The Effects of Fright Bias on Sampling Efficiency for Stream Fish Assemblages

Objectives of Study

- which of three techniques was the most efficient for sampling shallow-water fish assemblages
- whether disturbance and fright bias appears to affect sampling efficiency

Hypothesis Tested

- The sampling methodology which causes the least disturbance and fright-bias will be the most efficient for sampling shallow-water fish assemblages

Study Sites and Methods

Study Site

- Roanoke River in western Virginia
- 750 m section
- Sixth order stream, 25-30 meters in width
- Alternating pools and riffles
- Substratum: gravel, pebble, cobble, some boulder and bedrock ledges
- Water conductivity was 180 microseimens/cm
- Water temperature was 18 degrees C

Mesohabitat Types Sampled

- **Riffles** = shallow, fast flow, turbulent areas
- **Runs** = medium depth, slower flow, more laminar flow
- **Pools** = deep, slow to no flow

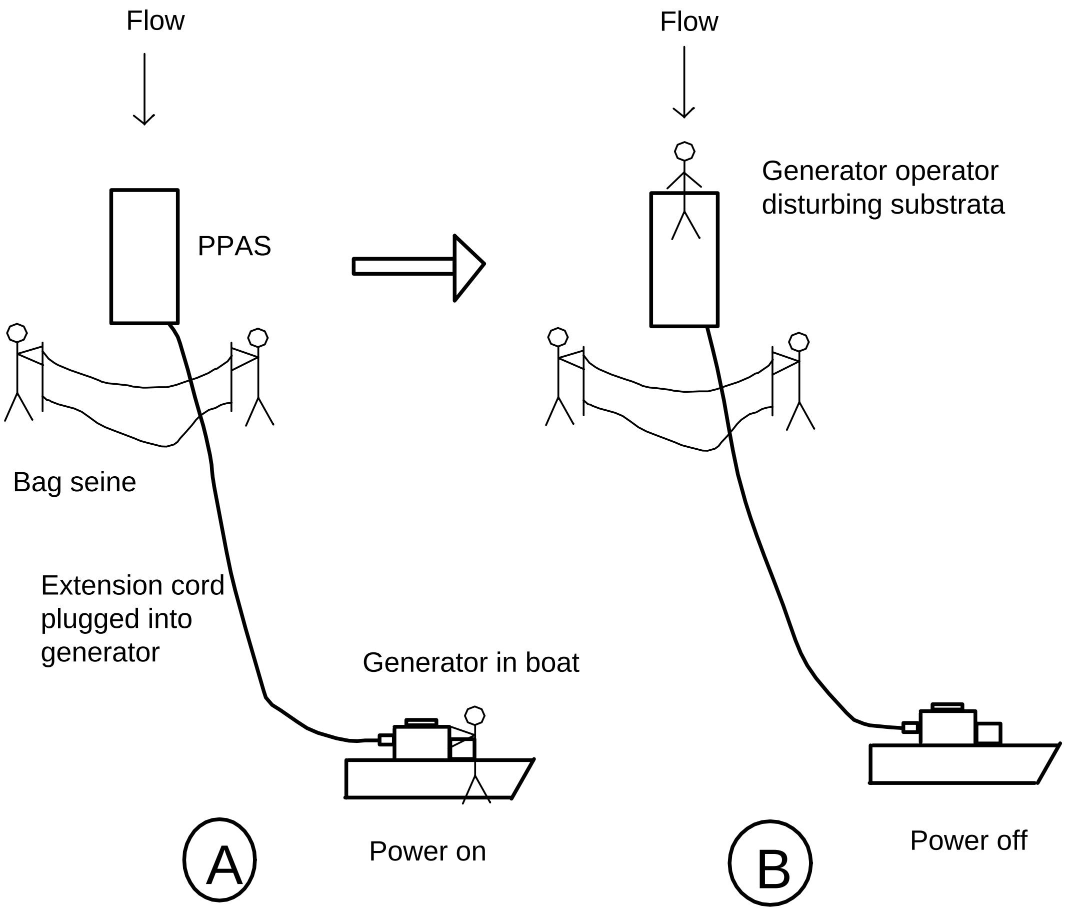
Fish Fauna

- Rather diverse: 42 species collected from past surveys
- Classified into 5 groups (based on taxonomy and mobility differences)
  - Water-column cyprinids (minnows)
  - Catostomids (suckers)
  - Centrarchids (sunfish)
  - Benthics (darters, some minnows)
  - Interstitial benthics (darters, sculpins)

