Fading behavior of red shafted flicker feathers

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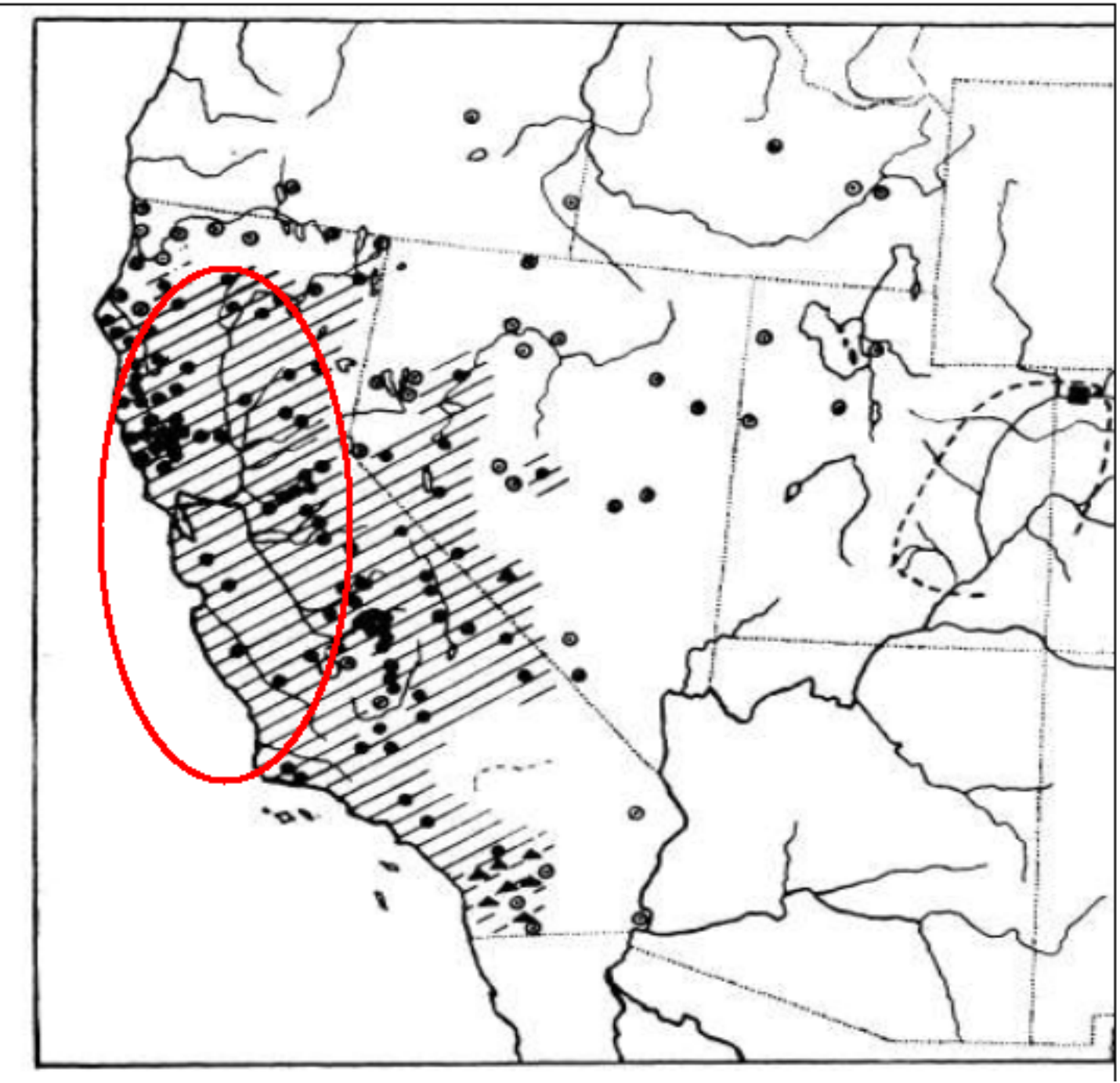
Scraping Gut and Plucking Feathers: Deterioration and Conservation of Feather and Gut Materials
York, England. October 06, 2009

Maidu and Pomo dancers wearing red shafted flicker feather headbands, Big Time festival, Jul 08

Tlingit Sea monster headdress
University of PA Museum
Collected in Wrangell, AL in 1924
by Shotridge

Tail feathers have characteristic black tips. With California headdresses, the barbs are trimmed off leaving the shafts of both tail and wing feathers.



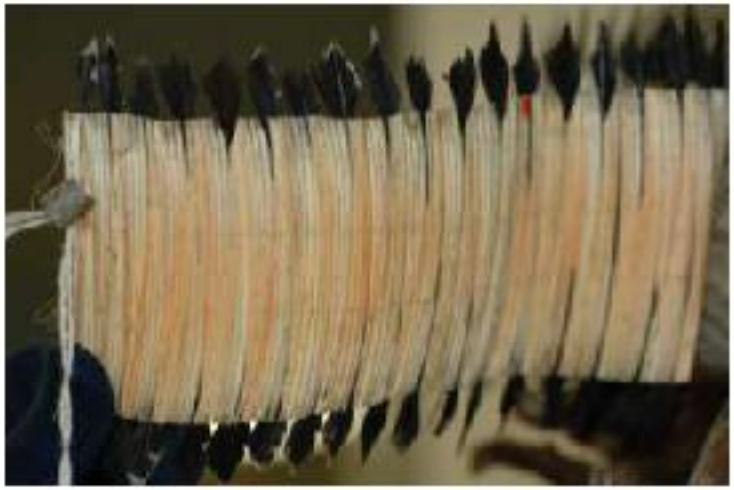
Distribution of flicker feather shaft dance regalia in North America

● Flicker feather headbands

◉ Regions w/o Flicker feather regalia

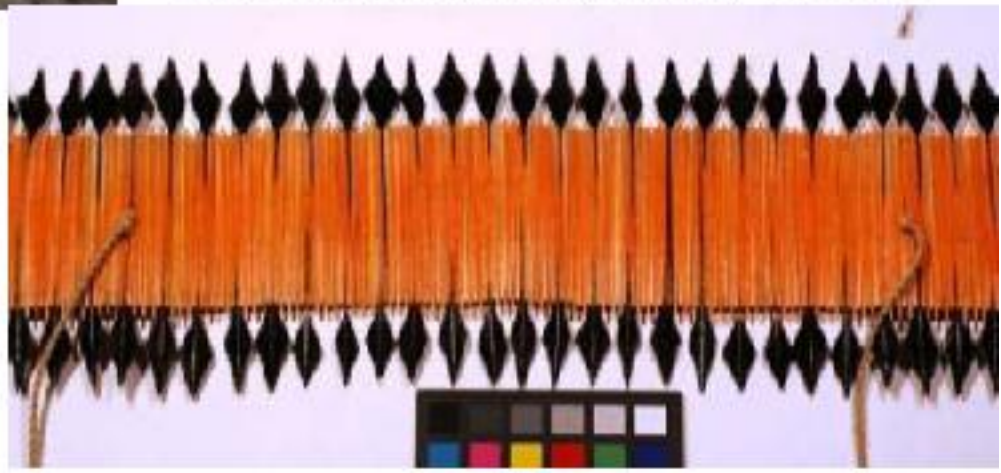
▲ No flicker headbands acknowledged by informants

After Hewes, *American Antiquity*, 1952.



