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Diversity Patterns of Decapod Crustaceans in Small Coastal Rivers of the Atlantic Forest in Southern Bahia, Brazil, During the El Niño Drought of 2015

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Abstract

This study investigated the structure of the decapod crustacean community in first- and second-order coastal rivers of the Atlantic Forest in southern Bahia, focusing on taxonomic composition, abundance, richness, and distribution of species. The main objective was to assess the possible effects of the severe drought of 2015, intensified by the El Niño event, on decapod species, also integrating analyses of land use and land cover by remote sensing. Collections were made in eight rivers between 2015 and 2017. In total, 7075 individuals of eight species were recorded, with *Macrobrachium olfersii* and *M. jelskii* being the most abundant in all seasons and locations sampled. Total abundance was higher in the rainy season, although the composition of the communities did not show significant differences between seasons. The Pancadinha and Represa rivers, which were most impacted, showed lower richness and absence of sensitive species such as *Atya scabra*, *M. carcinus*, *M. heterochirus*, and *Trichodactylus* sp. There were clear differences between impacted and unimpacted rivers. Land use classifications revealed marked changes between 2015 and 2016, with an increase in forest cover, especially in the northern zone. The results show that the combination of seasonality, environmental integrity, and land use shapes the dynamics of these communities.

Keywords: freshwater environments; seasonality; climate change; El Niño; Palaemonidae; Atyidae; Trichodactylidae

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1. Introduction

Decapod crustaceans play a fundamental ecological role in aquatic ecosystems, contributing to processes such as nutrient cycling, energy flow, and the structuring of biological communities. In addition to their ecological relevance, these organisms are socioeconomically important to riverside communities, where they are widely used as food and fishing bait [1–3]. Understanding how these species respond to environmental fluctuations, especially in environments subject to seasonal variation, is essential for predicting patterns of population persistence and ecological dynamics [4].

In southern Bahia, studies recorded the occurrence of 11 species of freshwater shrimp belonging to the families Atyidae: *Atya scabra* (Leach, 1816) and *Potimirim potimirim*

(Müller, 1881), and *P. brasiliana* Villalobos, 1959 and Palaemonidae: *Macrobrachium acanthurus* (Wiegmann, 1836), *M. amazonicum* (Heller, 1862), *M. carcinus* (Linnaeus, 1758), *M. heterochirus* (Wiegmann, 1836), *M. jelskii* (Miers, 1878), *M. olfersii* (Wiegmann, 1836), *M. potiuna* (Müller, 1880), and *Palaemon pandaliformis* (Stimpson, 1871) [5,6]. In addition to shrimps, freshwater crabs of the genus *Trichodactylus* Latreille, 1828 have also been recorded. Despite these advances, the number of studies in the region is still small, with limited sample coverage and focused on a few groups. The available evidence, however, indicates that southern Bahia is home to a high diversity of Decapoda, both in terms of richness and genetic diversity, suggesting the possible existence of taxa not yet described [7].

In this scenario, the increasing occurrence of extreme climatic events makes it even more urgent to expand knowledge about the distribution of these species. El Niño, for example, is an atmospheric-oceanic phenomenon characterized by above-average warming of the surface waters of the equatorial Pacific, altering atmospheric circulation patterns and influencing rainfall and temperature regimes in different regions of the planet [8,9].

In 2015, one of the most intense El Niño episodes ever recorded occurred, peaking between September and October and remaining active until early 2016, causing severe droughts in several tropical areas, floods in other regions, and contributing to 2015 being one of the hottest years in history [10]. El Niño events have the capacity to affect local climate but also have an impact on a global scale [11], affecting aquatic ecosystems that are sensitive to water variation. In Bahia (Brazil), a long period of drought severely affected the southern region. The expressive reduction in rainfall compromised rivers, reservoirs, and supply systems, forcing several cities to adopt rationing and declare a state of emergency. The impacts were particularly severe for family farming, resulting in production losses, falling incomes, and greater social vulnerability for rural communities. In addition, water scarcity affected aquatic ecosystems, altering the dynamics of watercourses.

The information available on the composition and distribution of decapod crustaceans in freshwater environments, especially in southern Bahia, is still insufficient to accurately assess the impacts of prolonged droughts associated with recent extreme events. Considering that episodes of this nature tend to become more frequent under the current climate change scenario [10], it is essential to map distribution patterns and identify areas of greater diversity to support conservation strategies focused on aquatic fauna.

In this context, the use of remote sensing tools emerges as a promising approach for biodiversity studies. Techniques based on geotechnologies have been widely used to assess impacts on different biological groups, such as forest fragmentation on plant communities [12] or the effects of urbanization on butterflies [13]. They offer great potential for studies with freshwater crustaceans, as they allow the integration of land use and land cover information that directly influences water quality. In addition, several studies have used Geographic Information Systems (GIS) to monitor shrimp farming and assess environmental impacts in different countries, like India [14] and Indonesia [15]. Thus, its application can significantly improve understanding of ecological patterns and the distribution of decapods in southern Bahia, especially in the face of environmental changes.

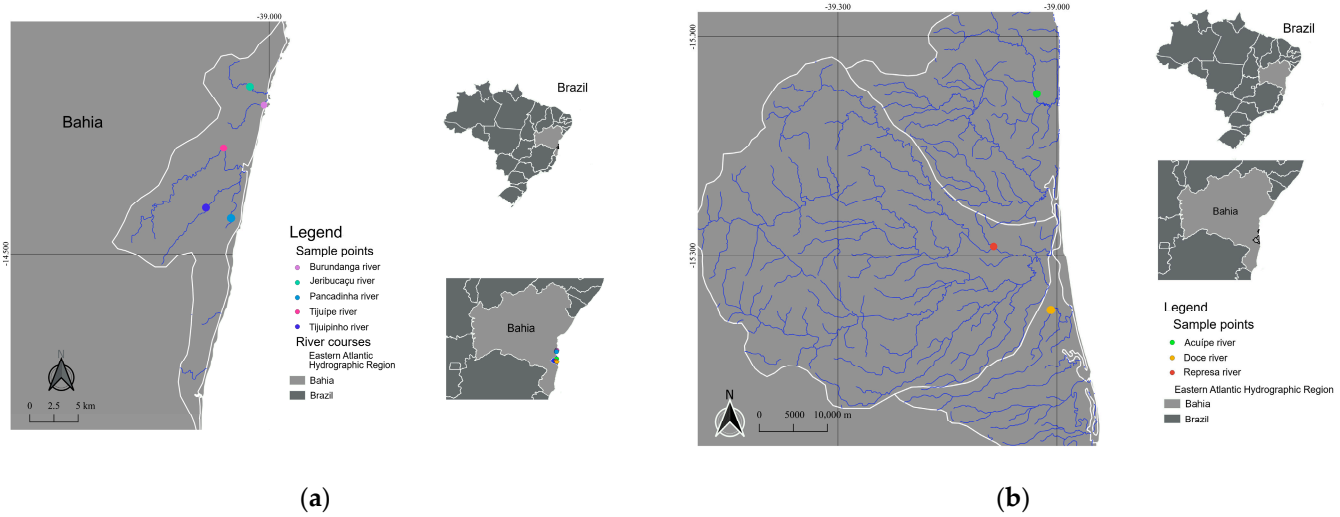
This study aimed to characterize the structure of the community (taxonomic composition, abundance, species richness, and distribution) of decapod and identify possible effects of periods of water scarcity that occurred in 2015 on crustacean fauna.

2. Materials and Methods

2.1. Study Area

Samples were collected from first- and second-order rivers located between Itacaré and Una, in the state of Bahia, Brazil, under a collection license (ICMBio Permanent License No. 48769). The collection sites were classified into two zones: The northern zone includes

five collection sites near Itacaré and Uruçuca, covering the Jeribucaçu, Burundanga, Tijuípe, Tijuipinho (Itacaré), and Pancadinha (Uruçuca) rivers. The southern zone comprises three sampling points near Ilhéus and Una, where samples were taken from the Acuípe (Ilhéus), Doce, and Roda D'água rivers (in two locations, Represa and Ceplac) (Una). All sampled micro-basins are classified as level 6 ottobasins, according to the National Water Agency's Metadata portal system, and are part of the East Atlantic Hydrographic Basin (Figure 1).



(**a**) (**b**)

Figure 1. Map of micro-basins in southern Bahia (Brazil) showing the location of rivers in (**a**) Northern Zone: Burundanga, Jeribucaçu, Tijuípe, and Tijuipinho (Itacaré) and Pancadinha (Uruçuca); (**b**) Southern Zone: Acuípe (Ilhéus), Doce, and Roda D'água, where two locations were sampled: Represa and Ceplac (Una). Colored points indicate collection sites.

2.2. Sampling

Two collection sites were selected on each river, each 20 m long, located above the tidal zone and at least 1.5 km away from both the source and the mouth of the river. The capture was carried out actively, using hand nets (puçás), covering the greatest possible diversity of microhabitats, such as roots, galleries under rocks, leaf litter, and marginal vegetation. The sampling effort consisted of three collectors working simultaneously for 30 min at each collection site.

Samples were collected during two dry periods (December 2015 and April 2016) and two rainy periods (December 2016 and April 2017). The collected specimens were stored in ice, photographed, and later transferred to 96° GL ethanol. After remaining refrigerated for 48 h, they were permanently preserved in 80% ethanol at room temperature.

The specimens were identified based on Melo (2003) [16] or, when necessary, using the species' original descriptions. Subsequently, all specimens were deposited in the Coleção de Invertebrados Aquáticos do Sul da Baia (CIASB), Universidade Federal do Sul da Bahia (UFSB).

2.3. Land Use and Occupancy Analysis

The data obtained by LANDSAT 8 were classified in QGIS 3.16.1 (with GRASS 7.8.4) using the dzetsaka: Classification Tool add-on. Ten spectrally distinct land use and land cover classes were delineated, namely: dense forest, forest, pasture, urban area, water, agriculture, cloud, cloud shadow, aquaculture, and bare soil. Each class was trained with 30 polygons and represented by a distinct color on the map.

