Report on Invertebrate Populations

Lac Bay

2022

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This project was funded by Stinapa and executed by Stichting Internos. Field work was conducted by Daniela Simal and Ray van Dijk.

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1. Background

Invertebrates play a critical role in maintaining a resilient and healthy environment. These species are one of the most globally abundant and diverse animal groups, comprising nearly 80% of all documented species to date (Brusca & Brusca, 2002). In fact, these species occupy a wide range of tropic levels, interacting with species throughout the food web.

One study (Prather et al, 2020) broke down the importance of invertebrates into the following four ecosystem services:

1) Supporting services. This includes primary production, decomposition, nutrient cycling, hydrologic flux and habitat formation and modification. Within the sediment, invertebrates can dramatically influence water movement, increasing soil porosity (Derouard et al., 1997) and decreasing litter quantity (Wardle, 2002).

2) Providing services. These contributions include serving as a food source, or generating household goods, inclusion in biochemical or pharmaceutical products as well as a boundless supply of scientific study. For Lac, the queen conch is an iconic species, whose meat was historically featured in local cuisine and shell is still used as decoration.

3) Regulating services. This includes ability to improve water quality, food web stability, disease regulation within populations as well as pest and invader control. In shallow marine ecosystems, bivalves (such as mussels and oysters) can provide substantial water filtration throughout the water column.

4) Cultural services. This includes benefits obtained from recreational services and their cultural significance. Many iconic invertebrate species, such as octopus, corals, sponges and conch create a vibrant landscape for scuba divers and snorkelers alike to explore.

Lac Bay has great economic, environmental and cultural value, none of which would be possible without a healthy and robust invertebrate population. These invertebrates are help build resilience within the sandy plateaus, seagrass beds and mangroves, serve as a point of interest for visitors, and are either themselves iconic, or vital to the success of other iconic species (such as the flamingo and sea turtle) within the bay.

Unfortunately, invertebrates are often overlooked in larger studies. Burrowing species can be difficult to find, while others are nearly invisible to the naked eye. More research is needed to fully understand the invertebrate populations of Lac Bay. This report serves to document invertebrates recorded during a 2022 biological survey of Lac and compare it to a previous survey conducted in 2020.

2. Previous Studies

In 1969, the first known qualitative invertebrate survey within Lac Bay was conducted by Wagenaar Hummelinck and Roos. In 1997, a follow-on survey was conducted by Cindy Lott covering the same study area. In 2013 Stinapa and Stichting Internos conducted a study and then follow-on studies have been conducted in 2016, 2020 and 2022.

Information from the 1969, and 1997 study were used to generate the species list for the 2013 survey. Due to shifts in methodology, a direct comparison between the newer and older studies are not possible, however, studies since 2013 have been done in a consistent manner to allow future comparison and trend analysis.

3. Methodology

This survey was completed between December 2021 and February 2022. Throughout Lac Bay, 49 locations (Figure 1) were selected at regular intervals. Of these locations GPS coordinates were recorded for the corners of a 30 by 30 m quadrant. Connecting the corners, 4 reel measuring tapes were laid out along the bottom to mark the outer periphery of the quadrant. The gps coordinates have been used in consecutive years since 2010 for related surveys.

