Title
Rangeland Monitoring Series: Visual Assessment of Riparian Health

Authors
Ward, T A
Tate, K W
Atwill, E R

Publication Date
2003-02-01

DOI
10.3733/ucanr.8089

Peer reviewed

RANGELAND MONITORING SERIES Publication 8089

Visual Assessment of Riparian Health

T. A. WARD, Livestock and Natural Resource Advisor, University of California Cooperative Extension, Stanislaus and San Joaquin Counties; **K. W. TATE,** Extension Rangeland Watershed Specialist, Department of Agronomy and Range Science, University of California, Davis; **E. R. ATWILL,** Associate Veterinarian and Associate Specialist, Department of Population Health and Reproduction, University of California, Davis.

UNIVERSITY OF CALIFORNIA
Division of Agriculture and Natural Resources
http://anrcatalog.ucdavis.edu

California Rangelands Research and Information Center
http://agronomy.ucdavis.edu/calrng/range1.htm

A 782K version of this 3.1Mb publication with lower-resolution photographs is available online at
http://anrcatalog.ucdavis.edu/pdf/8089LR.pdf

UC PEER REVIEWED

There are numerous ways to document a riparian area, ranging from simple photographs to more in-depth, cross-sectional surveys. Visual assessments can be a straightforward and simple method for rangeland managers in making a rough evaluation of the overall health of riparian areas. Visual assessments are not intended to be comprehensive, data-driven evaluations, nor are they intended to be monitoring tools for the long-term documentation of riparian health. The power of a visual assessment is that it provides a simple and rapid tool that allows a local manager to make a timely and cost-effective evaluation of the overall health of the riparian area(s). If the initial visual assessment indicates a problem, a more detailed analysis can be performed to identify the likely cause(s), the possible linkage of the problem to management (current, past, or upstream) or natural disturbances (floods, fires, etc.), the possible change in management to correct the problem, and the type of monitoring needed to document that the problem has been corrected or needs additional management effort.

In a minimal amount of time, managers can be trained in the prudent use of visual assessment methods, thus greatly increasing the number of California's rangeland riparian areas being assessed and managed. The critical component is the availability of a simple riparian assessment tool, designed for use by trained range managers and specific to rangeland riparian areas. There are currently several visual assessments available, each with some level of applicability to rangelands. The Environmental Protection Agency (EPA), Natural Resource Conservation Service (NRCS), Bureau of Land Management (BLM), and California Department of Fish and Game (CDFG) have each produced a method for visual assessment. Three of these four assessments concentrate on habitat parameters for trout and macroinvertebrates, while the other concentrates on hydrological functioning of the creek, with a combined total of 52 questions (For more information on being trained in and using visual assessments, contact your local UC Cooperative Extension, NRCS, or Resource Conservation District [RCD] office.)While each of these visual assessment methods is quite good, together they provide a comprehensive look at the major effects of stream health on rangeland riparian areas (aquatic habitat, hydrological function, stream bank stability, and riparian vegetation). By combining the four existing assessments into one, we present here a riparian health assessment developed specifically for use on Californian rangeland riparian areas.

Our first objective in compiling this new assessment tool was to make it simple and rapid. By reducing overlap among the four existing assessments and eliminating those questions that were not applicable to California rangelands, we were able to create an assessment for high gradient creeks with 9 questions and one for low gradient creeks with 10 questions.

Our second objective was to select questions for the assessments based on data that compare existing methods to a large cross-section of California rangeland riparian areas, as well as on our experiences in field-testing each of the existing methods with range managers.

