United States Department of the Interior

Cabeza Prieta National Wildlife Refuge

Vehicle Trails Associated with Illegal Border Activities on Cabeza Prieta National Wildlife Refuge – July 2011

Cabeza Prieta National Wildlife Refuge
U.S. Fish and Wildlife Service
Ajo, AZ

Executive Summary

The Cabeza Prieta National Wildlife Refuge (CPNWR) lies in southwest Arizona and shares 56 miles of border with Mexico. Over the past decade, the refuge has experienced significant impacts associated with illegal border crossings and subsequent interdiction efforts by law enforcement. These illegal crossings include the smuggling of undocumented aliens (UDAs) of various nationalities and drugs. Our concern is that smuggling and interdiction activities have resulted in significant impacts to wilderness character, and put other trust resources such as the federally endangered Sonoran pronghorn at risk.

To assess the extent of impacts associated with illegal border crossings and subsequent interdiction activities, CPNWR conducted an inventory of off-road vehicular travel within the refuge. Using high resolution aerial photography from 2008, we mapped 12,824 km (7,968 miles) of vehicular trails within the refuge, including 12,455 km (7,739) mile**s** in designated wilderness. The majority of these trails occurred in the broad alluvial valleys north of the El Camino del Diablo. The Growler Valley and Lechuguila Desert were the most significantly impacted. This inventory points to the need to develop a strategic plan designed to deter illegal border crossings along the Cabeza Prieta NWR and Mexican border.

Introduction

The CPNWR was established in 1939 for the conservation and development of natural wildlife and forage resources, primarily to assist in the recovery of desert bighorn sheep (*Ovis canadensis desertii*). Over the years, the refuge also became important as the core habitat for the remaining U.S. population of Sonoran pronghorn (*Antilocapra americana sonoriensis*), a federally endangered species pursuant to the Endangered Species Act of 1973, as amended. In 1990, the Arizona Desert Wilderness Act designated over 90 percent of the refuge as wilderness, forming the largest U.S. Fish and Wildlife Service managed wilderness area in the lower 48 states.

Current refuge management priorities include the protection of designated wilderness and ensuring the survival and recovery of the Sonoran pronghorn. The U.S. pronghorn population is estimated at 100 individuals in the wild and another 75 in a captive breeding program. The pronghorn occur within the Barry M. Goldwater Range (managed by the U.S. Air Force and Marine Corps), Organ Pipe Cactus National Monument, Bureau of Land Management lands in the Ajo area, and on the Refuge. The Refuge is centrally located between the other jurisdictions and, as the lead agency for recovery of the pronghorn, works with the other federal agencies and Arizona Game and Fish Department in implementing recovery actions.

In 2002, a year-long drought decimated the population, leaving just 21 pronghorn surviving in the U.S. Although this sharp population decline was attributed primarily to the impacts from a protracted drought event, this also was during a period of high illegal smuggling activity in important habitats utilized by pronghorn during the summer months. Since 2002, the refuge has worked with our partners to implement recovery actions that helped to increase the population. Despite the recent population increase, the Sonoran pronghorn continues to be at high risk of extinction. Prolonged drought and continued illegal smuggling activity may very well result in another population crash. In recent years, pronghorn have rarely been observed utilizing habitat within the southeastern portion of their range (i.e. Organ Pipe Cactus National Monument) that

they had previously used during the summer months. This area has also witnessed considerable illegal smuggling activity in the past few years.

The Wilderness Act of 1964 mandates that wilderness character be preserved and includes specific prohibitions enacted to preserve those characteristics. The Act states:

> *"Except as specifically provided for in this Act, and subject to existing private rights, there shall be no commercial enterprise and no permanent road within any wilderness area designated by this Act and, except as necessary to meet minimum requirements for the administration of the area for the purpose of this Act (including measures required in emergencies involving the health and safety of persons within the area), there shall be no temporary road, no use of motor vehicles, motorized equipment or motorboats, no landing of aircraft, no other form of mechanical transport, and no structure or installation within any such area."*

Refuge staff strive to manage for wilderness character. Wilderness character is viewed as possessing four traits: Untrammeled; Natural; Undeveloped; and Providing opportunities for solitude or a primitive and unconfined type of recreation. The untrammeled quality represents wilderness as areas where the landscape is unhindered and free from intentional modern human control and manipulation. The natural character of wilderness defines landscapes as ecological systems that are substantially free from the effects of modern civilization. The undeveloped quality of wilderness describes the landscape as having minimal evidence of modern human occupation or modification. Providing for outstanding opportunities for solitude or a primitive and unconfined type of recreation include those opportunities within wilderness areas for people to experience natural sights, sounds, freedom, risk, and the physical and emotional challenges of self-discovery.

