PARASITIC HELMINTHS AS AIDS IN STUDYING THE DISTRIBUTION OF SPECIES OF *RANA* IN IDAHO

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A preliminary study of the parasites of frogs of the genus *Rana,* collected in Idaho, indicates that the distribution of some of their host-specific parasites can be employed to strengthen ideas of relationships postulated by herpetologists for members of that genus.

Correlations of host phylogeny with parasite phylogeny have received considerable attention from parasitologists. Eichler (1940) stated two rules which express these correlations: 1) Szidat's Rule—the relative phylogenetic age of the host animals can usually be determined directly from the degree of organization of their permanent parasites; and 2) Fahrenholz' Rule—the relationships of host animals can usually be determined directly from the systematics of their permanent parasites.

Certain basic concepts are implicit in this type of study. First, the distribution and evolution of the parasite is controlled to a great extent by the distribution and migration of the host. Parasites cannot become established in new areas without suitable hosts. Consequently, parasites may be utilized to determine host distributions.

Secondly, changes in the morphology of a parasite may be expected to reflect changes in its host's physiology. Therefore, the evolution of a parasite is controlled considerably by the host.

Thirdly, parasites may often be used to show phylogenetic relationships of the hosts. It would be expected that closely related species of hosts would contain the same or closely related species of parasites.

It is important to point out that these three concepts are not always valid in individual cases. Many exceptions occur, but every host-parasite relationship warrants scrutiny to determine its possible significance in concepts of morphological and zoogeographic evolution of the host.

Materials and Methods

A representative sampling of frogs was made by the author from the range of each species in Idaho (Fig. 1). Thirteen *Rana pipiens* from 2 northern and 2 southern localities, 14 *R. catesbeiana* from 3 localities, 46 *R. pretiosa* from 10 northern and central localities, and 19 *R. pretiosa* x *R. sylvatica* hybrids from 3 northern localities (the only ones known for the hybrid population) were examined for parasites. All specimens are now in the collection of Dr. P. C. Dumas, University of Idaho, who identified them jointly with the author. The hosts were examined as soon after collecting as possible. The viscera were removed and placed in separate vessels containing 0.7% sodium chloride solution. The various organs were then teased open and the helminths removed, and relaxed by shaking or by refrigeration over-

night. Specimens were fixed under cover glass pressure. Fixatives used were Gilson's and A.F.A. All specimens were stored in 70% ethanol until staining. Stains used were Ehrlich's Hematoxylin, Semichon's Acetic Carmine, and Alum Cochineal.

Results and Discussion

Rana catesbeiana. Haematoloechus longiplexus was found in 50% of the bullfrogs but was not found in the other species. Previously this fluke had been found in bullfrogs in Canada by Stafford (1902), in *Rana pipiens* in northern United States, and in *Rana grylio* in Florida (Manter, 1938).

The worm apparently is rather cosmopolitan, found throughout North America. In Idaho, it appears to be limited to *Rana catesbeiana*. The frog occurs in three isolated areas in the state (see map), where it has been introduced. Since the fluke was found only in bullfrogs, undoubtedly the frogs carried the parasite into the state when they were introduced. Presumably the bullfrog population from which the introduced specimens were derived also possesses the same species of lung fluke. The absence of other *Rana* from ponds inhabited by bullfrogs undoubtedly helps to limit *H. longiplexus* to this host.

Rana pretiosa and *R. pretiosa* x *sylvatica* hybrids. *Rana pretiosa* occurs throughout Idaho with the exception of the Snake River drainage. The hybrid crosses between *R. pretiosa* and *R. sylvatica* occur in a small area in northern Idaho. These individuals resemble *R. pretiosa* in most respects, including the reddish coloring on the ventral surface of the legs. The anterior end of the frog, however, resembles *R. sylvatica*, especially in the prominent dark shoulder markings.

With the exception of one individual, the *R. pretiosa* contained no lung flukes. They did, however, harbor an intestinal fluke, *Haplometrana intestinalis*, reported previously by the author (Waitz, 1959). On the contrary, in the hybrids this fluke occurred with significantly lesser frequency. This supports the view that the population regarded as *hybrid* does not represent *pretiosa* but is closely related to that species.

Of the hybrids examined, 13 of 19 (68.4%) harbored the lung fluke *Haematoloechus parviplexus*. Only one *pretiosa* (of 46 examined) contained this worm. The worms were large enough to be mature, but there was no indication of uterine development. It is thought, therefore, that this was an accidental infection and that *R. pretiosa* is not a normal host for this worm. Irwin (1929), however, has described this worm from *Rana clamitans* in the Great Lakes region.

It is here assumed that *R. pretiosa* migrated to Idaho from either the south or the west, and in either case came in contact with *R. sylvatica* in the extreme northern part of the state, where the two interbred. As a result the hybrid frogs have acquired the lung fluke of the northern forms and the intestinal fluke of *R. pretiosa*. Since the lung fluke seemingly does not occur normally in *pretiosa*, and has been reported in Canadian frogs (*R. clamitans*; *R. sylvatica* has not been examined) its occurrence in the hybrid population

