

Supply Response of Commercial Fishermen and Implications for Management of Invasive Asian Carp

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Goals of the Study

- Assess price sensitivity of Asian carp harvest – is increased price a viable control strategy?
- Determine if production relationship exists between Asian carp and other fish – will bigger harvest affect native species?

Asian Carp – what's the problem?

Introduced in US in Arkansas,
Mississippi for aquaculture

First appeared in Illinois in early
1990s

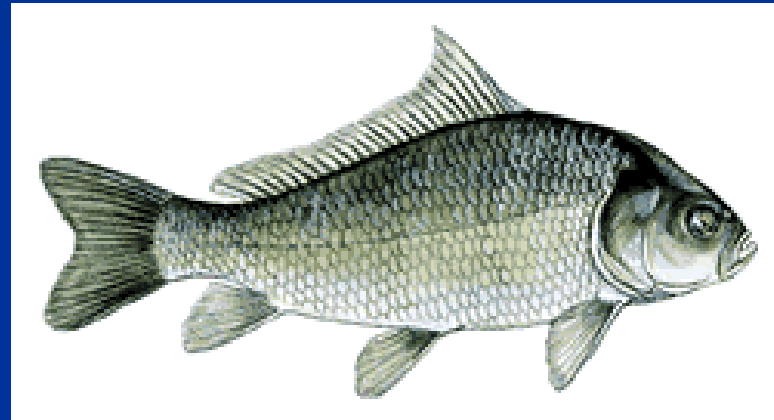
Now dominant fish species in
many parts of the Mississippi
River system



Photo courtesy Andy Whitcomb

The Commercial Fishery in Illinois

Species	Average Price Per Pound
Channel Catfish	\$0.43
Buffalo	\$0.22
Asian Carp	\$0.11
Common Carp	\$0.08



Bigmouth Buffalo

Iowa DNR

Conceptual Framework

- Revenue function – Leontief form
- Revenue is a function of prices, fixed input
- Hotelling's Lemma
 - derivative of revenue w.r.t. output prices \rightarrow system of supply equations
- Assumptions
 - maximize revenue given a fixed input
 - fishermen are price takers
 - stock sizes constant from year to year

Conceptual Framework

Strategy

- Estimate a system of supply equations
 - buffalo
 - catfish
 - Asian carp
 - common carp
 - other

- Test for joint production of fish species

- Generate supply elasticities

Data and Estimation

$$Q_i = \alpha_i + \sum_{i \neq j} \beta_{ij} (P_j / P_i)^{1/2} G + \beta_{ii} G + \beta_i G^2 + \sum_{l=1}^{14} \gamma_l D_l + \sum_{y=2002}^{2004} \gamma_y D_y + FT + \varepsilon$$

P_j = cross price

P_i = own price

G = gear

D_r = regional dummies

D_y = year dummies

FT = full time/part time dummy

Data and Estimation

- Data: Illinois Department of Natural Resources annual catch reports
- Unbalanced Panel – 487 observations, 212 individuals, 4 years
- Seemingly Unrelated Regression (SUR)
- Random effects

Results – parameter estimates

- Price Coefficients β_{ij}
 - Used to test for jointness-in-production
 - Used in calculating elasticities
- Gear coefficient negative in Asian carp
- FT highly significant for high-value species (buffalo, catfish) – not for “junk” (common carp and Asian carp)
- 2004 dummy significant for Asian carp

Results

Technological relationship – jointness-in-inputs

- All inputs required to produce all outputs, production decisions about one fish affect production of other fish
- Policies designed to affect harvest of one species will affect harvest of related species
- If a subsidy increases harvest of Asian carp, want to know which other fish will be affected

Results – joint production test

	χ^2	p-value	Decision
Overall	18.45	0.0478	Joint
Buffalo	6.36	0.1739	
Catfish	7.24	0.1237	
Common carp	10.02	0.0402	Joint
Asian carp	13.24	0.0101	Joint
Other	4.68	0.3218	

Results – supply elasticities

- Measure fishermen's ability to change species mix – fisherman as a multi-product firm
- Cross-price elasticities reveal production relationships between species (complements, substitution)

Results

Own-price supply elasticities

Buffalo	-0.36 <i>(1.84)</i>
Catfish	0.25* <i>(0.19)</i>
Common Carp	1.24 <i>(1.72)</i>
Asian Carp	-0.16 <i>(1.71)</i>
Other	-0.12 <i>(0.43)</i>

Cross-price supply elasticities

equations

		Buffalo	Catfish	Common Carp	Asian Carp	Other
prices	Buffalo	--	0.28* (0.35)	0.00 (0.31)	1.03 (2.82)	0.69 (2.79)
	Catfish	0.67 (1.43)	--	0.06 (0.35)	-2.59 (3.62)	0.03 (1.61)
	Common Carp	-0.29 (0.79)	0.03 (0.19)	--	1.28 (1.41)	-0.32 (1.39)
	Asian Carp	0.40 (1.28)	-0.55* (0.44)	-1.19 (1.59)	--	-0.28 (2.16)
	Other	-0.42 (0.96)	-0.01 (0.11)	-0.11 (0.42)	0.44 (1.31)	--

Results

Supply Elasticities – few are significant: why?

- No production relationship between species of interest: if fishermen target Asian carp, they can avoid buffalo
- Marginal changes in price do not affect harvest mix because of large price differential
- Possible model specification or data problems – variation due to fluctuations in stock size are not captured

Conclusions

- Will raising the price of Asian carp increase the commercial harvest?
 - Fish harvest not responsive to marginal changes in price in the short run
- Will increasing commercial harvest affect other native species?
 - Some joint production relationship
 - Results indicate increased Asian carp harvest would not affect buffalo

for reprint of paper contact:

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