**Supplementary Table S1**. List of taxa names, voucher numbers, localities, GenBank numbers and reference information for newly generated sequences and sequences downloaded from GenBank of taxa included in phylogenetic analyses. Newly generated sequences are shown in bold. N.A. = not available.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Taxa | Id. No. | Locality | Reference | GenBank Accession No. | | |
|  |  |  |  | *psb*A | *rbc*L | LSU |
| *Antithamnion* sp. | LAF 4355 | Ewing Bank, northwestern Gulf of Mexico | Richards et al. 2017 | - | KY994130 | KY980440 |
| *Ceramium horridum* | N.A. | Baja California Sur, Mexico | Cho et al. 2008 | - | AF521796 | DQ238807 |
| *Clathromorphum compactum* | US 170929 | Labrador, Canada | Adey et al. 2015 | KP142730 | KP142774 | - |
| *Corallinapetra gabrielii* | TRH B15-2362  Holotype | Australia | Jeong et al. 2021 | MT199330 | MT199335 | - |
| *Corallinapetra novaezealandiae* | CUK 17902 | New Zealand | Jeong et al. 2021 | MT199331 | MT199334 | - |
| *Corallinapetra novaezealandiae* | WELT A032914 | New Zealand | Nelson et al. 2015 | FJ361637 | KM369124 | - |
| *Crustaphytum atlanticum* | RB 777609 Isotype | Brazil | Jesionek et al. 2020 | MK524382 | MN201585 | - |
| *Crustaphytum pacificum* | NTOU 001359 | Taiwan | Liu et al. 2018 | MH376921 | - | - |
| *Dawsoniolithon* sp. | NCU 657198 | Quintana Roo, Mexico | Richards et al. 2021 | MW452887 | MW456938 | - |
| *Harveylithon catarinense* | NCU 601565 (NC495) | Onslow Bay, North Carolina, USA | Richards et al. 2021 | MW452880 | MW456932 | - |
| *Harveylithon dispersum* | NCU 673209 | Campeche, México | Richards et al. 2021 | MW452882 | MW456934 | - |
| *Harveylithon dispersum* | PC 0606454 (FRA2242C) | Guadeloupe, French West Indies | Richards et al. 2021 | MW439253 | - | - |
| *Harveylithon dispersum* | LAF 5792 (NCU 607186) | Sharm el Sheikh, Egypt | Richards et al. 2021 | MW452881 | MW456933 | - |
| *Harveylithon felderi* | LAF 4224 | Ewing Bank, northwestern Gulf of Mexico | Richards et al. 2021 | MW439247 | MW439237 | MT482088 |
| *Harveylithon felderi* | LAF 5422 | Ewing Bank, northwestern Gulf of Mexico | Richards et al. 2021 | MW439248 | MW439238 | MT482089 |
| *Harveylithon felderi* | LAF 5439 | Ewing Bank, northwestern Gulf of Mexico | Richards et al. 2021 | MW439249 | MW439239 | MT482090 |
| *Harveylithon munitum* | NCU 653829 | Quintana Roo, México | Richards et al. 2021 | MW452877 | - | - |
| *Harveylithon munitum* | NCU 627394 | Pickle Reef, Florida, U.S.A. | Richards et al. 2021 | MW452874 | - | - |
| *Harveylithon munitum* | LAF 6360 | Ewing Bank, northwestern Gulf of Mexico | Richards et al. 2021 | MW439246 | MW439236 | MT482087 |
| *Harveylithon munitum* | LAF 6641 | Ewing Bank, northwestern Gulf of Mexico | Richards et al. 2021 | MW439244 | MW439234 | MT482085 |
| *Harveylithon saldomum* | LAF 6632 | Ewing Bank, northwestern Gulf of Mexico | Richards et al. 2021 | MW439251 | MW439241 | MT482092 |