Left, 50/4032C, AMNH, head ornament on Maidu Burning figure

Below, Maidu headband, 1/525
Phoebe Hearst Museum, Berkeley California



The fading behavior of feathers colorants has not been systematically studied.

What accounts for this variability in the same feather types?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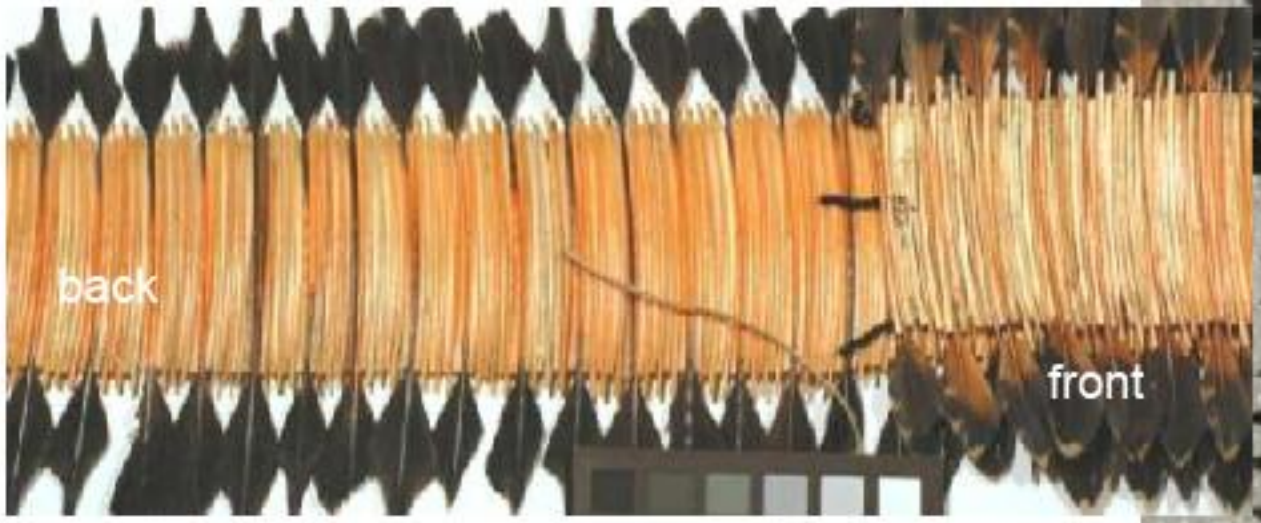
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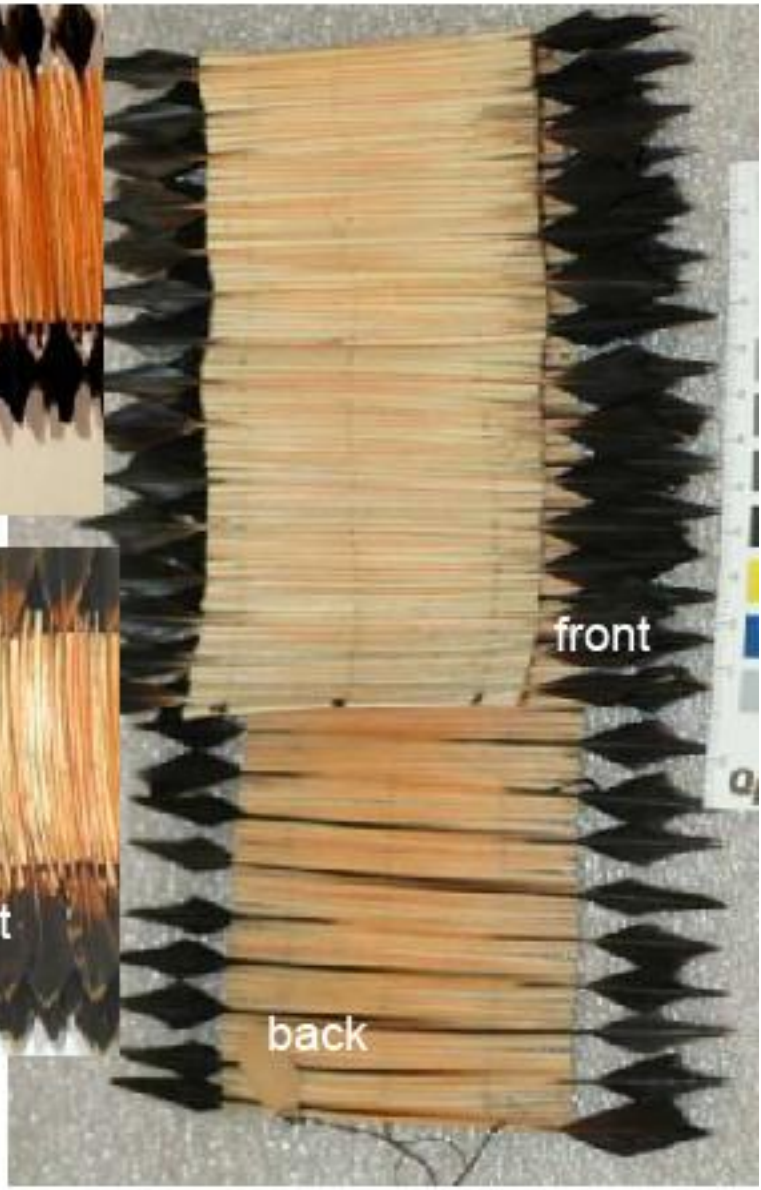
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Two parts:

I. Conservation methodology for evaluating feather color

II. Evaluating fading behavior of red shafted flickers

I. Conservation methodology for evaluating feather color:

What accounts for observed variation in feather coloration?

What occurs while feathers are still on the birds?

