Mapping of Marine Actinobacteria From The Neil Island, The Andamans

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Abstract- *Actinobacteria were distributed throughout many of the marine ecosystems including mangroves, coral reefs, and beaches. The secondary data of actinobacteria by used in this study. Water quality parameters data are taken from satellite and data was extracted from the different habitats (mangroves, coral reefs, and beaches) of Neil Island, Andaman identified were studied. In total, various actinobacteria genera were recorded viz., Streptomyces(56%), Nocardia(25%) and Nocardiopsis (19%). The data actinobacterial diversity from different habitats was plotted on a spatial map using geospatial software. The study provides reference line information on the geo-tagged actinobacterial diversity from different ecosystems of NeilIsland,Andaman.*

Keywords- Coastal habitats, GIS, Microbial data, Spatial, Neil Island

Specification table

Subject area	MarineActinobacteria
More specific subject area	Geographic information system and oceanmicrobiome
Type of data	Graph and Figure
How data was acquired	Secondary data, Satellite& Geo-database
Data format	Analysed
Experimental factors	Mapping of actinobacterial data using software
Experimental features	Mapping of the actinobacterial diversity of the Neil Island, Andaman on GIS platform andprocessed using the software
Data source location	Neil Island, Andaman

Value of data:

- This is a preliminary approach to map the actinobacterial diversity and environmental parameters of the Neil Island, Andaman.
- Recorded datasets act as a limelight for mapping the spatially and temporally diversity of actinobacteria in the Island environment.
- The study helps to pursue research in the field, knowing microbial communities of the Neil Island ecosystem and Earth's Microbiome subsequent expeditions in the future.

I. INTRODUCTION

Actinobacteria are best known as soil bacteria and most abundant in the terrestrial ecosystem and 99% of the diverse species have still been unexplored (Davies, 1999). Marine actinobacteria are believed to occur in the oceans mainly as dormant spores that are washed into the sea and are considered economically and biotechnologically valuable prokaryotes (Good fellow and Heynes, 1984). They are well recognized for their capabilities to produce useful natural products, which have great potential for applications in the medical, agricultural, and fine chemical industries (Zaho et al., 2016). Actinobacteria are gram-positive bacteria, with a high Guanine (G) plus Cytosine (C) ratio in their DNA (>55 mol %), which are phylogenetically related from the evidence of 16S ribosomal cataloging and DNA:rRNA pairing studies (Goodfellow and Williams, 1983). Actinobacteria are a source of various secondary metabolites, such as lignocellulose, hemicellulose immune modulators, anti-infective and anticancer agents (Stach and Bull, 2005).

Actinobacteria have a significant role in the decomposition of detritus in the mangrove environment that was reported (Whitman et al., 1998). Antifungal, antiviral, or antitumor properties of microbes are being probed in recent years. (Colwell, 1997). Microbial diversity and distribution in the mangrove (Thatoi et al., 2012), corals (Ainsworth et al., 2009) and the beach environment would help understand functionality and interactions in the ecosystems studied. Sediments that contain a limited amount of available organic matter, carbon being present in the complex forms (Magarvey et al., 2004).Streptomyces is one of the significant antibiotic producers in actinobacteria, and it is the largest genus in the actinobacteria and over 500 species have been described (Euzeby, 2008).

Streptomyces can produce bioactive secondary metabolites such as antifungals, antivirals, anti-tumors, anti-hypertensive, and mainly antibiotics and immunosuppressive agents (Procopio et al., 2012). *Nocardiopsis* is a widespread group in actinobacteria genera that also produce bioactive metabolites such as methylpendolmycins, apoptolidin, griseusin D, lipopeptidebiosurfactants, and naphthospironone. (Hong et al., 2013). *Nocardia* differs from *Nocardiopsis*in cell wall Characteristics, with 85 species. Its species are used in antimicrobial therapy (Komaki et al., 2014).

The biological diversity of actinobacteria in the coastal and marine ecosystems, such as deep seas, mangroves, coral reefs, and other ecosystems, is higher than that of the tropical rain forests(Lam,2006).

The study on the biogeography distribution of actinobacteria biodiversity over space and time is limited(Martiny et al., 2006). However, many studies on the diversity, distribution, and ecology of actinobacteria of the oceans (Stach*et al*., 2003 a, b) and reflections about the actinobacteria population in Andaman waters contain a good source of actinobacteria which is helpful for pharmaceutical and industrial application (Aarthi, 2009).

To understand the global distribution and temporal variability of actinobacteria, there is a need to integrate microbiological data and geographical location to improve our understanding to go through further research of the spatial and temporal patterns of microbial diversity. The Geographic Information System (GIS), a good approach to catalog microorganisms in the context of their geographical position, geological and geochemical habitats. This will help discern the spatial and temporal patterns of the distribution and activity of the microorganisms and visualize these trends at greater spatial scales (Jonathon, 2012). The study highlights the gep-tagged diversity of potential actinobacteria isolated from the mangrove, coral reefs, and beach environments of the Neil Island, Andamans.

