

## **Traditional Cultural Use as a Tool for Inferring Biogeography and Provenance: A Case Study Involving Painted Turtles (*Chrysemys picta*) and Hopi Native American Culture in Arizona, USA**

Author(s): Jeffrey E. Lovich, Charles T. LaRue, Charles A. Drost, and Terence R. Arundel

Source: Copeia, 2014(2):215-220. 2014.

Published By: The American Society of Ichthyologists and Herpetologists

DOI: <http://dx.doi.org/10.1643/CH-13-076>

URL: <http://www.bioone.org/doi/full/10.1643/CH-13-076>

---

BioOne ([www.bioone.org](http://www.bioone.org)) is a nonprofit, online aggregation of core research in the biological, ecological, and environmental sciences. BioOne provides a sustainable online platform for over 170 journals and books published by nonprofit societies, associations, museums, institutions, and presses.

Your use of this PDF, the BioOne Web site, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at [www.bioone.org/page/terms\\_of\\_use](http://www.bioone.org/page/terms_of_use).

Usage of BioOne content is strictly limited to personal, educational, and non-commercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

# Traditional Cultural Use as a Tool for Inferring Biogeography and Provenance: A Case Study Involving Painted Turtles (*Chrysemys picta*) and Hopi Native American Culture in Arizona, USA

Jeffrey E. Lovich<sup>1</sup>, Charles T. LaRue<sup>2</sup>, Charles A. Drost<sup>1</sup>, and Terence R. Arundel<sup>1</sup>

**Inferring the natural distribution and native status of organisms is complicated by the role of ancient and modern humans in utilization and translocation. Archaeological data and traditional cultural use provide tools for resolving these issues. Although the painted turtle (*Chrysemys picta*) has a transcontinental range in the United States, populations in the Desert Southwest are scattered and isolated. This pattern may be related to the fragmentation of a more continuous distribution as a result of climate change after the Pleistocene, or translocation by Native Americans who used turtles for food and ceremonial purposes. Because of these conflicting or potentially confounded possibilities, the distribution and status of *C. picta* as a native species in the state of Arizona has been questioned in the herpetological literature. We present evidence of a population that once occurred in the vicinity of Winslow, Arizona, far from current remnant populations on the upper Little Colorado River. Members of the Native American Hopi tribe are known to have hunted turtles for ceremonial purposes in this area as far back as AD 1290 and possibly earlier. Remains of *C. picta* are known from several pueblos in the vicinity including Homol'ovi, Awatovi, and Walpi. Given the great age of records for *C. picta* in Arizona and the concordance of its fragmented and isolated distribution with other reptiles in the region, we conclude that painted turtles are part of the native fauna of Arizona.**

It has long been axiomatic that humans, from ancient to modern times, have exerted a profound influence on the distribution of plants and animals. For example, in 1958, Charles Elton stated “we are living in a period of the world’s history when the mingling of thousands of kinds of organisms from different parts of the world is setting up terrific dislocations in nature . . .” However, prehistoric people contributed to the distributional patterns of various organisms well before Elton’s proclamation (Carlton, 2003). Given the longstanding and global scale of this ongoing interaction, it is difficult to determine the role and extent of human activities in the biogeography of some species, as noted by Davy et al. (2011). Nevertheless, diverse methods are available to decipher the natural biogeography of plants and animals including examination of the fossil and sub-fossil record (Enquist et al., 1995; Cole et al., 2011), phylogeographic analyses (Austin, 1999; Davy et al., 2011), the use of archaeological evidence (Adler, 1970), or traditional cultural resource use embedded in the framework of traditional ecological knowledge (see Berkes et al., 2000; Huntington, 2000). The latter author defined traditional ecological knowledge as “the knowledge and insights acquired through extensive observation of an area or a species, including knowledge passed down in an oral tradition, or shared among users of a resource.” In this paper, we present a case study using archaeological evidence and Hopi Native American traditional cultural use, not previously considered in the herpetological literature, to draw conclusions about the distribution and provenance of the painted turtle (*Chrysemys picta*) in the state of Arizona.

The painted turtle is the only native turtle in the United States with a transcontinental range extending from the Atlantic to the Pacific coasts (Ernst and Lovich, 2009). Within this wide distribution, four subspecies have been recognized historically, but there is substantial disagreement over the validity of this arrangement (Starkey et al., 2003; Ernst et al., 2006). Starkey et al. (2003) examined matrilineal

relationships throughout the range of *C. picta* and found that, with the exception of, *C. p. dorsalis*, the sister lineage to the remaining members of the species, *C. picta* was a genetically undifferentiated species throughout the remainder of its extensive range.

