The following supplement accompanies the article

Stable isotope analysis of eye lenses from invasive lionfish yields record of resource use

Joseph S. Curtis*, Mark A. Albins, Ernst B. Peebles, Christopher D. Stallings

*Corresponding author: joseph_curtis@ucsb.edu

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Supplementary Material

Removal Study Design

Specimens for this study were collected in association with a Before-After-Control-Impact (BACI) lionfish removal experiment (Stallings & Albins 2016). Each site was randomly assigned to one of three experimental treatments that underwent different levels of lionfish removal: control (no removal, n = 8 sites), tri-annual removal (n = 6 sites), and monthly removal (n = 6 sites). Lionfish removals began in September 2014 and continued for one year. During each removal event, BNP scientific staff collected all observed lionfish from each site. All lionfish from control sites were collected upon the conclusion of the experiment in September 2015. Graysby were collected during July and September of both 2014 and 2015. The number of individuals sampled from each site are provided in Table S1.

Isotopic Analyses

Isotopic values measured in lionfish muscle from control sites were excluded from descriptions of isoscapes due to their comparatively low sample sizes and often heavily skewed size distributions. Furthermore, we concluded that data collected during one sampling event in September 2015 could skew spatial-isotopic relationships encapsulated in fishes collected across a broader time-scale, as isoscapes can be temporally variable (Radabaugh et al. 2013).

Data from eye lenses were compared both within and among BACI removal treatments to investigate possible effects of lionfish removal on isotopic records (i.e., resource use patterns) in both lionfish and Graysby (Figures S1-S4). Frequency of lionfish removal in association with the BACI study design had no apparent relationship with patterns observed in lionfish or Graysby eye lens chronologies, suggesting that the extent of lionfish removal might not cause a consistent or predictable shift in patterns of resource use in either species. It is likely that the duration of lionfish removals was not sufficient to elicit a response that would manifest clearly in eye lens isotopic records, especially given the relatively low number of individuals sampled for this study. At the time of sampling, lionfish removals had only been ongoing for 6-9 months, a timeframe that would only allow synthesis of at most a small number of the outermost eye lens layers, therefore limiting interpretations of the effects of lionfish removal on individual fish resource use at a sub-annual time scale.

Literature Cited

Stallings CD & Albins MA (2016) Final report to Florida Sea Grant on Project # R/LR-B-66H. Florida Sea Grant.

Radabaugh KR, Hollander DJ & Peebles EB (2013) Seasonal δ13C and δ15N isoscapes of fish populations along a continental shelf trophic gradient. Continental Shelf Research 68:112–122.

Table S1. Number of lionfish and Graysby collected from sites belonging to different experimental removal treatments. Isotopic values measured in muscle samples of these individuals were averaged to provide the relationships between $\delta^{13}C$, $\delta^{15}N$, latitude, and depth described in the main text (see Figure 2, Table 1).

Site	Removal Frequency	Lionfish collected	Graysby collected
BNP 01	Quarterly	11	9
BNP 02	Monthly	39	8
BNP 03	Monthly	36	9
BNP 04	No removal	0	8
BNP 05	No removal	2	8
BNP 06	Quarterly	15	8
BNP 07	No removal	1	8
BNP 08	Monthly	18	9
BNP 09	Quarterly	10	9
BNP 10	Monthly	36	9
BNP 11	No removal	1	8
BNP 12	Quarterly	9	9
BNP 13	No removal	5	8
BNP 14	No removal	7	8
BNP 15	Monthly	37	8
BNP 16	No removal	17	11
BNP 17	Monthly	26	8
BNP 18	Quarterly	19	9
BNP 19	No removal	7	10
BNP 20	Quarterly	20	8