Satellite images with a spatial resolution of 30 m, covering the entire study area, were obtained from the United States Geological Survey (USGS) Landsat Look Viewer (https://landsatlook.usgs.gov/ (accessed on 21 April 2022)). For the years 2015 and 2017,

scenes with the least cloud cover were prioritized. Landsat 8 OLI/TIRS multispectral images were downloaded from Earth Explorer and used to estimate land use and land use change between the periods analyzed, using supervised classification.

For initial image processing, atmospheric correction was applied using the QGIS Semi-Automatic Classification Plugin (SCP), which converts Digital Numbers (DN) to top-of-atmosphere (TOA) reflectance [17]. Next, Dark Object Subtraction 1 (DOS1) correction was employed, a technique based on the image itself [18]. After the corrections, the rasters for each year were mosaically organized and cropped to cover only the area of interest, enabling subsequent classification.

Supervised classification of images was performed to detect changes in land use based on spectral signatures. The classes defined to characterize land use in areas influenced by rivers including primary forests and broadleaf forests. Initially, a set of bands was created, and the resulting shapefile was used to delimit several Regions of Interest (ROIs), supported by Google Earth images and different combinations of RGB bands. Among the classification algorithms available in SCP, the Maximum Probability method performed best and was therefore adopted as the supervised classification technique. This method identifies classes based on the spectral signature of pixels [18–20].

2.4. Statistical Analysis

To enable quantitative interpretation of the results, after classifying the images, post-processing was performed to estimate the percentage and area occupied by each land use class in the study area. The Semi-Automatic Classification Plugin (SCP) classification report tool was used, which generates a table containing the total number of pixels, the corresponding percentage, and the area in square meters for each class, identifying each of the supervised classifications used.

To minimize the influence of clouds and shadows on the land cover estimate, a correction factor was applied. This procedure consisted of calculating the percentage occupied by clouds and shadows in the study area, subtracting this value from the total cover, and dividing the result by 100% to obtain the correction factor. This factor was then multiplied by the areas of each class of interest, avoiding the distorting effect of these variables on the final estimate of land use classification area.

EcoTest.sample was also used, a randomization test used for the statistical comparison of rarefaction curves based on samples, with the aim of testing the ecological null hypothesis that the samples, represented by incidence data, were extracted from the same assembly [21,22]. In addition, rarefaction curves were calculated along with their respective 95% confidence intervals. The rarefaction curves were constructed based on the presence of species in the samples, not considering total richness or average values, but rather the incidence of each species at each sampled location. The analysis was performed using R software. All analyses were conducted in R version 3.1.1 using the packages “rareNMtests” [22], “vegan” [23].

To investigate the impact of the 2015 drought on freshwater shrimp communities in the rivers studied a non-metric multidimensional scaling (NMDS) was applied. The analysis was constructed from a Bray–Curtis dissimilarity matrix, using species abundance data transformed into Log(x + 1) to minimize the influence of extreme values. To assess whether there were significant differences between the compared groups, an Analysis of Similarities (ANOSIM) was performed, which tests the null hypothesis that the similarity within groups is equal to the similarity between groups. ANOSIM provides the R statistic, which indicates the degree of separation between groups: values close to 1 represent complete separation, while values close to 0 indicate no distinction [24].

Finally, to find out which shrimp species contribute most to seasonal or impact differences between and within study areas, a percentage similarity analysis (SIMPER) was performed. NMDS, ANOSIM, and SIMPER were all performed to compare the composition of shrimp species in the dry season of 2015 with the wet season of 2016, as well as to compare rivers with high anthropogenic impacts with those with low anthropogenic impacts. The ANOSIM and SIMPER analyses were performed using 9999 permutations with the free software PAST (Paleontological Statistics, version 4.02, 2020), while NMDS was performed using the "vegan" package of the R software (version 4.1.0, R Development Core Team, Vienna, Austria, 2021).

3. Results

3.1. Diversity of Decapod Crustaceans

A total of 7075 individuals distributed among eight species were found in the eight rivers sampled, namely, *Atya scabra* (Leach, 1816), *Macrobrachium acanthurus* (Wiegmann, 1836), *Macrobrachium carcinus* (Linnaeus, 1758), *Macrobrachium heterochirus* (Wiegmann, 1836), *Macrobrachium jelskii* (Miers, 1878), *Macrobrachium olfersii* (Wiegmann, 1836), *Potimirim potimirim* (Müller, 1881), and *Trichodactylus* sp. The most abundant species was *M. olfersii*, with 3941 individuals collected, followed by *M. jelskii*, with 1159 individuals. Among the rivers sampled, the highest abundances were recorded in the Jeribucaçu, Acuípe, and Doce rivers. The species *M. olfersii* was the most frequent, followed by *M. jelskii* and *M. acanthurus*. In contrast, the Represa/Roda D'água and Represa/Ceplac rivers had the lowest abundances of Decapoda during the sampling period (Figure 2).

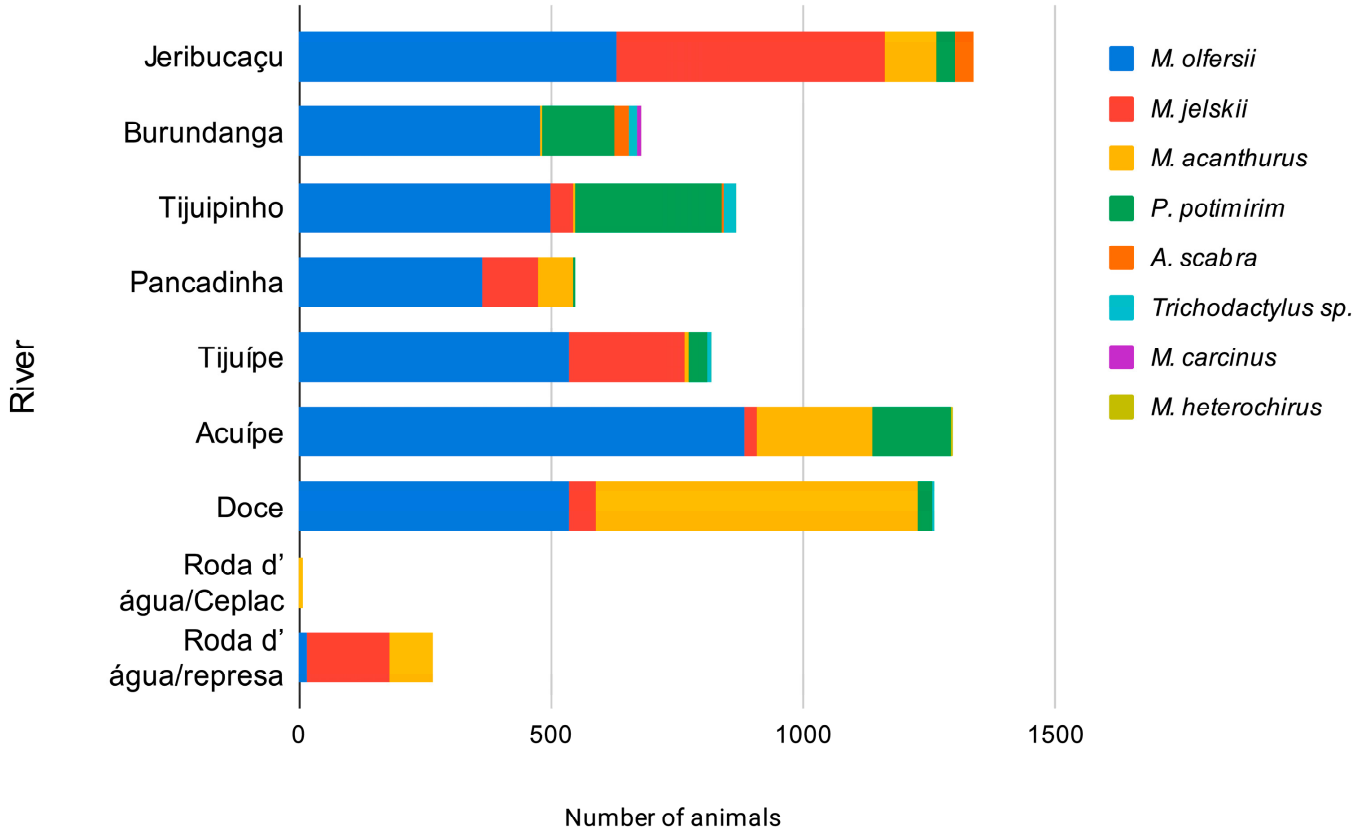


Figure 2. Occurrence of species and abundance of decapod crustaceans found in first- and second-order rivers in micro-basins in southern Bahia during dry season (December 2015 and April 2016) and the rainy season (December 2016 and April 2017).

The rivers with the highest species richness were Tijuipinho and Acuípe, with eight and seven species, respectively, followed by Tijuípe and Burundanga with six species each. The rivers with the lowest species richness were Roda d'água/Ceplac and Roda d'água/Represa with three species each (Figure 3).

