of uplands or channels of desert washes) use..... **Upland Vegetation Key**

Riparian Vegetation Key

1A. The combined individual cover amount for *Populus fremontii* ssp. *mesetae* (Arizona cottonwood), *Salix* spp. (willows), *Prosopis pubescens* (screwbean mesquite), and/or *Fraxinus velutina* (velvet ash) is > 15%..... go to **2**

> **2A.** The combined individual cover *of Populus fremontii* ssp. *mesetae* (Arizona cottonwood) and/or *Fraxinus velutina* (velvet ash) in the tree stratum is > 2%..... go to **3**

3A. The combined individual cover amount for *Salix* spp. (willows*), Prosopis pubescens* (screwbean mesquite), *Tamarix ramosissima* (tamarisk) and/or *Baccharis salicifolia* (seepwillow) is > 10%; naturally occurring woodlands, with unmanaged understories ..... **Cottonwood - Goodding Willow (Spring) Woodland**

3B. The combined individual cover amount for *Salix* spp. (willows), *Prosopis pubescens* (screwbean mesquite), *Tamarix ramosissima* (tamarisk) and/or *Baccharis salicifolia* (seepwillow) is < 10%; woodlands with managed (usually mowed) understories..... **Cottonwood - Ash Planted Woodland** (also known as)..... **[Mixed Ornamental and Planted Woodland]**

2B. The combined individual cover of *Populus fremontii* ssp. *mesetae* (Arizona cottonwood) and/or *Fraxinus velutina* (velvet ash) in the tree stratum is < 2%..... go to **4**

4A. *Prosopis pubescens* (screwbean mesquite) has the highest (or equal to highest) cover of any woody species..... **Cottonwood - Goodding Willow (Spring) Woodland**

4B. A species other than *Prosopis pubescens* (screwbean mesquite) has the highest cover of any woody species..... go to **5**

5A. The combined individual cover amount for all *Tamarix* spp. (tamarisk) is > than the combined individual cover amount for all Salix spp. (willows) ..... **Tamarisk - (Tree Tobacco) Riparian Shrubland**

5B. The combined individual cover amount for all *Tamarix* spp. (tamarisk) is < than the combined individual cover amount for all Salix spp. (willows) ..... go to **6**

6A. The combined individual cover amount for *Arundo donax* (giant cane), *Phragmites australis* (common reed), *Nicotiana glauca* (tree-tobacco), and/or *Vachellia farnesiana* (huisache) is > 1% ..... **Rio Grande Willow Riparian Bosque**

6B. The combined individual cover amount for *Arundo donax* (giant cane), *Phragmites australis* (common reed), *Nicotiana glauca* (tree-tobacco), and/or *Vachellia farnesiana* (huisache) is < 1% ..... **Cottonwood - Goodding Willow (Spring) Woodland**

1B. The combined individual cover amount for *Populus fremontii* ssp. *mesetae* (Arizona cottonwood), *Salix* spp. (willows), *Prosopis pubescens* (screwbean mesquite), and/or *Fraxinus velutina* (velvet ash) is < 15%..... go to **7**

7A. BOTH (1) The cover of *Fraxinus berlandieriana* (Mexican ash) is > 25% AND (2) out of the three species *Toxicodendron radicans* (eastern poison-ivy), *Vitis arizonica* (canyon grape), and/or *Maurandella antirrhiniflora* (climbing snapdragon), at least one is present; small patch vegetation of rocky terrain from Big Canyon downstream ..... **Mexican Ash - Poison-Ivy Alcove Woodland**

7B. EITHER (1) The cover of *Fraxinus berlandieriana* (Mexican ash) is < 25% OR (2) none of the three species *Toxicodendron radicans* (eastern poison-ivy), *Vitis arizonica* (canyon grape), and/or *Maurandella antirrhiniflora* (climbing snapdragon) is present, or both (1) and (2) are true; vegetation of wash channels, river bars, banks, floodplains, or alluvial terraces and generally distributed within RIGR ..... go to **8**

8A. BOTH (1) The total woody stratum cover (all species and strata pooled) is > 15% AND (2) the combined individual cover amount for *Prosopis glandulosa* (honey mesquite) and/or *Vachellia farnesiana* (huisache) is > 40% of the relative cover of the total woody strata cover ..... go to **9**

9A. The cover of *Vachellia farnesiana* (huisache) is > than the cover of *Prosopis glandulosa* (honey mesquite) ..... **Huisache Riparian Bosque**

9B. The cover of *Vachellia farnesiana* (huisache) is < than the cover of *Prosopis glandulosa* (honey mesquite) ..... **Rio Grande Mesquite Riparian Bosque**

8B. EITHER (1) The total woody stratum cover (all species and strata pooled) is < 15% OR (2) the combined individual cover amount for *Prosopis glandulosa* (honey mesquite) and/or *Vachellia farnesiana* (huisache) is < 40% of the relative cover of the total woody strata cover, or both (1) and (2) are true ..... go to **10**

10A. The woody cover (shrubs and trees combined) is > 15%..... go to **11**

11A. The combined individual cover amount for all *Tamarix* spp. (tamarisk) and/or *Nicotiana glauca* (tree-tobacco) is > 15% ..... **Tamarisk - (Tree Tobacco) Riparian Shrubland**

11B. The combined individual cover amount for all *Tamarix* spp. (tamarisk) and/or *Nicotiana glauca* (tree-tobacco) is < 15% ..... go to **12**

12A. The combined individual cover amount for *Chilopsis linearis* (desert willow), *Hymenoclea monogyra* (singlewhorl burrobrush), *Porophyllum scoparium* (shrubby poreleaf), *Brickellia laciniata* (splitleaf brickellia), and/or *Vachellia rigidula* (blackbrush) is > 3%..... go to **13**

13A. The combined individual cover amount for *Hymenoclea monogyra* (singlewhorl burrobrush) and/*or Chilopsis linearis* (desert willow) > than the combined individual cover amount for *Vachellia rigidula* (blackbrush) and/or *Brickellia laciniata* (splitleaf brickellia); generally, vegetation of either the Rio Grande banks and alluvial bars throughout or of channels of tributaries of Black Gap Wildlife Management Area and upstream..... **Big Bend Lowlands Wash Channel Shrubland**

OR (If Total Vegetation Cover is < 10%)..... **Big Bend Lowlands Sparsely Vegetated Wash Channel**

13B. The combined individual cover amount for *Hymenoclea monogyra* (singlewhorl burrobrush) and/or *Chilopsis linearis* (desert willow) < than the combined individual cover amount for *Vachellia rigidula* (blackbrush) and/or *Brickellia laciniata* (splitleaf brickellia); generally, vegetation of tributaries downstream from Black Gap Wildlife Management Area..... .....**Blackbrush - Brickellbush Wash Channel Shrubland**

12B. The combined individual cover amount for *Chilopsis linearis* (desert willow), *Hymenoclea monogyra* (singlewhorl burrobrush), *Porophyllum scoparium* (shrubby poreleaf), *Brickellia laciniata* (splitleaf brickellia), and/or *Vachellia rigidula* (blackbrush) is < 3%..... ..... **Rio Grande Seepwillow Riparian Shrubland** (also known as)..... **[Rio Grande Alluvial Herbaceous Vegetation]**

10B. The woody cover (shrubs and trees combined) is < 15%..... go to **14**

14A. The combined individual cover amount for *Sporobolus airoides* (alkali sacaton), *Sporobolus wrightii* (big sacaton), *Phragmites australis* (common reed), *Arundo donax* (giant cane), *Sorghum halepense* (Johnson grass), *Cynodon dactylon* (Bermuda grass) and/or *Salsola tragus* (Russian thistle) is > 25%..... go to **15**

15A. Either *Sporobolus airoides* (alkali sacaton) or *Sporobolus wrightii* (big sacaton) is the most abundant herbaceous species (or is tied in cover as the most abundant species)..... **Alkali Sacaton Riparian Grassland**

15B. At least one other herbaceous species has higher cover than *Sporobolus airoides* (alkali sacaton) and *Sporobolus wrightii* (big sacaton) ..... go to **16**

16A. *Cynodon dactylon* (Bermuda grass) is the most abundant herbaceous species (or no other herbaceous species is more abundant than *Cynodon dactylon*)..... go to **17**

17A. The combined individual cover amounts for *Phragmites australis* (common reed) and/or *Arundo donax* (giant cane) is < 25%..... ..... **Bermuda Grass Herbaceous Vegetation**

17B. The combined individual cover amount for *Phragmites australis* (common reed) and/or *Arundo donax* (giant cane) is > 25%..... go to **18**

18A. The cover of *Phragmites australis* (common reed) is > than the cover of *Arundo donax* (giant cane)..... .....**Common Reed Riparian Herbaceous Vegetation**

18B. The cover of *Phragmites australis* (common reed) is < than the cover of *Arundo donax* (giant cane)..... ..... **Giant Cane Riparian Herbaceous Vegetation**

16B. At least one other herbaceous species has higher cover than *Cynodon dactylon* (Bermuda grass)..... go to **19**

19A. *Phragmites australis* (common reed) is the most abundant herbaceous species (or no other herbaceous species is more abundant than *Phragmites australis*)..... **Common Reed Riparian Herbaceous Vegetation**

19B. At least one other herbaceous species has higher cover than *Phragmites australis* (common reed)..... go to **20**

20A. *Arundo donax* (giant cane) is the most abundant herbaceous species (or no other herbaceous species is more abundant than *Arundo donax*) ..... **Giant Cane Riparian Herbaceous Vegetation**

20B. At least one other herbaceous species has higher cover than *Arundo donax* (giant cane)..... go to **21**

21A. Either *Sorghum halepense* (Johnson grass) or *Salsola tragus* (Russian thistle) is the most abundant herbaceous species (or no other herbaceous species is more abundant than *Sorghum halepense* or *Salsola tragus*..... **Johnson Grass - Russian Thistle Desert Grassland**

21B. At least one other herbaceous species has higher cover than *Sorghum halepense* (Johnson grass) and *Salsola tragus* (Russian thistle) ..... go to **22**

22A. *Cynodon dactylon* (Bermuda grass) is the most abundant herbaceous species (or no other herbaceous species is more abundant than *Cynodon dactylon*)..... **Bermuda Grass Herbaceous Vegetation**

22B. At least one other herbaceous species has higher cover than *Cynodon dactylon* (Bermuda grass) ..... go to **23**

23A. The combined individual cover amount for all *Schoenoplectus* spp. (bulrushes), *Polygonum* spp. (smartweeds), *Typha* spp. (cattails), *Bacopa monnieri* (water hyssop), *Polypogon monspeliensis* (annual rabbitsfoot grass), *Heliotropium curassavicum* (salt heliotrope), and/or *Phyla nodiflora* (turkey tangle fogfruit) is > 10%..... **Wet Riverbank Herbaceous Vegetation** (also known as) ..... **[Rio Grande Alluvial Herbaceous Vegetation]**

23B. The combined individual cover amount for all *Schoenoplectus* spp. (bulrushes), *Polygonum* spp. (smartweeds), *Typha* spp. (cattails), *Bacopa monnieri* (water hyssop), *Polypogon monspeliensis* (annual rabbitsfoot grass), *Heliotropium curassavicum* (salt heliotrope), and/or *Phyla nodiflora* (turkey tangle fogfruit) is < 10%..... go to **24**

24A. The combined individual cover amount for *Hymenoclea monogyra* (singlewhorl burrobrush) and/or *Porophyllum scoparium* (shrubby poreleaf) is >3%..... **Big Bend Lowlands Wash Channel Shrubland**
OR (If Total Vegetation Cover is < 10%) ..... **Big Bend Lowlands Sparsely Vegetated Wash Channel**

24B. The combined individual cover amount for *Hymenoclea monogyra* (singlewhorl burrobrush) and/or *Porophyllum scoparium* (shrubby poreleaf) is <3%..... **Rio Grande Alluvial Herbaceous Vegetation**
OR (If Total Vegetation Cover is < 10%) ..... **Rio Grande Alluvial Sparse Vegetation**

14B. The combined individual cover amount for *Sporobolus airoides* (alkali sacaton), *Sporobolus wrightii* (big sacaton), *Phragmites australis* (common reed), *Arundo donax* (giant cane), *Sorghum halepense* (Johnson grass), *Cynodon dactylon* (Bermuda grass) and/or *Salsola tragus* (Russian thistle) is < 25%..... go to **25**

25A. The combined individual cover amount for *Hymenoclea monogyra* (singlewhorl burrobrush) and/or *Porophyllum scoparium* (shrubby poreleaf) is > 3%..... **Big Bend Lowlands Wash Channel Shrubland**
OR (If Total Vegetation Cover is < 10%)..... **Big Bend Lowlands Sparsely Vegetated Wash Channel**

25B. The combined individual cover amount for *Hymenoclea monogyra* (singlewhorl burrobrush) and/or *Porophyllum scoparium* (shrubby poreleaf) is < 3%..... go to **26**

26A. *Cynodon dactylon* (Bermuda grass) is the most abundant herbaceous species (or no other herbaceous species is more abundant than *Cynodon dactylon*)..... **Bermuda Grass Herbaceous Vegetation**

26B. At least one other herbaceous species has higher cover than *Cynodon dactylon* (Bermuda grass)..... go to **27**

27A. The combined individual cover amount for all *Schoenoplectus* spp. (bulrushes), *Polygonum* spp. (smartweeds), *Typha* spp. (cattails), *Bacopa monnieri* (water hyssop), *Polypogon monspeliensis* (annual rabbitsfoot grass), *Heliotropium curassavicum* (salt heliotrope), and/or *Phyla nodiflora* (turkey tangle fogfruit) is > 10%..... ..... **Wet Riverbank Herbaceous Vegetation** (also known as) ..... **[Rio Grande Alluvial Herbaceous Vegetation]**

27B. The combined individual cover amount for all *Schoenoplectus* spp. (bulrushes), *Polygonum* spp. (smartweeds), *Typha* spp. (cattails), *Bacopa monnieri* (water hyssop), *Polypogon monspeliensis* (annual rabbitsfoot grass), *Heliotropium curassavicum* (salt heliotrope), and/or *Phyla nodiflora* (turkey tangle fogfruit) is < 10%..... .....**Rio Grande Alluvial Herbaceous Vegetation** **OR** (If Total Vegetation Cover is < 10%)..... ..... **Rio Grande Alluvial Sparse Vegetation**

Upland Vegetation Key

1A. The combined individual cover amount for *Chilopsis linearis* (desert willow), *Hymenoclea monogyra* (singlewhorl burrobrush), *Porophyllum scoparium* (shrubby poreleaf), *Brickellia laciniata* (splitleaf brickellia), and/or *Fallugia paradoxa* (Apache plume) is > 15% of the relative shrub stratum cover..... go to **2**

2A. The combined individual cover amount for *Hymenoclea monogyra* (singlewhorl burrobrush) and/or *Chilopsis linearis* (desert willow) is > than the combined individual cover amount for *Vachellia rigidula* (blackbrush) and/or *Brickellia laciniata* (splitleaf brickellia); generally, vegetation of either the Rio Grande banks and alluvial bars or channels of tributaries upstream from and including Black Gap Wildlife Management Area..... ..... **Big Bend Lowlands Wash Channel Shrubland** **OR** (If Total Vegetation Cover is < 10%)..... .....**Big Bend Lowlands Sparsely Vegetated Wash Channel**

2B. The combined individual cover amount for *Hymenoclea monogyra* (singlewhorl burrobrush) and/or *Chilopsis linearis* (desert willow) is < than the combined individual cover amount for *Vachellia rigidula* (blackbrush) and/or *Brickellia laciniata* (splitleaf brickellia); generally, vegetation of tributaries downstream from Black Gap Wildlife Management Area..... .....**Blackbrush - Brickellbush Wash Channel Shrubland**

1B. The combined individual cover amount for *Chilopsis linearis* (desert willow), *Hymenoclea monogyra* (singlewhorl burrobrush), *Porophyllum scoparium* (shrubby poreleaf), *Brickellia laciniata*

(splitleaf brickellia), and/or *Fallugia paradoxa* (Apache plume) is < 15% of the relative shrub stratum cover..... go to **3**

3A. Total vascular plant cover is > 5%..... go to **4**

3B. Total vascular plant cover is < 5%..... go to **25**

4A. At least two of the following species (Chihuahuan calcareous indicators) are present: *Euphorbia antisyphilitica* (candelilla), *Hechtia texensis* (Texas false agave), *Leucophyllum candidum* (Boquillas silverleaf), *Yucca thompsoniana,* (Thompson's yucca), *Opuntia ×spinosibacca* (spiny-fruited pricklypear), *Escobaria tuberculosa* (cob cactus), *Ariocarpus fissuratus* (living rock cactus), *Tiquilia gossypina* (Texas crinklemat), *Tiquilia* hispidissima (hairy crinklemat), and/or *Tiquilia mexicana* (Mexican crinklemat) ..... go to **5**

5A. The combined individual cover amount for *Hechtia texensis* (Texas false agave), *Yucca faxoniana* (giant dagger), *Yucca thompsoniana* (Thompson's yucca), and/or *Leucophyllum minus* (Big Bend silverleaf) is > 2% generally at higher elevations..... ..... **Yucca - Sotol Calcareous Shrub Grassland**
OR (If in Wash Channel) ..... **Yucca Calcareous Wash Channel Shrubland**

5B. The combined individual cover amount for *Hechter texensis* (Texas false agave), *Yucca faxoniana* (giant dagger), *Yucca thompsoniana* (Thompson's yucca), and/or *Leucophyllum minus* (Big Bend silverleaf) is < 2%;..... go to **6**

6A. The combined individual cover amount for *Euphorbia antisyphilitica* (candelilla), *Hechtia texensis* (Texas false agave), *Opuntia rufida* (blind pricklypear), *Opuntia ×spinosibacca* (spiny-fruited pricklypear), and/or *Leucophyllum candidum* (Boquillas silverleaf) is > than the combined individual cover amount for *Lippia graveolens*,(Mexican oregano), and/or *Grusonia schottii* (Schott's dog cholla); generally, vegetation of Brewster County (upriver from Bone Watering Hole) ..... go to **7**

7A. The combined individual cover amount for *Leucophyllum minus* (Big Bend silverleaf), *Dasylirion leiophyllum* (green sotol*), Opuntia engelmannii* (Engelmann's pricklypear), and/or *Tiquilia greggii* (Gregg's crinklemat) is > than the combined individual cover amount for *Larrea tridentata* (creosotebush), *Fouquieria splendens* (ocotillo), *Leucophyllum frutescens* (cenizo), *Leucophyllum candidum* (Boquillas silverleaf), *Vachellia rigidula* (blackbrush), *Lippia graveolens* (Mexican oregano), *Tiquilia canescens* (woody crinklemat), *Echinocactus horizonthalonius* (turkshead cactus), *Opuntia ×spinosibacca* (spiny-fruited pricklypear), and/or *Cathestecum erectum* (false grama)..... **Calcareous Mixed Desert Scrub**
OR (If on Talus Substrate) ..... **Calcareous Talus Mixed Shrubland**

7B. The combined individual cover amount for *Leucophyllum minus* (Big Bend silverleaf), *Dasylirion leiophyllum* (green sotol), *Opuntia engelmannii*

(Engelmann's pricklypear), and/or *Tiquilia greggii* (Gregg's crinklemat) is < than the combined individual cover amount for *Larrea tridentata* (creosotebush), *Fouquieria splendens* (ocotillo), *Leucophyllum frutescens* (cenizo), *Leucophyllum candidum* (Boquillas silverleaf), *Vachellia rigidula* (blackbrush), *Lippia graveolens* (Mexican oregano), *Tiquilia canescens* (woody crinklemat), *Echinocactus horizonthalonius* (turkshead cactus), *Opuntia ×spinosibacca* (spiny-fruited pricklypear), and/or *Cathestecum erectum* (false grama).....go to **8**

8A. The combined individual cover amount for *Fouquieria splendens* (ocotillo), *Dasylirion leiophyllum* (green sotol), *Viguiera stenoloba* (skeletonleaf goldeneye), *Euphorbia antisyphilitica* (candelilla), *Parthenium incanum* (mariola), *Opuntia rufida* (blind pricklypear), *Tiquilia greggii* (Gregg's crinklemat), *Tiquilia canescens* (woody crinklemat), *Guaiacum angustifolium* (guayacan), *Leucophyllum* spp. (barometerbushes), and/or *Gutierrezia* spp. (snakeweeds) is > 1% .... **Creosotebush - Ocotillo - Lechuguilla Mixed Desert Scrub**

8B. The combined individual cover amount for *Fouquieria splendens* (ocotillo), Dasylirion leiophyllum (green sotol), *Viguiera stenoloba* (skeletonleaf goldeneye), *Euphorbia antisyphilitica* (candelilla), *Parthenium incanum* (mariola), *Opuntia rufida* (blind pricklypear), *Tiquilia greggii* (Gregg's crinklemat), *Tiquilia canescens* (woody crinklemat), *Guaiacum angustifolium* (guayacan), *Leucophyllum* spp. (barometerbushes), and/or *Gutierrezia* spp. (snakeweeds) is < 1% .....go to **9**

9A. The combined individual cover amount for *Opuntia ×spinosibacca* (spiny-fruited pricklypear), *Leucophyllum candidum* (Boquillas silverleaf), *Vachellia constricta* (whitethorn acacia), *Krameria* spp. (all species of ratany), and/or *Tiquilia* spp. (all species of crinklemat) is > than the combined individual cover amount for *Leucophyllum frutescens* (cenizo), *Vachellia rigidula* (blackbrush), *Lippia graveolens* (Mexican oregano), *Karwinskia humboldtiana* (coyotillo), and/or *Echinocereus stramineus* (strawberry hedgehog cactus)..... .....**Boquillas Basin Calcareous Creosotebush Desert Scrub**

9B. The combined individual cover amount for *Opuntia ×spinosibacca* (spiny-fruited pricklypear), *Leucophyllum candidum* (Boquillas silverleaf), *Vachellia constricta* (whitethorn acacia), *Krameria* spp. (all species of ratany), and/or *Tiquilia* spp. (all species of crinklemat) is < than the combined individual cover amount for *Leucophyllum frutescens* (cenizo), *Vachellia rigidula* (blackbrush), *Lippia graveolens* (Mexican oregano), *Karwinskia humboldtiana* (coyotillo), and/or *Echinocereus stramineus* (strawberry hedgehog cactus)..... ..... **Northeastern Chihuahuan Canyon Desert Scrub**

6B. The combined individual cover amount for *Euphorbia antisyphilitica* (candelilla), *Hechtia texensis* (Texas false agave), *Opuntia rufida* (blind pricklypear), *Opuntia ×spinosibacca* (spiny-fruited pricklypear), and/or *Leucophyllum candidum* (Boquillas silverleaf) is < than the combined individual cover amount for *Lippia graveolens*, (Mexican oregano), and/or *Grusonia schottii* (Schott's dog cholla); generally, vegetation of Terrell County (downriver from San Francisco Canyon) .... **Southern Stockton Plateau Mixed Desert Scrub**

4B. No more than one of the following species (Chihuahuan calcareous indicators) are present: *Euphorbia antisyphilitica* (candelilla), *Hechtia texensis* (Texas false agave), *Leucophyllum candidum* (Boquillas silverleaf), *Yucca thompsoniana*, (Thompson's yucca), *Opuntia ×spinosibacca* (spiny-fruited pricklypear), *Escobaria tuberculosa* (cob cactus), *Ariocarpus fissuratus* (living rock cactus), *Tiquilia gossypina* (Texas crinklemat), *Tiquilia hispidissima* (hairy crinklemat), and/or *Tiquilia mexicana* (Mexican crinklemat) ..... go to **10**

10A. (1) BOTH (1) the combined relative cover of *Prosopis glandulosa* (honey mesquite) is > 20% AND (2) the total shrub and tree strata cover combined is > 15% ..... go to **11**

11A. The combined individual cover amount for *Bouteloua ramosa* and/or *Selaginella* spp. (all species of spikemoss is > 5% **Southern Stockton Plateau Mixed Desert Scrub**

11B. The combined individual cover amount for *Bouteloua ramosa* and/or *Selaginella* spp. (all species of spikemoss is < 5% ..... go to **12**

12A. The combined individual cover amount for *Diospyros texana* (Texas persimmon) and/or *Forestiera angustifolia* (desert olive) is > 5%; primarily in wash or drainage .... **Texas Persimmon - Thornscrub Limestone Wash Shrubland**

12B. The combined individual cover amount for *Vachellia rigidula* (blackbrush), *Diospyros texana* (Texas persimmon), and/or Forestiera *angustifolia* (desert olive) is < 5%; not in a wash or drainage ..... go to **13**

13A. The combined individual cover amount for *Viguiera stenoloba* (skeletonleaf goldeneye), *Parthenium incanum* (mariola), *Fluorensia cernua* (American tarbush), *Vachellia constricta* (whitethorn acacia), *Vachellia vernicosa* (viscid acacia), *Senegalia* spp. (catclaw acacias), and/or *Yucca* spp. (yuccas) is > than the combined individual cover amounts of *Baccharis salicifolia* (seepwillow), *Vachellia farnesiana* (huisache), *Tamarix ramosissima* (tamarisk), *Celtis ehrenbergiana* (spiny hackberry), *Arundo donax* (giant cane)and/or *Cynodon dactylon* (Bermuda grass) ..... go to **14**

14A. At least some *Prosopis glandulosa* (honey mesquite) are taller than 10 meters ..... **Rio Grande Mesquite Riparian Bosque**

14B. No *Prosopis glandulosa* (honey mesquite) (if present) are taller than 10 meters ..... go to **15**

15A. The combined individual cover amount for *Prosopis glandulosa* (honey mesquite) *Larrea tridentata* (creosotebush), and/or *Opuntia engelmannii* (Engelmann's pricklypear) is > than the combined individual cover amounts of *Aloysia* spp. (beebrushes), *Vachellia* spp. (acacias), *Senegali*a spp. (catclaw acacias), and/or *Yucca elata* (soaptree yucca) ..... **Mesquite - Creosotebush Desert Scrub**

15B. The combined individual cover amount for *Prosopis glandulosa* (honey mesquite) *Larrea tridentata* (creosotebush), and/or *Opuntia engelmannii* (Engelmann's pricklypear) is < than the combined individual cover amounts of *Aloysia* spp. (beebrushes), *Vachellia* spp. (acacias), *Senegalia* spp. (catclaw acacias), and/or *Yucca elata* (soaptree yucca) ..... **Acacia - Mesquite Wash Shrubland**

13B. The combined individual cover amount for *Viguiera stenoloba* (skeletonleaf goldeneye), *Parthenium incanum* (mariola), *Aloysia* spp. (beebrushes), *Vachellia constricta* (whitethorn acacia), *Vachellia vernicosa* (viscid acacia), *Senegalia* spp. (catclaw acacias), *Yucca* spp. (yuccas), and/or *Bouteloua* spp. (grama grasses) is < than the combined individual cover amounts of *Baccharis salicifolia* (seepwillow), *Vachellia farnesiana* (huisache), *Tamarix ramosissima* (tamarisk), *Celtis ehrenbergiana* (spiny hackberry), *Arundo donax* (giant cane)and/or *Cynodon dactylon* (Bermuda grass) ..... go to **16**

16A. The cover of *Vachellia farnesiana* (huisache) is > than the cover of *Prosopis glandulosa* (honey mesquite) ....**Huisache Riparian Bosque**

16B. The cover of *Vachellia farnesiana* (huisache) is < than the cover of *Prosopis glandulosa* (honey mesquite) .... **Rio Grande Mesquite Riparian Bosque**

10B. EITHER (1) the combined relative cover of *Prosopis glandulosa* (honey mesquite) is < 20% OR (2) the total shrub and tree strata cover combined is < 15%, or both (1) and (2) are true ..... go to **17**

17A. Primarily herbaceous vegetation of areas that have been significantly disturbed in the recent past by human activity (construction, etc.) and/or that are maintained by ongoing maintenance (e.g., regular mowing). Dominated by a number of ruderal native or non-native species, including, but not limited to, *Heteropogon contortus* (tanglehead), *Eragrostis lehmanniana* (Lehmann lovegrass), *Pennisetum ciliare*

(buffelgrass), *Conyza canadensis* (Canadian horseweed), *Salsola tragus* (Russian thistle), and others ..... **Upland Ruderal Herbaceous Vegetation**

17B. Vegetation not as above (maintained by mostly natural processes) and of varied physiognomy. Includes natural vegetation that has been invaded by ruderal species, including riparian vegetation that has dominated by non-native grasses such as *Eragrostis lehmanniana* (Lehmann lovegrass) or *Pennisetum ciliare* (buffelgrass)) or regularly flooded riparian bars that have native and non-native ruderal species prominent ..... go to **18**

18A. EITHER (1) *Suaeda suffrutescens* (desert seepweed) has the highest cover of any species present (or is tied with another species with the highest cover) OR (2) at least two of the following species (gypseous indicators) are present: *Suaeda suffrutescens* (desert seepweed) *Sporobolus pyramidatus* (whorled dropseed), and/or *Echinochloa crus-galli* (barnyardgrass) ..... **Alkaline Clay Flat Shrubland**

18B. BOTH (1) A species other than *Suaeda suffrutescens* (desert seepweed) has the highest cover of any species present AND no more than one of the following species (gypseous indicators) are present: *Suaeda suffrutescens* (desert seepweed) *Sporobolus pyramidatus* (whorled dropseed), and/or *Echinochloa crus-galli* (barnyardgrass) ..... go to **19**

19A. The combined individual cover amount for *Vachellia rigidula* (blackbrush), *Lippia graveolens*, (Mexican oregano), *Leucophyllum frutescens* (cenizo), *Senegalia berlandieri* (guajillo), *Selaginella* spp. (all species of spikemoss), *Tiquilia canescens* (woody crinklemat), and/or *Sporobolus airoides* (alkali sacaton) is > 2%; vegetation generally of Terrell and easternmost Brewster counties - from Reagan Canyon (in Lower Canyons section) and downstream ..... go to **20**

20A. The combined individual cover amount for *Larrea tridentata* (creosotebush) and/or *Tiquilia canescens* (woody crinklemat) is > than the combined individual cover amount for *Vachellia rigidula* (blackbrush), *Senegalia berlandieri* (guajillo), *Prosopis glandulosa* (honey mesquite), *Lippia graveolens*, (Mexican oregano), *Leucophyllum frutescens* (cenizo), *Viguiera stenoloba* (skeletonleaf goldeneye), and/or *Fouquieria splendens* (ocotillo) ..... **Southern Stockton Plateau Creosotebush Desert Scrub**

20B. The combined individual cover amount for *Larrea tridentata* (creosotebush) and/or *Tiquilia canescens* (woody crinklemat) is < than the combined individual cover amount for *Vachellia rigidula* (blackbrush), *Senegalia berlandieri* (guajillo), *Prosopis glandulosa* (honey mesquite), *Lippia graveolens*, (Mexican oregano), *Leucophyllum*

frutescens (cenizo), *Viguiera stenoloba* (skeletonleaf goldeneye), and/or *Fouquieria splendens* (ocotillo) ..... go to **21**

21A. The combined individual cover amount for *Larrea tridentata* (creosotebush), *Bouteloua ramosa* (chino grama), and/or *Selaginell*a spp. (all species of spikemoss), *Tiquilia canescens* (woody crinklemat), and/or *Sporobolus airoides* (alkali sacaton) is > 5%..... ..... **Southern Stockton Plateau Mixed Desert Scrub**

21B. The combined individual cover amount for *Larrea tridentata* (creosotebush), *Bouteloua ramosa* (chino grama), and/or *Selaginell*a spp. (all species of spikemoss), *Tiquilia canescens* (woody crinklemat), and/or *Sporobolus airoides* (alkali sacaton) is < 5%..... ..... go to **22**

22A. The combined individual cover amount for *Porophyllum scoparium* (shrubby poreleaf), *Brickellia laciniata* (splitleaf brickellia), *Fallugia paradoxa* (Apache plume), *Chilopsis linearis* (desert willow), and/or *Hymenoclea monogyra* (singlewhorl burrobrush) is > 5%; vegetation generally of wash channels and banks..... **Blackbrush - Brickellbush Wash Channel Shrubland**

22B. The combined individual cover amount for *Porophyllum scoparium* (shrubby poreleaf), *Brickellia laciniata* (splitleaf brickellia), *Fallugia paradoxa* (Apache plume), *Chilopsis linearis* (desert willow), and/or *Hymenoclea monogyra* (singlewhorl burrobrush) is < 5%; vegetation generally of uplands..... ..... **Guajillo - Blackbrush - Torrey Yucca Shrubland**

19B. The combined individual cover amount for *Lippia graveolens*, (Mexican oregano), *Leucophyllum frutescens* (cenizo), *Selaginella* spp. (all species of spikemoss), *Tiquilia canescens* (woody crinklemat), and/or *Sporobolus airoides* (alkali sacaton) is < 2%; vegetation generally occurring upstream from Reagan Canyon..... go to **23**

23A. The combined individual cover amount for *Larrea tridentata* (creosotebush), *Fouquieria splendens* (ocotillo), *Vachellia* spp. (acacias), *Senegalia* spp. (catclaw acacias), *Jatropha dioica* (leatherstem), *Yucca torreyi* (Torrey's yucca), *Dasyochloa pulchella* (fluffgrass), and/or *Senna durangensis* (Durango senna) is > than the combined individual cover amount for *Agave lechuguilla* (lechuguilla), *Prosopis glandulosa* (honey mesquite), *Cylindropuntia leptocaulis* (Christmas cholla), *Atriplex* spp.(saltbushes), *Sporobolus* spp. (dropseeds), and/or *Bouteloua ramosa* (chino grama) ..... go to **24**

24A. The combined individual cover amount for *Larrea tridentata* (creosotebush), *Fouquieria splenden*s (ocotillo), *Jatropha dioica* (leatherstem) *Krameria* spp. (ratanys), *Dasyochloa pulchella* (fluffgrass), and/or *Senna durangensis* (Durango senna) is > than the combined individual covers of *Vachellia* spp. (straight-thorned acacias), *Senegalia* spp. (catclaw acacias), *Prosopis glandulosa* (honey mesquite), *Aloysia* spp. (beebrushes), and/or *Yucca elata* (soaptree yucca) .... **Big Bend Lowlands Creosotebush Desert Scrub**

OR (if Creosotebush is on Volcanic Substrate) .... **Big Bend Lowlands (Basalt, Lava, and Volcanic Rocks)**

OR (if Creosotebush is on Eroding Feature) ..... **Big Bend Lowlands (Eroding Slopes, Hillsides, and Badlands)**

OR (if Creosotebush is on Flat Areas)..... ..... **Big Bend Lowlands (Flats, Benches, and Plateaus)**

24B. The combined individual cover amount for Larrea tridentata (creosotebush), Fouquieria splendens (ocotillo), Jatropha dioica (leatherstem) Krameria spp. (ratanys), Dasyochloa pulchella (fluffgrass), and/or Senna durangensis (Durango senna) is < than the combined individual covers of Vachellia spp. (straight-thorned acacias), Senegalia spp. (catclaw acacias), Prosopis glandulosa (honey mesquite), Aloysia spp. (beebrushes), and/or Yucca elata (soaptree yucca)..... **Acacia - Mesquite Wash Shrubland**

23B. The combined individual cover amount for *Larrea tridentata* (creosotebush), *Fouquieria splendens* (ocotillo), *Vachellia* spp. (acacias), *Senegalia* spp. (catclaw acacias), *Jatropha dioica* (leatherstem), *Yucca torreyi* (Torrey's yucca), *Dasyochloa pulchella* (fluffgrass), and/or *Senna durangensis* (Durango senna) is < than the combined individual cover amount for *Agave lechuguilla* (lechuguilla), Prosopis glandulosa (honey mesquite), *Cylindropuntia leptocaulis* (Christmas cholla), *Atriplex* spp.(saltbushes), Sporobolus spp. (dropseeds), and/or *Bouteloua ramosa* (chino grama) ..... **Badlands Sparse Vegetation**

25A. Sparse vegetation or apparently unvegetated surfaces of either banks or alluvial bars of the Rio Grande or in channels of tributary washes..... go to **26**

26A. The combined individual cover amount for *Chilopsis linearis* (desert willow), *Hymenoclea monogyra* (singlewhorl burrobrush), *Diospyros texana* (Texas persimmon), *Rhus microphylla* (littleleaf sumac), *Porophyllum scoparium* (shrubby poreleaf), *Senegalia* spp. (catclaws), *Brickellia laciniata* (splitleaf brickellia), and/or *Fallugia paradoxa* (Apache plume) is > 2% ..... go to **27**

27A. The combined individual cover amount for *Hymenoclea monogyra* (singlewhorl burrobrush) and/or *Chilopsis linearis* (desert willow) > than the combined individual cover amount for *Vachellia rigidula* (blackbrush) and/or *Brickellia laciniata* (splitleaf brickellia); generally, vegetation of either the Rio Grande banks and alluvial bars or of channels of tributaries upstream from and including Black Gap Wildlife Management Area ..... **Big Bend Lowlands Wash Channel Shrubland**
OR (If Total Vegetation Cover is < 10%)..... .....**Big Bend Lowlands Sparsely Vegetated Wash Channel**

27B. The combined individual cover amount for *Hymenoclea monogyra* (singlewhorl burrobrush) and/or *Chilopsis linearis* (desert willow) < than the combined individual cover amount for *Vachellia rigidula* (blackbrush) and/or *Brickellia laciniata* (splitleaf brickellia); generally, vegetation of tributaries downstream from Black Gap Wildlife Management Area .....**Blackbrush - Brickellbush Wash Channel Shrubland**

26B. The combined individual cover amount for *Chilopsis linearis* (desert willow), *Hymenoclea monogyra* (singlewhorl burrobrush), *Diospyros texana* (Texas persimmon), *Rhus microphylla* (littleleaf sumac), *Porophyllum scoparium* (shrubby poreleaf), *Senegalia* spp. (catclaw acacias), *Brickellia laciniata* (splitleaf brickellia), and/or *Fallugia paradoxa* (Apache plume) is < 2% ....**Rio Grande Alluvial Herbaceous Vegetation**
OR (If Total Vegetation Cover is < 10%) .... **Rio Grande Alluvial Sparse Vegetation**

25B. Sparse vegetation or apparently unvegetated surfaces of various settings, not on banks or alluvial bars of the Rio Grande nor in channels of tributary washes.....go to **28**

28A. At least one of the following species (Chihuahuan calcareous indicators) are present: *Euphorbia antisyphilitic*a (candelilla), *Hechtia texensis* (Texas false agave), *Leucophyllum candidum* (Boquillas silverleaf), *Tiquilia gossypina* (Texas crinklemat), *Tiquilia hispidissima* (hairy crinklemat*), Tiquilia mexicana* (Mexican crinklemat), *Escobaria tuberculosa* (cob cactus), *Ariocarpus fissuratus* (living rock cactus), and/or *Opuntia ×spinosibacca* (spiny-fruited pricklypear).....go to **29**

29A. The combined individual cover amount for *Opuntia ×spinosibacca* (spiny-fruited pricklypear), *Leucophyllum candidum* (Boquillas silverleaf), *Vachellia constricta* (whitethorn acacia), *Krameria* spp. (all species of ratany), and/or *Tiquilia* spp. (all species of crinklemat) is > than the combined individual cover amount for *Leucophyllum frutescens* (cenizo), *Vachellia rigidula* (blackbrush), *Lippia graveolens* (Mexican oregano*), Karwinskia humboldtiana* (coyotillo), and/or *Echinocereus stramineus* (strawberry hedgehog cactus)..... .....**Boquillas Basin Calcareous Creosotebush Desert Scrub**

29B. The combined individual cover amount for *Opuntia ×spinosibacca* (spiny-fruited pricklypear), *Leucophyllum candidum* (Boquillas silverleaf), *Vachellia constricta* (whitethorn acacia), *Krameria* spp. (all species of ratany), and/or *Tiquilia* spp. (all species of crinklemat) is < than the combined individual cover amount for *Leucophyllum frutescens* (cenizo), *Vachellia rigidula* (blackbrush), *Lippia graveolens* (Mexican oregano), *Karwinskia humboldtiana* (coyotillo), and/or *Echinocereus stramineus* (strawberry hedgehog cactus)..... **Northeastern Chihuahuan Canyon Desert Scrub**

28B. None of the following species (Chihuahuan calcareous indicators) are present: *Euphorbia antisyphilitica* (candelilla), *Hechtia texensis* (Texas false agave), *Leucophyllum candidum* (Boquillas silverleaf), *Tiquilia gossypina* (Texas crinklemat), *Tiquilia hispidissima* (hairy crinklemat), *Tiquilia mexicana* (Mexican crinklemat), *Escobaria tuberculosa* (cob cactus), *Ariocarpus fissuratus* (living rock cactus), and/or *Opuntia ×spinosibacca* (spiny-fruited pricklypear)..... go to **30**

30A. Vegetation of cliffs or other bedrock outcrops, with vascular vegetation absent or restricted to crevices or ledges of calcareous substrates (limestone, etc.) .... **Calcareous Outcrop Lichen Vegetation**

30B. Vegetation of cliffs or other bedrock outcrops, with vascular vegetation absent or restricted to crevices or ledges of non-calcareous substrates..... go to **31**

31A. Lichen and/or sparse vascular vegetation on non-calcareous rock formations..... ..... **Low Elevation Non-calcareous Outcrop Lichen Vegetation**

31B. Sparse vascular vegetation not of cliffs or of other bedrock outcrops, and not restricted to crevices or ledges ..... go to **32**

32A. Vegetation of non-calcareous talus, scree, or sand dunes..... ..... **Low Elevation Talus and Dune Sparse Vegetation**

32B. Vegetation not on talus, scree, or sand dunes ..... go to **33**

33A. EITHER (1) *Suaeda suffrutescens* (desert seepweed) has at least 20% of the relative cover OR (2) at least two of the following species (gypseous indicators) are present: *Suaeda suffrutescens* (desert seepweed) *Sporobolus pyramidatus* (whorled dropseed), and/or *Echinochloa crus-galli* (barnyardgrass).....**Alkaline Clay Flat Shrubland**

33B. BOTH (1) *Suaeda suffrutescens* (desert seepweed) has less than 20% of the relative cover AND (2) no more than one of the following species (gypseous indicators) are present: *Suaeda suffrutescens* (desert seepweed) *Sporobolus pyramidatus* (whorled dropseed), and/or *Echinochloa crus-galli* (barnyardgrass)..... go to **34**

34A. The combined individual cover amount for *Larrea tridentata* (creosotebush), *Fouquieria splendens* (ocotillo), *Vachellia* spp. (acacias), *Senegalia* spp. (catclaw acacias), *Jatropha dioica* (leatherstem), *Yucca torreyi* (Torrey's yucca), *Dasyochloa pulchella* (fluffgrass), and/or *Senna durangensis* (Durango senna) is > than the combined individual cover amount for *Agave lechuguilla* (lechuguilla), *Prosopis glandulosa* (honey mesquite), *Cylindropuntia leptocaulis* (Christmas cholla), *Atriplex* spp.(saltbushes), *Sporobolus* spp. (dropseeds), and/or *Bouteloua ramosa* (chino grama) ..... **Big Bend Lowlands Creosotebush Desert Scrub**

OR (if Creosotebush is on Volcanic Substrate) .... **Big Bend Lowlands (Basalt, Lava, and Volcanic Rocks)**

OR (if Creosotebush is on Eroding Feature) ..... **Big Bend Lowlands (Eroding Slopes, Hillsides, and Badlands)**

OR (if Creosotebush is on Flat Areas)..... ..... **Big Bend Lowlands (Flats, Benches, and Plateaus)**

34B. The combined individual cover amount for *Larrea tridentata* (creosotebush), *Fouquieria splendens* (ocotillo), *Vachellia* spp. (acacias), *Senegalia* spp. (catclaw acacias), *Jatropha dioica* (leatherstem), *Yucca torreyi* (Torrey's yucca), *Dasyochloa pulchella* (fluffgrass), and/or *Senna durangensis* (Durango senna) is < than the combined individual cover amount for *Agave lechuguilla* (lechuguilla), *Prosopis glandulosa* (honey mesquite), *Cylindropuntia leptocaulis* (Christmas cholla), *Atriplex* spp.(saltbushes), *Sporobolus* spp. (dropseeds), and/or *Bouteloua ramosa* (chino grama) ..... **Badlands Sparse Vegetation**

Appendix D. RIGR Plant Association List and Descriptions

RIGR Plant Association rUSNVC List and Descriptions

List of Plant Associations within the rUSNVC Hierarchy for Rio Grande Wild and Scenic River

Vegetation associations are indicated by either (1) a global identification code assigned by NatureServe and beginning with the letters "CEGL", if the local association matches an association currently recognized by the USNVC or (2) a NPS identification code assigned by this project and beginning with the letters "NPS" (Lea 2011). Associations are grouped within their currently recognized (http:/usnvc.org) or projected USNVC hierarchy assignments. At this time, all alliances that have been recognized by the USNVC to date are under review and revision and descriptions are not available from or through usnvc.org. Plant species scientific names in text, tables, and locally recognized (NPS) vegetation types follow the treatment listed by USDA PLANTS as of January 31, 2019. Some plant species scientific names in vegetation types that are recognized by the USNVC follow other sources and may vary from the USDA PLANTS treatment.

USNVC Class: Forest & Woodland Class (1)

USNVC Subclass: Temperate and Boreal Forest & Woodland Subclass (1.B)

USNVC Formation: Warm Temperate Forest & Woodland Formation (1.B.1)

USNVC Division: Madrean-Balconian Forest & Woodland Division (D060)

USNVC Macrogroup: Balconian Forest & Woodland Macrogroup (M015)

USNVC Group: Balconian Dry-Mesic Hardwood Forest Group (G028)

USNVC Alliance: *Acer grandidentatum* - *Quercus muehlenbergii* - *Juglans major* Forest & Woodland Alliance (A3214)

NPS Association: *Fraxinus berlandieriana* / *Toxicodendron radicans* Alcove Woodland Association (NPSRIGR007)

(Park Name: Mexican Ash / Poison-ivy Alcove Woodland)

USNVC Formation: Temperate Flooded & Swamp Forest Formation (1.B.3)

USNVC Division: Western North American Interior Flooded Forest Division (D013)

USNVC Macrogroup: Interior Warm & Cool Desert Riparian Forest Macrogroup (M036)

USNVC Group: Western Interior Riparian Forest & Woodland Group (G797)

USNVC Alliance: *Populus fremontii* - *Fraxinus velutina* - *Salix gooddingii* Flooded Forest & Woodland Alliance (A3803)

USNVC Association: *Populus fremontii* - *Salix gooddingii* Woodland Association (CEGL000944)

(Park Name: Cottonwood - Goodding Willow Spring Woodland)

NPS Association: *Salix* (*gooddingii*, *thurberi*) Rio Grande Woodland Association (NPSBIBE019)

(Park Name: Rio Grande Willow Riparian Bosque)

USNVC Group: Tamaulipan Wet-Mesic Scrub Forest Group (G549)

USNVC Alliance: *Vachellia farnesiana* - *Celtis pallida* Riparian Scrub Alliance (A3841)

USNVC Association: *Vachellia farnesiana* - (*Prosopis glandulosa*) Woodland Association (CEGL002131)

(Park Name: Huisache Riparian Bosque)

USNVC Macrogroup: Interior West Ruderal Flooded & Swamp Forest Macrogroup (M298)

USNVC Group: Interior West Ruderal Riparian Forest & Scrub Group (G510)

USNVC Alliance: *Tamarix* spp. Ruderal Riparian Scrub Alliance (A0842)

USNVC Association: *Tamarix* spp. Temporarily Flooded Semi-natural Shrubland Association (CEGL003114)

(Park Name: Tamarisk - (Tree Tobacco) Riparian Shrubland)

USNVC Class: Shrub & Herb Vegetation Class (2)

USNVC Subclass: Shrub & Herb Wetland Subclass (2.C)

USNVC Formation: Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland Formation (2.C.4)

USNVC Division: Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland Division (D031)

USNVC Macrogroup: Warm Desert Lowland Freshwater Marsh, Wet Meadow & Shrubland Macrogroup (M076)

USNVC Group: North American Warm Desert Riparian Low Bosque & Shrubland Group (G533)

USNVC Alliance: *Prosopis glandulosa* - *Prosopis velutina* - *Prosopis pubescens* Wet Scrub Alliance (A3877)

USNVC Association: *Prosopis glandulosa* Wet Scrub Association (CEGL004934)

(Park Name: Rio Grande Mesquite Riparian Bosque)

USNVC Alliance: *Baccharis salicifolia* Wet Shrubland Alliance (A0933)

NPS Association: *Baccharis salicifolia* / (*Phragmites australis*) Chihuahuan Riparian Shrubland Association (NPSBIBE047)

(Park Name: Rio Grande Seepwillow Riparian Shrubland)

USNVC Macrogroup: Western North American Ruderal Marsh, Wet Meadow & Shrubland Macrogroup (M301)

USNVC Group: Western North American Ruderal Marsh, Wet Meadow & Shrubland Group (G524)

USNVC Alliance: *Phragmites australis* - *Arundo donax* - *Alopecurus pratensis* Ruderal Marsh Alliance (A3847)

USNVC Association: *Arundo donax* Riverbank Herbaceous Vegetation association (CEGL004101)

(Park Name: Giant Cane Riparian Herbaceous Vegetation)

NPS Association: *Phragmites australis* Chihuahuan Desert Riparian Herbaceous Vegetation Association (NPSBIBE023)

(Park Name: Common Reed Riparian Herbaceous Vegetation)

NPS Association: *Cynodon dactylon* Arid Southwest Herbaceous Vegetation Association (NPSBIBE017)

(Park Name: Bermuda Grass Herbaceous Vegetation)

USNVC Macrogroup: Arid West Interior Freshwater Marsh Macrogroup (M888)

USNVC Group: Arid West Interior Freshwater Marsh Group (G531)

USNVC Alliance: *Schoenoplectus americanus - Schoenoplectus acutus - Schoenoplectus californicus* Marsh Alliance (A3895)

USNVC Association: *Schoenoplectus pungens* Herbaceous Vegetation Association (CEGL001587)

(Park Name: Wet Riverbank Herbaceous Vegetation)

NPS Association: Arid West Alluvial Shrub Herbaceous Vegetation Association (NPSBIBE024)

(Park Name: Rio Grande Alluvial Herbaceous Vegetation)

USNVC Class: Desert & Semi-Desert Class (3)

USNVC Subclass: Warm Desert & Semi-Desert Woodland, Scrub & Grassland Subclass (3.A)

USNVC Formation: Warm Desert & Semi-Desert Scrub & Grassland Formation (3.A.2)

USNVC Division: North American Warm Desert Scrub & Grassland Division (D039)

USNVC Macrogroup: Chihuahuan Desert Scrub Macrogroup (M086)

USNVC Group: Chihuahuan Creosotebush - Mixed Desert Scrub Group (G288)

USNVC Alliance: *Larrea tridentata* Chihuahuan Desert Scrub Alliance (A3164)

NPS Association: *Larrea tridentata - Fouquieria splendens - Agave lechuguilla - Leucophyllum frutescens* Shrubland Association (NPSBIBE044)

(Park Name: Creosotebush - Ocotillo - Lechuguilla Mixed Desert Scrub)

NPS Association: *Larrea tridentata - Cylindropuntia leptocaulis / Dasyochloa pulchella - Cathestecum erectum* Shrubland Association (NPSBIBE031)

(Park Name: Big Bend Lowlands Creosotebush Desert Scrub)

NPS Association: *Larrea tridentata - Agave lechuguilla - Hechtia texensis - Echinocactus horizonthalonius* Shrubland Association (NPSBIBE011)

(Park Name: Boquillas Basin Calcareous Creosotebush Desert Scrub)

NPS Association: *Prosopis glandulosa - Larrea tridentata* - (*Flourensia cernua, Parthenium incanum*) Shrubland Association (NPSBIBE025)

(Park Name: Mesquite - Creosotebush Desert Scrub)

NPS Association: *Larrea tridentata / Grusonia schottii / Tiquilia canescens* Shrubland Association (NPSRIGR004)

(Park Name: Southern Stockton Plateau Creosotebush Desert Scrub)

USNVC Group: Chihuahuan Desert Succulent Scrub Group (G286)

USNVC Alliance: *Agave lechuguilla - Euphorbia antisyphilitica* Chihuahuan Desert Succulent Scrub Alliance (A3157)

NPS Association: *Euphorbia antisyphilitica - Agave lechuguilla - Hechtia texensis- Vachellia rigidula - Lippia graveolens* Shrubland Association (NPSRIGR003)

(Park Name: Northeastern Chihuahuan Canyon Desert Scrub)

NPS Association: *Prosopis glandulosa - Viguiera stenoloba - Larrea tridentata - Leucophyllum frutescens / Bouteloua ramosa - Selaginella wrightii* Shrubland Association (NPSRIGR005)

(Park Name: Southern Stockton Plateau Mixed Desert Scrub)

NPS Association: *Agave lechuguilla - Euphorbia antisyphilitica - Ephedra aspera / Bouteloua ramosa* Shrubland Association (NPSBIBE010)

(Park Name: Calcareous Mixed Desert Scrub)

USNVC Group: Chihuahuan Lowland Basin Semi-Desert Scrub Group (G299)

USNVC Alliance: *Atriplex canescens* Lowland Basin Desert Scrub Alliance (A3151)

NPS Association: *Atriplex canescens - Suaeda suffrutescens* / *Sporobolus airoides* Shrub Herbaceous Vegetation Association (NPSBIBE026)

(Park Name: Alkali Sacaton Riparian Grassland)

USNVC Macrogroup: Chihuahuan Semi-Desert Grassland Macrogroup (M087)

USNVC Group: Chihuahuan Desert Foothill-Piedmont & Lower Montane Grassland Group (G490)

USNVC Alliance: *Dasylirion* spp. - *Bouteloua curtipendula - Muhlenbergia setifolia* Foothill Desert Grassland Alliance (A3205)

NPS Association: *Yucca faxoniana - Yucca thompsoniana / Dasylirion leiophyllum - Nolina erumpens - Bouteloua curtipendula* Shrub Grassland Association (NPSBIBE040)

(Park Name: Yucca - Sotol Calcareous Shrub Grassland)]

USNVC Macrogroup: Tamaulipan Scrub and Grassland (M130)

USNVC Group: Tamaulipan Dry Mesquite and Thornscrub (G099)

USNVC Alliance: Tamaulipan *Vachellia rigidula - Leucophyllum frutescens - Senegalia berlandieri* Calcareous Thornscrub Alliance (A3191)

USNVC Association: *Vachellia rigidula - Leucophyllum frutescens - Senegalia berlandieri* Shrubland (CEGL007759)

(Park Name: Guajillo - Blackbrush - Torrey Yucca Shrubland)

USNVC Macrogroup: Chihuahuan Semi-Desert Grassland Macrogroup (M087)

USNVC Group: Chihuahuan Gypsophilous Grassland Group (G492)

USNVC Alliance: *Tiquilia hispidissima* / *Sporobolus nealleyi - Tidestromia carnosa* Gypsum Outcrop & Alluvial Flat Desert Scrub Alliance (A3243)

NPS Association: *Suaeda suffrutescens* / *Sporobolus pyramidatus* Shrubland Association (NPSBIBE027)

(Park Name: Alkaline Clay Flat Shrubland)

USNVC Association: *Atriplex obovata* / *Tidestromia carnosa* Dwarf-shrubland Association (CEGL004575)

(Park Name: Badlands Sparse Vegetation)

USNVC Macrogroup: North American Warm-Desert Xero-Riparian Scrub Macrogroup (M092)

USNVC Group: Warm Semi-Desert Shrub & Herb Dry Wash & Colluvial Slope Group (G541)

USNVC Alliance: *Hymenoclea monogyra - Brickellia laciniata* Chihuahuan-Sonoran Desert Wash Alliance (A3262)

NPS Association: *Diospyros texana - Senegalia berlandieri - Prosopis glandulosa - Eysenhardtia texana* Shrubland (NPSRIGR008)

(Park Name: Texas Persimmon - Thornscrub Limestone Wash Shrubland)

NPS Association: *Vachellia rigidula - Brickellia laciniata* Shrubland Association (NPSRIGR006)

(Park Name: Blackbrush - Brickellbush Wash Channel Shrubland)

NPS Association: *Hymenoclea monogyra - Chilopsis linearis –Porophyllum scoparium* Shrubland Association (NPSBIBE014)

(Park Name: Big Bend Lowlands Wash Channel Shrubland)

NPS Association: *Vachellia* spp. - *Senegalia greggii - Prosopis glandulosa – Yucca elata* Shrubland Association (NPSBIBE043)

(Park Name: Acacia - Mesquite Wash Shrubland)

USNVC Macrogroup: North American Warm Desert Ruderal Scrub & Grassland Macrogroup (M512)

USNVC Group: North American Warm Desert Ruderal Grassland Group (G677)

USNVC Alliance: *Eragrostis lehmanniana - Eragrostis curvula* Ruderal Desert Grassland Alliance (A2687)

NPS Association: *Sorghum halepense* Chihuahuan Desert Herbaceous Vegetation Association (NPSBIBE018)

(Park Name: Johnson Grass - Russian Thistle Desert Grassland)

NPS Association: (*Heteropogon contortus*, *Pennisetum ciliare*, *Eragrostis lehmanniana*) - Mixed Forbs Chihuahuan Ruderal Herbaceous Vegetation Association (NPSBIBE046)

(Park Name: Upland Ruderal Herbaceous Vegetation)

USNVC Class: Open Rock Vegetation Class (6)

USNVC Subclass: Temperate & Boreal Open Rock Vegetation Subclass (6.B)

USNVC Formation: Temperate & Boreal Cliff, Scree & Other Rock Vegetation Formation (6.B.1)

USNVC Division: Western North American Temperate & Boreal Cliff, Scree & Rock Vegetation Division (D052)

USNVC Macrogroup: Western North American Cliff, Scree & Rock Vegetation Macrogroup (M887)

USNVC Group: Western North American Cliff, Scree & Rock Vegetation Group (G565)

USNVC Alliance: Undefined

NPS Association: Chihuahuan Desert Calcareous Outcrop Lichen Vegetation Association (NPSBIBE039)

(Park Name: Calcareous Outcrop Lichen Vegetation)

USNVC Class: Agricultural & Developed Vegetation Class (7)

USNVC Subclass: Developed Vegetation Subclass (7.C)

USNVC Formation: Other Developed Vegetation Formation (7.C.2)

USNVC Division: Other Developed Vegetation Division (7.C.1.2)

USNVC Macrogroup: Tree Developed Vegetation Macrogroup (CGR040)

USNVC Group: Temperate Tree Developed Vegetation Group (CSG045)

USNVC Subformation: Other Developed Vegetation Subformation (7.C.2.1)

USNVC Cultural Group: Tree Developed Vegetation Cultural Group (CGR040)

USNVC Cultural Subgroup: Temperate Tree Developed Vegetation Cultural Subgroup (CSG047)

NPS Cultural Type: *Populus* spp. - *Fraxinus* spp. Planted Woodland Cultural Type (NPSBIBE045)

(Park Name: Mixed Ornamental and Planted Woodland)

Rio Grande Wild and Scenic River Plant Association Descriptions

Mexican Ash - Poison-Ivy Alcove Woodland

Local Type and Concept

Mesic woodlands dominated by *Fraxinus berlandieriana* (Mexican ash) in small patches in rocky, mesic settings in the Lower Canyons of RIGR.

Observation Points Within RIGR Included in Concept

RIGROBS0424, RIGROBS0432, RIGROBS0621, RIGROBS0722, RIGROBS0724, RIGROBS0725

Vegetation

Fraxinus berlandieriana (Mexican ash) usually is the sole dominant in a short tree stratum (< 10 meters tall) that has from 30% to 70% canopy closure. In one stand, *Pistacia mexicana* (Mexican pistachio), is co-dominant. The shrub stratum usually is sparse with *Diospyros texana* (Texas persimmon), *Senegalia berlandieri* (guajillo), *Ungnadia speciosa* (Mexican buckeye), *Prosopis glandulosa* (honey mesquite), *Tamarix ramosissima* (tamarisk), *Vachellia rigidula* (blackbrush), *Baccharis salicifolia* (seepwillow), *Ephedra aspera* (rough jointfir), and *Leucaena retusa* (littleleaf leadtree). Vines are prominent, typically at 5 to 30% cover. Woody species include *Toxicodendron radicans* (eastern poison-ivy) and *Vitis arizonica* (canyon grape); herbaceous species are *Maurandella antirrhiniflora* (climbing snapdragon), *Clematis pitcheri* (Pitcher's clematis), and *Cocculus carolinus* (Carolina coralbead). The herbaceous stratum is usually sparse but may be moderately dense with mostly non-native species. *Cynodon dactylon* (Bermuda grass), *Phragmites australis* (common reed), *Arundo donax* (giant cane), *Polypogon monspeliensis* (annual rabbitsfoot grass), *Rumex crispus* (curly dock), and the native *Helenium microcephalum* (small-headed sneezeweed) were recorded. Stratum and substrate cover for Mexican Ash - Poison-Ivy Woodland are shown in Table D-1.

Table D-1. Stratum and substrate cover recorded for Mexican Ash - Poison-Ivy Woodland at Rio Grande Wild and Scenic River (# observation points=6).

Category	Item	Mean Cover (%)	Range Cover (%)
Stratum	Tree	47	30-70
	Tall Shrub	4	0-12
	Short Shrub	2	0-12
	Herb	23	10-40
Substrate	Bedrock	45	0-97
	Large/Small Rocks	23	0-55
	Litter/Duff	12	0-40

Environment

This association occurs always in small patches in mesic alcoves or ledges on lower cliffs in the Lower Canyons section of RIGR and downstream. It was observed from Mile 46 below La Linda (Las Palmas Rapid) to Mile 82 (near Dryden Crossing). All six stands observed were on the Mexican (north-facing) side of the Rio Grande, suggesting that limited sun exposure within the arid climate conditions is important, if not critical, to the habitat. Although *Fraxinus berlandieriana* occurs also on floodplains, and some of the stands that represent this association may be incidentally flooded, four out of six stands were described as having an upland (i.e., never or seldom flooded) hydrologic regime. The topographic position most often was described as a middle or lower slope and the landform often described as "canyon". Sites were described as moderately steep to very steep, and bedrock and/or boulders constituted large amounts of the ground cover. The flora associated with F. berlandieriana is typical of mesic to somewhat xeric uplands, with some (usually invasive) floodplain species occasionally present.

