

Supplementary Material

Manuscript: Metal concentrations and biological effects from one of the largest mining disasters in the world (Brumadinho, Minas Gerais, Brazil)

Authors: Cristiane dos Santos Vergilio, Diego Lacerda, Braulio Cherene Vaz de Oliveira, Echily Sartori, Gabriela Munis Campos, Anna Luiza Pereira, Diego Borges de Aguiar, Tatiana da Silva Souza, Marcelo Gomes de Almeida, Fabiano Thompson, Carlos Eduardo de Rezende

Figure S1. a) Visual aspect water collected at Brumadinho sampling site (S3 – 5.2 km of the Dam rupture area). b) The road complete filled with the mud.



Table S2. Geospatial localization (latitude and longitude), distance of the dam, physical and chemical parameters of the sampling sites after Brumadinho dam rupture. SPM= Superficial Particulate Material, DOC = Dissolved Organic Carbon, TDN = Total Dissolved Nitrogen, DO = Dissolved Oxygen.

| Damming distance (km) | Sites | Latitude | Longitude | SPM (mg/L) | DOC (mg/L) | TDN (mg/L) | Water | | | | | Sediment | | |
|-----------------------|----------------------|------------|------------|------------|------------|------------|-----------------|-----------------------------------|------|-------------|-----------|----------|----------|----------|
| | | | | | | | Turbidity (NTU) | Conductivity ($\mu\text{s/cm}$) | pH | Temperature | DO (mg/L) | Sand (%) | Silt (%) | Clay (%) |
| -61.3 | Moeda | 20°20'40"S | 44°02'25"W | 18.36 | 1.99 | 1 | 6 | 176 | 7.55 | 27.8 | 4.3 | 100 | 0 | 0 |
| 0 | Tailing | 20°09'14"S | 44°09'34"W | - | - | - | - | - | - | - | - | 30 | 34 | 36 |
| 5.2 | Brumadinho | 20°08'27"S | 44°12'03"W | 516.14 | 1.34 | 0.69 | 3000 | 273 | 7.36 | 28 | 3.92 | 50 | 27 | 23 |
| 48 | Juatuba | 19°56'56"S | 44°18'18"W | 8.44 | 1.94 | 1.47 | 6.1 | 233 | 7.98 | 27.7 | 4.63 | 38 | 40 | 22 |
| 111 | São José da Varginha | 19°40'13"S | 44°28'51"W | 18.8 | 1.67 | 1.43 | 5.2 | 229 | 7.25 | 30 | 6.15 | 53 | 30 | 16 |
| 240 | Angueretá | 19°10'25"S | 44°42'05"W | 8.32 | 2.21 | 1.18 | 3.6 | 251 | 7.45 | 29.1 | 5.52 | 42 | 36 | 22 |
| 302 | Retiro Baixo | 18°54'09"S | 44°47'02"W | 4.45 | 6.16 | 0.69 | 1.7 | 177 | 7.55 | 30.4 | 5.32 | 36 | 38 | 26 |

Table S4. Metal concentrations in the water (total and dissolved) of the sampling sites after the Brumadinho Dam rupture. CONAMA values with * are set from the dissolved fraction.