However, the Arizona Desert Wilderness Act of 1990 recognized the need for United States Border Patrol (USBP) and other law enforcement agencies to gain and maintain operational control of the border. The Act states:

> *"Nothing in this Title, including the designation as wilderness of lands within the Cabeza Prieta National Wildlife Refuge, shall be construed as - (1) precluding or otherwise affecting continued border operations by the Immigration and Naturalization Service, the Drug Enforcement Administration, or the United States Customs Service within such refuge, in accordance with any applicable interagency agreements in effect on the date of enactment of this Act; or (2) precluding the Attorney General of the United States or the Secretary of the Treasury from entering into new or renewed agreements with the Secretary concerning Immigration and Naturalization Service, Drug Enforcement Administration, or United States Customs Service border operations within such refuge, consistent with management of the refuge for the purpose for which such refuge was established and in accordance with laws applicable to the National Wildlife Refuge System."*

The Act allows for continued operations by border law enforcement personnel consistent with the 2006 document titled "Memorandum of Understanding Among U.S. Department of

Homeland Security and U.S. Department of Interior and U.S. Department of Agriculture Regarding Cooperative National Security and Counterterrorism Efforts on Federal Lands along the United States' Borders" (MOU).

Under the MOU, the USBP may use existing administrative trails within designated wilderness and when necessary go off those trails. However, deviating off of approved administrative trails is only allowed under exigent/emergency circumstances. The USBP interprets this requirement broadly and often goes off approved administrative trails in pursuit of fresh tracks or other sign, or to respond to a signal fire or other information that may lead an agent to believe that UDAs or drug smugglers are in the area. We believe that the pursuit of UDAs /drug smugglers has created the greater proportion of trails. The refuge wilderness is often viewed as an area of conflict, where border law enforcement personnel are prohibited from implementing actions necessary to interdict illegal border activities. Over the last ten years, refuge staff have worked diligently with other Federal and state law enforcement agencies to ensure access is available to interdict illegal smuggling activity. This has been one of the most significant resource challenges refuge staff have worked on over the last ten years; balancing the need to protect the wilderness character of the refuge while allowing for the control of 56 miles of International Boundary with Mexico.

Over the last 10 years, the illegal movement of people and narcotics into the United States has significantly affected the CPNWR Wilderness Area. The very qualities that made the refuge worthy of designation as a unit of the National Wilderness Preservation System have made this an ideal location for the smuggling of people and contraband into the United States. CPNWR is located in one of the most remote sections of the Sonoran Desert. Due to the great distance from paved roads, rugged conditions, and lack of development, the refuge wilderness area has been used as a travel corridor for illegal border crossing and drug smuggling activities. These events, and the resulting interdiction efforts by the USBP, have resulted in significant impacts associated with a proliferation of trails driven by both smugglers and U.S. law enforcement agency personnel.

In 2003, the USBP in cooperation with CPNWR responded to the increased UDA and smuggling traffic by establishing a forward operating base in the south central portion of the refuge near the International border. The objective of the camp was to deter further illegal border crossings and to provide a continual USBP presence in one of the remotest sections along the Arizona-Mexico border. This action significantly reduced the amount of illegal smuggling activities via vehicles; nearly all vehicles entering the area were either apprehended or fled to Mexico. Additionally, the USBP constructed a vehicle barrier along the refuge's boundary with Mexico in 2007-2008, further reducing the number of vehicles illegally entering the U.S.

However, smuggling activities have continued to occur as groups of UDAs and drug smugglers have resorted to walking through the refuge. The conventional apprehension tactic used by USBP within CPNWR consists of identifying illegal activity and then directly pursuing that activity off-road. The MOU identifies the need for off-road pursuit of illegal activities when necessary and provides guidance for USBP agents on how off-road pursuit activities shall occur; they are instructed to use the method of pursuit with the least impacts to the environment. These methods of pursuit include: walking, pursuit on horseback, helicopters, ATV's and the use of

standard vehicles (typically ¾ ton vehicles). Because it is difficult to assess the amount of time that has passed since the illegal activity occurred and/or due to extreme temperatures, agents typically choose not to follow on foot. And because horses and helicopters are rarely available, interdiction activities are most commonly conducted in large motorized vehicles. However, within the last several years, USBP has begun to use smaller All Terrain Vehicles (ATV's) during some pursuit events. Furthermore, UDA's and smugglers are typically apprehended in remote areas away from roads and must be transported back to roads for transfer to the USBP stations. The use of large vehicles for interdiction and transport of UDA's and smugglers have the greatest potential to impact Sonoran pronghorn, wilderness, and other trust resources. It must be noted that the refuge supports the USBP in the completion of their mission and the impacts from interdiction would not be occurring if illegal activity were not occurring in the area.

