Departamento de Zoologia, Instituto de Biociências, Universidade de São Paulo, Rua Do Matão, Travessa 14, 101, São Paulo 05508 090, Brazil, Braz Departamento de Biologia Animal, Centro de Ciências Biológicas e da Saúde, Universidade Federal de Viçosa, Avenue Avenue P.H. \blacksquare ³ Wildlife and Ecology Group, School of Natural $S_{\rm{max}}$ Massey University, $P_{\rm{max}}$ 11 222, Palmerston North 4410, New Zealand

 \boxtimes $\qquad \qquad$ $\qquad \qquad$ amanfcunha@gmail.com

Fig. 1 1 $\sum_{i=1}^n \sum_{i=1}^n x_i x_i = \sum_{i=1}^n x_i$ and $\sum_{i=1}^n x_i = \sum_{i=1}^n x_i$ populations of three hydroid species of the genus *Orthopyxis* ana lysed in this study. Diferent colours indicate diferent populations

caliculata, O. crenata F_{ig. (e.g. *Sargassum* species on *Carpophyllum* sp., ^W}

Patterns of genetic variation

Nuclear and mitochondrial DNA sequence data were obtained from samples of the three species included in this study and used to infer spatial patterns of genetic variation. Part of these data was derived from a previous study with $\frac{1}{2}$ (ethopyxis (C_{unha} et al. [2015](#page-14-0)), $\frac{1}{2}$ $\tau_{\rm eff}$ of several new population samples (Table S1). Denoted from each colony (specimen) previously factores (in alcohol 90–100% using Agencourt DNAdvance extrac $\frac{1}{\sqrt{2}}$ (Beckman Coulter, Beverly, USA), in accordance with the manufacture's protocol. Portions of the genes $\mathcal{L}_{\mathbf{S}}=\left(\begin{array}{cc} 1 & 0 & 0 \\ 0 & 0 & 0 \end{array}\right)$ and the complete ITS $\left(\begin{array}{cc} 1 & 0 & 0 \\ 0 & 0 & 0 \end{array}\right)$ $\zeta = \gamma$ 00 bp including $\mathbf{w} = \gamma_1$ 2 s and sequenced following protocols protocols protocols protocols previously applied to the theoretical following protocols protocols protocols protocols protocols protocols protocol $G_{\rm c}$ et al. [2015](#page-14-1), [2017\)](#page-14-1). Sequencing was carried out al. 2017, 2017, 2017, 2017 $\sigma_{\rm T}$ 370 σ n analyzer (Applied Biosystems, Foster City, Were sexually were sequenced for most sequenced for most sequenced for most strands were sequenced for most sequenced for most sequenced for most sequenced for of the samples.

Second and Edited and edited and edited using Geneious v7.1 (Biomatters, Auckland, New Zealand), and aligned a
Second and aligned and ali

in accordance $\sum_{i=1}^{\infty}$ Fig. [4.](#page-7-0) Population in Brazil, $C_1 > n - \sqrt{2}$ CE—Ceará, AL—Alagoas, ES—Espírito Santo, RJ—Rio de Janeiro, SP—São Paulo, PR—Paraná, SC—Santa Catarina