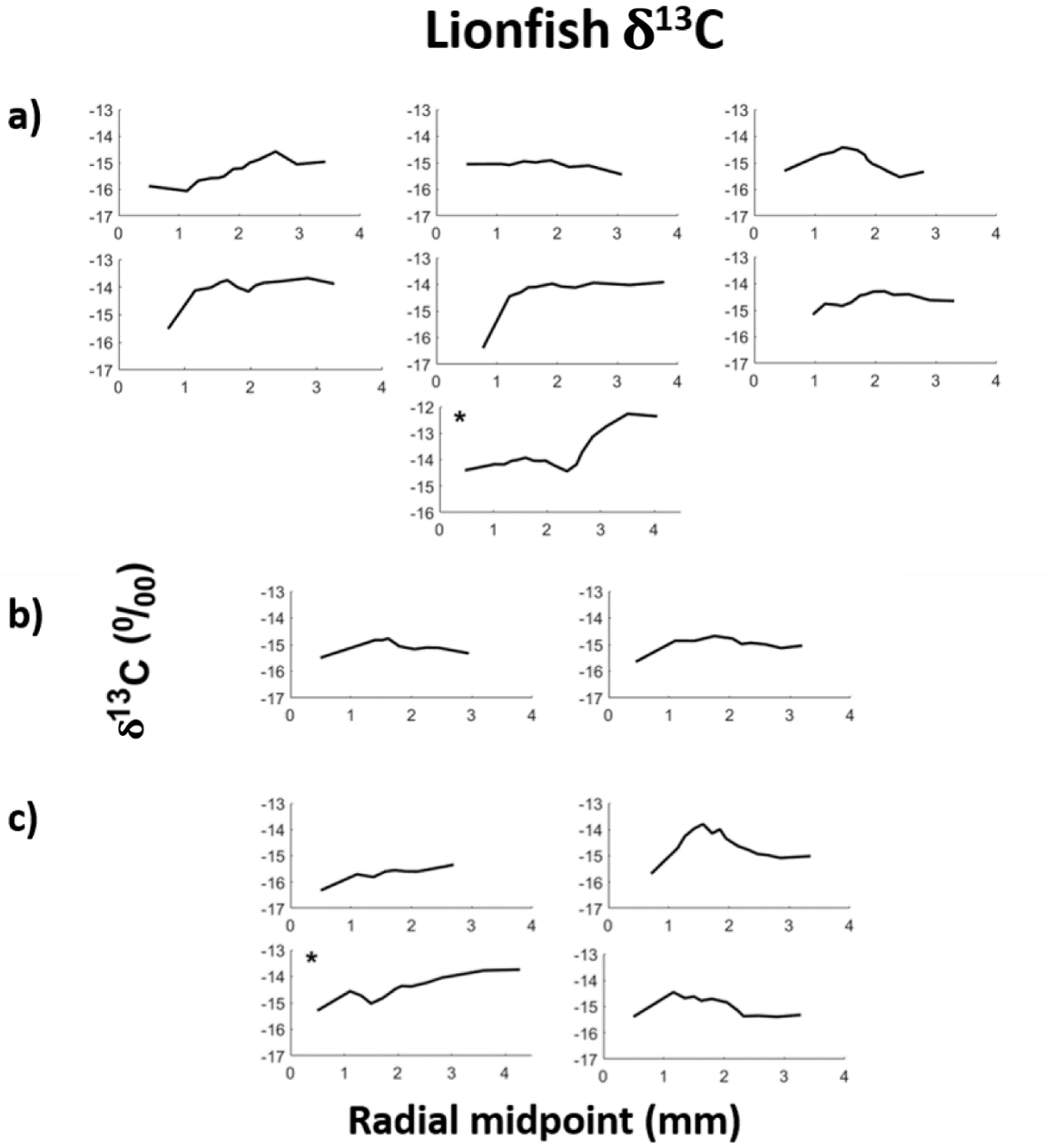

Figure S1. Individual chronologies of $\delta^{13}C$ values vs. radial midpoint of lionfish eye lenses collected from a) Removal sites in September 2014, b) Removal sites in September 2015, and c) Control sites in September 2015. * denotes an individual for which axes are scaled differently from other graphs in the same category.