Impacts from off-road pursuit via vehicles can have negative effects on soils, vegetation and wildlife species. Studies have been conducted throughout the southwest on the impacts of off-road use. Studies on soil disturbance have concluded that areas with heavy off-road vehicle traffic are impacted from soil compaction, destruction of biotic and abiotic soil crusts, and damage to areas with desert pavement, a unique desert surface covered with closely packed rocks and sand. Vegetation is affected from these direct impacts of soil disturbance and indirectly through the alteration of hydrological processes. Additionally, fragile desert vegetation is easily crushed by direct contact with vehicles. Vehicular traffic impacts wildlife through crushing animal burrows or direct mortality, and prolonged traffic disturbance has been shown to modify animal movement patterns. Disruption to movement patterns is a major concern due to the potential impacts on the Sonoran pronghorn population. Damage to cultural resources and impacts to wilderness character are also a significant concern.

From 2001-2009 refuge staff attempted to indirectly monitor the extent of off-road vehicle impacts from smuggling and subsequent USBP interdiction activities. This monitoring consisted of walking numerous established east-west transects across the refuge and recording off-road impacts observed. Through the course of implementing this monitoring program, it became apparent there were seemingly incalculable vehicle tracks throughout the refuge, none of which existed prior to the designation of the area as wilderness. While this monitoring effort established trends in trail densities, staff were not able to efficiently and accurately map, or enumerate the extent and magnitude of trails found across the refuge. In November 2009, CPNWR initiated a project to inventory and classify the trails found within the refuge using a combination of remote sensing and field survey techniques. This project was intended to provide a spatial framework of the off-road vehicle tracks that currently exist throughout CPNWR. This information will be used as an analysis tool to further identify and quantify direct and indirect ecological impacts resulting from smuggling and associated interdiction efforts.

Study Area

CPNWR is located in southwestern Arizona adjacent to the International border; the study area consisted of 807,658 acres of the refuge, including 756,250 acres of wilderness (Figure 1). We defined six geographic regions in the study area, largely made up of flat valley bottoms where vehicular trail densities had been observed to be highest. From east to west, the regions consisted of: Childs Valley, Growler Valley, San Cristobal Valley, Mohawk Valley, Tule Desert and Lechuguila Desert. An area of 49,376 acres in the Northeast corner of the refuge was not

included in the study because that portion of the refuge was not photographed as part of the baseline 2008 aerial photo mission that was used as the base analysis for the study.