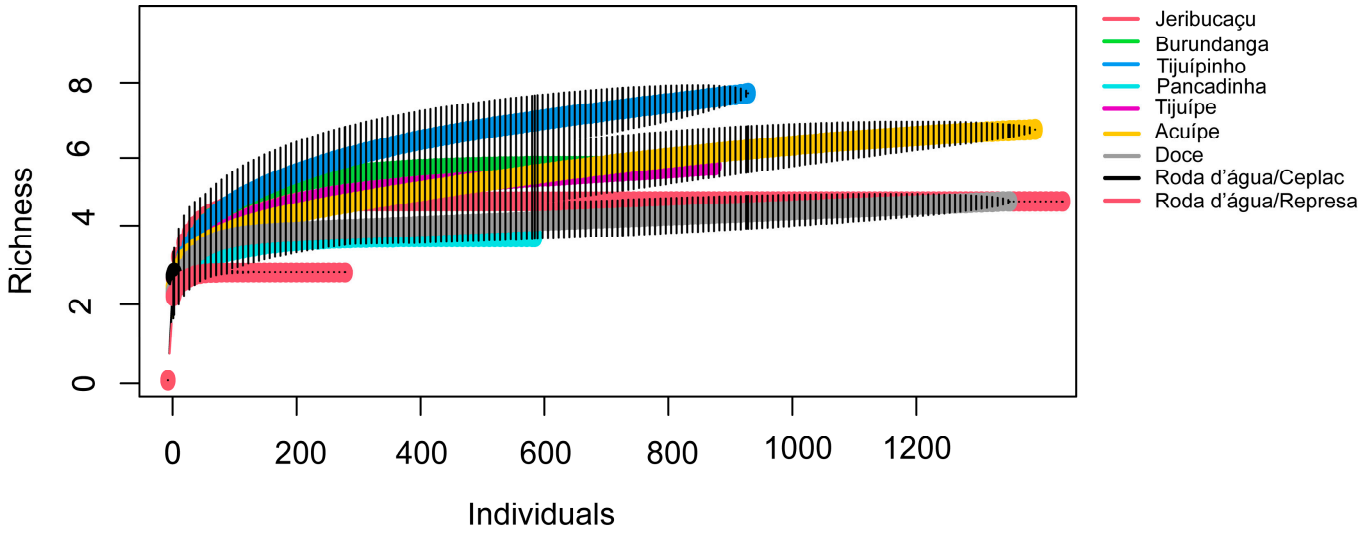


Figure 3. Rarefaction curve indicating the richness of decapod crustaceans found in first- and second-order rivers in micro-basins in southern Bahia dry season (December 2015 and April 2016) and the rainy season (December 2016 and April 2017).

3.2. Diversity of Decapod Crustaceans Associated with Rainy and Dry Periods

Considering the samples collected during the dry season (December 2015 and April 2016), 3044 individuals were collected, distributed among eight species: *A. scabra*, *P. potimirim*, *M. acanthurus*, *M. carcinus*, *M. heterochirus*, *M. jelskii*, *M. olfersii*, and *Trichodactylus* sp. The rivers with the highest species richness during this period were Tijuipinho, with eight species, followed by Tijuípe and Acuípe, with six species each. The Roda d'Água/Ceplac and Roda d'Água/Represa rivers had the lowest species richness (one species each) and the lowest abundances, with only two and one individuals recorded, respectively. The rivers with the highest abundance of decapods during the dry season were Acuípe (731), Doce (606), and Jeribucaçu (597).

During the samples carried out in the rainy season (December 2016 and April 2017), 4031 individuals belonging to seven species were collected: *A. scabra*, *P. potimirim*, *M. acanthurus*, *M. carcinus*, *M. heterochirus*, *M. jelskii*, and *M. olfersii*. The highest abundance was recorded in the Jeribucaçu (740), Doce (652), Acuípe (565), and Tijuípe (512) rivers. The rivers with the lowest abundance were Roda d'Água/Ceplac (7) and Roda d'Água/Represa (264). The highest richness in the rainy season was recorded in the Jeribucaçu, Burundanga, Tijuipinho, Tijuípe, and Acuípe rivers, all with five species. The Roda d'Água/Ceplac and Roda d'Água/Represa rivers had the lowest diversity, with three species each (Figure 4).

Comparing the two periods, it can be observed that except for the Acuípe River, all other rivers had a greater number of animals during the rainy season (Figure 5). The rarefaction test (EcoTest.sample) did not indicate a significant difference in species richness between the season ($p = 0.33$).

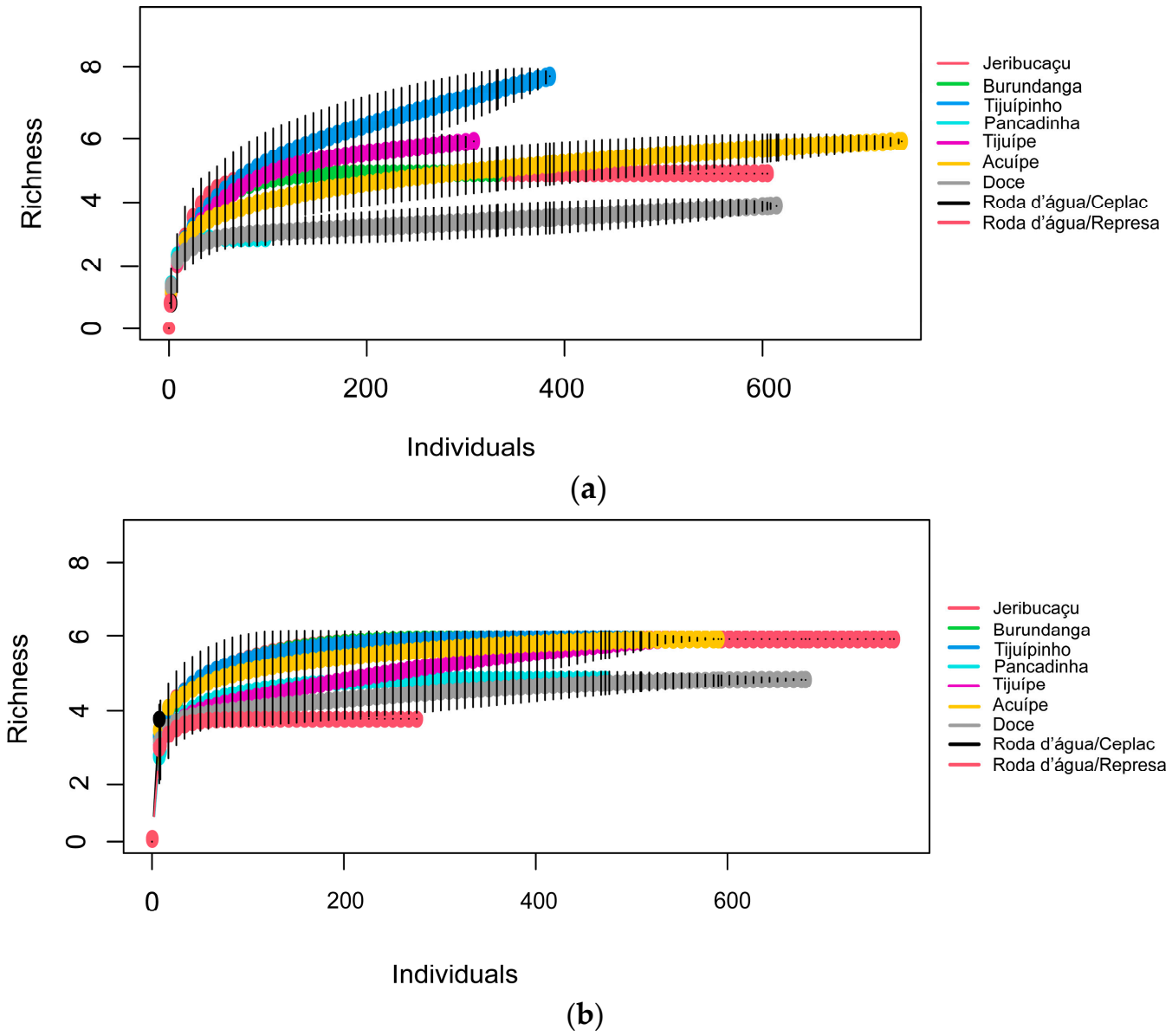


Figure 4. Rarefaction curve indicating the richness of decapod crustaceans found in first- and second-order rivers in micro-basins in southern Bahia (**a**) Dry season (December 2015 and April 2016); (**b**) Rainy season (December 2016 and April 2017).

M. olfersii was the most abundant species in both dry and rainy seasons, with higher abundance in the dry season. The species *A. scabra*, *M. carcinus*, and *Trichodactylus* sp. were also more abundant during the dry season, while *P. potimirim*, *M. acanthurus*, and *M. jelskii* were more abundant during the rainy season (Figure 6).

Some rivers showed higher species richness during the dry season (Tijuipinho, Tujuípe, and Acuípe rivers), while others had higher diversity during the rainy season (Pancadinha, Roda d'água Ceplac, and Roda d'água Represa rivers) (Figure 7).

It can be observed that abundance tends to be higher in the rainy season, while species richness tends to decrease (Figure 8).