| Sampling site | Compartment | Damming distance (km) | Ag | Al | As | Ba | Be | Bi | Ca | Cd | Ce | Co | Cr | Cu |
|--------------------------|-------------------|-----------------------|---------|---------|---------|--------|---------|---------|--------|---------|---------|---------|---------|---------|
| | | | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) |
| 1 - Moeda | Water (Total) | -61.3 | <0.0060 | 0.76 | <0.0062 | 0.020 | <0.0001 | <0.0024 | 5.33 | <0.0001 | 0.005 | 0.0047 | 0.005 | 0.015 |
| 3 - Brumadinho | Water (Total) | 5.2 | <0.0060 | 10.02 | <0.0062 | 0.121 | <0.0001 | <0.0024 | 5.30 | 0.007 | 0.010 | 0.0115 | 0.010 | 0.079 |
| 4 - Juatuba | Water (Total) | 48 | <0.0060 | 0.58 | <0.0062 | 0.011 | <0.0001 | <0.0024 | 6.39 | <0.0001 | <0.0016 | <0.0005 | 0.007 | 0.025 |
| 5 - São José da Varginha | Water (Total) | 111 | <0.0060 | 0.69 | <0.0062 | 0.022 | <0.0001 | <0.0024 | 6.71 | <0.0001 | <0.0016 | <0.0005 | 0.002 | 0.014 |
| 6 - Angueretá | Water (Total) | 240 | <0.0060 | 0.38 | <0.0062 | 0.020 | <0.0001 | <0.0024 | 6.33 | <0.0001 | <0.0016 | <0.0005 | <0.0003 | 0.019 |
| 7 - Retiro Baixo | Water (Total) | 302 | <0.0060 | 0.27 | <0.0062 | 0.020 | <0.0001 | <0.0024 | 6.35 | <0.0001 | <0.0016 | <0.0005 | <0.0003 | 0.021 |
| 1 - Moeda | Water (Dissolved) | -61.3 | <0.0060 | 0.27 | <0.0062 | 0.015 | <0.0001 | <0.0024 | 2.78 | <0.0001 | <0.0016 | <0.0005 | <0.0003 | 0.007 |
| 3 - Brumadinho | Water (Dissolved) | 5.2 | <0.0060 | 0.20 | <0.0062 | 0.100 | <0.0001 | <0.0024 | 3.29 | 0.0008 | 0.0018 | <0.0005 | <0.0003 | <0.0006 |
| 4 - Juatuba | Water (Dissolved) | 48 | <0.0060 | 0.04 | <0.0062 | 0.007 | <0.0001 | <0.0024 | 3.60 | <0.0001 | <0.0016 | <0.0005 | <0.0003 | 0.007 |
| 5 - São José da Varginha | Water (Dissolved) | 111 | <0.0060 | 0.08 | <0.0062 | 0.012 | <0.0001 | <0.0024 | 4.46 | <0.0001 | <0.0016 | <0.0005 | 0.001 | 0.001 |
| 6 - Angueretá | Water (Dissolved) | 240 | <0.0060 | 0.03 | <0.0062 | 0.006 | <0.0001 | <0.0024 | 4.82 | <0.0001 | <0.0016 | <0.0005 | <0.0003 | <0.0006 |
| 7 - Retiro Baixo | Water (Dissolved) | 302 | <0.0060 | 0.18 | <0.0062 | 0.009 | <0.0001 | <0.0024 | 5.42 | <0.0001 | <0.0016 | <0.0005 | <0.0003 | <0.0006 |
| | CONAMA | I | 0.01 | 0.10* | 0.01 | 0.70 | 0.04 | - | - | 0.001 | - | 0.0500 | 0.05 | 0.009* |
| | | III | 0.05 | 0.20* | 0.033 | 1.00 | 0.10 | - | - | 0.010 | - | 0.2000 | 0.05 | 0.013* |
| Sampling site | Compartment | Damming distance (km) | Dy | Er | Eu | Fe | Ga | Gd | Hg | Ho | In | K | La | Li |
| | | | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (ng/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) |
| 1 - Moeda | Water (Total) | -61.3 | <0.0002 | <0.0003 | <0.0001 | 1.39 | <0.0031 | <0.0004 | 3.55 | <0.0002 | <0.0018 | 1.52 | 0.0041 | 0.0013 |
| 3 - Brumadinho | Water (Total) | 5.2 | <0.0002 | 0.001 | <0.0001 | 48.15 | <0.0031 | 0.009 | 144.26 | 0.0004 | 0.2019 | 1.53 | 0.012 | 0.0041 |
| 4 - Juatuba | Water (Total) | 48 | <0.0002 | <0.0003 | <0.0001 | 0.87 | <0.0031 | <0.0004 | 4.12 | <0.0002 | 0.0089 | 2.12 | <0.0004 | 0.0007 |
| 5 - São José da Varginha | Water (Total) | 111 | <0.0002 | <0.0003 | <0.0001 | 0.76 | <0.0031 | <0.0004 | 4.16 | <0.0002 | <0.0018 | 1.92 | <0.0004 | 0.0005 |
| 6 - Angueretá | Water (Total) | 240 | <0.0002 | <0.0003 | <0.0001 | 0.50 | <0.0031 | <0.0004 | 2.46 | <0.0002 | <0.0018 | 1.80 | <0.0004 | 0.0004 |
| 7 - Retiro Baixo | Water (Total) | 302 | <0.0002 | <0.0003 | <0.0001 | 0.28 | <0.0031 | <0.0004 | 1.51 | <0.0002 | <0.0018 | 1.92 | <0.0004 | 0.0004 |
| 1 - Moeda | Water (Dissolved) | -61.3 | <0.0002 | <0.0003 | <0.0001 | 0.38 | <0.0031 | <0.0004 | 1.88 | <0.0002 | <0.0018 | 1.28 | <0.0004 | 0.0009 |
| 3 - Brumadinho | Water (Dissolved) | 5.2 | <0.0002 | <0.0003 | <0.0001 | 0.84 | <0.0031 | <0.0004 | 1.86 | <0.0002 | <0.0018 | 1.19 | <0.0004 | 0.0013 |
| 4 - Juatuba | Water (Dissolved) | 48 | <0.0002 | <0.0003 | <0.0001 | 0.02 | <0.0031 | <0.0004 | 1.01 | <0.0002 | 0.0028 | 1.76 | <0.0004 | 0.0004 |
| 5 - São José da Varginha | Water (Dissolved) | 111 | <0.0002 | <0.0003 | <0.0001 | 0.07 | <0.0031 | <0.0004 | 1.90 | <0.0002 | <0.0018 | 1.35 | <0.0004 | <0.0002 |
| 6 - Angueretá | Water (Dissolved) | 240 | <0.0002 | <0.0003 | <0.0001 | 0.01 | <0.0031 | <0.0004 | 1.31 | <0.0002 | <0.0018 | 1.45 | <0.0004 | <0.0002 |
| 7 - Retiro Baixo | Water (Dissolved) | 302 | <0.0002 | <0.0003 | <0.0001 | 0.12 | <0.0031 | <0.0004 | 0.66 | <0.0002 | <0.0018 | 1.00 | <0.0004 | <0.0002 |
| | CONAMA | I | - | - | - | 0.30* | - | - | 200 | - | - | - | - | 2.5000 |
| | | III | - | - | - | 5.00* | - | - | 2000 | - | - | - | - | 2.5000 |

