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# Illicit Redwood Theft in a California State Park: A Crime Script Analysis Approach

## Recolección ilegal de madera de secuoya en un parque estatal de California: análisis desde la perspectiva de los guiones delictivos

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**Abstract**

Empirical studies on flora poaching are scarce, and the few that exist tend to focus on the study of illegal logging. The goal of this paper is to provide a deeper understanding of the issue of timber theft in protected parks, as well as to identify potential avenues for detection and prevention of this criminal behavior, using the case study of split-rail theft at Humboldt Redwoods State Park in California (USA). We utilize script analysis to offer a detailed description of the crime-commission process and the procedural requirements to carry out this type of crime. To do so, we used a mixed methods design that included incident data collection, field observations, and informal interviews with park rangers. Interventions that could potentially disrupt the chain of events, based on Situational Crime Prevention, are identified, and discussed.

**Keywords:** guiones delictivos, prevención situacional del delito, recolección ilegal de flora, delitos contra la vida silvestre

**Resumen**

Los estudios empíricos sobre la recolección ilegal de flora son escasos, y los pocos que existen tienden a centrarse en el estudio de la tala ilegal de árboles. El objetivo de este artículo es proporcionar un conocimiento más profundo acerca del problema del robo de madera en parques protegidos, así como identificar vías potenciales para la detección y prevención de este delito, utilizando el estudio de caso del robo de madera partida en el Humboldt Redwoods State Park (EE.UU.). Utilizamos el análisis de guiones delictivos para ofrecer una descripción detallada del proceso de comisión de este tipo de delitos. Nuestras fuentes de datos incluyen la recogida de información sobre cada delito, observaciones de campo y entrevistas informales con agentes forestales. Se identifican y presentan una serie de intervenciones.

**Palabras clave:** crime scripts, situational crime prevention, flora poaching, wildlife crime

## Introduction

Coastal redwoods, or *Sequoia sempervirens*, are an endangered species (IUCN, 2023) largely endemic to the coastline of California, USA. They are the tallest trees on Earth and have a lifespan of nearly 2,000 years (Save the Redwoods, n.d.). Since the 1850s, logging operations of redwoods have decimated their numbers leaving only about 5 percent of the original growth redwood forest (Save the Redwoods, n.d.).

State and national parks in California were created, in part, to protect the remaining redwood forests. Within these parks, it is illegal to remove old-growth redwoods. However, redwoods can be legally removed from privately owned land. Because redwoods are coveted by consumers, reports of redwood theft are frequent in protected parks (Bourgon, 2022; Marteache& Pires, 2020; Pires & Marteache, 2023). Redwood theft is particularly problematic in Humboldt Redwoods State Park (HRSP)—the world's largest contiguous old-growth redwood forest that spans 69 km2 (California Dept. of Parks and Recreation). HRSP has kept track of hundreds of redwood timber poaching occurrences, most of which are in the form of "split-rail" theft. Split-rail is a term given to redwoods that naturally fall to the ground and break open as a result—making it easier for thieves to harvest thin, long wood posts from the perished tree. Owing to its natural desistance to decay, redwood lumber can be used in organic farming without the requirement for chemical treatment and is far more durable than pressure-treated wood, making it highly desirable by farmers and vineyard owners (HRSP rangers, personal communication, October 17, 2021).

Redwoods that have fallen to the ground offer the ecosystem two essential resources. One, the redwood decomposition process—which takes place over several hundred years—provides habitat to numerous species. Second, by fertilizing the soil, this breakdown process aids the survival of the redwoods in the area (Squatriglia, 2006). When timber poachers remove downed redwoods, they are depriving this delicate ecosystem of essential resources. In addition, when timber poachers drag redwood lumber through the park before loading it onto their truck beds, they commit further damage to vegetation and hillsides (Finegan, 2008).

Preventing split-rail theft of redwoods is difficult considering the many challenges HRSP rangers face. For one, HRSP consists of 214 $km^2$ and only 4 rangers are responsible for patrolling it, including a supervisor that divides his time between HRSP and other county state parks. Related, much of ranger resources are spent on other duties such as the enforcement of traffic and criminal laws, camping regulations, and aiding other personnel in cases of flooding or wildfires. As a result, this leaves little time to patrol areas that are potentially at risk of poaching. Making matters worse, only one ranger is on duty per shift and 24-hour enforcement is unavailable (HRSP rangers, personal communication, October 17, 2021).

Given the limited resources park rangers have at their disposal, the vast size of the park, and the number of problems and crimes occurring within park rangers' jurisdiction (e.g., theft from vehicles), a detailed understanding of the crime-commission process of redwood split-rail theft is necessary in order to identify potential interventions to reduce or eliminate opportunities. As such, a crime script analysis of redwood split-rail was applied using data collected through field observations, geocoded theft locations, and informal interviews with park rangers.

## Literature Review

An increasing number of studies have applied crime science to wildlife crime to better understand its opportunity structures (McFann & Pires, 2020). Also known as conservation crime science (Kahler & Gore, 2017), such research is focused on analyzing wildlife crime with regard to how, who, when, where, why and what is targeted to understand the *modus operandi* patterns of offenders and the underlying opportunity structures (Kurland & Pires, 2017). Conservation crime science's approach has been utilized in numerous studies, covering topics as varied as the international wildlife trade (Kurland & Pires, 2017), and species-specific studies such as poaching of: elephants at the macro-level (Lemieux & Clarke, 2009) and micro-level (Maingi et al., 2012), rhinos (Eloff & Lemieux, 2014), deer (Haines et al, 2012), and parrots in Mexico (Pires & Clarke, 2012) and Indonesia (Pires et al., 2021).