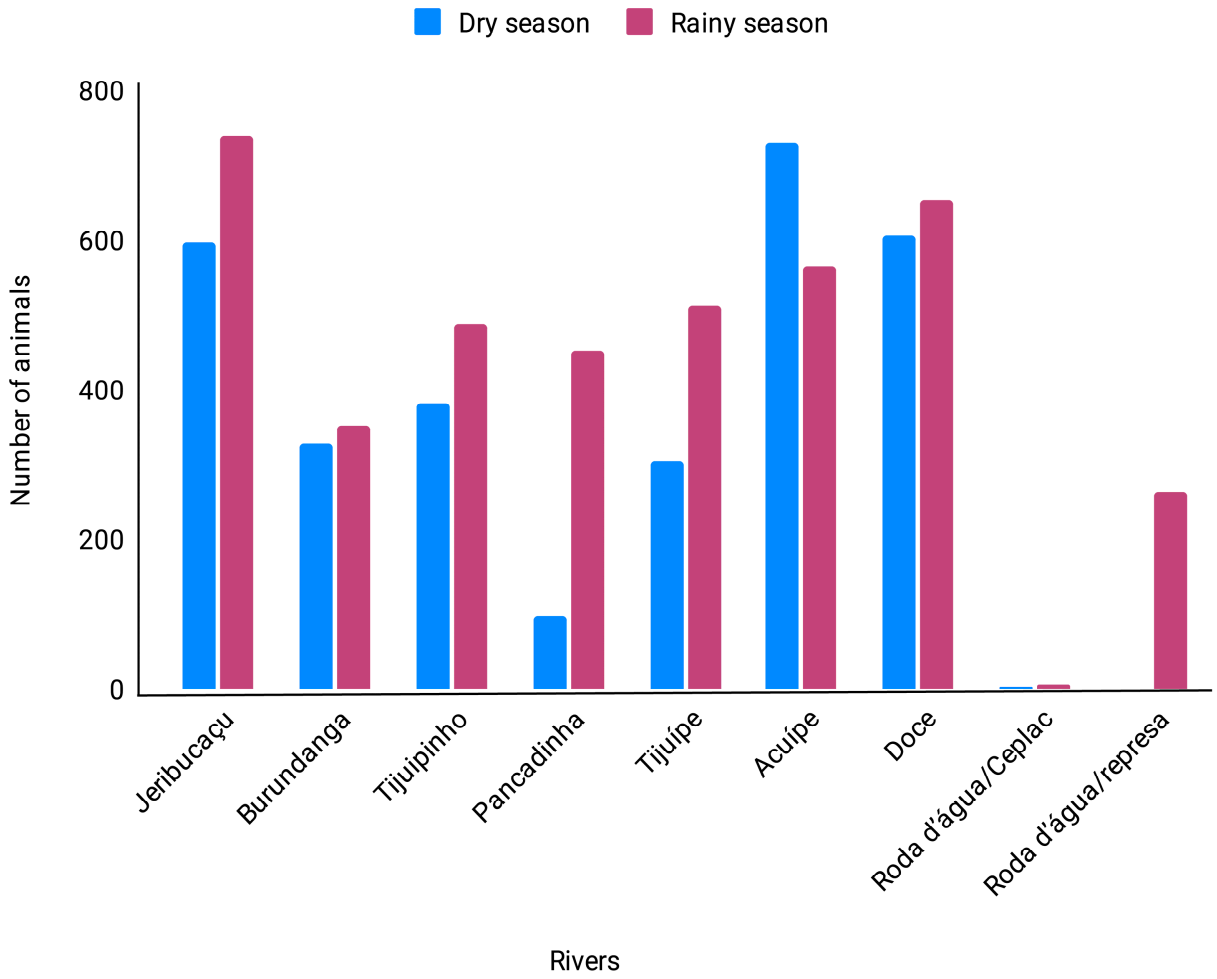


Figure 5. Abundance of decapod crustacean specimens found in first- and second-order rivers in micro-basins in southern Bahia during the rainy season (April 2016 and 2017) and dry season (December 2015 and 2016).

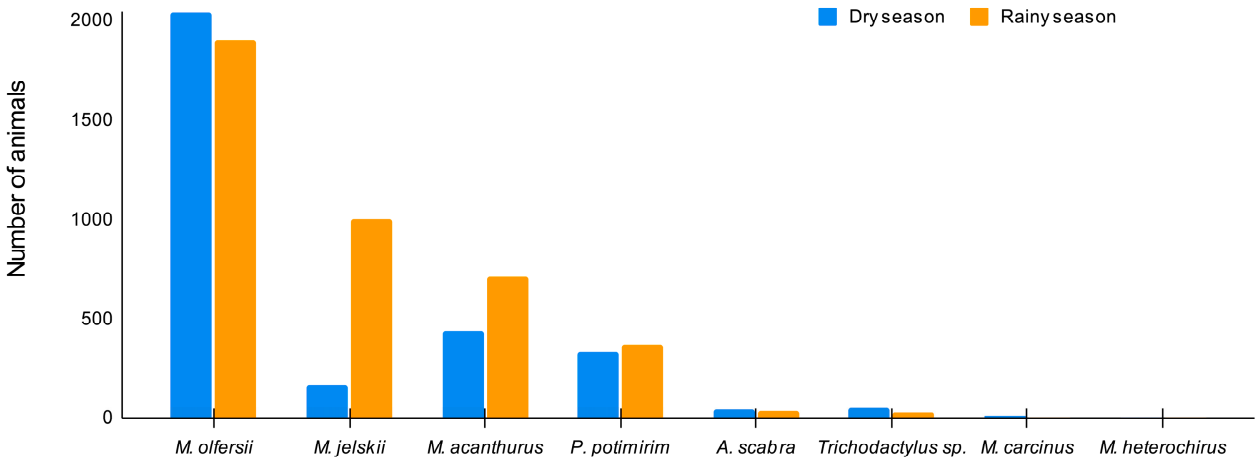


Figure 6. Composition of decapod crustacean specimens found in first- and second-order rivers in micro-basins in southern Bahia during the dry season (December 2015 and 2016) and rainy season (April 2016 and 2017).

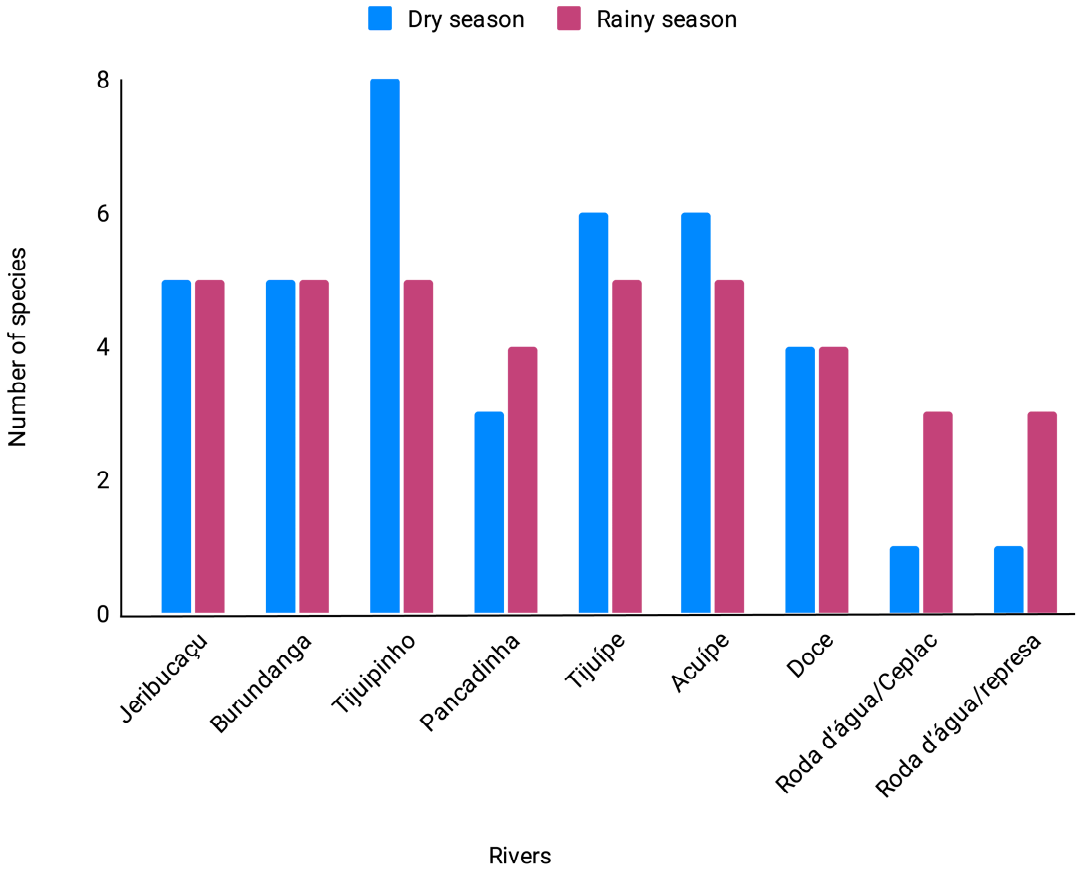


Figure 7. Number of species of decapod crustacean found in first- and second-order rivers in micro-basins in southern Bahia during the dry season (December 2015 and April 2016) and rainy season (December 2016 and April 2017).

