Pike stock management in designated brown trout fisheries: Anglers' preferences

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Management of Pike in Designated Wild Brown Trout Fisheries Review Group

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ESRI

Research Programme on socio-economics of Inland Fisheries

- 3 year programme
- IFI funded
- Research to date:
  - Angling impact in rural locations
  - Tournament anglers' expenditure
  - Anglers' preferences for site attributes
  - Angling & Water Quality
- Outputs: peer review journal publication

Outline

- Paper's research objective
- ESRI's Angler research panel
- Survey outline
- Statistical methodology
- Survey responses
- Anglers' preferences
- Summary

Research objectives

- Economics of pike and trout angling

- Assessing economic impact
  - Angler response from change in policy
  - Spending/angler - TDI study helpful but not sufficient
  - No. of anglers affected

- Focus on Anglers' **views about** pike policy

How to canvass anglers' opinions

- ## Representative Bodies

  - National Anglers Representative Association (NARA)
  - National Coarse Fishing Federation of Ireland (NCFFI)
  - Trout Anglers Federation of Ireland (TAFI)
  - The Irish Federation of Pike Angling Clubs (IFPAC)
  - The Irish Pike Society (IPS)
  - Angling clubs

- ## Objective data directly from anglers

  - Representative Random Surveys
  - ESRI's Angler Panel

ESRI's Angler Research Panel

- Online sign-up launched May 2016
    - http://www.esri.ie/angling/
- Extensive marketing
    - Rep bodies, angling clubs, national & local papers, social media, angling shops, local radio, angling show
- Excess 850 on panel, still growing
    - Sea angling
    - Salmon/trout game angling
    - Coarse
    - Pike

Survey outline

- 565 anglers invited to participate
  - Single response email invitation
- 6 October 2016 – 4 November 2016
- 466 anglers opened the email invitation
- 82% response rate

Angler profile questions

- Socio-demographics, e.g. age
- Angling frequency
- Self assessed skill level
- Angling practice, e.g. catch & release
- Fish in designated fisheries
- Angling Expenditure
- Fishing regulations

Choice experiment

- What is it?

- How was it designed?
  - 2 angler focus groups
    - Key choice attributes – e.g. bag limits, pike control
    - Attribute levels – e.g. bag limit: C&R, 2 fish, 4 fish, 6 fish
  - Pilot survey

Attributes & Levels

Attribute	Description	Levels
Catch	Avg No. fish caught by avg angler per day	1,2,3,4,5
Length (pike CE only)	Avg length of rod caught pike	55, 70, 85, 100, 110cm
Bag limit (trout CE only)	No. of trout permitted to take	C&R, 1, 2, 3, 4, 6
Pike control	Pike control methods	Cease culling, Electro-fishing only, Electro-fishing & gill netting
Lagarosiphon	Annual change in lagarosiphon cover	-100%, -50%, -20%, 0%, +20%
Water visibility	Distance can see into water column	1.5, 2.5, 3.5, 5 metres

Choice experiment layout - 1

- Introduce CE section – consider:
  - Mixed stock fishery/ trout and pike,
  - popular fishing destination
  - management issues such as species predation, invasive plant species
  - water quality problems
  - No specific location specified

- Ask respondent to self classify:
  - In which type of fishery are you most likely to fish?
    - Pike or Trout

Choice experiment layout - 2

- Explained the attributes
  - Catch
  - Length (pike CE only)
  - Bag limit (trout CE only)
  - Pike control
  - Lagarosiphon
  - Water visibility

  - Respondents have information on what they are being asked to respondent

Choice experiment layout - 3

Consider the scenario options in the table below. Please select the option that you prefer the most. If you dislike all 3 scenarios we nonetheless would like you to select the scenario that you find least disagreeable.