| *Harveylithon saldomum* | LAF 6503 | Ewing Bank, northwestern Gulf of Mexico | Richards et al. 2021 | - | MW439242 | - |
| *Harveylithon* sp. | NCU 627390 (note: this specimen was incorrectly listed as NCU 627394 in Richards et al. 2021) | Pickle Reef, Florida, U.S.A. (note: this locality was incorrectly listed as Pigeon Reef in Richards et al. 2021) | Richards et al. 2021 | MW452883 | MW456935 | - |
| *Heydrichia cerasina* | NCU 617165 Isotype | Western Cape Province, South Africa | Richards et al. 2017 | MF034551 | KY994128 | KY980439 |
| *Heydrichia woelkerlingii* | NCU 597127 Topotype | South Africa | Mateo-Cid et al. 2014, Adey et al. 2015 | JQ917415 | KP142788 | - |
| *Lithophyllum atlanticum* | NCU 651909 | Onslow Bay, offshore North Carolina | Richards et al. 2018 | MG517483 | MG515114 | - |
| *Lithophyllum incrustans* | GALW 15746 (E137) | France | Hernández-Kantun et al. 2015 | JQ896238 | KR708543 | - |
| *Lithophyllum neocongestum* | US 223011 Holotype | Caribbean Panama | Hernández-Kantún et al. 2016 | KX020466 | KX020484 | - |
| *Lithophyllum* sp. | LAF 4294 | Sackett Bank, northwestern Gulf of Mexico | Richards et al. 2014 | KJ418414 | KJ652015 | KJ412331 |
| *Lithophyllum* sp. | LAF 5438 | Sackett Bank, northwestern Gulf of Mexico | Richards et al. 2014 | KJ418415 | KJ652012 | KJ412332 |
| *Lithophyllum searlesii* | NCweed-398/ NCU 593934 Holotype | Onslow Bay, offshore North Carolina | Richards et al. 2018 | MG515130 | MG515129 | - |
| *Lithothamnion glaciale* | GWS 007312 | Newfoundland/ Labrador, Canada | Peña et al. 2021 | KP224290 | KC134336 | - |
| *Lithothamnion lemoineae* | US 169116 | Labrador, Canada | Peña et al. 2021 | KP142723 | KP142768 | - |
| *Lithothamnion muellerii* | CN Herb. Lenormand s.n. | Victoria, Australia | Jeong et al. 2021 | - | MT199336 | - |
| *Lithothamnion* sp. E | LAF 5421  (8-29-11-4-1) | Ewing Bank, northwestern Gulf of Mexico | Richards et al. 2016 | KU557493 | - | - |
| *Lithothamnion* sp. E | LAF 6494 | Sackett Bank, northwestern Gulf of Mexico | Richards et al. 2016 | KU557494 | - | - |
| *Lithothamnion* sp. F | LAF 6882 (NSFII-26-3) | Campeche Banks | Richards et al. 2016 | KU557495 | - | - |
| *Lithothamnion* sp. G | LAF 6548  (8-26-12-3) | Ewing Bank, northwestern Gulf of Mexico | Richards et al. 2016 | KU557492 | - | - |
| *Lithothamnion* sp. I | LAF 1437A | Florida Middle Grounds | Krayesky-Self et al. 2014; Richards et al. 2016 | KP844863 | - | KR075888 |
| *Lithothamnion* sp. I | LAF 6521 | Ewing Bank, northwestern Gulf of Mexico | Krayesky-Self et al. 2014; Richards et al. 2016 | KP844864 | - | KR075890 |
| *Lithothamnion* sp. I | SPF57882 (IBC1704) | Brazil | Richards et al. 2016 | KU529477 | - | - |
| *Lithothamnion* sp. I | SPF57883 (IBC1708) | Brazil | Richards et al. 2016 | KU529478 | - | - |
| *Lithothamnion* sp. I | SPF57884 (IBC1907) | Brazil | Richards et al. 2016 | KU529479 | - | - |
| *Lithothamnion* sp. J | PHYKOS 7249 | Pacific Panama | Krayesky-Self et al. 2014; Richards et al. 2016 | KP844865 | - | KR075891 |
