Foraging ecology and nursery habitat use of brown stingrays, *Dasyatis lata*

Jonathan Dale, Natalie Wallsgrove, Brian Popp, Kim Holland
University of Hawai‘i
Hawai‘i Institute of Marine Biology
Bays and Estuaries

• Important component of the life history of many elasmobranch species
  – Aggregation areas for mating
  – Sites of parturition

• Nursery areas
  – Potential long term habitat use
  – Increased prey abundance
  – Decreased predation risk
  – Increased juvenile survival
  – May lead to regulation of prey resources

• Highly susceptible to anthropogenic impacts
Foraging Ecology

• Stomach Contents
  – Snapshot of diet
  – Differential digestion rates
  – Uncertainty in estimates of trophic positions

• Bulk Tissue Stable Isotopes
  – Time integrated values of assimilated prey
  – Spatial and temporal variability
Bulk Stable Isotopes

δ¹³C (‰) vs. Trophic Position

δ¹⁵N (‰) vs. Trophic Position

Base of Food Web

Trophic Position
Foraging Ecology

• Stomach Contents
  – Snapshot of diet
  – Differential digestion rates
  – Uncertainty in estimates of trophic positions

• Bulk Tissue Stable Isotopes
  – Spatial and temporal variability

• Compound-specific nitrogen isotopic analysis of individual amino acids
Nitrogen Isotopic Analysis of Amino Acids

Chikaraishi et al. 2009
**Dasyatis lata**

- **Large benthic predator endemic to Hawai‘i**
  - Up to 5 ft. wide and > 200 lbs

- **Abundant in estuaries and coastal waters**
  - Depths up to 300 m
  - Nursery habitat?

- **Ecological Impacts unknown**
  - Very limited data available on even basic biology
Research Questions

• What are the feeding habits of brown stingrays?

• Do their feeding habits change through ontogeny?

• Do they use bays as nursery habitats?

• Does analysis of individual amino acids accurately reflect the trophic position of brown stingrays?
Methods

• Kāneʻohe Bay, Oʻahu

• Stomach Content Analysis
  – Prey composition and contribution (% number and % weight) to diet

• Stable Isotope Analysis
  – Bulk Tissue
  – Compound-specific nitrogen isotopic analysis of individual amino acids

• 3 size classes
  – Small (<55 cm DW)
  – Medium (55 – 70 cm DW)
  – Large (70-95 cm DW)
Results

Diet Composition

% Total

% Weight

% Number

Prey Group

Portunidae

Alpheidae

Stomatopoda

Gobiidae

Polycheata
Results
Ontogenetic Changes - Diet

P < 0.001, R-statistic = 0.7
Results
Ontogenetic Changes – Diet

δ¹⁵N (‰)

Disk Width (cm)

Trophic position:
Small = 3.3
Med = 3.5
Large = 3.6
Results
Ontogenetic Changes - Habitat

\[ \delta^{13}C \text{ (‰)} \]

\[ \delta^{15}N \text{ (‰)} \]

Disk Width (cm)

Disk Width (cm)
Results
Ontogenetic Changes - Habitat

δ¹⁵N (‰)

Male
Female

Disk Width (cm)
Results

Amino Acid Analysis

<table>
<thead>
<tr>
<th>Disk Width (cm)</th>
<th>Trophic Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>1.5</td>
</tr>
<tr>
<td>60</td>
<td>2.0</td>
</tr>
<tr>
<td>80</td>
<td>2.5</td>
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<tr>
<td>100</td>
<td>3.0</td>
</tr>
<tr>
<td>120</td>
<td>3.5</td>
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<table>
<thead>
<tr>
<th>Bulk δ¹⁵N (‰)</th>
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<tbody>
<tr>
<td>7</td>
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<tr>
<td>8</td>
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<td>9</td>
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<td>11</td>
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<td>12</td>
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<td>13</td>
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</tbody>
</table>

- **Trophic Position**
- **Bulk δ¹⁵N**
Results
Ontogenetic Changes - Habitat

$\delta^{15}N$ (%) vs. Disk Width (cm)

Bay
Offshore

Male
Female
Results
Amino Acid Analysis

Bulk $\delta^{15}N$ (‰)

Trophic Position

<table>
<thead>
<tr>
<th>Disk Width (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>40 60 80 100 120</td>
</tr>
<tr>
<td>1.5 2.0 2.5 3.0 3.5</td>
</tr>
</tbody>
</table>

Bulk $\delta^{15}N$ (‰)

Trophic Position

Bulk $\delta^{15}N$

Disk Width (cm)
$$TP_{\text{Glu/Phe}} = \frac{\delta^{15}N_{\text{Glu}} - \delta^{15}N_{\text{Phe}} - 3.4}{7.6} + 1$$

Chikaraishi et al. 2009
Chikaraishi et al. 2007

Speers-Roesch et al. 2006
Conclusions

• Generalist predator
• Shift in diet from shrimp dominated to crab dominated with growth
• Kāneʻohe Bay is an important nursery habitat for brown stingrays
  – Utilize sub-regions within the bay for extended periods of time
  – Remain in bay until sexually mature, then shift to offshore habitat
• Amino acid analysis accurately represented relative trophic position
  – TEF used to calculate absolute TP in previous studies requires adjustment for elasmobranchs
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