Specialization, competition and diet overlap of fish assemblages in the recently restored southern Iraqi marshes

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Abstract

Trophic competition, feeding specialization and diet overlap of fishes had been studied in three restored marshes (Al-Huweyza, Suq Al-Shuyoak and East Al-Hammar). Data obtained revealed that most of species studied were specialized and few were generalized, depend on the percentage of environmental restoration in each of the three marshes. Four pairs of trophic competition showed positive cases (\textit{Carassius auratus}, \textit{Barbus luteus}, \textit{Cyprinus carpio}; \textit{Barbus xanthopterus}, \textit{Acanthobrama marmid}; \textit{Alburnus mossulensis}, \textit{Aspius vora} and \textit{Silurus striostegus}).

Three trophic groups of multi species (carnivorous, omnivorous and herbivorous) and two single species trophic groups (detritivorous and benthivorous) were reached.

It seemed that fish species in the restored marshes alter their diets than previously known including native and alien. \textit{C. auratus} alter its food habits Other species including \textit{C. carpio become omnivorous}, \textit{A. vorax} and \textit{S. striostegus} become piscivorous species.

1-Introduction

The southern marshes of Iraq are populated by many freshwater species both native, alien and few diadromous marine species. The southern marshes ecologically referred as nursery and feeding grounds for many fish species (Hussain \textit{et al.} 2008a; Mohamed \textit{et al.} 2009). Several studies before desiccation in the nineties were conducted in the marshes dealing with the food and feeding habits of fishes (e.g. Barak and Mohamed, 1982, Al-Mukhtar, 1982; Naama, 1982; Dawood 1986; Al-Sayab, 1988 and Jasim, 1988). Most of previous studies concerned with one or two fish
species, these were reviewed by Hussain and Ali (2006). Only two were focused on feeding relationships and competition between species ( Al-Kanaani, 1989 and Hussain et al., 1992).

Hyslop (1980) stated that studies of diet of fishes help to understand the autecology of fish assemblage and ecological role of fish assemblages. It was also found that the distribution of fish species in a certain water body depends on the distribution of its food. Other advantages of studying fish diet is to understand inter and intraspecific relationships between species and productivity the area.

However no specific study was conduct on the trophic specialization and diet overlap of fishes in the southern marshes before the drainage during the nineties, as step to understand the food nature of different species living in the restored marshes.

The present work study is designed to throw light on trophic specialization, feeding habits, diet overlap, competition between species, mainly of the most dominant fish species in the three of the restored southern marshes.

2- Materials and Methods

Field works:

Monthly fish samples were collect from six stations, two in each marsh Al-Huweyza, Suq al-Shuyaok and East Al-Hammar as below, during the period from November 2004 to June 2006, using fixed gill net, cast net and electrical fishing device. The fish preserved in cold ice box until reaching to the laboratory. Small fish preserved in 4% formaldehyde and bigger fishes in deep freeze.

<table>
<thead>
<tr>
<th>Marsh</th>
<th>Station</th>
<th>GPS</th>
<th>Environment</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Huweyza</td>
<td>Um Aaj</td>
<td>N 31 38 30 E 47 35 21</td>
<td>Openness marsh</td>
<td>Natural station</td>
</tr>
<tr>
<td>Huweyza</td>
<td>Taraba</td>
<td>N 31 29 48 E 47 31 48</td>
<td>Dense Vegetation marsh</td>
<td>Desiccated station</td>
</tr>
<tr>
<td>Suq Al-Shuyaok</td>
<td>Amia</td>
<td>N 30 51 41 E 46 38 13</td>
<td>Channel marsh</td>
<td>Desiccated station</td>
</tr>
<tr>
<td>Suq Al-Shuyaok</td>
<td>Al Wineas</td>
<td>N 39 51 50 E 46 40 42</td>
<td>Openness marsh</td>
<td>Desiccated station</td>
</tr>
<tr>
<td>East Al-Hammer</td>
<td>Saddah</td>
<td>N 30 40 04 E 47 38 06</td>
<td>Tidal Channel marsh</td>
<td>Natural station</td>
</tr>
<tr>
<td>East Al-Hammer</td>
<td>Burkah</td>
<td>N 30 40 22 E 47 33 03</td>
<td>Tidal Openness marsh</td>
<td>Desiccated station</td>
</tr>
</tbody>
</table>
**Laboratory examinations:**

Fishes were identified after Beckman, (1962) and Coad, (1991).

