A Search for Mosquitocidal Fish Species as Biocontrol Agents

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Abstract

Experiment were conducted to investigate the feeding preferences of different indigenous fishes in natural habitat of NWFP. A total of 426 fish specimens were collected from two diverse localities of Peshawar and Swat. Identification of fish specimens revealed 9 and 6 different species from Peshawar and Swat respectively. Fishes were further categorized into carnivores, omnivores and herbivores by analyzing their gut contents. Main objective of our study was to identify digenous fishes which can serve as biocontrol agents to eradicate mosquito larvae in local conditions. Our preliminary results indicated that five species were carnivorous, four herbivorous and three omnivorous.

Introduction

Excessive use of deadly chemical pesticides to control mosquito, people have now unfortunately concerned about resistant mosquitoes to chemical pesticides, health hazards associated with the more toxic chemicals and adverse effects on the environment. In the presence of resistant mosquitoes, scientific studies to develop alternate strategies require long-term sustained commitment, which is becoming more difficult to achieve. The development of pesticide resistance in disease vectors and other detrimental effects of chemicals on flora and fauna, have rejuvenated the research on biological control of mosquitoes.

Both mosquito and fish are closely associated in an aquatic habitat. Larvicidal fish has a great potential to be employed as mosquito control agent in the breeding places (Amjad, 1968). Since, larvicidal fishes are a potential source to reduce mosquito larval populations (Ahmad et al., 1988), so the local fish habitat may help in mosquito control.

In the past, fishes have been recognized as effective and cheap source of mosquito control for almost past whole century (Coykendal, 1980). Biological control has a long history of use in pest management and has gained a renewed interest because of problems encountered with the use of pesticides.

During present century the use of fish for control of mosquitoes has also been grown. Mosquitocidal fish Gambusia affinis has been imported from South Eastern USA to waters in many countries around the globe for mosquito control. Two American fishes G. affinis and Poecilia reticulata has been used extensively for the eradication of mosquitoes. A total of 216 fishes has been documented as mosquitocidal ability so far (Gerberich, 1966).

The historical biological control has been spectacularly successful in many instances, with a number of pest problems permanently resolved by importation and successful establishment of natural enemies. These importation successes have been limited largely to certain types of ecosystems. Thus importation progress to date, are largely a matter of trial and error based on experience of the individual agents involved. It is thus preferable to use fish species that are already present in local habitat. Mosquitocidal fishes are found in almost every country in a wide variety of habitat.

Materials and Methods

Area of fish collection: Two drains were selected to undertake our search in N.W.F.P. One drain was situated in Swat valley, 6 km away from Mingora city near a moderately populated village, Aligrama. This drain passed through agricultural landscape. The flow of water varied at different places. The second water drain used for our fish collection, was a man made agricultural water drain in Shahi Payan village in District Peshawar. Fishes were collected from June through September, 1995.

Fish collection: Fish samples were collected with the help of a small narrow-meshed (size ranging) from 1 to 3.24 cm²) hand net. The fish samples were immediately preserved in 10 percent formalin after collection to stop their metabolism.

Fish identification: Collected fish samples were identified as documented (Mirza, 1982, 1990; Talwar and Jhingran, 1991).

Fish gut contents: Fish samples were dissected and their gut contents removed carefully and studied under binocular microscope. The insects recovered from the gut were identified as described (Pennak, 1953; Edmondson, 1959; Borror and Delong, 1970).

Results

This study was carried out on a total of 426 fish specimens belonging to 12 different species of local fishes. Five fish species were observed to be carnivores because no plant matter was found in their gut contents (Table 1). These five species were identified as Barilius vagra, Channa punctatus, Danio devario, Mystus bleekerii and Noemacheilus Botia. The food found in gut contents of B.
Table 1: Distribution of the total sample of fishes studied according to the nature of the stomach contents

<table>
<thead>
<tr>
<th>Fish species</th>
<th>Insects</th>
<th>Plant matter</th>
<th>Insects + Plants</th>
<th>Empty stomach</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aspidoparia morar</td>
<td>Nil</td>
<td>10</td>
<td>Nil</td>
<td>Nil</td>
<td>10</td>
</tr>
<tr>
<td>Barilius vagra</td>
<td>33</td>
<td>50</td>
<td>50</td>
<td>83</td>
<td></td>
</tr>
<tr>
<td>Channa punctatus</td>
<td>10</td>
<td>Nil</td>
<td>Nil</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>Crossocheilus latius</td>
<td>Nil</td>
<td>94</td>
<td>Nil</td>
<td>94</td>
<td></td>
</tr>
<tr>
<td>Danio devario</td>
<td>3</td>
<td>Nil</td>
<td>Nil</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Garra gutyla</td>
<td>Nil</td>
<td>40</td>
<td>Nil</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Mastacembelus armatus</td>
<td>19</td>
<td>2</td>
<td>4</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>Mystus bleekeri</td>
<td>8</td>
<td>Nil</td>
<td>Nil</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>Noemacheilus botia</td>
<td>6</td>
<td>Nil</td>
<td>Nil</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>Puntius sopher</td>
<td>1</td>
<td>13</td>
<td>Nil</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>Puntius ticto</td>
<td>5</td>
<td>57</td>
<td>8</td>
<td>72</td>
<td></td>
</tr>
<tr>
<td>Unidentified</td>
<td>Nil</td>
<td>2</td>
<td>Nil</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>85</td>
<td>218</td>
<td>12</td>
<td>426</td>
<td></td>
</tr>
</tbody>
</table>

