BASTERIA 37: 41–45, 1973

Soil type and habitat of the aquatic snail Lymnaea (Galba) bulimoides Lea during the dry season

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INTRODUCTION

Few studies have been done which mention soil types where aquatic snails have been found. Mehl (1932) stated that soil type was a factor influencing mollusc survival under drought conditions. Barlow (1935) reported *Planorbis pfeifferi* Krauss and *P. boissyi* Pot. & Mich. estivating on dry sandy soil during winter closure of canals. According to Peters (1938), *Lymnaea (Galba) truncatula* (Müller) generally showed a preference to clay soils. This was substantiated with a more concise description by Roberts (1950) in describing a *L. truncatula* habitat in Denbighshire, England, as rich diatomaceous alluvial clay. Olsen (1944) characterized the soil where *Stagnicola bulimoides techella* (Hald.) lived as poorly drained, flat terrain consisting of black prairie soil with an impervious clay subsoil. Traversing the terrain were strips of red alluvial soil that constituted wooded bottom lands. *Pseudosuccinea columella* (Say) and *Fossaria cubensis* (Pfr.) had breeding areas in alluvial deposits and were found to burrow as much as 10 cm into these deposits (Batte et al., 1951). Olivier and Barbosa (1956) found *Australorbis glabratus* (Say) on heavy, black drainage ditch soil containing much humus. Den Hartog (1963) found that *Aplexa hypnorum* (L.) preferred sandy and light clay soils having a salinity not exceeding 2.5‰ Cl'. Clay-loam canal bottoms have been sited by McNeil (1963) as being habitats for *S. palustris nuttalliana* (Lea) and *Physa propinqua* Tryon. The study reported here was undertaken to obtain information about locations in

various soil types where *L. bulimoides* Lea was estivating during the dry season. This information may later be correlated with snail control methods to limit pasture sites of infection where livestock contract fascioliasis during winter and early spring.

MATERIALS AND METHODS

During the months of July and August, 1969, a soil sampling survey of roadside drainage ditches and two state owned pastures in Benton County, Oregon, U.S.A., was done at occasionally convenient times to the author. The study was done on land sections range 4 west to range 7 west, township 10 south to township 14 south (U.S. Department of Interior Geological Survey Map, Corvallis, Oregon Quadrangle). Areas sampled were randomly selected on the basis of access by road. Since most of the land in the county was privately owned, the sampling was confined to publicly owned ditches, streams and pastures that could be reached with a truck and then by foot. Sampling involved stopping the vehicle at any convenient location along any road and taking a soil sample with an auger from an adjacent pasture or bed of a ditch or stream. In no case were samples taken with knowledge of the soil series in a particular area. Soil samples were always taken first and then their location was marked on a map indicating soil series. This map was a tracing-paper copy of an aerial photograph showing topographic dimensions (10 cm to the mile) and soil series outlines. The photograph was the property of the Soil Conservation Service in Corvallis, Oregon. The Service also provided detailed information on characteristics of classes and types of soil within a series.

Sixteen soil series over a 51.8 km^2 area were sampled. A total of 456 soil samples were taken with an average of 28 from each series. Each sample was 348 cm^3 taken from the top 7.6 cm of soil. They were taken with a 7.6 cm diameter orchard or bucket auger with a 20 cm closed faced barrel and 183 cm long handle.

Samples were placed in a 0.473 liter (1-pint) plastic carton and marked as to location. They were brought to the laboratory and filled with condensed and vaporized distilled water to a depth of 0.64 cm above the soil, covered with perforated plastic lids and kept at 21°C. Each sample was examined for live snails once each day for seven days with a three-power hand magnifier. If snails were observed on the soil surfaces or sides of the cartons, they were removed with aluminium forceps. The height (spire apex to basal edge of the lip) of each snail was then measured. This was done with an optical micrometer set in the ocular of a 10-20 power stereomicroscope. The number of snails re-

moved from each container was calculated daily as was the total number from all containers at the end of the seventh day.