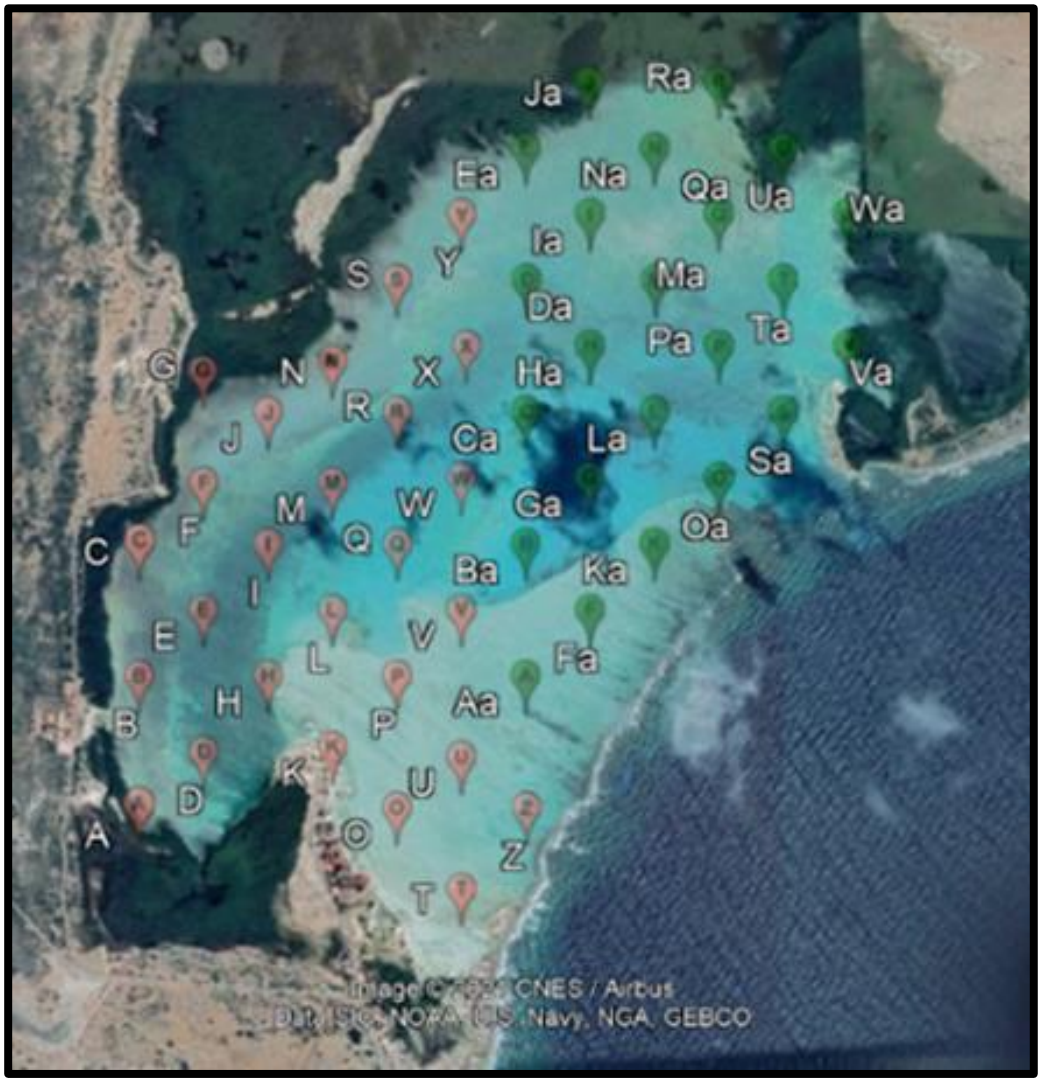

Figure 1: Map of 49 quadrants used during study

Depending on water depth and visibility the surveys were either conducted using snorkel or scuba equipment. The survey was completed using a "U" pattern (Figure 2) such that 100% of the substrate could be visually covered over the course of the survey. Two surveyors completed the pattern in opposite directions to ensure redundancy and full coverage.

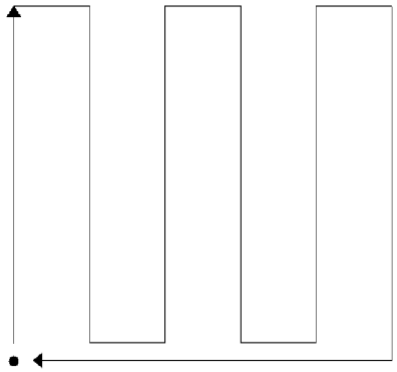

Figure 2: "U" pattern used during survey

During the surveys, selected invertebrates were counted and recorded within the quadrant. In the event that a specimen started in the quadrant but then left due to the presence of surveyors, this individual was counted within the total (for example octopus or conch). It should also be noted that there is one site (Aa) which is comprised of dense patches of staghorn coral, these have not been recorded in the species list as individual coral heads could not be counted.

4. Results

	2020	2022
Urchins		
Heart urchin (*Meoma*)	2	0
Sea egg urchin (*Tripneustes ventricosus*)	117	157
rock boring urchin (*Echinometra*)	6	0
Black sea urchin (*Diadema antillarum*)	1	3
Corals		
Grooved brain coral (*Diploria*)	3	11
Gorgonian coral	1	7
Boulder star coral (Orbicella annularis)	1	0
Mustard Hill Coral (Porites astreoides)	4	12
Hump coral (*Porites porites*)	5	25
Giant starlet coral (*Siderastrea*)	22	50
Massive Starlet Coral (*Siderastrea*)	0	17
Sponges		
Aiolochroia crassa	2	38
Agelas fistularis	1	0
Chondrilla nucula	3	15
Dysidea etheria	44	7
Haliclona sp.	83	4259
Haliclona compressa	1	205
Tedania ignis	3	8
Tridemnum cyanophora	1	0
Anemones		
Giant anemone (Condylactis gigantea)	456	510
hidden anemone (Lebrunia coralligens)	17	0
Corkscrew anemone (Macrodactyla doreensis)		4
Sun anemone (Stichodactyla helianthus)	6	13
Worms		
U-shaped burrowing worms (Arenicola)	15	7
Spaghetti worm (Eupolymnia crassicornis)	1	2
Bearded fireworm (Hermodice carunculata)	16	21
Burrowing worm (Mesochaetopterus sp.)	1	0
Feather duster worm (Sabellidae)	4	0

