Please find the reasons I sent the **attached** information for the committee. The committee asked SNH and SEPA to supply all this on the 26 May 2015.

1. DR Scot Mathieson and Professor Colin Bean stated that they were to carry out a fishing competition to ascertain the number of fish in the Ken. This information has already been accumulated in the fishing results from match fishing over the years.

2. DR Bean also stated in his letter to me that they would support the community in the control of the crayfish as long as the RNBCC can find the funding. So we went out and found the funding and they still stated this would still be classed as a commercial operation – no matter whether it was self-funding or not.

3. Regarding the documents on transport of live Crayfish: this is allowed in all member states in the EU under free movement of trade. This was asked to be supplied to the committee on how the crayfish were controlled in Spain, Norway and Sweden.

4. The preferred method of control is trapping or chemical pesticide. Trapping is the preferred method, as this has the least environmental impact. Using commercial trapping licenses did not increase the spread into non-connected waters - this is quite often caused by birds (the Grey Herring and seagulls) transferring egg laden females. They also stated that they have been in talks with the management of the Ken - this is not factual, as none of the water bailiffs have been contacted or the management committee for the running of the infected areas of the Ken Dee.

5. Galloway Fisheries Trust, along with the rest of the trusts, are being disbanded and absorbed into SNH and SEPA and the fresh waters management of Scotland. The local fishery boards are being forcibly disbanded. None of the agencies that they are speaking to manage the infected areas of the Ken river system as far as fishing or aquatic wild life are concerned.

6. Still no bio cleaning equipment in place. All that is in place to stop the spread is one water bailiff, which is me. One Ranger has authority, which only applies to the registering the watercraft. He also has to cover the rest of Dumfries and Galloway - so we may see him once a week.

7. As for the comment, we are waving fingers in the air in creating 50 jobs, as we have lost 60. It would only be a fair prediction that the jobs would come back once the cause of losing them was dealt with and curtail the loss of £475,000 thousand per annum for the region.

Thank you for all your help in this matter.

John Thom
on behalf of the RNBCC

Dear Chris, 15. 6. 15

As requested by the Committee Please find enclosed reports from Norway, Sweden, and Spain. also reports on Legal Judgement, regarding AMERICAN Single Crayfish in the E. U

Catch reports are included from 2011 - 2015 on the decline on Catch Weight over this period

Yours
J. Thom

R.N.B.CC. KEN Dee Catchment.

Thank You

EASTER FESTIVAL 2015

Angler	DAY 1 LBS	DAY 1 OZS	Day 1 PTS	DAY 1 PEG	DAY2 LBS	DAY2 OZS	Day 2 PTS	Total Points	PEG	TOTAL WEIGHT LBS	TOTAL WEIGHT OZS	DAY3 LBS	DAY3 OZS	Day 3 PTS	Total Points	PEG	TOTAL WEIGHT LBS	TOTAL WEIGHT OZS
L Addy	11	8	1	B04	6	5	1	2	C12	17	13	28	0	1	3	A14	45	13
D Sixsmith	7	12	2	C09	13	2	1	3	A06	20	14	9	6	1	4	B05	30	4
R Yates	15	0	2	A11	12	2	2	4	B12	27	2	9	6	1	5	C02	36	8
E Brydon	10	4	4	C06	10	8	2	6	A05	20	12	45	4	1	7	B11	66	0
J Hines	4	9	4	B13	15	9	2	6	C01	20	2	17	6	1	7	A03	37	8
M Shaw	7	0	3	C10	19	4	1	4	A12	26	4	5	6	3	7	B07	31	10
M Stephens	6	10	2	A05	18	0	1	3	B05	24	10	1	8	4	7	C10	26	2
M Burkhill	15	6	2	C04	9	14	3	5	A04	25	4	28	0	3	8	B13	53	4
D Stephens	12	8	3	A12	8	10	3	6	B10	21	2	5	8	2	8	C04	26	10
J Traynor	9	8	2	B05	16	10	1	3	C05	26	2	8	4	6	9	A07	34	6
E Morris	18	8	1	C05	6	15	6	7	A01	25	7	8	2	2	9	B06	33	9
K Clarke	5	8	5	A02	9	0	3	8	B03	14	8	4	10	1	9	C13	19	2
K Gardner	14	8	3	C02	8	12	3	6	A10	23	4	25	0	4	10	B12	48	4
J Messer	10	9	1	B14	12	2	4	5	C03	22	11	8	12	5	10	A02	31	7
P Darwin	8	10	1	C12	8	6	4	5	A14	17	0	4	9	5	10	B04	21	9
Demo	5	14	5	B03	12	7	3	8	C04	18	5	10	2	3	11	A05	28	7
P Cox	6	0	3	B08	4	11	3	6	C10	10	11	8	6	5	11	A10	19	1
M Howarth	7	8	2	B12	4	12	2	4	C14	12	4	6	6	7	11	A06	18	10
N Bromilow	5	12	4	A01	7	6	4	8	B04	13	2	1	12	3	11	C12	14	14
S Stott	9	8	5	C01	5	12	5	10	A08	15	4	30	12	2	12	B14	46	0
C Stephens	18	12	1	A13	7	0	5	6	B06	25	12	1	4	6	12	C09	27	0
D Collier	9	4	3	B01	2	8	5	8	C13	11	12	10	7	4	12	A12	22	3
M Harris	4	10	6	A08	11	4	2	8	B01	15	14	3	12	4	12	C07	19	10
G Whalley	3	0	6	B07	3	14	4	10	C08	6	14	10	4	2	12	A04	17	2
S Lister	3	2	6	B09	11	15	5	11	C02	15	1	20	0	2	13	A13	35	1
S Moss	8	7	1	A04	1	8	7	8	B08	9	15	1	6	5	13	C14	11	5
S Wood	6	8	4	B06	10	0	6	10	C06	16	8	10	0	4	14	A01	26	8
C Fawley	3	2	7	A06	14	4	1	8	B11	17	6	1	6	6	14	C06	18	12
R Hines	4	14	4	C14	7	14	4	8	A02	12	12	3	7	6	14	B03	16	3
B Thomas	2	10	7	A10	7	10	4	11	B13	10	4	4	8	3	14	C03	14	12
M Trueman	6	8	3	A03	4	10	5	8	B14	11	2	1	4	6	14	C08	12	6
N Spencer	6	8	4	A09	2	8	6	10	B09	9	0	3	4	5	15	C05	12	4
I Fewtrill	3	4	6	A07	1	8	7	13	B07	4	12	2	8	2	15	C11	7	4
S Bilsbury	3	0	7	B11	8	2	7	14	C07	11	2	10	13	3	17	A11	21	15
D Barnes	4	8	5	C08	2	12	7	12	A07	7	4	11	10	5	17	B09	18	14
M Addy	1	9	6	C11	7	8	5	11	A03	9	1	8	4	6	17	B10	17	5
I Luker	5	12	7	C07	5	8	6	13	A11	11	4	4	12	4	17	B01	16	0
S Pendlebury	1	8	7	C13	13	6	2	9	A13	14	14	0	0	8	17	B08	14	14
B Stephens	3	7	5	B10	1	15	6	11	C11	5	6	6	11	7	18	A09	12	1
L Balshaw	6	6	5	A14	6	0	6	11	B02	12	6	0	0	8	19	C01	12	6
M Gillespie	7	8	6	C03	4	8	7	13	A09	12	0	2	14	7	20	B02	14	14
D Hughes	2	2	7	B02	1	9	7	14	C09	3	11	6	15	6	20	A08	10	10