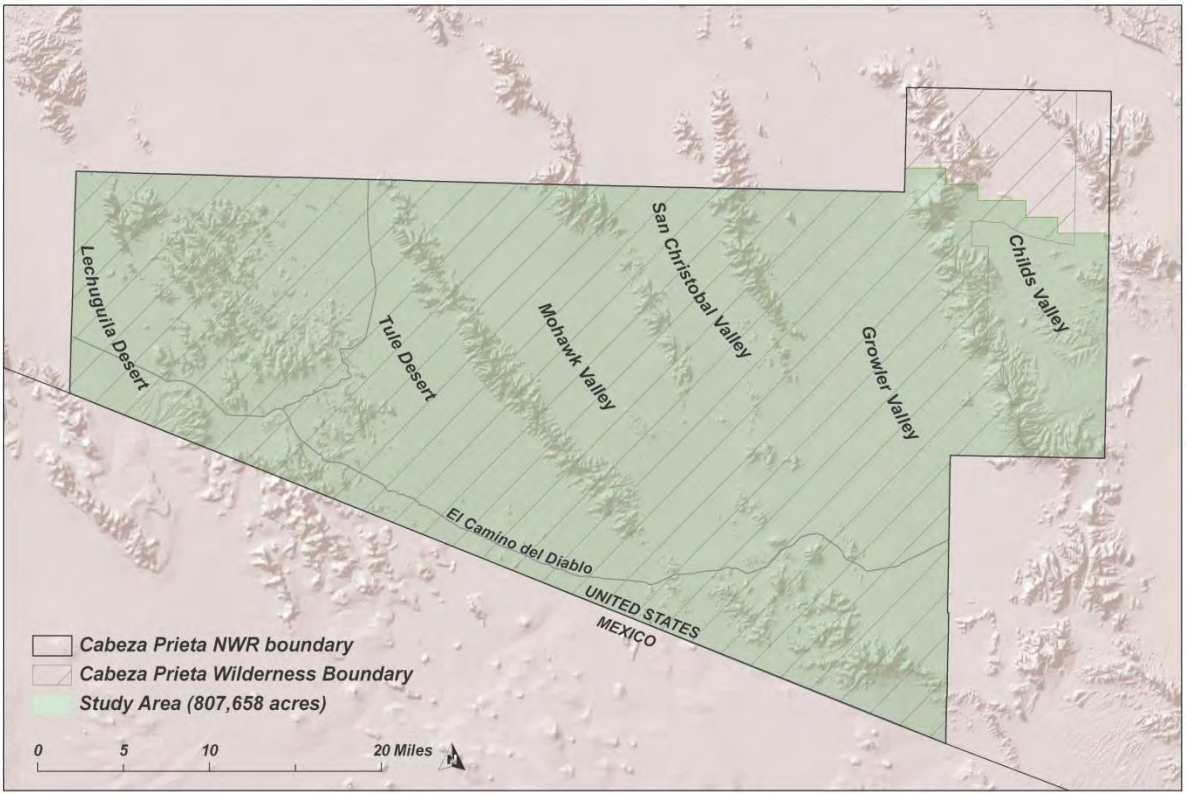

Figure 1. Project study area and associated geographic regions

The refuge is located in the Sonoran region of the Basin and Range Province of North America. This is an extensive system of fault block mountains trending north to south and are separated by broad alluvial valleys. Creosote *(Larrea tridentata)* desert shrubland encompassed the vast majority of the study area. Associated species include: white bursage *(Ambrosia dumosa)*, triangle-leaf bursage (*Ambrosia delotidea*), wolfberry *(Lycium ssp)*, ironwood *(Olneya tesota)*, saguaro cactus *(Carnegiea gigantea)*, and teddy bear cholla *(Opuntia bigelovii)*. Valley bottoms can be characterized as alluvial, consisting largely of fine grain sandy to sandy loamy soils. Areas of desert pavement are evident and dispersed throughout some regions of the study area.

Methods

High resolution ortho-rectified aerial imagery and photo interpretation were used to inventory the extent of vehicle trails. We used a 30 cm ground sample distance (GSD) true color imagery set as the basis of the analysis. We obtained this through the Borderlands project in cooperation with the Department of Defense. Image acquisition dates range from October to November 2008. Imagery covered approximately 93% of the refuge and 100% of those areas adjacent to the Mexican and US border.

Photo interpretation was conducted to interpret vehicular trail delineation and classification. Trails were classified into 4 disturbance categories as defined below. Photographic examples of the 4 categories are found in Appendix A.

Class 1 *- Tire tread impressions in soil, or soil berms built up around tire tracks. Undisturbed soil and/or vegetation growing between tracks*

Class 2 *– Multiple parallel Class 1 vehicle tracks with three or more crossings of tracks within 100 meters*

Class 3 *- Soil berms built up around tire tracks. Disturbed soil and no vegetation between tracks*

Class 4 *– Multiple parallel Class 3 vehicle tracks with three or more crossings of tracks within 100 meters*

Trails were digitized on screen and stored in an ArcGIS geodatabase. We utilized a digital grid of 1.5 km^2 cells to maintain a systematic and comprehensive approach to the inventory. Each grid cell was photo-interpreted completely before the inventory of adjacent cells commenced. We assigned technicians different sections of the grid to prevent duplication of data from occurring. When called for, we conducted additional field calibrations to account for variations in soil texture and vegetation density that would have affected the accuracy and consistency of the analysis.

To assess data quality, we conducted an accuracy assessment at the conclusion of the inventory. The assessment tested the accuracy of the trail classification (i.e., how often the trail classes assigned by photo interpretation agreed with trail classes observed in the field). The assessment was conducted using an error matrix derived from paired photo interpreted trails and field observations. To acquire field observations 41 stratified random 1.5 km^2 grid cells were selected. Random selection was stratified by 2 conditions: distance from access trails (<.8 km) and photo interpreted trail density (> 12 km /1.5 km^2) (Figure 2). Stratified conditions were used to ensure the appropriate amount of field data could be collected within the time and budget allotted by the project. Vehicular trails within each grid cell were evaluated at intercept points along randomly placed 1.5 km transects. Transect lines ran north-south or east-west, perpendicular to predominant photo interpreted trail direction. A total of 2,335 digitized trail intercept points were collected. Attribute data acquired included trail class (at time of field data collection) and interpretation of recent use. In addition to digitized trails, all trails not digitized were also recorded as intercept points along transects. A total of 518 non-digitized trail points were recorded. Due to the dynamic nature of trail impacts on the refuge, the 518 non-digitized trail intercept points could not be used in an assessment of trail density accuracy; we could not determine which trails were created before or after the acquisition date of the imagery.

