COMPOSITION AND RICHNESS OF INTESTINAL HELMINTH COMMUNITIES IN POPULATIONS OF EEL, ANGUILLA ANGUILLA – EXAMPLES FROM CROATIA AND AUSTRIA

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Aims of the study

- To investigate the intestinal helminth community of stocked eels from two different sites in Neusiedler See and from differnt locations with natural eel populations in Croatia
- To analyse qualitative and quantitative changes and differences in endoparasite communities relative to sites, seasonal aspects and host size
- To observe potential effects of changing host (fish) communities on parasite communities
- To compare the eel parasite fauna from freshwater, brackish and marine systems

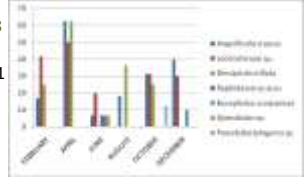
Croatian part

Croatian study area

- karstic Zrmanja River (69 km) of the Adriatic Sea basin (graveled bottom)
- Neretva river delta (biggest wetland area in Croatia)
- 131 of eels, April 2006 - February 2007

Zrmanja

- *Anguillicola crassus* 30%, 2
- *Deropristis inflata* **37%, 48**
- *Lecitochirium* sp. 35%, 2.7
- *Raphidascarus acus* 6.7%, 1
- *Bucephalus scorpaenae* 8.3%, 23
- *Pseudodactylogyrus* sp. 12.5%, 1
- *Opecolidae* 6.7%, 2

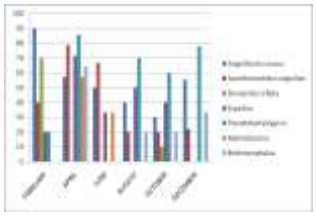


Zrmanja

	April	June	August	October	December	February
No. of species	2	4	1	2	2	2
No. of helminths	878	60	48	26	9	21
Shannon-Wiener index	0,03	0,72	0	0,62	0,35	0,56
S-W Evenness	0,04	0,52	0	0,89	0,5	0,81
Simpson's index	1	0,59	1	0,55	0,77	0,6
Berger-Parker index	1	0,75	1	0,69	0,88	0,75
Dominant species	*D.i.*	*B.s.*	*D.i.*	*D.i.*	*L.sp.*	*L.sp.*

Neretva

- *Anguillicola crassus* **53.7%, 2.8**
- *Deropristis inflata* 40%, 16
- *Bothriocephalus claviceps* 34%, 3.5
- *Raphidascarus acus* 45%, 4%
- *Acanthocephalus anguillae* 41%, 14
- *Pseudodactylogyrus* sp. 63%, 9.3
- *Ergasilius sieboldi* 43%, 13



Neretva

	April	June	August	October	December	February
No. of species	3	2	2	3	2	2
No. of helminths	150	62	6	43	102	104
Shannon-Wiener index	0,7	0,49	0,64	0,95	0,32	0,25
S-W Evenness	0,64	0,71	0,92	0,87	0,46	0,36
Simpson's index	0,61	0,68	0,47	0,41	0,82	0,87
Berger-Parker index	0,76	0,8	0,67	0,53	0,9	0,93
Dominant species	*A.a*	*A.a.*	*B.c.*	*A.a.*	*A.a.*	*D.i.*

Summary

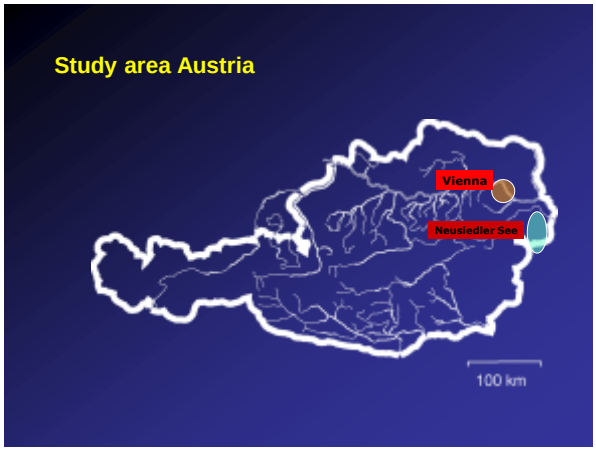
- Component community:10 helminth/ copepod, 3 myxozoan, 1 protozoan
- Zrmanja dominated by *Deropristis inflata*
- *A. crassus* more abundant and dominant in Neretva
- Structure and quantity - salinity