In the western portion of its range, *C. picta* (recognized traditionally as the subspecies *C. p. bellii*) occurs in isolated, disjunct populations (Fig. 1) including the upper San Juan and Rio Grande Rivers of New Mexico (Degenhardt and Christiansen, 1974; Degenhardt et al., 1996) and Colorado (Cooley et al., 2003), the Little Colorado River in Arizona (Jennings, 1987; Boundy, 1991), and the Rio Santa Maria, an internally-draining system in north-central Chihuahua, Mexico (Smith and Smith, 1979). Yarrow (1875) reported *Chrysemys oregonensis* (= *C. picta*) from “Rock Creek Cañon, south of Camp Apache, Ariz.” This location is on the south side of the White Mountains, in the Salt/Gila River drainage. Jennings (1987) questioned the validity of this record because of Yarrow’s history of improperly labeling specimen localities (Iverson, 1978), but also stated that this record was, “. . . the most reliable account of *C. p. bellii* in Arizona . . .” He also included a detailed discussion of the site name and its location, which he took to be Ash Creek, a tributary of the Black River in northern Graham County.

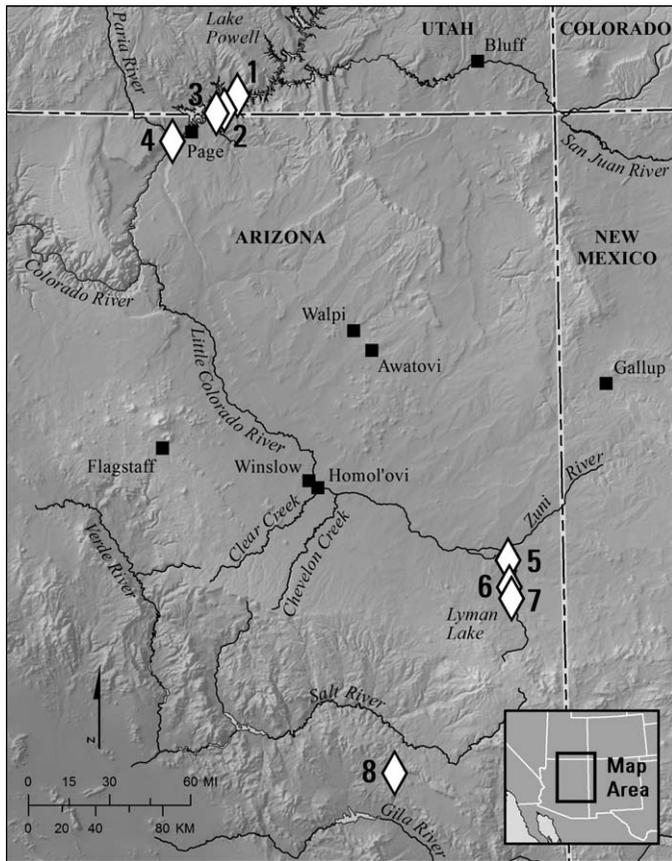
Jennings (1987) also questioned the record for Labyrinth Canyon in San Juan County, Utah (mapped in Stebbins, 1985, 2003; see Fig. 1), just north of the Arizona border, as an unverified sighting. However, records from Labyrinth Canyon and nearby tributary canyons of the Colorado River in Glen Canyon are well documented in reports with at least one extant specimen. Woodbury (1958:180) mentions, then illustrates, a specimen collected in “a pool in the mouth of Rock Creek, mile 55.6, 3200 ft, July 25, 1937 by LaMont C. Cole” and notes that Cole observed at least four others at this location. According to Woodbury (1959) specimens were also collected in Labyrinth Canyon (one collected by John Mull in June 1951) and Face Canyon (two collected by

<sup>1</sup>U.S. Geological Survey, Southwest Biological Science Center, 2255 North Gemini Drive, MS-9394, Flagstaff, Arizona 86004; E-mail: (JEL) jeffrey\_lovich@usgs.gov; (CAD) charles\_drost@usgs.gov; and (TRA) terry\_arundel@usgs.gov. Send reprint requests to JEL.

<sup>2</sup>3525 W. Lois Lane, Flagstaff, Arizona 86001; E-mail: ringtail@infomagic.net.

Submitted: 8 July 2013. Accepted: 8 November 2013. Associate Editor: J. D. Litzgus.

© 2014 by the American Society of Ichthyologists and Herpetologists DOI: 10.1643/CH-13-076



**Fig. 1.** Map showing location of native painted turtle (*Chrysemys picta*) records for Arizona and Utah as white diamonds. Archaeological records for Hopi pueblos discussed in the text are designated with black squares, as are other towns. Localities are labeled as follows: 1 = Rock Creek, 2 = Face Canyon, 3 = Labyrinth Canyon, 4 = Lees Ferry, 5 = Saint Johns, 6 = Salado Springs, 7 = Lyman Lake, and 8 = Ash Creek.