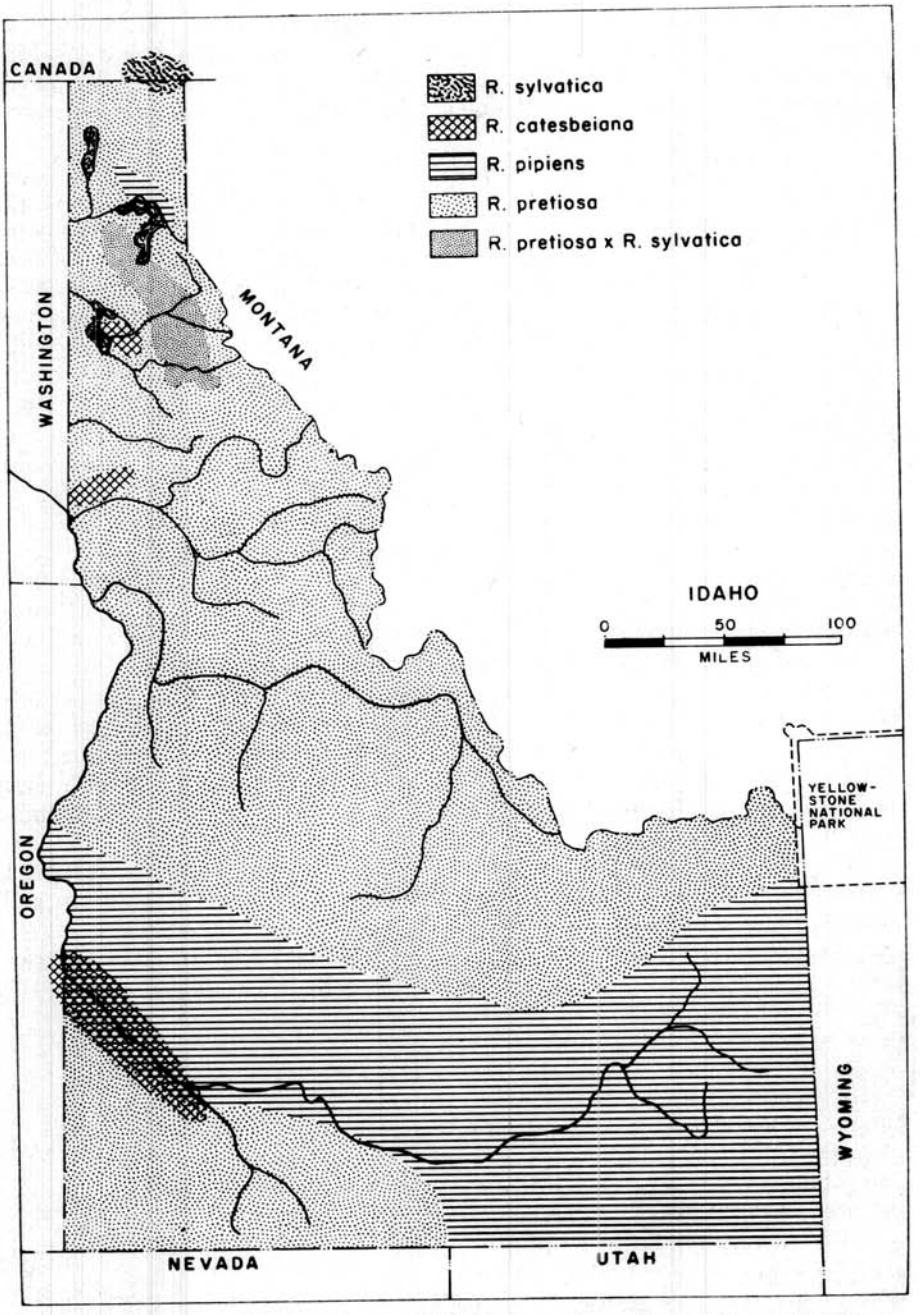

Fig. 1.—Map of Idaho showing distribution of species of *Rana* therein.

may be presumed to indicate derivation from *R. sylvatica*. Thus, *R. sylvatica* in Canada presumably have the same lung flukes but not *Haplometrana intestinalis*.

Rana pipiens. This frog occurs in Idaho along the Snake River and the Clarksfork River drainages. The northern population harbors *Haematoloechus medioplexus*. This fluke has been noted previously in *R. clamitans* in Canada and in *R. pipiens* in the northern Great Lakes region (Manter, 1938).

The frogs from southern Idaho harbor *H. coloradensis*. This fluke has been found by Cort (1915) in *R. pipiens* on the eastern side of the Rocky Mountains in Colorado, in Utah (Frandsen and Grundmann, 1956), and in *R. montezumae* in Mexico (Manter, 1938).

These facts suggest that *R. pipiens* in Idaho migrated from the Mississippi drainage to Idaho *via* two different pathways, those on the Clarksfork arriving through Canada and those on the Snake arriving across the Great Plains.

The lung flukes also provide some clues to the origin of the two populations of *R. pipiens* in Idaho. The majority of flukes in the genus *Haematoloechus* have a well defined acetabulum. A few, however, as is the case in *H. medioplexus*, recovered from the northern *R. pipiens*, lack an acetabulum. In my opinion, this indicates more recent differentiation or origin of *H. medioplexus*.

Therefore, the parasites provide strong support for the hypothesis that *Rana pipiens* in Idaho has been derived from two sources: a northern population of eastern origin in which at least the parasites have undergone significant change from primitive structure (as indeed the host may also have done in cryptic ways), and a southern population of Great Basin origin in which a less radical change has occurred in the parasites (and perhaps also in the host). Substantiation of this hypothesis is to be sought in structural and functional comparisons of the northern and southern populations of *R. pipiens* in Idaho and adjacent areas.

Summary

This investigation indicates that fairly host-specific parasites can be used as an efficient tool in zoogeographical studies. The parasites have reaffirmed the following:

1. That *R. catesbeiana* was introduced into Idaho and brought with it its own particular species of parasite.
2. That the identification of the *R. pretiosa* x *sylvatica* hybrids, based on morphological characteristics, is correct and that the interbreeding occurred in the vicinity of northern Idaho.
3. That *R. pipiens* arrived in Idaho over two different routes, and that those of northern Idaho are most probably of different geographic origin from those in southern Idaho.

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