2013 Club Matches.

The Ashes 2nd March 2013

Day (1)	1st	Chris Stephens	17lb	15oz
	2nd	Mike Shaw	12lb	10oz
	3rd	Phil Murphy	12lb	5oz
Day (2)	1st	Sam Pendlebury	18lb	4oz
	2nd	Steve Wood	17lb	12oz
	3rd	Phil Murphy	17lb	12oz

Easter Match 29th-31st March 2013

Day	1	Mike Shaw	24lb	2oz
"	2	Lee Addy	48lb	—
"	3	Paul Cox	28lb	7oz

Graham Dawes 25th-27th Sept 2013

Day	1	Jimmy Hines	32lb	6oz
"	2	Rick Yates	52lb	10oz
"	3	Barry Thomas	39lb	2oz

N.G.A.A 18th-20th Oct 2013

Day	1	Nigel Spencer	16lb	12oz
"	2	Eric Morris	37lb	—
"	3	Nigel Spencer	28lb	4oz.

Easter Festival 2012

	Name	DAY 1 LBS	DAY 1 OZS	DAY 1 PTS	DAY 1 PEG	DAY2 LBS	DAY2 OZS	DAY2 PTS	TOTAL PTS	PEG	TOTAL WEIGHT LBS	TOTAL WEIGHT OZS	DAY3 LBS	DAY3 OZS	DAY3 PTS	TOTAL PTS	PEG	TOTAL WEIGHT LBS	TOTAL WEIGHT OZS
→	G Taylor	16	0	1	B03	20	4	1	2		36	4	15	12	1	3		52	0
*	S Woods	34	4	1	B14	39	12	1	2		74	0	10	12	3	5		84	[illegible]
N.F.	C Fawley	7	10	2	C02	8	12	1	3		16	6	14	12	2	5		31	2
	K Dyall	10	8	1	A12	23	7	2	3		33	15	24	7	3	6		58	6
	M Hargreaves	12	8	2	B02	10	6	3	5		22	14	9	14	2	7		32	[illegible]
*	S Cocksey	6	12	5	A03	33	14	1	6		40	10	26	3	2	8		66	[illegible]
→	R Smith	13	8	1	C13	17	14	1	2		31	6	9	10	6	8		41	0
*	I Fewtrill	15	0	2	A05	15	0	5	7		30	0	26	4	1	8		56	4
*	E Bridon	16	8	5	B09	29	8	2	7		46	0	12	8	2	9		58	8
*	P Wilson	17	14	1	A04	15	11	4	5		33	9	12	10	4	9		46	3
*	M Howarth	12	1	2	C11	7	10	6	8		19	11	35	8	1	9		55	3
→	S Grimshaw	3	2	6	C04	7	2	2	8		10	4	33	6	1	9		43	[illegible]
→	L Griffiths	1	3	7	A10	29	15	2	9		31	2	32	12	1	10		63	[illegible]
*	J Messer	10	15	4	A02	24	12	3	7		35	11	13	4	3	10		48	[illegible]
*	C Stephens	6	0	5	C08	17	8	2	7		23	8	26	8	3	10		50	0
→	G Lambert	6	14	3	A08	13	4	3	6		20	2	24	6	4	10		44	8
*	J Traynor	6	10	4	A09	11	4	4	8		17	14	18	3	2	10		36	1
*	S Pendlebury	26	12	2	B11	15	2	5	7		41	14	4	0	4	11		45	[illegible]
N.F.	I Guest	19	12	3	B13	7	0	5	8		26	12	6	4	3	11		33	0
*	M Trueman	4	2	6	C10	5	10	3	9		9	12	26	9	2	11		36	5
*	S Bilsbury	8	0	4	B06	5	4	6	10		13	4	15	2	1	11		28	6
→	G Lambert	5	6	5	C07	15	8	3	8		20	14	19	4	4	12		40	2
→	M Birkhill	8	8	2	A11	10	4	5	7		18	12	22	9	5	12		41	5
*	P Trueman	11	10	6	B12	18	0	3	9		29	10	4	0	4	13		33	[illegible]
	D Collier	6	12	3	C05	8	0	5	8		14	12	3	12	5	13		18	8
*	N Bromillow	9	6	1	C06	7	0	7	8		16	6	12	6	5	13		28	[illegible]
*	A Howcroft	1	14	6	A13	27	10	1	7		29	8	0	0	7	14		29	8
*	N Spencer	3	0	6	B05	20	4	1	7		23	4	0	0	7	14		23	4

2012 Club Matches

N.G.A.A Match 26th Feb 2012

1st	Steve Wood	13lb	9oz
2nd	Nigel Spencer	11lb	10oz
3rd	Ian Whitson	10lb	2oz

N.G.A.A 4th March 2012

1st	Steve Wood	5lb	12oz
2nd	Neil Bromilow	5lb	4oz
3rd	Richie Vernon	2lb	—

Aug Bank Holiday 25th–27th Aug 2012

Day 1	Loyd Griffiths	20lb	8oz
" 2	Mark Howarth	33lb	8oz
" 3	Ian Fewtrell	19lb	8oz

Sept 5 Day 15th–20th Sept 2012

Day 1	Steve Wood	20lb	—
" 2	Jimmy Hines	21lb	4oz
" 3	Nigel Spencer	23lb	—
" 4	Neil Bromlow	15lb	8oz
" 5	Steve Wood	24lb	8oz

Rick Yates 24th – 26th Oct 2012

Day 1	Steve Cocksey	12lb	6oz
" 2	Mark Harris	17lb	2oz
" 3	Mick Gillespie	15lb	—

2011 Club Matches

The Ashes 13th Feb 2011

1st	Paul Cox	27lb
2nd	Demo	17lb 8oz
3rd	Ewan Weed	17lb 1oz
4th	Steve Wood	15lb 10oz

Ewan Weed 20th Feb 2011

1st	Steve Wood	22lb 12oz
2nd	James Wood	19lb 6oz
3rd	Frank Smith	17lb 9oz

John Turton 15th–17th April 2011

Day 1	Chris Stephens	13lb 15o
" 2	Eric Morris	14lb —
" 3	Scott Lister	15lb —

Eric Morris Easter

Day 1	Mick Birkhill	12lb 6oz
" 2	Nigel Spencer	16lb 10oz
" 3	John Turton	16lb 14oz