Table 2: Frequency distribution of fishes by aquatic animals found in their guts

| Fish species  | Total | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R |
|---------------|-------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A. armatus    | 32    | - | 2 | - | 1 | 7 | 2 | - | 11| 4 | 4 | - | - | - | - | - | - | 2 | 3 |
| C. punctatus  | 27    | - | - | - | 4 | 2 | 1 | 2 | - | 1 | - | - | - | 2 | 2 | - | - | 1 | 1 |
| D. devario    | 7     | - | - | - | - | 2 | 1 | - | - | - | - | - | - | - | 3 | - | - | - | 3 |
| P. ticto      | 72    | - | 1 | - | 1 | - | 2 | - | - | - | - | - | 8 | 1 | - | - | - | - | 1 |
| B. vagra      | 83    | 4 | - | 1 | - | - | - | - | - | - | - | - | - | 3 | - | - | 7 | 1 | 10 |
| M. bleekeri   | 19    | 8 | - | - | - | - | - | 1 | 1 | 1 | 1 | - | - | 5 | 1 | 4 | - | - | 1 |
| N. botia      | 26    | - | - | - | - | - | - | - | - | 1 | - | - | - | 4 | - | - | - | - | 4 |
| P. sopher     | 14    | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 |
| G. gutyla     | 40    | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 |
| C. latius     | 94    | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| A. morar      | 10    | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Unidentified  | 2     | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Total**     | 426   | 12| 3 | 1 | 1 | 1 | 12| 7 | 1 | 17| 1 | 6 | 13| 1 | 1 | 30| 7 | 6 | 2 |

Key:
- A. Ephemeroptera
- B. Odonata
- C. Orthoptera
- D. Plecoptera
- E. Hemiptera
- F. Coleoptera
- G. Neuroptera
- H. Trichoptera
- I. Lepidoptera
- J. Tabinids
- K. Chironomids
- L. Mosquitoes
- M. Hymenoptera
- N. Insect parts
- O. Other arthropods
- P. Mollusks
- Q. Fishes
- R. Total

vagras and D. devario were mainly insects. A mosquito larva (Culex quinquefasciatus) was also identified from the gut contents of B. vagra. C. punctatus and M. Bleekeri fed on a variety of animals like mollusks, insects and other arthropods. N. botia gut contents had caddisfly and chironomid as its food (Table 2).

Out of 12 species, three species, Mastacembelus armatus, Puntius sopher and Puntius ticto can be categorized omnivorous. M. armatus was found to be mainly carnivorous though some plant matter was also found in their guts. Gut contents of 23 specimens of M. armatus had eaten insects. Noemacheilus botia and Puntius ticto, two small fishes, were also found in the guts of two specimens of M. armatus. Puntius sopher and Puntius ticto gut contents contained a mixed food of plant and animal. The remaining four species, Crossocheilus latius, Garra gutyla, Aspidoparia morar and the unidentified one, were found to be herbivorous.

Discussion
Some of the fish specimens were found with empty stomachs which showed no availability of food material in their surroundings. The other possible reason could be the possibility of microorganisms as their food, or possibility of digestion of all food materials. The same reason seems more plausible, because there are reports which show marked periodicity in their feeding activity (Spencer, 1929; Spoor and Schloemer, 1939).

Channa punctatus: It was found to be a carnivore. Hodgson (1914) had documented C. punctatus as a predator of mosquito larvae.

Danio devario: It was also found to be a carnivore in collection while Khushul (1979) reported some plant in the gut contents of this fish. The possible reason...
pure carnivore in our fishes may be the availability of insects. This fish may prefer insect than plant material. In another report by Perri (1914) quoted that another related species of D. devario, Danio rerio can eradicate all the mosquito larvae in paddy field. Rao and Yazdani (1977) had also recommended the augmentation of this species as mosquito control agent.

### Rasoolius vagra

In our collection this species turned out to be a carnivore. Our observations are in total agreement with Wilson (1914), Meehane (1967) and Ali (1971).

**Puntius ticto:** Previous reports (Chacko and Kurigan, 1948) showed it as an insect eating fish. Later Ali (1971) found this fish as herbivore. Our results are in agreement with Ali (1971) found this fish as herbivore where as Khushdil (1979) had reported this species as a herbivore. Our results are in agreement with Ali (1971).

**Puntius sophore:** Khan (1943) had reported that P. sophore is a good predator in captivity but in natural conditions, it refers plant matter. There are contradictory reports Ali (1971), Ali and Hussain (1973) and Khushdil (1979).

**Barbota gotyla:** Previous reports from Khushdil (1979). Ali and Hussain (1973) confirmed its herbivore nature.

**Aspidoparia morar:** Ali (1971) had reported this fish as herbivore and our results are also in agreement.

**Mylos bleekerii:** Our result showed this fish species a carnivore which has already been recorded (Khushdil, 1979). On the basis of our observations in present study, v. vagra, P. ticto and P. sophore and C. punctatus found to be good choices for biological control and can be used for mosquito control. A detail study must be carried out before introduction of these fishes for mosquito control.

### Reference