| *Membranoptera platyphylla* | UC 1856248 | Washington, U.S.A. | Hughey et al. 2017 | KT266849 | KT266849 | KU821149 |
| *Membranoptera tenuis* | UC 266439 neotype | Washington, U.S.A. | Hughey et al. 2017 | KP675983 | KP675983 | KU821151 |
| *Membranoptera weeksiae* | UC 264804 holotype | California, U.S.A. | Hughey et al. 2017 | KJ513670 | KJ513670 | KU821150 |
| *Mesophyllum erubescens* | LAF 7380 | Ewing Bank, northwestern Gulf of Mexico | Richards et al. 2020 | MN966833 | - | MT025829 |
| *Mesophyllum erubescens* | LAF D1939 | Bright Bank, northwestern Gulf of Mexico | Richards et al. 2020 | MN966834 | - | MT025827 |
| *Mesophyllum lichenoides* | LBC0031 | France | Bittner et al. 2011 | GQ917439 | - | GQ917312 |
| *Mesophyllum lichenoides* | NCU 590286 | United Kingdom | Richards et al. 2017 | MF034552 | KY994129 | - |
| *Mesophyllum sphaericum* | CPVP 776 | Spain | Pardo et al. 2014 | KC819262 | - | - |
| *Neogoniolithon rhizophorae* | LAF 6903 | Florida, U.S.A. | Richards et al. 2021 | MW452891 | MW452895 | MW452326 |
| *Neogoniolithon spectabile* | LAF 6900 | Florida, U.S.A. | Richards et al. 2021 | MW452892 | MW456931 | MW452327 |
| *Neopolyporolithon arcticum* | UBC A88609 | British Columbia, Canada | Adey et al. 2015 | KP142762 | KP142806 | - |
| *Phymatolithon calcareum* | LBC0001 | France | Bittner et al. 2011 | GQ917436 | - | GQ917309 |
| *Phymatolithon calcareum* | BM 000712373 | United Kingdom | Hernández-Kantun et al. 2015; Hernández-Kantun et al. 2016 | JQ896231 | KX020487 | - |
| *Porolithon onkodes* | TRH A26-1494 | Papua New Guinea | Gabrielson et al. 2018 | KY212106 | KY212106 | KY212108 |
| *Roseapetra farriae* | WELT A029119 (NZC2014) | New Zealand | Nelson et al. 2015 | FJ361382 | KM369120 | - |
| *Roseolithon goytacae* | FPG6 | Brazil | Coutinho et al. 2021 | MT554688 | - | - |
| *Roseolithon karaiborum* | LMC92  Holotype | Brazil | Coutinho et al. 2021 | MT512002 | - | - |
| ***Roseolithon louisianense*** | LAF 6547 (field id. 11-16-12) Isotype | Ewing Bank, northwestern Gulf of Mexico | Richards et al. 2016, Present Study | KU557496 | - | **ON427743** |
| ***Roseolithon louisianense*** | LAF 6549 (field id. 11-16-12) Holotype | Ewing Bank, northwestern Gulf of Mexico | Richards et al. 2016, Present Study | KU557497 | **ON394005** | **ON427744** |
| ***Roseolithon occidentale-atlanticum*** | LAF 6957B  (field id. 9-7-14-1-3) Holotype | Sackett Bank, northwestern Gulf of Mexico | Richards et al. 2016, Present Study | KU557501 | **ON394007** | **ON427748** |
| *Roseolithon potiguarae* | LMC34  Holotype | Brazil | Coutinho et al. 2021 | MT554664 | - | - |
| *Roseolithon purii* | LMC95  Holotype | Brazil | Coutinho et al. 2021 | MT554686 | - | - |
| *Roseolithon purii* | IBC1886  Isotype | Brazil | Coutinho et al. 2021 | MT554687 | MW316628 | - |
