Chapter 4
Old Forts and New Amenities in the Southern Plains

Jason P. Julian

Abstract The Southern Plains of the United States (U.S.), specifically the states of Texas and Oklahoma, is a region of transition. Physically, it represents the transition from the humid, forested eastern U.S. with mostly perennial water resources to the dry western U.S. with grasslands, deserts, and mostly ephemeral water resources. Socioeconomically, it represents the transition from the densely populated eastern U.S. to the wild open spaces of the western U.S. Historically and culturally, it represents the transition from the French/English colonies of the eastern half of the U.S. to the Spanish territory of the Southwest. Later, it would represent the transition from the eastern pre-Civil War states to the western post-Civil War states. The Southern Plains also represent a transition in time when U.S. settlers were moving into western Native American lands. This occupation led to many intense battles between the European/American settlers and various Tribal Nations. Between 1821 and 1890, many forts were built in response to these conflicts and also to promote new settlements. Of these, 33 have been protected as publicly accessible places, including museums, state parks, national historic sites, city parks, resorts, and even a U.S. Department of Agriculture research facility. This chapter inventories and discusses the historical, cultural, and natural values of these 'protected forts' within the context of ecosystem services that have evolved from these sites.

4.1 Introduction

4.1.1 Forts Are Valuable Protected Places

Places have been protected because of their recognized historical, cultural, or natural values. Preserving these values is important for our well-being, whether it is reminiscing over our past, interacting with others who have similar values, or enjoying the benefits of the natural environment. The vast majority of protected places

J. P. Julian (✉)
Department of Geography, Texas State University, San Marcos, TX, USA
e-mail: jason.julian@txstate.edu

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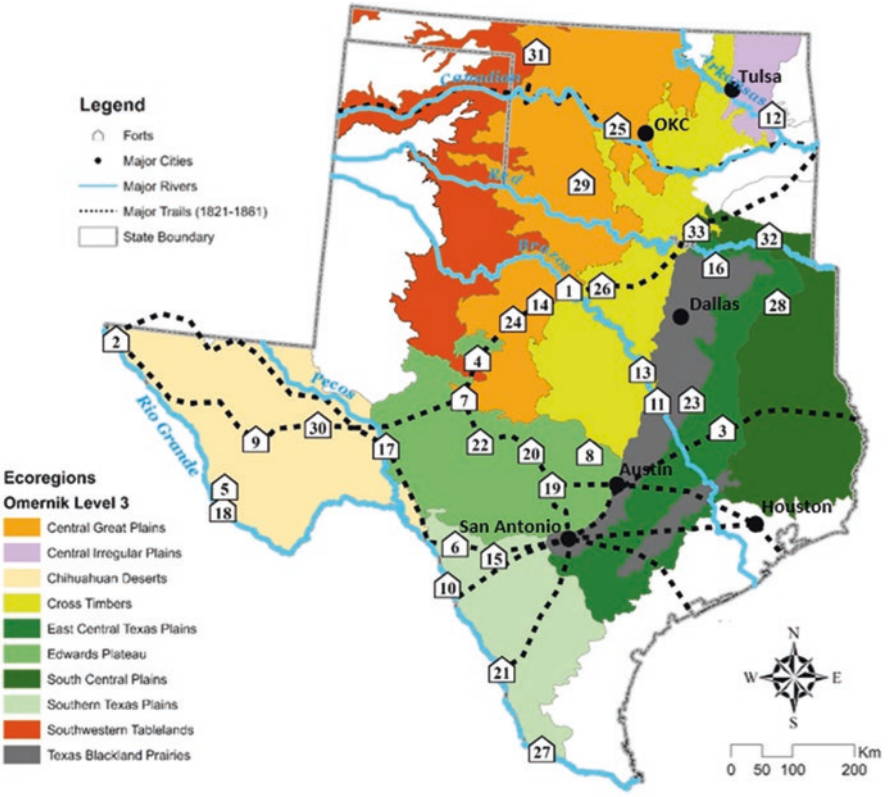

Fig. 4.1 Forts from the Southern Plains Indian Wars that have been commemorated, protected, and open to the public in present-day Oklahoma and Texas. The number on the fort corresponds to its alphabetical Fort ID in Table 4.3

embody one or two of these values. Rarely does a protected place encompass all three. In this chapter, I show how protected forts from the Southern Plains Indian Wars have historical, cultural, and natural values (Fig. 4.1).

Historically, these forts represent the beginnings of statehood for both Texas (TX) and Oklahoma (OK). They promoted settlement in a hostile environment, while also serving transportation and trade routes (Field 2006; Frantz 1970). Culturally, forts were and are the meeting place of diverse societies, including settlers from across North America and Europe, the military, and multiple Tribal Nations (Gwynne 2010; Michno 2011; Wooster 1987). Not only are they popular cultural heritage tourism destinations, but they also serve as sites for a wide range of modern cultural activities. Naturally, these protected places provide precious habitat and ecological functions in two states with relatively little protected land compared to their size and the rest of the U.S. They also provide the public with unique nature experiences and recreational opportunities across a spectrum of ecosystems, from deserts to temperate forests.

In my assessment of historical, cultural, and natural values, I investigated all forts in present-day TX and OK that were established 1821–1890 and used for war activities and support during the Southern Plains Indian Wars, which have also been referred to as the Texas-Indian Wars or the Comanche Wars. Accordingly, these forts include U.S. government installations, Texas Rangers posts, trading posts, lodging facilities, and settlers' forts, which were established by families, rancher groups, or local militias to protect settlers and livestock from raids by small parties of roaming Indians (Hannings 2006). Using the above criteria, I found a total of 73 forts. Of these, 33 have been commemorated, protected, and open to the public (Fig. 4.1). I collected information on these 33 forts related to their geography, history, and current amenities with a focus on ecosystem services, the benefits societies obtain from ecosystems (MEA 2005). Data was collected from a variety of online and literature sources. The online encyclopedias hosted by the Texas State Historical Association and Oklahoma Historical Society provided comprehensive overviews of all forts located within each state. Additionally, the Texas Historic Sites atlas provided locations for every historic marker associated with a recognized fort. Information about forts that were converted to local, county, state, and national parks was obtained from the parks' websites. Data on Forts Bliss and Sill, the only active forts in this list, was requested from the U.S. Army or obtained from the base website. Online sources were supplemented with Hannings's (2006) encyclopedia of U.S. forts, Pierce (1969) and Alexander and Utley's (2012) reviews of historical military sites in Texas, and Awbrey and Dooley's (1992) list of roadside historical markers in Texas. Finally, I visited all but three of the forts during 2016 and interviewed all the directors/managers to collect additional information on ecosystem services and societal benefits not provided in texts or on websites.

4.1.2 Background on Indian Wars and Forts

The American Indian Wars occurred over hundreds of years from colonial times till the early 1900s. Some of the most widespread fighting and deadliest battles occurred in the Southern Plains (Gwynne 2010; Michno 2011), what is now TX and OK. While there were forts in eastern TX used to battle American Indian tribes such as the Karankawas from the late 1600s to the early 1800s, the recognized start of the Southern Plains Indian Wars was Mexico's independence in 1821. The new Mexican Republic welcomed and incentivized American traders and settlers, largely to establish an official political and economic presence, and push out the Native Americans (Field 2006). Some even claim that the impetus for this policy was to create a buffer between the core of Mexico and its nemesis the Comanches (Gwynne 2010). During this period, several important trade and settlement routes were established and fortified. Around the same time, numerous tribes were relocated to the Indian Territory of what is now OK, with a surge following the Indian Removal Act of 1830 (Field

2006). Several military forts were established around this new 'Permanent Indian Frontier' to protect the boundary with white settlements, protect the 'Civilized Tribes' from the 'hostile' Plains Indians, police the territory, and enforce U.S. laws and policies (e.g., Forts Gibson, Towson, and Washita).

