



**A high-resolution diatom-based Middle and Late Holocene environmental history of the Little Belt region, Baltic Sea**

Journal:	<i>Boreas</i>
Manuscript ID	BOR-028-2019.R1
Manuscript Type:	Original Article
Date Submitted by the Author:	n/a
Complete List of Authors:	Warnock, Jonathan; Indiana University of Pennsylvania, Geoscience Andr�n, Elinor; S�dert�rn University, School of Natural Science, Technology and Environmental Studies Juggins, Steve; Newcastle University, School of Geography, Politics & Sociology Lewis, Jonathan; Loughborough University, Geography Ryves, David; Loughborough University, Geography and Environment Andr�n, Thomas; S�dert�rn University, School of Natural Science, Technology and Environmental Studies Weckstr�m, Kaarina; University of Helsinki, Ecosystems and Environment
Keywords:	IODP Expedition 347 Site M0059, palaeoecology, palaeoceanography, salinity, trophic state, diatoms, quantitative salinity reconstruction

1  
2  
3 1 **A high-resolution diatom-based Middle and Late Holocene environmental history of the Little Belt**  
4  
5 2 **region, Baltic Sea**

6  
7  
8 3 **Jonathan Warnock, Elinor Andrén, Steve Juggins, Jonathan Lewis, David B. Ryves, Thomas Andrén**  
9  
10 4 **Kaarina Weckström,**

11  
12  
13 5 The large-scale shifts in the salinity of the Baltic Sea over the Holocene are well understood and have  
14  
15 6 been comprehensively documented using sedimentary proxy records. More recent work has focused on  
16  
17 7 understanding how past salinity fluctuations have affected other ecological parameters (e.g. primary  
18  
19 8 productivity, nutrient content) of the Baltic basin, and salinity changes over key events and over short  
20  
21 9 timescales are still not well understood. The International Ocean Drilling Program Expedition 347 cored  
22  
23 10 the Baltic basin in order to collect basin-wide environmental records through a glacial-interglacial cycle.  
24  
25 11 Site M0059 is located in the Little Belt between the Baltic Sea and the Atlantic Ocean. A composite splice  
26  
27 12 section from Site M0059 was analysed at a decadal resolution to study changes in salinity, nutrient  
28  
29 13 conditions and other surface water column parameters based on changes in diatom assemblages and on  
30  
31 14 quantitative diatom-based salinity inferences. A mesotrophic slightly brackish assemblage is seen in the  
32  
33 15 lowermost analysed depths, corresponding to 7,800 – 7,500 cal. a BP. An increase in salinity and nutrient  
34  
35 16 content of the water column leads into a meso-eutrophic brackish phase. The observed salinity increase  
36  
37 17 is rapid, lasting from 7,500 to 7,150 cal. a BP. Subsequently, the Little Belt becomes oligotrophic and is  
38  
39 18 dominated by tythropelagic diatoms from ca. 7,100 to ca. 3,900 cal. a BP. This interval contains some of  
40  
41 19 the highest salinities observed followed by diatom assemblages similar to that of the Northern Atlantic  
42  
43 20 Ocean, composed primarily of cosmopolitan open ocean marine diatoms. A return to tythropelagic  
44  
45 21 productivity is seen from 3,850 to 980 cal. a BP. Anthropogenic eutrophication is detected in the last 300  
46  
47 22 years of the record which intensifies in the uppermost sediments. These results represent the first  
48  
49 23 decadal-resolved record in the region and provide new insight into the transition to a brackish basin  
50  
51 24 and subsequent ecological development.  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 **25 Key words**  
4  
5

6 **26** IODP Expedition 347 Site M0059; palaeoecology; palaeoceanography; salinity; trophic state; diatoms;  
7  
8 **27** quantitative salinity reconstruction  
9

10  
11 **28**  
12  
13

14 **29** Jonathan Warnock, jwarnock@iup.edu, Department of Geoscience, Indiana University of Pennsylvania,  
15  
16 **30** Indiana, PA 15705 USA  
17  
18