John Turton 22nd–24th July 2011

Day 1	Nigel Spencer	26lb 8oz
" 2	Steve Wood	34lb 4oz
" 3	Steve Wood	22lb 10oz

Aug Fest

Day 1	Steve Wood	39lb 12oz
" 2	Mark Howarth	35lb 8oz
" 3	Nigel Taylor	18lb 14oz

John Turton 21st–23rd Oct 2011

Day 1	Steve Wood	15lb 10oz
" 2	Steve Wood	17lb 12oz
" 3	John Traynor	25lb 4oz

LOCH KEN MATCH RESULTS 2011

JOHN TURTON FESTIVAL

DAY 1	18th JULY 2011	1ST	N. SPENCER	26-8-0
		2nd	I. FEWTRELL	24-8-0
		3rd	K. CLARKE	23-0-0
DAY 2	19th JULY 2011	1st	S. WOOD	22-10-0
		2nd JOINT	J. TURTON	22-4-0
			C. STEVENS	22-4-0
		3rd	M. HYDE	18-0-0
DAY 3	20th JULY 2011	1ST	M. HOWARTH	46-0-0
		2nd	M. BIRKHILL	29-6-0
		3rd	DEMO	24-2-0

RICHARD YATES CLUB MATCH 3 DAY FESTIVAL 27th–29th JULY 20

THREE DAY OVERALL WEIGHT	1ST	D. BRIERLEY	64-12-0
	2nd	L. BALSHAW	61-3-0
	3rd	N. BROMLOW	59-15-0

BURTREE ANGLING CLUB

DAY 1	11th AUG 2011	1ST	D. SUTTON	31-11-0
		2nd	K. WOOD	15-7-0
		3rd JT	G. ATKINSON	12-8-0
			G. CLARKE	12-8-0
DAY 2	12th AUG 2011	1ST	G. CLARKE	24-15-0
		2nd	G ATKINSON	13-11-0
		3rd	D. SUTTON	12-14-0
DAY 3	13th AUG 2011	1ST	D. SUTTON	44-9-0
		2nd	G. CLARKE	37-6-0
		3rd	G. ATKINSON	26-2-0

	Name	DAY 1 31/8/11	DAY 2 1/9/11	TOTAL	DAY 3 2/9/11	TOTAL
1	FRANK.					
2	ANDY BARKER.	4-3.	11-4	15-7.	[illegible]	/
3	S RAPER.	11-9.	15.4	26-13.	10.4	37.1
4	D. BEEVERS.	2-9.	1-10	4-3	—	4-3
5	J. HOLDSWORTH.	3-10	3-2	6-12	14.3	20.15
6	S FEARNLEY.	3-6	1-13	5-3	16.3	21-6
7	P. CLARK.	16-15.	12-13.	29-12	11-12	41.8
8	C. BARKER.	3-2.	3-11	6-13	3-2	9.15
9	M. THORPE.	1-5	8-6	9-11	20-12	30.7
10	IAN GOODALL	4-15.	3-5.	8-4	—	8.4
11	BOB RYMER.	5-15.	7-4	13-3	10.2	23.5
12	P. HYDE.	2-6	2-15.	5-5.	19-13	25.2
13	N. TAYLOR.	18-14..	5-11.	24-9	7-4	31.13
14	TOM RODGERS.	1-12.	4.14.	6-10	—	6-10
15	S. BURLEY.	5.2.	1-10	6-12	5-7	13.3
16	ANDY JACKSON.	11-3.	2-14.	14-1	—	14.1
17	KARL HEPPY.	14-0	4-9.	18-9.	—	18.9
18	NEIL RYMER.	12-11	12-6.	25-1.	10.10	35.11
19	SEAN R.	8-10	3-7.	12-1	—	12.1
20	DAVE MILES.	6-8	4-3	10-11.	4.8	15.3
21	STEVE WOODS.	15-6.	6-2½.	21-8½.	—	21.8½
22	TREVOR RYMER.	18.3.	8-9.	26-12.	17.12	44.8
23						
24	SEPT FESTIVAL	STEVE RAPER.				
25	2011					
26						
27						

The introduction of non native crayfish into Europe has, thus, had dramatic effects. Not only have they introduced and spread a fatal fungus to the native population, they also have disrupted the host community, reduced biological diversity, disrupted the host environment and community, and provided a now permanent source of spores for plague fungus. This in turn has caused a reduction in fish stock and slower growth of local fisheries, changed the diet of indigenous mammals and has had negative commercial implications within Europe. One might conclude that all European countries should make it their goal to protect the native crayfish population. However, as case C-131/93 illustrates, import restrictions between members of the European Union is contrary to the EC treaty. Therefore, are no easy answers as to what to do about the crayfish problem within the European Union.

3. Related Cases

BLUECRAB case	*FLORIDA* case
EUMEAT case	*LOBSTER* case
MUSSEL case	*SEACUKE* case
BALLAST case	*CAJUN* case
CRAWFISH case	*HAWAII* case
CAT case	*HOOF* case
SHRIMP case	*SHRIMP2* case
INDSHRMP case	*APPLEMX* case

Keyword Clusters

(1): Trade Product = CRAYFISH

(2): Bio-geography = TEMPERATE

(3): Measure = Regulatory Standard [REGSTD]

4. Draft Author: Christian S. Larson May 12, 1998

IDENTIFICATION LEGAL GEOGRAPHY TRADE ENVIRONMENT

B. LEGAL CLUSTERS

5. Discourse and Status: DISagree and COMPlete

There was originally a disagreement between the Commission and the Federal Republic of Germany concerning restrictions about the importation of live crayfish for commercial purposes. However, following the decision of case C-131/93 in 1994, there has been no further recourse. The decision stated that a law restricting intra-Community trade was contrary to ARTICLE 36 of the EC treaty. This article essentially states that a member state can not impose trade restrictions against another member state of the European Union.

6. Forum and Scope: EURCOM and REGION

The original decision was based on a national law within the Federal Republic of Germany. (Bundesnaturschutzgesetz) The Bundesnaturschutzgesetz is a general law with the goals of nature protection and landscape conservation. In particular, it aimed to maintain and develop (1) the efficiency of the ecosystem, (2)the utilization of natural resources, (3)the plant and animal world and the variety and beauty of the natural landscape. However, other non-German States within the EU protested against the regulation based on the Bundesnaturschutzgesetz, stating that it discriminated against non-German distributors of crayfish.

7. Decision Breadth: 15 (EURCOM)

This decision directly affected 15 member states of the European Union as the decision affirmed that trade restrictions could not be imposed against member states. However, with discussion of a possible enlargement of the European Union, other states may be affected in the future. Such states could, include Turkey, Cyprus, Malta, Switzerland, Hungary, Poland, Rumania, Slovakia, Latvia, Estonia, Lithuania, Bulgaria, the Czech Republic, and Slovenia.

8. Legal Standing: LAW

All decisions handed down by the European Court of Justice must be followed by all member states and supersede all national laws. The primary responsibilities of the European Court of Justice are to interpret treaties (such as the Treaty of Rome) and EU legislation which is often vague due to attempts at consensus building. In addition to adjudicating intra-community disputes, the ECJ has the task of ensuring that member states comply with all decisions. Community case law, of which case C-131/93 is an example, has proved to be a vehicle for advancing the objectives of the Treaty of Rome. (Dinan, 1994, 301) Among these objectives are the common external tariffs, a customs union and the free movement of goods, persons, services, and capital.