The movement of both whites and new Indian tribes into the Southern Plains was an invasion into Comancheria, the empire established by the Comanches during the eighteenth century. This act was met with widespread and brutal attacks on white settlers and travelers, and of course retaliatory attacks on the Comanches (Gwynne 2010; Michno 2011). This war with the Comanches, their main allies the Kiowas, and other engaged tribes continued until 1875 when Quanah Parker and the Comanches surrendered. Other tribes and renegades continued to resist until about 1890, coincidently the same year that the Census Bureau declared the frontier was officially closed (Michno 2011). Thus, this Southern Plains Indian War forts analysis covers the period 1821–1890. Over these 70 years, forts were established for multiple purposes: new settlements; preservation of law and order in the new frontier; trading posts for military, settlers, and Indians; enforcement of Indian displacement; soldier lodging; and various military activities (Field 2006).

The Southern Plains forts were important not only for regional development, but nationally as well. In 1848, the acquisition of the southwestern U.S. from Spain and the subsequent discovery of gold in California created the need for increased federal defense for westward emigrants and settlements, particularly across TX and present-day OK (1907 statehood) because this area provided for year-round trails not impacted by cold weather (Fig. 4.1). Indeed, most of the military forts in TX were built 1848–1855. During the Civil War (1861–1865), several of these forts were used by the Confederacy. Following the Civil War, the U.S. government reoccupied some of the old forts, created several new forts across TX and present-day OK, and invested a lot of money and resources in these forts (Smith 1999). Many of the Southern Plains forts, post-Civil War, became posts for the 'Buffalo Soldiers,' who played a key role in the Indian Wars from 1866–1890.[1]

Following the Southern Plains Indian Wars, a few of the forts continued to be used for military purposes periodically (e.g. Fort Reno as a German POW camp during WWII). But with the expansion of settlements and the Southern Pacific Railroad, along with the nation's shift in focus to global conflicts, the need for forts in this region diminished and almost all of the forts were abandoned by the beginning of the twentieth century (Wooster 1987; Hannings 2006). Only two of the forts became permanent military installations, Fort Bliss in TX and Fort Sill in OK.

[1] Buffalo Soldiers, so named for 'their dark skin, curly hair, and fierce fighting spirit,' were all-black U.S. Army cavalry and infantry regiments formed after the Civil War. Buffalo Soldiers played prominent roles in many military campaigns during the Indian Wars (more than 125 engagements), as well as the Spanish-American War in 1898. They also served as some of the first national park rangers (NPS 1993).

4.1.3 How the Forts Became Protected Places

After the forts were abandoned, most were stripped or destroyed for building materials (Alexander and Utley 2012; Alexander and Utley 2015; Field 2006). Some were saved by local citizens moving in to the fort buildings and using them for residence or business (Concho, Davis, McKavett). The Texas settlers' forts (Boggy, Cibolo, Inglish, Leaton, Parker) remained with the original landowner, but over time fell into disuse and the structures deteriorated. It is important to note that none of the Texas forts were on properties owned by the federal government, but instead were leased from private landowners or the state (Smith 1999). Even the land for Fort Bliss was not purchased by the federal government until after 1890. The Oklahoma forts, on the other hand, were on federal property. Following their abandonment, most were transferred to their respective Tribal Nations: Fort Towson (Choctaw), Fort Washita (Chickasaw), Fort Gibson (Cherokee). Fort Supply was transferred to the Department of Interior, and later to the state, where in 1908 it became Oklahoma's first state-operated mental institution. Fort Reno was eventually transferred to the Department of Agriculture (USDA) and became a research center.

Of the approximately 73 forts constructed 1821–1890 and used for the Southern Plains Indian Wars in present-day OK and TX, only 33 ended up being commemorated, protected, and open to the public (Fig. 4.1). These forts became protected places (and open to the public) by various means over a long timeline (Fig. 4.2).

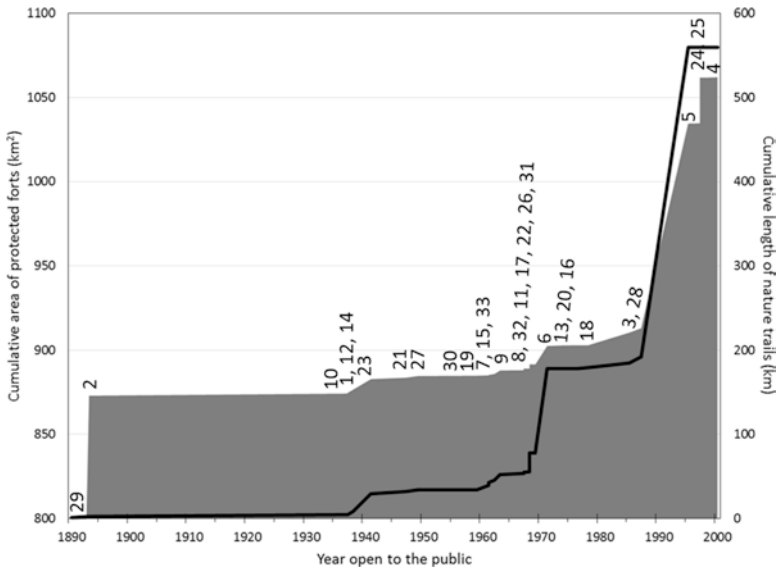

Fig. 4.2 Cumulative area of protected forts (grey area) and length of nature trails (solid black line) over time. Chart labels correspond to the alphabetical Fort ID in Table 4.3. The first fort open to the public, Fort Sill [29] in 1890, has an area of 379 km^2

Except the two U.S. Army bases, the first fort open to the public was Fort Duncan in 1935 when it became a city park. During the latter half of the 1930s, the Works Progress Administration (WPA) and Civilian Conservation Corps (CCC) were responsible for restoring several of the forts, building public parks, and creating amenities that included lakes, picnic areas, camping sites, and hiking trails. Fort Parker Lake, for example, was created by a dam built by the CCC in 1939. Fort structures restored by the CCC and WPA included Belknap, Gibson, Griffin, and McIntosh. Shortly after WWII, two forts became schools, as well as historical sites: McIntosh in 1947 and Ringgold in 1949. It was not until 1955 that other forts became restored and officially open to the public, beginning with Fort Stockton and followed by Martin Scott (1959), Inge (1961), and Concho (1961). All four of these forts were protected through the efforts of local activists and heritage associations in coordination with the city or county. Heritage associations and historical societies were responsible for protecting and restoring three other forts in following decades: Croghan (1967), Mason (1975), Inglish (1976). Most of the forts became protected 1962–1987 through purchases by or donations to the state, and they became state parks or official historical sites. Two forts were purchased privately and became resorts, Clark in 1971 and Cibolo in 1995 [note: Forts Cibolo, Cienega, and Morita are on the same property, but grouped for analysis purposes and collectively referred to as Cibolo]. Finally, two forts were protected by foundations set up by the landowner and became open to the public, Phantom Hill in 1997 and Chadbourne in 1999.

In order to be protected for public use, a few of the forts had to be moved. Fort Inglish was moved 2.0 km (1.2 mi) SW because a hospital was built on the original site. Fort Graham (now part of Old Fort Park) was moved 1.6 km (1.0 mi) E due to flooding from the impoundment of Lake Whitney. Fort Bliss was moved several times, once due to Rio Grande flooding and two other times due to municipal planning. Fort Fisher was moved approximately 1.0 km (0.6 mi) downstream along the Brazos River to be adjacent to I-35 and attract more tourism. The actual fort sites of Fisher, Boggy, and Sherman were lost, but all three were commemorated with a park at their estimated location (or at least a campground and cemetery in the case of Sherman). Consequently, these are the only three forts without ruins or restored fort buildings. The other 30 forts were all restored to varying standards. At three of the forts (Inge, Lancaster, Phantom Hill), only ruins were restored. The rest had at least one building reconstructed, with many almost completely restored.

