INDIVIDUAL CONSULTING REPORT

UPDATE THE IOC-UNESCO ANCA-HAEDAT PLATFORM

Deliverable 3.1 – Final Report

Presented to:
HAB-ANCA | IOCARIBE
International Oceanographic Comission
United Nations Educational, Scientific And Cultural Organization (UNESCO)

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Contract N°:
4500528664

Submission Date:
March 29th, 2025

Medellín, Colombia

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Executive Summary

Between January 29th and March 29th, 2025, a comprehensive analysis of the HAEDAT database was developed, focusing on the subdivisions ANCA (Caribbean Sea) and Region 2: CCA (Tropical Eastern Pacific). Composition of the database, data storage and facilities for users were examined to identify its actual functioning, weaknesses and opportunities for improvement. As a result, important issues in the data storage and availability were identified, including the lack of a metadata file, sections of the database that cannot be downloaded and translocations in the data storage.

The information contained in the database for the regions ANCA and CCA was analyzed through descriptive statistics. A total of 333 events in ANCA and 235 events in CCA were identified, which represented less than 5% of the approximately 14,000 records found in the global database. A total of 36% of ANCA events and 11% of CCA events cursed with affectations over human beings, and 44% of ANCA events and 9% of CCA events reported mass mortalities of fauna. The most common health affectation reported in ANCA was Neurotoxic Shellfish Poisoning, while in CCA, Paralytic Shellfish Poisoning was more prevalent. Ciguatera was an important preoccupation in the Caribbean Sea, while in the Pacific its incidence was far lower. An intercomparison between ANCA region and the "Centro de Epidemiología del Caribe" (CAREC-OPS) records found an important sub register in HAEDAT, highlighting the need of cooperation and exchange of information between ocean management and health surveillance institutions.

The main findings of this report were presented to the IOCARIBE Member State Representatives during a virtual meeting on March 17, 2025. The participants acknowledged the issues raised and agreed on a strategic roadmap to enhance cooperation in data acquisition and reporting. The proposed actions include establishing contact with a regional observatory in Chile, organizing a technical meeting to address platform-related challenges, and developing communication channels based on successful national initiatives.

1. Introduction

Harmful Algal Blooms (HABs) have emerged as a significant environmental concern worldwide, affecting marine and freshwater ecosystems, public health, and economic activities. These phenomena occur when certain species of algae, mainly unicellular phytoplankton, proliferate excessively, often in response to environmental factors such as nutrient enrichment, temperature variations, and hydrodynamic conditions. While algal blooms are natural occurrences, anthropogenic influences, including climate change and increased nutrient runoff from agricultural and industrial activities, have contributed to their increased frequency and intensity, and widen their geographic distribution.

HABs pose serious threats to aquatic ecosystems, as they can lead to hypoxic or anoxic conditions, disrupt food webs, and result in the mortality of fish and other marine organisms. HABs have also significant implications for public health: certain species involved in HABs produce potent biotoxins, which can accumulate in shellfish and fish, posing severe health risks to humans and wildlife. These toxins can cause illnesses such as paralytic, diarrhetic, and amnesic shellfish poisonings, among others.

From an economic perspective, HABs can have severe repercussions on fisheries, aquaculture, and tourism industries. Mass fish mortalities, contamination of seafood, and the degradation of water quality can lead to substantial financial losses. Furthermore, coastal communities dependent on these resources may experience socioeconomic challenges due to the reduced availability of safe seafood and the decline in tourism revenue.

As a result, HABs have become a critical issue requiring coordinated efforts between scientists, policymakers, healthcare professionals and stakeholders to develop effective management and mitigation strategies. The study of HABs encompasses various scientific disciplines, including oceanography, microbiology, chemistry, and environmental science. Advances in remote sensing, molecular biology, and predictive modeling have enhanced our understanding of the environmental drivers of HABs and improved early warning systems. However, challenges remain in accurately predicting bloom events, identifying emerging toxic species, and assessing the long-term ecological consequences of HABs under changing climate conditions. Additionally, more efforts are needed to coordinate initiatives and share information between environmental and public health policymakers, to adequately address the incidence of these phenomena.

Here is presented the Final Report of the consultancy developed under the Individual Consultant Contract N° 4500528664 of UNESCO, to assess the actual state and perform statistical analysis of the Harmful Algal Event Database (HAEDAT), which is a component of the Harmful Algal Information system (HAIS) and part of the Intergovernmental Oceanographic Commission (IOC) of UNESCO. The database contains records of harmful algal events from all regions of the world, which are generated and uploaded by the Member State representatives of each country, working on different regional networks. The consultancy focuses on the Region 2: CCA – Caribbean Sea and Adjacent Areas, which contains the reports of ANCA – IOCARIBE working group. The report contains the main insights obtained from the information available on the database, the detailed activity schedule developed during the consultancy and the feedback received from the ANCA – IOCARIBE members.

2. Objectives

2.1. General objective

Assess the current state, information gaps, challenges and opportunities for improvement in the IOC-UNESCO ANCA-HAEDAT platform (Caribbean Sea and adjacent areas), perform statistical analysis of HAB data, and support the training and capacity development of regional stakeholders.

2.2. Specific objectives

- Review the current state and information gaps in the IOC-UNESCO ANCA-HAEDAT platform.
- Identify opportunities for improvement in data collection and storage to be implemented in the database.
- Perform statistical analysis on the main variables of the database to infer possible trends in the behavior of HABs.
- Prepare practical guides and practical use examples to build capacity on the utilization of the database.

2.3. Deliverables and activities

2.3.1. D1. Initial Diagnostic Report: A detailed review of the current state of information on HAEDAT for IOCARIBE (17-02-2025)

The following activities were developed for Deliverable 1:

- Initial diagnostic of the ANCA and CCA databases, including type and quality of the data, main challenges in the handling of data, information gaps and missing documentation.
- Distribution of the data by country and date.
- Analysis of the quality of the data including georeferentiation.
- Nature of the main records in the database, causative agents and main affectations generated by the HAB events.

2.3.2. D2. Updated Platform Data: New and verified HAE records uploaded to HAEDAT, ensuring all recent data is reflected in the system (09-03-2025)

The following activities were developed for Deliverable 2:

- Assessing the state of verification of the data in the ANCA and CCA databases.
- Information about health syndromes in the ANCA and CCA databases, toxicity Assays, main toxins and causative organism associated with each toxin found in the HAB events.

2.3.3. D3. Training Materials, Sessions, and Final Report

The following activities were developed for Deliverable 3:

- Elaboration of the final report, organizing, refining and complementing the findings presented in D1 and D2, summarizing all activities conducted, results achieved, challenges encountered, and key recommendations for the maintenance of HAEDAT.
- Presentation of the main findings to the Member State representatives of ANCA – IOCARIBE working group during a virtual meeting on March 17th, 2025 (**Annex 1**).
- Proposal for a metadata file for the HAEDAT database, as the file was not available for downloading (**Annex 2**).
- Development of practical guide for the final users of the database in the ANCA – IOCARIBE region (**Annex 3**).

3. Methodology

3.1. Data recuperation

Data were downloaded in .csv files from the HAEDAT (IOC – ICES – PICES) database (https://haedat.iode.org/) with cut-off date February 3rd, 2025, to accomplish the deadline of D1. Data were accessed through the “Browse Events” menu and filtered with the ANCA and CCA checkboxes (**Figure 3-1**), including all areas containing the Caribbean Region according to the geographical distribution displayed in the database and showed in the page (**Figure 3-2**).

An email was sent to the Member State representatives of ANCA – IOCARIBE working group on February 20th, 2025, as part of D2 requirements, requesting for the updating of the database (**Annex 4**). The cut-off date of the data for this final report was March 7th, 2025.

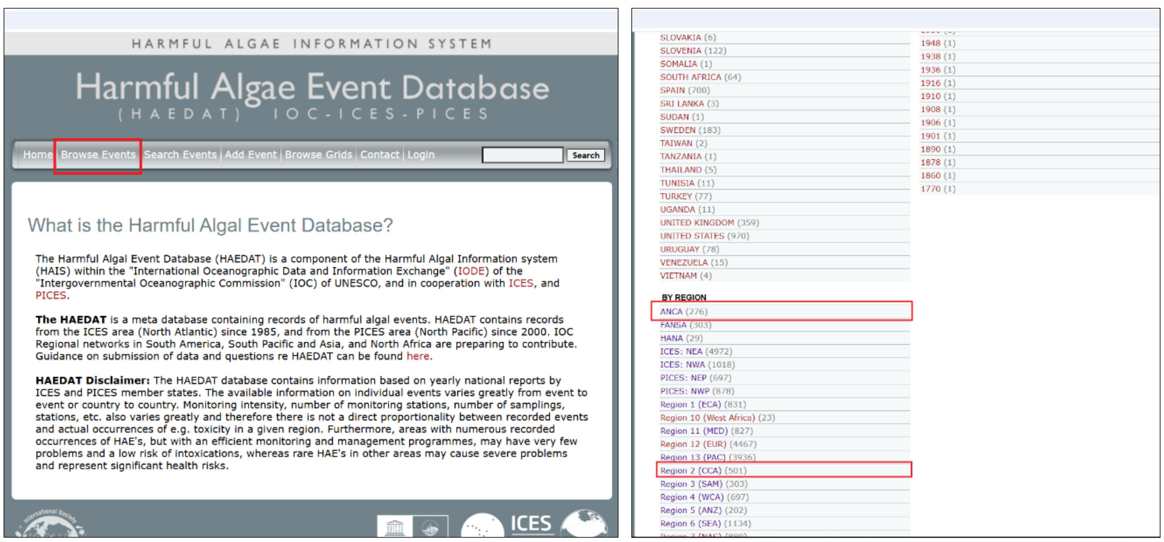


Figure 3-1 Main page (left) and menu of filters (right) in the HAEDAT database showing the route followed for accessing information

Figure 3-2 Geographical coverage of ANCA (left) and CCA (right) according to HAEDAT database. Images don´t display the Caribbean region of United States

As both areas overlap across all the Caribbean distribution, it was mandatory to make an interception between both databases to retrieve all the records of the Caribbean Region and exclude the duplicate records. For the effects of the present report, the term ANCA will be utilized for all records contained in the ANCA database, even if they were duplicated in the CCA one. On the other way, the term CCA will be applied exclusively to the records only present in CCA, which correspond to Colombian and Central American Pacific (**Figure 3-3**). The data analysis was performed using the Pandas library v2.2.2 in Jupyter Notebook under Python v3.9.19. Each column was evaluated depending on its data type and number of missing values. For this first report, the general database status and the descriptive statistics for the main variables are presented.

3.2. State of updating

Dates of each record were retrieved from the column **'eventYear'**. In the case of missing values, an alternative algorithm was developed to retrieve information from **'eventDate'**, **'initialDate'**, **'finalDate'**, **'quarantineStartDate'** and **'quarantineEndDate'** columns. As these columns contain information directly related to each event, they were combined to fulfill the most possible of missing values. Dates of entering of the record were retrieved from the column **'created_at'**, and dates of verification from the column **'checked_at'**.

3.3. Functioning of the form and data storage

A dummy entry (CO-25-001) was entered on March 25th, 2025, and the data was downloaded again to retrieve the data and assess its distribution in the database. The dummy entry was deleted after retrieving the information.

3.4. Dates

Dates of each register were retrieved from the field **'eventYear'**. In the case of missing values, an alternative algorithm was developed to retrieve information from **'eventDate'**, **'initialDate'**, **'finalDate'**, **'quarantineStartDate'** and **'quarantineEndDate'** columns. As these columns contain information directly related to each event, they were combined to fulfill the most possible of missing values.

Figure 3-3 Geographical coverage to denominate ANCA and CCA databases for the purposes of the present report

3.5. Georeferenced data

Data in each database were split into georeferenced and non-georeferenced records. Records were considered as georeferenced if the columns **'latitude'** and **'longitude'** were complete. Latitude and longitude in decimal format were transformed into geographical points by using the library Geopandas v0.14.4 to be deployed in the analysis. Maps were generated by using the library Folium v0.19.4.

3.6. Causative species

To obtain the list of causative species, the columns **'causativeSpeciesName0'**, **'causativeSpeciesName1'**, **'causativeSpeciesName2'** and **'causativeSpeciesName3'** were counted with the Pandas library v2.2.2, and the results were extracted to Microsoft Excel and combined into a unique list. The percentage of events with known species was extracted from the column **'causativeKnown'**.

3.7. Affectations

The information about affectations was extracted from the columns **'waterDiscoloration', 'massMortal', 'foamMucil', 'toxicityDetected', 'humansAffected', 'fishAffected', 'naturalFishAffected', 'aquacultureFishAffected', 'planktonicAffected', 'benthicAffected', 'shellfishAffected', 'birdsAffected', 'otherTerrestrialAffected', 'aquaticMammalsAffected'** and **'seaweedAffected'.** Positive values (1s) were compared with the total of registers in the database to obtain the percentages.

3.8. Syndrome information

Information about health syndromes was extracted from the column **'syndromeName'**, temporal distributions were obtained by filtering the database for each one of the syndromes. Associated organisms were obtained by comparing each syndrome of **'syndromeName'** with the columns **'causativeSpeciesName0', 'causativeSpeciesName1', 'causativeSpeciesName2'** and **'causativeSpeciesName3'** to extract the maximum information about the organisms.

3.9. Toxin information

Due to the difficulties previously reported with the columns referring to toxicity assays, the following approximation was followed:

- The name of the toxins was tracked in the columns **'toxicityRange'**, **'toxinAssayComments'**, **'assaytype'**, **'concentration'**, **'toxinType'** and **'toxin'**.

- The name was extracted from plain text by recognizing string fragments with any combination of uppercase and lowercase, as follows:
    - Saxitoxins: “saxitoxin”, “stx”.
    - Brevetoxins: “brevetoxin”.
    - Okadaic acid: “okadaic acid”, “okadaic”, “OA” (uppercase).
    - Domoic acid: “domoic acid”, “domoic”, “DA” (uppercase).
    - Microcystin: “microcystin”.
    - Ciguatoxins: “ciguatoxin”.
    - Cylindrospermopsins: “cylindrospermopsin”, “cyn”.
    - Pectenotoxins: “pectenotoxin”

Due to typographical errors and other issues related to plain texts, this method probably cannot detect 100% of the mentions, but it offers a good approximation to actual values.

4. Composition and functioning of the database

4.1. Column names and data type

The database is composed of 84 columns. A resume of field names and data types is presented in **Table 4-1**. A complete description of each field is presented in **Annex 5**. Data type of each one of the columns had to be inferred from the data, as no file with metadata was available for downloading.

Table 4-1 Column names and data types of the HAEDAT database

Column Names	Data Type
eventName, region, originalGridCode, programmeName, occurredBeforeText, otherEffectText, locationText, additionalLocationInfo, additionalDateInfo, pigmentAnalysisInfo, additionalAlgaeInfo, toxicityRange, freshwater, effectsComments, toxicityComments, transvectors, eventBiblio, syndromeText, syndromeName, speciesContaining, additionalHarmfulEffectInfo, toxinAssayComments, assaytype, concentration, toxinType, toxin, causativeSpeciesName0, cellsPerLitre0, comments0, additionalSpeciesName0, additionalCellsPerLitre0, additionalComments0, causativeSpeciesName1, cellsPerLitre1, comments1, causativeSpeciesName2, cellsPerLitre2, comments2, causativeSpeciesName3, cellsPerLitre3, comments3, additionalSpeciesName1, additionalCellsPerLitre1, additionalComments1, additionalSpeciesName2, additionalCellsPerLitre2, additionalComments2	Alphanumerical (str)
eventDate, initialDate, finalDate, quarantineStartDate, quarantineEndDate	Date
updated_at, checked_at, created_at	Datetime
eventYear, days, months	Integer (int)
latitude, longitude	Decimal (float)
monitoringProgramme, occurredBefore, waterDiscoloration, highPhyto, seafoodToxin, massMortal, foamMucil, otherEffect, causativeKnown, toxicityDetected, humansAffected, fishAffected, naturalFishAffected, aquacultureFishAffected, planktonicAffected, benthicAffected, shellfishAffected, birdsAffected, active, otherTerrestrialAffected, aquaticMammalsAffected, seaweedAffected, unexplainedToxicity	Binary (1: Yes – 0: No)

Column Names	Data Type
countryName	More than two options (list)

4.2. Comprehensibility of data downloading and identification

It is noteworthy that the database does not include a field that allows filtering the data based on their corresponding region (e.g., ANCA or CCA). Although the data of any region can be downloaded using the filters available on the website, there is no efficient way to replicate the filtering process based solely on the data when downloading the global database. This report attempted to replicate the filter to extract data for ANCA and CCA from the global database, but the process proved to be quite troublesome. For example, filtering by geographic area is challenging since many records lack georeferencing, and filtering by country is also problematic, as some countries involved, such as the United States of America or France, report data from vastly different regions of the world. This, combined with the partial overlap of several regions and the absence of a metadata file, could create obstacles for researchers, students, and decision-makers in efficiently using the database.

4.3. Metadata file

There was no metadata file available as part of the downloadable information from HAEDAT database.

4.4. Data entry form, storage and retrieval problems

The data entry form is composed of four sections and a total of 122 fields, 32 of them are checkboxes and the rest are fillable fields. Each section, its functioning and the problems encountered are described below:

4.4.1. General information

It collects information about the localization and date of the event (year and country), the nature of the event, the affectations generated by the event, if any toxicity was detected, the health syndromes associated with the event, the species carrying the contamination (in the case of alimentary intoxications), the monitoring program and historical occurrences of the event, and the professional responsible for giving the information. The issues found in this section are presented below, along with recommendations:

4.4.1.1. Toxicity range

The question presented in **Figure 4-1** feeds the columns **'toxicityDetected'** and **'toxicityRange'**.

Figure 4-1 Toxicity range section in the form

Keeping the **'toxicityRange'** column in an open format limits its usefulness for data analysis, as it mixes descriptions, names, and units within a single field It is recommended to implement a structured format, for example the following:

- **'toxinTested' (str):** Name of the toxin.
- **'toxicityRangeMin' (float):** Minimum concentration evaluated or toxicity threshold.
- **'toxicityRangeMax' (float):** Maximum concentration evaluated.
- **'toxicityRangeUnits' (list):** Measurement units (e.g. µg/L).
- **'toxicityRangeComments' (str):** (Optional) Additional information.

If multiple assays were performed (e.g., food consumption, respiratory, contact) or more than one toxin is present, multiple schemas (0, 1, 2…) could be implemented. Examples of issues registered with the actual format are presented in **Table 4-2**. Proposal of data organization is presented in **Table 4-3**.

Table 4-2 Examples of information handling problems due to the lack of specificity of the column type and purpose: unspecific comments (up), combination of number, letters and symbols (center), and use of the column when there is no data (down)

	toxicityRange
20	Yes. From respiratory irritation and known sym...
21	Yes. From respiratory irritation and known sym...
22	33.4 MU brevetoxin
23	33.4 MU brevetoxin
24	33.4 MU brevetoxin
...	...
274	CYN <21ngl-1; STXs 5ngl-1
281	None tested for
282	None tested for
283	No toxicity for human
303	7.15 pg/cell and 4.2 pg/cell (g-1algae wet wei...

Table 4-3 Proposal of organization of the columns containing mixes of alphanumerical characters. The example contains the same information than Table 4-2

toxinTested (str)	toxicityRangeMax (float)	toxicityRangeMin (float)	toxicityRangeUnits (list)
NaN	NaN	NaN	NaN
NaN	NaN	NaN	NaN
Brevetoxin	33.4	NaN	MU
Brevetoxin	33.4	NaN	MU
Brevetoxin	33.4	NaN	MU
NaN	NaN	NaN	NaN
NaN	NaN	NaN	NaN
NaN	NaN	NaN	NaN
NaN	4.2	7.15	pg/g dry weigth

4.4.1.2. Affectations

- One of the fields asks for specify which terrestrial organisms (other than humans or birds) are affected by the event. This information was not available in the downloaded database, and it is unknown where (or if) is being stored.

Figure 4-2 Affectations, red square shows the field which cannot be retrieved

– Finally, there is no field in the form pointing to the column 'fishAffected'. Maybe it is a reminder of an older version of the database, which was later divided into 'naturalFishAffected' and 'aquacultureFishAffected'.

4.4.1.3. Health syndromes

A very unusual data storage style was detected in this section (**Figure 4-3**). When more than one syndrome checkbox is selected, ***the database creates an identical copy of the record (including the ID) for each of the selected syndromes, but does not allow modification of any other data***, such as toxicity assays. Any further modification must be done from the option "Edit Event" in the platform page. An example of this behavior is presented in **Table 4-4**.

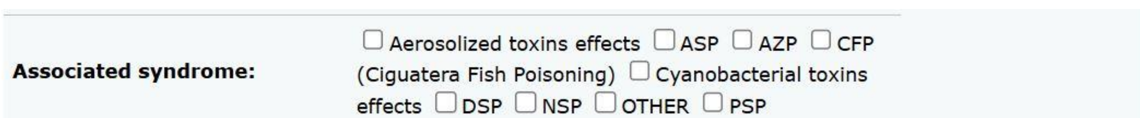


Figure 4-3 Associated syndromes

Table 4-4 Duplication of records when more than one syndrome is selected

syndromeText	active	created_at	updated_at	checked_at	countryName	syndromeName
NaN	NaN	2025-03-25 03:29:02	2025-03-25 04:40:20	NaN	COLOMBIA	ASP
NaN	NaN	2025-03-25 03:29:02	2025-03-25 04:40:20	NaN	COLOMBIA	CFP (Ciguatera Fish Poisoning)
NaN	NaN	2025-03-25 03:29:02	2025-03-25 04:40:20	NaN	COLOMBIA	DSP
NaN	NaN	2025-03-25 03:29:02	2025-03-25 04:40:20	NaN	COLOMBIA	NSP
NaN	NaN	2025-03-25 03:29:02	2025-03-25 04:40:20	NaN	COLOMBIA	OTHER

4.4.1.4. Events occurred before

In this section (), adding a new field (e.g., Name of the previous event → **'eventNameBefore'**) could enable cross-referencing with **'eventName'**, allowing users to see if the previous event was reported in the database and to track recurring events.

Figure 4-4 Events occurred before

4.4.1.5. Professionals to contact

This information is not available in the downloaded data.

4.4.2. Location & Date

It collects information related to the detailed spatial and temporal location of the event, including georeferentiation, name of the location of the event, and dates of beginning and end of the event and the quarantines related to its occurrence. The were issues related with the sub-section "General location information" (**Figure 4-5**). The HAB Area Code is used to generate part of the column '**eventName**' (the ID of each event), but it does not feed the column **'originalGridCode'**, which was (presumably) intended to help in the georeferentiation of the event. The **'originalGridCode'** column lacks sufficient information on the number and definition of polygons, leaving gaps in coverage for potential event locations. As a result, the column **'region'** becomes unspecific, as it contains open text with very local information.

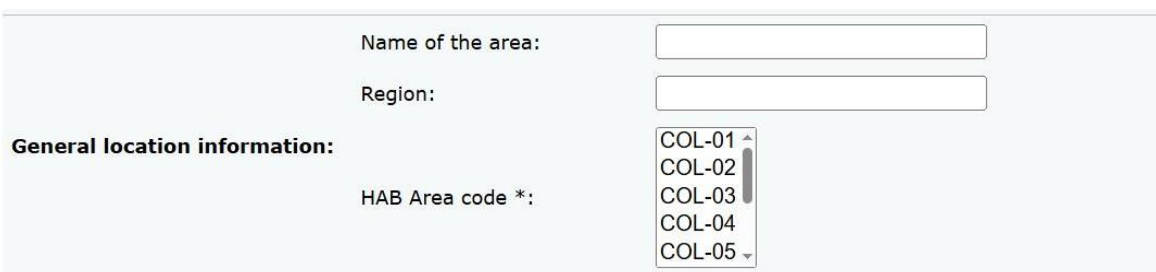


Figure 4-5 General location information

4.4.3. Microalgae

It collects specific information about the causative agent of the event, including its taxonomical identification and if it was a modification of photosynthetic pigments. Issues related to this section are reported as following:

4.4.3.1. Causative species

For the set of columns **'causativeSpeciesName'** and **'additionalSpeciesName'**, there is a list of predefined accepted species known to cause Harmful Algal Blooms, that can be displayed from a dropdown menu. However, the list has duplicated registers due to typographical errors and differences in writing styles (e.g. *Peridinium* sp. vs. *Peridinium* spp.; *Dinophysis caudata* vs. *Dinophysis caudata* Saville-Kent 1881) (**Table 4-5**). Also, the difference between causative agent and additional agent is not clearly defined. Researchers could be using both types of columns indistinctly.

Table 4-5 Examples of information duplicity due to typographic errors and styles

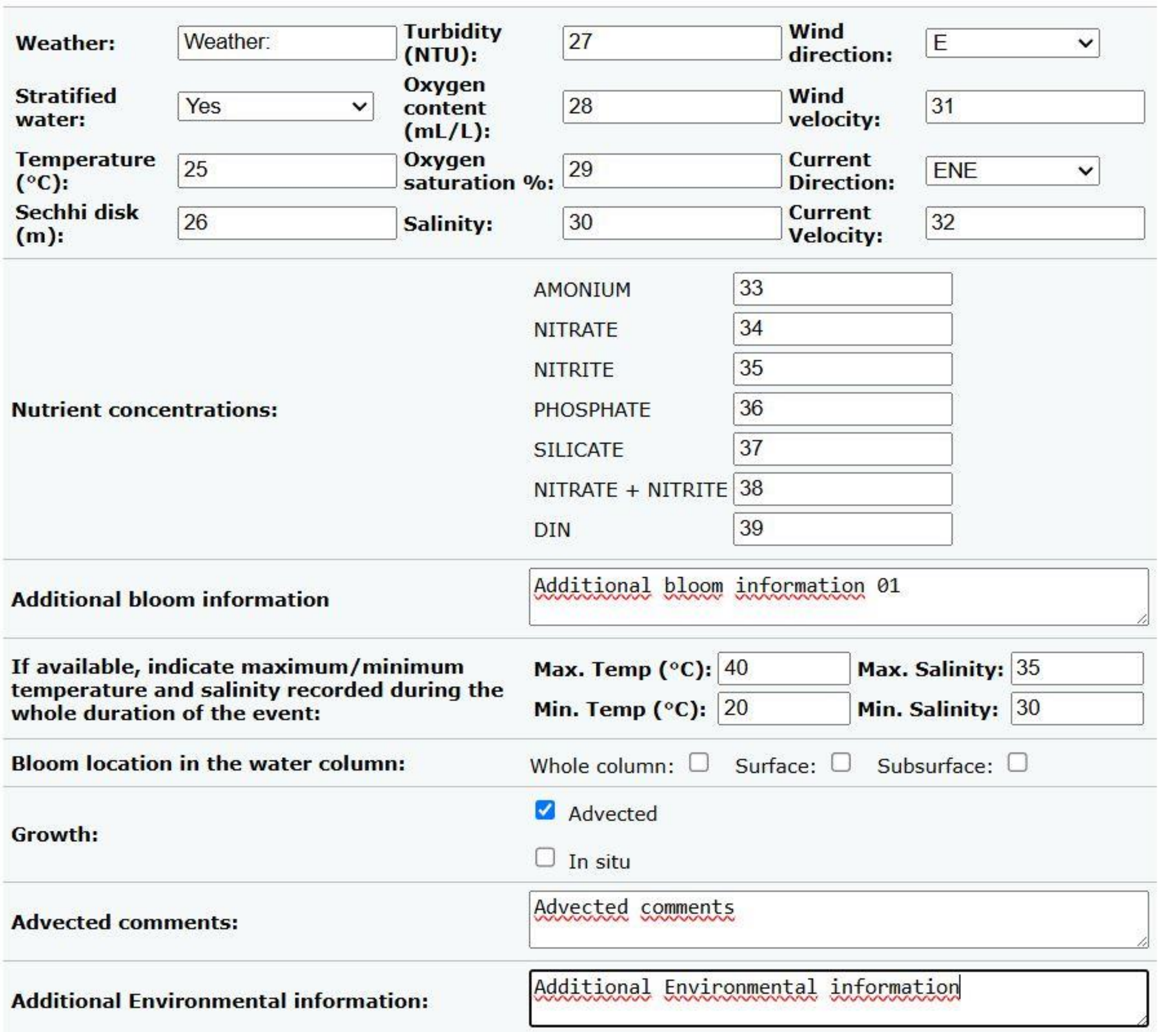
	causativeSpeciesName0	count
16	Akashiwo sanguinea	3
11	Alexandrium monilatum	5
42	Alexandrium sp.	1
8	Anabaena sp.	5
41	Anabaena spiroides	1
9	Anabaena spp.	5
4	Aureoumbra lagunensis	8
36	Chattonella subsalsa	1
43	Chattonella subsalsa Biecheler 1936	1
10	Cochlodinium polykrikoides	5
24	Cochlodinium polykrikoides Margalef 1961	2
28	Cochlodinium sp.	1

4.4.3.2. Concentration (cells per liter)

It is recommended to restrict the set of columns **'cellsPerLitre'** and **'additionalcellsPerLitre'** to a strictly numeric (int) value, as special characters and separators (<, >, periods, commas) significantly reduce its usefulness for efficient data analysis.