The digestive canals of fishes are removed and preserved in 4% formaldehyde until examination, then open in Petri dish and give the degree of fullness (0 for empty 5, 10, 15, 20) and counts of different food items. Frequency and point methods are used to analyze fish diet (Hynes, 1950). Edmondson (1959), Schmitt (1965), Smith (1971), Macan (1972) and Pielon et al. (1977) were used for food identification. Relative important index (IRI) was calculated according to Stergiou (1988) formula.

Trophic niche breadth was calculated according to the formula proposed by Levins (1968):

\[ B = \left( \sum P_i^2 \right)^{-1} \]

where, \( B \) is Levins index of niche breadth and \( P_i \) is proportion of food group (i) in the diet. To standardize niche breadth on a scale from 0-1, the modification was estimated after Krebs (1989) was adopted as follows:

\[ B_A = B - 1 / n - 1 \]

where, \( B_A \) is Levins standardized niche breadth, \( B \) is Levins index of niche breadth and \( n \) is number of food groups.

The Morisita overlap index was used to quantify the dietary overlap between species (Krebs 1989).

\[ C = 2 \sum P_j P_j / \left( \sum P_j + \sum P_j \right) \]

\( C \) = Morisita's index of overlap between species \( j \) and \( y \).

\( P_j \) = proportion resources \( j \) is of the total resources used by two species.

The similarity among fish species based on their diet was calculated according to Jaccard similarity coefficient, using SPSS software (ver. 11, 2001) statistical package.
Fig(1): Southern Iraqi restored marshes showing three studied marshes and sampling stations.
3-Results

Diets composition:

Five species (Liza abu, L.subviridis, L.kleningeri, Barbus sharpeyi and Ctenopharyngodon idella) depend on detritus, plankton and aquatic plants. Four species (Carassius auratus, Acanthobrama marmid, B.luteus and Cyprinus carpio) were omnivorous fed mainly on mixed diets of detritus, diatoms, algae, aquatic plants, insects, crustaceans, and snails. Carnivorous group consisted of four species (Alburnus mossulensis, B.xanthopterus, B.grypus and Acanthopagrus latus) consumed on insect, crustaceans, and snails. Pescivorous group formed of five species (Heteropneustes fossilis, Mastacembellus mastacembelus, Aspius vorax, Silurus triostegus and Thryssa mystax) take specifically crustaceans and fish with different ratio as illustrated in table (1).

Trophic breadth:

1-Al-Hammar marsh

Levins index of trophic niche breadth of each species from East Al-Hammer are given in Table (2). The trophic niche breadth values are ranging from 0.00 for C.idella to 0.67 for C.carpio for freshwater species and for migratory marine species 0.00 for T.mystax and A.latus and 0.02 for L.subviridis. Fish species having breadth <0.5 were considered as specialized feeders (B.sharpeyi, C.auratus, A.vorax, S.triostegus, L.abu, A.marmid, A.mossulensis, C.idella, B.grypus, M.mastacembelus, L.subviridis, L.kleningeri, T.mystax and A.latus), while those having diet breadth >0.5 were classified as generalized feeders (B.luteus and C.carpio).

2-Huweyza marsh

Levins index of trophic niche breadth of each species from Huweyza marsh are given in Table (3). The trophic niche breadth values are ranging from 0.00 for M.mastacembelus to 0.67 for C.carpio for freshwater species. Fish species having breadth <0.5 were considered as specialized feeders (B.sharpeyi, B.luteus C.auratus, A.vorax, S.triostegus, L.abu, A.marmid, C.idella, B.grypus, M.mastacembelus, H.fossilis and B.xanthopterus) while those having diet breadth >0.5 were classified as generalized feeders (A.mossulensis and C.carpio).
Table (1): Diets of the studied species both freshwater and diadromous species occurred in three marshes expressed as IRI (Index of relative importance) score.