Currently, the forts are owned and managed by the federal government (n = 5), the state (12), county (4), city (7), non-profit organizations (NPO; 3), and private entities (2). Of the federal properties, two are active military installations (Sill and Bliss), one is owned by the National Park Service (Davis), one is owned by the U.S. Army Corps of Engineers (Graham), and one is owned by the USDA (Reno). The fort structures of both Fort Reno and Fort Graham are managed by NPOs. Of the state properties, five are managed by the Texas Parks and Wildlife Department (TPWD; Boggy, Leaton, Parker, Richardson, and Sherman), three are managed by the Texas Historical Commission (THC; Griffin, Lancaster, and McKavett), and

four are managed by the Oklahoma Historical Society (OHS; Gibson, Supply, Towson, and Washita). The three managed by THC were acquired from TPWD in 2008. In 1992, TPWD released to the City of Groesbeck the historical site of *Old Fort Parker*, which is now owned and managed by an NPO. Forts Belknap, Inge, Inglish, and Mason are owned by their respective counties. And Forts Concho, Duncan, Fisher, Martin Scott, McIntosh, Ringgold, and Stockton are owned by their respective cities. While only three forts are owned by NPOs (Croghan, Chadbourne, and Phantom Hill, with the latter two being foundations established by the landowner), NPOs and volunteer organizations play a key role in the maintenance, operation, and events of most of the forts. The two forts owned by private entities are resorts whose amenities can be enjoyed by anyone willing to pay for accommodations. Fort Cibolo is a high-priced luxury resort, while Fort Clark Springs is much more affordable and has campgrounds and low-priced motel rooms located in the original cavalry barracks.

As is summarized later, these 33 forts are used for multiple purposes and activities, but the primary mission of the forts is as follows. Just over half are historical sites or museums: Chadbourne, Concho, Croghan, Davis, Gibson, Griffin, Inglish, Lancaster, Leaton, Martin Scott, Mason, McKavett, Phantom Hill, Stockton, Supply, Towson, and Washita. Of these, Fort Davis is the only National Historic Site. Fort Leaton also serves as the western visitor center for Big Bend Ranch State Park. Fort Supply is also part of a correctional facility and a behavioral/mental health center. Hamilton Creek Park is located on the original site of Fort Croghan, and is thus included in ecosystem service analyses. Likewise, Rio Concho Park is located on the original site of Fort Concho, and is also included in analyses. Five are city or county parks primarily used for local community activities and recreation: Belknap, Duncan, Fisher, Graham, and Inge. Fort Duncan is an agglomeration of multiple parks and city facilities, including recreational fields, golf course, library, museum, multi-purpose center, and an elementary school. Fort Fisher Park also contains the Waco tourist information center and the Texas Rangers Hall of Fame and Museum, which serves as the official museum and principal repository for artifacts and archives related to the Texas Rangers whose unorthodox battle techniques played a pivotal role in the Southern Plains Indian Wars. Four forts are state parks used for camping and outdoor recreation: Boggy, Parker, Richardson, and Sherman (the last named Lake Bob Sandlin State Park). The historic site of *Old Fort Parker* is now separate from the state park, but both are included in ecosystem service analyses. Two of the forts are now schools. Fort McIntosh is the site for Laredo Community College and its Lamar Bruni Vergara Environmental Science Center (LBVESC). Fort Ringgold is now the administrative complex for Rio Grande City Consolidated Independent School District and also contains Ringgold Elementary and Academy for Academic Enhancement Middle School. Two of the fort properties are resorts (Cibolo, Clark); however, both offer public programs and educational opportunities. One is a USDA research facility, but also houses the *Historic Fort Reno* historical site and museum, as well as the U.S. Cavalry Association headquarters and library. Of the 33 forts, only two remain as active military installations, Fort Sill in OK and Fort Bliss in TX.

4.2 Physical Geography, Land Use, and Ecoregions of the Forts

Before discussing the ecosystem services provided by the forts, it is helpful to understand the environment in which the forts were established and their current ecosystems. The Southern Plains of OK and TX have a semi-arid climate with extreme variations in precipitation and temperature, both annually and inter-annually. Consequently, floods and droughts are common, with the latter occurring in approximate decadal cycles that coincide with the La Niña phase of the El Niño-Southern Oscillation. Summers are typically very hot and dry. There is a strong precipitation gradient decreasing from east to west, which has largely dictated the natural vegetation pattern of forests in the east, tallgrass/mixed prairie in the mid-section, shortgrass prairie in the northwest, and a mix of desert grassland and shrubland (depending on soil type and elevation) in the southwest (Griffith et al. 2007; Woods et al. 2005).

Following the Indian Wars, TX and OK were converted to an agriculture-dominated landscape with croplands in ecoregions with productive soils (Central Great Plains, Central Irregular Plains, Texas Blackland Prairies, and river valleys of most ecoregions), pasture/rangeland in less fertile ecoregions (Southwestern Tablelands, East Central Texas Plains, Southern Texas Plains, Cross Timbers, Edwards Plateau, Chihuahuan Deserts), and plantation forestry in the forested ecoregion (South Central Plains). Extensive livestock grazing over the past 150 years suppressed the prairie fire regime and led to the spread of several invasive tree and shrub species, most notably eastern redcedar (*Juniperus virginiana*), Ashe juniper (*Juniperus ashei*), honey mesquite (*Prosopis glandulosa*), creosote bush (*Larrea tridentata*), and catclaw acacia (*Acacia greggii*) (Archer 1994). Urban development spread rapidly beginning in the mid-twentieth century, particularly along the I-35 corridor. The twentieth century was also a period of extensive resource mining, oil/gas drilling, and wind power development. The net result of these intensive and extensive land uses is that the Southern Plains is now a mosaicked landscape with only small areas of native prairie remaining. Although almost all of the forts were originally located on prairie, most of these grasslands have changed into shrublands or woodlands (Table 4.1). And now more than half of the forts are located in urban or suburban environments.

Table 4.1 Current land use and land cover surrounding the protected forts

	Land Use			
Land Cover	Rural/Agricultural	Suburban	Urban	Total
Grassland	1	2	2	5
Shrubland	7	1	7	15
Woodland	5	4	1	10
Forest	3	0	0	3
Total	16	7	10	33

4.3 Current Ecosystem Services of the Southern Plains Forts

4.3.1 Classification of Ecosystem Services

There is not an agreed upon or standard ecosystem services (ES) classification. The most thorough classification is the Common International Classification of Ecosystem Services (CICES); however, it has been found to be overly complex, has unclear terminology, and does not properly frame cultural services (Haines-Young 2016), a focus of this chapter. Thus, I instead used a more simplified classification that better accounts for the cultural ES provided by forts: the Economics of Ecosystems & Biodiversity (TEEB) framework (TEEB 2010). I adapted this framework to create a simplified classification of the ES provided by forts (Table 4.2). For each fort/park, I rated each ES as purposeful (P), incidental (I), or nonexistent (N). These ratings provide context for whether the fort is using resources to 'purposefully' manage for the ES as opposed to the ES taking place on the property 'incidentally.' In some cases, the ES may be there incidentally (e.g. Aesthetics and Inspiration from dark sky), but if the fort has designed and allocated resources for stargazing programs, it would receive a 'purposeful' rating in this category. These types of distinctions are made in each category below.

In addition to ecosystem services provided by the forts, I also identified other key variables including size of the protected area, its connectivity to other protected areas, ecoregion, surrounding land cover/use, length of nature trails, and annual average visitation (over recent years).

4.3.2 Provisioning Services

4.3.2.1 Habitat

By virtue of containing soil and vegetation (and in most cases water), all of the forts provide at least incidental habitat to a number of species. The total protected area of this potential habitat of the 33 forts is 1061 km^2, ranging from 0.6 ha (1.5 acres; Inglish) to 49,396 ha (122,061 acres; Bliss). This area has been increasing since 1935 (Fig. 4.2) and is still increasing as some forts acquire adjacent lands (e.g. Fort Davis NHS adding 17 ha in 2011). There is also potential for this area to increase with restoration of other Indian War forts such as Fort Bird, which is located in Arlington's River Legacy Park but has yet to be commemorated by more than a historical marker. These areas represent the quantity of potential habitat. A measure of habitat quality is the amount of 'connected and protected' habitat, particularly in highly modified landscapes such as the Southern Plains (Fischer and Lindenmayer 2007). The largest 'connected and protected' fort within the boundaries of TX and OK is Fort Cibolo, which connects Chinati Mountains State Natural Area and easement (23,672 ha) to its west and Big Bend Ranch State Park (136,588 ha) to its east.