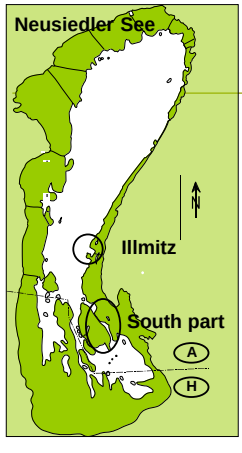
Introduction

The first part of this study investigated the endoparasitic helminths of eels, *Anguilla anguilla*, an allochthonous species maintained by regular massive stockings in Neusiedler See, Austria

After the prohibition of eel stocking in the early 90ies due to National Park Management the population was predicted to decline to extinction within 20 years

The study focused on the long-term development of the composition and richness of intestinal helminth communities and on the dynamics of the *Anguillicola crassus* infection





Study area - Austria

- Size: 320 km^2
- Mean depth: 0,8 m
- Max. water temp.: > 30°C
- Conductivity: > 2000 µS
- Half of the lake is covered by a reed belt
- Massive eel stockings since 1958
- Eel stocking prohibited after 1993
- Eel expected to be extinct within 20 years

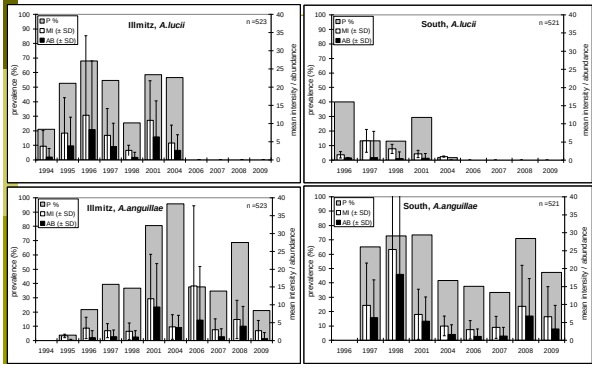
Material & Methods

- Eel sampling from **1994 to 2009** in Neusiedler See, Austria
- **1044** eels (size range 10,5 - 82,0 cm, mean size 42,6 ± 10,4 cm S.D.), caught by electro fishing, from two sampling sites (Illmitz & South) in the reed belt were investigated

Intestinale Parasite Community (Illmitz & South part)

Location	Illmitz			South		
No. of eels examined	523			521		
Parasite species	P%	MI (S.D.)	Abund. (S.D.)	P%	MI (S.D.)	Abund. (S.D.)
Acanthocephalus lucii	**48,18**	8,84 (15,08)	4,26 (11,35)	9,02	3,81 (5,43)	0,34 (1,95)
Acanthocephalus anguillae	28,11	5,76 (8,69)	1,62 (5,28)	**57,39**	11,06 (20,05)	6,35 (16,14)
Bothriocephalus claviceps	9,94	2,33 (2,62)	0,23 (1,07)	9,02	5,94 (12,33)	0,54 (4,04)
Proteocephalus macrocephalus	13,19	3,04 (3,20)	0,40 (1,55)	6,53	3,85 (3,80)	0,25 (1,35)
Raphidascaris acus.	1,34	4,57 (8,60)	0,06 (1,06)	3,07	4,19 (7,24)	0,13 (1,43)
Camallanus trunctatus	-	-	-	0,19	1,00	0,002 (0,04)

