

# FROM THE UNDERWORLD TO FLOWER WORLD FRONTIERS: ICONOGRAPHY AND MULTISENSORY PHENOMENOLOGY OF MOJAVE DESERT ROCK ART

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## SUMMARY

The phenomenological turn in rock art studies, and in the archaeology of visual culture more broadly, is enabled in part by cognitive approaches to anthropology. Presently, scholars engaging in experimental studies are mobilizing modern tools in the area of digital archaeology to expand the bounds of the discipline. Combining these tools of virtual representation with phenomenological considerations, unprecedented possibilities are created to document, interpret, and conserve visual culture and cultural landscapes. This paper provides case studies from North America's Mojave Desert to demonstrate how such methods in virtualization enrich scholars' capacities to undertake studies of iconography and multisensory phenomenologies in ethnographically informed contexts. Quantitative measures of archaeoacoustics along with immersion into 3D landscape topography at complex rock art landscapes not only significantly contribute to demonstrating the potential of technical approaches, but also reveal important and unprecedented evidence of the ancient cultural and linguistic history of the region studied.

## RIASSUNTO

La svolta fenomenologica negli studi sull'arte rupestre e, più in generale, nell'archeologia della cultura visiva, è resa possibile dagli approcci cognitivi all'antropologia. Attualmente, gli studiosi impegnati in studi sperimentali stanno mobilitando strumenti moderni nell'area dell'archeologia digitale per espandere i limiti della disciplina. Combinando questi strumenti di rappresentazione virtuale con considerazioni fenomenologiche, vengono create possibilità senza precedenti per documentare, interpretare e conservare la cultura visiva e i paesaggi culturali. Questo articolo fornisce casi di studio nel deserto del Mojave del Nord America per dimostrare come tali metodi nella virtualizzazione arricchiscono le capacità degli studiosi di intraprendere studi di iconografia e fenomenologie multisensoriali in contesti etnograficamente informati. Le misure quantitative dell'archeoaustica insieme all'immersione nella topografia del paesaggio 3D in complessi paesaggi di arte rupestre non solo contribuiscono in modo significativo a dimostrare il potenziale degli approcci tecnici, ma rivelano anche prove importanti e senza precedenti dell'antica storia culturale e linguistica della regione studiata.

## INTRODUCTION

Rock art from the western Great Basin, of which the Mojave Desert is a subregion, has been widely publicized yet contentiously debated. The region's parietal art has at once been mobilized to advance the neuropsychology model (e.g. LEWIS-WILLIAMS AND DOWSON 1988), as well as alternate behaviorist theories largely considered mutually exclusive. Entrenched positions along these theoretical fault lines risk stagnating the state of Great Basin and Mojave Desert rock art discourse, an issue that can be averted by addressing Allen's (2011, pp. 14) challenge to consider "religion, social identity, gender, and power" rather than staking a claim in polarizing paradigms. Data used here was constructed during a

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comprehensive study to address all these avenues of inquiry, however the scope of this paper focuses on clarifying the relevance of archaeoacoustics research, and placing Numic cosmology and iconography in context with neighboring and related groups. In doing so, I ascribe to the wisdom that scholarly and scientific findings directly impact local and indigenous communities, and resolve to mitigate institutional biases that omit Native American voices by incorporating indigenous oral traditions (BLACKHAWK 1997; ECHO-HAWK 2000, pp. 270; WHITE 2003; 2006). Ethnographic resources and primary sources from indigenous authors are thus integral to establishing a social context for visual, acoustical, and embodied experiences of rock art engagements in the area.

The application of neuropsychology principles in rock art archaeology gained prominence after it was proposed by Lewis-Williams and Dowson (1988), who supported their theory using evidence from Paleolithic European caves, Coso Range petroglyphs, and ethnographic research among modern San. This theoretical approach provides a neurological and physiological basis for linking shamanistic practices like those detailed by Eliade (1964) and refined by Winkelman (2010) to the creative processes for image acquisition in rock art production globally (e.g. LEWIS-WILLIAMS 2002) and in the Great Basin's Coso range in particular (e.g. WHITLEY 1994; 1998; 2000). Its foundational principles state that embodied practices involving dance, exhaustion, music, and possible use of mind-altering entheogens incite neurological activity (see FROESE ET AL. 2013) responsible for the subjective experience of complex geometric patterns. These patterns are interpreted with culturally-specific conventions makes it readily compatible with semiotic approaches to iconography (e.g. CONKEY 1997; 2001; 2009). Despite numerous critiques of the use and misuse of 'shamanism' (e.g. SUNDSTROM 2012; WALLIS 2019), evidence of the practices encapsulated by that anthropological construct remains demonstrable linked with the creative processes of meaning-making in parietal art engagements.

Discourse on the agency and animacy of landscapes associated with rock art sites in recent decades has shifted towards considerations of the locations' acoustical properties (e.g. WALLER 2002; DEVEREUX 2008; DÍAZ-ANDREU AND MATIOLI 2015; KOLAR 2017; WITT AND PRIMEAU 2018). Winkelman's (2010) criteria for shamanistic rites specifically identify practices involving the production and perception of sound, lending credence to connections between archaeoacoustics and neuropsychology. As I will argue later, these psychoacoustic effects were valued in the cultural traditions of peoples native to the Mojave Desert and American Southwest.

## BACKGROUND

The research at hand addresses cultural traditions of the Great Basin, of which the Mojave Desert is considered a subregion covering the Basin's southwestern quadrant. Both the Great Basin and Mojave Desert are variably defined based on geology, hydrology, ecology, and cultural history. Despite the mutually covered territory, in practice the Mojave Desert cultural sequence is treated as distinct from the Great Basin, despite high-profile type-sites for the Basin as a whole resting firmly inside the Mojave (LIWOSZ 2018, p. 33). (Fig. 1)