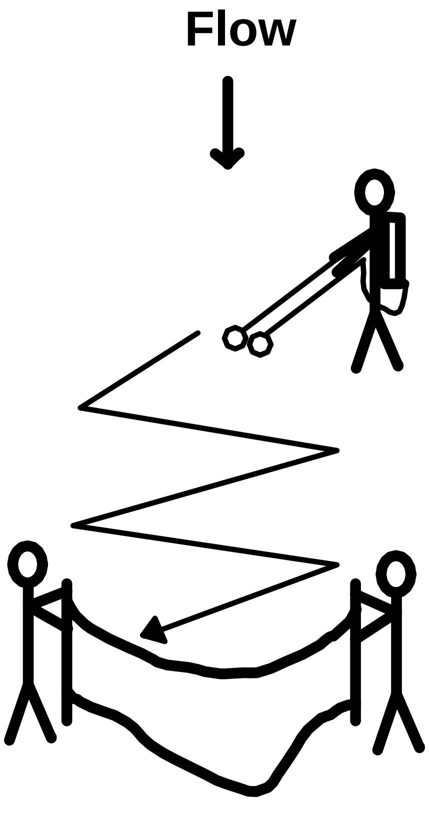
Sampling Techniques Compared

- PPAS = pre-positioned area shocker
- SPST = single pass backpack electrofishing into a block net
- MPMT = multiple pass shore-based electrofishing and seining into a block net

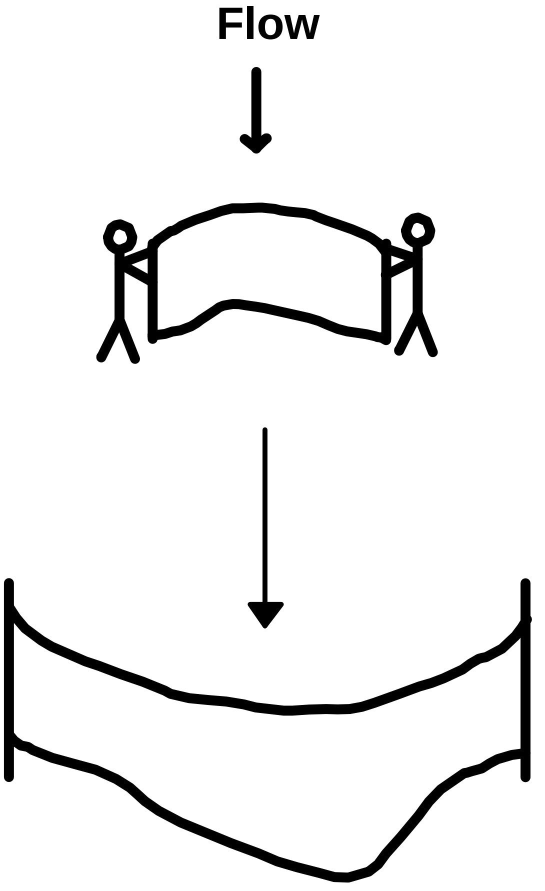
PPAS


Flow
PPAS
Bag seine
Extension cord plugged into generator
Generator in boat
A
Power on
Flow
Generator operator disturbing substrata
B
Power off