Table 4.2 Ecosystem services classification, adapted from the TEEB framework (TEEB 2010)

Category	Ecosystem Service	Definition
Provisioning	Habitat	The presence of food, water, and shelter needed by plants and animals to survive. Biodiversity and biological/pest control are byproducts of this service.
	Food	The presence of gardens/farms, ranching, or fishing that directly provide for human consumption.
	Raw materials and energy	The presence of materials used directly for construction, fuel, and energy production. Includes underground resources currently being mined, hydroelectric dams, and wind turbines.
	Fresh water	The presence of surface or ground water currently being used for any purpose.
Regulating	Climate and air quality	The presence of trees or other vegetation that remove pollutants from atmosphere, store/sequester carbon, contribute to the water cycle, and regulate air temperature.
	Water quality and flood control	The presence of wetlands or riparian habitats that mitigate downstream flooding and filter pollutants/pathogens.
	Soil protection/ fertility	The presence of vegetation, structures, or activities specifically designed to prevent soil erosion or promote soil fertility, such as composting.
	Pollination	The presence of habitat and vegetation on fort property, and a farm within 3 km radius of fort (typical forage distance of honey bees).
Cultural	Recreation for mental and physical health	The presence of features (e.g., nature trails, greenspace, water bodies) and activities (e.g., hiking, sports, hunting) that promote physical and mental health.
	Aesthetics and inspiration	The presence of unique, preserved, or scenic landscapes and activities that promote appreciation of arts, culture, or science.
	Identity and spirituality	The presence of natural features that are culturally significant, have sacred/religious meaning, or create a sense of place/pride.
	Tourism	The presence of programs designed to attract visitors for regional economic benefit.

For each ecosystem service for each fort, I assigned a rating of purposeful (P), incidental (I), or nonexistent (N)

The Fort Cibolo property is thus a centerpiece to a 1724-km^2 connected protected area that provides a potential migration corridor over 130 km in length. Beyond state boundaries, Fort Bliss is connected to approximately 12,000 km^2 of protected lands, including its property in New Mexico (and associated DoD lands) along with Franklin Mountains State Park, Lincoln National Forest, and White Sands National Park. If all adjacent federal and state lands are included, this connected and protected habitat extends across most of the southwestern U.S. Other notable protected and connected fort lands are the 1104-ha Davis Mountains State Park (Davis), the 23,885-ha Wichita Mountains National Wildlife Refuge (Sill), and 86,043 ha of Lake Texoma USACE lands and other parks/refuges adjacent to Fort Washita. In all,

there are 3978 km^2 of protected and connected fort lands within TX and OK. Not included in this figure are adjacent private lands with active environmental management such as the 566 ha property surrounding Fort Phantom Hill.

Another measure of habitat quality is coverage of native vegetation (Fischer and Lindenmayer 2007). As mentioned in Sect. 4.2, only a few small areas of native prairie remain in the Southern Plains. The protected forts have added to this inventory considerably through native plantings, prescribed fires, exotic/invasive vegetation removal, or grazer control. Fort Cibolo again tops the list in this measure of habitat quality, with almost 3000 ha of restored native prairie, which took years and millions of dollars to accomplish. Fort Reno protects more than 1200 ha of native tallgrass prairie that has never been plowed. Fort Sill maintains several large areas of native prairie, including a 970 ha tallgrass prairie preserve. Other forts that have actively maintained or restored native prairie or are in the process include Boggy, Bliss, Clark, Concho, Davis, Lancaster, Martin Scott, McIntosh, Parker, and Sherman. Fort McIntosh also has a native plant nursery with over 10,000 plants raised since 2003.

Water features on the fort properties also provide valuable habitat. Only five forts do not have water features on or adjacent to their property. Some have a variety of aquatic habitats. Fort Sill, for example, has approximately 220 lakes/ponds (142 managed as fisheries; rest designated as wildlife use), 452 wetlands (55 ha of palustrine; 10.5 ha of riverine; 308 ha of lacustrine), and approximately 800 km of rivers/streams. Aquatic and riparian habitats have been purposefully restored on a few of the forts, including a wetland on McIntosh and ~20 km of riparian buffers on Cibolo. Given that all of these Southern Plains forts are within the Central Flyway, these aquatic and riparian habitats likely serve millions of migratory birds every year. Six of the forts are located along or connected to the Rio Grande, which is a popular stopover for hundreds of bird species (Johnsgard 2012).

Overall, the large areas, high quality, and diversity of environments among the protected forts (Table 4.1; Fig. 4.1) provide a wealth of habitat for fish and wildlife. There is also high biological diversity within the protected lands of some of the larger forts. On Fort Bliss for example, approximately 335 species of birds, 58 species of mammals, 39 species of reptiles, and 8 species of amphibians have been documented in this desert shrub-grassland ecosystem (DPW 2015). Even on the much smaller 212-ha Fort Davis National Historic Site, there were 15 species of mammals, 125 species of birds, 39 species of reptiles, 10 species of amphibians, and 368 species of vascular plants (NPS 2016). Some forts have reintroduced native animals such as bison (Chadbourne, Cibolo) and wild turkey (Cibolo). Texas longhorn cattle, though not native, is a historically and culturally important species that is managed for on several fort properties (Chadbourne, Cibolo, Griffin). Fort Griffin is home to the Official State of Texas Longhorn Herd and its breeding program. During extreme droughts, Fort Sill allows longhorn cattle from the Wichita Mountains National Wildlife Refuge to graze on its grasslands. Other notable species managed for among the forts are pallid bats (*Antrozous pallidus*) at Fort Leaton's bat house (Fig. 4.3) and the threatened Texas horned lizard (*Phrysonsoma cornutum*) at Fort Lancaster by not using pesticides on harvester ants, the lizard's

Fig. 4.3 Habitat features in the desert shrubland ecosystem at Fort Leaton (top). The fort provides incidental habitat for nesting birds (bottom-left) and purposeful habitat for pallid bats (bottom-right)

primary food source. The only endangered animal species I found managed for was the black-capped vireo (*Vireo atricapillus*) at Fort Sill. Fort Bliss manages for several threatened/endangered plant species.

Overall and consistently, the forts that purposefully manage for habitat (Table 4.3) take an ecosystem-based approach rather than managing for specific species. This approach is documented in the Integrated Natural Resources Management Plans (INRMP) developed every five years at Forts Bliss and Sill (DPW 2015; Stout 2014), but was also evident in my discussions with other fort managers. An important component of this ecosystem-based approach at several forts was control of species (i.e. feral hogs, deer) that damage the habitat for other species, or degrade other ecosystem services. Feral hogs have become quite a nuisance in TX and OK, impacting soil, native vegetation, and agricultural productivity, resulting in at least $3 billion in damages and costs for control (Adams et al. 2005). While not having as intense of an impact as feral hogs, deer overpopulations reduce the abundance and health of native plant communities, which impacts other species. Feral hogs and/or deer are controlled (via hunting or trapping) at Boggy, Bliss, Cibolo, Clark, and Sill.

4.3.2.2 Food

Many ecoregions of the Southern Plains are known for their rich, productive soils, particularly the Central Great Plains, Central Irregular Plains, and Texas Blackland Prairies. Many forts are still taking advantage of these fertile soils with small gardens or orchards, including Belknap, Cibolo, Clark, Concho, Gibson, Inglish,

Table 4.3 Inventory of ecosystem services currently being provided by the protected forts

Fort ID	Fort Name	Land Use-Cover	PROVISIONING				REGULATING			
			Habitat	Food	Raw Materials and Energy	Fresh Water	Climate/Air Quality	Water Quality and Flood Control	Soil Protection/ Fertility	Pollination
1	Fort Belknap	R-W	I	P	N	N	P	N	N	P
2	Fort bliss	U-S	P	P	P	P	P	P	P	P
3	Fort boggy	R-F	P	I	N	P	P	I	I	N
4	Fort Chadbourne	R-S	I	P	N	N	I	N	N	N
5	Fort Cibolo	R-S	P	P	P	P	P	P	I	P
6	Fort Clark	U-S	P	P	N	P	I	P	I	P
7	Fort Concho	U-S	P	P	N	P	P	P	P	P
8	Fort Croghan	U-W	I	P	N	P	I	I	N	I
9	Fort Davis	S-S	P	N	N	P	P	P	I	N
10	Fort Duncan	U-S	I	I	N	I	P	I	I	N
11	Fort fisher	U-G	I	I	N	I	I	I	N	I
12	Fort Gibson	S-W	I	P	N	I	I	I	N	I
13	Fort Graham	S-W	I	P	N	I	I	I	N	I
14	Fort griffin	R-S	P	P	N	P	I	I	N	I
15	Fort Inge	R-S	I	P	N	P	I	I	N	I
16	Fort Inglish	U-G	I	P	N	N	I	N	N	I
17	Fort Lancaster	R-S	P	N	N	P	P	I	N	N
18	Fort Leaton	R-S	P	N	N	N	I	N	N	I
19	Fort Martin Scott	S-W	I	N	N	I	P	I	N	P
20	Fort Mason	S-W	I	N	N	N	I	N	N	I
21	Fort McIntosh	U-S	P	P	P	P	P	P	P	P

