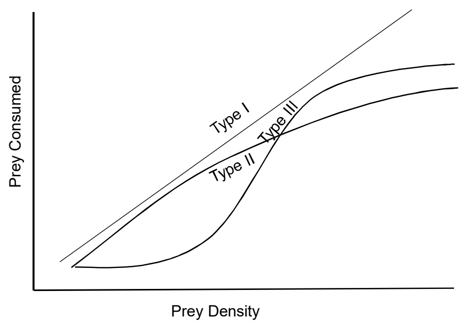
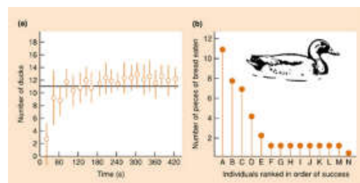
Switching Behavior



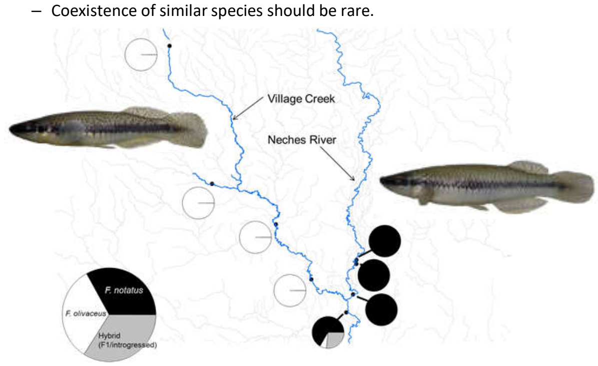
Ideal Free Distribution (IFD – Fretwell and Lucas 1970)

- Consumers should aggregate where resources are most abundant (OFT)
- Consumers will compete and interfere.
- Thus, patches with fewer competing consumers are most profitable
- Consumers should continually redistribute themselves to match patch quality
  - Assumes movement among all patches equal
  - Simultaneous knowledge of all patches



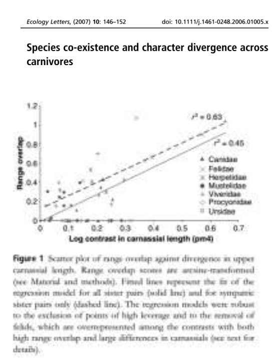
Evolutionary and Ecological Patterns

- Recall niche conservatism…
- **Coexistence –** Species with similar niches should compete for similar resources. Limiting recourses should result in **competitive exclusion**.
  - Coexistence of similar species should be rare.



Evolutionary and Ecological Patterns

- **Character Displacement** - Competitive interactions will select for divergence in traits to reduce competitive pressure.
- As species differences increase, changes in the niche allow for coexistence with less competitive pressure.
- Observe a relationship between the amount of dissimilarity and range overlap.
- **Specialization** – selection for specializing (shrinking the niche) in particular resources to reduce competitive pressure.



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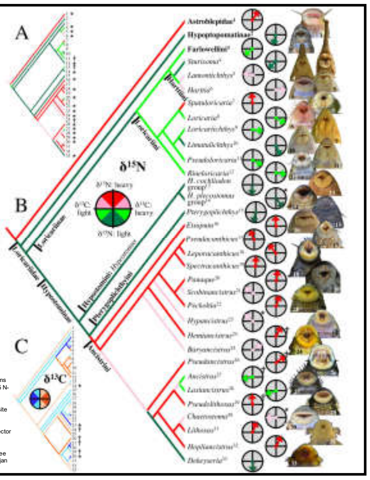
Species co-existence and character divergence across carnivores

Figure 1 Scatter plot of range overlap against divergence in upper carnassial length. Range overlap scores are arcsine-transformed (see Material and methods). Fitted lines represent the fit of the regression model for all sister pairs (solid line) and for sympatric sister pairs only (dashed line). The regression models were robust to the exclusion of points of high leverage and to the removal of felids, which are overrepresented among the contrasts with both high range overlap and large differences in carnassials (see text for details).

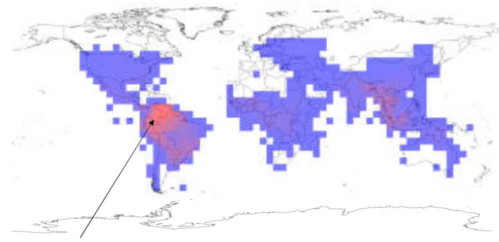
- Species radiations of fish often feature rapid evolution of feeding morphology.
- See also cichlid species radiations in African great lakes.

