

## Wincenty Wiśniewski: A retrospective view

Gerald W. Esch, Kyle Luth, Michael Zimmerman

Department of Biology, Wake Forest University, Winston-Salem, North Carolina 27106. U.S.A;  
E-mail: esch@wfu.edu

The term, eutrophication, stems from Naumann [1] who introduced the idea of “eutrophe”, a German word meaning “nutrient-rich”. He referred to the “general concepts of oligotrophy and eutrophy”, separating them on the basis of meager phytoplankton populations (the former condition) to extensive phytoplankton populations (the latter condition) [2]. Over the last 89 years, there has been an explosion of research by a large number of investigators dealing with the causes and effects of eutrophication all over the world. For those of us working in field parasitology, however, our inaugural effort occurred in Lake Drużno (Poland). The person taking the lead was Wincenty Wiśniewski. The paper in which he addressed questions regarding the relationship of parasitism and eutrophication was published, ironically, in the same year in which he died [3]. Esch [4] thoroughly assessed Wiśniewski’s study and analyzed it in a book entitled: “*Parasites People, and Places: Essays on Field Parasitology*”. The present paper is largely based on that analysis.

The main thrust of Wiśniewski’s research was to examine the parasite fauna in Lake Drużno and link it to eutrophication within the context of E.N. Pavloski’s ideas regarding the notion of biocoenoses [5]. In reality, both Wiśniewski and Dogiel were helping to shape an area of parasitology that was to evolve into landscape epizootiology/epidemiology.

Wiśniewski’s work was designed to answer a simple primary question, i.e., did eutrophication affect the parasite fauna in Lake Drużno? Over the years since 1958, this question, and a number of allied issues, have been considered by a number of other investigators in England, the Scandinavian countries, and in North America. In many of the new studies in which the eutrophication problem

was examined, however, the lakes are shallow and the littoral zones are extensive, including Lake Drużno. A question that was to repeatedly emerge is related to these physical qualities, i.e., do lake depth and the size of the littoral zone influence parasite communities rather than eutrophication?

Wiśniewski and his colleagues undertook a massive survey of invertebrates, fishes, amphibians, and birds from Lake Drużno. The dominant helminth parasites in the lake were cestodes (67 species) and trematodes (84 species). From the birds alone, 10 664 trematodes, 41 453 cestodes, 330 acanthocephalans, and 17 nematodes were recovered.

Based on these data, Wiśniewski formulated four very basic conclusions, three of which he contended were generalizations that could be applied to any body of water and one that focused on eutrophic waters alone. First, he concluded that the “final hosts of tapeworms, flukes and thorny-headed worms are a sort of concentrating sieve in a water biocoenosis, while intermediate hosts serve mainly to help these parasites pass to their final hosts proper”. Second, he noted the heterogeneous distribution of parasites and hosts within the lake. He said, “They occur in a greater congestion in some points”. Third, Wiśniewski observed that some of the parasites were typical of these systems (eutrophic) and others are not. Finally, he said that, “in eutrophic bodies of water, particularly in shallow ones, the parasite fauna of birds prevails and is characteristic of them”.

Each of these observations and conclusions described by Wiśniewski [3], except the last one, have been confirmed again and again over the intervening years since 1958. Another of them, the idea regarding heterogeneous distributions of parasites and their hosts in Lake Drużno, can now be

described in terms of landscape ecology. Taking this a step further, it is a 'no brainer' to see that the whole idea of landscape epizootiology/epidemiology rests upon the non-random distribution of parasites in spatial terms, and of helminths in terms of host populations. In other words, parasites are generally present in certain areas of lakes or ponds (and terrestrial habitats as well) for a reason. For the most part, it is because hosts necessary to complete their life cycles are there, either as permanent residents or as ephemeral, but regular, visitors. An excellent example of heterogeneous distributions is the one described for the hemiurid fluke, *Halipegus occidualis*, in Charlie's Pond, a small impoundment in the Piedmont region of North Carolina (U.S.A.) [6]. With an estimated shoreline of ~350 m, they identified three sites as 'hotspots' in the pond, i.e., locations in which all four stages of the parasite could be successfully transmitted. In effect, there were 3 locations that were conducive for the successful completion of the entire life cycle of the parasite. Marcogliese [7] provides an excellent review of these sorts of occurrences in which he uses the ideas of food-webs and trophic interactions as a way of mapping host-parasite interactions at both community and population levels in the context of pollution problems (also see [8]).