Description	Scenario A	Scenario B	Scenario C (status quo)
Average catch per angler (No. of pike)	2	3	3
Average length of pike caught (cms)	55	55	70
Pike control	Electro-fishing only	Electro-fishing & gill-netting	Electro-fishing & gill-netting
Lagarosiphon (year on year change)	-50%	-50%	+20%
Water visibility (metres)	3.5	3.5	1.5

12 choice decisions per respondent

Methodology to analyse data

- ## Random Utility Model (RUM) Framework
  - McFadden, Daniel. (1973). Conditional logit analysis of qualitative choice behavior. *Frontiers in Econometrics*, pages 105–142. Academic Press, NY.
  - *Nobel prize in economics (2000) for "for his development of theory and methods for analyzing discrete choice".*

- ## Many applications:
  - Pradhan, N. C. and Leung, P. (2004). Modeling trip choice behavior of the longline fishers in Hawaii. *Fisheries Research*, 68(1):209–224
  - Parsons, G. R. and Massey, D. M. (2003). A RUM model of beach recreation. In Hanley, N., Shaw, W. D., and Wright, R. E., editors, *The New Economics of Outdoor Recreation*. Edward Elgar.
  - Siderelis, C., Brothers, G., and Rea, P. (1995). A boating choice model for the valuation of lake access. *Journal of Leisure Research*, 27(3):264.

Methodology - RUM

- Angler n's utility from scenario A is:

$$U_{nA} = \beta_1 C_{nA} + \beta_2 Lgt_{nA} + \beta_3 PC_{nA} + \beta_4 Lagro_{nA} + \beta_5 Viz_{nA} + \epsilon_{nA}$$

$$U_{nA} = \beta x_{nA} + \epsilon_{nA}$$

- We gave each angler 36 choices
- 12 decisions across scenarios A, B, & C

$$U_{nA} \quad ? \quad U_{nB} \quad ? \quad U_{nC}$$

Methodology – conditional logit

- Assuming errors, ϵ_n, are iid type I extreme value (Gumble)

- Conditional logit prob scenario i chosen is:

$$Pr(i) = \frac{exp(\beta x_{ni})}{\sum_{j \in A,B,C} exp(\beta x_{nj})}, \qquad i = A, B, C$$

- Assumes/imposes homogenous preferences

Methodology – mixture model

- Mixture or Latent class modelling:

$$Pr(i \mid g) = \frac{exp(\beta_g x_{ni})}{\displaystyle\sum_{j \in A,B,C} exp(\beta_g x_{nj})}, \qquad i = A, B, C$$

$$U_i = \beta_{1g} C_i + \beta_{2g} Lgt_i + \beta_{3g} PC_i + \beta_{4g} Lagro_i + \beta_{5g} Viz_i$$

Methodology – log likelihood function

$$logL = \sum_{n=1}^{N} log \left\{ \sum_{g=1}^{G} \pi_g \frac{exp(\beta_g x_{ni})}{\sum_{j \in A,B,C} exp(\beta_g x_{nj})} \right\}$$

Outline

- Research Objectives
- Angler panel
- Survey outline
- Statistical methodology
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Comparing survey responses

	Trout CE	Pike CE
Fished in a lake in past 12 months	0.81	0.90
Fished designated brown trout lake (with pike stock management)	0.68	0.40
Angling frequency in last year		
103+ days	0.10	0.09
27-102 days	0.57	0.58
0-26 days	0.33	0.33
Angler self-assessed skill level		
Novice	0.03	0.01
Average	0.26	0.26
Above-average	0.38	0.42
Advanced	0.33	0.31
Number of Respondents	197	144

Comparing survey responses

	Trout CE	Pike CE
Angler Age		
15-24	0.01	0.01
25-35	0.09	0.22
35-44	0.24	0.35
45-65	0.53	0.41
66+	0.13	0.02
Also a pike angler	0.37	na
Also a trout angler	na	0.38
Typically keep (i.e. harvest) fish caught:		
"Never"	0.26	0.73
"most" or "all of time"	0.12	0.01