- **They are selected by makers of regalia**
- Species specific colorant systems
- Location of feathers on bird
- Gender, diet, age of bird
- Relation to time of molting

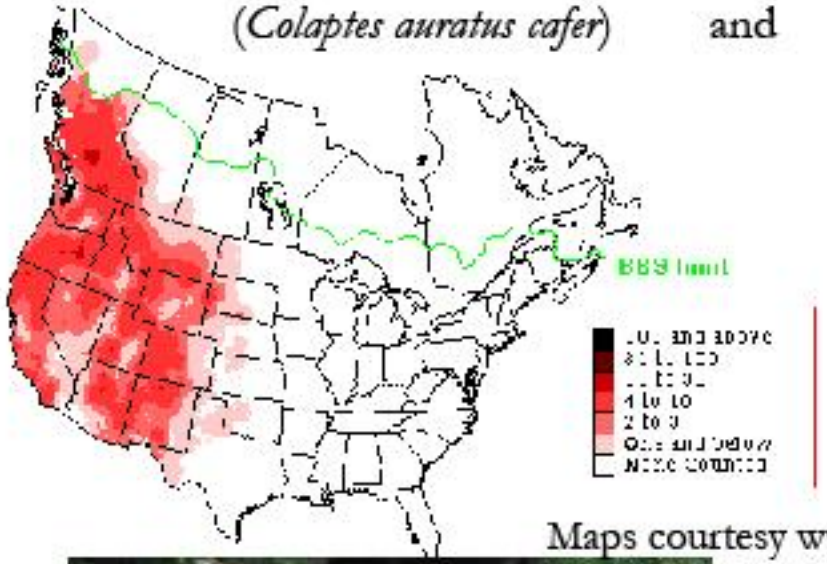
What occurs while feathers are part of a cultural object?

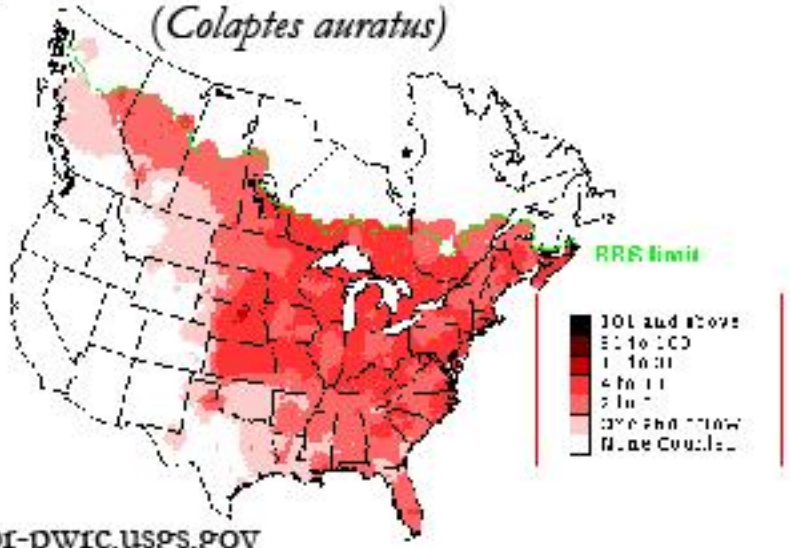
- Photochemical deterioration
- Dissolution from solvents
- Abrasion and insects

In use versus in the museum

Summer distribution: red shafted and yellow shafted flickers

(*Colaptes auratus cafer*) and (*Colaptes auratus*)