Frank Wright in 1958). One of the Face Canyon specimens was collected alive and held for a time at the Arizona Sonora Desert Museum in Tucson, AZ. These Utah locations are in San Juan County (Face and Labyrinth) and Kane County (Rock) just north of the Arizona border, 17–33 km northeast of Page, AZ. As far as we can determine, only one of the specimens is still available (UAZ 39731, collected by F. Wright, August 31, 1958, in Face Canyon, Fig. 2). The lower lengths of all of these canyons are now covered by the waters of Lake Powell, and recent surveys have not found extant populations of painted turtles in this area (Drost et al., 2008). Oral history reports of turtles at the mouth of the Paria River in the 20<sup>th</sup> century (Lees Ferry, Coconino County, AZ; L. E. Stevens, pers. comm.; Fig. 1), if true, most likely would have been *C. picta* as no other turtle species are known from this area. If valid, these latter records would extend the former occurrence of the species even farther downstream along the Colorado River.

The isolated nature of populations of *C. picta* in the Desert Southwest has two possible explanations. First, it could be a reflection of a relictual distribution resulting from aridification of the region at the end of the Pleistocene (Starkey et al., 2003) that confined the species to isolated wetlands. This pattern is supported in the fossil record and modern distribution of another western aquatic turtle, *Actinemys marmorata*, the Pacific pond turtle (Brattstrom and Sturn, 1959; Lovich and Meyer, 2002), as well as in other Desert

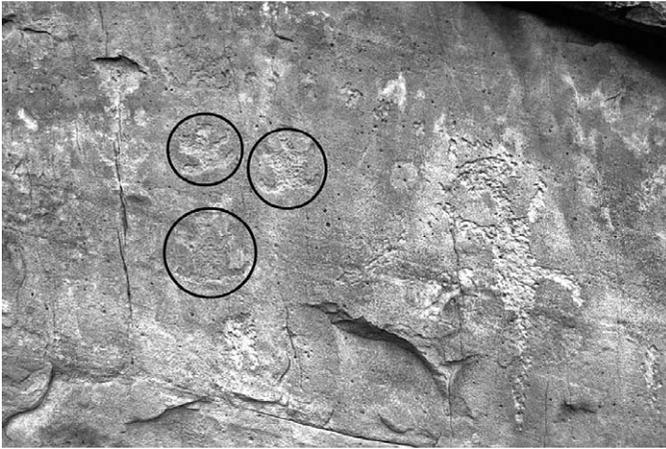


**Fig. 2.** Painted turtle (*Chrysemys picta bellii*) collected by F. Wright, August 31, 1958, in Face Canyon, San Juan County, Utah. University of Arizona (UAZ) 39731. Note the extensive dark plastron pigmentation typical of this subspecies.

Southwest reptiles (Grismer and McGuire, 1993; Lovich and Beaman, 2007). Alternatively, it could reflect the agency of Native Americans that transported various turtles and large lizards throughout the Desert Southwest for food or trade (Nabhan, 2000, 2002), thus altering their distributions (Schneider and Everson, 1989). The effect of Native Americans on the distribution of turtles is also well documented by Adler (1970) for box turtles (*Terrapene carolina*) in the eastern United States.

Webb (1985) offered eight criteria for determining the native status of a species, including fossil evidence, historical evidence, habitat, geographical distribution, ease of known naturalization elsewhere, genetic diversity, reproductive pattern, or supposed means of introduction. While Webb acknowledged that it would be rare for any one criterion to give a definitive answer, if several point in the same direction it is reasonable to conclude that a species is native to an area. Our objective in this paper is to provide a case study of how archaeological information and traditional cultural use can be incorporated into investigations of the provenance and distribution of a species. Our case study is based on information previously unreported in the herpetological literature for the painted turtle in Arizona.

**Traditional cultural use of painted turtles by the Hopi in Arizona.**—Ernest Beaglehole (1936) published a paper on Hopi hunting and hunting rituals. In it he described how the Hopi hunted painted turtles for the purpose of obtaining turtle shells to be used ceremonially as dance rattles. The traditional hunting location was the River lemóvayii', which translated means "cold, icy waters" (Sandy Lynch, pers. comm., *vide* Jerry Honawa, Hopi Elder). This is the present location of Clear Creek (aka East Clear Creek), near Winslow, Arizona, a tributary of the Little Colorado River (not to be confused with nearby West Clear Creek that flows into the Verde River). To the best of our knowledge, painted turtles are extirpated from this portion of the Little Colorado River basin. It is also possible that the location was just upstream (15 km) of Clear Creek on nearby Chevelon Creek (another tributary to the Little Colorado River), or both drainages. Support for Chevelon Creek is provided by the



**Fig. 3.** Petroglyphs in Chevelon Canyon near Winslow, Arizona carved into Coconino Sandstone. The three circled figures without tails resemble turtles, while the larger petroglyph to the right resembles a large-headed lizard. Photograph by Mike Terlep.

presence of petroglyphs in Chevelon Canyon that resemble turtles (Fig. 3). The style of the glyphs in this area of the Little Colorado River suggests a date of AD 900–1300 (e.g., Cole, 2008) but they most likely date to AD 1100–1250 based on the closest pueblo in the area (Charles Adams, pers. comm.).