<table>
<thead>
<tr>
<th>Species</th>
<th>Detritus</th>
<th>Diatoms and Clay</th>
<th>Algae</th>
<th>Aquatic plants</th>
<th>Insect</th>
<th>Crustacean</th>
<th>Snail</th>
<th>Fish</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Liza abu</em></td>
<td>112.5</td>
<td>5273.5</td>
<td>1260</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>L. subviridis</em></td>
<td>4200</td>
<td>1200</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>L. klenzingeri</em></td>
<td>4300</td>
<td>1200</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Barbus sharpeyi</em></td>
<td></td>
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<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td><em>Ctenopharyngodon idella</em></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Carassius auratus</em></td>
<td>2976</td>
<td>4709.5</td>
<td>152.6</td>
<td>55.5</td>
<td>468.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Barbus luteus</em></td>
<td></td>
<td></td>
<td>5000</td>
<td>146.4</td>
<td>120</td>
<td>1531.4</td>
<td>120</td>
<td></td>
</tr>
<tr>
<td><em>Acanthobrama marmid</em></td>
<td>231.6</td>
<td>221.7</td>
<td>1665</td>
<td>2441.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Cyprinus carpio</em></td>
<td>2190.3</td>
<td>904.6</td>
<td>47.6</td>
<td>3333.3</td>
<td>2500</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Alburnus mossulensis</em></td>
<td></td>
<td></td>
<td>714</td>
<td>2043.1</td>
<td>2142.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>B.xanthopterus</em></td>
<td>2500</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td><em>B.grypus</em></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Acanthopagrus latus</em></td>
<td>3000</td>
<td>600</td>
<td>600</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Heteropneustes</em></td>
<td>1750</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>fossilis</em></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Mastacembelus</em></td>
<td>4800</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>mastacembelus</em></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Silurus triostegus</em></td>
<td>659.3</td>
<td>5614</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Aspius vorax</em></td>
<td>1665</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Thryssa mystax</em></td>
<td>900</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>


Table (2): Degree of feeding specialization of resident freshwater species and migratory marine species in East Hammar marsh.

<table>
<thead>
<tr>
<th>Species</th>
<th>High specialization 0.0-0.25</th>
<th>Low specialization 0.26-0.49</th>
<th>Generalized ≥50</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. vorax i</td>
<td>0.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C. idella</td>
<td>0.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M. mastacembelus</td>
<td>0.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. marmid</td>
<td>0.15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. sharpeyi</td>
<td>0.15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S. triostegus</td>
<td>0.20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L. subviridis</td>
<td>0.02</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L. klenzingeri</td>
<td>0.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T. mystax</td>
<td>0.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. latus</td>
<td>0.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. grypus</td>
<td>0.40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L. abu</td>
<td>0.44</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C. auratus</td>
<td>0.46</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. luteus</td>
<td></td>
<td>0.50</td>
<td></td>
</tr>
<tr>
<td>C. carpio</td>
<td></td>
<td></td>
<td>0.67</td>
</tr>
</tbody>
</table>

Table (3): Degree of feeding specialization of resident freshwater species in Suq Al-Shuyaok marsh.

<table>
<thead>
<tr>
<th>Species</th>
<th>High specialization 0.0-0.25</th>
<th>Low specialization 0.26-0.49</th>
<th>Generalized ≥50</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. vorax</td>
<td>0.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S. triostegus</td>
<td>0.04</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. sharpeyi</td>
<td>0.23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H. fossilis</td>
<td></td>
<td>0.29</td>
<td></td>
</tr>
<tr>
<td>B. luteus</td>
<td></td>
<td>0.30</td>
<td></td>
</tr>
<tr>
<td>L. abu</td>
<td></td>
<td>0.31</td>
<td></td>
</tr>
<tr>
<td>B. xanthopterus</td>
<td></td>
<td>0.32</td>
<td></td>
</tr>
<tr>
<td>M. mastacembelus</td>
<td></td>
<td>0.39</td>
<td></td>
</tr>
<tr>
<td>B. grypus</td>
<td></td>
<td>0.44</td>
<td></td>
</tr>
<tr>
<td>C. idella</td>
<td></td>
<td>0.47</td>
<td></td>
</tr>
<tr>
<td>C. carpio</td>
<td></td>
<td></td>
<td>0.50</td>
</tr>
<tr>
<td>C. auratus</td>
<td></td>
<td></td>
<td>0.63</td>
</tr>
<tr>
<td>A. mossulensis</td>
<td></td>
<td></td>
<td>0.71</td>
</tr>
<tr>
<td>A. marmid</td>
<td></td>
<td></td>
<td>0.71</td>
</tr>
</tbody>
</table>
3-Suq Al-shuoak marsh

Levins index of trophic niche breadth of each species from Suq Al-shuoak marsh are given in Table (4). The trophic niche breadth values are ranging from 0.00 for \textit{A.vorax} to 0.71 for \textit{A.mossulensis} and \textit{A.marmid}. Fish species having breadth <0.5 were considered as specialized feeders (\textit{B.sharpeyi}, \textit{B.luteus}, \textit{A.vorax}, \textit{S.triostegus}, \textit{L.abu},\textit{C.idella},\textit{B.grypus}, \textit{M.mastacembelus}, \textit{H.fossilis} and \textit{B.xanthopterus}) while those having diet breadth >0.5 were classified as generalized feeders (\textit{A.mossulensis}, \textit{A.marmid}, \textit{C.auratus} and \textit{C.carpio}).