(continued)

Table 4.3 (continued)

Fort ID	Fort Name	Land Use-Cover	PROVISIONING				REGULATING			
			Habitat	Food	Raw Materials and Energy	Fresh Water	Climate/Air Quality	Water Quality and Flood Control	Soil Protection/ Fertility	Pollination
22	Fort McKavett	R-W	I	P	N	I	I	P	I	I
23	Fort Parker	R-W	P	P	N	P	P	I	P	P
24	Fort Phantom Hill	R-S	I	N	N	N	I	N	N	I
25	Fort Reno	R-G	P	P	P	P	P	P	P	P
26	Fort Richardson	R-W	I	P	P	P	I	I	N	N
27	Fort Ringgold	U-S	I	I	N	I	I	I	N	I
28	Fort Sherman	R-F	P	P	N	P	P	I	P	P
29	Fort sill	S-G	P	P	P	P	P	P	P	P
30	Fort Stockton	U-S	I	N	N	N	I	N	N	P
31	Fort supply	S-G	I	N	N	N	I	N	N	I
32	Fort Towson	R-F	I	N	N	I	I	I	N	I
33	Fort Washita	R-W	I	I	N	P	I	I	N	I

Fort ID	CULTURAL				Annual average visitors	Current fort protected area (ha)	Nature trails (km)
	Recreation for Mental and Physical Health	Aesthetics and Inspiration	Identity and Spirituality	Tourism			
1	P	I	N	P	30,000	6	0
2	P	P	P	I	4500	49,397	1.0
3	P	I	I	P	10,000	747	5.6
4	N	I	N	P	11,000	10	0
5	P	P	P	P	2500	12,141	366.9
6	P	P	P	P	3500	1093	99.8
7	P	P	I	P	54,800	16	5.4
8	P	P	P	P	2250	16	1.6
9	P	P	P	P	56,000	212	6.4
10	P	P	I	P	2000	121	2.2
11	P	I	I	P	80,000	6	0.8
12	P	I	N	P	55,000	35	0
13	I	I	N	I	100	36	0
14	P	P	I	P	11,000	205	4.0
15	P	P	P	P	1500	19	3.2
16	N	I	N	P	1750	1	0
17	N	I	N	P	3000	33	0
18	P	P	P	P	4500	9	1.6
19	N	I	N	P	16,000	10	0
20	N	I	N	I	2000	1	0
21	P	P	P	P	11,000	84	2.4

(continued)

Table 4.3 (continued)

Fort ID	CULTURAL				Annual average visitors	Current fort protected area (ha)	Nature trails (km)
	Recreation for Mental and Physical Health	Aesthetics and Inspiration	Identity and Spirituality	Tourism			
22	P	I	I	P	5000	32	2.4
23	P	P	P	P	53,000	620	21.1
24	N	I	N	I	5000	15	0
25	N	P	P	P	22,000	2711	0
26	P	P	I	P	36,100	184	20.0
27	P	P	I	P	200	98	2.0
28	P	I	I	P	62,500	259	7.2
29	P	P	P	I	16,000	37,901	1.3
30	I	P	N	P	12,500	11	0
31	N	I	N	I	600	2	0
32	I	P	N	P	9000	89	1.0
33	P	P	I	P	22,000	61	3.2

See Table 4.2 for description of ecosystem services. For each ecosystem service for each fort, I assigned a rating of purposeful (P), incidental (I), or nonexistent (N). Land uses are Rural (R), Suburban (S), and Urban (U). Land covers are Grassland (G), Shrubland (S), Woodland (W), and Forest (F)

McIntosh, McKavett, Parker, Ringgold, and Sill (Fig. 4.4). The organic garden on Fort McIntosh provides food for its animals, college personnel, farmers markets, and food banks, and is used for botany, culinary arts, and environmental classes at Laredo CC. Fort Gibson hosts several Bake Days every year where a restored brick oven is used to bake goods using corn and other crops from the garden. Some of their corn is also used for chicken feed at a nearby historical site. Fort Sill leases 2428 ha annually for hay, alfalfa, corn, winter wheat, sorghum, sesame, and livestock grazing. Serving as a USDA research facility, Fort Reno also does farming on a larger scale with more than 400 ha in periodic crop production (mostly winter wheat), most of which is used for livestock forage and feed (Fig. 4.4). Some of the cattle fed by Fort Reno crops include those at *Braum's* dairy farm just down the road in Tuttle, OK, which supplies dairy products to much of the Southern Plains. Some of the beef cattle fed by Fort Reno crops are used for human consumption. Other forts that raise livestock, where excess is sold or donated for slaughtering, are Chadbourne, Cibolo, and Griffin.

Gardens, farms, and ranching were all identified as purposeful food ecosystem resources (Table 4.3) because they require active management. Fishing on the other hand was listed as incidental, or purposeful if stocking occurred. Non-stocked fishing occurs on eight forts (Bliss, Clark, Concho, Duncan, Fisher, McIntosh, Ringgold, Washita), while stocked fishing occurs on ten forts (Boggy, Cibolo, Croghan, Graham, Griffin, Inge, Parker, Richardson, Sherman, Sill). Hunting (and limited trapping) occurs on five forts (Boggy, Bliss, Cibolo, Clark, Sill). I will note, how-

Fig. 4.4 Farming is still practiced on many of the forts, like in the small post gardens at Fort Gibson (top-left) and Fort McKavett (top-right). Fort Reno (bottom) is home to a USDA research facility that raises livestock and has more than 400 ha in periodic crop production, mostly winter wheat as shown here (Historic Fort Reno is in the background near the water tower)

ever, that fishing in the Rio Grande along Forts Duncan, McIntosh, and Ringgold is not productive because of poor water quality, limited access, and discouragement by the U.S. Border Patrol.

4.3.2.3 Raw Materials and Energy

Texas and Oklahoma have a wealth and wide variety of natural, mineral, and energy resources. The energy development of the region, whether oil, natural gas, wind, or solar, is particularly prominent. But by virtue of being protected places, extraction of raw materials and energy on the fort properties is limited. There are no vertical oil wells and only one vertical gas well on any of the properties (Richardson). Fort Richardson also has a directional gas well (i.e. wellhead not located on property), and Fort Griffin has a directional oil/gas well. Two forts had multiple small-scale wind turbines, Cibolo and McIntosh. Fort Cibolo also has a few solar panels. Fort Reno is a USDA Biomass Research Center and accordingly produces biofuels, but only periodically. The two U.S. Army bases have a federal mandate to increase renewable energy production, and have made some strides. Fort Sill has several geothermal wells to heat water and has installed solar panels on numerous buildings. There is also limited wood cutting allowed by the Fort Sill community. More ambitious, Fort Bliss has a "Net Zero" plan where it will produce as much energy as it consumes on an annual basis. So far, they have installed small-scale wind turbines, a 1.4-MW solar farm, and 13.4 MW in distributed rooftop solar panels on hundreds of buildings and houses. Both forts have a wealth of potential energy sources (via wind, solar, geothermal, natural gas) and are currently exploring options to further develop these resources.

