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Biogeography of Western Pond Turtles in the western Great Basin: Dispersal Across a Northwest Passage?

R. Bruce Bury

1410 NW 12th Street, Corvallis, Oregon 97330, e-mail: clemmys@gmail.com

***Abstract.*—The occurrence of the Western Pond Turtle (*Actinemys marmorata*) in Nevada and other areas of the western Great Basin has been debated as being either of a native origin or introduced. To evaluate its status, I reviewed the fossil record, archaeological evidence, historic reports (< 1980), and recent evidence (≥ 1980). The species or ancestor was present in the Great Basin since at least the Pleistocene. Several turtle scutes, bones, and artifacts have been found in caves used by Native Americans in the past. Turtles have been observed and caught in both historic and recent times in Nevada and adjacent northeast California and southeast Oregon. Overall, the species appears to be native in these areas but on-going genetic studies may reveal other explanations. The situation is clouded because some turtles may have been introduced by people on occasion. A new perspective on the arrival or dispersal of the turtle in western Nevada warrants consideration. Because of its close proximity, an earlier connection between western Nevada (e.g., Reno area) and the Sacramento Valley of California was proposed over Donner Summit (2,195 m elevation). However, there is less (-585 m) of an elevational barrier to turtles and other taxa around the north end of the Sierra Nevada to the Modoc Plateau and other high desert areas in northeast California and southeast Oregon, where the turtle is now known. This northern dispersal corridor of species regionally may be considered a northwest passage.**

Key Words.—Actinemys marmorata; distribution; geographic range; Great Basin; Nevada; northeast California; southeast Oregon

Introduction

The Western Pond Turtle, *Actinemys marmorata*, ranges over a large distance from the Puget Trough in Washington State south 2,000 km to Baja California Norte (Stebbins 1966; Iverson 1992; Bury et al. 2012). The species occurs chiefly west of the Cascade-Sierra crest. Few populations are > 200 km inland from the Pacific Ocean except for isolated colonies in west-central Nevada (Bury 1970; Bury and Germano 2008; Ernst and Lovich 2009). Recent molecular studies of this turtle suggested that most (five of six samples) from the Carson River, Nevada, had haplotypes not found west of the Sierra Nevada, but which differed only slightly from other northern clade haplotypes (Spinks and Shaffer 2005). The species occurs up to 1,500 m elevation with a record at 2,042 m, but turtles were introduced to some of these sites (Jennings and Hayes 1994; Buskirk 2002). These turtles frequent some inland waters in high desert habitats at 1,265 m elevation (Bury et al. 2012).

Most historic and recent records in Nevada are along a corridor (down the east side of the Sierra Nevada) in the west-center of the state. From north to south (Fig. 1), the Truckee River bisects Reno then flows eastward about 75 km to Pyramid Lake. At 55 km farther south is the Carson River, which empties into Lahonton Reservoir 65 km to the east and then 50 km more to wetlands at Stillwater National Wildlife Refuge. Lastly, at another 50 km south is the Walker River, which flows about 70 km southeast to Weber Reservoir. The rivers on the floor of the Great Basin range from 1,323 to 1,372 m elevation (at Reno) down to 1,285 m at Weber Reservoir to about 1,160 m at the other terminal lakes and wetlands (Fig. 1).

Whether the origin of this turtle is native or introduced in western Nevada has been debated for a long time. There are fossil records of this species or related forms from the Pleistocene in the western Great Basin (see Brattstrom and Strun 1959) as well as archaeological evidence (Hattori 1982). LaRivers (1942) appears to be the first to report live turtles in west-central Nevada (in the greater Reno area) and he stated that the turtle had been an inhabitant for many years but was apparently overlooked by all record compilers. He described observations and one capture (but the animal escaped) from three counties of westernmost Nevada. He reported that there was the possibility that the turtle spread naturally from its ancestral home in adjacent California but he concluded that it would seem that this species was the first reptile to be introduced to the State. Banta (1963) suggested that the occurrence of this species in western Nevada is not the result of introductions but that it had probably occurred there for a much longer period of time.

Isolated populations of *A. marmorata* were reported from the Carson and Truckee rivers in western Nevada (Holland, D.C. 1994. The Western Pond Turtle: habitat and history. Final Report DOE/BP-62137-1. U.S. Department of Energy, Bonneville Power Administration, Portland, Oregon. 302 p. Available at: https://pisces.bpa.gov/release/documents/DocumentViewer.aspx?doc=62137-1 [Accessed 4 February 2017]), and were probably the result of introductions earlier (Cary 1889). Jennings and Hayes (1994) mentioned these two sites and the Humboldt River (based on Cooper 1863; LaRivers 1942) and then stated that these records may represent historical remnants, recent introductions, or a combination of introductions and historical remnants. Bury and Germano (2008) reported an isolated population in the Carson River in Nevada, yet stated that records in western Nevada are likely turtles originally imported as a source of human food (Cary 1889).