19 **31** Elinor Andrén, elinor.andren@sh.se, School of Natural Science, Technology and Environmental Studies,  
20  
21 **32** Södertörn University, SE-14189 Huddinge, Sweden  
22  
23

24 **33** Steve Juggins, stephen.juggins@newcastle.ac.uk, The School of Geography, Politics and Sociology,  
25  
26 **34** Newcastle University, NE1 7RU, United Kingdom  
27  
28

29 **35** Jonathan Lewis, j.p.lewis@lboro.ac.uk, Geography and Environment, Loughborough University,  
30  
31 **36** Leicestershire, LE11 3TU, United Kingdom  
32  
33

34 **37** David B. Ryves, d.b.ryves@lboro.ac.uk, Geography and Environment, Loughborough University,  
35  
36 **38** Leicestershire, LE11 3TU, United Kingdom  
37  
38

39 **39** Thomas Andrén, thomas.andren@sh.se, School of Natural Science, Technology and Environmental  
40  
41 **40** Studies, Södertörn University, SE-14189 Huddinge, Sweden  
42  
43

44 **41** Kaarina Weckström, kaarina.weckstrom@helsinki.fi, Ecosystems and Environment Research Programme  
45  
46 **42** (ECRU), and Helsinki Institute of Sustainability Science, P.O. Box 65 (Viikinkaari 1), 00014 University of  
47  
48 **43** Helsinki, Finland, and Department of Marine Geology and Glaciology, Geological Survey of Denmark and  
49  
50 **44** Greenland (GEUS), Ø. Voldgade 10, DK-1350 Cph. K, Denmark  
51  
52

53  
54 **45 Introduction**  
55  
56  
57  
58  
59  
60

1  
2  
3 46 The Baltic Sea is an important resource for the nine nations sharing its coastline. Recently, the Baltic has  
4  
5 47 experienced intense eutrophication, leading to harmful algal blooms (Karlson et al., 2017) and increased  
6  
7 48 deep-water hypoxia (Gustafsson et al., 2012; Carstensen et al., 2014; Andersen et al., 2017; van  
8  
9  
10 49 Helmond et al., 2017), which have negative impacts on the ecology, recreational and economic utility of  
11  
12 50 the sea. In order to fully understand recent eutrophication in the Baltic Sea, past nutrient regimes must  
13  
14 51 be scrutinized. Furthermore, reconstructing past changes in Baltic nutrient conditions provides insight  
15  
16 52 into the long-term drivers of Baltic Sea ecosystems. Many previous studies have focused on  
17  
18 53 reconstructing the salinity history of the Baltic Sea during well-known alternating freshwater and  
19  
20 54 brackish water stages, which are primarily driven by glacioisostatic rebound (full reviews of the Baltic  
21  
22 55 Sea history can be found in; Andrén et al. 2000a; Björck, 2008; Andrén et al. 2011; Weckström et al.  
23  
24 56 2017). Briefly, deglaciation of the Baltic basin began c. 16,000 cal. a BP, initiating the freshwater Baltic  
25  
26 57 Ice Lake stage (Björck 2008; Andrén et al., 2011). Continued ice retreat opened a connection over south  
27  
28 58 central Sweden between the Baltic basin and the Atlantic, allowing for draining of the ice-dammed lake  
29  
30 59 and influx of saline water from the North Atlantic. Consequently, the partly brackish Yoldia Sea stage  
31  
32 60 began at c. 11,700 cal. a BP. Isostatic rebound caused a renewed separation of the Baltic basin and  
33  
34 61 Atlantic leading to the dammed freshwater Ancylus Lake stage, c. 10,700 cal. a BP. The Baltic's  
35  
36 62 connection to the Atlantic resumed at c. 9,800 cal. a BP, now in the southern part of the basin. This  
37  
38 63 ultimately resulted in renewed influx of saline water to the Baltic, causing a transition to the brackish  
39  
40 64 Littorina Sea stage, c. 8,000 cal. a BP (Andrén et al., 2000a; Berglund et al., 2005). The Littorina Sea stage  
41  
42 65 is further subdivided, with the Post-Littorina Sea stage beginning at c. 3,000 cal. a BP and the Recent  
43  
44 66 Baltic Sea state covering the last 1,000 years (Andrén et al., 2000a).