CONAMA: Conselho Nacional do Meio Ambiente – “National Council of Environment”

Table S4. Continuation.

| Sampling site | Compartment | Damming distance (km) | U (mg/L) | V (mg/L) | Y (mg/L) | Yb (mg/L) | Zn (mg/L) |
|--------------------------|-------------------|-----------------------|-------------|-------------|-------------|--------------|--------------|
| 1 - Moeda | Water (Total) | -61.3 | 0.06 | <0.0006 | 0.007 | <0.0002 | 0.016 |
| 3 - Brumadinho | Water (Total) | 5.2 | 0.14 | 0.007 | 0.017 | <0.0002 | 0.042 |
| 4 - Juatuba | Water (Total) | 48 | <0.0088 | <0.0006 | 0.000 | <0.0002 | 0.054 |
| 5 - São José da Varginha | Water (Total) | 111 | <0.0088 | <0.0006 | <0.0002 | <0.0002 | 0.005 |
| 6 - Angueretá | Water (Total) | 240 | <0.0088 | <0.0006 | <0.0002 | <0.0002 | <0.0018 |
| 7 - Retiro Baixo | Water (Total) | 302 | <0.0088 | <0.0006 | <0.0002 | <0.0002 | <0.0018 |
| 1 - Moeda | Water (Dissolved) | -61 | <0.0088 | <0.0006 | 0.0005 | <0.0002 | 0.004 |
| 3 - Brumadinho | Water (Dissolved) | 5 | <0.0088 | <0.0006 | <0.0002 | <0.0002 | 0.029 |
| 4 - Juatuba | Water (Dissolved) | 48 | <0.0088 | <0.0006 | <0.0002 | <0.0002 | 0.023 |
| 5 - São José da Varginha | Water (Dissolved) | 111 | <0.0088 | <0.0006 | <0.0002 | <0.0002 | 0.003 |
| 6 - Angueretá | Water (Dissolved) | 240 | <0.0088 | <0.0006 | <0.0002 | <0.0002 | <0.0018 |
| 7 - Retiro Baixo | Water (Dissolved) | 302 | <0.0088 | <0.0006 | <0.0002 | <0.0002 | <0.0018 |
| | CONAMA | I | 0.02 | 0.10 | - | - | 0.18 |
| | | III | 0.02 | 0.10 | - | - | 5.00 |