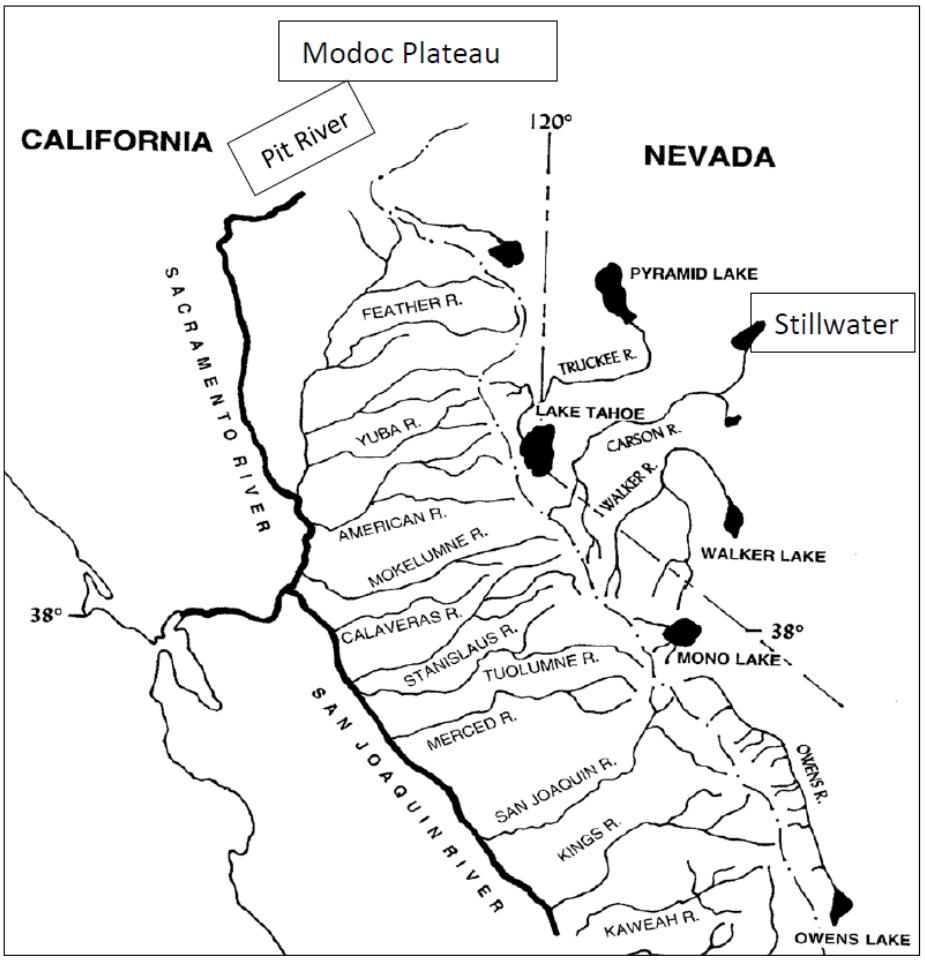

Figure 1. Surface drainage of rivers emanating from the Sierra Nevada, California and Nevada (cropped from Benson et al. 2002; addition of new geographic names are in boxes).

Many observations and captures in western Nevada have occurred in recent decades. Barela and Olson (2012, 2014) compiled data from many organizations and state data bases. They reported approximately 15 discrete sites (500-m apart) in western Nevada and indicated that introductions were suspected. Here, I summarize known records based on fossil, archaeological, and historic and recent evidence from descriptive accounts, agency reports, and published literature. I did an online search of key words. Further, I attempted to identify the origins of Nevada turtles by using a comparative approach with the biogeographical patterns of the regional biota, including herpetofauna and other aquatic taxa.

