# Molecular-based approaches to characterize coastal microbial community and their potential relation to the trophic state of Red Sea

Mohd Ikram Ansari [1], Moustapha Harb [1], Burton Jones [2], and Pei-Ying Hong [1*]

[1] Water Desalination and Reuse Center, Environmental Science and Engineering
[2] Red Sea Research Center, King Abdullah University of Science and Technology
(KAUST), 4700 King Abdullah Boulevard, Thuwal 23955-6900, Saudi Arabia

* Corresponding author:
Pei-Ying Hong
Email: peiying.hong@kaust.edu.sa
Phone: +966-12-8082218

**Table S1.** GPS coordinates of sampling sites.

| **Name** | **Description** | **Longitude** | **Latitude** |
|---|---|---|---|
| N1 | North sites | 39.0922° | 21.6085° |
| N2 | | 39.0923° | 21.5995° |
| N3 | | 39.0924° | 21.5906° |
| N4 | | 39.0932° | 21.5816° |
| N5 | | 39.0951° | 21.5727° |
| N6 | | 39.0684° | 21.5906° |
| N7 | | 39.0442° | 21.5906° |
| N8 | | 39.0201° | 21.5905° |
| N9 | | 38.9959° | 21.5905° |
| | | | |
| S1 | South sites | 39.0833° | 21.3413° |
| S2 | | 39.0838° | 21.3323° |
| S3 | | 39.0863° | 21.3235° |
| S4 | | 39.0882° | 21.3149° |
| S5 | | 39.0883° | 21.3060° |
| S6 | | 39.0592° | 21.3413° |
| S7 | | 39.0207° | 21.3413° |
| S8 | | 38.9965° | 21.3410° |
| | | | |
| NS1 | North-South sites | 39.0919° | 21.4970° |
| NS2 | | 39.0870° | 21.4209° |
| | | | |
| T1 | Transect | 38.9436° | 22.2798° |
| T2 | | 38.9309° | 22.1420° |
| T3 | | 38.8486° | 22.0287° |
| T4 | | 38.9350° | 21.9319° |
| T5 | | 39.0014° | 21.8141° |
| T6 | | 39.0718° | 21.6985° |
| T7 | | 39.1489° | 21.1000° |
| T8 | | 39.0853° | 21.6430° |
| | | | |
| KW1 | KAUST Beach | 39.0887° | 22.2925° |
| KW2 | | 39.0898° | 22.2924° |
| KW3 | | 39.0903° | 22.2918° |
| KW4 | | 39.0903° | 22.2909° |
| | | | |
| TW1 | Thuwal Beach | 39.0877° | 22.2765° |
| TW2 | | 39.0876° | 22.2751° |
| TW3 | | 39.0872° | 22.2743° |
| TW4 | | 39.0868° | 22.2732° |

**Table S2.** Oligonucleotide primer sequences used for microbial source tracking and for quantification of pathogens.

| **Primer names** | **Target** | **Sequence (5’-3’)** | **Amplicon size (bp)** | **Amplification factor** |
|---|---|---|---|---|
| 927F | Human-associated *Bacteroides vulgatus* | GGG CCC GCA CAA GCG G | 110 | 1.61 |
| Bvg1016R | | ATG CCT TGC GGC TTA CGG C | | |
| | | | | |
| 927F | Human-associated *Bacteroides fragilis* | GGG CCC GCA CAA GCG G | 118 | 1.74 |
| Bfrg1024R | | TCA CAG CGG TGA TTG CTC A | | |
| | | | | |
| 927F | Human-associated *Bacteroides uniformis* | GGG CCC GCA CAA GCG G | 110 | 1.65 |
| Bufm1018R | | CTG CCT TGC GGC TGA CA | | |
| | | | | |
| C367F | Cow-specific *Bacteroidales* | GGA AGA CTG AAC CAG CCA AGT A | 116 | 2.07 |
| C467R | | GCT TAT TCA TAC GGT ACA TAC AAG | | |
| | | | | |
| Pae-F | regA gene, *Pseudomonas aeruginosa* | CCGACTGACGCCAACGA | 211 | 2.09 |
| Pae-R | | CGACCCTACCTCCCACGAAT | | |
| | | | | |
| Cc-F1 | glyA gene, *Campylobacter coli* | CATATTGTAAAACCAAAGCTTATCGG | 133 | 1.96 |
| Cc-R1 | | AGTCCAGCAATGTGTGCAATG | | |
| | | | | |
| Abutz-F | rpoB gene, *Arcobacter butzleri* | ATA CTT TCT TGG TCT TGT GGT GTA | 132 | 2.35 |
| Agen-R | | CCA CAA AGA CAC TCA TAA TCT TTT AC | | |
| | | | | |