51 67 While the complex salinity history of the Baltic Sea has been qualitatively reconstructed  
52  
53 68 throughout most of the basin, there remain discussions about where and when the first marine inflows  
54  
55 69 occurred over the Danish Straits (Little Belt, Great Belt, Øresund), the transition areas which connect the  
56  
57  
58  
59  
60

1  
2  
3 70 present Baltic Sea to the North Sea. Weakly brackish conditions in the southern Baltic Sea and in  
4  
5 71 Swedish coastal waters have been recorded at 9,800 cal. a BP (Andrén et al., 2000a; Berglund et al.,  
6  
7 72 2005) and are interpreted as minor sporadic inflows via the Great Belt, which at that time functioned as  
8  
9 73 a calm fluvial environment (Björck 2008). In the Danish Straits no evidence for these early inflows are  
10  
11 74 found. The oldest marine shells in the Great Belt are dated at 8,100 cal. a BP (Bennike et al., 2004).  
12  
13 75 Øresund developed into a strait between 9,000-8,000 cal. a BP (Bennike et al., 2012) and in the Little  
14  
15 76 Belt area brackish conditions were established by ca. 8,500 cal. a BP, although the oldest marine shell  
16  
17 77 from the Little Belt dates to 7,700 cal. a BP (Bennike and Jensen 2011).  
18  
19  
20  
21

22 78 Diatoms, unicellular algae with opaline ( $\text{SiO}_2 \cdot n\text{H}_2\text{O}$ ) cell walls, are an ideal source of proxy data  
23  
24 79 for inferring ecological conditions in the Baltic Sea. Diatoms recovered from sediment cores have been  
25  
26 80 used to reconstruct, for example, surface water salinity (Lewis et al., 2016), water depth (Warnock et al.,  
27  
28 81 2017), micro- and macronutrient conditions (Cortese and Gersonde 2007; Weckström et al., 2007;  
29  
30 82 Andrén et al., 2017;), sea ice conditions (Armand et al., 2017) and upper water column nutrient recycling  
31  
32 83 (Warnock et al., 2015). Both studies evaluating the relationship between ecological and chemical  
33  
34 84 parameters and diatom species' distributions (e.g. Snoeijs et al. 1993-1998; Clarke et al., 2006;  
35  
36 85 Weckström et al., 2007; Andrén et al., 2017) and diatom-based palaeoecological investigations have  
37  
38 86 been published within the Baltic Sea area and associated basins (e.g. Andrén et al., 2000a,b; Witak and  
39  
40 87 Dunder 2007; Witkowski et al., 2009; Lewis et al., 2013; Lewis et al. 2016; Warnock et al., 2017).  
41  
42  
43  
44

45 88 In September 2013, the Integrated Ocean Drilling Program Expedition 347 cored a series of sites  
46  
47 89 across the Baltic basin with the goal of generating correlated, basin-wide records of Baltic Sea history.  
48  
49 90 Core site M0059 in the Little Belt region captured an extraordinarily high-resolution Holocene sediment  
50  
51 91 record (Fig. 1). A multiproxy study from this site detailed changes in salinity, precipitation and  
52  
53 92 temperature in the Little Belt region at centennial resolution (Kotthoff et al., 2017), and another inferred  
54  
55 93 seasonal hypoxia during the past 8000 years (van Helmond et al., 2017). The present study provides a  
56  
57  
58  
59  
60

1  
2  
3 94 decadal-resolution diatom-based assessment of ecological conditions at Site M0059 covering the past  
4  
5 95 ~7,800 cal. a BP with the aim to examine the fresh-brackish water transition in detail and develop  
6  
7 96 greater understanding of trends in surface water salinity and primary production from the Littorina Sea  
8  
9  
10 97 to the present day. The rate and timing of important events can be understood in detail by generating a  
11  
12 98 decadal-resolved data set. Our results will be discussed in the context of the overall development of  
13  
14 99 the Baltic Sea basin. Specific research questions which will be addressed are; when and how did the  
15  
16 100 transition into the brackish-marine stage (cf. Littorina Sea) occur, when did maximum salinity occur, how  
17  
18 101 did the Little Belt system change during the Holocene Thermal Maximum, Neoglacial cooling and the  
19  
20 102 Medieval Climate Anomaly, and when are the first traces of recent eutrophication recorded in the Little  
21  
22 103 Belt area?  
23  
24  
25  
26 104