Methods

I used several sources of information to denote the distribution of the Western Pond Turtle in Nevada, northeastern California, and southeastern Oregon. I searched online for museum records at the California Academy of Sciences (CAS) and CAS-Stanford series (CAS-SU); Museum of Vertebrate Zoology (MVZ), University of California at Berkeley; and the ARCTOS database (online museum collections available at: https://arctosdb.org/ [Accessed 30 March 2017]). I received many locations from the Biogeographic Data Branch, California Department Fish and Game (CDFG): BIOS (California BIOS 2017. Available at: https://www.wildlife.ca.gov/Data/BIOS [Accessed 3 May 2017]); and the California Natural Diversity Database (CNNDD). 2017. Available online at: https://www.wildlife.ca.gov/Data/CNDDB [Accessed 3 May 2017]). I obtained other records by contacting the Nevada Department of Wildlife, Nevada Nature Conservancy, Bureau of Land Management, and some regional biologists (long-time residents). Observations and reports are taken at face value (i.e., there was no way to verify identifications). Then, I did an online search for literature and other records using these key words: Western Pond Turtle as the main key word with Nevada, California, Fossil, or Archeology in association.

Results

Fossil records.—An ancestor of *A. marmorata* has existed in the western United States since at least the late Pliocene (Hay 1908). Brattstrom and Sturn (1959) described a fossil turtle (genus *Clemmys*), the prior

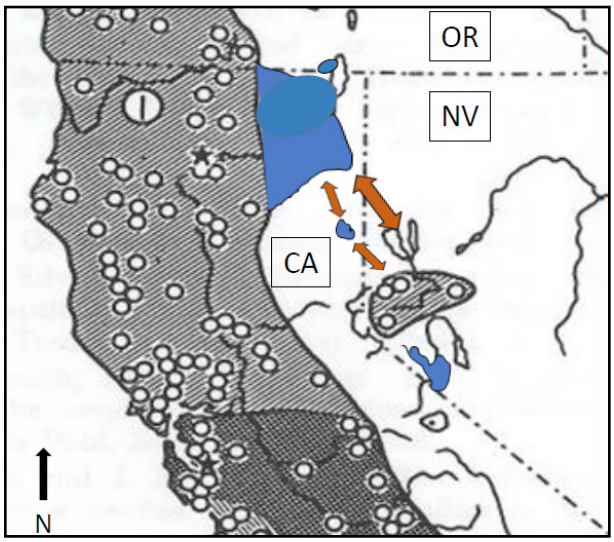

Figure 2. Distribution of the Western Pond Turtle (*Actinemys marmorata*) in western Nevada and adjacent northeastern California and southwestern Oregon (map base from Bury 1970). New areas of occurrence are shown in blue and possible directions of dispersal by turtles are indicated by arrows.

genus that included *A. marmorata*, from the Pliocene of Oregon. This turtle also occurred in the western parts of the Great Basin in Nevada, Oregon, and Washington in the Pleistocene (Brattstrom and Sturn 1959). Zug (1969) reported a fossil form, *Clemmys owyheensis*, in the upper Pliocene in Idaho that appears to be closely related to *A. marmorata*. He postulated that the Snake River, which now flows from Idaho west to the Pacific Ocean, was then in southeastern Oregon across northwestern Nevada to central California. Thus, the current Nevada population of *A. marmorata* may be a relict as its present distribution coincides with this old drainage pattern. The absence of turtles in the Columbian Plateau (Snake River) and the northern half of the Basin and Range Province appears to be of relatively recent occurrence, for *A. marmorata* or ancestors persisted in the surrounding areas and have been found in Plio-Pleistocene deposits of this region (Zug 1969).

Archaeological evidence.—There are many shells and artifacts of *A. marmorata* in caves and deposits used earlier by Native Americans. Hattori (1982) had radiocarbon dates from artifacts at Kramer Cave, Nevada, that were 3,900 to 3,620 B.P., which included basketry, dart foreshafts, juniper seed beads, marine shell ornaments, and 19 carapace and seven plastron fragments that represent at least eight individuals of *A. marmorata*. This location is in the northwestern edge of the Winnemucca Lake basin (see Benson et al. 2002), and due east of Modoc Co., California. Further, she reported three other archaeological sites on the western border of the Great Basin that had remains of this turtle: Tule Lake in northeastern California, where turtles occur today; and Marble Bluff in western Nevada (near Pyramid Lake); and a cave in the drainage basin of the Carson River. She concluded that these represented native origin of the turtle in western Nevada. However, other items (e.g., marine shells) reported by Hattori (1982) were being traded by North American natives. This suggests the potential of products (including turtles) being transported around the west.

