

NOTES

OCCURRENCE OF A COLONIAL PROTOZOAN ON THE WESTERN POND TURTLE, *CLEMMYS MARMORATA*

David J. Germano

Department of Biology, California State University, Bakersfield, California 93311, USA

Email: dgermano@csubak.edu

A variety of organisms are associated with aquatic turtles. Leeches (*Placobdella* spp.) are known to afflict *Chelydra serpentina* (Brooks et al. 1990; McAuliffe 1977), *Sternotherus depressus* (Dodd 1988), *Graptemys geographica* (Saumure and Livingston 1994), *Emydoidea blandingii* (Saumure 1990), *Clemmys insculpta* (Brewster and Brewster 1986; Farrell and Graham 1991; Hulse and Routman 1982; Koffler et al. 1978), *Chrysemys picta* (Ernst 1971; MacCulloch 1981), and *Pseudemys scripta* (Hendricks et al. 1971), usually attaching to the skin of appendages. Sarcophagid fly larvae infest *Clemmys muhlenbergii* (Beane and Zappalorti 1997) and *Chrysemys picta* (Chidester 1915), and temnocephalid turbellarian worms have been found attached to *Hydromedusa maximiliani* (Ernst and Lovich 1996). Besides these ectoparasites, algae sometimes occurs on the shell of aquatic turtles (Edgren et al. 1953; Neill and Allen 1954; Pope 1939), sometimes becoming extremely thick (Reilly 1983), and barnacles have been found on the skin of *Dermochelys coriacea* (Ernst et al. 1994). The peritrich protozoan, *Opercularia* sp., has also been found as a commensal on the plastron of *Sternotherus odoratus* (Reilly 1983).

The western pond turtle, *Clemmys marmorata*, occurs from northern Baja California to southern Washington, and along with the painted turtle, *Chrysemys picta*, is the only native turtles on the entire Pacific coast (Jennings and Hayes 1995; Stebbins 1985; Storer 1930). Although much reduced, the Central Valley of California once was

home to a large concentration of *C. marmorata*. This species now occurs in disjunct shallow water habitats on the valley floor. Here I report on the occurrence of a colonial protozoan in a population of *C. marmorata* in the southern San Joaquin Valley of California.

STUDY SITE AND METHODS

I have been studying a population of *Clemmys marmorata* at Goose Lake, Kern County, California since 1995. Habitat for turtles at Goose Lake consists of large earthen canals with permanent water as well as seasonal marshes to open-water habitat in the old lake bed. Much of the surrounding land is cultivated for agriculture, but there is a small amount of degraded saltbush shrub (*Atriplex* spp.) habitat on the fringes of the old lake bed. Turtles were captured only in the marsh and open-water habitat using wire-mesh funnel traps, and were taken back to the laboratory for measurement. Since 1996, I had noticed that some turtles had a brownish-tan gelatinous coating that covered soft parts and sometimes portions of the plastron. In many turtles that had this coating, the coverage was minor, but in a few individuals most of the soft parts and much of the plastron were covered (Fig. 1). Although gelatinous when wet, I found that the coating could be blotted dry with a paper towel and could be rubbed off with some effort. In 1998, I noted all turtles that carried this gelatinous coating and I had a specimen identified by a protozoologist.

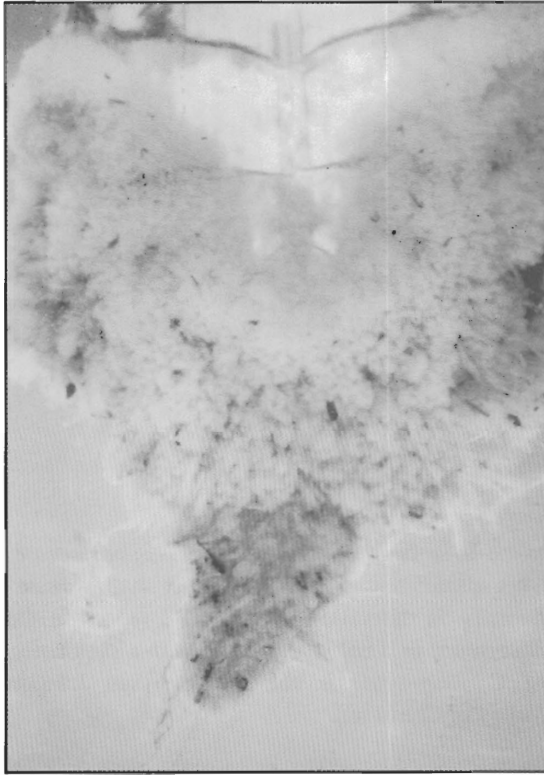


Figure 1. Heavy infestation of *Epistylis niagarae* on the plastron of a western pond turtle, *Clemmys marmorata*, in the southern San Joaquin Valley, California