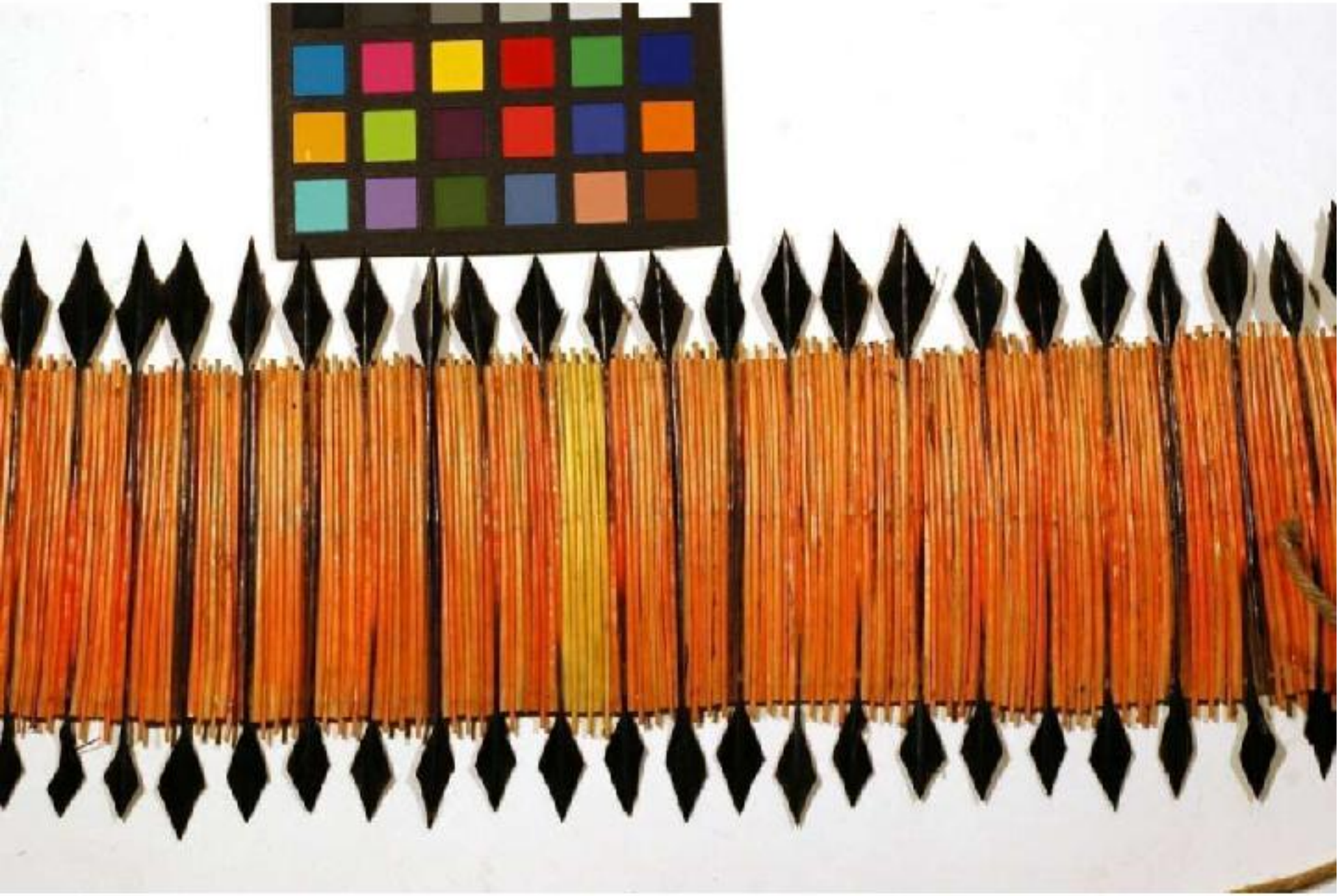




Maps courtesy www.mbr-pwrc.usgs.gov

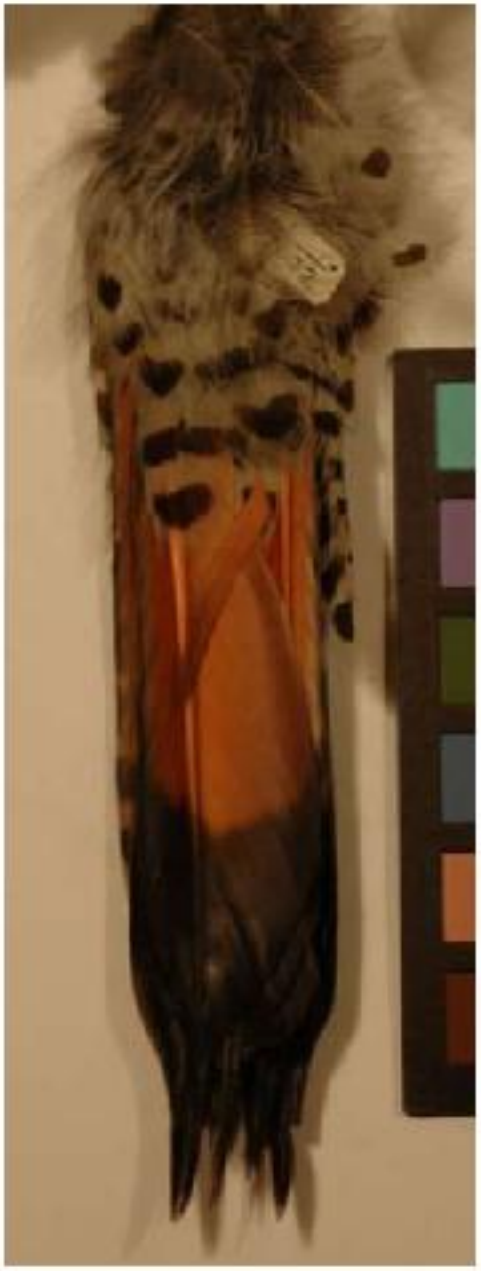
Photo Courtesy Kenneth McEnaney

Photo: Courtesy GregScott.com



Yellow and red shafted flicker feathers used together, Maidu headband 1/2359

Dance headdress with red and yellow flicker feathers. (American Museum of Natural History 50.2/1131), Donated by Mrs. Mary Austin, 1918-28; collected in the Panamint Mountains, Inyo County, California, probably Shoshone



Berkeley 1/700 wing shafts paler than tail shafts

In a study of red shafted and yellow shafted flickers in a hybrid zone in British Columbia, feather colors ranged from brilliant red, through orange, to yellow.

Males are more brilliant red than females.

Wiebe and Bortolotti

Wilson Bull., 114(3), 2002, pp. 393–400

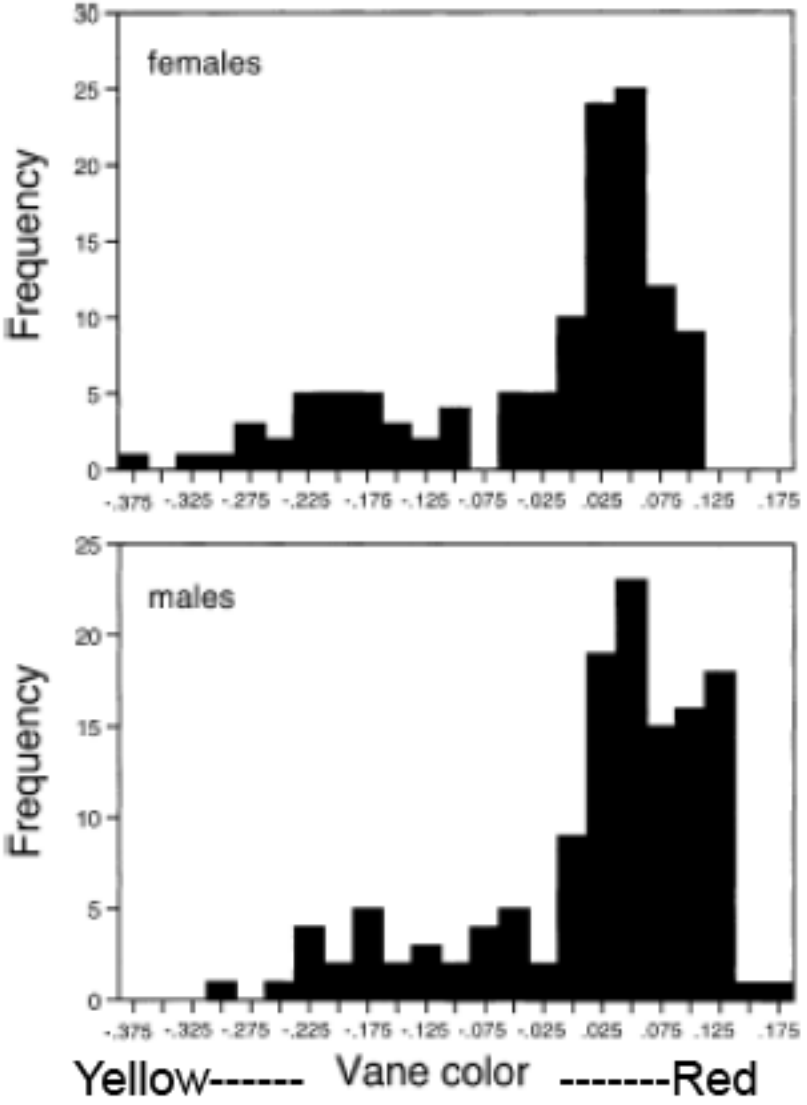
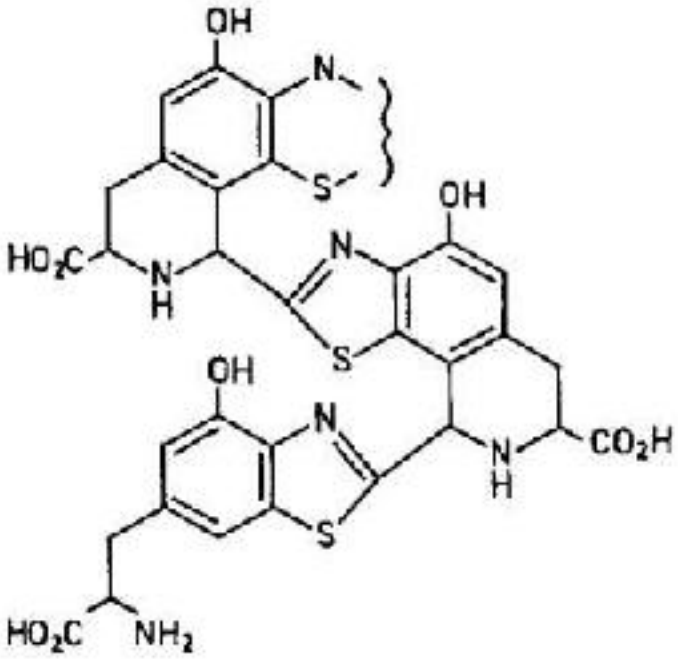