IDENTIFICATION LEGAL GEOGRAPHY TRADE ENVIRONMENT

C. GEOGRAPHIC CLUSTERS

9. Geographic Locations

a. Geographic Domain : EUROPE

b. Geographic Site : Western Europe [WEUR]

c. Geographic Impact : GERMANY

Since Germany was the sole state being sued by the European Commission, it was the primary party affected. However, all states within the union are required to follow the decisions of the European Court of Justice. Thus, all states within the European Union are prohibited from restricting trade within the union.

10. Sub-National Factors: NO

German importers of crayfish are, once again, obliged to compete with all other importers of live crayfish from within the European Union. They can no longer enjoy the barriers to trade as established by the BUNDESNATURSCHUTZGESETZ even though the Germans contend that such trade might have negative effects to the local fauna within Germany.

11. Type of Habitat: TEMPERATE

IDENTIFICATION LEGAL GEOGRAPHY TRADE ENVIRONMENT

D. TRADE CLUSTERS

12. Type of Measure: Import ban [IMBAN]

The Federal Republic of Germany placed a ban on the importation of crayfish in an effort to protect native species from a deadly fungus known as Aphanomyces astaci. The European Court of Justice, however, ruled that member states can not implement import bans against other member states. As a result Germany was forced to lift the ban. Precedents for such free movement of goods was made in 1979 when the court handed down its ruling in the now famous *Cassis de dijon* decision. This decision essentially allowed the Commission to develop the principle of mutual recognition. Mutual recognition is one of the most important elements behind the concept of a single market. Mutual recognition was defined as...

> Any product imported from another member state must in principle be admitted ... if it has been lawfully produced, that is, conforms to rules and processes of manufacture that are customarily and traditionally accepted in the exporting country, and is marked in the territory of the latter.(Dinan, 1994, 117)

This is why states find it necessary to implement import bans only against non-member states. Such action is not contrary to the trade laws of the European Union since these import bans are only against states outside of the European Union.

13. Direct vs. Indirect Impacts: DIRect

The German law in question, the Bundesnaturschutzgesetz, provided the legal basis for the German government to directly ban the importation of live crayfish except for the purposes of research or teaching. The Bundesnaturschutzgesetz was implemented to protect the nature and landscape of Germany. In particular, it was enacted in an attempt to maintain a healthy and viable ecosystem. Such aspects of the ecosystem like the soil, water, air, climate,vegetation and animals were protected. This law is relevant to Germany's decision to ban the importation of live crayfish since it guarantees the protection of the habitat and living conditions of native species. The crayfish plague carried by foreign species of crayfish was seen as a threat to the habitat and living conditions of natural species of German crayfish. Since the import restriction was overturned by the European Court of Justice, no ban exists prohibiting the importation of live crayfish into Germany from member states of the European Union.

14. Relation of Measure to Environmental Impact

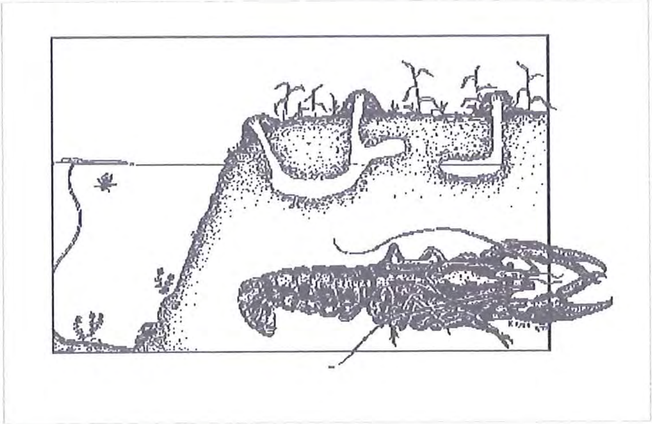
a. Directly Related : YES

b. Indirectly Related : NO

c. Not Related : NO

d. Process Related : YES

The ban against the importation of live crayfish was implemented in an attempt to protect local fauna. Since imported crayfish may carry the crayfish plague, they may spread the disease to native, non-infected, individuals.This in turn would adversely affect the local ecosystem. The loss of crayfish would disrupt the food chain in Germany, denying mammals and fish an important part of their diet. This could potentially lead to overgrown waterways and other environmental



Burrows and Breeding

A crayfish burrow is a cone-shaped mound or "chimney" composed of mud pellets that mark the entrance to the burrow. Most burrows are located along the shoreline close to the water's edge. These burrows may range from a few inches to greater than 36 inches deep, and will be from 1/4 to 2 inches in diameter. Crayfish burrows may be dug straight down or at a slight angle. Burrows dug horizontally into a sloping bank often run straight for about a foot and then angle downward. Most burrows are capped with a compact plug of mud, and they may have more than one entrance hole. Male and female crayfish use the burrows as a refuge to escape from predators and as a resting place during molting and inactive periods. Female crayfish often use these burrows as a nursery for their young, particularly during periods of low water.

The breeding season peaks in early spring, but may extend throughout the summer and into late fall depending on the species and water temperatures. During mating, the male crayfish deposits sperm into an external receptacle on the female. The sperm remain here until the mature eggs pass from the oviduct and are fertilized simultaneously. A female crayfish carrying a cluster of egg is characterized as "in berry." The eggs hatch in from 2 to 20 weeks depending on the water temperature. After hatching, young crayfish may remain attached to the female for a week or two before crawling dispersing. During drought, the young will be released into the burrows, but many do not survive due to lack of food and crowding.

Extensive burrowing around ponds and lakes can undermine the structural integrity of dams. Fortunately, several control measures can be employed effectively to reduce crayfish densities to a level at which structural damage and water leaks will be minimized. Efforts at total eradication usually are futile because crayfish can migrate considerable distances and will reinvade the pond continually.

Biological Controls

Biological control of crayfish refers to the deliberate introduction and establishment or encouragement of natural enemies of crayfish. An excellent method for reducing high numbers of crayfish is to stock and maintain a healthy population of sportfish in the infested waters. Trout, bass, catfish, and large bluegills (bream) eat crayfish and can help to reduce excessive numbers. Properly stocked sportfish ponds seldom have burrowing crayfish problems. Other natural predators that feed heavily on both young and adult crayfish are: amphibians (bullfrogs, salamanders), reptiles (turtle, water snakes), waterbirds (herons, kingfishers, ducks, geese), and mammals (raccoons, otters, mink). Encouraging wildlife species that eat crayfish to live near your pond by providing suitable habitat is a good strategy. They act as biological controls providing year-round protection from burrowing crayfish problems without the need for expensive trapping and potentially dangerous chemical application.

Complete elimination of all crayfish usually is not possible, seldom practical, and certainly undesirable, considering their beneficial value. Control is successful when the balance between the predator (fish, birds, mammals) and the prey species (crayfish) is reached, and excessive burrowing damage is reduced to an acceptable level.

Trapping Crayfish

Trapping crayfish is a very effective control method. Several types of crayfish traps are available or can be made using one-half inch (1/2") mesh chicken wire. Funnel-end commercial minnow traps are often modified by enlarging the openings to 2 inches (2") in diameter to allow for easy entry by large crayfish. A string of funnel traps left overnight should produce a good catch. Most other traps are similar to those used to catch saltwater crabs. Drop and lift type crab traps can be used to catch crayfish. Simply lower the baited trap to the bottom, and quickly pull it up at frequent intervals (depending on the number of crayfish being caught).