Trophic overlap

Morisita’s overlap index between each pair of species is given in Table (5). The index showed eight low diet overlaps or insignificant between the species out of 12 examined. On the contrary four exhibited significant overlaps with other species, \textit{C.carpio}, \textit{B.xanthopterus} and \textit{B.luteus} ; \textit{C.auratus}.

The Morisita’s diet overlap index of all species were subjected to cluster analysis (Fig. 2).

The cluster identified three major groups formed of multi species and two of single species of different diets and degree of association. The first group represent carnivorous include \textit{B.grypus}, \textit{M.mastacembelus}, \textit{H.fossilis}, \textit{A.vorax} and \textit{S.triostegus} and could be divided into two subgroups ,the first formed of the first three while the second include the last two which are predators species .Omnivorous group consisted of \textit{A.mossulensis}, \textit{A.marmid}, \textit{B.luteus}, \textit{C.auratus} and \textit{C.carpio}.

Herbivourus group formed of two species (\textit{B.sharpeyi} And \textit{C.idella}) weakly associated, due the first feed on mix diet of aquatic plants and algae and the second exclusively on aquatic plants (Fig.2).Single species group represent by \textit{L.abu} is detritovorus feeder and \textit{B.xanthopterus} is benthic feeder depend on snails and worms.
Table (4) Degree of feeding specialization of resident freshwater species in Huwayza marsh.

<table>
<thead>
<tr>
<th>Species</th>
<th>High specialization</th>
<th>Low specialization</th>
<th>Generalized</th>
</tr>
</thead>
<tbody>
<tr>
<td>M.mastacembelus</td>
<td>0.00</td>
<td>0.26-0.49</td>
<td>≥50</td>
</tr>
<tr>
<td>S.triostegus</td>
<td>0.02</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L.abu</td>
<td>0.02</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.xanthopterus</td>
<td>0.02</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A.vorax</td>
<td>0.08</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C.idella</td>
<td>0.17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A.marmid</td>
<td>0.37</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H.fossilis</td>
<td>0.38</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.grypus</td>
<td>0.44</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.luteus</td>
<td>0.46</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C.auratus</td>
<td>0.48</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C.carpio</td>
<td>0.53</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A.mossulensis</td>
<td>0.67</td>
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<td></td>
</tr>
</tbody>
</table>

Table (5): Degree of feeding competition between resident freshwater species in three studied marshes (Huwayza, Suq Al-Shuyaok east Al-Hammar marshes).

<table>
<thead>
<tr>
<th>Species</th>
<th>Low competition (≤50)</th>
<th>Medium competition (50-70)</th>
<th>High competition (≥50-70)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C.auratus x C.carpio</td>
<td>0.21</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C.auratus x A.mossulensis</td>
<td>0.22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C.carpio x A.marmid</td>
<td>0.39</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.luteus x A.mossulensis</td>
<td>0.35</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.luteus x C.carpio</td>
<td>0.41</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C.carpio x A.mossulensis</td>
<td>0.41</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.luteus x A.mossulensis</td>
<td>0.43</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A.marmid x A.mossulensis</td>
<td>0.51</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C.carpio x B.xanthopterus</td>
<td>0.69</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C.auratus x B.luteus</td>
<td>0.90</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A.vorax x S.triostegus</td>
<td>0.99</td>
<td></td>
<td></td>
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</table>
4- Discussion

One of the steps to understand community structure is to estimate the overlap in using resources among different species. The most common resources measured in order to calculate overlap are food and space (niche) (Bagenal, 1978). Therefore, the productivity level and diverse ecology of the three studied southern marshes reflect the degree of specialization, diet overlap and competition between resident, introduce and diadromous marine species.

Previous authors like Al-Kanaani (1989) and Hussain et al. (1992) postulated that the feeding competition between fish species in East Hammar marsh were negligible due to the occurrence of major food items in enough quantities which offset competition and represent positive case of food partitioning.

Diet composition of examined species were impartial agreement with previous studies.
concerned with food habit like (Dawood, 1986, Hussein and Al-Kanaani 1989 and 1991) on food of C. carpio and A. vorax and Al-Daham et al. (1992) on B. xanthopterus in Al-Hammar marsh. Recently was noticed prey-predator relationship so clear in A vorax and S. triostegus that were pescivorous feeder on small fish (ARID 2006 and Hussain et al 2008a).

The desiccation of marshes affect the structure of the bottom soil in addition to be burn several times, led to change their properties chemically and physically from soft sediments to hard ceramic substance as stated by Fitzpatric (2004), becoming hard to be recolonized again by benthos communities which formed favorite food for several cyprinid fish species (e.g. B. xanthopterus and B. grypus). C. carpio become unable to suck the sediments to extract the benthic organisms and forced to alter its diet to be omnivorous instead previously known as carnivorous (Dawood 1986).