with MAFFT (Katoh et al. [2002](#page-15-0)). We confrmed from skim sequencing of genomic DNA from three individuals that var iation in ITS exists with individual solution in \mathbf{w} . It is explicit concert lution of this multicopy marker. As a result, two sequence variants were identifed in several individual ITS amplicons. The sequence variants within an individual difered by two or eight nucleotide substitutions (within samples of *O. cre***nata** \mathbf{a} **b** \mathbf{a} **caliculata** \mathbf{a} \mathbf{a} in \mathbf{a} in the \mathbf{a} species, \mathbf{a} **in** \mathbf{a} \mathbf{a} in the species, variant sites in the species, variant sites in the species, variant sites in cies *O. sargassicola* (as ambiguous. TCS network code as a sample α C works (Clement et al. [2002](#page-14-2)) for the combined mitochondrial mito $\left(\begin{array}{cc}1&\frac{1}{2}x\\-\frac{1}{2}x&\frac{1}{2}x\end{array}\right)$ and $\left(\begin{array}{cc}1&\frac{1}{2}x\\-\frac{1}{2}x&\frac{1}{2}x\end{array}\right)$ markers of each special spe cies were generated using PopART (Leigh and Bryant [2015](#page-15-1)). Summary statistics was performed with the packages *apex* $\frac{1}{2}$ (Separadis [2020](#page-16-0)), *pegas* v_{1.} 20₁₁ (Paradis [2010](#page-15-2)), *pegas* v_{1.} 2010), *pegas* v₁. 2010), *pegas* v and **mmod** $=$ $(V_{11}$ $)$ $=$ $($ $)$ $=$ $($ $)$ $($ $\begin{array}{c} \mathbf{w} \rightarrow \mathbf{F} \rightarrow \mathbf{g} \rightarrow \mathbf{g$ α_s 19% was removed i[n](#page-3-0) 16S+CoI alignments and 1% in 16S+COI alignments and 10% in 10% Its 1-Here IIIs 2, see Table 1 \mathbf{F}_{α} , the number of number of number of number of \mathbf{F}_{α} المنوي في العالمية العود العربية والمناطق والحريرة العاملية والمناطق والمناطق والمناطق والمناطق والمناطق والمن T_c (Ramos-Onsins and T_c and T_c and T_c and T_c and T_c and T_c and T_c tances, as well as global (across loci) standardised fxation $\overline{\mathfrak{C}}$ st, Meirimans [2006](#page-15-3)) and diversity (D, Jost [2008\)](#page-15-4) indices (D, Jost 2008) indices $\overline{\mathfrak{C}}$

 $\overline{\mathcal{K}}_{\mathbb{C}[\mathbb{C}$

Fig. 2 Representative individuals from the lineages of *Orthopyxis* analysed in this study, with landmark confguration used in geometric morphometrics analyses. **a** *O. caliculata*_{-line} \mathcal{A} 2554, **2554** $\sum_{i=1}^{n}$ **A** $\sum_{i=1}^{n}$ **Linearly in the NiWA** $\sum_{i=1}^{n}$ **b** *O. caliculata* w_{hite} and $\sum_{i=1}^{n}$ *N₁*5063, specimen **N**₂ grey circles in (a) indicate fxed landmarks and semi-landmarks, \therefore **c** *O. crenata*_{-line} $\frac{1}{4}$, M_Z₂, specimens</sub>

from Alagoas, northern Brazil; **d** *O. crenata*_{-line} \mathcal{A} 2584, $\frac{1}{2}$ specimen from Paraná, southern Brazil; **e** *O. crenata*-lineage- $\begin{bmatrix} 7 & e & 0 & 1 \ 1 & 7 & 1 & 0. \end{bmatrix}$ substitution for $\begin{bmatrix} 1 & 0 & 0 \ 1 & 7 & 4 \end{bmatrix}$ $\begin{bmatrix} 7 & 4 \end{bmatrix}$ $\begin{bmatrix} 4 & 0 \end{bmatrix}$ $\begin{bmatrix} 8 & 1 \end{bmatrix}$ **f** see \mathbf{r} specimen from Espírito Santo, southern Brazil (M \mathbf{r} $(\mathbf{r} \cdot \mathbf{r})$ **g** $s_{\rm s}$ specimen from Santa Catarina, southern Brazil (M \sim Catarina, Santa **h i**) specimens from São Paulo, southern Brazil, southern Brazil, southern Brazil, \mathbf{h} **h** \mathbf{A} $\begin{array}{l} \begin{array}{c} \textbf{a} & \textbf{b} \\ \textbf{h} & \textbf{b} \end{array} \\ \begin{array}{c} \textbf{a} & \textbf{b} \\ \textbf{b} & \textbf{c} \end{array} \\ \begin{array}{c} \textbf{a} & \textbf{c} \\ \textbf{b} & \textbf{c} \end{array} \end{array} \begin{array}{c} \begin{array}{c} \textbf{a} & \textbf{b} \\ \textbf{b} & \textbf{c} \\ \textbf{c} & \textbf{c} \end{array} \end{array} \begin{array}{c} \begin{array}{c} \textbf{a} & \textbf$