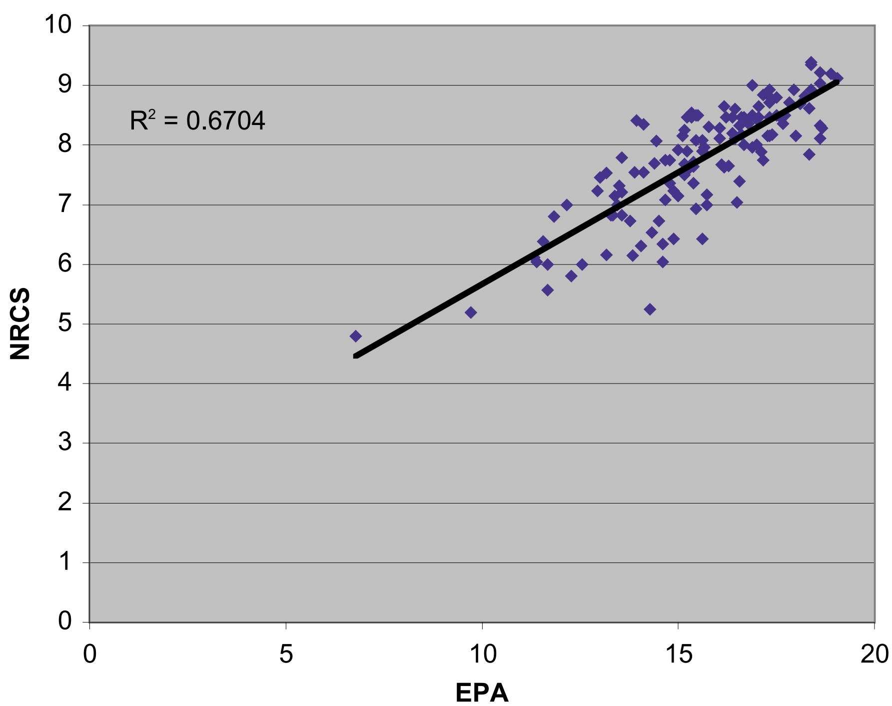
To achieve our second objective in developing this assessment, we applied each of the four existing assessments to 230 rangeland riparian areas across the state. We then statistically analyzed (linear regression, correlation analysis, and multivariate analysis) these data to determine

- similarities between assessments in final overall score and individual assessment question scores
- overlapping questions within and between assessments
- which specific questions were important for predicting a final assessment score (high or low)

The significance of each question selected for inclusion in our assessment and the rationale for its inclusion are provided below.

Strong relationships were found between the habitat assessments (R^2=67%) (fig. 1), and between high habitat scores and Proper Functioning Condition (PFC) ($p<0.01$). This provides the manager with the best of the four assessments in one easy-to-use riparian health assessment method for rangelands.

Figure 1. Fish and macroinvertebrate habitat. There is a linear relationship between EPA and NRCS outcome scores for habitat.



HIGH OR LOW GRADIENT?

The first step in using the assessment is to determine whether the creek is high or low gradient. There are basic differences in how the two types function and dissipate energy. These differences are easily noted in the slope, with high gradient creeks generally having a slope of 5 percent or greater, accompanied by the dominance of riffles. Low gradient creeks have a slope of less than 5 percent and are characterized by bends. If the slope is not known, and a clinometer is not available, the presence or absence of riffles can be used to determine whether the creek is high or low gradient.

It is important to note that this assessment is meant to provide baseline data and that it can be used with intermittent and ephemeral creeks, with the assessment being completed while water is flowing.

HIGH GRADIENT CREEKS

Question 1 Channel Condition

This question determines whether a creek has experienced downcutting in the past, restricting full utilization of the floodplain. The score is lower if downcutting is currently active. A channel condition question was present on all assessments. It was found to be significant (NRCS: $p=0.001$; EPA: $p<0.001$; PFC: $p<0.001$) at predicting final habitat scores (NRCS: $R^2=0.998$; EPA: $R^2=0.997$; PFC: $R^2=0.757$).

Figure 2. Channel condition. This creek scores a 3 since it no longer has access to the floodplain. See figures 3, 15, and 16 for more examples of scoring for channel condition.

Figure 3. Channel condition. Evidence of past downcutting is one of the factors indicating a score of 8. See figures 2, 15, and 16 for more examples of scoring channel condition.

Question 2 Access to Floodplain

This question determines how often a creek exceeds bankfull. A creek should exceed bankfull every 1½ to 2 years, even if only briefly. This can be linked to Question 1. If a channel has been downcut, it will not have access to its normal floodplain (NRCS: $p=0.005$, $R^2=0.998$).

