

Seasonal patterns on isotopic niches and diet of Bigeye and Southern Spotted Opah (Lamprididae) in Southwestern Atlantic Ocean

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Abstract

Opahs (Lampris spp.) are large deep-water epi-mesopelagic predator fishes captured worldwide as bycatch of longline fisheries targeting large pelagic fishes. Despite the growing culinary interest leading to increasing commercial interest, several basic biological information about the species is still poorly known. This study uses stable isotope and stomach content analysis to access the diet and seasonality on the isotopic niche of the Big-eye Opah, *Lampris megalopsis*, and the Southern Spotted Opah *Lampris australensis* in the Southwest Atlantic Ocean (SWAO). Generalized Linear Models were applied to investigate the influence of the species, sex, seasons, and furcal length on ^{13}C and ^{15}N isotopic compositions. Significant differences were observed only for Autumn and for *L. megalopsis*. The isotopic niches resulted in overlapped 40% ellipses between the species. Seasonal differences for ^{15}N in hot and cold seasons for both species related to the dynamic of the Brazilian and the Malvinas (Falkland) currents and the shift on the baseline source of nitrogen. Differences in ^{13}C , with enriched values in the warmer season, were observed only for *L. megalopsis* and suggested movements to areas with depleted ^{15}C values. Diet for both species was composed predominantly by Cephalopods and Teleost's, followed by Crustacea, in smaller quantities. An alarming high plastic frequency of occurrence was observed in 40% of the stomachs of *L. megalopsis* and 31% of *L. australensis*. This study advances in understanding the Opah fishes feeding ecology in SWAO and provides information on community dynamics and the functional role that these species play in the structure of all marine ecosystems where they occur. Given the growing global commercial importance of *Lampris* spp., it is also increasingly important to know their inter and intraspecific relationships and the anthropological impacts they are suffering.

Keywords: *Lampris*, ^{13}C and ^{15}N , plastic pollution

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1. Bibliography styles

Here are two sample references: Feynman and Vernon Jr. (1963; Dirac, 1953).

By default, natbib will be used with the `authoryear` style, set in `classoption` variable in YAML and with `elsearticle-harv.bst` which is among provided style by `elsarticle` documentclass. Other available style

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are `elsarticle-num.bst` and `elsarticle-num-names.bst` — the first one can be used for the numbered scheme, second one for numbered with new options of `natbib.sty`.

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```
natbiboptions: longnamesfirst,angle,semicolon
```

There are various more specific bibliography styles available at https://support.stmdocs.in/wiki/index.php?title=Model-wise_bibliographic_style_files. To use one of these, add it in the header using, for example, `biblio-style: model1-num-names`.

1.1. Using CSL

If `citation_package` is set to default in `elsevier_article()`, then `pandoc` is used for citations instead of `natbib`. In this case, the `cs1` option is used to format the references. Alternative `cs1` files are available from <https://www.zotero.org/styles?q=elsevier>. These can be downloaded and stored locally, or the url can be used as in the example header.

2. Equations

Here is an equation:

$$f_X(x) = \left(\frac{\alpha}{\beta}\right) \left(\frac{x}{\beta}\right)^{\alpha-1} e^{-\left(\frac{x}{\beta}\right)^\alpha}; \alpha, \beta, x > 0.$$

Here is another:

$$a^2 + b^2 = c^2. \tag{1}$$

Inline equations: $\sum_{i=2}^{\infty} \{\alpha_i^\beta\}$

3. Figures and tables

Figure 1 is generated using an R chunk.

4. Tables coming from R

Tables can also be generated using R chunks, as shown in Table 1 for example.

```
knitr::kable(head(mtcars)[,1:4],
  caption = "\\label{tab1}Caption centered above table"
)
```

Table 1: Caption centered above table

	mpg	cyl	disp	hp
Mazda RX4	21.0	6	160	110
Mazda RX4 Wag	21.0	6	160	110
Datsun 710	22.8	4	108	93
Hornet 4 Drive	21.4	6	258	110
Hornet Sportabout	18.7	8	360	175
Valiant	18.1	6	225	105

References

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- Feynman, R.P., Vernon Jr., F.L., 1963. The theory of a general quantum system interacting with a linear dissipative system. *Annals of Physics* 24, 118–173. doi:10.1016/0003-4916(63)90068-X.

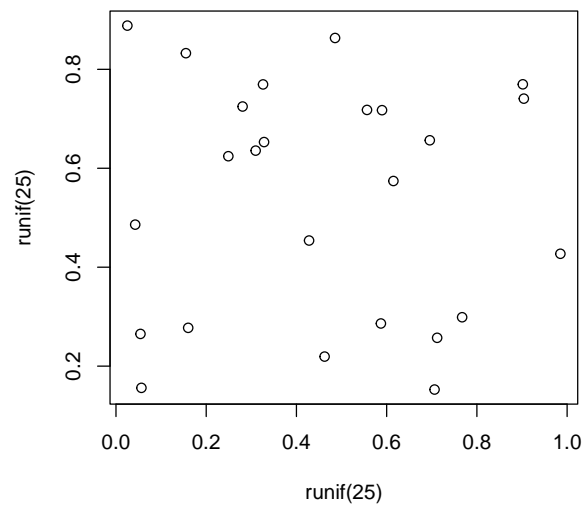


Figure 1: A meaningless scatterplot.