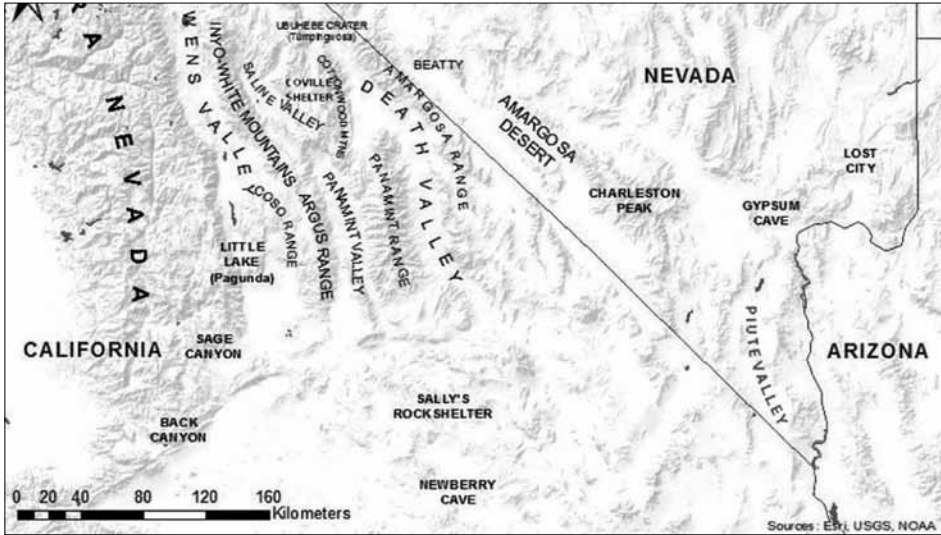


Fig. 1 - Regional map

For the Great Basin, the exact cultural sequence is hotly debated and largely unresolved. Two modes of thought predominate in the discourse. Conventional wisdom infers a break in the cultural sequence between the producers of pecked rock art and ethnohistoric groups (e.g. GARFINKEL 2007; GILREATH AND HILDEBRANDT 2008). By contrast, the opposing position holds there was a largely unbroken sequence of *in-situ* cultural development since at least the Middle Holocene (e.g. WHITLEY 2013; THOMAS 2019).

For the Mojave Desert, essentially a southern pendant of the Great Basin, the issue becomes yet more complicated. Minimally three culture-areas overlap the region, with Numa and their predecessors occupying and entering from the north, groups from the the Pacific Coast and Mount San Jacinto area entering from the west, and Hakataya/Patayan groups (as well as their Yuman-speaking progeny) occupying and entering from the east (SUTTON 2017). The result is a patchwork landscape with overlapping ranges, and a 'common pooled resource zone' (CPR) demonstrating complex horizontal and vertical depositional sequences bearing attributes of multiple distinct cultural traditions (SUTTON 2017, p. 22). The same too should be presumed for the region's parietal art.

The case of the central Mojave's CPR significantly complicates the archaeological record. Distinctive cultural traditions depositing adjacent and overlapping materials contributes to ambiguities in all levels of theoretical discussions. The case of SBR-199 (Newberry Cave) is a paramount example of these complications. Located in the central Mojave Desert, SBR-199 has been used as a type site for Late Holocene human adaptations and cultural traditions throughout the region. It is elevated to be the namesake for the Great Basin's Newberry Period spanning from 4,000 to 1,350 BP (KELLY 1997, p. 17), despite being situated squarely inside the Mojave Desert where the current chronological convention is to refer to the

period from 4,000 to 1,750 BP as the Gypsum Complex (SUTTON ET AL. 2007). Well-controlled stratigraphic contexts from SBR-199 contain diagnostic Elko projectile points characteristic of Great Basin flaked stone traditions. More intriguingly, these points are contemporaneous with SBR-199's most famous example of visual culture: three split-twig ungulate figurines, carbon-dated to a range from 3,320 ±180 cal. BP to 2,970 ±250 BP (COULAM AND SCHROEDL 2004, p. 50). While the Elko points are consistent with Great Basin cultural traditions, the figurines are stylistically more comparable Colorado River traditions (c.f. SCHROEDER 1979). Similarly, green quadruped pictographs at SBR-199 mimic the form of the figurines, yet deviate substantially in style and technique from Great Basin ungulate motifs (LESKA 2009, p. 136).

The Newberry figurines exemplify how complex interactions between Great Basin and American Southwest cultures played out on these regions' mutual margins in the Mojave Desert. Trade routes connecting the Southwest interior with the Pacific Coast through the Mojave Desert are well evidenced in the movement of material culture (e.g. HUNT 1960; LANGE 1979; WHITLEY 1994; VAN TILBURG ET AL. 2012; ALLEN 2013; BETTINGER 2015) and in oral traditions (e.g. MYERS 1987, 1997; 2006; WHITLEY 1982; 2006; FINGER 2012). Exchange among, and similarities between cultures of North America's desert regions for the first seven to nine millennia of the Holocene led Jennings (1957) to propose a long lived 'Desert Culture' tradition with only ephemeral regional diversity, a monolithic idea that although inspiring was ultimately short-lived (JENNINGS 1973). The legacy of the 'Desert Culture' is evident in rock art research, as Archaic petroglyphs as far east as the Rio Grande are often classified as 'Great Basin curvilinear abstract,' after Heizer and Baumhoff (1962). In more contemporary use (e.g. HUFFMAN AND EARLY 2017) the term 'Desert Culture' is sometimes used for Archaic Period Proto-Northern Uto-Aztec ancestors of numerous ethno-linguistic groups throughout the desert regions, including Numic, Takic, and Puebloan peoples. This contemporary heuristic is distinct in that it implicitly acknowledges both regionalization and other contemporaneous Archaic cultural traditions (LIWOSZ 2018, p. 59). While I generally avoid the term because of its complicated use history, the notion of an ancestral Uto-Aztec Desert Culture remains an important consideration for the transmission of religious beliefs, iconography, and ritual technologies evident in rock art and other media.

### *Oral Traditions*

The neuropsychology model, while well known for its emphasis on abstract geometric entoptic images, explicitly relies on the application of emic cultural knowledge (LEWIS-WILLIAMS AND DOWSON 1988). Social constructs and symbols shape the process of meaning-making, so an effective application of this theoretical framework requires some background in emic ontologies. For the scope and context of this study three Numic narrative themes have been identified as most relevant. These themes are the underworld and animal regeneration, the origins of echoes, and Numic cosmological topology. This listing is by no means exhaustive, and themes related to Numic origin traditions covered more thoroughly by Myers (1987; 1997) were also identified.

Hunting, regeneration, and the underworld were conceived by Numic peoples as parts of a continuous cycle of world renewal overseen by a supernatural agent known as the Animal Master, or *Yahwera* in Kawaiisu. *Yahwera's* place of dwelling was associated with the underworld and the color black, and appears to have inspired exceptional experiences during crisis rites (WHITLEY 2000; GARFINKEL ET AL. 2009; GARFINKEL AND WALLER 2012). Underground spaces were also associated with stories of a witch or monster by the names of *Teugai* or *Tso'apittse*, whose mocking voice is the source of echoes (POWELL 1881; LOWIE 1924; SMITH AND HAYES 1993; WALLER 2000; 2004). The color association of black with the underworld is a part of a multi-tiered and highly chromatic cosmic typology exemplified by ethnographic accounts of Ute and Paiute about Mount Charleston east of Death Valley (GOSS 1972; VANDER 1997; GARFINKEL ET AL. 2014). In ascending order the chromatic sequence is black for the underworld, red for valleys, blue-green or grey for foothills and forests, yellow for mountains, and white for the heavens.

