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LITERATURE CITED

- ANDERSON, A. H., AND A. ANDERSON. 1973. The Cactus Wren. Univ. Arizona Press, Tucson.
- BLAIR, R. H., AND B. W. TUCKER. 1941. Nest-sanitation. *Br. Birds* 34:206-215, 226-235, 250-255.
- HERRICK, F. H. 1900. Care of nest and young. *Auk* 17:100-103.
- LIGON, J. D. 1970. Behavior and breeding biology of the Red-cockaded Woodpecker. *Auk* 87:255-278.
- MAYFIELD, H. 1960. The Kirtland's Warbler. *Cranbrook Inst. Sci. Bull.* 40.
- MCNABB, R. A., AND F.M.A. MCNABB. 1975. Urate excretion by the avian kidney. *Comp. Biochem. Physiol.* 51A:253-258.
- MCNABB, F.M.A., AND T. L. POULSON. 1970. Uric acid excretion in pigeons, *Columba livia*. *Comp. Biochem. Physiol.* 33:933-939.
- MORTON, M. L. 1979. Fecal sac ingestion in the Mountain White-crowned Sparrow. *Condor* 81:72-77.
- NOLAN, V., JR. 1978. The ecology and behavior of the Prairie Warbler *Dendroica discolor*. *Ornithol. Monogr.* 26. American Ornithologists' Union, Washington, DC.
- PETIT, D. R., AND L. J. PETIT. 1987. Fecal sac dispersal by Prothonotary Warblers: Weatherhead's hypothesis re-evaluated. *Condor* 89:610-613.
- SAS INSTITUTE. 1985. SAS user's guide: statistics. SAS Institute, Cary, NC.
- SHOEMAKER, V. H. 1972. Osmoregulation and excretion in birds, p. 527-575. *In* D. S. Farner and J. R. King [eds.], *Avian biology*. Vol. 2. Academic Press, New York.
- SKUTCH, A. F. 1976. Parent birds and their young. Univ. Texas Press, Austin.
- STURKIE, P. D. 1976. Kidneys, extrarenal salt excretion, and urine, p. 263-285. *In* P. D. Sturkie [ed.], *Avian physiology*. Springer-Verlag, New York.
- TINBERGEN, N., G. J. BROEKHUYSEN, F. FEEKES, J.C. W. HOUGHTON, H. KRUK, AND E. SZULC. 1963. Egg shell removal by the Black-headed Gull, *Larus ridibundus* L.: a behavior component of camouflage. *Behavior* 19:74-117.
- WEATHERHEAD, P. J. 1984. Fecal sac removal by Tree Swallows: the cost of cleanliness. *Condor* 86:187-191.
- WEATHERHEAD, P. J. 1988. Commentary: adaptive disposal of fecal sacs? *Condor* 90:518-519.
- WELTY, J. C. 1982. *The life of birds*. Alfred A. Knopf, New York.
- WILLIAMS, L. 1952. Breeding behavior of the Brewer Blackbird. *Condor* 54:3-47.

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GREAT BLUE HERON DEATHS CAUSED BY PREDATION ON PACIFIC LAMPREY¹

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Key words: *Great Blue Heron*; *Ardea herodias*; *Pacific lamprey*; *Entosphenus tridentata*; *mortality*; *prey induced*.

Encounters between predator and prey commonly lead to the death of the prey species; accidental deaths of the predator are believed to be relatively rare. Here we report two cases of Great Blue Heron (*Ardea herodias*) mortality involving the Pacific lamprey (*Entosphenus tridentata*) in Alviso, California.

The Great Blue Heron is known for its diversity of diet, attacking almost any mammal, bird, fish, or invertebrate that stands a remote chance of being swallowed (Bayer 1978, Bent 1926, Palmer 1962). However, its ability to capture large and unwieldy prey has on more than one occasion led to the death of the heron. Frogs (Langdale 1897), carp (Ryder 1950), bullheads (Bent 1926), and snakes (Cottam 1938) have been involved in such deaths. To our knowledge the Pacific lamprey has not been previously recorded as a prey species of the Great Blue Heron.

Although diversity typifies the herons' feeding habits, they are mainly piscivorous. In a study conducted by Willard (1977) of the feeding habits of five species of herons, the Great Blue Heron consistently captured fish that were too large for the other heron species.

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TABLE 1. Characteristics of the Pacific lamprey found with Great Blue Herons, January 1988.