**Table S3.** Resistance patterns for enterococci and staphylococci isolates retrieved from the beach sands.

| No. of antibiotics | No. of resistant isolates | Resistance Pattern |
|---|---|---|
| 1 | 2 *E. faecium,* | K |
| | 1 *E. casseliflavus* | Cz |
| | 1 *E. faecalis* | C |
| | 1 *S. epidermis* | A |
| 2 | 1 *E. faecalis* | K, Cf |
| | 2 *E. faecium* | K, Cz |
| 3 | 1 *E. faecalis* | K, E, Cz |
| 4 | 1 *E. faecium* | K, E, C, Mp |
| | 1 *E. faecium* | K, Cz, C, Mp |
| 5 | 1 *E. faecium* | K, E, Cz, C, Cf |
| | 1 *E. faecium* | K, E, Cz, C, Mp |

Abbreviations:

Ampicillin (A), chloramphenicol (C), ciprofloxacin (Cf), kanamycin (K), tetracycline (T), Erythromycin (E), Ceftazidime (Cz), Meropenem (Mp)

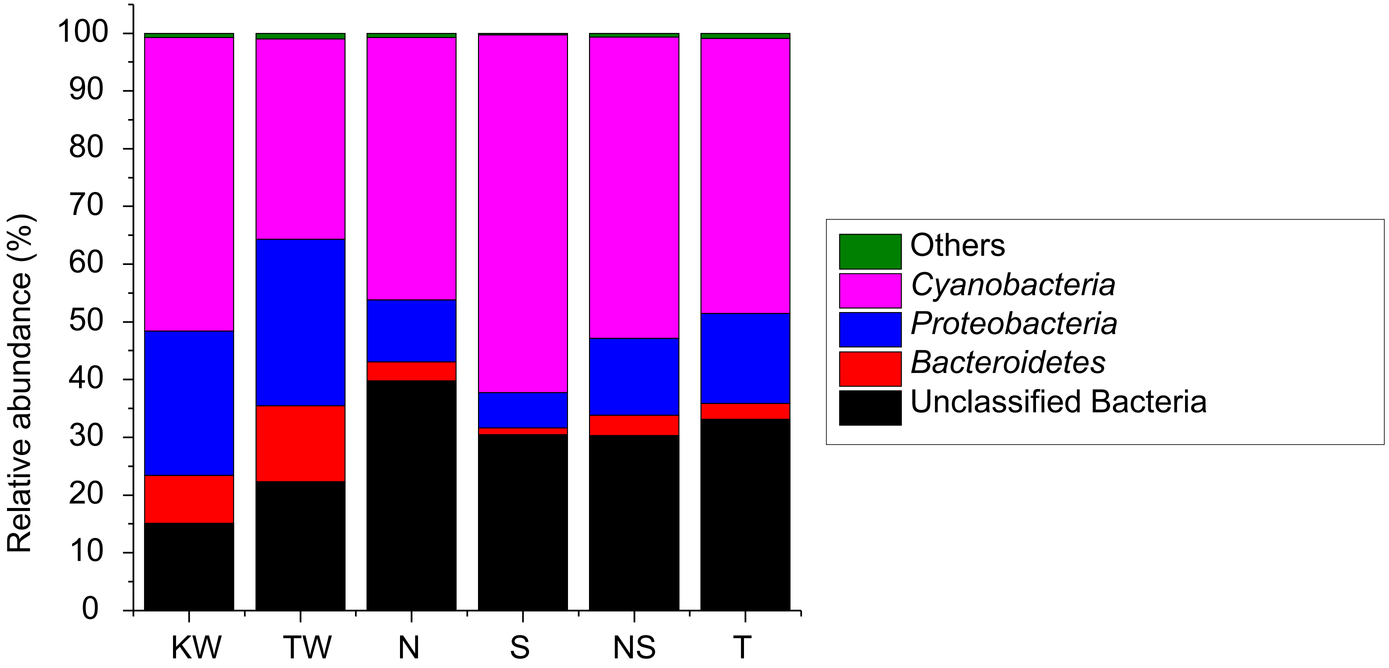

