Invasive fish in Dutch aquatic systems

A blessing or a curse?

Martijn Dorenbosch
Introduction

• Backgrounds on non-native fish in the Netherlands.
• Possible positive and negative impacts.
• Example species.
• Management strategies.
Introduction

- At present, 26 species of non-native fish in the Netherlands.
- Rapid increase in the last two decade.
- Ponto-Caspian species.
Introduction

• How did non-native enter Dutch aquatic systems?
• Almost 50% wanted introductions.
• Since 1995, invasions of Ponto-Caspian species since opening Main Donau channel (1992).

First records of non-native fish in Dutch waters

1992: Main Donau channel
Example species non-native fish

Wanted introduction
- Pikeperch
- Carp

Escaped
- Eastern mudminnow
- Pumpinkseed

Unwanted invasion
- Round goby
- Pontian bighead goby
Possible impacts of non-native fish

+ 
  - Stimulation of commercial and recreational fisheries.
  - Biologic control of other invasive species.
  - Function as new food sources for piscivorous.

- 
  - Introduction of diseases, parasites.
  - Competition / exclusion of native congeneric species.
  - Impact on the structure of the food web.
  - Impact on water quality by mobilizing nutrients / predation of zooplankton.
  - Genetic threats: hybridisation.
Common carp (≈ 1500’s)

+  - High economic value: Dutch turnover of carp angling industry 30 – 60 million euro.

-  - Strong negative impact on waterquality.

Schiphouwer et al., 2016; Lougheed et al., 1998
Pikeperch (1888)

+ - High economic value for commercial and recreational fisheries.
  - ‘Accepted’ as part of the Dutch fauna.

- - Top predator, can impact distribution of prey fish.
  - In Netherlands, no clear impact on native fish.
  - Turkey: strong predation on native fish.
  - Possible relation with P loading and Pike populations.
Grass carp (≈ 1970)

- Consumption of waterplants.

Dorenbosch & Bakker, 2012
Grass carp (≈ 1970)

+ Consumption of waterplants.

- Biological control of invasive waterplants.
- Triploïd grasscarp control dense fields of *Hydrilla verticillata* in Florida.

*Hydrilla growth before introduction*  
*Hydrilla eliminated after introduction*
Pumpkinseed (≈ 1900)

+ None described.
- Strong negative impact on macro-invertebrates and amphibians in moorland pools.

<table>
<thead>
<tr>
<th></th>
<th>Without pumpkinseed (N = 4)</th>
<th>With pumpkinseed (N = 4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trioclada</td>
<td>13.2 ± 6.1</td>
<td>0.0 ± 0.0</td>
</tr>
<tr>
<td>Gastropoda</td>
<td>847.2 ± 458.3</td>
<td>188.0 ± 167.1</td>
</tr>
<tr>
<td>Harpaticulina</td>
<td>11.5 ± 5.1</td>
<td>0.0 ± 0.0</td>
</tr>
<tr>
<td>Oligochaeta</td>
<td>170.7 ± 58.2</td>
<td>5.0 ± 1.5</td>
</tr>
<tr>
<td>Araneida</td>
<td>6.7 ± 6.2</td>
<td>1.5 ± 0.7</td>
</tr>
<tr>
<td>Acarina</td>
<td>107.2 ± 38.4</td>
<td>98.5 ± 13.3</td>
</tr>
<tr>
<td>Isopoda</td>
<td>34.5 ± 19.5</td>
<td>1.3 ± 1.3</td>
</tr>
<tr>
<td>Odonata</td>
<td>40.3 ± 6.7</td>
<td>5.4 ± 4.2</td>
</tr>
<tr>
<td>Ephemeroptera</td>
<td>49.7 ± 39.3</td>
<td>5.0 ± 2.3</td>
</tr>
<tr>
<td>Heteroptera</td>
<td>85.7 ± 19.3</td>
<td>8.3 ± 3.7</td>
</tr>
<tr>
<td>Megaloptera</td>
<td>1.2 ± 1.2</td>
<td>0.0 ± 0.0</td>
</tr>
<tr>
<td>Coleoptera</td>
<td>32.2 ± 17.2</td>
<td>3.0 ± 1.1</td>
</tr>
<tr>
<td>Diptera</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chaoboridae</td>
<td>1.3 ± 1.3</td>
<td>0.0 ± 0.0</td>
</tr>
<tr>
<td>Culicina</td>
<td>0.2 ± 0.2</td>
<td>0.0 ± 0.0</td>
</tr>
<tr>
<td>Chironomidae</td>
<td>560.3 ± 247.5</td>
<td>31.7 ± 5.9</td>
</tr>
<tr>
<td>Centopogonidae</td>
<td>44.0 ± 8.0</td>
<td>4.2 ± 1.5</td>
</tr>
<tr>
<td>Tabanidae</td>
<td>0.0 ± 0.0</td>
<td>0.2 ± 0.2</td>
</tr>
<tr>
<td>Trichoptera</td>
<td>25.2 ± 22.3</td>
<td>0.0 ± 0.0</td>
</tr>
<tr>
<td>Lepidoptera</td>
<td>1.3 ± 0.6</td>
<td>0.0 ± 0.0</td>
</tr>
<tr>
<td>Total *</td>
<td>2032.2 ± 327.2</td>
<td>352.1 ± 8.6</td>
</tr>
</tbody>
</table>

* P ≤ 0.05 (Mann-Whitney U-test)

Van Kleef et al., 2010
Round goby (2004)

- Strong negative impact on native bullhead in the Meuse river.

Van Kessel et al., 2013; 2016
Round goby (2004)

- Competition for food.

Potential prey item: Bullhead Round goby
Crustacea Dikerogammarus villosus << 0.03 0.03
Crustacea Dikerogammarus villosus >> 0.09 0.03
Isopoda Assellus aquaticus 0.85 0.83
Odonata Calopteryx splendens 0.06 0.01
Trichoptera 0.03 0.01
Mollusca Dreissena rostriformis 0.04 0.01
Mollusca Unio pictorum << 0.05 0.01
Mollusca Corbicula fluminea >> 0.07 0.01
Mollusca Corbicula fluminea << 0.05 0.02
Mollusca Acroloxus lacustris 0.04 0.02
Mollusca Radix peregra 0.05 0.02
Mollusca Viviparus viviparus 0.06 0.02

1 Mixsir $^{15}$N/$^{14}$N & $^{13}$C/$^{12}$C isotope mixing model
Round goby (2004)

+ Round goby can function as important prey for piscivorous fish and birds.

- Great lakes: 85% diet of Couble crested cormorants existed out of Round goby.

- Other consumers: Watersnakes, Herons, Perch, Pikeperch, Pike.
Managemant strategies

Decrease settlement chances

→ smart habitat design
→ application of natural structures
  (large woody debris)

Dorenbosch et al., 2015
Managemant strategies

Eradication of populations in isolated pools.

→ dredging of pools.

→ application of biocides.
Managemant stategies

Controlled fish stocking.

→ Controlled stocking of carp by recreational fisheries.

→ Triploïd grasscarp as biological control of invasive waterplants?