| ***Roseolithon purii*** | LAF 7384  (field id. 5-16-19-3-1) | Ewing Bank (28° 05.506’ N; 91° 01.985’ W) northwestern Gulf of Mexico, offshore Louisiana, U.S.A., 58 meters deep, *leg.* R.P Kittle III, W.E. Schmidt and S. Fredericq, 16.v.2019 | Present Study | **ON365774** | **ON365776** | **ON427742** |
| ***Roseolithon rhodolapidosum*** | LAF 6820 Holotype | Ewing Bank, northwestern Gulf of Mexico | Richards et al. 2016, Present Study | KU557498 | **-** | **ON427746** |
| ***Roseolithon rhodolapidosum*** | LAF 6956B  (field id. 9-7-14-1-2) | Sackett Bank, northwestern Gulf of Mexico | Richards et al. 2016, Present Study | KU557499 | **ON394006** | **ON427747** |
| ***Roseolithon* sp.** | LAF 6555B (field id. NSF-II-11-23) | Campeche Banks (22° 15.88’ N; 90° 35.64’ W) southwestern Gulf of Mexico, offshore México, 42-43 meters deep*, leg.* S. Fredericq, C.F.D. Gurgel and D. Gabriel, 6.vi.2005 | Present Study | - | - | **ON427745** |
| ***Roseolithon* sp.** | LAF 6631 | Pacific Panama | Richards et al. 2016 | KU557500 | - | - |
| *Roseolithon* sp. OTU 3 (as Hapalidiaceae sp. in Coutinho et al. 2021) | 16.032 | Brazil | Coutinho et al. 2021 | MT554662 | - | - |
| *Roseolithon* sp. OTU 7 (as Hapalidiaceae sp. in Coutinho et al. 2021) | LMC19 | Brazil | Coutinho et al. 2021 | MT554678 | - | - |
| *Roseolithon* sp. OTU 8 (as Hapalidiaceae sp. in Coutinho et al. 2021) | IBC1526 | Brazil | Coutinho et al. 2021 | MT512003 | - | - |
| *Roseolithon* sp. OTU 8 (as Hapalidiaceae sp. in Coutinho et al. 2021) | MCH22 | Brazil | Coutinho et al. 2021 | MT554683 | - | - |
| *Roseolithon tamoioi* | LMC1  Isotype | Brazil | Coutinho et al. 2021 | MT554658 | - | - |
| *Roseolithon tremembei* | LMC74 Holotype | Brazil | Coutinho et al. 2021 | MT554663 | - | - |
| *Roseolithon tupii* | LMC62 Holotype | Brazil | Coutinho et al. 2021 | MT554650 | - | - |
| *Roseolithon tupii* | IBC1547 | Brazil | Coutinho et al. 2021 | MT554656 | MW316626 | - |
| *Roseolithon tupii* | IBC1876 | Brazil | Coutinho et al. 2021 | - | MW316624 | - |
| *Roseolithon tupii* | IBC1188 | Brazil | Coutinho et al. 2021 | - | MW316625 | - |
| *Sporolithon amadoi* | RB 779736 Holotype | Espírito Santo, Brazil | Richards et al. 2019 | MN434069 | - | - |
| *Sporolithon amadoi* | LAF 7256  (5-4-18-4-2) Paratype | Ewing Bank northwestern Gulf of Mexico, offshore Louisiana, U.S.A. | Richards et al. 2019 | MN266235 | MN258542 | MN266234 |
| *Sporolithon eltorense* | NCU 606659  (LAF 5850) Holotype | El Tor, Egypt, Gulf of Suez | Richards et al. 2017 | MF034543 | MG051269 | KY980433 |
| *Sporolithon eltorense* | LAF 5767  (NCU 649164) | Dahab, Egypt, Gulf of Aqaba | Richards et al. 2017 | MF034544 | - | KY980434 |
| *Sporolithon episporum* | NCU 598843 (PHYKOS 5467) [*rbc*L is identical to holotype of this species] | Bocas del Toro, Panama, Caribbean Sea | Richards et al. 2017 | MF034547 | KY994124 | - |
| *Sporolithon franciscanum* | GM AF5 | Brazil | Adey et al. 2015 | KP142752 | KP142786 | - |