Figure 4. Access to floodplain. This site scores a perfect 12. See figures 5, 17, and 18 for more examples of scoring access to floodplain.

Figure 5. Access to floodplain. This creek receives a score of 1 because it is deeply incised and does not flood. See figures 4, 17, and 18 for more examples of scoring access to floodplain.

Question 3 Bank Stability

This question was present in some form on all four existing assessments. Bank stability is important for healthy, functioning creeks (NRCS: $p<0.001$, $R^2=0.998$; EPA: $p=0.001$, $R^2=0.997$). Scoring banks separately allows for documentation of the condition of each one. For instance, if the right bank is actively eroding while the left bank is stable, assigning one score for the two together does not indicate an accurate assessment, while scoring each bank independently does. This also allows for improvements made on one bank to be more apparent in the future.

Figure 6. Bank stability. This site scores a 12 (6 for each bank). See figures 7, 19, and 20 for more examples of scoring bank stability.

Figure 7. Bank stability. Active bank sloughing indicates a score of 2. See figures 6, 19, and 20 for more examples of scoring bank stability.

Question 4 Riparian Zone

Divided into perennial and intermittent creeks, riparian vegetation plays an important part in the health of a creek, providing root mats that can withstand high streamflow events (PFC: $p=0.007$, $R^2=0.757$), protect banks, and dissipate energy (PFC: $p<0.001$, $R^2=0.757$), as well as filter overland runoff of sediment and nutrients. As with bank stability, each bank is scored separately.

Figure 8. Riparian zone—perennial creek. This site scores a perfect 12. See figure 9 for another example of scoring the riparian zone of a perennial creek. See figures 21 and 22 for examples of scoring the riparian zone of annual systems.

Figure 9. Riparian zone—perennial creek. Due to lack of vegetation, this creek scores a 1. See figure 8 for another example of scoring the riparian zone of a perennial creek. See figures 21 and 22 for annual systems.

Question 5 Macroinvertebrate Habitat

All creeks contain some macroinvertebrates. Therefore, it is important to examine the habitat available to them (EPA: $p<0.001$, $R^2=0.997$). Possible habitats include cobbles, boulders, coarse gravel, and aquatic vegetation. To score this question, the types of habitats present are counted and categorized.

Figure 10.
Macroinvertebrate habitat. This site contains four habitat types: large woody debris, fine woody debris, cobbles, and undercut banks.

Question 6 Macroinvertebrates Observed

Macroinvertebrates found in a creek can be indicators of water quality (USDA Natural Resources Conservation Service 1998). Although this question was not statistically significant for high gradient creeks, it can still be an important indicator of water quality. Please see the NRCS Stream Visual Assessment (ibid.) for a reference sheet describing common macroinvertebrates, placing them into three categories: Class I, Class II, and Class III. Class I species are intolerant of water pollution, and are, therefore, indicators of good water quality. Class II species can tolerate some levels of pollution in the form of temperature or sediment and nutrients. Class III species can survive anywhere, in both clean and polluted water. Finding a diversity of species is also important. For example, if Class I macroinvertebrates are present, there should be many different species.

Question 7 Fish Habitat (if applicable)

Not all of California's creeks and streams have the potential to support a fishery due to inadequate year-round flow, natural downstream obstructions such as waterfalls, and other natural factors. This question should be answered if it is reasonable to expect a fishery for the creek in question. Fish habitat is an important factor to consider (EPA: $p<0.001$, $R^2=0.997$) and is scored similarly to macroinvertebrate habitat (Question 5), with possible habitat types including large woody debris, cobbles, boulders, aquatic vegetation, riffles, and so on.

Figure 11. Fish habitat. This creek has a deep pool habitat with fish in it. See figures 12, 23, and 24 for more examples of fish habitat.

Figure 12. Fish habitat. This creek has a stable, undercut bank. See figures 11, 23, and 24 for more examples of fish habitat.