That *C. picta* is still found farther upstream in the Little Colorado River (Boundy, 1991; Drost, unpubl. records) lends strong support to the previous existence of the species near Winslow. Beaglehole does not give a time for the hunting expeditions he recounts but indicates that “This has not been done for many years . . .” We provide excerpts of his account for the benefit of readers who would undoubtedly find it difficult to obtain a copy of Beaglehole’s relatively obscure publication, and to provide details of the intricate relationship between Hopi and painted turtles in Arizona.

Turtle hunts were planned before the Niman (Home Dance) festival in July to provide rattles for dancers. Men would be away from their villages for six or seven days while on a turtle hunting expedition. Upon entering the water, the men sometimes formed a line, wading up the river feeling for turtles with their hands and feet. When the water was high they would dive in to bring up turtles from the river bottom. After removing turtles from their shells, the remains were brought back to the village and hung up to dry in the sun. Sheep or deer hooves were tied to the shells when dried to clack against the bottom of the shell like a drum. Much of what was reported by Beaglehole was confirmed to us by Jerry Honawa, a Hopi Elder from Hotevilla, Arizona (*in litt.*). According to Beaglehole, “the Little Colorado tributary” (Clear Creek, assumed to be East Clear Creek) was the main source for turtles. However, one informant told him that it was not unusual for Hopi men to travel much farther south, to the Salt River, to hunt turtles. If the Hopi hunted for aquatic turtles in the Salt River, they would have encountered only Sonora mud turtles (*Kinosternon sonoriense*), as *C. picta* is unexpected in that river (Lovich and Beaman, 2008), save for the one questionable Yarrow specimen detailed above (Jennings, 1987). The only other turtle in the vicinity of the Salt River (Ernst and Lovich, 2009) would be the terrestrial Morafka’s desert tortoise (*Gopherus morafkai*). The latter species is in “wide use” by the Hopi today (Olson and Wheeler, 1978). It is interesting that

we did not find reports of *K. sonoriense* or *G. morafkai* remains in the literature we reviewed for the pueblos discussed below.

Support for Beaglehole’s statement that the main source of turtle shells was Clear Creek is provided by Olson and Wheeler (1978) who conducted a faunal analysis of bones collected between 1935 and 1939 at a nearby Hopi site known as Awatovi pueblo. Awatovi is about 86 km northeast of Winslow. The pueblo was founded sometime after 1300 and was the first Hopi village to be visited and conquered by the Spanish (Montgomery et al., 1949). Significantly, the only reptile remains recovered at Awatovi included the complete shells of four *C. picta* (about 17 cm in carapace length). The shells were found in a room associated with a postrebellion period (after 1680) human burial. Since the Awatovi site was sacked and abandoned in 1700 (Montgomery et al., 1949), the shells predate that time. As illustrated in Olson and Wheeler (1978), the shells were used as leg rattles due to the presence of drilled holes for attachment thongs. The attachment method is identical to that used today by the Hopi. Additional fragments of carapaces and plastrons of *C. picta* were found in other rooms at the pueblo. There was no evidence for or against the use of the turtles for food. Olson and Wheeler concluded that the occurrence of *C. picta* in the ruins was “. . . interesting in that it is not a common resident of the state at the present time.” They also stated, “Whether this turtle was brought from its range outside the area . . . or whether it ranged nearby in the seventeenth century is unknown.” Surprisingly, they make no mention of Beaglehole’s earlier publication documenting the presence of *C. picta* in nearby Clear Creek.

Other nearby pueblos, including Homol’ovi IV, next to the present day town of Winslow have yielded turtle bones (Adams, 2004), including those of *C. picta* from Homol’ovi I (LaMotta, 2006; Charles Adams, pers. comm.), Homol’ovi III (Pierce, 2001), and Walpi pueblo (Szuter, 1991), 93 km north of Clear Creek. The Homol’ovi I and III remains date to the period from 1290–1400 while those from Walpi date to 1700–1950 (Charles Adams, pers. comm.). The Homol’ovi area was considered prime territory for the Hopi people in the late 1200s according to Adams (2000). He believes the area was settled for partly strategic reasons including the fact that turtles could be acquired there.