Chromatic themes, including overt references to the Mount Charleston topology, are referenced in in the Numic *Naraya* oral tradition. This tradition contains songs appropriate for both the Round Dance ceremony, and the Ghost Dance which grew out of it (CRUM 1980), although some (e.g. CRUM ET AL. 2001) distinguish between Round Dance *nua hupia* and Ghost Dance *Natayaa hupia* songs. As a genre, *Naraya's* songs are considered particularly potent (e.g. HILL 1992, pp. 121-122). Despite the insistence of previous researchers to the contrary (e.g. LILJEBLAD AND FOWLER 1986), *Naraya* contains loaded metaphors describing a verdant and colorful world (CRUM 1980; HILL 1992; VANDER 1997; CRUM ET AL. 2001).

### *Flower World Complex*

First proposed by Hill (1992), the Flower World is a hypothesized religious complex linking late Precontact Mesoamerica with Northwest Mexico and the American Southwest. Among numerous indigenous peoples, many belonging to Uto-Aztecan ethnolinguistic groups, the Flower World is expressed in the verbal arts of song and oration, and has been identified as a likely inspiration for certain conventionalized designs in the visual culture of ceramic pottery decoration, kiva murals, and rock art (HAYS-GILPIN AND HILL 1999; HERNBRODE AND BOYLE 2017). Flower World verbal expressions, and thus hypothetical visual correlates, impart colorful imagery through flowers, birds, butterflies, and rainbows. Additionally, blooming and burning may be metaphors for each other, and the complex is accompanied by a belief in the 'Flower World' ancestral spirit land, often accessible by a Flowery Path (HILL 1992, p. 122). For Southern California including the Mojave Desert, the Flower World Complex is believed to be partially indicated yet incomplete. Numic and Takic traditions fall into the Southern California caveat, although Hill's (1992, pp. 125, 130-137) suggestion that earlier Uto-Aztecan ancestors of these peoples believed in and practiced an early rendition of the complex has remained largely unexplored.

One of the more promising areas to investigate Numic retention or absorption of Flower World Complex themes is in the *Naraya* (or *Natayaa*) song tradition. The spiritual power of *Naraya* songs as sung for the Ghost Dance religious movement is purported to cause the uninitiated to fall ill (HILL 1992, pp. 121-122), an effect

which may imply a great age to the genre as the songs gained layered symbolism (LIWOSZ 2018, p. 143 footnote 44). Candidate connections between Numic verbal expressions and the Flower World Complex will be addressed in the discussion.

#### RESEARCH DESIGN

Datasets analyzed here were produced at two separate study areas in the Mojave Desert. Each project area was chosen not only for its prevalence of rock art, but also for the associated landforms containing labyrinthine dry gorges. One project area was located in the vicinity of Little Lake, California, and the other near Death Valley, California. Both project areas cover several archaeological sites (see table 1 below) which collectively represent cultural landscapes. Within each of these two landscapes, particularly detailed attention is given to the parietal art and semi-enclosed spaces of short and exceptionally narrow slot canyons. These locations were chosen largely based on the following criteria: the presence of rock art in semi-enclosed spaces, the high density and/or large number of elements visible, and the project area's relationship to the widely published rock art landscape of the Coso Range. Although neither project area is within the designated Coso Rock Art Landmark, interpretations are deemed applicable as together they box it in with Little Lake to the west and Death Valley to the north and east.

#### *Methods*

Methods used to examine iconography and phenomenology include enhancing images of the rock surfaces, 3D modeling, artificial lighting, and experimental techniques for sound. While iconographic studies benefit from generations of scholars refining strategies for documenting, describing, and categorizing visual design elements, phenomenology studies are still relatively new and strategies vary based upon the sensations in question. For this project, I address phenomenological concerns of lighting, space, and sound through a combination of virtual 3D environments and on-site acoustic experiments.

At the heart of this project's virtualization methods is 3D spatial modelling. I employed photogrammetry tools recently developed for object and architecture scale modelling to cover the complex geomorphology of selected petroglyph sites in order to circumvent issues with existing standard practices (see LIWOSZ 2017; 2018). The 3D modelling approach yields numerous advantages, including high resolution detail on a continuum from microcartographic to landscape scales. Other authors (e.g. LERMA ET AL. 2010) cover the advantages and disadvantages of wide-scale photogrammetry with terrestrial laser scanning (TLS). Specific techniques used to generate models were drawn from Agisoft's suggested photography procedures, with modifications to address terrain and time constraints. During fieldwork, sites were subdivided into discrete loci by landform. These loci became the "chunks" while modelling with Agisoft Photoscan. I exported finished models with textures into a variety of widely readable formats, including .obj and .ply. Exported models were accessed with open source programs Blender and Meshlab for further iconographic analysis and 3D animation.

Archaeoacoustics studies are not unprecedented in the Great Basin (e.g. WALLER 2004; 2012). I developed a rudimentary set of non-invasive, non-impacting

methods to systematically document and quantify sonic variables loosely based on the standards set forth by Díaz-Andreu and

Mattioli (2015). Experiments and later analysis aimed to quantify echo delay, reverberation, and 'room modes' or resonant tones of partially enclosed spaces with rock art. Each project area contained a culturally-sterile (devoid of artifacts, features, and images) control site of comparable geology to serve as an acoustic baseline, effectively establishing a null hypothesis for comparison. Results not exceeding the standard set by control site sound samples were dismissed.

I divided specific acoustic experiments into three categories: percussion, signal sweeps, and impromptu 'pop tests.' Percussion experiments attempted to reproduce the sounds of petroglyph manufacture by tapping hammerstones on portable tabular stones at variable tempos. Next sinusoidal signal sweeps through the entire human audible range were broadcast from a bluetooth speaker to identify resonant 'room modes.' Finally, 'pop tests' were reserved for exploring unexpected phenomena, which ultimately included evidence of interaudibility between sites 0.5km apart. All tests were recorded using a Zoom H5 digital audio recorder with one onboard two-channel microphone attachment, and two XLR cardioid microphones placed up to 10m away.

For sound analysis, I used two open-source programs: Audacity and Sonic Visualizer. Files were stored in .wav and lossless .flac format. All analyzed sound clips were first normalized to -1db before being assessed for echo, reverb, and resonance. Reverberation was verified by noting multiple successive echo events within 50 ms of each other, however the reverb decay rate metric of RT60 was not calculated. Identifying room modes required a degree of skepticism. Candidate tones were identified as frequency-specific strong responses in both programs before being reported.