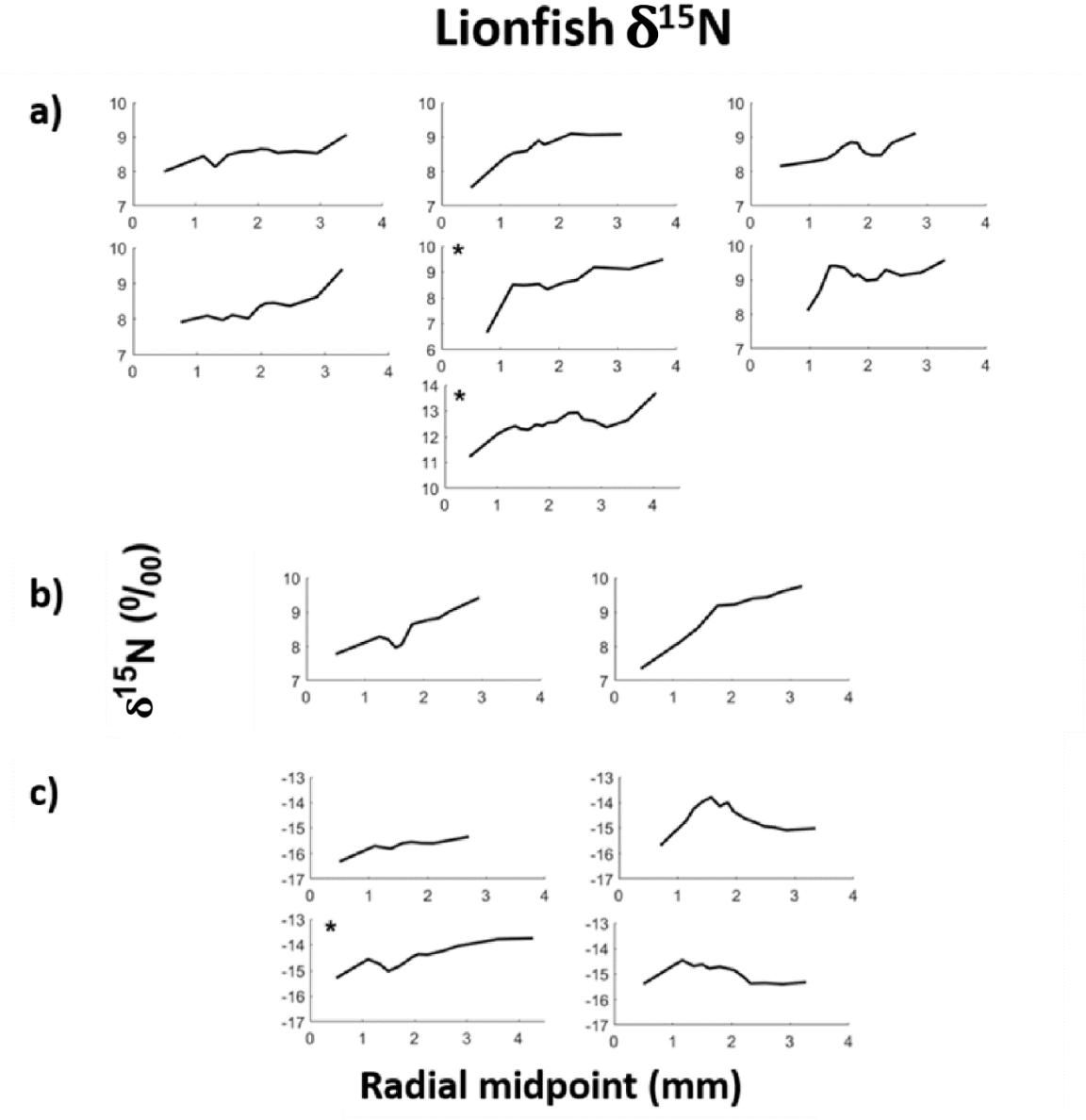

Figure S2. Individual chronologies of δ^{15}N values vs. radial midpoint of lionfish eye lenses collected from a) Removal sites in September 2014, b) Removal sites in September 2015, and c) Control sites in September 2015. * denotes an individual for which axes are differently scaled than the other graphs.