That some of the bones in Homol’ovi I and III were assignable to *Terrapene ornata*, a species that is not native to the Colorado Plateau (but is native to southeastern Arizona), suggests that Hopi expeditions to collect turtles were far-ranging (or that *Terrapene ornata* was once more widely distributed in Arizona), as described in Beaglehole (1936), or they were trading for turtles. It is interesting that the remains of turtles reported above did not include Sonora mud turtles (*Kinosternon sonoriense*), as this species is relatively common in Arizona and New Mexico south of the Mogollon Rim (Ernst and Lovich, 2009). In fact, Hopi expeditions would have passed through habitat of *K. sonoriense* on the way to collect *T. ornata* if they were going to southeastern Arizona where the latter species lives today. Perhaps *K. sonoriense* was not preferred for rattle making.

## DISCUSSION

The herpetological literature on *C. picta* contains conflicting views regarding the origin of the species in Arizona. Is it native to Arizona or was it introduced by Native Americans? There is no doubt that some populations, particularly those

in urban Phoenix and Tucson, are modern introductions from elsewhere in the range as noted by Jennings (1987) and Brennan and Holycross (2006). The provenance of painted turtles in the Little Colorado River and the Colorado River near the present site of Lake Powell is more controversial. Rosen and Herrmann (2008) considered the painted turtle a native of Arizona on the basis of evidence presented by Boundy (1991) and Brennan and Holycross (2006). Paradoxically, the latter authors state that, "Populations in Apache County near St. Johns and Concho **might** (emphasis added) be native." Lovich and Beaman (2008) and Drost et al. (2008) concluded that it is likely that the species is native to Arizona.

Populations of painted turtles still occur in the upper Little Colorado River valley (as at Lyman Lake, Apache Co., AZ, 15 km south of St. Johns, and 135 km southeast of the mouth of Clear Creek). The turtles in this area have a mixed size/age distribution, suggesting a reproducing population (authors, unpubl. obs.). The possible occurrence of painted turtles in the "Colorado Chiquito River" (=Little Colorado River) is indicated by Coues (1875) who reported collecting two species of turtles in this area, one of which "may have been *Chrysemys oregonensis* [= *Chrysemys picta*]." This report is further discussed by Jennings (1987). The apparently extirpated painted turtle populations in Labyrinth and Face Canyons in the Glen Canyon region (within 1 km and 3 km, respectively, of the Arizona border), along with the population in Rock Creek, on the opposite side of the Colorado River, were in a very remote region. It seems unlikely that the turtles were directly introduced into that area.

Previous herpetological publications overlooked the archaeological information presented in this paper, indicating that painted turtles have been present in Arizona for a very long time. This still leaves the question of whether the painted turtle is a native relictual species in Arizona or if it was transported here from elsewhere by Native Americans, possibly the Zuni or Hopi. The indigenous status of *C. picta* in nearby northwestern New Mexico and southwestern Colorado has not been questioned in the literature so these areas could have served as a source for turtles that eventually made it to Arizona due to hunting or trade. Boundy (1991) reported that in the 1940s, ". . . bands of Zuni Indians would come here [Salado, on the upper Little Colorado River, Arizona, ca. 115 km southeast from Winslow] from the north to get turtles for food." On the weight of this evidence he concluded that this "suggests" the natural occurrence of *C. picta* in the Little Colorado River as an indigenous species, while acknowledging the possibility of dispersal by Native Americans. It is just as logical to suggest that the Zuni transported *C. picta* from the Little Colorado River, where they may have always been native, to the San Juan or Rio Grande rivers where they might represent introduced populations.

It is of interest to note that records of *C. picta* in Arizona and New Mexico are concentrated along rivers and creeks because elsewhere in its range the species is fond of still waters with soft substrates (Ernst and Lovich, 2009). Degenhardt and Christiansen (1974) reviewed the distribution of *C. picta* in New Mexico and observed that even along rivers, the species is found in ponds, ditches, and swamps with deep ditches. Natural marshes in this region provide the preferred habitat of *C. picta*, but such habitat types have experienced long-term declines. Observations and analyses

of stream flows along the Little Colorado River over the last 30 years show significant changes in base flow and perennial flow of the river in this region, with drying of riparian habitat and wetlands and changes from perennial flow to ephemeral flow (D. Bills, pers. comm.; see also Anning and Parker, 2009). Most of the recent drying is the result of groundwater withdrawals in the area to support municipal, industrial, and agricultural water demands (Hart et al., 2002). We can only speculate that pre-European contact habitats along the Little Colorado River were characterized by marshes or oxbows that provided more favorable habitat as preferred by *C. picta*. On the upper portions of the Little Colorado River today, the species is found in marshy ponds at the base of the spillway at Lyman Lake, a manmade reservoir, and springs along the river. The Clear Creek site at Winslow was dammed to provide water for the town of Winslow before Beaglehole (1936) published his paper, potentially providing good habitat at the time.