FIG. 1. Distribution of color scores in the hybrid flicker population at Riske Creek, British Columbia, 1998–2000, as determined with a digital camera. Males were redder than females as shown by the greater frequency of higher (positive) color scores.

Eastern red-shafted flicker (*Colaptes auratus cafer*) undergoing molt. Left wing is approaching molt; right wing has undergone molt. Note color differences on feather shafts. (Photo courtesy Nicholas Sly at slybird.blogspot.com/2008_02_01_archive.html)

Below, Courtesy of www.colourandlife.com/



What is the colorant in red and yellow shafted flickers?

Carotenoids: hydrocarbons, alcohols and ketones, derive their color from long conjugated chains of double bonded carbons in phenyl groups

Red shafted: Astaxanthin, adonirubin, α-doradexathin, and canthaxanthin

Yellow shafted: Lutein, zeaxanthin, and β-cryptoxanthin

Likely to fade?

Plus feather structure: keratin and melanin, caused by refraction of light through the spongy cellular structure of the feather protein

Not likely to fade?

Preventive strategy tells us to avoid excessive illumination of feathers:

BISHOP MUSEUM
Art Conservation Handout

THE CARE OF FEATHERS

Light

An obvious cause of damage is color fading from exposure to light. Although less obvious, light may also cause other types of damage. As the energy contained in light strikes your feathers, it will begin to break molecular bonds.

http://www.bishopmuseum.org/research/conservation.html

Maintain collections at 50 lux with elimination of all ultraviolet radiation

John Mathias, "Housing and Maintenance of Collections", in G. Stansfield, J. Mathias, and G. Reid, *Manual of Natural History Curatorship*, London, Museums and Galleries Commission (1994), p. 101

Lighting targets for preservation,
Michalski and Tétreault, Getty Conservation Institute Lighting Workshop, 2002

Category	LOAED	Preservation Targets		
		1000 yrs	**100 yrs**	**10 yrs**
High Sensitive ISO 1, 2, 3	ISO 2: 1.0 Mlx hr	50 lux for 20 hrs/yr	50 lux for 25 days/yr 500 lux for 25 hrs/yr	50 lux for 250 days/yr 500 lux for 25 days/yr
Medium Sensitivity ISO 4, 5, 6	ISO 4: 10 Mlx hr	50 lux for 25 days/yr 500 lux for 20 hrs/yr	50 lux for 250 days/yr 500 lux for 25 days/yr	340 lux for 365 days/yr 500 lux for 250 days/yr
Low Sensitive ISO 7, 8, above	ISO 7: 300 Mlx hr	100 lux for 365 days/yr 500 lux for 75 days/yr	1000 lux for 365 days/yr (500 lux/yr for target 200 yrs)	

More recently, Stefan Michalksi at the Canadian Conservation Institute updated ISO Blue Wool values for "the colors of most fur and feathers" to Medium Sensitivity, ISO BWS 4, 5, 6

Table 4. Approximate light dose to cause a "just noticeable fade" of the ISO Blue Wool standards ("Just noticeable fade" is defined here as Grey Scale 4 (GS4) as used in the Blue Wool data. The uncertainty in each dose estimate ranges approximately to the estimates of the adjacent Blue Wool.)

	Light dose (Mlx h) to cause a "just noticeable fade" of the Blue Wool standards							
ISO Blue Wool number	#8	#7	#6	#5	#4	#3	#2	#1
Dose for "just noticeable fade" if UV present	120	50	20	8	3.5	1.5	0.5	0.22
	Light dose (Mlx h) to cause a "just noticeable fade" of the Blue Wool standards							
Dose for "just noticeable fade" if UV removed	1000	300	100	30	10	3	1	0.3
Sensitivity category used in Table 3	Low sensitivity			Medium sensitivity			High sensitivity	

The cumulative light dose required to cause a "just noticeable fade" in featherwork then increases to 3.5-20 Mlux hours with UV , and 10-100 Mlux hours with UV filtered.

II. Evaluating fading behavior of red shafted flickers

Experimental design:

Expose recently harvested red shafted flicker tail feathers to equivalent doses of window fading and accelerated microfading (MFT)

•Measure Delta E

•Measure against each other and against ISO Blue wool standards.

Research questions:

•Are red shafted flicker tail shafts equivalent to ISO BW 1,2, 3 or to 4, 5, 6 ?

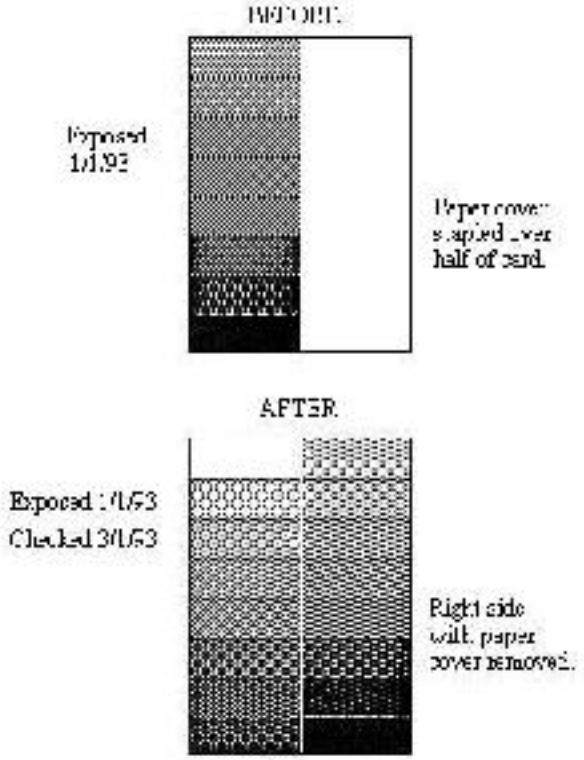
•Does MFT provide equivalent results with window fading, therefore providing predictive outcomes about museum fading?

