



The distribution of *Fasciola hepatica* in Queensland, Australia, and the potential impact of introduced snail intermediate hosts

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Abstract

A survey was conducted to establish the distribution of the liver fluke, *Fasciola hepatica*, in the state of Queensland, Australia, and to evaluate the impact of the introduced snail intermediate hosts, *Pseudosuccinia columella* and *Austropeplea viridis*. Serum samples from a total of 5103 homebred cattle in 142 beef herds distributed throughout the state and 523 pooled milk samples from dairy herds from the state's major dairying regions were tested for antibodies to *F. hepatica* by ELISA. Snails were collected on infected properties around the limits of the *F. hepatica* distribution. *F. hepatica* infection was detected in 44 dairy herds and two beef herds. The distribution of infected herds indicates that *F. hepatica* is established only in southeast Queensland. The distribution there was patchy but the parasite was more widespread than suggested by an earlier survey. The predominant intermediate host species found along the northern limit of the distribution was *P. columella*. We conclude that the introduction of *P. columella* and *A. viridis* has not yet had a major impact on the distribution of *F. hepatica* in Queensland. However, the presence of *P. columella*, which is much more adaptable to tropical habitats than the native intermediate host, *Austropeplea tomentosa*, at the northern limit of the *F. hepatica* distribution suggests that there is potential for the parasite to expand its range.

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1. Introduction

The liver flukes, *Fasciola hepatica* and *Fasciola gigantica*, are economically important parasites that

infect a wide range of livestock species including cattle and sheep (Boray, 1999; Rolfe et al., 1997). Only *F. hepatica* is present in Australia and has been estimated to cost livestock industries US\$ 80 million/year in lost production (Boray, 1999).

Historically, the distribution of *F. hepatica* in Australia has been governed by the distribution of the only native snail intermediate host, *Austropeplea*

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tomentosa (formerly *Lymnaea tomentosa*), which occurs throughout much of the southeast of the country and extends north into parts of southeast corner of the state of Queensland (Baldock and Arthur, 1985). However, the introduction in fish tank weed, of two exotic snail species (*Pseudosuccinia columella* and *Austropeplea viridis*) that can also act as intermediate hosts for *F. hepatica* could have a profound effect the parasite's distribution (Boray, 1978). The introduction of *P. columella* in New Zealand led to a rapid expansion of the range of liver fluke in that country (Pullan and Whitten, 1972). Both species were discovered in creeks within the Brisbane metropolitan area about 25 years ago (P.E. Green and M. Lyndal-Murphy, personal communication).

The last survey of *F. hepatica* in Queensland was conducted in 1985 using data collected by post-mortem examination of livers at abattoirs (Baldock and Arthur, 1985). That survey indicated that the parasite was confined to the southeast corner of the state. A number of isolated cases were identified outside that area but it was concluded that the majority were due to movement of infected cattle. The existence of a small, isolated node of infection in central Queensland near the town of Springsure has been recognized since early last century (Carroll et al., 1984).

The aim of the present survey was to assess the impact of the introduced snails on the distribution of *F. hepatica* in Queensland, and to determine which snail species were present on infected properties near the limits of the distribution. Serum collected from homebred cattle in beef herds distributed throughout Queensland, and vat milk samples from dairy herds distributed throughout the state's dairying regions were tested using a commercial ELISA kit that was recently evaluated for use in Queensland (Molloy et al., 2005).

2. Materials and methods

2.1. Serum and milk samples

An existing collection of sera assembled in 1997 as part of an ongoing structured surveillance programme, and representing homebred beef cattle in herds distributed throughout the five Queensland adminis-

trative regions was tested for antibodies to *F. hepatica*. In all, 5103 sera from 142 herds were tested (southeast—1133 cattle in 28 herds, central—1027 cattle in 32 herds, south—1030 cattle in 26 herds, north—1095 cattle in 36 herds and west—818 cattle in 20 herds).

Milk samples were accessed through the enzootic bovine leucosis accreditation programme operating in Queensland. A total of 523 vat milk samples from dairy herds distributed throughout the major dairying regions in southeast Queensland and on the Atherton Tableland in north Queensland were tested. Because the area provided an ideal habitat for the snail intermediate hosts to become established, all 113 dairy herds on the Atherton Tableland were sampled.