II. MATERIALS AND METHODS

Study area and sampling:

Neil Island: The Island is located south part of the Andaman groups of the Island. The total area of the Island is13.7 km^2 much smaller Island. It consists no. of biodiversities such as beaches, mangroves, and coral reefs.

Beaches: Open broad shore covered by sand. Gastropod population (Cerithium) occured in the intertidal area (poongodi,2011).

Mangroves: Mangrove patches appeared in muddy and intertidal regions where most present *Rhizophoramucronata, Lumnitzeralittorea* , *Lumnitzeraracemosa, L. littorea*and *L. racemosa*(Giesen et al. 2006).

Corals: Shallow depth corals (*Galaxea*, *Pocillopora*) are visible and cleared where the seagrass (*Halophilaovalis*) bed was appeared (T.mondal et al., 2011).

Samples (secondary data) were collected from different locations and ecosystems such as beaches, mangroves, and coral reefs of Neil Island, Andaman during November 2011. Data on sea surface temperature, salinity, and pH were collected from MODIS AQUA from ocean color web over 4km resolution(Saleh et al., 2019). The study area and sampling station was given in Figure 1.

Fig 1: Location of the study area indicating different stations from Neil Island, Andamans, India

III. RESULTS

Water quality parameters

The observed sea surface water temperature ranges from 28.8 to 28.9°C(Avg ± 28.8) whereas the salinity varies between 32.3 and 32.4 ppt (Avg ±32.35) and the water pH ranges from 7.9 to 8.05(Avg ±7.9).

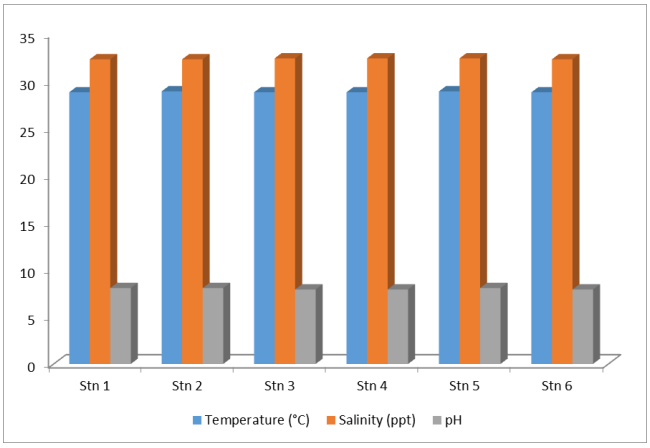


Fig: 1 Water quality observed during November 2011 (Source: MODIS aqua)

Actinobacterial load in different stations

In the study area, three genera of Actinobacteriaviz. *Streptomyces*(56%), *Nocardiopsis*(25%) and

Nocardia(19%)were reported. The coral reefstation 5 represents all three genera whereas station 6 is represented by *Strep to myces* and *Nocardia*. Similarly, mangrove station 3 represents all three genera whereas station 5 representsonly *Streptomyces*. The beaches (Stations 1 and 2) equal representation two genera viz., *Streptomyces* and *Nocardiopsis*. The distribution of Actinobacteria and it is percent composition is mentioned in the below table.