Any fresh fish or meat serves as an effective bait to lure crayfish to the trap. Meat scraps, fish heads, soybean cake, perforated cans of dog food, or almost any high-protein substance will work. For overnight trap setting times, enclose the bait in hardware cloth to prevent the trapped crayfish from eating all the bait, and reducing trap effectiveness.

The habits of crayfish strongly influence how easily they are caught. Crayfish overwinter in their burrows or the bottom muds or shoreline banks, and emerge as the water warms. Mid-April is the time when crayfish first become active in Virginia. The optimal water temperature range for crayfish is between 40°F (4°C) and 75°F (24°C). As temperatures drop below or rise above this range, crayfish become inactive and stop feeding. Crayfish are nocturnal and are most active at night. Therefore, traps should be set in late afternoon and left overnight. To handle crayfish safely, grasp the body just behind the claws. For beginners, a pair of heavy gloves will ward off pinches.

Chemical Control

Chemical treatments are not recommended because they: (1) threaten water quality, (2) kill beneficial plants and animals as well as pests, and (3) can be widely distributed by wind and water movements. No chemicals are currently registered for crayfish control. Never apply toxic chemicals directly to waters or near shorelines where they can seep into waterways.

Cleaning and Cooking Crayfish

The freshwater crayfish not only looks like a miniature lobster, but tastes almost as good as its saltwater relative. The first step to preparing crayfish for the table is to wash the live crayfish in cool, clean water. After washing, the crayfish are blanched (par boiled) in hot water for about five minutes. This process kills and cooks the crayfish, kills any bacteria present, turns the crayfish a brilliant red color, and facilitates peeling the meat from the claws and tail. Next, remove the intestinal track by twisting and pulling the middle flipper of the tail. Some prefer to cook only the claws and tails. After simmering, remove the meat from the claws and tail, add butter, salt, and pepper, and enjoy; crayfish meat may be served hot or cold.

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May 1, 2009

Publications and Educational Resources

The Control of Burrowing Crayfish in Ponds

420-253

Louis A. Helfrich, Extension Specialist; Jim Parkhurst, Extension Specialist; and Richard Neves, Extension Specialist; Department of Fisheries and Wildlife Sciences, Virginia Tech

At times landowners may be confronted with serious water losses resulting from the sudden collapse or gradual deterioration of earthen pond dams, irrigation canals, and drainage ditches. Although the loss of water from small earthen impoundments is frequently due to faulty construction, it may also be the result of undetected biological forces. Burrowing animals such as muskrats, Norway rats, and particularly crayfish, construct their homes or "burrows" by digging into soil banks along the shorelines of waterbodies. Tunnels dug below the water level provide channels through which water can escape. Tunnels dug above the water level can decrease structural support of the embankment and increase the risk of washout during flood conditions. These hazards are multiplied in waters where burrowing animals are abundant and where water levels fluctuate. Rising and falling water levels often stimulate these animals to dig new burrows, thereby increasing the potential for structural damage and water leaks. The most abundant invertebrate burrower in Virginia's waters is the crayfish.

Crayfish, also known as crawfish, crawdad, freshwater crab and other local names, are found in freshwaters throughout the world. There are 550 species worldwide, 390 species in North America, 338 species in the United States, and more than 25 species in Virginia. Worldwide, they range in size from the tiny dwarf crayfish of Louisiana, less than one inch in length at maturity, to the marron crayfish of Australia, which reaches a length of 16 inches and a maximum weight of 4 pounds. The world's largest crayfish is a Tasmanian species which can attain a weight of 8 pounds. The crayfish species that inhabit Virginia's waters are considerably smaller, seldom exceeding 4 inches in total length.

Ecological and Economic Importance

Crayfish play an important role in aquatic ecosystems (ponds, lakes, streams, marshes, etc.), by serving as a preferred food item for a large number of aquatic and terrestrial animals. Many sportfish (trout, bass, and larger sunfishes), birds (egrets, herons, kingfishers, ducks), amphibians (bullfrogs), and mammals (raccoons, otters, mink) consume large quantities of crayfish. Because crayfish will eat both living and dead plant and animal material, they help to reduce the amount of decaying matter, and thereby improve water quality. Most crayfish are not active predators and have difficulty capturing fast moving animals. Approximately 40 percent of their diet consists of worms and insects inhabiting the bottom muds. The remainder consists of living and decaying aquatic vegetation. In fact, crayfish have been suggested as biological controls for nuisance waterweeds.

In addition to their valuable ecological benefits, crayfish have attained economic importance as: (1) a commercial food product for human consumption, (2) fish bait, and (3) laboratory organisms for biological studies. Although not as well known as their saltwater relative - the lobster - freshwater crayfish are highly esteemed as a luxury food item in southern states, notably Louisiana, and in European countries, such as France. In these areas, wild crayfish are harvested by commercial trappers or raised in rice-field ponds. Over 10 million pounds of red-swamp crayfish - valued at $5 million - are harvested annually from Louisiana's crayfish farms. Smaller crayfish often are sold as fish bait. Despite the fact that almost all freshwater crayfish are edible and considered a table delicacy rivaling the lobster, they generally are underutilized by man. Thus, should you be fortunate enough to be plagued by burrowing crayfish problems, an immediate solution would be to literally eat your problem away!

Although crayfish are essential components of aquatic ecosystems and represent a valuable economic resource, some burrowing species of crayfish can seriously interfere with man's multiple-uses of inland waters. As previously suggested, significant water losses may occur when the tunneling activities of burrowing crayfish weaken earthen dams or create water leaks. Lawns, gardens and agricultural crops are frequently damaged by crayfish. Therefore, landowners who have invested the time and money to construct small water impoundments should take some precautions to prevent possible damage from burrowing crayfish. Precautions should include occasional inspection of the shorelines, especially in the vicinity of the dam, for the presence of large numbers of crayfish and evidence of extensive burrowing. Some species of crayfish are notorious burrowers, others do not burrow at all. Unfortunately, it is difficult to distinguish burrowing crayfish from non-burrowing ones.

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Finnish Food Safety Authority Evira

Import from another EU member state and Norway of live crayfish to be cooked in Finland

12.07.2007 10:32

Crayfish imported for cooking can not be marketed live to the consumer in Finland and their access to natural waters has to be prevented. ' orters of live crayfish to Finland from the EU and Norway for use as food have to be registered as first destination operators with the municipal food control authority.

Protection of the Finnish crayfish species and populations

Under the Fishing Act 1982/286, sections 94 and 95, the import of crayfish is not permitted to endanger crayfish species and populations found in the wild in Finland. Therefore, crayfish imported for cooking can not be marketed live to the consumer in Finland and are not to be even temporarily kept in natural waters and they have to be prevented from getting into the natural waterways.

Amendment to the legislation

When importing live crayfish from the internal market for food to Finland the operator has to register as a first destination operator with the municipal food control authority, and does not have to register with Evira's Animal Health and Welfare Unit.