Comparing survey responses

	N	Mean	Median	Std. Dev	Minimum	Maximum
Trout anglers' expenditure on typical fishing trip						
All trout anglers	187	289	105	449	5	3,874
Fished in designated brown trout lake with pike stock management in past 12 months						
Yes	130	305	125	478	5	3,874
No	57	250	60	376	6	1,650
Frequency of angling						
High: 103+ days in last year	18	280	133	314	10	1,050
Medium: 27-102 days in last year	107	302	110	488	5	3,874
Low: 0-26 days in last year	62	268	90	415	6	2,500
Pike anglers' expenditure on typical fishing trip						
All pike anglers	141	237	100	476	13	4,050
Fished in designated brown trout lake with pike stock management in past 12 months						
Yes	56	373	128	691	15	4,050
No	85	146	85	212	13	1,500
Frequency of angling						
High: 103+ days in last year	13	242	140	400	20	1,500
Medium: 27-102 days in last year	81	230	100	519	15	4,050
Low: 0-26 days in last year	47	246	105	425	13	1,987

Angler preferences - model estimates

	Trout CE				Pike CE		
	$g = 1$	$g = 2$	$g = 3$		$g = 1$	$g = 2$	$g = 3$
Catch	0.173***	-0.039	0.315***	*Catch*	0.254***	0.565	-0.067***
	(0.031)	(0.051)	(0.092)		(0.068)	(0.175)	(0.153)
Bag	-0.025	-0.299***	0.324***	*Length*	0.035	0.058***	-0.008***
	(0.064)	(0.083)	(0.088)		(0.01)	(0.016)	(0.021)
Electro	-0.262	0.702**	0.444	*Electro*	-0.381	-4.378**	-1.917
	(0.163)	(0.325)	(0.932)		(0.282)	(0.978)	(0.854)
Gill	-1.107***	0.492*	1.19**	*Gill*	-1.686***	-12.659*	-3.217**
	(0.263)	(0.26)	(0.501)		(0.313)	(2.778)	(0.837)
Weed	-0.011***	-0.003	-0.012***	*Weed*	-0.006***	0.026	-0.007***
	(0.002)	(0.002)	(0.003)		(0.002)	(0.011)	(0.002)
Visibility	0.096***	0.125***	0.307***	*Visibility*	0.083***	0.92***	-0.277***
	(0.024)	(0.045)	(0.092)		(0.037)	(0.326)	(0.063)
ASC_{SQ}	-1.898***	-0.207	1.986***	ASC_{SQ}	-1.545***	4.134	2.487***
	(0.31)	(0.288)	(0.505)		(0.562)	(1.86)	(0.969)
π_g	0.613***	0.26***	0.127***	π_g	0.257***	0.694***	0.05***
	(0.054)	(0.052)	(0.024)		(0.04)	(0.041)	(0.02)

Standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Scenario probabilities

Scenario			Trout CE	
		π_i	Base	Scenario
Avg Catch:		0.61	0.46	0.54
+1 fish		0.26	0.51	0.49
		0.13	0.42	0.58
		Total	0.47	0.53

Two site options, only difference is in average number of fish caught. +1 fish in scenario site compared to base.

Scenario probabilities

| | π_i | Trout CE | |
Scenario		Base	Scenario
Avg Catch:	0.61	0.46	0.54
+1 fish	0.26	0.51	0.49
	0.13	0.42	0.58
	Total	0.47	0.53

Two site options, only difference is in average number of fish caught

Overall: 53% trout anglers would select the site with higher catch
0.53/0.47 ->1.13 times more likely pick higher catch scenario

Group 3 (π_i =0.13) most interested in higher catches – 58% would select higher catch site. A group 3 angler 1.4 times more likely to select higher catch site

Group 2 (π_i =0.26) close to 50/50

Group 1 (π_i =0.61) 54% select higher catch site

Scenario probabilities

Scenario	π_i	Trout CE Base	Scenario	π_i	Pike CE Base	Scenario
Avg Catch:	0.61	0.46	0.54	0.26	0.44	0.56
+1 fish	0.26	0.51	0.49	0.69	0.36	0.64
	0.13	0.42	0.58	0.05	0.52	0.48
	Total	0.47	0.53	Total	0.39	0.61