| ***Sporolithon gracile*** | LAF 7382  (field id. 5-20-19-5-1)  Holotype | Parker Bank (27˚ 58.180’ N; 92˚ 02.80’ W), northwestern Gulf of Mexico, offshore Louisiana, U.S.A., 92 meters deep, *leg.* R. P. Kittle III, W. E. Schmidt, and S. Fredericq, 20.v.2019 | Present Study | **ON365773** | **ON365775** | **ON427741** |
| *Sporolithon indopacificum* | L 3964509 Holotype | Tanzania | Maneveldt et al. 2017 | MG051270 | MG051266 | - |
| *Sporolithon mesophoticum* | NCU 658543  (BDA 2048) Holotype | Plantagenet (Argus) Bank, SSW of Bermuda | Richards et al. 2018b | MK159180 | MK159181 | - |
| *Sporolithon molle* | NCU 606657  (LAF 5848) Topotype | El Tor, Egypt, Gulf of Suez | Maneveldt et al. 2017, Richards et al. 2017 | MG051272 | KY994120 | KY980432 |
| *Sporolithon ptychoides* | NCU 606660  (LAF 5875) Topotype | El Tor, Egypt, Gulf of Suez | Richards et al. 2017 | MF034541 | KY994117 | KY980430 |
| *Sporolithon ‘ptychoides’* | ARS02349 | Hawaii | Sherwood et al. 2010 | - | - | HQ421906 |
| *Sporolithon ‘ptychoides’* | ARS02819 | Hawaii | Sherwood et al. 2010 | - | - | HQ421797 |
| Sporolithales | ARS02572 | Hawaii | Sherwood et al. 2010 | - | - | HQ421744 |
| *Sporolithon sinusmexicanum* | LAF 6956A Holotype | Sackett Bank,  northwestern Gulf of Mexico | Richards et al. 2017, Richards & Fredericq | MF034549 | KY994126 | KY980437 |
| *Sporolithon sinusmexicanum* | LAF 6970B | Dry Tortugas Vicinity, southeastern Gulf of Mexico | Richards et al. 2017 | MF034550 | KY994127 | KY980438 |
| ***Sporolithon sinusmexicanum*** | LAF 7255 (field id. 5-4-18-3-7) | Ewing Bank (28˚ 06.263’ N; 91˚ 01.558’ W), northwestern Gulf of Mexico, offshore Louisiana, U.S.A., 75 meters deep, *leg.* J. Richards, S. Pecnik, and S. Fredericq, 4.v.2018 | Present study | - | **ON365777** | - |
| ***Sporolithon* sp.** | LAF 6726 (field id. 12-5-10-7-5) | Southeast of Jakkula Bank and Southwest of Ewing Bank (27˚ 59.014’ N; 91˚ 39.176’ W), NWGMx, offshore Louisiana, U.S.A., 63.2 meters deep, *leg.* S. Fredericq and W.E. Schmidt | Present study | - | - | **ON427749** |
| *Sporolithon* sp. | LBC0695 | Fiji | Bittner et al. 2011 | GQ917501 | - | GQ917344 |
| *Sporolithon* sp. | ARS02833 | Hawaii | Sherwood et al. 2010 | - | - | HQ421810 |
| *Sporolithon tenue* | US 170943 | Brazil | Adey et al. 2015 | KP142751 | KP142785 | - |
| *Sporolithon yoneshigueae* | RB 600359 Paratype | Brazil | Bahia et al. 2015, Richards et al. 2017 | MF034545 | KY994122 | KY980435 |
| *Synarthrophyton patena* | NZC5537A | New Zealand | Twist et al. 2019 | MK413327 | MK674242 | - |
| *Tectolithon fluminense* | RB 760364 | Brazil | Jesionek et al. 2020 | MH123887 | MN201584 | - |
| *“Titanoderma”* sp. 2 | LAF 6735 | Sackett Bank, northwestern Gulf of Mexico | Richards et al. 2014 | KJ418413 | KJ652016 | KJ412335 |
| *“Titanoderma”* sp. 1 | LAF 6557A | Ewing Bank, northwestern Gulf of Mexico | Richards et al. 2014 | KJ418412 | KJ652014 | KJ412334 |
| *“Titanoderma”* sp. 1 | LAF 6556A | Ewing Bank, northwestern Gulf of Mexico | Richards et al. 2014 | - | KJ652013 | KJ671144 |

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