Question 8 Velocity Depth Regime

High gradient creeks should have a variety of velocity depth regimes present, providing different habitat niches for various aquatic life. Fast-shallow sections add dissolved oxygen into the creek, and slow-deep sections allow fish cover out of the current. This question was again found to be a significant factor in stream health (EPA: $p<0.001$, $R^2=0.997$).

Figure 13. Velocity depth regime. A combination of fast-shallow (purple circle), fast-deep (yellow circle), and slow-shallow (red circle) regimes are present at this site.

Question 9 Riffle Embeddedness

High gradient creeks are dominated by riffles, important features in both dissipating velocity and providing habitat. To function properly, riffles should be free of sediment and the cobble and gravel substrate should not be embedded in the silts and clays. This question was evaluated by the percent of fines accumulating in the riffle (EPA: $p=0.027$, $R^2=0.997$).

Figure 14. Riffle embeddedness. This creek shows a good example of a clean riffle.

LOW GRADIENT CREEKS

Question 1 Channel Condition

This question determines whether a creek has experienced downcutting in the past, restricting full utilization of the floodplain. The score is lower if there is active downcutting. A channel condition question was present on all assessments in some form. It was found to be significant (NRCS: $p=0.002$; EPA: $p<0.001$; PFC: $p<0.001$) at predicting habitat scores (NRCS: $R^2=0.996$; EPA: $R^2=0.996$; PFC: $R^2=0.774$).

Figure 15. Channel condition. This site scores a 12 because this is the natural channel and there is no evidence of downcutting. See figures 2, 3, and 16 for more examples of scoring channel condition.

Figure 16. Channel condition. A score of 4 goes to this creek because the floodplain is restricted and downcutting has been extensive throughout the reach. See figures 2, 3, and 15 for more examples of scoring channel condition.

Question 2 Access to Floodplain

This question determines how often a creek exceeds bankfull. A creek should exceed bankfull every 1½ to 2 years, even if only briefly. This can be linked to Question 1. If a channel has been downcut, it will not have access to its normal floodplain. (PFC: $p<0.001$, $R^2=0.774$)

Figure 17. Access to floodplain. This creek scores a 7 due to limited flooding. Flooding only takes place with large storm systems that occur approximately every 10 to 15 years. See figures 4, 5, and 18 for more examples of scoring access to floodplain.

Figure 18. Access to floodplain. This site scores an 8 because there is a limited incision that reduces access to the floodplain to 3- to 5-year events. See figures 4, 5, and 17 for more examples of scoring access to floodplain.

Question 3 Bank Stability

This question was present in some form on all existing assessments. Bank stability is important for healthy, functioning creeks (NRCS: $p<0.001$, $R^2=0.996$; EPA: $p<0.001$, $R^2=0.996$). Scoring banks separately allows for documentation of the condition of each one. For instance, if the right bank is actively eroding while the left bank is stable, assigning one score for the two together does not indicate an accurate assessment while scoring each bank independently does. This also allows for improvements made on one bank to be more apparent in the future.

Figure 19. Bank stability. Because of the unstable areas circled in red, a score of 11 is given to this creek (6 for the right bank and 5 for the left bank). See figures 6, 7, and 20 for more examples of scoring bank stability.

Figure 20. Bank stability. Because of the unstable area circled in red, this site scores 8.5 (3 for the eroding left bank and 5.5 for the stable right bank). See figures 6, 7, and 19 for more examples of scoring bank stability.

Question 4 Riparian Zone

Divided into perennial and intermittent creeks, riparian vegetation plays an important part in the health of a creek, protecting banks and dissipating energy (NCRS: p=0.001, R^2=0.996; PFC: p<0.001, R^2=0.774), as well as filtering overland runoff of sediment and nutrients. It is also important that a diverse age class (PFC: p=0.020, R^2=0.774) and a diverse composition (PFC: p=0.038, R^2=0.774) be present. Revegetating point bars are also an upward sign of riparian health (PFC: p<0.001, R^2=0.774). As with bank stability, each bank is scored separately.