RESULTS AND DISCUSSION

The coating on *Clemmys marmorata* at Goose Lake consisted of colonies of the protozoan, *Epistylis niagarae* (Fig. 2). *Epistylis niagarae* is a peritrichean ciliate that exists on the end of stalks (Jahn et al. 1979). This species usually exists in colonies of 40–50 individuals, and each individual has an expanded body about 160 μm long with a prominent peristomal ring (Kudo 1966). Of the 156 *C. marmorata* I captured in 1998, 18.6% had colonies of *E. niagarae*, and the percentage of turtles with colonies was more than four times greater after 1 July than before this date (Table 1). Of the 29 turtles that carried *Epistylis niagarae* in 1998, most had a light infestation, but I considered 17.3% to be heavily covered (Fig. 3).

Peritrich ciliates are found as commensals on a variety of aquatic organisms (Jahn et al. 1979; Lom 1973; Sprague and Couch 1971), and several species

in the genus *Epistylis* have been found to occur on the surface of freshwater fish (Hazen et al. 1978; Lom 1966, 1973), on the gills of crawfish (Bishop and Jahn 1941; Vogelbein and Thune 1988), and on several species of turtles (Bishop and Jahn 1941). *Epistylis niagarae* is known to occur on *Chrysemys picta* and *Chelydra serpentina* (Bishop and Jahn 1941). Colonies of *E. niagarae* do not seem to have a negative effect on *Clemmys marmorata*. I have often had to remove this protist from part of the plastron so that I could record annuli dimensions. I have never seen any effects to the shell. I also found one turtle in the spring of 1998 without any infestation that had a moderate infestation in 1997. No damage to its shell or skin was apparent.

The greatest chance of harm by these organisms could be to very young turtles rather than older turtles because of their small size. It is possible that infestations on young turtles could interfere with foraging. In July and August 1998, I caught 18 turtles in their first year of life (< 90 mm carapace length), half of which had infestations of *E. niagarae*. I used ANCOVA to test for differences in mass between those turtles infested and those that were not. No differences were found between groups (slopes: $F_{1,14} = 2.079$, $P = 0.177$; elevations: $F_{1,15} = 0.38$, $P = 0.553$). Also, no shell or skin damage was apparent.

Peritrich ciliates, such as *Epistylis niagarae*, are commonly found in mesotrophic and eutrophic

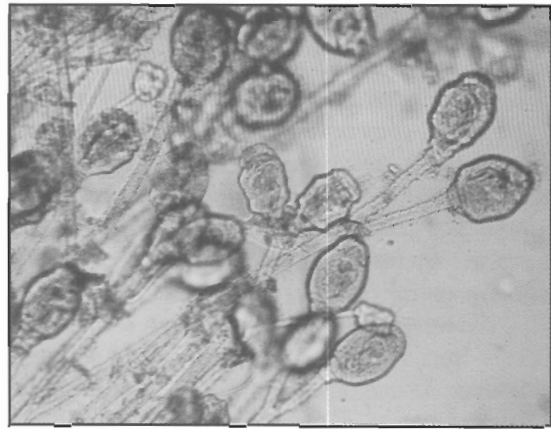


Figure 2. The colonial protozoan, *Epistylis niagarae*, found on the undersurface of some western pond turtles, *Clemmys marmorata*, in the southern San Joaquin Valley, California.

TABLE 1. Occurrence of *Epistylis niagarae* in 1998 on *Clemmys marmorata* at Goose Lake, Kern County, California.

	Turtles with <i>E. niagarae</i>	Total Number of Turtles	Percent Occurrence
Whole Year	29	156	18.6 %
Before 1 July	6	82	7.3 %
After 1 July	23	74	31.1 %

lakes where they filter feed on small particles and bacteria (Laybourn-Parry 1992). They require a firm substrate for attachment. Infestation of *E. niagarae* on *C. marmorata* may be limited to shallow water habitat of the Central Valley. The Central Valley of California can be exceedingly warm in the summer, and coupled with shallow water habitat, provides warm water for *C. marmorata* for many months. I have caught turtles in much of the species' range and have only found this colonial protozoan at three sites in the San Joaquin Valley