Historical records (< 1980).—No turtles were mentioned in Nevada by early surveys conducted by Ruthven and Gaige (1915) in the Humboldt River region of north central Nevada, across western North America (Van Denburgh 1922), and statewide (Linsdale 1940). Seeliger (1945) examined geographic variation in *A. marmorata*, but showed none from Nevada or northeastern California. I found no preserved specimens for Nevada or adjacent northeastern California and southeastern Oregon in museum collections. LaRivers (1942) had a captured turtle but it escaped. Thus, to my knowledge, evidence of Western Pond Turtles in this region is not based on any specimen(s) in the historical period.

Still, this turtle has occurred in high desert areas and plateaus to the northwest of Nevada records (Fig. 2). I found specimens taken earlier at Klamath Falls, Klamath County, Oregon, collected in June 1894 (CAS-SU 2735-36) and September 1909 (CAS 20160), and in Siskiyou County, California, at Gazelle in June 1917 (CAS 43581-87) and at Klamath Lake, June 1918 (CAS 44271-73). These are all at elevations of approximately 1,250 m. They are barely into the Great Basin province yet records were present early in our knowledge base. The region seems to be overlooked as turtle habitat. In part, the weather is cold in winter with average minimum temperatures below freezing for 5–6 mo of the year (Western Regional Climate Center, Monthly Climate Summary, Klamath Falls, http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?or4506 [Accessed 8 May 2017]). Yet, there are warm to hot summers in this high desert setting and these conditions allow viable populations of turtles (see Bury et al. 2010).

LaRivers (1962) stated that Fish Commissioner Cary in 1889 said "Believing the soils and waters of the State were adaptable to the growth of the eatable terrapin,… I therefore purchased one hundred and eighty and distributed them throughout the State." There is no indication of what species were released or of their continued existence. Further, La Rivers (1942) reported that residents of Carson mentioned turtles that were common in the Carson River in the past (> 50 y earlier). This site is approximately 40 km south of Reno, Nevada. He also reported six other sites in western Nevada, mostly along the Truckee River and Reno area (Table 1). Banta (1963) stated that Cooper (1863:120–121) remarked "… about *Actinemys marmorata* (= *Clemmys marmorata*), found within the great Utah Basin, in the Mojave River, and [I] have also heard of it near Carson Valley…" Hattori (1982) reported turtle remains at a

Table 1. List of museum specimens, observations, and reports of the Western Pond Turtles (*Actinemys marmorata*) in Nevada. Records are listed from north to south.

County / Location	Type of Data	Year	Source / citation
Washoe County (vicinity of Reno)			
Truckee River between Reno and Sparks	Caught, escaped		La Rivers 1942
South of Truckee River, between Reno and Sparks, near Wadsworth	Observed		La Rivers 1942
Wadsworth Slough (= Washoe slough), on the east side of Truckee River, 5 mi N of Wadsworth	Observed		La Rivers 1942
Truckee River, a mile east of Sparks	Observed		La Rivers 1942
Reno, Truckee River	Observed	1940–41	Banta 1963
Truckee River	One reported	1987	Panik and Barrett 1994
Vista	Unclear	1940	Nevada Bureau of Land Management
Douglas County			
Wally Hot Springs, 2 miles S of Genoa	Eight caught, released		La Rivers 1942
Walley's Hot Spring 38º 58' 56.19" N, 119º 49' 46.09" W	Two disarticulated skeletons	1987–88	CAS 260502, 260600 Coll.: D.C. Holland
Genoa Lane, 1.1 me E of Genoa 38º 59' 55.42" N, 119º 49' 36.72 W	Three disarticulated skeletons	1987	CAS 260503–505 Coll.: D.C. Holland
David Walley Resort, Carson River	Observed	2011	Duana R. Petite, pers. comm.
Kirman Field, a few miles downstream from Walley Resort	Observed	2011	" " " "
Carson River	Reports		Banta 1963
Carson River, 1–5 mi. E of Deer Run Bridge (4 sites)	Captures, release		Holland, unpubl. report; Holland (1994 *op. cit*.)
Carson River 38.9913N, 119.8240W	Genetic tissue		Spinks and Shaffer 2005
Carson River 39.2372N, 119.5879W	Genetic tissue		" " "
Minden	Observed	1997	BLM files
Lyon County (Walker River)			
Carson River, River Run Road bridge 39.08675, -119.75207	Genetic tissue		Spinks et al. 2014
West Walker River	Observed		Holland 1994, *op. cit.*
Churchill County (Lahontan Valley)			
Fallon	Observed		La Rivers 1942
Fallon	Report (see above)		Bury 1970
Fallon	Caught: pet	2011	William Henry, pers. comm..
Lahonton Mountains	Observed	1940	BLM files

Chinese settlement at Lovelock occupied from the 1890s to the 1930s but the source of the turtles was not known.