For instance, Maingi et al. (2012) discovered that the locations of elephant poaching in southeast Kenya were spatially predicted by the presence of bodies of water, elephant abundance, and roads. As such, opportunity structures in the natural and built environments, such as bodies of water and roads, enable the poaching of endangered species as well as suggest the tactical deployment of patrol rangers in space to potentially deter would-be offenders. Beyond studies focused on megafauna and other charismatics species, a conservation crime science approach has been applied to several other species such as illegal fishing (Petrossian et al., 2015; Weekers et al., 2019), longline fishing and albatross endangerment (Petrossian et al., 2022), illegal logging (Thompson & Magrath, 2021), in addition to formulating prevention strategies using situational crime prevention for a variety of wildlife (Kurland et al., 2017; Lam et al., 2023; Lemieux, 2014; Marteache et al., 2020).

Yet, the majority of these conservation crime science studies have been applied to the illegal trade or removal of fauna, not flora. Research on plant exploitation or other small-scale timber theft has been conspicuously absent from wildlife crime research. Such "plant blindness" (Margulies et al., 2019; Wandersee & Schussler, 1999) is concerning, considering that 85 percent of all species protected by the Convention on International Trade in Endangered Species of Wild Fauna and Flora are flora (CITES, n.d.). In fact, three of the five most threatened taxonomic groups according to the IUCN Red List are flora (Goettsch et al., 2015).

The United Nations Office of Drugs and Crime (2022) defines illegal exploitation of flora as "the taking, trading (supplying, selling or trafficking), importing, exporting, processing, possessing, obtaining and consumption of wild flora, including timber and non-timber products, in contravention of national laws or international frameworks". While much of the illegal exploitation of flora is generally focused on the Global South, a number of coveted, and poached flora species are endemic to the U.S. More specifically, there is a long history of targeting Venus flytraps (Yearsley, 2017) and American ginseng in the Appalachia region (Anderson et al. 2002; Young et al., 2011), and a relatively recent trend of poaching and trafficking cacti in the American Southwest region (Robbins, 2003).

Relevant to the current study, there are a few recent studies that have analyzed the spatial dynamics of coastal redwood poaching in northern California. Specific to Redwood National and State Parks (RSNP), Kurland et al., (2018) found redwood burl poaching—a tumor-like growth that develops on select redwoods—was spatially concentrated and near illegal burl markets, primary roads, and in areas with greater redwood abundance. In a related study by Marteache & Pires (2020),

further research discovered that offenders were almost exclusively targeting redwood burls below ten feet—as opposed to high up in trees—because these were easier to remove. In addition, offenders only targeted redwood trees with burls that were at a higher or at the same elevation as the nearby road. This cumulative evidence suggests that redwood burl poachers are highly opportunistic in that they target highly accessible and redwood-rich areas where burls are low to the ground and can be easily rolled down hills so that they can load them onto truck beds (Marteache & Pires, 2020; Pires et al., 2020).

As an extension of the work on redwood burl poaching, Pires & Marteache (2023) replicated earlier work in RSNP to Humboldt Redwoods State Park (HRSP), albeit with a different redwood theft problem—split-rail theft. Similar to burl theft, split-rail theft was spatially clustered and was more likely to occur in areas near roads, parking spots or trails, with a presence of old-growth redwoods, and more distant from campgrounds—a proxy measure of capable guardianship. This evidence suggests many offenders were only willing to commit redwood theft in areas accessible by car and by foot, and not willing to commit such crimes in areas where bystanders may be found. Previous research has given us a broader view of the problem of how offenders operate from a spatial perspective in relation to other environmental features. What remains unknown are the exact steps required to commit split-rail theft and the associated opportunities at each stage that facilitates such crime. In doing that, we can pinpoint stage-specific interventions that, if implemented, can cumulatively reduce the likelihood of such future events. In the next section, we discuss crime script theory and its potential use for this problem.

## Crime Scripts

Drawing on the cognitive sciences, Cornish (1994) articulated that crime events do not begin with the crime event—there are several preparatory steps that must be executed well before a criminal act occurs. Identifying these preparatory steps for each specific crime are as important for crime prevention purposes as the crime event itself. For example, at the preparation stage for bushmeat hunting in Rubirizi, Uganda, offenders must first acquire wheel traps and wire snares to then trap animals during the crime activity stage (Ashaba, 2020).

Crime scripts were developed to better understand the sequence of events that led up to specific crimes and their aftermath in highly specific contexts. In doing so, the opportunity structures that facilitate crime at each stage of the crime sequence (i.e., before, during, after) can be identified so that stage-specific interventions can be deployed to make crime more risky, difficult, and less attractive (Cornish, 1994). With the bushmeat hunting example from above, one intervention may require close monitoring of steel businesses that produce wheel traps and wire snares to effectively remove coveted tools for poaching (Ashaba, 2020). While this intervention alone may not impede some offenders from continued bushmeat poaching, its effect is to disrupt the causal chain of events. Consequently, offenders would need to find alternative tools, often less preferred and effective, to continue bushmeat poaching.

Crime scripting consists in the description of the series of steps involved in the commission of a crime, from the preparatory activities conducted to procure necessary tools and information, to the actions taken in the aftermath of the crime to successfully benefit from it while remaining