Shrimp		
Snapping shrimp (Alpheus spp.)	3	0
Burrowing shrimp	6	0
Banded coral shrimp (Stenopus hispidus)	1	0
Mantis shrimp (stomatopods)	2	0
Other		
Milk conch (Strombus costatus)	7	12
Queen conch (Strombus gigas)	85	66
Scotch Bonnet (Phalium granulatum)	1	0
pen shells (Pinnidae)	5	0
Upside Down jellyfish (Cassiopea sp.)	42	189
hydroids	3	0
Donkey Dung Sea cucumber (Holothuria mexicana)	7	0
burrowing sea cucumber (Holothuria arenicola)	1	0
lettuce slug (Elysia crispata)	2	0
Inflated Sea Biscuit (Clypeaster rosaceus)	1	0
Seastar (Oreaster reticulatus)	0	7
Caribbean spiny lobster (Panulirus argus)	0	6
Octopus (Octopus briareus)	0	1

5. Discussion and Recommendations

There are a few things to note within the findings. Ghost shrimp (*Callianassid*) mounds appear to be undercounted in the 2022 survey. It is unlikely that the population of ghost shrimp has disappeared in this time frame so it is assumed that the surveyors must have missed this species during the most recent survey. These shrimps can be very difficult to see so it is likely they have been overlooked. This will be highlighted in follow-on surveys to ensure adequate representation.

The burrowing worm (*Mesochaetopterus sp.)* is a new species documented in Lac Bay. As a burrowing species, this worm can be very difficult to identify and is often overlooked. Additionally, this species is known to retract in their tubes upon the slightest disturbance in the environment. There was only one specimen documented in 2020 but it will continue to be included for follow-on surveys.

Other species, such as the upside-down jellyfish (*Cassiopia sp*.) can also be difficult to quantify. This species can dramatically range in size, from just a few millimeters across to the size of a dinner plate, therefore smaller specimens can be easily missed. Furthermore, in some cases the number of jellyfish is very large, with multiple jellyfish lying on top of one another which makes counting very difficult. It is likely that the 2020 numbers for this species have been undervalued, and the reader should not see this as a dramatic increase in population size between surveys.

Sponges can be hard to identify, both at the species level and within populations for individuals. One instance involves *Haliclona sp.,* where in 2020, the surveyors counted groups of *Haliclona sp*. together whereas surveyors in 2022 counted individual specimen resulting in the overall counts varying drastically. It is assumed there was no significant shift in populations between these two surveys.

The 2020 recording of the tunicate *Trididemnum cyanophorum* is indicative of presence (and not 1 specimen) as this species is typically found in large numbers. This species was first observed on Bonaire in Lac Bay in 2007, and nowhere else on island. The identification process started in 2012 and was executed by Naturalis and experts from Brazil (Dr. Rosana Moreira da Rocha, Universidade Federal do Paraná). The final identification as *T. cyanophorum* was completed in 2017. The recent 2019 Naturalis expedition to Bonaire again found unidentified tunicates in Lac Bay.

Figure 3: Images of *Trididemnum cyanophorum* ***found in Lac Bay***

As mentioned in the background section, invertebrates provide a number of critical ecosystem services to Lac Bay. There is an undeniable connection between the health of the invertebrates and the overall environmental conditions of neighboring habitats. Without a healthy invertebrate population, the coral reef, seagrass beds and mangroves will undoubtedly suffer.

There are a number of issues threatening the current invertebrate populations. Deteriorating water quality, both from global warming and over development, create less than ideal conditions within the bay. Human disturbances, which includes trampling and poaching (in the case of lobster and conch) can also significantly damage local populations. Lastly, large influxes of sargassum can smother entire benthic communities and negatively impact water quality, making the bay inhabitable for a number of invertebrate species.

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