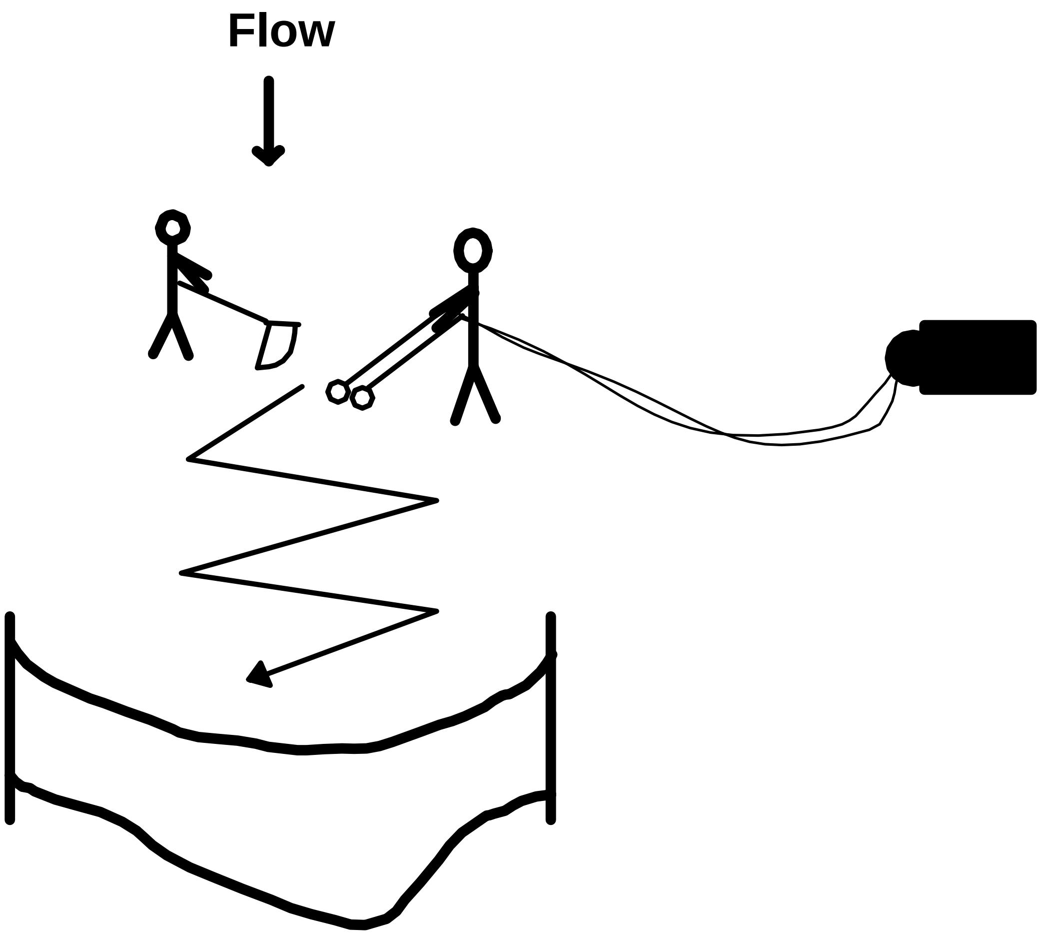
SPST



MPMT (First stage)



MPMT (Second stage)



Disturbance and Potential for Fright Bias

- PPAS (remote sampling) assumed to have lowest disturbance and least potential for fright bias

- SPST assumed intermediate

- MPMT assumed to have greatest disturbance and potential for fright bias

Evaluation of Relative Gear\Technique Efficiency

- Comparing species-area curves among techniques within each habitat type

- Comparing lenth-frequency distributions among techniques within each fish group