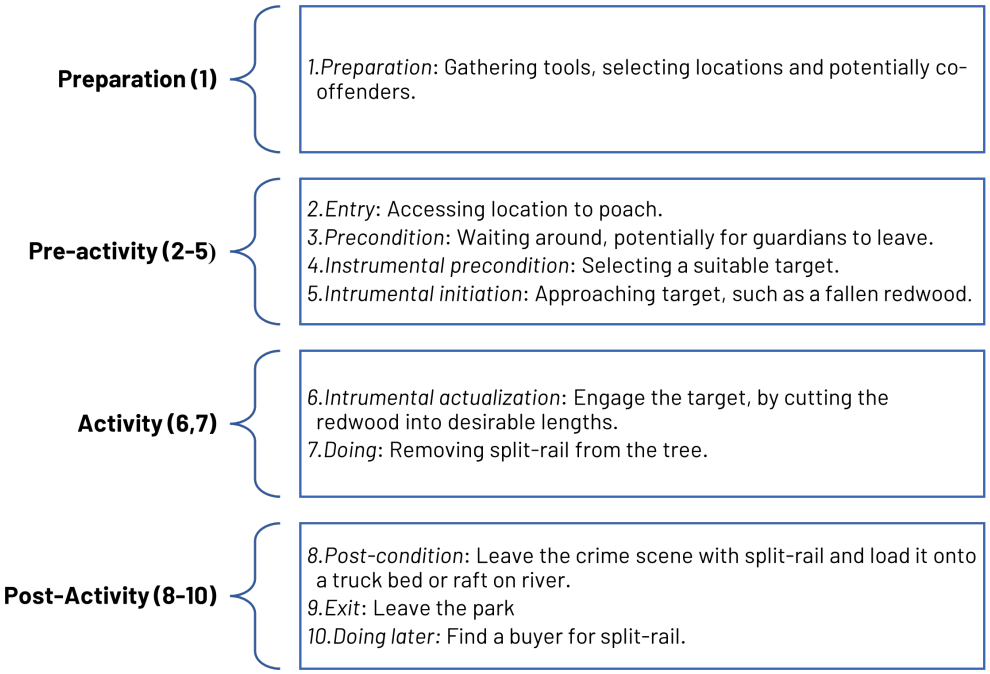
undetected (Cornish, 1994). Crime scripting exercises provide an opportunity for crime analysts to unpack decision-making by offenders and identify all necessary conditions, tools, and places of interest in greater detail. Such details are essential to inform interventions that are place-based and crime-specific. For these reasons, crime scripts were developed as a complement to situational crime prevention (Cornish, 1994)—a suite of intervention techniques designed to manipulate environments to increase the effort and risk of crime as well as reduce provocations, excuses, and rewards (Clarke, 2008; Kurland et al., 2017). Together with situational crime prevention (SCP), there are over 100 case studies of applications of crime scripts to a wide variety of crimes (Dehghanniri & Borrion, 2021). An illustration of how SCP interventions are informed by scripting the required steps for a crime such as 'joyriding' can include: controlling equipment sales to steal autos such as hand scanners and duplicate keys to address the preparatory stage of the crime; encouraging parking lot barriers for both entrance and exit stages, such as attendants, to prevent successful entrance and/or exit by offenders; improving natural surveillance in parking lots and using vehicle alarms and immobilizers to prevent offenders from breaking into cars and starting them; and activating GPS devices on vehicles to monitor vehicles in the aftermath of the commission of the crime, that is, once the vehicle is stolen and in possession of the offender (Clarke & Eck, 2005).

Recently, crime scripting has been applied to wildlife crime in various ways such as: illegal ivory markets (Moreto & Lemieux, 2015); IUU fishing and seafood fraud (Petrossian & Pezzella, 2018); jaguar paste production (Lemieux & Bruschi, 2019); poaching of rhinos (van Doormaal et al., 2018); rhino horn and pet trafficking (Viollaz et al., 2018); illegal live coral harvesting (Sosnowski et al., 2020); and various other wildlife crimes included in an edited volume on Crime Script Analysis (Lemieux, 2020). This body of work suggests not only that crime scripting is a valuable tool that can produce a "more detailed view of the problem", but it is applicable to various wildlife crimes in a variety of settings, and can identify information gaps that, if known, can inform future interventions (Lemieux & van der Ploeg, 2020, p. 1). With an increasing focus on applying crime scripts to a greater variety of crimes in both urban and rural contexts, it remains to be seen if crime scripting is equally applicable to crimes of flora as it is to fauna. It is with this intention that we are applying crime scripts to an altogether new problem—split-rail theft of redwoods in HRSP. In doing so, we identified the necessary conditions, tools, and places of interest to commit this crime. Cornish (1994) originally suggested up to ten separate stages for their inclusion in crime script analysis, that are then adapted by researchers using this methodology to the specific crime type being analyzed and its process. Consistent with recent crime script analyses of wildlife crimes cited above (Lemieux, 2020), we have broken down the script for redwood split-rail theft into four main stages: Preparation, Pre-activity, Activity, and Post-activity (Figure 1). Using SCP to inform our recommended interventions that could potentially disrupt the chain of events, this study lays the groundwork for an evaluation of potential solutions and their effect on the theft of natural resources.

The rest of this article provides details on the study location and the methodology of this research, describes in detail the nature of split-rail theft at HRSP, analyzes the different steps in the commission of the crime utilizing the crime script perspective, and discusses existing and potential intervention initiatives to prevent this crime.

Figure 1

*A Crime Script for Redwood Split-rail Theft*




## Methods

### Study location

Humboldt Redwoods State Park (HRSP) is a state park in Northern California (U.S.) that offers a variety of activities such as hiking, biking, horseback riding, camping, swimming, and fishing, and is open year-round (California Dept. of Parks and Recreation, n.d.), although most of their yearly two million visitors concentrate between the months of May and November. The U.S. 101 highway, as well as the adjacent secondary road known as the Avenue of the Giants, provide easy access to the park. These roads run parallel to the East River as they cross HRSP north-south (Figure 2).