Additional milk samples were collected from 192 cows in a dairy herd on the Atherton Tableland that tested positive for antibodies to *F. hepatica* in the initial vat milk test. Additional serum samples were collected from 48 beef cattle in a cluster of herds along the Burdekin River near Charters Towers in north Queensland in which up to 10% of animals produced results marginally above the positive threshold for the ELISA in the first round of testing.

2.2. Snail collection

Snails were collected on properties where testing of milk or serum samples from cattle showed clear evidence of *F. hepatica* infection. Properties toward the northern and western limits of the apparent distribution of *F. hepatica* were targeted so as to provide the most information on the impact of *P. columella* and *A. viridis*. Snails were identified to species level on the basis of morphology.

2.3. ELISA

The ELISA was obtained from Institut Pourquier (Montpellier, France) and used according to the manufacturer's instructions to test individual serum and milk samples and vat milk samples. In dairy herds, the proportion of cattle infected was estimated from the result of the vat milk test using a table provided by Institut Pourquier that relates the intensity of the response in the ELISA to infection prevalence. The table ranks prevalence as uninfected, low (<20%), medium (20–50%) or high (>50%).

2.4. Statistical analysis

Approximate confidence intervals for infection prevalence were calculated according to Fleiss (1981).

3. Results

3.1. Distribution and prevalence of *F. hepatica* infection

The distribution and approximate prevalence of infection in beef and dairy herds are shown in Fig. 1. Of the 523 dairy herds tested, 44 were positive by ELISA. Infection prevalence ranged between high (22 herds), medium (10 herds) and low (12 herds). In contrast, only two of 142 beef herds showed clear evidence of infection. Infection prevalences in those herds were 100% (95% confidence limits: 90.2 and

100) and 35.9% (95% confidence limits: 21.7 and 52.8). ELISA results marginally above the prescribed positive threshold were recorded from up to 10% of sera from cattle in some beef herds (grey dots in Fig. 1). Follow-up tests were conducted on freshly collected serum samples from 48 animals in what appeared to be a cluster of herds with a low level of infection along the Burdekin River in north Queensland. One animal was weakly positive but the remaining 47 were negative, leading us to the conclusion that the initial positive results were due to low-level cross-reactions in the ELISA. A dairy herd with a medium level of infection, based on a bulk milk test, was detected on the Atherton Tableland in north Queensland. Follow-up testing of individual milk samples from the entire milking herd demonstrated an 18.8% prevalence of infection (95% confidence limits: 13.6 and 25.1), but the infection was confined to introduced cattle and there had been