USNVC Crosswalk

USNVC Class: Forest & Woodland Class (1)

USNVC Subclass: Temperate and Boreal Forest & Woodland Subclass (1.B)

USNVC Formation: Warm Temperate Forest & Woodland Formation (1.B.1)

USNVC Division: Madrean-Balconian Forest & Woodland Division (D060)

USNVC Macrogroup: Balconian Forest & Woodland Macrogroup (M015)

USNVC Group: Balconian Dry-Mesic Hardwood Forest Group (G028)

USNVC Alliance: *Acer grandidentatum - Quercus muehlenbergii - Juglans major* Forest & Woodland Alliance (A3214)

NPS Association: *Fraxinus berlandieriana / Toxicodendron radicans* Alcove Woodland Association (NPSRIGR007)

Comments

Although small and described from observation points only, this vegetation seems to be a continuously repeating assemblage through the Lower Canyons. Because none of the observations were made on the United States side of the Rio Grande, and the Mexican side appears to have better supporting conditions (more shaded exposures), this association might be considered more as potential than documented for United States and the USNVC, although a limited amount of the vegetation might be expected to occur somewhere on the Texas side, especially in short sections in which the river deviates somewhat from its generally west-to-east course.

The described association concept does not include stands with *F. berlandieriana* on floodplains. Where *F. berlandieriana* does occur on floodplains (which are of limited extent in the Lower canyons), it usually is as scattered trees that are best treated as a component of other associations of floodplain settings.

This association poses a U NVC hierarchy placement challenges from two perspectives. First, the apparent ability for *F. berlandieriana* to persist both on floodplains and in mesic uplands and the fact

that some stands may be very occasionally flooded pose a Formation placement challenge. Moreover, the location of the Lower Canyons near the intersection of several USNVC Divisions (variously representing Balconian, Madrean, Tamaulipan, and Western Arid Interior biomes) and the general scarcity of precedent-setting mesic deciduous forests and woodlands in this arid region makes USNVC Division and Macrogroup assignment somewhat ambiguous. The USNVC Balconian Dry-Mesic Hardwood Forest Group (G028) was judged to be the best placement for this local vegetation. Even though it is somewhat a geographic outlier from the Balconian (Edwards Plateau) region, it is related to mesic Balconian canyon forests in having a similar upland mesic setting in a lowland arid climate.

Pistacia mexicana (Mexican pistachio), known in the United States only along the Rio Grande in Val Verde County, occurs in this vegetation type.



Photo 1. Mexican Ash - Poison-Ivy Alcove Woodland, at mile 46 below La Linda, Mexican side of Rio Grande, across river from Palmas Canyon (RIGROBS0432) (Jessica Strickland).



Photo 2. Mexican Ash - Poison-Ivy Alcove Woodland (on cliff), near mile 76 below La Linda, Mexican side of Rio Grande, across river from Middle Watering (RIGROBS0722) (Phillip Schulze).

Cottonwood - Goodding Willow Spring Woodland

Local Type and Concept

Closed to open (forest to woodland, occasionally tall shrubland) stands of *Populus fremontii* ssp. *mesetae* (Arizona cottonwood) and/or *Salix gooddingii* (Goodding willow) associated with springs or other groundwater emergences.

Classification Plots Within RIGR Included in Concept

BIBE3009, BIBE3022, BIBE3026

Vegetation

In the tree stratum, a combination of *Populus fremontii* ssp. *mesetae* (Arizona cottonwood) and/or *Salix gooddingii* (Goodding willow) is dominant. Although *P. fremontii* ssp. *mesetae* often is more prominent, *S. gooddingii* is the more constant species. *Prosopis pubescens* (screwbean mesquite) is not as constant as the other species but is characteristic and may co-dominate. When they are present, P. fremontii and *P. pubescens* both are fairly reliable indicators of this association. *S. gooddingii*, *P. pubescens*, *Prosopis glandulosa* (honey mesquite), *Baccharis salicifolia* (seepwillow), and *Diospyros texana* (Texas persimmon) are the most constant shrubs in a tall (usually 2 to 5 meters) shrub stratum. Herb stratum composition is variable; this heterogeneity may represent some vegetation from surrounding vegetation habitats (floodplain, dry wash) being included with the spring-influenced species in the sampling. *Andropogon glomeratus* (bushy bluestem), *Bothriochloa ischaemum* (yellow bluestem), *Bothriochloa laguroides* (silver bluestem), and *Sporobolus airoides* (alkali sacaton) are the most constant species. *Clematis drummondii* (Drummond's clematis) and *Maurandella antirrhiniflora* (climbing snapdragon) are occasionally occurring vines. Stratum and substrate cover for Cottonwood - Goodding Willow Spring Woodland are shown in Table D-2.

Table D-2. Stratum and substrate cover recorded for Cottonwood - Goodding Willow Spring Woodland at Big Bend National Park and Rio Grande Wild and Scenic River (# plots=15).

Category	Item	Mean Cover (%)	Range Cover (%)
Stratum	Tree	48	0-100
	Tall Shrub	15	5-50
	Short Shrub	9	1-31
	Herb	23	4-85
Substrate	Bedrock	0	0-2
	Large/Small Rocks	12	0-70
	Litter/Duff	44	2-93

Environment

This association occurs in small patches around springs and other groundwater emergences, which often occur within otherwise dry washes or on more elevated parts of the Rio Grande floodplain.

Within RIGR, stands are small and somewhat marginal. All known RIGR stands are in the Hot Springs to Boquillas area, within the Big Bend National Park section.

USNVC Crosswalk

USNVC Class: Forest & Woodland Class (1)

USNVC Subclass: Temperate and Boreal Forest & Woodland Subclass (1.B)

USNVC Formation: Temperate Flooded & Swamp Forest Formation (1.B.3)

USNVC Division: Western North American Interior Flooded Forest Division (D013)

USNVC Macrogroup: Interior Warm & Cool Desert Riparian Forest Macrogroup (M036)

USNVC Group: Western Interior Riparian Forest & Woodland Group (G797)

USNVC Alliance: *Populus fremontii - Fraxinus velutina - Salix gooddingii* Flooded Forest and Woodland Alliance (A3803)

USNVC Association: *Populus fremontii - Salix gooddingii* Riparian Woodland Association (CEGL000944)

Comments

This association, as described, is somewhat heterogeneous in floristic composition, but further segregation would leave a large number of clusters with just a few plots, each of which seems difficult to interpret. It is possible that some variability within plots assigned to this unit may be due to some plots being placed across steep hydrological gradients, in areas where the surface water source is limited in extent.

A number of associations within the USNVC (2017) *Populus fremontii - Fraxinus velutina - Salix gooddingii* Flooded Forest & Woodland Alliance (A3803) may fit this vegetation, at least in part. The translation to the *Populus fremontii - Salix gooddingii* Riparian Woodland (CEGL000944) was made because it includes the occurrence of both of the most constant tree species. However, that association is a somewhat awkward biogeographical fit because of its extension into the Colorado Plateau. The *Salix gooddingii / Muhlenbergia rigens* Riparian Woodland (CEGL005982), attributed to southeastern New Mexico, may fit the RIGR vegetation better, based on phytogeographic criteria. Most frequent plant taxa recorded in Cottonwood - Goodding Willow Spring Woodland are shown in Table D-3.

Table D-3. Synthesis table for the most frequent plant taxa recorded in Cottonwood - Goodding Willow Spring Woodland at Big Bend National Park and Rio Grande Wild and Scenic River (# plots=15).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Salix gooddingii	Tree / Shrub	86.7%	17.4	0-50
Populus fremontii ssp. *mesetae*	Tree	66.7%	18.9	0-75
Prosopis glandulosa	Shrub/Tree	86.7%	3.2	0-25
Baccharis salicifolia	Shrub	80.0%	8.2	0-45

Table D-3 (continued). Synthesis table for the most frequent plant taxa recorded in Cottonwood - Goodding Willow Spring Woodland at Big Bend National Park and Rio Grande Wild and Scenic River (# plots=15).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Tamarix ramosissima	Shrub / Tree	66.7%	3.6	0-25
Prosopis pubescens	Shrub / Tree	53.3%	10.4	0-50
Ziziphus obtusifolia	Shrub	46.7%	0.3	0-2
Diospyros texana	Shrub	26.7%	0.4	0-2
Guaiacum angustifolium	Shrub	26.7%	0.3	0-1
Larrea tridentata	Shrub	20.0%	0.1	0-1
Nicotiana glauca	Shrub	20.0%	0.1	0-1
Hymenoclea monogyra	Shrub	13.3%	1.3	0-5
Rhus virens	Shrub	13.3%	0.7	0-5
Celtis ehrenbergiana	Shrub	13.3%	0.1	0-2
Senegalia roemeriana	Shrub	13.3%	0.1	0-1
Rhus microphylla	Shrub	13.3%	0.1	0-1
Viguiera stenoloba	Shrub	13.3%	<0.1	0-1
Clematis drummondii	Vine	20.0%	0.1	0-2
Maurandella antirrhiniflora	Vine	20.0%	0.1	0-1
Andropogon glomeratus	Herb	26.7%	1.3	0-25
Nicotiana obtusifolia	Herb	26.7%	0.1	0-1
Cynodon dactylon	Herb	20.0%	6.0	0-95
Bothriochloa ischaemum	Herb	20.0%	4.5	0-75
Bothriochloa laguroides	Herb	20.0%	2.3	0-50
Adiantum capillus-veneris	Herb	20.0%	0.4	0-2
Sporobolus airoides	Herb	20.0%	0.2	0-2
Sorghum halepense	Herb	13.3%	4.3	0-75
Thelypteris ovata var. *lindheimeri*	Herb	13.3%	1.3	0-25
Toxicodendron radicans	Herb	13.3%	0.4	0-10
Imperata brevifolia	Herb	13.3%	0.3	0-5
Samolus ebracteatus	Herb	13.3%	0.1	0-1
Aristida purpurea	Herb	13.3%	0.1	0-1

Table D-3 (continued). Synthesis table for the most frequent plant taxa recorded in Cottonwood - Goodding Willow Spring Woodland at Big Bend National Park and Rio Grande Wild and Scenic River (# plots=15).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Eustoma exaltatum	Herb	13.3%	0.1	0-1
Teucrium laciniatum	Herb	13.3%	0.1	0-1
Verbesina encelioides	Herb	13.3%	0.1	0-1
Heliotropium curassavicum	Herb	13.3%	<0.1	0-1



Photo 3. Cottonwood - Goodding Willow Spring Woodland, near Boquillas Crossing, Big Bend National Park (BIBE3009) (Karen Clary).



Photo 4. Cottonwood - Goodding Willow Spring Woodland, Hot Springs, Big Bend National Park (BIBE3022) (Damon Waitt).

Rio Grande Willow Riparian Bosque

Local Type and Concept

Stands dominated or co-dominated by *Salix* spp. (willows) that occur within the zone of flooding influence of the Rio Grande.

Classification Plots Within RIGR Included in Concept

BIBE3021, RIGR2008, RIGR2009, RIGR2010, RIGR2018, RIGR2108, RIGR2111

Vegetation

Either *Salix gooddingii* (Goodding willow) or *Salix thurberi* (Thurber's willow) (= *Salix exigua*, in the broad sense, in part), is dominant in a short tree (> 5 meters tall) or a tall shrub (< 5 meters tall) stratum. Infrequently, both species may be present. *Tamarix ramosissima* (tamarisk) and *Baccharis salicifolia* (seepwillow) usually are present and occasionally may co-dominate that stratum. Low cover woody species may include *Nicotiana glauca* (tree tobacco), *Prosopis glandulosa* (honey mesquite), *Vachellia farnesiana* (huisache), and/or *Parkinsonia aculeata* (retama). The herbaceous stratum cover varies from either sparse to dense. *Cynodon dactylon* (Bermuda grass), *Phragmites australis* (common reed) and/or *Arundo donax* (giant cane) may occur at fairly dense cover; otherwise, the herbaceous stratum tends to be sparse, with a wide variety of [usually ruderal] species possibly present in small amounts. Stratum and substrate cover for Rio Grande Willow Riparian Bosque are shown in Table D-4.

Table D-4. Stratum and substrate cover recorded for Rio Grande Willow Riparian Bosque at Big Bend National Park and Rio Grande Wild and Scenic River (# plots=9).

Category	Item	Mean Cover (%)	Range Cover (%)
Stratum	Tree	60	0-100
	Tall Shrub	28	0-98
	Short Shrub	3	0-8
	Herb	26	2-85
Substrate	Bedrock	4	0-35
	Large/Small Rocks	4	0-35
	Litter/Duff	26	3-60

Environment

This vegetation was observed throughout RIGR. It usually occurs on moist alluvial bars, banks, and floodplains. It often occurs in stands that are too small to be mapped.

USNVC Crosswalk

USNVC Class: Forest & Woodland Class (1)

USNVC Subclass: Temperate and Boreal Forest & Woodland Subclass (1.B)

USNVC Formation: Temperate Flooded & Swamp Forest Formation (1.B.3)

USNVC Division: Western North American Interior Flooded Forest Division (D013)

USNVC Macrogroup: Interior Warm & Cool Desert Riparian Forest Macrogroup (M036)

USNVC Group: Western Interior Riparian Forest & Woodland Group (G797)

USNVC Alliance: *Populus fremontii - Fraxinus velutina - Salix gooddingii* Flooded Forest & Woodland Alliance (A3803)

NPS Association: *Salix* (*gooddingii, thurberi*) Rio Grande Woodland Association (NPSBIBE019)

Comments

Because few stands were sampled early in the project and there was uncertainty about the potential co-occurrence and environmental equivalence of the most common willow species involved, a broadly-defined Rio Grande willow type was applied to cover all combinations of willow species (e.g., *Salix gooddingii, Salix thurberi,* and the apparently infrequent *Salix exigua)* and to cover both shrubland and woodland stand physiognomies. Since the two most common willow species that occur along this section of the Rio Grande, *S. gooddingii* (more often of tree stature) and *S. thurberi* (often shrubby) seem mostly not to co-occur, it may prove best ultimately to split this unit into two associations, one for each species that may be dominant in an individual stand.

This association is more related floristically to other alluvial shrubland and woodland associations along the Rio Grande than it is to the Coyote Willow Spring Shrubland, which occurs near groundwater emergences along smaller drainages.

The taxonomic concept of *Salix gooddingii* (Goodding willow) previously has been subsumed under the closely related and more eastern *Salix nigra.* (e.g., Turner et al. 2003). This alternative taxonomic treatment probably accounts for reports of *S. nigra* from BIBE. Powell and Worthington (2018) concluded that most Trans-Pecos willows from this complex are either *S. gooddingii* or hybrids between *S. gooddingii* and *S. nigra* (in the narrow sense). In its pure form, the latter taxon is sporadic in the Trans-Pecos and, when present, is usually in the most southeastern portion.

Salix thurberi is closely related to and similar to *Salix exigua*, and, traditionally, the two entities have been subsumed under a broad concept of *S. exigu*a. For purposes of this classification, *S. thurberi* is segregated as a distinct species, and is the primary member of the *S. exigua* complex in southern Texas and northeastern Mexico and in RIGR. *S. exigua* (in the narrow sense) has been recorded along the Rio Grande upstream from RIGR at Terlingua Creek (Powell and Worthington (2018). Most frequent plant taxa recorded in Rio Grande Willow Riparian Bosque are shown in Table D-5.

Table D-5. Synthesis table for all plant taxa recorded in Rio Grande Willow Riparian Bosque at Big Bend National Park and Rio Grande Wild and Scenic River (# plots=9).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Salix thurberi	Shrub	66.7%	75.9	0-100
Baccharis salicifolia	Shrub	66.7%	11.8	0-27
Tamarix ramosissima	Shrub	66.7%	6.8	0-40
Nicotiana glauca	Shrub	66.7%	0.9	0-5
Prosopis glandulosa	Shrub	44.4%	0.7	0-2
Salix gooddingii	Shrub	33.3%	56.0	0-85
Vachellia farnesiana	Shrub	22.2%	8.8	0-25
Tamarix aphylla	Shrub	11.1%	1.5	0-2
Celtis laevigata var. *reticulata*	Shrub	11.1%	1.0	0-2
Fraxinus berlandieriana	Shrub	11.1%	0.5	0-1
Ziziphus obtusifolia var. *obtusifolia*	Shrub	11.1%	0.5	0-1
Arundo donax	Herb	88.9%	10.9	0-50
Cynodon dactylon	Herb	77.8%	12.4	0-50
Phragmites australis	Herb	44.4%	10.5	0-50
Heliotropium curassavicum	Herb	22.2%	0.3	0-1
Schoenoplectus pungens var. longispicatus	Herb	11.1%	37.5	0-50
Typha domingensis	Herb	11.1%	17.5	0-25
Bothriochloa ischaemum	Herb	11.1%	0.5	0-1
Eustoma exaltatum	Herb	11.1%	0.5	0-1
Pennisetum ciliare	Herb	11.1%	0.5	0-1
Phyla nodiflora	Herb	11.1%	0.5	0-1
Polygonum	Herb	11.1%	0.5	0-1
Polypogon monspeliensis	Herb	11.1%	0.5	0-1
Sorghum halepense	Herb	11.1%	0.5	0-1
Allionia incarnata	Herb	11.1%	0.1	0-trace
Baileya multiradiata	Herb	11.1%	0.1	0-trace
Boerhavia coccinea	Herb	11.1%	0.1	0-trace

Table D-5 (continued). Synthesis table for all plant taxa recorded in Rio Grande Willow Riparian Bosque at Big Bend National Park and Rio Grande Wild and Scenic River (# plots=9).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Bolboschoenus maritimus ssp. *paludosus*	Herb	11.1%	0.1	0-trace
Centaurium calycosum	Herb	11.1%	0.1	0-trace
Chenopodium	Herb	11.1%	0.1	0-trace
Clematis drummondii	Herb	11.1%	0.1	0-trace
Cyperus laevigatus	Herb	11.1%	0.1	0-trace
Helenium amarum	Herb	11.1%	0.1	0-trace
Machaeranthera	Herb	11.1%	0.1	0-trace
Nama havardii	Herb	11.1%	0.1	0-trace
Nerisyrenia camporum	Herb	11.1%	0.1	0-trace
Oenothera curtiflora	Herb	11.1%	0.1	0-trace
Orobanche cooperi	Herb	11.1%	0.1	0-trace
Perityle vaseyi	Herb	11.1%	0.1	0-trace
Rumex crispus	Herb	11.1%	0.1	0-trace
Rumex maritimus	Herb	11.1%	0.1	0-trace
Solanum	Herb	11.1%	0.1	0-trace
Sphaeralcea angustifolia	Herb	11.1%	0.1	0-trace
Thymophylla aurea var. *aurea*	Herb	11.1%	0.1	0-trace
Verbena neomexicana var. *hirtella*	Herb	11.1%	0.1	0-trace
Xanthium strumarium	Herb	11.1%	0.1	0-trace



Photo 5. Rio Grande Riparian Willow Bosque with *Salix thurberi*, Rio Grande at mile 95 below La Linda (RIGR2008) (Jeff Renfrow).



Photo 6. Rio Grande Riparian Willow Bosque with *Salix gooddingii*, Rio Grande floodplain near Terrell - Val Verde County line (RIGR2111) (Kelon Crawford).

Huisache Riparian Bosque

Local Type and Concept
Riparian woodlands or tall shrublands immediately along the Rio Grande, with Vachellia farnesiana (huisache) dominant or co-dominant in the uppermost stratum.

Classification Plots Within RIGR Included in Concept
RIGR2011, RIGR2024

Observation Points Within RIGR Included in Concept
RIGROBS0223, RIGROBS0233, RIGROBS0234, RIGROBS0325, RIGROBS0335, RIGROBS0521

Accuracy Assessment Sites Within RIGR Included in Concept
RIGRAA1011, RIGRAA1017, RIGRAA1112, RIGRAA1113

Vegetation
Vachellia farnesiana (=*Acacia farnesiana*) (huisache) usually is dominant in the uppermost (tree or tall shrub) stratum, which is usually 3 to 7 meters high. It achieves a higher proportion of dominance and higher cover in stands with woodland physiognomy. In stands with shrubby physiognomy, stands may be relatively open, and dominance by *V. farnesiana* may be shared with *Prosopis glandulosa* (honey mesquite), *Tamarix ramosissima* (tamarisk) and *Baccharis salicifolia* (seepwillow), and/or *Nicotiana glauca* (tree tobacco). The most frequent shorter shrubs are *Tamarix ramosissima*, *Prosopis glandulosa* (honey mesquite), *Baccharis salicifolia* and/or *Cephalanthus occidentalis* (common buttonbush). The most constant and abundant herbaceous species include *Cynodon dactylon* (Bermuda grass), *Bacopa monnieri* (water hyssop), *Eleocharis* spp. (spike rushes), and *Arundo donax* (giant cane). Stratum and substrate cover for Huisache Riparian Bosque are shown in Table D-6.

Table D-6. Stratum and substrate cover recorded for Huisache Riparian Bosque at Rio Grande Wild and Scenic River (#n=8, 6 observation points, 2 plots).

Category	Item	Mean Cover (%)	Range Cover (%)
Stratum	Tree	33	0-100
	Tall Shrub	15	0-95
	Short Shrub	3	0-20
	Herb	36	2-95
Substrate	Bedrock	0	0-0
	Large/Small Rocks	19	0-60
	Litter/Duff	25	0-98

Environment

This type was encountered along the Rio Grande below La Linda from near river Mile 22.5 to the Terrell / Val Verde County line (Mile 120). Although V. farnesiana occurs with BIBE, this association probably does not occur within the Big Bend National Park section of RIGR. Huisache-dominated woodlands and tall shrublands appear to occur mostly on bars and low parts of floodplains, including high water channels, in lower and moister settings than mesquite-dominated vegetation.

USNVC Crosswalk

USNVC Class: Forest & Woodland Class (1)

USNVC Subclass: Temperate and Boreal Forest & Woodland Subclass (1.B)

USNVC Formation: Temperate Flooded & Swamp Forest Formation (1.B.3)

USNVC Division: Western North American Interior Flooded Forest Division (D013)

USNVC Macrogroup: Interior Warm & Cool Desert Riparian Forest Macrogroup (M036)

USNVC Group: Tamaulipan Wet-Mesic Scrub Forest Group (G549)

USNVC Alliance: *Vachellia farnesiana* - *Celtis pallida* Riparian Scrub Alliance (A3841)

USNVC Association: *Vachellia farnesiana* - (*Prosopis glandulosa*) Woodland Association (CEGL002131)

Comments

While it is uncertain whether this is the same association as the similar named type at Amistad National Recreation Area, it is similar enough to treat it as the same USNVC association. Most frequent plant taxa recorded in Huisache Riparian Bosque are shown in Table D-7.

Table D-7. Synthesis table for the most frequent plant taxa recorded in Huisache Riparian Bosque at Rio Grande Wild and Scenic River (# plots=2).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Vachellia farnesiana	Tree	100.0%	75.5	50-100
Baccharis salicifolia	Shrub	50.0%	2.0	0-4
Prosopis glandulosa	Shrub	50.0%	1.5	0-3
Celtis laevigata var. *reticulata*	Shrub	50.0%	0.3	0-1
Porophyllum scoparium	Shrub	50.0%	0.3	0-1
Cynodon dactylon	Herb	100.0%	9.5	1-25
Arundo donax	Herb	100.0%	5.5	2-10
Erigeron sp.	Herb	50.0%	0.3	0-1

Table D-7 (continued). Synthesis table for the most frequent plant taxa recorded in Huisache Riparian Bosque at Rio Grande Wild and Scenic River (# plots=2).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Gaillardia sp.	Herb	50.0%	0.3	0-1
Lactuca sp.	Herb	50.0%	0.3	0-1
Rumex sp.	Herb	50.0%	0.3	0-1
Xanthium strumarium	Herb	50.0%	0.3	0-1
Lupinus havardii	Herb	50.0%	0.1	0-trace
Panicum sp.	Herb	50.0%	0.1	0-trace



Photo 7. Huisache Riparian Bosque, floodplain of Rio Grande at mile 18 below La Linda, Black Gap Wildlife Management Area (RIGRAA1112) (Jeff Renfrow).



Photo 8. Huisache Riparian Bosque, floodplain of Rio Grande at mile 40 below La Linda, San Rosendo Canyon (below Hot Springs Rapid) (RIGROBS0335). (Jessica Strickland).

Tamarisk - (Tree Tobacco) Riparian Shrubland

Local Type and Concept

Stands dominated or co-dominated by *Tamarix ramosissima* (tamarisk) and, occasionally by *Tamarix aphylla* (athel tamarisk) and/or tree tobacco (*Nicotiana glauca*), occurring in the riparian zone of Rio Grande.

Classification Plots Within RIGR Included in Concept

BIBE0238, BIBE3004

Observation Points Within RIGR Included in Concept

RIGROBS0121, RIGROBS0122, RIGROBS0125, RIGROBS0131, RIGROBS0132, RIGROBS0133, RIGROBS0221, RIGROBS0232, RIGROBS0235, RIGROBS0334, RIGROBS0422, RIGROBS0536, RIGROBS0734

Accuracy Assessment Sites Within RIGR Included in Concept

RIGRAA1021

Vegetation

A combination of *Tamarix ramosissima* (tamarisk) and/or *Nicotiana glauca* (tree tobacco), separately or in some combination, dominates a rather open to mostly closed tall shrub stratum. In most cases, *N. glauca* is a minor species. *Tamarix aphylla* (athel tamarisk) may occur as scattered trees or taller shrubs but is not consistently present. The most constant tall shrub associates are *Baccharis salicifolia* (seepwillow), *Prosopis glandulosa* (honey mesquite), and *Parkinsonia aculeata* (retama). *Chloracantha spinosa* (devilweed) and *Porophyllum scoparium* (shrubby poreleaf) are occasional short shrubs. The herbaceous stratum varies from rather sparse to dense. It usually is dominated by ruderal non-native species, any of which may be locally dominant. These include *Cynodon dactylon* (Bermuda grass), *Arundo donax* (giant cane), and *Salsola tragus* (Russian thistle). Somewhat less constant and less abundant herbaceous species are *Rumex crispus* (curly dock), *Phragmites australis* (common reed), *Pennisetum ciliare* (buffelgrass), *Sorghum halepense* (Johnson grass), and *Sphaeralcea angustifolia* (copper globemallow). Stratum and substrate cover for Tamarisk - (Tree Tobacco) Riparian Shrubland are shown in Table D-8.

Table D-8. Stratum and substrate cover recorded for Tamarisk - (Tree Tobacco) Riparian Shrubland at Big Bend National Park and Rio Grande Wild and Scenic River (n=16, 13 observation points, 3 plots).

Category	Item	Mean Cover (%)	Range Cover (%)
Stratum	Tree	0	0-0
	Tall Shrub	31	2-60
	Short Shrub	34	4-64
	Herb	8	5-10

Table D-8 (continued). Stratum and substrate cover recorded for Tamarisk - (Tree Tobacco) Riparian Shrubland at Big Bend National Park and Rio Grande Wild and Scenic River (n=16, 13 observation points, 3 plots).

Category	Item	Mean Cover (%)	Range Cover (%)
Substrate	Bedrock	0	0-0
	Large/Small Rocks	0	0-0
	Litter/Duff	25	20-30

Environment

The type is distributed along banks and floodplains throughout RIGR. It may extend up larger tributary streams a short distance. This vegetation tends to occur on higher bars and low floodplains, at similar elevations above water level to that of the Bermuda Grass Riparian Herbaceous Vegetation.

USNVC Crosswalk

USNVC Class: Forest & Woodland Class (1)

USNVC Subclass: Temperate and Boreal Forest & Woodland Subclass (1.B)

USNVC Formation: Temperate Flooded & Swamp Forest Formation (1.B.3)

USNVC Division: Western North American Interior Flooded Forest Division (D013)

USNVC Macrogroup: Interior West Ruderal Flooded & Swamp Forest Macrogroup (M298)

USNVC Group: Interior West Ruderal Riparian Forest & Scrub Group (G510)

USNVC Alliance: *Tamarix* spp. Ruderal Riparian Scrub Alliance (A0842)

USNVC Association: *Tamarix* spp. Temporarily Flooded Semi-natural Shrubland Association (CEGL003114)

Comments

This vegetation type recently has decreased in terms of both the size and abundance of stands within BIBE, evidently due to releases and rapid population increases of tamarisk beetles (*Diorhabda* spp.) and subsequent Tamarix mortality. This phenomenon was observed during the map accuracy assessment, with a number of tamarisk stands that were mapped just a few years earlier found to be in decline. Most frequent plant taxa recorded in Tamarisk – (Tree Tobacco) Riparian Shrubland are shown in Table D-9.

Table D-9. Synthesis table for all plant taxa recorded in Tamarisk – (Tree Tobacco) Riparian Shrubland at Big Bend National Park and Rio Grande Wild and Scenic River (#plots=3).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Baccharis salicifolia	Shrub	100.0%	12.2	few-28
Tamarix ramosissima	Shrub	66.7%	33.6	0-78
Tamarix aphylla	Tree /Shrub	66.7%	14.6	0-60
Prosopis glandulosa	Shrub	66.7%	6.0	0-25
Nicotiana glauca	Shrub	66.7%	0.2	0-1
Chloracantha spinosa	Shrub	33.3%	0.2	0-1
Selinocarpus angustifolius	Shrub	33.3%	0.2	0-1
Chrysothamnus baileyi	Shrub	33.3%	<0.1	0-trace
Cynodon dactylon	Herb	66.7%	13.0	0-50
Arundo donax	Herb	66.7%	1.2	0-5
Sphaeralcea angustifolia	Herb	66.7%	0.7	0-2
Heliotropium curassavicum	Herb	66.7%	0.2	0-1
Eustoma exaltatum	Herb	33.3%	1.2	0-5
Helenium microcephalum	Herb	33.3%	0.5	0-2
Salsola tragus	Herb	33.3%	0.5	0-2
Allionia incarnata	Herb	33.3%	0.2	0-1
Bouteloua trifida	Herb	33.3%	0.2	0-1
Machaeranthera pinnatifida	Herb	33.3%	0.2	0-1
Machaeranthera tanacetifolia	Herb	33.3%	0.2	0-1
Nerisyrenia camporum	Herb	33.3%	0.2	0-1
Pectis angustifolia	Herb	33.3%	0.2	0-1
Phragmites australis	Herb	33.3%	0.2	0-1
Schoenoplectus pungens var. *longispicatus*	Herb	33.3%	0.2	0-1
Sorghum halepense	Herb	33.3%	0.2	0-1
Sporobolus cryptandrus	Herb	33.3%	0.2	0-1
Xanthium strumarium	Herb	33.3%	0.2	0-1
Cirsium texanum	Herb	33.3%	<0.1	0-trace
Helianthus annuus	Herb	33.3%	<0.1	0-trace

Table D-9 (continued). Synthesis table for all plant taxa recorded in Tamarisk – (Tree Tobacco) Riparian Shrubland at Big Bend National Park and Rio Grande Wild and Scenic River (#plots=3).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Sonchus sp.	Herb	33.3%	<0.1	0-trace
Thymophylla pentachaeta	Herb	33.3%	<0.1	0-trace



Photo 9. Tamarisk Riparian Shrubland, Rio Grande at mile 21 below La Linda, Black Gap Wildlife Management Area (RIGROBS221) (Phillip Schulze).



Photo 10. Tamarisk Riparian Shrubland, Rio Grande at mile 29 below La Linda, below Reagan Canyon, Lower Canyons (RIGROBS235) (Jessica Strickland).

Rio Grande Mesquite Riparian Bosque

Local Type and Concept
Shrublands or woodlands on floodplains or alluvial terraces with *Prosopis glandulosa* (honey mesquite) dominant in the uppermost stratum.

Classification Plots Within RIGR Included in Concept
BIBE0017, BIBE0236, BIBE0237, BIBE3028, RIGR2023, RIGR2107, RIGR2110

Observation Points Within RIGR Included in Concept
RIGROBS0224, RIGROBS0226, RIGROBS0227, RIGROBS0231, RIGROBS0237, RIGROBS0332, RIGROBS0337, RIGROBS0421, RIGROBS0431, RIGROBS0433, RIGROBS0731, RIGROBS0732

Accuracy Assessment Sites Within RIGR Included in Concept
BIBEAA1028, BIBEAA1037, BIBEAA1038, BIBEAA1042, BIBEAA1091, BIBEAA1093, BIBEAA1094, BIBEAA1096, BIBEAA1097, BIBEAA1098, BIBEAA1117, BIBEAA1119, BIBEAA1120, BIBEAA1127, BIBEAA1128, BIBEAA1132, BIBEAA1133, BIBEAA1134, BIBEAA1135, BIBEAA1253, RIGRAA1012, RIGRAA1013, RIGRAA1014, RIGRAA1015, RIGRAA1016, RIGRAA1018, RIGRAA1019, RIGRAA1020, RIGRAA1100, RIGRAA1101

Vegetation
Prosopis glandulosa (honey mesquite) is dominant, and often strongly so, in a short tree or tall shrub stratum that ranges from about 15% to 70% cover. Species that are present as low cover tall shrubs include, in descending order of constancy, *Tamarix ramosissima* (tamarisk), *Baccharis salicifolia* (seepwillow), *Ziziphus obtusifolia* (lotebush), *Larrea tridentata* (creosotebush), *Celtis ehrenbergiana (= C. pallida*, spiny hackberry), *Guaiacum angustifolium* (guayacan), *Nicotiana glauca* (tree tobacco), *Lycium berlandieri* (Berlandier's wolfberry), *Parkinsonia aculeata* (retama), *Vachellia farnesiana* (huisache) (mostly from San Vicente downstream), and *Tamarix aphylla* (athel tamarisk). The last two species may reach tree stature, as may *T. ramosissima*. *Atriplex canescens* (fourwing saltbush), *Cylindropuntia leptocaulis* (Christmas cactus), and *Echinocereus enneacanthus* (pitaya cactus) are occasional shorter shrubs. The herbaceous stratum usually is sparse, but occasionally may have moderate to quite dense cover, where either of the non-native grasses *Arundo donax* (giant cane), *Cynodon dactylon* (Bermuda grass), or *Pennisetum ciliare* (buffelgrass) may be well-established. Lower cover and less constant herbaceous species may include *Nicotiana obtusifolia* (desert tobacco), *Sphaeralcea angustifolia* (copper globemallow), and *Verbesina encelioides* (golden crownbeard), and *Parietaria pensylvanica* (Pennsylvania pellitory). Stratum and substrate cover for Rio Grande Mesquite Riparian Bosque are shown in Table D-10.

Table D-10. Stratum and substrate cover recorded for Rio Grande Mesquite Riparian Bosque at Big Bend National Park and Rio Grande Wild and Scenic River (n=18, 7 observation points, 11 plots).

Category	Item	Mean Cover (%)	Range Cover (%)
Stratum	Tree	11	0-60
	Tall Shrub	14	0-50
	Short Shrub	15	1-50
	Herb	14	1-70
Substrate	Bedrock	0	0-0
	Large/Small Rocks	0	0-1
	Litter/Duff	25	1-55

Environment

This vegetation was recorded throughout RIGR. It tends to occur on floodplains (occasionally on higher terraces), at similar elevations above water level to (or slightly higher than) that of the Giant Cane Riparian Herbaceous Vegetation.

USNVC Crosswalk

USNVC Class: Shrub & Herb Vegetation Class (2)

USNVC Subclass: Shrub & Herb Wetland Subclass (2.C)

USNVC Formation: Temperate to Polar Freshwater Marsh, Wet Meadow and Shrubland Formation (2.C.4)

USNVC Division: Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow and Shrubland Division (D031)

USNVC Macrogroup: Warm Desert Lowland Freshwater Marsh, Meadow & Shrubland Macrogroup (M076)

USNVC Group: North American Warm Desert Riparian Low Bosque & Shrubland Group (G533)

USNVC Alliance: *Prosopis glandulosa - Prosopis velutina - Prosopis pubescens* Wet Scrub Alliance (A3877)

USNVC Association: *Prosopis glandulosa* Wet Scrub Association (CEGL004934)

Comments

The USNVC (2017) concept of *Prosopis glandulosa* Wet Scrub (CEGL004934) has no floristic description and very little information, but is reported from arid regions of Texas and, so, is used for the USNVC translation. Most frequent plant taxa recorded in Rio Grande Mesquite Riparian Bosque are shown in Table D-11.

Table D-11. Synthesis table for the most frequent plant taxa recorded in Rio Grande Mesquite Riparian Bosque at Big Bend National Park and Rio Grande Wild and Scenic River (# plots=11).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Prosopis glandulosa	Shrub / Tree	100.0%	36.6	9-75
Larrea tridentata	Shrub	54.5%	1.7	0-11
Guaiacum angustifolium	Shrub	36.4%	1.4	0-12
Cylindropuntia leptocaulis	Shrub	36.4%	0.2	0-2
Lycium berlandieri	Shrub	27.3%	2.7	0-25
Tamarix ramosissima	Shrub / Tree	27.3%	2.0	0-25
Baccharis salicifolia	Shrub	27.3%	0.5	0-7
Celtis ehrenbergiana	Shrub	18.2%	2.3	0-35
Echinocereus enneacanthus	Shrub	18.2%	0.7	0-10
Atriplex canescens	Shrub	18.2%	0.5	0-5
Ziziphus obtusifolia	Shrub	18.2%	0.2	0-2
Gutierrezia sp.	Shrub	18.2%	0.018	0-trace
Opuntia camanchica	Shrub	9.1%	0.7	0-10
Vachellia farnesiana	Shrub / Tree	9.1%	0.7	0-10
Ziziphus obtusifolia var. *obtusifolia*	Shrub	9.1%	0.3	0-5
Aloysia gratissima	Shrub	9.1%	0.1	0-2
Diospyros texana	Shrub	9.1%	0.1	0-2
Salix gooddingii	Shrub	9.1%	0.1	0-2
Viguiera stenoloba	Shrub	9.1%	0.1	0-2
Tamarix aphylla	Shrub / Tree	9.1%	0.1	0-2
Clematis drummondii	Vine	9.1%	0.3	0-5
Funastrum cynanchoides	Vine	9.1%	0.3	0-5
Cynodon dactylon	Herb	36.4%	7.8	0-50
Pennisetum ciliare	Herb	36.4%	5.8	0-75
Nicotiana obtusifolia	Herb	36.4%	0.2	0-2
Arundo donax	Herb	27.3%	1.5	0-10
Physalis sp.	Herb	27.3%	0.1	0-1
Parietaria pensylvanica	Herb	18.2%	1.0	0-10

Table D-11 (continued). Synthesis table for the most frequent plant taxa recorded in Rio Grande Mesquite Riparian Bosque at Big Bend National Park and Rio Grande Wild and Scenic River (# plots=11).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Poa sp.	Herb	18.2%	0.5	0-5
Verbesina encelioides	Herb	18.2%	0.4	0-5
Nicotiana obtusifolia	Herb	18.2%	0.2	0-2
Lupinus havardii	Herb	18.2%	0.1	0-1
Bahia absinthifolia	Herb	18.2%	0.1	0-1
Chamaesyce sp.	Herb	18.2%	0.1	0-1
Sphaeralcea angustifolia	Herb	18.2%	0.1	0-1
Bouteloua barbata	Herb	9.1%	0.7	0-10
Parthenium confertum	Herb	9.1%	0.1	0-2
Sporobolus airoides	Herb	9.1%	0.1	0-2
Verbena plicata	Herb	9.1%	0.1	0-2



Photo 11. Rio Grande Mesquite Riparian Bosque, Rio Grande floodplain west of La Clocha, Big Bend National Park (BIBEAA0190) (Rebecca Evans).



Photo12. Rio Grande Mesquite Riparian Bosque, Rio Grande at mile 25 below La Linda, Black Gap Wildlife Management Area (RIGROBS0237) (Jessica Strickland).

Rio Grande Seepwillow Riparian Shrubland

Local Type and Concept

Sparse to moderately dense shrublands on banks and alluvial bars of the Rio Grande, with *Baccharis salicifolia* (seepwillow) dominant.

Classification Plots Within RIGR Included in Concept

BIBE3000, BIBE3002, BIBE3005, BIBE3011, BIBE3020, RIGR2012, RIGR2022, RIGR2102

Observation Points Within RIGR Included in Concept

RIGROBS0322, RIGROBS0324, RIGROBS0331, RIGROBS0333, RIGROBS0526

Accuracy Assessment Sites Within RIGR Included in Concept

BIBEAA1123

Vegetation

Baccharis salicifolia (seepwillow) is the dominant species in a short to somewhat tall shrub stratum that varies from somewhat sparse to dense. *Tamarix ramosissima* (tamarisk) is a constant shrub stratum associate and may co-dominate stands with *B. salicifolia*. *Parkinsonia aculeata* (retama), *Prosopis glandulosa* (honey mesquite), *Nicotiana glauca* (tree tobacco), and *Salix thurberi* (Thurber's willow) are frequent low to moderate cover tall shrub species. The herbaceous stratum cover varies from sparse to dense and is comprised of a variety of native and non-native ruderal species. *Cynodon dactylon* (Bermuda grass) is usually present and often is the most abundant herbaceous species. Other constant species include *Xanthium strumarium* (rough cocklebur), *Rumex maritimus* (golden dock), *Phragmites australis* (common reed), *Schoenoplectus pungens* var. *longispicatus* (threesquare bulrush*), Polypogon monspeliensis* (annual rabbitsfoot grass), *Arundo donax* (giant cane), *Salsola tragus* (Russian thistle), *Verbesina encelioides* (golden crownbeard), *Eustoma exaltatum* (catchfly prairie gentian), *Leptochloa fusca* ssp. *uninervia* (Mexican sprangletop), *Pennisetum ciliare* (buffelgrass), and *Heliotropium curassavicum* (salt heliotrope). Stratum and substrate cover for Rio Grande Seepwillow Riparian Shrubland are shown in Table D-12.

Table D-12. Stratum and substrate cover recorded for Rio Grande Seepwillow Riparian Shrubland at Big Bend National Park and Rio Grande Wild and Scenic River (n=14, 5 observation points, 9 plots).

Category	Item	Mean Cover (%)	Range Cover (%)
Stratum	Tree	<1	0-5
	Tall Shrub	23	0-90
	Short Shrub	11	0-35
	Herb	13	0-30
Substrate	Bedrock	0	0-0
	Large/Small Rocks	8	5-12
	Litter/Duff	40	5-92

Environment

This vegetation was observed throughout RIGR. It tends to occur on moist alluvial bars and banks, at similar elevations above water level to that of the Common Reed Riparian Herbaceous Vegetation and the Rio Grande Willow Riparian Bosque. It usually occurs in linear stands that are too small or too narrow to be mapped effectively.

USNVC Crosswalk

USNVC Class: Shrub & Herb Vegetation Class (2)

USNVC Subclass: Shrub & Herb Wetland Subclass (2.C)

USNVC Formation: Temperate to Polar Freshwater Marsh, Wet Meadow and Shrubland Formation (2.C.4)

USNVC Division: Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland Division (D031)

USNVC Macrogroup: Warm Desert Lowland Freshwater Marsh, Meadow & Shrubland Macrogroup (M076)

USNVC Group: North American Warm Desert Riparian Low Bosque & Shrubland Group (G533)

USNVC Alliance: *Baccharis salicifolia* Wet Shrubland Alliance (A0933)

NPS Association: *Baccharis salicifolia* / (*Phragmites australis*) Chihuahuan Riparian Shrubland Association (NPSBIBE047)

Comments

This association is an alluvial vegetation type that is environmentally and compositionally different from the other shrubland association that has *B. salicifolia* characteristic, the Seepwillow - Bushy Bluestem Spring Vegetation of non-alluvial groundwater emergences. Most frequent plant taxa recorded in Rio Grande Seepwillow Riparian Shrubland are shown in Table D-13.

Table D-13. Synthesis table for the most frequent plant taxa recorded in Rio Grande Seepwillow Riparian Shrubland at Big Bend National Park and Rio Grande Wild and Scenic River (# plots=9).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Baccharis salicifolia	Shrub	100.0%	42.0	10-100
Tamarix ramosissima	Shrub	88.9%	10.1	0-50
Chloracantha spinosa	Shrub	44.4%	2.2	0-25
Prosopis glandulosa	Shrub	44.4%	0.7	0-5
Parkinsonia aculeata	Shrub	22.2%	0.1	0-1
Isocoma pluriflora	Shrub	11.1%	0.8	0-10
Ziziphus obtusifolia var. *obtusifolia*	Shrub	11.1%	0.4	0-5

Table D-13 (continued). Synthesis table for the most frequent plant taxa recorded in Rio Grande Seepwillow Riparian Shrubland at Big Bend National Park and Rio Grande Wild and Scenic River (# plots=9).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Salix thurberi	Shrub	11.1%	0.4	0-5
Guaiacum angustifolium	Shrub	11.1%	0.1	0-1
Salix gooddingii	Shrub	11.1%	0.0	0-trace
Nicotiana glauca	Shrub	11.1%	0.0	0-trace
Fraxinus berlandieriana	Shrub	11.1%	0.0	0-trace
Prosopis pubescens	Shrub	11.1%	0.0	0-trace
Selinocarpus angustifolius	Shrub	11.1%	0.0	0-trace
Vachellia farnesiana	Shrub	11.1%	0.0	0-trace
Vachellia rigidula	Shrub	11.1%	0.0	0-trace
Cynodon dactylon	Herb	88.9%	12.2	0-50
Xanthium strumarium	Herb	55.6%	4.3	0-50
Rumex maritimus	Herb	44.4%	0.3	0-2
Phragmites australis	Herb	33.3%	3.2	0-25
Schoenoplectus pungens var. *longispicatus*	Herb	33.3%	1.1	0-10
Polypogon monspeliensis	Herb	33.3%	0.1	0-1
Arundo donax	Herb	22.2%	0.4	0-1
Eustoma exaltatum	Herb	22.2%	0.2	0-2
Rumex	Herb	22.2%	0.1	0-1
Heliotropium curassavicum var. *curassavicum*	Herb	22.2%	0.0	0-trace
Leptochloa fusca ssp. *uninervia*	Herb	22.2%	0.0	0-trace
Bacopa monnieri	Herb	11.1%	0.2	0-2
Helenium microcephalum var. *microcephalum*	Herb	11.1%	0.2	0-2
Phyla nodiflora	Herb	11.1%	0.1	0-1
Bolboschoenus maritimus ssp. *paludosus*	Herb	11.1%	0.1	0-1
Cyperus odoratus	Herb	11.1%	0.1	0-1

Table D-13 (continued). Synthesis table for the most frequent plant taxa recorded in Rio Grande Seepwillow Riparian Shrubland at Big Bend National Park and Rio Grande Wild and Scenic River (# plots=9).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Eleocharis	Herb	11.1%	0.1	0-1
Machaeranthera tanacetifolia	Herb	11.1%	0.1	0-1
Polygonum lapathifolium	Herb	11.1%	0.1	0-1
Rumex crispus	Herb	11.1%	0.1	0-1
Symphyotrichum expansum	Herb	11.1%	0.1	0-1
Thelesperma ambiguum	Herb	11.1%	0.1	0-1
Tiquilia canescens var. *canescens*	Herb	11.1%	0.1	0-1
Chamaesyce serpens	Herb	11.1%	0.0	0-trace
Chilopsis linearis	Herb	11.1%	0.0	0-trace
Juncus torreyi	Herb	11.1%	0.0	0-trace
Lupinus havardii	Herb	11.1%	0.0	0-trace
Lygodesmia texana	Herb	11.1%	0.0	0-trace
Oenothera curtiflora	Herb	11.1%	0.0	0-trace
Oligomeris linifolia	Herb	11.1%	0.0	0-trace
Pennisetum ciliare	Herb	11.1%	0.0	0-trace
Sesuvium verrucosum	Herb	11.1%	0.0	0-trace
Sisymbrium	Herb	11.1%	0.0	0-trace



Photo 13. Rio Grande Seepwillow Riparian Shrubland, Rio Grande at mile 38 below La Linda, just below Las Yeguas Canyon, Lower Canyons (RIGROBS0324) (Phillip Schulze).



Photo 14. Rio Grande Seepwillow Riparian Shrubland, Rio Grande at mile 38.5 below La Linda, just below Silber Canyon, Lower Canyons (RIGROBS0333) (Jessica Strickland).

Giant Cane Riparian Herbaceous Vegetation

Local Type and Concept

Tall herbaceous (somewhat woody) thickets with high cover of *Arundo donax* (giant cane) in the Rio Grande alluvial zone, with low cover by all other species.

Classification Plots Within RIGR Included in Concept

BIBE0113, BIBE0239, BIBE1105, BIBE3006

Observation Points Within RIGR Included in Concept

BIBEOBS01466, RIGROBS0434, RIGROBS0532, RIGROBS0721, RIGROBS0733

Accuracy Assessment Sites Within RIGR Included in Concept

BIBEAA1034, BIBEAA1035, BIBEAA1039, BIBEAA1040, BIBEAA1055, BIBEAA1092, BIBEAA1126, RIGRAA1033, RIGRAA1036, RIGRAA1041

Vegetation

Arundo donax (giant cane), a somewhat woody grass, is dominant and usually strongly so in a very tall herbaceous stratum. Cover contributed by other species is typically very low. The most frequent woody stratum species are *Prosopis glandulosa* (honey mesquite), *Tamarix ramosissima* (tamarisk), *Baccharis salicifolia* (seepwillow), *Parkinsonia aculeata* (retama), and *Tamarix aphylla* (athel tamarisk). Among the few herbaceous species that are competitive enough to become established, even at low cover, are the non-natives *Pennisetum ciliare* (buffelgrass) and *Cynodon dactylon* (Bermuda grass). Stratum and substrate cover for Giant Cane Riparian Herbaceous Vegetation are shown in Table D-14.

Table D-14. Stratum and substrate cover recorded for Giant Cane Riparian Herbaceous Vegetation at Big Bend National Park and Rio Grande Wild and Scenic River (n=8, 2 observation points, 6 plots).

Category	Item	Mean Cover (%)	Range Cover (%)
Stratum	Tree	0	0-0
	Tall Shrub	0	0-0
	Short Shrub	1	0-2
	Herb	94	90-100
Substrate	Bedrock	0	0-0
	Large/Small Rocks	0	0-0
	Litter/Duff	51	1-99

Environment

This vegetation was recorded throughout RIGR and becomes progressively more abundant downstream from BIBE. It tends to occur on floodplains, at similar elevations above water level to, or slightly lower than, that of the Rio Grande Mesquite Riparian Bosque.

USNVC Crosswalk

USNVC Class: Shrub & Herb Vegetation Class (2)

USNVC Subclass: Shrub & Herb Wetland Subclass (2.C)

USNVC Formation: Temperate to Polar Freshwater Marsh, Wet Meadow and Shrubland Formation (2.C.4)

USNVC Division: Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland Division (D031)

USNVC Macrogroup: Western North American Ruderal Marsh, Wet Meadow & Shrubland Macrogroup (M301)

USNVC Group: Western North American Ruderal Marsh, Wet Meadow & Shrubland Group (G524)

USNVC Alliance: *Phragmites australis - Arundo donax - Alopecurus pratensis* Ruderal Marsh Alliance (A3847)

USNVC Association: *Arundo donax* Riverbank Herbaceous Vegetation Association (CEGL004101)

Most frequent plant taxa recorded in Giant Cane Riparian Herbaceous Vegetation are shown in Table D-15.

Table D-15. Synthesis table for all plant taxa recorded in Giant Cane Riparian Herbaceous Vegetation at Big Bend National Park and Rio Grande Wild and Scenic River (# plots=6).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Tamarix ramosissima	Shrub	83.3%	3.4	0-25
Baccharis salicifolia	Shrub	33.3%	0.7	0-5
Nicotiana glauca	Shrub	33.3%	0.3	0-2
Baccharis havardii	Shrub	16.7%	0.3	0-2
Chloracantha spinosa	Shrub	16.7%	0.3	0-2
Prosopis glandulosa	Shrub	16.7%	0.3	0-2
Arundo donax	Herb	100.0%	83.3	25-100
Cynodon dactylon	Herb	33.3%	1.7	0-10
Phragmites australis	Herb	16.7%	2.9	0-25
Xanthium strumarium	Herb	16.7%	0.6	0-5

Table D-15 (continued). Synthesis table for all plant taxa recorded in Giant Cane Riparian Herbaceous Vegetation at Big Bend National Park and Rio Grande Wild and Scenic River (# plots=6).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Chenopodium incanum	Herb	16.7%	0.3	0-2
Nerisyrenia camporum	Herb	16.7%	0.3	0-2
Nicotiana obtusifolia	Herb	16.7%	0.3	0-2
Heliotropium curassavicum	Herb	16.7%	0.1	0-2
Machaeranthera tanacetifolia	Herb	16.7%	0.1	0-1
Mentzelia multiflora	Herb	16.7%	0.1	0-1
Salsola tragus	Herb	16.7%	0.1	0-1
Solanum elaeagnifolium	Herb	16.7%	0.1	0-1
Sphaeralcea angustifolia	Herb	16.7%	0.1	0-1
Verbesina encelioides	Herb	16.7%	0.1	0-1
Oenothera curtiflora (=*Gaura parviflora*)	Herb	16.7%	<0.1	0-trace
Matelea reticulata	Herb	16.7%	<0.1	0-trace



Photo 15. Giant Cane Riparian Herbaceous Vegetation, Rio Grande floodplain at Gravel Pit, Big Bend National Park (BIBE0056) (Christian Skorik).



Photo 16. Giant Cane Riparian Herbaceous Vegetation, Rio Grande at mile 50 below La Linda (above Rodeo Rapid), Lower Canyons (RIGROBS0434) (Jessica Strickland).

Common Reed Riparian Herbaceous Vegetation

Local Type and Concept

Tall herbaceous stands with high relative cover, and, usually, high absolute cover, of *Phragmites australis* (common reed) on Rio Grande alluvial bars and banks. *P. australis* exceeds all other species in cover, except (occasionally) *Cynodon dactylon* (Bermuda grass).

Classification Plots Within RIGR Included in Concept

BIBE0112, BIBE0426, BIBE3001, BIBE3007, BIBE3010, BIBE3012

Observation Points Within RIGR Included in Concept

RIGROBS0225, RIGROBS0336, RIGROBS0523, RIGROBS0531, RIGROBS0534, RIGROBS0537, RIGROBS0624, RIGROBS0631, RIGROBS0633, RIGROBS0634

Accuracy Assessment Sites Within RIGR Included in Concept

RIGRAA1066

Vegetation

Phragmites australis (common reed) is strongly dominant in a tall herbaceous stratum and exceeds 25% cover, except for stands that may have low overall herbaceous cover. *Cynodon dactylon* (Bermuda grass) and *Arundo donax* (giant cane) are often present. The abundance of *C. dactylon* is variable, and it may form a secondary dominant low herbaceous stratum. The cover of *A. donax,* which appears to favor less saturated soils than does *P. australis*, may be moderately high, but it never exceeds that *of P. australis.* Other herbaceous stratum members are generally ruderal species present at low cover and with lower constancy; these include several species of *Rumex* (docks) and of *Typha* (cattails), *Polypogon monspeliensis* (annual rabbitsfoot grass), *Xanthium strumarium* (rough cocklebur), *Helenium microcephalum* (smallhead sneezeweed), and *Symphyotrichum expansum* (southwestern annual saltmarsh aster). *Baccharis salicifolia* (seepwillow), which appears to have similar hydrologic regime preferences to those of *P. australis*, usually is present in a low cover tall shrub stratum. Other shrubs that may be present include *Tamarix ramosissima* (tamarisk) and *Chloracantha spinosa* (devilweed). Stratum and substrate cover for Common Reed Riparian Herbaceous Vegetation are shown in Table D-16.

Table D-16. Stratum and substrate cover recorded for Common Reed Riparian Herbaceous Vegetation at Big Bend National Park and Rio Grande Wild and Scenic River (n=13, 7 observation points, 6 plots).

Category	Item	Mean Cover (%)	Range Cover (%)
Stratum	Tree	0	0-0
	Tall Shrub	3	0-10
	Short Shrub	0	0-0
	Herb	74	50-98

Table D-16 (continued). Stratum and substrate cover recorded for Common Reed Riparian Herbaceous Vegetation at Big Bend National Park and Rio Grande Wild and Scenic River (n=13, 7 observation points, 6 plots).

Category	Item	Mean Cover (%)	Range Cover (%)
Substrate	Bedrock	0	0-0
	Large/Small Rocks	0	0-0
	Litter/Duff	1	0-10

Environment

This vegetation was observed throughout RIGR, on moist alluvial bars and banks, at similar elevations above water level to that of the Rio Grande Seepwillow Riparian Shrubland and the Rio Grande Willow Riparian Bosque. It usually occurs in stands that are too small to be mapped.

USNVC Crosswalk

USNVC Class: Shrub & Herb Vegetation Class (2)

USNVC Subclass: Shrub & Herb Wetland Subclass (2.C)

USNVC Formation: Temperate to Polar Freshwater Marsh, Wet Meadow and Shrubland Formation (2.C.4)

USNVC Division: Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland Division (D031)

USNVC Macrogroup: Western North American Ruderal Marsh, Wet Meadow & Shrubland Macrogroup (M301)

USNVC Group: Western North American Ruderal Marsh, Wet Meadow & Shrubland Group (G524)

USNVC Alliance: *Phragmites australis - Arundo donax - Alopecurus pratensis* Ruderal Marsh Alliance (A3847)

USNVC Association: *Phragmites australis* Chihuahuan Desert Riparian Herbaceous Vegetation (NPSBIBE023)

Comments

Generally, *Phragmites australis* (common reed) is considered a native species along the Rio Grande (subspecies *berlandieri*). However, Powell and Worthington (2018) note that all Trans-Pecos collections at the Sul Ross Herbarium (SRSC), including those from BIBE, appear to represent the non-native subspecies *australis*. Most frequent plant taxa recorded in Common Reed Riparian Herbaceous Vegetation are shown in Table D-17.

Table D-17. Synthesis table for all plant taxa recorded in Common Reed Riparian Herbaceous Vegetation at Big Bend National Park and Rio Grande Wild and Scenic River (# plots=6).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Baccharis salicifolia	Shrub	83.3%	3.1	0-10
Tamarix ramosissima	Shrub	66.7%	0.6	0-2
Chloracantha spinosa	Shrub/Herb	33.3%	0.1	0-1
Prosopis glandulosa	Shrub	16.7%	0.3	0-2
Salix thurberi (= *Salix exigua* in the broad sense)	Shrub	16.7%	0.3	0-2
Nicotiana glauca	Shrub	16.7%	<0.1	0-trace
Parkinsonia aculeata	Shrub	16.7%	<0.1	0-trace
Phragmites australis	Herb	100.0%	53.8	25-95
Cynodon dactylon	Herb	83.3%	4.4	0-25
Rumex sp.	Herb	66.7%	0.4	0-2
Arundo donax	Herb	50.0%	3.8	0-25
Xanthium strumarium	Herb	50.0%	0.4	0-2
Helenium microcephalum	Herb	50.0%	0.1	0-1
Woodsia sp.	Herb	33.3%	3.5	0-25
Polypogon monspeliensis	Herb	33.3%	0.1	0-1
Symphyotrichum expansum	Herb	33.3%	0.1	0-1
Eclipta prostrata	Herb	16.7%	0.1	0-1
Pennisetum ciliare	Herb	16.7%	0.1	0-1
Ambrosia psilostachya	Herb	16.7%	<0.1	0-trace
Eustoma exaltatum	Herb	16.7%	<0.1	0-trace
Oenothera curtiflora (=*Gaura parviflora*)	Herb	16.7%	<0.1	0-trace
Leptochloa fusca ssp. uninervia	Herb	16.7%	<0.1	0-trace
Senna bauhinioides	Herb	16.7%	<0.1	0-trace
Sonchus sp.	Herb	16.7%	<0.1	0-trace
Sphaeralcea angustifolia	Herb	16.7%	<0.1	0-trace



Photo 17. Common Reed Riparian Herbaceous Vegetation, Rio Grande at mile 58 below La Linda (below Lower Madison Falls), Lower Canyons (RIGROBS0523) (Phillip Schulze).



Photo 18. Common Reed Riparian Herbaceous Vegetation, Rio Grande at mile 70 below La Linda, Lower Canyons (RIGROBS0633) (Jessica Strickland).

Bermuda Grass Riparian Herbaceous Vegetation

Local Type and Concept

Herbaceous vegetation associated with riparian or other moist sites, with *Cynodon dactylon* (Bermuda grass) dominant.

Classification Plots Within RIGR Included in Concept

BIBE0048, BIBE3008, BIBE3018, BIBE3019, BIBE3027

Observation Points Within RIGR Included in Concept

RIGROBS0123, RIGROBS0124, RIGROBS0134, RIGROBS0222, RIGROBS023, RIGROBS0435, RIGROBS0522, RIGROBS0527, RIGROBS0623, RIGROBS0626, RIGROBS0723, RIGROBS0726

Accuracy Assessment Sites Within RIGR Included in Concept

BIBEAA1105, BIBEAA1118, BIBEAA1121, BIBEAA1122, BIBEAA1130, RIGRAA1114

Vegetation

Cynodon dactylon (Bermuda grass) is dominant in the herbaceous stratum, which can vary in cover from 5% in alluvial bar settings to nearly 100% on floodplains (i.e., Bermuda grass "meadows"). *Pennisetum ciliare* (buffelgrass) frequently occurs and occasionally co-dominates with *C. dactylon*. Less frequent herbaceous stratum species include *Arundo donax* (giant cane), *Sorghum halepense* (Johnson grass), *Verbesina encelioides* (golden crownbeard), *Xanthium strumarium* (rough cocklebur), and *Solanum elaeagnifolium* (silverleaf nightshade). A sparse shrub stratum (up to about 15% cover) may be present, with *Prosopis glandulosa* (honey mesquite), *Tamarix ramosissima* (tamarisk), *Baccharis salicifolia* (seepwillow) occurring as fairly constant woody species and *Hymenoclea monogyra* (singlewhorl burrobrush), *Parkinsonia aculeata* (retama), and *Tamarix aphylla* (athel tamarisk) less frequent. Stratum and substrate cover for Bermuda Grass Riparian Herbaceous Vegetation are shown in Table D-18.

Table D-18. Stratum and substrate cover recorded for Bermuda Grass Riparian Herbaceous Vegetation at Big Bend National Park and Rio Grande Wild and Scenic River (n=15, 10 observation points, 5 plots).