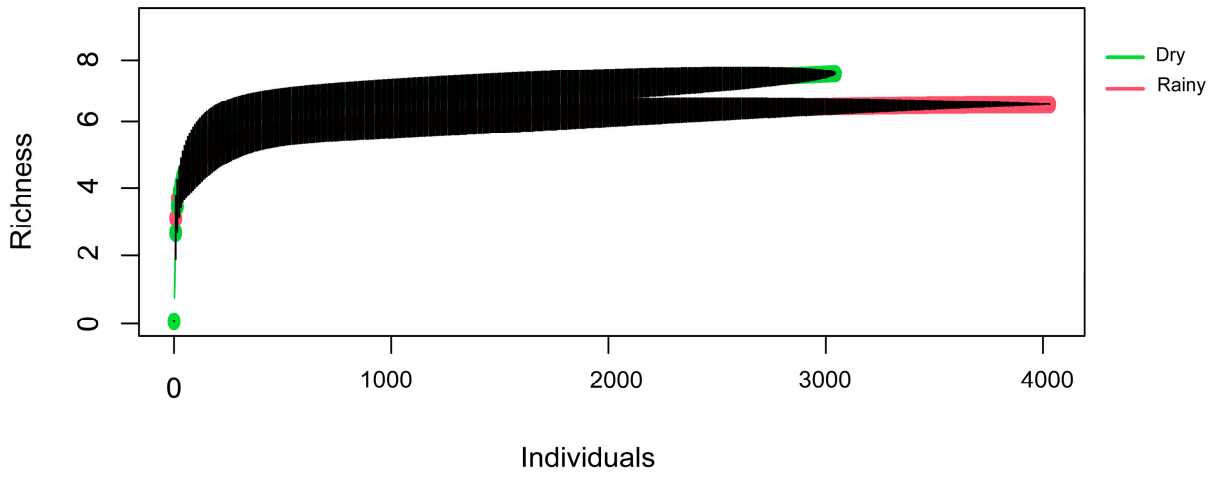
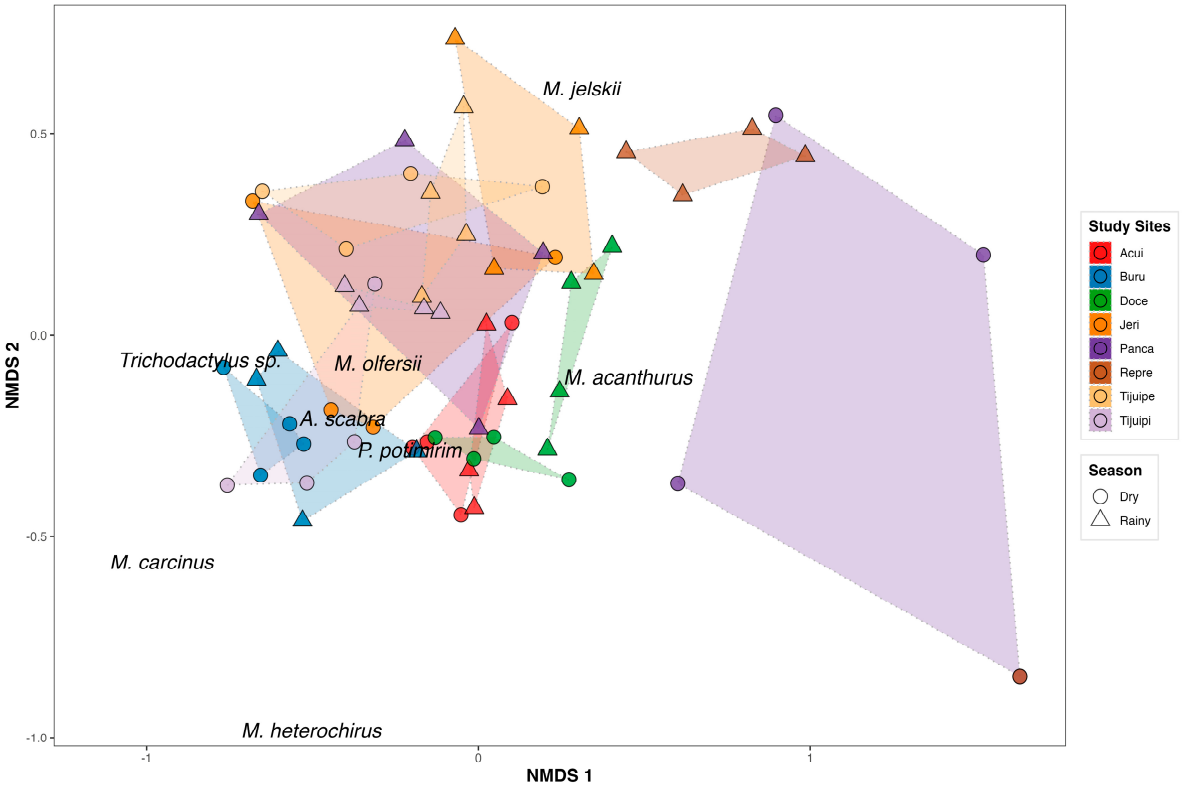
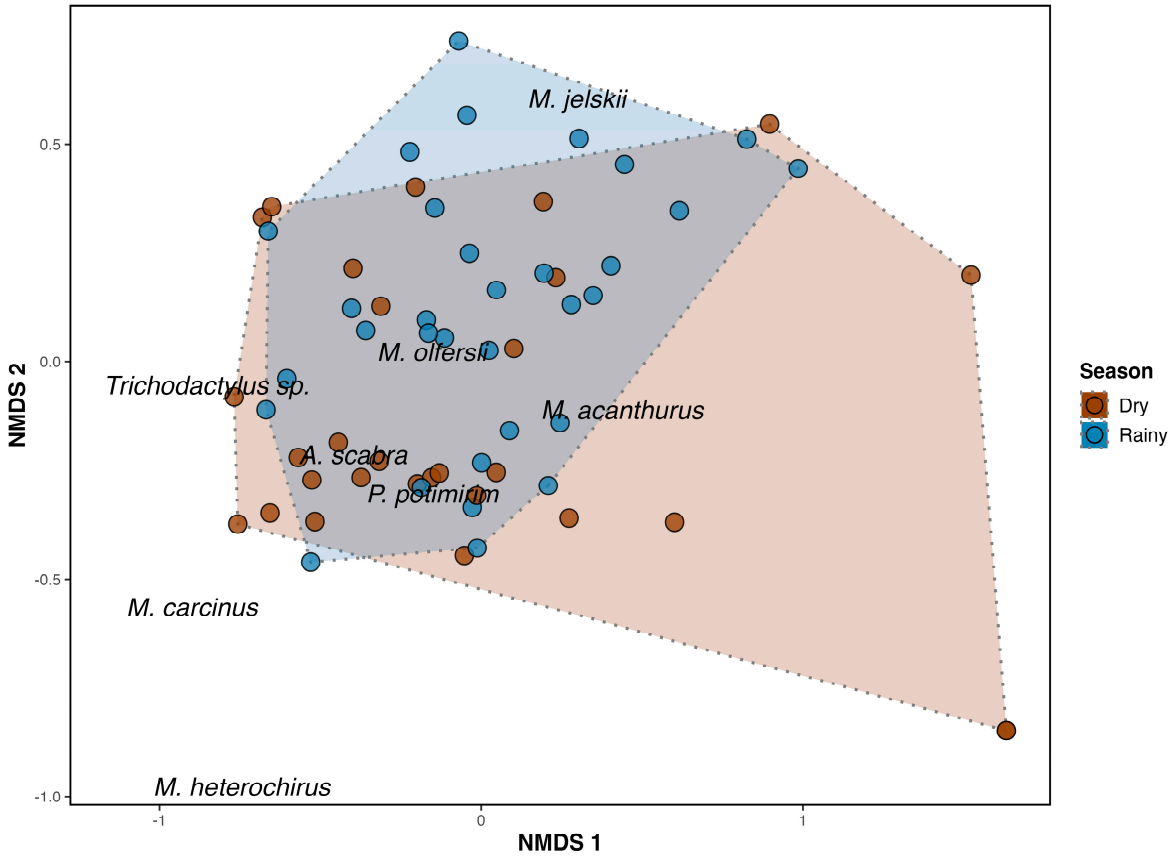


Figure 8. Rarefaction curve indicating the richness of decapod crustaceans found in first- and second-order rivers in micro-basins in southern Bahia in dry season (December 2015 and April 2016) and rainy season (December 2016 and April 2017).

Similarity analysis (ANOSIM) indicated that, in general, there were no significant differences in the composition of the crustacean community between the dry and rainy seasons (R = 0.02; p = 0.1008) (Figure 9).



(**a**)



(**b**)

Figure 9. Non-metric multidimensional scaling (NMDS) analysis of decapod crustacean communities in the first- and second-order rivers in micro-basins in southern Bahia during dry and rainy periods. (**a**) of all basins; (**b**) of the basins in general.

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When comparing the two collections made in the dry season separately with the two collections made in the rainy season, a significant difference was observed between specific dates: the dry season collection one (December 2015) differed from the rainy season collection one (April 2016) (R = 0.07; $p < 0.05$; ANOSIM) (Figure 10). The SIMPER analysis showed that this difference was mainly influenced by two species: *M. olfersii*, which contributed 42.78% of the variation between seasons, and *M. jelskii*, with 22.32%. It was also observed that *M. carcinus* was not recorded in any of the collections during the rainy season, highlighting a possible influence of seasonality on its distribution.

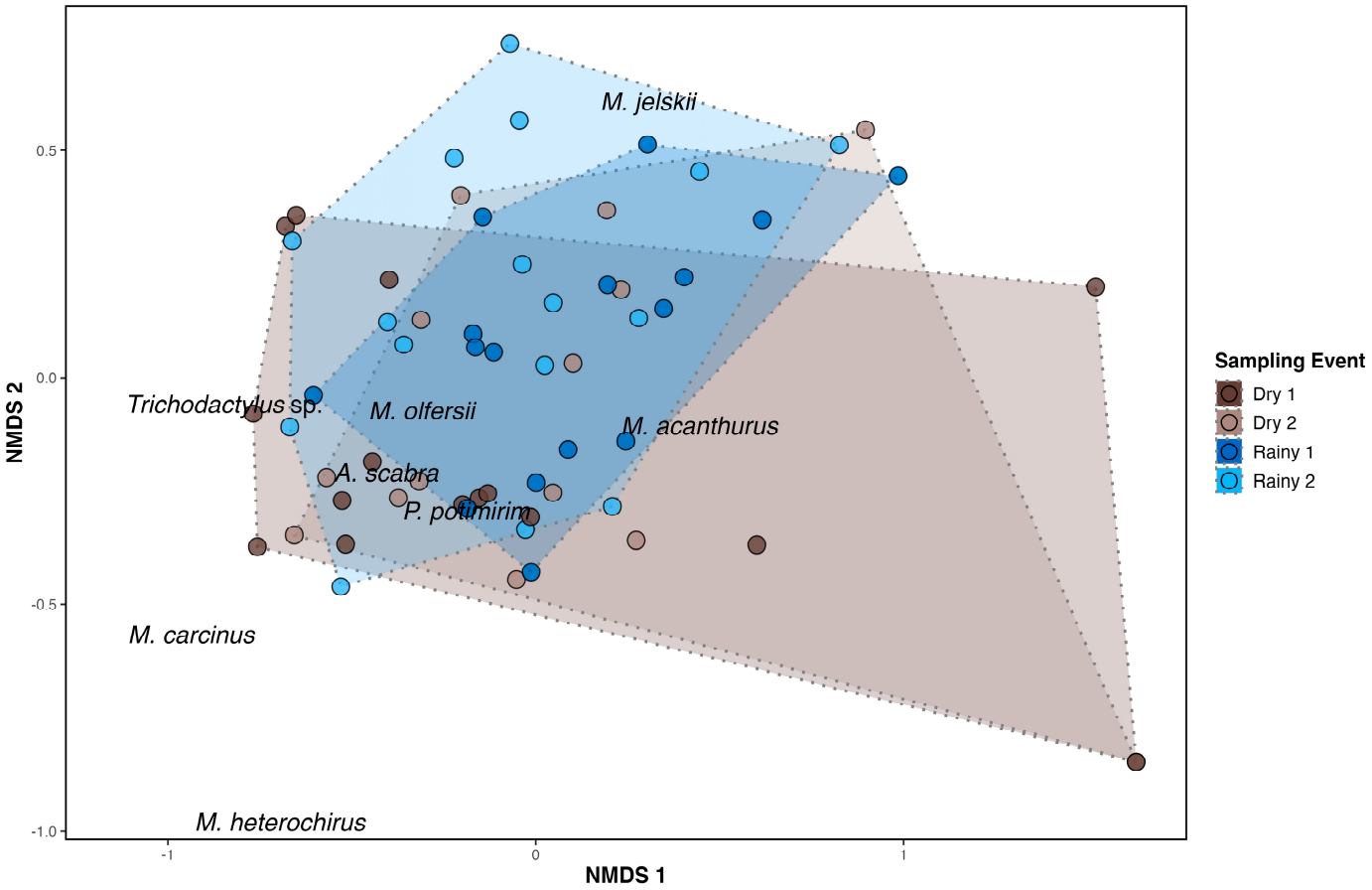


Figure 10. Non-metric multidimensional scaling (NMDS) analysis of decapod crustacean communities in the first- and second-order rivers in micro-basins in southern Bahia during dry and rainy periods considering each of the two collections within each period.