Parasite community - sampling sites & years

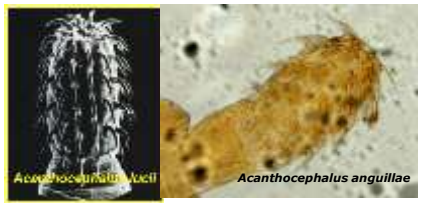


The effects of host size, season of sampling and year of study on A. lucii & A. anguillae

- All three parameters had a significant influence on the prevalence, mean intensity and mean abundance of *A. lucii* and *A. anguillae* in both sites
- Both acanthocephalan species exhibited higher infestation levels in larger eels and in different seasons of the year and the infestation parameters were significantly different between the years of study

Composition of the parasite community

- The intestinal helminth community was composed of six species:2 acanthocephalan, 2 cestode and 2 nematode species
- Acanthocephalans dominated the parasite community



Component community profiles

	Illmitz										South								
	1994	1995	1996	1997	1998	2001	2004	2006	2007	2008	2009	1996	1997	1998	2001	2004	2006	2007	2008	2009
No. of species	2	5	5	5	5	5	4	3	2	3	3	2	5	5	5	5	2	3	4	4
No. of helminths	17	637	1292	190	161	675	154	101	25	105	80	18	1313	1469	242	107	73	80	359	319
Shannon-Wiener index	0,52	0,36	0,79	1,49	2,07	1,22	1,32	0,50	0,24	1,02	1,42	0,65	0,74	0,27	1,27	0,46	0,97	0,91	1,32	1,56
S-W Evenness	0,52	0,16	0,34	0,64	0,89	0,53	0,66	0,32	0,24	0,65	0,89	0,65	0,32	0,12	0,55	0,20	0,97	0,57	0,66	0,78
Simpson's index	1,26	1,11	1,32	2,18	4,02	2,1	2,21	1,20	1,08	1,92	2,47	1,38	1,32	1,07	1,73	1,14	1,92	1,59	1,86	2,75
Berger Parker index	0,88	0,95	0,87	0,64	0,3	0,57	0,55	0,91	0,96	0,62	0,51	0,83	0,87	0,97	0,75	0,93	0,60	0,76	0,71	0,45
Dominant species	A. l.	A. l.	A. l.	A. l.	A. l.	A. a.	A. a.	A. a.	A. a.	A. a.	P. m	B. c.	A. a.	A. a.	A. a.	A. a.	A. a.	A. a.	A. a.	B. c.
Ratio A. l. : A. a.	15:0	76:1	11:01	3,4:1	1,3:1	0,7:1	0,7:1	-	-	-	-	0,125	0,1:1	0,02:1	0,1:1	0,01:1	-	-	-	-

- Max. number of parasite species 5
- Dominant species in Illmitz up to 2001 was *A. lucii* after 2001 *A. anguillae*, in 2009 cestodes took over
- South part of the lake dominated by *A. anguillae*

Infracommunity profiles

	Illmitz										South									
	1994	1995	1996	1997	1998	2001	2004	2006	2007	2008	2009	1996	1997	1998	2001	2004	2006	2007	2008	2009
Tot. Nr.eels	19	156	134	33	41	41	23	16	23	18	19	5	180	77	34	60	40	51	38	36
mean Nr helminths	0,9	4,1	9,6	5,8	3,9	16,5	6,7	6,3	1,1	5,8	4,21	3,6	7,3	19,1	7,1	1,8	1,8	1,6	9,4	8,9
STD	2,4	7,9	19,7	7,9	5,2	19,1	6,2	14,9	2,3	6,2	5,41	7,0	11,9	34,9	7,8	2,8	3,1	2,8	13,4	15,1
mean Nr species	0,3	0,7	1,1	1,4	1,4	1,7	1,7	0,8	0,4	1,2	1,05	0,6	0,8	1,0	1,4	0,5	0,6	0,5	1,1	1,3
STD	0,5	0,7	0,8	0,9	1,1	0,8	0,8	0,8	0,5	0,6	0,71	0,9	0,7	0,7	0,9	0,7	0,7	0,6	0,7	1,0
max sp per eel	1	3	3	3	4	4	3	2	1	2	2	2	3	3	4	3	2	2	3	3
mean BI	0,0	0,1	0,1	0,3	0,3	0,3	0,3	0,1	0,0	0,1	0,15	0,1	0,1	0,1	0,2	0,1	0,1	0,1	0,1	0,2
% 0-1 spec.	100,0	90,4	69,4	51,5	53,7	41,5	47,8	81,3	100,0	72,2	73,68	80,0	86,7	76,6	55,9	93,3	90,0	94,1	78,9	55,6