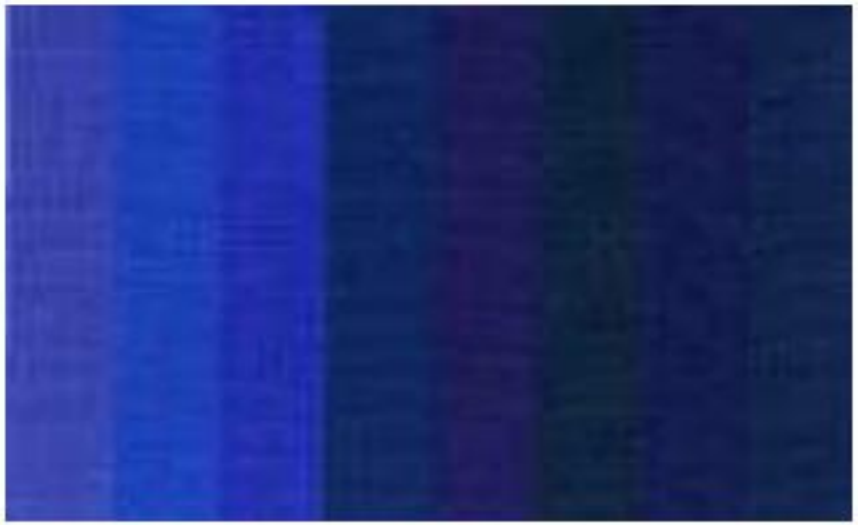
•What do cultural experts tell us about selection and use of red shafted flicker feathers that helps us interpret fading data?

Measuring color change in museum objects

ISO Blue wool (ISO=International Organization for Standardization)

The blue wool standard consists of eight wool textiles selectively dyed so that, under the same exposure conditions, standard number 1 fades most rapidly, and each **higher** number fades at half the rate of the previous lower number.





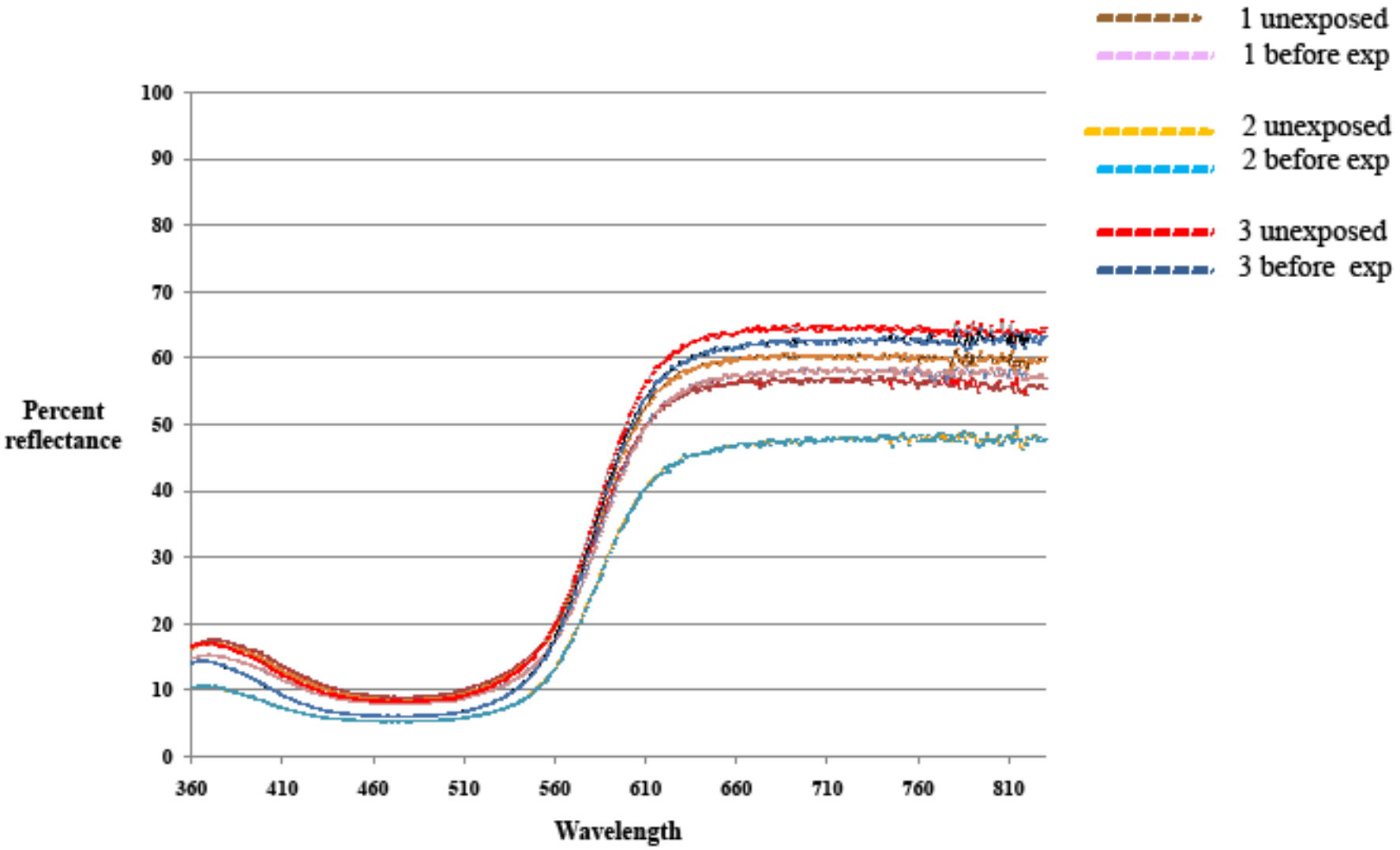
Courtesy NEDCC

How can we evaluate how much fading occurs to flicker feather regalia once it is part of a cultural object?

Measurement of plumage color using reflectance spectroscopy.

Courtesy Barcelona Science Museum, http://w10.bcn.es/APPS/wprmuseuciencies/Museu.GeneradorPagines

When measuring color of unfaded shafts from same bird, result is 10-15% different at maximum reflectance beyond 600nm. Unexposed refers to concealed parts of feathers following window exposure; before exposure is before feathers are ever placed in windows.