Iconographic analysis relied heavily on digital photographs from several field seasons, as well as non-photographic archival data. Photo processing proceeded in variable ways depending on quality, content, and discretion. Open-source image editing programs GNU Image Manipulation Program (GIMP), and ImageJ with the DStretch plugin were used alone and in concert. Outlined illustrations of individual elements were superfluous and reserved for special cases. Considering images as mnemonic devices (after MILLER 1983; WHITLEY 2008) proved useful when revisiting the iconographic inventory to identify themes from theoretical models and/or oral traditions.

Identifying astronomical observations was not initially a primary goal of this project, but concordances identified between multi-element compositions and oral traditions demanded it. Candidate compositions were modeled in a 3D virtual environment to ascertain the spatial relationships between elements and their host spaces. Next, I used the open-source virtual planetarium Stellarium to display possible correlate constellations from an appropriate observation point set to the project area's geographic coordinates, within the constraints of a viable date range.

## RESULTS

Combined, the Death Valley and Little Lake project areas cover roughly 50 new and previously documented archaeological sites, roughly a dozen of which were

visited during this project’s seven field sessions. Excluding post-contact (Historic/American Period) sites and isolated finds of any age, six visited sites included one or more petroglyph panels. Each project area contained a narrow slot canyon with petroglyphs in its interior spaces, and these canyons were subject to the most intensive acoustical, iconographic, and mapping attention (table 1). Preliminary and comprehensive results are reported elsewhere (LIWOSZ 2017; 2018, pp. 225-355, 511-536).

Table 1: Select studied sites for each project area. This list is not exhaustive.

Project area	Brief description	Previous designation
Death Valley	Multi-tiered rock shelter with hearth	INY-130*
	Canyon with petroglyphs & pictographs	INY-3074
	‘Campsite’ with habitation, metate, & petroglyph	none
	Petroglyph panel on partially buried boulder	none
Little Lake	Village area extending into canyon with petroglyphs	INY-1634
	Village with rock shelter in basalt labyrinth	INY-1638
	‘Harrington Fossil Falls Site’ previously excavated	INY-1643
	Village of <i>Pagunda</i> , extensive rock art site	INY-3826

\*multiple sites have been assigned this number

As many of the sites visited were either small or previously recorded, only three (INY-1634, INY-1638, and INY-3074) warranted 3D modelling, with complete coverage only being given to the two slot canyons. INY-1638’s canyon was subdivided into five loci based on qualitative assessment of its morphology. Using the same discretionary process, INY-3074’s canyon was subdivided into 18 loci. Numbering at each begins with what is inferred to be the most likely traditional approach to enter the canyon spaces, with INY-1634 believe to be approached descending from the head of the canyon, and INY-3074 ascending from the mouth below.

Precontact-age images at INY-1634 appear constrained to four panels in Locus 1, which reaches from a labyrinth of rocky protrusions at the rim down to dry fall of approximately 5m or less in height. These images were concentrated at two small circular natural potholes, one with an open roof depicting bighorn sheep and few simple geometric forms (Panel 1), the other a nearly enclosed and very dark void with a hole in the roof, which contained an abstract geometric composition incorporating a sheep and possible iconographic snake (Panels 2-3).

Acoustical results from INY-1634 are surprising subdued given the height of the canyon’s vertical walls (figure 2a below). Despite sound propagating poorly, the entire canyon shares interaudibility. Possible room modes were identified in three spots within Locus 1, each position being associated with one of the two potholes bearing images. Both petroglyph potholes responded above control levels between 107 and 120 Hz. The strongest evidence of complex overtones, including odd number intervals and a possible perfect fourth, was recorded just outside the enclosed void with the abstract images of Panels 2 and 3. Even overtones at



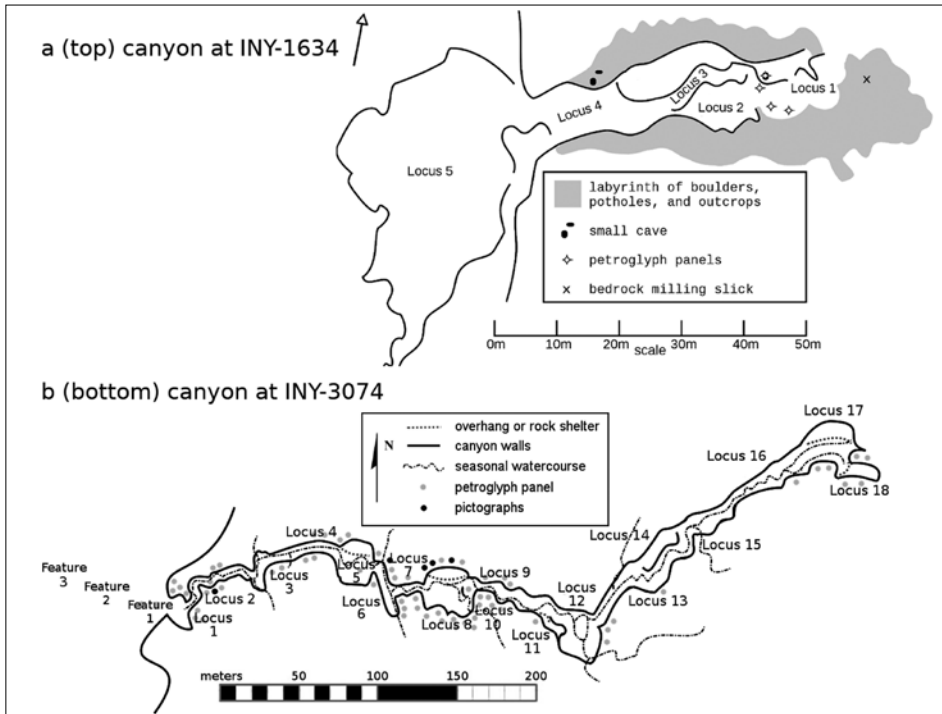


Fig. 2 - Schematics of a) INY-1634, and b) INY-3074)

the Panel 1 void are indicated but to a lesser degree. Room modes not exceeding control limits are ignored. (Fig. 2).

As a larger and more complex space, INY-3074 contains more interior spaces than can be addressed in this article with any detail (figure 2b). Chambers at Loci 5 and 8, along with a gallery at Locus 6 provide the bulk of data used in the subsequent discussion. Additional iconographic information from Loci 1, 10 through 12, and 17 was found to be relevant as well. Additionally, remarkable results from sound experiments at Loci 3, 10, and 18 contribute to the psychoacoustics discussion. Of these loci to be discussed, Loci 1 and 5 contain eight panels, Locus 10 has five panels, Locus 6 four panels including the extensive Panel 47, three panels each at Loci 6, 12, and 17, and two panels at Loci 11 and 18.