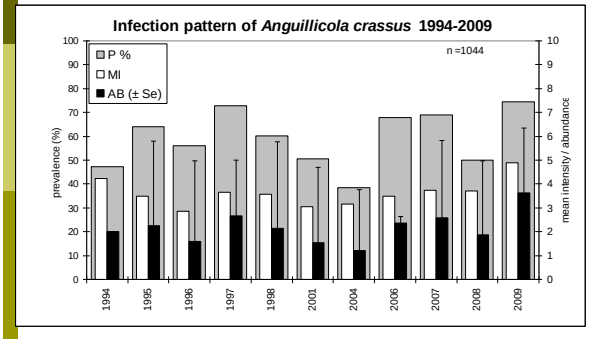
- Max. number of species per eel = 4
- Highest number of parasite-species and specimen/eel in Illmitz
- Proportion of eels with 0 or 1 parasite species decreased until 2001 & increased until 2009 again

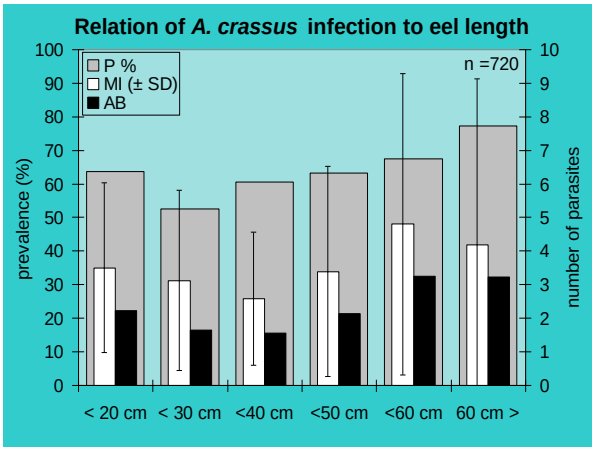
The population dynamics of Acanthocephalus lucii & A. anguillae

- Between 1994 and 2004, the intestinal parasite community of the sampling site in Illmitz, which was originally dominated by ***A. lucii***, changed, as levels of ***A. anguillae*** increased to a point at which it dominated the community
- The southern sampling site remained rather constant with a continuously high infection level of ***A. anguillae*** and low abundance of ***A. lucii***
- After 2004, ***A. lucii* completely disappeared** in both sampling sites, whereas *A. anguillae* remained at constant levels