4.4.4. Environmental conditions

It collects information about meteorological and physicochemical conditions associated with the event (**Figure 4-6**). Although the information seems to be stored in the database, ***no data from this section could be downloaded from the HAEDAT page***.



Weather:	Weather:	Turbidity (NTU):	27	Wind direction:	E
Stratified water:	Yes	Oxygen content (mL/L):	28	Wind velocity:	31
Temperature (°C):	25	Oxygen saturation %:	29	Current Direction:	ENE
Sechhi disk (m):	26	Salinity:	30	Current Velocity:	32

Nutrient concentrations:

AMONIUM	33
NITRATE	34
NITRITE	35
PHOSPHATE	36
SILICATE	37
NITRATE + NITRITE	38
DIN	39

Additional bloom information: Additional bloom information 01

If available, indicate maximum/minimum temperature and salinity recorded during the whole duration of the event: Max. Temp (°C): 40 Max. Salinity: 35 Min. Temp (°C): 20 Min. Salinity: 30

Bloom location in the water column: Whole column: ☐ Surface: ☐ Subsurface: ☐

Growth: ☑ Advected ☐ In situ

Advected comments: Advected comments

Additional Environmental information: Additional Environmental information

Figure 4-6 Environmental conditions section

4.4.5. Toxin assay information

It collects information about toxicity assays performed during the event, including the nature of the toxin and the consequences associated with its dissemination (**Figure 4-7**).

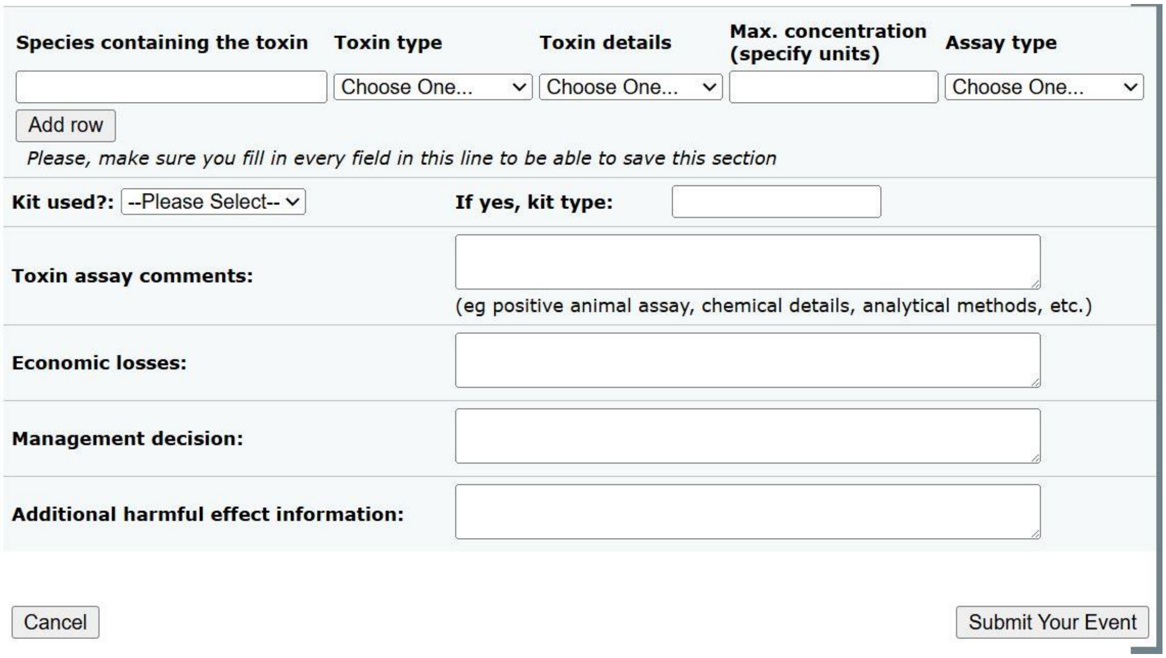


Figure 4-7 Toxicity assays section and end of the form

Multiple issues were detected in this section, as described below:

4.4.5.1. Species containing the toxin

Although it is possible to enter multiple rows of data to track multiple toxins, only the last row could be downloaded from the database.

4.4.5.2. Translocations

- The information from the field “Toxin Details” cannot be downloaded. Whether the information is available is unknown. The data must go to the column **'toxin'**.
- The data from the field “Toxin Type” is stored in the column **'toxin'**. The data must go to the column **'toxinType'**.
- The data from the field “Max. Concentration (specify units)” is stored in the column **'toxinType '**. The data must go to the column **'concentration'**.
- No field in the form is filling the column **'concentration'**. The column is automatically filled in the database with the text 'LC-UV' without being selected.
- The information from the field “Assay Type” cannot be downloaded. Whether the information is available is unknown. The data must go to the column **'assaytype'**.

– The data from the field “Toxin Assay Comments” is stored in the column **'assaytype '**. The data must go to the column **'toxinAssayComments'**.

– The data from the field “Additional harmful effect information:” is duplicated. Although it is correctly stored in **'additionalHarmfulEffectInfo'**, an undesired copy is stored in **'toxinAssayComments'**.

– The information contained in “Kit Used”, “If yes, kit type”, “Economic losses” and “Management decision” cannot be downloaded. None of these fields appear to have an assigned column.

A schematic representation of these translocations is presented in **Figure 4-8**.

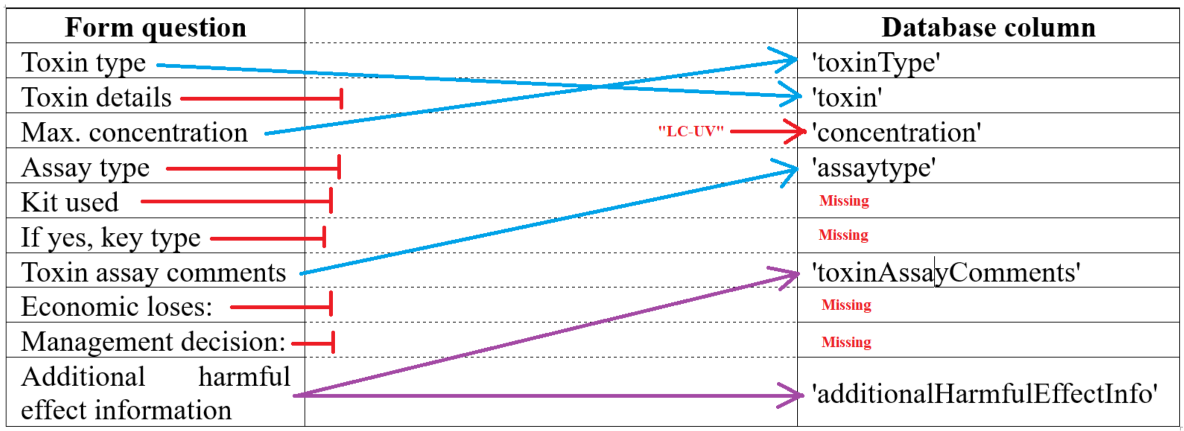


Figure 4-8 Schematic representation of the translocations found in section 5: Toxin assay information of the HAEDAT database. The (presumably) correct assignments are paired front to front. Red lines represent missing information, blue arrows represent translocations and purple arrows represent duplications.

4.4.5.3. Concentration units

Keeping the column **'concentration'** in an open format limits its usefulness for data analysis, as it combines numbers and symbols within a single field. It is recommended to use the following structure:

– **'concentration' (float):** Detected toxin concentration.

– **'concentrationUnits' (str):** Measurement units (e.g., µg/L).

If multiple toxins are present, multiple schemas (0, 1, 2…) could be implemented.

The detailed functioning of the form and data storage is presented in **Annex 6**.

5. ANCA Database

5.1. State of updating

5.1.1. Last occurred event registered by country

The **Table 5-1** shows the ***most recent event reported*** in the ANCA database. Countries with no data in the area appear in the last row of the tables. Events were sorted considering the date of occurrence of the event, not the date of entering the record in the database.

Table 5-1 Last records by country sorted by date of the event in the ANCA database

<table>
<tr><th>Event Name</th><th>Country Name</th><th>Year</th><th>Event Date</th><th>Observations</th></tr>
<tr><td>CO-97-001</td><td>COLOMBIA</td><td>2021</td><td>5/02/2021</td><td></td></tr>
<tr><td>CR-18-001</td><td>COSTA RICA</td><td>2018</td><td>6/11/2018</td><td></td></tr>
<tr><td>CU-21-006</td><td>CUBA</td><td>2021</td><td></td><td>No detailed date.</td></tr>
<tr><td>DO-15-001</td><td>DOMINICAN REPUBLIC</td><td>2015</td><td>17/08/2015</td><td></td></tr>
<tr><td>GT-16-002</td><td>GUATEMALA</td><td>2016</td><td></td><td>No detailed date.</td></tr>
<tr><td>JM-12-001</td><td>JAMAICA</td><td>2012</td><td>11/09/2012</td><td></td></tr>
<tr><td>MX-16-009</td><td>MEXICO</td><td>2016</td><td>23/09/2016</td><td>Quarantine date.</td></tr>
<tr><td>US-22-009</td><td>UNITED STATES</td><td>2022</td><td>17/10/2022</td><td></td></tr>
<tr><td>VE-23-001</td><td>VENEZUELA</td><td>2023</td><td>24/07/2023</td><td></td></tr>
<tr><td>No Data</td><td>ANTIGUA & BARBUDA
BAHAMAS
BARBADOS
BELIZE
DOMINICA
FRANCE**
GRENADA
GUYANA
HAITI
HONDURAS
NETHERLANDS**
NICARAGUA*
PANAMA*
ST. KITTS & NEVIS
ST. LUCIA
ST. VINCENT
SURINAME
TRINIDAD & TOBAGO
UNITED KINGDOM**</td><td colspan="3">* The country has reported events in the CCA database.
** The country has reported events in other regions of the world.</td></tr>
</table>

Most recent events were reported by the United States, Cuba and Colombia in the years 2021 and 2022. Rest of the countries present in the database have only reported events until the past decade. In the case of Jamaica and Venezuela, most recent registers are from 2012 and 2014, respectively. Of the participating countries in the ANCA region, 19 don't have registers in the database, although four of them have registers in another regions.

5.1.2. Last record entered by country

The **Table 5-2** shows the ***most recent record entered*** in the ANCA database. Events were sorted considering the date of entering the record in the database, which does not necessarily coincide with the date of occurrence, as records can be entered to fill past gaps in the information. Countries without records were not included.

Table 5-2 Last records by country sorted by date of entering in the ANCA database

Event Name	Country Name	Event Year	Datetime of creation (record)
CO-15-010	COLOMBIA	2015	25/08/2017 10:09
CR-18-001	COSTA RICA	2018	11/11/2018 5:24
CU-21-006	CUBA	2021	22/06/2022 7:36
DO-15-001	DOMINICAN REPUBLIC	2015	28/10/2015 9:29
GT-16-002	GUATEMALA	2016	15/05/2018 6:49
JM-85-001	JAMAICA	1985	30/10/2015 8:25
MX-16-009	MEXICO	2016	4/01/2019 12:38
US-16-043	UNITED STATES	2016	6/04/2023 4:06
VE-14-001	VENEZUELA	2014	23/02/2021 1:06

In the case of Colombia, an inconsistency was identified in one of the records, which shows an entry date preceding the occurrence of the event. This is likely due to a data entry error and explains the apparent antiquity of the most recent records for this country (**Table 5-3**).

Table 5-3 Inconsistency of the dates in one of the records from Colombia

Event Name	Country Name	Date of the event	Datetime of creation (record)
CO-97-001	COLOMBIA	5/02/2021	28/10/2015 9:11

5.1.3. Verified registers (column 'checked_at')

According to the values of the column **'checked_at'**, only 11 out of 333 records in the ANCA database have been verified (**Figure 5-1**), all of them corresponding to events occurred in the United States.

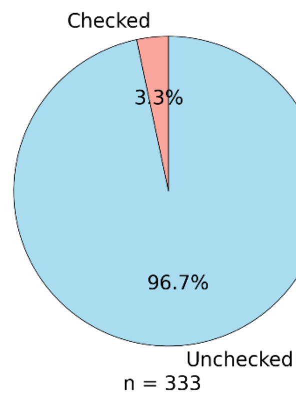


Figure 5-1 Percentage of verified records in the ANCA database

5.2. Distribution of data

5.2.1. Records by country

The ANCA database is composed of 333 records, accounting for 2.4% of the global records (**Figure 5-2**). Within ANCA, the United States accounts for near 72% of the records, followed by Mexico and Colombia, with approximately 8% each one. The remaining records come from Cuba, Venezuela, Jamaica, Guatemala, the Dominican Republic, and Costa Rica (**Figure 5-3**).

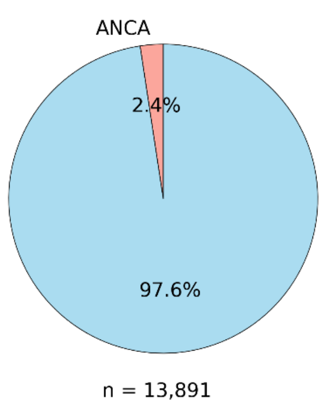


Figure 5-2 Proportion of ANCA records within the global HAEDAT database

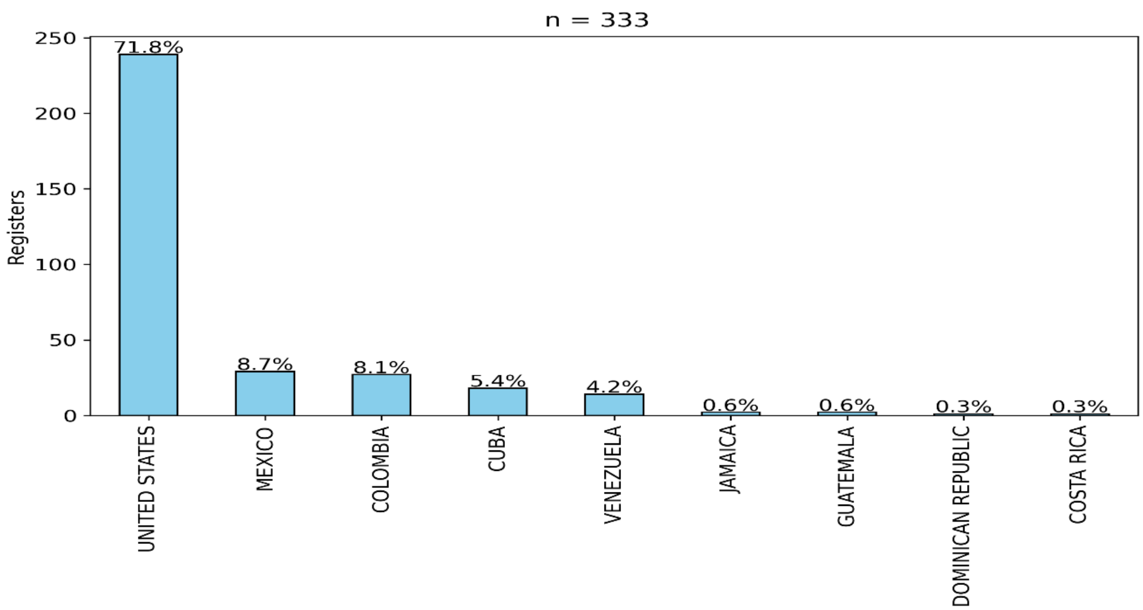


Figure 5-3 Number and percentage of records for each country in the ANCA database

5.2.2. Historical trend

The database covers the period from 1956 to 2022, although most records are posterior to 1990. The number of records followed a growing trend until 2015, which is the year with the higher number of records (n = 22), followed by 2005 (n = 20). Since then, the number of records has been descending, with 2020 reaching a minimum in the last 22 years (n = 1). Historical trend is showed in **Figure 5-4**.

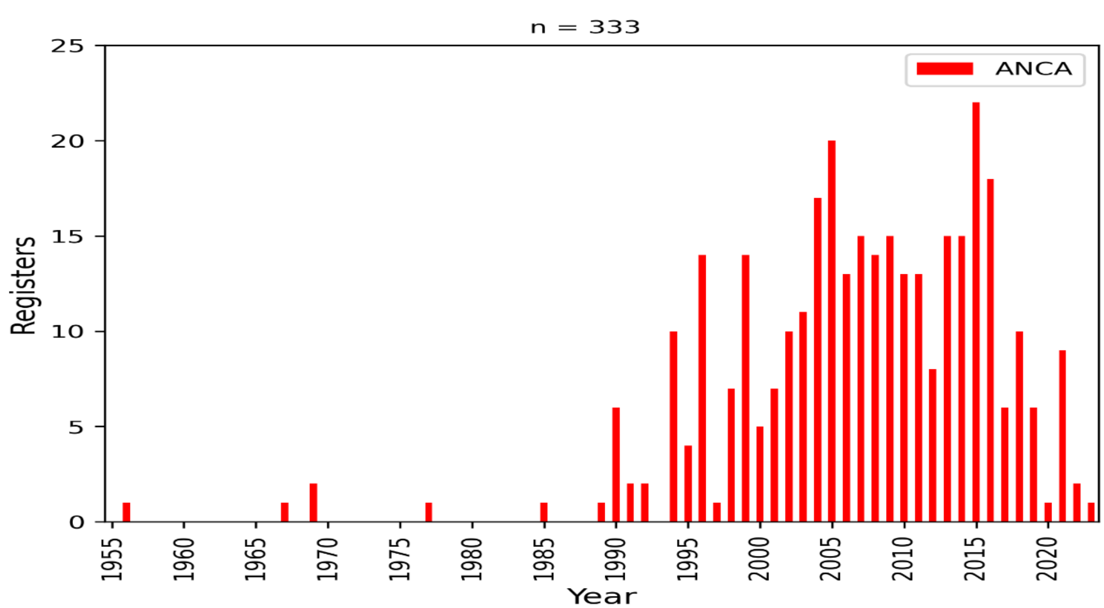


Figure 5-4 Historical trend in records in the ANCA database

5.2.3. Georeferentiation

There were 94 out of 333 referenced records (28.2% of total), while the rest lacked georeferentiation (**Figure 5-5**). Six (6) records have positions outside the geographic range of ANCA (**Figure 5-6**); however, they correspond to records from Cuba, Venezuela and the United States (**Annex 7**). Therefore, they are likely due to data entry errors.

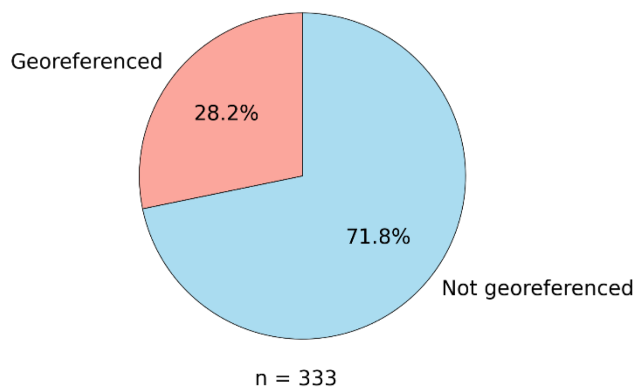


Figure 5-5 Percentage of georeferenced data in the ANCA database

Figure 5-6 Location of georeferenced records in the ANCA database

5.3. Nature of the events

5.3.1. Causative agent

In the ANCA database, in 277 out of 333 events the causative agent was identified, while in 56 events the causative agent was unknown (**Figure 5-7**). A total of 71 species belonging to 42 genera were identified, but more than 50% of events had the presence of at least one of these five causative agents: *Karenia brevis*, *Gymnodinium breve*, *Pyrodinium bahamense, Anabaena* sp. and *Prorocentrum minimum* (**Table 5-4**). The total number of registers is 397, as more than one species can be present per event. The database has up to four columns capable of registering species within the same record. The exhaustive table of species for ANCA database is presented in **Annex 8**.

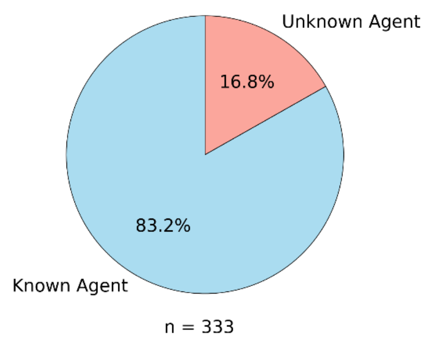


Figure 5-7 Proportion of records where the causative agent was identified in the ANCA database

Table 5-4 Frequency of the main causative species in the ANCA database

Causative Species Name	Presences	Percentage (%)	Accumulated percentage (%)
Karenia brevis	109	27.46%	27.46%
Gymnodinium breve	41	10.33%	37.79%
Pyrodinium bahamense	23	5.79%	43.58%
Anabaena sp.	20	5.04%	48.62%
Prorocentrum minimum	18	4.53%	53.15%
Heterocapsa rotundata	16	4.03%	57.18%
Pseudo-nitzschia sp.	14	3.53%	60.71%
Prorocentrum scutellum	9	2.27%	62.98%
Aureoumbra lagunensis	8	2.02%	65.00%
Cochlodinium polykrikoides	7	1.76%	66.76%
Other 61 species	115	33.24%	100.00%
Total	**397**	**100.00%**	**---**

5.3.2. Affectations generated by the events

According to data from ANCA database, 58% of events cursed with water discoloration, and 47% of events presented reported toxicity and mass mortality of fish, those three the most common affectations. Affectations on human beings were reported in 36% of the cases, which brings important repercussions from the point of view of public health. For an economic perspective, it highlights the affectations to shellfish cultures, present in 27% of events. Aquatic mammals account for affectations in 19% of cases, which is noticeable for conservation efforts. Less common are the affectations towards birds (9%), terrestrial animals (4%) and commercial fish cultures (3%). A complete report on affectations is showed in **Figure 5-8**. The main causative species related with each one of the affectations is presented in **Annex 9**.

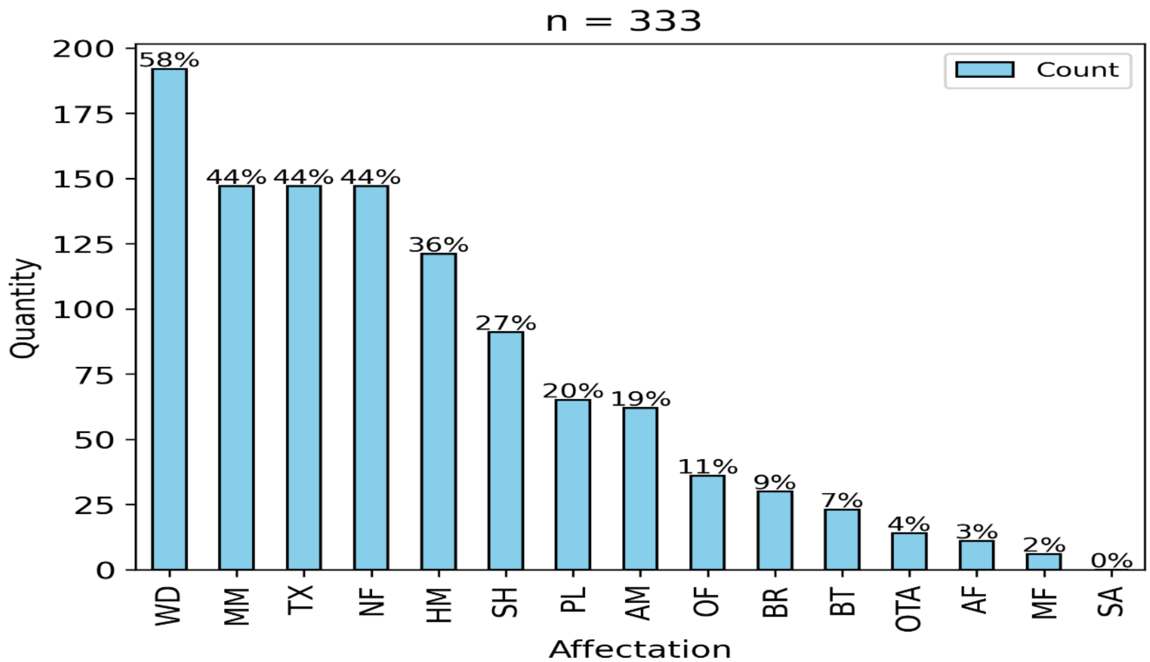


Figure 5-8 Quantity and percentage of affectations (compared with the total number of records) in the ANCA database. Captions: WD = Water discoloration; MM = Mass mortality; TX = Toxicity; NF = Natural Fish Affected; HM = Humans Affected; SH = Shellfish Affected; PL = Planktonic Affected; AM = Aquatic Mammals Affected; OF = Other Fish Affected; BR = Birds Affected; BT = Benthic Organisms Affected; OTA = Other Terrestrial Animals Affected; AF = Aquaculture Fish Affected; MF = Mucilage Formation; SA = Seaweed Affected.

5.4. Health syndromes associated with the occurrence of events

In the ANCA database, 215 out of 333 records (64.8%) are associated with at least one health syndrome (**Figure 5-9**). The following syndromes are tracked within the database:

Neurotoxic Shellfish Poisoning (NSP), Paralytic Shellfish Poisoning (PSP), Ciguatera Fish Poisoning (CFP), Diarrhetic Shellfish Poisoning (DSP), Amnesic Shellfish Poisoning (ASP), effects by cyanobacterial toxins, effects by aerosolized toxins and other related. The incidence of each one of the syndromes is reported in **Figure 5-10**.