Recent evidence (≥ 1980).—*Southeastern Oregon*. Holland (1994 *op. cit*.) reported on two turtles taken and released by others at Drewes Creek (1,434 m elevation) on the west side of Goose Lake in the southwest corner of Oregon. This is the easternmost record in Oregon. The site is shown as one dot on a distribution map (Holland 1994 *op. cit*.). There is a disarticulated skeleton of one turtle (CAS 260595; 4 September 1988; D.C. Holland) from Pankey Reservoir, Klamath County, Oregon, 58 km east southeast of Klamath Falls (city) at an elevation of 1,437 m.

Northeastern California.—Holland (1994:81 *op. cit*.) reported turtles as extant populations based on verified sightings in northeastern California at Susanville and the northwest corner of Lassen County, and one just across the county line in Modoc County. He indicated an extinct population in the northwest corner of Modoc County. These records appear to be included in Jennings and Hayes (1994), who show eight sites in the plateau area of northeastern California with two records each in northeastern Siskiyou County, Modoc County (northeast corner of state), Lassen County just to the south, and just to the west in the corner of Shasta County (Table 2).

Eagle Lake in Lassen County is a large lake and wetlands, but has had no turtle sightings over a 21-y period (Jay Bogiatto, pers. comm.). Buskirk (1985) reported three nearby localities for Modoc County including Ash Creek Wildlife Area, and Buskirk (1990) observed four basking turtles in the Pit River at Pittville,

Table 2. List of museum specimens, observations, and reports of the Western Pond Turtles (*Actinemys marmorata*) in California. Records are listed from north to south.

County / Location	Type of Data	Year	Source / citation
Modoc County			
Ash Creek, 2 km W Adin	Eight observed		Buskirk 1985
Northwest corner	One "		Jennings and Hayes 1994
Upper Pit, Willow Creek 1275 m; -120.96896, 41.19332	Eight "		CNNDB
On border with Lassen Co., Upper Pit, Parker Creek 1352 m elev.; -120.482, 41.51635	One "		"
Upper Pit, Pine Creek 1319 m elev.; -120.517, 41.4579	One "		"
Modoc National Wildlife Refuge 1,329 m elev.; -43258.83, 382434.36	One "		CDFG BIOS record
North Fork Pit River 1,352 m elev.; -40308.54, 388900.64	One "		" " "
Bayley Reservoir 1,575 m elev.; -53396.98808, 361306.3609	One "		" " "
Ballard Reservoir 1,416 m elev; -68744.02608, 375030.9769	One "		" " "
Shasta County			
Ahjumawi Lava Springs State Park Horr Pond and Big Lake, 1008 m elev.	Egg shell fragments		Calif State Parks Dept. (sent to RB Bury)
Tule R. at Fall River Mills.	Three caught	1988	CDFG Scientific Permit Annual Report (D.C. Holland)
Lassen County			
Pit River at Pittville	Six observed; three photographs	1988	Buskirk 1990
Susan River (on border with Modoc Co)			CDFG Species of Concern, Thomson et al. 2016
Susanville			Holland 1994 *op. cit.*; Jennings and Hayes 1994
Deep Cut Creek, Honey-Eagle Lakes 1218 m elev.; -37950.80208, 251563.0859			Frank Hall, CDFG BIOS Record

in Lassen County and reported that a local rancher said that turtles had become scarce over the years. Another record was near Honey Lake, closer to the Nevada line, but it is likely a release.

Jennings and Hayes (1994) showed two records each for Modoc, Lassen, and easternmost Shasta counties. The two in Modoc County are in the northwest corner (now labeled extinct) and one on the border to the south with Lassen County. One record is in northwestern Lassen County, and the other is Susanville in south central Lassen County. Records that I compiled include 22 sites for the same region: eight in Modoc County, two in Lassen County, and 12 in easternmost Shasta County (Table 2). Recently, many of these sites in northeastern California are shown in Bury and Germano (2008), Barela and Olson (2012, 2014) and Thomson et al. (2016).

Western Nevada.—Bury (1970) showed four sites in the Truckee and Carson River basins (see Fig. 2) based on published literature (LaRivers 1942; Banta 1965a,b). The only recent reports in Nevada appear to be Holland (1994 *op. cit.*), who noted them in the Truckee, Carson and Walker rivers, Nevada. He suggests these are probably introductions.