Figure 21. Riparian zone—intermittent creek. This creek scores an 11 (left bank: 5; right bank: 6), noting the bare sand bars. See figure 22 for more on scoring the riparian zone of an intermittent creek, and figures 8 and 9 for perennial systems.

Figure 22. Riparian zone—intermittent creek. Due to the bare gravel bars, this creek scores a 10 (left bank: 4.5; right bank: 5.5). See figure 21 for more on scoring the riparian zone of an intermittent creek, and figures 8 and 9 for perennial systems.

Question 5 Macroinvertebrate Habitat

All creeks contain some macroinvertebrates. Therefore, it is important to examine the habitat available to them (EPA: $p<0.001$, $R^2=0.996$). Possible habitats include cobbles, boulders, coarse gravel, and aquatic vegetation. To score this question, the types of habitats present are counted and categorized.

Question 6 Macroinvertebrates Observed

Macroinvertebrates found in a creek can be indicators of water quality (USDA NRCS 1998) and are a significant factor for low gradient creeks (NRCS: $p<0.001$, $R^2=0.996$). Please see the NRCS *Stream Visual Assessment* (USDA NRCS 1998) for a reference sheet describing common macroinvertebrates, placing them into three categories: Class I, Class II, and Class III. Class I species are intolerant of water pollution and are, therefore, indicators of good water quality. Class II species can tolerate some levels of pollution in the form of temperature or sediment and nutrients. Class III species can survive anywhere, in both clean and polluted water. Finding a diversity of species is also important. For example, if Class I macroinvertebrates are present, there should be many different species.

Question 7 Fish Habitat (if applicable)

Not all of California's creeks and streams have the potential to support a fishery due to inadequate year-round flow, natural downstream obstructions such as waterfalls, and other natural factors. This question should be answered if it is reasonable to expect a fishery for the creek in question. Fish habitat is an important factor to consider (NRCS: $p<0.001$, $R^2=0.996$; EPA: $p<0.001$, $R^2=0.996$) and is scored similarly to macroinvertebrate habitat (Question 5), with possible habitat types including large woody debris, cobbles, boulders, aquatic vegetation, and riffles.

Figure 23. Fish habitat. A stable, undercut bank is a good fish habitat. See figures 11, 12, and 24 for more examples of fish habitat.

Figure 24. Fish habitat. A deep pool and large woody debris are good habitats for fish. See figures 11, 12, and 23 for more examples of fish habitat.

Question 8 Pool Variability

Low gradient creeks can provide various habitat niches through pool variability. The presence of an even combination of various sizes and depths is important for a healthy system (NRCS: $p<0.000$, $R^2=0.996$; EPA: $p=0.016$, $R^2=0.996$). For this question, *deep* and *shallow* are relative to the average depth of the creek.

Question 9 Pool Substrate

Pools with firm substrate and aquatic vegetation allow for greater diversity in aquatic species than pools with no vegetation and only mud or clay. It is important that pools have an optimal substrate to allow for the largest possible diversity (EPA: $p=0.001$, $R^2=0.996$). If firm substrates are present but aquatic vegetation is not, the score should be lower.

Question 10 Channel Flow

Even while considering that channel flow varies depending on the time of year, it is still an important factor to monitor (EPA: $p<0.001$, $R^2=0.996$). When water does not fill the majority of the channel, substrate can be exposed, limiting both fish and macroinvertebrate habitat potential. For intermittent or ephemeral creeks, the assessment should be completed while there is still a flowing creek.

Figure 25. Channel flow. This site scores a 12 because of its full flow. See figure 26 for another example of scoring channel flow.

Figure 26. Channel flow. This creek has low channel flow. It scores a 3. See figure 25 for another example of scoring channel flow.

PHOTO POINT MONITORING

Photographs are by far the easiest monitoring tool a manager has available. They are an inexpensive, visual record of the site over time. Establishing permanent photo points in the riparian pasture provides another method of documenting changes and serves as a complement to the habitat assessment sheets. Please see *Rangeland Watershed Program Fact Sheet #16: Photo Points as a Monitoring Tool* (University of California Cooperative Extension 1992) for more information on photo points, including the selection of permanent sites.