Table S5. Metal concentrations in the sediment of the sampling sites after the Brumadinho Dam rupture.

| Sampling site | Damming distance (km) | Ag (µg/g) | Al (mg/g) | As (µg/g) | Ba (µg/g) | Be (µg/g) | Bi (µg/g) | Ca (µg/g) | Cd (µg/g) | Ce (µg/g) | Co (µg/g) | Cr (µg/g) | Cu (µg/g) |
|--------------------------|-----------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| 1 - Moeda | -61.3 | <0.50 | 8.9 | 10.23 | 135.3 | <0.09 | 2.82 | 292 | 2.62 | 26.88 | 28.21 | 44.4 | 8.94 |
| 2 - Tailing | 0 | 1.31 | 10.8 | 4.69 | 76.6 | 0.49 | 15.20 | 161 | 30.94 | 15.05 | 10.43 | 16.4 | 36.03 |
| 3 - Brumadinho | 5.2 | 2.31 | 21.7 | 2.43 | 121.8 | 0.91 | 13.24 | 311 | 32.57 | 9.72 | 14.09 | 28.0 | 66.42 |
| 4 - Juatuba | 48 | 0.81 | 75.8 | 3.68 | 235.9 | 0.88 | <1.62 | 843 | 7.62 | 34.86 | 10.09 | 50.2 | 24.00 |
| 5 - São José da Varginha | 111 | <0.50 | 9.9 | <0.90 | 138.0 | <0.09 | 2.05 | 246 | 2.32 | 10.11 | 8.74 | 10.0 | 5.92 |
| 6 - Angueretá | 240 | 0.95 | 47.9 | 11.86 | 134.8 | 1.22 | <1.62 | 288 | 8.99 | 8.00 | 14.76 | 92.3 | 36.98 |
| 7 - Retiro Baixo | 302 | 0.84 | 37.2 | 14.52 | 158.4 | 1.31 | <1.62 | 159 | 7.39 | 45.51 | 13.79 | 156.1 | 38.24 |
| | TEL | - | - | 5.90 | - | - | - | - | 0.60 | - | - | 37.3 | 35.7 |
| | PEL | - | - | 17.0 | - | - | - | - | 3.53 | - | - | 90 | 197 |
| Sampling site | Damming distance (km) | Dy (µg/g) | Er (µg/g) | Eu (µg/g) | Fe (mg/g) | Ga (µg/g) | Gd (µg/g) | Hg (ng/g) | Ho (µg/g) | In (µg/g) | K (mg/g) | La (µg/g) | Li (µg/g) |
| 1 - Moeda | -61.3 | 0.76 | <0.40 | <0.44 | 16.1 | 1.08 | 1.77 | 32.0 | <0.42 | 56.3 | 2625 | 2.80 | 7.42 |
| 2 - Tailing | 0 | 5.13 | 0.70 | 1.61 | 264.9 | 92.34 | 50.61 | 101.3 | <0.42 | 210.2 | 354 | 22.20 | 8.67 |
| 3 - Brumadinho | 5.2 | 7.36 | 0.98 | 1.18 | 279.6 | 113.85 | 48.49 | 184.5 | <0.42 | 402.6 | 961 | 13.82 | 17.32 |
| 4 - Juatuba | 48 | 1.47 | 0.96 | 1.33 | 71.9 | 51.27 | 12.17 | 51.5 | <0.42 | 26.1 | 13723 | 16.69 | 24.65 |
| 5 - São José da Varginha | 111 | 0.86 | <0.40 | <0.44 | 4.9 | <0.66 | 0.53 | 14.0 | <0.42 | 11.1 | 5450 | 1.82 | 3.57 |
| 6 - Angueretá | 240 | 3.72 | 1.08 | 1.13 | 71.3 | 59.62 | 12.28 | 63.0 | <0.42 | 57.3 | 13040 | 4.41 | 28.47 |
| 7 - Retiro Baixo | 302 | 0.98 | 1.74 | 1.44 | 53.3 | 48.92 | 10.67 | 49.8 | <0.42 | 44.6 | 20412 | 10.75 | 25.62 |
| | TEL | - | - | - | - | - | - | 174 | - | - | - | - | - |
| | PEL | - | - | - | - | - | - | 486 | - | - | - | - | - |
| Sampling site | Damming distance (km) | Lu (µg/g) | Mg (µg/g) | Mn (mg/g) | Mo (µg/g) | Na (µg/g) | Nd (µg/g) | Ni (µg/g) | P (µg/g) | Pb (µg/g) | Pr (µg/g) | Rb (µg/g) | Rh (µg/g) |
| 1 - Moeda | -61.3 | 0.49 | 211 | 0.99 | <1.25 | 874 | 9.99 | 22.03 | 50 | 3.03 | 1.02 | 15.65 | <0.66 |
| 2 - Tailing | 0 | 6.33 | 236 | 4.78 | <1.25 | 232 | 14.19 | 17.20 | 1031 | 14.65 | 39.48 | 2.26 | <0.66 |
| 3 - Brumadinho | 5.2 | 6.09 | 464 | 10.51 | <1.25 | 139 | 10.28 | 24.16 | 1347 | 18.38 | 37.65 | 2.78 | <0.66 |
| 4 - Juatuba | 48 | 1.60 | 970 | 0.99 | <1.25 | 2428 | 22.85 | 18.56 | 506 | 14.87 | 9.99 | 72.31 | <0.66 |
| 5 - São José da Varginha | 111 | <0.47 | 113 | 0.24 | <1.25 | 1567 | 9.46 | 9.58 | 26 | <0.40 | <0.59 | 31.90 | <0.66 |
| 6 - Angueretá | 240 | 1.66 | 315 | 2.59 | <1.25 | 961 | 8.70 | 32.84 | 576 | 10.01 | 9.49 | 22.97 | <0.66 |
| 7 - Retiro Baixo | 302 | 1.45 | 960 | 0.53 | <1.25 | 460 | 15.54 | 32.18 | 346 | 12.90 | 9.28 | 56.60 | <0.66 |
| | TEL | - | - | - | - | - | - | 18 | - | 35.8 | - | - | - |
| | PEL | - | - | - | - | - | - | 36 | - | 91.3 | - | - | - |