Category	Item	Mean Cover (%)	Range Cover (%)
Stratum	Tree	0	0-0
	Tall Shrub	1	1-1
	Short Shrub	2	1-2
	Herb	80	80-80
Substrate	Bedrock	0	0-0
	Large/Small Rocks	12	12-12
	Litter/Duff	1	1-1

Environment

This vegetation was observed throughout RIGR. It tends to occur on higher bars and low floodplains, at similar elevations above water level to that of the Tamarisk - (Tree Tobacco) Riparian Shrubland.

USNVC Crosswalk

USNVC Class: Shrub & Herb Vegetation Class (2)

USNVC Subclass: Shrub & Herb Wetland Subclass (2.C)

USNVC Formation: Temperate to Polar Freshwater Marsh, Wet Meadow and Shrubland Formation (2.C.4)

USNVC Division: Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland Division (D031)

USNVC Macrogroup: Western North American Ruderal Marsh, Wet Meadow & Shrubland Macrogroup (M301)

USNVC Group: Western North American Ruderal Marsh, Wet Meadow & Shrubland Group (G524)

USNVC Alliance: *Phragmites australis - Arundo donax - Alopecurus pratensis* Ruderal Marsh Alliance (A3847)

NPS Association: *Cynodon dactylon* Arid Southwest Herbaceous Vegetation Association (NPSBIBE017)

Comments

The USNVC association CEGL004701 (*Cynodon dactylon* Herbaceous Vegetation), an association in G583 (Southeastern Old Field Group) of the southeastern U.S., is probably inappropriate for *Cynodon dactylon* (Bermuda grass) stands in the arid southwestern U.S. Therefore, a local type with a globally appropriate name is employed for the translation. Most frequent plant taxa recorded in Bermuda Grass Riparian Herbaceous Vegetation are shown in Table D-19.

Table D-19. Synthesis table for the most frequent plant taxa recorded in Bermuda Grass Riparian Herbaceous Vegetation at Big Bend National Park and Rio Grande Wild and Scenic River (# plots=5).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Prosopis glandulosa	Shrub	100.0%	2.6	0-10
Tamarix ramosissima	Shrub	80.0%	2.3	0-10
Baccharis salicifolia	Shrub	60.0%	0.7	0-2
Larrea tridentata	Shrub	40.0%	0.1	0-1
Chloracantha spinosa	Shrub	40.0%	0.1	0-1
Salix gooddingii	Shrub	20.0%	2.1	0-1
Vachellia farnesiana	Shrub	20.0%	0.7	0-1

Table D-19 (continued). Synthesis table for the most frequent plant taxa recorded in Bermuda Grass Riparian Herbaceous Vegetation at Big Bend National Park and Rio Grande Wild and Scenic River (# plots=5).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Chilopsis linearis	Shrub	20.0%	0.3	0-1
Hymenoclea monogyra	Shrub	20.0%	0.1	0-1
Nicotiana glauca	Shrub	20.0%	0.1	0-1
Aloysia gratissima	Shrub	20.0%	<0.1	0-trace
Parkinsonia aculeata	Shrub	20.0%	<0.1	0-trace
Cynodon dactylon	Herb	100.0%	71.0	25-95
Xanthium strumarium	Herb	60.0%	0.2	0-1
Sphaeralcea angustifolia	Herb	60.0%	0.1	0-1
Leptochloa fusca ssp. *uninervia*	Herb	40.0%	0.2	0-1
Pennisetum ciliare	Herb	40.0%	0.2	0-1
Phragmites australis	Herb	40.0%	0.2	0-1
Sorghum halepense	Herb	40.0%	0.1	0-1
Cirsium texanum	Herb	40.0%	<0.1	0-trace
Bahia pedata	Herb	20.0%	0.1	0-1
Bouteloua barbata	Herb	20.0%	0.1	0-1
Boerhavia diffusa	Herb	20.0%	0.1	0-1
Bothriochloa ischaemum	Herb	20.0%	0.1	0-1
Eustoma exaltatum	Herb	20.0%	0.1	0-1
Heteropogon contortus	Herb	20.0%	0.1	0-1
Helenium microcephalum	Herb	20.0%	0.1	0-1
Machaeranthera tanacetifolia	Herb	20.0%	0.1	0-1
Nerisyrenia camporum	Herb	20.0%	0.1	0-1
Pectis angustifolia	Herb	20.0%	0.1	0-1
Polypogon monspeliensis	Herb	20.0%	0.1	0-1
Rumex sp.	Herb	20.0%	0.1	0-1
Thelesperma megapotamicum	Herb	20.0%	0.1	0-1
Argemone albiflora ssp. *texana*	Herb	20.0%	<0.1	0-trace
Baileya multiradiata	Herb	20.0%	<0.1	0-trace

Table D-19 (continued). Synthesis table for the most frequent plant taxa recorded in Bermuda Grass Riparian Herbaceous Vegetation at Big Bend National Park and Rio Grande Wild and Scenic River (# plots=5).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Oenothera curtiflora (=*Gaura parviflora*)	Herb	20.0%	<0.1	0-trace
Nama hispidum	Herb	20.0%	<0.1	0-trace
Sonchus sp.	Herb	20.0%	<0.1	0-trace



Photo 19. Bermuda Grass Riparian Herbaceous Vegetation, Rio Grande floodplain near Hot Springs, Big Bend National Park (BIBE0048) (Christian Skorik).



Photo 20. Bermuda Grass Riparian Herbaceous Vegetation, Rio Grande at mile 19 below La Linda, Black Gap Wildlife Management Area (RIGROBS0124) (Phillip Schulze).

Wet Riverbank Herbaceous Vegetation

Local Type and Concept

Herbaceous wetlands along low banks and alluvial bars of the Rio Grande, dominated by hydrophytic species, such as *Schoenoplectus pungens* (threesquare bulrush), *Typha* spp. (cattails), *Polygonum* spp. (smartweeds), and others.

Classification Plots Within RIGR Included in Concept

BIBE3003

Observation Points Within RIGR Included in Concept

RIGROBS0423, RIGROBS0525

Vegetation

In many stands, one species is strongly dominant. This may be *Schoenoplectus pungens* (threesquare bulrush), *Typha domingensis* (southern cattail), or *Polygonum* sp. (smartweed). Other herbaceous species, many to most of them hydrophytes, occur, usually at low cover. *Cynodon dactylon* (Bermuda grass), *Symphyotrichum expansum* (southwestern annual saltmarsh aster), and *Polypogon monspeliensis* (annual rabbitsfoot grass) are the most frequently recorded. If present, a shrub stratum is sparse, with *Baccharis salicifolia* (seepwillow) the most constant species. Stratum and substrate cover for Wet Riverbank Herbaceous Vegetation are shown in Table D-20.

Table D-20 Stratum and substrate cover recorded for Wet Riverbank Herbaceous Vegetation at Rio Grande Wild and Scenic River (# plots=3).

Category	Item	Mean Cover (%)	Range Cover (%)
Stratum	Tree	17	0-100
	Tall Shrub	19	0-95
	Short Shrub	3	0-20
	Herb	37	2-95
Substrate	Bedrock	0	0-0
	Large/Small Rocks	24	0-60
	Litter/Duff	27	0-98

Environment

This type probably occurs throughout RIGR, usually in stands that are too small to be mapped. Stands were encountered on riverbanks and gravel bars where the soil or sediment is saturated to near the surface for extended periods.

USNVC Crosswalk

USNVC Class: Shrub & Herb Vegetation Class (2)

USNVC Subclass: Shrub & Herb Wetland Subclass (2.C)

USNVC Formation: Temperate to Polar Freshwater Marsh, Wet Meadow and Shrubland Formation (2.C.4)

USNVC Division: Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland Division (D031)

USNVC Macrogroup: Arid West Interior Freshwater Marsh Macrogroup (M888)

USNVC Group: Arid West Interior Freshwater Marsh Group (G531)

USNVC Alliance: *Schoenoplectus americanus* - *Schoenoplectus acutus* - *Schoenoplectus californicus* Marsh Alliance (A3895)

USNVC Association: *Schoenoplectus pungens* Herbaceous Vegetation Association (CEGL001587)

Most frequent plant taxa recorded in Wet Riverbank Herbaceous Vegetation are shown in Table D-21.

Table D-21. Synthesis table for the most frequent plant taxa recorded in Wet Riverbank Herbaceous Vegetation at Rio Grande Wild and Scenic River (# plots=3).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Baccharis salicifolia	Shrub	100.0%	0.8	few-2
Tamarix ramosissima	Shrub	33.3%	0.2	0-1
Nicotiana glauca	Shrub	33.3%	0.0	0-trace
Schoenoplectus pungens var. *longispicatus*	Herb	100.0%	54.2	25-75
Cynodon dactylon	Herb	100.0%	12.8	2-25
Symphyotrichum expansum	Herb	66.7%	1.0	0-2
Polypogon monspeliensis	Herb	66.7%	0.3	0-1
Juncus torreyi	Herb	33.3%	0.5	0-2
Paspalum distichum	Herb	33.3%	0.5	0-2
Helenium microcephalum	Herb	33.3%	0.2	0-1
Phragmites australis	Herb	33.3%	0.2	0-1
Rumex sp.	Herb	33.3%	0.2	0-1
Eustoma exaltatum	Herb	33.3%	0.1	0-trace
Leptochloa fusca ssp. uninervia	Herb	33.3%	0.1	0-trace
Lythrum californicum	Herb	33.3%	0.1	0-trace
Nerisyrenia camporum	Herb	33.3%	0.1	0-trace

Table D-21 (continued). Synthesis table for the most frequent plant taxa recorded in Wet Riverbank Herbaceous Vegetation at Rio Grande Wild and Scenic River (# plots=3).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Oligomeris linifolia	Herb	33.3%	0.1	0-trace
Phyla nodiflora	Herb	33.3%	0.1	0-trace



Photo 21. Wet Riverbank Herbaceous Vegetation, along Rio Grande near Loop Camp, Big Bend National Park (BIBE3014). *Schoenoplectus pungens* dominant (Karen Clary).



Photo 22. Wet Riverbank Herbaceous Vegetation, Rio Grande Lower Canyons, Mile 49 (below La Linda) (RIGROBS0423). *Polygonum* sp. dominant (Damon Waitt).

Rio Grande Alluvial Herbaceous Vegetation

Local Type and Concept

Sparse, primarily herbaceous, vegetation on frequently inundated alluvial bars and riverbanks. The concept also applies to more dense herbaceous vegetation in openings on floodplains of the Rio Grande River.

Classification Plots Within RIGR Included in Concept

BIBE0081, BIBE3015, BIBE3030, RIGR2005, RIGR2006, RIGR2019

Observation Points Within RIGR Included in Concept

RIGROBS0538

Accuracy Assessment Sites Within RIGR Included in Concept

BIBEAA1051, BIBEAA1052, BIBEAA1056, BIBEAA1057, BIBEAA1058, BIBEAA1059, BIBEAA1060, BIBEAA1061, BIBEAA1062, BIBEAA1129, BIBEAA1256, RIGRAA1022, RIGRAA1063, RIGRAA1067

VEGETATION:

A sparse tall or short shrub stratum is often present (more often on floodplain expressions than on alluvial bar and bank expressions). *Tamarix ramosissima* (tamarisk) is the most frequent and abundant species. Less constant, and, generally, lower cover woody species include *Prosopis glandulosa* (honey mesquite), *Baccharis salicifolia* (seepwillow), *Parkinsonia aculeata* (retama), *Hymenoclea monogyra* (singlewhorl burrobrush), *Porophyllum scoparium* (shrubby poreleaf), *Nicotiana glauca* (tree tobacco), and *Chloracantha spinosa* (devilweed). The herbaceous stratum density varies from very sparse (e.g., on recently scoured alluvial bars) to dense (e.g., on infrequently inundated floodplains). The composition is quite variable, depending on geomorphic position and moisture. More frequent species include *Cynodon dactylon* (Bermuda grass), *Arundo donax* (giant cane), *Pennisetum ciliare* (buffelgrass), *Salsola tragus* (Russian thistle), *Machaeranthera pinnatifida* (lacy tansyaster), *Verbesina encelioides* (golden crownbeard), *Rumex* spp. (docks), *Xanthium strumarium* (rough cocklebur), *Sporobolus flexuosus* (mesa dropseed), *Nerisyrenia camporum* (bicolor fanmustard*), Sphaeralcea angustifolia* (copper globemallow), *Solanum elaeagnifolium* (silverleaf nightshade), and *Heliotropium curassavicum* (salt heliotrope), *Phacelia congesta* (caterpillar phacelia), and *Nama* spp. (fiddleleaf). Stratum and substrate cover for Rio Grande Alluvial Herbaceous Vegetation are shown in Table D-22.

Table D-22. Stratum and substrate cover recorded for Rio Grande Alluvial Herbaceous Vegetation at Big Bend National Park and Rio Grande Wild and Scenic River (# plots=6).

Category	Item	Mean Cover (%)	Range Cover (%)
Stratum	Tree	0	0-0
	Tall Shrub	1	0-3
	Short Shrub	4	0-18
	Herb	13	2-38
Substrate	Bedrock	0	0-0
	Large/Small Rocks	55	0-98
	Litter/Duff	<1	0-1

Environment

This vegetation occurs on frequently flooded depositional bars of sand, gravel, cobbles, and/or boulders throughout RIGR. This rather broad concept also includes areas of floodplain that are relatively free from woody vegetation open due to disturbance (e.g., flooding, grazing).

USNVC Crosswalk

USNVC Class: Shrub & Herb Vegetation Class (2)

USNVC Subclass: Shrub & Herb Wetland Subclass (2.C)

USNVC Formation: Temperate to Polar Freshwater Marsh, Wet Meadow and Shrubland Formation (2.C.4)

USNVC Division: Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland Division (D031)

USNVC Macrogroup: Arid West Interior Freshwater Marsh Macrogroup (M888)

USNVC Group: Arid West Interior Freshwater Marsh Group (G531)

USNVC Alliance: *Schoenoplectus americanus* - *Schoenoplectus acutus* - *Schoenoplectus californicus* Marsh Alliance (A3895)

NPS Association: Arid West Alluvial Shrub Herbaceous Vegetation Association (NPSBIBE024)

Comments

This concept covers both (often sparse) low bar and bank vegetation that is frequently inundated and denser vegetation of less frequently flooded floodplains. Vegetation in these two settings probably warrants different associations, but the relative scarcity of data from across this vegetation gradient and its overall heterogeneity necessitate this broad treatment for now.

A USNVC (2017) Group that is applicable to relatively permanent streams and rivers within the Arid West and that is analogous to G568 (Great Plains Riverine Scour Group) is probably needed within

the USNVC (or the concept of G533 could be expanded). Most frequent plant taxa recorded in Rio Grande Alluvial Herbaceous Vegetation are shown in Table D-23.

Table D-23. Synthesis table for all plant taxa recorded in Rio Grande Alluvial Herbaceous Vegetation at Big Bend National Park and Rio Grande Wild and Scenic River (# plots=6).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Tamarix ramosissima	Shrub	83.3%	1.4	0-5
Baccharis salicifolia	Shrub	33.3%	1.2	0-5
Nicotiana glauca	Shrub	33.3%	0.3	0-2
Salix gooddingii	Shrub	16.7%	0.6	0-5
Fraxinus berlandieriana	Shrub	16.7%	0.3	0-2
Prosopis glandulosa var. *torreyana*	Shrub	16.7%	0.0	0-trace
Vachellia farnesiana	Shrub	16.7%	0.0	0-trace
Cynodon dactylon	Herb	66.7%	4.3	0-10
Heliotropium curassavicum	Herb	50.0%	1.4	0-10
Phragmites australis	Herb	33.3%	0.2	0-1
Sonchus asper	Herb	16.7%	2.9	0-25
Helenium microcephalum var. *microcephalum*	Herb	16.7%	0.3	0-2
Nama havardii	Herb	16.7%	0.3	0-2
Oligomeris linifolia	Herb	16.7%	0.3	0-2
Amaranthus sp.	Herb	16.7%	0.1	0-1
Argemone albiflora ssp. texana	Herb	16.7%	0.1	0-1
Cyperus sp.	Herb	16.7%	0.1	0-1
Helenium elegans	Herb	16.7%	0.1	0-1
Nama sp.	Herb	16.7%	0.1	0-1
Nama undulatum	Herb	16.7%	0.1	0-1
Parietaria pensylvanica	Herb	16.7%	0.1	0-1
Phyla nodiflora	Herb	16.7%	0.1	0-1
Poa sp.	Herb	16.7%	0.1	0-1
Quincula lobata	Herb	16.7%	0.1	0-1

Table D-23 (continued). Synthesis table for all plant taxa recorded in Rio Grande Alluvial Herbaceous Vegetation at Big Bend National Park and Rio Grande Wild and Scenic River (# plots=6).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Rumex crispus	Herb	16.7%	0.1	0-1
Salsola tragus	Herb	16.7%	0.1	0-1
Verbena neomexicana var. *hirtella*	Herb	16.7%	0.1	0-1
Verbena plicata	Herb	16.7%	0.1	0-1
Bothriochloa ischaemum	Herb	16.7%	0.0	0-trace
Cirsium texanum	Herb	16.7%	0.0	0-trace
Nerisyrenia camporum	Herb	16.7%	0.0	0-trace
Nicotiana obtusifolia	Herb	16.7%	0.0	0-trace
Xanthium strumarium	Herb	16.7%	0.0	0-trace



Photo 23. Rio Grande Alluvial Herbaceous Vegetation, Rio Grande at mouth of San Francisco Canyon, Mile 66 below La Linda (RIGROBS0538) (Jessica Strickland).



Photo 24. Rio Grande Alluvial Herbaceous Vegetation, Rio Grande, about 1 mile downstream from Mesquite Canyon (Mile 108 below La Linda) (RIGR2019) (Jeff Renfrow).

Southern Stockton Plateau Creosotebush Desert Scrub

Local Type and Concept

Desert scrub plant communities dominated by Larrea tridentata (creosotebush) on usually gentle slopes or flats on limestone substrates within the eastern part of Rio Grande Wild and Scenic River (Terrell County).

Classification Plots Within RIGR Included in Concept

RIGR2001, RIGR2003, RIGR2016, RIGR2020, RIGR2025, RIGR2026, RIGR2101, RIGR2105, RIGR2109

Vegetation

Larrea tridentata (creosotebush) is the leading dominant shrub, and usually has much of the relative cover in this stratum. *Grusonia schottii* (Schott's dog cholla) is a constant low cover dwarf shrub. Taller shrub associates present at low cover include *Fouquieria splendens* (ocotillo), *Prosopis glandulosa* (honey mesquite), *Lippia graveolens* (Mexican oregano), and *Leucophyllum frutescens* (cenizo). *Cylindropuntia leptocaulis* (Christmas cactus), *Menodora scabra* (rough menodora), *Echinocereus enneacanthus* var. *brevispinus* (pitaya cactus), and *Echinocactus horizonthalonius* (eagle-claw cactus) are frequent short or dwarf shrubs. *Tiquilia canescens* (woody crinklemat), a semi-woody perennial forb, is constant and sometimes occurs at considerable cover. In the somewhat sparse to fairly dense herbaceous stratum, the perennial grasses *Bouteloua trifida* (red grama), *Bouteloua ramosa* (chino grama), *Dasyochloa pulchella* (fluffgrass), *Sporobolus airoides* (alkali sacaton), *Aristida purpurea* (purple threeawn), and *Tridens muticus* (slim tridens), and the annual grass *Bouteloua barbata* (sixweeks grama) account for much of the cover. Forbs that often are present (usually at low cover) include *Allionia incarnata* (trailing windmills), *Bahia absinthifolia* (hairyseed bahia), *Sida abutifolia* (spreading fanpetals), and *Thymophylla pentachaeta* var. *pentachaeta* (fiveneedle pricklyleaf). Stratum and substrate cover for Southern Stockton Plateau Creosotebush Desert Scrub are shown in Table D-24.

Table D-24. Stratum and substrate cover recorded for Southern Stockton Plateau Creosotebush Desert Scrub at Rio Grande Wild and Scenic River (# plots=9).

Category	Item	Mean Cover (%)	Range Cover (%)
Stratum	Tree	0	0-0
	Tall Shrub	1	0-5
	Short Shrub	39	15-85
	Herb	30	11-70
Substrate	Bedrock	1	0-5
	Large/Small Rocks	50	0-98
	Litter/Duff	2	1-5

Environment

This association occurs on limestone in RIGR throughout Terrell County (generally, to the east of Bone Watering and the Lower Canyons section). In this area, it is sympatric with the Southern Stockton Plateau Mixed Desert Scrub, but usually occurs on more gentle tablelands farther from the Rio Grande than the latter association, which is more typical of steeper slopes, often with more bedrock exposure. The Southern Stockton Plateau Creosotebush Desert Scrub likely constitutes much of the matrix vegetation to the immediate north of RIGR in Terrell County.

USNVC Crosswalk

USNVC Class: Semi & Semi-Desert Class (3)

USNVC Subclass: Warm Desert & Semi-Desert Woodland, Scrub & Grassland Subclass (3.A)

USNVC Formation: Warm Desert & Semi-Desert Scrub & Grassland Formation (3.A.2)

USNVC Division: North American Warm Desert Scrub & Grassland Division (D039)

USNVC Macrogroup: Chihuahuan Desert Scrub Macrogroup (M086)

USNVC Group: Chihuahuan Creosotebush-Mixed Desert Scrub Group (G288)

USNVC Alliance: *Larrea tridentata* Chihuahuan Desert Scrub Alliance (A3164)

NPS Association: *Larrea tridentata* / *Grusonia schottii* / *Tiquilia canescens* Shrubland Association (NPSRIGR004)

Comments

The Southern Stockton Plateau Creosotebush Desert Scrub, which may occur over large areas of southern Terrell County, is an analog to the Big Bend Lowlands Creosotebush Desert Scrub of a more western distribution (Big Bend area). The two are strongly creosotebush-dominated and occur over large areas of relatively gentle slope. Unlike the Big Bend Lowlands Creosotebush Desert Scrub of primarily non-calcareous substrates, the Southern Stockton Plateau Creosotebush Desert Scrub occurs on limestone. A number of the sub-dominant species between the two associations differ.

The nominal species and setting of the USNVC (2017) *Larrea tridentata - Opuntia schottii* Shrubland Association (CEGL004567) fit this RIGR vegetation well (note that *Opuntia schottii* is a synonym for *Grusonia schottii*). However, the [rather sparse] USNVC description notes that the *L. tridentata* (creosotebush) plants often are stunted and spacing between them is usually wide, whereas those in this RIGR vegetation are tall and relatively dense, at least as compared to other *L. tridentata* dominated vegetation in Trans-Pecos Texas. Furthermore, the *Larrea tridentata - Opuntia schottii* Shrubland Association is placed by the USNVC in a different Group (Chihuahuan Desert Succulent Desert Scrub Group (G286)) from that of most Chihuahuan Desert vegetation with strong creosotebush dominance and a low proportion of succulents (the Chihuahuan Creosotebush-Mixed Desert Scrub Group (G288)). Since descriptive information for CEGL004567 currently is sparse, that concept might be reworked and replaced within the hierarchy to fit this RIGR vegetation, which now is well documented along about 40 river miles of the Rio Grande. At this point, however, a translation of the RIGR vegetation to CEGL004567 would be premature and somewhat misleading, given the hierarchy placement of the latter concept and some uncertainty about what it represents.

Grusonia schottii (= *Opuntia schottii*, = *Corynopuntia schottii*) is an indicator of the eastern Trans-Pecos region (Powell and Worthington 2018).

Most frequent plant taxa recorded in Southern Stockton Plateau Creosotebush Desert Scrub are shown in Table D-25.

Table D-25. Synthesis table for the most frequent plant taxa recorded in Southern Stockton Plateau Creosotebush Desert Scrub at Rio Grande Wild and Scenic River (# plots=9).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Larrea tridentata	Shrub	100.0%	26.4	2-60
Grusonia schottii	Shrub	88.9%	1.2	0-5
Fouquieria splendens	Shrub	55.6%	1.4	0-10
Prosopis glandulosa	Shrub	55.6%	0.3	0-2
Lippia graveolens	Shrub	44.4%	0.4	0-2
Leucophyllum frutescens	Shrub	44.4%	0.2	0-2
Menodora scabra	Shrub	33.3%	0.3	0-2
Cylindropuntia leptocaulis	Shrub	33.3%	0.2	0-2
Echinocactus horizonthalonius	Shrub	33.3%	0.2	0-1
Echinocereus enneacanthus var. *brevispinus*	Shrub	33.3%	0.1	0-1
Vachellia vernicosa	Shrub	22.2%	0.3	0-2
Vachellia constricta	Shrub	22.2%	0.2	0-2
Agave lechuguilla	Shrub	22.2%	0.2	0-2
Ariocarpus fissuratus	Shrub	22.2%	0.1	0-1
Cevallia sinuata	Shrub	22.2%	0.1	0-1
Heliotropium confertifolium	Shrub	22.2%	0.1	0-1
Hibiscus denudatus	Shrub	22.2%	0.1	0-1
Guaiacum angustifolium	Shrub	22.2%	0.1	0-1
Coryphantha echinus	Shrub	22.2%	0.0	0-trace
Echinocereus enneacanthus	Shrub	22.2%	0.0	0-trace
Viguiera stenoloba	Shrub	22.2%	0.0	0-trace
Cylindropuntia kleiniae	Shrub	11.1%	0.4	0-5
Euphorbia antisyphilitica	Shrub	11.1%	0.2	0-2

Table D-25. Synthesis table for the most frequent plant taxa recorded in Southern Stockton Plateau Creosotebush Desert Scrub at Rio Grande Wild and Scenic River (# plots=9).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Tiquilia canescens	Herb	100.0%	9.8	few-25
Bouteloua trifida	Herb	66.7%	2.9	0-25
Dasyochloa pulchella	Herb	66.7%	0.6	0-2
Bouteloua ramosa	Herb	55.6%	1.8	0-10
Aristida purpurea	Herb	55.6%	0.5	0-2
Allionia incarnata	Herb	55.6%	0.4	0-2
Tridens muticus	Herb	44.4%	1.4	0-10
Sida abutifolia	Herb	44.4%	0.2	0-1
Bouteloua barbata	Herb	33.3%	4.4	0-50
Sporobolus airoides	Herb	33.3%	1.4	0-10
Bahia absinthifolia	Herb	33.3%	0.1	0-1
Setaria reverchonii ssp. *ramiseta*	Herb	33.3%	0.1	0-1
Thymophylla pentachaeta var. *pentachaeta*	Herb	33.3%	0.1	0-1
Lupinus havardii	Herb	22.2%	1.0	0-10
Thymophylla pentachaeta var. *puberula*	Herb	22.2%	0.1	0-1
Verbesina encelioides	Herb	22.2%	0.1	0-1
Thymophylla micropoides	Herb	22.2%	0.1	0-1
Dalea pogonathera	Herb	22.2%	0.0	0-trace
Selaginella wrightii	Herb	11.1%	1.9	0-25
Lycurus sp.	Herb	11.1%	0.8	0-10



Photo 25. Southern Stockton Plateau Creosotebush Desert Scrub, near Dryden Crossing (RIGR2001) (Kelon Crawford).



Photo 26. Southern Stockton Plateau Creosotebush Desert Scrub, Terrell - Val Verde County line (RIGR2025) (Jeff Renfrow).

Big Bend Lowlands Creosotebush Desert Scrub

Local Type and Concept

Desert scrub on non-calcareous substrates within the Big Bend National Park section of RIGR. Larrea tridentata (creosotebush) is constant and usually a dominant or co-dominant species, although absolute cover of all species may be quite low. Species that are indicators of calcareous substrates generally are absent, and Agave lechuguilla (lechuguilla) is consistently absent. Overall plant cover and species richness is lower than in most other desert scrub types.

Classification Plots Within RIGR Included in Concept

BIBE0114

Accuracy Assessment Sites Within RIGR Included in Concept

BIBEAA1001, BIBEAA1008, BIBEAA1088, BIBEAA1166, BIBEAA1167, BIBEAA1168

Vegetation

Both shrub and herbaceous strata are sparse to moderate in cover. *Larrea tridentata* (creosotebush) is almost always the leading dominant shrub, and usually has much of the relative cover in this stratum. *Fouquieria splendens* (ocotillo*), Cylindropuntia leptocaulis* (Christmas cactus), *Prosopis glandulosa* (honey mesquite), *Jatropha dioica* (leatherstem), *Grusonia aggeria* (Big Bend dog cholla), and *Vachellia constricta* (whitethorn acacia), have relatively high constancy, usually at low cover, but occasionally abundant enough to be co-dominant with *L. tridentata*. Other shrubs include *Echinocereus enneacanthus* var. *enneacanthus* (pitaya cactus), *Krameria grayi* (white ratany), *Krameria erecta* (littleleaf ratany), *Opuntia camanchica* (Comanche pricklypear), and *Yucca torreyi* (Torrey's yucca). The herbaceous stratum is mostly sparse, although the grass *Cathestecum erectum* (false grama) may provide significant cover in a minority of stands. *Dasyochloa pulchella* (fluffgrass) is more constant, but less abundant, than *C. erectum*. Other herbaceous species include *Aristida purpurea* (purple threeawn), *Senna durangensis* (Durango senna), *Bahia absinthifolia* (hairyseed bahia), and (occasionally) the non-native and invasive *Pennisetum ciliare* (buffelgrass).

Notably, *Agave lechuguilla* (lechuguilla), a constant and often dominant species in most other desert scrub associations at BIBE, is absent over large areas of the Big Bend Lowlands Creosotebush Desert Scrub, and its presence in much quantity is a contra-indicator of this association. Stratum and substrate cover for Big Bend Lowlands Creosotebush Desert Scrub are shown in Table D-26.

Table D-26. Stratum and substrate cover recorded for Big Bend Lowlands Creosotebush Desert Scrub at Big Bend National Park and Rio Grande Wild and Scenic River (# plots=31).

Category	Item	Mean Cover (%)	Range Cover (%)
Stratum	Tree	0	0-0
	Tall Shrub	3	0-25
	Short Shrub	13	2-40
	Herb	14	0-60

Table D-26 (continued). Stratum and substrate cover recorded for Big Bend Lowlands Creosotebush Desert Scrub at Big Bend National Park and Rio Grande Wild and Scenic River (# plots=31).

Category	Item	Mean Cover (%)	Range Cover (%)
Substrate	Bedrock	0	0-5
	Large/Small Rocks	66	0-100
	Litter/Duff	5	0-50

Environment

This association is the dominant desert scrub type in much of the upper part of RIGR, from Talley downstream at least to Boquillas Canyon. It occurs on non-calcareous surfaces, usually on extensive alluvial fans and flats.

USNVC Crosswalk

USNVC Class: Semi & Semi-Desert Class (3)

USNVC Subclass: Warm Desert & Semi-Desert Woodland, Scrub & Grassland Subclass (3.A)

USNVC Formation: Warm Desert & Semi-Desert Scrub & Grassland Formation (3.A.2)

USNVC Division: North American Warm Desert Scrub & Grassland Division (D039)

USNVC Macrogroup: Chihuahuan Desert Scrub Macrogroup (M086)

USNVC Group: Chihuahuan Creosotebush-Mixed Desert Scrub Group (G288)

USNVC Alliance: *Larrea tridentata* Chihuahuan Desert Scrub Alliance (A3164)

NPS Association: *Larrea tridentata - Cylindropuntia leptocaulis / Dasyochloa pulchella - Cathestecum erectum* Shrubland Association (NPSBIBE031)

Most frequent plant taxa recorded in Southern Stockton Plateau Creosotebush Desert Scrub are shown in Table D-27.

Table D-27. Synthesis table for the most frequent plant taxa recorded in Big Bend Lowlands Creosotebush Desert Scrub at Big Bend National Park and Rio Grande Wild and Scenic River (# plots=31).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Larrea tridentata	Shrub	100.0%	4.7	0-50
Fouquieria splendens	Shrub	60.0%	2.1	0-26
Grusonia aggeria	Shrub	53.3%	0.7	0-10
Jatropha dioica	Shrub	43.3%	0.7	0-6

Table D-27 (continued). Synthesis table for the most frequent plant taxa recorded in Big Bend Lowlands Creosotebush Desert Scrub at Big Bend National Park and Rio Grande Wild and Scenic River (# plots=31).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Krameria grayi	Shrub	43.3%	0.3	0-3
Cylindropuntia leptocaulis	Shrub	36.7%	0.4	0-3
Yucca torreyi	Shrub	36.7%	0.3	0-4
Vachellia constricta	Shrub	33.3%	0.4	0-7
Opuntia camanchica	Shrub	30.0%	0.2	0-4
Menodora scabra	Shrub	26.7%	0.2	0-2
Echinocereus enneacanthus	Shrub	23.3%	0.1	0-1
Echinocereus stramineus	Shrub	23.3%	0.1	0-1
Prosopis glandulosa	Shrub	26.7%	0.1	0-2
Echinocactus horizonthalonius	Shrub	16.7%	0.1	0-1
Viguiera stenoloba	Shrub	13.3%	0.6	0-25
Echinocereus dasyacanthus	Shrub	13.3%	<0.1	0-1
Coryphantha macromeris	Shrub	13.3%	<0.1	0-trace
Grusonia densispina	Shrub	10.0%	0.2	0-5
Parthenium incanum	Shrub	10.0%	0.2	0-5
Hibiscus denudatus	Herb	10.0%	0.1	0-1
Senegalia roemeriana	Shrub	10.0%	0.1	0-5
Krameria erecta	Shrub	10.0%	<0.1	0-1
Opuntia rufida	Shrub	10.0%	<0.1	0-1
Tiquilia greggii	Shrub	10.0%	<0.1	0-1
Dasyochloa pulchella	Herb	60.0%	1.5	0-50
Cathestecum erectum	Herb	50.0%	7.3	0-75
Senna durangensis	Herb	46.7%	0.2	0-1
Croton sp.	Herb	23.3%	0.1	0-2
Tiquilia canescens	Herb	23.3%	0.1	0-2
Bahia absinthifolia	Herb	20.0%	0.1	0-1
Aristida sp.	Herb	16.7%	0.1	0-1
Bouteloua ramosa	Herb	16.7%	0.1	0-10

Table D-27 (continued). Synthesis table for the most frequent plant taxa recorded in Big Bend Lowlands Creosotebush Desert Scrub at Big Bend National Park and Rio Grande Wild and Scenic River (# plots=31).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Bouteloua trifida	Herb	13.3%	0.8	0-25
Pennisetum ciliare	Herb	13.3%	0.6	0-25
Tiquilia hispidissima	Herb	13.3%	0.1	0-1
Boerhavia sp.	Herb	10.0%	0.1	0-1
Cevallia sinuata	Herb	10.0%	0.1	0-1
Chamaesyce sp.	Herb	10.0%	0.1	0-1
Dalea sp.	Herb	10.0%	0.1	0-1
Senna bauhinioides	Herb	10.0%	0.1	0-1
Argythamnia neomexicana	Herb	10.0%	<0.1	0-1



Photo 27. Big Bend Lowlands Creosotebush Desert Scrub, near La Clocha, Big Bend National Park (BIBE0114) (Jenny Goucher).



Photo 28. Big Bend Lowlands Creosotebush Desert Scrub, near Woodson’s Camp along Rio Grande, Big Bend National Park (BIBEAA1167) (Kelsey Wogan).

Mesquite - Creosotebush Desert Scrub

Local Type and Concept

Desert scrub with some combination of *Prosopis glandulosa* (honey mesquite) and *Larrea tridentata* (creosotebush) present and with one or both dominant, occurring on gentle slopes with finer-textured soils. *Flourensia cernua* (American tarbush) may occur and is diagnostic when present in quantity.

Accuracy Assessment Sites Within RIGR Included in Concept

BIBEAA0768, BIBEAA1089 , BIBEAA1090, BIBEAA1099, BIBEAA1283

Vegetation

Prosopis glandulosa (honey mesquite) and *Larrea tridentata* (creosotebush) are both constant and one or the other, or both, are dominant as a tall or short shrub. *P. glandulosa* height tends to be 1.5 to 3 meters (i.e., relatively short, compared to its normal stature in the Rio Grande Riparian Mesquite Bosque), while *L. tridentata* height tends to be 1 to 2 meters (i.e., relatively tall, compared to its normal stature in other desert scrub associations in RIGR). Some stands lack *L. tridentata*. Within parts of BIBE, *Flourensia cernua* (American tarbush) may have significant cover and is fairly diagnostic of this association, when present, but it has not been observed in stands within RIGR. *Ziziphus obtusifolia* (lotebush) and *Senegalia greggii* (Gregg's catclaw) often are present as low cover tall shrubs, *Cylindropuntia leptocaulis* (Christmas cactus), *Atriplex canescens* (fourwing saltbush), *Vachellia constricta* (whitethorn acacia), *and Echinocereus enneacanthus* var. *enneacanthus* (pitaya cactus) may occur as shorter shrubs. The herbaceous stratum typically is sparse. Species that were recorded in RIGR stands include *Allionia incarnata* (trailing windmills), *Bahia absinthifolia* (hairyseed bahia), *Nerisyrenia camporum* (bicolor fanmustard), *Senna bauhinioides* (twinleaf senna), *Setaria leucopila* (streambed bristlegrass), and *Tidestromia lanuginosa* (woolly tidestromia). Stratum and substrate cover for Mesquite - Creosotebush Desert Scrub are shown in Table D-28.

Table D-28. Stratum and substrate cover recorded for Mesquite - Creosotebush Desert Scrub at Big Bend National Park (# plots=9).

Category	Item	Mean Cover (%)	Range Cover (%)
Stratum	Tree	0	0-0
	Tall Shrub	2	0-10
	Short Shrub	32	2-80
	Herb	4	1-15
Substrate	Bedrock	0	0-0
	Large/Small Rocks	51	1-85
	Litter/Duff	11	0-20

Environment

The Mesquite - Creosotebush Desert Scrub occupies several types of settings at RIGR. It occurs in extensive stands on flats and lower, finer-textured parts of extensive alluvial fans. It also occupies gentle slopes near washes, often for some distance from the wash although often not immediately along the banks (the primary habitat of the Acacia - Mesquite Wash Shrubland). The common factor of these settings appears to be relatively poor soil drainage (among desert scrub types). Although apparently frequent in RIGR from Talley to Rio Grande Village, it was not observed downstream from Rio Grande Village. It may occur within the Black Gap Wildlife Management Area, but apparently requires areas of relatively gentle slopes and finer-textured soils, which are uncommon in the Lower Canyons and downstream to the Terrell-Val Verde county line.

USNVC Crosswalk

USNVC Class: Semi & Semi-Desert Class (3)

USNVC Subclass: Warm Desert & Semi-Desert Woodland, Scrub & Grassland Subclass (3.A)

USNVC Formation: Warm Desert & Semi-Desert Scrub & Grassland Formation (3.A.2)

USNVC Division: North American Warm Desert Scrub & Grassland Division (D039)

USNVC Macrogroup: Chihuahuan Desert Scrub Macrogroup (M086)

USNVC Group: Chihuahuan Creosotebush-Mixed Desert Scrub Group (G288)

USNVC Alliance: *Larrea tridentata* Chihuahuan Desert Scrub Alliance (A3164)

NPS Association: *Prosopis glandulosa - Larrea tridentata* - (*Flourensia cernua, Parthenium incanum*) Shrubland Association (NPS0025)

Comments

Following the classification sampling phase for BIBE, this vegetation was conceived as a primarily *Prosopis glandulosa* dominated type of uplands or "quasi-riparian" settings, with *Larrea tridentata* constant and *Flourensia cernua* and *Parthenium incanum* occasionally important. During the accuracy assessment, the concept expanded somewhat to recognize a continuum of desert scrub that covered large areas of lower (older) alluvial fans that have finer-textured soils, as well as gentle slopes near drainages, and that have varying combinations of *Prosopis glandulosa*, *Larrea tridentata*, *Flourensia cernua*, and *Parthenium incanum*. *Flourensia cernua* and *Parthenium incanum* are rare in or absent from RIGR stands.

The *Larrea tridentata - Prosopis glandulosa* Shrubland (CEGL001275), reported for New Mexico and Texas (USNVC 2017) might include this vegetation, but there is no description foe the unit (it appears as a name only). Most frequent plant taxa recorded in Mesquite - Creosotebush Desert Scrub are shown in Table D-29.

Table D-29. Synthesis table for the most frequent plant taxa recorded in Mesquite - Creosotebush Desert Scrub at Big Bend National Park (# plots=9).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Prosopis glandulosa	Shrub	100.0%	13.6	1-55
Larrea tridentata	Shrub	88.9%	7.0	0-27
Opuntia engelmannii	Shrub	66.7%	1.9	0-15
Parthenium incanum	Shrub	66.7%	0.9	0-5
Flourensia cernua	Shrub	55.6%	2.2	0-12
Cylindropuntia leptocaulis	Shrub	55.6%	0.7	0-4
Guaiacum angustifolium	Shrub	33.3%	0.6	0-6
Yucca torreyi	Shrub	33.3%	0.2	0-2
Atriplex canescens	Shrub	33.3%	0.1	0-1
Senegalia roemeriana	Shrub	33.3%	0.1	0-1
Agave lechuguilla	Shrub	22.2%	1.2	0-10
Cylindropuntia imbricata	Shrub	22.2%	0.3	0-3
Ephedra aspera	Shrub	22.2%	0.2	0-2
Echinocereus enneacanthus var. *enneacanthus*	Shrub	22.2%	0.1	0-1
Ibervillea tenuisecta	Shrub	22.2%	0.1	0-1
Koeberlinia spinosa	Shrub	22.2%	0.1	0-1
Opuntia camanchica	Shrub	22.2%	0.1	0-1
Viguiera stenoloba	Shrub	11.1%	4.2	0-51
Krameria erecta	Shrub	11.1%	4.2	0-50
Aloysia gratissima	Shrub	11.1%	0.2	0-3
Opuntia sp.	Shrub	11.1%	0.2	0-3
Rhamnus serrata	Shrub	11.1%	0.2	0-2
Dasylirion leiophyllum	Shrub	11.1%	0.1	0-1
Echinocereus coccineus var. *paucispinus*	Shrub	11.1%	0.1	0-1
Echinocereus dasyacanthus	Shrub	11.1%	0.1	0-1
Echinocereus stramineus	Shrub	11.1%	0.1	0-1
Gutierrezia sp.	Shrub	11.1%	0.1	0-1

Table D-29 (continued). Synthesis table for the most frequent plant taxa recorded in Mesquite - Creosotebush Desert Scrub at Big Bend National Park (# plots=9).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Krameria grayi	Shrub	11.1%	0.1	0-1
Lycium berlandieri	Shrub	11.1%	0.1	0-1
Mortonia scabra	Shrub	11.1%	0.1	0-1
Heteropogon contortus	Herb	77.8%	0.4	0-1
Bouteloua ramosa	Herb	55.6%	0.9	0-5
Kallstroemia parviflora	Herb	22.2%	7.0	0-75
Bouteloua barbata	Herb	22.2%	0.1	0-1
Sporobolus sp.	Herb	22.2%	0.1	0-1
Chloris virgata	Herb	11.1%	0.4	0-5
Blepharoneuron tricholepis	Herb	11.1%	0.2	0-2
Helianthus petiolaris	Herb	11.1%	0.2	0-2
Pleuraphis mutica	Herb	11.1%	0.2	0-2
Bothriochloa laguroides	Herb	11.1%	0.1	0-1
Bouteloua curtipendula	Herb	11.1%	0.1	0-1
Dasyochloa pulchella	Herb	11.1%	0.1	0-1
Eragrostis sp.	Herb	11.1%	0.1	0-1
Funastrum cynanchoides	Herb	11.1%	0.1	0-1
Muhlenbergia schreberi	Herb	11.1%	0.1	0-1
Panicum hallii	Herb	11.1%	0.1	0-1
Pennisetum ciliare	Herb	11.1%	0.1	0-1
Proboscidea louisianica	Herb	11.1%	0.1	0-1



Photo 29. Mesquite - Creosotebush Desert Scrub, near Solis, Big Bend National Park (BIBEAA0768) (Kelsey Wogan).



Photo 30. Mesquite - Creosotebush Desert Scrub, at Rio Grande Village, Big Bend National Park (BIBERAA1090) (Rebecca Evans).

Boquillas Basin Calcareous Cresotebush Desert Scrub

Local Type and Concept

Desert scrub on calcareous substrates (limestone) within the Big Bend National Park section of RIGR and downstream at least to Reagan Canyon. *Larrea tridentata* (creosotebush) is constant and usually is a dominant or co-dominant species. Species that are indicators of calcareous substrates, including *Opuntia ×spinosibacca* (spiny-fruited pricklypear), *Leucophyllum candidum* (Boquillas silverleaf), and *Hechtia texensis* (Texas false agave), are present, although they may be scattered and/or at low cover.

Accuracy Assessment Sites Within RIGR Included in Concept

BIBEAA1004, BIBEAA1005, BIBEAA1007, RIGRAA1024, RIGRAA1068, RIGRAA1069, RIGRAA1081, RIGRAA1082, RIGRAA1084, RIGRAA1085, RIGRAA1086, RIGRAA1087, RIGRAA1152, RIGRAA1156, RIGRAA1161, RIGRAA1163

Vegetation

The shrub stratum has sparse to moderate cover. *Larrea tridentata* (creosotebush) is constant and usually is the leading dominant or is co-dominant with other constant species, such as *Agave lechuguilla (*lechuguilla), *Opuntia ×spinosibacca* (spiny-fruited pricklypear), *Fouquieria splendens* (ocotillo), *Leucophyllum candidum* (Boquillas silverleaf), and/or *Hechtia texensis* (Texas false agave). Within BIBE, the presence of *A. lechuguilla* in quantity helps to differentiate this vegetation from the Big Bend Lowlands Creosotebush Desert Scrub. *O. ×spinosibacca* and *L. candidum* are fairly useful diagnostic species for this vegetation because of their restriction to calcareous substrates and their limited distribution both upstream and downstream from the center of distribution for this vegetation (Boquillas area and southeastern Big Bend National Park). Fairly constant low cover shrub species include *Echinocactus horizonthalonius* (eagle-claw cactus), *Krameria grayi* (white ratany), and *Krameria erecta* (littleleaf ratany). *Tiquilia* spp. (crinklemats), including *T. greggii, T. hispidissima, T. canescens, T. mexicana*, and/or T. *gossypina* are characteristic low cover subshrubs. Less constant shrubs include *Euphorbia antisyphilitica* (candelilla), *Jatropha dioica* (leatherstem), *Vachellia constricta* (whitethorn acacia), *Opuntia rufida* (blind pricklypear), Yucca torreyi (Torrey's yucca), Escobaria tuberculosa (cob cactus), Argythamnia serrata (Yuma silverbush), *Echinocereus stramineus* (strawberry hedgehog cactus), *Guaiacum angustifolium* (guayacan), *Grusonia aggeria* (Big Bend dog cholla), and *Hibiscus denudatus* (paleface rosemallow). Herbaceous cover typically is sparse (typically, 0-10% cover); the grasses *Bouteloua ramosa* (chino grama) and *Dasyochloa pulchella* (fluffgrass) are the most constant and abundant species. Other species include *Selaginella lepidophylla* (resurrection plant), *Senna durangensis* (Durango senna), *Tridens muticus* (slim tridens), *Panicum hallii* (Hall's panicgrass), *Bouteloua trifida* (red grama), *Aristida purpurea* (purple threeawn), and *Allionia incarnata* (trailing windmills). Stratum and substrate cover for Boquillas Basin Calcareous Creosotebush Desert Scrub are shown in Table D-30.

Table D-30. Stratum and substrate cover recorded for Boquillas Basin Calcareous Creosotebush Desert Scrub at Big Bend National Park (# plots=15).

Category	Item	Mean Cover (%)	Range Cover (%)
Stratum	Tree	0	0-0
	Tall Shrub	0	0-25
	Short Shrub	13	3-40
	Herb	6	3-10
Substrate	Bedrock	14	0-90
	Large/Small Rocks	73	1-99
	Litter/Duff	2	0-20

Environment

This association occurs on calcareous substrates (limestones) within the BIBE part of RIGR, occurring in BIBE only at low elevations in the southeastern part, west to the west side of Mariscal Mountain. It appears to occur downstream at least to the upstream end of the RIGR Lower Canyons (Reagan Canyon) and, possibly, in small patches within a larger matrix of Northeastern Chihuahuan Canyon Desert Scrub within the Lower Canyons themselves. It generally occurs on relatively gentle slopes.

USNVC Crosswalk

USNVC Class: Semi & Semi-Desert Class (3)

USNVC Subclass: Warm Desert & Semi-Desert Woodland, Scrub & Grassland Subclass (3.A)

USNVC Formation: Warm Desert & Semi-Desert Scrub & Grassland Formation (3.A.2)

USNVC Division: North American Warm Desert Scrub & Grassland Division (D039)

USNVC Macrogroup: Chihuahuan Desert Scrub Macrogroup (M086)

USNVC Group: Chihuahuan Desert Succulent Desert Scrub Group (G286)

USNVC Alliance: Agave lechuguilla - Euphorbia antisyphilitica Chihuahuan Desert Succulent Scrub Alliance (A3157)

NPS Association: *Larrea tridentata - Agave lechuguilla - Hechtia texensis - Echinocactus horizonthalonius* Sparse Shrubland Association (NPSBIBE011)

Comments

This association is the calcareous analog to the Big Bend Lowlands Creosotebush Desert Scrub, with which it is sympatric, and a western (and apparently allopatric) analog to the Southern Stockton Plateau Creosotebush Desert Scrub. Most frequent plant taxa recorded in Boquillas Basin Calcareous Creosotebush Desert Scrub are shown in Table D-31.

Table D-31. Synthesis table for the most frequent plant taxa recorded in Boquillas Basin Calcareous Creosotebush Desert Scrub at Big Bend National Park (# plots=15).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Larrea tridentata	Shrub	93.3%	1.9	0-7
Echinocactus horizonthalonius	Shrub	73.3%	0.3	0-1
Agave lechuguilla	Shrub	66.7%	2.4	0-25
Fouquieria splendens	Shrub	60.0%	0.5	0-5
Jatropha dioica	Shrub	60.0%	0.4	0-2
Menodora scabra	Shrub	60.0%	0.4	0-2
Grusonia aggeria	Shrub	53.3%	0.3	0-1
Echinocereus dasyacanthus	Shrub	53.3%	0.2	0-1
Hechtia texensis	Shrub	46.7%	1.4	0-8
Opuntia ×spinosibacca	Shrub	46.7%	0.4	0-3
Cylindropuntia leptocaulis	Shrub	46.7%	0.2	0-2
Echinocereus stramineus	Shrub	46.7%	0.2	0-1
Ariocarpus fissuratus	Shrub	46.7%	0.2	0-1
Opuntia rufida	Shrub	40.0%	0.3	0-3
Tiquilia greggii	Shrub	40.0%	0.2	0-1
Escobaria tuberculosa	Shrub	40.0%	0.2	0-1
Vachellia constricta	Shrub	33.3%	0.2	0-2
Prosopis glandulosa	Shrub	33.3%	0.1	0-1
Leucophyllum minus	Shrub	26.7%	0.4	0-6
Euphorbia antisyphilitica	Shrub	26.7%	0.3	0-3
Viguiera stenoloba	Shrub	26.7%	0.1	0-1
Coryphantha echinus	Shrub	26.7%	0.1	0-1
Krameria erecta	Shrub	26.7%	0.1	0-1
Ephedra aspera	Shrub	20.0%	0.1	0-2
Hibiscus denudatus	Shrub	20.0%	0.1	0-1
Cylindropuntia imbricata	Shrub	13.3%	0.1	0-2
Krameria grayi	Shrub	13.3%	0.1	0-1
Leucophyllum candidum	Shrub	13.3%	0.0	0-1

Table D-31 (continued). Synthesis table for the most frequent plant taxa recorded in Boquillas Basin Calcareous Creosotebush Desert Scrub at Big Bend National Park (# plots=15).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Bouteloua ramosa	Herb	86.7%	1.3	0-10
Dasyochloa pulchella	Herb	80.0%	0.6	0-5
Tiquilia canescens	Herb	73.3%	0.4	0-2
Selaginella lepidophylla	Herb	40.0%	0.3	0-2
Aristida purpurea	Herb	33.3%	0.2	0-2
Tiquilia hispidissima	Herb	33.3%	0.2	0-1
Allionia incarnata	Herb	26.7%	0.1	0-1
Cathestecum erectum	Herb	26.7%	0.1	0-1
Polygala macradenia	Herb	26.7%	0.1	0-1
Aristida sp.	Herb	20.0%	0.1	0-1
Senna durangensis	Herb	20.0%	0.1	0-1
Bahia absinthifolia	Herb	20.0%	0.1	0-1
Mandevilla macrosiphon	Herb	20.0%	0.1	0-1
Echinomastus warnockii	Herb	13.3%	0.1	0-1
Selaginella peruviana	Herb	13.3%	0.1	0-1
Tetraneuris scaposa	Herb	13.3%	0.1	0-1



Photo 31. Boquillas Basin Calcareous Creosotebush Desert Scrub, along Hot Springs Canyon Rim Trail, Big Bend National Park (BIBEAA1004) (Rebecca Evans).



Photo 32. Boquillas Basin Calcareous Creosotebush Desert Scrub, near Rooney's Place, Big Bend National Park (BIBEAA1005) (Kelsey Wogan).

Northeastern Chihuahuan Canyon Desert Scrub

Local Type and Concept

Desert scrub of limestone canyons in southeastern Brewster County, usually dominated by some combination of the Chihuahuan succulent species *Euphorbia antisyphilitica* (candelilla), *Agave lechuguilla* (lechuguilla), *Hechtia texensis* (Texas false agave), *Fouquieria splendens* (ocotillo), and/or *Opuntia rufida* (blind prickly pear), along with the non-succulent *Larrea tridentata* (creosotebush), and at least a small component of more characteristically Tamaulipan species, such as *Vachellia rigidula* (blackbrush), *Leucophyllum frutescens* (cenizo), *Lippia graveolens* (Mexican oregano), *Karwinskia humboldtiana* (coyotillo), and others.

Observation Points Within RIGR Included in Concept

RIGROBS0524, RIGROBS0533

Accuracy Assessment Sites Within RIGR Included in Concept

RIGRAA1068, RIGRAA1069, RIGRAA1070, RIGRAA1071, RIGRAA1076, RIGRAA1077, RIGRAA1078, RIGRAA1080, RIGRAA1083, RIGRAA1084, RIGRAA1085, RIGRAA1086, RIGRAA1087, RIGRAA1136, RIGRAA1140, RIGRAA1145, RIGRAA1148, RIGRAA1152, RIGRAA1153, RIGRAA1154, RIGRAA1155, RIGRAA1156, RIGRAA1157, RIGRAA1160, RIGRAA1161, RIGRAA1163, RIGRAA1165

Vegetation

The shrub stratum usually has mixed species dominance, with a strong component of short succulent species. *Euphorbia antisyphilitica* (candelilla), *Agave lechuguilla* (lechuguilla), *Hechtia texensis* (Texas false agave), and *Larrea tridentata* (creosotebush) are the most constant and abundant species. The taller *Fouquieria splendens* (ocotillo), and/or *Opuntia rufida* (blind prickly pear) often are present and may co-dominate. Lower cover shrubs include *Vachellia rigidula* (blackbrush), *Leucophyllum frutescens* (cenizo), *Lippia graveolens* (Mexican oregano), *Jatropha dioica* (leatherstem), *Yucca torreyi* (Torrey's yucca), *Karwinskia humboldtiana* (coyotillo), *Prosopis glandulosa* (honey mesquite), and *Viguiera stenoloba* (skeletonleaf goldeneye). Frequent small cactuses include *Echinocereus stramineus* (strawberry hedgehog cactus), *Escobaria tuberculosa* (cob cactus), and *Echinocereus enneacanthus* var. *enneacanthu*s (pitaya cactus), Less constant species are *Fraxinus greggii* (littleleaf ash), *Opuntia engelmannii* var. *engelmannii* (Engelmann's pricklypear), *Ziziphus obtusifolia* (lotebush), *Cylindropuntia leptocaulis* (Christmas cactus), *Forestiera angustifolia* (desert olive), E*phedra antisyphilitica* (clapweed), *Argythamnia serrata* (Yuma silverbush), *Vachellia constricta* (whitethorn acacia), *Jefea brevifolia* (shortleaf jefea), *Diospyros texana* (Texas persimmon), *Ruellia parryi* (Parry's wild petunia), *Hibiscus denudatus* (paleface rosemallow), and *Ferocactus hamatacanthus* (eagle-claw cactus). Several shrub species are present in this vegetation that are characteristic of Tamaulipan limestone thornscrub assemblages but are rare or absent to the west include *V. rigidula, L. graveolens, K. humboldtiana* (coyotillo), and (on limestone) *L. frutescens*. Less frequently encountered species with this distribution pattern include *Senegalia berlandieri* (guajillo*), Dasylirion texanum* (Texas sotol), and *Opuntia engelmannii* var. *lindheimer*i (Texas pricklypear). The herbaceous stratum has mostly low to, occasionally moderate cover, with grasses such as *Bouteloua ramosa* (chino grama), *Panicum hallii* (Hall's panicgrass),

Dasyochloa pulchella (fluffgrass), *Bouteloua barbata* (sixweeks grama), and *Tridens muticus* (slim tridens). *Bahia absinthifolia* (hairyseed bahia) is perhaps the most frequent forb, while *Selaginella lepidophylla* (resurrection plant) and *Astrolepis cochisensis* (Cochise cloak fern) are representative pteridophytes. Some stands have become abundantly invaded by *Pennisetum ciliare* (buffelgrass), particularly where fires, probably originating in downslope Arundo donax (giant cane) stands, have occurred and the shrub cover also has been diminished.

Environment

This vegetation is the dominant upland vegetation of the Lower Canyons section of RIGR, occurring on limestone, often on steep, rocky slopes. It extends from at least La Linda (and possibly upstream on steep terrain into Boquillas and Mariscal Canyons) downstream to just east of the Brewster - Terrell County line.

USNVC Crosswalk

USNVC Class: Semi & Semi-Desert Class (3)

USNVC Subclass: Warm Desert & Semi-Desert Woodland, Scrub & Grassland Subclass (3.A)

USNVC Formation: Warm Desert & Semi-Desert Scrub & Grassland Formation (3.A.2)

USNVC Division: North American Warm Desert Scrub & Grassland Division (D039)

USNVC Macrogroup: Chihuahuan Desert Scrub Macrogroup (M086)

USNVC Group: Chihuahuan Desert Succulent Desert Scrub Group (G286)

USNVC Alliance: *Agave lechuguilla - Euphorbia antisyphilitica* Chihuahuan Desert Succulent Scrub Alliance (A3157)

NPS Association: *Euphorbia antisyphilitica - Agave lechuguilla - Hechtia texensis - Leucophyllum frutescens - Vachellia rigidula* Shrubland Association (NPSRIGR003)

Comments

Although the Northeastern Chihuahuan Canyon Desert Scrub was not sampled by classification plots, the map accuracy assessment data suggests that it is a reasonably distinct association. While it most resembles the *Agave lechuguilla - Euphorbia antisyphilitica - Ephedra aspera* / *Bouteloua ramosa* Shrubland Association (Calcareous Mixed Desert Scrub) of Big Bend National Park in floristics and environmental setting, there are distinct floristic differences, with higher elevation species such *as Tiquilia greggii* (Gregg's crinklemat), *Leucophyllum minus* (Big Bend silverleaf), *Dasylirion leiophyllum* (green sotol), and *Ephedra aspera* (rough jointfir) differential for the former and the more eastern (characteristically Tamaulipan), *Vachellia rigidula* (blackbrush), *Leucophyllum frutescens* (cenizo), *Lippia graveolens* (Mexican oregano), *Karwinskia humboldtiana* (coyotillo) indicative of the latter. The two associations are largely allopatric by geography and elevation.

The Northeastern Chihuahuan Canyon Desert Scrub apparently intergrades with the upstream Boquillas Basin Calcareous Creosotebush Desert Scrub of similar elevation and limestone substrate, somewhere in the reach from Boquillas Canyon to the downstream end of the Las Vegas de las Ladrones in the Black Gap Wildlife Management Area. Stands sampled in the latter area are somewhat intermediate between the two types. The former association is characterized by a more

significant component of succulent species and the presence of species more characteristically of a Tamaulipan distribution versus stronger dominance by *Larrea tridentata* (creosotebush) and the presence of more localized species such as *Opuntia ×spinosibacca* (spiny-fruited pricklypear) and *Leucophyllum candidum* (Boquillas silverleaf) in the latter association.

Leucophyllum frutescens is a frequent shrub in this vegetation and in other vegetation types on limestone to the east. Paradoxically, to the west, in Big Bend National Park, it is absent over large areas of limestone (where it is replaced by other *Leucophyllum* species) yet is regularly present in desert scrub on non-limestone substrates.



Photo 33. Northeastern Chihuahuan Canyon Desert Scrub, mile 37.5 below La Linda (near mouth of Las Yeguas Canyon), Lower Canyons (RIGRAA1156) (Kelon Crawford).



Photo 34. Northeastern Chihuahuan Canyon Desert Scrub, mile 57.5 below La Linda (vicinity of Lower Madison Falls), Lower Canyons (RIGRAA1165) (Kelon Crawford).

Southern Stockton Plateau Mixed Desert Scrub

Local Type and Concept

Shrublands of mixed species dominance of slopes on moderate to steep slopes on limestone substrates within the eastern part of Rio Grande Wild and Scenic River (Terrell County). A component of succulent species is usually a significant part of the shrub stratum.

