CHAPTER 5

The Evolutionary Genetics of Xiphophorus

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1. Introduction

Fishes of the genus Xiphophorus, the platyfish and swordtails, are common inhabitants of the streams and rivers of Central America. The 15 species described occupy a variety of habitats, ranging widely through the Atlantic drainage from northeastern Mexico, south-east through Guatemala, Honduras and Belize. Like most other members of the family Poeciliidae, Xiphophorus species are internally fertilizing and ovoviviparous (Rosen and Bailey, 1963). Females can store sperm and produce broods for several months after a successful mating.

Xiphophorus species are phenomenally variable in genetically determined melanic pigmentation and coloration patterns. Eight of the species are polymorphic for melanic pigmentation patterns, which are controlled by at least six different sex-linked and autosomal loci (Table I). At the tailspot locus in X. maculatus alone, eight different alleles segregate in some populations (H. Gordon and Gordon, 1957). Furthermore, several of the species are highly variable for yellow and red (YR) coloration patterns (Kallman, 1975). For example, no fewer than 19 different sex-linked alleles control YR patterns in X. maculatus (Borowsky and Kallman, 1976; Kallman, 1965, 1970), and populations in one of the river systems (Belize River) contain at least 15 of these (Kallman, 1975). The known variation in two of the species, X. maculatus and X. variatus,
Table I
The Distribution of Melanic Spotting Patterns among the Species of
*Xiphophorus*¹

<table>
<thead>
<tr>
<th>Species</th>
<th>Micromelanophore</th>
<th>Macromelanophore</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tailspot</td>
<td>Caudal blot</td>
</tr>
<tr>
<td><em>X. gordoni</em></td>
<td>6</td>
<td></td>
</tr>
<tr>
<td><em>X. variatus</em></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td><em>X. xiphidium</em></td>
<td>8</td>
<td></td>
</tr>
<tr>
<td><em>X. maculatus</em></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td><em>X. milleri</em></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td><em>X. nigrensis</em></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><em>X. montezumae</em></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><em>X. cortezi</em></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><em>X. helleri</em></td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

¹The table lists the number of distinct patterns observable. The distinction between micro-
melanophore and macromelanophore patterns follows M. Gordon (1927). Data compiled
from Kallman (1975), Kallman and Atz (1966), Kallman and Borowsky (1972), and the
present study.

equals or exceeds that found in “textbook” examples of polymorphic
species such as *Cepaea nemoralis, Papilio dardanus,* or *Maniola jurtina*
(Ford, 1971). Furthermore, the full extent of the polymorphism is not yet
known. This degree of polymorphism is remarkable and demands
explanation.

One of the key questions in population biology is how genetic vari-
ation is maintained in natural populations. Without variation there can be
no evolution, yet adaptive evolution tends to reduce population variation
because its mechanism is selection. Evolution proceeds and populations
remain variable, however. Thus there must be factors or relationships
having considerable effect in natural populations that shield variation from
selectional loss and promote polymorphism. *Xiphophorus* is a suitable
organism to address this problem because of its extensive polymorphism.
While *Xiphophorus* is atypical because the polymorphism in question is
conspicuous, there is no reason to believe that the mechanisms fostering
the polymorphism are atypical. Furthermore, the conspicuousness of the
variation aids its study. The research summarized here indicates that
environmental variability, both cyclic-seasonal and spatial variation, plays
an important role in this polymorphism.

To discuss all aspects of polymorphism in *Xiphophorus* is a task
beyond the scope of this chapter. I have chosen, therefore, to emphasize
one aspect of the melanic variation, the tailspot polymorphism (Table I),