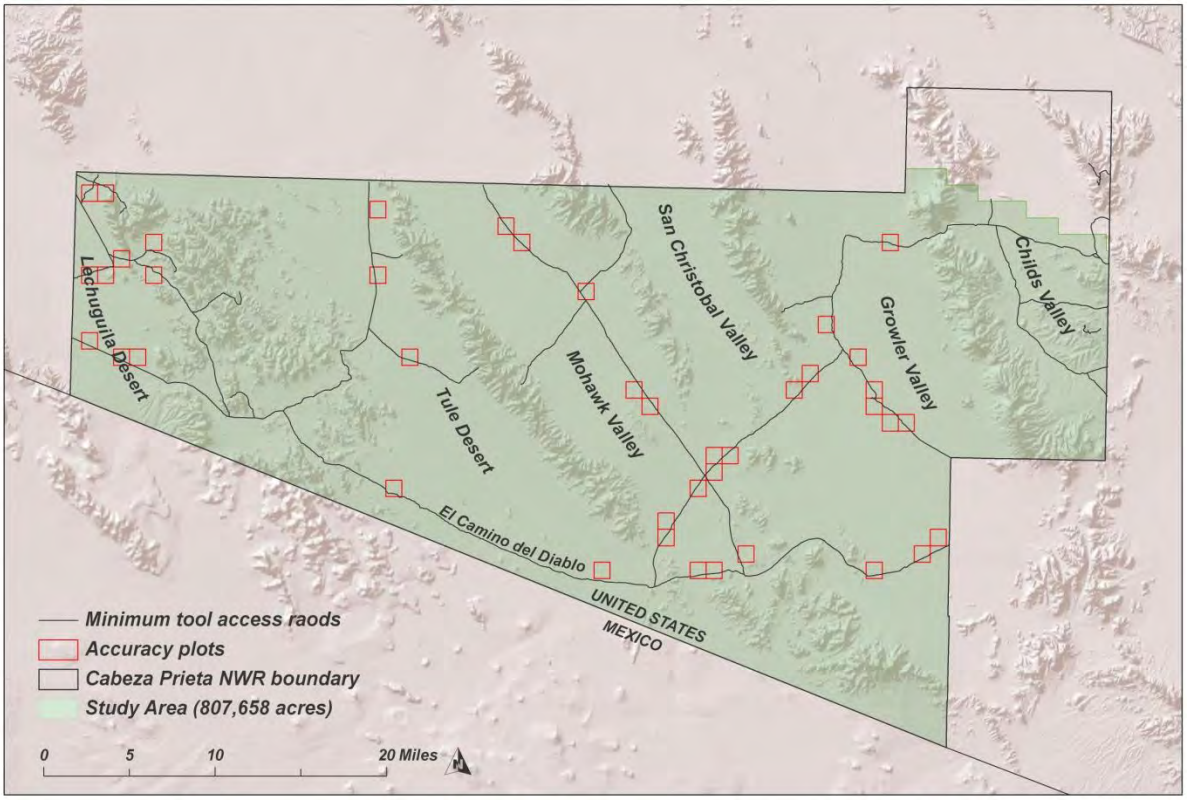

Figure 2. Accuracy assessment plot distribution

Results

In total 12,824 km (7,968 miles) of vehicular trails were inventoried with 12,455 km (7,739 miles) occurring in wilderness. We classified 98.8% as Class 1 (Figure 3). The overall classification accuracy was 98% (K_{hat}= 0.97) indicating strong agreement between classification results and field assessment. Due to the temporal difference between the base imagery acquisition (October-November 2008) and field assessment of the inventory (March 2010), it is not possible to determine the accuracy of trail density. The additional 518 non-digitized trail intercepts collected during the field accuracy assessment do indicate that a significantly higher trail density may have existed at the time of the 2008 aerial imagery acquisition and were not detected during the photo interpretation process. However, the un-digitized trails may have been created during the 15 months between the acquisition of photographs and the field assessment.