At INY-3074 positive acoustical results are overall more clearly identifiable, and more widespread throughout the site. Interaudibility of sound impulses paradoxically did not extend throughout the entire site, but did link lower reaches of the canyon with the surrounding landscape. A pop-test confirmed sound impulses from the rim of Loci 3-5 return from the direction of the INY-130 shelter with a delay of approximately 3.4s, consistent with the 510m distance (LIWOSZ 2017, p. 192). In all, the canyon's soundshed breaks down into three zones, with Zone 1 including sites outside the canyon like the isolated panel and INY-130, while two interior zones are not audible from the surrounding landscape.

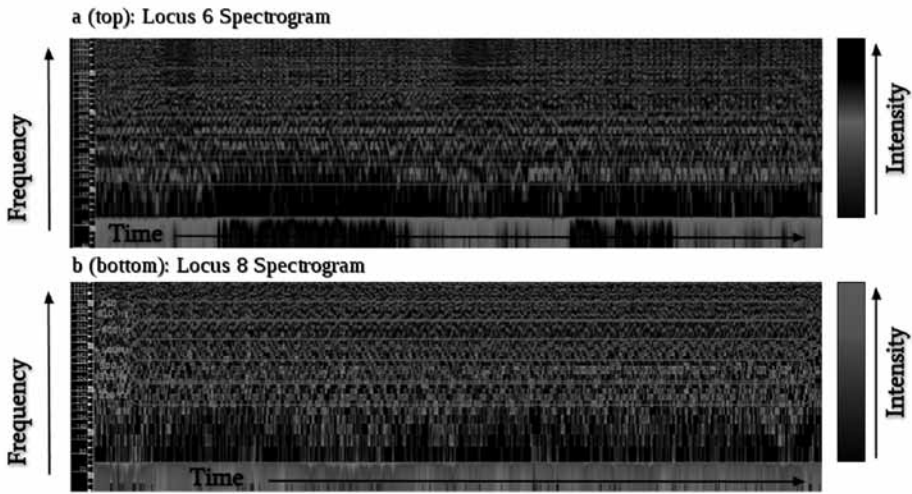


Fig. 3 - Spectrograms of a) Locus 6, and b) Locus 8

For the constraints of this paper's topic, results from Zone 2 are most relevant, including Loci 6-12. Reverberation is weak in Locus 10 and strong in Loci 6 and 8, the latter two also showing strong resonance. Locus 6's room modes include a fundamental tone of 166Hz, integer harmonics, and a possible perfect fourth chord (figure 3a). Locus 8's room modes include a strong resonant band at 220Hz, on which build higher harmonics including a perfect fourth (4:3 ratio), perfect fifth (3:2), and even integer multiples (figure 3b). Additional subjective psychoacoustic effects noted in Locus 10 could not be quantified upon analysis. Well-organized harmonics including a possible infrasound signature are reported for Locus 18 (LIWOSZ 2017, pp. 195, 202-204) in Zone 3 as well. (Fig. 3)

## DISCUSSION

### *Hunting, Renewal, and 'Coso Style'*

Both the geographic context and iconographic content of Great Basin rock art are acknowledged to contain ubiquitous bighorn sheep hunting imagery (e.g. HEIZER AND BAUMHOFF 1962; GRANT ET AL. 1968). Within the project areas, numerous examples of 'Coso style' petroglyphs - largely iconic motifs including pecked bighorn - abound. For the Little Lake project area this is unsurprising, as the petroglyphs are on basalt from the Coso volcanic fields. For the Death Valley project area, the most outstanding of the myriad of examples is a large (>50cm x 50cm) boat-bodied bighorn sheep with divergent horns and an upright tail (figure 4a). An abstract rugby-ball shaped element superimposes the sheep's neck. This two-element ungulate-oval palimpsest recalls the Numic Series I origin myth in which Coyote successfully hunts a bighorn and uses its neck to bring fertility to *Kwasikantün* by breaking her vagina dentata, so they can conceive the first people (LOWIE 1924, p. 103; WHITLEY 1982, p. 263; MYERS 1987, pp. 177-178).

The similar subject matter shared by the bighorn motif and split-twig figurines has raised speculation about how each relate to big game hunting, affecting how to weight theoretical models. SBR-199 figurines are the westernmost example of this distinctive artifact type by some 500km, and the closest correlates in the Grand Canyon area pre-date them on average by about 520 years. Some (e.g. HILDEBRANDT AND MCGUIRE 2002) link the visual form of this split-twig figurine to conspicuously prevalent bighorn sheep images in the Coso rock art complex as both indicative of hunting magic. The complementary Totemism hypothesis interprets the figurines as totems of a hunting society engaged in 'increase rites' (COULAM AND SCHROEDL 2004; GARFINKEL ET AL. 2016). This is seen to support the hunting magic hypothesis (e.g. HEIZER AND BAUMHOFF 1962) as adapted to the Great Basin, which suggests that a regionally specific feedback loop between sympathetic hunting magic and declining bighorn sheep populations lead to social collapse and population replacement. This model is consistent with the costly signaling model for rock art and big game hunting, and evident subsistence shifts to seed-and-nut processing (GILREATH AND HILDEBRANDT 2008).

The applicability of the SBR-199 effigies, the relevance of totemism to Numic religion, and the reported frequencies of bighorn images in rock art are all questionable. Totemic practices among neighboring Yokuts are not generally believed to have transferred to Numa (STEWART 1929; WHITLEY 2000; KEYSER AND WHITLEY 2006; WHITLEY AND WHITLEY 2012), despite protracted contact. Numic petroglyph arrangements do not exhibit the qualities of known totemic clan sign compositions as can be found readily among Uto-Aztec Hopi rock art sites (WHITLEY 2011, pp. 106, 122-131). The split-twig bighorn effigies of SBR-199 have no correlates elsewhere in the Basin but are wholly consistent with the Grand Canyon style. Geographically both SBR-199 and Grand Canyon cluster are on territorial margins of the Hakataya (alternatively Patayan) from the Colorado River area (SCHROEDER 1979), both peripheral geographies exemplary of Sutton's (2017) CPR. Like the later intaglios of the Mohave people (ALTSCHUL AND EZZO 1995), the figurines may have served to unify and integrate individuals in contested areas.