### Data sources

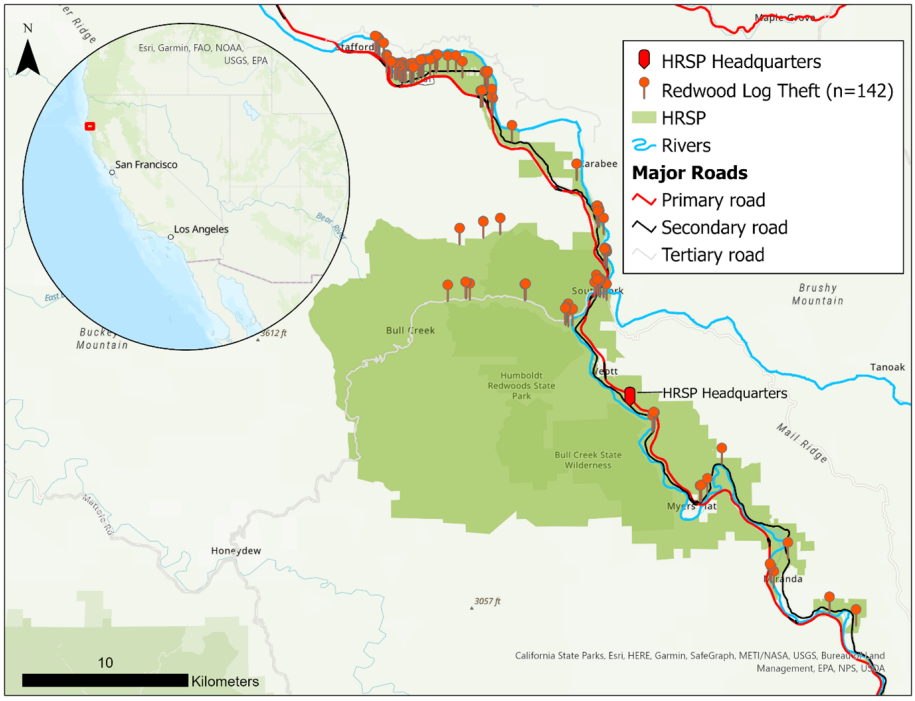
The authors visited HRSP during the span of 5 days in October 2021 to conduct field observations of victimized sites, collect GPS data of known split-rail poaching, and perform informal interviews with park rangers. The visit was carried out in collaboration with a team of three HRSP rangers who assisted us in planning our observations and guided our data collection. The members of the rangers' team had extensive experience in identifying and analyzing incidents of split-rail poaching, as they had a cumulative 30+ years working in HRSP.

All poaching sites known to the rangers were visited during a total of 35 hours of fieldwork (we were accompanied by at least one member of the team during 23 of those 35 hours). It could not be determined whether some down redwood trees were targeted in multiple instances over time. Thus, each tree was recorded as a unique incident to avoid double-counting. A total of 142 poached

trees were identified and recorded using a Garmin eTrex 10 device and mapped using ArcGIS Pro 2.8 (Figure 2). A prior analysis by the Pires & Marteache (2023) on the spatial distribution of split-rail redwood theft and the relationship of incidents to other environmental features, such as major roads, campgrounds, parking lots and parking spots, informed the crime script related to *modus operandi* of offenders.

Figure 2

*Map of Humboldt Redwood State Park with location of known poaching incidents.*




Informal interviews with rangers (n=3) were conducted both before and throughout the course of data collection and covered a variety of topics as it related to the who, what, where, when, why, and how of redwood split-rail theft, which are integral to developing a crime script (Cornish, 1994). Questions posed included: what redwood split-rail is used for, how it can be legally and illegally obtained, what types of redwood trees and locations tend to be most targeted, how exactly the crime is committed, who are the offenders involved, how is the split-rail removed from the park, what are the likely end buyers, detection and prevention strategies used, etc.

Triangulation of GPS data and other spatial environmental data, observational data from poaching sites, and information obtained from informal interviews with park rangers were used to develop a crime script approach. Information acquired from these mixed methods was coded based on the four main stages of the crime script process and analyzed independently to find common patterns. This resulted in an actor-based script (Cornish, 1994) developed for the illegal procurement of redwood split-rail.

## Results: description and stages of redwood split-rail theft

### Split-rail theft at HRSP

#### *The target*

As indicated in the Introduction, old-growth redwood timber is particularly valuable due to being very strong, dense, and durable, as well as resistant to harm from rot or insects (Shirley, 1940). Removal of this type of timber from National and State Parks is prohibited in all cases, and that includes parts of fallen trees.

Old-growth redwoods fall naturally due to a number of causes (i.e., heavy rainfall, wind) and, once they hit the ground, some of them split open. It is not possible to predict which trees will split open upon falling, as it depends on the characteristics of the tree and the specific way the tree falls. This is a common occurrence, resulting in numerous downed and split redwoods throughout the park. HRSP rangers estimate that about 40% of the downed and split trees are victimized and believe that the reasons why the rest are not targeted are mostly because the access to the nearby road is difficult or narrow, or its location makes it difficult to hide a vehicle.

#### *The market*

The demand for old-growth redwood timber in the form of split-rail stems mostly from organic farming (i.e., to use as grape stakes and posts for vineyards), as well as fencing (Figure 3).

Figure 3

*Common uses for split-rail theft: (a) grape stakes in vineyard, (b) fencing*

(a) *Grape stakes at the Eberle Winery near Paso Robles, California [Photograph]*, by *Christensen (2008)*

(b) *Split rail fencing [Photograph]*, by *Elf (2005)*

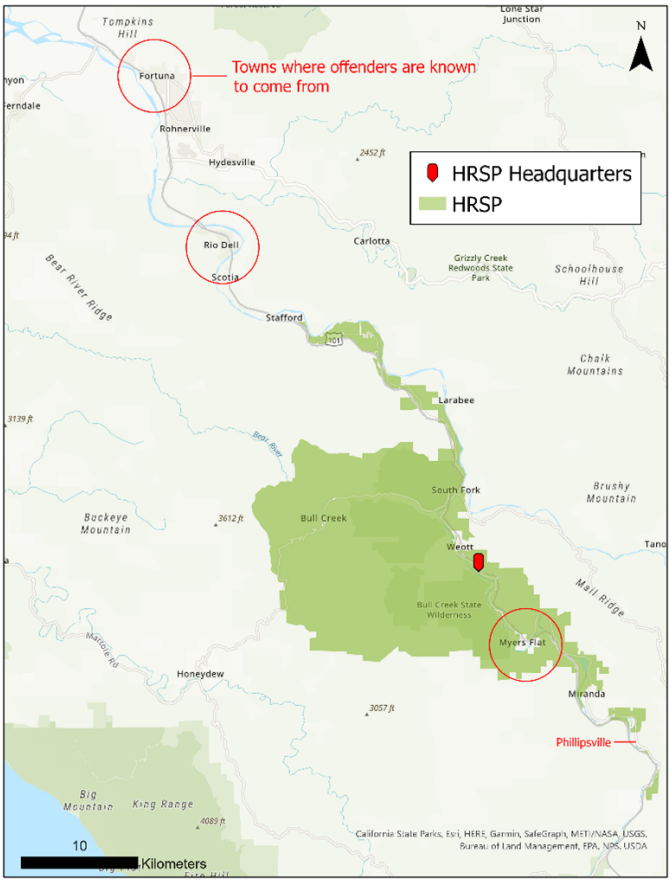
Poachers tend to sell poached timber to middlemen, who in turn sell it to the final buyer. HRSP rangers confirmed that there are several individuals known to them acting as middlemen in the area, and that local mills do not seem to be involved in this activity. If the final buyer purchases the timber through a middleman, they may not be aware of the origin of the wood.