4.3.2.4 Fresh Water

Given the semi-arid and drought-prone climate of the Southern Plains, all the forts were established near [presumably] reliable water sources. Water sources ended up not being reliable at Belknap and Chadbourne, resulting in their closure; and accordingly, there is no current use of surface or groundwater on their property. For the other forts where water resources are currently nonexistent (Table 4.3), this is a consequence of the property boundaries contracting since their establishment, away from their original water source. The rest of the forts contain rivers (impounded reservoirs in eight cases), springs, lakes/ponds, or wetlands; meaning they have at least incidental use of water resources. The larger forts, like Fort Sill mentioned in Sect. 4.3.2.1, contain most or all of these features.

Half of the forts (n = 17) are purposefully managing their water resources for a variety of benefits (Table 4.3). The fort water source benefitting the most people is the 27.5-million-gallon-per-day (mgd) solar-powered Kay Bailey Hutchison Desalination Plant on Fort Bliss, reportedly the largest inland desalination plant in

the world. Not only does it serve the 164,000 people of the Fort Bliss military community, but it also contributes to El Paso Water Utilities' supply, which serves over 750,000 people. At a much smaller scale, Fort Parker Lake is the backup water supply for the City of Groesbeck, with a population of 4300. The other purposeful uses of water on the forts include local water supply, irrigation, boating, fishing, swimming, and tourism (Fig. 4.5). Obviously, these purposeful uses of water are benefitting other ecosystem services, some already described (habitat; irrigation for food crops) and others detailed below. One great example is how Fort Davis uses a groundwater well to keep its cottonwood grove alive during droughts, which benefits habitat, air quality, soil protection, aesthetics, and tourism, and has cultural significance (Myers 2000).

Fig. 4.5 Water resources on the forts are used for many benefits. At the Fort Clark Springs resort (top), Las Moras Springs, fed by the Edwards Aquifer, forms the headwaters of Las Moras Creek (bottom-left), which empties into the Rio Grande. In addition to local water supply, irrigation, fishing, recreation, and tourism, the 20 °C (68 °F) water from the springs is used to fill a 0.2 ha swimming pool on fort grounds (bottom-right) used for swimming and body temperature regulation

4.3.3 Regulating Services

4.3.3.1 Climate and Air Quality

When the forts were established, trees were highly valued as building materials and fuel. Nowadays, trees and other vegetation within the forts are valued more for their benefits to air quality. All the forts contain vegetation and thus incidentally benefit climate and air quality; however, 14 forts have allocated resources to plant new trees and preserve old ones (Table 4.3), like Fort Davis mentioned above. Fort Bliss alone has planted thousands of trees (DPW 2015). Many of the forts have planted native trees or restored native prairie (see Sect. 4.3.2.1), which also filters the air, stores/sequesters carbon, contributes to the water cycle, and regulates air temperature (Fig. 4.6). As the location of the Southern Plains Regional Climate Hub, Fort Reno is instrumental in demonstrating these benefits, as well as researching strategies to mitigate climate change. The air quality benefit of vegetation in forts is particularly important for the ten forts located in urban environments with artificial surfaces, high emissions, and higher levels of air pollution; however, fossil fuel fired power plants, smelters, industrial boilers, petroleum refineries, manufacturing, increased vehicular traffic, and wind-blown dust from around the two states and northern Mexico impact air quality of the entire region. The noticeable decrease in air quality since the mid-twentieth c. has led to hazes that impact the aesthetic views from the forts.

4.3.3.2 Water Quality and Flood Control

Water quality and flood control are additional environmental issues some of the forts have to address. Three quarters of the forts (n = 25) are located within active floodplains, and therefore incidentally mitigate downstream flooding and filter water pollutants, at least during floods, which are frequent in the Southern Plains. A few of the forts purposefully manage for floods and water quality (Table 4.3). Forts Bliss, Cibolo, Clark, Concho, Davis, McIntosh, McKavett, Reno, and Sill all maintain and restore riparian corridors throughout their property. Ten of the forts are

Fig. 4.6 Native grassland restoration is being carried out at several of the forts, including Fort Lancaster (left) and Fort Martin Scott (right)

located along or have creeks that flow into the Rio Grande, which in 1993 was designated by *American Rivers* as the most endangered river in the U.S. due to overpumping and excessive pollution. Consequently, these ten forts have the opportunity to improve its water quality, which Fort McIntosh has seized. With millions of gallons of raw sewage from Mexican tributaries and a plethora of toxic chemicals and trash from Laredo factories and warehouses, the Laredo section of the Rio Grande that runs along Fort McIntosh has been found to be the most polluted. In response, the Lamar Bruni Vergara Environmental Science Center (LBVESC) on Fort McIntosh has made many and considerable contributions to benefit the river by working with U.S. Border Patrol to mitigate its environmental impacts to the river and its riparian zone, including saving hundreds of trees from being felled, restoring 4 ha of native riparian habitat, restricting ATV usage on riverside trails, and preventing the construction of a border 'wall' in the floodplain which could increase downstream flooding. Fort Bliss has also benefited the Rio Grande by rehabilitating numerous incised arroyos which not only improves water quality, but also reduces soil erosion.

4.3.3.3 Soil Protection/Fertility

Of all the ecosystem services, soil protection/fertility was the least purposefully managed (Table 4.3). The argument could be made that all the forts are incidentally protecting soil by having vegetation, but I assessed whether the vegetation, structure, or activities were specifically designed to prevent soil erosion or promote soil fertility. Thus, forts with only mowed fields received a nonexistent for this category. I also did not count maintenance of the walking trails around fort buildings and ruins as incidental or purposeful. The forts that I identified as incidental were one that allows natural composting by not mowing or clearing vegetation (Boggy), ones that indirectly protect soil through riparian restoration (Bliss, Cibolo, Clark, Concho, Davis, McIntosh, McKavett, Reno, Sill), and ones that indirectly reduce soil erosion by hunting overpopulations of deer and feral hogs (Boggy, Bliss, Cibolo, Clark, Sill). Only seven forts purposefully manage for soil protection/fertility, one through riverbank stabilization (Concho) and three through composting (McIntosh, Parker, Sherman). Fort Parker State Park has also constructed several terraces to reduce soil erosion. Forts Bliss and Sill, according to their INRMPs, actively address all soil erosion on their property including nonpoint sources, plan land uses that minimize erosion, reroute roads out of arroyos or other eroding landscapes, reseed bare areas, limit hay cuttings to at least 10 cm above the soil, and construct stream crossings to prevent in-channel erosion. Fort Sill also fertilizes its agricultural fields with sludge from its wastewater treatment plant. Also noteworthy is that Fort Sill has 10,144 ha of 'prime farmland soils' which are protected under the Farmland Protection Policy Act of 1981. As a USDA research facility, Fort Reno conducts many activities to reduce soil erosion (no-till agriculture, cover crops) and promote soil fertility (manuring and other natural fertilizers).

4.3.3.4 Pollinaton

Pollination as it is used here (*sensu* TEEB 2010) is specific to cultivated crops. In order for a fort to receive a purposeful rating for this category, they have to (1) be using resources to plant or maintain wildflowers or other vegetation that attracts pollinators, (2) have at least one of the purposes of this activity being to attract pollinators, and (3) be located within 3 km (typical forage distance of honey bees) of 'cultivated crops' as identified using the 2011 National Land Cover Database (Homer et al. 2015) or have their own gardens (e.g. Clark, McIntosh). This third requirement resulted in some forts like Boggy receiving 'nonexistent' even though they are restoring a portion of their property to native vegetation potentially used by pollinators. Similarly, Forts Chadbourne, Davis, Duncan, Lancaster, and Richardson are all more than 3 km from any cultivated crops, and therefore received nonexistent (Table 4.3). Several of the forts are planting wildflowers, but are doing so merely for aesthetic purposes, and therefore receive an incidental rating. Of the forts that purposefully manage for pollination, most restore native prairie, manage butterfly gardens, and plant wildflowers with the purpose to attract pollinators. Fort McIntosh, for example, has two designated wildflower gardens and one butterfly garden which has already attracted over 40 species. Forts Bliss and Sill manage for specific plant and animal species that are important pollinators (DPW 2015). And Fort Reno conducts research and outreach on pollination.