Records that I received from the Nevada Department of Wildlife included two field efforts at multiple sites. First, Dan Holland (unpubl. report) listed them at four sites east of Deer Run Bridge, Carson River, Carson City County, Nevada. He noted them as abundant at the first site. Further, he reported turtles from 1.6 km east of Genoa along the Carson River, and from Walley's Hot Springs, Douglas County, Nevada. Three were saved as disarticulated skeletons (Table 1). He noted them as common at both sites. In 2001–2003, Elizabeth Ammon (unpubl. report) reported turtles at several sites: two adults at "FJ7," a marsh in Washoe County; 11 adults at McCarran (ranch), Storey County; and four at Irrigation slough, Douglas County. Recently, Enders and Jones (Enders, M., and J. L. Jones. 2017. Habitats, home ranges, and demographics of the Western Pond Turtles in Nevada's Carson River. Abstract of The Western Section of The Wildlife Society. Available at: http://tws-west.org/events/2017/2017_abstracts_by_session.pdf [Accessed 7

July 2017]) reported catch, mark, and release of many turtles (> 50) in the Carson River as part of an ecological study on the species.

The Carson River empties into Stillwater Lake and wetlands around Fallon, some 40+ km east of Genoa. General surveys in the Fallon area since 1989 have revealed one *A. marmorata*, and it was thought to be an escaped pet (William Henry, pers. comm.). He stated that recent archaeological work there did not show them present earlier. The Truckee River empties into Pyramid Lake (35 km and more northeast of Reno), which may be too alkaline for turtles (John Mosley, pers. comm.).

In Nevada, Holland (1994 *op. cit*.) showed the turtle as extinct (i.e., no sightings) at three sites along the Truckee River (two in Washoe County and in western Churchill County). He considered the turtle in Nevada to now be confined to only the Carson River, Douglas and Washoe counties, and present in low densities. Still, he captured 20 turtles and sighted 40 turtles in an estimated 30+ h of visual and snorkeling surveys over a two-year period. Holland (1994 *op. cit*.) showed one location in a more southern water: Walker River, Lyon County. He reported the elevational range as up to 2,048 m in California but the species is uncommon anywhere above 1,529 m. Holland (1994 *op. cit*.) showed the presence of the turtle in Pine Nut Creek (half way between the Carson and Walker rivers), Nevada, and at Susanville (elevation 1,276 m), California, 120 km north northwest Reno (elevation 1,375 m). The latter is also depicted in CaliforniaHerps.com (http://www.californiaherps.com/turtles/pages/a.m.marmorata.html). Tissue samples were taken and later analyzed for genetic variation in the turtle (see Spinks and Shaffer 2005; Spinks et al. 2010).

Bury (1970) showed four localities for the species in the region around Reno, Nevada. The California Natural Diversity Data Base shows occurrence in high plains of northeast California: Modoc County at five sites; northeast portion of Shasta County at 11 sites; and Lassen County at one site. Barela and Olson (2012, 2014) showed six sites in western Nevada and five along the Pit River extending onto the Modoc plateau in the northeast corner of California.

Biogeographic Patterns

Several other taxa extend from California or Oregon into west central Nevada. Linsdale (1940) noted the occurrence of two garter snakes (*Thamnophis elegans* and *T. infernalis*) that barely enter central western Nevada (both in the Truckee and Carson rivers) from adjacent California. Rossman et al. (1996) reported that the Sierra Garter Snake (*Thamnophis couchii*) occurred from the south side of the Pit River, in northeastern California, through the west side of the Sierra Nevada and extending eastward through the Lake Tahoe region to the Truckee and Carson rivers, Nevada. They also showed isolated populations southeast of the Carson River, Nevada, and the Owens Valley in extreme eastern California. They occur up to 2,438 m elevation. Further, the Western Terrestrial Garter Snake (*T. e. elegans*) ranges from southern Oregon to central California. It extends east into the Reno area of western Nevada.

Zug (1969) also pointed out that other aquatic animals such as mollusks (see Taylor 1966) and fish (see Miller 1965) show an affinity between faunas of southern Idaho and central California. This has led to the postulation of a different drainage pattern for the Snake River during the Pliocene and most of the Pleistocene. The course of the river was then across southeastern Oregon and northwestern Nevada to central California (current route is across the north boundary of Oregon). Thus, the Nevada population of *A. marmorata* may be a relict as its present distribution coincides with an old drainage pattern.