 $\mathbb{E}_{\mathbb{E}[Y]}=\mathbb{E}_{\mathbb{E}[Y]}$ associated with manipulation of samples in $\mathbb{E}_{\mathbb{E}[Y]}$ scope slides and digitalization were estimated with experi mental replication, involving fve photographs of the same $\mathcal{S}_\mathcal{A}$ specimented and removed and removed and removed and removed $\mathcal{S}_\mathcal{A}$ $\frac{1}{\sqrt{2}}$ and digitalization step on the same photograph, with a dataset comprising $\frac{1}{\sqrt{2}}$ different specific different specific different specific different specific different specific different specific differe imens (Online Resource 4). A Process Anova was used to estimate the variance in shape associated with each mea
Anova was used to estimate the variance in shape associated with each measure in shape associated with each me urement $\frac{1}{2}$ using the package $\frac{1}{2}$ geomorph. $4 \cdot (\frac{1}{2} + \frac{1}{2})$ $\begin{array}{lllllllllllll} \mathbf{w}_1 & \mathbf{0}_1 & \mathbf{0}_1 & \mathbf{0}_2 & \mathbf{0}_2 & \mathbf{0}_3 & \mathbf{0}_3 & \mathbf{0}_4 & \mathbf{0}_5 & \mathbf{0}_4 & \mathbf{0}_5 & \mathbf{0}_6 & \mathbf{0}_7 & \mathbf{0}_7 & \mathbf{0}_7 & \mathbf{0}_8 & \mathbf{0}_7 & \mathbf{0}_8 & \mathbf{0}_7 & \mathbf{0}_7$ $\frac{1}{\sqrt{2}}\left(\frac{1}{\sqrt{2}}\right)$ for an and digitalization measurement errors, which were therefore considered negligible for subsection $\frac{1}{\sqrt{2}}$

section and the section of $\sum_{i=1}^{\infty} \frac{1}{i} \sum_{i=1}^{\infty} \frac{1}{i} \sum_{j=1}^{\infty} \frac{1}{j} \sum_{j$ $\begin{array}{c}\n\mathbb{E}\left[\text{exp}\left\{1+\left(1+\frac{1}{2}\right)\right\}+\left(1+\frac{1}{2}\right)\right]^{2}+\mathbb{E}\left\{1+\left(1+\frac{1}{2}\right)\right\}^{2}\n\end{array}$ and α and α in \mathbf{w} programming language. Hydrothese cal shape variation was evaluated with Canonical Variate A_{max} (CVA) $\frac{1}{2}$ using the package *Morpho* v²($\frac{1}{2}$ v₃ $2n$ in addition, differences in shape and size with Procrustes $\frac{1}{2}$ (*geomorph*), followed by pairwise tests (*RRPP*). Centroid size was included as a response variable in linear models in investigating size variation and as a predictor in models with shape as the response variable, to consider the relative amount of shape variation attributed to size. Similarly, the $\left\{\begin{array}{l} \begin{array}{c} \mathcal{C} \end{array} \right\} \begin{array}{c} \begin{array}{c} \mathcal{C} \end{array} \end{array} \begin{array}{c} \mathcal{C} \end{array} \begin{array}{c} \mathcal{C} \end{array} \end{array} \begin{array}{c} \mathcal{C} \end{array} \begin{array}{c} \math$ els to investigate patterns of both shape and size variation. Details of these analyses are provided in Online Resource 5.

Environmental data and covariation with morphological data

one in southern Brazil (Rio de Janeiro, São Paulo, Paraná, S *C. crenata*_{-line}age in S ₁) and S ₁) and S ₁) and S ₁) and one lineage in S northern Brazil (Alagoas, Ceará; *O. crenata*

