**Supplementary information**

Table S1. Systematic review of the literature using Scopus. Search was done within the Title, Abstract, Keywords’ field using ‘Antarctic’ with the terms ‘e\*DNA’, ‘environmental DNA’ ‘Next Generation Sequencing’ (NGS), ‘High Throughput Sequencing’ (HTS), ‘barcoding’ and ‘Metagenomics’. Papers were excluded where the sampling was not done in Antarctica, the sub-Antarctic or the Southern Ocean or where genetic data were not collected from environmental samples. Papers were assessed and divided by the environmental source of DNA (water, soil, sediment, ice/snow and other). References in bold are repeats within the same environmental source but different search terms. Studies that targeted vertebrate DNA are marked with \*.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Sample** | | **Search Term** | **Hits** | **References** |
| **Water** | *Seawater* | **Total** | **38** |  |
| *e\*DNA* | 4 | **Cowart et al. 2018\*; Flaviani et al. 2018;** Fuentes et al. 2019; **Mariani et al. 2019\*** |
| *Environmental DNA* | 5 | Rich et al. 2008; Rodríguez-Martínez et al. 2009; **Cowart et al. 2018\*; Flaviani et al. 2018; Mariani et al. 2019\*** |
| *\*barcoding* | 2 | **Zoccarato et al. 2016; Mariani et al. 2019\*** |
| *NGS* | 10 | Ghiglione et al. 2012; Wolf et al. 2013a; Wolf et al. 2013b; **Lee et al. 2015;** Millard et al. 2016; **Moreno-Pino et al. 2016; Flaviani et al. 2018; De Corte et al. 2019;** Moss et al. 2020; **Sadaiappan et al. 2020** |
| *HTS* | 11 | Alonso-Sáez et al. 2011; **Lee et al. 2015;** Yu et al. 2015; **Moreno-Pino et al. 2016; Zoccarato et al. 2016;** Lin et al. 2017; **Cowart et al. 2018\*;** Gast et al. 2018; Lin et al. 2019; Liu and Jiang 2020; **Zhang et al. 2020** |
| *Metagenomics* | 19 | Alonso-Sáez et al. 2012; Grzymski et al. 2012; Wilkins et al. 2013; Williams et al. 2013, 2014; Bertrand et al. 2015; Delmont et al. 2015; **Lee et al. 2015;** Brum et al. 2016; Gionfriddo et al. 2016; Miranda et al. 2016; Alcamán-Arias et al. 2018; **Cowart et al. 2018\*;** Alarcón-Schumacher et al. 2019; **De Corte et al. 2019;** Kim et al. 2019; Yang et al. 2019a; Yang et al. 2019b; **Sadaiappan et al. 2020; Zhang et al. 2020** |
| *Terrestrial water bodies* | **Total** | **27** |  |
| *e\*DNA* | 1 | Fröls et al. 2012 |
| *Environmental DNA* | 1 | Karr et al. 2005 |
| *\*barcoding* | 0 |  |
| *NGS* | 4 | Lagkouvardos et al. 2014; Li et al. 2020b; Picazo et al. 2019; Weisleitner et al. 2019 |
| *HTS* | 5 | Archer et al. 2014; Quiroga et al. 2015 Archer et al. 2016; Schiaffino et al. 2016; Cho et al. 2020 |
| *Metagenomics* | 17 | Ng et al. 2010; Lauro et al. 2011; Yau et al. 2011; Durso et al. 2012; Demaere et al. 2013; Huang et al. 2013; Yau et al. 2013; **Lagkouvardos et al. 2014;** Lõpez-Bueno et al. 2015; Simmons et al. 2015; Tschitschko et al. 2015; de Cárcer et al. 2016; Cornet et al. 2018; Tschitschko et al. 2018; Hamm et al. 2019; Yang et al. 2019; Li et al. 2020b |
| **Soil** |  | **Total** | **43** |  |
| *e\*DNA* | 1 | **Fraser et al. 2018** |
| *Environmental  DNA* | 8 | **Cieśliński et al. 2009b; Cieśliński et al. 2009a;** Rao et al. 2012; Teasdale et al. 2013; **Pansu et al. 2015; Czechowski et al. 2016b; Czechowski et al. 2016a; Fraser et al. 2018** |
| *\*barcoding* | 6 | **Pansu et al. 2015; Czechowski et al. 2016a; Fraser et al. 2018; Khomich et al. 2018;** Rippin et al. 2018; Canini et al. 2020 |
| *NGS* | 6 | Bergstrom et al. 2015; Pessi et al. 2015; **Baeza et al. 2017;** Yan et al. 2017; **Borsetto et al. 2019;** Weisleitner et al. 2019 |