Mean reflectance averages of 5 measurements on each of 3 feathers

Works of art have been measured for about 10 years using micro-fadeometry (MFT) as a tool to accelerate fading behavior and enable comparison with ISO Blue Wool Standards

Exposes .4mm area of color to high intensity Illumination.

Materials with light sensitivity equal to or greater than BWS 2 can be identified in less than 10 minutes.

Materials with light Sensitivity of BWS 3 or higher, and which need UV to fade, will require substantially longer exposures (Whitmore 1999)

Micro-fadeometry illustrated by its developer, Paul Whitmore, Director, Artist Materials' Center, Carnegie Mellon University

1. High intensity lamp

2. Filters (<10% trans. below 380 nm in UV filter used for study)

3. Color measurement device

4. Computer

5. Light focusing lens

6. Color detection lens

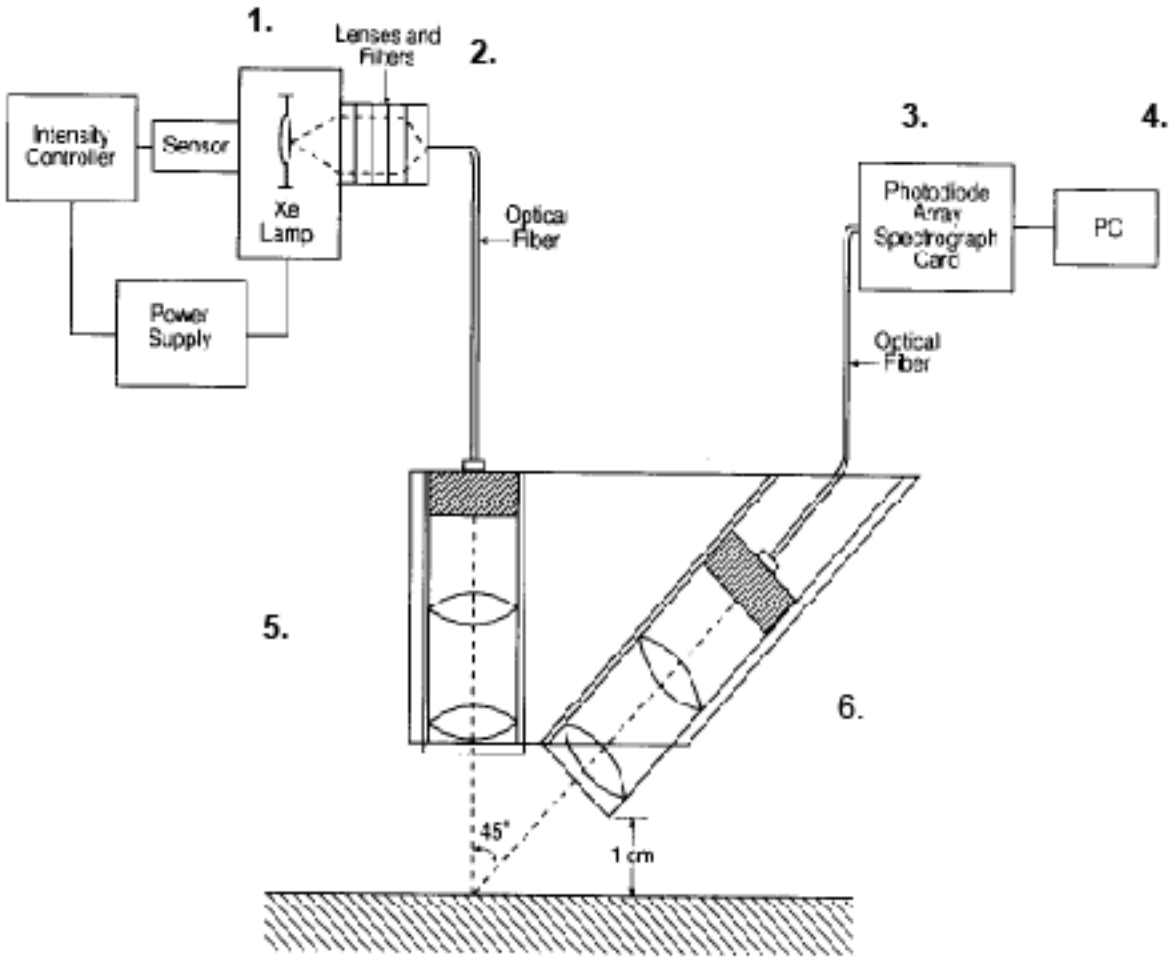


Fig. 1. Schematic of the microfading tester

Journal of the American Institute for Conservation(1999) 38, 395-409

Microfading Testing

<10% transmission between 300-380 nm
i.e. ultraviolet radiation

41 minutes=4,609,435 lux, enough to fade materials which are equivalent to BWS 1-2

IF RECIPROCITY HOLDS THEN:
4,609,435 lux divided by 50 lux= 92,000 hours, or 27 years at 3400 hours/year on display

Window fading conditions

39 days of exposure=4,609,000 lux hours

IF RECIPROCITY HOLDS THEN:

