EXTENT AND CONDITION OF INFORMAL TRAILS IN MEADOWS

The Extent and Condition of Informal Trails in Meadows indicator is intended to monitor the proliferation and condition of informal trails in meadows and the resulting fragmentation of meadow habitat. While the indicator is still in development, informal trail monitoring is currently being implemented in both the Merced and Tuolumne River corridors.

Introduction

Informal trails (or visitor-created "social" trails) may be defined as discernible and continuous trail segments that were created by visitors and which do not follow a park's formal trail system (Leung et al. 2002). Since informal trails are not planned or constructed, they are usually poorly located with respect to terrain and receive very little or no maintenance by park staff. These factors substantially increase their potential for degradation in comparison to formal trails. The proliferation of informal trails may increase habitat fragmentation and can directly threaten sensitive habitats (Figure 1). From a social perspective, a web of informal trails creates a visually scarred landscape and may lead to safety and liability concerns (Marion et al. 2006).

Monitoring can provide timely information on the extent, distribution and condition of these trail segments. The findings from data collection, combined with established minimum acceptable conditions (standards), can serve as warning signs of resource degradation and habitat disturbance. Such information can be used to inform management decisions regarding protection of meadow health in Yosemite National Park. This report serves as a summary of informal trail monitoring and subsequent data analyses for work completed in 2010 (Table 1).

Figure 1 Informal Trails in El Capitan Meadow in Yosemite Valley in 2010

Findings and Highlights

Table 1 Extent and Condition of Informal Trails: Parameters, Plan/Application, Standards & Observed Conditions

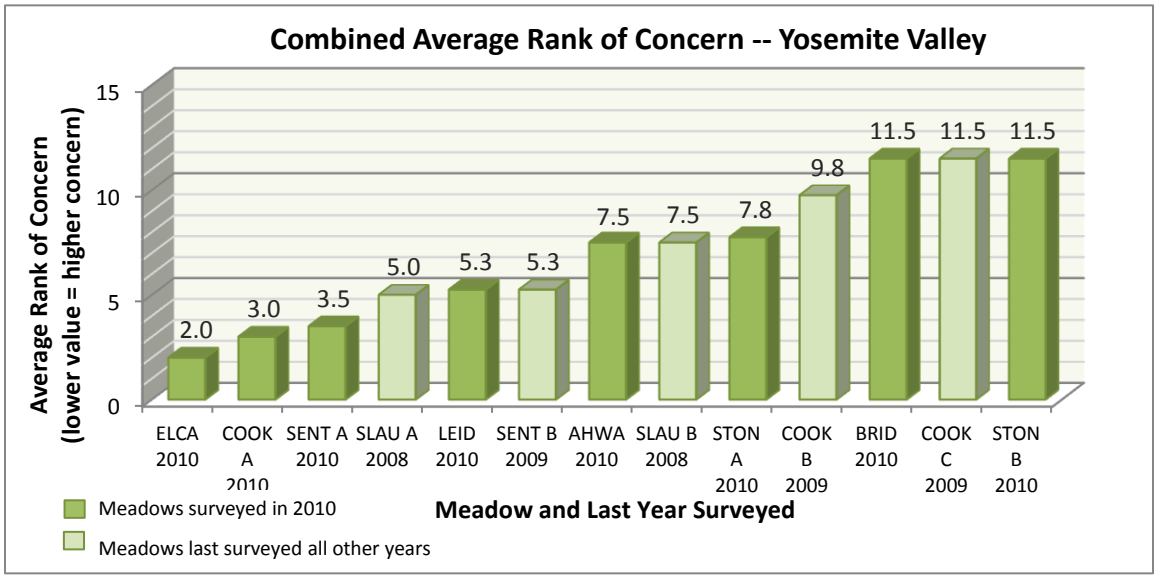
Parameter	Plan/Application	Standard	Observed Condition
Weighted Mean Patch Index (WMPI)	Draft Tuolumne River Plan/ In development as a potential indicator for the Merced River corridor	Standards for WMPI are currently being developed.	In Yosemite Valley, Cooks A, was rated meadow of greatest concern in 2010 using the WMPI (0.08). Ranger Station A was the Tuolumne meadow rated of greatest concern (WMPI=0.21)
Largest Five Patches Index (L5PI)	Draft Tuolumne River Plan/ In development as a potential indicator for the Merced River corridor	A draft standard of 92.84% has been developed for L5PI for meadows within the Tuolumne corridor. Standards for the Merced River corridor are currently being developed.	L5P1 in El Capitan Meadow has decreased from 91.23% (2006) to 80.31% (2010); Cooks A Meadow from 95.68% (2006) to 77.39% (2010); Section A of Sentinel Meadow from 95.46% (2007) to 90.59% (2010).
Total Impact Extent	Draft Tuolumne River Plan/ In development as a potential indicator for the Merced River corridor	Standards for Total Impact Extent are currently being developed.	Since 2006, El Capitan Meadow has experienced a 58% increase in total extent of impact from 4535 m^2 to 7170 m^2; Section A of Sentinel Meadow showed a 191 m^2 decrease in total impacted area.
Total Impact Percent	Draft Tuolumne River Plan/ In development as a potential indicator for the Merced River corridor	Standards for Total Impact Percent are currently being developed.	Section A of Sentinel Meadow showed a 9% decrease in total impacted area (2138 m^2 in 2007 to 1947 m^2 in 2010). Tuolumne Meadow Section B has nearly doubled, going from 13061 m^2 (.88%) in 2009 to 25474 m^2 (1.72%) in 2010.
Condition Class	Draft Tuolumne River Plan/ In development as a potential indicator for the Merced River corridor	Trend data will demonstrate improvement of condition for recorded informal trails in meadows.	Data analysis in progress