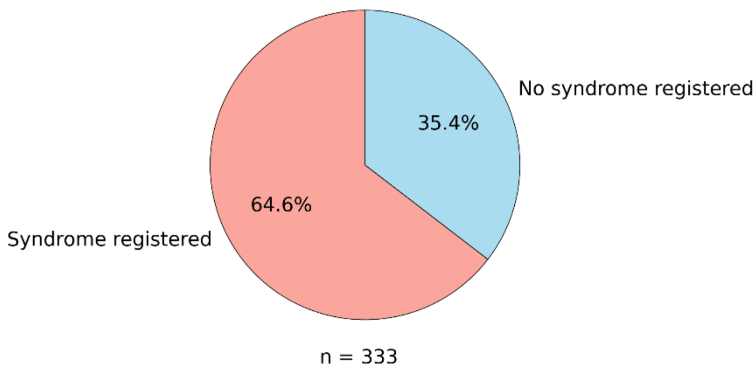


Figure 5-9 Incidence of seafood-induced health syndromes within the reported events in the ANCA database

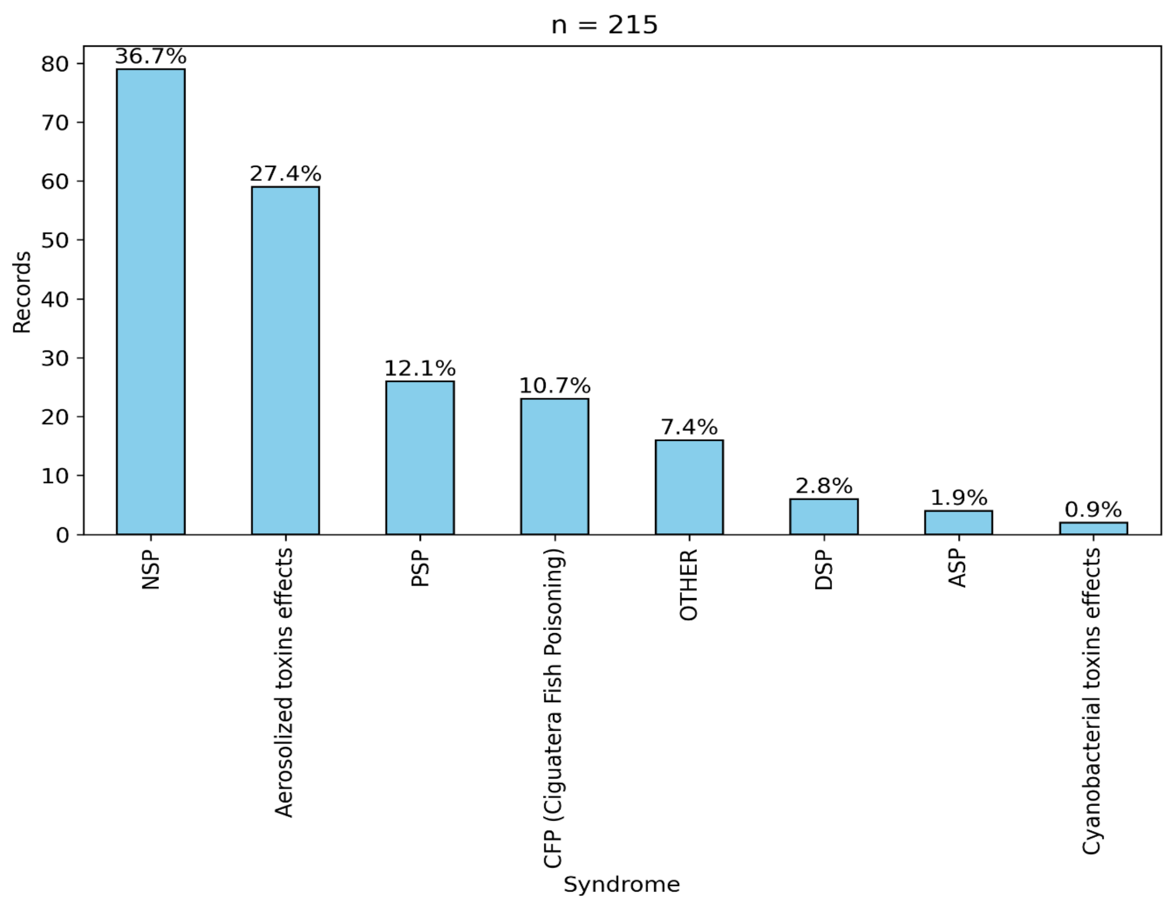


Figure 5-10 Incidence of each seafood-induced health syndrome within the reported events with syndrome presentation in the ANCA database

Figure 5-11 shows the temporal distribution of the four main syndromes reported in the database: Neurotoxic Shellfish Poisoning (NSP), effects by aerosolized toxins, Paralytic Shellfish Poisoning (PSP) and Ciguatera Fish Poisoning (CSP). Non-classified effects (a.k.a. “Other” in the database) reach the fifth place with 7.4% of the events, but the column **'syndromeText'**, intended to describe the effects of the syndrome, has never been utilized, so there is no detailed information about those. The distribution of the data, in general terms, fits with the distribution of information in the database presented in D1, with no notable peaks of any of the syndromes.

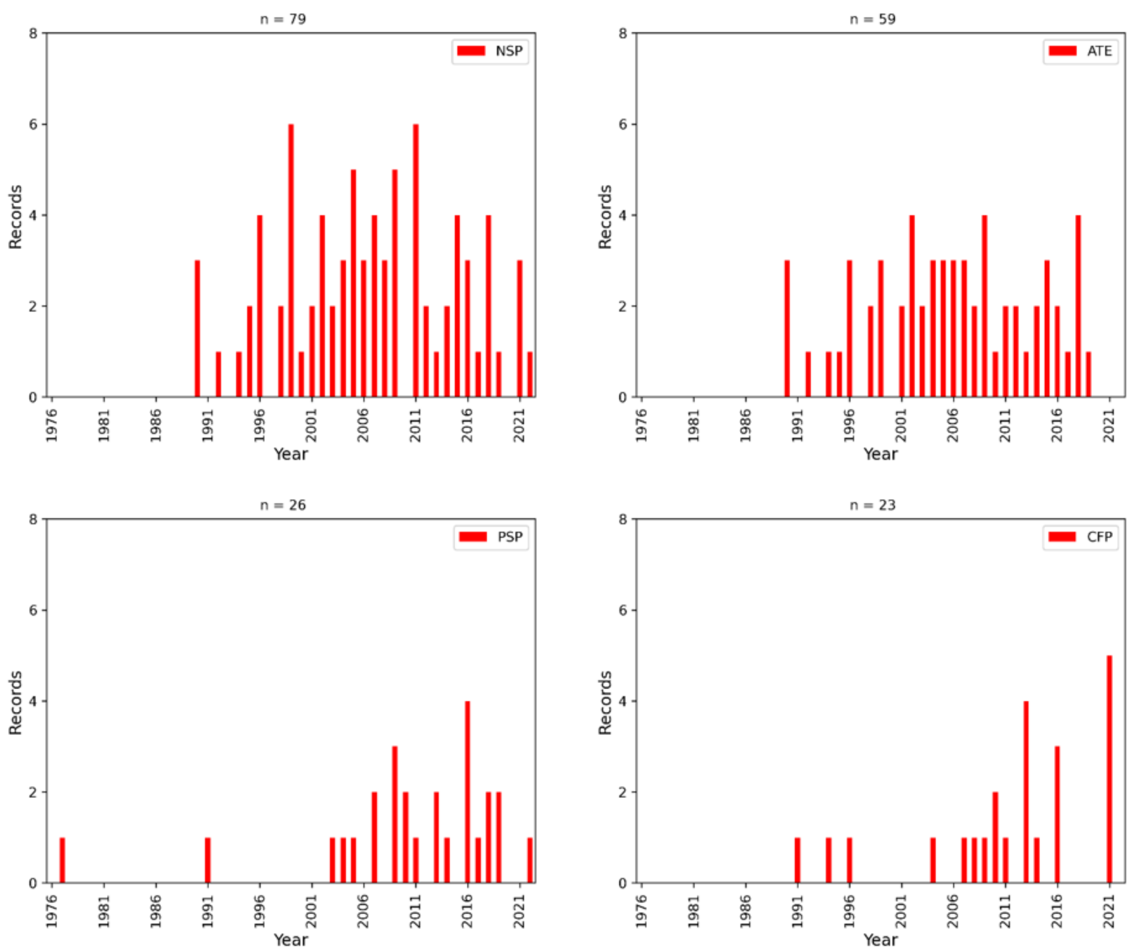


Figure 5-11 Temporal distribution of most reported events associated with HABs in the ANCA database. Neurotoxic Shellfish Poisoning (upper left), effects by aerosolized toxins (upper right), Paralytic Shellfish Poisoning (bottom left) and Ciguatera Fish Poisoning (bottom right)

5.5. Exercise: comparison between ANCA and CAREC records

For comparison purposes, data of Ciguatera reports of the Caribbean Epidemiology Center – CAREC (IRIS – PAHO) in the period 1980 – 2016 were accessed. The information shows a sub-register greater than 99% in the ANCA database respect with the data reported by CAREC (12,823 cases vs. 18 cases). In the CAREC database, cases of Ciguatera reached a peak of approximately 700 annual cases around 2001 and declined to approximately 200 annual cases around 2010 (**Figure 5-12**).

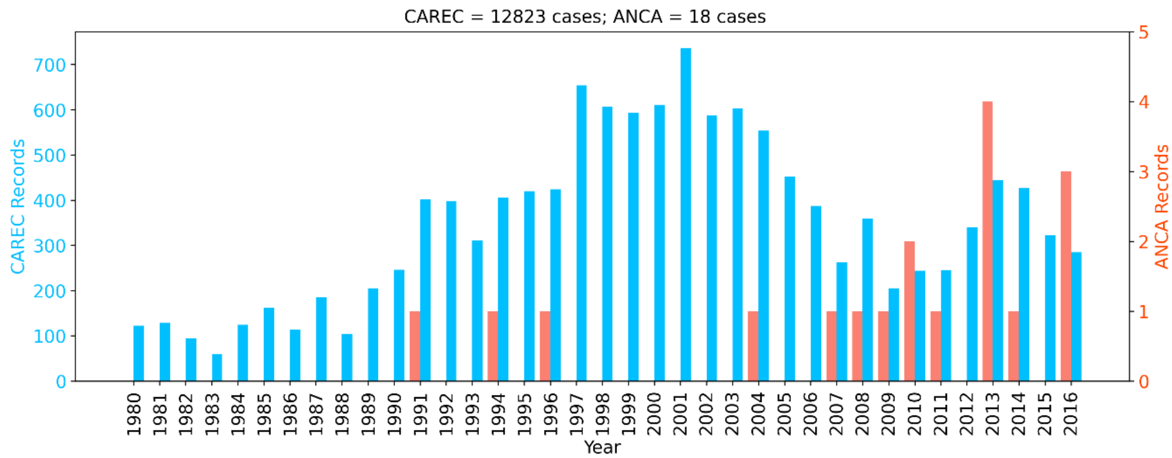


Figure 5-12 Comparison between the number of Ciguatera records in CAREC (blue) and ANCA (red) databases, in the period 1980 – 2016. Note the difference in scales between CAREC (blue, left) and HAEDAT-ANCA (red, right)

From the previous data, it follows that the information contained in ANCA could be substantially enriched if cross-checks were performed with other databases. In the case of effects on human health, institutions like WHO and PAHO could be a valuable source of information. The drawback of this approach is that some fields related to the biological aspects of the events might remain without information, as CAREC databases have a different focus.

5.6. Organisms associated with each syndrome

This section explores the causative species that were associated with events where health syndromes were registered. In the following graphics, the number of organisms could be greater than the number of events, as more than one organism can be present in the same event.

5.6.1. Neurotoxic Shellfish Poisoning (NSP)

All events presenting Neurotoxic Shellfish Poisoning (NSP) were linked with two species: *Karenia brevis* (75.9%) and *Gymnodinium breve* (24.1%) (**Figure 5-13**).

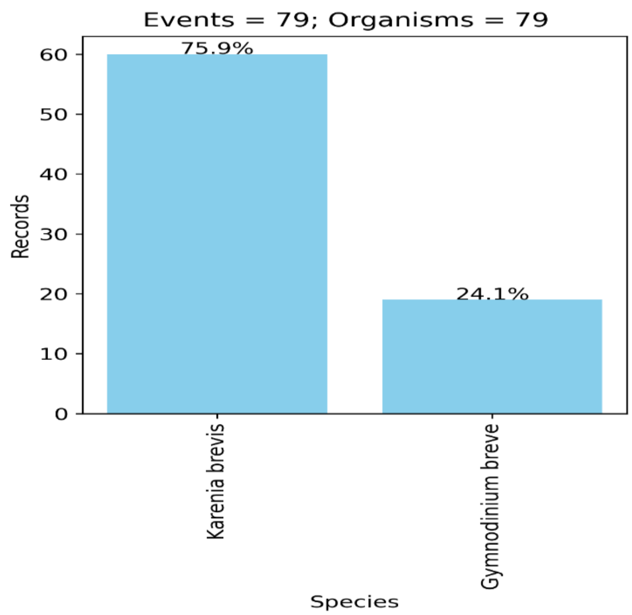


Figure 5-13 Causative species associated with Neurotoxic Shellfish Poisoning (NSP) in the ANCA database

5.6.2. Aerosolized toxin effects

Karenia brevis (71.7%) and *Gymnodinium breve* (25.0%) accounted for more than 95% of these effects. *Eutreptiella gymnastica* and *Fibrocaspa japonica* had minor participation (**Figure 5-14**).

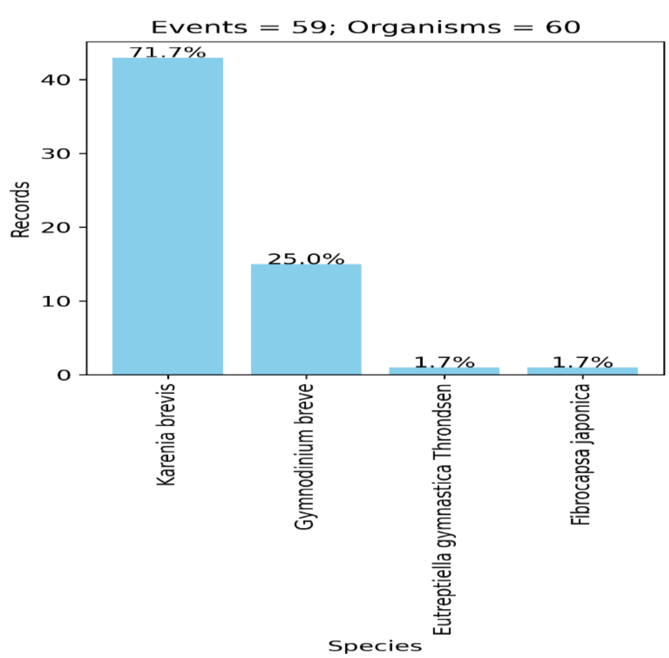


Figure 5-14 Causative species associated with aerosolized toxin effects in the ANCA database

5.6.3. Paralytic Shellfish Poisoning (PSP)

Pyrodinium bahamense (72.4%) was the main agent, followed by *Cylindrospermopsis* sp., *Gonyaulax tamarensis, Prorocentrum gracile* and *Prorocentrum hoffmannianum* (**Figure 5-15**).

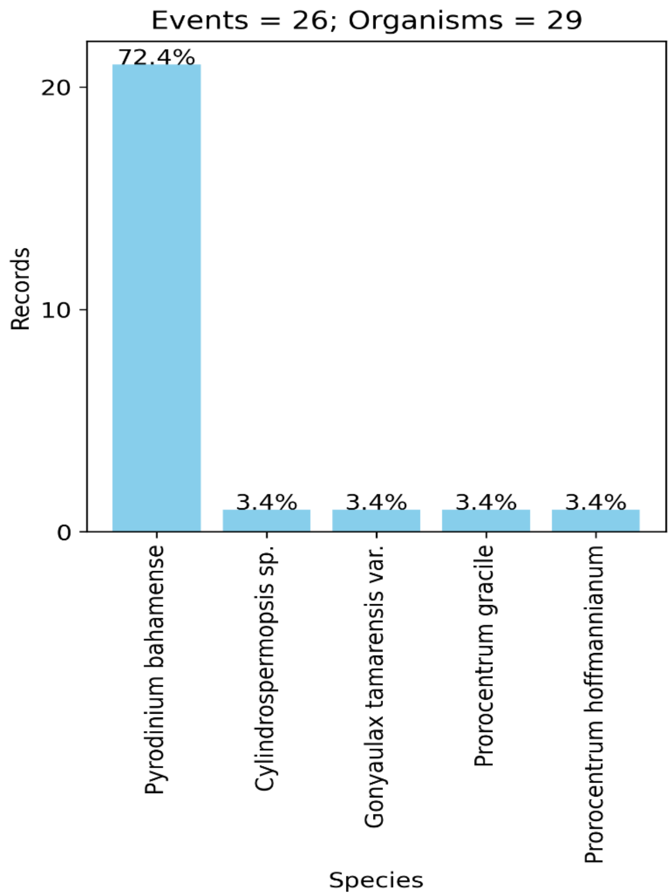


Figure 5-15 Causative species associated with Paralytic Shellfish Poisoning (PSP) in the ANCA database

5.6.4. Ciguatera Fish Poisoning (CSP)

Only 4 out of 23 events were associated with an organism, all of them being members of the genre *Gambierdiscus* (*G. toxicus and G. yasumotoi*).

5.6.5. Diarrheic Shellfish Poisoning

The main causative agent was Dinophysis ovum (37.5%), with the rest of occurrences equally distributed between *Dinophysis* sp., *Prorocentrum hoffmannianum, Prorocentrum mexicanum* and *Pseudo-nitzschia* sp. (**Figure 5-16**).

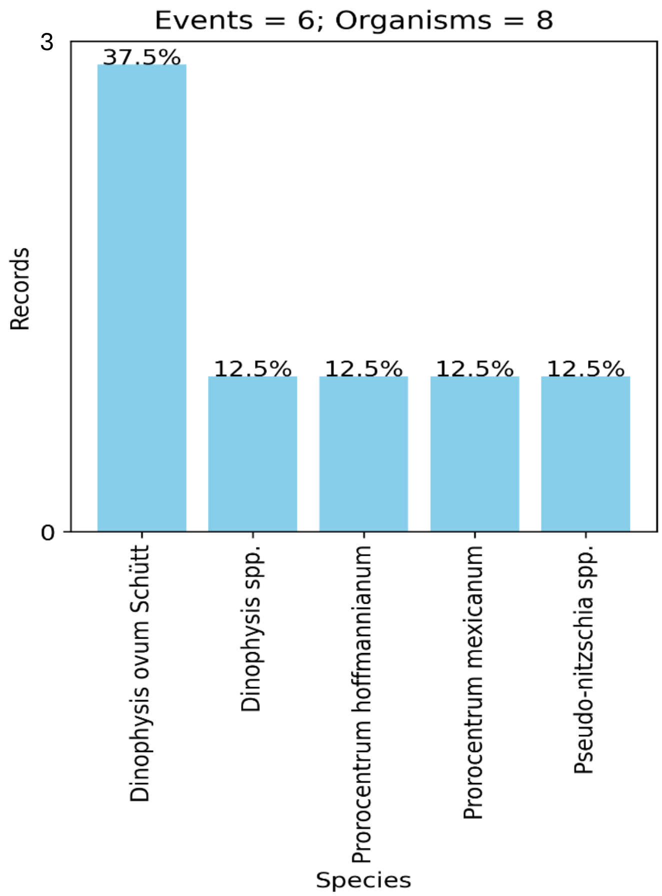


Figure 5-16 First five causative species associated with Diarrheic Shellfish Poisoning (DSP) in the ANCA database

5.6.6. Amnesic Shellfish Poisoning (ASP)

Most of the events associated with this syndrome were characterized by presenting more than one causative agent, normally *Pseudo-nitzschia* sp. accompanied by another organism, such as *Karenia brevis*, *Prorocentrum hoffmannianum, Prorocentrum mexicanum* or *Pyrodinium bahamiense* (**Figure 5-17**).

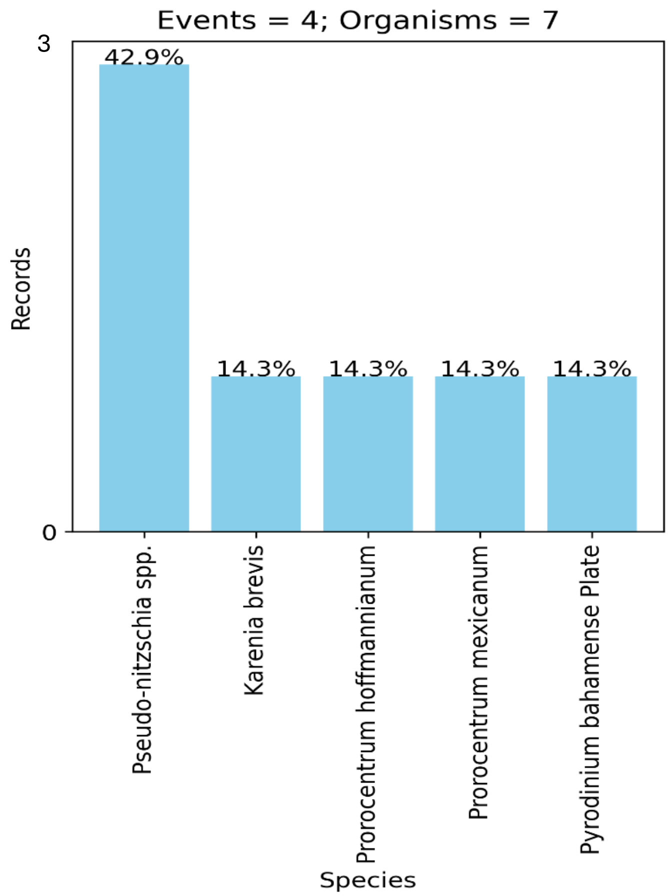


Figure 5-17 Causative species associated with Amnesic Shellfish Poisoning (ASP) in the ANCA database

5.6.7. Cyanobacterial toxin effects

Of the two events reported with this syndrome, only one was associated with *Cylindrospermopsis* sp.

5.6.8. Other effects

In this category any special distribution was observed. Causative agents were diverse, among them *Alexandrium monilatum, Aureoumbra lagunensis, Gymnodinium breve, Gymnodinium sanguineum, Prymesium parvum*, etc.

5.7. Toxicity Assays

The **Figure 5-18** shows the percentage of events where at least one toxicity assay was performed, considering the total number of events and the events where health syndromes were reported. One hundred events (30.0%) contain information about toxicity assays, 93 of them referring to syndromes (43.3%).

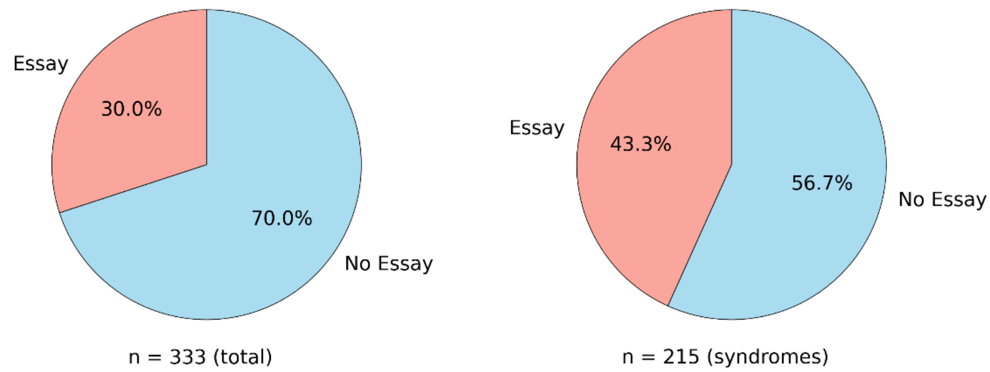


Figure 5-18 Percentage of events where toxicity assays were performed, from total events (left) and from events with a syndrome registered (right) in the ANCA database

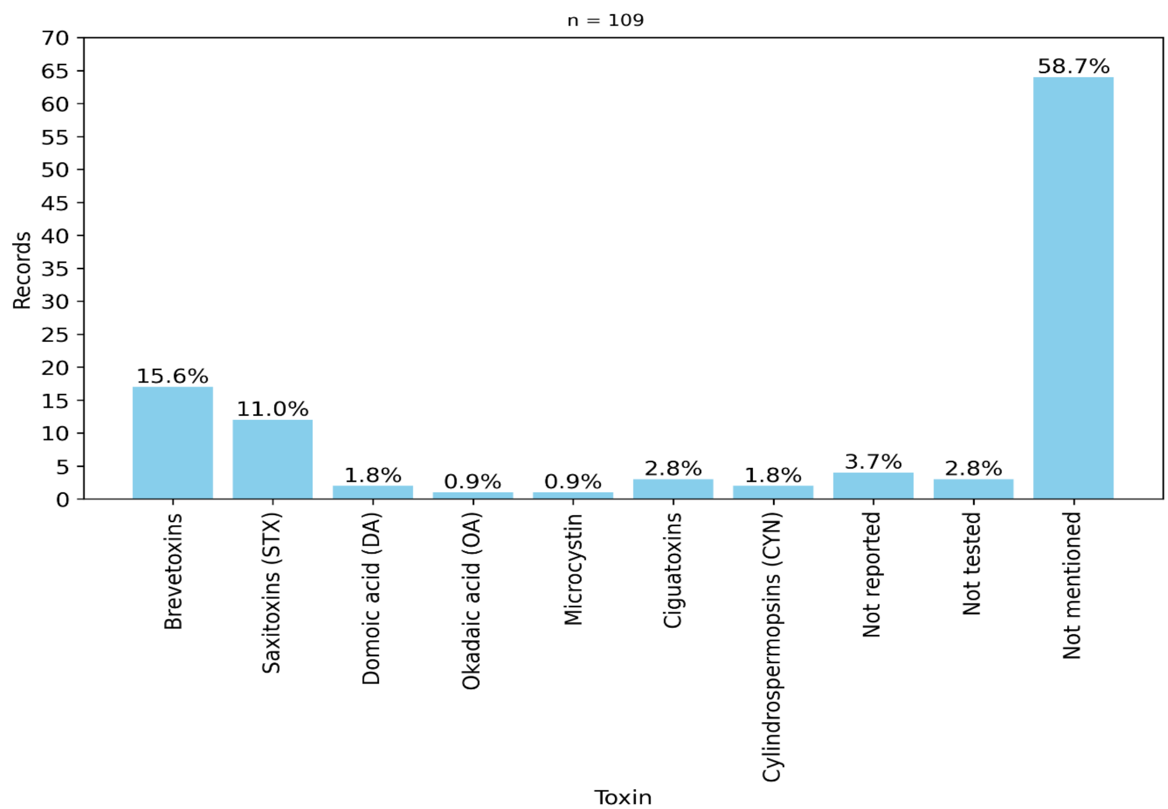


Figure 5-19 Distribution of known toxins found in the toxicity assays performed in the events of ANCA database

Of the events reported with an assay or toxin name associated, 64 events (58.7%) reported threshold values without referring specifically to the toxin involved, 17 assays (15.6%) reported the presence of Brevetoxins, and 12 events (11.0%) reported Saxitoxins. Other toxins had minor representation, including Ciguatoxins, Microcystin, Cylindrospermopsins, Okadaic acid and Domoic acid. Four events (3.7%) perform assays with no toxicity detected, and three (2.8%) do not perform tests although using the column (**Figure 5-19**). It is important to note that the **'toxin'** column has been not being utilized effectively, as it contains only seven values. Most researchers have opted to include the toxin name within the **'toxicityAssay'** column or other fields. This issue arises from the configuration of these columns as open text fields, making it highly challenging to track the information, as previously reported in D1. Something similar occurs with the column **'toxinType'**, which has been utilized only seven times, all of them reporting concentrations that don't belong to the intended purpose of the column. This leads to an important lack of information about the assays performed.