**Figure S1.** Predominant microbial phyla detected in the water samples.

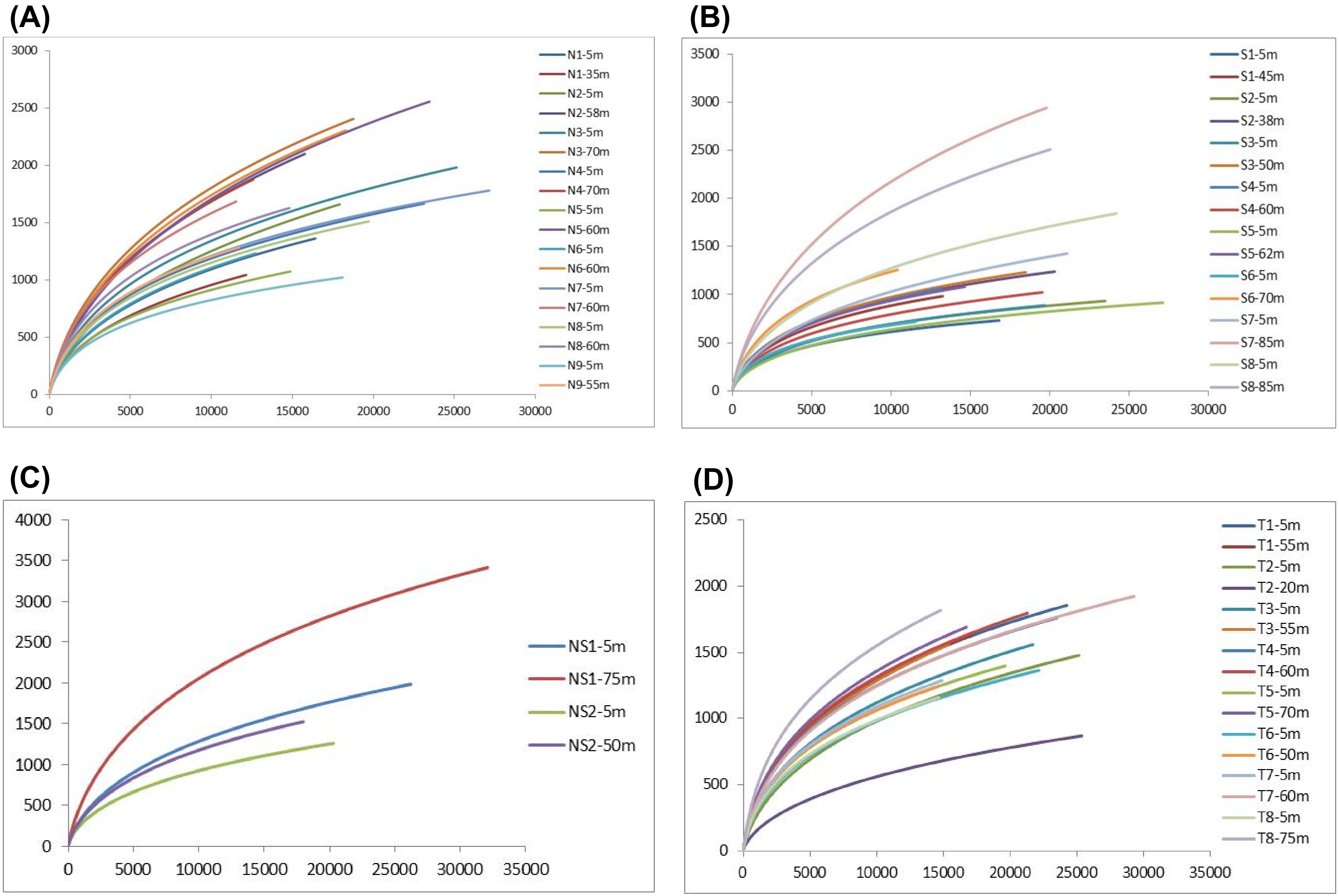

**Figure S2.** Rarefaction curves for all samples collected from **(A)** N sites, **(B)** S sites, **(C)** NS sites, and **(D)** T transects.

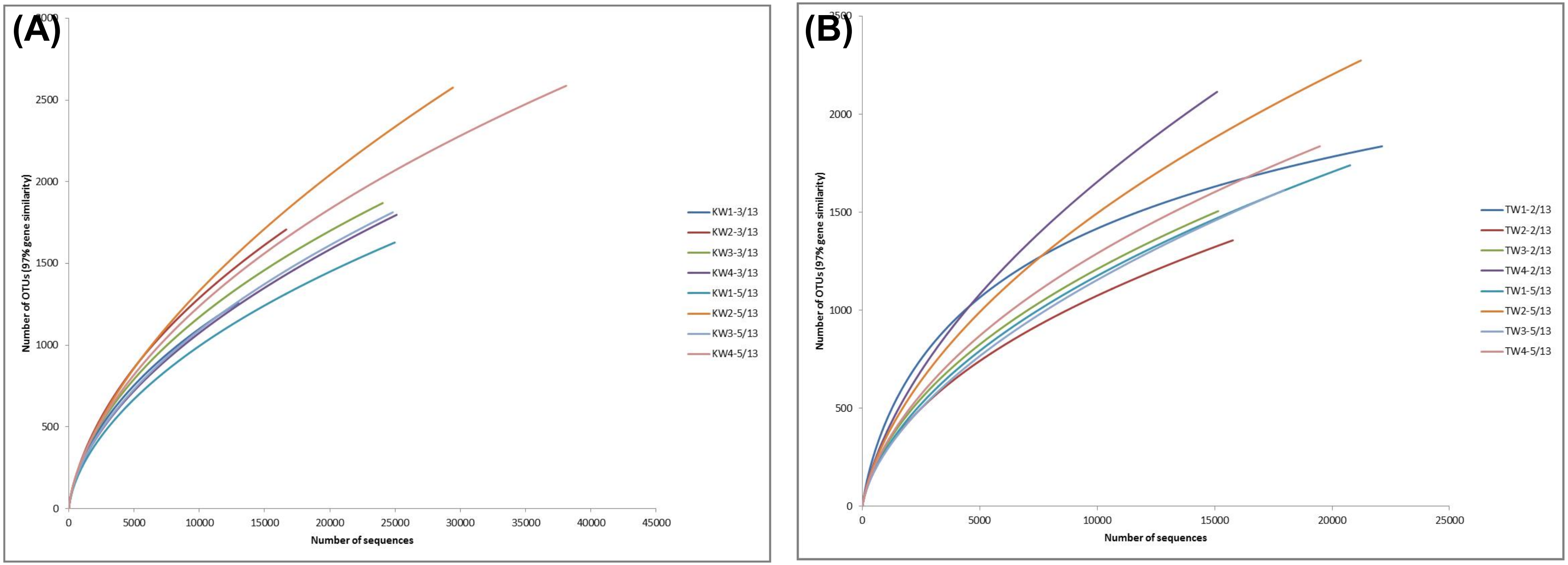

**Figure S3.** Rarefaction curves for all water samples collected from **(A)** KAUST beach, and **(B)** Thuwal beach