Morphological variation

 $G_{\rm eff}$ Geometric morphometric morphometric analysis indicated that size and σ shape variation is better explained by the diferent genetic $\frac{1}{2}$ lineages than sampling localiculata. In $\frac{1}{2}$ als from the population of Santa Catarina in Brazil, cor $\int_{\mathbb{R}^n}$ $\int_{\mathbb{R}^n}$ *O. caliculata-*lineage-I (happen H₁₁ and $\int_{\mathbb{R}^n}$ ITS sequences AF, Fig. $\left(1-\frac{1}{\epsilon}\right)$, were smaller when compared compared when compared when compared when compared when ϵ to re[ma](#page-11-0)ining individuals (*F* 5.121, *P* 0.008; Fig. [5a](#page-10-0), Table). Similarly, shape is also diferent among genetic $\frac{1}{\sqrt{W}}$ $\frac{1}{\sqrt{1-\sqrt{2}}}$ (*F* $\frac{1}{\sqrt{2-\sqrt{2}}}$, *P* $\frac{1}{\sqrt{2}}$, $\frac{1}{\sqrt{2}}$ sification accuracy of 4.4% and showed that specimens specimens **o.caliculata-**
 $\begin{array}{c}\n\mathbf{w} & \mathbf{v} \\
\mathbf{w} & \mathbf{v} \\
\mathbf{v} & \mathbf{v$ Considering the species *O. crenata*, geometric mor phometric data showed that specimens from Brazil α . α $\begin{bmatrix} \text{c} & \text{c$ $\mathbf{F}_{\mu} = \frac{1}{\sqrt{1}}$ and $\frac{1}{\sqrt{1}}$ and $\frac{1}{\sqrt{1}}$ are concordant with genetic origins (which are concordant with genetic wit lineages). The shape of the hydrotheca in our population sample of *O. crenata*-lineage-III (from $\left(\begin{array}{ccc} 1 & 1 \\ 1 & 1 \end{array} \right)$) \ddot{C}_{max} and \ddot{C}_{max} and \ddot{C}_{max} and \ddot{C}_{max} \ddot{C}_{max} \ddot{C}_{max} P 0.001; Table 1.001; Table $\frac{1}{2}$ using the same grouping $\frac{1}{2}$ and shows the same grouping $\frac{1}{2}$ and shows that $\frac{1}{2}$ the shape of the hydrothecae vary from more campanulate in the populations of New Zealand and southern Brazil
Brazil to more campanulate in the populations of New Zealand and southern Brazil to more campanulate in the mo cylindri[ca](#page-4-0)l in populations from northern Brazil (Fig. [5d](#page-10-0), also F_i, \ldots) Although no differences in size \mathcal{A} , we recover \mathcal{A} , we recover \mathcal{A} population sam[ple](#page-11-0)s of *O. sargassicola* (*F* P ^{1.6} \mathbf{F}_{μ} , they show differences in shape (CVA) show differences in shape (CVA). overall classification accuracy 77.42%), $(1 + \sqrt{2})$ from Espírito Santo Santo Santo (ES) having a thicker periode campanulate hydrothecae when compared to populat
The populations of Rio de Janeiro and Santa Catarina (SC), which have think (SC), which have think have think
 ner perisarc and more cy[lin](#page-11-0)drical hydrothecae (*F* 3.5252, P 0.001; F_{ig.} [5f](#page-10-0), Table 1, T ation among the population samples of São Paulo probably explains the lack of signifcant diferences when compare[d t](#page-10-0)o populations of ES [an](#page-4-0)d SC in pairwise post hoc tests (Fig. [5](#page-10-0)f, compare with Fig. f-i).

Association between environmental and morphological data

 \mathcal{F}_{c} course than 2000 kms of the Brazilian coast and included sites in \mathcal{F}_{c} in \mathcal{F}_{c} therefore considerable variation in environmental con[di](#page-2-0)tion in \mathbf{w} tions ζ_1 , and another sampling locations (Fig. ζ). Partial least squares analysis revealed signifcant covariation between morphology and environmental variables (*O. caliculata P O. crenata P O. sargassicola P* 0.528, *P* 0.528, *P* 0.528, *P* 0.528, *P* 0.001 V ariable Importance in the Projection (VIP) scores suggests that the covariations are covariations are carri[ed](#page-11-1) by different environmental by different environmental by different environmental are carried by different environmental by different environmental by different environment variables in each species (Fig. α). For instance, which satisfies α ity showed an important contribution to the observed shape differences in all species, bathymetry was more important to the observed shape differences in all species, bathymetry was more important to the contribution of th for *O. caliculata*, temperature *O. crenata*, and current for *O. crenata*, and current curre $v_{\text{av}} = \frac{1}{\sqrt{N}}$ *O. sargassicola*. I_{n fac}tions with $\frac{1}{\sqrt{N}}$ and corresponding corresponding corresponding $\frac{1}{\sqrt{N}}$ related with the diferences observed in perisarc thickness of $p_{\text{ref}}(F_{\text{ref}})$ samples of *O. sargassicola* (F_{igs.} [5f](#page-10-0), c).