One of the long standing roadblocks in relating the corpus of Great Basin parietal images to rock art in the American Southwest is the reported prevalence of sheep images. A mixture of confirmation bias and misquoted data perpetuates a common myth that this motif outnumbers all others (LIWOSZ 2014, pp. 427-428). Grant, Baird, and Pringle (1968, p. 120) cataloged 14,084 elements in the Coso Range, reputedly determining 51.1 percent to be variations of the bighorn motif; what they actually reported, however, was that bighorn motifs were 51.1 percent of *figurative* (or 'representational') elements, excluding all abstract designs. The bighorn design is one of the most widely recognizable icons from the region's visual lexicon, and is thus prone to be identified more readily than other motifs, especially large abstract compositions. Discounting scratched and painted designs, bighorn elements amounted to 6% of 4,112 images at the Little Lake project area, and 6.8% of 417 inventoried elements at the Death Valley project area (Liwosz 2018, p. 432). Allowing that abstract designs actually account for more than half of all elements (Liwosz 2014, p. 432), variations on the bighorn motif amount to a narrow plurality of iconic (figurative/representational) themes. Without di-

scouting the importance of bighorn symbolism, this still requires seeking other theoretical foundations for a majority of images.

Hunting is only one facet of bighorn symbolism, and its connection to world-renewal is expressed elegantly at INY-3074 Locus 5 Panel 49. A series of four bighorn parade across exposed bedrock towards anthropomorphs connected to a jagged line interpreted to be a hunting corral (D'ASCENZO AND DEAL 1987). Following Allen (2011), the composition communicates using natural features and colors, as the sheep begin at the mouth of a low, dark void and parade out into the chamber. It evokes the Numic narrative of a supernatural Animal Master (*Yahwera* in Kawaiisu) who regenerates the sheep that then emerge from his Underworld domain. This scene thus marks the space behind Locus 5 - Locus 6's perpetually twilight corridor with snake portal imagery - as the underworld.

Bighorn symbolism also features prominently in the heavens. Ethnographic interviews and *Naraya* songs indicate a constellation widely shared among Numic and Yuman peoples of mountain sheep and hunters in Orion (CRUM ET AL. 2001, pp. 68-69; FOWLER 2006). In key variants, there are three bighorn linked to Orion's belt, often surrounded by Coyote and a hunting party. To Death Valley's Timbisha Shoshone the word *Wasüppin* encapsulates bighorn sheep and all large game, and is the name for Orion (DAYLEY 1989, p. 188). Panel 35 at INY-3074 Locus 8 closely matches descriptions and diagrams of the *Wasüppin* constellation, with Orion's belt aligning with one sheep's hind legs and tail, and his dagger with the upturned tail of a sheep whose hind hoof matches Saiph and head is near Rigel (see figure 6 below). Brightly pecked infilled circles correspond with the positions of Betelgeuse, Bellatrix, and possibly Rigel and/or Saiph the hunters (LIWOSZ 2018, pp. 486-488).

### *Sound in cultural context*

Sound and especially novel sonic events join light, color, and space among phenomenological considerations. Quantifiable empirical observations and references to novel sound in indigenous oral traditions validate its significance. Sounds indicate agency and thus animacy of places vis-a-vis other-than-human agents who embody and personify the living, animating force of *puha* (HULTKRANTZ 1986; LIWOSZ 2017; THOMAS 2019). The process of personification helps guide how to characterize sounds. Correlating room modes with gendered vocal ranges may help identify known agents. Musically significant harmonic overtones reveal details of practitioners acquiring songs. Expressly, spirits perceived present during a power quest award *puha* by harmonizing with the carver/singer in a discursive interaction to impart songs.

Reports of song acquisition (e.g. LEWIS-WILLIAMS 2002, p. 273) are consistent with the glossolalia phenomenon. In Numic contexts glossolalia may be encoded as vocables - sequences of sounds and syllables functioning as rhythmic expressions rather than communication through words (HILL 1992, p. 123). Vocables should be expected to be heard more frequently in newly acquired songs, and to diminish in frequency (but not vanish) in progressively older song traditions. They appear to be encoded in 'song words' which retain rhythmic suffixes not part of their conversational counterparts (e.g. CRUM ET AL. 2001). Vocables are a verbali-

zed and auralized equivalent to visualized entoptic images, indexing moments of creative innovation with a frequency inversely proportional to the age of the song(s) (LIWOSZ 2018, p. 448). The practice does not seem isolated, and may be abstracted to cases throughout North America, and shamanistic contexts in the broadest global sense.

### *Naraya and the Round Dance*

Basin and Mojave parietal art is linked to a ceremonial complex that also peppered the landscape with geoglyphs, bedrock grinding features, middens, cairns, and rock alignments (HUNT 1960; ALTSCHUL AND EZZO 1995; WHITLEY 2000; GIAMBASTIANI ET AL. 2005; GARFINKEL 2014). Communal songs were typically lead by shamanic doctors (*puhakanti*) or respected orators (*pakwinavi*), who acquired songs *a priori* from powerful places including rock art locales (MILLER 1983; WHITLEY 1994; GIAMBASTIANI ET AL. 2005). As Numic mourning ceremony songs belonged to the *Naraya* tradition (CRUM 1980; KEHOE 1989; CRUM ET AL. 2001), Round Dance iconography identified at the Death Valley project area suggests it was a repository for these songs.

Elongated figures at INY-3074 found at Locus 8 Panel 37 and Locus 17 Panel 12 may evoke the Round Dance. In the latter instance, a contextual reading can be derived from the elongated figure's position among other elements in the panel. It is nearly centered between two more conventionally proportioned simple infilled anthropomorphs, with a fourth figure apart from the group in an action pose holding a long ceremonial object topped with a circle (LIWOSZ 2018, pp. 317, 449). Elongated figures appear to occur in several locations, including a suspected depiction of the Ghost Dance at Panamint Range site INY-1378 (GARFINKEL ET AL. 2007). Linking these elongated figures with late period *Naraya* leads to the possibility that these are anthropomorphic depictions of personified central dance poles which functioned as *axis mundi* during Round Dance events (see GAYTON 1930, p. 68). Although Van Tilburg (2012, p. 172) suggests the bisected circle motif represents the Round Dance pole, I argue that the pole is represented as these long figures (LIWOSZ 2018, p. 448), anthropomorphized as an expression of animacy. My interpretation aligns with reports by Hultkrantz (1986) both of the personification of *puha* during power quests, and the central pole during the syncretic Sun Dance of Great Plains Shoshone gaining *puha*.