Species-area Formula

$$S_a = S_e(1 - e^{(-G*A)})$$

where,

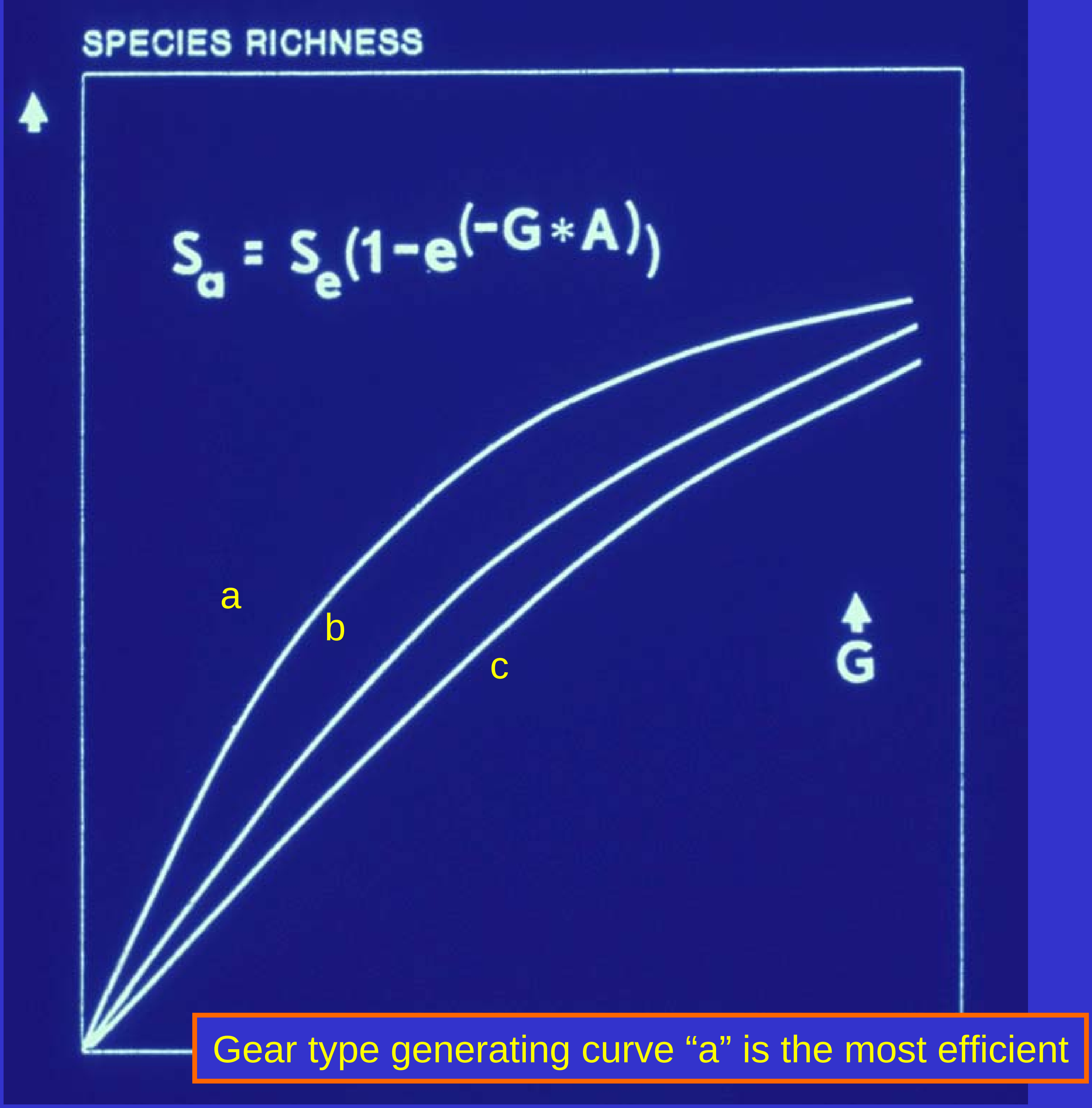
S_a = number of species collected over a particular amount of area sampled

S_e = asymptotic species number

G = species accumulation rate

A = total area sampled

e = natural logarithm


SPECIES RICHNESS
$S_a = S_e(1-e^{(-G*A)})$
a
b
c
G
Gear type generating curve "a" is the most efficient