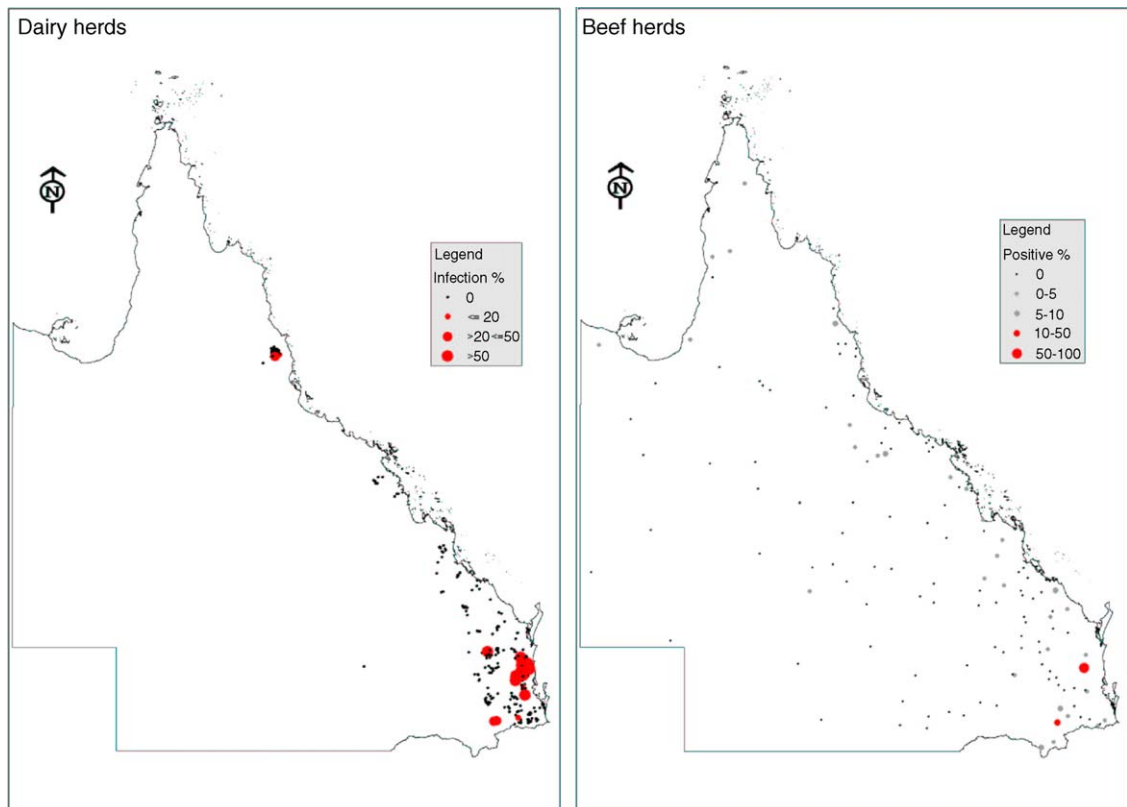


Fig. 1. The distribution and prevalence of *F. hepatica* in Queensland beef and dairy herds.

no transmission to homebred cattle. All infected cattle were subsequently treated with a flukicide.

3.2. Intermediate hosts present on infected properties

Fifteen properties infected with *F. hepatica* in southeast Queensland were examined for snails. *P. columella* was found on three properties along the northern limit of the distribution (near the townships of Maleny, Kilcoy and Jimna) and *A. tomentosa* was found on a property at the western limit of the distribution (near the town of Goondiwindi). No intermediate hosts could be found on the remaining properties.

4. Discussion

F. hepatica appears to be still confined to southeast Queensland. The distribution of the parasite there is patchy but apparently more widespread than was reported in the 1985 survey (Baldock and Arthur, 1985), possibly as a consequence of the presence of *P. columella*. An alternative explanation could be that the 1985 survey, being an abattoir survey, would have focussed more on beef cattle, whereas the present survey included both beef and dairy herds. It is clear that *F. hepatica* infection is much more common in dairy herds than in beef herds, probably because dairy herds are usually found in higher rainfall areas with habitats suitable for the survival of aquatic snails.

The antibody test for liver fluke performed as expected although the number of apparently false positive results from individual sera in some beef herds was well above that predicted by a recent evaluation of the assay in Queensland cattle (Molloy et al., 2005). Most of the herds were in areas where there was no history of fasciolosis (no reports of condemnation of livers at slaughter), and the fact that almost all the positive results were only marginally above the prescribed positive threshold for the ELISA led us to the conclusion that they were false positives caused by cross-reactions. That conclusion was supported by the results of more intensive follow-up testing in selected herds. The source of the cross-reaction is uncertain but on the basis of the recent evaluation of the ELISA (Molloy

et al., 2005) it is unlikely to be due to infection with stomach flukes. Interestingly, there was a strong tendency for herds with low levels of weak positive results to be near the coast or along river systems.

Snail collection focussed on infected properties along the northern and western limits of the *F. hepatica* distribution so as to provide information on the potential for the parasite to increase its range. However, finding the intermediate hosts proved difficult because of the exceptionally dry condition that prevailed in southeast Queensland for most of the survey period. Along the northern limit of the distribution, we found *P. columella* on two dairy farms (at Maleny and Kilcoy) and one beef property (at Jimna). Whether *P. columella* was the only species present or whether it was more plentiful because of its superior ability to survive in marginal conditions is uncertain. *A. tomentosa* was identified on an infected sheep property at the western limit of the distribution (near Goondiwindi), albeit in a somewhat unique habitat (the overflow from a sewerage treatment plant). No intermediate hosts could be found on other infected properties.

5. Conclusion

On the basis of this survey, the introduction of *P. columella* and *A. viridis* does not appear to have had a major impact on the distribution of *F. hepatica* thus far, although earlier work (Boray, 1978) clearly demonstrates that there is potential for it to do so. The environment on the Atherton Tableland is eminently suitable for the establishment of *P. columella* and *A. viridis*, but, despite surveying all 113 dairy farms in the area, and the presence of *F. hepatica*-infected cattle on at least one farm, there was no evidence that the parasite had become established. However, the presence of at least one of the introduced snail hosts on infected properties in southeast Queensland suggests that *F. hepatica* will eventually spread northwards.

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