Discussion

 $T_{\rm eff}$ three species of O rthopyxis included in this study \mathbf{w} is a space common life \mathbf{w} is are traditionally consider traditionally consider traditionally consider the \mathbf{w} ered widespread and co-occur in the southwestern Atlantic Ocean (Cornelius [1982](#page-14-7); Cunha et al. [2015;](#page-14-0) Oliveira et al. [2016](#page-15-6)). However, our analyses revealed they have important differences in genetic and morphological patterns. While the second patterns in \mathcal{A} $s_{\rm s}$ s *O. sargassicola* showed low genetic diversity and no geographical structure nor isolation by distance, the specific structure $\mathbf{w}^{(k)}$ mens identified as *O. caliculata* and *O. crenata* showed higher genetic diferentiation suggesting the occurrence of cryptic speciation within these nominal species. Within *O. caliculata* $\frac{1}{2}$ the divergence $\left(\frac{1}{2}$ of $\frac{1}{2}$ the allocatric populations where this separated by large geographic distances, $\mathcal{C}_{\pmb{\beta}}$ is also observed among sympatric population samples in Brazil. We detected contrasting genetic patterns among these three taxa despite all sharing an absence of a long-lived medusa stage. This observation suggests that their presumed limited disper sal is not the sole factor determining the levels of population connectivity with the lineages. In the lineage
Sole factor of population connectivity with the lineages. In the lineages of the lineages of the lineages of t

Spatial patterns of genetic variation

All three species of *Orthopyxis* studied here are known to release a reduced medusa (medusoid) during their life cycle (Hirohito [1969](#page-14-8); Cornelius [1982,](#page-14-7) [1995](#page-14-9); Migotto 1995; Migotto [1996](#page-15-7); Migotto 1996; Migotto 1996; Migotto 19 but there are reports of this medusoid being facultatively retained in some species (Cornelius [1982,](#page-14-7) [1995;](#page-14-9) Llobet et al. [1991](#page-15-8)). The reduced media does not have manually stated media does not have manually stated media of the brium, mouth, or tentacles, and it is liberated with fully developed gonads (Russel [1953](#page-16-7); Hirohito [1969;](#page-14-8) Migotto 1996 medusoids have been reported to live in the plankton for up to a few days, spawning occurs connected to a few days connected to a few days connected to a few days connected to a few days, spawning occurs connected comitantly or shortly after release (Russel [1953](#page-16-7); Cornelius 1953; Cornelius 1953; Cornelius 1953; Co \mathcal{L}_{μ} and \mathcal{L}_{ν} is the sumably constraint constraint constraint long-distance long-distance constraint constra dispersal. In addition, planula larvae liberated directly from

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 $\mathcal{C} \xrightarrow{\mathcal{C}} \mathcal{C} \xrightarrow{\$ ny taona 2015. Io amin'ny soratra desimaly papara agest completes start) $(1, 1)$ ($() %)$ $\left($. O. calicula(t37(7)]TJ /T122 1 Tf[(consi(s8(tedy oftwP)26oydi(s)]TJ 0 Tc 0 Tw (-)Tj .056 Tc- $\int \mathcal{J}$. an 10 km $\dot{ap}(r)$ ty(H11-13), and concortdancey of nuclearrl rkers. Simailr(l)27(y)37(,our sam).3ples of7O. craena(t37(7)]TJ/T122 1 Tf 0 Tc 0 Tw 238016 0 Td ,-)Tjerp(r)+thrn Brtazilrl Alagoa(u).5and Ceará).l hte aseeoe a livedpalnt28.5oent-9eient-7.5(ht)65(e).5(s)65(e20(rl)]TJ.059 Tc. gassd co(7)|TJ/T122 1 Tf- .025 Tw(and 3)Tj/T132 1 Tf(O. calicula(t39.(a-7)|TJ/T122 1 Tf((tlieeg)1..19e-II. P)16. ervnurt ofisola (i o bv) 19.7 yrl s8t-9nsgneione nenit ainvrt this coa(s8(ttlie. In addi(i o,f7)]TJ /T132 1 Tf[(O. calicula(t37(-7)]TJ /T122 1 Tf[(tlieeg)1.9e-Ily(H1)10))5(ri os o 2..399999618(v)24.399999618(r 700 v-248.7km (di San(t)98.699999809(Ca(t)98.7(r)-)8068inayand Rio)1 rae, since bi ooutlingand tr e(l)27(gi(v)2(enf(t-8(heir oll)2(wgfr)2(eq)133uencyg onhar)2(d)5(rl)]TJ ..36 Tw 0 -1.25 Td [ssbs)8(tr): these species di Sou(t)7.8(h Amer)-vre neport-7.09herrl ae or epizoicy onoth(r h)y(r)619oods (Oli(v)2(eir)2(a (e).19())17al.rl216-) hapstaniy(19649oolestedcoli harbours and m(a) wi(t-8.119999809(di (t)-8.199999809(h)1.19rl)]TJ. cies off40rl99999809(opt46.199999809yxi(s)]TJ /T122 1 Tf- .025 Tw[((Mar)10.1199999809q)1381199999809ues (e tt200,77 http://tand31772999999923075e75ex(7)(03)T79999922137(v).152579e94999263970,157 Td [O. calicula(t2.83(7)]TJ /T122 1 Tf(and3)Tj /T1 divnity ofalgOli(v)34.5(art)165ayandrl mha and Jacobucci, -210-). It is alsorl t-9nt28.5oeosdrt-7.5(ht).5asntnloldbtenescosl s8.19(t)988eenceymigti os and xpansi os (t-7.09hat wP)2619ouldrl t-7.5(ht).5(r)-ns nntert28.5(e9).5(t).5(e).5dn a nnei(e).5dnnntr(i).5lonrl see Marg). In fPt-t-cies of7Ortt49hopt49yxi(s)]TJ/T122 1 Tf .085 Tw[(w)18(er)2(e p(r2(edom(nant(l)038399999618tyfa)39ound vrt28.5 | mactrSars,gar po(s).5oti(v)24.399999618(l)y1 oat fas8.28ttncesyaftrt20.19rl $t28.30$ t-120.5act1.8.(hment fr).8.9om ttt-8..5hos, dr i o and w