| *HTS* | 12 | van Dorst et al. 2014; Cox et al. 2016; **Czechowski et al. 2016a; Czechowski et al. 2016b;** Tahon et al. 2016; Wei et al. 2016; Cong et al. 2017; Kleinteich et al. 2017; Chua et al. 2018; **Khomich et al. 2018;** Han et al. 2019; Rego et al. 2019 |
| *Metagenomics* | 25 | Berlemont et al. 2009; **Cieśliński et al. 2009a; Cieśliński et al. 2009b;** Heath et al. 2009; Berlemont et al. 2011; Hu et al. 2012; Pearce et al. 2012; Bartasun et al. 2013; Berlemont et al. 2013; Chan et al. 2013; Winsley et al. 2014; Amos et al. 2015; Anderson et al. 2015; **Baeza et al. 2017;** Goordial et al. 2017b; Ji et al. 2017; Pulschen et al. 2017; Santamans et al. 2017; Donovan et al. 2018; Van Goethem et al. 2018; **Borsetto et al. 2019;** Li et al. 2019a; Molina-Montenegro et al. 2019; Oh et al. 2019; Yuan et al. 2019 |
| **Sediment** |  | **Total** | **22** |  |
| *e\*DNA* | 0 |  |
| *Environmental DNA* | 7 | Gordon et al. 2000; Habura et al. 2004; Karr et al. 2005; Pawlowski et al. 2005; Jaraula et al. 2010; Pawlowski et al. 2011; Ficetola et al. 2018\* |
| *\*barcoding* | 3 | **Fonseca et al.  2017;** Brannock et al. 2018; Vause et al. 2019 |
| *NGS* | 1 | Weisleitner  2019 |
| *HTS* | 6 | Emil Ruff et al. 2014; Archer et al. 2015; Fonseca et al.  2017; Li et al. 2019a; Cho et al. 2020; Li et al. 2020a |
| *Metagenomics* | 6 | Huang et al. 2013; Hopkins et al.  2014; Matos et al. 2016; Vishnivetskaya et al. 2018; Centurion et al. 2019; Millán-Aguiñaga et al. 2019 |
| **Ice/Snow** |  | **Total** | **12** |  |
| *e\*DNA* | 0 |  |
| *Environmental DNA* | 0 |  |
| *\*barcoding* | 2 | Davey et al. 2019; Soto et al. 2020 |
| *NGS* | 1 | Weisleitner et al. 2019 |
| *HTS* | 7 | Webster-Brown et al. 2015; **Lopatina et al. 2016;** Sommers et al. 2018; Gast et al. 2018; Campen et al. 2019; Lutz et al. 2019; Sommers et al. 2019a |
| *Metagenomics* | 5 | Shtarkman et al. 2013; Antony et al. 2016; Gionfriddo et al. 2016; **Lopatina et al. 2016;** Sommers et al. 2019b |
| **Other** | *Air* | **Total** | **3** |  |
| *e\*DNA* | 0 |  |
| *Environmental DNA* | 0 |  |
| *\*barcoding* |  |  |
| *NGS* | 2 | Weisleitner et al. 2019; Kobayashi et al. 2016 |
| *HTS* | 1 | Bottos et al. 2014 |
| *Metagenomics* | 1 |  |
| *Rock* | **Total** | **13** |  |
| *e\*DNA* | 1 | Vause et al. 2019 |
| *Environmental DNA* | 1 | De la Torre et al. 2003 |
| *\*barcoding* | 4 | Coleine et al. 2018; Coleine et al. 2019; Coleine et al. 2020a; **Coleine et al. 2020b** |
| *NGS* | 0 |  |
| *HTS* | 4 | Archer et al. 2017; Lacap-Bugler et al. 2017; Rego et al. 2019; **Coleine et al. 2020b** |
| *Metagenomics* | 4 | Chan et al. 2013; Le et al. 2016; Guerrero et al. 2017; Li et al. 2019b |
| *Microbial Mat* | **Total** | **14** |  |
| *e\*DNA* | 0 |  |
| *Environmental DNA* | 1 | Callejas et al. 2011 |
| *\*barcoding* | 0 |  |
| *NGS* | 3 | **Zawar-Reza et al. 2014; Koo et al. 2017a;** Koo et al. 2017b |
| *HTS* | 7 | Tytgat et al. 2014; Pessi et al. 2016; Johnson et al. 2017; **Koo et al. 2017a;** Pessi et al. 2018; Almela et al. 2019; Lezcano et al. 2019 |
| *Metagenomics* | 6 | **Zawar-Reza et al. 2014;** Koo et al. 2016; Velázquez et al. 2016; **Koo et al. 2017a;** Zaikova et al. 2019; Dillon et al. 2020 |
| *Bio film* | **Total** | **1** |  |
| *e\*DNA* | 0 |  |
| *Environmental DNA* | 0 |  |
| *\*barcoding* | 0 |  |
| *NGS* | 0 |  |
| *HTS* | 0 |  |
| *Metagenomics* | 1 | Tighe et al. 2017 |
| *Faeces* | **Total** | **7** |  |
| *e\*DNA* | 0 |  |
| *Environmental DNA* | 0 |  |
| *\*barcoding* | 0 |  |
| *NGS* | 2 | Varsani et al. 2014; McInnes et al. 2016\* |
| *HTS* | 4 | Medeiros et al. 2016; Neira et al. 2017; Yew et al. 2017; Morandini et al. 2019 |
| *Metagenomics* | 1 | Grzesiak et al. 2020 |

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