Trophic diversity in the evolution and community assembly of loricariid catfishes



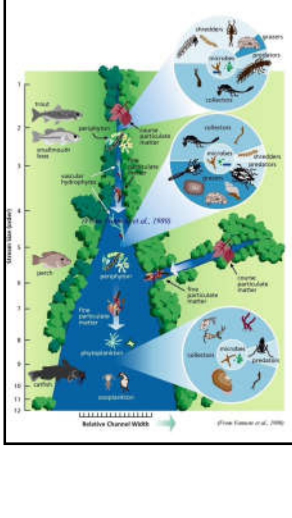
Evolutionary patterns of loricariid trophic diversification revealed by assemblage centroid-standardized isotope vector analysis (ACSIVA) of C and N stable isotope data (Figure3; See Additional file 4 : Figures 3–10 for isotope biplots of all local assemblages examined). Cladograms A and B represent the hypothesized ancestral distributions of lineages along a vertical axis of 15 N-enrichment relative to assemblage centroid (pink to red being 15 N-enriched relative to centroid, light green to green being 15 N-depleted relative to centroid). Cladogram A represents a phylogenetic regression of 649 individual vectors (Figure 3A) grouped by genus irrespective of site (see Additional file 2: Figure S1 for a full size version of this phylogeny), and cladogram B represents a regression of 120 mean genus x site vectors (Figure 3 C). Circle plots illustrate the direction of mean genus x site vectors for each genus and statistical significance of the mean vector is indicated by * (Rayleigh's Z test: P < 0.05) or † (0.10 > P > 0.05; Tables 1, 2). Cladogram C resulted from the same analysis as B, but is color-coded to reflect hypothesized distributions of ancestral lineages along a horizontal axis of 13 C-enrichment relative to assemblage centroid (see Additional file 3: Figure S2 for a full size version of this phylogeny). Oral disk photos by N. K. Lujan or M. H. Sabaj Pérez.

Catfish global diversity



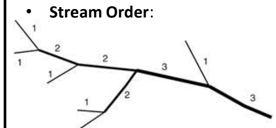
Loricariidae radiation – partitioning of resources, primarily through changes in feeding morphology and ecology to reduce niche overlap (competition).

Freshwater Fish Gradients

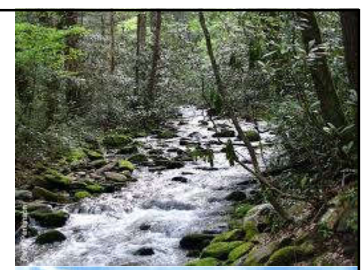


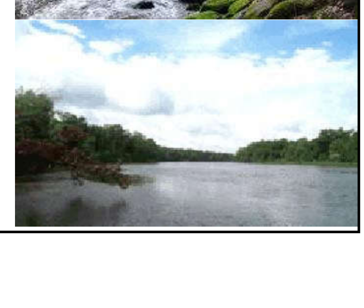
- **River Continuum Concept** – As you progress from upstream headwaters to larger rivers:
  - Canopy cover decreases
  - Water temperature increases
  - Substrate size decreases
  - Water clarity decreases
  - Productivity shifts from **allochthonous** (carbon input from outside the system) to **autochthonous** (carbon fixed inside).
  - Shifts in invetebrate feeding groups
  - Shift to more piscivorous fish

- River continuum gradients consistent throughout freshwater ecosystems globally.
- **Stream Order**:



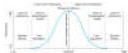
- Other metrics of size: **Cumulative Drainage Area** or **River Discharge**.

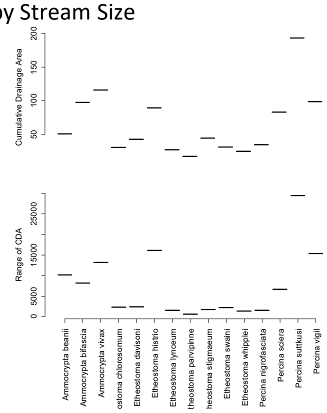




Defining Species Niche by Stream Size

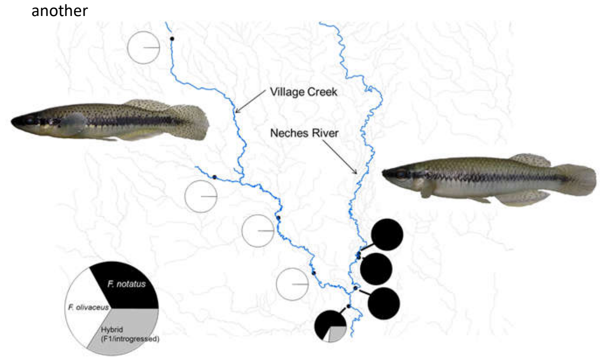
- Recall our definition of niche…
- Compiled occurrence data for all darters, calculated the mean (geometric) and variance in stream size occupied.