Definitive support for the indigenous status of *C. picta* in Arizona might be revealed through identification of unique genetic markers in future studies. The phylogeographic analysis conducted by Starkey et al. (2003) throughout the range of *C. picta* using the mitochondrial control region found that Arizona populations were part of a wide-ranging maternal lineage distributed across 16 states extending from Michigan to Washington, and Montana to the Desert Southwest, and Minnesota to Missouri. The control region may be inappropriate for examining fine-scale genetic variation as suggested by a similar lack of genetic variation across the wide range of another turtle species, *Glyptemys insculpta* (Amato et al., 2008). In contrast, microsatellite analysis demonstrated high genetic variability among populations of *G. insculpta* (Tessier et al., 2005). Resolution of this matter for *C. picta* in Arizona will require additional population-level analyses to be undertaken.

The archaeological information summarized in this paper supports the notion that *C. picta* is a native in the Little Colorado River of Arizona based on the following. First, the great age of records and traditional cultural use by at least two different tribes suggests longstanding use and familiarity with this species from at least 1290 to about 1936. Second, the disjunct nature of populations of *C. picta* in the Desert Southwest is consistent with the distribution observed in some other riparian and xero-riparian reptiles in the region. Sundered ranges appear to be related to changes in climate (aridification) that occurred at the end of the Pleistocene (Grismer, 1994; Lovich and Meyer, 2002; Starkey et al., 2003). The pre-historical and historical evidence, fragmented distribution (typical of other Southwestern reptiles), potential genetic similarity to other *C. picta* in the large lineage to which Arizona turtles belong, and occurrence in natural habitats meet at least four of the criteria suggested by Webb (1985) for defining a native species. Based on this combination of evidence, we conclude that *C. picta* is indigenous to Arizona occurring as remnant populations from a formerly more widespread distribution.

Modern-day Hopi suggest that traditional ecological knowledge and traditional cultural use may provide insights into population trends and former distributions of native plants and animals (Helen Fairly, pers. comm.). These observations on painted turtles in Arizona are a good example of the insights provided by archaeological data and traditional cultural use, and suggest the value of such sources in deciphering the distributional patterns and

provenance of other plants and animals today. Such insights may be particularly important in understanding long-term fluctuations of species distribution patterns, in the face of climate- and human-mediated changes to the environment.

#### ACKNOWLEDGMENTS

Special thanks to S. Mankiller; S. Lynch, Curator of Anthropology Sharlot Hall Museum; and Hopi Elder J. Honawa for assistance with translation of Hopi words and for providing additional information. E. Adams, Curator of Archaeology and Professor of Anthropology, Arizona State Museum, University of Arizona provided important citations and archaeological information. Earlier versions of the manuscript benefitted from comments offered by H. Fairley, M. Austin, and M. Agha.