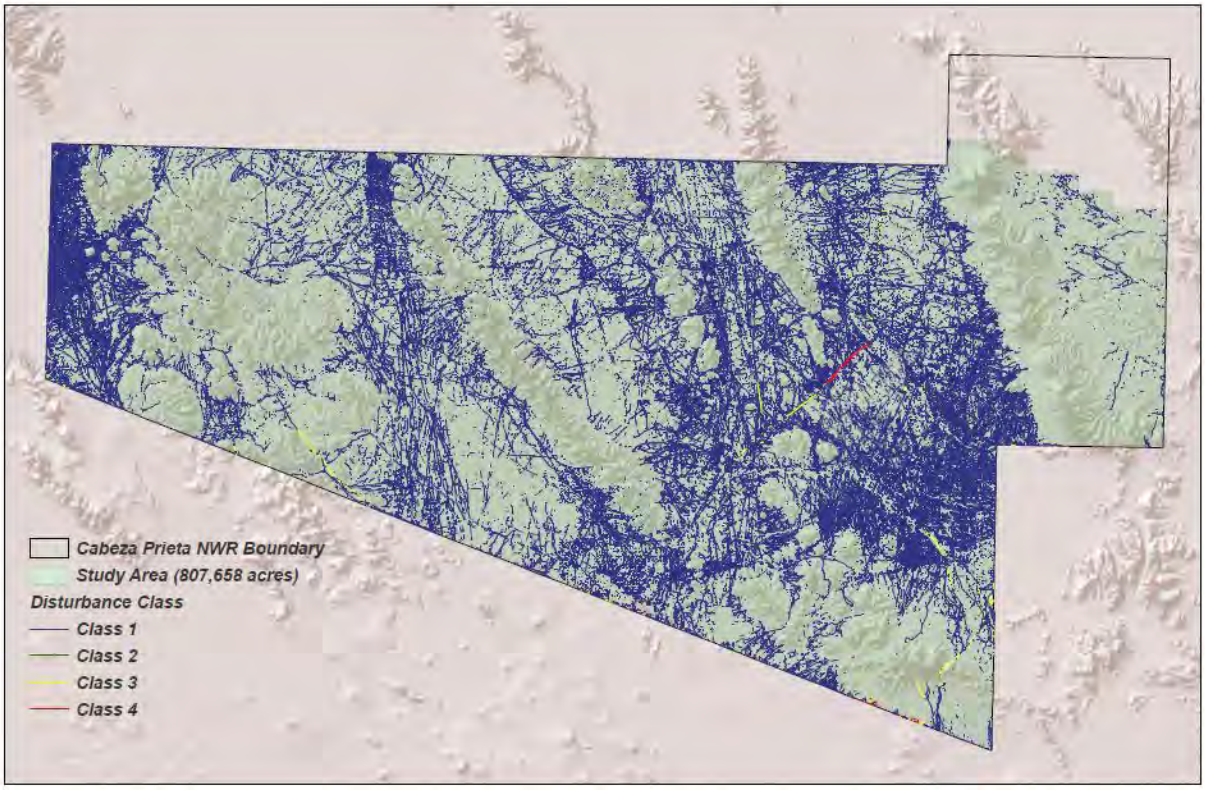

Figure 3. Digitized off road distribution and classification, October, 2008

To assess the spatial extent of vehicular trail disturbance a density analysis was conducted. We calculated the total distance of inventoried trails within each digital grid of 1.5 km^2. Trail densities ranged from 0-80.0 km / 1.5 km^2 (≈ 0-49.9 miles / 1 $mile^2$) (Figure 4, Table 1). High trail densities were primarily associated with flat broad alluvial valleys and areas north of El Camino del Diablo, the major east-west access road (Figure 3). Although these broad alluvial valleys contain finer grain soils that are more sensitive to topographic alterations that could be observed through photo interpretation, calculated trail densities were consistent with the results collected during the field accuracy assessment. Of the 6 geographic regions, the Growler Valley contained the highest mean trail density (14.7 km / 1.5 km^2 or ≈ 9.1 miles / 1 $mile^2$). Much of the high trail density in the Growler Valley can be attributed to a contiguous 22,500 hectares (55,599 acres) area north of the El Camino del Diablo road with a mean density of 29.9 km / 1.5 km^2 (≈ 18.8 miles / 1 $mile^2$). The Childs Valley had the lowest trail density with a mean of 1.5 km / 1.5 km^2 (≈ 0.91 miles / 1 $mile^2$).