Characteristic	Date found	
	10 January	30 January
Body length (cm)	61.9	57.6
Circumference (cm)	13.6	13.4
Diameter (cm)	4.3	4.3
Weight (g)	510	410

On 10 January 1988, at 07:00 a dead Great Blue Heron was found lying next to a slough at the south end of the San Francisco Bay near the town of Alviso. A second dead Great Blue Heron was found on a Coyote Creek Riparian Station trail immediately adjacent to lower Coyote Creek where it flows into the San Francisco Bay on 30 January 1988 at 06:30. In both instances the tail of a large Pacific lamprey was found protruding slightly from the bill (Fig. 1). After photographs, the lamprey were removed from the herons and meristic data were taken (Table 1). The Pacific lamprey measured 57.6 and 61.9 cm in total length and are known to attain a total length of approximately 69 cm (McGinnis 1984). Fourteen stab wounds (three were completely through the body) were found in the head and gill region of the lamprey found on 10 January

and 16 stab wounds were found in the head and gill region of the lamprey found on 30 January (Fig. 2). Both lamprey were adults and were probably migrating upstream to spawn in Coyote Creek.

Both herons appeared to have been healthy immediately prior to death, with moderate deposits of fat in their furcula region. The heron found on 10 January was an after hatching year (AHY) bird with a wing length (chord) of 47.6 cm and weight of 3 kg. The second heron, found on 30 January was also an AHY bird with a wing chord measurement of 45 cm and weight of 2.55 kg.

The proximal portion of the neck of each heron was dissected to examine the esophagus in the region where the head of the lamprey had lodged. Large quantities of blood accompanied the lamprey during its removal from the heron collected on 30 January. However, no breaks were found in either heron's esophagus or the surrounding blood vessels. From our examination it appeared that the head of each lamprey had lodged just anterior to the beginning of the proventriculus. The dorso-ventral measurement of each heron's esophagus between the position of the head of the lamprey and the proventriculus was 5 cm. This indicates that there was no potential problem in that part of the esophagus for further ingestion. It is likely that the lamprey were dead prior to ingestion and were not capable of wounding the heron with their rasping teeth.

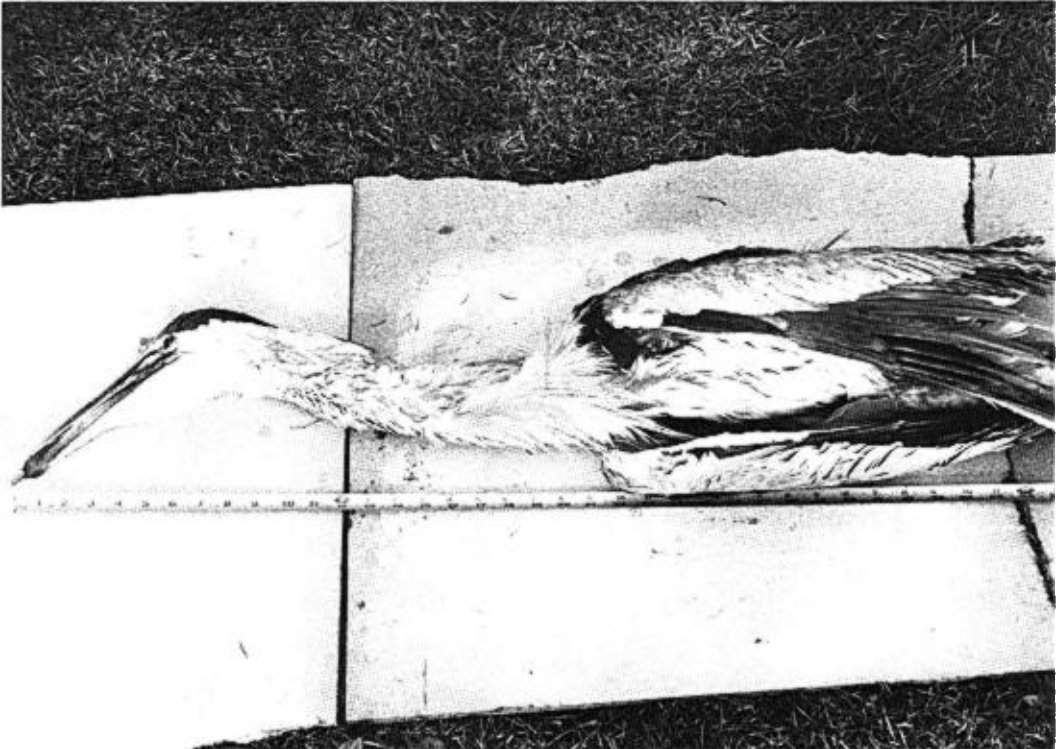


FIGURE 1. Figure showing the tail of the Pacific lamprey protruding from the Great Blue Heron found on 10 January 1988.