### *Offenders*

HRSP rangers indicate that offenders tend to work in pairs, sometimes even in larger groups, given the physical effort and logistics involved in this crime. They are usually repeat offenders and have a record for other types of crimes and, in most cases, they live in the local area, in towns like Myers Flat, Phillipsville, and Fortuna (Figure 4). According to HRSP rangers, many of them are drug addicts who resort to this type of crime as a convenient way to get fast cash.

Figure 4

*Map of HRSP and adjacent towns*




### *Indicators of illegal activity*

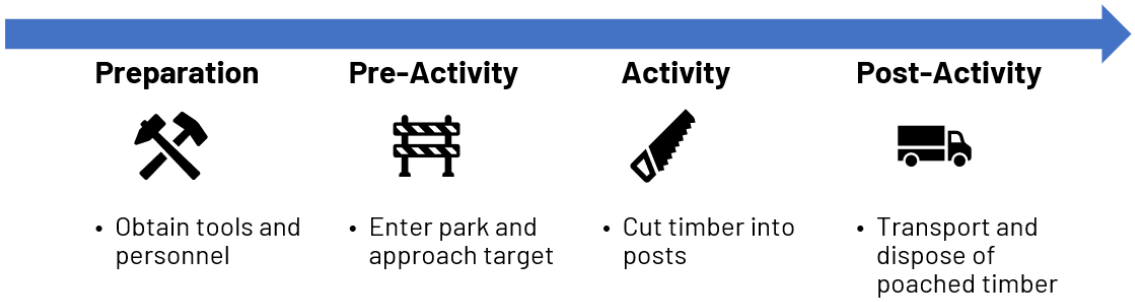
According to HRSP rangers and our own observations, there are a number of signs that indicate that illegal activity is taking place at the park, namely: vehicle tracks or drag marks on the ground; visual discovery of cuts or piles of posts; broken branches at human height indicating someone has accessed a certain area that is usually undisturbed; reports by informants, or by locals, or hikers, who call the park's hotline, discovery of parked vehicles or boats at unusual locations/times (i.e. nighttime); and sighting of a truck with posts in the truck bed.

## Crime script

Below we describe the four different stages of the crime script for the problem of split-rail timber theft at HRSP (Figure 5). A summary table with all four stages can be found in the Appendix.

Figure 5

*Stages in the crime script of split-rail timber theft*




***Stage 1. Preparation***

The first stage consists of the planning or preparation stage. Once offenders decide to become involved in split-rail timber theft at HRSP, they must make numerous decisions regarding how the crime will be committed.

*Who will participate in the crime?*

• Due to the work involved and the weight of the posts at least two offenders are needed according to HRSP rangers. Offenders recruit other co-offenders through their networks, ideally selecting others who are also familiar with the park and/or the types of tools needed to carry out the crime.

• Sellers may be identified and contacted at this point or during the Post-Activity stage.

*What is the intended target?*

• Offenders may enter the park in search of targets deemed suitable or even encounter suitable targets during their everyday routines in and around the park, particularly if they live in the vicinity of the park. Preferred target areas include those containing old-growth redwoods and close to a road that facilitates entry and exit, with parking spots nearby where a vehicle could be stationed without drawing attention, and far from busy areas such as camping sites (Pires & Marteache, 2023). As seen in our observations, there is no need to venture into the park too much as there are plenty of downed and split trees along the road. Ideally, the target would be near the road, close enough to make transportation of the posts to the vehicle easy, but not in plain sight of anyone who may drive through the park.

*How will the crime be committed?*

• A variety of tools are needed to commit this crime: chainsaws, wedges, mallets, floating devices, ropes/ties, headlamps, bolt cutters, etc. (Figure 6). Such tools can be purchased legally, or they can be obtained illegally. Many locals have some of these tools (i.e., chainsaws) in their cars in case tree limbs or full logs fall in the middle of the road. In the next three stages, a description of what these tools are used for will be provided.

Figure 6

*Tools commonly used to commit the crime (photos of material seized by HRSP rangers)*

(a) *Chainsaws*

(b) *Mallet and ties*

• Offenders need to map out their entry and exit strategies, secure access to a suitable vehicle to access the park, as well as to transport the stolen timber out of the park (i.e., pickup truck for land transportation, boat for river transportation) according to conversations with rangers. Locals tend to own trucks and pickups, and either own or have access to someone who owns a boat, as fishing is very popular in the area.

• If their intended entry/exit point to the park is gated and secured with a lock, HRSP rangers report that sometimes offenders cut park locks and replace them with their own in advance to facilitate entry on the day of the commission of the crime. Replacing the lock conceals the fact that offenders have tampered with the gate.

• A facility to store the split rail (until sold) must be identified, unless the stolen timber is being transported from the park directly to the buyer.

• If offenders intend to disguise the sale as legitimate while transporting redwood products, in the Preparation stage they need to forge a Bill of Sale which is required by California's Penal Code (PEN § 384.5 (a)(1)).