4,609,435 lux divided by 50 lux=

92,000 hours, or 27 years at 3400 hours/year on display

26% transmission between 300-380 nm, i.e. ultraviolet radiation

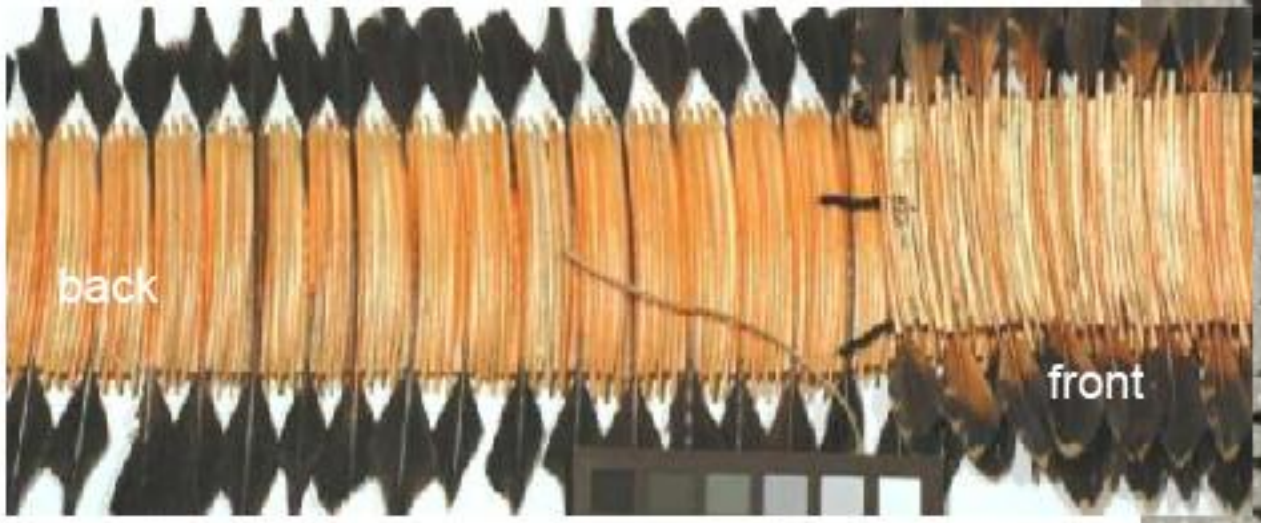
Sample	ΔE '94 41 min
Microfaded Feather 1	0.34
Microfaded Feather 2	0.33
Microfaded Feather 3	0.33
	ΔE '94 39 days
Window Feather 1	2.64
Window Feather 2	3.90
Window Feather 3	1.71
BW1	23.04
BW2	14.41
BW3	2.09
BW4	0.63
BW5	0.87

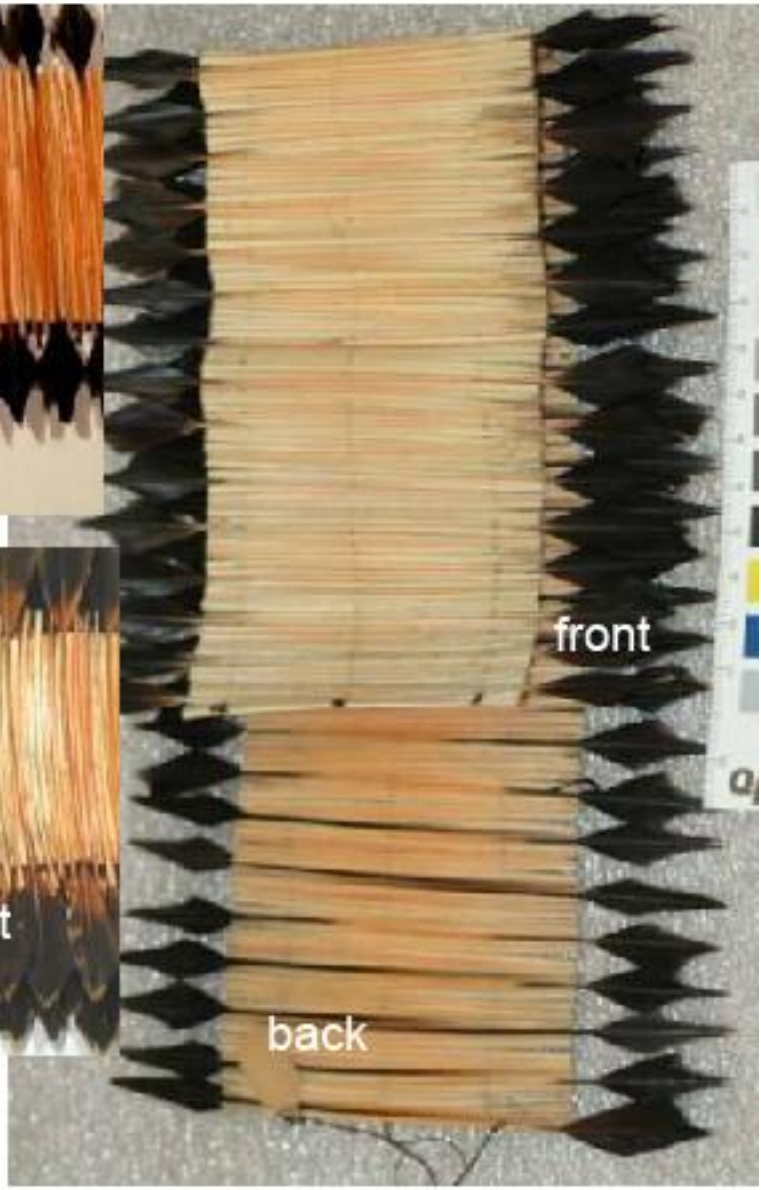
ΔE of 1= just noticeable fade=JNF

- Microfading measures change in same location on shaft, results averaged
- 90% UV below 380nm was filtered
- Temperature and RH uniform throughout test
- ΔE '94 is 0.3 after 4,609,000 lux
- Feather sensitivity w/o UV is equivalent to BW 4

- Window fading was measured at different locations on shaft, results averaged
- 75% UV below 380nm was filtered
- Temperature and RH varied throughout test
- ΔE '94 averages 2.75 after 4,609,000 lux hours

- BW 1 , and 2 are much more sensitive than most sensitive Flicker feather shaft, with UV included





Given tested sensitivity of greater than BW 3, what does cultural information tell us about color variation?

Value is definitely placed on brilliant red: tribal stories say the birds are red from getting too close to a fire.

Pomo doll with felt band imitating flickers

Painted sticks replace flicker shafts for young dancers.

Check out color of flicker roof trim on storage building at Clear Lake Pomo Rancheria

Flickers are hard to come by,
regalia kept for 30+ years for dances

Likelihood is that most of the
fading might take place during use

2 hours dancing in full sunlight=
10,000 lux

Regalia can accumulate an equivalent
4,600,000 lux hours of exposure if it
was danced 8 times per year over
30 years

Conclusions

Methodology for determining the original color of feathers should consider:

- variations in color systems between species
- variations based on diet, gender, age, location
- seasonal variation

Fading behavior of Red Shafted Flicker (colaptes cafer) :

- equivalent to ISO Blue Wool 3, but much more stable than 1 or 2, according to window fading
- Ultraviolet radiation plays a significant role in fading
- MFT with UV filtration *may* under-predict the fading behavior

American Museum of Natural History Catalog No: 50 / 275

Acknowledgements

Jim Druzik, Senior Scientist, Getty Conservation Institute

Cultural advisors Gifford James, Frank Tuttle, and especially Frank LaPena

For access to museum collections : Kirsten Kvam, Nancy Rosoff, Lisa Bruno, Judith Levinson, Vuka Russakis, Laila Williamson, Angela McGrew, Özge Gençay-Üstün, Jane Williams and Natasha Johnson

For feathers: Thomas Wake, Zooarchaeology Lab, UCLA

For technical assistance: Vincent Beltran and Lucette Landry

My travel partner Les Goldman