## 28 105 **Material and Methods**

### 31 106 **Regional setting**

34 107 The Baltic Sea Area as defined by HELCOM (1993) includes the Baltic Sea and the shallow transition zone  
35  
36 108 to the North Sea, the Kattegat and the Belt Sea (including Great Belt and Little Belt), which is markedly  
37  
38 109 influenced by the brackish water outflow from the Baltic Sea. The Baltic Sea *sensu stricto* is confined by  
39  
40 110 the shallow sill between Sweden and Denmark, the Drogden sill (8 m water depth) and the sill between  
41  
42 111 Denmark and Germany, the Darss sill (18 m water depth) (Snoeijs-Leijonmalm and Andrén, 2017). These  
43  
44 112 sills mark the natural biological boundary of species distribution between the more marine-influenced  
45  
46 113 Belt Sea and the low-salinity brackish water of the Baltic Sea. At present, the Baltic Sea consists of a  
47  
48 114 mixture of marine North Sea water and freshwater runoff from the drainage area four times the size of  
49  
50 115 the sea surface area itself (Snoeijs-Leijonmalm and Andrén, 2017). This results in a spatially extensive  
51  
52 116 surface water salinity gradient (in g l<sup>-1</sup>) ranging from ~12-30 in Kattegat, ~10-23 in Belt Sea, ~5-11 in the  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 117 Baltic Sea proper, ~4-7 in the Bothnian Sea and ~2-4 in Bothnian Bay (Snoeijs-Leijonmalm and Andrén,  
4  
5 118 2017).

6  
7 119 Five cores were obtained in the Little Belt from the geotechnical research vessel *Greatship*  
8  
9 120 *Manisha* at site M0059 (55°0.29'N, 10°6.19'E), water depth 37.1 m, using an advanced piston corer as  
10  
11 121 part of IODP Expedition 347 in September 2013 (Andrén et al., 2015a). The composite splice section,  
12  
13 122 sampled for this study, was generated via the Correlator software package and a composite depth scale  
14  
15 123 (meters composite depth; mcd) was established (Andrén et al., 2015a). Samples were collected and  
16  
17 124 subsampled by the on-shore science party at Marum, University of Bremen, Germany in January and  
18  
19 125 February 2014 with a sampling interval of ~20 cm.  
20  
21  
22  
23

24 126 The lithology at site M0059 is divided into seven lithostratigraphic units. The lowermost Unit VII  
25  
26 127 encountered Cretaceous limestone bedrock at 169 m composite depth (mcd below sea floor), Units VI–  
27  
28 128 IV (169-83 mcd) consisted of diamicton interlayered with sand and silt indicative of a succession of  
29  
30 129 repeated glaciations, followed by Unit III (83 to 53 mcd), interpreted as glaciolacustrine deglaciation  
31  
32 130 sediment deposited as varved glacial clay of unknown age (Andrén et al., 2015a;b). Unit III is erosionally  
33  
34 131 cut off by Unit II, a c. 2 cm upwards coarsening sandy-silty layer indicative of a rapid regression and sea-  
35  
36 132 level low stand (Andrén et al., 2015b). The uppermost unit, Unit I, consists of c. 52 m of Holocene  
37  
38 133 sediments and is divided into subunit Ib and Ia. Subunit Ib (53.57-49.37 mcd) consists of greenish gray  
39  
40 134 well-sorted silty clay with prominent cm-scale laminae while subunit Ia (49.37–0 mcd) is mostly  
41  
42 135 homogeneous black to greenish black well-sorted organic rich clay with faint millimeter-scale laminae  
43  
44 136 showing minor bioturbation (Andrén et al., 2015a). Sub-units Ia and Ib are utilized for this study.  
45  
46  
47  
48  
49