Two site options, only difference is in average number of fish caught

Overall: 53% trout anglers select the site with higher catch (odds: 1.13)
         61% pike anglers select the site with higher catch (odds: 1.56)

Scenario probabilities

Scenario		Trout CE			Pike CE		
	π_i	Base	Scenario		π_i	Base	Scenario
Avg Catch:	0.61	0.46	0.54		0.26	0.44	0.56
+1 fish	0.26	0.51	0.49		0.69	0.36	0.64
	0.13	0.42	0.58		0.05	0.52	0.48
	Total	0.47	0.53		Total	0.39	0.61
Trout: bag limit =3	0.61	0.49	0.51				
	0.26	0.43	0.57				
	0.13	0.58	0.42				
	Total	0.49	0.51				
Pike: length +10cm					0.26	0.41	0.59
					0.69	0.36	0.64
					0.05	0.52	0.48
					Total	0.38	0.62

Scenario probabilities

Scenario	π_i	Trout CE Base	Scenario	π_i	Pike CE Base	Scenario
Pike control:	0.61	0.30	0.70	0.26	0.21	0.79
Electro-fishing	0.26	0.45	0.55	0.69	0.00	1.00
only	0.13	0.68	0.32	0.05	0.21	0.79
	Total	0.39	0.61	Total	0.07	0.93
Pike Control:	0.61	0.25	0.75	0.26	0.16	0.84
No control	0.26	0.62	0.38	0.69	0.00	1.00
	0.13	0.77	0.23	0.05	0.04	0.96
	Total	0.41	0.59	Total	0.04	0.96

Scenario probabilities

Scenario		Trout CE			Pike CE		
	π_i	Base	Scenario		π_i	Base	Scenario
Lagarosiphon:	0.61	0.39	0.61		0.26	0.44	0.56
-20% p.a.	0.26	0.47	0.53		0.69	0.74	0.26
	0.13	0.39	0.61		0.05	0.43	0.57
	Total	0.41	0.59		Total	0.65	0.35
In-water	0.61	0.46	0.54		0.26	0.47	0.53
visibility	0.26	0.45	0.55		0.69	0.20	0.80
+1.5m	0.13	0.39	0.61		0.05	0.60	0.40
	Total	0.45	0.55		Total	0.29	0.71

Scenario probabilities

Scenario		Trout CE				Pike CE		
	π_i	Base	Scenario		π_i	Base	Scenario	
No pike control	0.61	0.17	0.83		0.26	0.13	0.87	
& lagarosiphon	0.26	0.59	0.41		0.69	0.00	1.00	
-20% p.a.	0.13	0.67	0.33		0.05	0.03	0.97	
	Total	0.35	0.65		Total	0.03	0.97	
No pike control &	0.61	0.15	0.85		0.26	0.16	0.84	
lagarosiphon -20% &	0.26	0.41	0.59		0.69	0.00	1.00	
visibility +1m &	0.13	0.74	0.26		0.05	0.04	0.96	
Trout: bag limit =2	Total	0.30	0.70		Total	0.04	0.96	
OR Pike: length -10cm								

Summary

- Anglers' preferences on 5 key attributes
  - Incl. on pike management policy
- Not estimating economic impact
- No homogenous angler: No 'single' voice
  - 2x3 distinct groups based on stated preferences
- Pike Anglers
  - All 3 groups opposed to pike control
    - 69% strongly opposed
  - Pike control dominant issue in choice preferences
  - Size, catch, weed & visibility have importance also

Summary

- Trout Anglers
  - Mixed views on pike control
    - 61% oppose gill netting
    - 39% favour gill netting
      - 13% strongly favour
      - 26% moderately favour
  - All favour improved visibility & weed control
  - Bag limits – mixed views
    - 26% - favour reduced bag limit
    - 13% - favour increased bag limit
    - 69% - no strong preference