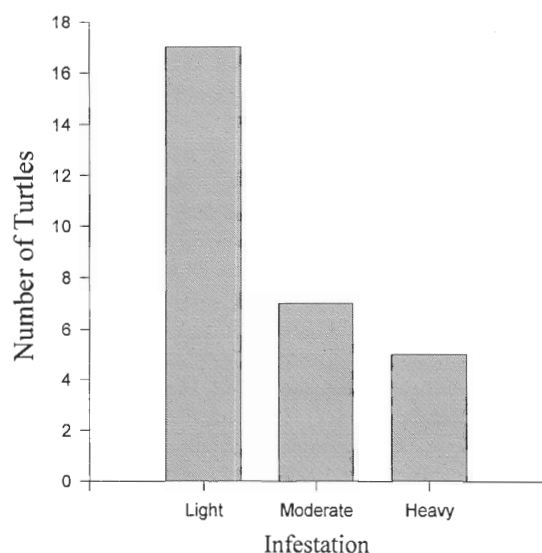


Figure 3. Number of *Clemmys marmorata* with light, moderate, or heavy infestations of the colonial protozoan, *Epistylis niagarae*, in 1998 at Goose Lake, Kern County, California. A light infestation was if colonies occurred on soft parts and < 10% of the plastron of a turtle; moderate infestation was if colonies occurred on soft parts and 10–25% of the plastron; and a heavy infestation was if colonies occurred on soft parts and > 25% of the plastron.

(Table 2). Covering of skin and shell by brown, gelatinous material (probably colonial protozoans) also has been seen on *C. marmorata* and on a variety of non-native turtles in Davis, California (J. Crayon, pers. comm.), which is also on the valley floor. In most of the rest of this species' range, turtles occur in fairly cool waters, which may be too cool to support colonies of *E. niagarae*. Also, I have found *E. niagarae* only on the undersurface of turtles. In contrast, algae that grow on turtles are found disproportionately on the carapace (Edgren et al. 1953). I have found green algae growing on the carapace of western pond turtles at several sites in the Sacramento Valley of California (Table 2). Unlike algae, I suspect that this protozoan cannot tolerate the extreme drying that occurs on the carapace of *C. marmorata* when the turtle basks in the sun. Most turtles may not bask long enough for the plastron and limbs to become completely dry.

ACKNOWLEDGMENTS

I thank G. Clark for identifying the colonial protozoan found on western pond turtles from Goose Lake. I also thank T. Weinheimer and L. Wells for their enthusiasm with the identification of the protozoan. T. Weinheimer read an earlier draft and made helpful comments. This study was carried out with a California scientific permit.

LITERATURE CITED

- Beane, J.C. and R.T. Zappalorti. 1997. *Clemmys muhlenbergii* (bog turtle). Parasitism. Herpetol. Rev. 28:148–149.
- Bishop, E.L., Jr. and T.L. Jahn. 1941. Observations on colonial peritrichs (Ciliata; Protozoa). Proc. Iowa Acad. Sci. 98:417–421.

Table 2. Rate of occurrence of symbiotic organisms on *Clemmys marmorata* at six sites in the Central Valley of California in 1998 (Goose Lake) and 1999 (other sites). Numbers in parentheses are percentages of total turtles at a site carrying the symbiont.

Site	Total Captured	Number with Symbiont	
		<i>Epistylis niagarae</i>	Green Algae ¹
Goose Lake	156	29 (18.6%)	0
Hanford Waste. Treat. Plant	8	4 (50%)	0
Fresno Waste. Treat. Plant	77	15 (19.5%)	0
Dry Creek	46	0	0
Five-Mile Slough	123	0	0
Sacramento refuges	21	0	7 (33%)