5.7.1. Brevetoxins

Figure 5-20 and **Figure 5-21** show the syndromes and the causative agents associated with the presence of Brevetoxins. Almost half of the cases were associated with Neurotoxic Shellfish Poisoning, and the other half with aerosolized toxin effects. On the other hand, all the cases were related to *Gymnodinium breve* (47.3%) and *Karenia brevis* (52.9%).

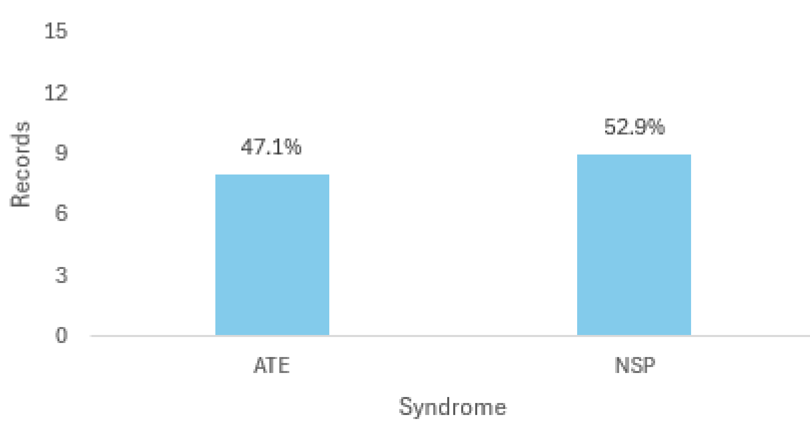


Figure 5-20 Syndromes associated with the presence of Brevetoxins in the ANCA database. NSP = Neurotoxic Shellfish Poisoning; ATE = Aerosolized toxin effects

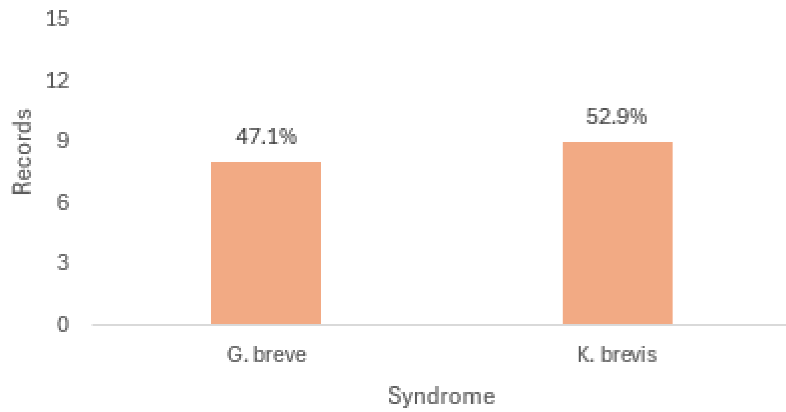


Figure 5-21 Main causative species associated with the presence of Brevetoxins in the ANCA database

5.7.2. Saxitoxins

Figure 5-22 and **Figure 5-23** show the syndromes and the causative agents associated with the presence of Saxitoxins. More than 80% of Saxitoxin events were associated with Paralytic Shellfish Poisoning, and the rest were associated with Cyanobacterial Toxin Effects (8.3%) and Other Effects (8.3%). On the other hand, three quarts of the cases were associated with the presence of *Pyrodinium bahamense*, while *Cylindrospermopsis* sp. and *Prorocentrum gracile* were associated with a few events.

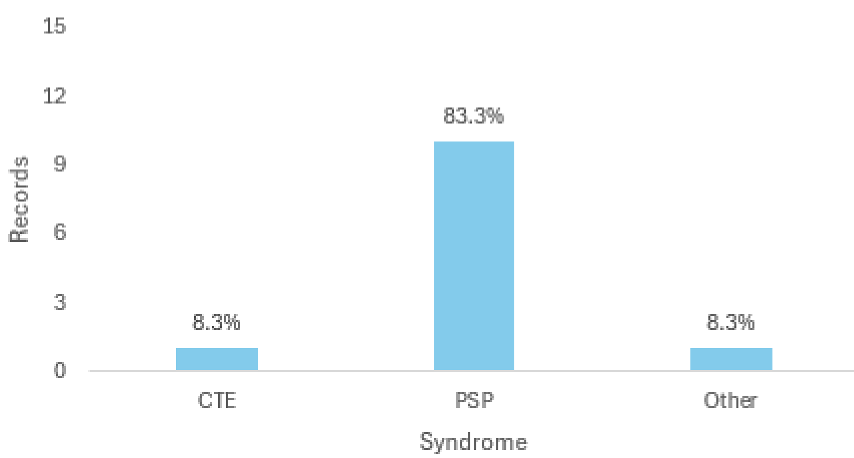


Figure 5-22 Syndromes associated with the presence of Saxitoxins in the ANCA database. PSP = Paralytic Shellfish Poisoning; CTE = Cyanobacterial toxin effects

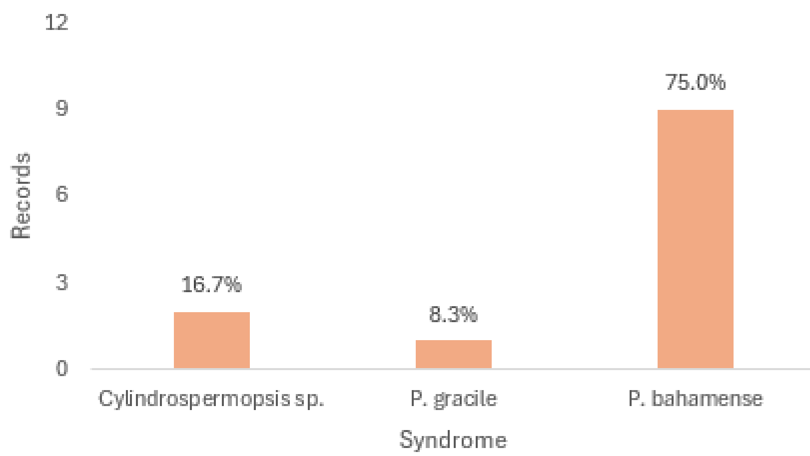


Figure 5-23 Main causative species associated with the presence of Saxitoxins in the ANCA database

5.7.3. Domoic acid

The two reported cases were both associated with Amnesic Shellfish Syndrome (ASP) and organisms of the genre *Pseudo-nitzschia* (no species level reported).

5.7.4. Okadaic acid

The only case was associated with Diarrheic Shellfish Poisoning (DSP) and the organism *Dinophysis ovum*.

5.7.5. Microcystin

The only case was associated with *Anabaena* sp., with no syndromes.

5.7.6. Ciguatoxins

The three cases were not linked to any organism. Although all Ciguatera reports could be associated with the generic name "Ciguatoxins", this section only considered the cases explicitly mentioned in the database.

5.7.7. Cylindrospermopsins

All cases were related to *Cylindrospermopsis* sp. One case was related to Paralytic Shellfish Poisoning and another with Cyanobacterial Toxin Effects.

6. CCA Database

6.1. State of updating

6.1.1. Last occurred event registered by country

The **Table 6-1** shows the ***most recent event reported*** in the CCA database. Countries with no data in the area appear in the last row of the tables. Events were sorted considering the date of occurrence of the event, not the date of entering the record in the database.

Table 6-1 Last records by country sorted by date of the event in the CCA database

Event Name	Country Name	Year	Event Date	Observations
CR-22-001	COSTA RICA	2022	20/05/2022	
SV-22-001	EL SALVADOR	2022	28/02/2022	
GT-19-001	GUATEMALA	2019	8/11/2019	
MX-23-004	MEXICO	2023	4/07/2023	Quarantine date.
NI-18-001	NICARAGUA	2018	10/01/2018	
PTY-17-001	PANAMA	2017	5/05/2017	
No Data	COLOMBIA***** HONDURAS	* The country has reported events in the ANCA database.		

All countries but two have reported events between 2017 and 2023, being Mexico the country with the most recent report and Panama the less recent. Colombia and Honduras don't have records in the CCA region (Pacific), although Colombia has abundant registers in the Caribbean region.

6.1.2. Last record entered by country

The **Table 6-2** shows the ***most recent record entered*** in the ANCA and CCA databases, respectively. Events were sorted considering the date of entering the record in the database, which does not necessarily coincide with the date of occurrence, as records can be entered to fill past gaps in the information. Countries without records were not included.

Table 6-2 Last records by country sorted by date of entering in the CCA database

Event Name	Country Name	Year	Datetime of creation (record)
CR-22-001	COSTA RICA	2022	21/06/2022 2:52
SV-22-001	EL SALVADOR	2022	20/06/2022 9:37
GT-19-001	GUATEMALA	2019	20/09/2022 4:45
MX-23-004	MEXICO	2023	11/12/2023 12:26

Event Name	Country Name	Year	Datetime of creation (record)
NI-18-001	NICARAGUA	2018	26/02/2018 10:18
PTY-17-001	PANAMA	2017	12/11/2018 4:06

6.1.3. Verified registers (column 'checked_at')

According to the values of the column **'checked_at'**, none of the records in the CCA database have been verified (**Figure 6-1**).

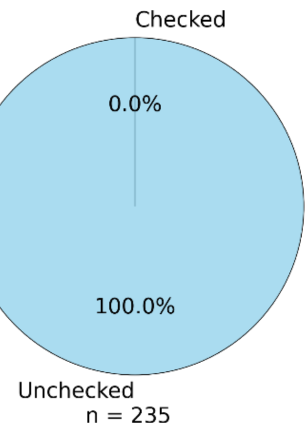


Figure 6-1 Percentage of verified records in the CCA database

6.2. Distribution of data

6.2.1. Records by country

The CCA database (once common data with ANCA were excluded) is composed of 235 records, accounting for 1.7% of the global records (**Figure 6-2**). Within CCA, Mexico accounts for 84% of the records, followed by El Salvador with approximately 7%. The remaining records come from Guatemala, Costa Rica, Nicaragua and Panama (**Figure 6-3**).

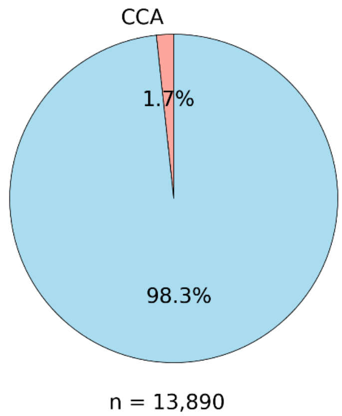


Figure 6-2 Proportion of CCA records within the global HAEDAT database

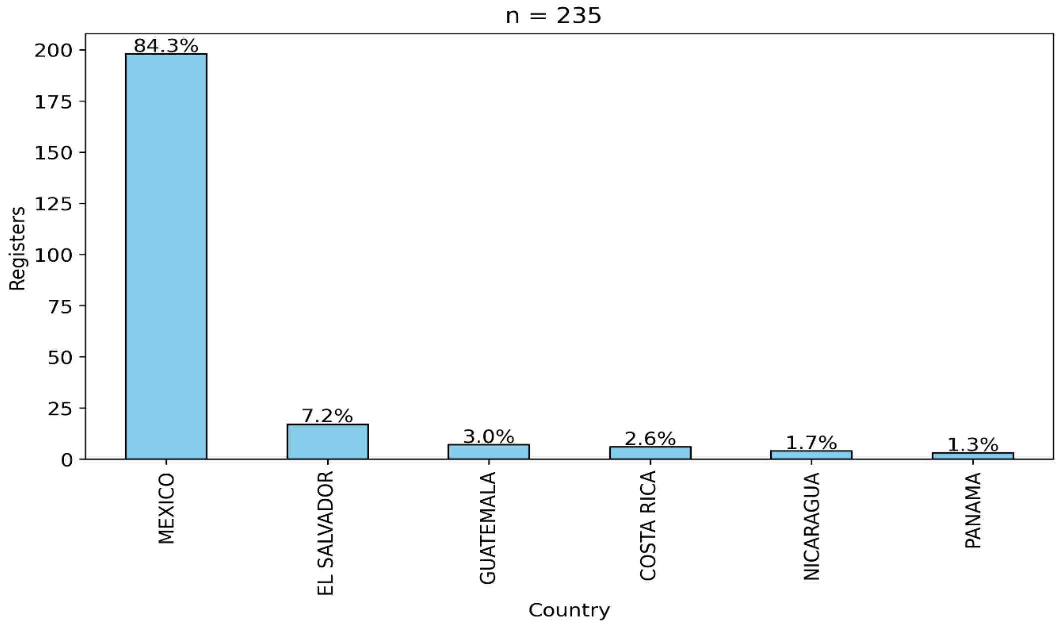


Figure 6-3 Number and percentage of records for each country in the CCA database

6.2.2. Historical trend

The database covers the period from 1979 to 2023, although most records are posterior to 2000. The number of records reached a maximum in 2012 (n = 36). In this database it was also observed that there was a marked fall in the number of registers around 2020 (n = 1). Historical trend is showed in **Figure 6-4**.

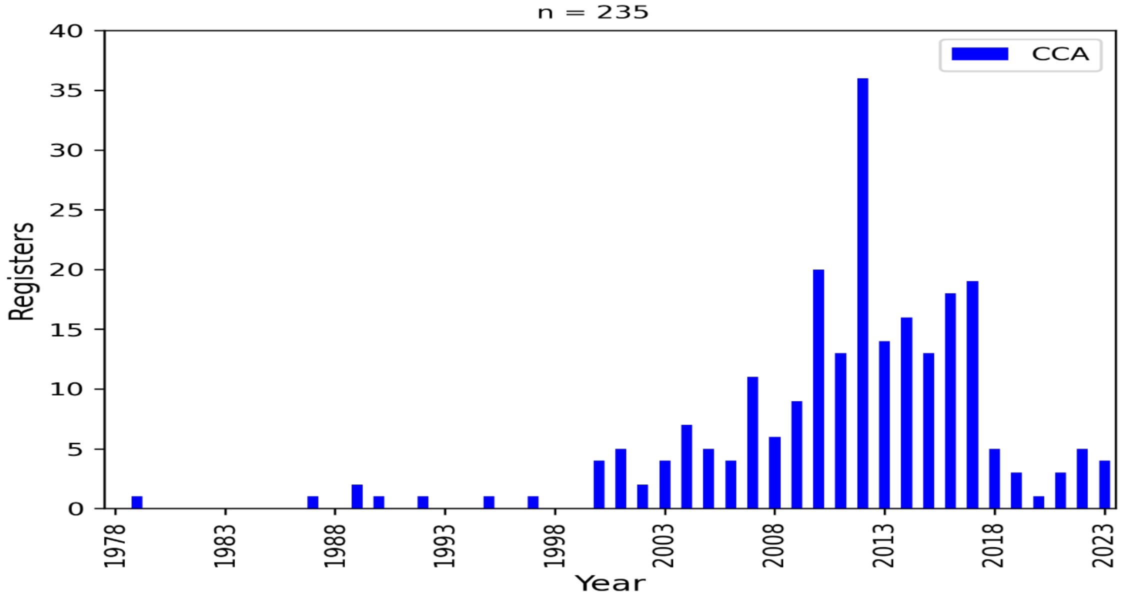


Figure 6-4 Historical trend in records in the CCA database

6.2.3. Georeferentiation

There were 70 out of 235 referenced records (29.8% of total), while the rest lacked georeferentiation (**Figure 6-5**). Seven (7) records have positions outside the geographic range of CCA (**Figure 6-6**); however, they correspond to records from Mexico, Nicaragua and Panama (¡Error! No se encuentra el origen de la referencia.). Therefore, they are likely due to data entry errors.

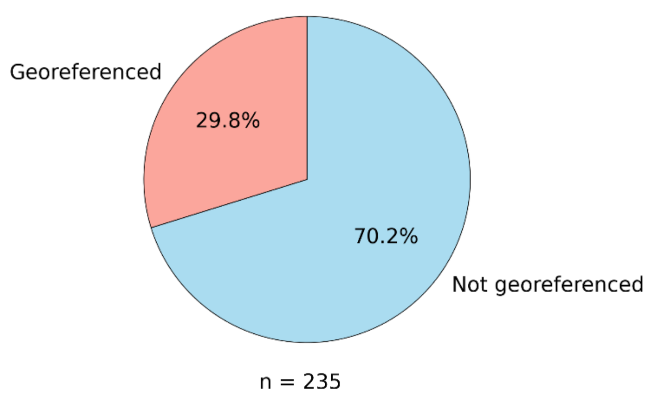


Figure 6-5 Percentage of georeferenced data in the CCA database

Figure 6-6 Location of georeferenced records in the CCA database

6.3. Nature of the events

6.3.1. Causative agent

In the CCA database, in 190 out of 235 events the causative agent was identified, while in 45 events the causative agent was unknown (**Figure 6-7**). A total of 51 species belonging to 27 genera were identified, but more than 60% of events had the presence of at least one of these six causative agents: *Gymnodinium catenatum, Margalefidinium polykrikoides, Myrionecta rubra, Pseudo-nitzschia* sp.*, Pyrodinium bahamense* var. *compressum* and *Pyrodinium bahamense* (**Table 6-3**). The total number of registers is 283, as more than one species can be present per event. The exhaustive table of species for CCA database is presented in **Annex 11**.

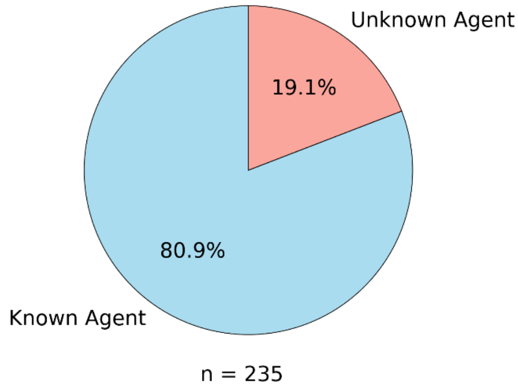


Figure 6-7 Proportion of records where the causative agent was identified in the CCA database

Table 6-3 Frequency of the main causative species in the CCA database

Causative Species Name	Presences	Percentage (%)	Accumulated percentage (%)
Gymnodinium catenatum	65	22.97%	22.97%
Margalefidinium polykrikoides	25	8.83%	31.80%
Myrionecta rubra	23	8.13%	39.93%
Pseudo-nitzschia sp.	20	7.07%	47.00%
Pyrodinium bahamense var. compressum	20	7.07%	54.07%
Pyrodinium bahamense	17	6.01%	60.08%
Dinophysis caudata	15	5.30%	65.38%
Dinophysis sp.	11	3.89%	69.27%
Cochlodinium polykrikoides	9	3.18%	72.45%
Alexandrium sp.	6	2.12%	74.57%
Other 41 species	72	25.43%	100.00%
Total	**283**	**100.00%**	**---**

6.3.2. Affectations generated by the events

According to data from CCA database, the two main reported affectations were affectations over planktonic organisms (67%) and natural fish populations (47%). Water discoloration only was present in 27% of the cases, while reported toxicity was present in 21%. Affectations on human beings were reported in 11% of the cases, being less than 1/3 of the percentage reported in ANCA. For an economic perspective, it highlights the affectations to shellfish cultures, present in 31% of events. Aquatic mammals account for affectations in 3% of cases, far less than their counterpart in the ANCA database. Less common are the affectations in birds (1%) and terrestrial animals (1%). A complete report of affectations is showed in **Figure 6-8**. The main causative species associated with each type of affectation is presented in **Annex 12**.

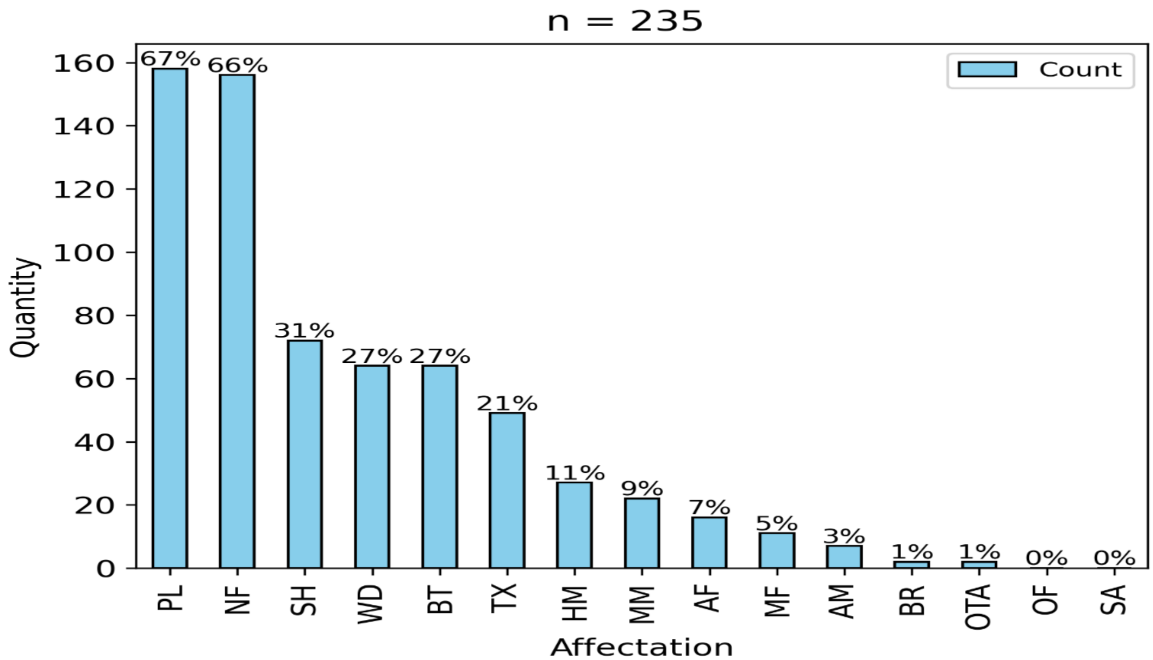


Figure 6-8 Quantity and percentage of affectations (compared with the total number of records) in the CCA database. Captions: PL = Planktonic Affected; NF = Natural Fish Affected; SH = Shellfish Affected; WD = Water discoloration; BT = Benthic Organisms Affected; TX = Toxicity; HM = Humans Affected; MM = Mass mortality; AF = Aquaculture Fish Affected; MF = Mucilage Formation; AM = Aquatic Mammals Affected; BR = Birds Affected; OTA = Other Terrestrial Animals Affected; OF = Other Fish Affected; SA = Seaweed Affected.

6.1. Health syndromes associated with the occurrence of events

In the CCA database, 217 out of 235 records (92.3%) are associated with at least one health syndrome (**Figure 6-9**). Paralytic Shellfish Poison (PSP) accounts for more than 50% of the reported cases, followed by other syndromes (24.9%) and Diarrhetic Shellfish Poisoning (DSP) (15.2%). The other tracked syndromes have minor representation. The incidence of each one of the syndromes is reported in Figure 6-10.

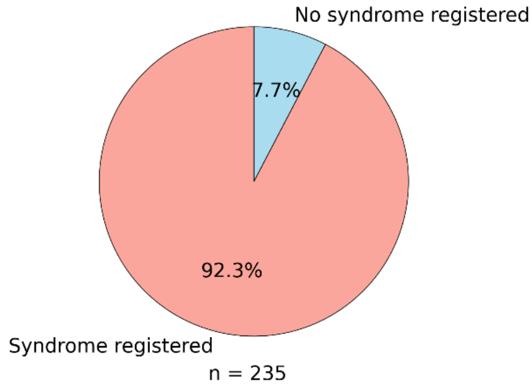


Figure 6-9 Incidence of seafood-induced health syndromes within the reported events in the CCA database

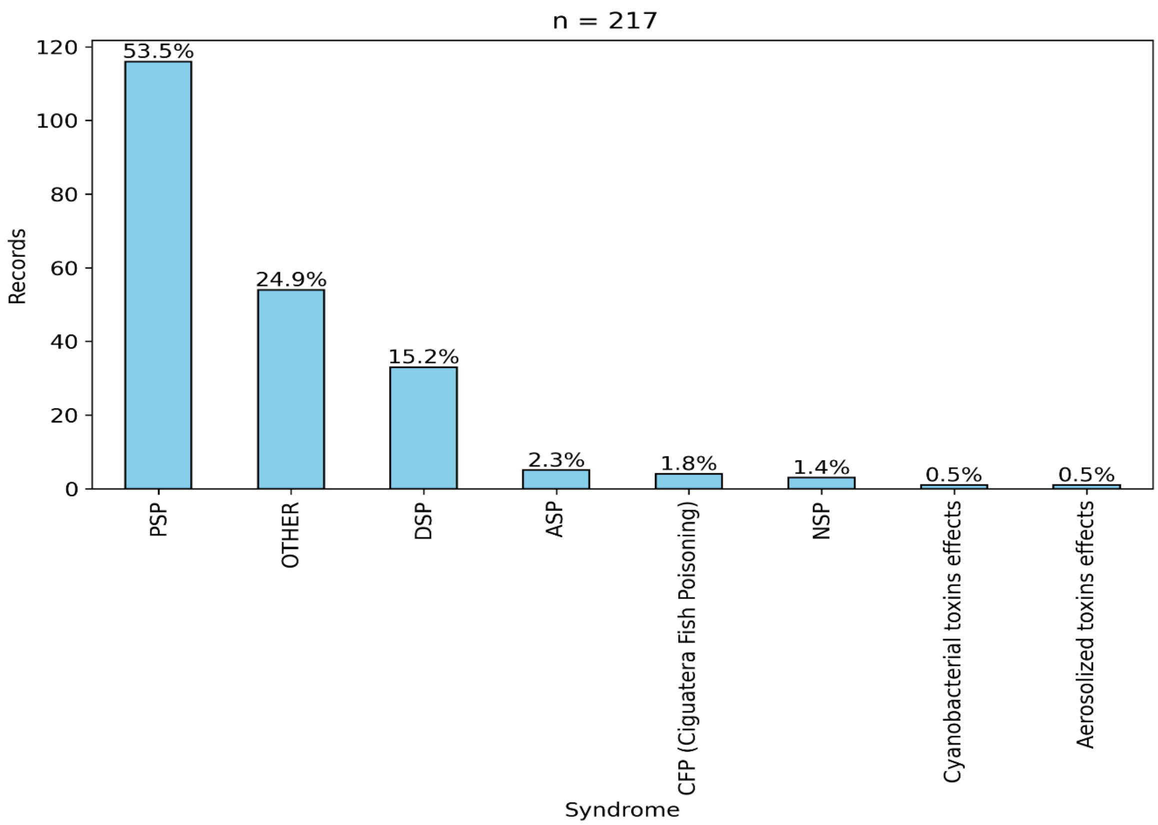


Figure 6-10 Incidence of each seafood-induced health syndrome within the reported events with syndrome presentation in the CCA database

Figure 6-11 shows the temporal distribution of the four main syndromes reported in the database: Paralytic Shellfish Poisoning (PSP), Diarrhetic Shellfish Poisoning (DSP), Amnesic Shellfish Poisoning (ASP) and other effects. It's noteworthy that, although other effects have the second highest frequency, the column **'syndromeText'** has never been utilized, so there is no detailed information about those. The epidemiology of the syndromes in the CCA region notably differs from its counterpart in the Caribbean Sea, characterized by a grater incidence of PSP and the almost total absence of aerosolized effects, NSP and Ciguatera. The distribution of the data fits with the distribution of information in the database presented in D1, with a peak of incidence around the years 2008 – 2013.