50  
51 138 Dating  
52  
53

54 139 A robust radiocarbon-based age model was created using 16 fragmentary or intact bivalves which  
55  
56 140 resulted in a mean sedimentation rate of 6.6 mmyr<sup>-1</sup> in Sub-unit Ia (van Helmond et al., 2017). The age  
57  
58  
59  
60

1  
2  
3 141 model was generated with Clam version 2.2 (Blaauw 2010) with 2000 iterations and using the Marine13  
4  
5 142 calibration data set (Reimer et al., 2013). A deviation ( $\Delta R$ ) of  $-90 \pm 53$  years from the Marine13 reservoir  
6  
7 143 age was used, based on the mean value for  $\Delta R$  for suspension and deposit feeders in three study sites  
8  
9  
10 144 relatively close to Site M0059, as reported in the Marine Reservoir Correction Database  
11  
12 145 (<http://calib.org/marine/>), Map-No 1692, 1693 (Lougheed et al., 2013) and Map-No 93 (Heier-Nielsen et  
13  
14 146 al., 1995). The sediment surface is not assumed to be modern because of piston coring techniques. Due  
15  
16 147 to lack of suitable material to date, the age model is linearly extrapolated below 48.64 mcd ( $\sim 7,400$  cal.  
17  
18 148 a BP) down to the lowermost analyzed sample at 53.12 mcd, which corresponds to an age of 7,800 cal. a  
19  
20  
21 149 BP.  
22  
23  
24 150  
25  
26  
27 151 Diatoms

28  
29  
30 152 Sediment preparation and slide creation followed Warnock & Scherer (2014). Sediment  
31  
32 153 subsamples were freeze-dried prior to weighing, with  $\sim 0.05$  g of sediment used per sample. Weighed  
33  
34 154 samples were gently crushed, using only vertical motion in a mortar and pestle, to disaggregate the  
35  
36 155 sediment and treated with a few mL each of 10%  $H_2O_2$  to remove organics and 10% HCl to remove  
37  
38 156 carbonates. The treated sediment slurry, a  $\sim 10$  mL volume, was then settled through a water column in  
39  
40  
41 157 a beaker with a known cross section containing a coverslip. This technique allows for the calculation of  
42  
43 158 absolute diatom abundance (ADA) in valves/gram dry weight of sediment ( $v\text{gdw}^{-1}$ ). After the beaker was  
44  
45 159 drained, coverslips were allowed to air dry and slides were permanently fixed with Naphrax (refractive  
46  
47 160 index = 1.65). Diatoms were identified to the species level primarily following Snoeijs *et al.* (1993-1998),  
48  
49  
50 161 with additional identifications from Witkowski *et al.* (2000), Cleve-Euler (1951), Fryxell & Hasle (1972,  
51  
52 162 1980), Hasle (1978a, b), Hasle & Lange (1992), Hustedt (1930), Krammer & Lange-Bertalot (1988, 1991a,  
53  
54 163 199b), Muylaert & Sabbe (1996), Mölder & Tynni (1967-1973), Sabbe & Vyverman (1995), Snoeijs  
55  
56  
57  
58  
59  
60



1  
2  
3 164 (1992), and Tynni (1975, 1976, 1978, 1980). At least 300 valves were counted per sample at 1000x  
4  
5 165 magnification using Nomarski differential interference contrast and oil immersion on an Olympus BX53  
6  
7 166 microscope. *Chaetoceros* resting spores (CRS) were also counted, but not included in the 300 valve  
8  
9  
10 167 count, as many spores are notoriously difficult to identify to species level and this genus covers a large  
11  
12 168 range of ecological conditions. The salinity-based affinities of Snoeijs *et al.* (1993-1998) were used to  
13  
14 169 categorize diatoms as freshwater (F), brackish-fresh (BF), brackish (B), brackish-marine (BM) and marine  
15  
16 170 (M). Snoeijs *et al.* (1993-1998) did not use quantitative salinity measurements in defining these five  
17  
18 171 categories, instead the categories are based on observations of present-day distributions of diatom  
19  
20 172 species in the Baltic Sea. Three exceptions are *Stauroneis radissonii*, which is classified by Snoeijs *et al.*  
21  
22 173 (1993-1998) as brackish-marine, *Pauliella taeniata*, which is classified as brackish and *Fragilariopsis*  
23  
24 174 *cylindrus*, which is classified as brackish-fresh. Ecological studies reveal that these diatoms are  
25  
26 175 associated with stratified water columns resultant from sea-ice melt and formation (Poulin & Cardinal  
27  
28 176 1982; Okolodkov 1993; Armand *et al.* 2005; Zheng *et al.* 2011; Mundy *et al.* 2011). As such, *S. radissonii*,  
29  
30 177 *P. taeniata*, and *F. cylindrus* are placed into a sea-ice category and are not counted with the salinity  
31  
32 178 groups.  
33  
34  
35