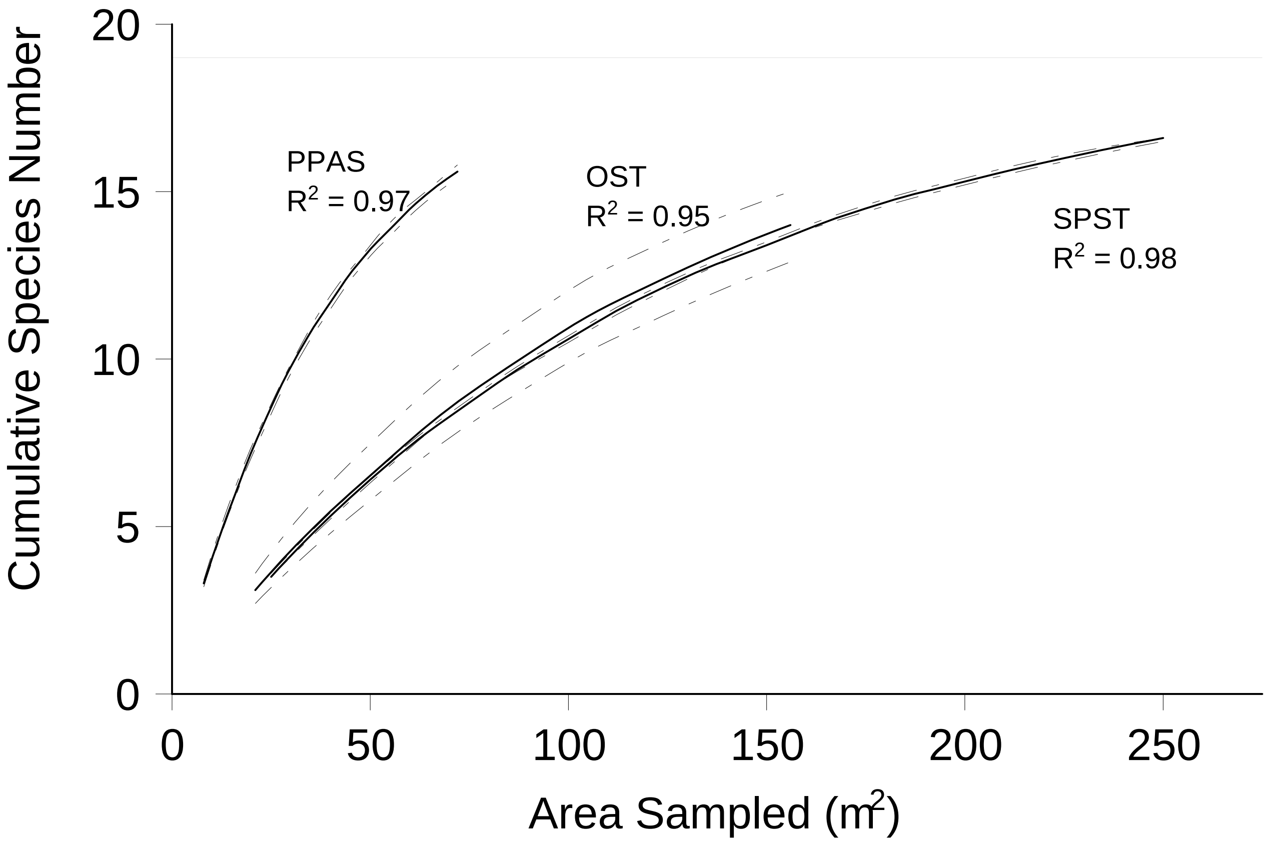
Results

Number of Species Captured by Technique

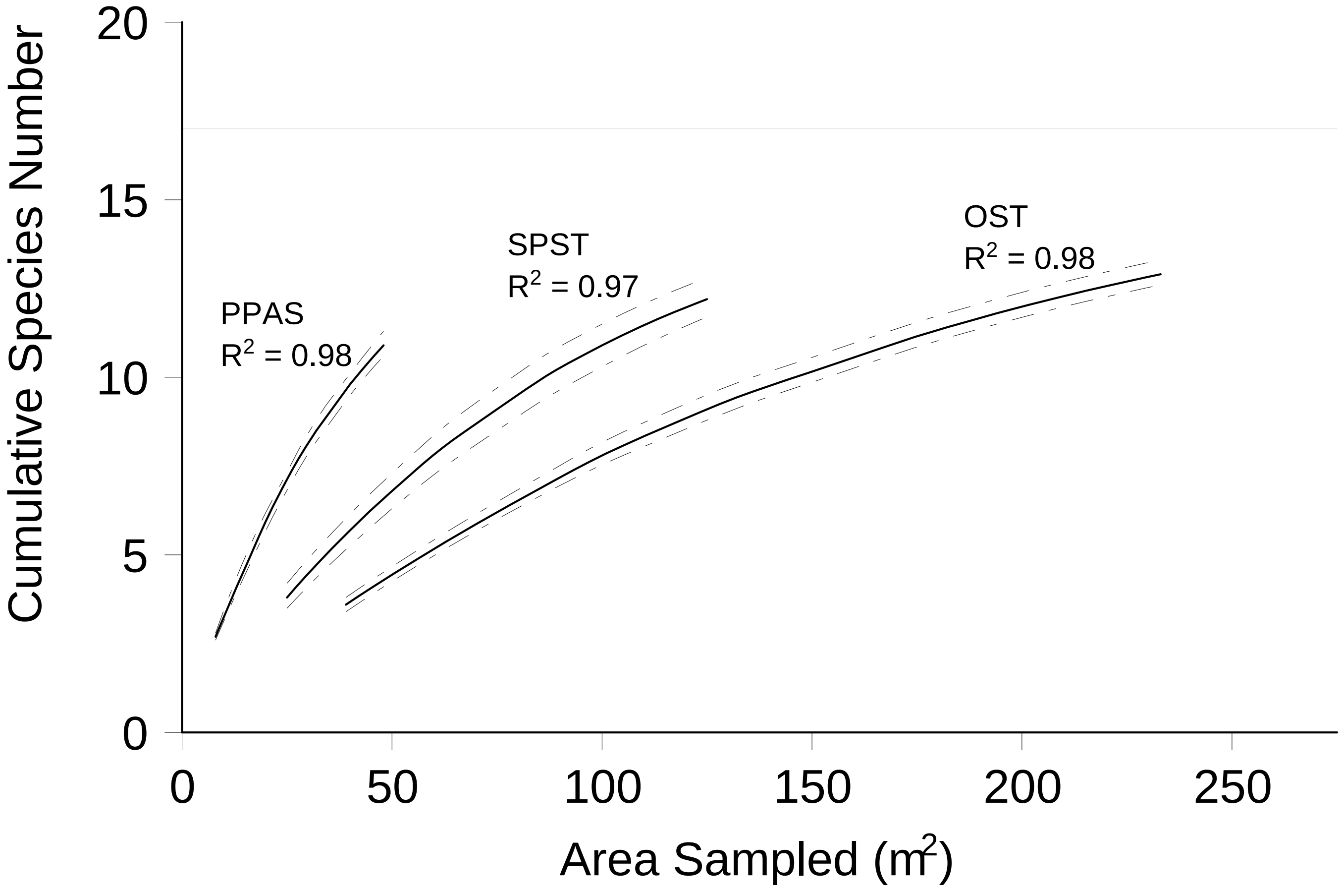
- PPAS: 20
- SPST: 18
- MPMT: 19

Species Accumulation Rates

Riffle Habitat

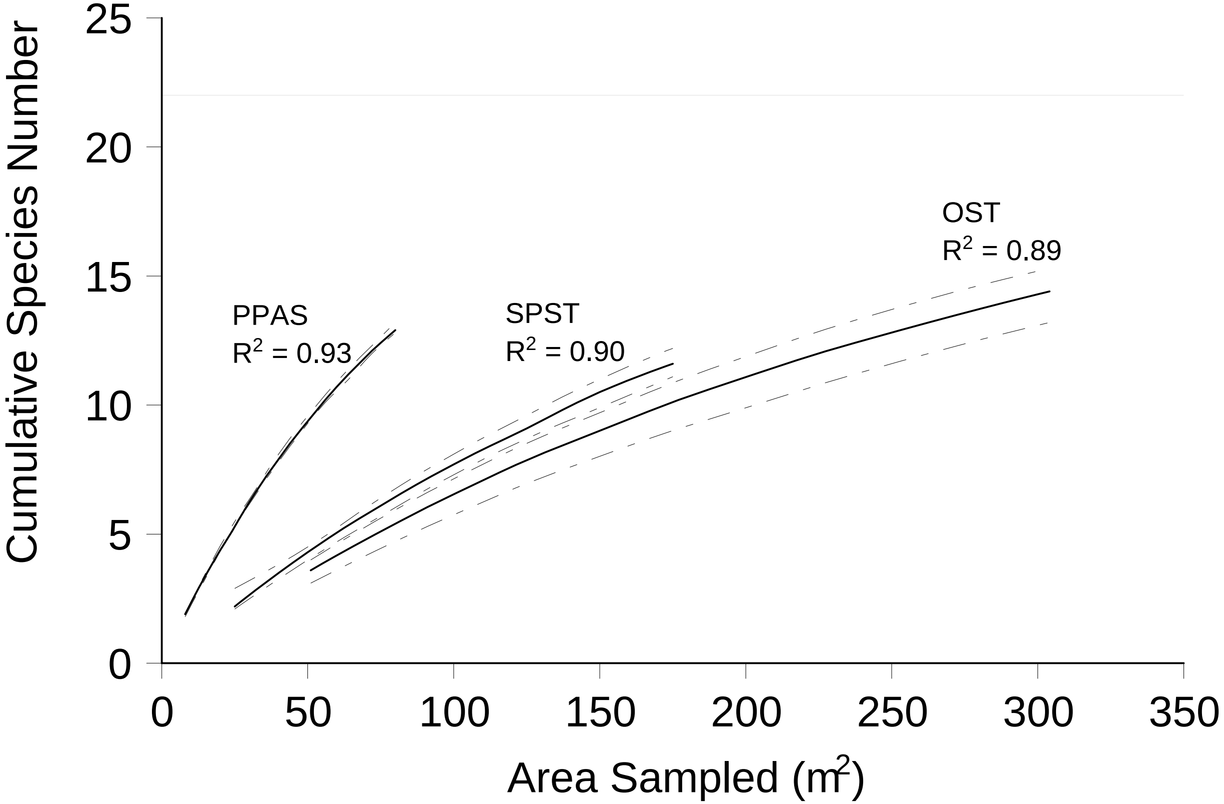


Run Habitat



Cumulative Species Number
20
15
10
5
0
0
50
100
150
200
250
Area Sampled (m2)
PPAS
R2 = 0.98
SPST
R2 = 0.97
OST
R2 = 0.98

Pool Habitat



Species Acumulation Rates

Conclusion

- PPAS is consistently the most efficient technique for sampling fish assemblages in shallow-water habitats

Length-frequency Distributions

- **Only water-column cyprinid and benthic groups were captured in sufficient numbers and size classes to allow Chi-square analysis**

Water-column Cyprinid Group

Fish Length Interval (mm)	Percent Captured		
	PPAS	SPST	MPMT
20 - 60	20	25	24
61 - 100	38	55	61
101 - 140	33	19	10
> 140	9	1	5

$p < 0.001$

Conclusion

- PPAS causes less fright bias and is therefore more efficient for capturing water column cyprinids

Benthic Group

- **No differences among methods were observed for the benthic group ($p > 0.05$)**
- **Consistent with previous studies that benthic fishes move less with disturbance**