4.3.4 Cultural Services

4.3.4.1 Recreation for Mental and Physical Health

Recreational opportunities on the forts that improve mental and physical health are multifarious. For 11 forts, outdoor recreation is their primary mission, including the Texas State Parks (Boggy, Parker, Richardson, Sherman), city/county parks (Belknap, Duncan, Fisher, Graham, Inge), and two resorts (Cibolo, Clark). The two schools, McIntosh and Ringgold, have outdoor recreational complexes and host a variety of activities that promote physical and mental health. The two U.S. Army bases have very active outdoor recreation programs and numerous parks, notably Biggs Park (Bliss) and Lake Elmer Thomas Recreation Area (Sill). Further, two of the heritage sites have parks on original fort property, which are included in this analysis: Hamilton Creek Park on Croghan and Rio Concho Park on Concho. Fort Graham received an incidental rating for this category because no resources are currently used for its maintenance, on account of Hill County recently terminating the lease with USACE. The other incidental rating is Fort Stockton, which is used for leisure walking and occasionally for city events like races, but does not use its resources for recreational purposes. The rest of the forts are primarily heritage sites that do not offer recreational opportunities (Table 4.3).

The most popular recreational activity on the forts with a purposeful rating is hiking (Fig. 4.7). Among all the forts, there are 559 km (347 mi) of nature hiking trails (Fig. 4.2); however, this value is skewed by Cibolo, which has 367 km alone. The other resort, Fort Clark Springs, has the next longest trail system with a total of 100 km, but only 27 km is available for everyday public use. The third longest trail system is 20 km, which Fort Richardson and Fort Parker State Parks each have. The median nature trail length among all forts is 1.6 km. The walking trails around fort buildings and ruins are not included in any of these figures, only trails that involve interaction with nature. Many of these trails are also used for biking, and some for horseback riding (Cibolo, Clark, Griffin, Inge, Richardson). Given the historical and cultural significance of the forts, many fort grounds and trails are used for prominent running and adventure races like the Port to Fort Adventure Race at Fort Gibson. Fort Washita hosts an annual track meet for about 3000 people.

The second most popular recreational activity is fishing, available at all four state parks (Fig. 4.8), both resorts, six city/county parks, both U.S. Army bases, both schools, and two of the heritage sites (Griffin, Washita), with most of these fish-stocking. Seasonal hunting is allowed on five forts (Boggy, Bliss, Cibolo, Clark, Sill). Boating, swimming, and camping are allowed at many of the sites as well. Most of the city/county parks have playgrounds and athletic fields, and four forts have golf courses (Bliss, Clark, Duncan, Sill). Among all the forts, there is a recreational activity for practically anyone's taste, even if it is just leisure walking around the heritage sites.

Fig. 4.7 Nature hiking is a popular recreational activity at many of the forts. At Fort Davis, hikers can explore 6.4 km of trails through mountainous terrain overlooking the fort

Fig. 4.8 Fishing is another popular recreational activity at many of the forts, especially the state parks like Fort Richardson (top). The quarry pond at Fort Richardson (bottom-left) is stocked with fish annually. Note how the fishing sign at the quarry pond (bottom-right) brings together various ecosystem service concepts

4.3.4.2 Aesthetics and Inspiration

All of the protected forts have historical and cultural significance, and all but a few are archaeological landmarks where cultural remains have been protected. Further, two-thirds of the forts have 'Living History Days' where they demonstrate cultural and technological aspects of the forts during the mid-1800s. Thus all these forts have incidental aesthetic and inspirational value, but some of the forts are purposefully dedicating resources [beyond just Living History Days] to promote appreciation of arts, culture, and science (Table 4.3). These activities include nature centers, art shows/classes, and modern cultural events. Fort Concho collaborates with the San Angelo Museum of Fine Arts for multiple events and programs. Similarly, Fort Leaton works with multiple organizations, including the Mexican Consulate, to host many and various arts and cultural events/programs/conferences. Native American cultural programs are held at Gibson, Towson, and Old Fort Parker Historic Site. Fort Richardson has a nature center (mostly preserved animals) on the fort grounds. Fort McIntosh has a more sophisticated environmental science center, natural history exhibit hall, and living laboratory that includes live native animals (Fig. 4.9). Forts Bliss, Clark, Duncan, McIntosh, Ringgold, and Sill all have multi-purpose centers used regularly for arts and cultural events.

Several forts take advantage of their unique, scenic landscape to host arts, cultural, and scientific activities. Fort Reno (with their 1200-ha native prairie) and Fort

Fig. 4.9 Fort Ringgold (top-left) is the site of numerous cultural activities, classes, and centers, including the community Multipurpose Center (top-right). Fort McIntosh provides a wide variety of community services (bottom-left) and is home to the Lamar Bruni Vergara Environmental Science Center & Natural History Exhibit Hall (bottom-right)

Davis (with their biodiverse mountainous desert terrain) both use their aesthetic landscapes for scientific research and classes in film, photography, botany, technology, and conservation. Fort McIntosh is home to the Rio Grande International Study Center, which not only conducts scientific research, but also leads a binational collaboration that preserves and protects the Rio Grande, its watershed and environment for the purpose of improving the environmental health of the community (Fig. 4.9). Regular scientific research also occurs on Forts Bliss, Lancaster, Leaton, Ringgold, and Sill. Fort Cibolo uses its picturesque landscape with abundant wildlife to provide guided trips for nature photography, horseback riding, and hiking. Fort Griffin offers several types of nature hikes and programs. Fort Griffin is also well-known for its Star Parties (i.e. stargazing events), which benefit from its unusually dark skies (Fig. 4.10). Other forts that have dark skies and regularly host stargazing events are Cibolo and Inge.

4.3.4.3 Identity and Spirituality

All of the forts create a sense of place/pride, but in keeping with the TEEB (2010) framework, I limit this classification to natural features such as springs, rivers, vegetation, and mountains. The Rio Grande, for example, is culturally significant, has sacred/religious meaning, and creates a sense of place/pride for multiple cultures. The four forts located along the Rio Grande receive at least an incidental rating for this category, but Leaton and McIntosh purposefully dedicate resources to promote

Fig. 4.10 Stargazing events are held regularly at three of the forts, with the most well-known being at Fort Griffin. (Image courtesy of the Texas Historical Commission)

this identity and spirituality. Fort McIntosh hosts the Dia del Rio festival every October which includes a river art exhibit, kayaking excursions, sustainability workshops, and a ceremony where ministers of multiple faiths bless the river and adjacent trail. A Native American ceremony is also held at this rare, natural crossing of the Rio Grande, where 5000 years of their history is acknowledged and blessed. The site of Fort Leaton is particularly significant and commemorated with multiple events because it is located along the *Camino Real* (of Mexico) and at *La Junta de los Rios*, the confluence of Rio Grande and Rio Conchos. Fort Ringgold, located on the Rio Grande, receives a purposeful rating for a different reason; it has three volcanic ash mounds (currently the sites for the Robert E. Lee House, Telegraph House, and Observation Tower) which were used by prehistoric Native Americans for stone tools and likely religious ceremonies. Created during the same geologic epoch about 30 million years ago is the 43-m high volcanic plug known as Mount Inge (Fig. 4.11), which was used by prehistoric and modern Native Americans. Mount Inge now serves another ecosystem service, blocking the light pollution from the city of Uvalde so that Fort Inge can still have stargazing events. The entire 12,140 ha property of Cibolo Creek Ranch is on a volcanic landscape, also from the same geologic epoch (Oligocene), and its three forts are located in a caldera. Fort Cibolo also benefits from its views over the Chisos Mountains, caves with fossils and Native American art, and springs.

Springs, important for identity and spirituality, are a common natural feature among the forts. Accordingly, cultural artifacts, some prehistoric, have been found

Fig. 4.11 Natural and cultural features at Fort Inge

around these springs. The most prominent of the springs is Fort Clark Springs, which has been transformed into a pond habitat, swimming pool, and park that hosts a wide variety of activities (Fig. 4.5). Other forts with notable springs include Bliss, Inge, McKavett, Parker, Richardson, Sherman, and Sill. Fort Sill also contains part of the Wichita Mountains, named for the Native American tribe that inhabited this region prior to European settlement, but also an important site to the Apache and Comanche tribes.