> $: 217a-.2$ @m7)8t-8(h(

 $\sum_{i=1}^{n}$ dispersal for species of the genus $\sum_{i=1}^{n}$ all cryptic linear are into sampling $\sum_{i=1}^{n}$ are into sampling design will be necessary for further into sampling design will be necessary further investig their spatial genetic patterns and dispersal routes.

Morphological and environmental variation

Our sampling of *Orthopyxis*

that phenotypic differences were at least partially explained at least partially explained at least partially explained at ℓ $\sum_{i=1}^{\mathbf{w}}\frac{1}{i}\frac{q_i}{i}\frac{q_i}{i}\frac{p_i}{i}\frac{q$ $\begin{pmatrix} 0 & \text{C} & \text{C}{\bf r} & \text{D.} & \text{c} & \text{c} & \text{C}{\bf r} & \text{A.} & \text{A.} & \text{A.} \\ \text{A.} & \text{B.} & \text{C.} & \text{C.} & \text{C.} & \text{D.} & \text{D.} & \text{D.} & \text{D.} \\ \text{C.} & \text{C.} & \text{C.} & \text{D.} & \text{D.} & \text{D.} & \text{D.} & \text{D.} & \text{D.} \\ \text{D.} & \text{D.} & \text{D.$ $\sum_{i=1}^{N} \frac{1}{i} \sum_{j=1}^{N} \frac{1}{j} \sum_{j=1}^{N} \frac{1}{j$ for a finite value of the maximally being taller \mathbf{r}^{\prime} and \mathbf{r}^{\prime} longer hydrothecae in several campanulariid species (e.g. $\mathbb{R}^{\mathbf{w}}$ and Thomson [1968](#page-16-10); Naumov 1968; Naumov [1969](#page-15-13)). However, this pattern is not entirely consistent among benefits and \mathbb{R} thic hydroids, with colony size as a result of the interaction between lower temperatures, reduced growth rates
Interaction between lower temperatures, reduced growth rates and less availability of the interaction between food $(F_{\alpha_{i+1},\alpha_{i+2},\ldots,\alpha_{i-2$ attest to the importance of temperature as an environmen tal input triggering morphological variation among hydroids and the second second second second among hydroids p
Populations in populations $U_1 = \frac{1}{2}$ is variation was not observed and $\frac{1}{2}$ in $V_2 = \frac{1}{2}$ and $V_1 = \frac{1}{2}$ o. *O. caliculata.* Instead, covariation patterns in O . *Caliculata* (executive relation patterns in O . *O. caliculata* (executive relation patterns in O . *O. caliculata* (executive relation patterns in O . *O. caliculata* (executive to diferences in perisarc thickness and be[st](#page-11-1) explained by variations in bathymetry and saling (\mathbf{F}_μ) . Similarly, we are $\sum_{i=1}^{n}$ from northern and southern $F_i' = \bigcup_{\alpha_i} F_i = \bigcup_{\alpha_i} G$. caliculata $\bigcup_{\alpha_i} G$. crenata showed differences in shape and size and size among genetic lineages, further \mathbf{w} there suggesting that we might be looking at interspective at interspective at interspective at interspective \mathcal{C} interaspectific variation. Despite the significant associations between environmental variables and morphometric v tion we did not detect convergent shapes among sympatric lineages, and the signal of isolation by distance within *O.* **crenata** is compatible with more to describe to drift. In the possibility that lineages with the possibility that li rently defined species might represent companies.
The production of the production is means that future analogue