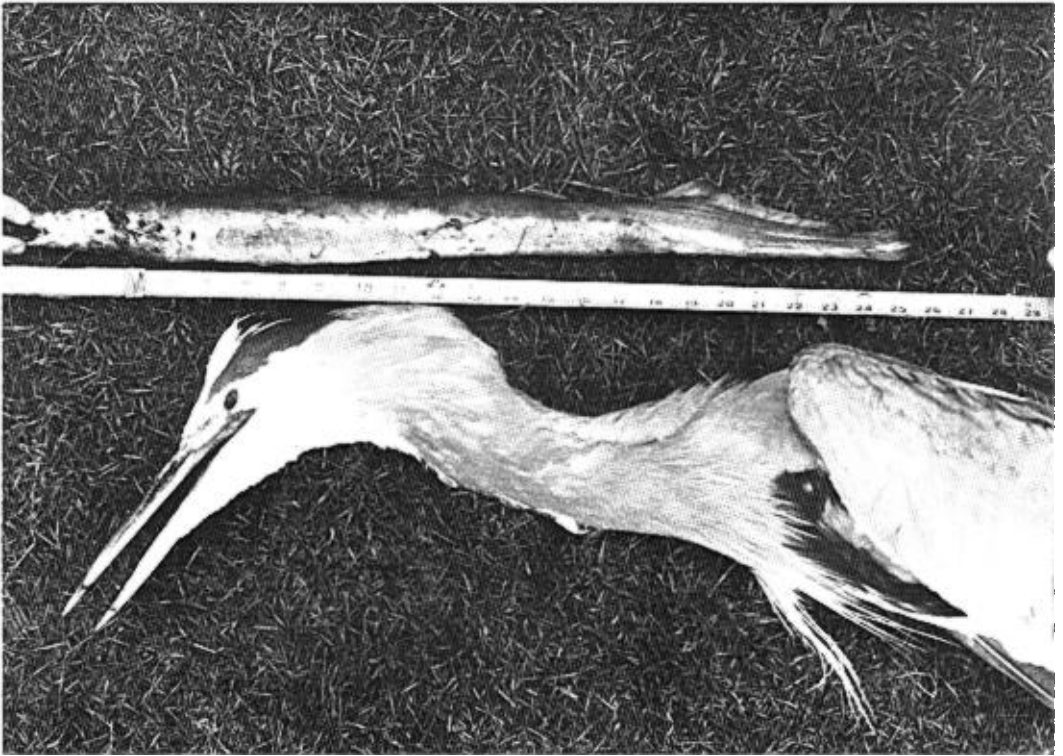


FIGURE 2. Relative lengths of the Pacific lamprey and the neck of the Great Blue Heron found on 10 January 1988.

Further examination revealed that the glottis, located in the floor of the heron's mouth approximately 20 cm from the tip of the lower mandible, was in all likelihood obstructed by the body of the lamprey and that the herons died from suffocation. In each case the diameter of the lamprey at its position over the heron's glottis indicates this scenario. These incidents would seem to be a direct result of the length of this prey species, combined with its diameter, and possibly exacerbated by copious mucous secreted by the integument of the lamprey. We suggest it is likely that it took too much time for each heron to move the lamprey past its glottis and this subsequently caused suffocation. Suffocation was also suggested by Ryder (1950) as one of the possible causes of death in the incident he reported involving a Great Blue Heron and a carp. These incidents, when added to previously published reports, suggest that death caused by attempted ingestion of large or unwieldy prey by Great Blue Herons may be an important factor when considering adult mortality and population dynamics of this and similar species.

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LITERATURE CITED

- BAYER, R. D. 1978. Great Blue Heron attacks Horned Grebe. *Bird-Banding* 50:264-265.
- BENT, A. C. 1926. Life histories of North American marsh birds. U.S. Natl. Mus. Bull. 135:1-392.
- COTTAM, C. 1938. A fatal combat between heron and snake. *Wilson Bull.* 50:140.
- LANGDALE, H. M. 1897. Heron choked by a frog. *Zoologist* 1:572.
- MCGINNIS, S. M. 1984. Freshwater fishes of California. Univ. California Press, Berkeley.
- PALMER, R. S. 1962. Handbook of North American birds. Vol. 1: Loons through flamingos. Yale Univ. Press, New Haven, CT.
- RYDER, R. A. 1950. Great Blue Heron killed by a carp. *Condor* 52:40-41.
- WILLARD, D. E. 1977. The feeding ecology and behavior of five species of herons in southeastern New Jersey. *Condor* 79:462-470.