Classification Plots Within RIGR Included in Concept

RIGR2002, RIGR2004, RIGR2014, RIGR2015, RIGR2021, RIGR2103, RIGR2104, RIGR2112

Accuracy Assessment Sites Within RIGR Included in Concept

RIGRAA1164, RIGRAA1320, RIGRAA1324

Vegetation

The shrub stratum usually has mixed species dominance, usually with a combination of *Prosopis glandulosa* (honey mesquite), *Viguiera stenoloba* (skeletonleaf goldeneye), *Fouquieria splendens* (ocotillo), *Leucophyllum frutescens* (cenizo), *Larrea tridentata* (creosotebush), *Cylindropuntia leptocaulis* (Christmas cactus), *Lippia graveolens* (Mexican oregano), and/or *Agave lechuguilla* (lechuguilla). Species that occur at usually lower cover include the taller shrubs *Forestiera angustifolia* (desert olive), *Senegalia berlandieri* (guajillo), *Guaiacum angustifolium* (guayacan), *Ziziphus obtusifolia* (lotebush), and *Diospyros texana* (Texas persimmon). Short cactuses include *Echinocereus enneacanthus* var. *brevispinus* (pitaya cactus) and *Grusonia schottii* (Schott's dog cholla). The herbaceous stratum has low to moderately dense overall cover, with the grass *Bouteloua ramosa* (chino grama) and the pteridophytes *Selaginella wrightii* (Wright's spikemoss) and/or fairly constant and sometimes at high cover. Other grasses *include Bouteloua trifida* (red grama), *Tridens muticus* (slim tridens), and *Aristida purpurea* (purple threeawn). Other pteridophytes are *Selaginella lepidophylla* (resurrection plant) and *Astrolepis integerrima* (hybrid cloak fern), with the former species occasionally locally abundant. *Tiquilia canescens* (woody crinklemat) is a fairly constant low cover perennial forb or subshrub. Other forbs include *Bahia absinthifolia* (hairyseed bahia), *Dalea pogonathera* (bearded prairie clover), *Lupinus havardii* (Big Bend lupine), *Sida abutifolia* (spreading fanpetals), *Acleisanthes longiflora* (angel's trumpets), *Allionia incarnata* (trailing windmills), and *Portulaca pilosa* (shaggy portulaca). Stratum and substrate cover for Southern Stockton Plateau Mixed Desert Scrub are shown in Table D-32.

Table D-32. Stratum and substrate cover recorded for Southern Stockton Plateau Mixed Desert Scrub at Rio Grande Wild and Scenic River (# plots=9).

Category	Item	Mean Cover (%)	Range Cover (%)
Stratum	Tree	0	0-2
	Tall Shrub	6	0-30
	Short Shrub	49	25-90
	Herb	32	15-60

Table D-32 (continued). Stratum and substrate cover recorded for Southern Stockton Plateau Mixed Desert Scrub at Rio Grande Wild and Scenic River (# plots=9).

Category	Item	Mean Cover (%)	Range Cover (%)
Substrate	Bedrock	24	0-80
	Large/Small Rocks	37	0-70
	Litter/Duff	1	0-5

Environment

This association occurs on limestone in RIGR throughout Terrell County (generally, to the east of Bone Watering and the Lower Canyons section). In this area, it is sympatric with the Southern Stockton Plateau Creosotebush Desert Scrub, but usually occurs on steeper slopes, often with more bedrock exposure. It evidently is frequent near the Rio Grande, where it likely occurs in a mosaic with the Southern Stockton Plateau Creosotebush Desert Scrub, which appears to be more dominant on more gentle terrain to the north of the river corridor.

USNVC Crosswalk

USNVC Class: Semi & Semi-Desert Class (3)

USNVC Subclass: Warm Desert & Semi-Desert Woodland, Scrub & Grassland Subclass (3.A)

USNVC Formation: Warm Desert & Semi-Desert Scrub & Grassland Formation (3.A.2)

USNVC Division: North American Warm Desert Scrub & Grassland Division (D039)

USNVC Macrogroup: Tamaulipan Scrub and Grassland Macrogroup (M130)

USNVC Group: Chihuahuan Desert Succulent Desert Scrub Group (G286)

USNVC Alliance: *Agave lechuguilla - Euphorbia antisyphilitica* Chihuahuan Desert Succulent Scrub Alliance (A3157)

NPS Association: *Prosopis glandulosa - Viguiera stenoloba - Larrea tridentata - Leucophyllum frutescens* / *Bouteloua ramosa - Selaginella wrightii* Shrubland Association (NPSRIGR005)

Comments

Placement of this association is provisionally within the Chihuahuan Desert Succulent Desert Scrub Group (G286). Although thorny and other non-succulent shrubs provide most of the shrub stratum cover, there usually is at least a significant component of succulents (*Fouquieria splendens, Agave lechuguilla*, cactuses) and the setting is on rocky slopes.

Of the desert scrub associations of RIGR, the Southern Stockton Plateau Mixed Desert Scrub shows the most affinity to the thornscrub associations of Amistad National Recreation Area (AMIS), with a significant component of Tamaulipan species. Several of the Chihuahuan succulent species that are widespread in the western (Brewster County) sections of RIGR, including *Euphorbia antisyphilitica* (candelilla), *Hechtia texensis* (Texas false agave), and *Opuntia rufida* (blind pricklypear) are

inconstant to absent in this section of RIGR. While there are some floristic differences, this association shows similarities to the *Vachellia rigidula - Opuntia engelmannii* var. *lindheimeri - Jatropha dioica - Lippia graveolens* Shrubland (NPSAMIS026) of western AMIS. One difference is the virtual absence of *Vachellia rigidula* (=*Acacia rigidula*) in the Southern Stockton Plateau Mixed Desert Scrub and over large areas of the Terrell County section of RIGR, whereas it is frequent, although not often abundant, in the more western Brewster County (Lower Canyons) section.

Most frequent plant taxa recorded in Southern Stockton Plateau Mixed Desert Scrub are shown in Table D-33.

Table D-33. Synthesis table for the most frequent plant taxa recorded in Southern Stockton Plateau Mixed Desert Scrub at Rio Grande Wild and Scenic River (# plots=9).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Prosopis glandulosa	Shrub	100.0%	7.3	few-56
Viguiera stenoloba	Shrub	88.9%	4.1	0-28
Larrea tridentata	Shrub	88.9%	3.4	0-13
Fouquieria splendens	Shrub	88.9%	2.3	0-21
Leucophyllum frutescens	Shrub	77.8%	9.0	0-50
Cylindropuntia leptocaulis	Shrub	77.8%	0.8	0-2
Lippia graveolens	Shrub	55.6%	10.1	0-50
Echinocereus enneacanthus var. *brevispinus*	Shrub	55.6%	0.3	0-1
Agave lechuguilla	Shrub	44.4%	3.0	0-25
Forestiera angustifolia	Shrub	44.4%	0.8	0-6
Senegalia berlandieri	Shrub	44.4%	0.7	0-5
Guaiacum angustifolium	Shrub	44.4%	0.3	0-2
Grusonia schottii	Shrub	44.4%	0.3	0-2
Ziziphus obtusifolia	Shrub	44.4%	0.2	0-2
Diospyros texana	Shrub	33.3%	1.0	0-10
Lycium berlandieri	Shrub	22.2%	1.1	0-13
Yucca torreyi	Shrub	22.2%	0.4	0-5
Opuntia camanchica	Shrub	22.2%	0.3	0-2
Ruellia parryi	Shrub	22.2%	0.2	0-2
Hibiscus denudatus	Shrub	22.2%	0.2	0-2

Table D-33 (continued). Synthesis table for the most frequent plant taxa recorded in Southern Stockton Plateau Mixed Desert Scrub at Rio Grande Wild and Scenic River (# plots=9).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Dalea formosa	Shrub	22.2%	0.2	0-2
Parthenium incanum	Shrub	22.2%	0.2	0-2
Menodora scabra	Shrub	22.2%	0.1	0-1
Heliotropium torreyi	Shrub	22.2%	0.1	0-1
Yucca thompsoniana	Shrub	22.2%	0.1	0-1
Escobaria tuberculosa	Shrub	22.2%	0.1	0-1
Mimosa borealis	Shrub	22.2%	0.1	0-1
Echinocactus horizonthalonius	Shrub	22.2%	0.1	0-1
Heliotropium confertifolium	Shrub	22.2%	0.1	0-1
Ephedra antisyphilitica	Shrub	22.2%	0.1	0-1
Bouteloua ramosa	Herb	88.9%	9.7	0-85
Tiquilia canescens	Herb	88.9%	1.1	0-5
Selaginella wrightii	Herb	77.8%	10.3	0-85
Tridens muticus	Herb	77.8%	0.5	0-2
Bahia absinthifolia	Herb	77.8%	0.5	0-1
Aristida purpurea	Herb	66.7%	0.8	0-5
Bouteloua trifida	Herb	66.7%	0.4	0-2
Selaginella lepidophylla	Herb	55.6%	5.2	0-25
Lupinus havardii	Herb	55.6%	0.3	0-2
Dalea pogonathera	Herb	55.6%	0.2	0-1
Sida abutifolia	Herb	55.6%	0.2	0-1
Acleisanthes longiflora	Herb	44.4%	0.2	0-1
Allionia incarnata	Herb	33.3%	0.2	0-2
Astrolepis integerrima	Herb	33.3%	0.1	0-1
Portulaca pilosa	Herb	33.3%	0.1	0-1
Bouteloua barbata	Herb	22.2%	1.0	0-10
Sporobolus airoides	Herb	22.2%	0.3	0-2
Verbena plicata	Herb	22.2%	0.3	0-2



Photo 35. Southern Stockton Plateau Mixed Desert Scrub, along Rio Grande, 1.5 miles downstream from Cook Creek (RIGR2104) (Kelon Crawford).



Photo 36. Southern Stockton Plateau Creosotebush Desert Scrub, Terrell - Val Verde County line (RIGR2112) (Kelon Crawford).

Calcareous Mixed Desert Scrub

Local Type and Concept

Desert scrub with the common environmental influences of middle elevations within the desert scrub zone (typically, 2,500 to 4,000 feet) and calcareous substrates. The shrub stratum is dominated by a mix of generalist desert scrub species, with several calcareous substrate indictors. *Bouteloua ramosa* (chino grama) is constant. It occurs immediately above the elevation range of the Boquillas Basin Calcareous Creosotebush Desert Scrub and is limited to the Big Bend National Park section of RIGR, where it is likely limited in extent.

Vegetation

The shrub stratum is relatively species rich, with *Agave lechuguilla* (lechuguilla), *Larrea tridentata* (creosotebush), *Dasylirion leiophyllum* (green sotol), and *Euphorbia antisyphilitica* (candelilla) the most constant and, overall, the most abundant species. Other relatively important shrub species are *Hechtia texensis* (Texas false agave) (which can be locally abundant), *Ephedra aspera* (rough jointfir), *Fouquieria splendens* (ocotillo), *Viguiera stenoloba* (skeletonleaf goldeneye), *Leucophyllum minus* (Big Bend silverleaf), *Leucophyllum candidum* (Boquillas silverleaf), *Opuntia camanchica* (Comanche pricklypear), *Guaiacum angustifolium* (guayacan), *Jatropha dioica* (leatherstem), *Tiquilia greggii* (plumed crinklemat), *Yucca torreyi* (Torrey's yucca), *Opuntia rufida* (blind pricklypear), *Forestiera angustifolia* (desert olive), and *Dalea formosa* (featherplume) are relatively constant. Smaller cactus flora includes *Echinocereus dasyacanthus* (Texas rainbow cactus), *Echinocactus horizonthalonius* (turkshead cactus), *Ariocarpus fissuratus* (living rock cactus), and *Escobaria tuberculosa* (cob cactus). Subshrubs are represented by *Thymophylla acerosa* (pricklyleaf dogweed) and by several species of subshrubs of the genus *Tiquilia* (crinklemats), including *T. hispidissima, T. canescens, T. mexicana*, and *T. gossypina*. Among herbaceous species, *Bouteloua ramosa* (chino grama) is the most constant and abundant species of the herbaceous stratum. It becomes progressively more abundant with elevation and may achieve up to 50% cover. Other constant herbaceous species include *Selaginella lepidophylla* (resurrection plant), *Selaginella wrightii* (Wright's spikemoss), *Dasyochloa pulchella* (fluffgrass), *Aristida purpurea* (purple threeawn), *Tridens muticus* (slim tridens), *Panicum hallii* (Hall's panicgrass), *Polygala macradenia* (glandleaf milkwort), and *Bahia absinthifolia* (hairyseed bahia). *Nerisyrenia camporum* (bicolor fanmustard) is a frequent spring-flowering annual forb.

Among calcareous desert scrub associations in BIE and RIGR, the occurrence of *Dasylirion leiophyllum* (green sotol) and/or *Leucophyllum minus* (Big Bend silverleaf) is fairly diagnostic of this type. Stratum and substrate cover for Lechuguilla - (Candelilla, False Agave) Calcareous Mixed Desert Scrub are shown in Table D-34.

Table D-34. Stratum and substrate cover recorded for Lechuguilla - (Candelilla, False Agave) Calcareous Mixed Desert Scrub at Big Bend National Park (# plots=45).

Category	Item	Mean Cover (%)	Range Cover (%)
Stratum	Tree	0	0-0
	Tall Shrub	2	0-25
	Short Shrub	27	2-50
	Herb	18	3-50
Substrate	Bedrock	24	0-99
	Large/Small Rocks	60	1-96
	Litter/Duff	7	0-40

Environment

This association occurs generally above 2,450 feet (occasionally as low as 2,200 feet) and ranges to about 4,800 feet in the Dead Horse Mountains of BIBE. It occurs extensively within BIBE on calcareous (limestone) substrates. Most of RIGR lies below its elevation range, where limestone substrates support the analogous lower elevation Boquillas Basin Calcareous Creosotebush Desert Scrub and the Northeastern Chihuahuan Canyon Desert Scrub. Although it was not observed within RIGR boundaries during either the classification plot data collection or the map accuracy assessment, the Calcareous Mixed Desert Scrub probably occurs on Mariscal Mountain in the vicinity of the Mariscal Canyon Rim Trail and may occur within the boundaries of RIGR also in remote parts of the southern Dead Horse Mountains above the rim of Boquillas Canyon, at suitable elevations.

USNVC Crosswalk

USNVC Class: Semi & Semi-Desert Class (3)

USNVC Subclass: Warm Desert & Semi-Desert Woodland, Scrub & Grassland Subclass (3.A)

USNVC Formation: Warm Desert & Semi-Desert Scrub & Grassland Formation (3.A.2)

USNVC Division: North American Warm Desert Scrub & Grassland Division (D039)

USNVC Macrogroup: Chihuahuan Desert Scrub Macrogroup (M086)

USNVC Group: Chihuahuan Desert Succulent Desert Scrub Group (G286)

USNVC Alliance: *Agave lechuguilla* - *Euphorbia antisyphilitica* Chihuahuan Desert Succulent Scrub Alliance (A3157)

NPS Association: *Agave lechuguilla* - *Euphorbia antisyphilitica – Ephedra aspera* / *Bouteloua ramosa* Shrubland Association (NPSBIBE010)

Most frequent plant taxa recorded in Calcareous Mixed Desert Scrub are shown in Table D-35.

Table D-35. Synthesis table for the most frequent plant taxa recorded in Calcareous Mixed Desert Scrub at Big Bend National Park (# plots=45).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Agave lechuguilla	Shrub	90.9%	5.0	0-50
Ephedra aspera	Shrub	77.3%	0.5	0-3
Dasylirion leiophyllum	Shrub	75.0%	2.6	0-26
Euphorbia antisyphilitica	Shrub	68.2%	4.7	0-51
Leucophyllum minus	Shrub	65.9%	1.3	0-11
Echinocereus dasyacanthus	Shrub	63.6%	0.3	0-1
Opuntia camanchica	Shrub	56.8%	0.4	0-3
Larrea tridentata	Shrub	50.0%	1.4	0-32
Hechtia texensis	Shrub	45.5%	2.7	0-25
Viguiera stenoloba	Shrub	45.5%	0.5	2.5
Jatropha dioica	Shrub	45.5%	0.4	0-3
Tiquilia greggii	Shrub	43.2%	0.4	0-5
Fouquieria splendens	Shrub	38.6%	0.5	0-7
Senegalia greggii	Shrub	38.6%	0.3	0-3
Thymophylla acerosa	Shrub	36.4%	0.2	0-2
Echinocereus stramineus	Shrub	36.4%	0.2	0-1
Menodora scabra	Shrub	36.4%	0.2	0-1
Opuntia rufida	Shrub	34.1%	0.2	0-3
Forestiera angustifolia	Shrub	31.8%	0.3	0-3
Tiquilia canescens	Shrub	31.8%	0.2	0-2
Dalea formosa	Shrub	29.5%	0.3	0-10
Jefea brevifolia	Shrub	29.5%	0.2	0-5
Yucca thompsoniana	Shrub	29.5%	0.1	0-2
Escobaria tuberculosa	Shrub	29.5%	0.1	0-1
Ariocarpus fissuratus	Shrub	29.5%	0.1	0-1
Parthenium incanum	Shrub	27.3%	0.7	0-25
Guaiacum angustifolium	Shrub	22.7%	0.1	0-2
Cylindropuntia leptocaulis	Shrub	22.7%	0.1	0-2

Table D-35 (continued). Synthesis table for the most frequent plant taxa recorded in Calcareous Mixed Desert Scrub at Big Bend National Park (# plots=45).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Echinocactus horizonthalonius	Shrub	22.7%	0.1	0-1
Opuntia sp.	Shrub	22.7%	0.1	0-2
Tiquilia hispidissima	Shrub	20.5%	0.1	0-2
Opuntia engelmannii	Shrub	20.5%	0.1	0-3
Flourensia cernua	Shrub	15.9%	0.1	0-3
Grusonia aggeria	Shrub	15.9%	0.1	0-1
Prosopis glandulosa	Shrub	15.9%	0.0	0-1
Bouteloua ramosa	Herb	95.5%	11.8	0-50
Selaginella lepidophylla	Herb	50.0%	1.8	0-25
Croton sp.	Herb	36.4%	0.2	0-1
Aristida sp.	Herb	31.8%	0.2	0-2
Polygala macradenia	Herb	29.5%	0.1	0-1
Selaginella wrightii	Herb	27.3%	0.3	0-5
Dasyochloa pulchella	Herb	27.3%	0.2	0-2
Bouteloua curtipendula	Herb	18.2%	0.5	0-25
Aristida arizonica	Herb	18.2%	0.2	0-2
Astrolepis cochisensis	Herb	18.2%	0.1	0-1
Chamaesyce sp.	Herb	15.9%	0.1	0-1



Photo 37. Calcareous Mixed Desert Scrub, along west side of Mariscal Mountain, about 3 kilometers southeast of River Road (BIBE0421) (Matt Yarbrough).



Photo 38. Calcareous Mixed Desert Scrub, along Old Ore Road near Willow Tank (BIBEAA0601) (Kelon Crawford).

Yucca - Sotol Calcareous Shrub Grassland

Local Type and Concept

Shrub grassland (steppe) at the higher elevations of mountain ranges dominated by calcareous (limestone) substrates, with *Yucca faxoniana* (giant dagger), *Yucca thompsoniana* (Thompson's yucca) and *Nolina erumpens* (foothill beargrass) characteristic, and generally with a mixture of grasses dominant, including *Bouteloua* spp. (gramas), *Aristid*a spp. (threeawns), and/or *Tridens muticus* (slim tridens).

Vegetation

Because of the access challenges in reaching the habitat of this vegetation within RIGR, this vegetation was not sampled during the classification and was recognized and mapped based on Sotol-Yucca Grassland concept of Fenstermacher (2007) and data collected at BIBE. This vegetation fundamentally is grassland, but usually has significant (up to 40%) amounts of shrub cover.

Short to tall and emergent (up to 5 meters) individuals of *Yucca faxoniana* (giant dagger) are regularly scattered, usually at 2 to 8% cover. *Yucca thompsoniana* (Thompson's yucca) also is frequent but is less constant and abundant. *Dasylirion leiophyllum* (green sotol) is a ubiquitous, lower-statured associate. Other constant shrubs include *Quercus pungens* (sandpaper oak), *Nolina erumpens* (foothill beargrass), *Viguiera stenoloba* (skeletonleaf goldeneye), *Agave lechuguilla* (lechuguilla), *Agave lechuguilla* (lechuguilla), *Rhus virens* (evergreen sumac), and *Leucophyllum minus* (Big Bend silverleaf), and *Cercocarpus montanus* (alderleaf mountain mahogany). *Juniperus pinchotii* (Pinchot juniper), *Ephedra aspera* (rough jointfir), *Dalea formosa* (featherplume), *Opuntia camanchica* (Comanche pricklypear), *Fraxinus greggii* (littleleaf ash), *Gymnosperma glutinosum* (gumhead), *Hechtia texensis* (Texas false agave) (locally numerous on rockier, more exposed sites), *Garrya ovata* ssp. *goldmanii* (Goldman's silktassel), *Opuntia engelmannii* var. *engelmannii* (Engelmann's pricklypear), *Vauquelinia corymbosa* ssp. *angustifolia* (slimleaf rosewood), *Chrysactinia mexicana* (damianita), *Quercus grisea* (grey oak), *Parthenium incanum* (mariola), *Senegalia roemeriana* (Roemer's catclaw), *Bernardia obovata* (desert myrtlecroton), *Argythamnia serrata* (Yuma silverbush), *Mahonia trifoliolata* (agarita), *Fouquieria splendens* (ocotillo), and *Dalea formosa* (featherplume) are less constant shrub species. While not always constant, *Parthenium argentatum* (guayule), *Purshia ericifolia* (heath cliffrose), and *Zinnia acerosa* (spinyleaf zinnia) are characteristic of this association within BIBE. *Coryphantha echinus* (sea urchin cactus), *Echinocereus dasyacanthus* (Texas rainbow cactus), and *Neolloydia conoidea* (Texas cone cactus) are small cacti that often are present.

The herbaceous stratum is moderately dense to dense and usually dominated by some combination of the five grass species *Bouteloua curtipendula* (sideoats grama), *Bouteloua hirsuta* (hairy grama), *Tridens muticus* (slim tridens), *Aristida purpurea* (purple threeawn), and/or *Panicum hallii* (Hall's panicgrass). With the exception of *Heteropogon contortus*, which appears not to occur in this association, this is the same suite of grass species that is characteristic of the low montane shrub grasslands of the Chisos Mountains. Fenstermacher (2007) noted *Enneapogon desvauxii* (feather pappusgrass), *Leptochloa dubia* (green sprangletop), and *Muhlenbergia tenuifolia* (mesa muhly) in this vegetation. Frequent pteridophytes and forbs include *Astrolepis cochisensis* (Cochise scaly cloak

fern), *Selaginella lepidophylla* (resurrection plant), *Selaginella wrightii* (Wright's spikemoss), *Lesquerella purpurea* (rose bladderpod), and *Chamaesyce* sp. (sandmats).

The Calcareous Mixed Desert Scrub occurs just below the Yucca - Sotol Calcareous Shrub Grassland (up to about 4,800 feet) in the Dead Horse Mountains, and its higher elevation stands may have some of the same shrub species, including *Yucca faxoniana* (giant dagger). The best differential condition between the two associations where they may overlap is the relative abundance and usual leading dominance of *Bouteloua ramosa* (chino grama) among grass species in the Calcareous Mixed Scrub versus its replacement by the more cold-tolerant species listed above for the Yucca - Sotol Calcareous Shrub Grassland.

Environment

This association occurs generally above 2,450 feet (occasionally as low as 2,200 feet) and ranges to about 4,800 feet in the Dead Horse Mountains of BIBE. It occurs extensively within BIBE on calcareous (limestone) substrates. Although it was not observed within RIGR boundaries during either the classification plot data collection or the map accuracy assessment, the Yucca - Sotol Calcareous Shrub Grassland probably occurs on Mariscal Mountain in the vicinity of the Mariscal Canyon Rim Trail and may occur within the boundaries of RIGR also in remote parts of the southern Dead Horse Mountains above the rim of Boquillas Canyon, at suitable elevations.

USNVC Crosswalk

USNVC Class: Semi & Semi-Desert Class (3)

USNVC Subclass: Warm Desert & Semi-Desert Woodland, Scrub & Grassland Subclass (3.A)

USNVC Formation: Warm Desert & Semi-Desert Scrub & Grassland Formation (3.A.2)

USNVC Division: North American Warm Desert Scrub & Grassland Division (D039)

USNVC Macrogroup: Chihuahuan Semi-Desert Grassland Macrogroup (M087)

USNVC Group: Chihuahuan Desert Foothill-Piedmont & Lower Montane Grassland Group (G490)

USNVC Alliance: *Dasylirion spp.* - *Bouteloua curtipendula* - *Muhlenbergia setifolia* Foothill Desert Grassland Alliance (A3205)

NPS Association: *Yucca faxoniana* - *Yucca thompsoniana* - *Dasylirion leiophyllum* / *Nolina erumpens* - *Bouteloua curtipendula* Shrub Grassland Association (NPS040)

Comments

The species accounted for by the USNVC *Yucca faxoniana* / *Bouteloua hirsuta* - *Bouteloua gracilis* - *Bouteloua eriopoda* Shrub Herbaceous Vegetation Association (CEGL004248), attributed to the Dead Horse Mountains and the most similar association recognized by the USNVC (2017), apparently describes vegetation of somewhat lower elevations, perhaps from the Black Gap Wildlife Management Area. While there is some overlap in species, the concept of CEL004248 does not match the vegetation observed by this project or by Fenstermacher (2007), and two of its four nominal species were not seen by either of the latter studies. Therefore, the BIBE vegetation association is not translated to any currently published USNVC type.



Photo 39. Yucca - Sotol Calcareous Shrub Grassland (BIBEAA1199) (Jeff Renfrow).



Photo 40. Yucca - Sotol Calcareous Shrub Grassland (BIBEAA1204) (Rebecca Evans).

Creosotebush - Ocotillo - Lechuguilla Mixed Desert Scrub

Local Type and Concept

Desert scrub with the common environmental influences of middle elevations within the western desert scrub zone of RIGR in the overlap areas with BIBE (typically, 2,500 to 3,200 feet) and on substrates that are non-calcareous (usually, of igneous origin). The shrub stratum usually is dominated by some mix of *Fouquieria splendens* (ocotillo), *Larrea tridentata* (creosotebush), and/or *Agave lechuguilla* (lechuguilla), and calcareous substrate indicators are generally absent. *Bouteloua ramosa* (chino grama) is constant, but usually does not attain high cover.

Vegetation

Some mix of *Fouquieria splendens* (ocotillo), *Larrea tridentata* (creosotebush), and/or *Agave lechuguilla* (lechuguilla) dominates the shrub stratum, with, usually, at least two, and, often, all three, species present. Many other shrub species contribute modest cover, among the most constant are *Prosopis glandulosa* (honey mesquite*), Opuntia engelmannii* var. *engelmannii* (Engelmann's pricklypear*), Parthenium incanum* (mariola), *Viguiera stenoloba* (skeletonleaf goldeneye), *Opuntia camanchica* (Comanche pricklypear), *Senegalia greggii* (Gregg's catclaw), *Guaiacum angustifolium* (guayacan), *Opuntia azurea* var. *parva* (Big Bend purplish pricklypear), *Yucca torreyi* (Torrey's yucca), *Opuntia rufida* (blind pricklypear), *Jatropha dioica* (leatherstem), *Leucophyllum frutescens* (cenizo), *Echinocereus stramineus* (strawberry hedgehog cactus), *Cylindropuntia leptocaulis* (Christmas cactus), *Flourensia cernua* (American tarbush), *Vachellia constricta* (whitethorn acacia), *Tiquilia greggii* (plumed crinklemat), *Echinocereus enneacanthus* var. *enneacanthus* (pitaya cactus), and *Krameria erecta* (littleleaf ratany). The herbaceous stratum has sparse to moderate cover, with the grasses *Bouteloua ramosa* (chino grama) and *Dasyochloa pulchella* (fluffgrass) the most constant species. Other moderately constant grass species include *Heteropogon contortus* (tanglehead), *Aristida purpurea* (purple threeawn), *Digitaria californica* (Arizona cottontop), *Cathestecum erectum* (false grama), and *Panicum hallii* (Hall's panicgrass). Forbs include *Bahia absinthifolia* (hairyseed bahia), *Senna durangensis* (Durango senna), *Chamaesyce* spp. (sandmats), *Boerhavia* spp. (spiderlings), and *Croton* spp. (crotons). Annual forbs appearing in spring include *Lupinus havardii* (Big Bend bluebonnet) and *Phacelia* spp. (phacelias).

Environment

This association is frequent over large areas on non-calcareous substrates from about 2,500 to about 4,200 feet in elevation, and sparingly as low as 1,800 feet. It occurs mostly in the western half of RIGR where it overlaps with BIBE.

USNVC Crosswalk

USNVC Class: Semi & Semi-Desert Class (3)

USNVC Subclass: Warm Desert & Semi-Desert Woodland, Scrub & Grassland Subclass (3.A)

USNVC Formation: Warm Desert & Semi-Desert Scrub & Grassland Formation (3.A.2)

USNVC Division: North American Warm Desert Scrub & Grassland Division (D039)

USNVC Macrogroup: Chihuahuan Desert Scrub Macrogroup (M086)

USNVC Group: Chihuahuan Creosotebush-Mixed Desert Scrub Group (G288)

USNVC Alliance: *Larrea tridentata* Chihuahuan Desert Scrub Alliance (A3164)

NPS Association: *Larrea tridentata - Fouquieria splendens- Agave lechuguilla - Leucophyllum frutescens* Shrubland Association (NPSBIBE044)

Comments

Stands that have a limited number of calciphiles (calcareous indicators) (usually, *Euphorbia antisyphilitica* and *Leucophyllum candidum*) and that are, therefore, intermediate between Creosotebush - Ocotillo - Lechuguilla Mixed Desert Scrub and the Calcareous Mixed Desert Scrub of limestone substrates. Because of the overall greater similarity with the former association, they are treated as a variant of it. These stands have *Leucophyllum frutescens* (cenizo), a shrub species that tends to be absent from limestone substrates within RIGR).

Assignment of this unit to an existing USNVC (2017) association assignment is problematic because this type has a mixed dominance of some combination of *Larrea tridentata* (creosotebush), *Fouquieria splenden*s (ocotillo), and *Agave lechuguilla* (lechuguilla). Within RIGR and BIBE, *F. splendens* is a good character species for this type of primarily non-calcareous (igneous rock derived) substrates, attaining higher frequency and cover in this type than in other desert scrub types. It displays a reduction in constancy and abundance in calcareous desert scrub types and lower elevation desert scrub types. However, recognized USNVC associations for the Chihuahuan Desert that have *F. splendens* as a nominal do not include appropriate companion species to describe this unit. The *Larrea tridentata - Agave lechuguilla* Shrubland (CEGL004562) is problematic because the published record lacks any description and because these two nominal species occur in some abundance in most of the BIBE desert scrub types.



Photo 41. Creosotebush - Ocotillo - Lechuguilla Desert Scrub (BIBEAA0570) (Jeff Renfrow).



Photo 42. Creosotebush - Ocotillo - Lechuguilla Desert Scrub (BIBEAA0777) (Jeff Renfrow).

Alkali Sacaton Riparian Grassland

Local Type and Concept
Grassland dominated by *Sporobolus airoides* (alkali sacaton), with sparse shrub cover.

Classification Plots Within RIGR Included in Concept
BIBE0038

Accuracy Assessment Sites Within RIGR Included in Concept
BIBEAA0342, BIBEAA1023

Vegetation
Sporobolus airoides (alkali sacaton) is strongly dominant in the herbaceous stratum, and few other species are present. A sparse shrub stratum usually is present, with *Atriplex canescens* (fourwing saltbush) the most constant species. Occasional saplings of *Populus fremontii* ssp. *mesetae* (Arizona cottonwood) and individual tall shrubs of *Prosopis glandulosa* (honey mesquite), *Ziziphus obtusifolia* (lotebush), *Larrea tridentata* (creosotebush), and/or *Baccharis salicifolia* (seepwillow) may be present. Stratum and substrate cover for Alkali Sacaton Riparian Grassland are shown in Table D-36.

Table D-36. Stratum and substrate cover recorded for Alkali Sacaton Riparian Grassland at Big Bend National Park and Rio Grande Wild and Scenic River (# plots=1).

Category	Item	Mean Cover (%)	Range Cover (%)
Stratum	Tree	1	1-1
	Tall Shrub	20	20-20
	Short Shrub	4	3-4
	Herb	70	70-70
Substrate	Bedrock	0	0-0
	Large/Small Rocks	0	0-0
	Litter/Duff	60	60-60

Environment
This association is a small patch and localized type known at RIGR from apparent former impoundments in the Rio Grande Village area of Big Bend National Park. The species composition suggests highly alkaline conditions, possibly induced by water collection during precipitation or high flood water events and subsequent evaporation and accumulation of precipitated salts.

USNVC Crosswalk

USNVC Class: Semi & Semi-Desert Class (3)

USNVC Subclass: Warm Desert & Semi-Desert Woodland, Scrub & Grassland Subclass (3.A)

USNVC Formation: Warm Desert & Semi-Desert Scrub & Grassland Formation (3.A.2)

USNVC Division: North American Warm Desert Scrub & Grassland Division (D039)

USNVC Macrogroup: Chihuahuan Desert Scrub Macrogroup (M086)

USNVC Group: Chihuahuan Lowland Basin Semi-Desert Scrub Group (G299)

USNVC Alliance: *Atriplex canescens* Lowland Basin Desert Scrub Alliance (A3151)

NPS Association: *Atriplex canescens* - *Suaeda suffrutescens* / *Sporobolus airoides* Shrub Herbaceous Vegetation Association (NPSBIBE026)

Comments

Most associations with a combination of *Atriplex canescens* (fourwing saltbush) and/or *Sporobolus airoides* (alkali sacaton) important that are recognized by the USNVC (2017) are from cooler regions (e.g., the Great Basin or the Great Plains. For the RIGR occurrence, the use of *Suaeda suffrutescens* (desert seepweed) as a nominal species distinguishes this type as a warm semi-desert entity. Most frequent plant taxa recorded in Alkali Sacaton Riparian Grassland are shown in Table D-37.

Table D-37. Synthesis table for the most frequent plant taxa recorded in Alkali Sacaton Riparian Grassland at Big Bend National Park and Rio Grande Wild and Scenic River (# plots=1).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Populus fremontii ssp. *mesetae*	Tree	100.0%	0.5	0-1
Atriplex canescens	Shrub	100.0%	8.9	5-10
Ziziphus obtusifolia	Shrub	100.0%	7.5	5-10
Nicotiana glauca	Shrub	100.0%	3.5	2-5
Suaeda suffrutescens	Shrub	100.0%	3.5	2-5
Baccharis salicifolia	Shrub	100.0%	0.5	few-1
Sporobolus airoides	Herb	100.0%	62.5	50-75



Photo 43. Alkali Sacaton Riparian Grassland, near Rio Grande Village campground, Big Bend National Park (BIBE0038) (Christian Skorik).



Photo 44. Alkali Sacaton Riparian Grassland, near Rio Grande Village campground, Big Bend National Park (BIBEAA1023) (Rebecca Evans).

Guajillo - Blackbrush - Torrey Yucca Shrubland

Local Type and Concept

Upland thornscrub shrublands dominated by shrub species of a primarily Tamaulipan distribution, mostly by *Vachellia rigidula* (=*Acacia rigidula*, blackbrush) and/or (*Senegalia berlandieri* (=*Acacia berlandieri*, guajillo). Species of a primarily Chihuahuan Desert distribution are present, but generally do not dominate.

Classification Plots Within RIGR Included in Concept

RIGR2007

Vegetation

The vegetation description is based on a single classification plot observed at RIGR and is augmented by data collected for the Amistad National Recreation Area (AMIS) vegetation classification project, where this vegetation is more abundant and was sampled more completely.

The shrub stratum is taller than in most non-riparian shrublands in RIGR, with the taller shrubs usually exceeding 2 meters. It is dominated by some combination of *Vachellia rigidula* (blackbrush), *Senegalia berlandieri* (guajillo), and/or *Karwinskia humboldtiana* (coyotillo). In the single sampled RIGR plot, *V. rigidula* was strongly dominant and the other two species were present at moderate cover. Other tall shrubs at RIGR included *Diospyros texana* (Texas persimmon), *Fraxinus greggii* (littleleaf ash*), Forestiera angustifolia* (desert olive), *Rhus microphylla* (littleleaf sumac), *Leucophyllum frutescens* (cenizo), *Yucca torreyi* (Torrey yucca), and *Larrea tridentata* (creosotebush). *Dasylirion texanum* (Texas sotol), *Agave lechuguilla* (lechuguilla*), Echinocereus enneacanthus* var. *brevispinus* (pitaya cactus), *Heliotropium torreyi* (slimleaf heliotrope), *Opuntia rufida* (blind pricklypear), *Ruellia parryi* (Parry's wild petunia are present *Lippia graveolens* (Mexican oregano), and *Viguiera stenoloba* (skeletonleaf goldeneye) are short shrubs that were present at low cover. The herbaceous stratum had moderately high low cover, mostly due to the presence of the invasive *Pennisetum ciliare*, (buffelgrass); native species cover appears to be naturally low. Among native species, the forb *Acourtia runcinata* (featherleaf desertpeony) and the grasses *Bouteloua ramosa* (chino grama) and *Aristida purpurea* (purple threeawn) were seen. Stratum and substrate cover for Guajillo - Blackbrush - Torrey Yucca Shrubland are shown in Table D-38.

Table D-38. Stratum and substrate cover recorded Guajillo - Blackbrush - Torrey Yucca Shrubland at Rio Grande Wild and Scenic River (# plots=1).

Category	Item	Mean Cover (%)	Range Cover (%)
Stratum	Tree	0	0-0
	Tall Shrub	30	30-30
	Short Shrub	35	35-35
	Herb	30	30-30

Table D-38 (continued). Stratum and substrate cover recorded Guajillo - Blackbrush - Torrey Yucca Shrubland at Rio Grande Wild and Scenic River (# plots=1).

Category	Item	Mean Cover (%)	Range Cover (%)
Substrate	Bedrock	20	20-20
	Large/Small Rocks	35	35-35
	Litter/Duff	0	0-0

Environment

This vegetation was observed in a single location in RIGR, in a very steep-sided tributary drainage to the Rio Grande. At Amistad National Recreation Area, it occurs mostly on middle to lower canyon slopes.

USNVC Crosswalk

USNVC Class: Semi-Desert (3)

USNVC Subclass: Warm Semi-Desert Scrub & Grassland (3.A)

USNVC Formation: Warm Desert & Semi-Desert Scrub & Grassland (3.A.2)

USNVC Division: North American Warm Desert Scrub & Grassland (D039)

USNVC Macrogroup: Tamaulipan Scrub and Grassland (M130)

USNVC Group: Tamaulipan Dry Mesquite and Thornscrub (G099)

USNVC Alliance: Tamaulipan *Vachellia rigidula - Leucophyllum frutescens - Senegalia berlandieri* Calcareous Thornscrub Alliance (A3191)

USNVC Association: *Vachellia rigidula - Leucophyllum frutescens - Senegalia berlandieri* Shrubland (CEGL007759)

Comments

This vegetation seems to resemble closely stands occurring along the Devils River corridor in Amistad National Recreation Area (AMIS). Compared to the RIGR stand, the AMIS stands tend to have greater dominance by *Senegalia berlandieri* and some regularly occurring minor species that are absent or uncommon in RIGR (*Meximalva filipes*, *Sophora secundiflora*, *Croton incanus*, and *Salvia ballotiflora*), but otherwise are quite similar in composition. The association, which is more typical of taller thornscrub assemblages that are widespread at AMIS, is apparently quite limited within RIGR to sites with less solar exposure, where locally reduced rates of evapotranspiration may compensate for reduced moisture available from precipitation, as compared to AMIS.

The park name applied and the USNVC (2017) translation is that employed for this association at AMIS. It is acknowledged in the global description that the association currently is a concept that may be overly broad. Most frequent plant taxa recorded in Guajillo - Blackbrush - Torrey Yucca Shrubland are shown in Table D-39.

Table D-39. Synthesis table for the most frequent plant taxa recorded in Guajillo - Blackbrush - Torrey Yucca Shrubland at Rio Grande Wild and Scenic River (# plots=1).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Vachellia rigidula	Shrub	100.0%	45.5	30-61
Karwinskia humboldtiana	Shrub	100.0%	8.0	5-11
Senegalia berlandieri	Shrub	100.0%	4.0	2-6
Diospyros texana	Shrub	100.0%	4.0	2-6
Fraxinus greggii	Shrub	100.0%	4.0	2-6
Forestiera angustifolia	Shrub	100.0%	1.5	1-2
Dasylirion texanum	Shrub	100.0%	1.0	few-2
Rhus microphylla	Shrub	100.0%	1.0	few-2
Agave lechuguilla	Shrub	100.0%	0.5	few-1
Echinocereus enneacanthus	Shrub	100.0%	0.5	few-1
Heliotropium torreyi	Shrub	100.0%	0.5	few-1
Leucophyllum frutescens	Shrub	100.0%	0.5	few-1
Yucca torreyi	Shrub	100.0%	0.5	few-1
Larrea tridentata	Shrub	100.0%	0.5	few-1
Opuntia rufida	Shrub	100.0%	0.5	few-1
Ruellia parryi	Shrub	100.0%	0.5	few-1
Fouquieria splendens	Shrub	100.0%	0.1	trace
Lippia graveolens	Shrub	100.0%	0.1	trace
Viguiera stenoloba	Shrub	100.0%	0.1	trace
Pennisetum ciliare	Herb	100.0%	17.5	10-25
Acourtia runcinata	Herb	100.0%	0.5	few-1
Aristida purpurea	Herb	100.0%	0.5	few-1
Bouteloua ramosa	Herb	100.0%	0.5	few-1



Photo 45. Guajillo - Blackbrush - Torrey Yucca Shrubland, near Mile 93 below La Linda (RIGR2007) (Jeff Renfrow).



Photo 46. Guajillo - Blackbrush - Torrey Yucca Shrubland, near Mile 93 below La Linda (RIGR2007) (Jeff Renfrow).

Texas Persimmon - Thornscrub Limestone Wash Shrubland

Local Type and Concept

Somewhat open to dense shrublands, usually along dry tributary washes, occurring in eastern RIGR, with mixed dominance by tall stature (usually > 2 meters tall) *Diospyros texana* (Texas persimmon), *Prosopis glandulosa* (honey mesquite), *Senegalia berlandieri* (guajillo), *Eysenhardtia texana* (Texas kidneywood), and other, often thorny, shrubs.

Classification Plots Within RIGR Included in Concept

RIGR2013, RIGR2017

Observation Points Within RIGR Included in Concept

RIGROBS0321, RIGROBS0735

Vegetation

Stands are tall shrublands (occasionally woodlands), with dominance by tall (> 2 meters) *Diospyros texana* (Texas persimmon) and *Prosopis glandulosa* (honey mesquite). A variety of other tall, often thorny, shrub species may be present and may co-dominate, including *Eysenhardtia texana* (Texas kidneywood), *Senegalia berlandieri* (guajillo), *Lippia graveolens* (Mexican oregano), *Viguiera stenoloba* (skeletonleaf goldeneye), *Leucophyllum frutescens* (cenizo), *Forestiera angustifolia* (desert olive), *Aloysia gratissima* (whitebrush), *Lycium berlandieri* (Berlandier's wolfberry), *Senegalia greggii* (Gregg's catclaw), and others. The herbaceous stratum has low to moderate overall cover, with the grasses *Heteropogon contortus* (tanglehead), *Bouteloua curtipendula* (sideoats grama), *Aristida purpurea* (purple threeawn), and *Bothriochloa laguroides* (silver bluestem), and the forb *Thelesperma simplicifolium* (slender greenthread) present in both plots. Stratum and substrate cover for Persimmon - Thornscrub Limestone Wash Shrubland are shown in Table D-40.

Table D-40. Stratum and substrate cover recorded for Persimmon - Thornscrub Limestone Wash Shrubland at Rio Grande Wild and Scenic River (# plots=2).

Category	Item	Mean Cover (%)	Range Cover (%)
Stratum	Tree	0	0-0
	Tall Shrub	25	10-40
	Short Shrub	27	21-32
	Herb	10	10-10
Substrate	Bedrock	3	0-5
	Large/Small Rocks	40	35-45
	Litter/Duff	3	1-5

Environment

The vegetation occurs in the Terrell County, and possibly, in the eastern Brewster County section of RIGR (from the Lower Canyons east), along ephemeral washes.

USNVC Crosswalk

USNVC Class: Semi & Semi-Desert Class (3)

USNVC Subclass: Warm Desert & Semi-Desert Woodland, Scrub & Grassland Subclass (3.A)

USNVC Formation: Warm Desert & Semi-Desert Scrub & Grassland Formation (3.A.2)

USNVC Division: North American Warm Desert Scrub & Grassland Division (D039)

USNVC Macrogroup: North American Warm-Desert Xero-Riparian Scrub Macrogroup (M092)

USNVC Group: Warm Semi-Desert Shrub & Herb Dry Wash & Colluvial Slope Group (G541)

USNVC Alliance: *Hymenoclea monogyra - Brickellia laciniata* Chihuahuan - Sonoran Desert Wash Alliance (A3262)

NPS Association: *Diospyros texana - Senegalia berlandieri - Prosopis glandulosa* / *Eysenhardtia texana* Shrubland Association (NPSRIGR008)

Comments

This vegetation has grossly similar composition to the Tall Mixed Shrubs Wash Shrubland of higher elevations within BIBE and might even be considered an eastern variant of that type, with both types having a mix of shrub species that have distributions across parts of the Chihuahuan, Balconian, and Tamaulipan phytogeographic regions. There are enough minor to moderately abundant diagnostic species of different distributions in each type (usually, Chihuahuan versus Tamaulipan) to warrant at least provisional recognition of two associations. It also is undoubtedly related to, and may be the same association as, the *Vachellia rigidula - Prosopis glandulosa - Diospyros texana* Shrubland (Blackbrush - Honey Mesquite - Persimmon that was observed along dry washes in Amistad National Recreation Area (but note recorded by plot data). This entire gradient of dense, thorny wash margin shrublands across these west and south Texas wash margins, which are distinct from the surrounding upland desert scrub, does not appear to have recognition within the current USNVC (2017) and warrants region wide examination. Most frequent plant taxa recorded in Texas Persimmon - Thornscrub Limestone Wash Shrubland are shown in Table D-41.

Table D-41. Synthesis table for the most frequent plant taxa recorded in Texas Persimmon - Thornscrub Limestone Wash Shrubland at Rio Grande Wild and Scenic River (# plots=2).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Diospyros texana	Shrub	100.0%	22.8	2-56
Lippia graveolens	Shrub	100.0%	3.6	2-5
Eysenhardtia texana	Shrub	100.0%	3.5	2-6

Table D-41 (continued). Synthesis table for the most frequent plant taxa recorded in Texas Persimmon - Thornscrub Limestone Wash Shrubland at Rio Grande Wild and Scenic River (# plots=2).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Viguiera stenoloba	Shrub	100.0%	3.5	2-5
Senegalia berlandieri	Shrub	100.0%	3.3	2-5
Leucophyllum frutescens	Shrub	100.0%	2.8	1-5
Prosopis glandulosa	Shrub	100.0%	2.5	1-5
Forestiera angustifolia	Shrub	100.0%	2.3	1-4
Aloysia gratissima	Shrub	100.0%	1.8	1-3
Lycium berlandieri	Shrub	100.0%	1.6	1-2
Senegalia greggii	Shrub	100.0%	0.8	trace-2
Celtis ehrenbergiana	Shrub	50.0%	1.5	0-4
Larrea tridentata	Shrub	50.0%	0.8	0-2
Mimosa borealis	Shrub	50.0%	0.8	0-2
Wedelia acapulcensis var. *hispida*	Shrub	50.0%	0.8	0-2
Ephedra antisyphilitica	Shrub	50.0%	0.3	0-1
Grusonia schottii	Shrub	50.0%	0.3	0-1
Heliotropium torreyi	Shrub	50.0%	0.3	0-1
Lantana achyranthifolia	Shrub	50.0%	0.3	0-1
Ruellia parryi	Shrub	50.0%	0.1	0-trace
Yucca thompsoniana	Shrub	50.0%	0.1	0-trace
Ziziphus obtusifolia	Shrub	50.0%	0.1	0-trace
Funastrum cynanchoides	Vine	50.0%	0.1	0-trace
Heteropogon contortus	Herb	100.0%	2.0	few-5
Bouteloua curtipendula	Herb	100.0%	1.5	1-2
Aristida purpurea	Herb	100.0%	1.0	few-2
Bothriochloa laguroides	Herb	100.0%	0.5	few-1
Thelesperma simplicifolium	Herb	100.0%	0.3	trace-1
Acleisanthes longiflora	Herb	50.0%	0.3	0-1
Allium kunthii	Herb	50.0%	0.3	0-1
Ambrosia artemisiifolia	Herb	50.0%	0.3	0-1

Table D-41 (continued). Synthesis table for the most frequent plant taxa recorded in Texas Persimmon - Thornscrub Limestone Wash Shrubland at Rio Grande Wild and Scenic River (# plots=2).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Bahia absinthifolia	Herb	50.0%	0.3	0-1
Bouteloua ramosa	Herb	50.0%	0.3	0-1
Bouteloua trifida	Herb	50.0%	0.3	0-1
Psilostrophe tagetina	Herb	50.0%	0.3	0-1
Tridens muticus	Herb	50.0%	0.3	0-1
Selaginella lepidophylla	Herb	50.0%	0.1	0-trace
Stenaria nigricans	Herb	50.0%	0.1	0-trace
Tiquilia canescens	Herb	50.0%	0.1	0-trace



Photo 47. Texas Persimmon - Thornscrub Limestone Wash Shrubland (on banks of wash), unnamed tributary to Rio Grande near Mile 102 below La Linda (RIGR2013) (Jeff Renfrow).



Photo 48. Texas Persimmon - Thornscrub Limestone Wash Shrubland (on banks of wash), unnamed tributary to Bear Canyon, near Mile 106 below La Linda (RIGR2017) (Jeff Renfrow).

Blackbrush - Brickellbush Wash Channel Shrubland

Local Type and Concept

Sparse to open, low shrublands in the channels of small, high-gradient tributary washes to the Rio Grande in Terrell County and southeastern Brewster County, with some combination of *Vachellia rigidula* (blackbrush) and/or *Brickellia laciniata* (splitleaf brickellbush) dominant or important.

Classification Plots Within RIGR Included in Concept

RIGR2106

Observation Points Within RIGR Included in Concept

RIGROBS0323, RIGROBS0622, RIGROBS0625, RIGROBS0632

Vegetation

Vachellia rigidula (blackbrush) occurs as a dominant or co-dominant shrub (5-50% cover) in the two Lower Canyons (observation point) sites. *Brickellia laciniata* (splitleaf brickellbush) is the sole dominant at the eastern Terrell County site and co-dominant at one of the Lower Canyons sites (10-25% cover at each). *Porophyllum scoparium* (shrubby poreleaf) is present at all three sites, co-dominant at one Lower Canyons site (10-25% cover) and important (5-10% cover) at the other. The shrub *Nicotiana glauca* (tree-tobacco) and *Cynodon dactylon* (Bermuda grass), each present at two of the sites, are the only other species recorded at more than one site. The herbaceous stratum is sparse to moderately dense, with C. dactylon at moderately high (10-25%) cover at one site. Species recorded at one site with more than a trace amount of cover include *Lippia graveolens* (Mexican oregano), *Nicotiana repanda* (fiddleleaf tobacco), *Perityle vaseyi* (Vasey's rockdaisy), *Diospyros texana* (Texas persimmon), *Viguiera stenoloba* (skeletonleaf goldeneye), *Aristida* sp. (threeawn grass), *Hedeoma* sp. (false pennyroyal), *Karwinskia humboldtiana* (coyotillo), *Wedelia acapulcensis* var. *hispida* (hairy wedelia*), Datura wrightii* (sacred thorn-apple), and *Baccharis salicifolia* (seepwillow). Stratum and substrate cover for Blackbrush - Brickellbush Wash Channel Shrubland are shown in Table D-42.

Table D-42. Stratum and substrate cover recorded for Blackbrush - Brickellbush Wash Channel Shrubland at Rio Grande Wild and Scenic River (n=5, 4 observation points, 1 plot).

Category	Item	Mean Cover (%)	Range Cover (%)
Stratum	Tree	4	0-20
	Tall Shrub	6	0-10
	Short Shrub	36	15-60
	Herb	25	5-55
Substrate	Bedrock	24	0-90
	Large/Small Rocks	59	0-95
	Litter/Duff	<1	0-1

Environment

All sites were reported as occurring in washes with a temporary or intermittently flooded flow regime. The substrate is rocky in all cases (mostly bedrock, boulders, or cobbles).

The sites were at the mouth of Yeguas Canyon (about 38 miles below La Linda) (where it is possibly also flooded by the Rio Grande), in "Mare" Canyon (about 69 miles below La Linda), and in Bear Canyon (about 106 miles below La Linda). The watershed sizes above the sites range from 1,200 to 2,700 hectares.

USNVC Crosswalk

USNVC Class: Semi & Semi-Desert Class (3)

USNVC Subclass: Warm Desert & Semi-Desert Woodland, Scrub & Grassland Subclass (3.A)

USNVC Formation: Warm Desert & Semi-Desert Scrub & Grassland Formation (3.A.2)

USNVC Division: North American Warm Desert Scrub & Grassland Division (D039)

USNVC Macrogroup: North American Warm-Desert Xero-Riparian Scrub Macrogroup (M092)

USNVC Group: Warm Semi-Desert Shrub & Herb Dry Wash & Colluvial Slope Group (G541)

USNVC Alliance: *Hymenoclea monogyra - Brickellia laciniata* Chihuahuan - Sonoran Desert Wash Alliance (A3262)

NPS Association: *Vachellia rigidula - Brickellia laciniata - Porophyllum scoparium* Shrubland Association (NPSBIBE006)

Comments

The description of the composition of this vegetation is somewhat hampered by incomplete data. It is based on a single plot and several observation points, with the latter of variable completeness.

Despite the need for better floristic information, this vegetation appears to be a valid entity. As currently described in the context of the ranges of the nominal species, it almost certainly would be limited to the eastern part of Trans-Pecos Texas within the United States.



Photo 49. Blackbrush - Brickellbush Wash Channel Shrubland, Rio Grande at mile 38 below La Linda, mouth of Yeguas Canyon (RIGROBS0323) (Phillip Schulze).



Photo 50. Blackbrush - Brickellbush Wash Channel Shrubland, Rio Grande at mile 106 below La Linda, Bear Canyon (RIGR2106) (Kelon Crawford).

Big Bend Lowlands Wash Channel Shrubland

Local Type and Concept

Shrublands or sparse shrublands in the channels of large washes and, occasionally on bars of the Rio Grande, with shrub stratum composition involving some combination of *Hymenoclea monogyra* (singlewhorl burrobrush), *Chilopsis linearis* (desert willow), and/or *Porophyllum scoparium* (shrubby poreleaf).

Classification Plots Within RIGR Included in Concept

BIBE3024, BIBE3029, BIBE3031

Observation Points Within RIGR Included in Concept

RIGROBS0211

Accuracy Assessment Sites Within RIGR Included in Concept

BIBEAA1043, BIBEAA1053, BIBEAA1064, BIBEAA1065, BIBEAA1131, BIBEAA1289, RIGRAA1115

Vegetation

A shrub stratum, usually from about 1 to 3 meters tall, is sparse to moderately dense. *Hymenoclea monogyra* (singlewhorl burrobrush) is the most constant and, usually the most abundant shrub species and is highly diagnostic of the type. *Chilopsis linearis* (desert willow) and *Prosopis glandulosa* (honey mesquite) are other constant, and sometimes, dominant or co-dominant species. *Porophyllum scoparium* (shrubby poreleaf) is a characteristic shorter-statured (usually to 0.5-meter-tall) shrub. Scattered *Larea tridentata* (creosotebush) and *Vachellia constricta* (whitethorn acacia) often are present. In stands along the Rio Grande, *Porophyllum scoparium* often is more prominent than *Hymenoclea monogyra*, and *Chilopsis linearis* usually is absent. Less constant shrubs include *Tamarix ramosissima* (tamarisk) and *Senegalia greggii* (Gregg's catclaw). Herbaceous stratum cover is sparse, except when densely invaded by non-native grasses such as *Pennisetum ciliare* (buffelgrass) or, less often, *Sorghum halepense* (Johnson grass), as frequently happens. Native species that may occur include *Bouteloua barbata* (sixweeks grama), *Dasyochloa pulchella* (fluffgrass), and others. Stratum and substrate cover for Big Bend Lowlands Wash Channel Shrubland are shown in Table D-43.

Table D-43. Stratum and substrate cover recorded for Big Bend Lowlands Wash Channel Shrubland at Big Bend National Park and Rio Grande Wild and Scenic River (# plots=16).

Category	Item	Mean Cover (%)	Range Cover (%)
Stratum	Tree	0	0-0
	Tall Shrub	9	0-40
	Short Shrub	16	2-73
	Herb	6	1-18

Table D-43 (continued). Stratum and substrate cover recorded for Big Bend Lowlands Wash Channel Shrubland at Big Bend National Park and Rio Grande Wild and Scenic River (# plots=16).

Category	Item	Mean Cover (%)	Range Cover (%)
Substrate	Bedrock	0	0-0
	Large/Small Rocks	17	2-47
	Litter/Duff	3	0-10

Environment

Sampled stands generally occur in the channels of large to moderately large washes, and occasionally on scoured alluvial bars of the Rio Grande, throughout the Big Bend National Park and Black Gap Wildlife Management Area sections of RIGR. In the lower parts of RIGR (Lower Canyons and downstream, the type appears to be limited to small patches along the Rio Grande itself and is replaced in tributary washes channels by the Blackbrush - Brickellbush Wash Channel Shrubland.

The park name Big Bend Lowlands Wash Channel Shrubland originates from the association's context within BIBE, where it is the lower of two analogous wash channel associations, the other being the Foothills Wash Channel Shrubland (which does not occur within RIGR).

USNVC Crosswalk

USNVC Class: Semi & Semi-Desert Class (3)

USNVC Subclass: Warm Desert & Semi-Desert Woodland, Scrub & Grassland Subclass (3.A)

USNVC Formation: Warm Desert & Semi-Desert Scrub & Grassland Formation (3.A.2)

USNVC Division: North American Warm Desert Scrub & Grassland Division (D039)

USNVC Macrogroup: North American Warm-Desert Xero-Riparian Scrub Macrogroup (M092)

USNVC Group: Warm Semi-Desert Shrub & Herb Dry Wash & Colluvial Slope Group (G541)

USNVC Alliance: *Hymenoclea monogyra - Brickellia laciniata* Chihuahuan - Sonoran Desert Wash Alliance (A3262)

NPS Association: *Hymenoclea monogyra - Chilopsis linearis -Porophyllum* scoparium Shrubland Association (NPSBIBE014)

Most frequent plant taxa recorded in Big Bend Lowlands Wash Channel Shrubland are shown in Table D-44.

Table D-44. Synthesis table for the most frequent plant taxa recorded in Big Bend Lowlands Wash Channel Shrubland at Big Bend National Park and Rio Grande Wild and Scenic River (# plots=15).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Hymenoclea monogyra	Shrub	66.7%	4.1	0-25
Porophyllum scoparium	Shrub	66.7%	2.6	0-25
Prosopis glandulosa	Shrub	66.7%	0.4	0-1
Chilopsis linearis	Shrub	46.7%	4.1	0-38
Vachellia constricta	Shrub	46.7%	1.0	0-10
Cylindropuntia leptocaulis	Shrub	33.3%	0.2	0-1
Baccharis salicifolia	Shrub	26.7%	0.6	0-10
Senegalia roemeriana	Shrub	26.7%	0.3	0-5
Selinocarpus parvifolius	Shrub	26.7%	0.1	0-1
Senegalia roemeriana	Shrub	20.0%	0.3	0-5
Yucca elata	Shrub	20.0%	0.2	0-2
Larrea tridentata	Shrub	20.0%	0.2	0-2
Salix gooddingii	Shrub	20.0%	0.2	0-2
Grusonia aggeria	Shrub	13.3%	0.1	0-1
Isocoma pluriflora	Shrub	13.3%	<0.1	0-1
Lycium berlandieri	Shrub	13.3%	<0.1	0-1
Atriplex canescens	Shrub	13.3%	<0.1	0-1
Opuntia camanchica	Shrub	13.3%	<0.1	0-1
Pennisetum ciliare	Herb	60.0%	4.9	0-75
Sorghum halepense	Herb	40.0%	0.5	0-5
Bouteloua barbata	Herb	40.0%	0.2	0-1
Croton sp.	Herb	33.3%	0.4	0-1
Cynodon dactylon	Herb	26.7%	1.8	0-25
Allionia incarnata	Herb	26.7%	0.2	0-1
Boerhavia intermedia	Herb	26.7%	0.1	0-1
Dasyochloa pulchella	Herb	26.7%	0.1	0-1
Xanthium strumarium	Herb	26.7%	0.1	0-1
Aristida purpurea	Herb	20.0%	0.1	0-1

Table D-44 (continued). Synthesis table for the most frequent plant taxa recorded in Big Bend Lowlands Wash Channel Shrubland at Big Bend National Park and Rio Grande Wild and Scenic River (# plots=15).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Bahia absinthifolia	Herb	20.0%	0.1	0-1
Nerisyrenia camporum	Herb	20.0%	0.1	0-1
Pectis angustifolia	Herb	20.0%	0.1	0-1
Poa sp.	Herb	20.0%	0.1	0-1
Bothriochloa ischaemum	Herb	13.3%	0.1	0-10
Bothriochloa laguroides	Herb	20.0%	0.1	0-1
Chamaesyce fendleri	Herb	13.3%	0.1	0-1
Sporobolus airoides	Herb	13.3%	0.1	0-1
Thelesperma megapotamicum	Herb	13.3%	0.1	0-1
Tidestromia carnosa	Herb	13.3%	0.1	0-1
Dalea neomexicana	Herb	13.3%	<0.1	0-1
Senna durangensis	Herb	13.3%	<0.1	0-1
Kallstroemia parviflora	Herb	13.3%	<0.1	0-trace



Photo 51. Big Bend Lowlands Wash Channel Shrubland, along Rio Grande at mile 23 below La Linda (Taylor's Farm) (RIGROBS0211). *Hymenoclea monogyra* is the dominant shrub. (Doug Hens).