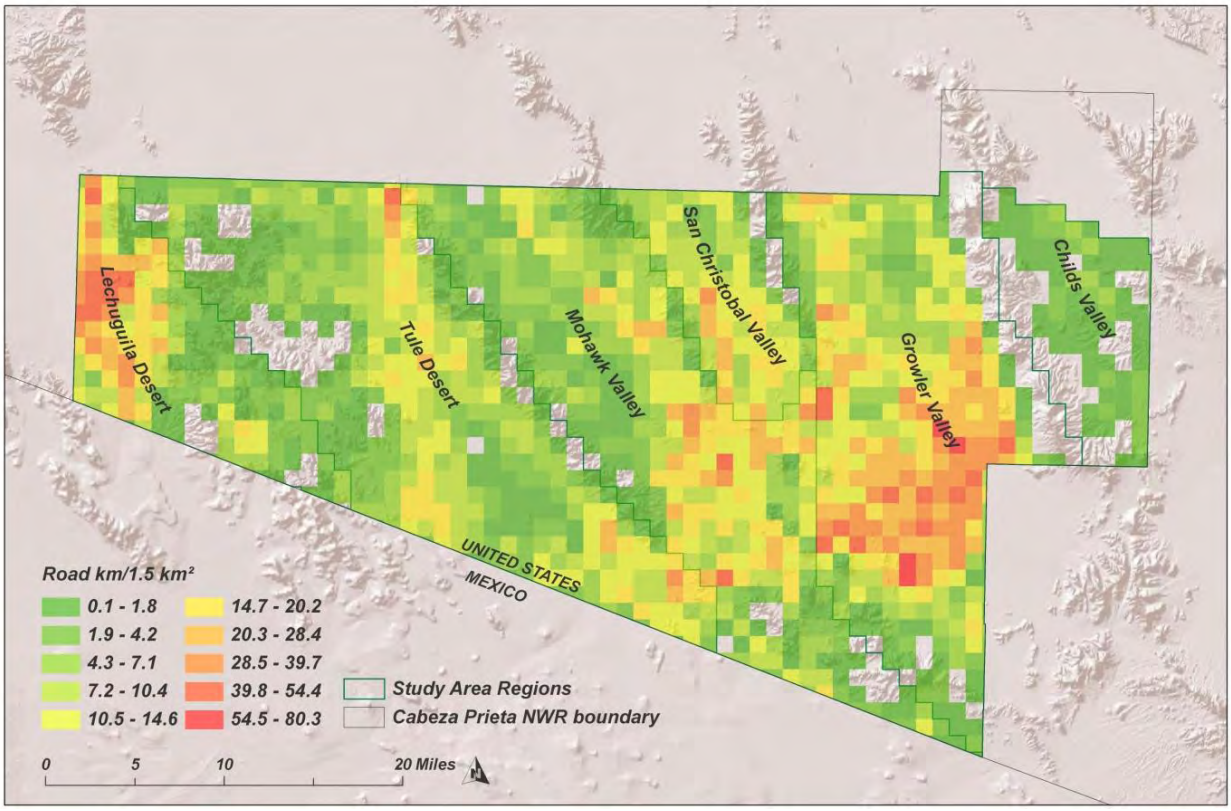

Figure 4. Vehicular trail density analysis, October/November, 2008

Table 1. Trail density summary by geographical region (kilometers)

Project Region	trail mean km²	trail max km²	trail sum km	region ha
Childs Valley	1.5 (0.9 mi)	6.1 (3.8 mi)	111.4 (69.2 mi)	25875 (63938.5 acres)
Growler Valley	14.7 (9.1 mi)	80.3 (49.9 mi)	4938.5 (3068.6 mi)	84150 (207939.2 acres)
San Cristobal Va.	9.9 (6.2 mi)	31.8 (19.7 mi)	904.4 (562.0 mi)	22050 (54486.7 acres)
Mohawk Valley	7.5 (4.7 mi)	48.3 (30.0 mi)	2606.8 (1619.8 mi)	82350 (203491.3 acres)
Tule Desert	6.4 (4.0 mi)	54.5 (33.9 mi)	2421.5 (1504.7 mi)	94050 (232402.6 acres)
Lechuguila Desert	11.9 (7.4 mi)	53.0 (33.0 mi)	1845.6 (1146.8 mi)	37125 (91737.9 acres)

Discussion

We are disturbed over both the magnitude and extent of the impacts we recorded during this inventory; we did not expect to find almost 8,000 miles of vehicle trails through the CPNWR wilderness area. The frequent use of mechanized transport associated with illegal smuggling activities and interdiction efforts precludes opportunities for solitude. Furthermore, the amount of damage from off-road activities may be significantly impacting the natural quality of wilderness character by such means as altering hydrological process, affecting plant distribution, impacts to wildlife inhabiting tunnels and dens below the surface, and disrupting habitat use of wildlife where high intensity traffic areas may be avoided due to the frequent presence of humans and vehicles. It is possible the observed low population size and the current infrequent use of habitat areas by Sonoran pronghorn in the southeastern portion of their range may be in part due to the level of activity associated with illegal smuggling and subsequent interdiction

activities in this area. The unintentional establishment of a trail network inarguably compromises the undeveloped quality of the refuge wilderness.

