

Tamarisk and Russian Olive Occurrence and Absence Dataset Collected in Select Tributaries of the Colorado River for 2017

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Abstract: Non-native and invasive tamarisk (*Tamarix* spp.) and Russian olive (*Elaeagnus angustifolia*) are common in riparian areas of the Colorado River Basin and are regarded as problematic by many land and water managers. Widespread location data showing current distribution of these species, especially data suitable for remote sensing analyses, are lacking. This dataset contains 3476 species occurrence and absence point records for tamarisk and Russian olive along rivers within the Colorado River Basin in Arizona, California, Colorado, Nevada, New Mexico, and Utah. Data were collected in the field in the summer of 2017 with high-resolution imagery loaded on computer tablets. This dataset includes status (live, dead, defoliated, etc.) of observed tamarisk to capture variability in tamarisk health across the basin, in part attributable to the tamarisk beetle (*Diorhabda* spp.). For absence points, vegetation or land cover were recorded. These data have a range of applications including serving as a baseline for the current distribution of these species, species distribution modeling, species detection with remote sensing, and invasive species management.

Dataset: Dataset submitted as supplement to this paper.

Dataset License: CC BY 4.0.

Keywords: Colorado River Basin; *Diorhabda* spp.; *Elaeagnus angustifolia*; invasive species; riparian; Russian olive; tamarisk; tamarisk beetle; *Tamarix* spp.

1. Summary

Non-native and invasive tamarisk (saltcedar, *Tamarix* spp.) and Russian olive (*Elaeagnus angustifolia*) have become some of the most common and abundant woody riparian species across the western United States [1,2]. These species receive particular attention from land and water managers in the Colorado River Basin due to their potential impacts on native riparian vegetation [3–5], geomorphology [6], water resources [7], recreation, and wildlife [8,9]. Tamarisk and Russian olive were introduced and widely planted for erosion control, wind breaks, and landscaping in the 19th and 20th centuries and escaped cultivation in the early and mid-20th century [2]. Both species can either

form dominant monocultures or can coexist with native riparian vegetation [10,11]. They are generally found in moist areas such as around rivers, irrigation channels, lakes, and reservoirs.

Concerns about the negative impacts of these invasive species have led to their active removal in many areas and the introduction of the tamarisk beetle (*Diorhabda* spp.) as biocontrol. The tamarisk beetle was first approved for release outside of experimental settings in 2001 and has since become widespread [12]. The tamarisk beetle is now established throughout the Western U.S. ranging from Texas, Oklahoma, and Kansas in the east to California in the west and from Mexico in the south to Oregon, Idaho, and Wyoming in the north [12]. These beetles exhibit a cyclic pattern with tamarisk whereby they defoliate tamarisk initially and then return after tamarisk has recovered to defoliate the plant again. This repeated defoliation within a growing season, or over several growing seasons, has resulted in high tamarisk mortality in some areas, but minimal mortality at other sites [13,14]. Due to this biocontrol, removal efforts, and the spread of tamarisk and Russian olive, their distributions are changing—data documenting their locations and condition are critical for monitoring and mapping efforts.

Broad-scale maps of tamarisk and Russian olive are needed to inform management and our understanding of these invasions [2]. We set out to map tamarisk and Russian olive distributions in the Colorado River Basin, but found existing field data to be inadequate for the task. Existing tamarisk and Russian olive distribution data are limited in their geographic extent—the data are concentrated in some areas and sparse or nonexistent in other areas. Another challenge we encountered is that presence points are frequently incompatible for analyses with remotely-sensed imagery—georegistration errors may be large (e.g., a point is placed on a road adjacent to a tamarisk stand rather than in the tamarisk stand itself) and there may not be a minimum cover or abundance requirement to be included as a presence (e.g., a single tamarisk shoot in an area dominated by other vegetation may be marked as a presence point). These points are well-suited for some applications such as habitat suitability modeling [15,16], but are inadequate when pairing field data with high (e.g., National Agriculture Imagery Program) or moderate-resolution (e.g., Landsat, Sentinel-2) remotely-sensed imagery to detect a specific species. Timing between field data collection and remotely-sensed imagery collection needs to align when mapping species to ensure accurate representation of the current extents of these species and to not confound the analysis with outdated records. Furthermore, tamarisk and/or Russian olive absence points are often not included in datasets but are important for developing models to map species' locations. The data presented in this article address these issues and are highly suitable for remote sensing analyses which are often not possible with records in existing databases containing invasive species occurrence points (e.g., the Early Detection and Distribution Mapping System (EDDMapS), the Global Biodiversity Information Facility (GBIF)).