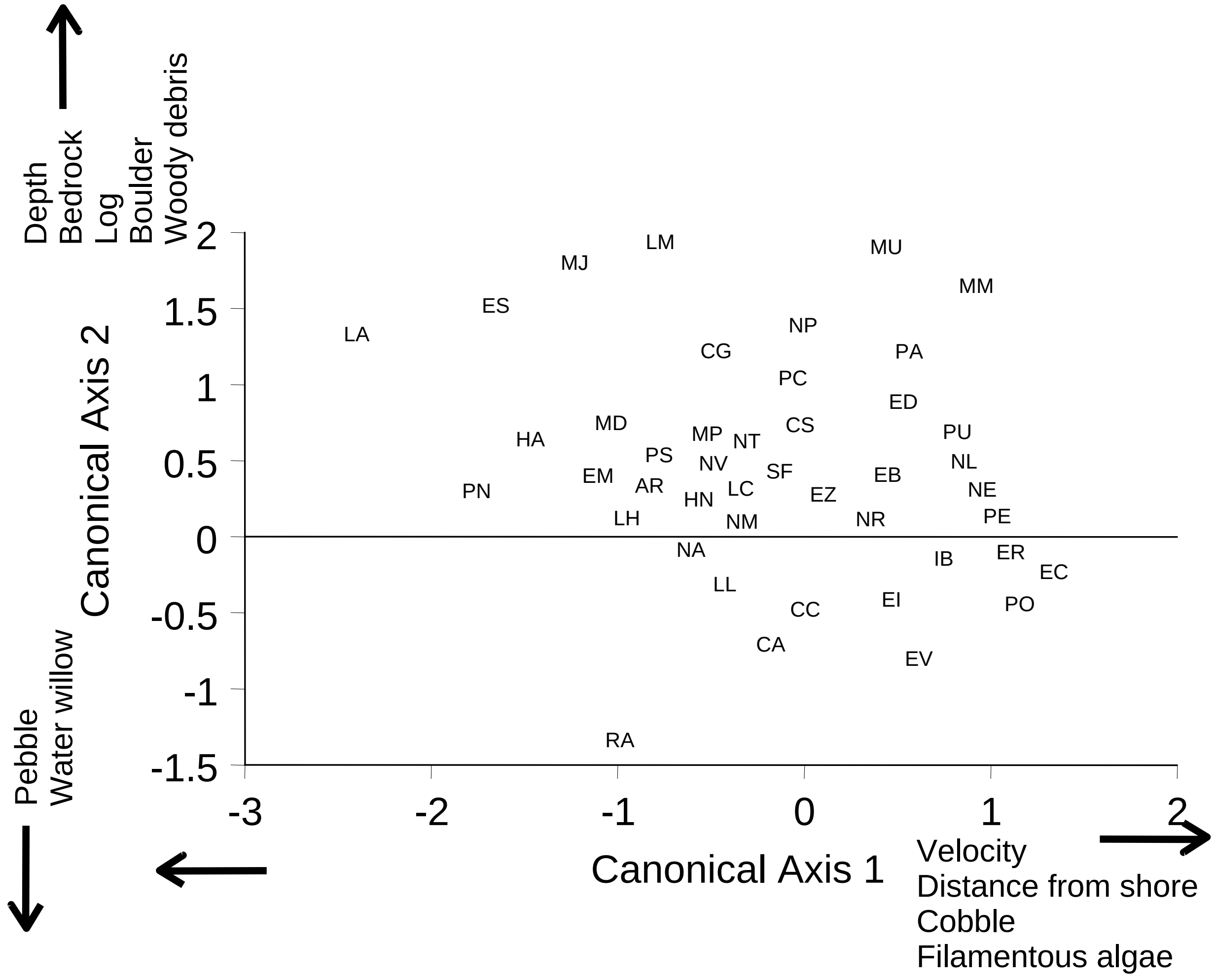
Overall Conclusion

- Length-frequency and species accumulation data agree
- PPAS is most efficient method for sampling entire fish assemblage
- Methods that cause greater disturbance result in increased fright bias and lower sampling efficiency

Implications for Stream Fish Studies

- The use of PPAS can increase the resolution of biomonitoring programs and fish-habitat studies

Fish-habitat relationships



(2 letter codes represent position of different fish species)