High Gradient Riparian Health Assessment for Rangelands

Site: ______________________________ **Date:** ______________

1 **Channel condition**	natural channel, no evidence of downcutting	evidence of past channelization or downcutting, but with significant recovery; adequate access to the floodplain	channelization or downcutting extensive; floodplain restricted	channel actively downcutting or widening; floodplain access prevented
Score	12 11 10	9 8 7	6 5 4	3 2 1
2 **Access to floodplain**	flooding every $1\frac{1}{2}$–2 years —not incised	flooding every 3–5 years —limited incision	flooding every 6–10 years —deeply incised	no flooding; deeply incised
Score	12 11 10	9 8 7	6 5 4	3 2 1
3 **Bank stability** (looking downstream)	banks stable; outside bends protected by roots	moderately stable; infrequent, small areas of erosion, mostly healed over	moderately unstable; outside bends actively eroding; banks high; high erosion potential	unstable; actively eroding
Left bank score	6 5.5 5	4.5 4 3.5	3 2.5 2	1.5 1 0.5
Right bank score	6 5.5 5	4.5 4 3.5	3 2.5 2	1.5 1 0.5
4a **Riparian zone —perennial creek** (looking downstream)	natural vegetation (e.g., sedge, rush, willow, alder, aspen, cottonwood, sycamore) at least 2 active channel widths; score higher if point bars revegetating and all age classes of woody species present (seedling, young, mature, old)	natural vegetation extends 1 active channel width OR covers floodplain	natural vegetation extends $\frac{1}{2}$ active channel width OR filtering function moderately compromised	natural vegetation extends less than $\frac{1}{2}$ active channel width OR lack of regeneration OR filtering function severely compromised
Left bank score	6 5.5 5	4.5 4 3.5	3 2.5 2	1.5 1 0.5
Right bank score	6 5.5 5	4.5 4 3.5	3 2.5 2	1.5 1 0.5
4b **Riparian zone —intermittent creek** (looking downstream)	natural vegetation (e.g., oak, buckeye, alder, cotton-wood, annual grass, some sedge and rush) at least 2 active channel widths; score higher if point bars revegetating and all age classes of woody species present (seedling, young, mature, old)	natural vegetation 1 active channel width; bare spots common OR covers floodplain	natural vegetation $\frac{1}{2}$ active channel width; bare spots common OR filtering function moderately compromised	natural vegetation less than $\frac{1}{2}$ active width; bare spots common OR lack of regeneration OR filtering function severely compromised
Left bank score	6 5.5 5	4.5 4 3.5	3 2.5 2	1.5 1 0.5
Right bank score	6 5.5 5	4.5 4 3.5	3 2.5 2	1.5 1 0.5
5 **Macroinvertebrate habitat**	more than 5 habitat types; score higher if good diversity	3–4 habitat types	1–2 habitat types	0–1 habitat type
Score	12 11 10	9 8 7	6 5 4	3 2 1
Cover types	boulders, cobbles, coarse gravel, leaf packs, fine woody debris, submerged logs, overhanging vegetation, macrophytes (aquatic vegetation)			

6 **Macroinvertebrates observed**	Class I dominates; score higher if good diversity and number	Class II dominates	Class III dominates	no macroinvertebrates present
Score	12 11 10	9 8 7	6 5 4	3 2 1
7 **Fish habitat** (if applicable)	more than 7 habitat types; score higher for good diversity	6–4 habitats present	3–2 habitats present	1–0 habitats present
Score	12 11 10	9 8 7	6 5 4	3 2 1
Cover types	logs or large woody debris, deep pools, overhanging vegetation, riffles, boulders or cobbles, thick root mats, isolated or backwater pools, dense macrophyte beds, undercut banks			
8 **Velocity depth regime**	combination of 4 regimes present: slow-deep, slow-shallow, fast-deep, fast-shallow	3 regimes present (lower score if fast-shallow is missing)	2 regimes present (lower score if fast-shallow and slow-shallow are missing)	primarily 1 regime present (usually slow-deep)
Score	12 11 10	9 8 7	6 5 4	3 2 1
9 **Riffle embeddedness**	gravel, cobble, and boulders in riffle; 0–25% surrounded by fines	riffle 25–50% surrounded by fines	riffle 50–75% embedded	riffle >75% embedded
Score	12 11 10	9 8 7	6 5 4	3 2 1