#### LITERATURE CITED

- Adams, E. C. 2000. Homol'ovi: an ancestral Hopi place. *Archaeology Southwest* 14:1–3.
- Adams, E. C. 2004. Homol'ovi IV: the first village. Arizona State Museum.
- Adler, K. K. 1970. The influence of prehistoric man on the distribution of the box turtle. *Annals of the Carnegie Museum* 41:263–280.
- Amato, M. L., R. J. Brooks, and Z. Fu. 2008. A phylogeographic analysis of populations of the wood turtle (*Glyptemys insculpta*) throughout its range. *Molecular Ecology* 17:570–581.
- Anning, D. W., and J. T. Parker. 2009. Predictive models of the hydrological regime of unregulated streams in Arizona. U.S. Geological Survey.
- Austin, C. C. 1999. Lizards took express train to Polynesia. *Nature (London)* 397:113–114.
- Beaglehole, E. 1936. Hopi hunting and hunting ritual. Yale University Publications in Anthropology 4:1–26.
- Berkes, F., J. Colding, and C. Folke. 2000. Rediscovery of traditional ecological knowledge as adaptive management. *Ecological Applications* 10:1251–1262.
- Boudry, J. 1991. A possible native population of the painted turtle, *Chrysemys picta*, in Arizona. *Bulletin of the Chicago Herpetological Society* 26:33.
- Brattstrom, B. H., and A. Sturn. 1959. A new species of fossil turtle from the Pliocene of Oregon, with notes on other fossil *Clemmys* from western North America. *Bulletin, Southern California Academy of Sciences* 58:65–71.
- Brennan, T. C., and A. T. Holycross. 2006. A field guide to amphibians and reptiles in Arizona. Arizona Game and Fish Department.
- Carlton, J. 2003. Community assembly and historical biogeography in the North Atlantic Ocean: the potential role of human-mediated dispersal vectors. *Hydrobiologia* 503:1–8.
- Cole, K. L., K. Ironside, J. Eischeid, G. Garfin, P. B. Duffy, and C. Toney. 2011. Past and ongoing shifts in Joshua tree distribution support future modeled range contraction. *Ecological Applications* 21:137–149.
- Cole, S. J. 2008. *Legacy on Stone: Rock Art of the Colorado Plateau and Four Corners Region*. Johnson Books, Boulder, Colorado.
- Cooley, C. R., A. O. Floyd, A. Dolinger, and P. B. Tucker. 2003. Demography and diet of the painted turtle (*Chrysemys picta*) at high-elevation sites in southwestern Colorado. *Southwestern Naturalist* 48:47–53.
- Coues, E. 1875. Synopsis of the reptiles and batrachians of Arizona; with critical and field notes, and an extensive synonymy, p. 585–633. *In: Report upon geographical and geological explorations and surveys west of the One Hundredth Meridian, in charge of First Lieut. Geo. M. Wheeler, Vol. V, Engineer Department, United States Army, Washington, D.C.*
- Davy, C. M., F. R. Méndez de la Cruz, A. Lathrop, and R. W. Murphy. 2011. Seri Indian traditional knowledge and molecular biology agree: no express train for island-hopping spiny-tailed iguanas in the Sea of Cortés. *Journal of Biogeography* 38:272–284.
- Degenhardt, W. G., and J. L. Christiansen. 1974. Distribution and habitats of turtles in New Mexico. *The Southwestern Naturalist* 19:21–46.
- Degenhardt, W. G., C. W. Painter, and A. H. Price. 1996. *Amphibians and Reptiles of New Mexico*. University of New Mexico Press, Albuquerque, New Mexico.
- Drost, C. A., T. B. Persons, A. J. Monatesti, R. Platenberg, and E. M. Nowak. 2008. Reptile and amphibian inventory of Glen Canyon National Recreation Area. U.S. Geological Survey, Flagstaff, Arizona.
- Elton, C. S. 1958. *The Ecology of Invasions by Plants and Animals*. Methuen and Co., Ltd., London.
- Enquist, B., M. Jordan, and J. Brown. 1995. Connections between ecology, biogeography, and paleobiology: relationship between local abundance and geographic distribution in fossil and recent molluscs. *Evolutionary Ecology* 9:586–604.
- Ernst, C. H., A. F. Laemmerzahl, and T. R. Creque. 2006. A review of morphological and pattern variation in the painted turtle, *Chrysemys picta*, in Missouri, USA, with an alternate hypothesis of the origin of *Chrysemys picta marginata*. *Herpetological Bulletin* 95:6–15.
- Ernst, C. H., and J. E. Lovich. 2009. *Turtles of the United States and Canada*. Johns Hopkins University Press, Baltimore, Maryland.
- Grismer, L. 1994. The origin and evolution of the peninsular herpetofauna of Baja California, México. *Herpetological Natural History* 2:51–106.
- Grismer, L. L., and J. A. McGuire. 1993. The oases of central Baja California, Mexico. Part I. A preliminary account of the relict mesophilic herpetofauna and the status of the oases. *Bulletin, Southern California Academy of Sciences* 92:2–24.
- Hart, R. J., J. J. Ward, D. J. Bills, and M. E. Flynn. 2002. Generalized hydrogeology and ground-water budget for the C Aquifer, Little Colorado River basin and parts of the Verde and Salt River basins, Arizona and New Mexico. U.S. Geological Survey Water-Resources Investigations Report 02-4026.
- Huntington, H. P. 2000. Using traditional ecological knowledge in science: methods and applications. *Ecological Applications* 10:1270–1274.
- Iverson, J. B. 1978. Distributional problems of the genus *Kinosternon* in the American Southwest and adjacent Mexico. *Copeia* 1978:476–479.
- Jennings, M. R. 1987. Status of the western painted turtle (*Chrysemys picta bellii*) in Arizona. *Journal of the Arizona-Nevada Academy of Science* 22:129–133.
- LaMotta, V. M. 2006. Zooarchaeology and Chronology of Homol'ovi I and Other Pueblo IV Period Sites in the Central Little Colorado River Valley, Northern Arizona.