3.3. Land Use

The classification of land use in the micro-basins where the collections were made between December 2015 and April 2017 used a combination of bands 6, 5, and 4 (RGB) in all processing. Ten categories of land use and cover were identified: dense forest (dark green), forest (medium green), pasture (light green), urban area (light pink), water (light blue), agriculture (beige), cloud (grayish blue), cloud shadow (gray), aquaculture (dark blue), and exposed soil (orange).

With the exception of the points located on the Doce, Roda D'água, and Pancadinha rivers, all other sampled points have extensive vegetation cover in the surrounding area, located in areas far from urban zones. Due to this dense vegetation cover, the watercourses were often not classified, as they were completely covered by vegetation. The classification and land use maps corroborated which rivers were more impacted, namely Pancadinha and Roda D'água, which are closer to urban areas and more susceptible to anthropogenic

actions. The presence of dams was verified, which reduces water flow and discourages the presence of more species, with only a few having the plasticity to adapt to the formed habitat (Figures 11 and 12).

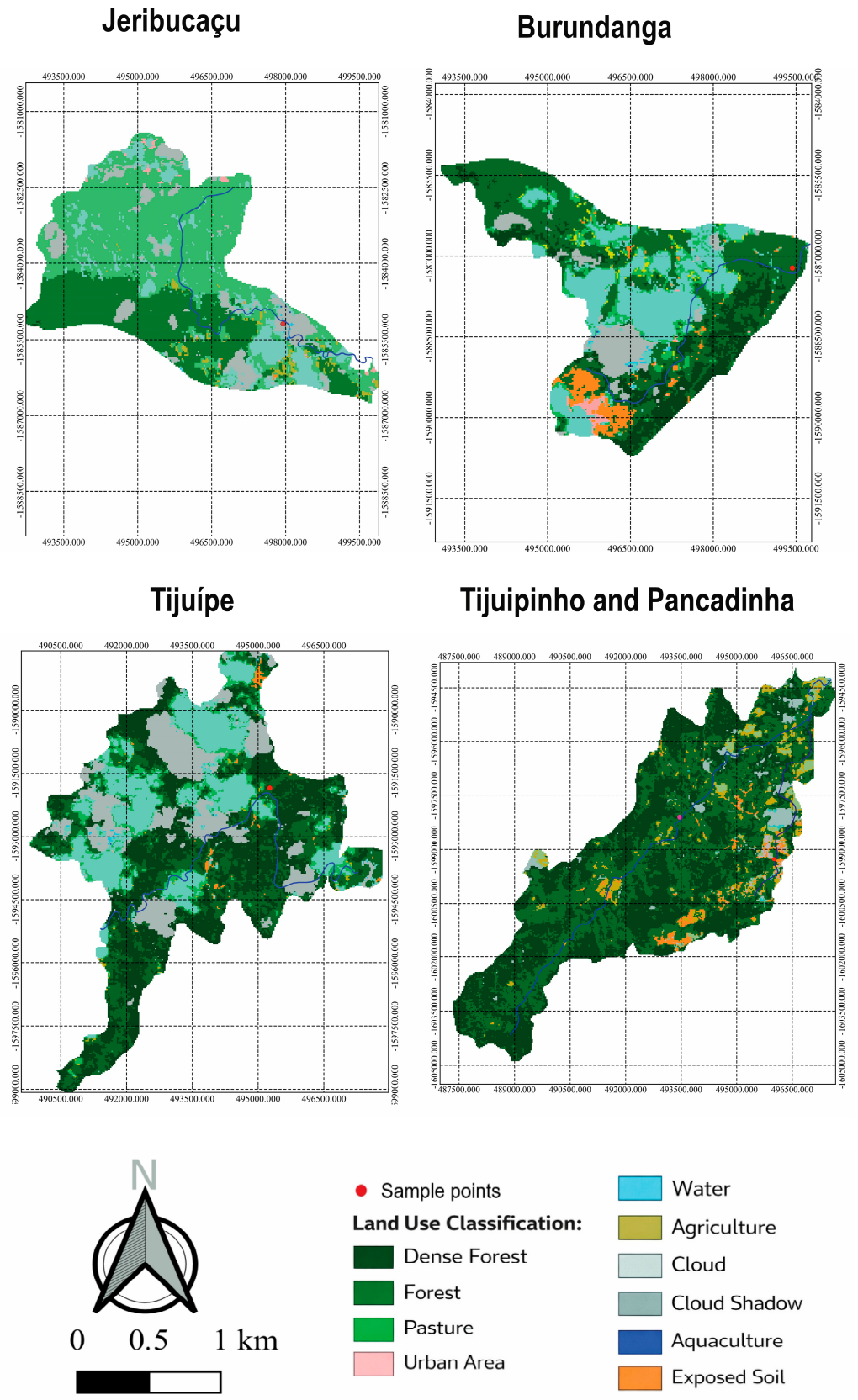


Figure 11. Classification and land use map of the rivers in micro-basins in southern Bahia.

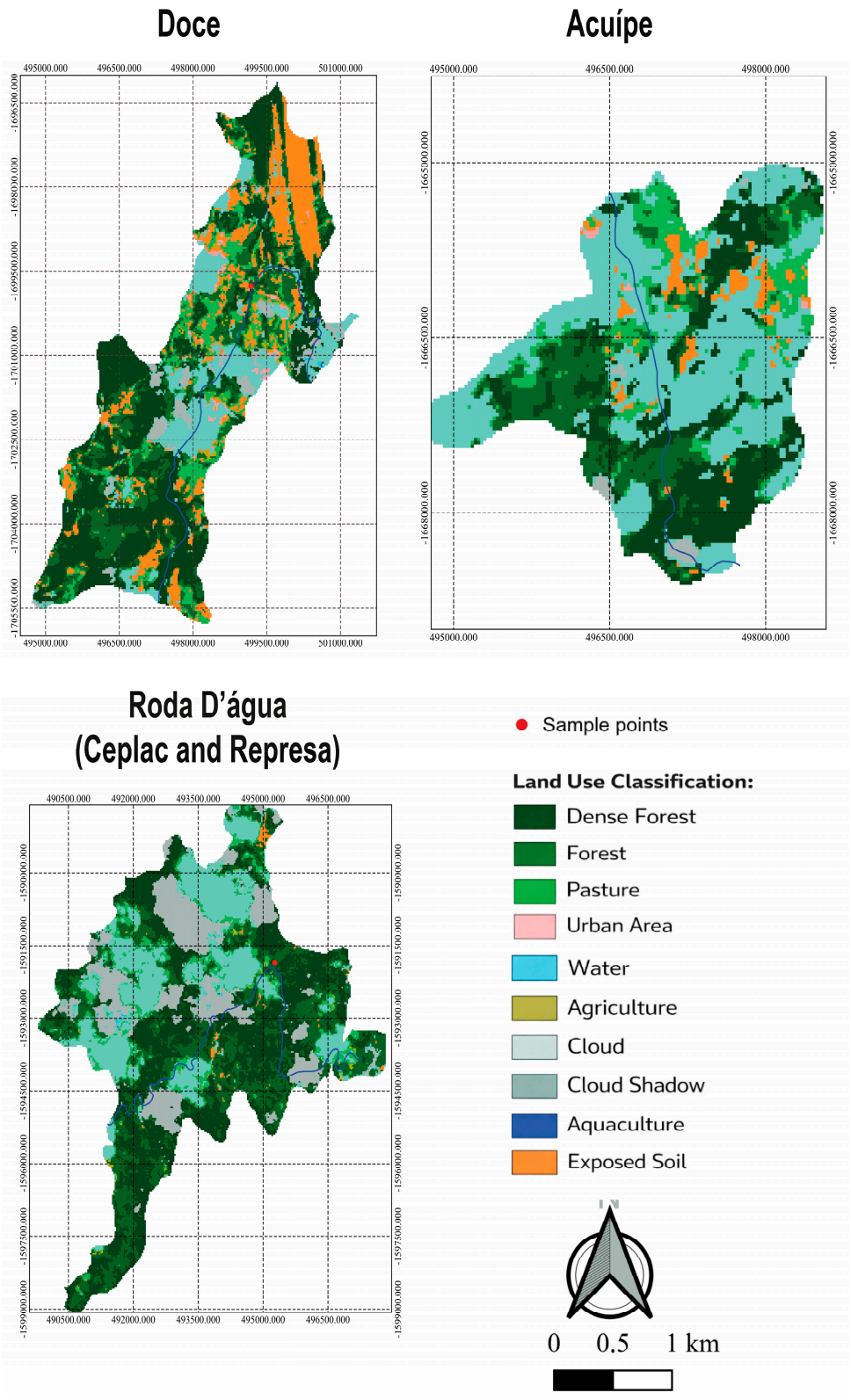


Figure 12. Classification and land use map of the rivers in micro-basins in southern Bahia.

Changes were identified in four general categories of land use in the study area: primary and deciduous forests; secondary forests and crops; water bodies; and eroded, eroded/bare soils, and cities. To improve the interpretation of Landsat 8 images and reduce the influence of dense clouds, the analysis was divided between the northern and southern zones.