In the late Pleistocene to fairly recently, there were vast interior lakes from basins that have mostly become dry in recent times (Reheis et al. 2002; Adams et al. 2008). La Rivers (1962) reported that Lake Lahonton (mostly in Nevada) had its maximum stage 65,000 y ago, and its greatest depth was 270 m in the basin now occupied by Pyramid Lake northeast of Reno, Nevada. The fish fauna of the now isolated Lahonton System most likely was from the Klamath Lake (southern Oregon/northern California) region to the northwest. This region is today covered widely and deeply with lava flows which have obliterated whatever evidence might have existed as proof for these connections.

Moyle (2002) described an ancestral fish fauna that was part of a widespread western fauna that became fragmented through the complex geologic activity. The Pit River in the northeastern corner of California (see Fig. 1) was part of the ancestral upper Klamath drainage, which connected to a large river flowing from the Great Basin. Just prior to its divorce from the Klamath drainage, the Pit drainage included one of more lakes containing fishes similar to those that now live in the Klamath Lakes of Oregon (and large lakes of the Great Basin). He reported that the Eagle Lake region in northeastern California was a large terminal lake that once drained into Lake Lahonton in Nevada. It contains an endemic subspecies of rainbow trout (only rainbow trout native to the Great Basin), whose ancestors presumably crossed one of the low divides separating the Eagle Lake drainage from the Pit River. The Lahonton basin on the east side of the Sierra Nevada has inflows, from north to south: Susan, Truckee, Carson, and Walker rivers. During the Pleistocene, these basins all drained into Lake Lahonton (northern Nevada) and Honey Lake (northeastern California).

Discussion

Although unknown in historical times (before 1980), many new records of *A. marmorata* are now known in

plateau areas of northwestern California (Fig. 2.). There are many turtles in the Klamath Lake basin at 1,220 m elevation (Bury and Germano 2008; Barela and Olson 2012). They appear common along the Pit River in northeast California, and range eastward up the Pit River to the Modoc Plateau. Moreover, the increase in number of sites is combined with knowledge of large populations in high desert waters (Bury et al. 2010). Still, no one has conducted a mark/recapture study or other surveys to estimate their population sizes in the Modoc Plateau region. There are moderately high passes between the Pit River, the Modoc Plateau of California and those in the old Lahonton Lake region of Nevada. One pass north of Susanville along Highway 395 is at 1,609 m elevation and another pass between the Modoc Plateau and basins to the east in northern Nevada is 1,675 m elevation.

Spinks et al. (2010) showed that the northern clade of *A. marmorata* occurred west of the Sierra Nevada in northern California with two eastern out-pockets. One arm (only two sites) of the clade extends somewhat east along the Pit River in northeastern California. They showed a connection from the Sacramento region of central California eastward to west-central Nevada. This is the route of Interstate 80 between Sacramento, California, and Reno, Nevada, going over Donner Summit at 2,160 m elevation. This is the shortest distance between turtle sites in the foothills of the Sierra Nevada and Sacramento Valley to west-central Nevada.

However, there is less of an elevational barrier (585 m difference) across the mountain ranges of northeastern California into northern Nevada. Thus, I suggest that turtles most likely dispersed from the Pit River-Modoc Plateau (northeast California, southeast Oregon) around the northern end of the Sierra Nevada rather than from the Sacramento Valley, in central California, eastward over Donner Summit (Fig. 2). There is the possibility that, in the past, turtles dispersed from western and other parts of Nevada westward through this northwest passage route. If so, some turtles in Nevada may be relicts of the species. Further, other taxa (molluscs, fishes, and garter snakes) appear to have dispersed across the northern route into western Nevada.

There are now approximately 15 localities for the Western Pond Turtle in western Nevada. However, some of these records are repetitive (i.e., same observation counted over) or obscure locations. Until recently, turtles were not captured and marked, so there is the potential to observe or report the same individual(s) more than once. Moreover, lists of occurrences appear to rely on earlier records with imprecise data and locations often were poorly defined (e.g., is a reported record at a kilometer east of Sparks measured from the edge of town or the post office?). Reported locations likely represent occurrence along the linear waterways, so represent members of a population and not discrete entities. With these caveats in mind, I suggest it is best to consider turtles frequenting three rivers along the east sides of the Sierra Nevada in west-central Nevada.

Because of few recent observations, the species appears to be scarce in the Truckee River (Reno area downstream to Pyramid Lake). The turtle appears to be numerous in parts of the Carson River (Holland 1994 *op. cit*.; Enders and Jones 2017 op cit.). Only one site exists to the south on the Walker River, but extensive wetlands there need further searches. In general, it is now known that the turtle is limited to three rivers along the eastern flanks of the Sierra Nevada in west-central Nevada.