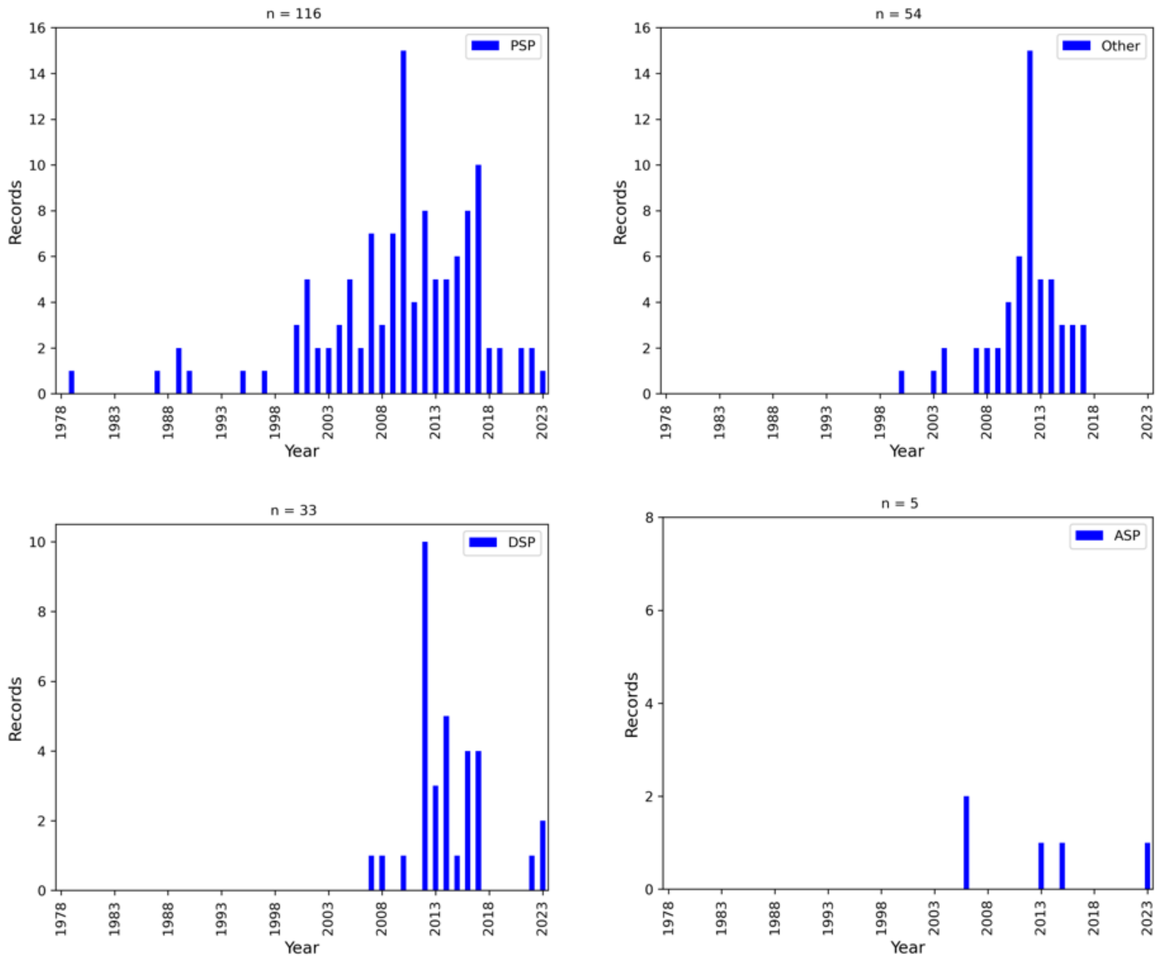


Figure 6-11 Temporal distribution of most reported events associated with HABs in the CCA database. Paralytic Shellfish Poisoning (upper left), other effects (upper right), Diarrhetic Shellfish Poisoning (bottom left) and Amnesic Shellfish Poisoning (bottom right)

6.2. Organisms associated with each syndrome

This section explores the causative species that were associated with events where health syndromes were registered. In the following graphics, the number of organisms could be greater than the number of events, as more than one organism can be present in the same event.

6.2.1. Paralytic Shellfish Poisoning (PSP)

A significative percentage of the events associated with this syndrome were characterized by presenting more than one causative agent, *Gymnodinium catenatum* being the most important of them (38.2% of the cases), followed by *Pyrodinium bahamense* var. *compressum* (11.7%), *Pyrodinium bahamense* (7.6%), and *Pseudo-nitzschia* sp. (6.9%) (**Figure 6-12**).

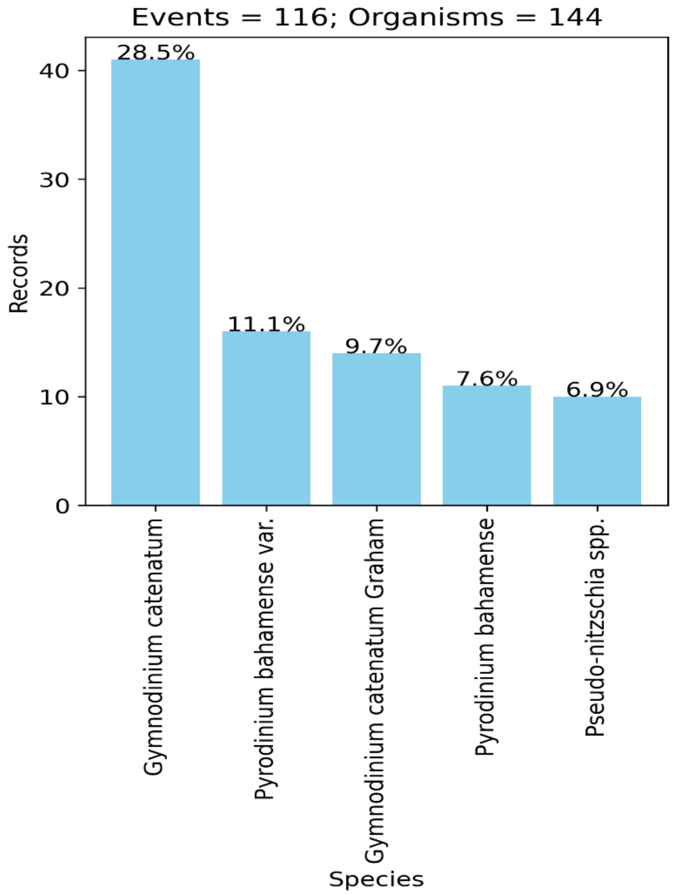


Figure 6-12 Four main causative species associated with Paralytic Shellfish Poisoning (PSP) in the CCA database. Duplicity in *Gymnodinium catenatum* due to different denomination styles in the database.

6.2.2. Diarrheic Shellfish Poisoning (DSP)

This syndrome was associated with a great number of organisms with relatively low incidence each one. The most representative was *Dinophysis caudata* (18.2%), followed by *Myrionecta rubra*, *Dinophysis* sp., *Gonyaulax polyedra* and *Gymnodinium catenatum* (9.1% each one) (**Figure 6-13**).

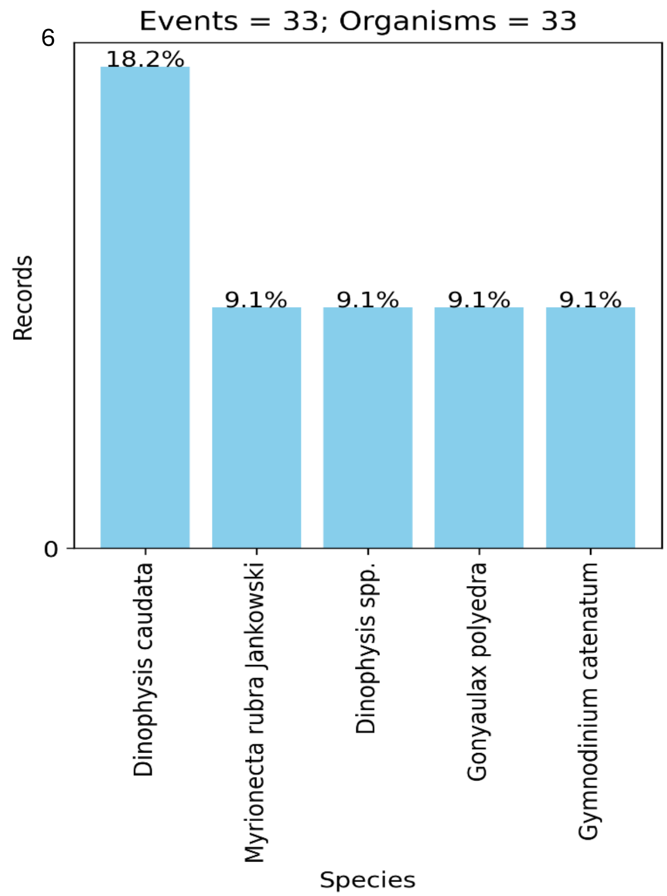


Figure 6-13 Five main causative species associated with Diarrheic Shellfish Poisoning (DSP) in the CCA database

6.2.3. Ciguatera Fish Poisoning (CFP)

Only four events were associated with an organism, including *Gambierdiscus toxicus* (60% of the cases), *Ceratium* sp. and *Ostreopsis siamensis* (20% each one).

6.2.4. Neurotoxic Shellfish Poisoning (NSP)

Only three events were associated with an organism, including *Pseudo-nitzschia* sp. (60% of the cases), *Dinophysis* sp. and *Margalefidinium polykrikoides* (20% each one).

6.2.5. Amnesic Shellfish Poisoning (ASP)

Most of the events were associated with the genre *Pseudo-nitzschia* (*P. pungens and P. seriata*), with participation of *Pyrodinium bahamense* (**Figure 6-14**).

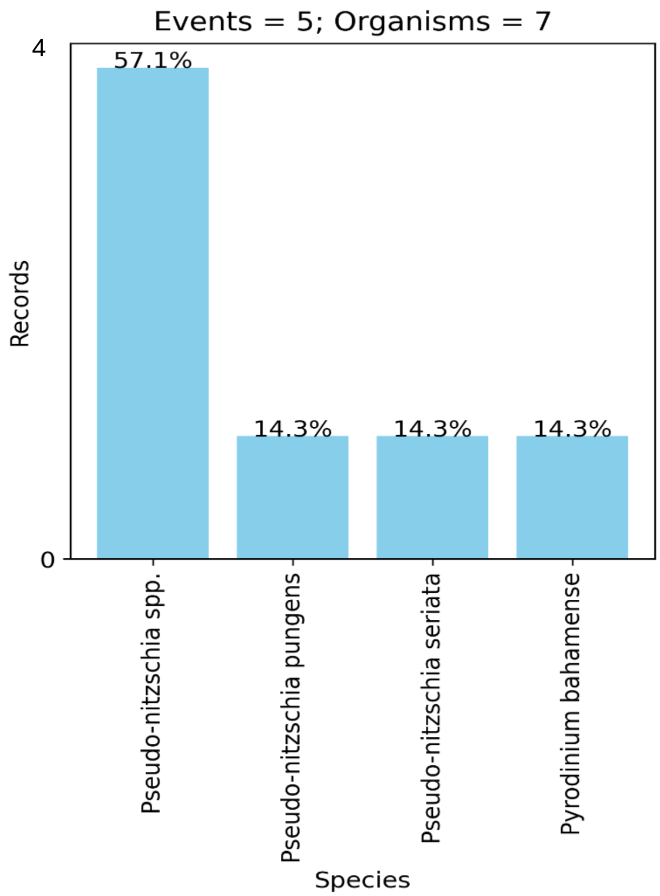


Figure 6-14 Main causative species associated with Amnesic Shellfish Poisoning (ASP) in the CCA database

6.2.6. Cyanobacterial toxin effects

The only case reported in the database was associated with *Lyngbya majuscula*.

6.2.7. Aerosolized toxin effects

The only case reported in the database was associated with *Pyrodinium bahamense* var. *compressum.*

6.2.8. Other effects

In this case, there was a slight dominance of *Myrionecta rubra* (26.2% of the cases) and *Margalefidinium polykrikoides* (21.5%), followed by *Gymnodinium catenatum* (7.7%), *Cochlodinium polykrikoides* and *Noctiluca scintillans* (4.6% each one) (**Figure 6-15**).

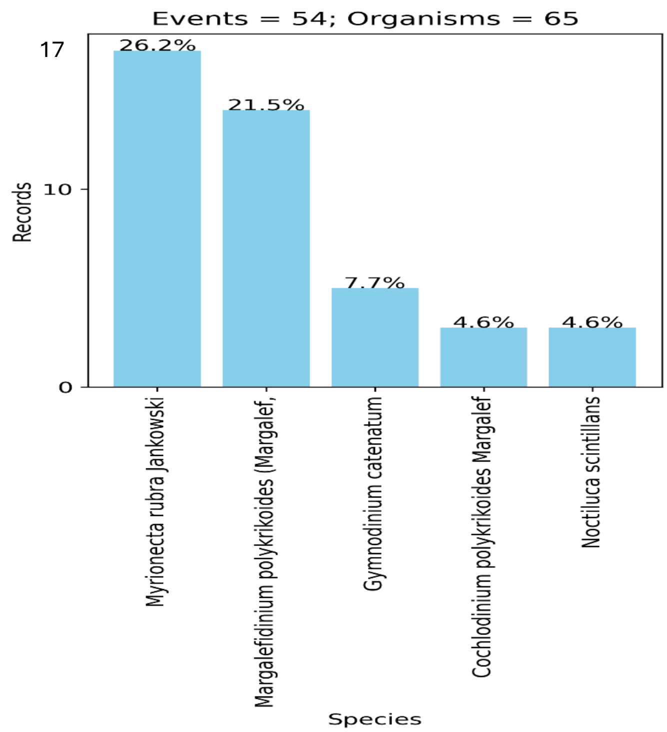


Figure 6-15 Five main causative species associated with Other Effects in the CCA database

6.3. Toxicity assays

The **Figure 6-16** shows the percentage of events where at least one toxicity assay was performed, considering the total number of events and the events where health syndromes were reported. Thirty-two events (13.6%) contain information about toxicity assays, all of them referring to syndromes (14.7%).

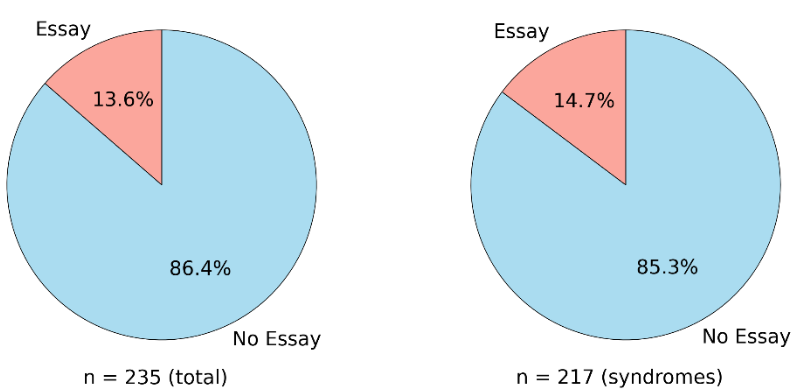


Figure 6-16 Percentage of events where toxicity assays were performed, from total of events (left) and from events with a syndrome registered (right) in the CCA database

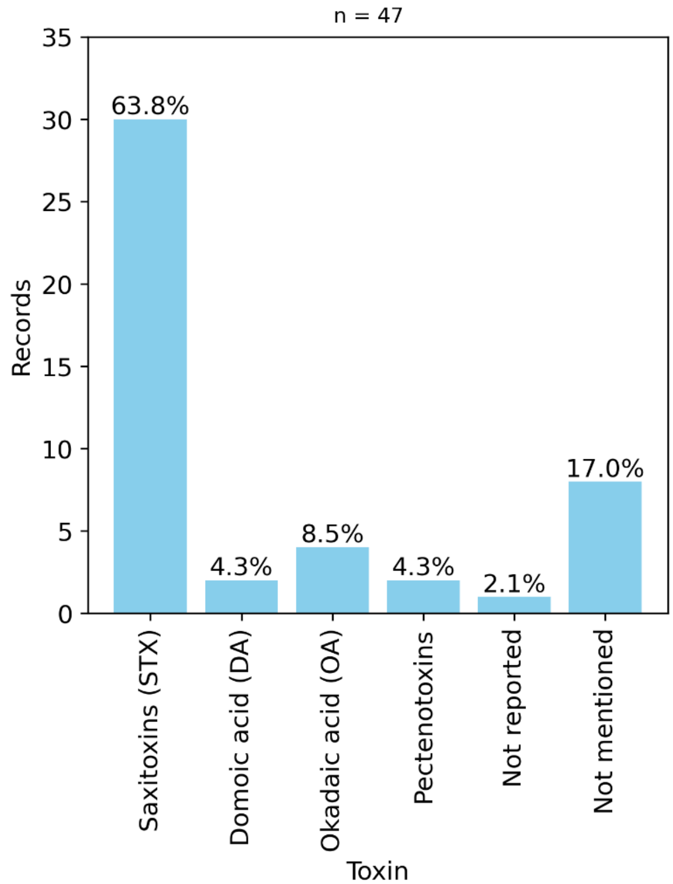


Figure 6-17 Distribution of known toxins found in the toxicity assays performed in the events of CCA database

Of the events reported with an assay or toxin name associated, 30 events (63.8%) reported the presence of Saxitoxins, and 8 events (17.0%) reported threshold values without referring specifically to the toxin involved. Other toxins with minor representation were Pectenotoxins, Okadaic acid and Domoic acid. One event (2.1%) performed assays with no toxicity detected (**Figure 6-17**). In this case, 27 out of 38 events with a toxin mentioned were adequately reported under the **'toxin'** column, which reveals a better utilization of the field, although with some missing values. Even so, configuring **'toxicityAssay'** as an open column leads to information duplication and makes it difficult to extract quantities, as reported in D1.

6.3.1. Saxitoxins

Figure 6-18 and **Figure 6-19** show the syndromes and the causative agents associated with the presence of Saxitoxins. Almost the totality of Saxitoxins were associated with Paralytic Shellfish Poisoning, with only one case where aerosolized effects were detected. On the other hand, almost half of the cases were associated with the presence of *Gymnodinium catenatum* (43.3%), followed by *Pyrodinium bahamense* (23.3%) and *Pyrodinium bahamense var. compressum* (16.7%). *Alexandrium affine* and *Myrionecta rubra* had a minor representation, and two cases (6.7%) were not associated with any organism.

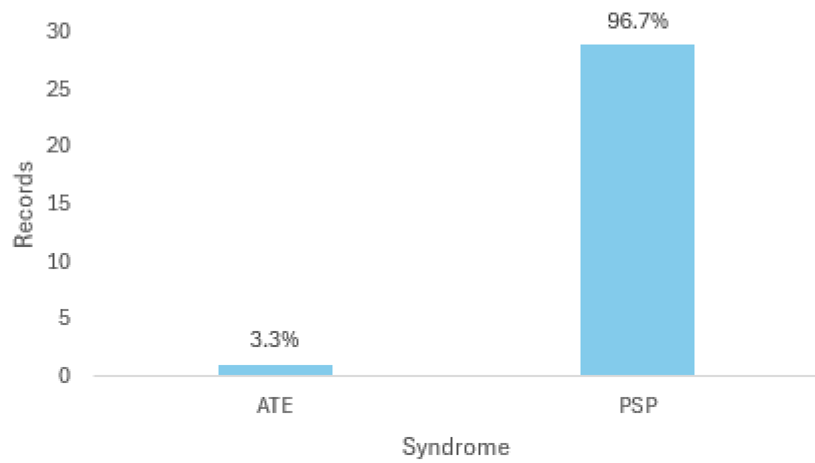


Figure 6-18 Syndromes associated with the presence of Saxitoxins in the CCA database. PSP = Paralytic Shellfish Poisoning; ATE = Aerosolized toxin effects

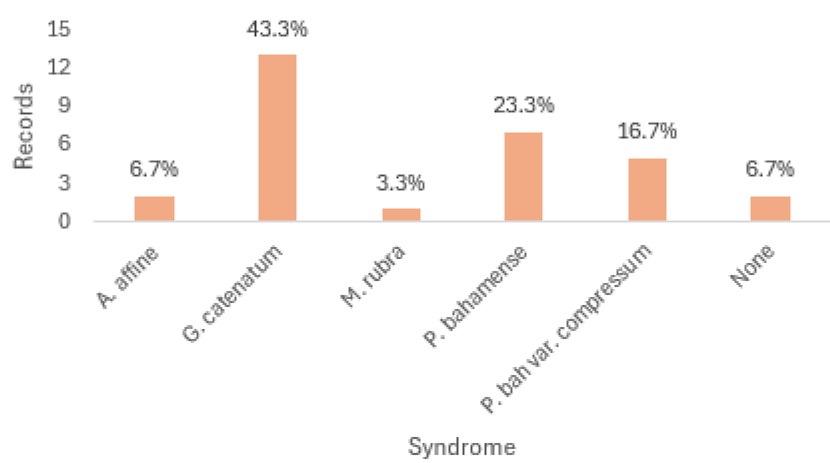


Figure 6-19 Main causative species associated with the presence of Saxitoxins in the CCA database

6.3.2. Domoic acid

Of the two cases reported, one of them was associated with Diarrhetic Shellfish Poisoning (DSP) and another with Amnesic Shellfish Poisoning (ASP). One of the cases was linked to the organism *Dinophysis fortii*.

6.3.3. Okadaic acid

All four cases reported were associated with Diarrhetic Shellfish Poisoning (DSP). Two of the cases were linked to *Dinophysis caudata* and one to *Dinophysis fortii*.

6.3.4. Pectenotoxins

Of the two cases reported, one of them was associated with Diarrhetic Shellfish Poisoning (DSP) and another with Paralytic Shellfish Poisoning (PSP). No organisms were associated.

7. Meeting with IOCARIBE Member State Representatives

7.1. Executive summary

On March 17th, 2025, a meeting of the IOCARIBE Member State Representatives was held via Zoom to present the preliminary findings of the present contract and discuss the state of art and improvement initiatives of the HAB reporting in the HAEDAT platform. The participants addressed technical challenges, proposed improvements, and explored opportunities for regional collaboration. Particular attention was given to strengthening links between scientific, health, and tourism sectors, and to integrating the regional observatory initiative led by Chile.

7.2. Attendants

The list of Member State representatives attending the meeting is presented in the **Table 7-1**.

Table 7-1 Member State representatives attending the meeting of March 17th, 2025

Name	Job title	Institution
Karla Evelyn Paz Cordón	Professor / Researcher	Centro de Estudios del Mar y Acuicultura CEMA USAC
Alex Palomino Cadena	Data and website management IOCARIBE	IOCARIBE
Julian Franco Angulo	Researcher	INVEMAR
Marck Oduber	SC Liaison	NC UNESCO Aruba
Julio Morell	Director	CARIBBEAN COASTAL OCEAN OBSERVING SYSTEM INC.
Loraine Martell-Bonet	Associated scientist	CARICOOS
Aleisha Dennie	Environmental Quality Program Laboratory Technician	Institute of Marine Affairs
Kathia Broce	Researcher	Universidad Tecnológica de Panamá
Rosalba Alonso Rodríguez	Main Researcher	Universidad Nacional Autonoma de Mexico
Fiorella Vásquez Fallas	Researcher	Universidad de Costa Rica
Zoraida Altagracia Zapata Lantigua	VRCM Project Representant in Dominican Republic 30 x 30	Ministerio de Medio Ambiente
Daniel Felipe Bernal Glen	Individual Consultant	UNESCO
José Ernesto Mancera	Full Professor	Universidad Nacional de Colombia
Angélica Toro		
Óscar		

Name	Job title	Institution
Lorna Inniss	Head	IOC-UNESCO Regional Secretariat for IOCARIBE
Juan		IOCARIBE
Lorelys Valerio		
Carlos Seixas		
Silvia García	Interpreter	
Vivien Campo	Interpreter	

7.3. Overview of HAEDAT Database

Mr. Daniel Felipe Bernal, biological engineer and individual consultant of the present contract, presented the main findings on the HAEDAT database developed during Deliverables 1 and 2, focusing on the following key issues:

- Data Quality and Structure: The database suffers from non-standardized fields and lack of metadata.
- Underrepresentation: These regions account for less than 5% of total records in the global HAEDAT database.
- Low Verification Rates: Only 3.3% of ANCA records have been verified (all from the United States), with no verified records in CSA.
- Outdated Submissions: Several countries have not updated their data in the last years.
- A comparative analysis for Ciguatera between the ANCA region in HAEDAT database, and the “Centro de Epidemiología del Caribe” (CAREC) database, highlighted a major gap in data gathering. While CAREC reported a mean of 400–700 annual cases of Ciguatera during its activity time, ANCA recorded only 4–6 cases per year for the same period. This discrepancy suggests the need to develop stronger linkages between marine management databases and health surveillance systems.

7.4. Challenges in HAB event reporting

Representatives from Trinidad and Tobago, Panama, Costa Rica, Colombia, Guatemala, El Salvador, Puerto Rico, Venezuela, Aruba, and Mexico shared experiences regarding the use of the ANCA platform. Common challenges included:

- Difficulty navigating the platform interface.

- Lack of standardized reporting protocols (for example, is it appropriate to report an event with no affectations?).
- Limited data-sharing agreements between public health systems and marine monitoring agencies.
- Bureaucratic barriers to publicizing HAB data.
- Some participants manifested interest in whether it is appropriate to include sargassum strandings in the HAEDAT database, though not currently intended for.

7.5. Regional integration and observatory coordination

Mr. Jose Mancera led a strategic discussion on the need to enhance HAEDAT functionality. Mr. Carlos proposed establishing a regional HAB observatory to select, classify and standardize the reports to HAEDAT. In response, Ms. Rosalba shared that an existing initiative led by Mr. Daniel Carrasco in Chile is already underway, involving 18 countries. It was agreed to pursue collaboration with this initiative to:

- Strengthen integration among national and regional databases.
- Expand participation across the region.
- Align efforts under a common framework for HAB data reporting.