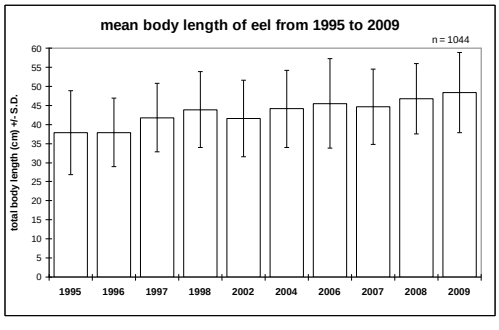
Anguillicola crassus in Neusiedler See

Results – *A. crassus*

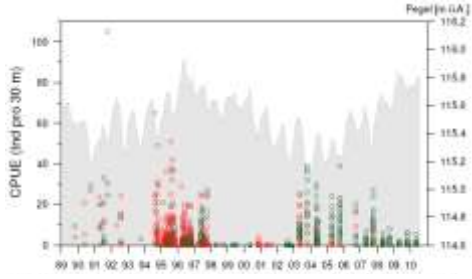




Eel body lenght

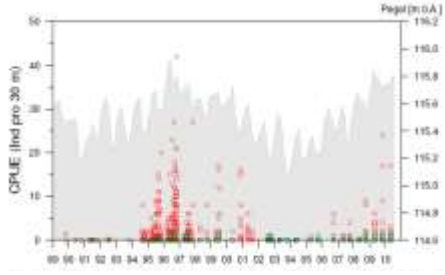


Population dymamics of Anguilla anguilla



Long- term trend (1989-2010) in the stock of *Anguilla anguilla*; red = reed belt; green = edge of reed belt, grey shading = water level (Wolfram et al. 2010)

Population dymamics of Perca fluviatilis



Long- term trend (1989-2010) in the stock of *Perca fluviatilis*; red = reed belt; green = edge of reed belt, grey shading = water level (Wolfram et al. 2010)

Summary

The parasite community showed characteristics similar to those in the natural eel populations in rivers of the U.K. and mainland Europe: it was species poor, with only 5 species comprising the **component community** and a maximum **infracommunity** richness of 4 species.

Summary

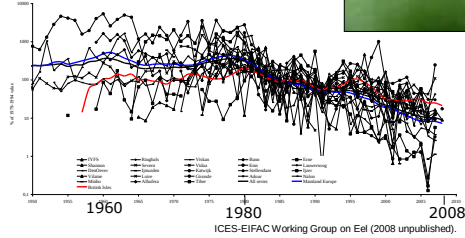
- Significant differences in the abundance and prevalence of *A. lucii* and *A. anguillae* between the two sampling sites and over the years were observed
- Both acanthocephalans have the same intermediate host (*Asellus aquaticus*) and sampling sites are similar except their fish community
- Perch (*Perca fluviatilis*) is the preferred final host of *A. lucii* and eel (*Anguilla anguilla*) is the preferred final host of *A. anguillae* in Neusiedler See
- Due to the higher abundance of perch in Illmitz until 2001 more *A. lucii* were introduced to the parasite community and hence dominated the parasite community of Illmitz

Summary

- Perch population crashed in 2003 when the complete reed belt fell dry and *A. lucii* disappeared after 2004
- Eel population declined but not as drastically as perch and *A. anguillae* remained at constant infestation levels in both sampling sites after 2004
- **Hence changes and differences in the fish communities of the two sampling sites rather than interspecific competition seem to be possible explanations for the differences in the parasite communities of the two sites in Neusiedler See**

The European eel stock in decline

Trend in glass eel recruitment in Europe

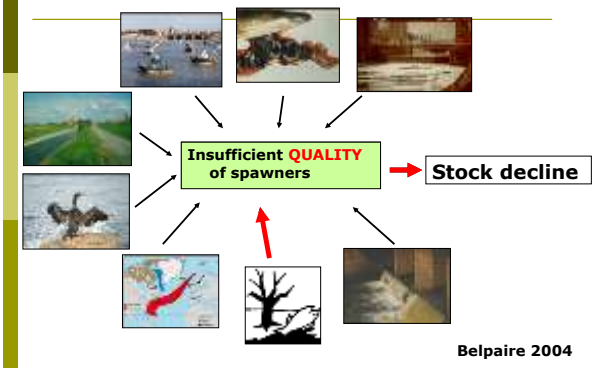


ICES-EIFAC Working Group on Eel (2008 unpublished).

Possible reasons for decline of eel stocks

- Over-fishing
- Pollution
- Loss of habitats
- Barriers to migration
- Climatic and oceanic changes
- Parasites and diseases

Possible reasons for decline of eel stock



Belpaire 2004

Combination of approaches,

integration of host-parasite ecology, fish pathology, ecotoxicology and environmental factors

Provide a tool for the detailed assessment of " the ecological status of aquatic systems"

Thanks to:

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