Three of the forts have culturally significant vegetation: the native prairie on Fort Reno that has never been plowed, the cottonwood grove on Fort Davis (detailed in Myers 2000), and multiple native species on Fort Bliss. Fort Bliss still allows multiple tribes to harvest natural resources used in religious ceremonies or that have cultural significance. One tribe is the Mescalero Apache who use agaves native to Fort Bliss for many different cultural/spiritual purposes.

4.3.4.4 Tourism

All of the forts are tourist attractions, attracting more than 600,000 people every year overall. The mean fort visitation is 18,370 and the median is 10,000. Only six of the forts received an incidental rating because they are not currently using resources to increase tourism (Table 4.3). The most visited fort is Fort Fisher due to it being situated along a riverwalk next to a major university (Baylor) in a large city (Waco) that is located along one of the busiest interstates in the nation (I-35), and also because it is the site of the Texas Ranger Hall of Fame and Museum (Fig. 4.12). In fact, the 80,000 annual visitors I documented are only for the Museum. The hundreds of people that use the Waco tourist information center, Riverwalk, and Fisher

Fig. 4.12 Fort Fisher Park (top) is home to the Texas Ranger Hall of Fame and Museum, which receives more than 80,000 tourists each year. Not pictured in this photo are the Riverwalk and Waco tourist information center, which are used by hundreds of people each day. Fort Sherman (middle), located in Lake Bob Sandlin State Park, is one of the most used campgrounds in Texas and the Southern Plains. Fort Davis National Historic Site (bottom) receives more than 100,000 tourists in some years

Park every day were not taken into account. Fort Sherman, as part of Lake Bob Sandlin State Park, is the second most visited with a range of 50–75 k over recent years. The popularity of this park is due to its proximity to Dallas and a major interstate (I-30), having a large lake with excellent fishing and other outdoor amenities, and functioning as a Texas State Park with one of the largest and most scenic campgrounds in the region (Fig. 4.12). Texas State Parks are well-advertised, affordable, and appeal to a large population of outdoor enthusiasts. The other two State Parks with campgrounds, Parker and Richardson, were also some of the most visited forts, 6th and 7th respectively. The other State Park, Boggy, does not have a campground and is relatively far from a major city. The third most visited fort, with 56,000 annually, is Fort Davis which is a National Historic Landmark and advertised broadly by the National Park Service. Visitation here has been as high as 135,800, in 1966 (Fig. 4.12).

The high attendance at some of the forts is due in part to their location in popular tourist destinations. This is definitely the case for Fort Martin Scott which is located in the new national tourist hotspot of Fredericksburg, known as one of the best wine regions in the nation. The fort property also contains the Texas Rangers Heritage Center. Fort Concho, the fifth most visited fort, is located in the metropolitan area of San Angelo, which is a popular regional tourist destination. Fort Concho is also highly engaged in tourism promotion and cultural events, plus a wide range of public service activities. Located along Route 66, Fort Reno experiences higher visitation than most forts, especially since it is primarily a research facility. Fort Gibson, one of the most visited of all forts despite being far from any major cities or highways, benefits from its location on the Trail of Tears National Historic Trail and being a Cherokee Nation cultural tourism destination. Likewise, McIntosh benefits from its location along El Camino Real de los Tejas National Historic Trail.

The protected natural areas of the forts and their diverse habitats (Sect. 4.3.2.1) also attract ecotourism. In terms of wildlife viewing, birding is by far the most popular activity on the forts. About half of them have birding events or provide field guides, and twenty are *eBird* hotspots (ebird.org). As described previously, the Rio Grande forts are prime birding destinations. Fort McIntosh, in particular, is one of the main stops for the annual Laredo Birding Festival, attended by birders from all over the U.S. Fort McIntosh also contains the Paso del Indio Nature Trail, which provides opportunities to experience, learn about, interpret, and conserve the natural environment. Other forts with popular and educational nature trails include Boggy, Clark, Davis, Griffin, Leaton, McKavett, Parker, Richardson, and Sherman. These nature trails enhance environmental awareness of fort visitors, in a manner that promotes all of the ecosystem services.

4.4 Concluding Remarks: Forts Then and Now

The forts established during the Southern Plains Indian Wars of 1821–1890 forever changed the physical and cultural landscape of Texas and Oklahoma. During this 70-year period, the forts allowed Texas to grow from just three settlements with a few thousand people in 1820 to 2.2 million people scattered across the state by 1890. Oklahoma (then part of the Arkansas Territory) was experiencing the beginnings of Indian relocation in 1820, but by 1889, Oklahoma was open to all settlers with the first of many Land Runs. The forts were set in places that provided a combination of ecosystem services: a clean and reliable water supply, timber or stone construction materials, arable soil, and productive grazing lands (Wooster 1987). Their location was also influenced by economic considerations. In fact, these economic (and political) considerations often outweighed military strategy (Wooster 1987). When the forts were established in Texas and Oklahoma in the nineteenth century, they provided numerous economic benefits. They were the impetus for infrastructure such as roads, rail, and water wells; they became centers of trade; they attracted many enterprises; and they were a major source of appropriations and other government funding (Smith 1999; Wooster 1987, pp. 13–14). In Texas alone, the federal government spent over $83 million between 1849 and 1900 on army infrastructure, operations, and soldier pay (Smith 1999). Although created with military, political, and economic intentions, these forts were more instrumental in creating societies, societies with an improved level of well-being.

Today, these forts continue to improve human well-being through their ecosystem services (Tables 4.2 and 4.3). They provide the provisioning services of habitat, food, raw materials, energy, and fresh water. A few of the forts even provide permanent human habitat (Bliss, Clark, Sill). They provide regulating services such as climate/air quality, water quality, flood control, soil protection/fertility, and pollination for crops. And they provide the often-overlooked cultural services of recreation for mental and physical health, aesthetics, inspiration, identity, spirituality, and tourism. Tourism is particularly important because the provision of ecosystem services is largely dependent on the amount of funding and resources of the fort.

Indeed, my ‘purposeful’ classification requires that resources are used to manage the ecosystem service. Many of the forts are limited in this regard. Managing for ecosystem services requires (wo)manpower. Several of the forts had only one full-time staff member or less (Duncan, Graham, Inge, Mason, Supply, Washita), and many others only had 2–3 staff members. Many of the forts have also experienced a decrease in volunteers over the past decade, which has forced them to reduce their operating hours, program offerings such as Living History Days, and educational outreach. Attendance has also decreased at some of the forts due to changes in infrastructure (e.g. decreased traffic by Fort Lancaster due to Interstate 10 replacing Highway 290 as the major route to western Texas) or simply changes in tourism patterns. This decrease in tourism reduces funding of the forts and their ability to provide services. Consequently, some forts have had to move their museums or headquarters to nearby cities to increase awareness (Phantom Hill, Supply).

Other forts have seen increases in attendance. With Fredericksburg becoming a major tourist destination, Fort Martin Scott is experiencing increases in attendance and funding, and accordingly is adding ecosystem services to their property such as prairie restoration, nature trails, and more educational programs. With the re-enchantment of Route 66, Fort Reno has also experienced increases in tourism, programs, and services. If ecosystem services are to increase, then more funding and resources will be needed.

One of my findings from this research is that many of the 'purposeful' ecosystem services are recent activities, as the forts have transitioned from heritage centers to multi-use facilities. Further, this concept of ecosystem services is relatively new to several of the fort directors/managers; they are in the process of incorporating ES into their property management, tourism, and education. At Fort Belknap, for example, a wildflower and butterfly garden was recently planted. Fort Towson is in the process of planting a native educational garden and expanding their trail system. Fort Griffin plans to expand their campground. Fort Martin Scott is in the process of restoring native prairie and plans to construct nature trails in the future. These are just a few of the examples of the initiatives of the protected forts, and thus my inventory of ecosystem services here is likely to expand over the coming years. And hopefully new forts like Fort Bird will be protected, commemorated, and restored. In the past few centuries, historical places such as forts have become increasingly protected, whether a national park, state park, city park, or through private entities. As William Cronon so elegantly conveyed in Ken Burns' (2011) documentary on *The National Parks: America's Best Idea*: "We come from nature. But we also come from our own past. And so the interpretation of nature and history, together, is not a distraction that the parks face. It is the very core of the enterprise. They're all about where we come from."

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