To address this need, we designed and implemented a sampling protocol that utilizes high-resolution imagery and computer tablets to efficiently collect data compatible with remote sensing across large areas (i.e., multiple states). We collected 3476 presence and absence locations of tamarisk and Russian olive in the Colorado River Basin across six states. These data are compatible with moderate-resolution satellite sensors like Landsat and Sentinel-2 and could potentially be used to map these species across large areas. This dataset in Supplementary Materials can also serve as a snapshot of tamarisk and Russian olive distribution in the summer of 2017, from which we can better understand change in distribution over time and tamarisk beetle impacts.

2. Data Description

This dataset in Supplementary Materials provides information on the presence and absence of tamarisk and Russian olive in select tributaries in the Colorado River Basin. The basin extends over about 630,000 km² in Western North America from the Rocky Mountains to the Gulf of Mexico (Figure 1). Our data span Arizona, California, Colorado, Nevada, New Mexico, and Utah. Data were collected during summer 2017 in the field using high-resolution imagery [17] on a digital collection interface along the Animas, Colorado, Dolores, Escalante, Fremont, Gila, Paria, San Juan, San Miguel,

San Pedro, San Rafael, Verde, Virgin, Little Colorado, and Santa Clara Rivers and McElmo Creek. Approximately 3500 presence and absence locations are available as Global Positioning System (GPS) coordinates (“x” and “y” columns) in World Geodetic System 1984 (WGS 84) decimal degrees in three formats: shapefile, Keyhole Markup Language (KMZ), and comma-separated values (CSV). The classification of each point in the “Veg_LandCover” column represents the dominant (>50% of the cover) vegetation or cover type within a roughly 7 m radius circle. This column describes the status (live, dead, defoliated, etc.) of observed tamarisk for tamarisk points, and the vegetation or land cover of locations collected as tamarisk absences. Two additional columns, “TamPresAbs” and “ROPresAbs”, indicate if tamarisk or Russian olive, respectively, are dominant (“present”) or not (“absent”). Any tamarisk point, regardless of the status, is considered as “Present” in the “TamPresAbs” column. Each of these data attributes are described in the dataset’s accompanying metadata.