• In this stage offenders may also learn law enforcement practices and patrol schedules to avoid detection when committing the crime.

***Stage 2. Pre-Activity***

The Pre-Activity stage encompasses all the steps that immediately precede the actual poaching of the timber. HRSP rangers indicate that thefts of redwood split-rail occur mostly during the Winter (October-March) because there are fewer people visiting the park and it is also the rainy season. The sound of the rain muffles the noise from chainsaws and mallets. Further, most incidents occur at night when all rangers are off-duty and there are no visitors around (2-3 am). Perfect conditions include a full moon (good visibility) during a winter storm to improve visibility and muffle sounds. In this stage, offenders wait for adequate time and conditions.

Once they decide to proceed, HRSP have found that some offenders listen to the ranger

scanner/radio to determine when, and how many rangers are working at any given time, and to confirm that they are not in the vicinity of the intended target. They then enter the park through open public roads or use multipurpose or private roads that are often gated. They can get around any physical barriers by cutting the lock with bolt cutters or even cutting through the gate itself with pipe cutters or similar tools (i.e., in the case of tubular barrier gates). They then proceed to park close to the target: if planning to transport the stolen wood by water, at this point they need to dock their boat nearby.

***Stage 3. Activity***

Once at the crime site, offenders need to check whether the wood is in good condition (not moldy or rotten). Based on our observations and conversations with rangers, a simple cut with a chainsaw provides enough information, as the resulting sawdust's color and texture show the state inside of the log. Previously victimized sites leave the grain exposed so offenders can skip this first "testing" step. Curved wood or knotty parts of the tree cannot be used to make posts, so they are left undisturbed.

After a satisfactory test, offenders start the process of cutting the split rail into posts 2.5-3 meters long (8-10 ft) and about 12x20 cm wide (5x8 in) (Figure 7). Offenders first cut the desired length with a chainsaw, and then use mallets and wedges to get the desired width. The use of a chainsaw, which is the loudest part of this stage, is limited to a few cuts.

Figure 7

*Poaching sites at HRSP*

As learned from our previous study, targets that are at the same elevation relative to the road are preferred as offenders can drag the wood downhill to their trucks. If the log is downhill from the road

but above or near a river, water transportation may be preferred (depending on the effort needed to bring the posts uphill and the availability of river transportation options).

Often offenders will access a site, cut several posts and stack them, and then retrieve them with a truck. Sometimes offenders cannot take all the posts at once, and a pile of ready-to-go posts is discovered, which then becomes an active site to monitor by the rangers (Figure 8).

Figure 8

*Piles of posts recovered by HRSP rangers*

***Stage 4. Post-Activity***

According to HRSP rangers, transportation is done on land for about 90% of incidents. Given the size and length, about 20 posts fit in a pickup truck bed. Each post sells for about $15-$20, or about $400 for each pickup load. Sometimes transportation is done using the Eel River, a river that runs through the park (see Fig. 2). River transportation involves lowering the posts onto the river, tying the posts together forming a raft, adding floating devices, tying the raft to a boat, and accompanying it down the river (going North). Rafts are recovered at riverbanks in Rio Dell (north of the park) or Myers Flat (if poaching occurred in the southern part of the park) (see Figure 4). It takes about 2 hours to transport the wood from the park to Rio Dell using the river. River transportation requires more effort and involves a higher risk of detection as it is difficult to conceal the raft once on the river, but has higher rewards because it allows transportation for a greater number of posts.

Offenders may need to return to the crime site multiple times if they left ready-to-go posts that they could not transport on the first trip. After collecting the wood, it must be transported to either a storage facility or to the buyer's location. If a buyer has not been identified at this point, the loot may be advertised in search of a buyer. After the sale, which can be in-person or online, co-offenders share their profits.

## Discussion of prevention strategies

As discussed in the Introduction, one of the main purposes of using crime scripting is to identify the necessary conditions and elements of the different steps of the crime commission, with the goal of designing stage-specific interventions. Situational Crime Prevention (SCP) is often used in combination with crime scripts to propose place- and time-based preventive measures that aim to modify the opportunities afforded by the immediate environment. The five main SCP mechanisms by which opportunity reduction is achieved are increasing the effort and the risk to commit the crime, reducing the rewards it affords and the provocations to commit it, as well as remove excuses used to justify the offenders' actions (Clarke, 2008).

Below we describe the SCP responses that are, or could be, implemented to prevent split-rail theft at each of the different stages of its crime script, classified according to the five SCP mechanisms. Table 1 presents a summary of these responses. No measures directed at Reducing Provocations have been found suitable for this crime problem, as they are geared toward crimes that occur as an impulsive response to frustrating and stressful situations, often in enclosed spaces.

***Interventions at the Preparation stage***

The activities included in the Preparation stage are focused on planning an illegal act, but they are not illegal in themselves. Given that most offenders are from the local area, and there may be a perception that dead trees are no longer valuable, preventive efforts could focus on implementing educational campaigns in the nearby towns. This campaign would highlight that all natural resources, including downed trees, are protected in State Parks, as well as the important role that these decaying trees play in the ecosystem of the park as a form of *removing excuses*.

***Interventions at the Pre-Activity stage***

Making *the crime commission process more difficult* (Increase the Effort) can be achieved through a number of interventions. Completely blocking access to the park at night is not an option, given that the park has multiple entrances, and because the roads going through the park are the main thoroughfare connecting the towns North and South of HRSP. However, establishing a no parking policy in the park from dusk to dawn would make accessing suitable targets and removing the posts more difficult, as any parked vehicles would draw immediate attention. Another possibility would be blocking access to the park from private roads. There are currently 12 gates throughout the park banning access to some multipurpose park or private roads, although these gates or their locks are sometimes vandalized to gain access to the park. To prevent this, vandal-proof gates and locks need to be used. Figure 9 displays a tubular gate with difficult-to-reach placement for the lock to prevent the lock from being cut using bolt cutters. In addition, it is important to monitor lock integrity. HRSP rangers frequently check the locks on the gates to make sure they have not been cut or disabled.