R quirements concerning first destination operations

When importing live crayfish from the internal market to Finland for food the decree of the Ministry of Agriculture and Forestry on first destination operations (118/2006), is to be complied with. Evira's instructions on first destination control may be found on Evira's Internet pages at the address: http://www.evira.fi/portal/fi/elintarvikkeet/valvonta_ja_yritt__j__t/ensisaapumisvalvonta/ (in Finnish).

Live crayfish brought to Finland from the internal market have to be either cooked at the first destination or be delivered from the first destination to food premises approved for cooking (for example a fish processing establishment or a restaurant). It is prohibited to sell the crayfish live directly to the consumer. The crayfish have to originate from an establishment approved by an authority of the country in question.

Import of foreign crayfish species and populations for restocking or farming

Importing foreign crayfish species and populations for stocking or farming requires either a registration (crayfish imported for farming) or an import permit (crayfish imported for restocking purposes) (decree of the Ministry of Agriculture and Forestry 977/2006 and the decree of the Ministry of Agriculture and Forestry 312/2007). Registration or import permit is applied for from Evira's Animal Health and Welfare Unit. In addition, the import of new species and populations of crayfish requires an import permit issued by the Department of Fisheries and Game of the Ministry of Agriculture and Forestry, and restocking requires a permit issued by the local TE Centre.

For more information, please contact:
First destination control
Senior Officer Marko Naapuri, tel. 020 77 24239, marko.naapuri@evira.fi
Senior Officer Britta Wiander, tel. 020 77 25381, britta.wiander@evira.fi (from 6.8)

Import permits (stocking) registration (culture)
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Management in Practice

Long-term management of the invasive *Pacifastacus leniusculus* (Dana, 1852) in a small mountain stream

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Abstract

Pacifastacus leniusculus (an invasive species in European water bodies) was detected for the first time in the Andalusia Region (S. Spain) in the year 2000. Since 2005, a continuous control management programme has been carried out by the Environmental Regional Government. Management efforts aimed to reduce the population size, to contain the dispersal and reduce the probability of deliberate translocation into other rivers caused by illegal captures. A combination of techniques was used, including crayfish traps, manual removal from artificial refuges and electrofishing. In the 2005-2009 period, 31 374 specimens were captured. The mean catch rate per worker and day declined from 30.4 ± 3.2 specimens in the first year to 9.8 ± 1.7 in the fourth year, therefore suggesting a sharp decrease in population size. Summer was the period of mating and maximum yields, whereas minimum yields were obtained in Winter, coinciding with egg incubation in burrows. The results obtained and the experience gained will provide essential baseline information for the future management of non-native crayfish in the region.

Key words: non-native, introduction, signal crayfish, invasion, containment, Spain

Introduction

Pacifastacus leniusculus (Dana, 1852) (Crustacea: Astacidae) is an invasive North American crayfish species that has become widely introduced and successfully established throughout Europe in numerous rivers and streams since the 1960s (Gherardi and Holdich 1999; Holdich 2002; Souty-Grosset et al. 2006) for fishing. However, the introduction of this species has posed different environmental problems such as decimating invertebrates and aquatic plants through predation and destabilising river banks by burrowing (Nyström et al. 1996; Stebbing et al. 2004; Rosenthal et al. 2006). This species has also been partially responsible for the decline of several indigenous European crayfish species through competition and transmission of aphanomycosis (crayfish plague) (Westman et al. 2002; Souty-Grosset et al. 2006).

The first and until now, only population of *P. leniusculus* known in Southern Spain was detected in 2000 in the Riofrío River (Loja, Granada) as a well-established population located close to a fish-hatchery. The upper part of the river harboured an important population of *Austropotamobious pallipes* (Lereboullet, 1858), an endangered species according to regional, national and European laws. This species has been traditionally fished by local people until the 1990s but nowadays, only isolated individuals can be occasionally observed. Besides this, the risks of downstream dispersal, illegal fishing of *P. leniusculus* by citizens (as a substitute for the native species as in the case of the red swamp crayfish, *Procambarus clarkii* (Girard, 1852)) was considered as an additional risk that could lead to repeated translocation and introduction into neighbouring aquatic habitats and streams. As a consequence, in 2005, the Regional Environmental Council (Consejería de Medio

Ambiente) of Andalucia (a territory of 87 268 km^2), considered the incipient invasion of *P. leniusculus* as an urgent problem that need to be managed. The short-term goals were to: 1) maintain a physical presence of the Public institution through field staff that could help to diminish illegal fishing, 2) reduce the population size of the invasive species and subsequently, a) increase the effort needed for local fishermen to obtain their captures, b) decrease the risk of downstream dispersal, and c) to gather practical experience on the management on the species, which could be used to deal with invasions in similar scenarios. However, no previous published reports on successful control measures and techniques were found (see Holdich et al. 1999; Stebbing et al. 2004). No time was available for previous analysis of population features and ecological processes involved. Therefore, an adaptive management approach was adopted (Meffe et al. 2006; Williams et al. 2007) in order to improve management efficiency and to correct the suboptimal solutions chosen at initial stages.

The aim of this paper is to report the results of the long-term management of the invasive *Pacifastacus leniusculus* obtained in the period from August 2005 – August 2009, and to show how some management limitations at initial stages can be overcome with an adaptive management approach.

Materials and methods

Area of study and fishing techniques

Control measures for *Pacifastacus leniusculus* were conducted in the Riofrío River (37°09′6.7′′N; 4°12′20.5′′W), a small mountain stream (11 km length; 700-800 m altitude) with a Mediterranean climate. The river bed consists of patches of mud (2%), sand (33%) and gravel (65%) with abundant plant roots on the banks. The riparian vegetation is dominated by *Ficus carica*, *Salix* sp., *Rubus ulmifolius*, *Fraxinus angustifolia*, *Populus alba* and *Ulmus minor*. For the first year (August 2005), crayfish traps were set along the river (every 50 m) to analyse the species distribution and to establish the upper and lower boundaries of the population. Sampling was repeated annually. Preliminary work was undertaken to remove rubbish and closed riparian vegetation to increase the river accessibility for workers. Intense fishing was then carried out using a combination of three techniques: (1) Baited crayfish traps (similar to minnow traps) (Figure 1) were set in areas with difficult access for workers (depths > 1 m). Traps were 0.5 m long and 0.3 m in diameter, with rings of 0.65 m diameter, and 5 mm square mesh. Nets were left in the river and emptied every 24 h. Trout and herring were used as bait (1/4 fish per trap) and were set hanging inside the trap using safety pins (Figure 1) to avoid their consumption by crayfish arriving from outside the trap. (2) Artificial refuges had an area of 1 m^2 (n = 25), 4 m^2 (n = 34) and 6 m^2 (n = 31) and were built with stones (10-50 cm length) from the bed of the river mixed with a number of bricks. Artificial refuges were located on shallow (< 0.5 m) banks of the river and were manually emptied every 24 h. Previous experiences showed that artificial shelters attracted crayfish that were more accessible to workers. (3) Electrofishing was selected as a complementary technique from the year 2009, once catches became established and no significant changes were observed. The crayfish were captured with Hans Grassl GmbH ELT 6011 GI Honda GXV50 electrofishing gear, using 25-50 Hz current with a voltage of 200–400 V.