From a wilderness stewardship perspective, the density and extent of the off-road travel is alarming. However, impacts to endangered species, plant and animal communities, and cultural resources are more significant than just the mere presence of tire tracks within wilderness. Past research of vehicle use in off-road areas have demonstrated significant impacts to soils, plants, and wildlife. Many of the direct and indirect effects currently occurring on the refuge are yet to be quantified. Direct impact concerns include: soil compaction, increased soil erosion, damage to soil crusts, altered hydrological processes, disruption of migration patterns for Sonoran pronghorn and other wildlife, wildlife mortality, damage to vegetation from vehicle impacts, damage to cultural resources and degradation of wilderness values. Indirect impact concerns include: alteration to the entire biotic community within CPNWR as a result of a disruption to surface hydrology patterns, and potential spread of invasive species. Furthermore, many of these impacts may be significantly interrelated; impacts from soil compaction and alteration of sheet flow events may affect plant distributions that may further impact pronghorn movements and habitat use. To protect federally endangered Sonoran pronghorn, wilderness values, and other trust resources found within CPNWR and to provide an informed plan to reduce the impact of illegal smuggling activities and the subsequent interdiction efforts on these refuge resources, additional information is required. The following actions should be considered to meet these challenges:

1. Conduct soils inventory and associated soil vulnerability analysis
2. Develop a hydro-geomorphic model (HGM) to examine trail impacts to surface hydrology and associated vegetation communities
3. Examine potential disturbance issues related to Sonoran pronghorn migration and human activities (This is currently being researched as part of the Sec. 7 consultation mitigation of the Ajo 1 project.)
4. Assess direct impact to vegetation resulting from vehicular off-road travel

In addition to suggesting further research to determine the breadth of impacts associated with off-road activities on the refuge, this study identifies the magnitude of off-road impacts associated with illegal smuggling and subsequent interdiction activities on the refuge. Although the interdiction efforts being conducted by the USBP are consistent with the MOU, the extent of the impacts suggests there is a need to reevaluate this strategy. This document is not intended to implicate the USBP as the source of the problem, but to illustrate the level of impacts associated with the current interdiction strategy employed. We recognize that all of the impacts discussed in this document were the result of the illegal smuggling of people and narcotics into the U.S. Given the level of impacts and the potential concerns to our ability to manage a species protected pursuant to the Endangered Species Act of 1973, as amended, and our ability to protect wilderness character pursuant to the Wilderness Act of 1964, it is necessary to develop a more proactive strategy that protects trust resources on the CPNWR, but also allows for the ability of the USBP to interdict illegal activity in this area.

The types of strategies capable of implementing a smuggling deterrence include the deployment of more personnel to the area and technological infrastructure that has been demonstrated to be

successful in other areas along the Arizona border. Systems such as ground-based radar and infra-red cameras deployed within high use areas would be a major asset in moving from an interdiction to a deterrence strategy. Other strategies such as increasing the number of horse patrols in the area would also be helpful.

It is important to note the deployment of these technological assets may need to occur within the refuge wilderness area. Given the amount of impacts observed, simply continuing with the current employed methodology will result in continued impacts as illustrated by this study. We must strive to work with USBP to develop a proactive deterrence strategy that may in the short term result in the placement of structures within wilderness to reduce the amount of impacts to wilderness, endangered species, cultural resources, and other trust resources.

The goals of USBP and CPNWR are not necessarily in conflict. One of the main goals of the USBP is to deter illegal activity from occurring. This concept of deterrence would meet the goals of both agencies. We must work with USBP to develop a deterrence strategy that when implemented will result in illegal activity no longer occurring in this area. Although this goal may not be easily obtained, it is imperative that we work cooperatively to ensure the successful completion of a strategy that benefits the missions of both agencies.

Appendix A: Disturbance classes

Class 1 *- Tire tread impressions in soil, or soil berms built up around tire tracks. Undisturbed soil and/or vegetation growing between tracks*

Class 2 *- Parallel Class 1 vehicle tracks with three or more crossings of tracks within 100 meters*

Class 3 *- Soil berms built up around tire tracks. Disturbed soil and no vegetation between tracks*

Class 4 *- Parallel Class 3 vehicle tracks with three or more crossings of tracks within 100 meters*