Table S5. Continuation.

| Sampling site | Damming distance (km) | S | Sb | Sc | Se | Sm | Sn | Sr | Tb | Th | Ti | Tl | Tm |
|--------------------------|-----------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| | | (µg/g) | (µg/g) | (µg/g) | (µg/g) | (µg/g) | (µg/g) | (µg/g) | (µg/g) | (µg/g) | (mg/g) | (µg/g) | (µg/g) |
| 1 - Moeda | -61.3 | 280 | <0.53 | 1.63 | <0.90 | <0.47 | 20.6 | 12.6 | 2.48 | <1.04 | 0.40 | <0.73 | <0.49 |
| 2 - Tailing | 0 | 241 | 0.69 | 2.41 | <0.90 | <0.47 | 547.4 | 15.0 | 42.18 | <1.04 | 0.43 | <0.73 | <0.49 |
| 3 - Brumadinho | 5.2 | 266 | 1.65 | 2.52 | <0.90 | <0.47 | 619.8 | 26.8 | 43.87 | <1.04 | 0.59 | <0.73 | <0.49 |
| 4 - Juatuba | 48 | 417 | <0.53 | 7.10 | <0.90 | <0.47 | 146.3 | 19.3 | 7.89 | <1.04 | 2.93 | <0.73 | <0.49 |
| 5 - São José da Varginha | 111 | 189 | 2.94 | 0.69 | <0.90 | <0.47 | 0.7 | 16.0 | 1.06 | <1.04 | 0.21 | <0.73 | <0.49 |
| 6 - Angueretá | 240 | 394 | <0.53 | 3.56 | <0.90 | <0.47 | 161.2 | <0.10 | 8.29 | <1.04 | 3.81 | <0.73 | <0.49 |
| 7 - Retiro Baixo | 302 | 339 | <0.53 | 5.72 | <0.90 | <0.47 | 117.7 | <0.10 | 5.73 | <1.04 | 3.46 | <0.73 | <0.49 |
| | TEL | - | - | - | - | - | - | - | - | - | - | - | - |
| | PEL | - | - | - | - | - | - | - | - | - | - | - | - |
| Sampling site | Damming distance (km) | U | V | Y | Yb | Zn | | | | | | | |
| | | (µg/g) | (µg/g) | (µg/g) | (µg/g) | (µg/g) | | | | | | | |
| 1 - Moeda | -61.3 | 57.1 | 23.54 | 1.58 | <0.46 | 11.86 | | | | | | | |
| 2 - Tailing | 0 | 1457.4 | 27.81 | 13.96 | 1.30 | 68.50 | | | | | | | |
| 3 - Brumadinho | 5.2 | 1674.1 | 36.08 | 11.42 | 1.34 | 89.51 | | | | | | | |
| 4 - Juatuba | 48 | 390.3 | 74.37 | 6.95 | 0.62 | 79.38 | | | | | | | |
| 5 - São José da Varginha | 111 | 21.5 | 7.67 | 1.17 | <0.46 | 6.16 | | | | | | | |
| 6 - Angueretá | 240 | 421.0 | 126.11 | 0.67 | <0.46 | 76.04 | | | | | | | |
| 7 - Retiro Baixo | 302 | 318.3 | 125.08 | 5.08 | 0.59 | 48.98 | | | | | | | |
| | TEL | - | - | - | - | 123 | | | | | | | |
| | PEL | - | - | - | - | 315 | | | | | | | |