Efforts were subjectively adapted to staff availability (8 to 80 work days per month, mean 40 ± 18). Under these management conditions, the main problems encountered were due to: (i) variability of fishing efforts due to marked seasonal variability in species activity (e.g. lower yields in winter due to hatching inside burrows); (ii) heterogeneous accessibility to riverbank refuges, which could lead to lower yields in some stretches and a subsequent increase in recruitment; (iii) uncontrolled visits by local people with occasional vandalism (e.g., trap robbery); (iv) scarce biological and ecological information for the area invaded (e.g. repeated census, recruitment rates, microhabitat distribution of age classes) either previous or simultaneous to population reduction.

Data collection

Each specimen collected was sexed and measured (carapace length, CL, to the nearest 0.1 mm). The observed size ranges of mature females showing any of the different reproductive stages (maculation during mating, egg or fry carrying) was used to classify *P. leniusculus* specimens into two groups: juveniles and sub-adults (CL<20 mm) and adults.

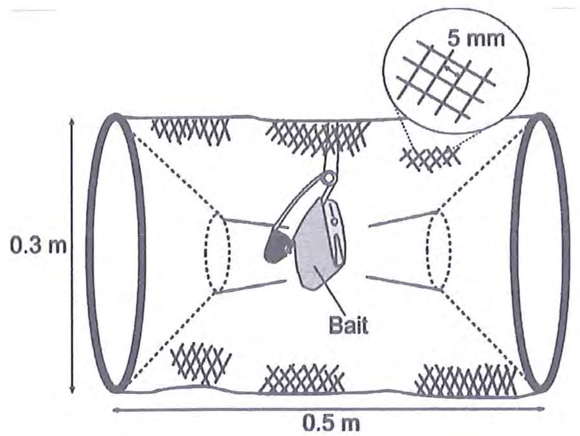

Figure 1. Detail of the crayfish trap used, showing the layout of the bait inside.

This gave information on the present age-classes, cohorts and changes in population structure during management efforts.

Relative abundance of the population was expressed as catch-per-unit-effort (CPUE = number of individuals fished per total work days (considering a combination of hand collection in artificial refuges and trapping). This parameter has been confirmed to be a good indicator of the relative abundance of crayfish (Shimizu and Goldman 1983; Skurdal et al. 1995).

Estimation of population size

In Summer 2009, the size of the signal crayfish population (highest population activity and catchability of juveniles), was estimated by a modification of the capture-mark-recapture method (Ricker 1975). This 2009 estimate of the overall population seemed to have reduced from previous years, and more precise information became necessary for evaluation of capture efficiency. This population size estimate served as a reference level to be compared with captures and thus obtain an annual indicator of capture efficiency and the crayfish number that remained to be captured. Mean estimated longevity of *Pacifastacus leniusculus* is between 6 to 16 years, the amplitude of the range varying with site conditions and techniques employed for age-estimate (e.g. Mason 1963; Belchier et al. 1998). Population estimates are also key to assessing population trends and future eradication feasibility.

Statistical analysis

Yearly CPUE (August 2005-August 2009) data were tested for normal distribution by a Kolmogorov–Smirnov test. Barlett's and Levene's tests of equality of variances were also performed. Differences among yearly CPUE were subsequentally tested by non-parametric estimators (Kruskal-Wallis and Mann Whitney tests). Differences were considered significant when $p < 0.05$.

Results and discussion

P. leniusculus is distributed along a stretch of 850 m with a mean depth of 0.2 m (0.0-0.9 m) and a mean width of 4 m (1.6-14.4 m). The upstream and downstream geographical boundaries of the population remained constant during the study. Overall CPUE showed a significant decrease between years (Kruskal-Wallis; $\chi^2 = 24.82$; $p < 0.001$) (Figures 2 and 3) with a total of 31 374 individuals removed from the Riofrío River between August 2005 - August 2009. Paired comparisons between years showed a significant reduction of total CPUE during the initial stage of measures (Table 1). This was probably due to the high population density and the greater abundance of large adult individuals at the initial stage of field work (Figure 2). Adult specimens are more easily observed by field workers either in artificial refuges or when electrofishing. During the last three years, CPUEs showed significantly lower values than in the first year, however, a significant decline was not detected between years in the 2006-2009 period. A similar pattern has been found in other long-term management studies reported for controlling invasive crayfish (e.g. Hein et al. 2007). Considering the different age-classes, CPUE of adults showed no significant reduction since 2006 (Table 1, Figure 3). Juveniles and sub-adults also showed a progressive reduction of CPUE which was significant in 2009 with respect to previous years. It must be taken into account that detection and catchability decrease as a consequence of a density reduction. These results suggest that the invasive population has remained rather constant in size, and therefore, current catching efforts appear to have been paired with natural recruitment. Therefore, catching efforts by artificial refuges and baited traps in 2006-2008 appear to have been useful to control natural recruitment of the invasive population.

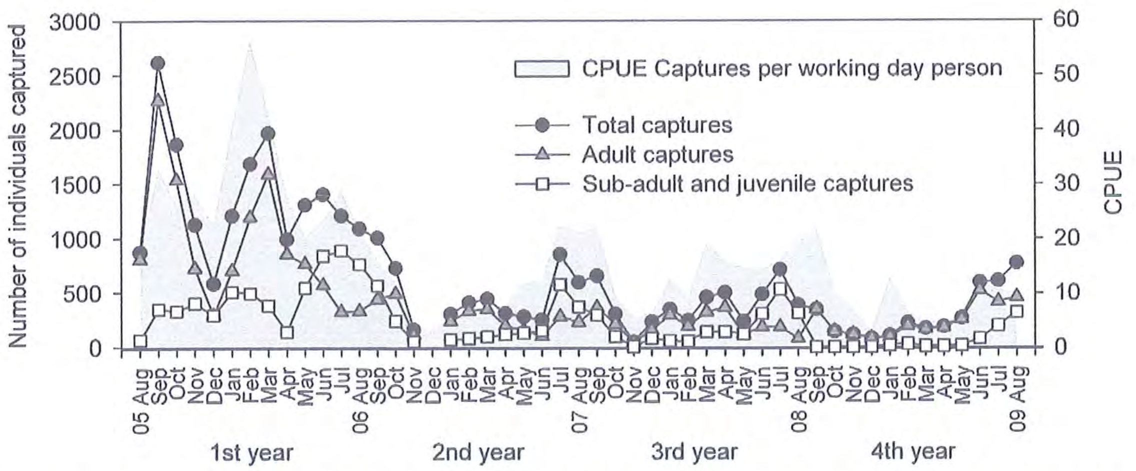

Figure 2. Evolution of the number of individuals captured (total, adults, sub-adults and juveniles) and CPUE during the study period.

Table 1. Results of U Mann-Whitney test of differences in CPUE between paired years.