Descriptions of each of the 2010 indices for the Extent and Condition of Informal Trails in Meadows draft indicator are provided (Table 2) along with information pertaining to interpretation. During analysis, selected landscape indices - chosen due to their reflection of trail proliferation and landscape fragmentation - are calculated for each meadow. All indices have been applied to meadows within both the Merced and Tuolumne River corridors.

Table 2 Descriptions and Interpretation of 2010 Indices for the Extent and Condition of Informal Trails in Meadows Draft Indicator

Index	Description	Interpretation
Weighted Mean Patch Index (WMPI)	Indicative of the average size of patches without informal trails with consideration to the dominance of informal trail features in a landscape	A lower value equals greater concern; given in hectares
Largest Five Patches Index (L5PI)	Derived from the sum of the areas of the five largest patches created by informal trailing, divided by total landscape (meadow) area.	A lower value equals greater concern; given as a percent
Total Impact Extent	Total area (meters squared) of informal trails and disturbed areas in a meadow	A higher value equals greater concern; given in square meters.
Total Impact Percent	Total percent of meadow area impacted; calculated by dividing the total extent of impact by the total meadow area	A higher value equals greater concern; given as a percent
Condition Class	Trail conditions are recorded for each trail segment monitored. Condition ratings include: "stunted vegetation", "some bare ground", and "stunted." Disturbed areas are also recorded with the same condition classes.	This method offers managers a method to monitor degradation of trails in addition to the formation of new trails. Trails conditions are compared against earlier monitoring data on a rotation schedule of 3-5 years.

These indices are each explored separately during analysis, as well as considered collectively, to develop a ranking system which provides a more objective way to determine monitoring priorities and relative meadow health; i.e. through an overall ranking of concern for Yosemite Valley meadows (Figure 2).



Meadow name abbreviations:

AHWA	Ahwahnee	ELCA	El Capitan	SLAU	Slaughterhouse (A/B)
BRID	Bridalveil	LEID	Leidig	STON	Stoneman (A/B)
COOK	Cooks (A/B/C)	SENT	Sentinel (A/B)		

Figure 2 Combined Average Rank of Concern for Meadows in Yosemite Valley 2008-2010.

Conclusion & Future Implications

In 2010, seven meadows in Yosemite Valley along with the main meadow complex of Tuolumne Meadows were surveyed for informal trail impacts. Although specific index standards for Yosemite Valley meadows are still in development, conclusions may be drawn from trends in data, with additional consideration to the ranking system, to determine which meadows are in greater need of further evaluation and prioritize restoration efforts. For the purposes of this report, the three meadows of greatest concern in Yosemite Valley are highlighted. Each of these meadows, El Capitan, Cooks A, and Sentinel A, demonstrate different degrees of impact from the other two, presenting an excellent example of why it is important to consider the indices both individually and collectively (through the ranking system).

The combined average ranking system places El Capitan Meadow in the position of greatest concern in relation to all other Yosemite Valley meadows. Trend observations suggest an increase in concern for all indices in El Capitan Meadow from 2006 to 2010. Since 2006, the meadow has experienced a 58% increase in total extent of impact from 4535 m^2 to 7170 m^2 and has shown an overall decreasing trend in the Largest Five Patches Index (L5PI) from 91.23% to 80.31%. Analysis of section A of Cooks Meadow falls into the second position for rank of concern. The decreasing trend in L5PI values for Cooks A, from 95.68% in 2006 to 77.39% in 2010, indicates a higher degree of fragmentation despite only slight variability between years in total impact extent values. It is important to note that Cooks A has a relatively small meadow area and is therefore more sensitive to changes in patch size. Section A of Sentinel Meadow has also experienced a decline in its L5PI value from 95.46% in 2007 to 90.59% in 2010. The number of patches has nearly doubled (from 23 to 45) as well, suggesting increased fragmentation despite a 9% (191 m^2) decrease in total impacted area.

Measuring the extent of trampling and analyzing for subsequent habitat fragmentation is essential when determining the overall health of a meadow sustaining informal trail impacts, but is not the only factor that should be considered. Additional research is underway to determine the ecological significance of the informal trail indicator through a cooperative agreement between the National Park Service and North Carolina State University (Leung, Bigbsy & Kollar, 2011). In 2010, a crew of park botanists completed vegetation surveys in the same Yosemite Valley meadows that were surveyed that year for trail impacts; at each plot, information was gathered on several attributes, including but not limited to: dominant species cover (top three species); total non-native species cover; bare ground cover and type; soil moisture; and informal trail cover and classification. Relationships between these vegetation datasets and informal trail data are being explored utilizing geospatial and statistical analyses (Yosemite National Park, 2011).