Photo Point Monitoring

	Location description	Compass heading	Landmarks
Witness point			
Photo point 1			
Photo point 2			
Photo point 3			

Date/time	Photographer	Photo point #	Camera/lens film speed	Roll #/ frame #	Observations

Low Gradient Riparian Health Assessment for Rangelands

Site: ______________________ **Date:** ______________

1 **Channel condition**	natural channel, no evidence of downcutting	evidence of past channelization or downcutting, but with significant recovery; adequate access to the floodplain	channelization or downcutting extensive; floodplain restricted	channel actively downcutting or widening; floodplain access prevented
Score	12 11 10	9 8 7	6 5 4	3 2 1
2 **Access to floodplain**	flooding every 1½–2 years —not incised	flooding every 3–5 years —limited incision	flooding every 6–10 years —deeply incised	no flooding; deeply incised
Score	12 11 10	9 8 7	6 5 4	3 2 1
3 **Bank stability** (looking downstream)	banks stable; outside bends protected by roots	moderately stable; infrequent, small areas of erosion, mostly healed over	moderately unstable; outside bends actively eroding; banks high; high erosion potential	unstable; actively eroding
Left bank score	6 5.5 5	4.5 4 3.5	3 2.5 2	1.5 1 0.5
Right bank score	6 5.5 5	4.5 4 3.5	3 2.5 2	1.5 1 0.5
4a **Riparian zone —perennial creek** (looking downstream)	natural vegetation (e.g., sedge, rush, willow, alder, aspen, cottonwood, sycamore) at least 2 active channel widths; score higher if point bars revegetating and all age classes of woody species present (seedling, young, mature, old)	natural vegetation extends 1 active channel width; OR covers floodplain	natural vegetation extends ½ active channel width OR filtering function moderately compromised	natural vegetation extends less than ½ active channel width OR lack of regeneration OR filtering function severely compromised
Left bank score	6 5.5 5	4.5 4 3.5	3 2.5 2	1.5 1 0.5
Right bank score	6 5.5 5	4.5 4 3.5	3 2.5 2	1.5 1 0.5
4b **Riparian zone —intermittent creek** (looking downstream)	natural vegetation (e.g., oak, buckeye, alder, cottonwood, annual grass, some sedge and rush) at least 2 active channel widths; score higher if point bars revegetating and all age classes of woody species present (seedling, young, mature, old)	natural vegetation 1 active channel width; bare spots common OR covers floodplain	natural vegetation ½ active channel width; bare spots common OR filtering function moderately compromised	natural vegetation less than ½ active width; bare spots common OR lack of regeneration OR filtering function severely compromised
Left bank score	6 5.5 5	4.5 4 3.5	3 2.5 2	1.5 1 0.5
Right bank score	6 5.5 5	4.5 4 3.5	3 2.5 2	1.5 1 0.5
5 **Macroinvertebrate habitat**	more than 5 habitat types; score higher if good diversity	3–4 habitat types	1–2 habitat types	0–1 habitat type
Score	12 11 10	9 8 7	6 5 4	3 2 1
Cover types	boulders, cobbles, coarse gravel, leaf packs, fine woody debris, submerged logs, overhanging vegetation, macrophytes (aquatic vegetation)			