### *Evidence of the Flower World Complex*

Southwestern archaeologists have identified several rock art motifs throughout the Four Corners states which potentially invoke Flower World symbolism (e.g. HERNBRODE AND BOYLE 2017). Motifs believed to represent flowers often included concentric circles, 'spoked' or 'cogged' circles, and rayed lines or 'asterisks.' These motifs, however, have alternately been interpreted as cogged stones and cactus sections (APODACA 2001), entoptic images derived during trances (WHITLEY 1994; 2000), the Huichol *nierika* apothecic eye (MUKHOPADHYAY AND GARFINKEL 2016), and Sun Spider's web of *puha* (HUFFMAN AND EARLY 2017). (Fig. 4)

Such ambiguities do not persist over the entire Numic visual lexicon. Butterflies are conventionalized as hourglass shapes in rock art (FINGER 2012, p. 193).

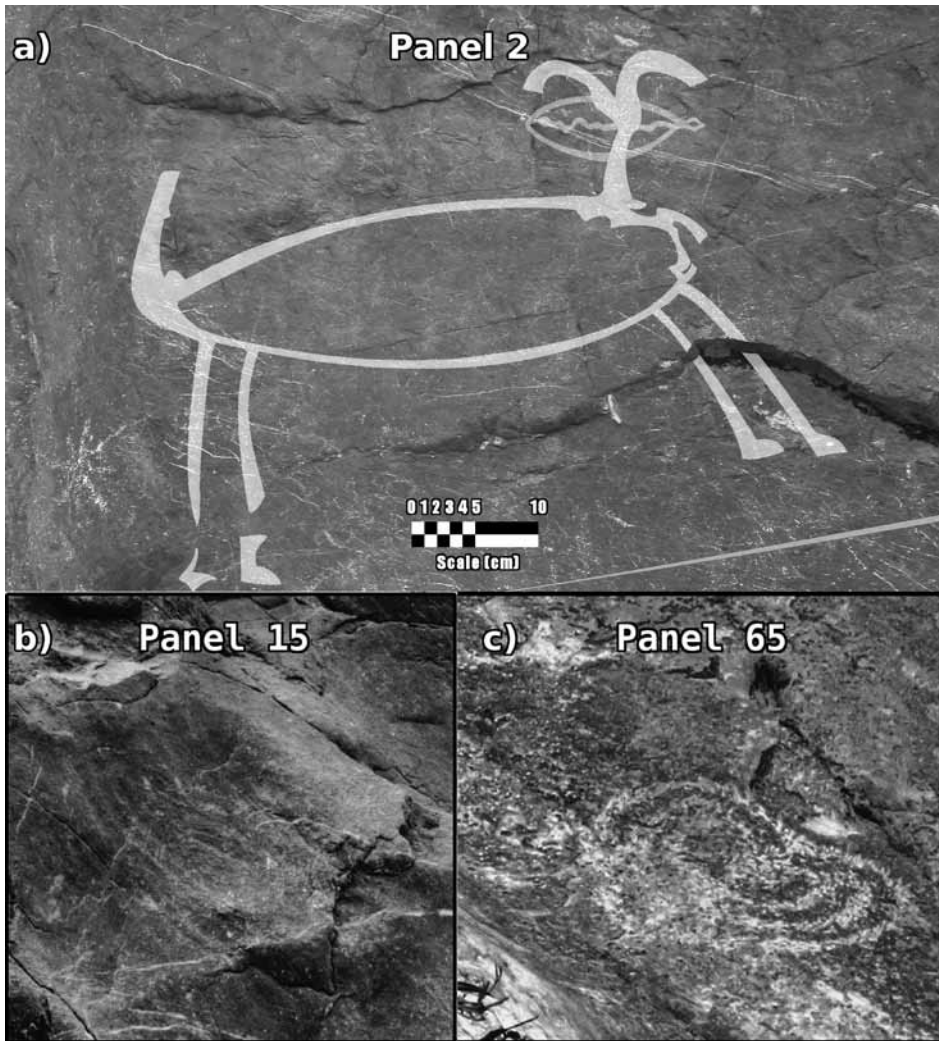


Fig. 4 - Example motifs. a) Panel 2 digital overlay of Coso Style bighorn; b - c) butterflies

They are present at INY-3074 Loci 12 and 13, Panels 15 and 65 respectively (figure 4). Butterflies are culturally significant in numerous expressions from hair styles to songs. They are a source of color in *puha hupia* power songs (CRUM ET AL. 2001, p. 148) and in *Naraya* as 'pine tree butterfly' (HILL 1992, p. 127). The Paiute girls' hairstyle equivalent to the well-known Hopi 'squash blossom' is a whorl called 'Lorentzen's butterfly' whose wearers were 'seeing themselves bloom' (HOPKINS 1883, pp. 46-47; HILL 1992, pp. 132-133). Whirls resembling a 'Lorenz butterfly' (e.g. figure 4b) and hourglass 'Lorentzen's butterflies' (e.g. figure 4c) may thus at once invoke 'blossoming' of pubescent girls, a chromatic spirit realm, and sacred song traditions.

3D models with sub-centimeter accuracy facilitate iconographic interpretation of many-element compositions, and aid addressing complex concepts like astronomical depictions. At INY-3074 Locus 8, a composition incorporating several different faces, a natural bench, and a shallow rock shelter includes a set of astronomical observations that simultaneously reference Numic oral traditions and the Flower World Complex. Faint red florette pictographs beginning in Panel 37 on the shelter's bench lead to bands of parallel pecking that cross the room, ending at Panel 35. The lines' terminus at the three bighorn sheep of *Wasüppin* in Panel 35 provides context for decoding the composition. The position and angle on approach to the sheep closely matches the Milky Way's relationship with Orion. This suggests that the parallel lines are the light bands on either side of the dusty lane in the middle of the galactic plane, confirming D'Ascenzo and Deal's (1987) hypothesized astronomical imagery in this locus. The bands match the Numic 'ancestral road', and with the Panel 37 rosettes they fit the 'flowery road' to the spirit land (HILL 1992, p. 125). Flower World motifs occurring in the resonant and reverberating Locus 8 parallels Hernbrode and Boyle's (2017, pp. 101-103) findings that Hohokam Flower World rock art coincides with acoustically significant loci, supporting a hypothesized musicality.

#### *Complimentary ritual technologies*

A common motif of a horizontal bar with vertical lines descending from it is often referred to as a 'rake' or 'fringe' and is sometimes conflated with 'rain signs' (e.g. VAN TILBURG ET AL. 2012). Elsewhere in the Great Basin, Paiute elders have identified the fringe motif as depictions of 'prayer knots,' strings that were knotted to be used as mnemonic devices keeping time and marking places. The 'rake' and 'rain' motifs should thus be distinguished, with the latter containing wavy and recurving ones, conceptually dividing prayer fringes from meteorological events. Prayer knots were at once memory devices, ritual offerings, and means of communicating with other-than-human entities (MILLER 1983, p. 78; HUFFMAN AND EARLY 2017, p. 17). The fringe motif is thus an icon of a ritual technology indexing the religious use of rock art landscapes.