36  
37 179 The diatom record was subdivided into six local diatom abundance zones (DAZ) using CONISS  
38  
39 180 sum of squares cluster analysis in the Tilia software package. Only diatom species with a 3 % relative  
40  
41 181 abundance in at least one sample were used for cluster analysis. Analysis of variance (ANOVA) was used  
42  
43 182 to evaluate the differences between the mean values for diatom salinity affinities, absolute diatom  
44  
45 183 abundance (ADA), species richness, benthic to pelagic (B:P) ratio, and CRS absolute abundance between  
46  
47 184 the six zones. A Tukey-Kramer pair-wise test was utilized to evaluate relationships between individual  
48  
49 185 DAZ. For all statistical tests performed, an  $\alpha$  value of 0.05 was used. All statistical relationships were  
50  
51 186 evaluated using PAST v. 3.10 (Hammer *et al.*, 2001).  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 187 Diatom preservation was assessed using a modification of the method of Ryves et al. (2009). In  
4  
5 188 each sample, fifty valves of two common diatom species were classified into one of two preservation  
6  
7 189 stages: pristine valves (showing no sign of dissolution) and valves with signs of dissolution. This included  
8  
9  
10 190 expansion of areolae, etching of the valve surface, and loss of the valve margins to dissolution. Ryves et  
11  
12 191 al. (2009) utilized between two and four preservation stages, representing progressive dissolution of the  
13  
14 192 valve face, to quantify diatom dissolution. A preservation index (F) was then calculated as a simple  
15  
16 193 percent of valves showing no evidence of dissolution (Ryves et al. 2001). Two robust diatom species,  
17  
18 194 *Paralia sulcata* and *Cocconeis scutellum*, were selected for this analysis because they were the only two  
19  
20 195 species present in every sample analysed. *Cocconeis scutellum* is an obligate benthic diatom, whereas  
21  
22 196 *Paralia sulcata* is facultatively pelagic (McQuoid and Nordberg, 2003). We argue that differences in  
23  
24 197 dissolution behaviour between the taxa can be interpreted in terms of taphonomic conditions  
25  
26 198 representative of their respective habitats, rather than intrinsic differences in robustness, as F values  
27  
28 199 show no systematic differences until the more recent part of the record (see Results and Discussion).  
29  
30  
31  
32

33 200 Quantitative palaeo-salinity estimates were made using a weighted averaging partial least  
34  
35 201 squares (WAPLS, ter Braak and Juggins, 1993) transfer function based on a modern pan-Baltic training  
36  
37 202 set (210 sites) sampled during the Molten/Define projects (Andrén et al. 2007). The training set is  
38  
39 203 described in more detail in Lewis et al. (2013, 2016 plus supplements) where it was applied to infer  
40  
41 204 salinity changes at Danish coastal/marine sites. The prediction error of each WAPLS component was  
42  
43 205 estimated by h-block cross-validation (Burman et al. 1994) in which samples closer than a cut-off  
44  
45 206 distance (h) from a target sample were excluded from contributing to the prediction of that sample. h-  
46  
47 207 block cross-validation (CV) was used to allow for spatial dependency in the calibration data, which can  
48  
49 208 lead to underestimation of the prediction error because of pseudoreplication. The cut-off distance (h)  
50  
51 209 was estimated by assessing the spatial structure of the residuals of the surface sample predictions.  
52  
53 210 Specifically, h was estimated as 37km using the range of a circular variogram fitted to the detrended  
54  
55  
56  
57  
58  
59  
60

211 residuals using the method described in Trachsel and Telford (2015). A randomization t-test applied to  
212 h-block prediction errors (van der Voet, 1994) indicated that only the first WAPLS component was  
213 significant (h-block cross-validation  $r^2=0.85$ , RMSEP=0.46 square-root salinity units).