RESULTS

Of sixteen soil series, five were positive for *L. bulimoides.* They were: Amity, Dayton, McBee (or Coburg), Waldo (or Conser) and Willamette soil series. A total of 60 living snails were collected. The Waldo series yielded the greatest number of snails (32). The Amity series yielded the least (4). The average snail length was 1.5 mm with a range of 0.5-5.5 mm.

The soil series positive for *L. bulimoides* fell into two physiographic groups. The McBee and Waldo series were found in nearly level flood plains of minor tributaries. The Amity, Dayton and Willamette series were found in nearly level and broad, gently sloping (0-3%) old valley floor terraces. The series in both groups had gradual and smooth boundaries making them excellent for grain and hay crops. Most of the land examined was used as pasture for cattle.

The class of soil for all series except the McBee was dark brown silt loam and consisted of over 50% silt, less than 20% clay, 1-9% coarse to very fine sand and 0.4-0.6% fine gravel. The McBee series consisted of 20-30% clay, 50% or more silt and the remainder sand.

From a depth of 0-18 cm, these soils had a moderately fine subangular blocky structure with many fine interstitial pores, roots and few fine to medium iron concretions. All were medium acid (pH 5.6-5.8), friable, slightly plastic, gritty and sticky.

All soils were considered to be poorly drained except the McBee and the Willamette series which were moderately well drained. All had a moderately slow permeability, slow surface runoff and slight erosion hazard. Every series except the Dayton had high water tables.

The elevation of the soils varied from 64-70 m above sea level. At this height, the soils received 103-127 cm of annual precipitation. The average frost-free season lasted about 210 days. The mean annual soil temperature was approximately 12°C at about the 10 cm depth.

DISCUSSION

The possibility of predicting habitats by finding *L. bulimoides* in certain soil types during dry seasons is indicated. The snail is known to harbor *Fasciola hepatica* parthenitae while estivating in soil (unpublished research). Chemical or biological control methods could easily be

applied to soils during summer months as opposed to the wet winter and spring months where vagility of the snail presents a control problem (Foster, 1971).

The soil series in Benton County number at least 42 with 39 variations convering 1678 km^2. This survey included only 16 series and can only be considered a preliminary survey to a more complete study where there should be sampling by use of gridding and a random numbers table.

Although soil type may be only one influencing factor of geographical molluscan distribution, soil moisture, degree of acidity, elevation and resulting temperature-pressure gradients may be involved. These and other factors were not explored but should be considered in future studies.

ABSTRACT

Four hundred and fifty six soil samples were randomly taken with an orchard auger from 16 soil series covering a 51.8 km^2 area in Benton County, Oregon, U.S.A., during the summer of 1969. In the laboratory, 60 living *Lymnaea bulimoides* Lea were seen to emerge within seven days from dampened soil from five series. These soils were of the dark brown silt loam and silty clay loam classes. Further characterization of the soils and implications for control of snails harboring *Fasciola hepatica* parthenitae while estivating are discussed.

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SAMENVATTING

De auteur heeft het zomergedrag van de zoetwaterslak *Lymnaea (Galba) bulimoides* Lea in de zomer van 1969 in Benton County, Oregon (V.S.), bestudeerd. Totaal werden 456 grondmonsters van 16 series grondsoorten langs opgedroogde afwateringsgoten en in weilanden over een oppervlakte van iets meer dan 50 vierkante km genomen; deze monsters werden in het laboratorium bevochtigd om te zien of na enige tijd de slakken inderdaad zouden verschijnen. Dat bleek bij vijf series grondsoorten het geval te zijn, waar na een week levende *Lymnaea bulimoides* te voorschijn kwam. In dit verband is het van belang de grondsoorten te kennen om een voorspelling te kunnen doen waar eventueel *Lymnaea bulimoides* huist; deze zoetwaterslak is nl. in de Verenigde Staten tussengastheer van de leverbot (*Fasciola hepatica*), een parasiet van verschillende typen vee. In het droge zomerseizoen zijn de slakken eenvoudiger te bestrijden dan in het natte winterseizoen, wanneer de slak zeer beweeglijk blijkt te zijn (Foster, 1971).