 $\mathbf{p}_{\text{max}} = \mathbf{p}_{\text{max}} = \mathbf{p}_{\text{max}}(\mathbf{p}_{\text{max}})$ (i.e., Com sy \mathbf{p}_{max}

 $\frac{1}{4}\int_{0}^{\frac{\pi}{2}}\frac{1}{\sqrt{2}}\frac{e^{i\frac{2\pi}{3}}\left(1+e^{i\frac{2\pi}{3}}\right)}{\left(\frac{2\pi}{3}\right)^2\left(\frac{2\pi}{3}\right)^2\left(\frac{2\pi}{3}\right)^2}=\frac{1}{\sqrt{2}}\left(\frac{2\pi}{3}\right)^2\left(\frac{2\pi}{3}\right)^2\left(\frac{2\pi}{3}\right)^2\left(\frac{2\pi}{3}\right)^2\left(\frac{2\pi}{3}\right)^2\left(\frac{2\pi}{3}\right)^2\left(\frac{2\pi}{3}\right)^2\left(\frac{$ $v_{\rm max} = \frac{1}{2} \int_{0}^{1} \int_{0}^{1} (1-t)^{2} \, dt$ (i.e.) $v_{\rm max} = \frac{1}{2} \int_{0}^{1} \int_{0}^{1} t^{2} \, dt$ *nata*

biographic modelling. Glob \mathcal{A}_{c} is $\partial_{\alpha} \phi_{\alpha}$ is a set of the set

- Boero F (1984) The ecology of marine hydroids and effects of environmental $\mathbf{F}(\cdot)$ ronmental factors: a review. Mar Ecol 5:93–118. [https://doi.org/](https://doi.org/10.1111/j.1439-0485.1984.tb00310.x) 10.1111114 10.1111114
- Boissin E, Hoareau TB, Postaire B, Gravier-Bonnet N, Bourmaud CAF (2018) Cryptic diversity, low connectivity and suspected human-mediated dispersal among 17 widespread Indo-Pacifc hydroid species of the south-western Indian Ocean. J Biogeogr 45:2104–2117.<https://doi.org/10.1111/jbi.13388>

 $\mathcal{L}(\mathcal{L}(\mathcal{L}))$ stepolding predictors: species distribution modelling predictors: species distribution modelling predictors: species distribution modelling predictors: species distribution modelling predictors: specie datasets. R package version 0.2.8. W B_1 S, B_2 (2018) Supervised multiplock and C_4 supervised multiplock analysis in R with the ade4 package. J $\frac{1}{2}$ $C_{\rm eff}$ (2013) $C_{\rm eff}$ shallow-water hydro $C_{\rm eff}$ (cnidaria: Hydro $C_{\rm eff}$) from the central east coast coast coast \mathbf{F}_{α} and α 3648:1–723:1–724 Calder D, Choong H, Carlton J, Chapman J, Miller J, Geller J (2014) Hydroids (Canidaria: Hydroids washing ashore in the northwestern United States. Aquation of the northwestern U
Aquation Indian in the northwestern United States. Aquation Indian in the northwestern United States. Aquation Indians 9:55–425–440. https://doi.org/10.3391/ai.2014. $\frac{4}{\sqrt{3}}$. $C_{\rm eff}$ Physical oceanography of the western Atlantic continental shelf located between $C_{\rm eff}$ $\mathcal{S}_{\mathcal{A}}$ segment \mathcal{A} are \mathcal{A} are \mathcal{A} are \mathcal{A} are Sea. Johnson Ar, \mathcal{A} Willy $\&$ support in the sons income U $C \rightarrow \mathbb{R}$ interactive web maps with the javascript "Leafet" library. R Package Vers 2:3:3:3:4 \mathbb{R}

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