In the northern zone, which comprises five locations near Itacaré and Uruçuca, distributed across three areas totaling 129 km^2, marked changes were observed between the 2015 (dry season) and 2016 (rainy season) campaigns. The coverage of primary and deciduous forests increased from 46% in 2015 to 63% in 2016. Secondary forests and cultivated areas also grew, from 32% to 35%. In contrast, areas classified as eroded, dry, or exposed soils decreased dramatically from 22% to about 1% over the same period (Figure 13).

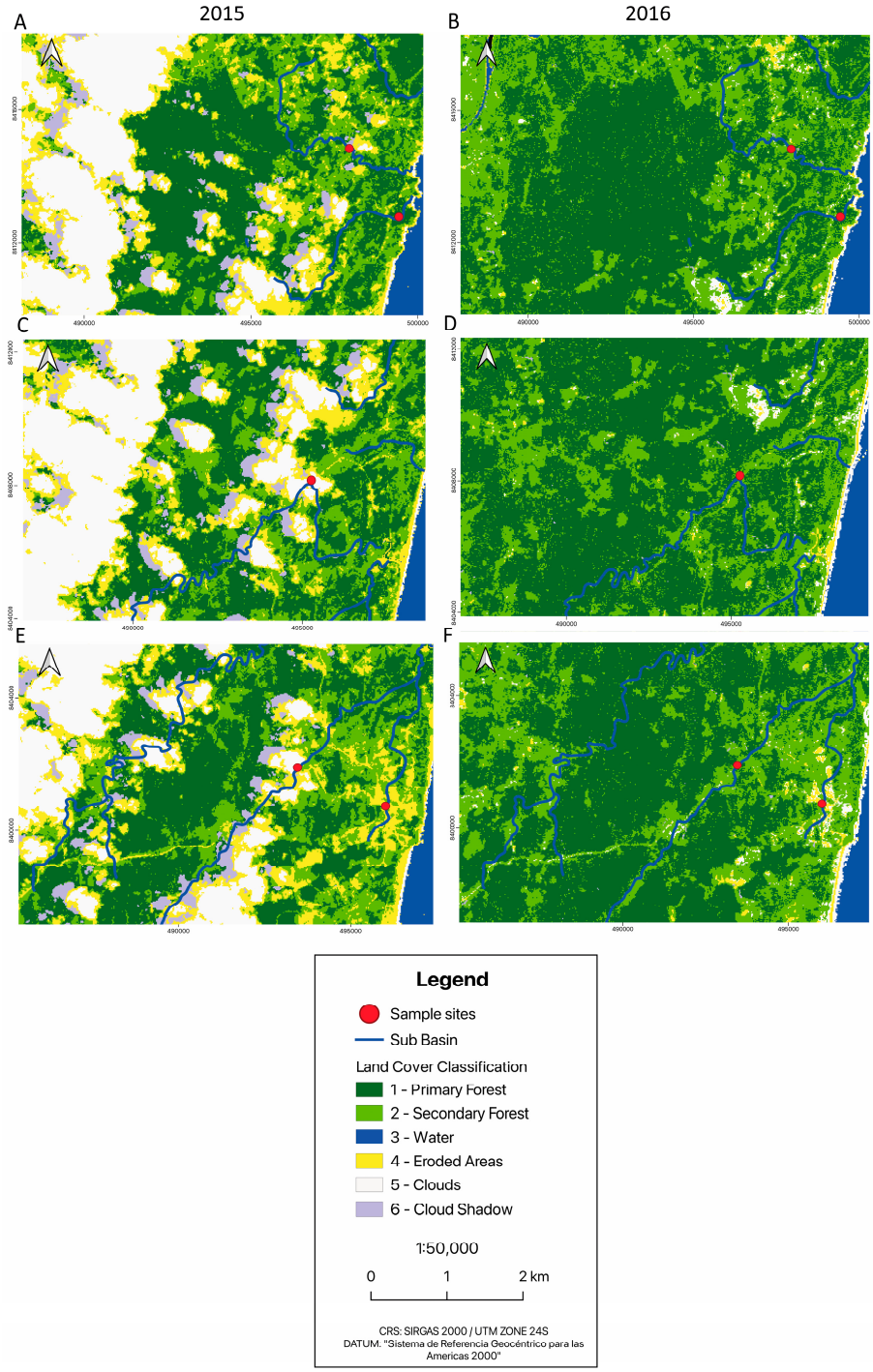


Figure 13. Supervised classification of land use in the three areas and two years corresponding to the collection sites in the northern zone. (**A**) Jeribucaçu and Burundanga Rivers (Itacaré) 2015; (**B**) Jeribucaçu and Burundanga Rivers (Itacaré) 2016; (**C**) Tijuípe River (Itacaré) 2015 (**D**) Tijuípe River (Itacaré) 2016; (**E**) Tijuipinho River (Itacaré) and Pancadinha River (Uruçuca) 2015; (**F**) Tijuipinho River (Itacaré) and Pancadinha River (Uruçuca) 2016.

In the southern zone, which includes three collection sites near Ilhéus and Una, changes in land use were less significant. Even so, there was an increase in primary and deciduous forest cover, rising from 21% in 2015 to 40% in 2016. Secondary forests and agricultural areas remained at similar levels, varying from 40% to 39%. Finally, areas of eroded, exposed, and urbanized soils showed a marked decline, decreasing from 38% to 21% between 2015 and 2016 (Figure 14).

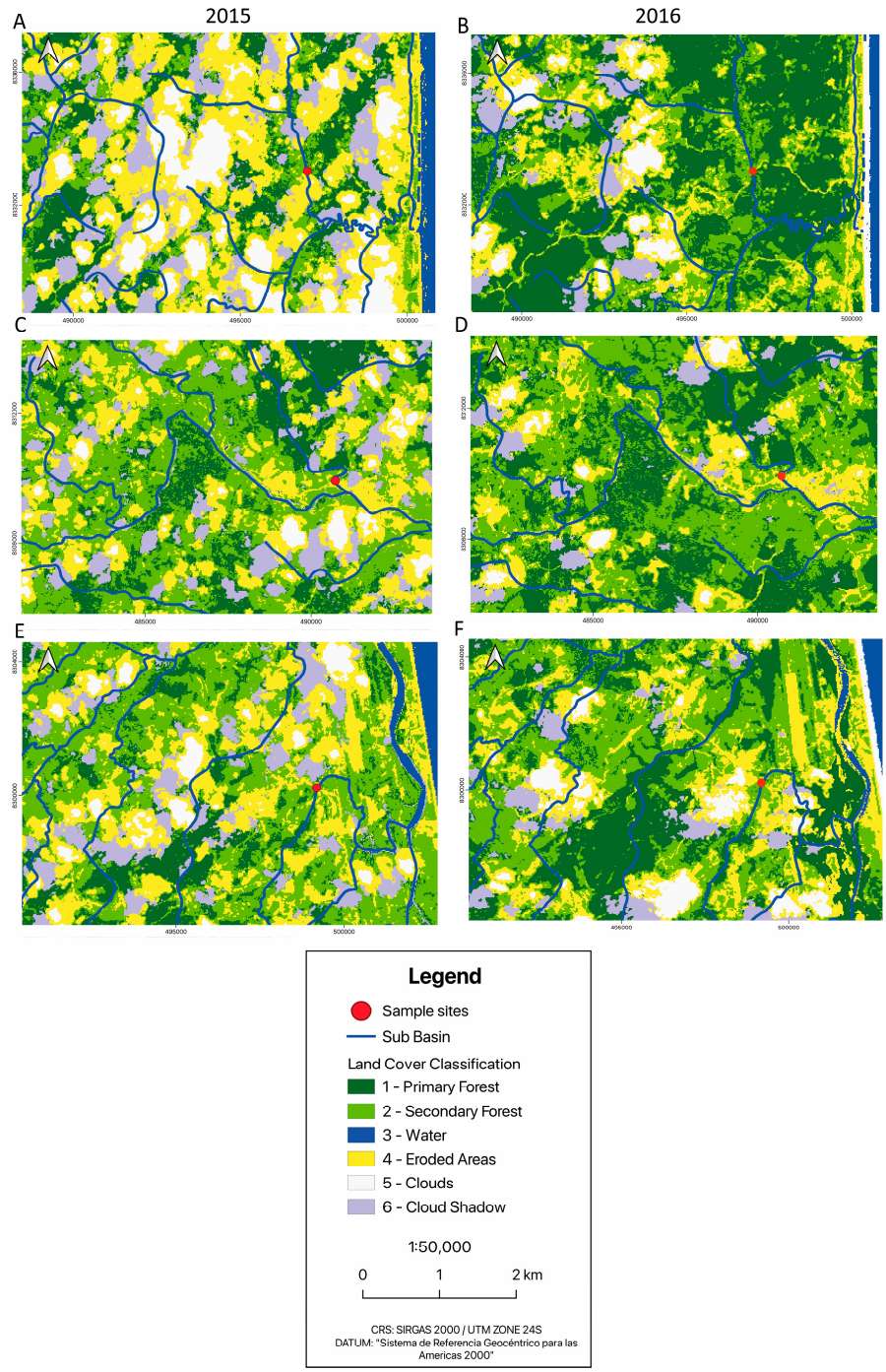


Figure 14. Supervised classification of land use in the three areas and two years corresponding to the collection sites in the southern zone. (**A**) Acuípe River (Ilhéus) 2015; (**B**) Acuípe River (Ilhéus) 2016; (**C**) Roda D'água River; (Una) 2015; (**D**) Roda D'água River (Una) 2016; (**E**) Doce River (Una) 2015; (**F**) Doce River (Una).

3.4. Diversity of Decapod Crustaceans Associated with Anthropogenic Impact

The Pancadinha and Roda D'Água rivers were classified as the most impacted. In these environments, the most frequent species were *M. olfersii* and *M. jelskii*, which, together with *P. potimirim* and *M. acanthurus*, were the only ones found in impacted areas. On the contrary, the species *A. scabra*, *M. carcinus*, *M. heterochirus*, and *Trichodactylus* sp. occurred exclusively in the least impacted rivers.