Wiśniewski's [3] main thrust was an attempt to link eutrophication and parasitism in aquatic ecosystems. He stated, "In eutrophic bodies of water, particularly shallow ones, the parasitofauna of birds prevails and is characteristic of them". In our opinion, this conclusion is largely correct, but not because of eutrophication. Based on a review of the literature [9–14], we would assert that while eutrophication may influence trophic dynamics associated with helminth transmission, it is the extent of the littoral zone (and shallowness of the lake or pond) that supercedes, and ultimately influences the nature of the parasite fauna. In part, this conclusion is also based on a long-term study (1969–1988) of the allocreadiid trematode, *Crepidostomum cooperi*, which focused on oligotrophic Gull Lake in southwestern lower Michigan (USA) [15, 16]). These investigations actually focused on metacercariae of the parasite in the second intermediate host, the burrowing mayfly, *Hexagenia limbata*. The first intermediate hosts are sphaeriid clams and the definitive hosts are centrarchid fishes. When the work began in 1969, the prevalence of metacercariae in male mayflies was >80% and >90% in females. For the next 15 years,

it was consistently high, but from 1984 through 1988, the prevalence dropped to <40%. The decline in prevalence coincided with construction of a sewer system around the lake, which prevented nutrient acquisition by the lake and reversed eutrophication. Sampling along a depth gradient also revealed an increase in intensity of infection and prevalence with decreasing depth. It was speculated that parasite transmission from clams to mayfly nymphs was highest in the shallower areas of the littoral zone since mayfly nymphs had been forced by 'creeping' anoxia to move into shallower parts of the lake, away from deeper and more favorable habitats. When eutrophication was reversed, anoxia gradually disappeared and mayfly nymphs could move back, and away from parts of the lake where transmission was likely the highest. The example just given does not prove anything regarding food web biology, but it does show that eutrophication can influence parasite transmission dynamics, although not in the way suggested by Wiśniewski.

Wincenty Wiśniewski died in 1958. His legacy remains, however, in large part because of his brilliant seminal studies on parasite communities and eutrophication in Lake Drużno, Poland.

## References

- [1] Naumann E. 1919. Nagra synpunkter angående limnoplanktons okologi med sarskild hansyn till fytoplankton. *Svensk Bot. Tidskr.* 13: 129–163.
- [2] Wetzel R.G. 1975. *Limnology*. W.B. Saunders Philadelphia, Pennsylvania.
- [3] Wiśniewski W.L. 1958. Characterization of the parasitofauna of an eutrophic lake. *Acta Parasitologica Polonica* 6: 1–64.
- [4] Esch G.W. 2004. *Parasites, people, and places: Essays on field parasitology*. Cambridge University Press, U.K.
- [5] Dogiel V.A. 1964. *General parasitology*. Oliver and Boyd London, U.K.
- [6] Zelmer D.A., Wetzel E.J., Esch G.W. 1999. The role of habitat in structuring *Halipegus occidualis* populations in the green frog. *Journal of Parasitology* 85: 19–24.
- [7] Marcogliese D.J. 2005. Parasites of the superorganism: Are they indicators of ecosystem health? *International Journal for Parasitology* 35: 705–716.
- [8] Poulin R. 2007. *Evolutionary ecology of parasites*. Princeton University Press, New Jersey.
- [9] Chubb J.C. 1963. On the characterization of the parasite fauna of the fish of Llyn Tegid. *Proceedings of the Zoological Society of London* 141: 609–621.

- [10] Esch G.W. 1971. Impact of ecological succession on the parasite fauna in centrarchids from oligotrophic and eutrophic ecosystems. *American Midland Naturalist* 86: 160–168.
- [11] Halvorsen N.G. 1971. Studies on the helminth fauna of Norway. XVIII. On the composition of the parasite fauna of coarse fish in the River Gloma, southeastern Norway. *Norwegian Journal of Zoology* 19: 181–192.
- [12] Wooten R. 1973. The metazoan parasite fauna of fish from Hanningfield reservoir. Essex in relation to features of the habitat and host populations. *Journal of Zoology*, London 171: 323–331.
- [13] Kennedy C.R. 1978. An analysis of the metazoan parasitocoenoses of brown trout *Salmo trutta* from British lakes. *Journal of Fish Biology* 13: 255–263.
- [14] Kennedy C.R., Burrough R.J. 1978. Parasites of trout and perch in Malham Tarn. *Journal of Fish Biology* 11: 619–633.
- [15] Esch G.W., Hazen T.C., Marcogliese D.J., Goater T.M., Crews A.E. 1986. Long-term studies on the population biology of *Crepidostomum cooperi* (Allocreadiidae) in the burrowing mayfly, *Hexagenia limbata* (Ephemeroptera). *American Midland Naturalist* 116: 304–314.
- [16] Marcogliese D.J., Goater T.M., Esch G.W. 1990. *Crepidostomum cooperi* (Allocreadiidae) in the burrowing mayfly, *Hexagenia limbata* (Ephemeroptera) related to trophic status of a lake. *American Midland Naturalist* 124: 309–317.