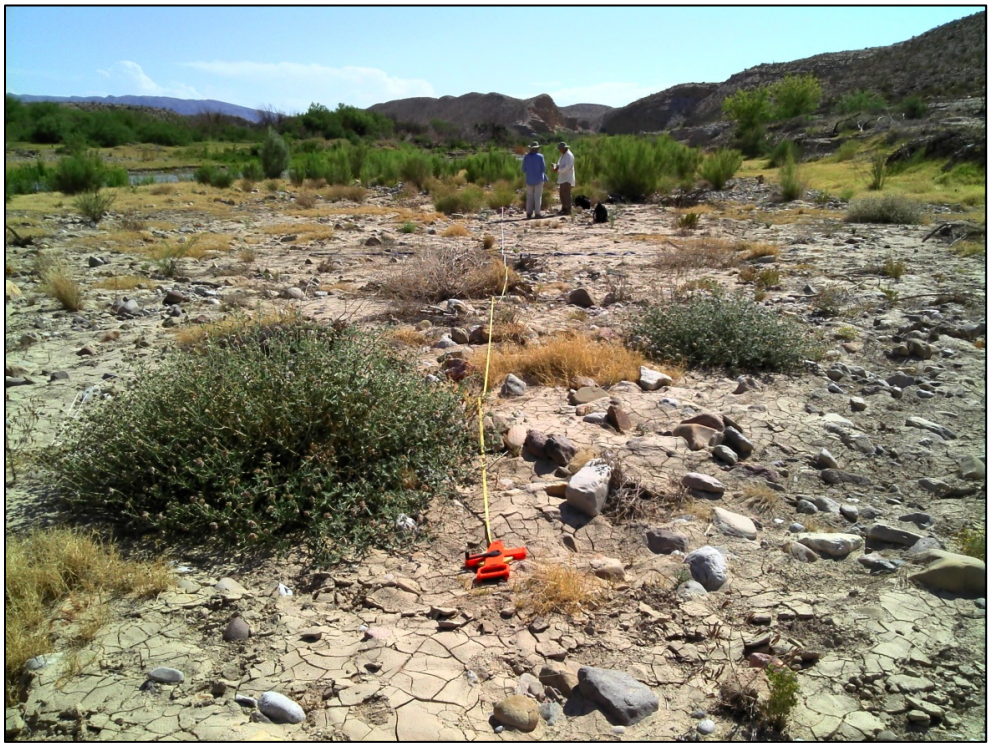


Photo 52. Big Bend Lowlands Wash Channel Shrubland, along Rio Grande at Hot Springs, Big Bend National Park (BIBE3024). *Porophyllum scoparium* is the dominant shrub (Karen Clary).

Acacia - Mesquite Wash Shrubland

Local Type and Concept

Moderately dense to somewhat open tall shrublands dominated by *Vachellia constricta*, *Senegalia* spp., *Prosopis glandulosa*, and/or other riparian shrubs on banks and terraces of large washes and in the channel of smaller washes.

Accuracy Assessment Sites Within RIGR Included in Concept

BIBEAA1047, RIGRAA1102

Vegetation

Both the shrub and the herbaceous strata are sparse to moderate in cover. A moderately dense to somewhat open tall shrub stratum is dominated by some combination of *Prosopis glandulosa* (honey mesquite), *Senegalia greggii* (Gregg's catclaw), *Vachellia constricta* (whitethorn acacia), and/or *Larrea tridentata* (creosotebush). *Yucca elata* (soaptree yucca) is a characteristic low cover species. Species that are more typical of channels, including *Hymenoclea monogyra* (singlewhorl burrobrush), *Chilopsis linearis* (desert willow), and/or *Porophyllum scoparium* (shrubby poreleaf) may occur in small amounts. *Vachellia vernicosa* (viscid acacia) and *Salazaria mexicana* (bladdersage) are two species of limited distribution within BIBE that may occur. *Dasyochloa pulchella* (fluffgrass), *Croton* spp. (crotons), *Senna durangensis* (Durango senna), and the exotic grass *Pennisetum ciliare* (buffelgrass) are the most constant herbaceous stratum species, which is usually very sparse, with the exception of occasional dense invasions of *P. ciliare*. Stratum and substrate cover for Acacia - Mesquite Wash Shrubland are shown in Table D-45.

Table D-45. Stratum and substrate cover recorded for Acacia - Mesquite Wash Shrubland at Big Bend National Park and Rio Grande Wild and Scenic River (# plots=2).

Category	Item	Mean Cover (%)	Range Cover (%)
Stratum	Tree	0	0-0
	Tall Shrub	15	5-25
	Short Shrub	25	25-25
	Herb	33	15-50
Substrate	Bedrock	0	0-0
	Large/Small Rocks	3	1-5
	Litter/Duff	20	10-29

Environment

The Acacia - Mesquite Wash Shrubland occurs in linear stands along banks and floodplains of low gradient washes, and typically occurs in association with the Big Bend Lowlands Wash Channel Shrubland, which is the dominant vegetation of the channel itself. The Acacia - Mesquite Wash Shrubland also occurs in wider stands across areas of braided (partially channelized) flow across the

lower parts of alluvial fans or in channel beds of infrequent flow, where it represents a transitional between riparian wash channel vegetation and non-alluvial upland scrub. This association occurs throughout the BIBE and probably into the Black Gap Wildlife Management Area sections of RIGR, on relatively low gradient terrain, but evidently not in the steeper tributaries farther downstream.

USNVC Crosswalk

USNVC Class: Semi & Semi-Desert Class (3)

USNVC Subclass: Warm Desert & Semi-Desert Woodland, Scrub & Grassland Subclass (3.A)

USNVC Formation: Warm Desert & Semi-Desert Scrub & Grassland Formation (3.A.2)

USNVC Division: North American Warm Desert Scrub & Grassland Division (D039)

USNVC Macrogroup: North American Warm-Desert Xero-Riparian Scrub Macrogroup (M092)

USNVC Group: Warm Semi-Desert Shrub & Herb Dry Wash & Colluvial Slope Group (G541)

USNVC Alliance: *Hymenoclea monogyra* - *Brickellia laciniata* Chihuahuan - Sonoran Desert Wash Alliance (A3262)

NPS Association: *Vachellia* spp. - *Senegalia greggii* - *Prosopis glandulosa* - *Yucca elata* Shrubland Association (NPSBIBE043)

Comments

While this association may have elements of the Big Bend Lowlands Creosotebush Desert Scrub and the Mesquite - Creosotebush Desert Scrub, it is more strictly associated with washes than are those associations. Most frequent plant taxa recorded in Acacia - Mesquite Wash Shrubland are shown in Table D-46.

Table D-46. Synthesis table for all plant taxa recorded in Acacia - Mesquite Wash Shrubland at Big Bend National Park and Rio Grande Wild and Scenic River (# plots=2).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Vachellia constricta	Shrub	100.0%	5.2	0-10
Larrea tridentata	Shrub	100.0%	1.8	0-3
Viguiera stenoloba	Shrub	100.0%	1.7	0-3
Prosopis glandulosa	Shrub	100.0%	1.6	0-5
Yucca elata	Shrub	100.0%	1.1	0-3
Krameria grayi	Shrub	100.0%	0.3	0-1
Aloysia gratissima	Shrub	50.0%	9.0	0-26
Senegalia roemeriana	Shrub	50.0%	5.0	0-15
Salazaria mexicana	Shrub	50.0%	1.5	0-6

Table D-46 (continued). Synthesis table for all plant taxa recorded in Acacia - Mesquite Wash Shrubland at Big Bend National Park and Rio Grande Wild and Scenic River (# plots=2).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Lycium berlandieri	Shrub	50.0%	1.3	0-5
Aloysia wrightii	Shrub	50.0%	0.8	0-2
Leucophyllum frutescens	Shrub	50.0%	0.3	0-1
Cylindropuntia imbricata	Shrub	50.0%	<0.1	0-trace
Gutierrezia sp.	Shrub	50.0%	<0.1	0-trace
Parthenium incanum	Shrub	50.0%	<0.1	0-trace
Cuscuta sp.	Vine	50.0%	0.3	0-1
Pennisetum ciliare	Herb	100.0%	19.5	0-25
Heteropogon contortus	Herb	100.0%	4.0	0-50
Poa sp.	Herb	100.0%	1.5	few-5
Amaranthus sp.	Herb	50.0%	0.8	0-2
Desmanthus glandulosus	Herb	50.0%	0.3	0-1
Argythamnia humilis	Herb	50.0%	0.3	0-1
Boerhavia intermedia	Herb	50.0%	0.3	0-1
Euphorbia exstipulata	Herb	50.0%	0.3	0-1
Helianthus petiolaris	Herb	50.0%	0.3	0-1
Ibervillea tenuisecta	Herb	50.0%	0.3	0-1
Kallstroemia grandiflora	Herb	50.0%	0.3	0-1
Kallstroemia parviflora	Herb	50.0%	0.3	0-1
Pectis angustifolia	Herb	50.0%	0.3	0-1
Proboscidea louisianica	Herb	50.0%	0.3	0-1
Senna durangensis	Herb	50.0%	0.3	0-1
Sporobolus sp.	Herb	50.0%	0.3	0-1
Tetraclea coulteri	Herb	50.0%	0.3	0-1



Photo 53. Acacia - Mesquite Wash Shrubland, River Road East along Tornillo Creek, Big Bend National Park (about 1 km from RIGR) (BIBEAA0790) (Kelsey Wogan).



Photo 54. Acacia - Mesquite Wash Shrubland, at mile 18 below La Linda, Black Gap Wildlife Management Area (RIGRAA1102) (Kelon Crawford).

Badlands Sparse Vegetation

Local Type and Concept

Very sparse to moderately dense vegetation of variable composition on clay "badlands". The perennial grass *Cathestecum erectum* (false grama) is somewhat characteristic, but variable in occurrence and abundance from stand to stand. Other than this species, total plant cover is usually low, often less than 15% total cover. Within RIGR, probably limited to non-calcareous substrates within the Big Bend National Park section along River Road East.

Vegetation

Total plant cover averages about 20%, but is quite variable, and is often less than 15%. *Larrea tridentata* (creosotebush), *Prosopis glandulosa* (honey mesquite), and/or *Cylindropuntia leptocaulis* (Christmas cactus) are the most constant species of a sparse (average 5% total cover) shrub stratum. *Atriplex acanthocarpa* (tubercled saltbush) is a characteristic subshrub. Other (less constant) shrub species include *Opuntia camanchica* (Comanche pricklypear) *Grusonia aggeria* (Big Bend dog cholla), *Fouquieria splendens* (ocotillo), *Krameria grayi* (white ratany), *Atriplex canescens* (fourwing saltbush), *Echinocereus enneacanthus* var. *enneacanthus* (pitaya cactus), *Echinocereus stramineus* (strawberry hedgehog cactus), *Coryphantha macromeris* (little beehive cactus), and *Echinocereus dasyacanthus* (Texas rainbow cactus). The recently described Big Bend endemic *Grusonia densispina* (dense-spine dog cholla) occurs in this association. The herbaceous stratum has variable and sometimes patchy cover. It usually is sparse, but *Cathestecum erectum* (false grama), the most constant species, may contribute locally high cover. Less constant grass species include the perennials *Bouteloua ramosa* (chino grama) *Dasyochloa pulchella* (fluffgrass), *Bouteloua trifida* (red grama), and (non-native) *Pennisetum ciliare* (buffelgrass), and the annual *Bouteloua barbata* (sixweeks grama). Forbs, which include *Chamaesyce albomarginata* (whitemargin sandmat) *Bahia absinthifolia* (hairyseed bahia), and *Tidestromia carnosa* (fleshy honeysweet), usually are sparse. Stratum and substrate cover for Badlands Sparse Vegetation are shown in Table D-47.

Table D-47. Stratum and substrate cover recorded for Badlands Sparse Vegetation at Big Bend National Park (# plots=15).

Category	Item	Mean Cover (%)	Range Cover (%)
Stratum	Tree	0	0-0
	Tall Shrub	1	0-7
	Short Shrub	6	0-15
	Herb	22	0-90
Substrate	Bedrock	1	0-10
	Large/Small Rocks	82	34-99
	Litter/Duff	2	0-7

Environment

BIBE stands were found scattered throughout the western and southern parts of that park and usually were recorded as occurring on badlands. These are areas of eroded sedimentary deposits with locally high soil clay content and often have a surface layer of abundant small rocks ("desert pavement"). During the map accuracy assessment for BIBE, stands also were recorded along River Road East, within 1.5 km of RIGR, and the association likely extends into RIGR in this limited area. Sites often are mapped as the Aguja Formation or the Pen Formation.

USNVC Crosswalk

USNVC Class: Semi & Semi-Desert Class (3)

USNVC Subclass: Warm Desert & Semi-Desert Woodland, Scrub & Grassland Subclass (3.A)

USNVC Formation: Warm Desert & Semi-Desert Scrub & Grassland Formation (3.A.2)

USNVC Division: North American Warm Desert Scrub & Grassland Division (D039)

USNVC Macrogroup: North American Warm Semi-Desert Cliff, Scree & Rock Vegetation Macrogroup (M117)

USNVC Group: North American Warm Semi-Desert Cliff, Scree & Pavement Sparse Vegetation Group (G569)

USNVC Alliance: Sparsely Vegetated Clay Flats, Hills & Badlands Alliance (A4023)

USNVC Association: *Atriplex obovata / Tidestromia carnosa* Dwarf-shrubland Association (CEGL004575)

Comments

In analysis, the plots cluster into two groups: those with relatively high cover and *Cathestecum erectum* (false grama) and those with low cover and without *C. erectum*. When *C. erectum* is eliminated from the analysis, composition is very similar between the clusters, with overall [non-*Cathestecum erectum*] plant cover low. This appears to be due to the patchy occurrence of *C. erectum* at the plot scale and wide spacing of plants in otherwise fairly homogeneous vegetation. Most frequent plant taxa recorded in Badlands Sparse Vegetation are shown in Table D-48.

Table D-48. Synthesis table for all plant taxa recorded in Badlands Sparse Vegetation at Big Bend National Park and Rio Grande Wild and Scenic River (# plots=16).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Larrea tridentata	Shrub	75.0%	1.0	0-6
Opuntia camanchica	Shrub	68.8%	0.2	0-1
Prosopis glandulosa	Shrub	62.5%	0.8	0-6
Grusonia aggeria	Shrub	56.3%	0.3	0-2
Cylindropuntia leptocaulis	Shrub	50.0%	0.4	0-5

Table D-48 (continued). Synthesis table for all plant taxa recorded in Badlands Sparse Vegetation at Big Bend National Park and Rio Grande Wild and Scenic River (# plots=16).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Krameria grayi	Shrub	31.3%	0.2	0-2
Echinocereus dasyacanthus	Shrub	25.0%	0.1	0-1
Echinocereus stramineus	Shrub	25.0%	0.1	0-2
Fouquieria splendens	Shrub	25.0%	0.1	0-1
Agave lechuguilla	Shrub	18.8%	0.8	0-10
Leucaena retusa	Shrub	18.8%	0.5	0.5
Echinocactus horizonthalonius	Shrub	18.8%	0.1	0-1
Cylindropuntia imbricata	Shrub	18.8%	0.0	0-1
Ephedra aspera	Shrub	18.8%	0.0	0-1
Atriplex obovata	Shrub	12.5%	0.3	0-5
Vachellia vernicosa	Shrub	12.5%	0.2	0-3
Jatropha dioica	Shrub	12.5%	0.1	0-2
Yucca torreyi	Shrub	12.5%	0.1	0-2
Atriplex canescens	Shrub	12.5%	0.1	0-2
Echinocereus enneacanthus var. *enneacanthus*	Shrub	12.5%	0.1	0-1
Echinocereus russanthus	Shrub	12.5%	0.1	0-1
Cathestecum erectum	Herb	43.8%	13.8	0-95
Bouteloua ramosa	Herb	43.8%	1.9	0-25
Dasyochloa pulchella	Herb	37.5%	0.2	0-1
Chamaesyce albomarginata	Herb	31.3%	0.2	0-1
Croton sp.	Herb	18.8%	0.1	0-1
Bouteloua trifida	Herb	12.5%	1.6	0-25
Boerhavia intermedia	Herb	12.5%	0.1	0-2
Bouteloua sp.	Herb	12.5%	0.1	0-2
Panicum hallii	Herb	12.5%	0.1	0-1
Trianthema portulacastrum	Herb	12.5%	0.1	0-1
Bahia absinthifolia	Herb	12.5%	0.0	0-1



Photo 55. Badlands Sparse Vegetation, along River Road East northeast of Rooney's Place, in Big Bend National Park (about 1.5 km from RIGR) (BIBEAA1231) (Kelsey Wogan).



Photo 56. Badlands Sparse Vegetation, along River Road East near Solis, Big Bend National Park (about 2 km from RIGR) (BIBEAA1235) (Kelon Crawford).

Alkaline Clay Flat Shrubland

Local Type and Concept

Grasslands or shrublands with somewhat sparse to moderately dense cover on relatively level sites with high soil clay content and likely alkaline (possibly gypseous), with *Suaeda suffrutescens* (desert seepweed) present in the shrub stratum and Sporobolus pyramidatus (whorled dropseed) and/or other alkaline-preferring or gypsophilous species in the herbaceous stratum.

Vegetation

The observations indicate a fairly distinctive floristic composition. The subshrub *Suaeda suffrutescens* (desert seepweed) is consistently present, although at widely ranging cover levels (from less than 1% to 60%). The subshrub *Atriplex acanthocarpa* (tubercled saltbush) and the taller *Prosopis glandulosa* (honey mesquite) are also fairly constant. The herbaceous stratum is grassy and may be sparse to moderately dense, with *Sporobolus pyramidatus* (whorled dropseed) and the annual *Bouteloua barbata* (sixweeks grama), the most constant species. Other species observed at multiple sites include *Coryphantha macromeris* (little beehive cactus), *Trichloris crinita* (false Rhodes grass), *Trianthema portulacastrum* (desert horsepurslane), and *Echinochloa crus-galli* (barnyardgrass). Stratum and substrate cover for Alkaline Clay Flat Shrubland are shown in Table D-49.

Table D-49. Stratum and substrate cover recorded for Alkaline Clay Flat Shrubland at Big Bend National Park (# plots=2).

Category	Item	Mean Cover (%)	Range Cover (%)
Stratum	Tree	0	0-0
	Tall Shrub	1	0-1
	Short Shrub	27	20-35
	Herb	25	20-30
Substrate	Bedrock	0	0-0
	Large/Small Rocks	36	0-71
	Litter/Duff	5	4-5

Environment

This association appears to be localized and uncommon within BIBE and is somewhat hypothetical in occurrence within RIGR. The stands from which the two classification plots and three accuracy assessment observations were recorded are generally on gentle slopes in zones near active wash or river channels, but not immediately adjacent to them. Soils were observed to have high clay content and would be characterized as clay loams or clays. All stands occur where either on the Aguja or Pen Formations or on alluvial deposits immediately next to one of these units are mapped as geologic units. The preferences of the dominant species suggest that the substrate is alkaline and perhaps gypseous. No stands were confirmed within RIGR, but one was observed along River Road East,

about 1.2 km from RIGR during the map accuracy assessment for BIBE. The association may occur somewhere within RIGR above Boquillas Canyon, although it would be rare and restricted, as it seems to be within BIBE.

USNVC Crosswalk

USNVC Class: Semi & Semi-Desert Class (3)

USNVC Subclass: Warm Desert & Semi-Desert Woodland, Scrub & Grassland Subclass (3.A)

USNVC Formation: Warm Desert & Semi-Desert Scrub & Grassland Formation (3.A.2)

USNVC Division: North American Warm Desert Scrub & Grassland Division (D039)

USNVC Macrogroup: Chihuahuan Semi-Desert Grassland Macrogroup (M087)

USNVC Group: Chihuahuan Gypsophilous Grassland Group (G492)

USNVC Alliance: *Tiquilia hispidissima* / *Sporobolus nealleyi - Tidestromia carnosa* Gypsum Outcrop & Alluvial Flat Desert Scrub Alliance (A3243)

NPS Association: *Suaeda suffrutescens / Sporobolus pyramidatus* Shrubland Association (NPSBIBE027)

Comments

The most abundant and constant shrub species and the most abundant and constant herbaceous species are said to occur on gypseous clays and shales in the Trans-Pecos (Powell 1994, Powell 1998). Most frequent plant taxa recorded in Alkaline Clay Flat Shrubland are shown in Table D-50.

Table D-50. Synthesis table for all plant taxa recorded in Alkaline Clay Flat Shrubland at Big Bend National Park (# plots=2).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Suaeda suffrutescens	Shrub	100.0%	12.6	1-35
Prosopis glandulosa	Shrub	100.0%	0.5	few-1
Atriplex acanthocarpa	Shrub	50.0%	3.8	0-10
Cylindropuntia leptocaulis	Shrub	50.0%	0.8	0-2
Tamarix ramosissima	Shrub	50.0%	0.3	0-1
Grusonia aggeria	Shrub	50.0%	0.3	0-1
Coryphantha macromeris	Shrub	50.0%	0.3	0-1
Sporobolus pyramidatus	Herb	100.0%	12.5	5-25
Bouteloua barbata	Herb	100.0%	0.5	few-1
Trianthema portulacastrum	Herb	100.0%	0.5	few-1
Echinochloa crus-galli	Herb	100.0%	0.5	few-1

Table D-50 (continued). Synthesis table for all plant taxa recorded in Alkaline Clay Flat Shrubland at Big Bend National Park (# plots=2).

Species Latin Name	Primary Stratum	Constancy	Mean Cover (%)	Range Cover (%)
Trichloris crinita	Herb	50.0%	8.8	0-25
Leptochloa panicea ssp. *mucronata*	Herb	50.0%	0.8	0-2
Pennisetum ciliare	Herb	50.0%	0.3	0-1
Tidestromia carnosa	Herb	50.0%	0.3	0-1
Bahia absinthifolia	Herb	50.0%	0.3	0-1
Chamaesyce albomarginata	Herb	50.0%	0.3	0-1
Digitaria californica	Herb	50.0%	0.3	0-1
Pleuraphis mutica	Herb	50.0%	0.3	0-1



Photo 57. Alkaline Clay Flat Shrubland, along River Road East, north of La Clocha, Big Bend National Park (BIBEAA1227). Most plant cover visible is *Suaeda suffrutescens* (Rebecca Evans).



Photo 58. Alkaline Clay Flat Shrubland, along River Road East, north of La Clocha, Big Bend National Park (BIBEAA1227). Most plant cover visible is *Suaeda suffrutescens* (Rebecca Evans).

Johnson Grass - Russian Thistle Desert Grassland

Local Type and Concept

Grasslands dominated (usually strongly so) by *Sorghum halepense* (Johnson grass) and, less frequently, by *Salsola tragus* (Russian thistle).

Accuracy Assessment Sites Within RIGR Included in Concept

BIBEAA1254, BIBEAA1255

Vegetation

In both stands observed within RIGR, the non-native *Sorghum halepense* (Johnson grass) is dominant in the herbaceous stratum, with about 40% cover. *Salsola tragus* (Russian thistle) may be an alternative dominant in some stands. *Sphaeralcea angustifolia* (copper globemallow) and *Arundo donax* (giant cane) were present in both stands. A variety of forbs and grasses, most of them ruderal species, are likely to occur. Shrubs may be present at low cover (usually, less than 15%); these may include *Prosopis glandulosa* (honey mesquite), *Baccharis salicifolia* (seepwillow), *Tamarix ramosissima* (tamarisk) and others. *Clematis drummondii* (Drummond's clematis) and other vines may be present and may achieve high cover.

This association was described from BIBE, where it more often occurs in upland basins and invades upland desert grassland and desert scrub. In that setting, it has different (generally non-riparian) associated species. The riparian variant described here is the only one believed to occur within RIGR.

Environment

In RIGR, this association occurs on the Rio Grande floodplain and is known only above Rio Grande Village. It may be promoted not only by flood disturbance, but also by trespass grazing, which occurs in the area it was observed within RIGR. In RIGR, it appears to occur in small, localized patches.

USNVC Crosswalk

USNVC Class: Semi & Semi-Desert Class (3)

USNVC Subclass: Warm Desert & Semi-Desert Woodland, Scrub & Grassland Subclass (3.A)

USNVC Formation: Warm Desert & Semi-Desert Scrub & Grassland Formation (3.A.2)

USNVC Division: North American Warm Desert Scrub & Grassland Division (D039)

USNVC Macrogroup: North American Warm Desert Ruderal Scrub & Grassland Macrogroup (M512)

USNVC Group: North American Warm Desert Ruderal Grassland Group (G677)

USNVC Alliance: *Eragrostis lehmanniana* - *Eragrostis curvula* Ruderal Desert Grassland Alliance (A2687)

NPS Association: *Sorghum halepense* Chihuahuan Desert Herbaceous Vegetation Association (NPSBIBE018)

Comments

The USNVC (2017) *Sorghum halepense* Herbaceous Vegetation (CEGL004108), an association in G583 (Southeastern Old Field Group) of the southeastern U.S., is an inappropriate translation for *Sorghum halepense* stands in the arid southwestern U.S. In general, semi-natural grasslands dominated by exotic species do not appear to be included in the USNVC hierarchy for the western United States, outside of California, this unit is provided as a local provisional unit to cover similar situations in the Chihuahuan Desert region.



Photo 59. Johnson Grass - Russian Thistle Desert Grassland, Rio Grande floodplain northeast of San Vicente, Big Bend National Park (BIBEAA1254) (Rebecca Evans).



Photo 60. Johnson Grass - Russian Thistle Desert Grassland, Rio Grande floodplain northeast of San Vicente, Big Bend National Park (BIBEAA1255) (Kelsey Wogan).

Upland Ruderal Herbaceous Vegetation

Local Type and Concept

This is a "placeholder" association for grasslands or herbaceous forb vegetation characterized by ruderal native and/or non-native species that have become established by significant anthropogenic disturbance and/or are maintained by regular human activities.

Vegetation

The Upland Ruderal Herbaceous Vegetation is herbaceous vegetation of areas that have been significantly disturbed in the recent past by human activity (construction, etc.) and/or that are maintained by ongoing maintenance (e.g., regular mowing). Plot data for this vegetation were not collected, but observations indicate that it is dominated by a number of ruderal native or non-native species, including, but not limited to, *Heteropogon contortus* (tanglehead), *Eragrostis lehmanniana* (Lehmann lovegrass), *Pennisetum ciliare* (buffelgrass), *Conyza canadensis* (Canadian horseweed), *Salsola tragus* (Russian thistle), *Helianthus annuus* (common sunflower), and others.

Environment

This vegetation includes much of the mowed roadside strips and other maintained areas throughout BIBE and into RIGR in the vicinity of Rio Grande Village, as well as vegetation in areas of significant soil disturbance around buildings or representing sites of relatively recent construction.

USNVC Crosswalk

USNVC Class: Semi & Semi-Desert Class (3)

USNVC Subclass: Warm Desert & Semi-Desert Woodland, Scrub & Grassland Subclass (3.A)

USNVC Formation: Warm Desert & Semi-Desert Scrub & Grassland Formation (3.A.2)

USNVC Division: North American Warm Desert Scrub & Grassland Division (D039)

USNVC Macrogroup: North American Warm Desert Ruderal Scrub & Grassland Macrogroup (M512)

USNVC Group: North American Warm Desert Ruderal Grassland Group (G677)

USNVC Alliance: *Eragrostis lehmanniana* - *Eragrostis curvula* Ruderal Desert Grassland Alliance (A2687)

NPS Association: (*Heteropogon contortus, Pennisetum ciliare, Eragrostis lehmanniana*) - Mixed Forbs Chihuahuan Ruderal Herbaceous Vegetation Association (NPSBIBE046)

Comments

This concept excludes vegetation dominated by ruderal species that are maintained by natural disturbances, such as herbaceous vegetation of alluvial bars, banks and floodplains (which is covered by the concept of the Rio Grande Alluvial Herbaceous Vegetation). It also excludes wash shrublands that are dominated by ruderal invasive species such as *Pennisetum ciliare* (buffelgrass), *Eragrostis lehmanniana* (Lehmann lovegrass), or *Sorghum halepense* (Johnson grass) (which would be considered invaded variants of otherwise natural vegetation associations such as the Big Bend Lowlands Wash Channel Shrubland.



Photo 61. Upland Ruderal Herbaceous Vegetation, Big Bend National Park landfill (BIBE1281). Photo by Chris Lea.

Calcareous Outcrop Lichen Vegetation

Local Type and Concept

This is a "placeholder" association representing all nonvascular (primarily saxicolous lichen) and sparse vascular vegetation on limestone cliffs and other bedrock outcrops.

Vegetation

No plot data were collected. Vegetation would be comprised of saxicolous lichens and sparse vascular plants mostly limited to crevices. Vascular species would likely be those present in the Calcareous Mixed Desert Scrub. Species of the genus *Perityle* (rockdaisy) may occur and be characteristic.

Environment

Cliffs and other bedrock outcrops on calcareous substrates (limestone, etc.) throughout RIGR.

USNVC Crosswalk

USNVC Class: Open Rock Vegetation Class (6)

USNVC Subclass: Temperate & Boreal Open Rock Vegetation Subclass (6.B)

USNVC Formation: Temperate & Boreal Cliff, Scree & Other Rock Vegetation Formation (6.B.1)

USNVC Division: Western North American Temperate & Boreal Cliff, Scree & Rock Vegetation Division (D052)

USNVC Macrogroup: Western North American Cliff, Scree & Rock Vegetation Macrogroup (M887)

USNVC Group: Western North American Cliff, Scree & Rock Vegetation Group (G565)

USNVC Alliance: Undefined

NPS Association: Chihuahuan Desert Calcareous Outcrop Lichen Vegetation Association (NPSBIBE039)

Comments

This is a "placeholder" unit intended to represent nonvascular and sparse vascular vegetation on all calcareous cliffs and other bedrock outcrops, for mapping.



Photo 62. Calcareous Outcrop Lichen Vegetation, near Maravillas Canyon (Jeff Renfrow).

Mixed Ornamental and Planted Woodland

Local Type and Concept
Woodlands of formerly planted trees and shrubs, with highly managed understories (regularly mowed "lawn" areas).

Accuracy Assessment Sites Within RIGR Included in Concept
BIBEAA1009, BIBEAA1010, BIBEAA1279

Vegetation
An open (usually, 10- 40% cover) tree stratum is dominated by tall *Populus fremontii* ssp. *mesetae* (Arizona cottonwood), with *Populus deltoides* ssp. *wislizeni* (Rio Grande cottonwood) also possibly present. Shorter trees or saplings include *Fraxinus velutina* (velvet ash), *Vachellia farnesiana* (huisache), *Gleditsia triacanthos* (honey locust) and possibly others. There essentially is no shrub stratum. The herbaceous stratum is strongly dominated by a "lawn" of rhizomatous planted grasses, including *Bothriochloa ischaemum* (yellow bluestem), Cynodon dactylon (Bermuda grass) and others.

Environment
This vegetation occurs along the Rio Grande floodplain in and around campground and picnic areas at the Rio Grande Village with Big Bend National Park.

USNVC Crosswalk

USNVC Class: Agricultural & Developed Vegetation Class (7)

USNVC Subclass: Developed Vegetation Subclass (7.C)

USNVC Formation: Other Developed Vegetation Formation (7.C.2)

USNVC Division: Other Developed Vegetation Division (7.C.1.2)

USNVC Macrogroup: Tree Developed Vegetation Macrogroup (CGR040)

USNVC Group: Temperate Tree Developed Vegetation Group (CSG045)

USNVC Subformation: Other Developed Vegetation Subformation (7.C.2.1)

USNVC Cultural Group: Tree Developed Vegetation Cultural Group (CGR040)

USNVC Cultural Subgroup: Temperate Tree Developed Vegetation Cultural Subgroup (CSG047)

NPS Cultural Type: *Populus* spp. - *Fraxinus* spp. Planted Woodland Cultural Type (NPSBIBE045)

Comments
Although not a naturally occurring vegetation type, stands are large enough to be mapped and have some natural vegetation characteristics, including a predominance of native tree species.

This vegetation provides nesting habitat for the common black hawk (Buteogallus anthracinus), a species of conservation concern in Texas.



Photo 63. Mixed Ornamental and Planted Woodland, Rio Grande Village, Big Bend National Park (BIBEAA1009) (Rebecca Evans).



Photo 64. Mixed Ornamental and Planted Woodland, Rio Grande Village, Big Bend National Park (BIBEAA1279) (Chris Lea).

Appendix E. RIGR Mapping Unit Key

RIGR Mapping Conventions and Visual Key

Appendix E. describes the map units for the Rio Grande Wild and Scenic River (RIGR) Vegetation Inventory Project.

The purpose or this key is to:

- Provide a visual key to the RIGR map units;
- Describe the vegetation of each map unit;
- Provide a representative ground photograph(s) for each map unit;
- Describe the link between each map unit and the revised U.S. National Vegetation Classification (rUSNVC);
- Provide visual examples of each map unit with digital overhead images and delineated overlays.

The map units for RIGR were based on a combination of rUSNVC plant associations, local requests (i.e. Park Specials), the limitations of the digital imagery, and land use / land cover classes. The vegetation described in this section reflects the classification designed specifically for this project. Non-vegetated and land-use map units are not described in this key. For more information on the development of the mapping scheme for RIGR please reference the mapping sections of this report and the digital information (i.e. lookup tables, metadata) included in the digital project files.

This key follows the physiognomic grouping of each map unit starting with woodland types. Each map unit is fully described by a variety of characteristics and features. First, the common plant species and rUSNVC crosswalk (if applicable) is presented. Next is a description of the mapping concept and a representative ground photograph. A map of the distribution for each mapping unit across the study area follows along with an example of the 2015 Texas Orthoimagery Program (TOP) basemap ortho-imagery (color infrared bands are shown). The imagery snapshot examples also include representative polygon outlines that highlight the map unit signatures. Many of the map unit descriptions rely heavily on the vegetation field data collected in 2011, and 2010. The sample ground photographs were taken during the 2003, 2008, 2009, 2010 field data collection efforts.

Woodlands

Map Code	*Cottonwood - Goodding Willow Spring Woodland*
W_CWD	**Populus fremontii - Salix gooddingii Spring Woodland**

Common Species

- Arizona cottonwood (*Populus fremontii*)
- Goodding willow (*Salix gooddingii*)
- Seepwillow (Mule-fat) (*Baccharis salicifolia*)
- Honey mesquite (*Prosopis glandulosa*)
- Texas persimmon (*Diospyros texana*)
- Silver beardgrass (*Bothriochloa laguroides*)
- Yellow bluestem (*Bothriochloa ischaemum*)

rUSNVC Association
Populus fremontii - Salix gooddingii Riparian Woodland (CEGL000944)



Example photo of Cottonwood - Goodding Willow Spring Woodland.

Description
Frequency: Cottonwood riparian woodlands were rare and only found near springs, catchments, and seeps, often in riparian settings.

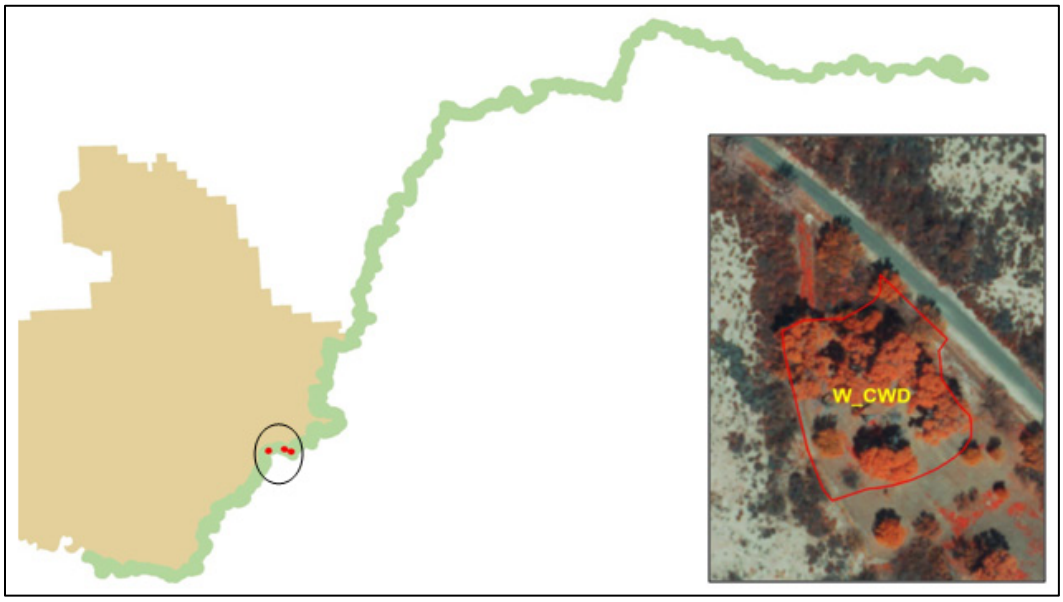
Physiognomy: W_CWD polygons contained sparse to moderate dense stands of tall deciduous trees (3- 10 meters) with Goodding willows and other deciduous riparian trees and shrubs. Most sites had thick shrub, grass, and mesic herbaceous vegetation in the understory.

Condition: Fair. Cottonwood trees occurring in riparian corridors are likely impacted by flash flooding events and may be threatened by prolonged drought and water shortages. Wildlife usage of springs and seeps may affect cottonwood and willow regeneration.

CIR Signature: On the imagery, canopies of W_CWD appeared as bushy, orange/red blotches (trees). Polygons were usually clumped in appearance and often contained mottled short shrubs or smooth grass colors in the understory.

Mapping Notes: The W_CWD map unit occurred in mesic and riparian areas that may have contained other dominant deciduous tree species. Some natural cottonwood stands along the Rio Grande River were likely included in the larger S_MRIP and S_RWIL types. Recently planted cottonwoods were mapped using the W_FOR map class.

Photo Signature and Distribution



Example photo signature and distribution map for Cottonwood - Goodding Willow Spring Woodland.

Map Code ***Mixed Ornamental and Planted Woodland***
W_FOR

Common Species

- Arizona cottonwood (*Populus fremontii* ssp. *mesetae*)
- Eastern cottonwood (*Populus deltoides*)
- Velvet ash (*Fraxinus velutina*)
- Huisache (*Vachellia farnesiana*)
- Palm Trees (*Areacaceae* spp.)
- Other Decorative, Planted, and Cultivated Trees and Shrubs

rUSNVC Association
Populus spp. - *Fraxinus* spp. Planted Woodland Cultural Type (NPSBIBE045) [Provisional]



Example photo of Mixed Ornamental and Planted Woodland.

Description
Frequency: Various residential, campground, and developed areas in RIGR were found to have trees and tall shrubs that were planted and/or maintained.

Physiognomy: W_FOR polygons contained sparse to moderate stands of trees and shrubs that may contain both native and non-native evergreen and deciduous species. The understories for this map unit were mainly mixes of planted and maintained grasses, shrubs and other landscape plantings.

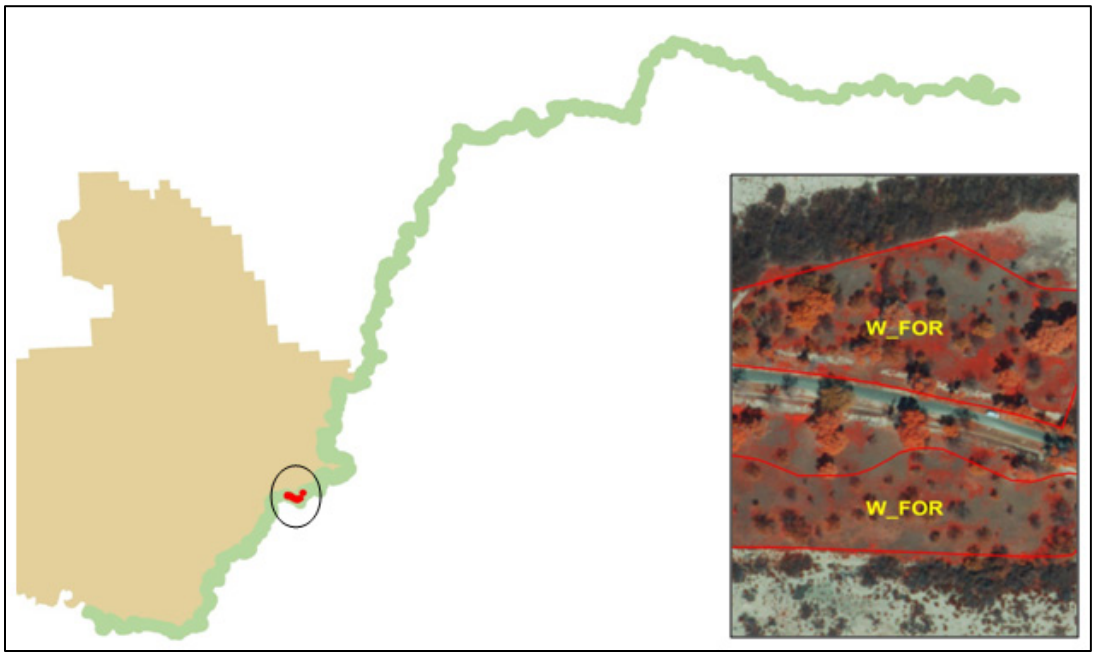
Condition: Poor. Planted and ornamental trees and shrubs may represent non-native species and species that may spread. Native and natural vegetation may be suppressed or displaced by these plants under the right conditions.

CIR Signature: On the imagery, canopies of W_FOR varied depending on the species present. Most contained red, brown, and orange tuffs with a smooth red color representing lawns underneath. Dead

or dormant grass patches appeared as a smooth gray color. Dark shadows from the taller trees were often present.

Mapping Notes: The W_FOR map unit was created to address mostly developed areas in campgrounds, old homesteads, and other park facilities. In some cases, they were mixed with native cottonwood (W_CWD) and mesquite trees (S_MRIP). None of these areas were sampled during this project.

Photo Signature and Distribution



Example photo signature and distribution map for Mixed Ornamental and Planted Woodland.

Map Code ***Huisache - (Honey Mesquite) Riparian Woodland***
W_HR ***Vachellia farnesiana* - (*Prosopis glandulosa*) Riparian Woodland**

Common Species

- Huisache (Sweet acacia) (*Acacia farnesiana*)
- Honey mesquite (*Prosopis glandulosa*)
- Baccharis spp. (*Baccharis* spp.)
- Tree tobacco (*Nicotiana glauca*)
- Bermuda grass (*Cynodon dactylon*)

rUSNVC Association
Vachellia farnesiana - (*Prosopis glandulosa*) Riparian Woodland (CEGL002131)



Example photo of Huisache - (Honey Mesquite) Riparian Woodland.

Description
Frequency: Huisache woodlands and tall shrublands were common along the edges of the Rio Grande River (especially on the Mexican side). Short shrub variants and seedlings were also common in areas that were recently flooded.

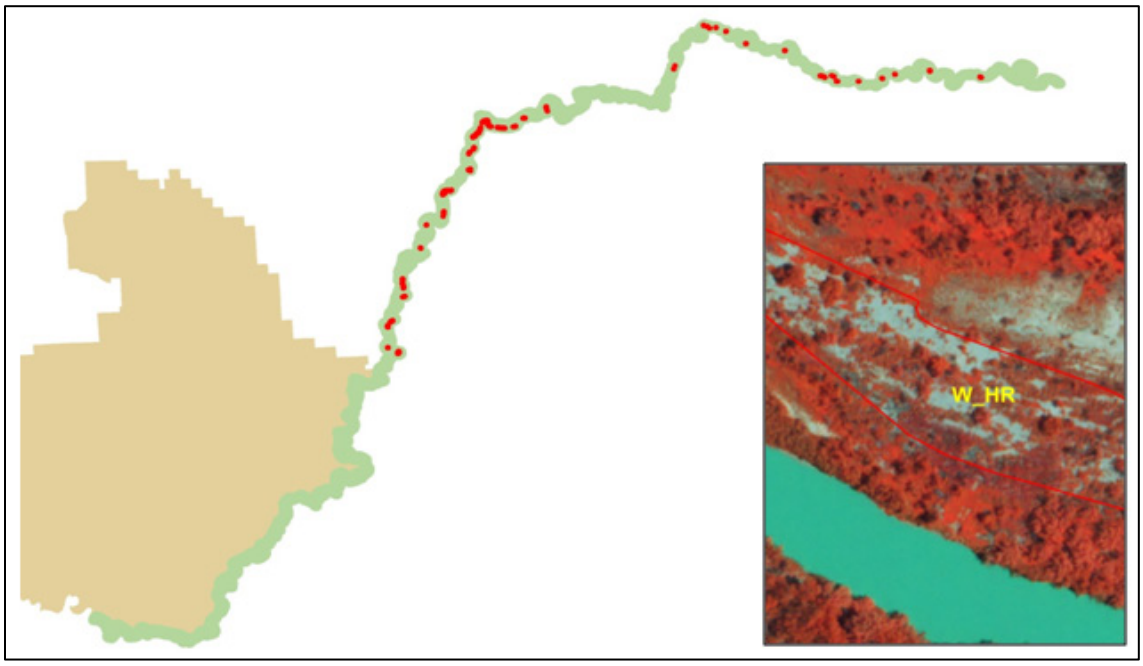
Physiognomy: W_HR polygons contain sparse stands of tall evergreen trees/shrubs or shorter and sparser shrubs and seedlings. Understories were limited and varied depending on location. Early successional grasses, forbs and common early inundation shrubs were often present. Honey mesquite was a widespread associate.

Condition: Fair. Huisache stands were rare along the Rio Grande River and typically only occurred in small stands or linear bands. All forms of huisache, from trees to seedlings, were found in the sampling and appeared to be healthy. Large floods and draught may kill or greatly reduce the presence of huisache at RIGR.

CIR Signature: On the imagery, W_HR trees appear as large or medium rounded dark red tuffs with either red (Bermuda grass), white (soil/rock), or gray (dead grass/soil) understories. Shorter shrubs and seedlings appeared as small brown spots and splotches.

Mapping Notes: W_HR was very similar in appearance to the W_MA map unit and also to taller tamarisk shrubs/trees. More ground truthing, monitoring, and sampling of the W_HR stands at RIGR would help improve the accuracy of the mapping and better document its distribution.

Photo Signature and Distribution



Example photo signature and distribution map for Huisache - (Honey Mesquite) Riparian Woodland.

Map Code ***Mexican Ash / Poison-ivy Alcove Woodland***
W_MA ***Fraxinus berlandieriana* / *Toxicodendron radicans* Alcove Woodland**

Common Species

- Mexican ash (*Fraxinus berlandieriana*)
- Huisache (Sweet acacia) (*Acacia farnesiana*)
- American sycamore (*Platanus occidentalis*)
- Pecan (*Carya illinoinensis*)
- Netleaf hackberry (*Celtis laevigata*)
- Texas persimmon (*Diospyros texana*)
- Poison ivy (*Toxicodendron radicans*)

rUSNVC Association
Fraxinus berlandieriana / Toxicodendron radicans Alcove Woodland (NPSRIGR007) [Provisional]



Example photo of Mexican Ash / Poison-ivy Alcove Woodland.

Description
Frequency: Mexican ash woodlands and tall shrublands were rare along the upper shoreline of the Rio Grande River especially in rock alcoves, side drainages, and along mesic rock outcrops.

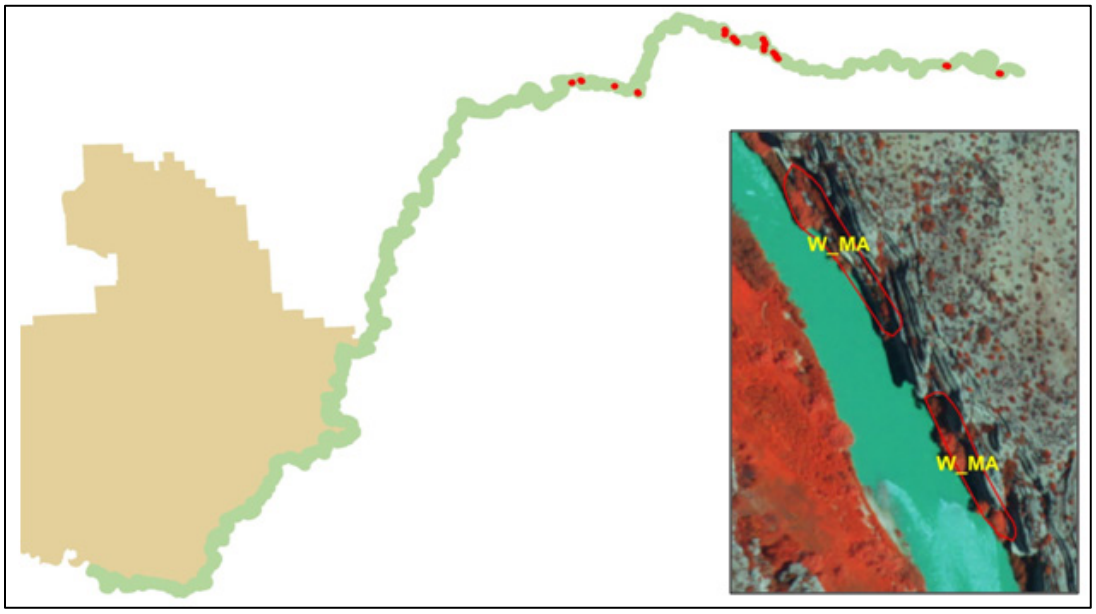
Physiognomy: W_MA polygons contained small stands of deciduous trees with other common deciduous riparian tree species, shrubs, vines, and mesic grasses/forbs in the understory.

Condition: Fair. W_MA sites are rare but appear to be in good health. Their limited distribution and floodplain location make them prone to large floods and/or prolonged drought and water shortages. No regeneration was noted. Non-native species such as tamarisk were often found close by.

CIR Signature: On the imagery, canopies of W_MA appeared next to prominent gray and white rock formations, Mexican Ash trees were often bright red. Polygons of W_MA usually contained other tree species that appeared light red, orange, and/or brown in color.

Mapping Notes: The W_MA map unit was created for this project to document the Mexican Ash trees in RIGR. Mexican ash trees are likely related to higher moisture levels in rock cervices and lack of disturbance along the upper shorelines. Other riparian types, such as W_CWD and W_HR were similar in appearance and were often located in close proximity.

Photo Signature and Distribution



Example photo signature and distribution map for Mexican Ash / Poison-ivy Alcove Woodland.

Shrublands

Map Code ***Acacia - Mesquite Wash Shrubland***

S_ACAMEQ ***Vachellia* spp. - *Senegalia* spp. - *Prosopis glandulosa* Wash Shrubland**

Common Species

- Gregg's catclaw (*Senegalia greggii*)
- Honey mesquite (*Prosopis glandulosa*)
- Soaptree yucca (*Yucca elata*)
- Whitethorn acacia (*Vachellia constricta*)
- Roemer's catclaw (*Senegalia roemeriana*)
- Spiny hackberry (*Celtis ehrenbergiana*)
- Texas persimmon (*Diospyros texana*)

rUSNVC Association

Vachellia spp. - *Senegalia greggii* - *Prosopis glandulosa* - *Yucca elata* Shrubland (NPSRIGR43) [Provisional]



Example photo of Acacia - Mesquite Wash Shrubland.

Description

Frequency: S_ACAMEQ was a fairly common type found on mesic sites such as drainages and low washes throughout the high upland portions of RIGR where it forms the upper boundary of the mesquite bosque (S_MRIP) shrublands.

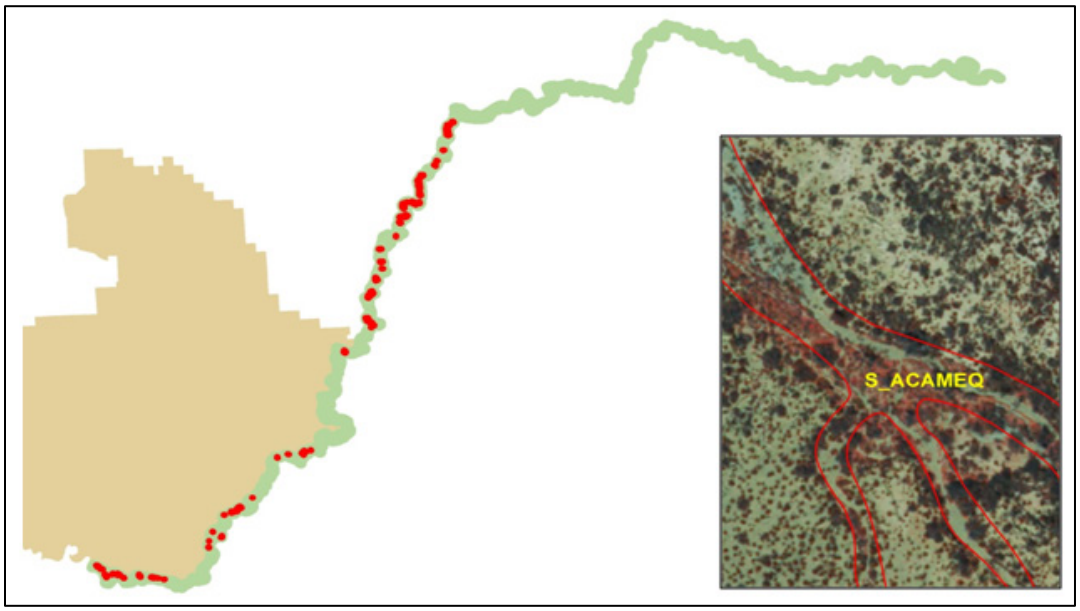
Physiognomy: S_ACAMEQ contains tall (> 1 meter) evergreen acacia and honey mesquite shrubs with an understory of shorter evergreen shrubs, cacti, succulents, and grasses.

Condition: Good. The S_ACAMEQ type was widespread and appeared healthy and stable. Threats to this map unit include invasion by non-native grasses, prolonged drought, floods, and wildfires.

CIR Signature: On the imagery, the acacia and honey mesquite shrubs were large dark brown and black spots against a light blue or white background (bare soil). Linear drainages were common in the S_ACAMEQ polygons. Grasses and herbaceous understory species had a red and pink color.

Mapping Notes: S_ACAMEQ was very similar in appearance to the S_MRIP and S_WASH types but usually contained rounder and fuller shrubs wide spaces in the canopy. The S_MEQ map unit contained similar species but were smaller in size and were not usually associated with drainages.

Photo Signature and Distribution



Example photo signature and distribution map for Acacia - Mesquite Wash Shrubland.

Map Code ***Blackbrush - Brickellbush Wash Channel Shrubland***
S_BBWASH ***Vachellia rigidula - Brickellia laciniata*** **Wash Channel Shrubland**

Common Species

- Blackbrush (*Vachellia rigidula*)
- Honey mesquite (*Prosopis glandulosa*)
- Texas swampprivet (*Forestiera angustifolia*)
- Texas persimmon (*Diospyros texana*)
- Trans-Pecos poreleaf (*Porophyllum scoparium*)
- Mexican ash (*Fraxinus berlandieriana*)
- Brickellbush (*Brickellia* spp.)

rUSNVC Association
Vachellia rigidula - Prosopis glandulosa - Diospyros texana Shrubland (NPSRIGR006) [Provisional]



Example photo of Blackbrush - Brickellbush Wash Channel Shrubland.

Description
Frequency: S_BBWASH was a fairly common tall shrub type found in the eastern portions of RIGR in rocky drainages, washes, and more mesic upland areas.

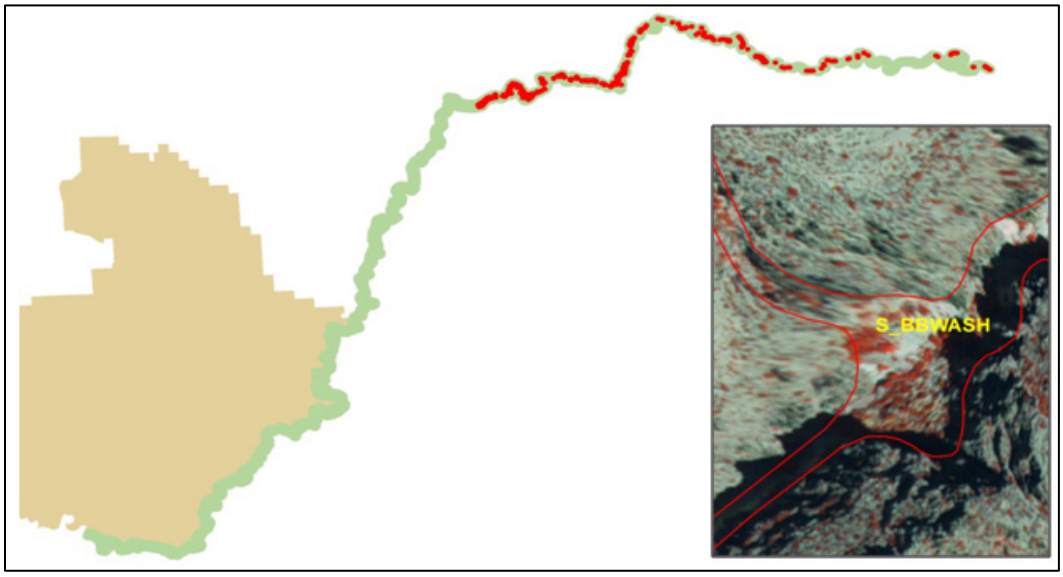
Physiognomy: S_BBWASH contained tall evergreen and deciduous shrubs with an understory of shorter, thornscrub species and sparse grasses and forbs. Shrubs were found growing in mainly rock cracks and crevices.

Condition: Good. Threats to this map unit include invasion by non-native species, human and animal disturbance, flooding, and wildfires.

CIR Signature: On the imagery, blackbrush shrubs had a diagnostic mottled purple reddish color and honey mesquite had a light to dark brown hue. Most S_BBWASH polygons contained prominent linear drainages and a high percentage of visible bare rocks. Other thornscrub and desert species were also present and appeared as brown and red spots and streaks. Texas persimmon was usually a minor component and appeared as dark red spots.

Mapping Notes: The S_BBWASH may be a transition type between the Tamaulipan vegetation found further east at Amistad National Recreation Area and the Chihuahuan desert species found at Big Bend National Park to the west. S_BBWASH was similar in appearance to the other wash types (S_WASH, S_PTWASH, and SP_WASH) and some confusion may have occurred when mapping these similar plant communities.

Photo Signature and Distribution



Example photo signature and distribution map for Blackbrush - Brickellbush Wash Channel Shrubland.

Map Code ***Creosotebush Desert Scrub***
S_CB ***Larrea tridentata* Desert Scrub**

Common Species

- Creosotebush (*Larrea tridentata*)
- False grama (*Cathestecum erectum*)
- Fluffgrass (*Dasyochloa pulchella*)
- Lehmann lovegrass (*Eragrostis lehmanniana*)
- Big Bend dog cholla (*Grusonia aggeria*)
- Littleleaf ratany (*Krameria erecta*)
- Engelmann's prickly pear (cactus apple) (*Opuntia engelmannii* var. *engelmannii*)

rUSNVC Association
Larrea tridentata - Cylindropuntia leptocaulis / *Dasyochloa pulchella - Cathestecum erectum* Shrubland (NPSBIBE031 [Park Special]) [Provisional]



Example photo of Creosotebush Desert Scrub.

Description
Frequency: Low elevation creosotebush shrublands were widespread throughout the lowest elevations of Big Bend National Park and extend along the Rio Grande River in the western half of RIGR.

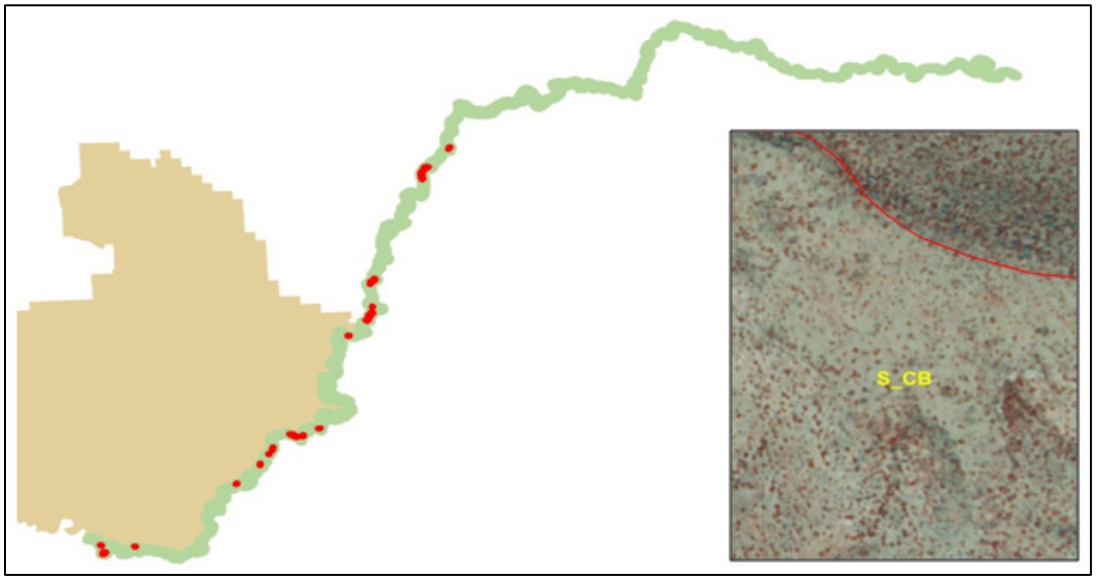
Physiognomy: Polygons of S_CB were dominated by short evergreen shrubs with a sparse understory (if present) of mainly cacti and some grasses and forbs.

Condition: Good-Fair. S_CB polygons were widespread in the lower elevations. Most sites contained very few associated species and contained little species diversity. Wildfires and invasion by non-native grasses are potential threats to this type.

CIR Signature: On the imagery, S_CB polygons were characterized by a smooth light gray, blue, and white background color (bare soils and rocks) with obvious shrub patterns that appeared as brown and red spots. Grasses, if present, appeared as pink and red streaks and splotches.

Mapping Notes: As a species, creosotebush was prolific and was found throughout the upland desert regions of RIGR both as a dominant species and as an associate in other map units. An effort was made during the mapping to separate out nearly monotypic stands of creosotebush at low elevations from those occurring with other species at slightly higher elevations. The S_CB type also usually lacked ocotillo and lechuguilla and this helped separate it from the similar S_CBO map unit.

Photo Signature and Distribution



Example photo signature and distribution map for Creosotebush Desert Scrub.

Map Code ***Creosotebush - Ocotillo - Lechuguilla Mixed Desert Scrub***
S_CBO ***Larrea tridentata - Fouquieria splendens - Agave lechuguilla*** **Mixed Desert Scrub**

Common Species

- Creosotebush (*Larrea tridentata*)
- Ocotillo (*Fouquieria splendens*)
- Lechuguilla (*Agave lechuguilla*)
- Chino grama (*Bouteloua ramosa*)
- False grama (*Cathestecum erectum*)
- Viscid acacia (*Vachellia vernicosa*)
- Leatherstem (*Jatropha dioica*)

rUSNVC Association

Larrea tridentata - Fouquieria splendens - Agave lechuguilla - Leucophyllum frutescens Shrubland (NPSBIBE044) [Provisional]



Example photo of Creosotebush - Ocotillo - Lechuguilla Mixed Desert Scrub.