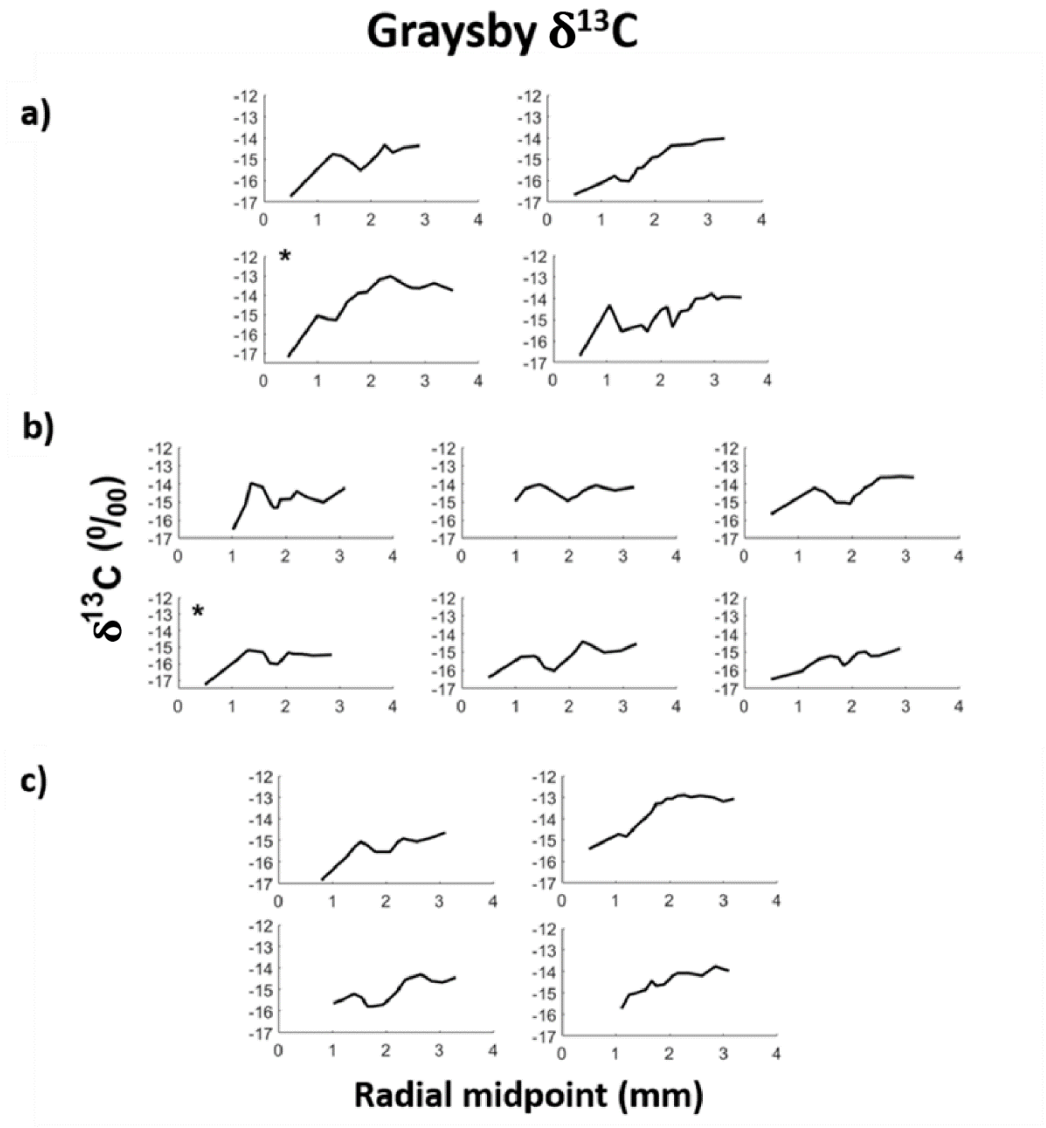

Figure S3. Individual chronologies of $\delta^{13}C$ values vs. radial midpoint of Graysby eye lenses collected from a) Removal sites in September 2014, b) Removal sites in September 2015, and c) Control sites in September 2015. * denotes an individual for which axes are differently scaled than the other graphs.