- Unpubl. Ph.D. diss., University of Arizona, Tucson, Arizona.
- Lovich, J. E., and K. R. Beaman.** 2007. A history of Gila monster (*Heloderma suspectum cinctum*) records from California with comments on factors affecting their distribution. *Bulletin, Southern California Academy of Sciences* 106:39–58.
- Lovich, J. E., and K. R. Beaman.** 2008. Distribution of native turtles in the arid southwestern United States with comments on *Kinosternon sonoriense*: a species presumed to be lost from California's herpetofauna, p. 127–134. *In: The 2008 Desert Symposium and Field Guide and Proceedings.* R. E. Reynolds (ed.). California State University, Desert Studies Consortium and LSA Associates, Inc.
- Lovich, J., and K. Meyer.** 2002. The western pond turtle (*Clemmys marmorata*) in the Mojave River, California, USA: highly adapted survivor or tenuous relict? *Journal of Zoology, London* 256:537–545.
- Montgomery, R. G., W. Smith, and J. O. Brew.** 1949. Franciscan Awatovi; the excavation and conjectural reconstruction of a 17<sup>th</sup>-century Spanish mission establishment at a Hopi Indian town in northeastern Arizona. *Papers of the Peabody Museum of American Archaeology and Ethnology, Cambridge, Massachusetts.*
- Nabhan, G. P.** 2000. Cultural dispersal of plants and reptiles to the Midriff Islands of the Sea of Cortés: integrating indigenous human dispersal agents into island biogeography. *Journal of the Southwest* 42:545–558.
- Nabhan, G. P.** 2002. When desert tortoise talks, Indians listen. University of Arizona Press and the Arizona-Sonora Desert Museum, Tucson.
- Olson, S. J., and R. P. Wheeler.** 1978. Bones from Awatovi: northeastern Arizona. *Papers of the Peabody Museum of Archaeology and Ethnology* 70:1–74.
- Pierce, L.** 2001. Homol'ovi III: A Pueblo Hamlet in the Middle Little Colorado River Valley, p. 273–284. *In: Arizona State Museum Archaeological Series.* E. C. Adams (ed.). University of Arizona, Tucson.
- Rosen, P. C., and H.-W. Herrmann.** 2008. Aridlands turtles in southwestern North America I. Definition and description of the fauna. *Sonoran Herpetologist* 21:118–122.
- Schneider, J. S., and G. D. Everson.** 1989. The desert tortoise (*Xerobates agassizii*) in the prehistory of the southwestern Great Basin and adjacent areas. *Journal of California and Great Basin Anthropology* 11:175–202.
- Smith, H. M., and R. B. Smith.** 1979. Synopsis of the herpetofauna of Mexico. Vol. VI. Guide to Mexican turtles. Bibliographic addendum III. John Johnson, North Bennington, Vermont.
- Starkey, D. E., H. B. Shaffer, R. L. Burke, M. R. J. Forstner, J. B. Iverson, F. J. Janzen, A. G. J. Rhodin, and G. R. Ultsch.** 2003. Molecular systematics, phylogeography, and the effects of Pleistocene glaciation in the painted turtle (*Chrysemys picta*) complex. *Evolution* 57:119–128.
- Stebbins, R. C.** 1985. *A Field Guide to Western Reptiles and Amphibians.* Houghton Mifflin Co., Boston.
- Stebbins, R. C.** 2003. *A Field Guide to Western Reptiles and Amphibians.* Houghton Mifflin Harcourt.
- Szuter, C.** 1991. Homol'ovi II: Archaeology of an Ancestral Hopi Village, p. 103–111. *In: Anthropological Papers of the University of Arizona.* E. Charles Adams and K. A. Hays (eds.). University of Arizona Press, Tucson.
- Tessier, N., S. R. Paquette, and F.-J. Lapointe.** 2005. Conservation genetics of the wood turtle (*Glyptemys insculpta*) in Quebec, Canada. *Canadian Journal of Zoology* 83:765–772.
- Webb, D.** 1985. What are the criteria for presuming native status? *Watsonia* 15:231–236.
- Woodbury, A. M.** 1958. Preliminary report on biological resources of the Glen Canyon Reservoir. University of Utah Anthropological Papers No. 31 (Glen Canyon Series Number 2).
- Woodbury, A. M.** 1959. Amphibians and reptiles of Glen Canyon, p. 135–148. *In: Ecological Studies of the Flora and Fauna in Glen Canyon.* University of Utah Anthropological Papers No. 40 (Glen Canyon Series Number 7).
- Yarrow, H. C.** 1875. Report upon the collections of batrachians and reptiles made in portions of Nevada, Utah, California, Colorado, New Mexico, and Arizona during the years 1871, 1872, 1873 and 1874. *In: Report upon geographical and geological explorations and surveys west of the One Hundredth Meridian, in charge of First Lieut. Geo. M. Wheeler.* Vol. V, Washington, D.C.