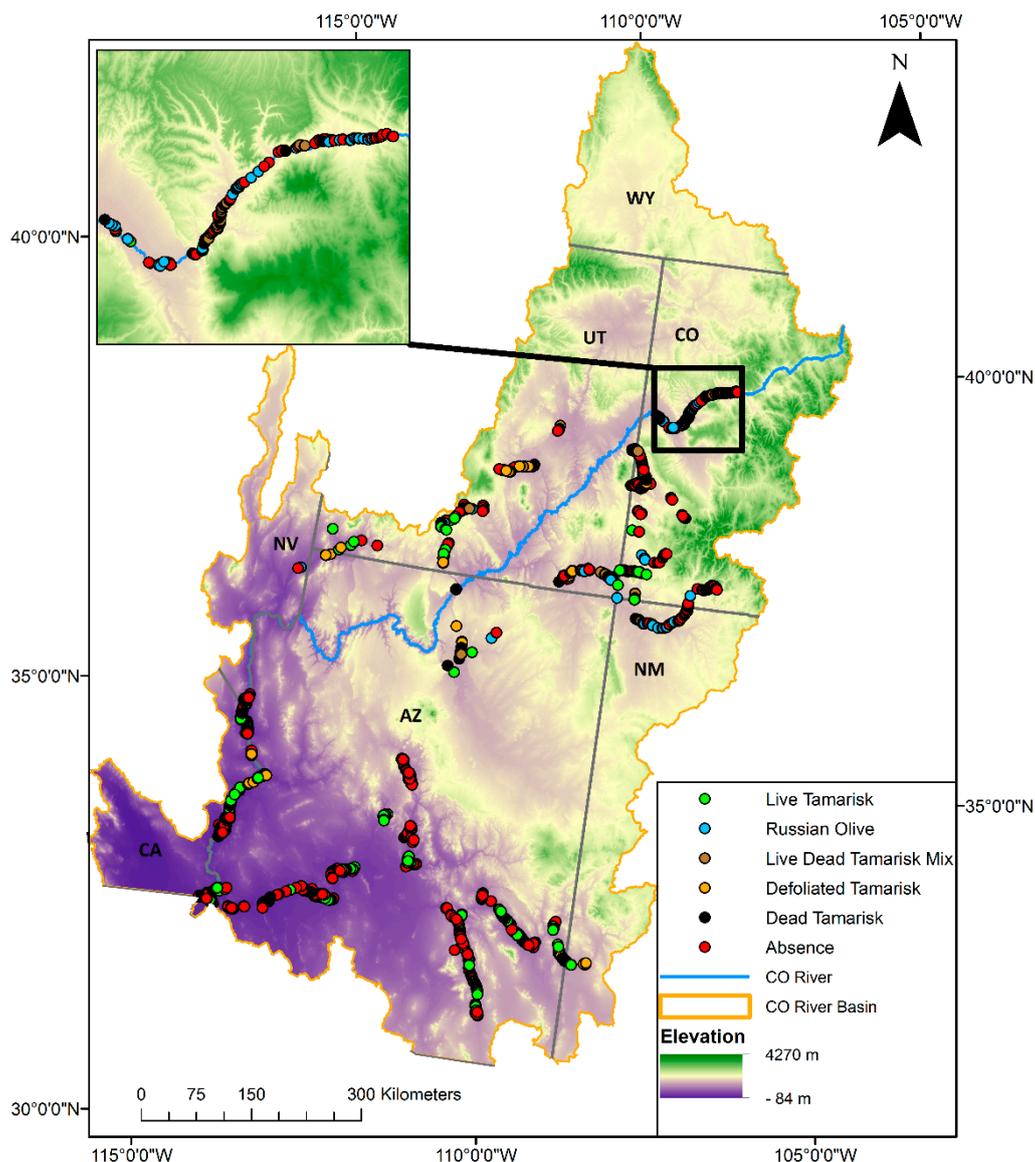


Figure 1. The extent of the Colorado River Basin in the southwestern United States and locations of the samples included in this dataset. The inset shows data collected along the Colorado River in western Colorado. State labels correspond to the following states: AZ = Arizona; CA = California; CO = Colorado; NV = Nevada; NM = New Mexico; UT = Utah; WY = Wyoming.

3. Methods

We collected these data in July and August of 2017 for use with remotely sensed data to map tamarisk and Russian olive distribution in the Colorado River Basin (Figure 1). The sampling protocol was designed to be compatible with satellite imagery and for efficient data collection across large geographic areas. The most recent high-resolution imagery base maps [17] were loaded on Samsung Galaxy A electronic tablets in the Collector for ArcGIS program [18] and observers placed and classified points on this imagery as they viewed vegetation in the field, typically from a distance. Observers matched vegetation seen in the field with color, structure, and texture patterns observed in the high-resolution imagery to place points in the correct location and classify vegetation. Sampling was conducted opportunistically where land ownership and road access were allowed. Most points were collected from vehicles along roads for efficiency.

Points were classified based on their dominant vegetation to capture locations of tamarisk and Russian olive, and absences (Figure 2). Dominance was defined as occupying greater than 50% of the cover as seen from above within a roughly 7 m radius circle [19]. This plot size was selected based on its use across a broad range of agencies, and its utility in training models fit with remotely sensed imagery [20]. Most of the sampling was done quickly from vehicles, so determination of dominance was based on ocular estimates from a distance. The absence designation indicates that tamarisk and/or Russian olive were absent from or composed a minor portion of the overstory, but should not be interpreted as complete absence from that location since many of these sites were observed from a distance.