7.6. Cross-Sector communication and outreach

Participants emphasized the importance of fostering collaboration across academic, health, and tourism sectors. Notable examples include:

Mexico: Successful coordination with the health sector, as described by Ms. Rosalba. The process included a strategy to improve communication between information generators and personnel in charge of updating the platforms.

Panama: An academic-led strategy (the FAN-PANAMA Group) to articulate cooperation between institutions and maintain continuity over time amid political instability, presented by Mr. Carlos. The group includes cooperation with students through environmental education about HABs.

Mr. Jose proposed the need to promote communication efforts through the HAB Newsletter to increase regional visibility.

7.7. Agreed next steps

The agreements and compromises of the meeting are presented in **Table 7-2**.

Table 7-2 Agreements of the meeting

Responsible Party	Action Item
Jose	- Contact Daniel Carrasco to explore integration of Chile's algal bloom observatory with HAEDAT.
Rosalba	- Share Mr. Carrasco's contact details to facilitate coordination.
Jose and IOCARIBE	- Schedule a technical meeting with Henrik to address improvements to HAEDAT.
All Member Countries	- Update and upload the most recent HAB data to HAEDAT. - Develop a standardized manual for HAEDAT data entry (***a proposal of a manual for navigating the platform interface is presented in this Deliverable as a first step towards this objective***). - Establish communication channels with health and tourism sectors to enhance information exchange. - Contribute news and updates to the HAB Newsletter to raise awareness. - Launch a regional data upload campaign, modeled on Mexico's initiative.

7.8. Conclusions

The meeting highlighted the urgent need to improve data quality, standardization, and accessibility within the HAEDAT platform. Strengthening ties between marine, health, and tourism sectors, as well as integrating regional observatory efforts, will be crucial to addressing the increasing frequency and impact of harmful algal blooms.

8. Conclusions

8.1. Data storage and database functioning

- There are significative issues in the functioning of the HAEDAT database, including non-standardized fields, translocations in the storage of information (particularly in Section 5: Toxicity Assays) and data unavailable to download (including all Section 4: Environmental information).

8.2. Participation of countries and gaps in information

- Only 9 out of 28 countries belonging to ANCA, and 6 out of 8 countries of CCA, have reported records in the database. Among the countries without entries the main group is the Antilles, and it is noticeable the lack of registers of United Kingdom, France and Netherlands, countries with wide participation in other geographical regions, but not in their territories in the Caribbean zone.
- There is an important gap in georeferenced information, as only 28.0% of ANCA records and 29.8% of CCA records are georeferenced. The polygons defined by some of the countries for helping georeferentiation (additional to latitude and longitude) are not working properly, partly due to an insufficient number of them, and partly due to database functioning.
- There is a lack of representativity of the region compared to their counterparts in other regions of the world, as combined registers of CCA and ANCA account for less than 5% of global registers.
- A significative percentage of countries have not uploaded data in recent years. The call to update the database made during the present contract generated very few new information.
- Only 3.3% of records in ANCA and no registers in CCA have been reviewed and verified. Only the United States are using this tool in the platform, although with a very limited reach.

8.3. Event prevalence and distribution

- Health syndromes constitute a significative part of the events in ANCA (64.8%) and CCA (93.8%) databases, but the geographical distribution is uneven. While in ANCA the main syndromes are NSP, aerosolized toxins, PSP and Ciguatera; in CCA the PSP, DSP and Other have the major representation.
- Saxitoxins are widely distributed both in ANCA and CCA regions, while Brevetoxins and Ciguatoxins are prevalent only in the Caribbean region. Nevertheless, a significative percentage of assays don't mention the toxins involved, in part due to the confusing implementation of this section of the form.
- The causative organisms are well characterized, as more than 80% of records in both databases have their causative organisms identified. The main causative organisms were *Karenia brevis*, *Gymnodinium breve*, *Pyrodinium bahamense*, *Anabaena* sp. and *Prorocentrum minimum* in the ANCA region, and *Gymnodinium catenatum*, *Margalefidinium polykrikoides*, *Myrionecta rubra*, *Pseudo-nitzschia* sp. and *Pyrodinium bahamense* var. *compressum* in the CCA region. These organisms were responsible for more than 50% of reported events.

8.4. Cross-Sector communication and outreach

- The comparison with the CAREC database and the interventions of Member State Representatives revealed the need to strengthen cooperation with other information-generating and information-gathering institutions, especially in the health and tourism sectors. Although significant efforts are still required to develop a comprehensive strategy in the regional level, there are successful initiatives in some of the member states, such as Mexico or Panama.

9. Glossary

Aerosolized toxin effects: In humans, inhalation of aerosolized toxins reportedly results in conjunctival irritation, copious catarrhal exudates, rhinorrhea, nonproductive cough, and wheezing. The normal population can reportedly rapidly reverse the irritation and wheezing by leaving the beach area or entering an air-conditioned area; however, people with asthma apparently are particularly susceptible (Fleming et al., 2005).

Amnesic Shellfish Poisoning (ASP): Intoxication produced by the biotoxin Domoic Acid. Symptoms include vomiting, nausea, diarrhea, abdominal cramps, headache, dizziness, confusion, disorientation, short-term memory loss, and motor weakness (WSDH, 2025a).

Category: Type of data that has categories and an ordered property, which list their possible values and whether the ordering matters or not.

Ciguatera Fish Poisoning (CSP): Ciguatera is a food-borne illness caused by eating reef fish contaminated with a toxin called "ciguatoxin". Ciguatoxin is tasteless and odorless. Fish contaminated with ciguatoxin cannot be identified by appearance. It is characterized by neurological symptoms including tingling and numbness, sore muscles and tooth pain, temperature reversal (hot things feel cold and cold things feel hot) and feeling of exhaustion (Traylor et al., 2025).

Column: In a relational database, a column is a set of data values of a particular type. A column may contain text values, numbers, or any other type of data.

Cyanobacterial toxin effects: Category generally utilized to describe the effects of direct contact with toxins in the water. Adverse health effects may range from a mild skin rash to serious illness or in rare circumstances, death. Acute illnesses caused by short-term exposure to cyanobacteria and cyanotoxins during recreational activities include hay fever-like symptoms, skin rashes, and respiratory and gastrointestinal distress. Common toxins include Microcystin and Cylindrospermopsin (EPA, 2025).

Diarrheic Shellfish Poisoning: Illness with gastrointestinal symptoms, predominantly nausea, vomiting, abdominal cramping, and diarrhea (WSDH, 2025b).

Float: Type of data containing decimal (non-integer) numbers.

Int: Integer. Type of data containing integer numbers.

Neurotoxic Shellfish Poisoning (NSP): Disease caused by the consumption of molluscan shellfish contaminated with brevetoxins; these are a group of more than ten natural neurotoxins produced by the marine dinoflagellate, *Karenia brevis* (formerly known as *Gymnodinium breve* and *Ptychodiscus brevis*) (Watkins et al., 2008).

Paralytic Shellfish Poisoning (PSP): Paralytic shellfish poisoning (PSP) is a serious illness caused by eating shellfish contaminated with algae that contains Paralytic Shellfish Toxin (PST), a toxin harmful to humans. Symptoms include tingling, numbness, dizziness, and paralysis. In severe cases, PSP can be fatal (WSDH, 2025c).

Record: In a relational database, a record, or row, represents a set of data corresponding to a data entry.

Str: String. Type of data characterized by alphanumerical symbols (letters, numbers, special characters).

Toxin (biological definition): Poisonous substance produced within living cells or organisms. Toxins can be small molecules, peptides, or proteins capable of interfering with metabolic processes or trigger an immune response (PK Gupta, 2018).

10. Bibliography

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11. Annexes

Annex 1 Presentation to the Member State representatives of ANCA – IOCARIBE working group on March 17th, 2025 (cover slide)

Annex 2 Proposal for a metadata file for the HAEDAT database (screenshot)

HAEDAT Database README

Presentation

The Harmful Algal Event Database (HAEDAT) is a component of the Harmful Algal Information system (HAIS) within the "International Oceanographic Data and Information Exchange" (IODE) of the "Intergovernmental Oceanographic Commission" (IOC) of UNESCO, and in cooperation with ICES, and PICES.

The HAEDAT is a meta database containing records of harmful algal events. HAEDAT contains records from the ICES area (North Atlantic) since 1985, and from the PICES area (North Pacific) since 2000. IOC Regional networks in South America, South Pacific and Asia, and North Africa are preparing to contribute. Guidance on submission of data and questions re HAEDAT can be found here.

HAEDAT Disclaimer: The HAEDAT database contains information based on yearly national reports by ICES and PICES member states. The available information on individual events varies greatly from event to event or country to country. Monitoring intensity, number of monitoring stations, number of samplings, stations, etc. also varies greatly and therefore there is not a direct proportionality between recorded events and actual occurrences of e.g. toxicity in each region. Furthermore, areas with numerous recorded occurrences of HAE's, but with efficient monitoring and management programs, may have very few problems and a low risk of intoxication, whereas rare HAE's in other areas may cause severe problems and represent significant health risks.

Version: 1.0
File's author: Daniel Bernal-Glen / Email: dfbernal@unal.edu.co

Detailed composition of the HAEDAT database

Column Name	Description	Data Type
'eventName'	Unique code to identify the event.	str
'eventYear'	Year of the event.	int
'region'	Name of the region or locality where the event occurred.	str
'originalGridCode'	Geographical polygon where the event took place.	int
'monitoringProgramme'	Detected as part of a monitoring program (1:True/0:False).	Binary
'programmeName'	Name of the monitoring program.	str
'occurredBefore'	If the event was reported before.	Binary
'occurredBeforeText'	Description of the previous event.	str
'waterDiscoloration'	Water discoloration occurred (1:True/0:False).	Binary
'highPhyto'	High phytoplankton abundance (1:True/0:False).	Binary
'seafoodToxin'	Toxins were detected (1:True/0:False).	Binary
'massMortal'	Mass mortalities detected (1:True/0:False).	Binary
'foamMucil'	Presence of mucus/mucilage in water (1:True/0:False).	Binary
'otherEffect'	Other non-listed effects occurred (1:True/0:False).	Binary
'otherEffectText'	Description of 'otherEffect'.	str
'days'	Duration in days.	int
'months'	Duration in months.	int

Annex 3 Practical guide for the final users of the database in the ANCA – IOCARIBE region (cover page).

INDIVIDUAL CONSULTING REPORT

UPDATE THE IOC-UNESCO ANCA-HAEDAT PLATFORM

Deliverable 3.3 – User Guide

Presented to:
HAB-ANCA | IOCARIBE
International Oceanographic Comission
United Nations Educational, Scientific And Cultural Organization (UNESCO)

Consultant:
DANIEL FELIPE BERNAL GLEN

Contract N°:
4500528664

Submission Date:
March 27th, 2025

Medellín, Colombia

Annex 4 Email sent to Member State representatives responsible for updating the database in each of the IOCARIBE member countries

Actualizaciòn ANCA-HAEDAT /HAEDAT-ANCA update Externo Recibidos ×

Jose Ernesto Mancera Pineda

jue, 20 feb, 19:52 (hace 3 días)

para lorelysvalerio, soraya.j.silva, rosalba, kathia.broce, Carlos, azra.blythemallett, kevelynpaz, cesiah.quintanilla, ddellunde22, rubyts2016, mvmontero, julian.franco, Gustavo, Lorna, Alex, Bianis, Henrik, DANIEL

Estimados colegas

En el 2021 cuando desarrollamos un curso virtual de entrenamiento en HAEDAT, ustedes fueron nominaron como editores por sus piases.
En el momento estamos revisando la actualizaciòn de eventos HAB en nuestra regiòn en los ùltimos años y encontramos muy pocos registros recientes.

Adjunto la información encontrada en el sistema HAEDAT en los últimos años.

Les agradezco informen si no ha habido eventos HAB en sus respectivos paises, ò si no han podido subir registros. Esto con el fin de establecer el nivel de actualizaciòn del sistema HAEDAT para la regiòn IOCARIBE.

Atento saludo

Dear colleagues

In 2021 when we developed a virtual training course in HAEDAT, you were nominated as editors by your countries.
At the moment we are reviewing the update of HAB events in our region in recent years and we found very few recent records.

Attached is the information found in the HAEDAT system in recent years.

I would appreciate it if you could inform me if there have been no HAB events in your respective countries, or if you have not been able to upload records. This is in order to establish the update level of the HAEDAT system for the IOCARIBE region.

Kind regards

--

Josè Ernesto Mancera Pineda, PhD
Profesor Titular
Departamento de Biología
Facultad de Ciencias - Sede Bogotá
Universidad Nacional de Colombia

Mangrove Macrobenthos Management Conference - MMM6
Chair
mmm6.co

Annex 5 Detailed composition of the HAEDAT database with descriptions, data types, recommendations and number of missing data by column

Column Name	Description	Data Type	Number of NANs		Observations / Recommendations
			ANCA	CCA	
'eventName'	Unique code to identify the event.	str	0	0	---
'eventYear'	Year of the event.	int	0	0	---
'region'	Name of the region where the event occurred.	str	46	9	Being a column with open text reduces its usefulness. A column with predefined options could be preferable to better define the geographical location (at the national level or within ANCA), while an open **'locationText'** column could be used for specific information such as the name of the municipality, the water body, etc.
'originalGridCode'	Geographical polygon where the event took place.	int	235	235	There is a lack of information in the number and definition of the polygons, as they do not cover the entire geographical area where events could potentially occur.
'monitoringProgramme'	If the event was detected as part of a stablished monitoring program.	category	0	0	---
'programmeName'	If 'monitoringProgramme' is True, name of the program.	str	199	53	---
'occurredBefore'	If the event was reported before.	category	49	32	A third column (e.g. **'eventNameBefore'**) could be included to make a cross reference with the column **'eventName'**, allowing to visualize if the previous event was reported in the database, and make chains with recurrent events.
'occurredBeforeText'	Description of the event reported before.	str	133	30	
'waterDiscoloration'	If water discoloration occurred during the event.	category	0	0	---

Column Name	Description	Data Type	Number of NANs		Observations / Recommendations
			ANCA	CCA	
'highPhyto'	If the event was characterized by high abundance of phytoplankton.	category	0	0	---
'seafoodToxin'	If the event was characterized by the presence of toxins in food.	category	0	0	---
'massMortal'	If the event was characterized by mass mortality of any organism.	category	0	0	---
'foamMucil'	If there was presence of mucus or mucilage in water.	category	0	0	---
'otherEffect'	If the event was characterized by other effects non mentioned above.	category	0	0	---
otherEffectText'	If ' otherEffect ' is True, description of the effect.	str	310	20	---
'days'	Duration of the event in days.	int	0	0	---
'months'	Duration of the event in months.	int	0	0	---
'locationText'	Name of the location where the event occurred.	str	16	4	See **'region'**.
'latitude'	Decimal latitude of the event occurrence.	float	215	70	---
'longitude'	Decimal longitude of the event occurrence.	float	235	72	---
'additionalLocationInfo'	Additional information about location, local conditions, etc.	str	144	55	---
'eventDate'	Date of occurrence of the event (year-month-day) if available.	Date	239	49	These two columns present redundant information.

Column Name	Description	Data Type	Number of NANs		Observations / Recommendations
			ANCA	CCA	
'initialDate'	The start date of the event (year-month-day), if available.	Date	188	51	
'finalDate'	The end date of the event (year-month-day), if available.	Date	194	54	---
'quarantineStartDate'	If a quarantine or restriction was stablished (over an area, a product or an activity), the start date of such quarantine.	Date	281	208	---
'quarantineEndDate'	If a quarantine or restriction was stablished (over an area, a product or an activity), the end date of such quarantine.	Date	289	213	---
'additionalDateInfo'	Additional information about any of the dates reported above, if applicable.	str	170	207	---
'causativeKnown'	If the causative agent of the event was identified.	category	0	0	---
'pigmentAnalysisInfo'	Describe the pigment analysis that was performed to characterize the event, if applicable.	str	291	220	---
'additionalAlgaeInfo'	Detailed descriptions of the event, the causative agents, local conditions, or any other available that could increase the understanding about the event.	str	249	212	---
'toxicityDetected'	If toxicity assays were performed.	category	0	0	Maybe the column name could be more explicative (e.g. **'toxicityAssay'**).

Column Name	Description	Data Type	Number of NANs		Observations / Recommendations
			ANCA	CCA	
'toxicityRange'	Range of toxicity detected in the assays.	str	232	203	Keeping this column in an open format severely undermines its usefulness for efficient data analysis, as it combines various descriptions, names and units within a single field. It is recommended to implement the following scheme: **'toxinName'** (str) Name of the toxin. **'toxicityRangeMin'** (float) Minimum concentration evaluated, or toxicity umbral. **'toxicityRangeMax'** (float) Maximum concentration evaluated. **'toxicityRangeUnits'** (str) Units of the measurement, e.g. µg/l. **'toxicityRangeComments'** (str) Any additional information. More than one schema (0, 1, 2…) could be implemented if more than one Assay was performed (e.g. food consumption, respiratory, contact, etc.), or if more than one toxin is present.
'humansAffected'	If human beings were affected.	category	0	0	---
'fishAffected'	If fish were affected.	category	0	0	These two columns present redundant information.
'naturalFishAffected'	If natural fish were affected.	category	0	0	
'aquacultureFishAffected'	If aquaculture fish were affected.	category	0	0	---
'planktonicAffected'	If planktonic organisms were affected.	category	0	0	---
'benthicAffected'	If benthic organisms were affected.	category	0	0	---

Column Name	Description	Data Type	Number of NANs		Observations / Recommendations
			ANCA	CCA	
'shellfishAffected'	If commercial shellfish culture were affected.	category	0	0	Maybe the column name could be more explicative (e.g. **'commShellfishAffected'**).
'birdsAffected'	If birds were affected.	category	0	0	---
'otherTerrestrialAffected'	If other terrestrial animals were affected.	category	0	0	---
'aquaticMammalsAffected'	If aquatic mammals were affected.	category	0	0	---
'seaweedAffected'	If commercial seaweed culture were affected.	category	0	0	Maybe the column name could be more explicative (e.g. **'commSeaweedAffected'**).
'freshwater'	If the event occurred in freshwater.	category	183	199	Column should be mandatory (Yes/No), as there is a big quantity of missing data.
'effectsComments'	Any complementary information about the effects of the event.	category	208	217	---
'unexplainedToxicity'	If another source of toxicity not detected in the assays was present.	category	115	55	---
'toxicityComments'	Any complementary information about the toxicity assays.	str	323	229	---
'transvectors'	Name of the species that acted as vectors of contamination (e.g. food poisoning for fish consumption).	str	256	206	---
'eventBiblio'	If the event was published in scientific literature, insert the reference.	str	178	24	---
'syndromeText'	Description of the syndrome detected, if applicable.	str	333	235	---

Column Name	Description	Data Type	Number of NANs		Observations / Recommendations
			ANCA	CCA	
'active'	If the event is active	category	333	235	Column should be mandatory (Yes/No), because there is a big quantity of missing data.
'created_at'	Date of creation of the record in the database.	Date	171	0	---
'updated_at'	Date of modification of the record in the database.	Date	147	166	---
'checked_at'	Date of revision of the record in the database.	Date	321	235	---
'countryName'	Name of the country where the event took place.	category	0	0	---
'syndromeName'	Name of the syndrome detected, if applicable.	str	117	18	---
'speciesContaining'	Name of the species containing the toxin.	str	329	218	It is not clear if this information is equivalent to **'transvectors'**.
'additionalHarmfulEffectInfo'	Any complementary information about the effects of the toxin.	str	331	228	Possible redundant information.
'toxinAssayComments'	Any complementary information about the performance of the assays.	str	331	228	
'assaytype'	Type of assay, or methodological description.	str	330	229	---
'concentration'	Concentration of the toxin detected.	str	325	208	Keeping this column in an open format severely undermines its usefulness for efficient data analysis, as it combines numbers and symbols within a single field. It is recommended to implement the following scheme: **'concentration'** (float) Concentration of the toxin detected.

Column Name	Description	Data Type	Number of NANs		Observations / Recommendations
			ANCA	CCA	
					'concentrationUnits' (str) Units of the measurement, e.g. µg/l. More than one schema (0, 1, 2…) could be implemented if more than one toxin is present.
'toxinType'	Classification of the toxin (?)	str	325	209	It is not clear what the column is intended for, but records refer to concentrations.
'toxin'	Name of the toxin.	str	325	208	Records refer to generic names, maybe more appropriate for **'toxinType'**.
'causativeSpeciesName0'	Causative species of the event (4 columns available).	str	35	33	It could be considered to restrain the content of the first one or two columns to a closed list of previous defined and accepted species capable of causing Harmful Algal Blooms. This could minimize variability in the data due to typographical errors or different writing styles among researchers (e.g. *Peridinium* sp. vs. *Peridinium* spp.; *Dinophysis caudata* vs. *Dinophysis caudata* Saville-Kent 1881). The other columns could remain open to include unregistered species.
'causativeSpeciesName1'		str	292	184	
'causativeSpeciesName2'		str	300	213	
'causativeSpeciesName3'		str	304	228	
'cellsPerLitre0'	Concentration of the causative agent in cells/l.	str	102	186	It is recommended to restrict this field to a strictly numeric (int) value, as the presence of special characters and separators (<, >, periods, commas) significantly weakens its utility to perform efficient data analysis.
'cellsPerLitre1'		str	303	229	
'cellsPerLitre2'		str	309	231	
'cellsPerLitre3'		str	313	232	
'comments0'	Complementary information about the causative agent in cells/l.	str	224	216	---
'comments1'		str	303	232	
'comments2'		str	309	235	
'comments3'		str	313	235	
'additionalSpeciesName0'		str	262	194	

Column Name	Description	Data Type	Number of NANs		Observations / Recommendations
			ANCA	CCA	
	Additional species in the event (3 columns available).				The difference between causative agent and additional agent is not clearly defined. People could be using both types of columns indistinctly. See 'causativeSpeciesName0'.
'additionalSpeciesName1'		str	317	210	
'additionalSpeciesName2'		str	326	226	
'additionalcellsPerLitre0'	Concentration of the complementary agent in cells/l.	str	279	221	It is recommended to restrict this field to a strictly numeric (int) value, as the presence of special characters and separators (<, >, periods, commas) significantly weakens its utility to perform efficient data analysis.
'additionalcellsPerLitre1'		str	325	232	
'additionalcellsPerLitre2'		str	327	233	
'additionalcomments0'	Complementary information about the causative agent in cells/l.	str	308	235	---
'additionalcomments1'		str	327	235	
'additionalComments2'		str	327	234	

Annex 6 Analysis of HAEDAT platform form and data storage

Section	Subsection	Name in the spreadsheet	Column name	Observations
1. General information	Event Year *	Event Year *	eventYear	
	Country: *	Country: *	countryName	
	Indicate the nature of the reported harmful event:	Water Discoloration	waterDiscoloration	
		High Phyto concentration	highPhyto	
		Seafood toxins	seafoodToxin	
		Mass mortalities	massMortal	
		Foam/Mucilage in the coast	foamMucil	
		Freshwater	freshwater	
		Other effect	otherEffect	
		Please provide more details about...	otherEffectText	
	Has the event directly affected:	Planktonic life	planktonicAffected	
		Natural Fish	naturalFishAffected	
		Birds	birdsAffected	
		Benthic Life	benthicAffected	
		Aquaculture Fish	aquacultureFishAffected	
		Shellfish	shellfishAffected	
		Aquatic Mammals	aquaticMammalsAffected	
		Humans	humansAffected	
		Seaweed	seaweedAffected	
		Other Terrestrial	otherTerrestrialAffected	
		Other Terrestrial (please specify)	None	The field is not being downloaded. Whether the information is available is unknown.
		Comments:	effectsComments	
	Has any toxicity been detected?	Yes/No	toxicityDetected	
		Approximate Range	toxicityRange	

Section	Subsection	Name in the spreadsheet	Column name	Observations
	Associated syndrome:	Aerosolized toxins effects	syndromeName	When more than one option is selected, a copy of the record is generated for each one of the syndromes, mantaining all the rest of information identical, even the eventName.
		ASP		
		AZP		
		CFP (Ciguatera Fish Poisoning)		
		Cyanobacterial toxin effects		
		DSP		
		NSP		
		OTHER		
		PSP		
	Unexplained toxicity:	Yes/No	unexplainedToxicity	
		(If yes, comments:)	toxicityComments	
	If intoxication occurred...	Transvectors	transvectors	
	Is this report the outcome of a monitoring programme?	Yes/No	monitoringProgramme	
		(If yes, which program:)	programmeName	
	Has the event occurred before in this location?	Yes/No	occurredBefore	
		(If yes, comments:)	occurredBeforeText	
	Individuals to contact: *	Contact 1:		This information is not contained in the database available for public download
		Contact 2:		
		Contact 3:		
2. Location & Date	Location	Latitude (N-S)	latitude	The input is in degrees, minutes, seconds format. Data are automatically combined and stored in decimal format.
		Latitude (Deg)		
		Latitude (Min)		
		Latitude (Sec)		
		Longitude (N-S)	longitude	The input is in degrees, minutes, seconds format. Data are automatically combined and stored in decimal format.
		Longitude (Deg)		
		Longitude (Min)		
		Longitude (Sec)		

Section	Subsection	Name in the spreadsheet	Column name	Observations
	General location information:	Name of the area:	locationText	
		Region:	region	
		HAB Area code *:	None	Available as part of the eventName. Maybe this information should also feed the column 'originalGridCode'?
	Additional location information:	Additional location information:	additionalLocationInfo	
	Event date:	Event date:	eventDate	
	Start of bloom event:	Start of bloom event:	initialDate	
	End of bloom event:	End of bloom event:	finalDate	
	Date of detection of quarantine levels:	Date of detection of quarantine levels:	quarantineStartDate	
	End of quarantine levels:	End of quarantine levels:	quarantineEndDate	
	Additional date-related information:	Additional date-related information:	additionalDateInfo	
			days	Automatically calculated from dates (start and end of bloom)
			months	Automatically calculated from dates (start and end of bloom)
3. Microalgae	Causative organism known?	Yes/No	causativeKnown	
	Causative Species/genus	row 1, row 2, row 3, row 4	causativeSpeciesName0	Additional rows appear when added with the "Add row" button
			causativeSpeciesName1	
			causativeSpeciesName2	
			causativeSpeciesName3	
	Cells/L (max.)	row 1, row 2, row 3, row 4	cellsPerLitre0	Additional rows appear when added with the "Add row" button
			cellsPerLitre1	
			cellsPerLitre2	
			cellsPerLitre3	
	Comments	row 1, row 2, row 3, row 4	comments0	Additional rows appear when added with the "Add row" button
			comments1	

Section	Subsection	Name in the spreadsheet	Column name	Observations
			comments2	
			comments3	
	Co-Occurring Species/genus	row 1, row 2, row 3	additionalSpeciesName0	Additional rows appear when added with the "Add row" button
			additionalSpeciesName1	
			additionalSpeciesName2	
	Cells/L (max.)	row 1, row 2, row 3	additionalCellsPerLitre0	Additional rows appear when added with the "Add row" button
			additionalCellsPerLitre1	
			additionalCellsPerLitre2	
		row 1, row 2, row 3	additionalComments0	Additional rows appear when added with the "Add row" button
			additionalComments1	
			additionalComments2	
	Chlorophyll concentration, if known (ï¿½g/l)	Chlorophyll concentration, if known	pigmentAnalysisInfo	The required unit is not clear in the spreadsheet
	Additional microalgae information:	Additional microalgae information:	additionalAlgaeInfo	
	Event-related bibliography:	Event-related bibliography:	eventBiblio	
4. Environmental conditions	Weather:	Weather:	None	This section of the database is not being download with the rest of the information. Whether the information is available is unknown.
	Turbidity (NTU):	Turbidity (NTU):	None	
	Wind Direction:	Wind Direction:	None	
	Stratified Water:	Stratified Water:	None	
	Oxygen content (mL/L):	Oxygen content (mL/L):	None	
	Wind velocity:	Wind velocity:	None	
	Temperature (°C):	Temperature (°C):	None	
	Oxygen saturation %:	Oxygen saturation %:	None	
	Current Direction:	Current Direction:	None	
	Sechhi disk (m):	Sechhi disk (m):	None	
	Salinity:	Salinity:	None	
	Current Velocity:	Current Velocity:	None	

Section	Subsection	Name in the spreadsheet	Column name	Observations
	Nutrient concentrations:	AMONIUM	None	
		NITRATE	None	
		NITRITE	None	
		PHOSPHATE	None	
		SILICATE	None	
		NITRATE + NITRITE	None	
		DIN	None	
	Additional bloom information	Additional bloom information	None	
	If available, indicate maximum/minimum temperature and salinity recorded during the whole duration of the event:	Max. Temp (°C):	None	
		Min. Temp (°C):	None	
		Max. Salinity:	None	
		Min. Salinity:	None	
	Bloom location in the water column:	Whole column	None	
		Surface	None	
		Subsurface	None	
	Growth:	Advected	None	
		In situ	None	
	Advected comments:	Advected comments:	None	
	Additional Environmental information:	Additional Environmental information:	None	
5. Toxin Assay Information	Species containing the toxin	row 1, row 2, row 3...	speciesContaining	Although the spreadsheet has the posibility to add multiple rows, only the information of the last row is available in the database. Whether the information of the rest of columns is stored somewhere is unknown.
	Toxin details	row 1, row 2, row 3...	None	The field is not being download. Whether the information is available is unknown. The data must go to 'toxin'.