Table S6. Metal concentrations in the *D. rerio* muscle of the sampling sites after the Brumadinho Dam rupture. \pm standard deviation.

| Compartment | Damming distance (km) | Sites | Al | Fe | Mn |
|-------------|-----------------------|----------------------|-------------------|------------------|------------------|
| Water | -61.3 | Moeda | 10.04 \pm 5.43 | 17.99 \pm 8.11 | 6.3 \pm 4.88 |
| | 5.2 | Brumadinho | 16.29 \pm 11.55 | 18.84 \pm 4.44 | 6.16 \pm 5.67 |
| | 48 | Juatuba | 13.96 \pm 1.66 | 17.13 \pm 2.04 | 2.47 \pm 0.27 |
| | 111 | São José da Varginha | 19.41 \pm 14.33 | 19.04 \pm 2.44 | 1.87 \pm 0.2 |
| | 240 | Angueretá | 10.37 \pm 5.01 | 19.68 \pm 8.1 | 1.77 \pm 0.11 |
| | 302 | Retiro Baixo | 8.15 \pm 3.52 | 10.91 \pm 1.13 | 1.57 \pm 0.05 |
| | | | Mean | 13.04 \pm 4.29 | 17.27 \pm 3.24 |
| Sediment | -61.3 | Moeda | 4.99 \pm 0.81 | 12.93 \pm 9.15 | 1.91 \pm 0.15 |
| | 5.2 | Brumadinho | 7.75 \pm 5.81 | 37.71 \pm 9.32 | 5.93 \pm 2.01 |
| | 48 | Juatuba | 22.49 \pm 2.03 | 16.88 \pm 4.33 | 2.69 \pm 0.58 |
| | 111 | São José da Varginha | 2.99 | 5.35 \pm 0.32 | 2.21 \pm 0.05 |
| | 240 | Angueretá | 12.83 \pm 7.99 | 11.49 \pm 0.21 | 2.61 \pm 0.32 |
| | 302 | Retiro Baixo | 11.5 \pm 0.72 | 8.44 \pm 0.34 | 1.35 \pm 0.02 |
| | | | Mean | 10.43 \pm 6.99 | 15.47 \pm 11.6 |
| | control | | 3.33 \pm 3.27 | 5.99 \pm 3.99 | 1.27 \pm 0.25 |

Video. Video with satellite images (©Maxar Technologies) obtained from Google Earth Pro (version 7.3.2.5776), before (July 21, 2018) and after the dam failure (March 14, 2019). The video was produced using the power point software (Microsoft Office Professional Plus - 2019 - Version 1808).