Description

Frequency: Mixed creosotebush, ocotillo, and lechuguilla shrublands were widespread throughout the middle elevations and dry desert regions of Big Bend National Park and only occurred at some of the higher areas of RIGR.

Physiognomy: Polygons of S_CBO were dominated by short evergreen shrubs and taller ocotillo cacti. Most sites had a prominent understory consisting of succulents, cacti, and some Chino grama grass.

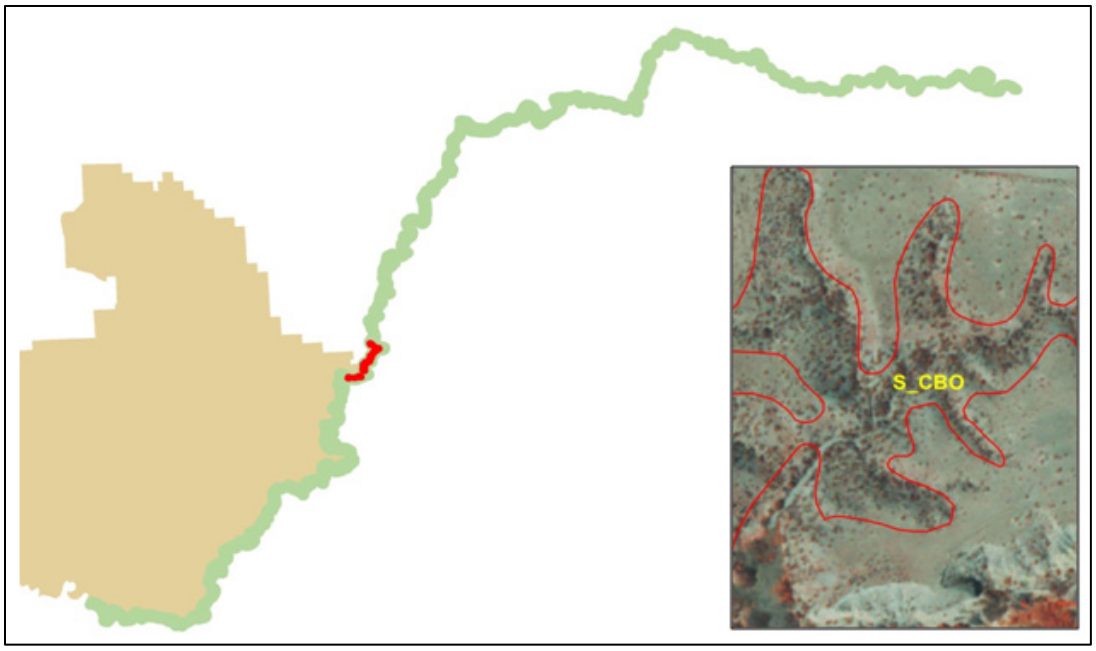
Condition: Good-Fair. S_CBO polygons were widespread throughout BIBE but restricted to one general location at RIGR. Most sites appeared healthy, but some showed evidence of obvious grass

and succulent die-off likely from prolonged freezing. Wildfires and invasion by non-native grasses are potential threats to this type.

CIR Signature: On the imagery, S_CBO polygons were characterized by a smooth light gray, blue, and white background color (bare soils and rocks) with obvious shrub patterns that appeared as brown and red spots. Grasses appeared as pink and brown streaks and splotches.

Mapping Notes: An effort was made during the mapping to separate out the common mix of creosotebush, ocotillo, and lechuguilla from similar sites at lower elevations that were solely dominated by creosotebush.

Photo Signature and Distribution



Example photo signature and distribution map for Creosotebush - Ocotillo - Lechuguilla Mixed Desert Scrub.

Map Code ***Calcareous Mixed Desert Scrub***
S_CDS

Common Species

- Lechuguilla (*Agave lechuguilla*)
- Candelilla (*Euphorbia antisyphilitica*)
- Rough jointfir (*Ephedra aspera*)
- Chino grama (*Bouteloua ramosa*)
- Texas false agave (*Hechtia texensis*)
- Green sotol (*Dasylirion leiophyllum*)
- Thompson's yucca (*Yucca thompsoniana*)
- Leatherstem (*Jatropha dioica*)
- Big Bend silverleaf (*Leucophyllum minus*)

rUSNVC Association
Agave lechuguilla - *Euphorbia antisyphilitica* - *Ephedra aspera / Bouteloua ramosa* Shrubland (NPSBIBE010) [Provisional]



Example photo of Calcareous Mixed Desert Scrub.

Description

Frequency: Calcareous mixed desert scrublands were common throughout the higher elevation limestone regions of RIGR on uplands above the Rio Grande River.

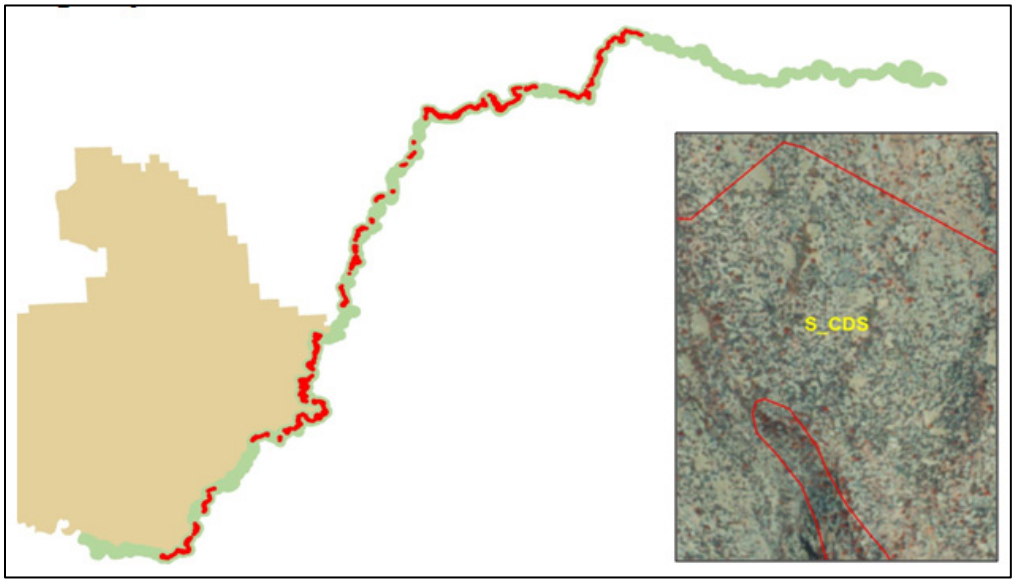
Physiognomy: S_CDS contained sparse to moderate vegetation on dry rock, soil, and other stable substrates and were comprised of short desert evergreen shrubs (mainly cacti and succulents) with scattered grasses and forbs.

Condition: Good. The S_CDS is a limestone type that is widespread both at BIBE and at RIGR. Drought, climate change, and prolonged freezing events may alter the composition of this type.

CIR Signature: Polygons of S_CDS exhibited various colors and textures including swirls and bands. Bare ground colors ranged from blue/gray to tan and white. The vegetation appeared as small red and brown spots and understory grasses (if present) were tan in color.

Mapping Notes: The S_CDS map unit contained similar vegetation found in the S_CTAL and S_YUC map units. S_CDS was used to map large, limestone areas containing sparse and short vegetation. The various SP_LDES and the S_CB map units were used in similar, non-limestone areas.

Photo Signature and Distribution



Example photo signature and distribution map for Calcareous Mixed Desert Scrub.

Map Code ***Alkaline Clay Flat Shrubland***
S_CLAY

Common Species

- Desert seepweed (*Suaeda suffrutescens*)
- Madagascar dropseed (*Sporobolus pyramidatus*)
- False Rhodes grass (*Trichloris crinita*)
- Tubercled saltbush (*Atriplex acanthocarpa*)
- Christmas cactus (*Cylindropuntia leptocaulis*)
- Honey mesquite (*Prosopis glandulosa*)
- Desert horsepurslane (*Trianthema portulacastrum*)
- Creosotebush (*Larrea tridentata*)

rUSNVC Association

Suaeda suffrutescens / Sporobolus pyramidatus Shrubland (NPSBIBE027) [Provisional]



Example photo of Alkaline Clay Flat Shrubland.

Description

Frequency: Clay flats were fairly common in the western overlap region of BIBE and RIGR where they were found in low elevation areas, often associated with badland formations. Gypseous flats are rarer than the clay formations and may not occur in most parts of RIGR.

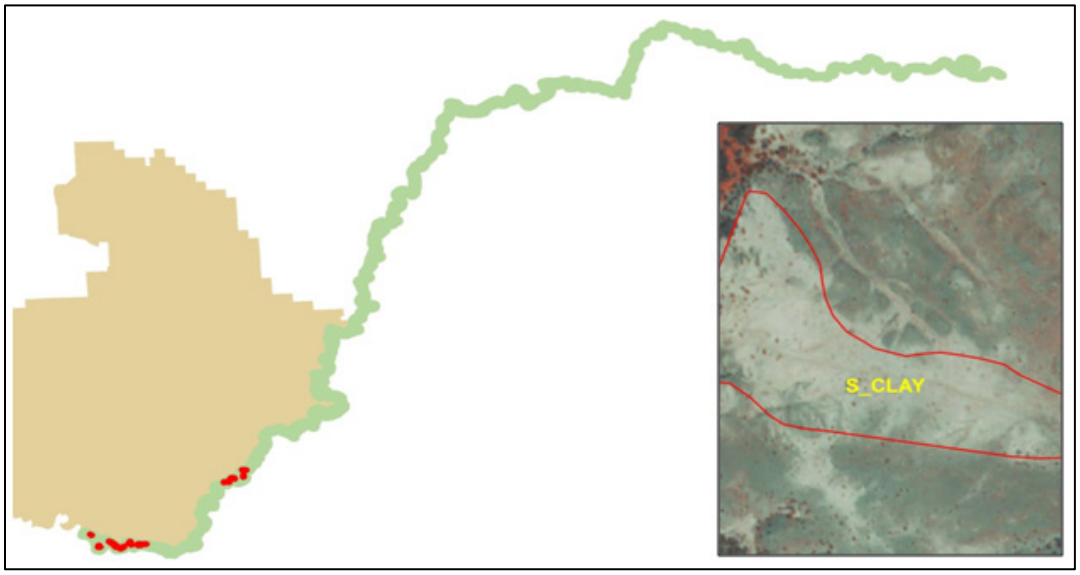
Physiognomy: S_CLAY polygons were mostly bare and devoid of vegetation. Some isolated patches of bunch grasses, low growing mesquite and creosotebush shrubs, and early successional weedy species were locally abundant. Gypseous flats supported some unique, but sparse evergreen short shrubs and perennial grasses.

Condition: Fair. The S_CLAY map unit was mostly devoid of vegetation and the nature of the substrate makes it unlikely that extensive vegetation will ever occur in these areas. S_CLAY should be monitored for the presence of weedy species that may invade from nearby vegetation communities.

CIR Signature: The S_CLAY unit appeared as large smooth white and gray flat areas. If present, shrubs occurred as red and brown dots and grasses appeared as orange and brown smudges.

Mapping Notes: The S_CLAY map unit was used to map all of the large flat areas that mostly lacked vegetation. Future mapping and ground-truthing efforts could help separate the gypseous from non-gypseous flat areas.

Photo Signature and Distribution



Example photo signature and distribution map for Alkaline Clay Flat Shrubland.

Map Code ***Calcareous Talus Mixed Shrubland***
S_CTAL

Common Species

- Thompson's yucca (*Yucca thompsoniana*)
- Green sotol (*Dasylirion leiophyllum*)
- Torrey's yucca (*Yucca torreyi*)
- Lechuguilla (*Agave lechuguilla*)
- Candelilla (*Euphorbia antisyphilitica*)
- Rough jointfir (*Ephedra aspera*)

rUSNVC Association
Agave lechuguilla - Euphorbia antisyphilitica - Ephedra aspera / Bouteloua ramosa Shrubland (NPSBIBE010) [Park Special] [Provisional]



Example photo of Calcareous Talus Mixed Shrubland.

Description
Frequency: S_CTAL polygons were common on limestone formations at mid to high elevations throughout RIGR on eroding mountain and hill slope formations.

Physiognomy: S_CTAL polygons contained sparse to moderate vegetation on cobbly, rocky, and talus substrates consisting of short to medium sized evergreen shrubs (mainly yuccas and cacti) with a scattered grass understory component.

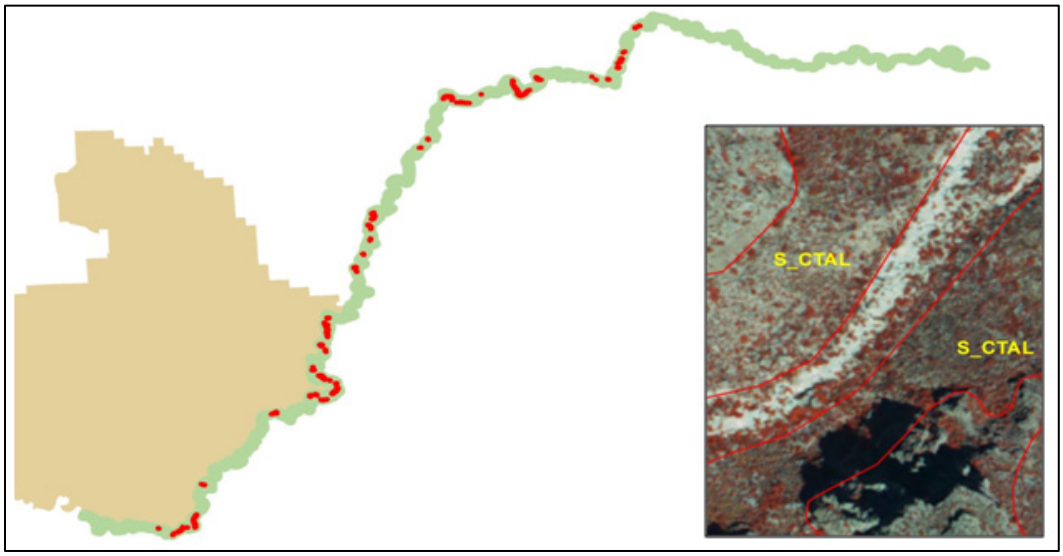
Condition: Good. The S_CTAL is a limestone talus, boulder, and scree formation that is widespread on steep slopes above the Rio Grande River at RIGR. Drought, climate change, and prolonged

freezing events may alter the composition of this type (especially the grasses and succulent components).

CIR Signature: Polygons of S_CTAL exhibited various colors and textures depending on the geologic parent material. Colors ranged from gray to tan and white. Textures were coarse for large cobbles and boulders and smooth for scree and talus. The vegetation appeared as small red spots and understory grasses were tan in color. Cool and mesic sites had denser vegetation.

Mapping Notes: The S_CTAL type was similar in species composition to the S_CDS and S_YUC map units and may represent a transitional area. S_CTAL was used to map large areas containing talus/scree material occurring directly below eroding limestone outcrops. The splitting of S_CTAL from S_CDS was done to help provide more information on the dynamic nature of the vegetation growing on limestone formations in RIGR.

Photo Signature and Distribution



Example photo signature and distribution map for Calcareous Talus Mixed Shrubland.

Map Code ***Guajillo - Blackbrush - Torrey Yucca Shrubland***
S_GBTY ***Senegalia berlandieri - Vachellia rigidula - Yucca torreyi* Shrubland**

Common Species

- Guajillo (*Senegalia berlandieri*)
- Blackbrush (*Vachellia rigidul*a)
- Torrey yucca (*Yucca torreyi*)
- Cenizo (*Leucophyllum frutescens*)
- Texas pricklypear (*Opuntia engelmannii*)
- Leatherstem (*Jatropha dioica*)
- Coyotillo (*Karwinskia humboldtiana*)

rUSNVC Association
Vachellia rigidula - Leucophyllum frutescens - Senegalia berlandieri Shrubland (CEGL007759)



Example photo of Guajillo - Blackbrush - Torrey Yucca Shrubland.

Description
Frequency: S_GBTY polygons were rare and may represent the western most extent of this type. At RIGR was S_GBTY polygons were only found in a few mesic drainages and on cool and moist slopes.

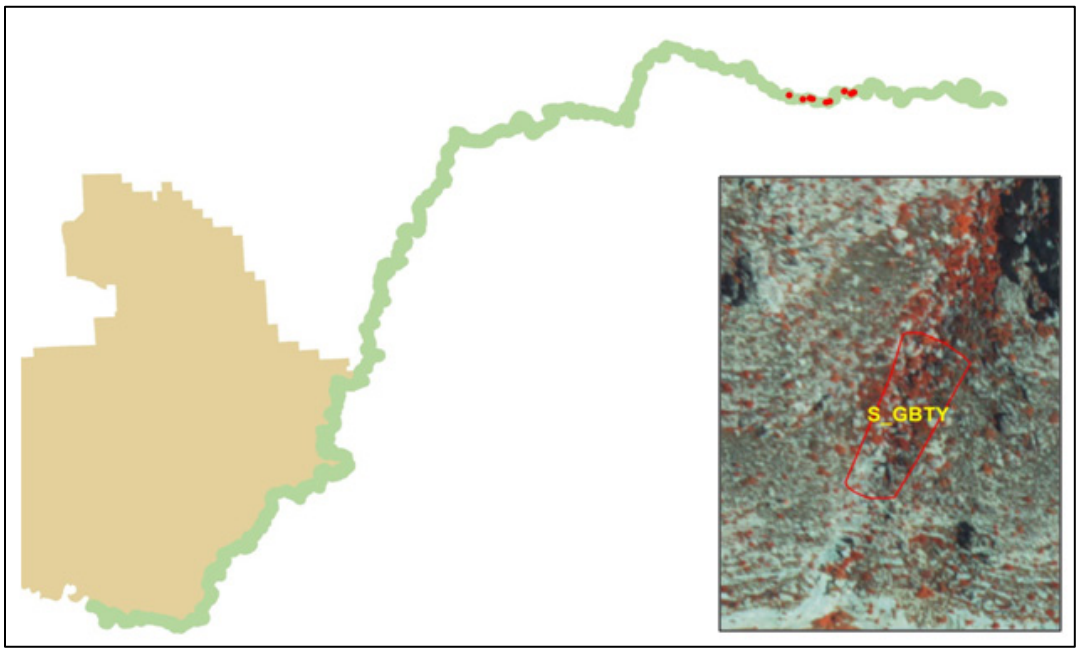
Physiognomy: S_GBTY sites were dominated by short to medium-sized evergreen and deciduous mixed shrubs with understories consisting of mainly grasses, forbs, and other minor short and dwarf-shrubs.

Condition: Good- Fair. Although widespread further to the east, the S_GBTY map class at RIGR was greatly restricted and may be more prone to disturbances from drought, fire, and grazing.

CIR Signature: Polygons of S_GBTY had a textured appearance consisting of brown and orange spots with some gray and white splotches in the canopy openings. Guajillo and blackbrush shrubs may be large and robust creating large orange and red circles.

Mapping Notes: The S_GBTY map unit was very similar in appearance to the S_BBWASH, S_PTWASH, and S_SSMS types at RIGR. More ground-truthing of the upland shrubland types, especially in the eastern half of RIGR may allow for further refinement and increased accuracy in the mapping of these similar plant communities.

Photo Signature and Distribution



Example photo signature and distribution map for Guajillo - Blackbrush - Torrey Yucca Shrubland.

Map Code ***Mesquite - Creosotebush Desert Scrub***
S_MEQ ***Prosopis glandulosa - Larrea tridentata* Desert Scrub**

Common Species

- Honey mesquite (*Prosopis glandulosa*)
- Creosotebush (*Larrea tridentata*)
- Mariola (*Parthenium incanum*)
- American tarwort (*Flourensia cernua*)
- Warty caltrop (*Kallstroemia parviflora*)
- Fourwing saltbush (*Atriplex canescens*)
- Sixweeks grama (*Bouteloua barbata*)
- Tanglehead (*Heteropogon contortus*)

rUSNVC Association

Prosopis glandulosa - Larrea tridentata - (*Flourensia cernua*, *Parthenium incanum*) Shrubland (NPSBIBE025) [Provisional]



Example photo of Mesquite - Creosotebush Desert Scrub.

Description

Frequency: S_MEQ polygons were common on dry upland flats and desert areas throughout the western overlap area of RIGR and BIBE. It was not found in the eastern portions of the study area.

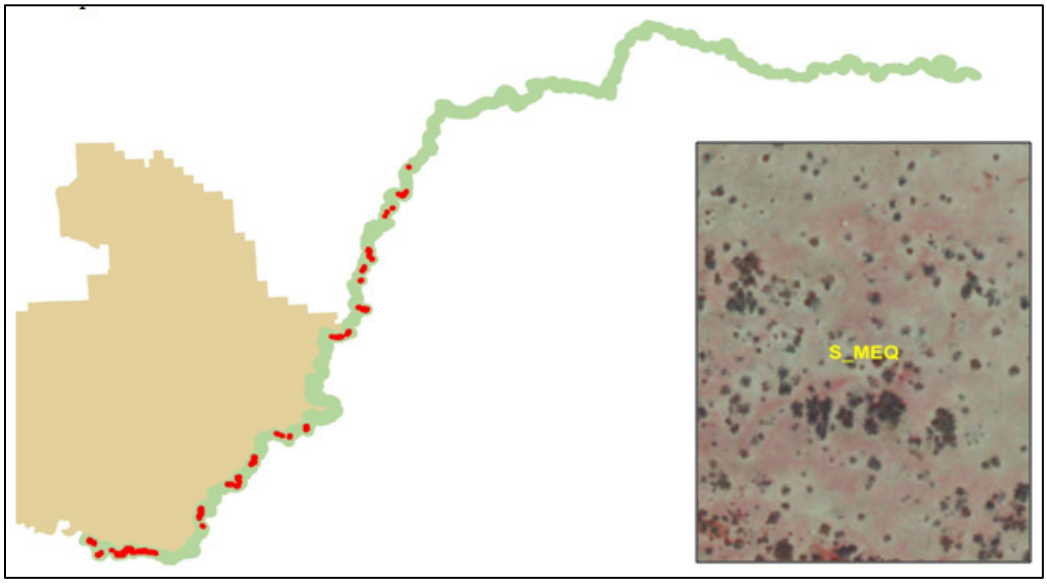
Physiognomy: S_MEQ sites were dominated by short to medium-sized evergreen shrubs with sparse understories consisting of sparse cacti, grasses, forbs, and other minor short shrubs.

Condition: Fair. S_MEQ polygons may indicate past disturbed areas. Some sites contained dead or dormant shrubs. Non-native species, fire, and animal/human pressure are potential threats.

CIR Signature: Polygons of S_MEQ consisted of large dark brown to black color splotches with grey and tan spots (dormant grasses and bare ground) in the canopy openings. Individual honey mesquite shrubs may be large and robust appearing as large circles on the imagery.

Mapping Notes: The S_MEQ map unit was created to address upland stands of honey mesquite as opposed to the more mesic and tall riparian stands (S_MRIP). Some confusion likely occurred between the two honey mesquite map units and more ground-truthing may allow for further refinement and increased accuracy. The S_MEQ map unit may have inclusions of S_CBO, S_CB, and H_GRS. The heavy presence of honey mesquite shrubs helped to define this map unit.

Photo Signature and Distribution



Example photo signature and distribution map for Mesquite - Creosotebush Desert Scrub.

Map Code ***Rio Grande Mesquite Riparian Bosque***
S_MRIP **Rio Grande *Prosopis glandulosa* Riparian Bosque**

Common Species

- Honey mesquite (*Prosopis glandulosa*)
- Creosotebush (*Larrea tridentata*)
- Huisache (Sweet acacia) (*Vachellia farnesiana*)
- Giant reed (*Arundo donax*)
- Fourwing saltbush (*Atriplex canescens*)
- Willows (*Salix* spp.)
- Common reed (*Phragmites australis*)
- Tamarisk (Salt cedar) (*Tamarix ramosissima*)

rUSNVC Association
Prosopis glandulosa Wet Scrub Association (CEGL004934)



Example photo of Rio Grande Mesquite Riparian Bosque.

Description
Frequency: Riparian stands of S_MRIP were common all along the Rio Grande River occurring as tall and solid stands of almost impenetrable thickets.

Physiognomy: S_MRIP polygons contained moderate to very dense stands of tall to medium sized evergreen shrubs/trees. Understories varied by location, with most having a few mixed shrubs and grasses or were completely sparse.

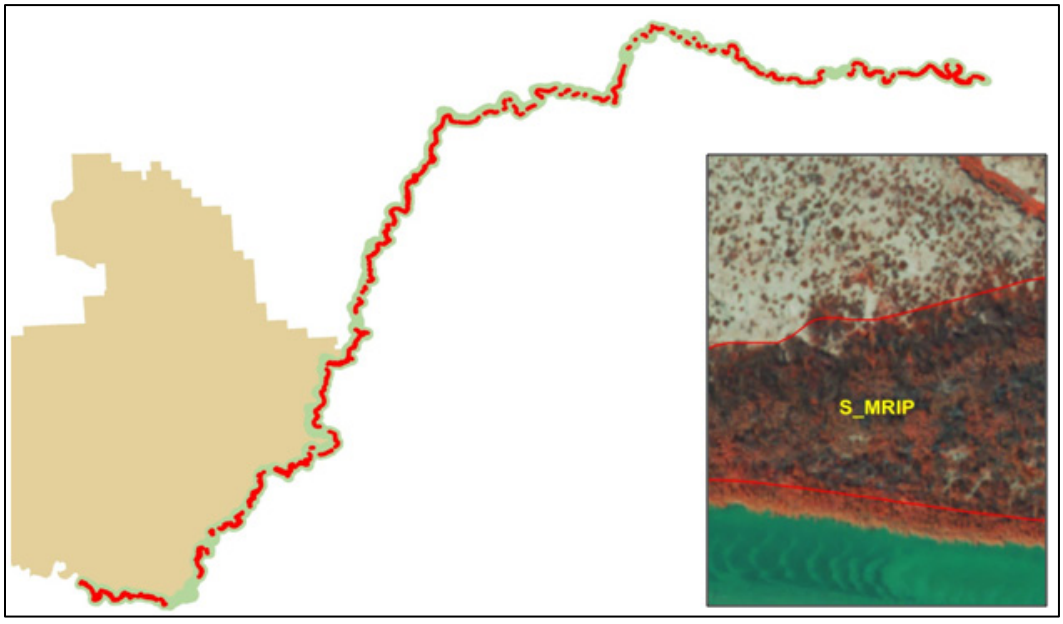
Condition: Good-Fair. Honey mesquite trees (shrubs) at RIGR were widespread. Fuel loading of dead woody material may present a fire hazard and most sites are prone to flooding. Non-native plant

invasion (e.g. giant cane and tamarisk) , extended flooding, drought, animal pressure, and human disturbance are potential threats to this type.

CIR Signature: On the imagery, canopies of S_MRIP had a very characteristic mix of light brown (living trees) and grey (dead or dying tree) colors. When present, the understory was often a mottled light gray/white color (bare ground) or a mix of light brown and red spots (other shrubs) and pink streaks (giant cane and Bermuda grass).

Mapping Notes: The S_MRIP map unit was created to address the unique Rio Grande Riparian Mesquite Bosque community. Shorter upland honey mesquite stands were mapped as the S_MEQ type. Although not widespread, some huisache and Mexican ash trees were likely included in this map unit as single trees or as small inclusions.

Photo Signature and Distribution



Example photo signature and distribution map for Rio Grande Mesquite Riparian Bosque.

Map Code ***Northeastern Chihuahuan Canyon Desert Scrub***
S_NECC

Common Species

- Candelilla (*Euphorbia antisyphilitica*)
- Lechuguilla (*Agave lechuguilla*)
- Texas false agave (*Hechtia texensis*)
- Blackbrush (*Vachellia rigidul*a)
- Mexican oregano (*Lippia graveolens*)
- Buffelgrass (*Pennisetum ciliare*)
- Texas barometer bush (*Leucophyllum frutescens*)
- Fragrant mimosa (*Mimosa borealis*)

rUSNVC Association

Euphorbia antisyphilitica - Agave lechuguilla - Hechtia texensis - Vachellia rigidula - Lippia graveolens Shrubland (NPSRIGR003) [Provisional]



Example photo of Northeastern Chihuahuan Canyon Desert Scrub.

Description

Frequency: The S_NECC map unit represented a common upland mixed shrub type found on limestone deposits in the central portions of RIGR.

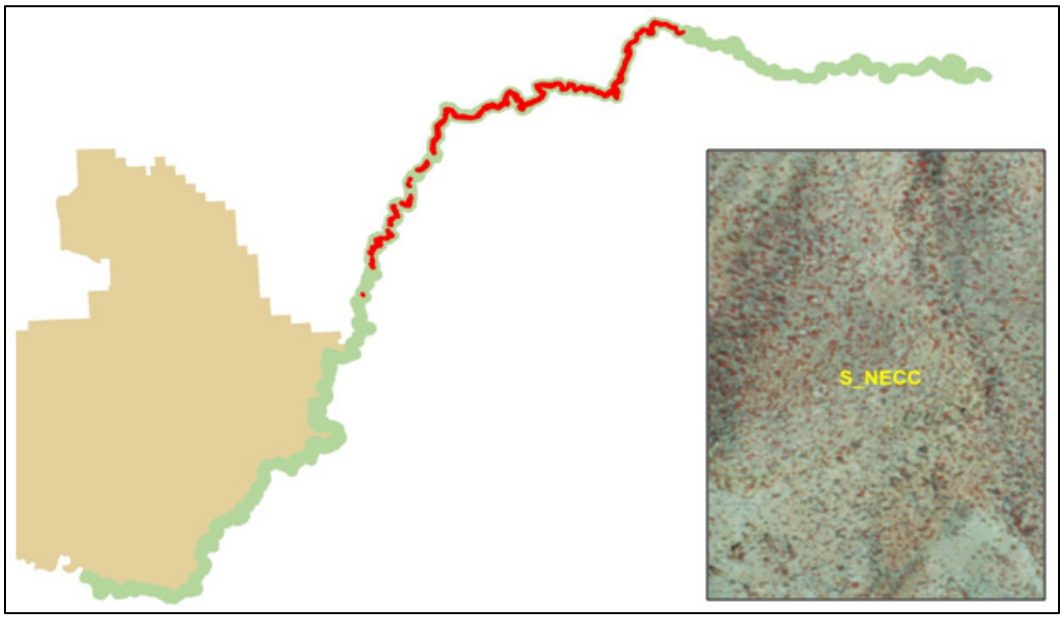
Physiognomy: S_NECC sites were dominated by short to medium-sized evergreen and deciduous mixed shrubs with understories consisting of grasses, forbs, and other minor short and dwarf-shrubs.

Condition: Good-Fair. Although widespread, disturbances such as prolonged draught, fire, and grazing are potential threats to this type. Most S_NECC sites contained high cover of buffelgrass in the understory.

CIR Signature: Polygons of S_NECC had a textured appearance consisting of brown and orange spots with a gray or white undertone of bare rock in the canopy openings.

Mapping Notes: The S_NECC map unit was very similar in appearance to the S_CDS, S_CTAL, and SP_LCAL types. The location of this type on uplands (away from the river) in the central portion of RIGR helped to define this map unit. More ground-truthing of the upland shrub types at RIGR may allow for further refinement and increased accuracy in the mapping.

Photo Signature and Distribution



Example photo signature and distribution map for Northeastern Chihuahuan Canyon Desert Scrub.

Map Code ***Texas Persimmon - Thornscrub Limestone Wash Shrubland***
S_PTWASH ***Diospyros texana* - Thornscrub Limestone Wash Shrubland**

Common Species

- Texas persimmon (*Diospyros texana*)
- Guajillo (*Senegalia berlandieri*)
- Honey mesquite (*Prosopis glandulosa*)
- Texas kidneywood (*Eysenhardtia texana*)
- Blackbrush (*Vachellia rigidula*)
- Roundflower catclaw (*Senegalia roemeriana*)
- Texas barometer bush (*Leucophyllum frutescens*)

rUSNVC Association
Diospyros texana - Senegalia berlandieri - Prosopis glandulosa - Eysenhardtia texana Shrubland NPSRIGR008 [Provisional]



Example photo of Texas Persimmon - Thornscrub Limestone Wash Shrubland.

Description
Frequency: Washes and drainages dominated by Texas persimmon and other tall shrubs and short trees were rare at RIGR and were only found in a few locations in the eastern half of the study area.

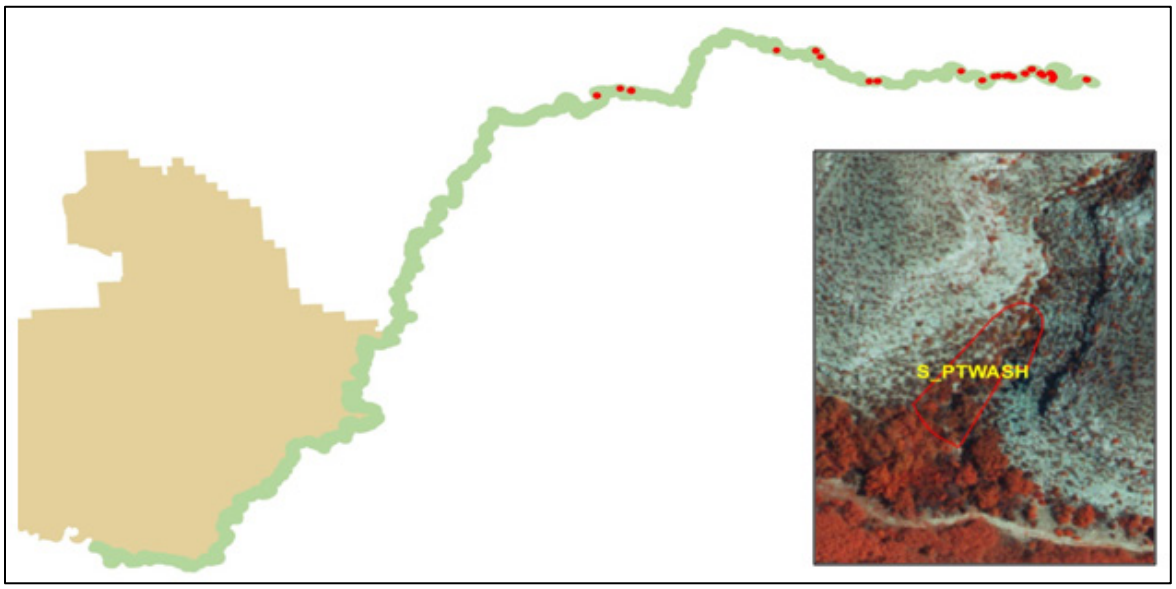
Physiognomy: S_PTWASH polygons contained moderate to dense stands of tall trees (5-15 meters) with a mix of thick deciduous and evergreen tall shrubs and shorter trees. Understory composition was diverse and varied with the presence of thick short shrubs, forbs, and grasses.

Condition: FAIR. Mixed shrub and tree washes were rare and likely represent a transition between the Tamaulipan vegetation found further east at Amistad National Recreation Area and the Chihuahuan desert species found at Big Bend National Park to the west. S_PTWASH stands were found in mesic areas that might be prone to wildlife and human pressure (shade, water, forage, etc.).

CIR Signature: On the imagery, canopies of S_PTWASH appeared as large, rounded dark tuffs with various colors ranging from red (Texas persimmon), to dark brown (mesquite), orange (willows), and red (various deciduous trees). Linear and bare drainage bottoms and sheer rock outcrops were usually present in and near this type.

Mapping Notes: S_PTWASH polygons were mapped primarily based on where it was known to occur. Other stands of this type may be present in similar drainages or mix with the similar S_BBWASH map class.

Photo Signature and Distribution



Example photo signature and distribution map for Texas Persimmon - Thornscrub Limestone Wash Shrubland.

Map Code ***Rio Grande Willow Riparian Bosque***
S_RWIL **Rio Grande *Salix* spp. Riparian Bosque**

Common Species

- Thurber's willow (*Salix thurberi*)
- Goodding willow (*Salix gooddingii*)
- Tamarisk (Salt cedar) (*Tamarix ramosissima*)
- Giant reed (*Arundo donax*)
- Bermuda grass (*Cynodon dactylon*)
- Common reed (*Phragmites australis*)
- Tree tobacco (*Nicotiana glauca*)

rUSNVC Association
Salix (*gooddingii, thurberi*) Rio Grande Shrubland (NPSBIBE019) [Provisional]



Example photo of Rio Grande Willow Riparian Bosque.

Description
Frequency: Willow shrublands were found scattered in the riparian corridor along the Rio Grande River at RIGR.

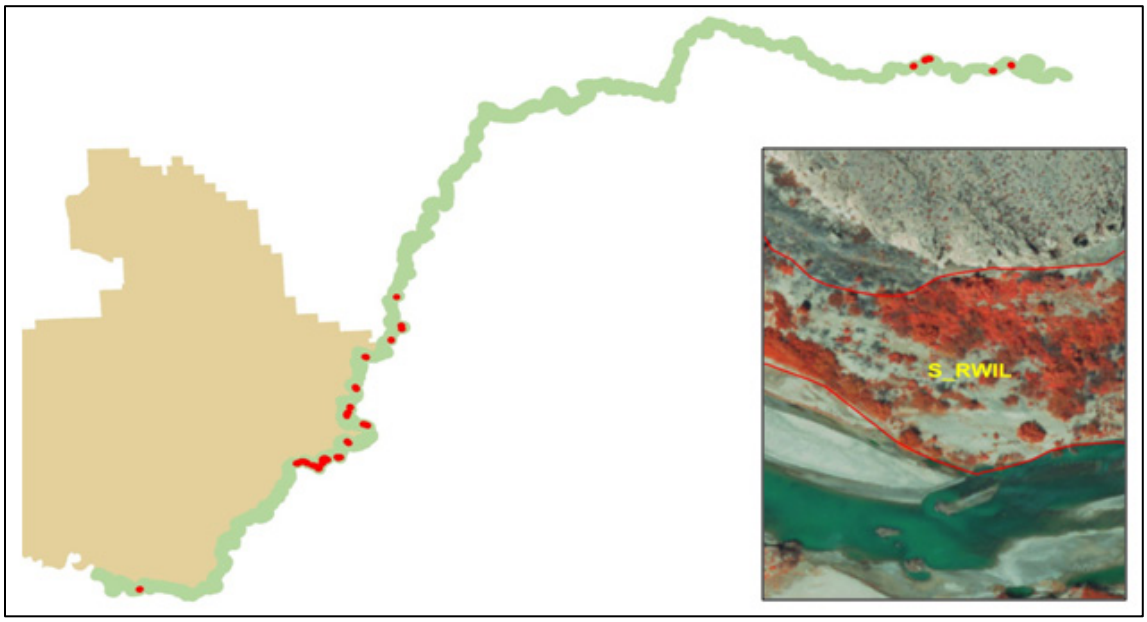
Physiognomy: S_RWIL polygons contained stands of deciduous shrubs and short trees of various sizes. The understory and sub-canopy layers, if present, had a mix of tall grasses, non-native species, and some weedy or early successional herbaceous vegetation.

Condition: Poor. Willow shrublands are an important riparian habitat and are potentially threatened by prolonged flooding and drought. Willow regeneration was observed in some areas. Pressure from non-native species, especially tamarisk and giant cane was documented in many of the stands that were sampled.

CIR Signature: On the imagery, canopies of S_RWIL had a feathery, pink and orange color. If present, giant cane understories were bright pink, tamarisk dark red, and mesquite trees were brown. Shrub polygons of S_RWIL were often located in new floodplains and older tree versions in higher, more established stream banks.

Mapping Notes: The S_RWIL map unit included stands with willow trees, saplings, and seedlings. Polygons often contained varying amounts of giant cane, mesquite, and tamarisk. The W_CWD map unit was used to map upland willow stands. Stands of tamarisk may have been confused with this map unit in some areas.

Photo Signature and Distribution

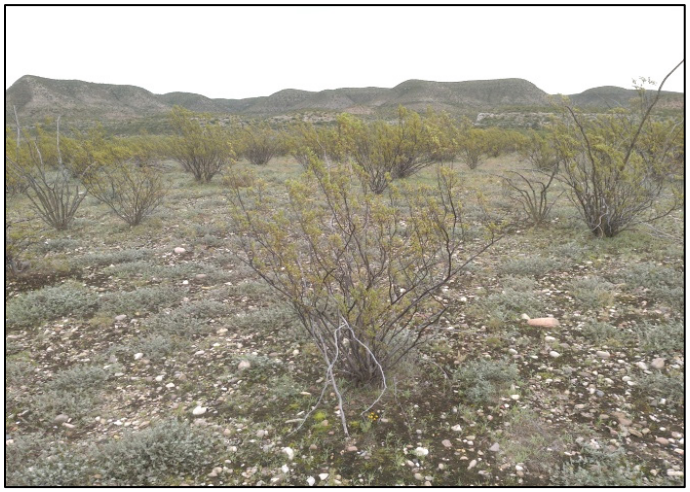


Example photo signature and distribution map for Rio Grande Willow Riparian Bosque.

Common Species

- Creosotebush (*Larrea tridentata*)
- Mexican oregano (*Lippia graveolens*)
- Texas barometer bush (*Leucophyllum frutescens*)
- Whitethorn acacia (*Vachellia constricta*)
- Woody crinklemat (*Tiquilia canescens*)
- Texas pricklypear (*Opuntia engelmannii*)

rUSNVC Association
Larrea tridentata / Grusonia schottii / Tiquilia canescens Shrubland (NPSRIGR004) [Provisional]



Example photo of Southern Stockton Plateau Creosotebush Desert Scrub.

Description
Frequency: The S_SSCB map unit was used to map creosotebush stands found in the far eastern section of RIGR. In these areas, the S_SSCB type was common on flat to moderately sloped uplands above the Rio Grande River and on cobbly soils.

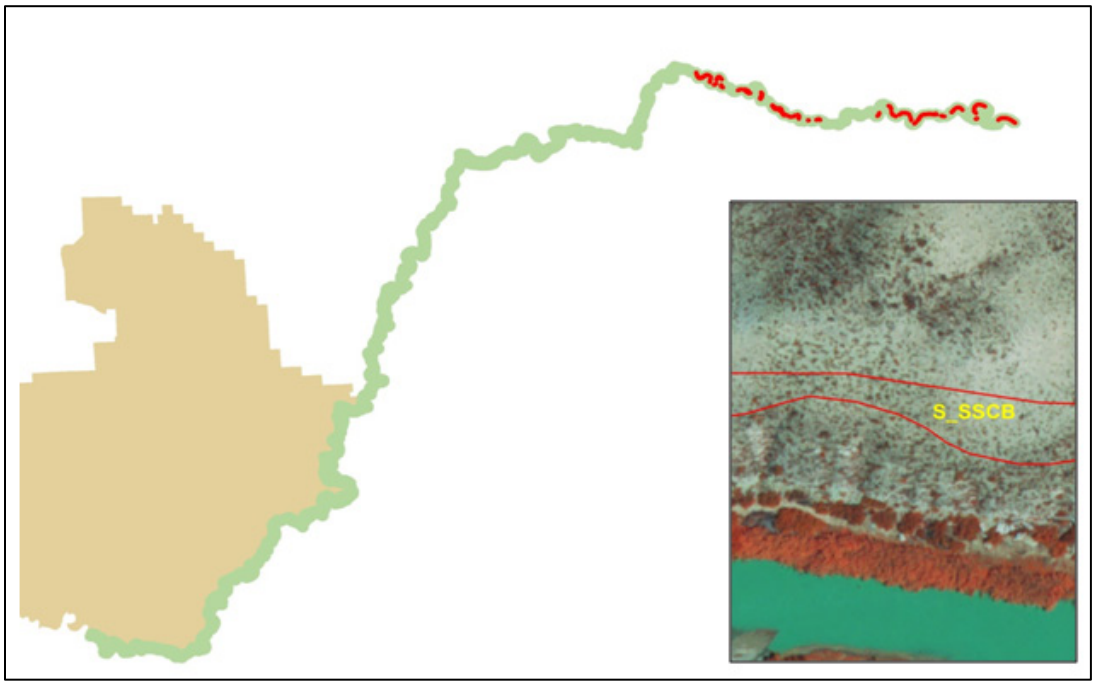
Physiognomy: S_SSCB sites were dominated by sparse short to medium-sized evergreen shrubs, mainly creosotebush, with understories consisting of grasses, forbs, and other minor short and dwarf-shrubs.

Condition: Fair. Although this type is likely widely distributed in the area, it was limited in abundance within RIGR, which may make it prone to drought, fire, and grazing. Some S_SSCB sites may represent former disturbed or grazed sites.

CIR Signature: S_SSCB polygons had a textured appearance consisting of brown and orange spots with a high amount of white (bare ground) showing through the canopy.

Mapping Notes: The S_SSCB map unit was very similar in appearance to the S_CB and S_CBO map units found in BIBE and further to the west. The S_SSMS map unit was used to map similar shrubland communities in the same vicinity that had more mixed shrubs and a lesser amount of creosotebush.

Photo Signature and Distribution



Example photo signature and distribution map for Southern Stockton Plateau Creosotebush Desert Scrub.

Map Code ***Southern Stockton Plateau Mixed Desert Scrub***
S_SSMS

Common Species

- Splitleaf brickellbush (*Brickellia laciniata*)
- Resinbush (*Viguiera stenoloba*)
- Creosotebush (*Larrea tridentata*)
- Chino grama (*Bouteloua ramosa*)
- Viscid acacia (*Vachellia vernicosa*)
- Ocotillo (*Fouquieria splendens*)
- Candelilla (*Euphorbia antisyphilitica*)

rUSNVC Association

Prosopis glandulosa - Viguiera stenoloba - Larrea tridentata - Leucophyllum frutescens / Bouteloua ramosa -Selaginella wrightii Shrubland NPSRIGR005 [Provisional]



Example photo of Southern Stockton Plateau Mixed Desert Scrub.

Description

Frequency: S_SSMS polygons were common in the intersection of the upper floodplains of the Rio Grande River and the drier mixed shrub uplands, all in the far eastern section of RIGR.

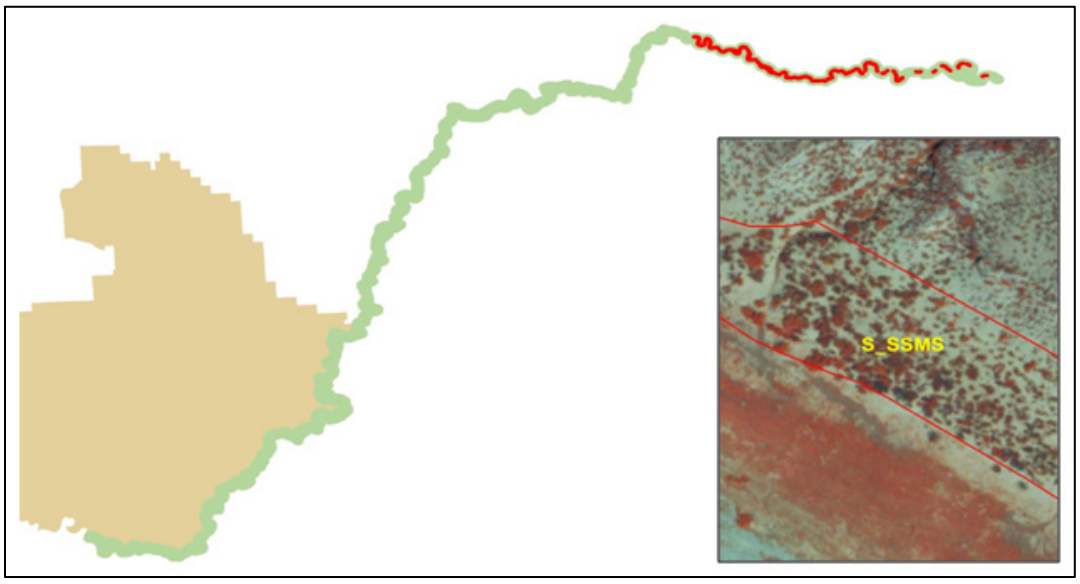
Physiognomy: S_SSMS sites were dominated by short to medium-sized evergreen and deciduous mixed shrubs with understories consisting of grasses, forbs, and other minor short and dwarf-shrubs.

Condition: Fair. Although this type is likely widely distributed in the area, it was limited in abundance within RIGR, which may make it prone to drought, fire, and grazing.

CIR Signature: Polygons of S_SSMS had a textured appearance consisting of brown and orange spots with some gray and white (bare ground) splotches in the canopy openings. Some of the shrubs may be large and robust creating large orange and brown circles.

Mapping Notes: The S_SSMS map unit was very similar in appearance to the S_MEQ map unit and had some species overlap with the S_SSCB type. The S_SSMS map unit may represent a transition type between the Tamaulipan vegetation found further east at Amistad National Recreation Area and the Chihuahuan desert species found at Big Bend National Park to the west.

Photo Signature and Distribution



Example photo signature and distribution map for Southern Stockton Plateau Mixed Desert Scrub.

Map Code ***Tamarisk - (Tree Tobacco) Riparian Shrubland***
S_TAM ***Tamarix* spp. - (Nicotiana glauca) Riparian Shrubland**

Common Species

- Tamarisk (Salt cedar) (*Tamarix ramosissima*)
- Athel tamarisk (*Tamarix aphylla*)
- Tree tobacco (*Nicotiana glauca*)
- Honey mesquite (*Prosopis glandulosa*)
- Willows (*Salix* spp.)
- Giant Cane (*Arundo donax*)
- Seepwillow (Mule-fat) (*Baccharis salicifolia*)

rUSNVC Association
Tamarix spp. Temporarily Flooded Semi-natural Shrubland (CEGL003114)



Example photo of Tamarisk - (Tree Tobacco) Riparian Shrubland.

Description
Frequency: Tamarisk (salt cedar) was a common species along the Rio Grande River in RIGR.

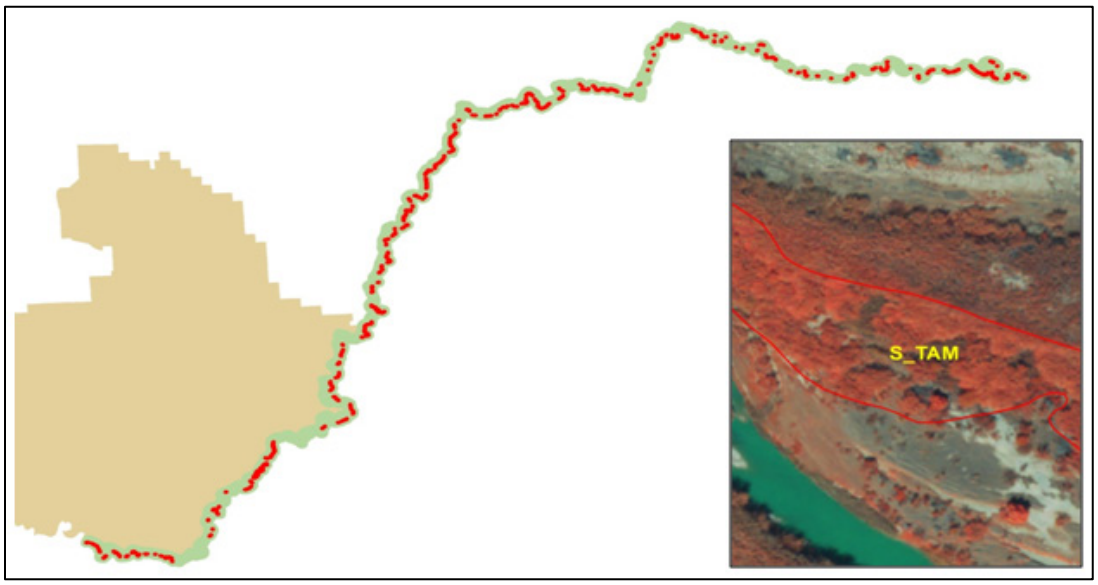
Physiognomy: S_TAM varied from thick, monotypic stands of evergreen tall shrub/short trees to sparse pockets of low growing seedlings. Barren understories were common in thick stands, whereas high levels of Bermuda grass, annual grasses, and weedy forbs were common when tamarisk was sparse.

Condition: Poor. S_TAM is a non-native species that can displace native shrubs and trees. Prolonged flooding may help to control or kill established tamarisk stands, but upstream locations may act as potential seed sources.

CIR Signature: On the imagery, S_TAM varied from solid, dark- red bands and clumps to open red splotches on grey and white backgrounds (bare soil/rock). Open and sparse polygons often had a red/pink/orange (Bermuda grass) undertone. Treatment areas had a dark gray color relating to the dead or burned tamarisk trees/shrubs.

Mapping Notes: The S_TAM map unit represented areas clearly dominated by tamarisk or where recently treated. Tamarisk may be more widespread at RIGR than indicated since it likely occurs at reduced levels in some of the H_RIO, SP_RIO, S_RWIL, and S_MRIP polygons. Due to similarities in density and height, S_TAM may have been confused with the H_CANE and S_RWIL types during the mapping. Low floodplain areas delineated as S_TAM are probably more dynamic and subject to rapid change.

Photo Signature and Distribution



Example photo signature and distribution map for Tamarisk - (Tree Tobacco) Riparian Shrubland.

Map Code ***Big Bend Lowlands Wash Channel Shrubland***
S_WASH

Common Species

- Desert willow (*Chilopsis linearis*)
- Singlewhorl burrobrush (*Hymenoclea monogyra*)
- Trans-Pecos poreleaf (*Porophyllum scoparium*)
- Seepwillow (Mule-fat) (*Baccharis salicifolia*)
- Roemer's catclaw (*Senegalia roemeriana*)
- Spiny hackberry (*Celtis ehrenbergiana*)
- Creosotebush (*Larrea tridentata*)
- Apache plume (*Fallugia paradoxa*)

rUSNVC Association

Hymenoclea monogyra - Chilopsis linearis - Porophyllum scoparium Shrubland (NPSBIBE014) [Provisional]



Example photo of Big Bend Lowlands Wash Channel Shrubland.

Signature Description

Frequency: Desert washes and drainages were very common throughout the western portions of RIGR.

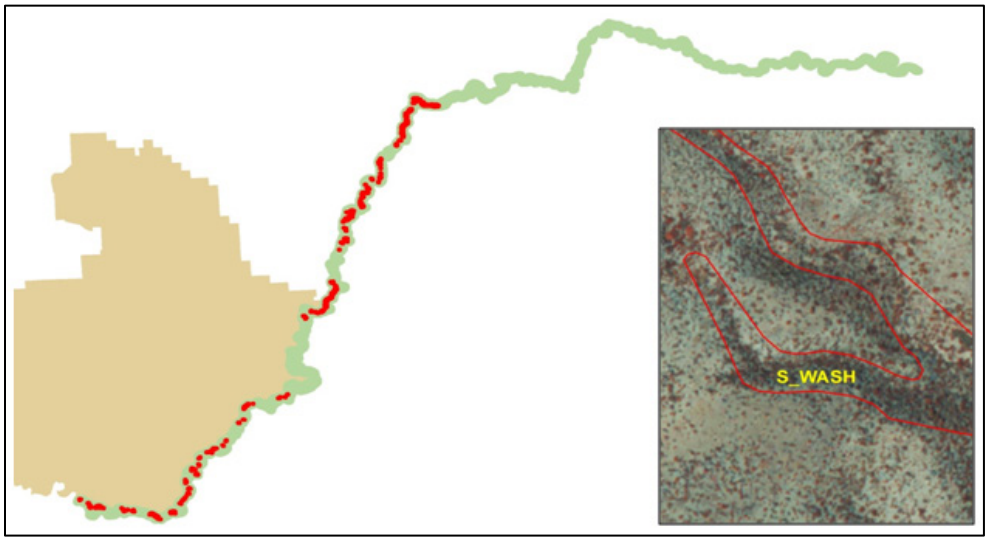
Physiognomy: Polygons of S_WASH were dominated by short to medium sized evergreen and some deciduous shrubs. The understory often contained low-growing evergreen shrubs, cacti, succulents, and sparse grasses.

Condition: Good. All desert washes are prone to flash flooding events. Overall, this type is potentially threatened by invasion from non-native grasses, localized erosion, and other disturbances.

CIR Signature: Polygons of S_WASH had a characteristic linear pattern with obvious thin drainage channels. Taller shrubs appeared as dark red and brown spots. Smaller dots represented understory species. Grasses, if present, were a smooth brown color.

Mapping Notes: The S_WASH map unit was used to map all of the very complex, low elevation desert washes and drainages common to both RIGR and BIBE. The importance of hydrology and drainage patterns influenced the mapping of this type down to about 2 -3 meters in width. Common desert species, especially creosotebush and mesquite, often occurred in the drainages and caused some confusion during the mapping of this type. The S_WASH map unit may overlap with the similar S_BBWASH, S_PTWASH, and SP_WASH map units at RIGR.

Photo Signature and Distribution



Example photo signature and distribution map for Big Bend Lowlands Wash Channel Shrubland.

Map Code ***Yucca - Sotol Calcareous Shrub Grassland***
S_YUC ***Yucca* spp. - *Dasylirion leiophyllum* Calcareous Shrub Grassland**

Common Species

- Eve's needle (giant dagger) *(Yucca faxoniana*)
- Thompson's yucca (*Yucca thompsoniana*)
- Green sotol (*Dasylirion leiophyllum*)
- Torrey's yucca (*Yucca torreyi*)
- Spiny greasebush (*Glossopetalon spinescens*)
- Gregg's catclaw (*Senegalia greggii*)
- Skeletonleaf goldeneye (*Viguiera stenoloba*)
- Sideoats grama (*Bouteloua curtipendula*)

rUSNVC Association

Yucca faxoniana - Yucca thompsoniana - Dasylirion leiophyllum - Nolina erumpens / Bouteloua curtipendula Shrub Grassland (NPSBIBE040) [Provisional]



Example photo of Yucca - Sotol Calcareous Shrub Grassland.

Description

Frequency: Polygons of S_YUC were rare at RIGR occurring only on the highest elevation limestone formations.

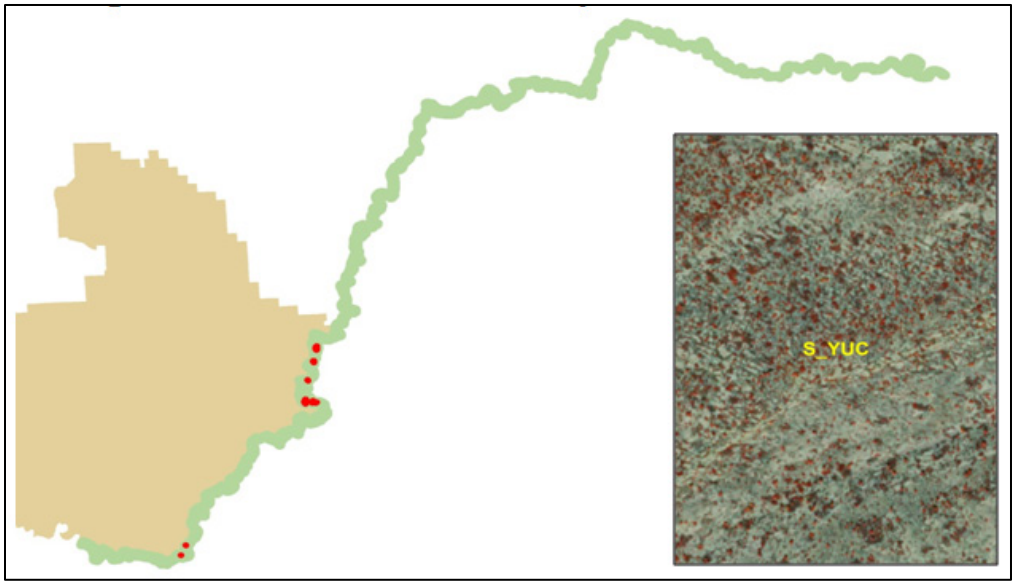
Physiognomy: The S_YUC map unit contained a characteristic mix of evergreen shrub, cacti, and succulents with a moderate to thick understory of grasses and herbaceous vegetation.

Condition: Fair. Areas with S_YUC are likely influenced by the water retained from surrounding rock formations and may represent a transition from desert scrub to chaparral. Prolonged drought and cold weather may affect this type and cause the yuccas, grasses, and succulents to decline.

CIR Signature: On the imagery, the S_YUC had a typical white, gray, and blue background color. Taller yucca shrubs were dark red and were larger than the small brown and red dots associated with the understory shrub species. Grasses and herbaceous vegetation (if present) were brown in color.

Mapping Notes: The S_YUC map unit contains similar vegetation found in the S_CDS, and S_CTAL map units. All of the S_YUC at RIGR occurred in the RIGR and BIBE overlap zone.

Photo Signature and Distribution



Example photo signature and distribution map for Yucca - Sotol Calcareous Shrub Grassland.

Map Code ***Yucca Calcareous Wash Channel Shrubland***
S_YWASH ***Yucca* spp. Calcareous Wash Channel Shrubland**

Common Species

- Soaptree yucca (*Yucca elata*)
- Eve's needle (giant dagger) (*Yucca faxoniana*)
- Thompson's yucca (*Yucca thompsoniana*)
- Green sotol (*Dasylirion leiophyllum*)
- Torrey's yucca (*Yucca torreyi*)

rUSNVC Association
Yucca faxoniana - Yucca thompsoniana - Dasylirion leiophyllum - Nolina erumpens / Bouteloua curtipendula Shrub Grassland (NPSBIBE040- Park Special) [Provisional]



Example photo of Yucca Calcareous Wash Channel Shrubland.

Description
Frequency: Yucca drainages were rare at RIGR occurring only within highest elevation limestone formations.