¹unidentified to species

- Brewster, K.N. and C.M. Brewster. 1986. *Clemmys insculpta* (wood turtles). Ecotoparasitism. Herpetol. Rev. 17:48.
- Brooks, R.J., D.A. Galbraith, and J.A. Layfield. 1990. Occurrence of *Placobdella parasitica* (Hirudinea) on snapping turtles, *Chelydra serpentina*, in south-eastern Ontario. J. Parasitol. 76:190–195.
- Chidester, F.E. 1915. Sarcophagid larvae from the painted turtle. J. Parasitol. 2:48–49.
- Dodd, C.K., Jr. 1988. Patterns of distribution and seasonal use of the turtle *Sternotherus depressus* by the leech *Placobdella parasitica*. J. Herpetol. 22:74–81.
- Edgren, R.A., M.K. Edgren, and L.H. Tiffany. 1953. Some North American turtles and their epizootic algae. Ecology 34:733–740.
- Ernst, C.H. 1971. Seasonal incidence of leech infestation on the painted turtle, *Chrysemys picta*. J. Parasitol. 57:32.
- Ernst, C.H. and J.E. Lovich. 1996. *Hydromedusa maximiliani* (Maximilian's snake-necked turtle). Epizootic commensal. Herpetol. Rev. 27:76–77.
- Ernst, C.H., J.E. Lovich, and R.W. Barbour. 1994. *Turtles of the United States and Canada*. Smithsonian Institution Press, Washington, D.C.
- Farrell, R.D. and T.E. Graham. 1991. Ecological notes on the turtle *Clemmys insculpta* in northwestern New Jersey. J. Herpetol. 25:1–9.
- Hazen, T.C., M.L. Raker, G.W. Esch, and C.L. Fliermans. 1978. Ultrastructure of red-sore lesions on large-mouth bass (*Micropterus salmoides*): association of the ciliate *Epistylis* sp. and the bacterium *Aeromonas hydrophila*. J. Protozool. 25:351–355.
- Hendricks, A.C., J.T. Wyatt, and D.E. Henley. 1971. Infestation of a Texas red-eared turtle by leeches. Texas J. Sci. 22:247.
- Hulse, A.C. and E.J. Routman. 1982. Leech (*Placobdella parasitica*) infestations on the wood turtle, *Clemmys insculpta*. Herpetol. Rev. 13:116–117.
- Jahn, T.L., E.C. Bovee, and F.F. Jahn. 1979. *How to know the protozoa*. Wm. C. Brown, Dubuque, Iowa.
- Jennings, M.R. and M.P. Hayes. 1994. *Amphibian and Reptile Species of Special Concern in California*. California Department of Fish and Game, Final Report, Contract No. 8023, Rancho Cordova, California.
- Koffler, B.R., R.A. Seigel, and M.T. Mendonca. 1978. The seasonal occurrence of leeches on the wood turtle, *Clemmys insculpta* (Reptilia, Testudines, Emydidae). J. Herpetol. 12:571–572.
- Kudo, R.R. 1966. *Protozoology*. Charles C. Thomas, Springfield, Illinois.
- Laybourn-Parry, J. 1992. *Protozoan plankton ecology*. Chapman and Hall, London.
- Lom, J. 1966. Sessiline peritrichs from the surface of some freshwater fishes. Fol. Parasitol. 13:36–56.
- Lom, J. 1973. The mode of attachment and relation to the host in *Apiosoma piscicola* Blanchard and *Epistylis lwoffii* Faure-Fremiet, ectocommensals of freshwater fish. Fol. Parasitol. 20:105–112.

- MacCulloch, R.D. 1981. Leech parasitism on the western painted turtle, *Chrysemys picta belli*, in Saskatchewan. *J. Parasitol.* 67:128–129.
- McAuliffe, J.R. 1977. An hypothesis explaining variations of hemogregarine parasitemia in different aquatic turtle species. *J. Parasitol.* 63:580–581.
- Neill, W.T. and E.R. Allen. 1954. Algae on turtles: some additional considerations. *Ecology* 35:581–584.
- Pope, C.H. 1939. *Turtles of the United States and Canada*. Alfred A. Knopf, New York.
- Reilly, S.M. 1983. *Sternotherus odoratus* (Stinkpot). Algal relationships. *Herpetol. Rev.* 14:76.
- Saumure, R.A. 1990. *Emydoidea blandingi* (Blanding's turtle). Parasites. *Herpetol. Rev.* 21:60.
- Saumure, R.A. and P.J. Livingston. 1994. *Graptemys geographica* (common map turtle). Parasites. *Herpetol. Rev.* 25:121.
- Sprague, V. and J. Couch. 1971. An annotated list of protozoan parasites, hyperparasites, and commensals of decapod Crustacea. *J. Protozool.* 18:526–537.
- Stebbins, R.C. 1985. *A Field Guide to Western Reptiles and Amphibians*. Houghton Mifflin Company, Boston, Massachusetts.
- Storer, T.I. 1930. Notes on the range and life-history of the Pacific fresh-water turtle, *Clemmys marmorata*. *Univ. California Publ. Zool.* 32:429–441.
- Vogelbein, W.K. and R.L. Thune. 1988. Ultrastructural features of three ectocommensal protozoa attached to the gills of the red swamp crawfish, *Procambarus clarkii* (Crustacea: Decapoda). *J. Protozool.* 35:341–348.