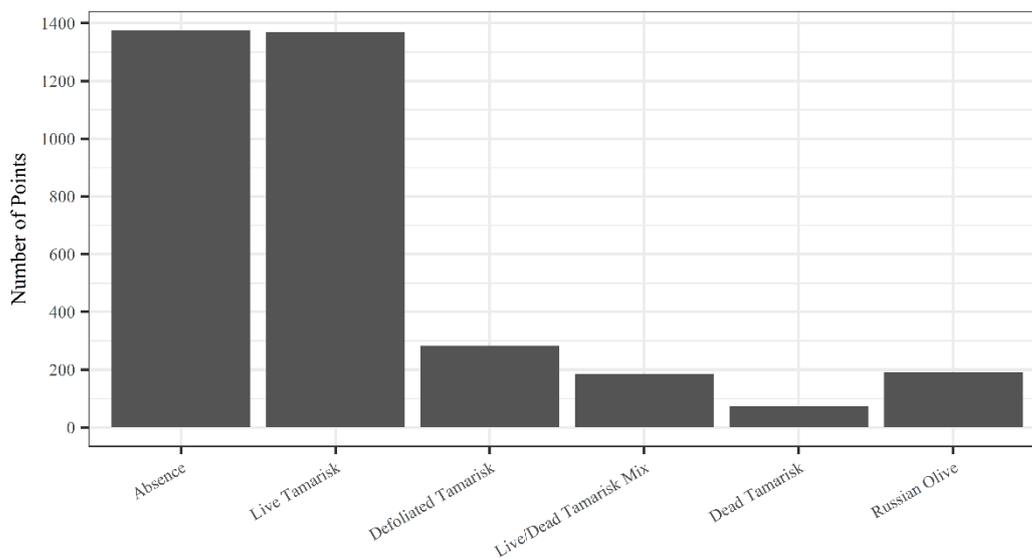


Figure 2. The number of points by vegetation class for a total of 3476 plots.

Tamarisk health varies broadly across the Colorado River Basin, largely due to defoliation by the tamarisk beetle [12]. We collected information to classify the predominant status of tamarisk as either live, dead (leafless with no obvious evidence of live growth as determined from distance sampling), a mixture of live and dead, or defoliated (having a reddish appearance from tamarisk beetle defoliation and desiccation; Figure 3). We classified the absence points to indicate the dominant vegetation or land cover (i.e., water, bare ground, etc.) at that location. Most points are classified to genus, but some are identified to the species, family, or land cover type. Our distance sampling method did not allow for the identification of tamarisk to the species level, however *Tamarix ramosissima* and *T. chinensis* and their hybrids are the most common species in the western U.S. [1,2,21]. Additional species known to be established in the U.S. that we may have encountered in our sampling include *T. aphylla*, *T. parviflora*, *T. canariensis*, and *T. gallica* [1,2,21]. At the beginning of sampling, points not classified

as tamarisk or Russian olive were not labeled with the vegetation/land cover—these points were labeled as an “unclassified absence”. Sample points were placed in vegetation and land cover types representative of the area being sampled, but sampling frequency was not necessarily proportional to the area covered by a given vegetation or land cover. Data were checked in the office and the “Veg_LandCover” column was edited so that naming conventions were consistent for equivalent vegetation and cover types. This dataset in Supplementary Materials provides valuable information on the 2017 distribution and status of tamarisk and Russian olive in the Colorado River Basin.



Figure 3. An example of reddish tamarisk in the foreground that has been impacted by tamarisk beetles. It would be classified as “defoliated” in this dataset. Photo credit: Dr. Amanda West.

Supplementary Materials: The following are available online at <http://www.mdpi.com/2306-5729/3/4/42/s1>, Tamarisk and Russian olive occurrence and absence point data in three formats: shapefile, KMZ, and CSV.

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