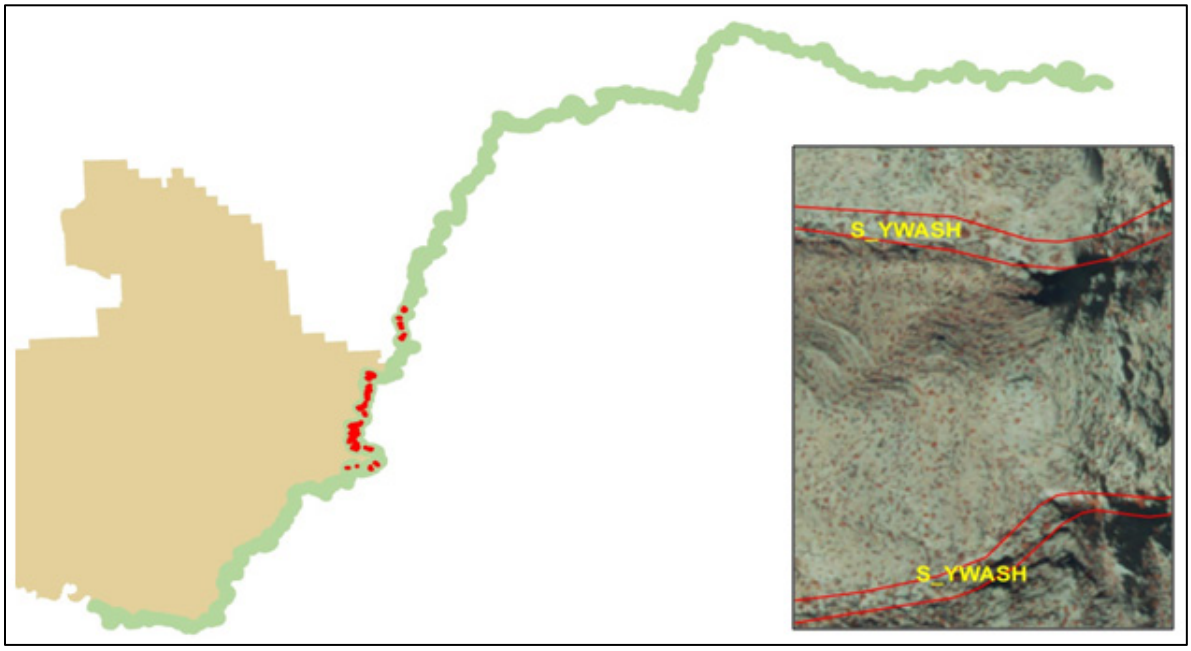
Physiognomy: The S_YWASH map unit contained a characteristic mix of evergreen shrub, cacti, and succulents with a sparse understory of grasses and herbaceous vegetation found growing in and around desert washes.

Condition: Fair. Areas with S_YWASH are likely influenced by periodic flooding and relatively mesic conditions. Prolonged drought and cold weather may affect this type and cause the yuccas, grasses, and succulents to decline.

CIR Signature: On the imagery, the S_YWASH had a linear wash pattern with bare white and gray drainage channels. Taller yucca shrubs were dark red and were larger than the small brown and red dots associated with the understory shrub species. Grasses and herbaceous vegetation (if present) were brown in color.

Mapping Notes: The S_YWASH was similar in species composition to the S_YUC map unit. The splitting of S_YWASH from S_YUC was done to help provide more information on the vegetation growing on limestone formations in RIGR. Some similarity may exist between this type and the other wash map units.

Photo Signature and Distribution



Example photo signature and distribution map for Yucca Calcareous Wash Channel Shrubland.

Herbaceous Vegetation

Map Code ***Alkali Sacaton Riparian Grassland***
H_ASAC ***Sporobolus airoides*** **Riparian Grassland**

Common Species

- Alkali sacaton (*Sporobolus airoides*)
- Fourwing saltbush (*Atriplex canescens*)
- Desert seepweed (*Suaeda suffrutescens*)
- Lotebush (*Ziziphus obtusifolia*)
- Tree tobacco (*Nicotiana glauca*)

rUSNVC Association
Atriplex canescens - Suaeda suffrutescens / Sporobolus airoides Shrub Herbaceous Vegetation (NPSBIBE026) [Provisional]



Example photo of Alkali Sacaton Riparian Grassland.

Description
Frequency: Only a few polygons of H_ASAC occurred in the overlap zone with RIGR and BIBE. These were found in the Rio Grande Village area. The presence of this type may be related to past disturbance events.

Physiognomy: H_ASAC polygons contained high cover of perennial grasses with some minor non-native shrub, native shrub, forb and other grass components. Most areas with this type were mesic.

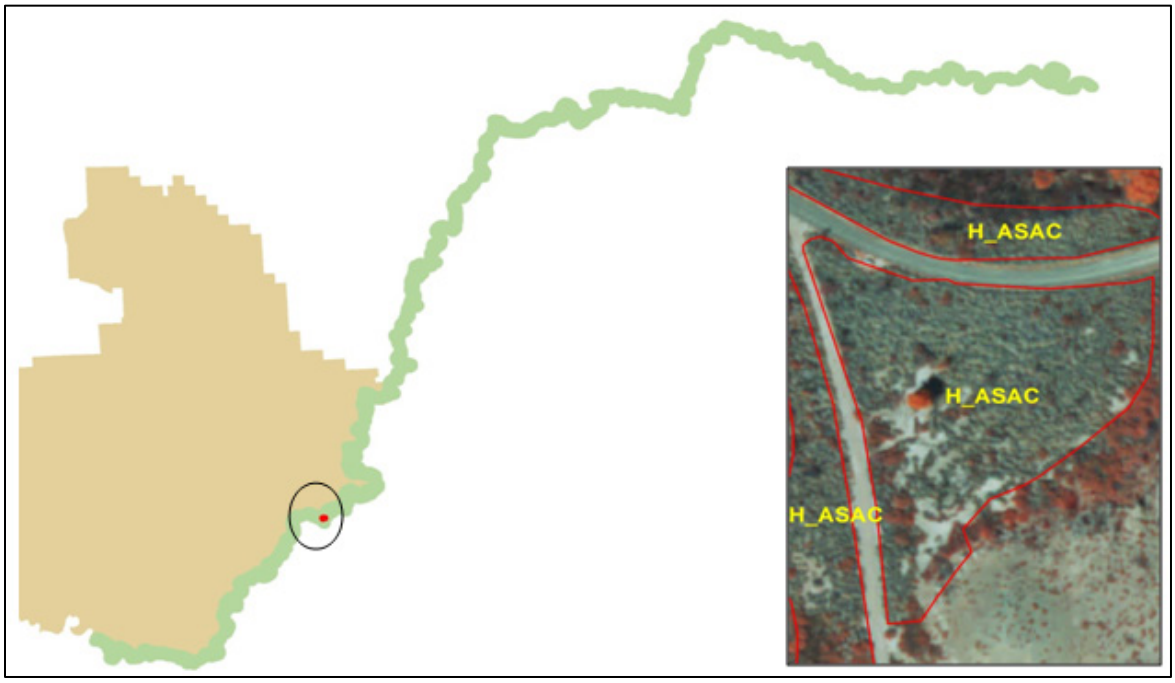
Condition: Poor. This map unit is restricted to few locations and may occur only after past disturbance events. Invasion and overgrowth from shrubs and trees may occur.

CIR Signature: On the imagery, the H_ASAC map unit had a characteristic coarse gray signature with white areas representing bare soil. The gray color is likely from the grass being dormant, when

actively growing it would likely exhibit a pink or orange color. Red and brown spots indicate shrubs and short trees.

Mapping Notes: This map unit was primarily used to map alkali sacaton in areas where it was known to occur and that were large enough to map. Further ground-truthing, would help refine and improve the distribution of this mapping unit.

Photo Signature and Distribution



Example photo signature and distribution map for Alkali Sacaton Riparian Grassland.

Map Code ***Bermuda Grass Herbaceous Vegetation***
H_BERM ***Cynodon dactylon* Herbaceous Vegetation**

Common Species

- Bermuda grass (*Cynodon dactylon*)
- Tamarisk (Salt cedar) (*Tamarix ramosissima*)
- Tanglehead (*Heteropogon contortus*)
- Creosotebush (*Larrea tridentata*)
- Honey mesquite (*Prosopis glandulosa*)
- Johnson grass (*Sorghum halepense*)
- Buffelgrass (*Pennisetum ciliare*)

rUSNVC Association
Cynodon dactylon Arid Southwest Herbaceous Vegetation (NPSBIGE017) [Provisional]



Example photo of Bermuda Grass Herbaceous Vegetation.

Description
Frequency: Bermuda grass was found all along the Rio Grande River corridor where it occurred on new floodplains, in the understories of older shoreline shrublands, and recently flooded or inundated areas. Bermuda grass was also found in the campgrounds and facilities where it was maintained as lawns.

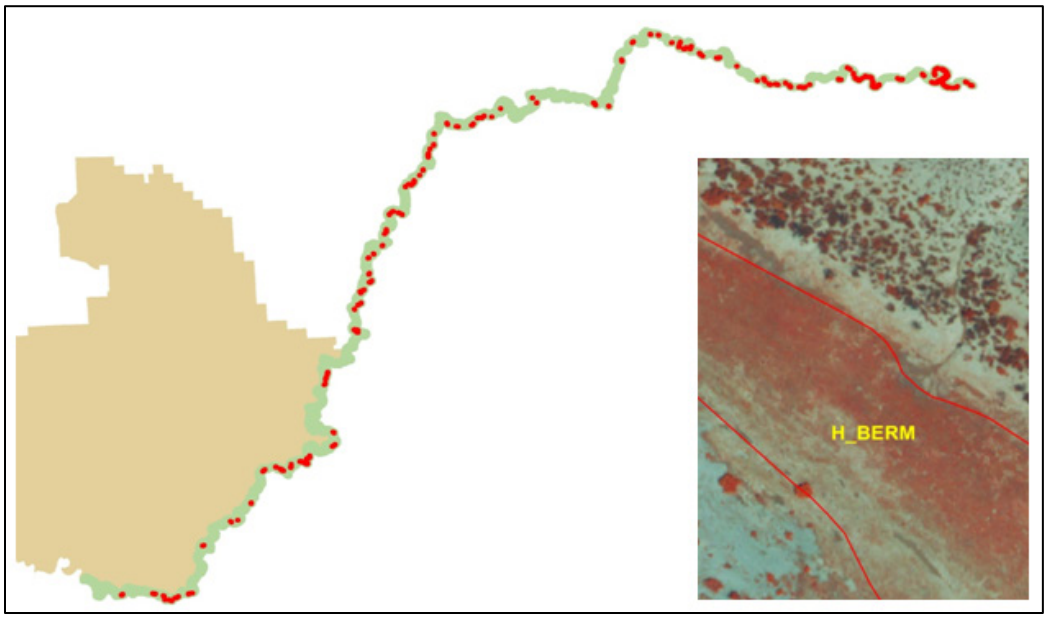
Physiognomy: H_BERM polygons contain high cover of perennial grasses with some weedy forbs and short early successional shrubs and trees.

Condition: Poor. H_BERM is an early successional type and its presence likely points to areas that were recently flooded or disturbed. Bermuda grasslands may be vectors for other invasive species like giant cane and tamarisk.

CIR Signature: On the imagery, the H_BERM map unit had a characteristic smooth, bright pink and red color. Brown and gray streaks likely indicate dead or dormant stands. Pink and red spots were small shrubs, tree/shrub seedlings, and/or weedy forbs.

Mapping Notes: The H_BERM type will likely change in cover and abundance with seasonal flooding . Sites may also become overgrown with shrubs and trees when dry for extended periods. Areas maintained as lawns were also mapped using this type.

Photo Signature and Distribution



Example photo signature and distribution map for Bermuda Grass Herbaceous Vegetation.

Map Code ***Giant Cane Riverbank Herbaceous Vegetation***
H_CANE ***Arundo donax* Riverbank Herbaceous Vegetation**

Common Species

- Giant cane (*Arundo donax*)
- Bermuda grass (*Cynodon dactylon*)
- Tree tobacco (*Nicotiana glauca*)
- Mealy goosefoot (*Chenopodium incanum*)
- Tamarisk (Salt cedar) (*Tamarix ramosissima*)

rUSNVC Association
Arundo donax Riverbank Herbaceous Vegetation (CEGL004101)



Example photo of Giant Cane Riverbank Herbaceous Vegetation.

Description
Frequency: Tall, thick stands of giant cane were common along the Rio Grande River at RIGR.

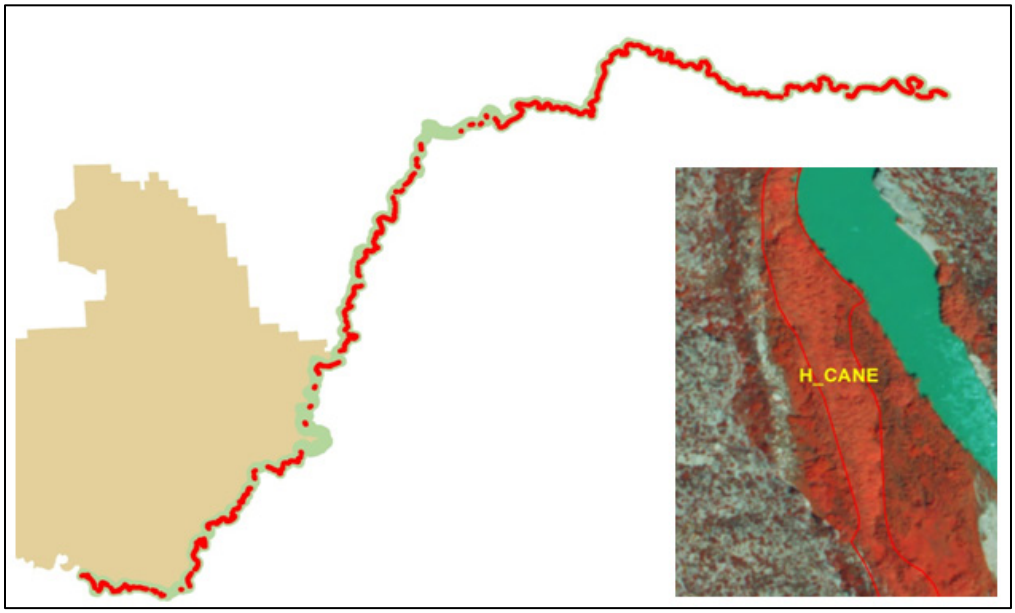
Physiognomy: Polygons of H_CANE contained linear bands and thick clumps of tall (> 1 meter), perennial grasses. Other associated species were mostly absent due the density of the giant cane stands.

Condition: Poor. Giant cane is considered an invasive species that invades riparian corridors and floodplains. The thick and tall growth of this type displaces native species and prevents them from re-establishing. Monitoring and suppression of this type through fire and removal may be needed.

CIR Signature: On the imagery, the H_CANE type exhibited a very bright pink color that was taller than the other herbaceous riparian types but shorter than the nearby willow and tamarisk woodlands. Polygons of this type were often bunched or linear in shape and were next to open water. Treatment areas had a dark gray color relating to the dead or burned giant cane grasses.

Mapping Notes: Mixing of the giant cane with tamarisk and willow trees presented some confusion during the mapping and more ground-truthing may help to improve the accuracy of this type.

Photo Signature and Distribution



Example photo signature and distribution map for Giant Cane Riverbank Herbaceous Vegetation.

Map Code ***Johnson Grass - Russian Thistle Desert Grassland***
H_GRS ***Sorghum halepense - Salsola tragus* Desert Grassland**

Common Species

- Johnson grass (*Sorghum halepense*)
- Tobosa grass (*Pleuraphis mutica*)
- Russian thistle (*Salsola tragus*)
- Honey mesquite (*Prosopis glandulosa*)
- Creosotebush (*Larrea tridentata*)
- Whitebrush (*Aloysia gratissima*)
- Berlandier's wolfberry (*Lycium berlandieri*)
- Silverleaf nightshade (*Solanum elaeagnifolium*)

rUSNVC Association
Sorghum halepense Chihuahuan Desert Herbaceous Vegetation (NPSRIGR018) [Provisional]



Example photo of Johnson Grass - Russian Thistle Desert Grassland.

Description
Frequency: Johnson grass was a common grass species in BIBE but was only found in a few locations at RIGR, all within the overlap zone of the two parks.

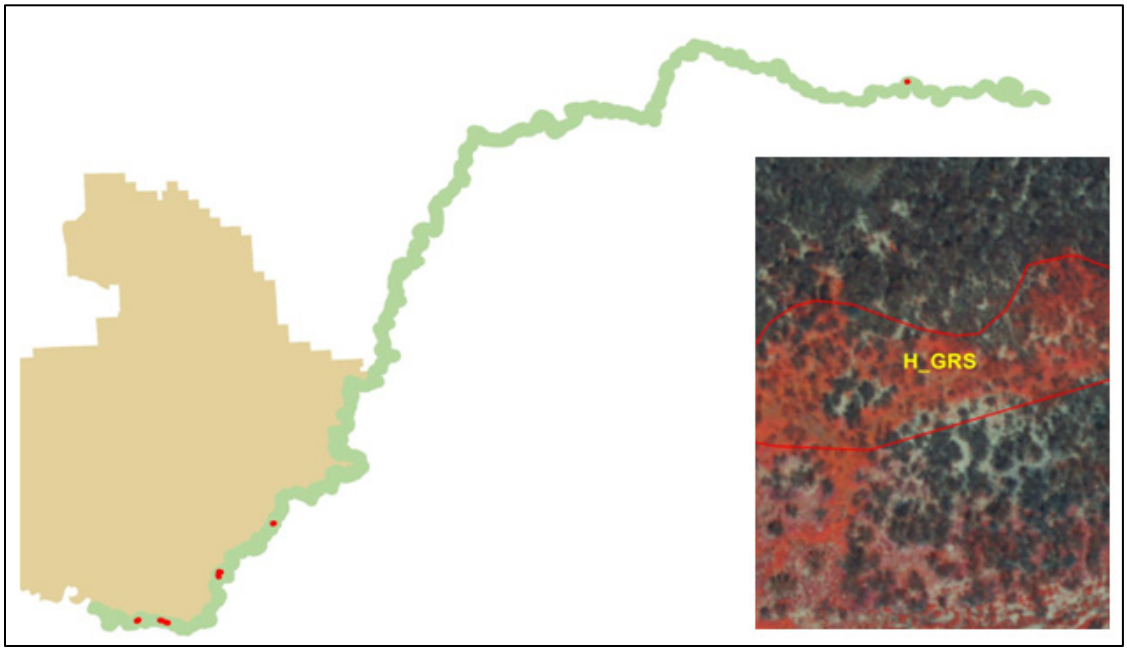
Physiognomy: H_GRS polygons contain mainly perennial non-native grasses with some minor native shrubs.

Condition: Poor. This map unit is an early successional type found on disturbed sites. Johnson grass may invade other native types.

CIR Signature: On the imagery, the H_GRS map unit had a characteristic mottled appearance and was often red or pink (healthy) in color or gray and dark (dead grass). Pockets of Johnson grass often contained small shrubs that appeared as brown or red dots. Usually this type occurred in more mesic depressions and drainages.

Mapping Notes: This map unit was primarily used to map disturbed sites in RIGR found within the S_MRIP and S_TAM map unit. Tobosa grass and buffelgrass may mix with this type. Further ground-truthing, especially in disturbed areas would help refine and improve the accuracy of the H_GRS map unit.

Photo Signature and Distribution



Example photo signature and distribution map for Johnson Grass - Russian Thistle Desert Grassland.

Map Code ***Common Reed Riparian Herbaceous Vegetation***
H_REED ***Phragmites australis* Riparian Herbaceous Vegetation**

Common Species

- Common reed (*Phragmites australis*)
- Giant cane (*Arundo donax*)
- Bermuda grass (*Cynodon dactylon*)
- Tamarisk (Salt cedar) (*Tamarix ramosissima*)
- Seepwillow (Mule-fat) (*Baccharis salicifolia*)
- Rough cocklebur (*Xanthium strumarium*)

rUSNVC Association
Phragmites australis Chihuahuan Desert Riparian Herbaceous Vegetation (NPSBIBE023) [Provisional]



Example photo of Common Reed Riparian Herbaceous Vegetation.

Description
Frequency: Common reed sites were only found along the Rio Grande River at RIGR.

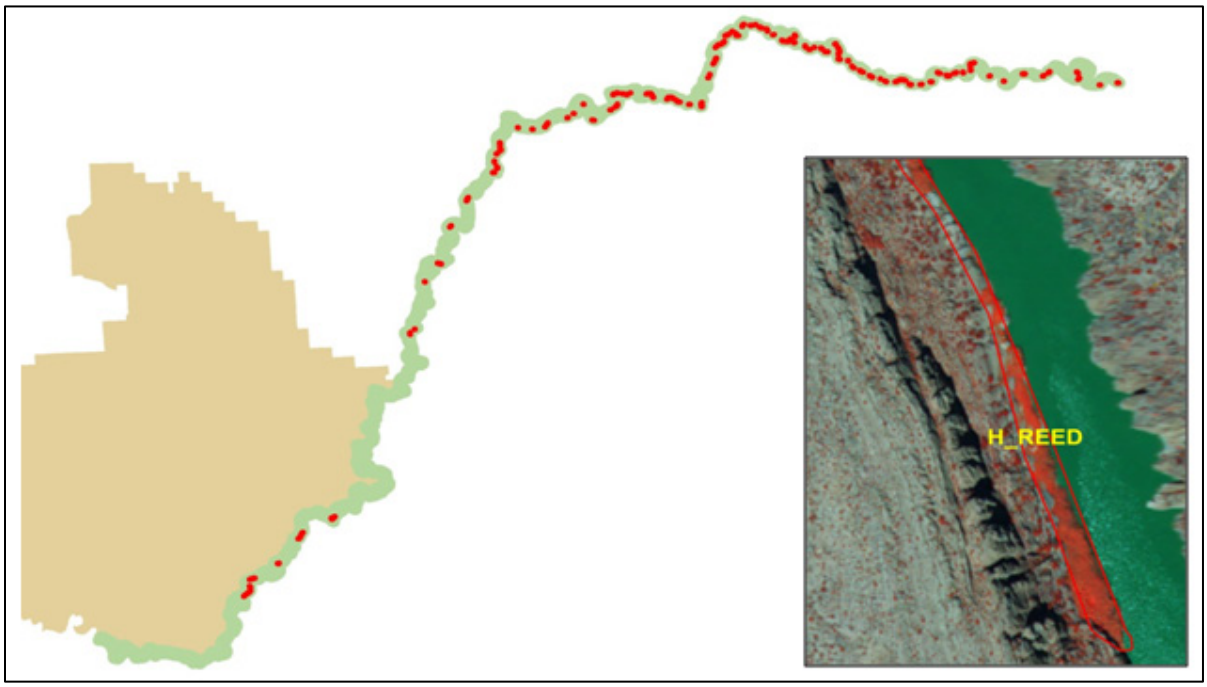
Physiognomy: This type includes mostly perennial herbaceous vegetation consisting of various riparian grasses, sedges and other herbaceous species.

Condition: Good - Fair. Localized patches are likely prone to flooding and low water levels. Non-native species such as tamarisk and giant cane may invade these areas.

CIR Signature: Polygons of H_REED appeared as linear bands and clumps of low-growing orange and red colored grasses. Open water and rocks were usually present.

Mapping Notes: The H_REED map unit was used to map riparian areas dominated by common reed. Nearby species such as giant cane, tamarisk, and willows were sometimes present. Polygons of H_CANE, H_RIO, and S_TAM map units likely contain some common reed but at lower levels of abundance.

Photo Signature and Distribution



Example photo signature and distribution map for Common Reed Riparian Herbaceous Vegetation.

Map Code ***Rio Grande Alluvial Herbaceous Vegetation***
H_RIO

Common Species

- Seepwillow (Mule-fat) (*Baccharis salicifolia*)
- Pretty sneezeweed (*Helenium elegans*)
- Salt heliotrope (*Heliotropium curassavicum*)
- Curly dock (*Rumex crispus*)
- Giant cane (*Arundo donax*)
- Bermuda grass (*Cynodon dactylon*)
- Russian thistle (*Salsola tragus*)
- Tamarisk (Salt cedar) (*Tamarix ramosissima*)

rUSNVC Associations
Baccharis salicifolia / (*Phragmites australis*) Chihuahuan Riparian (NPSRIGR047) [Provisional]
Schoenoplectus pungens Herbaceous Vegetation (CEGL001587)



Example photo of Rio Grande Alluvial Herbaceous Vegetation.

Description
Frequency: Polygons of H_RIO were restricted to the active Rio Grande River channel, floodplain, and portions of the larger tributaries that flow into it.

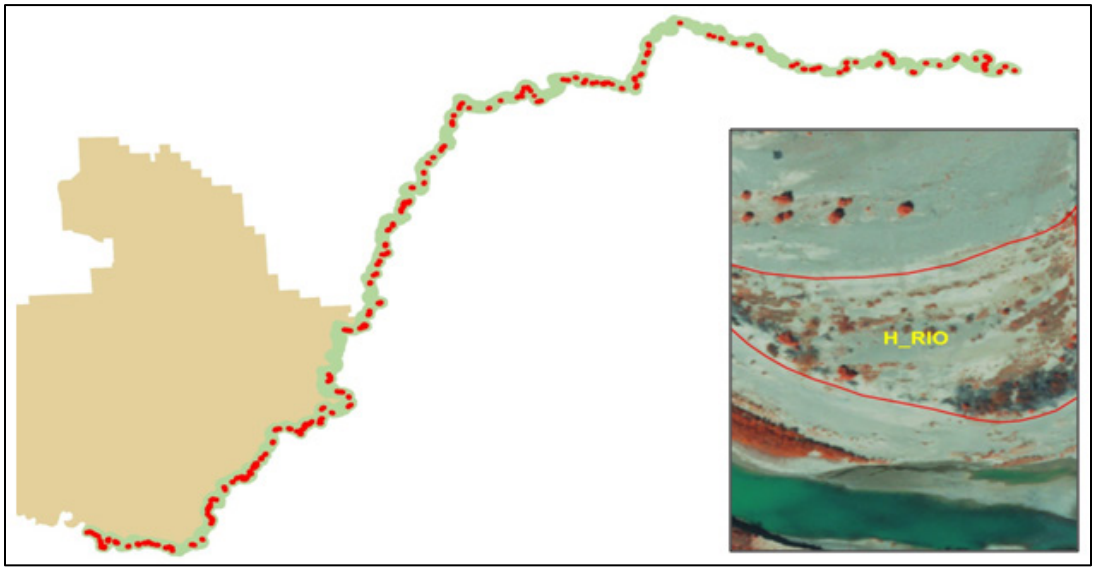
Physiognomy: The H_RIO type contained sparse to moderate amounts of mixed annual grasses, forbs, and early successional weedy shrubs.

Condition: Poor. H_RIO is an early successional type found on disturbed, previously inundated shorelines, drainages, and floodplains. The presence of this type likely indicates recent flooding, inundation, and disturbance.

CIR Signature: On the imagery, the H_RIO map unit had a strong soil and rock reflectance (usually white or gray) with associated red, pink, and orange patches indicating short and actively growing vegetation.

Mapping Notes: H_RIO polygons are dynamic and may be wiped out with flooding and reappear in different locations (especially on SP_RIO sites). With less flooding these sites may evolve into other more established riparian shrubland and woodland types. The SP_RIO type was used to map similar areas that contained little herbaceous or shrub cover.

Photo Signature and Distribution



Example photo signature and distribution map for Rio Grande Alluvial Herbaceous Vegetation.

Map Code ***Upland Ruderal Herbaceous Vegetation***
H_UPG

Common Species

- Russian thistle (*Salsola tragus*)
- Buffelgrass (*Pennisetum ciliare*)
- Tanglehead (*Heteropogon contortus*)
- Canadian horseweed (*Conyza canadensis*)

rUSNVC Association
(*Heteropogon contortus, Pennisetum ciliare, Eragrostis lehmanniana*) - Mixed Forbs Chihuahuan Ruderal Herbaceous Vegetation (NPSBIBE046) [Provisional]



Example photo of Upland Ruderal Herbaceous Vegetation.

Description
Frequency: Upland ruderal mixed grasslands were only found in one location at RIGR on a recently disturbed site possibly related to a watering dugout or catchment. Other locations containing mixed planted grasses, exotic grasses, and weedy forbs likely exist but were too small to map or were a minor component of other map units.

Physiognomy: Polygons of this type contained perennial grasses and forbs.

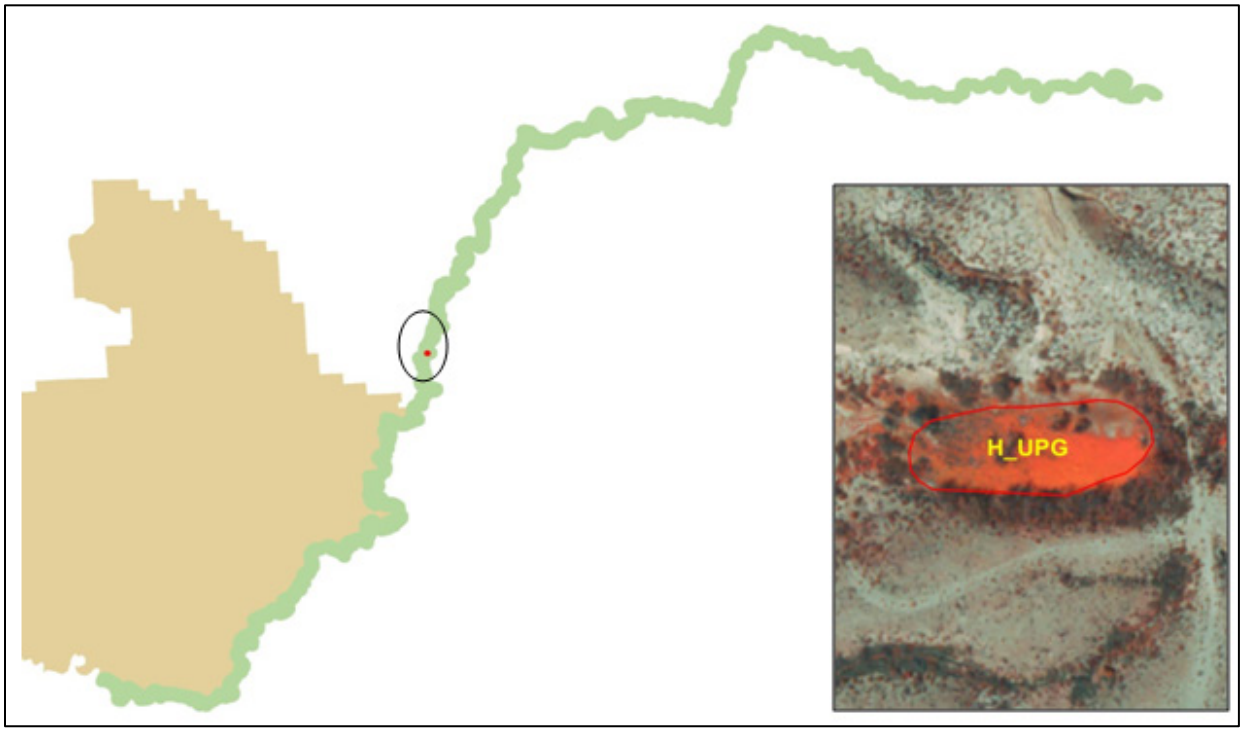
Condition: Poor. H_UPG represents mostly weedy herbaceous sites and other disturbed areas. Left alone or restored these areas may revert back to more natural types like S_CBO or S_MEQ.

CIR Signature: On the imagery, polygons of H_UPG exhibited a bright orange color representing actively growing vegetation.

Mapping Notes: The H_UPG map class was used to map one area dominated by buffelgrass. The H_GRS map unit was similar to the H_UPG type. Buffelgrass was also common as an understory

component in many of the upland shrubland types. These areas were indicated in the RIGR vegetation polygon layer as a separate attribute.

Photo Signature and Distribution



Example photo signature and distribution map for Upland Ruderal Herbaceous Vegetation.

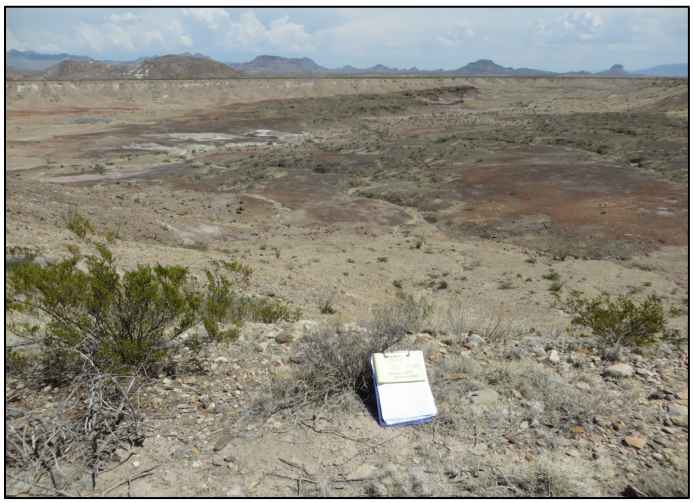
Sparse Vegetation

Map Code ***Badlands Sparse Vegetation***
SP_BAD

Common Species

- Honey mesquite (*Prosopis glandulosa*)
- Creosotebush (*Larrea tridentata*)
- False grama (*Cathestecum erectum*)
- Big Bend dog cholla (*Grusonia aggeria*)
- Mound saltbush (*Atriplex obovata*)
- Littleleaf leadtree (*Leucaena retusa*)
- Fluffgrass (*Dasyochloa pulchella*)

rUSNVC Association
Atriplex obovata / Tidestromia carnosa Dwarf-shrubland (CEGL004575)



Example photo of Badlands Sparse Vegetation.

Description
Frequency: Polygons of SP_BAD were only found in the western overlap area between BIBE and RIGR.

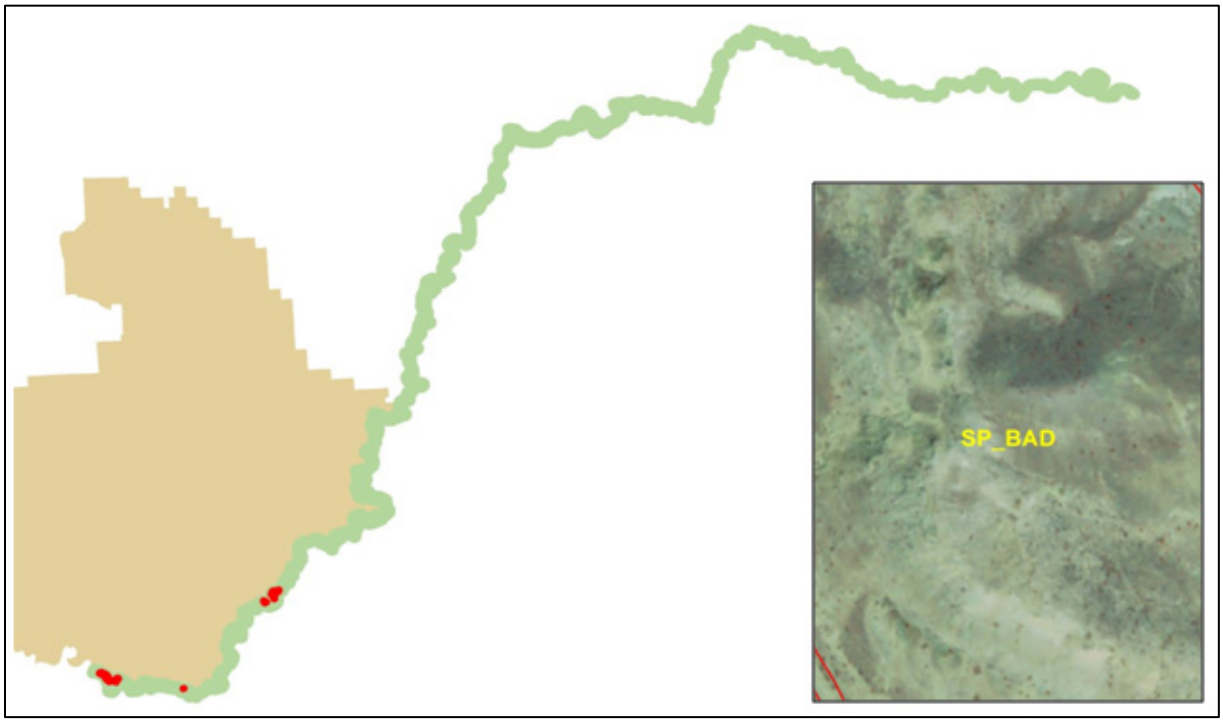
Physiognomy: The SP_BAD map unit consisted of primarily very sparse, low-growing mixed desert shrubs and perennial herbaceous vegetation. Plant species composition varied by location.

Condition: Good - Fair. The SP_BAD type was widespread throughout BIBE but was rare at RIGR. The alkaline soil types and active erosion from water and wind likely makes plant establishment difficult in these locations.

CIR Signature: On the imagery, the various soil and geology colors were prevalent and variable. Common colors included swirls of white, gray, brown, and light pinks. Vegetation was mostly absent or appeared as small dots.

Mapping Notes: The SP_BAD map unit was used to delineate almost barren badland formations. The SP_LDES2 map unit was used in similar areas that contained more vegetation cover.

Photo Signature and Distribution



Example photo signature and distribution map for Badlands Sparse Vegetation.

Map Code ***Calcareous Outcrop Lichen and Sparse Vegetation***
SP_CAL

Common Species

- Creosotebush (*Larrea tridentata*)
- Lechuguilla (*Agave lechuguilla*)
- Eagle-claw cactus (*Echinocactus horizonthalonius*)
- Texas false agave (*Hechtia texensis*)
- Ocotillo (*Fouquieria splendens*)
- Whitethorn acacia (*Vachellia constricta*)
- Chino grama (*Bouteloua ramosa*)
- Fluffgrass (*Dasyochloa pulchella*)
- Resurrection plant (*Selaginella lepidophylla*)

rUSNVC Association
Chihuahuan Desert Calcareous Outcrop Lichen Vegetation (NPSBIBE039) [Provisional]



Example photo of Calcareous Outcrop Lichen and Sparse Vegetation.

Description
Frequency: Barren and sparsely vegetated polygons of SP_CAL were common in the higher limestone regions of RIGR above the Rio Grande River and its floodplains.

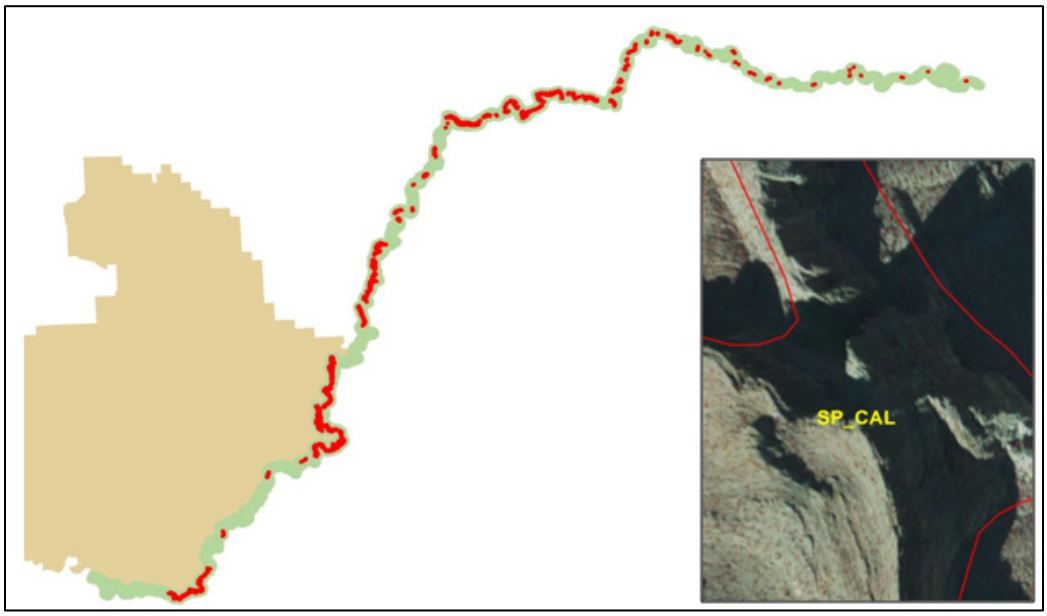
Physiognomy: SP_CAL sites contained sparse evergreen shrubs, succulents, and grasses.

Condition: Good. SP_CAL polygons represent mostly barren rock outcrops that may never support extensive stands of vegetation. Drought, freezing, and climate change may alter and affect this type.

CIR Signature: Polygons of SP_CAL had the characteristic limestone white and gray/blue colors and dark shadows were usually present. Sites with large rocks were coarse in texture and bedrock appeared smooth. Shrubs appeared as small red and brown dots.

Mapping Notes: High elevation limestone formations were common and were split from the nearby S_CDS and S_YUC map units. Vegetated limestone talus was mapped with the S_CTAL map unit. Limestone outcrops at lower elevations were mapped with the SP_CAL map unit.

Photo Signature and Distribution



Example photo signature and distribution map for Calcareous Outcrop Lichen and Sparse Vegetation.

Map Code ***Boquillas Basin Calcareous Creosotebush Desert Scrub***
SP_LCAL **Boquillas Basin Calcareous *Larrea tridentata* Desert Scrub**

Common Species

- Creosotebush (*Larrea tridentata*)
- Lechuguilla (*Agave lechuguilla*)
- Eagle-claw cactus (*Echinocactus horizonthalonius*)
- Texas false agave (*Hechtia texensis*)
- Ocotillo (*Fouquieria splendens*)
- Whitethorn acacia (*Vachellia constricta*)
- Chino grama (*Bouteloua ramosa*)
- Fluffgrass (*Dasyochloa pulchella*)
- Resurrection plant (*Selaginella lepidophylla*)

rUSNVC Association
Larrea tridentata - *Agave lechuguilla* - *Hechtia texensis* - *Echinocactus horizonthalonius* Shrubland (NPSBIBE0011)



Example photo of Boquillas Basin Calcareous Creosotebush Desert Scrub.

Description
Frequency: Sparsely vegetated polygons of SP_LCAL were common on limestone formations at low elevations in RIGR.

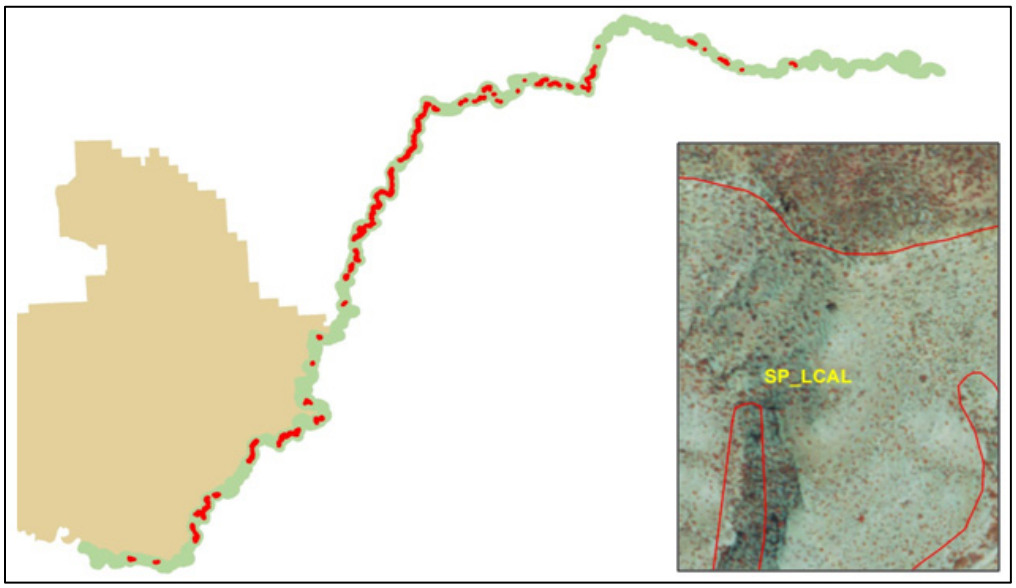
Physiognomy: SP_LCAL sites contained sparse evergreen shrubs, succulents, and grasses. Species composition and density may vary based on location.

Condition: Fair. SP_LCAL polygons represent scrubby desert sites on limestone bedrock that are impacted by dry conditions. Drought, freezing, and climate change may alter and affect this type.

CIR Signature: Polygons of SP_CAL had the characteristic white and blue colors of the limestone substrate. Bands and drainage patterns were often apparent. The vegetation was mostly sparse and scattered with red and brown dots representing shrubs and small pink dots grasses and succulents.

Mapping Notes: Low elevation limestone formations were common and were split from the nearby and higher elevation shrubland types . Vegetated limestone talus was mapped with the S_CTAL map unit. Similar sites at higher elevation were mapped with the SP_CAL map unit.

Photo Signature and Distribution



Example photo signature and distribution map for Boquillas Basin Calcareous Creosotebush Desert Scrub.

Map Code ***Big Bend Lowlands (Flats, Benches, and Plateaus)***
SP_LDES1

Common Species

- Creosotebush (*Larrea tridentata*)
- False grama (*Cathestecum erectum*)
- Chino grama (*Bouteloua ramosa*)
- Lechuguilla (*Agave lechuguilla*)
- Mound saltbush (*Atriplex obovata*)
- Christmas cactus (*Cylindropuntia leptocaulis*)
- Fluffgrass (*Dasyochloa pulchella*)

rUSNVC Association
Larrea tridentata - Cylindropuntia leptocaulis / Dasyochloa pulchella - Cathestecum erectum Shrubland (NPSBIBE031) [Park Special] [Provisional]



Example photo of Big Bend Lowlands (Flats, Benches, and Plateaus).

Description
Frequency: Sparsely vegetated polygons of SP_LDES1 were common on flats, benches, low plateaus, and other non-limestone formations at low elevations in RIGR.

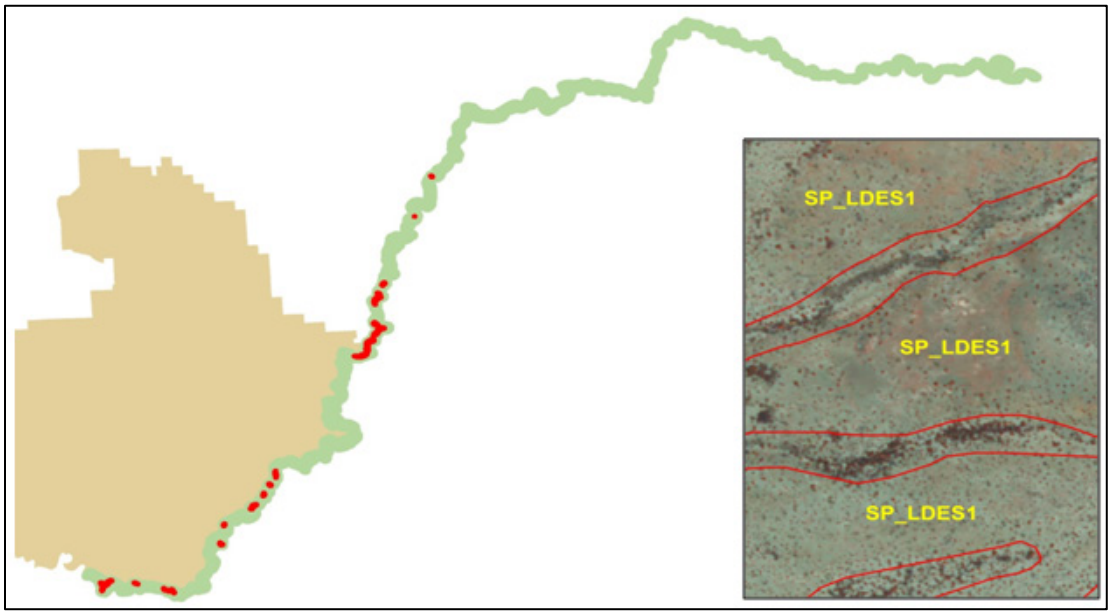
Physiognomy: SP_LDES1 sites contained sparse evergreen shrubs, succulents, and grasses. Species composition and density varied based on location.

Condition: Fair. SP_LDES1 polygons represent scrubby desert sites on various bedrock formations. All areas are dry and receive little moisture. Drought, freezing, and climate change may affect this type.

CIR Signature: Polygons of SP_LDES1 had various colors reflecting the different substrates. The vegetation was sparse and scattered with red and brown dots representing shrubs and pink dots grasses and succulents.

Mapping Notes: Low elevation scrub sites were common and were split into those types occurring on basalt (SP_LDES3), and those on eroding slopes and hillsides (SP_LDES2). S_CB differed from this type due to the higher cover of creosotebush. The S_CLAY map unit was also similar to this type but was restricted to flat clay and gypseous basins that were almost completely devoid of all vegetation.

Photo Signature and Distribution



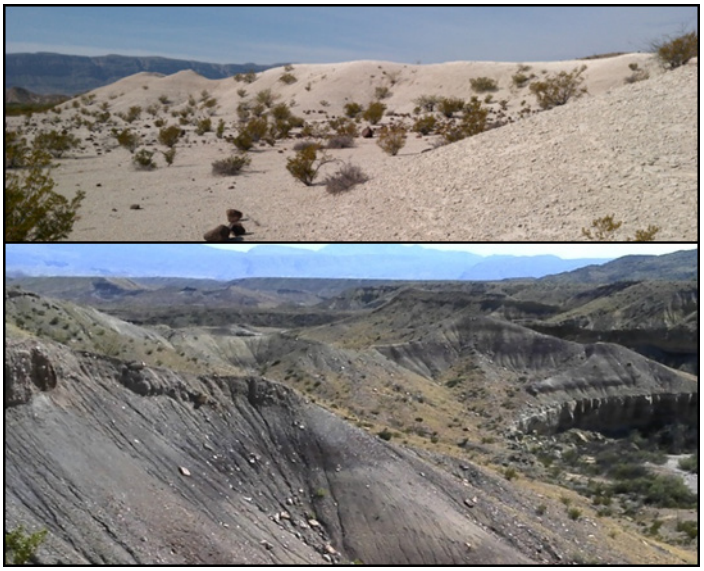
Example photo signature and distribution map for Big Bend Lowlands (Flats, Benches, and Plateaus).

Map Code ***Big Bend Lowlands (Eroding Slopes, Hillsides, and Badlands)***
SP_LDES2

Common Species

- False grama (*Cathestecum erectum*)
- Chino grama (*Bouteloua ramosa*)
- Lechuguilla (*Agave lechuguilla*)
- Mound saltbush (*Atriplex obovata*)
- Creosotebush (*Larrea tridentata*)
- Christmas cactus (*Cylindropuntia leptocaulis*)
- Littleleaf leadtree (*Leucaena retusa*)
- Big Bend dog cholla (*Grusonia aggeria*)

rUSNVC Association
Larrea tridentata - Cylindropuntia leptocaulis / Dasyochloa pulchella - Cathestecum erectum Shrubland (NPSBIBE031) [Park Special] [Provisional]



Example photo of Big Bend Lowlands (Eroding Slopes, Hillsides, and Badlands).

Description
Frequency: Sparsely vegetated polygons of SP_LDES2 were common on eroding slopes, hillsides, and other areas, some similar to badland formations at low elevations in RIGR.

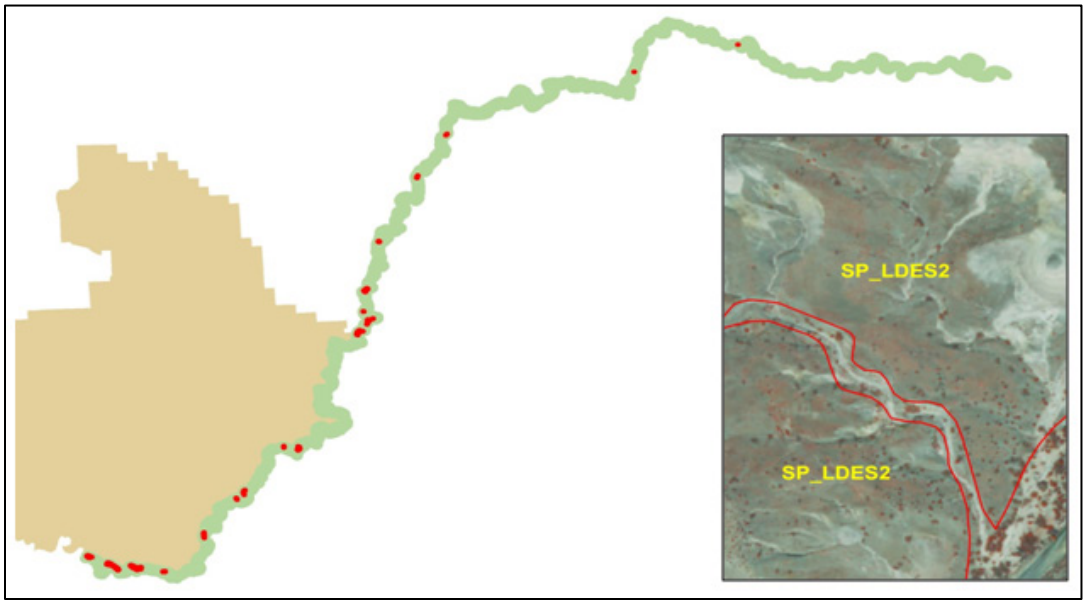
Physiognomy: SP_LDES2 sites contained sparse evergreen shrubs, succulents, and grasses. Species composition and density varied based on location.

Condition: Fair. SP_LDES2 polygons represent scrubby desert sites on various eroding bedrock formations not including limestone. All areas are dry and receive little moisture. Drought, freezing, erosion, and climate change may affect this type.

CIR Signature: Polygons of SP_LDES2 had various colors reflecting the different substrates. The vegetation was sparse and scattered with red and brown dots representing shrubs and pink dots grasses and succulents.

Mapping Notes: Low elevation scrub sites were common and were split into those types occurring on flatter areas (SP_LDES1) and those occurring on basalt (SP_LDES3). The SP_BAD map unit differed from this type since it had little if any cover of vegetation.

Photo Signature and Distribution



Example photo signature and distribution map for Big Bend Lowlands (Eroding Slopes, Hillsides, and Badlands).

Map Code ***Big Bend Lowlands (Basalt, Lava, and Volcanic Rocks)***
SP_LDES3

Common Species

- Rough jointfir (*Ephedra aspera*)
- Featherplume (*Dalea formosa*)
- Christmas cactus (*Cylindropuntia leptocaulis*)
- Fluffgrass (*Dasyochloa pulchella*)
- Creosotebush (*Larrea tridentata*)
- Big Bend dog cholla (*Grusonia aggeria*)
- Bastardsage (*Eriogonum wrightii*)

rUSNVC Association
Larrea tridentata - Cylindropuntia leptocaulis / Dasyochloa pulchella - Cathestecum erectum Shrubland (NPSBIBE031 [Park Special] [Provisional]



Example photo of Big Bend Lowlands (Basalt, Lava, and Volcanic Rocks).

Description
Frequency: Sparsely vegetated polygons of SP_LDES3 were rare at RIGR only occurring on a few areas with basalt, lava and other volcanic formations.

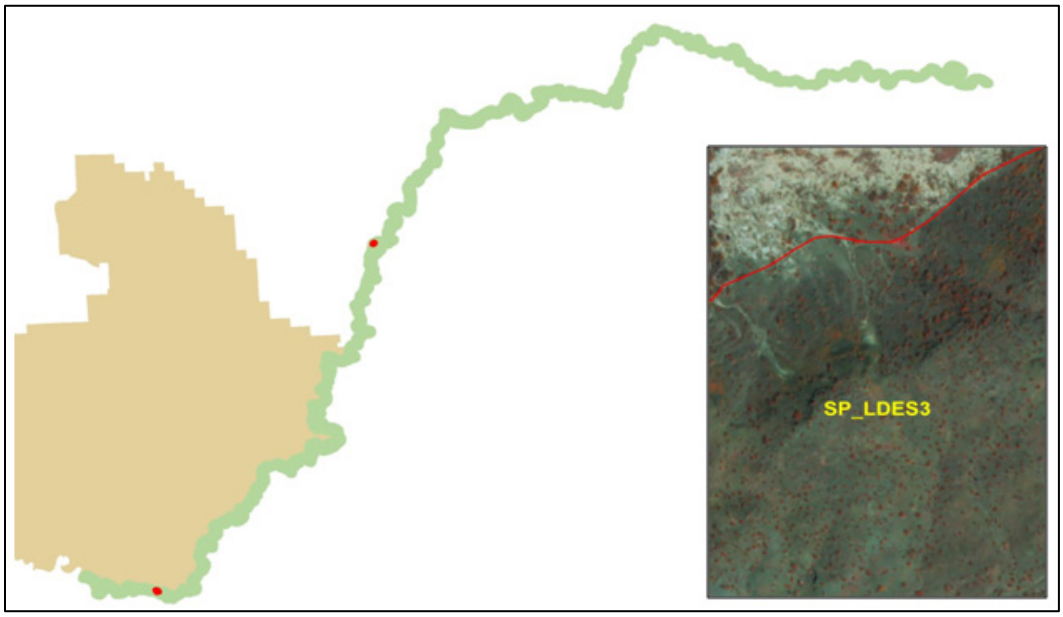
Physiognomy: SP_LDES3 sites contained sparse evergreen shrubs, succulents, and grasses. Species composition and density varied based on location.

Condition: Fair. SP_LDES3 polygons represent scrubby desert sites on various basalt and volcanic formations. All areas are dry and receive little moisture. Drought, freezing, erosion, and climate change may affect this type.

CIR Signature: Polygons of SP_LDES3 had mostly a black or dark color reflecting the basalt substrate. The vegetation was sparse and scattered with red and brown dots representing shrubs and pink dots grasses and succulents.

Mapping Notes: Low elevation scrub sites were common and were split into those types occurring on flatter areas (SP_LDES1) and those occurring on erosional hillsides and slopes (SP_LDES2). The SP_LDES3 map unit was mapped primarily based on the color and type of substrate. Small pockets of S_CBO, S_CB, and S_MEQ likely occur within some polygons of this type.

Photo Signature and Distribution



Example photo signature and distribution map for Big Bend Lowlands (Basalt, Lava, and Volcanic Rocks).

Map Code ***Rio Grande Alluvial Sparse Vegetation***
SP_RIO

Common Species

- Pretty sneezeweed (*Helenium elegans*)
- Salt heliotrope (*Heliotropium curassavicum*)
- Curly dock (*Rumex crispus*)
- Russian thistle (*Salsola tragus*)
- Tamarisk (Salt cedar) (*Tamarix ramosissima*)

rUSNVC Association
Arid West Alluvial Bar Shrub Herbaceous Vegetation (NPSBIBE024) [Provisional]



Example photo of Rio Grande Alluvial Sparse Vegetation.

Description
Frequency: Polygons of SP_RIO were restricted to the active Rio Grande River channel, recent floodplains, and portions of the larger tributaries that flow into it.

Physiognomy: The SP_RIO type contained very sparse mixes of annual grasses, forbs, and early successional weedy shrubs.

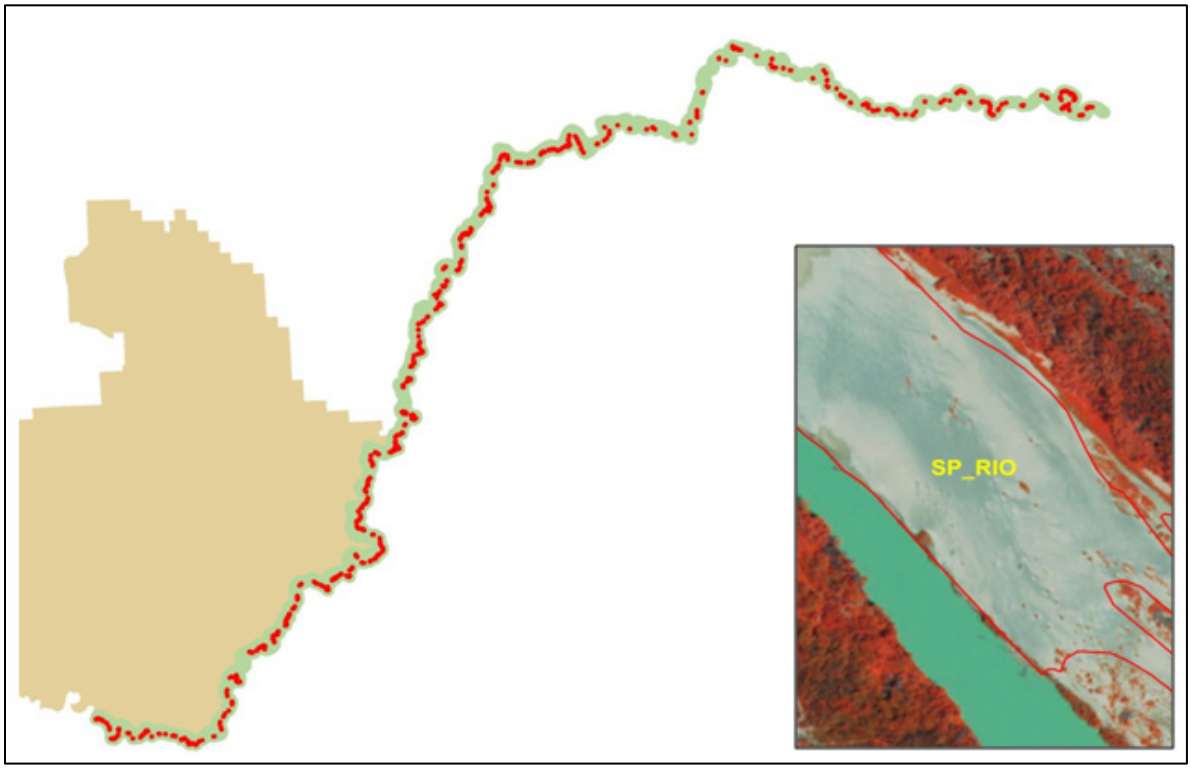
Condition: Poor. SP_RIO is an early successional type found on disturbed and previously inundated shorelines, drainages, and floodplains. The presence of this type likely indicates recent flooding, inundation, and disturbance.

CIR Signature: On the imagery, the SP_RIO map unit had a strong soil and rock reflectance (usually white or gray) with scattered red, pink, and orange patches indicating low-growing vegetation.

Mapping Notes: SP_RIO polygons are dynamic and may be wiped out with flooding and reappear in different locations. With less flooding these sites may evolve into other more established riparian

types. The H_RIO type was used to map similar areas that contained more cover of herbaceous vegetation.

Photo Signature and Distribution



Example photo signature and distribution map for Rio Grande Alluvial Sparse Vegetation.

Map Code ***Low Elevation Talus and Dune Sparse Vegetation***
SP_TAL

Common Species

- Leatherstem (*Jatropha dioica*)
- Blind pricklypear (*Opuntia rufida*)
- Lechuguilla (*Agave lechuguilla*)
- Ocotillo (*Fouquieria splendens*)
- Green sotol (*Dasylirion leiophyllum*)
- Sideoats grama (*Bouteloua curtipendula*)
- Buffelgrass (*Pennisetum ciliare*)
- False grama (*Cathestecum erectum*)

rUSNVC Association
Jatropha dioica - *Opuntia rufida* Talus Sparse Vegetation (NPSBIBE036) [Provisional]



Example photo of Low Elevation Talus and Dune Sparse Vegetation.