Section	Subsection	Name in the spreadsheet	Column name	Observations
	Toxin type	row 1, row 2, row 3...	toxin	Translocation. The data must go to 'toxinType'
	Max. concentration (specify units)	row 1, row 2, row 3...	toxinType	Translocation. The data must go to 'concentration'
	None	None	concentration	Translocation. The column is filled with the text 'LC-UV' without being selected or writed.
	Assay type	row 1, row 2, row 3...	None	The field is not being download. Whether the information is available is unknown. The data must go to 'assaytype'.
	Toxin assay comments:	Toxin assay comments:	assaytype	Translocation. The data must go to 'toxinAssayComments'.
	Additional harmful effect information:	Additional harmful effect information:	additionalHarmfulEffectInfo toxinAssayComments	Duplication. The data must go only to 'additionalHarmfulEffectInfo' and no to 'toxinAssayComments'.
	Kit used?:	Kit used?:	None	The field is not being download. Whether the information is available is unknown.
	If yes, kit type:	If yes, kit type:	None	The field is not being download. Whether the information is available is unknown.
	Economic losses:	Economic losses:	None	The field is not being download. Whether the information is available is unknown.
	Management decision:	Management decision:	None	The field is not being download. Whether the information is available is unknown.
Other (not in the spreadsheet)	---	---	eventName	Automatically asssigned when the report is submitted
	---	---	created_at	Automatically generated with the record is created.

Section	Subsection	Name in the spreadsheet	Column name	Observations
	---	---	updated_at	Automatically generated or actualized with the record is updated.
	---	---	checked_at	Automatically generated with the record is checked.
	None	None	syndromeText	There is no field in the spreadshhet pointing to this column.
	None	None	active	There is no field in the spreadshhet pointing to this column.
	None	None	fishAffected	There is no field in the spreadshhet pointing to this column. Maybe is a reminder of an older version of the database, which was later divided into "Natural Fish" and "Aquaculture Fish".
	None	None	originalGridCode	There is no field in the spreadshhet pointing to this column.

Annex 7 Misrepresented records in the georeferenced ANCA database

eventName	region	countryName	latitude	longitude
CU-15-001	2	CUBA	82.233333	23.200000
CU-03-001	2	CUBA	82.233333	23.200000
VE-91-001	Nueva Esparta	VENEZUELA	10.986667	63.935556
US-16-038	NaN	UNITED STATES	27.000000	81.000000
US-08-001	Gulf of Mexico	UNITED STATES	24.716944	81.357500
US-10-002	West Coast of Florida	UNITED STATES	27.946944	82.458333

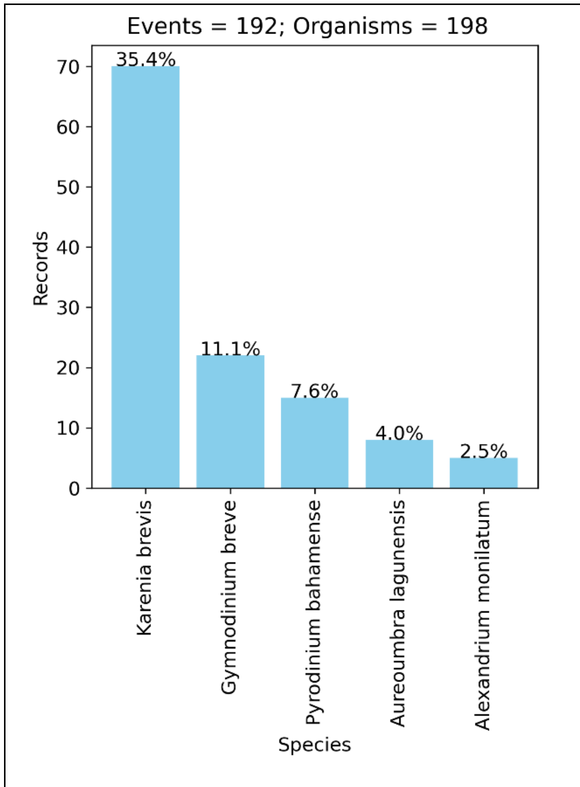
Annex 8 Exhaustive list of causative species for the ANCA database (causativeSpeciesName 0, 1, 2 and 3)

causativeSpeciesName	Count	Percent	Acc_percent
Karenia brevis	109	27.46%	27.46%
Gymnodinium breve	41	10.33%	37.79%
Pyrodinium bahamense	23	5.79%	43.58%
Anabaena sp.	20	5.04%	48.62%
Prorocentrum minimum	18	4.53%	53.15%
Heterocapsa rotundata	16	4.03%	57.18%
Pseudo-nitzschia sp.	14	3.53%	60.71%
Prorocentrum scutellum	9	2.27%	62.98%
Aureoumbra lagunensis	8	2.02%	65.00%
Cochlodinium polykrikoides	7	1.76%	66.76%
Alexandrium monilatum	6	1.51%	68.27%
Prorocentrum gracile	6	1.51%	69.78%
Synechocystis sp.	6	1.51%	71.29%
Prorocentrum compressum	5	1.26%	72.55%
Dinophysis ovum	4	1.01%	73.56%
Planktolyngbya contorta	4	1.01%	74.57%
Prorocentrum mexicanum	4	1.01%	75.58%
Prorocentrum sp.	4	1.01%	76.59%
Prymnesium parvum	4	1.01%	77.60%
Pseudo-nitzschia pseudodelicatissima	4	1.01%	78.61%
Raphidiopsis curvata	4	1.01%	79.62%
Akashiwo sanguinea	3	0.76%	80.38%
Gambierdiscus toxicus	3	0.76%	81.14%
Gonyaulax sp.	3	0.76%	81.90%
Mesodinium rubrum	3	0.76%	82.66%
Mesodinium sp.	3	0.76%	83.42%

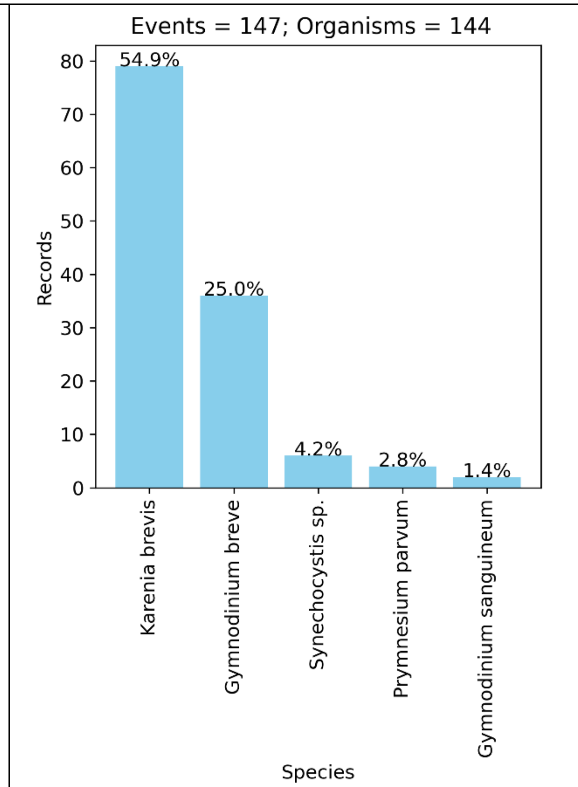
causativeSpeciesName	Count	Percent	Acc_percent
Prorocentrum hoffmannianum	3	0.76%	84.18%
Prorocentrum micans	3	0.76%	84.94%
Pseudo-nitzschia delicatissima	3	0.76%	85.70%
Pseudo-nitzschia multiseries	3	0.76%	86.46%
Pseudo-nitzschia pungens	3	0.76%	87.22%
Pyrodinium bahamense var. Bahamense	3	0.76%	87.98%
Synechococcus elongatus	3	0.76%	88.74%
Chattonella subsalsa	2	0.50%	89.24%
Cylindrospermopsis raciborskii	2	0.50%	89.74%
Cylindrospermopsis sp.	2	0.50%	90.24%
Fibrocapsa japonica	2	0.50%	90.74%
Gymnodinium sanguineum	2	0.50%	91.24%
Gyrodinium sp.	2	0.50%	91.74%
Heterosigma sp.	2	0.50%	92.24%
Alexandrium sp.	1	0.25%	92.49%
Aphanizomenon sp.	1	0.25%	92.74%
Cochlodinium sp.	1	0.25%	92.99%
Cyclotella sp.	1	0.25%	93.24%
Dinophysis caudata	1	0.25%	93.49%
Dinophysis sp.	1	0.25%	93.74%
Euglena sp.	1	0.25%	93.99%
Eutreptiella gymnastica	1	0.25%	94.24%
Exuviaella baltica	1	0.25%	94.49%
Gambierdiscus yasumotoi	1	0.25%	94.74%
Gonyaulax tamarensis var. excavata	1	0.25%	94.99%
Guinardia delicatula	1	0.25%	95.24%
Gymnodinium pulchellum	1	0.25%	95.49%

causativeSpeciesName	Count	Percent	Acc_percent
Heterocapsa circularisquama	1	0.25%	95.74%
Heterosigma carterae	1	0.25%	95.99%
Karenia papilionacea	1	0.25%	96.24%
Laboea sp.	1	0.25%	96.49%
Microcystis sp.	1	0.25%	96.74%
Nitzschia sp.	1	0.25%	96.99%
Noctiluca scintillans	1	0.25%	97.24%
Nostoc sp.	1	0.25%	97.49%
Ostreopsis siamensis	1	0.25%	97.74%
Peridinium sp.	1	0.25%	97.99%
Prorocentrum lima	1	0.25%	98.24%
Pseudo-nitzschia subfraudulenta	1	0.25%	98.49%
Pyrodinium sp.	1	0.25%	98.74%
Raphidiopsis sp.	1	0.25%	98.99%
Rhizosolenia sp.	1	0.25%	99.24%
Scrippsiella sp.	1	0.25%	99.49%
Skeletonema costatum	1	0.25%	99.74%
Takayama pulchella	1	0.25%	99.99%

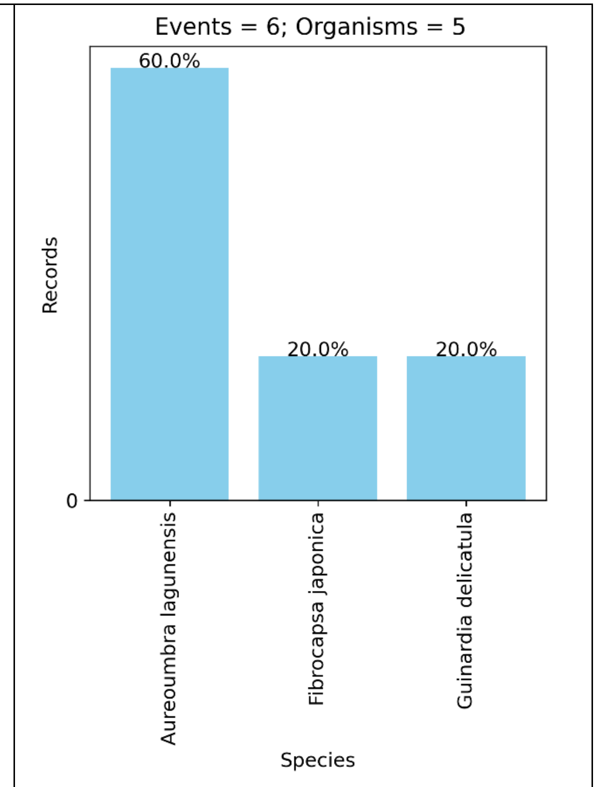
Annex 9 Main causative species per type of affectation (Graphics) in the ANCA database



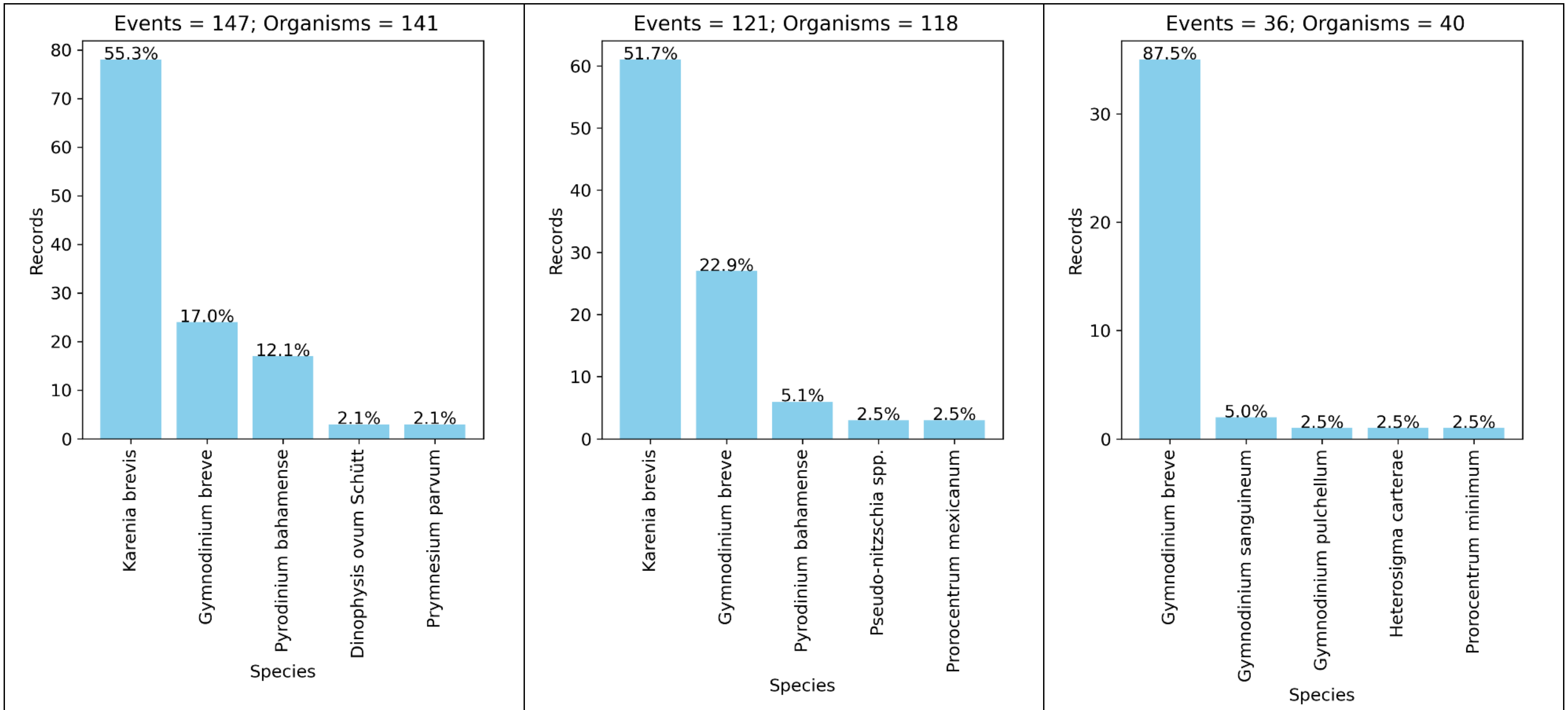
Water discoloration



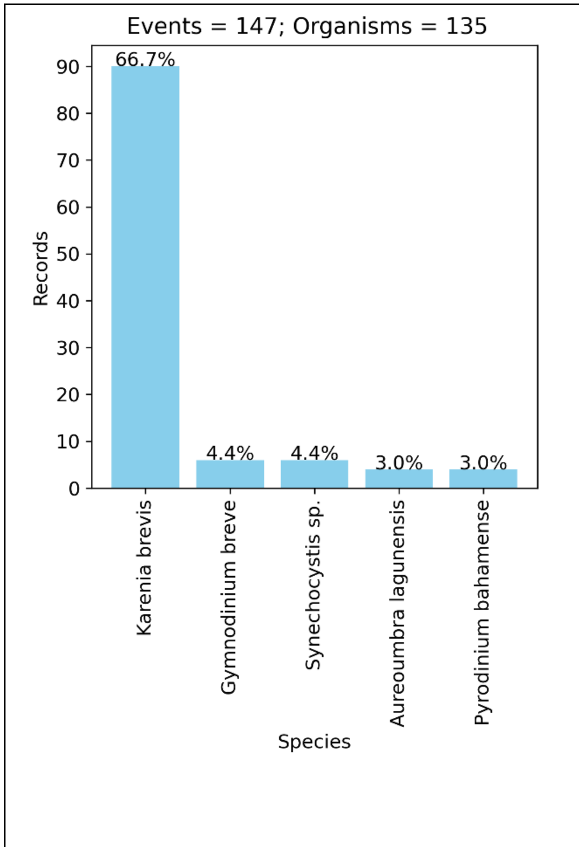
Mass mortality



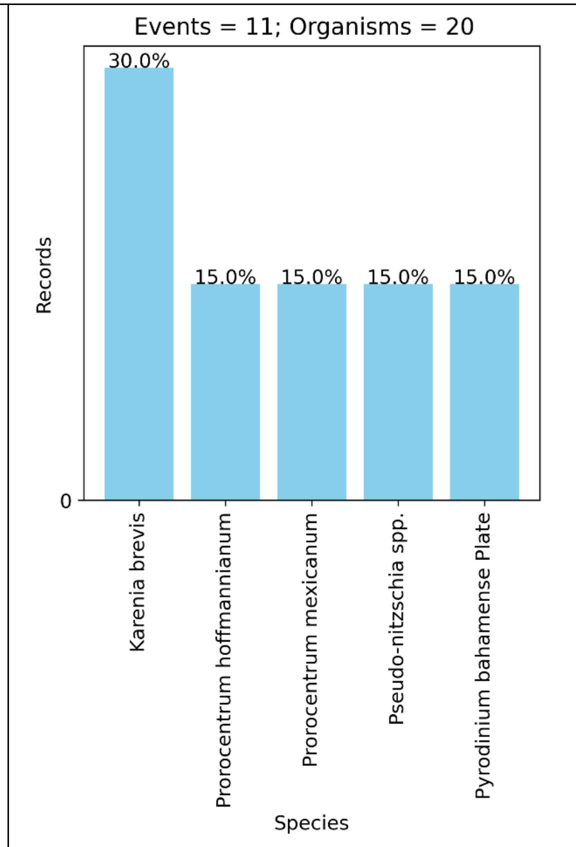
Mucilage formation



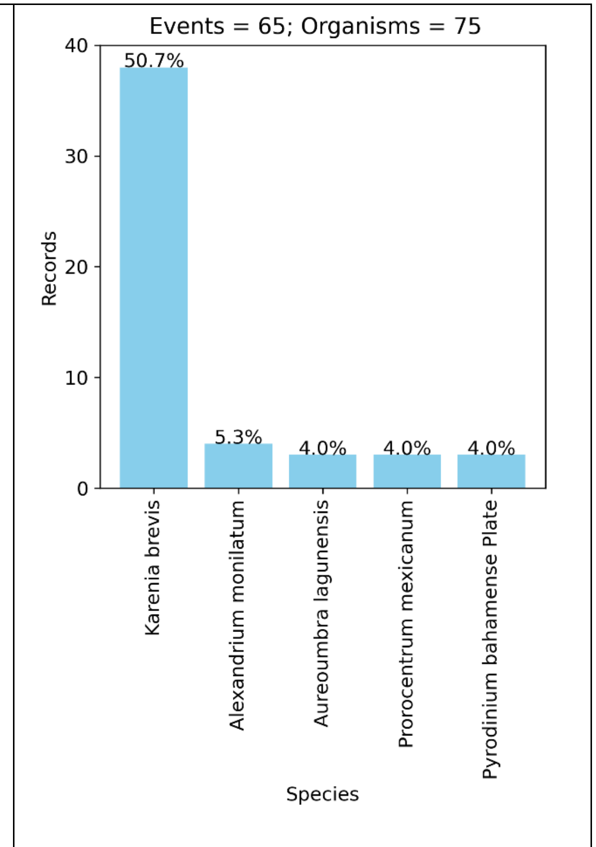
Toxicity Detected	Humans Affected	Fish Affected