Better determination of the origin of Nevada turtles awaits further genetic analyses that are currently underway (see Spinks et al. 2014) and other studies. Although different authors have proposed native or introduced status of the turtle in western Nevada, I believe it is now a mix, even if turtles have been native in the past. This turtle has been moved around by people. Earlier, Storer (1930) reported that automobile travelers are prone to pick up animals like turtles and transport them. Further, he stated that important extensions of range henceforth must be very well authenticated. Caution is needed for results with just a few turtles or only a couple of sites are recorded because these may be mixed stocks (native, introduced).

Recently, biologists with the Nevada Department of Fish and Wildlife have caught, marked and released many turtles in the Carson River (Enders and Jones 2017 op cit.). Still, it will continue to be a struggle to determine the origin of turtles if basic distribution and abundance data in the other wetlands are lacking. Further, the level of knowledge is thin on the geographic variation of resident turtles. Despite all the work and papers to date, many are anecdotal or unpublished reports (gray literature). To my knowledge, there is not one preserved specimen of *A. marmorata* for Nevada. I do not call for collecting specimens as much as better reporting of accurate measurements and close-up photography of animals that can be done on live turtles. Any shells or other material needs to be collected as museum vouchers. Such information (e.g., morphometrics) would greatly complement the on-going studies of genetic variation in the species.

In conclusion, current evidence indicates several areas of occurrence of *A. marmorata* in high desert waters (> 1,200 m elevation) and a much wider distribution than known earlier, especially in northeastern California. There is evidence of *A. marmorata* present as fossils (see Zug 1969) and in archaeological sites (see Hattori 1982) in the western Great Basin. Mountain passes are as low as 1,610 m between northeastern California and Nevada. Although it appears a short geographic distance, dispersal of turtles over the central Sierra Nevada at Donner Pass entails crossing over 2,160 m elevation, likely an impassable barrier. Alternatively, I propose that the most likely route for natural dispersal of

turtles between eastern California and western Nevada was around the north end of the Sierra Nevada (585 m lower elevation). As such, this corridor would serve as a regional Northwest Passage.

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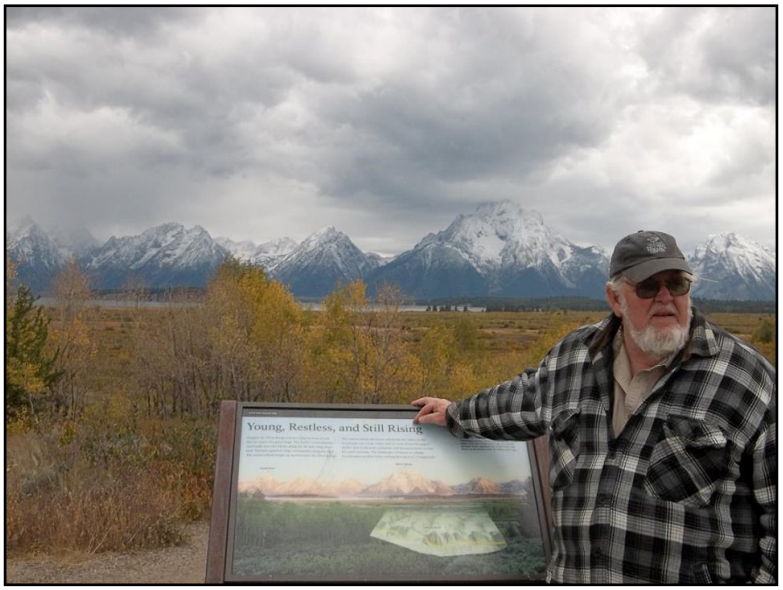

R. Bruce Bury is an Emeritus Scientist, U.S. Geological Survey, Corvallis, Oregon (earlier in Research Division, U.S. Fish and Wildlife Service). He has studied the biology of the Western Pond Turtle since penning his first published note on the turtle in 1963. Later, he studied its ecology for his Ph.D. dissertation at the University of California, Berkeley. In 1972, he was hired as the first full-time herpetologist by U.S. Fish and Wildlife Service, which entailed work at the National Museum of Natural History, Washington, D.C. After 5 y, field interests lead to a transfer to Colorado (for 18 y) and then back to his native Pacific Northwest. Bruce is still publishing papers and now is up to 175 titles. He is currently the Editor-in-Chief of *Herpetological Conservation and Biology*. (Photographed by Gwen Bury).