214

## 215 Results

216 A total of 301 samples were counted at a resolution of ~20 cm (~30 years, on average with a standard  
217 deviation of 14; Fig. 2). Due to intense sampling of some intervals, a 20 cm resolution could not be used  
218 throughout the entire studied section. Table 1 provides ranges and averages for diatom environmental  
219 metrics, i.e. ADA, CRS abundance, the ratio of benthic to pelagic life forms (B:P) and species richness (R),  
220 as well as salinity affinities for each DAZ. A total of 210 diatom species and varieties, from within 83  
221 genera, were identified within the core (species with >3% relative abundance are given in Table 2).  
222 Branching points in the CONISS tree were used to separate six adjacent diatom assemblage zones, DAZ 1  
223 – DAZ 6. ANOVA revealed significant differences between each DAZ. Results of Tukey-Kramer pairwise  
224 tests of the differences between specific variables for adjacent DAZ are presented in Table 3.

225 DAZ 1 covers the period between ~ 7,800 to ~7,500 cal a BP and is dominated by diatoms from  
226 within the genera *Aulacoseira* (mean 38%), *Stephanodiscus* (mean 17%) and *Cyclotella* (mean 11%) (Fig.  
227 3) that are predominantly freshwater-affiliated and planktic (Fig. 4). Based on the diatom assemblage  
228 and presence of CRS, the assemblage is not purely freshwater. Diatom preservation is poor (Fig. 6), with  
229 both species used to assess preservation having the lowest recorded average percent of undissolved  
230 valves (*Paralia sulcata* – 45%, *C. scutellum* – 37%).

231 DAZ 2 covers the timespan from ~7,500 to ~7,150 cal a BP. It is comprised of a mixed  
232 assemblage of all salinity preferences, dominated by brackish diatoms. Diatom salinity preferences shift  
233 rapidly through this interval, estimated at ~0.85 g L<sup>-1</sup>/decade. Brackish taxa *Paralia sulcata* (mean 19%),

1  
2  
3 234 *Cyclotella choctawhatcheeana* (mean 6%), the brackish-marine *Thalassionema nitzschioides* (mean 8%)  
4  
5 235 and marine *Hyalodiscus scoticus* (mean 9%) are the most common diatoms in this zone. Statistically  
6  
7 236 significant changes compared to DAZ 1 were identified with respect to R, B:P, CRS and the percent of  
8  
9 237 freshwater, brackish, brackish-marine and marine species. Diatom preservation increases greatly in this  
10  
11 238 interval, with *Paralia sulcata* having an F value of 72% and *Cocconeis scutellum* having an F value of 77%.

12  
13  
14  
15 239 DAZ 3 occurs between ~7,150 and ~5,500 cal a BP. DAZ 3 is similar to DAZ 2 in that *Paralia*  
16  
17 240 *sulcata* (mean 41%) and *Thalassionema nitzschioides* (mean 9%) dominate. It is distinguished by a  
18  
19 241 decline in the marine-affiliated diatom *Hyalodiscus scoticus* (mean 4%), while the other dominant  
20  
21 242 marine-affiliated taxa *Dimeregramma minor* (mean 8%) and *Shionodiscus oestrupii* (nominata variety,  
22  
23 243 mean 6%) display their highest abundances in the whole stratigraphy. The assemblage is primarily  
24  
25 244 composed of brackish and marine species. Richness (mean = 46.81) and B:P (mean = 0.50) decline  
26  
27 245 significantly with respect to DAZ 2, while ADA (mean =  $6.02 \cdot 10^7$ ) significantly increases. In addition,  
28  
29 246 statistically significant decreases in freshwater and brackish-fresh diatoms as well as increases in  
30  
31 247 brackish and marine diatoms are detected relative to DAZ 2. Diatom preservation decreases in this  
32  
33 248 interval, with F values of 66% (*Paralia sulcata*) and 65% (*Cocconeis scutellum*).