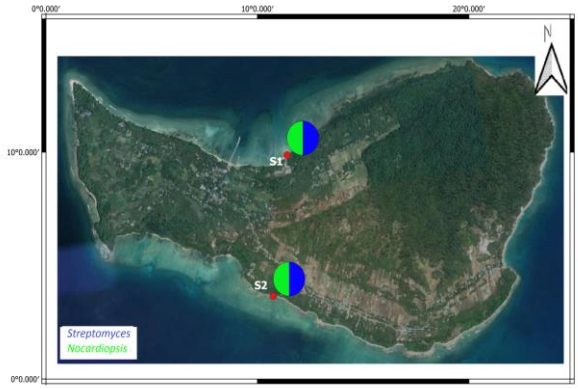


Fig :3 Beach region(S1& S2)along the Neil Island, Andamans

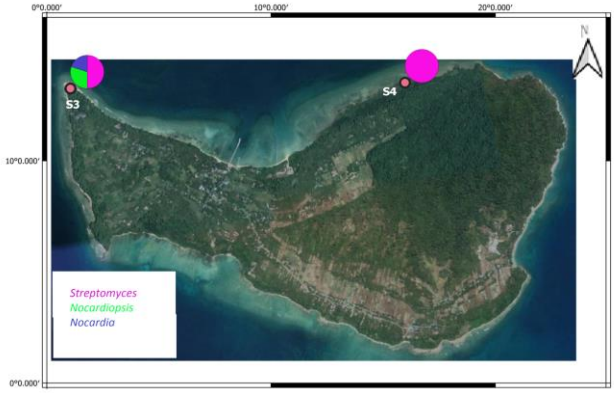


Fig 4: Mangrove region(S3&S4) along Neil Island, Andamans

Fig4: Coral region(S5&S6) along the Neil Island, Andamans

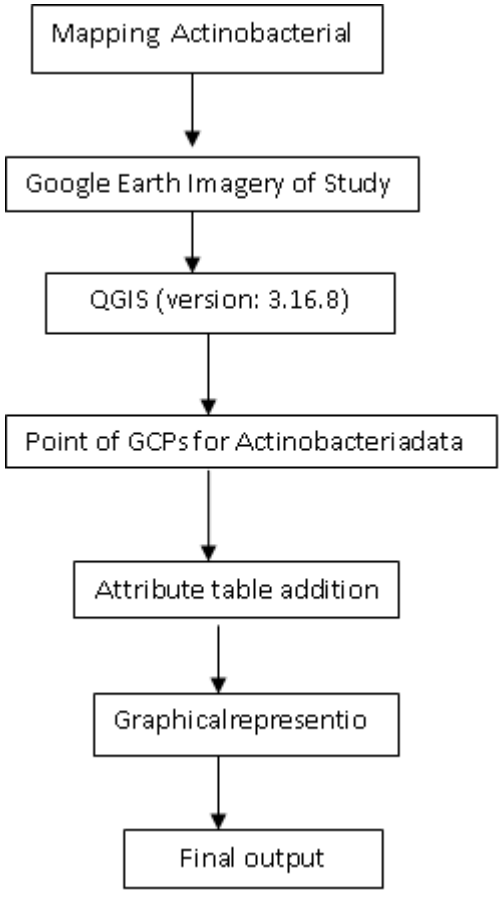
Table 1: Distributionof Actinobacteriaand its percent compositon

Stations	Latitude	Longitude	*Streptomyces*	*Nocardia*	*Nocardiopsis*
Beach					
S1	11°50'14.10"N,	93°2'20.60"E	50%	-	50%
S2	11°49'15.95"N,	93°2'4.30"E	50%	-	50%
Mangroves					
S3	11°50'55.93"N,	93°0'47.54"E	50%	30%	20%
S4	11°50'35.20"N,	93°3'9.20"E	100%	-	-
Coralreefs					
S5	11°49'32.10"N,	93°1'40.10"E	50%	50%	-
S6	11°48'46.70"N,	93°3'7.40"E	35%	35%	30%
Total			56%	19%	25%

IV. DIGITAL IMAGE PROCESSING

QGIS was used to create final vector maps for spatial mapping. All manually collected GPS points for microbial diversity were plotted as a point location on the spatial map. These spatial maps were used to create a composite of satellite imagery and microbial diversity data.

A detailed flow chart is given below:



Secondary sources of data i.e. molecular diversity data of Poongodi (2011), especially the species composition of actinobacteria of the Neil and, corresponding to the present GIS sites, have been used in the present study.

V. DISCUSSION

GIS is being widely used in many fields including marine zones such as mangroves (Kamal et al., 2014), coral reefs (Andrefouet, 2014), and seagrasses (Nobi et al., 2013). In this study, GIS is used three marine region of Actinobacteria respectively. Using (Microsoft access database which is linked to Arc internet map server software, ESRI) Yellowstone microbial database server and using the range of monikers and approaches, Stoner *et al.* (2001) detected, identified, and classified the microorganisms along with the water pH level and temperature and mapped only the abundant genus *Thermus*in the Octopus Spring. The present study,a base map was collected from the google platform and a map make from QGISalong with MODIS water quality data such as sea surface temperature, salinity, pH, and mapped Actinobacterial diversity. The influence of temporal and spatial variations on the microbial community composition has been assessed in the unique coastal mangroves of the Sundarbans (Basak et al., 2014). In this study,a spatial and temporal variation on the microbial community has been assessed in three different coastal stations such as beach, mangrove, and coral reef environmentof Neil Island, Andamans.

Sivasankar et al (2018) have also assessed the integration of microbiological data and found that geographical locations. They used Geographic Information System (GIS) to map and catalog the data on the actinobacterial diversity of the Southern Ocean waters. GIS mapping of microbial diversity especially actinobacteria paves way for the applied researchers to easily identify the regions of the availability of important species. In addition, the microbial diversity data delineated in the maps also will facilitate comprehensive understanding. Distinct spatial variations of actinobacteria were observed in the GIS mapping in the Neil island, where actinobacterial distribution was more in the mangrove habitats followed by the coral and beach habitats. The present study has mapped the different genera of actinobacteria such as *Streptomyces, Nocardiopsis,* and *Nocardia* in the Neil island of the Andamans.

Saleh (2019) reported MODIS-derived SST, salinity, and pH on Red sea data important to potential fish growth and activity. The present study showed the optimum level of water quality for growth conditions and activities of actinobacteria. The present study reports the actinobacterial distribution in Neil island, using the GIS map. *Streptomyces* distribution is higher and dominant than others such as *Nocardiopsis* and *Nocardia.*

VI. CONCLUSION

The study developed a GIS-based microbial map to explore the spatial diversity of the microbes (Actinobacteria) of the Neil island of the Andamans. The present study will be a forerunner to future workers to pursue research in the field of actinobacterial diversity, both spatially and temporally. This would greatly help explore the useful and potential actinobacteria from the appropriate coastal and marine locations, for use in biotechnology, bioprospecting, bioremediation, etc

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