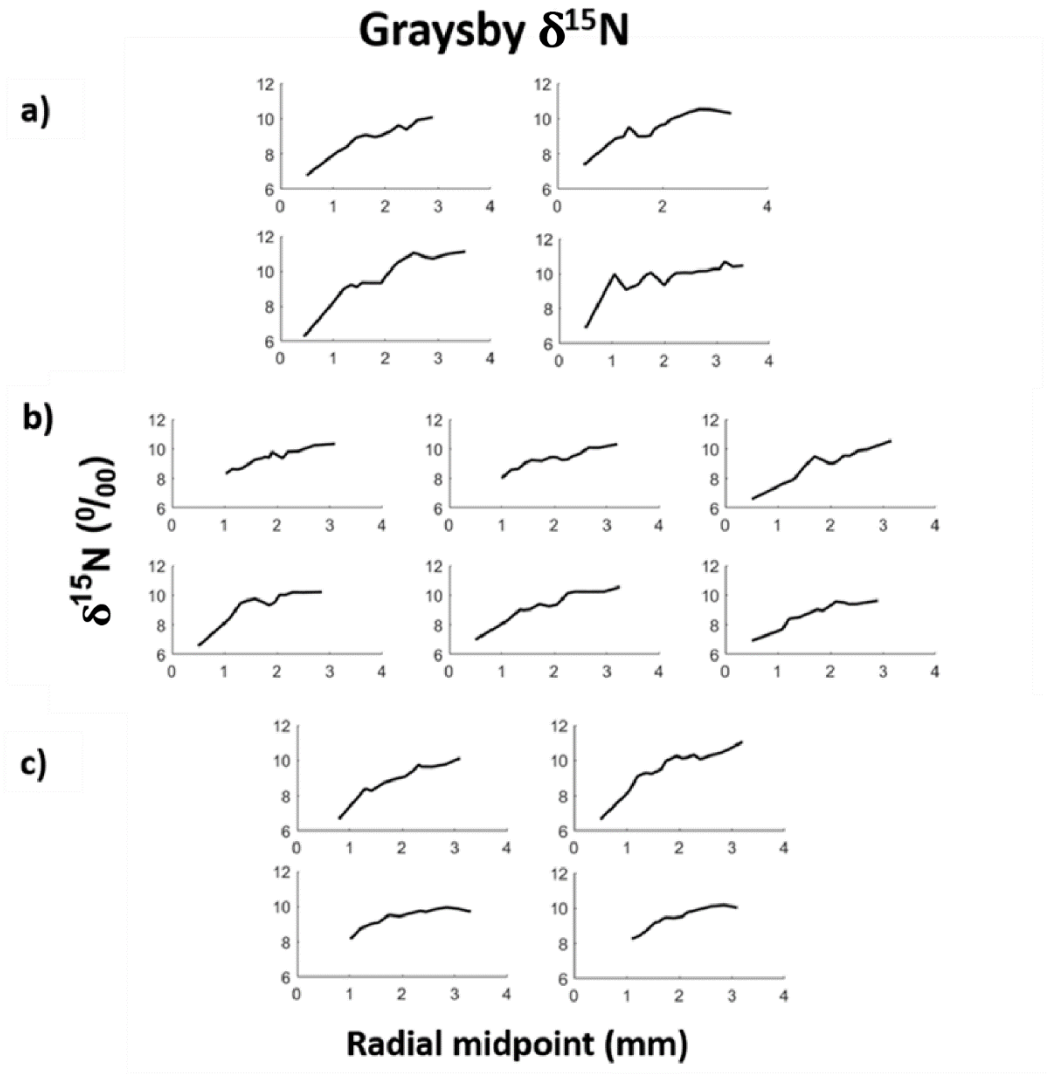

Figure S4. Individual chronologies of $\delta^{15}N$ values vs. radial midpoint of Graysby eye lenses collected from a) Removal sites in September 2014, b) Removal sites in September 2015, and c) Control sites in September 2015. * denotes an individual for which axes are differently scaled than the other graphs.