Table 1

*SCP interventions by stage of the crime script for split-rail theft*

| Stage | Increase the Effort | Increase the Risks | Reduce the Rewards | Remove Excuses |
|---|---|---|---|---|
| **Preparation** | | | | - Educational campaigns in the local area |
| **Pre-activity** | - Block park access at night<br>- No parking policy at night<br>- Close access from private roads<br>- Vandal-proof gates and locks<br>- Monitor lock integrity | - More patrols, incl. overnight<br>- Focus patrols on hotspots<br>- CCTV at high-risk entrance/exit points<br>- CCTV in/around potential targets<br>- Rangers changing shifts, using cellphones not radios | | |
| **Activity** | | - Tremor sensors<br>- Metal detectors<br>- Hotline<br>- Investigate cars parked at night | | |
| **Post-activity** | - Remove planks over ditches | - CCTV in active sites<br>- Hotline<br>- CCTV at high-risk entrance/exit points<br>- Ask drivers for Bill of Sale | - Removal of sitting ducks<br>- Make cuts to potential targets<br>- Mark found posts<br>- Educate likely final buyers | |

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The potential of detection and apprehension of offenders can be enhanced (*Increase the Risks*) by increasing the number of patrols if additional staff members are hired in the future. However, this option is not currently feasible given HRSP is severely understaffed, with a total of 4 rangers assigned to the park. Additionally, rangers have many different issues to tend to: traffic laws in the park, illegal camping, natural resource protection, fights/issues among campers, protestors, wildfires, etc., which limits the time that can be dedicated to preventive patrols. Rangers working overnight shifts would be a more optimal strategy but is unlikely given the level of understaffing, especially because overnight shifts require 2 rangers working together. A more effective use of resources would be to focus patrols on known crime hotspots as recommended by Pires & Marteache (2023). A risk map was created using the crime data compiled during our visit, which shows that split-rail theft is heavily concentrated in the northern and central-east ends of the park off of the primary road, Avenue of the Giants. (Figure 10). This information can be used to direct patrols to high-risk spots.

The risk of detection can be increased by installing CCTV at entrances/exits near hot spots. HRSP rangers have a total of 12 battery-operated cameras with motion detectors that they can place in and around park accesses. Some of the issues with those cameras are that photo download and battery replacement must be done manually, which requires that the rangers access each camera every few days. If the cameras are stolen, which is a problem HRSP experiences often, the images cannot be recovered. A potential improvement would be to acquire and use satellite-connected cameras that can send real-time images so rangers can deploy resources to apprehend offenders. Another option would be to install a closed-circuit camera system that automatically downloads images to a central terminal, which could be placed inside the rangers' station. CCTV can also be used in/around potential targets. Once a new suitable target is identified (fresh downed, split open, and accessible), rangers could place motion detection cameras nearby, considering the limitations stated above.

Offenders often listen to ranger scanner and radio frequency to determine when, and how many, rangers are on duty. As a prevention measure, rangers sometimes change their shifts (to make them unpredictable) and check in/out using their cellphones instead of the radio. Finally, levels of guardianship can be increased by informing locals/visitors of indicators of suspicious activity and asking them to report using the existing hotline. The hotline is currently advertised, but only at known hotspot locations to avoid "sign pollution", which happens when there are so many signs that people stop paying attention to them.

***Interventions at the Activity stage***

The crime prevention strategies at this stage aim to *Increase the Risks*. Tremor sensors could be installed to detect footsteps in a risky or active site. This measure only works in isolated areas, not in those that have heavy foot traffic. Metal detectors could be buried near newly downed and split redwoods to detect the use of tools. Locals and visitors could be encouraged to report suspicious activity using the hotline as explained above. Finally, investigating cars parked at night—especially if a parking ban is in effect—can be an effective deterrent.

Figure 9

*Tubular gate with vandal-proof lock*

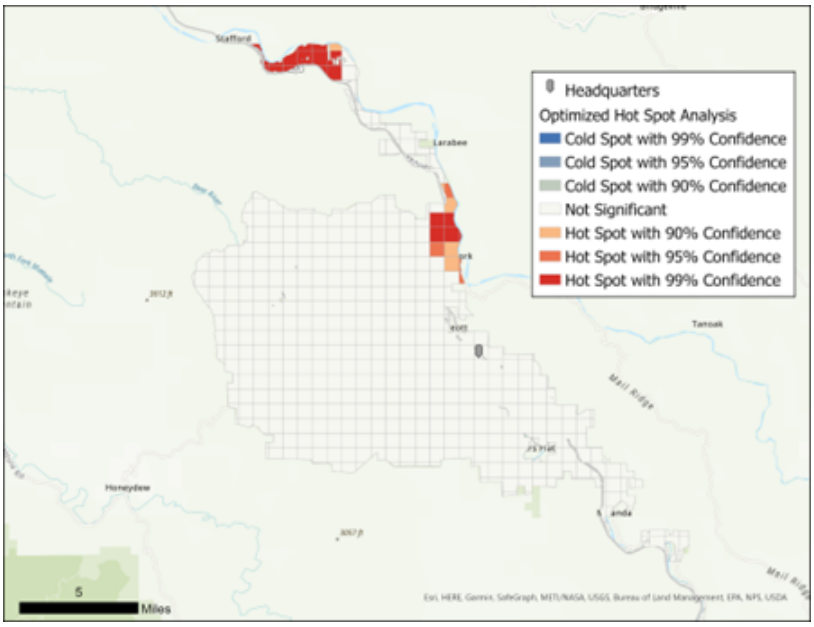
(a) *Tubular gate preventing access to/from private road (lock receptacle on the right of the photo)*

(b) *Vandal-proof lock receptacle*

(c) *View from below the lock receptacle*

Figure 10

*An Optimized Hot Spot Analysis of split-rail theft at HRSP*




***Interventions at the Post-Activity stage***

Sometimes if there is a ditch between log location and road, offenders will place a piece of wood or a plank to be able to drag posts over the ditch. If they must return to retrieve the rest of the wood, removal of the plank i*ncreases the effort*.