It is well known that the feeding and trophic relationships of fish change with availability of food, locality and spatial distribution within the habitat (Bagenal, 1978). The desiccation of the marshes alter largely inter and intra specific relations of the fish community and brought major changes in the structure due to harsh environment prevailing and to change in ways of productions especially primary production of aquatic plants and phytoplankton, consequently change in secondary productivity of zooplankton and macroinvertebrate.

Huge occurrence of alien species like C. auratus effect the marsh feeding relationships and competed with native species like benni B. sharpeyi and Himree B. luteus. It was known that the occurrence of exotic species like C. carpio affect the abundance of other native species like B. xanthopterus and B. kersin (Al-Kanaani 1989) The same was noticed in Shadegan marshes/southern Iran by introduction C. auratus and Hypophthalmichys molitrix which competed heavily with B. sharpeyi (Evans 2002).

Leven's breadth index of the three studied marshes showed difference in species specialization because these marshes were ecologically different. East Al.Hammar is brackish tidal marsh, Al-Huweya is freshwater non-tidal marsh and Suq Al-shuyoak is oligosaline non-tidal marsh, consequently they were different in production level and food webs existed in each of them. C. carpio is generalized feeder in the three marshes, A. mossulensis only in two of non-tidal marshes (Al-Huweya and Suq Al-shuyoak). The higher number of generalized feeders was in Suq Al-shuyoak could be to low restoration percentage in comparison with other two studied marshes (IMRP, 2006 and ARID, 2006). Degree of specialization of species was variable from one marsh to another like Labu score 0.44, 0.02 and 0.31 in East Hammar, Al-
Huweyza and Suq Al-shuyoak respectively, the same for *B. sharpeyi*. Other species were strictly specialized like *A. vorax* and *S. triostegus* because they are predator species.

High competition and trophic overlap exist between *C. auratus* and *B. luteu*, the first is alien or introduce species, the second is native one. *C. auratus* is more abundant in the three studied southern marshes than *B. luteu* according to Hussain et al. (2008b).

Fierce competition between *S. triostegus* and *A. vorax* both species fed on small fishes even they occupied different niche, the first is ambush feeder between aquatic plants while the second is open water chaser. Before desiccation *A. vorax* supplemented its diet with insect and crustacean by 50% because benthos communities did not recover enough to support it, while *S. triostegus* previously had mixed diet of fishes, frogs and crabs.

Mild overlap and diet competition (0.69) existed between *B. xanthopterus* (native species) and *C. carpio* (alien species), the first occur in low numbers in comparison with the second, competition was previously noticed by Al-Kanaani (1989) i.e before drainage of the marshes.

Cluster analysis of Morisita index of present study was fundamentally different from that before desiccation (Hussain and Ali, 2006) and even the species association were altered due to change in food resources availability and destructive effect of desiccation on the marshes environment.

Further comprehensive studies concerning with food partitioning and diet overlap among different species might be considered particularly important in case of introduced species (alien species) with native species.

5- References


التنافس والتعاون والتداخل الغذائي لجمع الأسماك في الاهوار المسترجة في جنوب العراق

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ملخص
التناقص والتخصيص والتداخل الغذائي درس في ثلاثة اهوار مسترجة وهي (البحثية، سوق السبع، وشرق الحماس) أن التنافس المستحيلة تفيد بأن غالبية أنواع الأسماك المدرسة هي متخصصة والاقلية هي عامة التنافسية وتتمد على نسبة استرجاع ثلات هذه الأهوار والثلاث وتوفر الغذاء المناسب.

وجدت أربعة حالات موجهة من التنافس الغذائي بين الكاراسين والحمري والكرب والكتان والسمان الجربخ والسمان الشيف (Carassius auratus، Barbus luteus، Cyprinus carpio; Barbus xanthopterus Acanthobrama marmid، Aspius vora و Silurus striostegus) :Alburnus mossulensis.

ثلاث مجاعات تغذوية تحتوي على عدة أنواع وهي (اللواء، الفوازير، العوالاب) ومجموعتين تحويلات على أنواع مفردة هي الفئاته والاقاعية.

ينبغي أن الأنواع المدرسة تغير غذائها عما يعرف منها سابقًا وتضم الأنواع النهرية بشقها (المستوطنة والتداخل) مثلاً أن الكاراسين غير من عاداته الغذائية وكذلك الكرب الذي أصبح قاتر، أما الشكل والجري فتحولت إلى متفردة للأسماك.