Description
Frequency: SP_TAL was rare in RIGR only occurring on actively eroding hills and small mountain formations that were not comprised of underlying limestone.

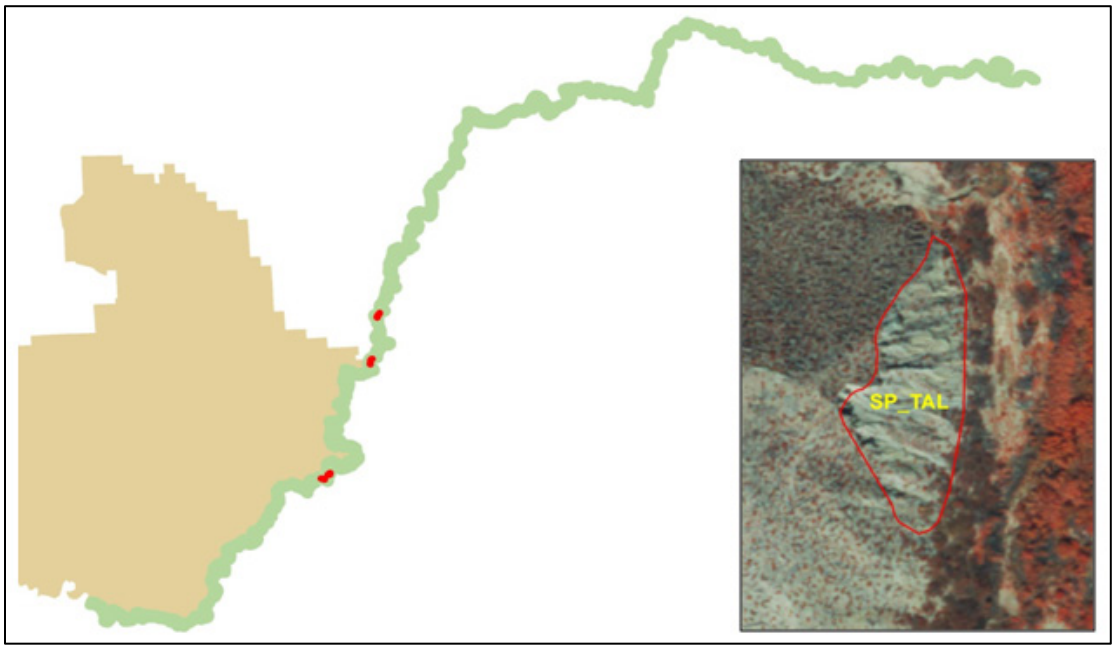
Physiognomy: Polygons of SP_TAL often contained sparse vegetation consisting of short evergreen shrubs with a scattered grass understory component.

Condition: Fair. SP_TAL is mostly a bare rock formation that contains some sparse vegetation. Local communities likely vary in composition and may be prone to small avalanches, erosion, and drought.

CIR Signature: Polygons of SP_TAL exhibited various colors and textures depending on the geologic parent material. Colors ranged from gray to tan to white. Textures were coarse for large cobbles and boulders and smooth for scree and talus.

Mapping Notes: Talus slopes with little (< 5% cover) or no vegetation cover were mapped with this map unit. The SP_LCAL and SP_CAL map units were used to map similar areas on limestone. The S_CTAL map unit was found on similar talus slopes but contained higher vegetation cover.

Photo Signature and Distribution



Example photo signature and distribution map for Low Elevation Talus and Dune Sparse Vegetation.

Map Code ***Big Bend Lowlands Sparsely Vegetated Wash Channel***
SP_WASH

Common Species

- Creosotebush (*Larrea tridentata*)
- Singlewhorl burrobrush (*Hymenoclea monogyra*)
- Trans-Pecos poreleaf (*Porophyllum scoparium*)
- Desert willow (*Chilopsis linearis*)
- False grama (*Cathestecum erectum*)
- Fluffgrass (*Dasyochloa pulchella*)
- Russian thistle (*Salsola tragus*)
- Whitethorn acacia (*Vachellia constricta*)
- Roemer's catclaw (*Senegalia roemeriana*)

rUSNVC Association
Hymenoclea monogyra - Chilopsis linearis -Porophyllum scoparium Shrubland (NPSBIBE014) [Park Special] [Provisional]



Example photo of Big Bend Lowlands Sparsely Vegetated Wash Channel.

Description
Frequency: Sparse and barren washes and drainages were very common throughout RIGR.

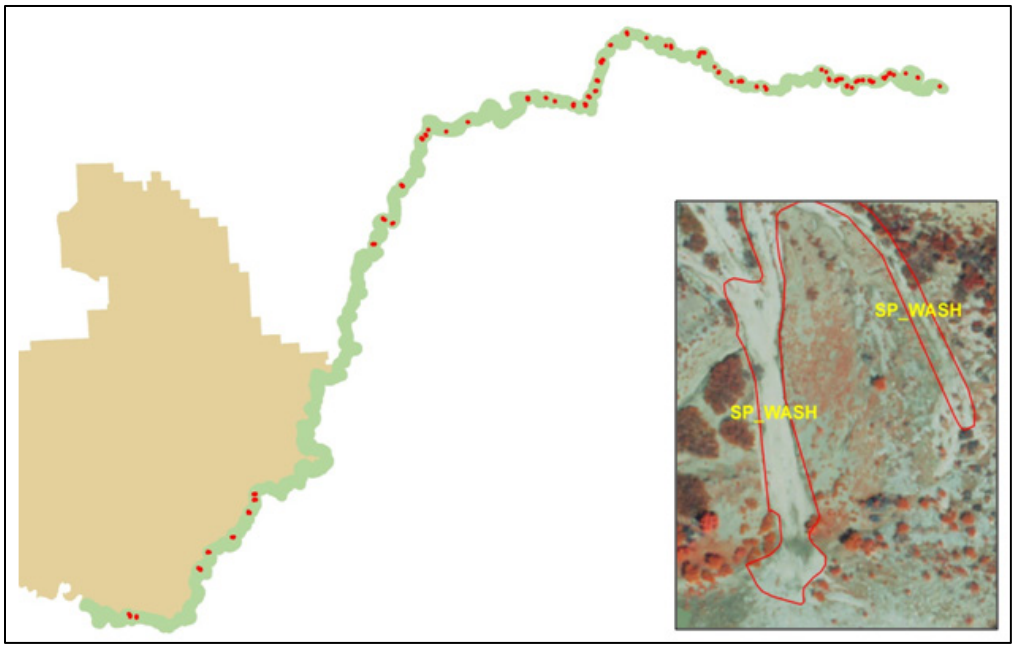
Physiognomy: Polygons of SP_WASH were mostly absent of vegetation. Some small isolated patches of short evergreen shrubs, bunch grasses, and other early successional species may be present.

Condition: Fair. All desert washes are prone to flash flooding and erosion. Some SP_WASH areas may become S_WASH, S_BBWASH, or S_PTWASH sites in the future.

CIR Signature: Polygons of SP_WASH had a characteristic smooth, linear pattern with obvious drainage channels.

Mapping Notes: The SP_WASH is a variant of the other wash types. The SP_WASH map unit was used to map the very complex, low elevation desert washes and drainages that were mostly devoid of vegetation. The importance of hydrology and drainage patterns at RIGR influenced the mapping of this type.

Photo Signature and Distribution



Example photo signature and distribution map for Big Bend Lowlands Sparsely Vegetated Wash Channel.

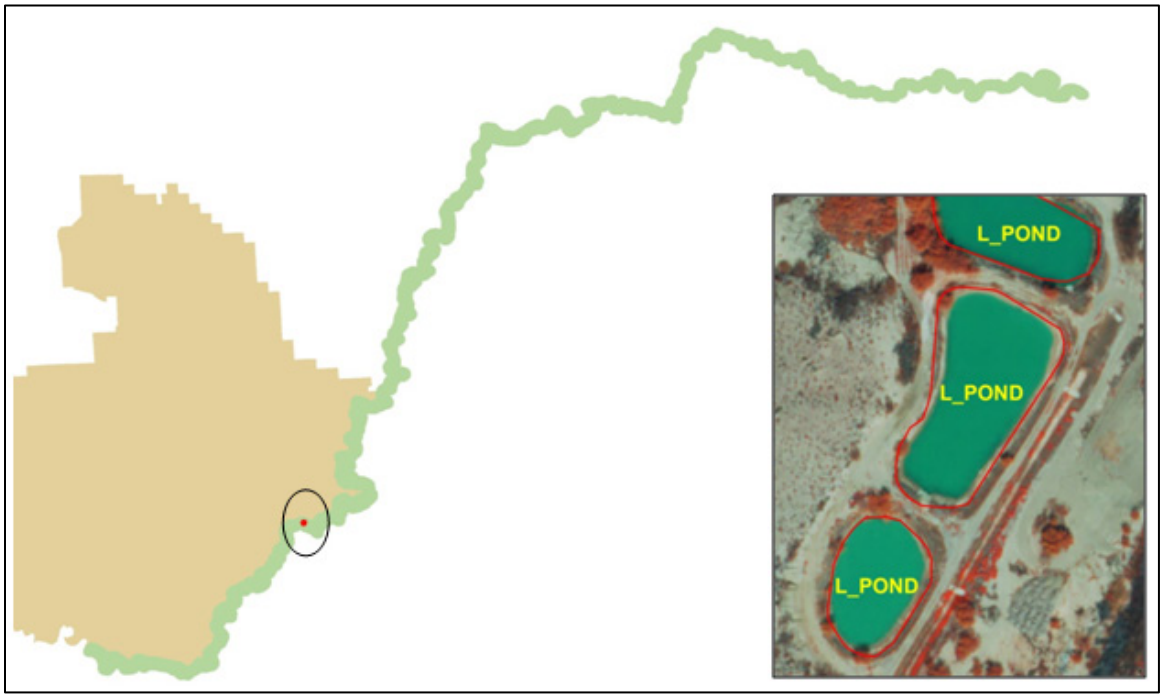
Land Use - Land Cover

L_FACL NPS and Other Facilities



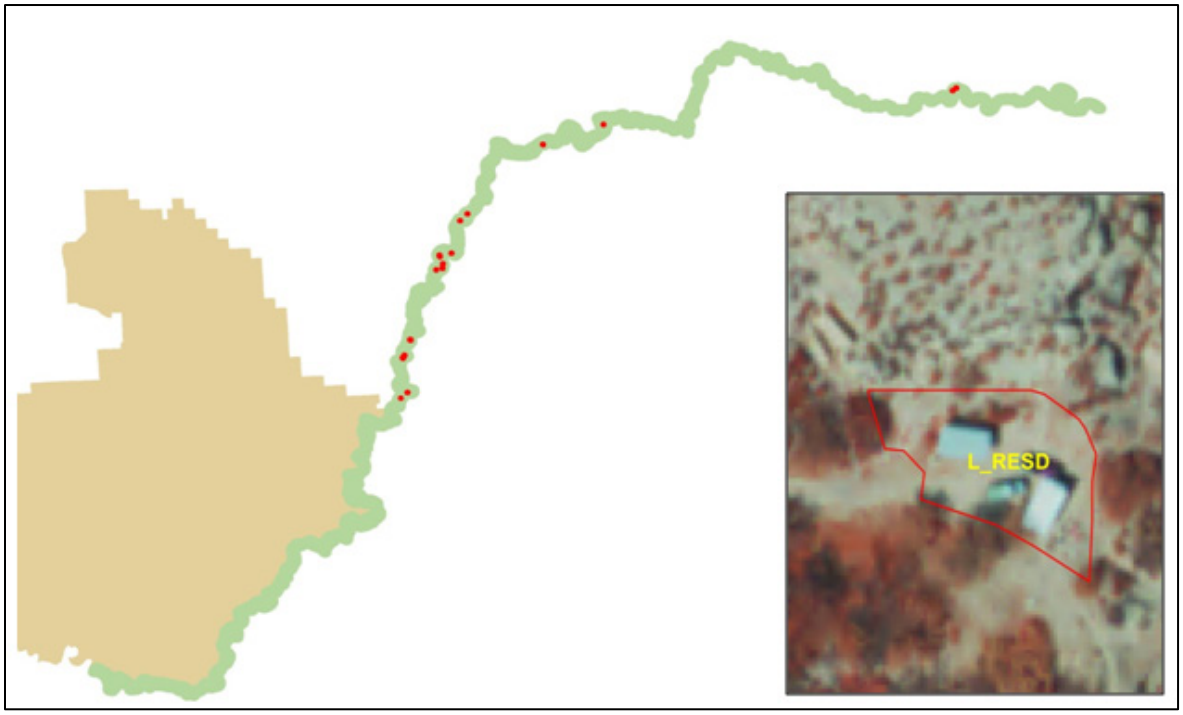
Example photo signature and distribution map for NPS and Other Facilities.

L_POND Small Lake / Pond / Watering Catchments



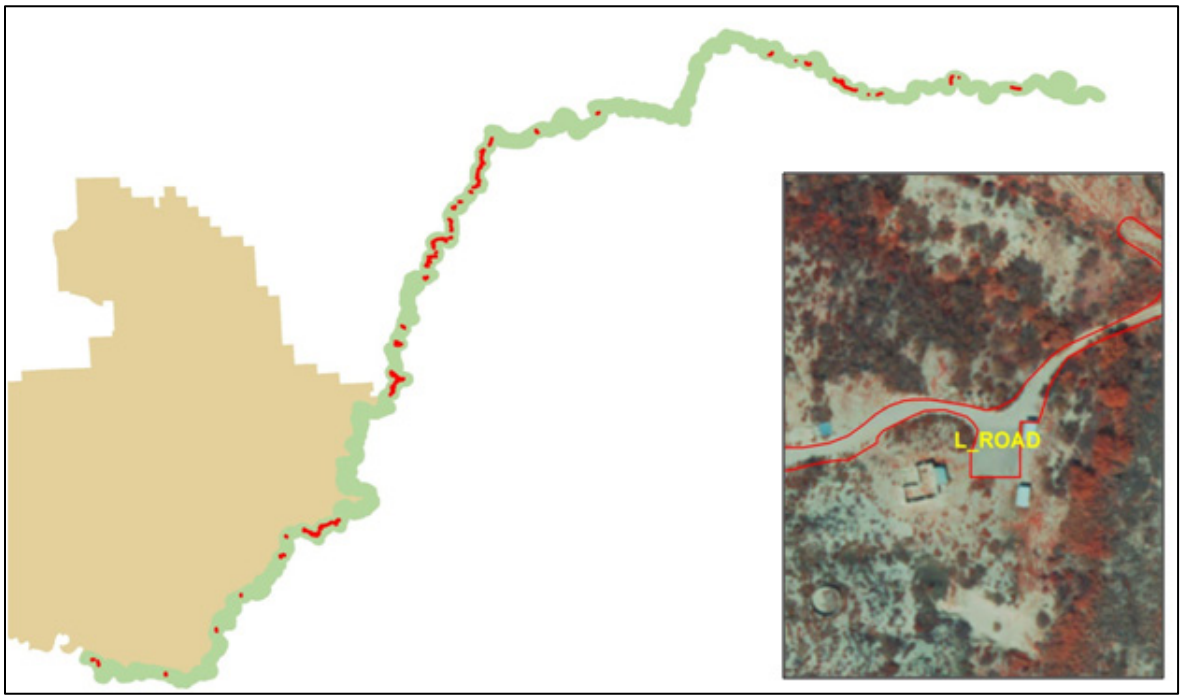
Example photo signature and distribution map for Small Lake / Pond / Watering Catchments.

L_RESD Residential Areas



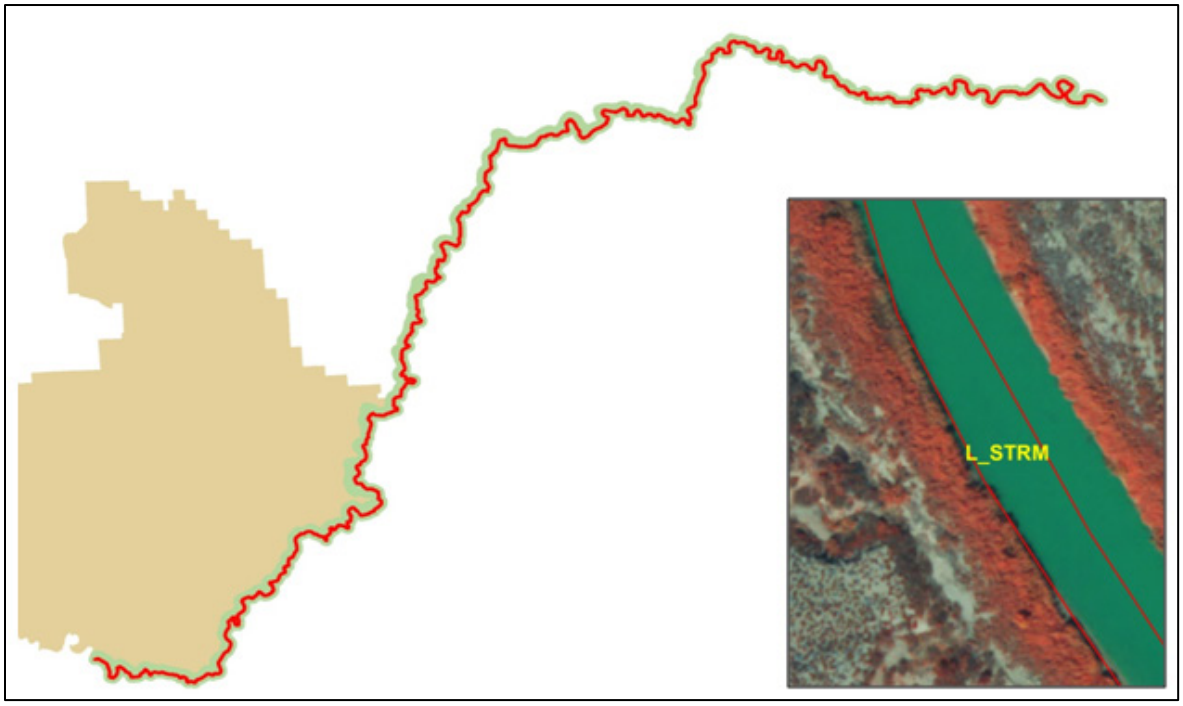
Example photo signature and distribution map for Residential Areas.

L_ROAD Main Roads and Transportation Structures



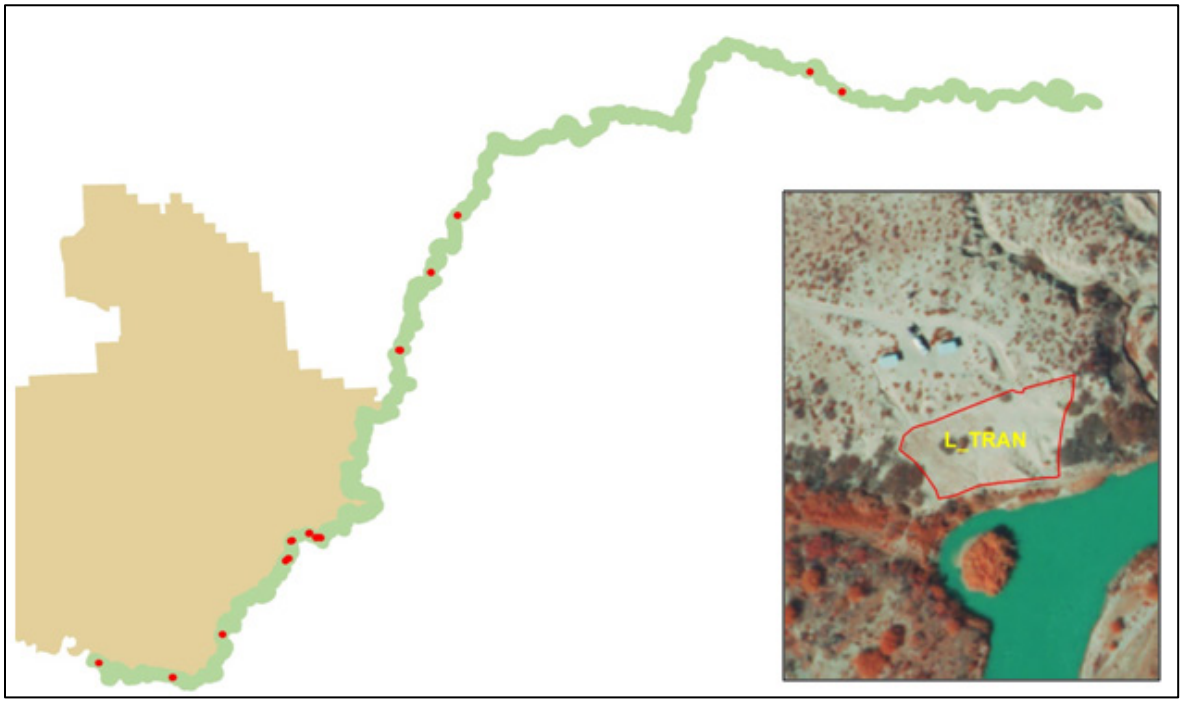
Example photo signature and distribution map for Main Roads and Transportation Structures.

L_STRM Stream / River



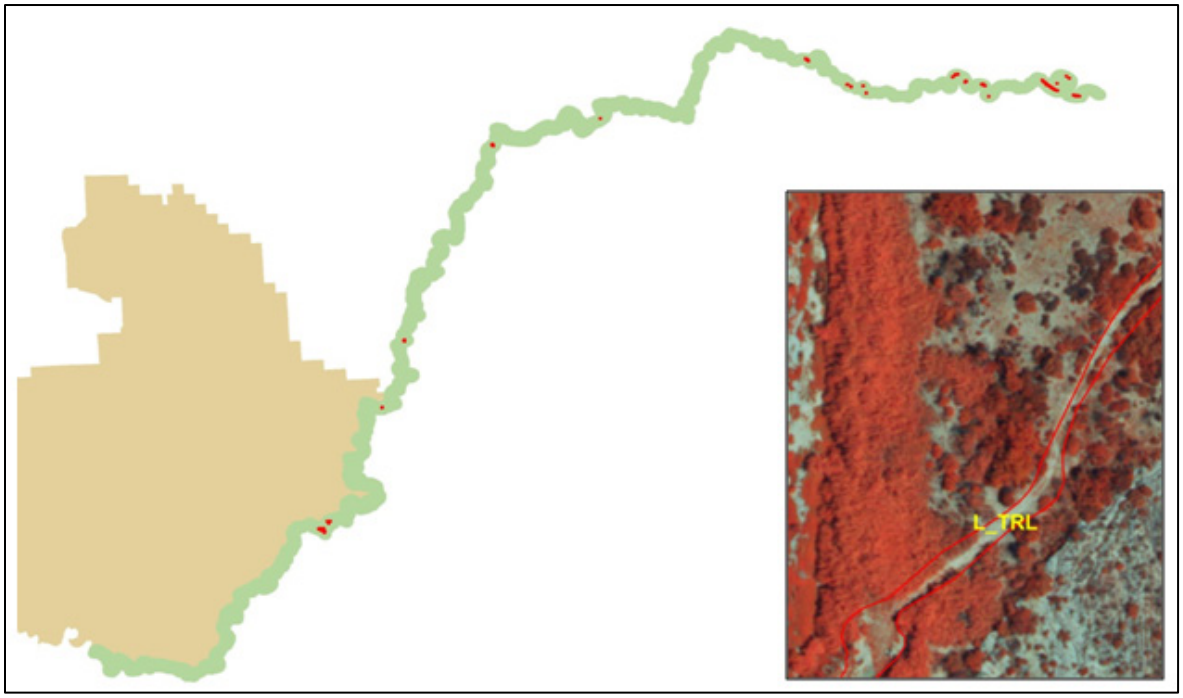
Example photo signature and distribution map for Stream / River.

L_TRAN Transitional Area



Example photo signature and distribution map for Transitional Area.

L_TRL Trails and Two-Track Roads



Example photo signature and distribution map for Trails and Two-Track Roads.

Appendix F. RIGR Vegetation Maps

For illustration purposes, the RIGR Vegetation Inventory Map is presented in two versions. The first two are overview maps showing the full scale of the project. The subsequent maps have been tiled into smaller sections to show more detail. The following pages contain an index map, overview map, tile map legend, and seven individual tiled maps (Figures F-1 – F-10). The background imagery for the maps is the 2015 TOP imagery using the true color bands. Please note that the digital imagery does not extend into Mexico.

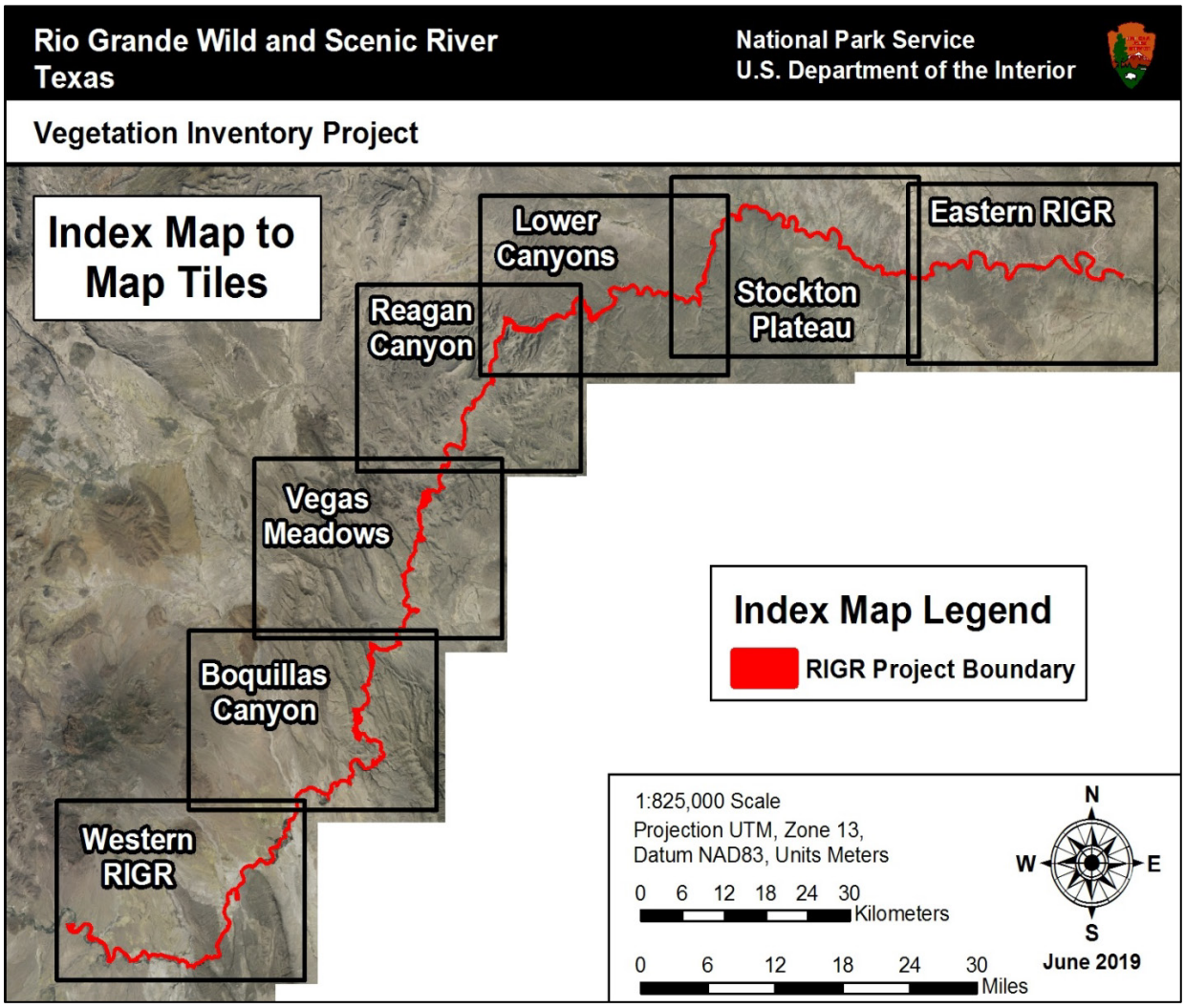


Figure F-1. RIGR Index Map to Vegetation Map Tiles.

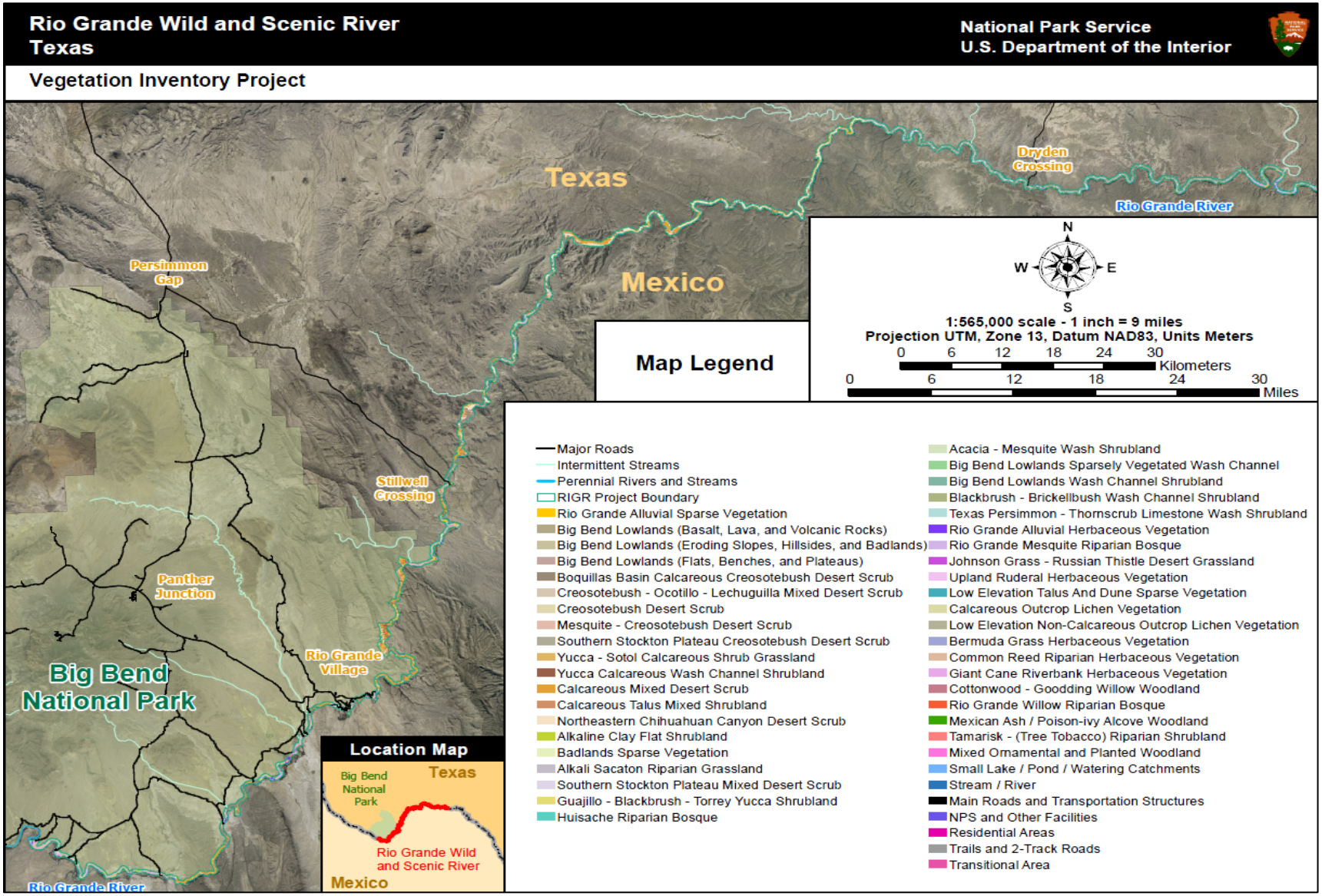


Figure F-2. RIGR Vegetation - Overview Map.

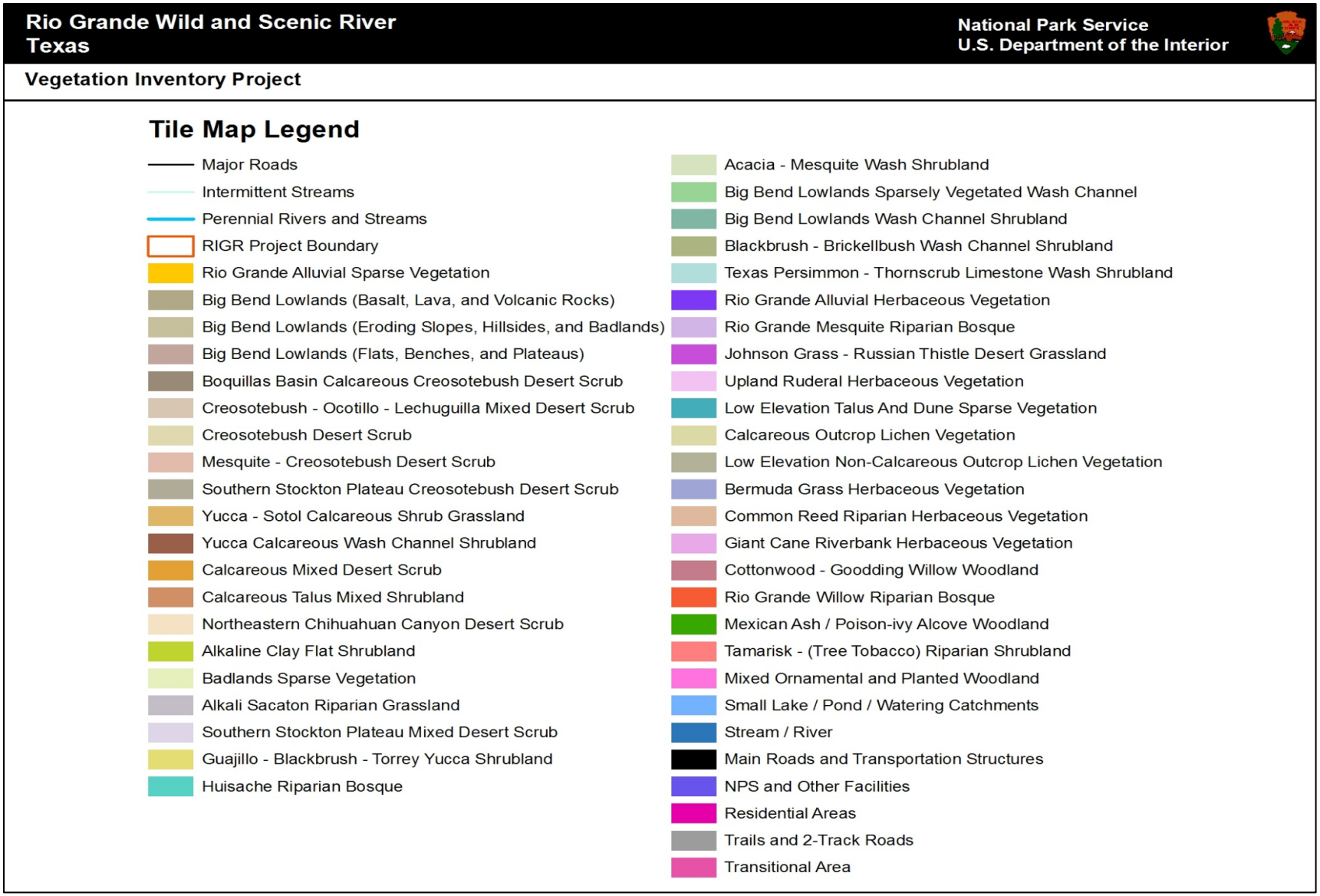


Figure F-3. RIGR Vegetation Tile Map Legend.

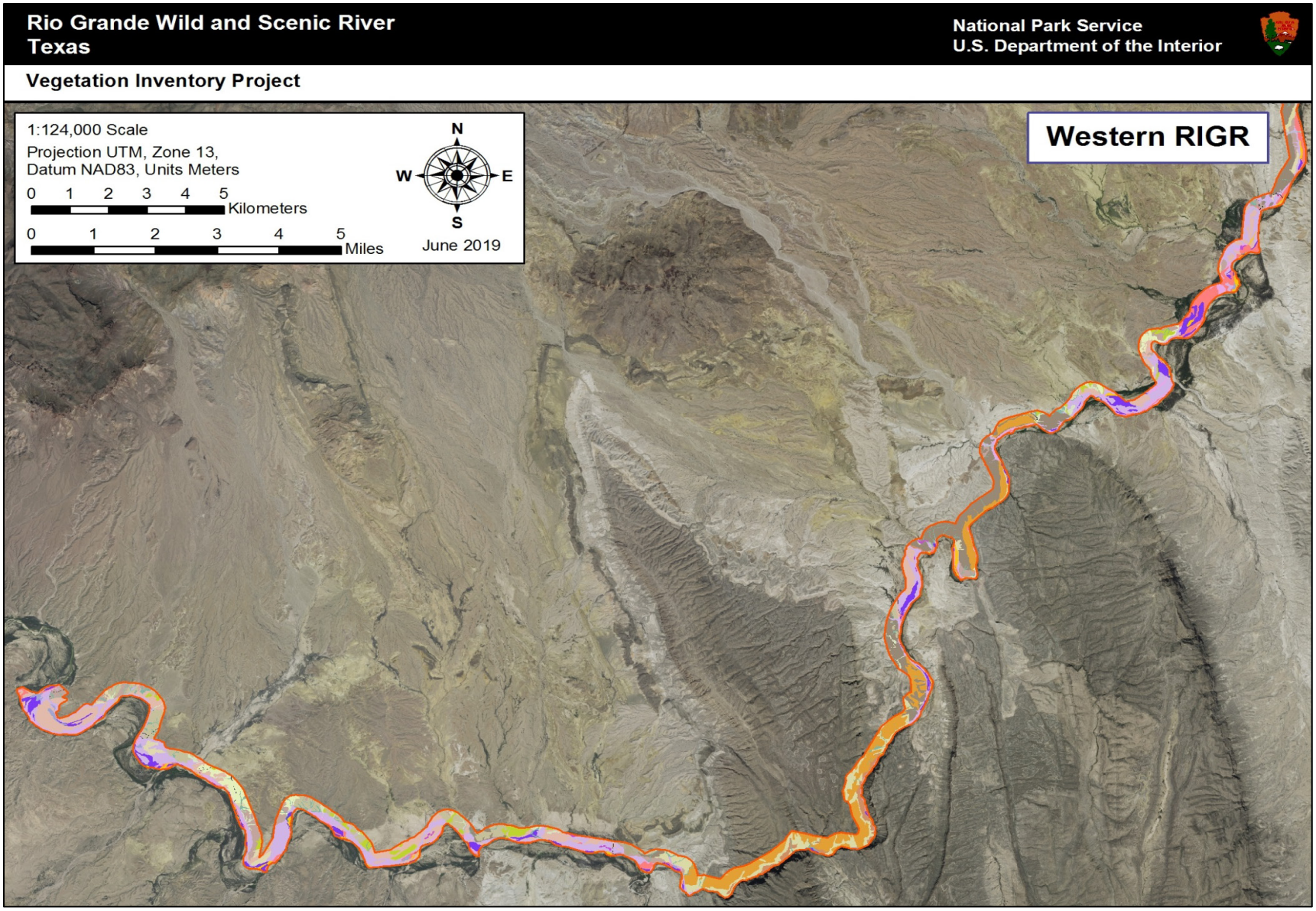


Figure F-4. RIGR Vegetation Tile Map 1 - Western Region.

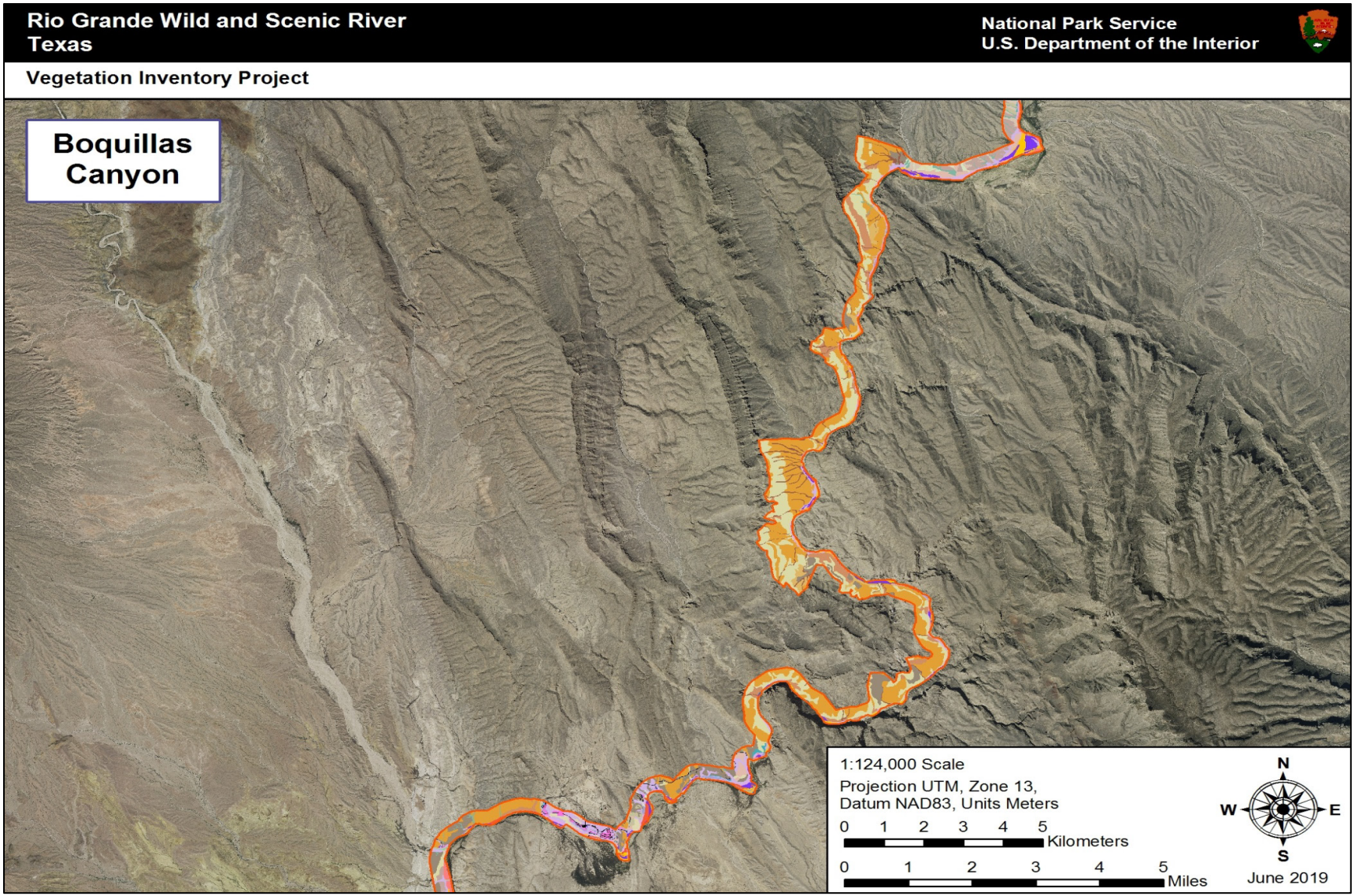


Figure F-5. RIGR Vegetation Tile Map 2 - Boquillas Canyon Region.

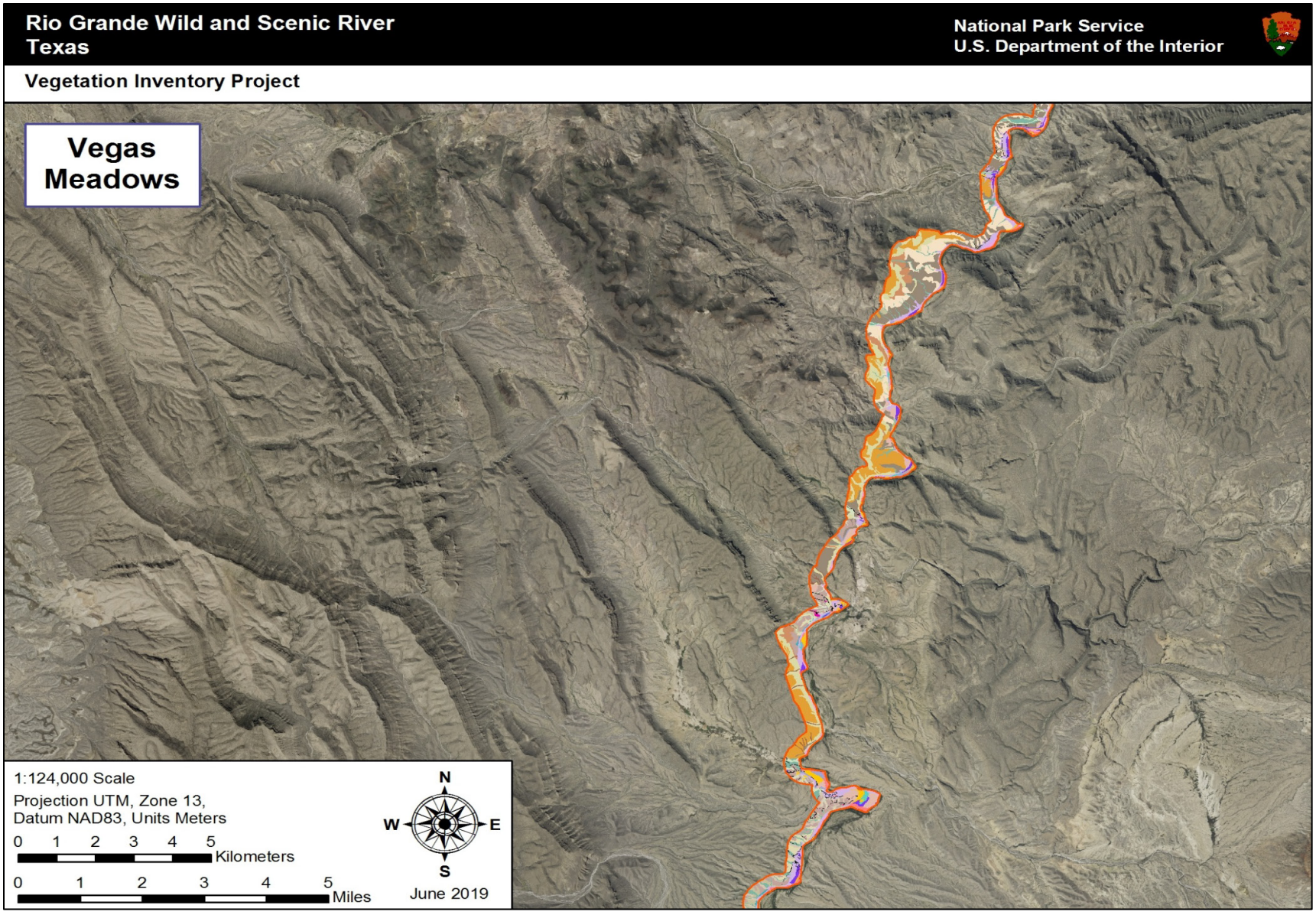


Figure F-6. RIGR Vegetation Tile Map 3 - Vegas Meadows Region.

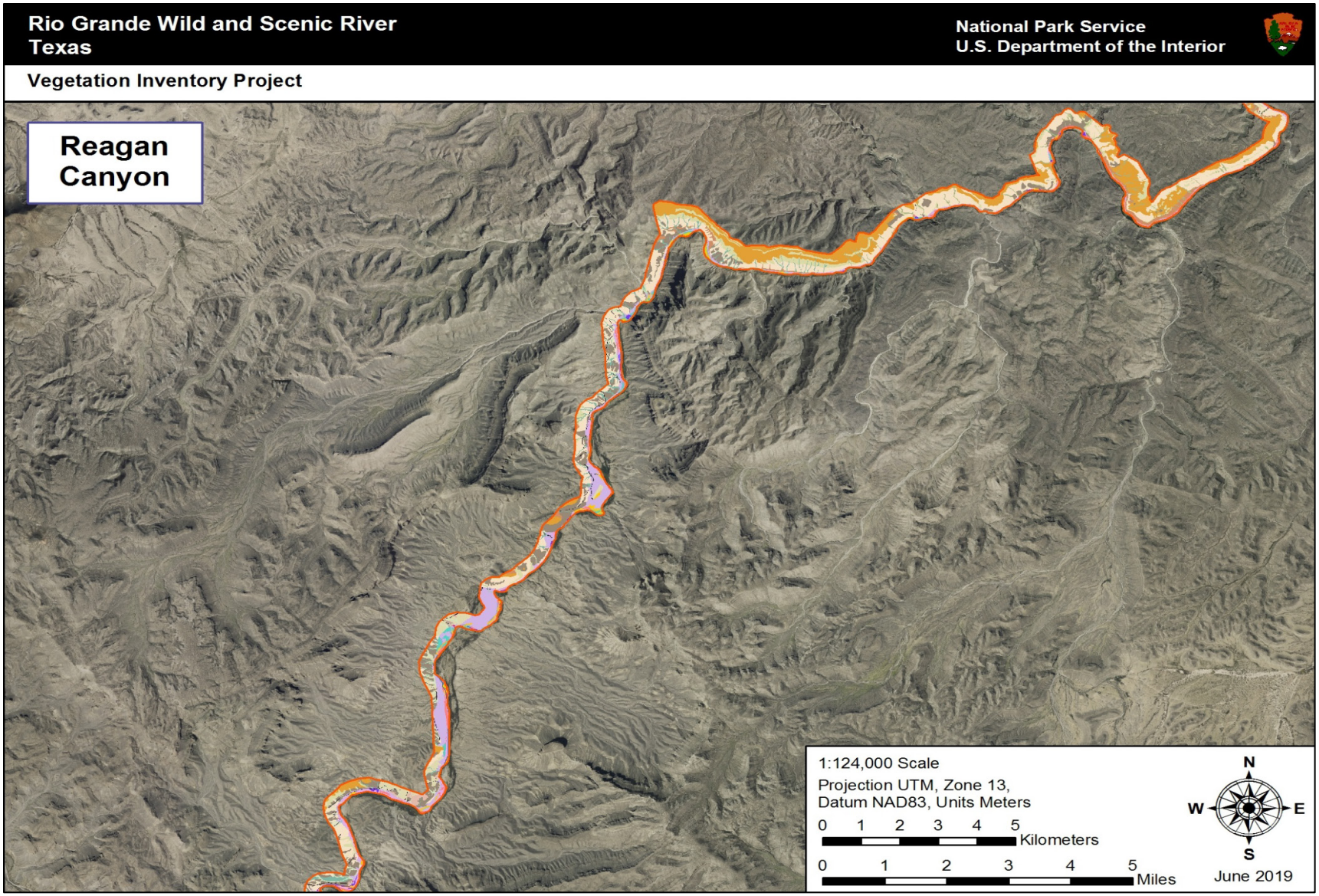


Figure F-7. RIGR Vegetation Tile Map 4 - Reagan Canyon Region.

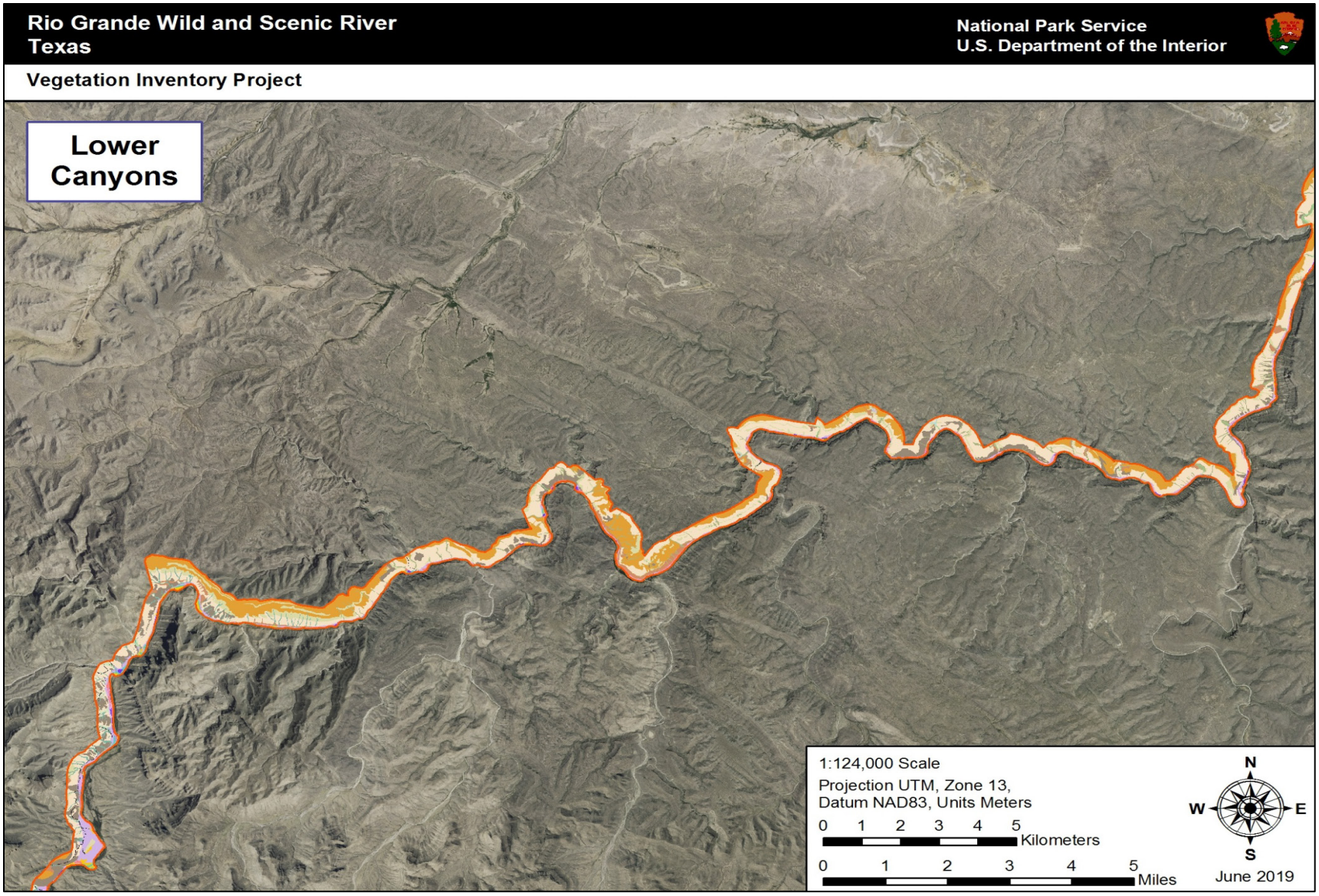


Figure F-8. RIGR Vegetation Tile Map 5 - Lower Canyons Region.

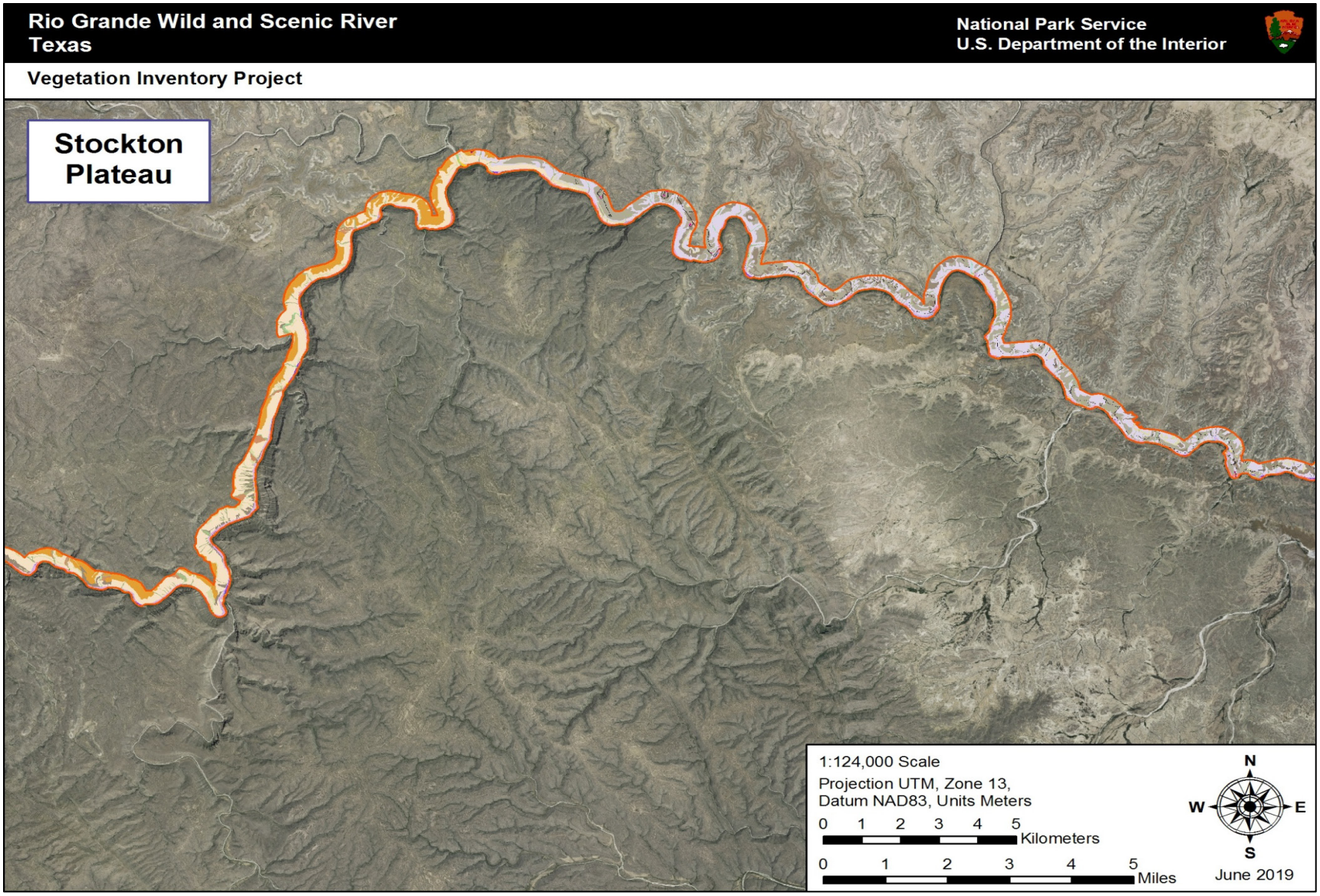


Figure F-9. RIGR Vegetation Tile Map 6 - Stockton Plateau Region.

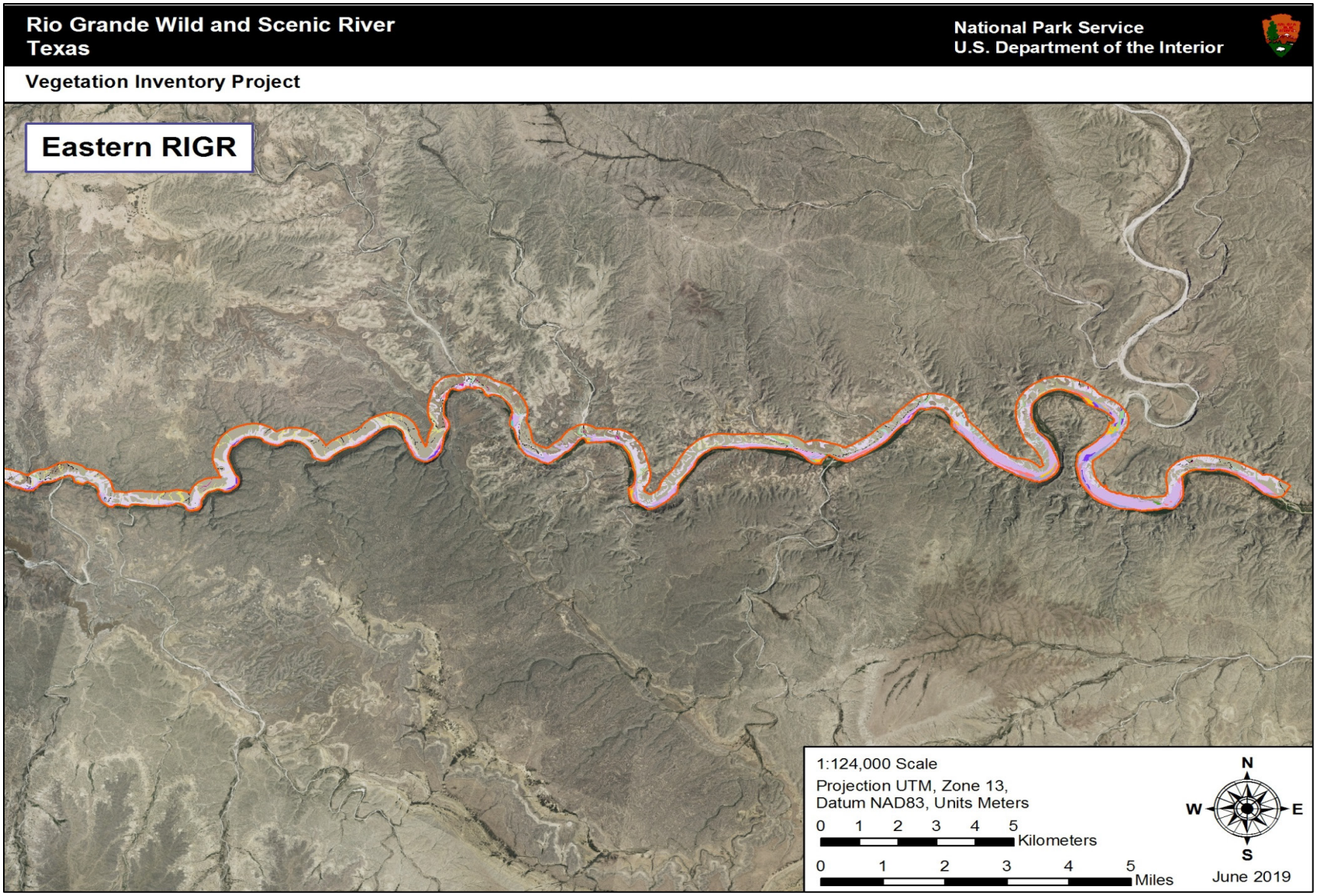


Figure F-10. RIGR Vegetation Tile Map 7 - Eastern Region.

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

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