Partitioning Habitats

- *Fundulus* "coexistence" facilitated by *F. notatus* living downstream, *F. olivaceus* living upstream.
- True coexistence only near confluences – rapid shifts from one habitat type to another



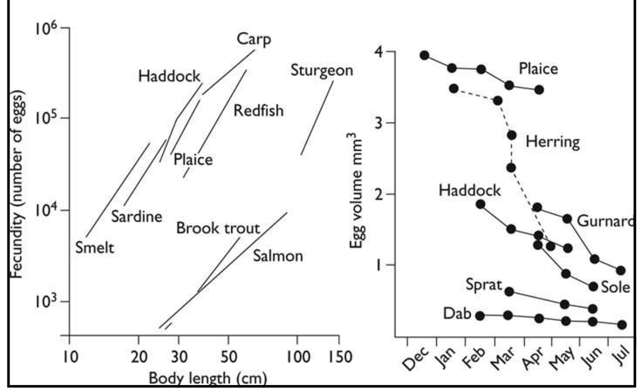
Life History

- The schedule and duration of various **ontogenetic** stages.
- Patterns of **energy allocation** to growth vs. reproduction throughout life.
- Selection should favor sets of traits that maximize **fitness**, why do we see such dramatic differences in life history?

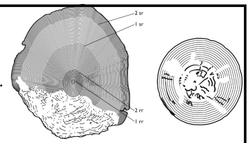
r-selected

K-selected

- High variability in reproductive investment.



Life History

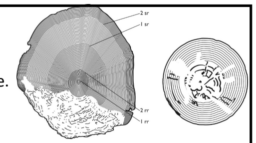


- Assessment of population demographic structure.
- Collection and ageing of individuals
- Individual reproductive capacity.

Age	n_x	l_x	d_x	q_x	s_x	m_x	l_xm_x	xl_xm_x
0	500	1.00	482.00	0.96	0.04	0	0	0
1	18	0.04	13.00	0.72	0.28	20	0.72	0.72
2	5	0.01	4.00	0.80	0.20	100	1	2
3	1	0.00	1.00	1.00	0.00	100	0.2	0.6
4	0	0						
						R	1.92	3.32
						T_c	1.73	

- n_x- number of each age class
- l_x- probability of survival to age
- d_x- number of mortalities at each age
- q_x- age specific mortality
- s_x- age specific survivorship
- m_x- age specific fecundity

Life History



- Assessment of population demographic structure.
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Age	n_x	l_x	d_x	q_x	s_x	m_x	l_xm_x	xl_xm_x
0	500	1.00	482.00	0.96	0.04	0	0	0
1	18	0.04	13.00	0.72	0.28	20	0.72	0.72
2	5	0.01	4.00	0.80	0.20	100	1	2
3	1	0.00	1.00	1.00	0.00	100	0.2	0.6
4	0	0						
						R	1.92	3.32
						T_c	1.73	

- l_xm_x- product of age specific mortality and fecundity
- R – sum of l_xm_x= rate of population increase
- T_c- sum of xl_xm_x divided by R = generation time

Life History

Age	n_x	l_x	d_x	q_x	s_x	m_x	l_xm_x	xl_xm_x
0	500	1.00	482.00	0.96	0.04	0	0	0
1	18	0.04	13.00	0.72	0.28	20	0.72	0.72
2	5	0.01	4.00	0.80	0.20	100	1	2
3	1	0.00	1.00	1.00	0.00	100	0.2	0.6
4	0	0						
						R	1.92	3.32
						T_c	1.73	

Age	n_x	l_x	d_x	q_x	s_x	m_x	l_xm_x	xl_xm_x
0	100	1.00	30.00	0.30	0.70	0	0	0
1	70	0.70	30.00	0.43	0.57	0	0	0
2	40	0.40	20.00	0.50	0.50	2	0.8	1.6
3	20	0.20	20.00	1.00	0.00	3	0.6	1.8
4	0	0						
						R	1.4	3.4
						T_c	2.43