6 Macroinvertebrates observed	Class I dominates; score higher if good diversity and number	Class II dominates	Class III dominates	no macroinvertebrates present
Score	12 11 10	9 8 7	6 5 4	3 2 1
7 Fish habitat (if applicable)	more than 7 habitat types; score higher for good diversity	6–4 habitats present	3–2 habitats present	1–0 habitat present
Score	12 11 10	9 8 7	6 5 4	3 2 1
Cover types	logs or large woody debris, deep pools, overhanging vegetation, riffles, boulders or cobbles, thick root mats, isolated or backwater pools, dense macrophyte beds, undercut banks			
8 Pool variablity	even mix of large-shallow, large-deep, small-shallow, and small-deep pools	majority of pools large-deep	shallow pools more prevalent than deep pools	majority of pools small-shallow OR no pools
	Depth relative to the depth of the creek. For example, if average depth = ½ ft, then deep > ¾ ft and shallow < ¼ ft.			
Score	12 11 10	9 8 7	6 5 4	3 2 1
9 Pool substrate	mix of substrate (gravel, firm sand, etc.); roots, submerged vegetation common	mix of soft sand, mud, and clay; some submerged vegetation	all mud, clay, or sand; little to no root mats or submerged vegetation	hard-pan clay or bedrock; no roots or submerged vegetation
Score	12 11 10	9 8 7	6 5 4	3 2 1
10 Channel flow	water reaches base of both lower banks; minimal substrate exposed	water fills >75% of channel; <25% of substrate exposed	water fills 25–75% of channel; riffle substrate mostly exposed	very little water in channel and mostly present in standing pools
Score	12 11 10	9 8 7	6 5 4	3 2 1

Photo Point Monitoring

	Location description	**Compass heading**	**Landmarks**
Witness point			
Photo point 1			
Photo point 2			
Photo point 3			

Date/time	**Photographer**	**Photo point #**	**Camera/lens film speed**	**Roll #/ frame #**	**Observations**

REFERENCES

Barbour, M. T., J. Gerritsen, B. D. Snyder, and J. B. Stribling. 1999. Rapid bioassessment protocols for use in streams and wadeable rivers: Periphyton, benthic macroinvertebrates and fish, 2nd edition. EPA 841-B-99-002. Washington, D.C.: U.S. Environmental Protection Agency, Office of Water. http://www.epa.gov/owow/monitoring/rbp/index.html

California Department of Fish and Game. California stream bioassessment procedure: Habitat and biological assessment for citizen monitors. Sacramento: Aquatic Bioassessment and Laboratories. http://www.dfg.ca.gov/cabw/cabw/csbp.html

Prichard, D., J. Anderson, C. Correll, J. Fogg, K. Gebhardt, R. Krapf, S. Leopnard, B. Mitchell, and J. Staats. 1998. Riparian area management TR 1737-15—A user guide to assessing proper functioning condition under the supporting sciences for lotic areas. Denver: National Business Center.

USDA Natural Resources Conservation Service. 1998. Stream visual assessment protocol, NWCC-TN-99-1. Portland, OR: National Water and Climate Center. http://www.wcc.nrcs.usda.gov/water/quality/common/nrcsdocs.html#aquatic

University of California Cooperative Extension. 1992. Rangeland watershed program fact sheet #16: Photo point as a monitoring tool. Dept. of Agronomy and Range Science, University of California, Davis.

FOR MORE INFORMATION

You'll find detailed information on many aspects of rangeland management in these titles and in other publications and videos from UC ANR:

Managing California's Annual Rangeland Vegetation, publication 21486

Rangeland Management Series: Annual Rangeland Forage Quality, publication 8022

Livestock Management during Drought, publication 8034

Regenerating Rangeland Oaks in California, publication 21601

To order these and other ANR products, visit our online catalog at http://anrcatalog.ucdavis.edu. You can also place orders by mail, phone, or fax, or request a printed catalog of publications, videos, slide sets, and CD-ROMs from

Agriculture and Natural Resources
Communication Services
6701 San Pablo Avenue, 2nd Floor
Oakland, California 94608-1239

Telephone: (800) 994-8849 or (510) 642-2431
FAX: (510) 643-5470
E-mail inquiries: danrcs@ucdavis.edu

Publication 8089

This publication has been anonymously peer reviewed for technical accuracy by University of California scientists and other qualified professionals. This review process was managed by the ANR Associate Editor for Natural Resources.

pr-2/03-GM/SB/VFG ISBN 978-1-60107-264-1