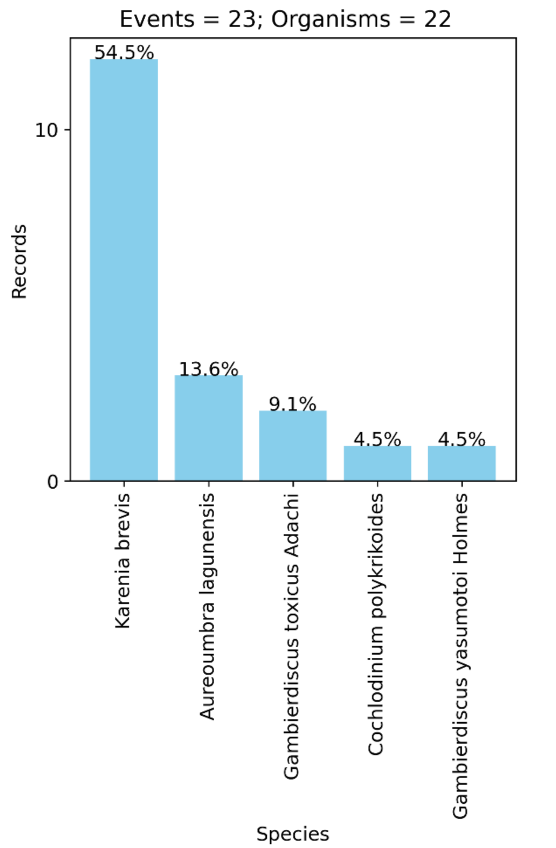
Natural Fish Affected



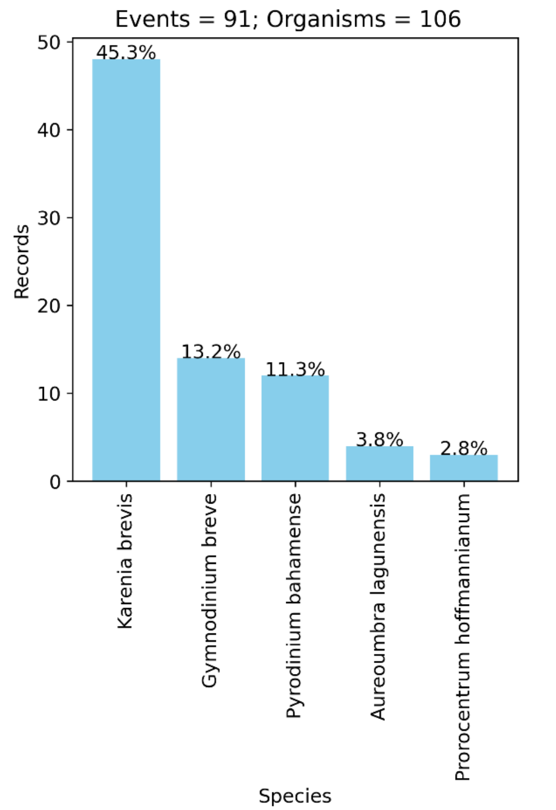
Aquaculture Fish Affected



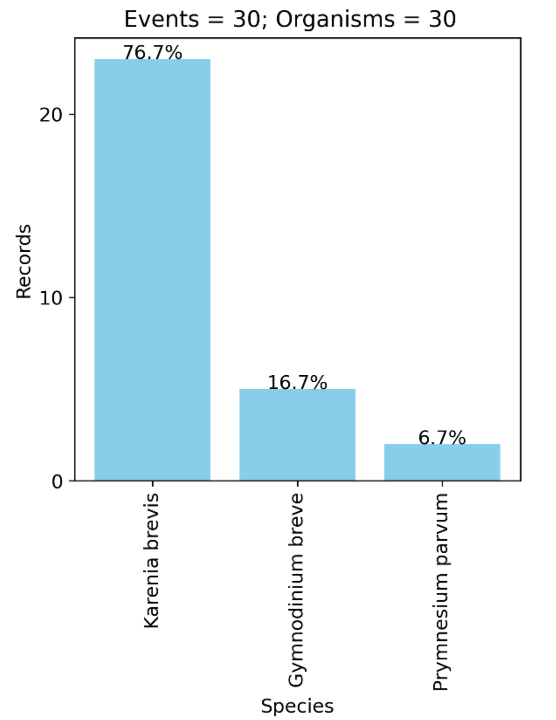
Planktonic Affected



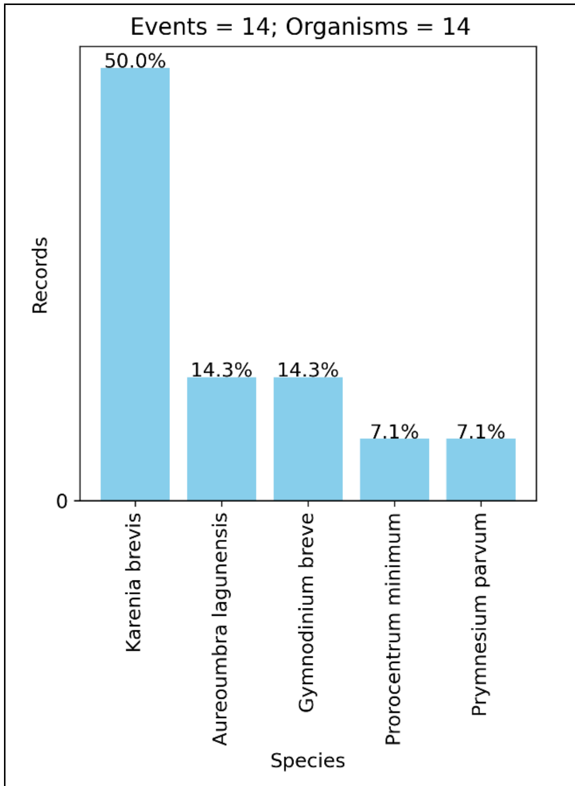
Benthic Affected



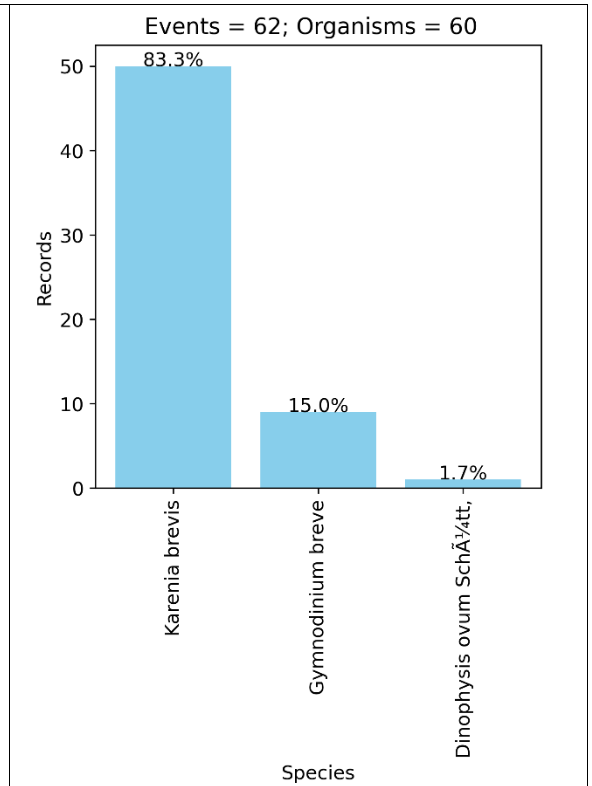
Shellfish Affected



Birds Affected



Other Terrestrial Fauna Affected



Marine Mammals Affected

Annex 10 Misrepresented records in the georeferenced CCA database

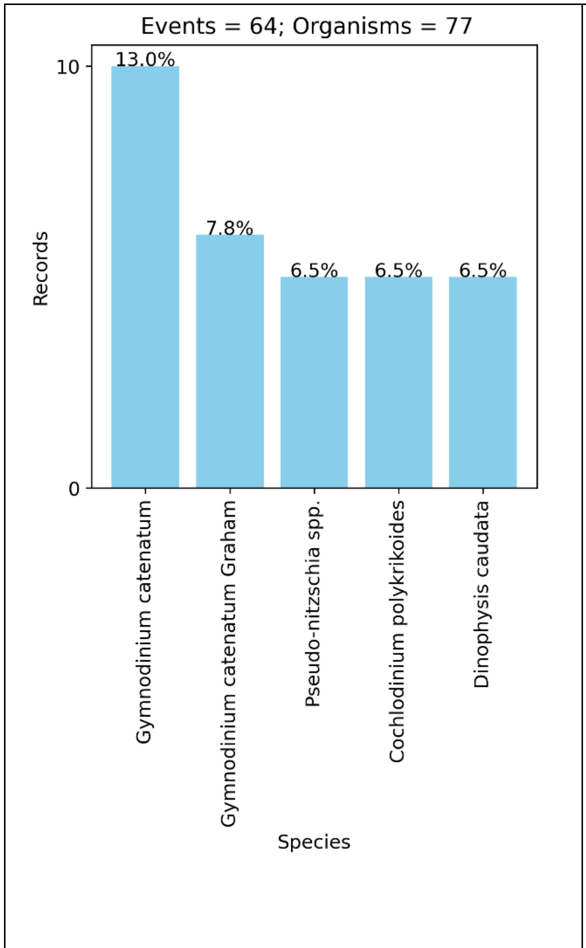
eventName	region	countryName	latitude	longitude
MX-13-011	Sinaloa	MEXICO	23.405833	23.232778
PTY-17-001	Province of Coclé	PANAMA	8.350000	80.216667
NI-16-001	Nicaragua, Central America	NICARAGUA	13.006389	87.500278
NI-18-001	Nicaragua, Central America	NICARAGUA	13.099444	87.575278
NI-12-001	Nicaragua, Central america	NICARAGUA	13.099444	87.575278
MX-23-004	Golfo de California	MEXICO	24.446111	107.577778
MX-23-003	Mulegé, Baja California Sur	MEXICO	26.819444	113.457500

Annex 11 Exhaustive list of causative species for the CCA database (causativeSpeciesName 0, 1, 2 and 3)

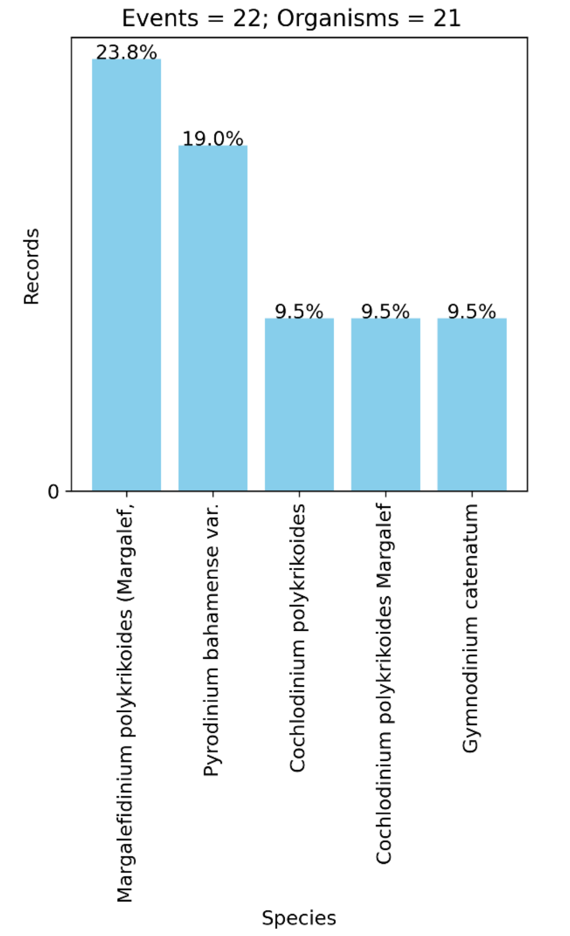
causativeSpeciesName	Count	Percent	Acc_percent
Gymnodinium catenatum	65	22.97%	22.97%
Margalefidinium polykrikoides	25	8.83%	31.80%
Myrionecta rubra	23	8.13%	39.93%
Pseudo-nitzschia sp.	20	7.07%	47.00%
Pyrodinium bahamense var. compressum	20	7.07%	54.07%
Pyrodinium bahamense	17	6.01%	60.08%
Dinophysis caudata	15	5.30%	65.38%
Dinophysis sp.	11	3.89%	69.27%
Cochlodinium polykrikoides	9	3.18%	72.45%
Alexandrium sp.	6	2.12%	74.57%
Prorocentrum micans	6	2.12%	76.69%
Ceratium furca	5	1.77%	78.46%
Noctiluca scintillans	5	1.77%	80.23%
Phaeocystis sp.	4	1.41%	81.64%
Prorocentrum sp.	4	1.41%	83.05%
Ceratium sp.	3	1.06%	84.11%
Chattonella marina	3	1.06%	85.17%
Gambierdiscus toxicus	3	1.06%	86.23%
Gonyaulax polyedra	3	1.06%	87.29%
Alexandrium affine	2	0.71%	88.00%
Gyrodinium instriatum	2	0.71%	88.71%
Lyngbya majuscula	2	0.71%	89.42%
Prorocentrum gracile	2	0.71%	90.13%
Akashiwo sanguinea	1	0.35%	90.48%
Alexandrium minutum	1	0.35%	90.83%
Alexandrium ostenfeldii	1	0.35%	91.18%

causativeSpeciesName	Count	Percent	Acc_percent
Aphanizomenon sp.	1	0.35%	91.53%
Ceratium teres	1	0.35%	91.88%
Ceratium tripos	1	0.35%	92.23%
Cochlodinium catenatum	1	0.35%	92.58%
Dinophysis fortii	1	0.35%	92.93%
Dinophysis tripos	1	0.35%	93.28%
Fibrocapsa japonica	1	0.35%	93.63%
Gonyaulax digitale	1	0.35%	93.98%
Gonyaulax polygramma	1	0.35%	94.33%
Gymnodinium chlorophorum	1	0.35%	94.68%
Gymnodinium mikimotoi	1	0.35%	95.03%
Gymnodinium sp.	1	0.35%	95.38%
Lingulodinium polyedra	1	0.35%	95.73%
Melosira sp.	1	0.35%	96.08%
Mesodinium rubrum	1	0.35%	96.43%
Oscillatoria sp.	1	0.35%	96.78%
Ostreopsis siamensis	1	0.35%	97.13%
Prorocentrum compressum	1	0.35%	97.48%
Prorocentrum emarginatum	1	0.35%	97.83%
Prorocentrum lima	1	0.35%	98.18%
Prorocentrum triestinum	1	0.35%	98.53%
Pseudo-nitzschia pungens	1	0.35%	98.88%
Pseudo-nitzschia seriata	1	0.35%	99.23%
Trichodesmium erythraeum	1	0.35%	99.58%
Umbilicosphaera sibogae	1	0.35%	99.93%

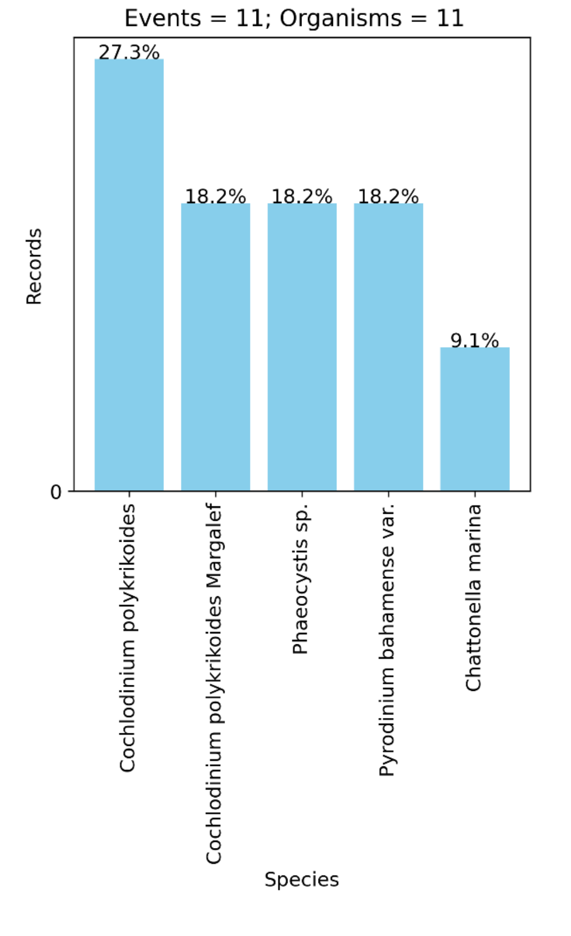
Annex 12 Main causative species per type of affectation (Graphics) in the CCA database



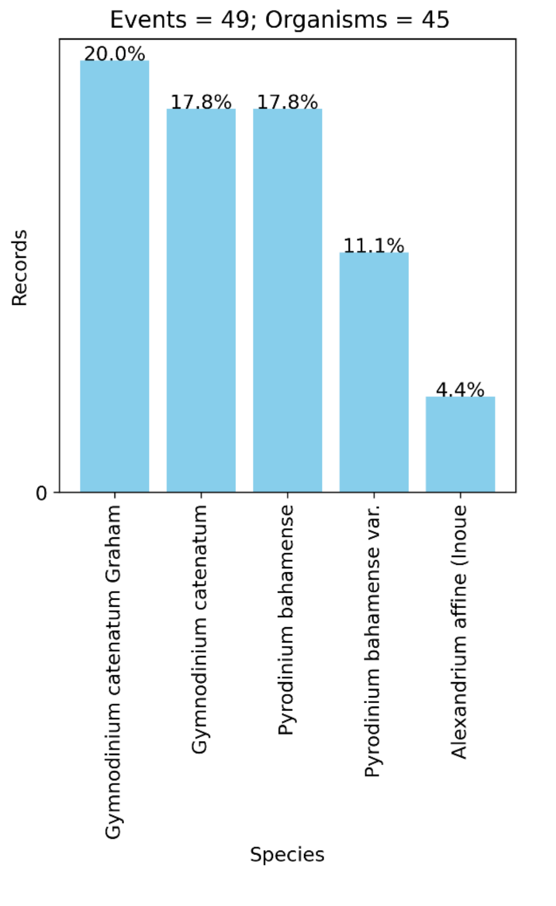
Water discoloration



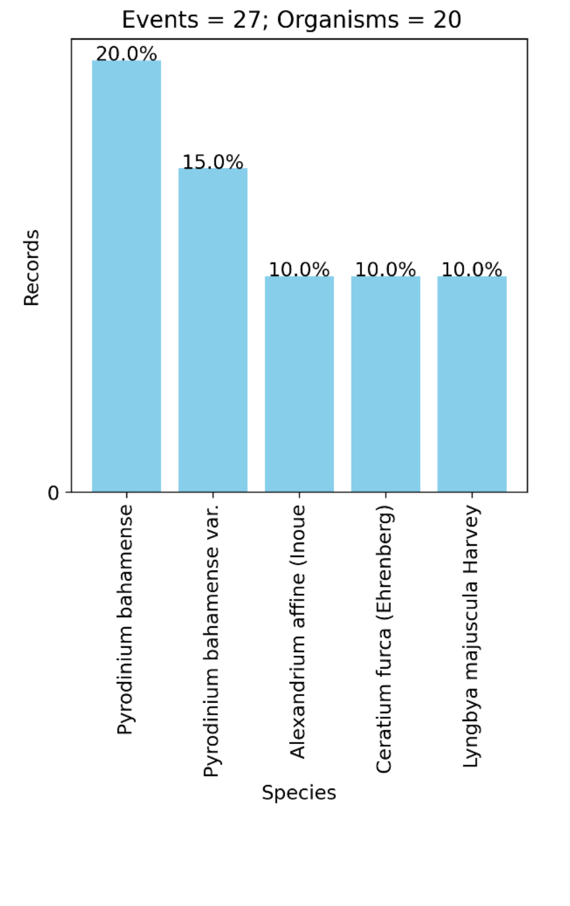
Mass mortality



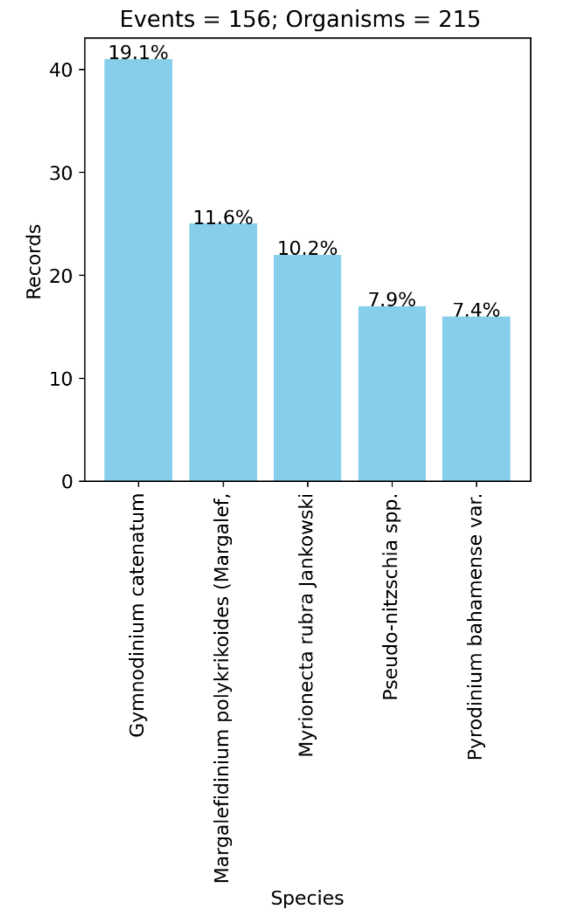
Mucilage formation



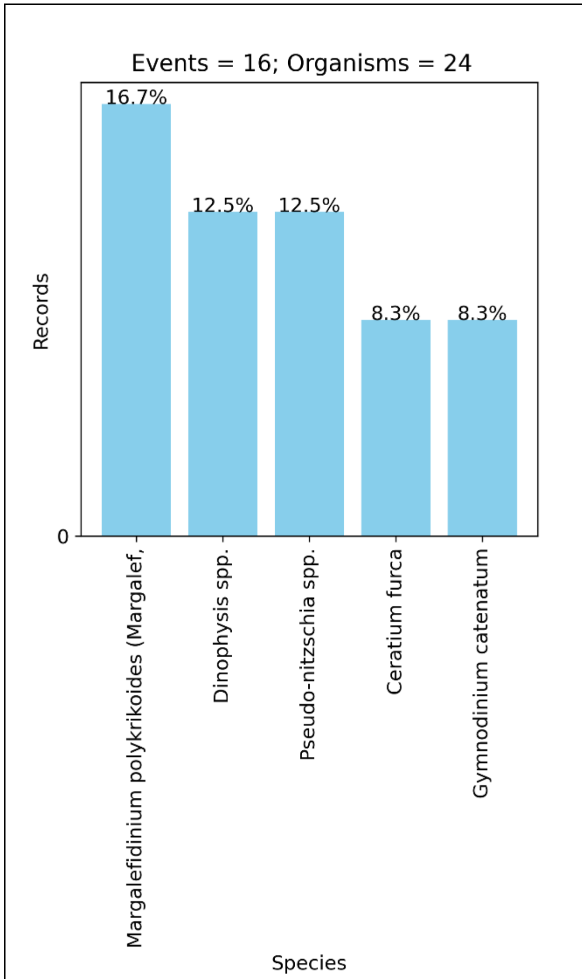
Toxicity Detected



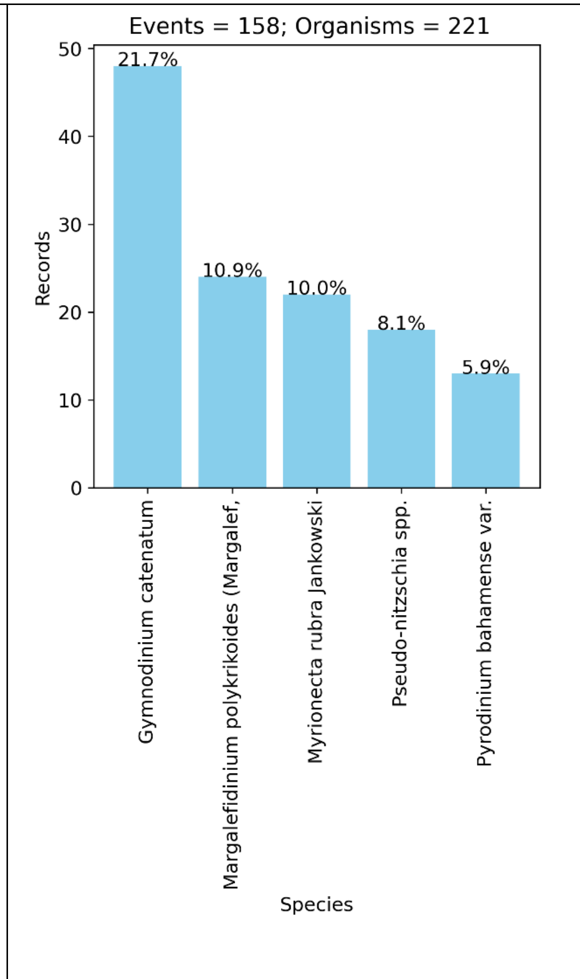
Humans Affected



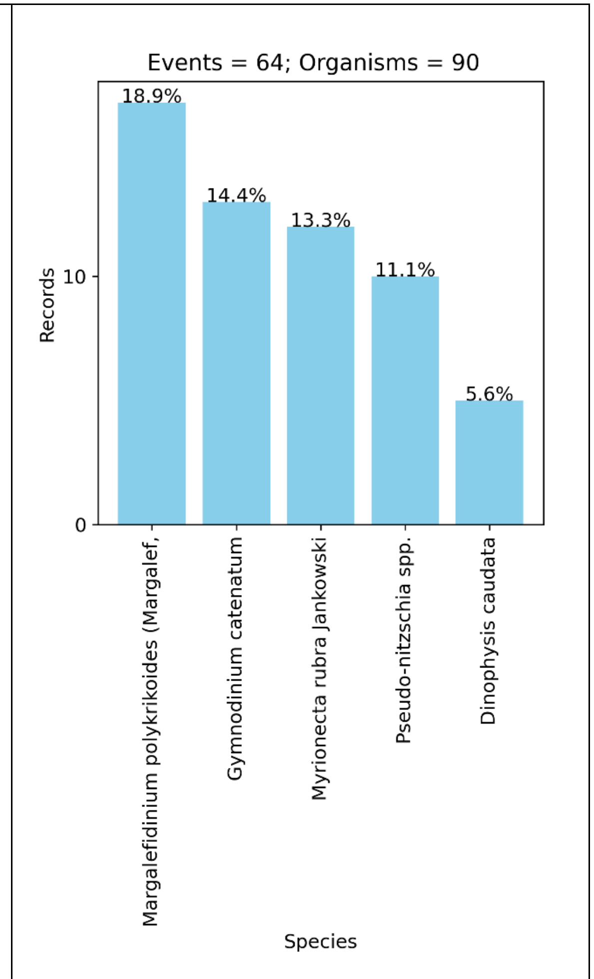
Natural Fish Affected



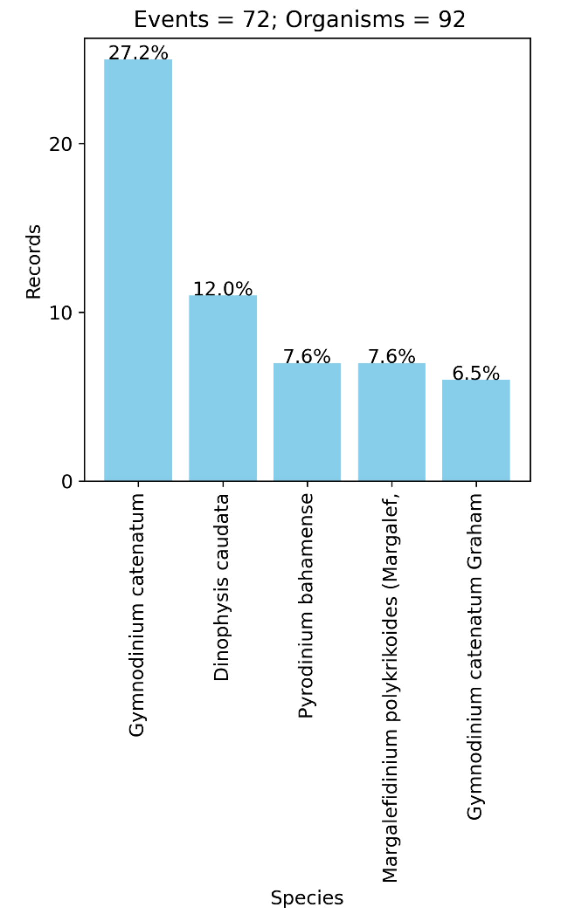
Aquaculture Fish Affected

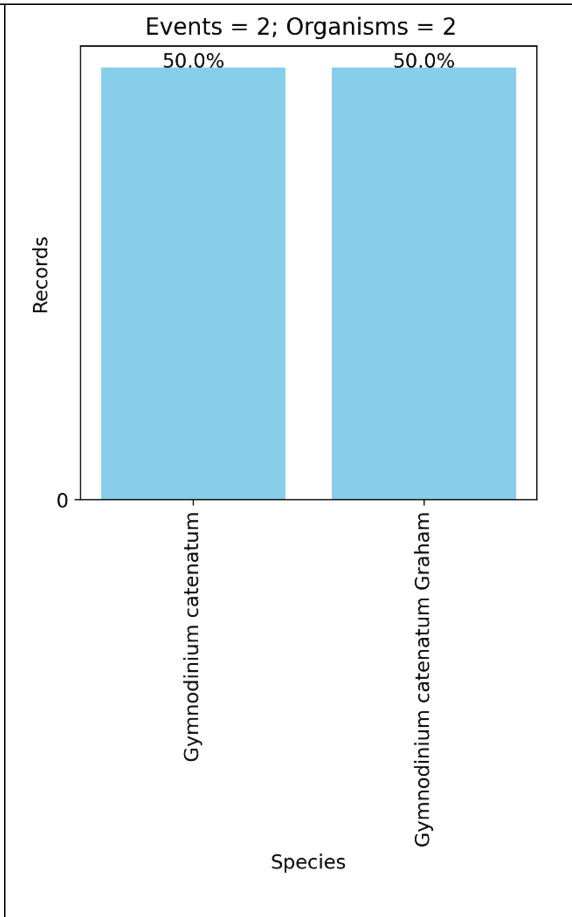


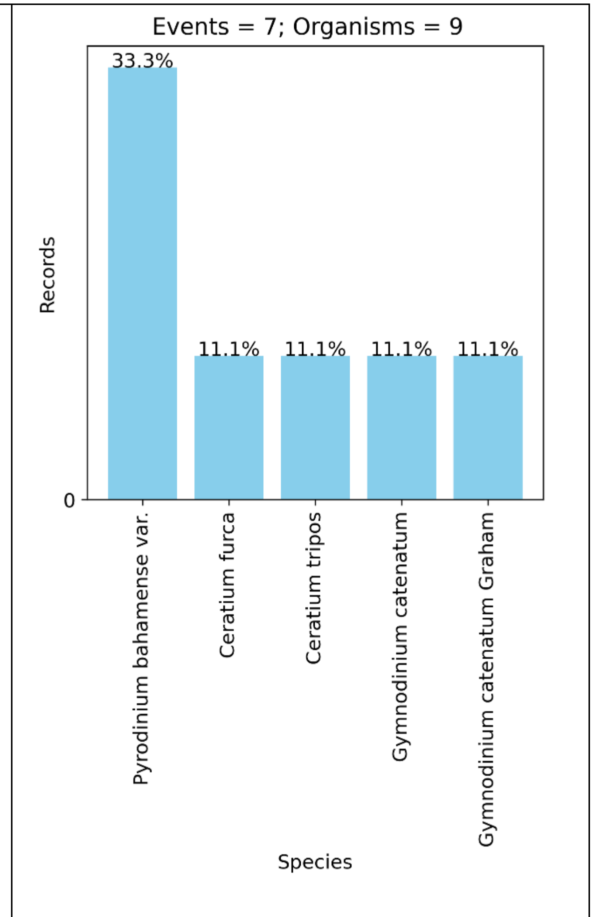
Planktonic Affected



Benthic Affected







Shellfish Affected	**Birds Affected**	**Marine Mammals Affected**