Years (paired comparison)		Total		Adults (>20mm CL)		Juveniles and sub-adults (< 20 mm CL)	
		U	p-value	U	p-value	U	p-value
1	2	5.0	<0.001	1.0	<0.001	37.0	0.079
1	3	5.0	<0.001	14.0	<0.001	42.0	0.088
1	4	3.0	<0.001	13.0	<0.001	12.0	<0.001
2	3	82.0	0.340	92.0	0.116	71.0	0.781
2	4	54.0	0.479	79.0	0.441	24.0	0.010
3	4	43.0	0.099	58.0	0.435	20.0	0.002

The adult population estimated in 2009 (late summer) was 2086 ± 500 individuals, while the overall captures in 2005 was clearly greater (Figure 2).

The intense removal of large size classes, especially during the first year (Figure 5), could have reduced the species recruitment, since the female's fecundity is related directly to body size (Mason 1975; Soderback 1995). Significant reduction of the abundance of adults and the subsequent dominance in population of age groups with lower fecundity may be facilitating this process. It also should be considered that a reduction of the large specimens could decrease the intraspecific competition for shelter and food, thus enhancing the growth rate and recruitment success (Sibley and Nöel 2002).

CPUE showed a clear seasonal variation (Figure 4) with significant differences between months (Kruskal Wallis; $X^2 = 21.10$; $p < 0.05$) showing maximum yields in summer and minimum captures from early Winter to early Spring. This is due to the reproductive cycle and behaviour of this species (mating encounters, females sheltering in Winter, etc.) and its thermo- photoperiodic response (Abrahamsson 1981; Shimizu and Goldman 1983; Lowery and Holdich 1988; Kirjavainen and Westman 1999; Ribbens and Graham 2004; Capurro et al. 2007) which lead to the yield patterns shown in Figure 4. In agreement with Ribbens and Graham (2004), an increase of the catch effort during the Summer increases the total captures.

The results of the management carried out in 2005-2009 to control the invasive *P. leniusculus* suggest that it is feasible to obtain a certain success in control strategies of an isolated population of *P. leniusculus* within the first 12 months of work by using a combination of fishing techniques (trapping and artificial

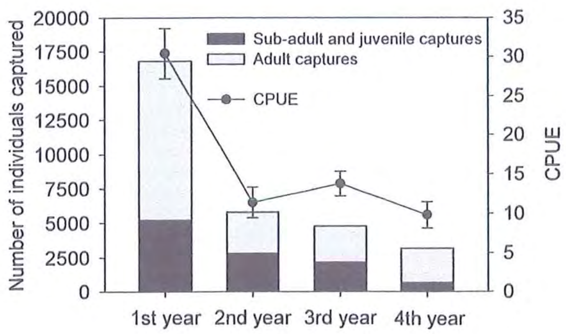

Figure 3. Total number of individuals captured over four years per size class and temporal evolution of CPUE. Each bar represent the mean ± the standard error of n = 4 years.

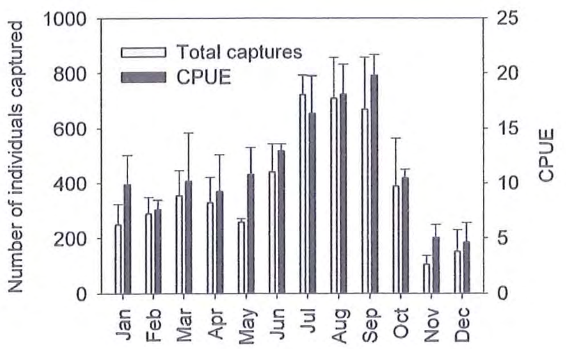

Figure 4. Number of individuals captured per month and CPUE during the last three years. Each bar represent the mean ± the standard error of n = 3 years.

refuges). These techniques may also serve to remove an important fraction of large and mature individuals, causing a significant reduction of population size and recruitment, specially affecting reproductive individuals. However, even when the population has been strongly reduced, the methods used and the continued presence of staff are also useful to contain population and dispersal by discouraging illegal fishing.

Conclusions

Long-term management programmes are necessary to control signal crayfish invasions in aquatic environments. Such programmes require high capture efforts and the use of a combination of methods to capture all size classes in the different micro-environments. However, once

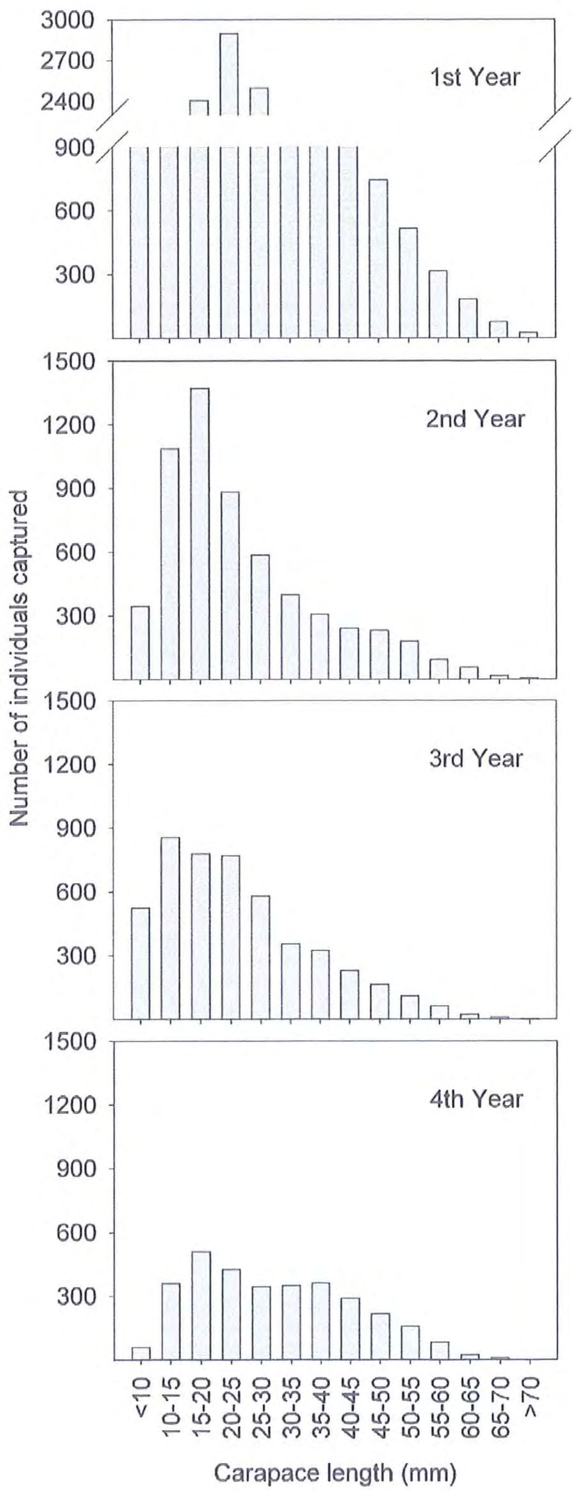

Figure 5. Size-frequency distributions of the individuals collected over four years.

sufficient resources were provided, continued and intensive removal of *P. leniusculus* for four years has reduced the population size and consequently, the risk of natural dispersal or deliberate translocation by local fishermen.

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