Fringe motifs occur at both the Little Lake and Death Valley project areas. Unfortunately an utter absence of surface artifacts at INY-3074 indicates the site has either been looted or collected without formal documentation. Alternate evidence comes from excavations in 1951 at rockshelters beginning 0.5 km south of the canyon with INY-130, and extending to 2 km away at INY-222 (MEIGHAN ET AL. 1953). Preserved cordage was found in two shelters, which together yielded 155 specimens of cordage, 33 of which (21.29%) contained one or more of a variety of knots (GRÉGOIRE 1953, p. 195). Materials included various plant fibers and animal tissues.

It would be presumptuous to assume a single use for all these specimens, as some juniper, rabbitskin, willow, and bark bundles likely came from sandals, blankets, baskets, and kindling (respectively). Each knot may encode information in the knot types, locations, count, and fiber choice. For example, one specimen tied with a granny knot, presumed to be a mistake (GRÉGOIRE 1953), could well instead be an intentional mnemonic device functionally similar to the vastly distant Inca

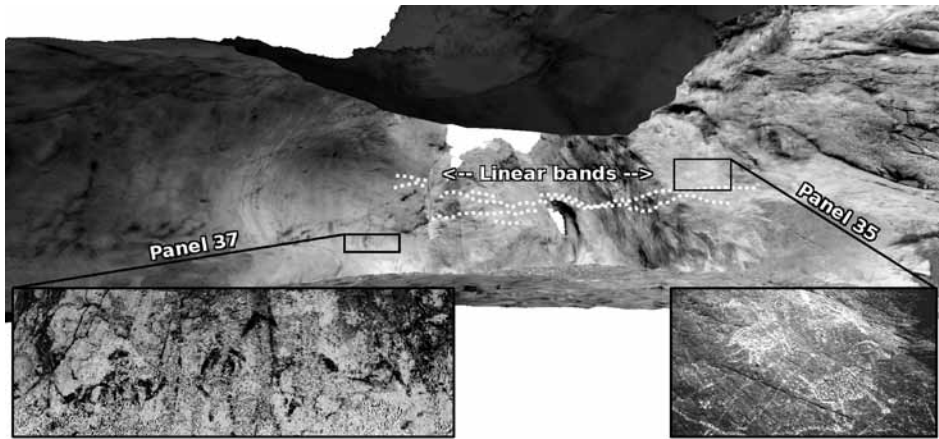


Fig. 5 - Virtual panorama of Locus 8, highlighting celestial imagery

*quipu*. Analogs are found much closer in the American Southwest. At the onset of the Pueblo Revolt, Native Americans coordinated simultaneous uprisings using knotted *Yucca sp.* ropes in the time-keeping manner described by Huffman and Early (2017). Elements recalling the fringe design thus provide further evidence of Great Basin exchanges of ritual technologies with Puebloan peoples.

#### *Naraya's Flower World Connections*

The central pole at the Round Dance can also be perceived as a ritual technology. According to Gayton (1930, p. 68), it functions as an *axis mundi*, bridging the cosmic tiers of the underworld, the plane of the living, and the heavens. From an etic perspective, it bridges cultural traditions set apart in time and space: from the Proto-Numic/Early Northern Uto-Aztecan spoken and visual symbolism, to the late Precontact celestial imagery, from Panamint Shoshone at the fringes of the Mojave Desert to the pole's syncretic appearance in ethnohistoric period Shoshoni Sun Dances in the Great Plains. In a very real sense, its iteration at INY-3074 Locus 8 can be read to span between ancestral time and the pilgrim's subjective present by transiting cosmological tiers. Its creation appears to have occurred in multiple events, with the elongated dendritic figure superimposed over the very faded florettes so as to appear to be holding them (Fig. 5).

With the florettes on the far (north) end of the room-crossing line that terminates as the Milky Way in the constellation *Wasüppin* (Orion) on its south end, the anthropomorphised pole holds the flowers firmly in the sky, marking a continuity of understanding from Archaic Northern Uto-Aztecan Flowerly Path (c.f. NICOLS 1981; HILL 1992, p. 125) through Numic celestial imagery in *Wasüppin* and the practice of placing a central pole at the focal point of the Round Dance (figure 6). Said continuity does not negate the passage of time but rather incorporates it, as the elongated digitate figure supporting the base of the galaxy's arc also invokes the anthropomorphised Milky Way of the *Chinigchinich* cult, a religious movement believed largely responsible for the Numic shift from flower-fire me-



taphors to astronomical chromaticism (HILL 1992, p. 130). This depiction of an *axis mundi* in its cosmological context iconographically connects with the ancestors, articulates with multiple modes of religious symbolism for astronomical observations, and fosters vibrantly colorful blossoms fitting for *Naraya* descriptions of flowers blooming in the spirit world (CRUM 1980; LILJEBLAD AND FOWLER 1986; CRUM ET AL. 2001; VANDER 2006). (Fig. 6)

#### CLOSING REMARKS

The discussion above represents a sample of the vast potential of combining emerging technologies with ethnographically sensitive approaches to archaeological studies, especially those involving visual culture. From a pragmatic standpoint, 3D modelling is neither suitable for all sites, nor limited to use at rock art locations. Similarly, socially significant acoustics are neither universally found, nor constrained to these site types. Further applications of 3D models and acoustical experiments will involve integrating these digital data into an interactive and immersive virtual reality environment for public outreach, interpretation, and ultimately cognitive experiments.

There is ample evidence to complicate existing understandings of Great Basin rock art. Entangled relationships between multi-motif compositions demonstrate the layering of meaning and metaphor, qualities that have for too long been denied to Numic and Great Basin rock art. Perhaps most notably, the evidence realizes Hill's long standing hypothetical connections between *Naraya* and the Flower World Complex. A *Naraya*/Flower World connection overturns entrenched assertions Numic peoples neither contributed significantly to the rock art



Fig. 6 - False color enhancement of digitate pole, with inset of overlay

in their homeland nor shared any relationship to Late Archaic inhabitants. This connection supports enduring symbolic structures in accordance with Whitley (2008) and Thomas (2019), implying an ancestral connection throughout the region. The wide reach of these shared systems upends a convention of treating the Great Basin in isolation, and places its cultures as influential participants in networks extending throughout North and Central Americas.

Further research at other regional sites is planned to substantiate these iconography claims, and their links to sound. The significance of vocables as evidence for glossolalia may have broader reaching implications. Future psychoacoustic work should consider the potential for feedback like reverberation to enhance the disinhibiting potential of the practice. Ideally this will be explored in diverse cultural contexts.

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