Similar to what has been discussed above, once an active site is identified (pile of posts ready for pickup, fresh cuts), rangers can place motion detection cameras nearby. Locals and visitors can report indicators of suspicious activity through the hotline, and CCTV can be used to monitor high-risk entrance/exit points. In addition, private trucks carrying posts in the local area could be stopped and required to produce a Bill of Sale (collaboration with California Highway Patrol may be necessary) (*Increase the Risk*).

The *rewards of the crime can be reduced* by removing "sitting ducks", that is, posts cut and piled that are waiting for offenders to retrieve them, as well as making potential targets unusable by identifying newly downed and split trees close to the road and cutting the wood. When split rail is identified as a potential target sometimes rangers make cuts at intervals of 1 meter (3 ft) to make the wood unusable as posts, and/or they cut it at odd angles for the same purpose (Figure 11). This measure could be implemented in a more systematic way. Pieces of wood likely to be taken (i.e. those found in a pile) could be marked with small signs or ink that can only be seen under a blue light to apprehend offenders. Finally, likely final buyers (i.e. local organic farmers) could be educated about this problem and encourage them to request proof of origin of posts purchased.

Figure 11

*Example of suitable target cut every meter by HRSP*

A couple of limitations of this study must be noted. The crime script was developed using a mixed methods design which included incident data collection of crime sites, field observations, and informal interviews with HRSP rangers. The use of additional data sources such as offender interviews, both by poachers and middlemen, could enhance the analysis and preventive solutions described in this paper, but were unavailable to the authors. Second, only the incidents known to HRSP were recorded and their locations visited. It is possible that there are differences between known and undiscovered incidents regarding how the crime is committed. However, working with a highly knowledgeable and experienced team of HRSP rangers helped minimize this potential issue.

## Conclusion

Using crime script analysis and a mixed methods design, this research presents a thorough description and analysis of an understudied flora poaching problem - the theft of redwood split-rail in a protected park. By mapping out the different stages of the crime, we were able to identify the steps, tools, and conditions needed to commit it. This, in turn, allowed us to use Situational Crime Prevention to recognize existing crime prevention strategies, as well as propose new ones tailored to each stage of the crime commission process.

This research adds to the scant existing literature on flora poaching and is one of the few crime script case studies ever applied to this type of issue. Being able to uncover the specific details and logistical requirements to successfully conduct each crime stage (i.e. types of tools used) opens up new avenues for prevention. This framework can be applied to the study of other timber and flora issues such as ginseng, venus flytrap, and saguaro cacti poaching in the U.S., orchid poaching in Southeast Asia, and poaching of certain Euphorbia species in Spain. While presenting existing and potential crime prevention strategies is a good starting point, the need for the evaluation of implemented responses must be emphasized if we want to develop evidence-based practices that can inform preventative interventions elsewhere.

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## Appendix

Table 2

*Crime script of split-rail theft at Humboldt Redwoods State Park*

| Stage | Steps | People | Spatial | Temporal |
|---|---|---|---|---|
| **Preparation** | | | | |
|  | · Recruit co-offenders through their networks, consider familiarity with park<br>· Determine potential buyers (i.e. intermediary)<br>· Site/target selection: *scouting ahead; available tools/skills; available routes for a vehicle; ease of transportation to vehicle (i.e. close to road, parking spots nearby, available trails), and far from busy areas (camping sites)*<br>· Decide and map out transportation to enter the park, and to get wood out of the park<br>· Secure access to a suitable vehicle (i.e. pick-up truck, and boat if transportation of timber is done by water)<br>· Identify facility to store the split rail until sold<br>· Forge Bill of Sale (if attempting to disguise sale as legit)<br>· Learn law enforcement practices/schedules | Poacher/s<br>Seller | Park (possibly legal entry posing as a visitor)<br>Offender home and awareness space | Anytime |
| **Pre-activity** | | | | |
|  | · Wait for appropriate weather conditions (i.e. storm, full moon)<br>· Listen to rangers' radio communications to determine where they are located<br>· Using owned/rented/stolen vehicle to enter park, using private or multipurpose roads when needed<br>· Entering the park can be done legally, or illegally by getting around any physical barriers (i.e. cutting chains barring entrance to the park), if any<br>· Park close to target<br>· (When using river transportation) Dock boat nearby | Poacher | Park (possibly legal entry posingas a visitor) | Between Oct-March<br>Mostly at night<br>Preferably during the Winter |
| **Activity** | | | | |
|  | · Test the quality of the wood by making a small cut<br>· Use a chainsaw to cut the wood into 2.5-3 meter posts<br>· Use a mallet and a wedge to split the wood into desired width (12x20cm)<br>· Pile up posts | Poacher | Park<br>Elevated terrain relative to the road<br>Near the road<br>Away from camping sites | Between Oct-March<br>As little time as possible<br>Mostly at night<br>Preferably in the Winter |
| **Post-Activity** | | | | |
|  | FOR LAND TRANSPORTATION:<br>· Load posts onto pickup truck bed<br>· Drive out of the park and to offloading/storage location or buyer<br><br>FOR RIVER TRANSPORTATION:<br>· Lower posts onto riverbed<br>· Build a raft using rope and floating devices<br>· Drag raft along the river with a boat<br>· Co-offenders drive to offloading location to recover the raft<br>· Load wood onto vehicle<br>· Potentially cover wood with a tarp or other material<br>· Drive to offloading/storage location or buyer<br><br>IN BOTH CASES:<br>· Potentially return to activity area multiple times to dispose of all posts piled up<br>· Contact buyers—known buyer or advertise<br>· Sell to known buyer or via internet<br>· Share gains | Poacher<br>Buyer | Park<br>Riverbed in and outside park<br>Storage location<br>Buyer location | Preferable shortly after Activity |

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