Non-metric multidimensional scaling (NMDS) revealed that the composition of crustacean community was significantly influenced by anthropogenic impacts observed in the analyzed rivers (R = 0.54; $p < 0.001$; ANOSIM). As in the pattern related to seasonality, *M. olfersii* (51%) and *M. jelskii* (19%) were the species that contributed most to the differences between less impacted rivers and more impacted rivers (Figure 15).

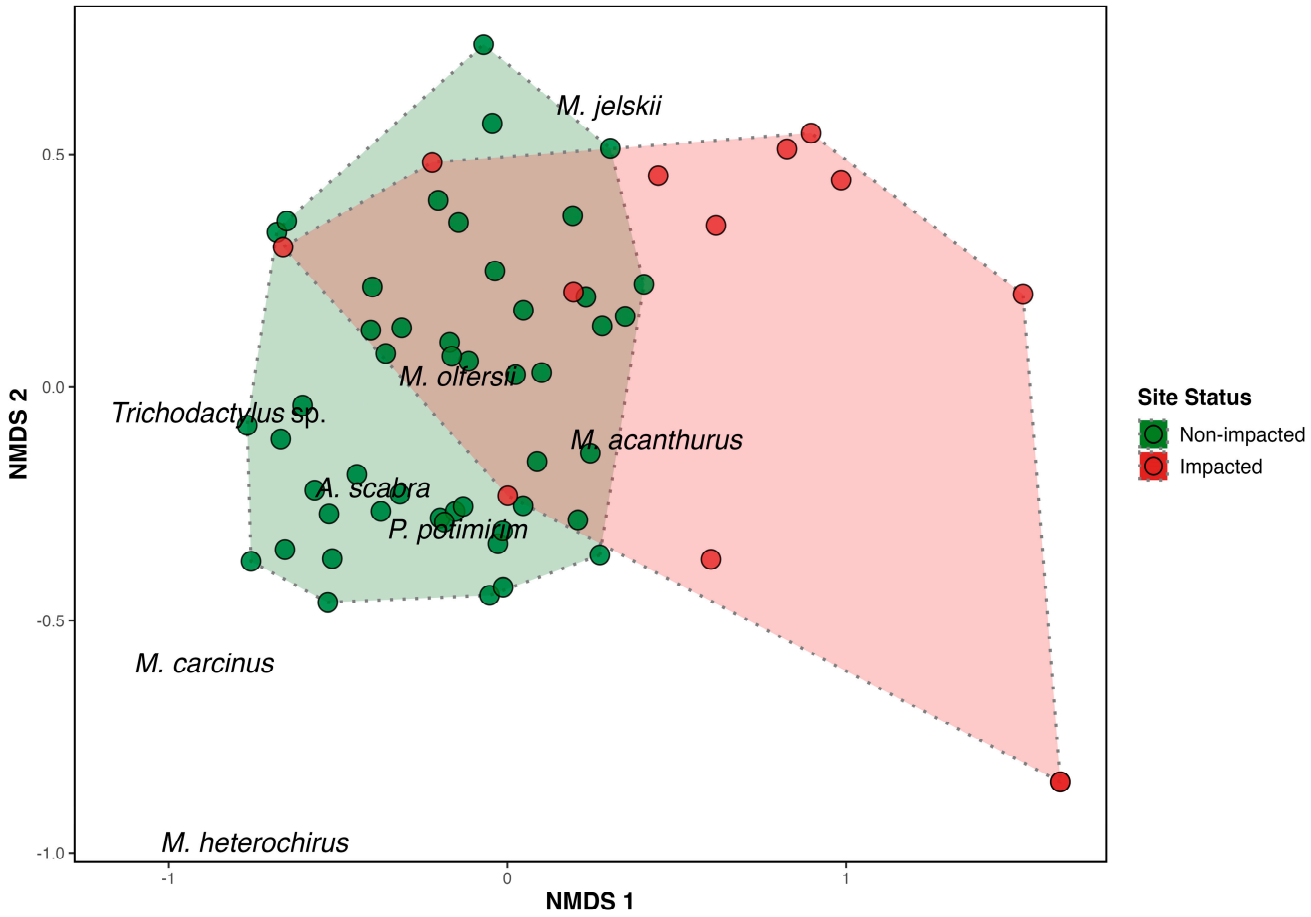


Figure 15. Non-metric multidimensional scaling (NMDS) analysis of decapod crustacean communities in the first- and second-order rivers in micro-basins in southern Bahia during dry and rainy periods, grouping them according to the level of impact.

4. Discussion

The decapod crustacean community recorded in micro-basins of southern Bahia showed patterns of abundance, richness, and composition influenced by both natural factors, such as rain, and anthropogenic conditions. The effects of the drought intensified by the 2015–2016 El Niño event appear to have been modulated by the conservation status of the micro-basins.

The strong predominance of *Macrobrachium olfersii* and *M. jelskii* observed in this study is consistent with widely documented records in neotropical ecosystems [25–27]. The continuous occurrence of these species throughout the sampling period demonstrates the

ecological tolerance of these species, widely recognized for their physiological plasticity [28] and their ability to occupy different microhabitats across environmental gradients [26].

Macrobrachium olfersii stands out for its generalist behavior and wide distribution in lotic environments, characteristics that favor its constant presence in diverse environmental conditions [27,28]. Similarly, *M. jelskii* also shows relatively constant abundance throughout the year [26], a characteristic associated with its continuous reproduction pattern. Although the species occurs during all months, the number of individuals tends to vary seasonally [29].

Seasons affect water levels, which change abiotic factors and directly impact on the structure and function of aquatic communities [30,31]. In addition, the history of floods and droughts also modifies primary productivity, affecting the abundance and distribution of invertebrates [32]. In the present study, the relationship between rain and abundance was evident, with a greater number of individuals collected during the rainy season, as can be observed in rivers except for the Acuípe River. This pattern has also been recorded in other studies with decapods [33,34], in which abundance and recruitment are directly associated with the water regime. Increased flow during the rainy season promotes the expansion of microhabitats and greater availability of food resources.

Despite the increase in total abundance, a reduction in richness was observed during the rainy season. This pattern may be associated with rising river levels, which increase the availability of shelters and favor the migration of individuals [5]. In addition, capture efficiency tends to decrease during this period, as stronger currents make collection in river environments more difficult. In the present study, collectors reported that, although they observed the presence of animals, it was more difficult to capture them during the rainy season, an effect also described by Odinetz-Collart and Moreira (1993) [35]. The reduction in recorded richness seems to be based mainly on the absence of *M. carcinus* during the rainy season. Considering that this species already occurred in low abundance, it is possible that stochastic effects associated with the sampling process, intensified by unfavorable hydrological conditions, reduced collection efficiency. The greater difficulty in accessing and sampling different microhabitats, especially in some rivers, may have limited the detection of the species, influencing the observed pattern. This factor may even explain the greater relative abundance of *Atya scabra*, *M. carcinus*, and *Trichodactylus* sp. recorded during the dry season.

Although similarity analyses (ANOSIM) did not identify marked differences between communities in the dry and rainy seasons in general, significant differences in specific collections indicate that specific changes in hydrological conditions can temporarily reorganize community structure. These differentiated responses between species are consistent with previous studies. One study shows that populations of *M. amazonicum* and *M. jelskii* respond differently to seasonal variations: while rainfall, depth, and ammonium influence *M. amazonicum*, temperature and total dissolved solids mainly affect *M. jelskii* [36]. Similarly, in our study, *M. jelskii* was one of the species that contributed most to the differences between seasons.

The results indicate that most rivers, especially those near conservation units such as the Parque Estadual da Serra do Conduru, have a greater capacity to maintain decapod crustacean populations even during periods of very low rainfall, such as the sampling periods in December 2015 and April 2016. In these more preserved environments, hydrological stability, the presence of riparian forests, and the maintenance of water flow throughout the year contribute to sustaining richer and more abundant communities. This pattern suggests high ecological resilience in response to the severe drought associated with the 2015–2016 El Niño event, whose intensity and frequency are known to influence periods of drought in northeastern Brazil [37].

In contrast, rivers considered to be more impacted due to their proximity to urban areas showed lower richness and abundance. Dams reduce flow and modify hydromorphological dynamics, creating unfavorable conditions for most decapod species and allowing only those with greater environmental plasticity to persist. Land use and land cover maps corroborated this pattern, identifying the Pancadinha and Roda D'água rivers as the most affected, with the lowest diversity.

The severe drought of 2015–2016 was also reflected in noticeable changes in land use, with clear differences between the coverages analyzed for 2015 and 2016. Even so, in preserved rivers, richness and abundance remained relatively stable between seasons, while in impacted rivers there was a marked increase in abundance during the rainy season. This suggests greater sensitivity to hydrological variations, with a rapid response to the recovery of flow and connectivity after rainfall. The return of filter-feeding species of the genus *Potimirim* to the Pancadinha River during the rainy season indicates a temporary improvement in conditions, such as increased oxygenation and cleaner water.

In the present study, anthropogenic impacts proved to be decisive in differentiating the sampled sites based on the composition and abundance of decapods communities. Species such as *Atya scabra*, *Macrobrachium carcinus*, *M. heterochirus*, and the crab *Trichodactylus* sp. did not occur in any river with anthropogenic impact. Although rare in the samples, their consistent absence in degraded areas indicates that they may act as potential bioindicators of water quality in the region's rivers.

This study contributed to the knowledge of the crustacean taxonomic composition of micro-basins in southern Bahia. Overall, the results show that, despite the relatively high diversity recorded in the region, the composition and abundance of species are strongly modulated by environmental and anthropogenic factors. The combination of seasonality, environmental integrity, and land use shapes the dynamics of these communities, highlighting the need for conservation strategies that consider both the protection of riparian vegetation and the control of direct impacts on water bodies. These findings reinforce the importance of micro-basins as fundamental units for environmental planning and the maintenance of aquatic biodiversity in southern Bahia.

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