34  
35  
36  
37  
38 249 DAZ 4 extends from ~5,500 to ~3,850 cal a BP. This assemblage is mainly brackish-affiliated. The  
39  
40 250 highest recorded average (48%) and absolute (72%) abundance of *Paralia sulcata* is found within DAZ 4.  
41  
42 251 There is a statistically significant decrease in ADA (mean =  $4.16 \cdot 10^7$  v  $\text{gdw}^{-1}$ ). A statistically significant  
43  
44 252 increase in the mean percent of brackish-affiliated diatoms and decrease in marine diatoms is also  
45  
46 253 detected between DAZ 3 and DAZ 4.

47  
48  
49  
50 254 DAZ 5 covers the interval from ~3,850 to ~1000 cal a BP. *Skeletonema marinoi* (mean 5%) is  
51  
52 255 abundant relative to the rest of the core. *Thalassionema nitzschioides* (mean 14%) increases in  
53  
54 256 abundance in this interval as well. *Paralia sulcata* (17%), previously dominant in DAZ 3 and 4, declines in  
55  
56  
57  
58  
59  
60

257 abundance within the first half of DAZ 5, and remains at lower abundance, typically < 20%, throughout  
258 the rest of the zone. The abundance of sea ice species, which during all the previous DAZ has been very  
259 low (~ 1%), increases around 3,000 cal a BP to ~3-5% and staying at similar levels throughout the rest of  
260 the core. Species richness (mean = 59.66), B:P (mean = 1.05) and CRS abundance (mean =  $1.41 \cdot 10^7$  v  
261  $\text{gdw}^{-1}$ ) reveal statistically significant increases relative to DAZ 4. Statistically significant increases in  
262 freshwater, brackish-marine and marine diatoms are detected, while brackish diatoms significantly  
263 decrease in abundance.

264 Finally, DAZ 6 spans from ~1000 cal a BP to the core top (i.e. present day). It is defined by a  
265 return to abundant *Paralia sulcata* (mean 20%) and decline of *Skeletonema marinoi* (mean 0.1%). In  
266 addition, *Cyclotella choctawhatcheeana* (mean 3%) and *Thalassiosira levanderi* (mean 1%) become more  
267 abundant in this zone, especially within the upper meter of the core (last 200 years). Furthermore, a  
268 distinct peak in *Thalassiosira proschkiniae* (mean 20%) is seen in the upper 0.4 m. The only statistically  
269 significant change detected among the environmental metrics relative to DAZ 5 is a decrease in the  
270 percent of marine diatoms.

#### 271 Quantitative salinity inferences

272 In terms of salinity change, there is an overall agreement between the salinity reconstruction based on  
273 Snoeijns et al. (1993-1998) diatom affinities and the DI-salinities (WAPLS), despite some concern over  
274 WA-based optima of individual taxa and the accuracy of salinity categorisation based on their present-  
275 day distribution in the Baltic Sea. Both records show a clear freshwater to weakly brackish phase before  
276 ~7,500 cal. a BP prior to a sharp salinity increase at ~7,500 cal. a BP. In the DI-record, highest salinities  
277 occur between ~7,000-3,900 cal. a BP, followed by a gradual decline after this date (over ~1000 years).  
278 Lower, but relatively stable salinities are inferred between ~3000-1,000 cal. a BP, though over this phase  
279 (i.e. DAZ 5), there is some disagreement with the qualitative interpretation based on the diatom

1  
2  
3 280 affinities. The last 1,000 years is characterised by greater fluctuation in salinity before approximately  
4  
5 281 300 years ago, after which salinity begins to decline towards its present-day value. It is noteworthy that  
6  
7 282 the reconstructed value for the core surface (present day) agrees very well with the average measured  
8  
9  
10 283 values in the Little Belt ( $15.9 \pm 0.4$  for a 10-year period (2004–2014; ICES, 2017), suggesting the diatom-  
11  
12 284 based inference model for salinity used here is robust.  
13  
14  
15 285  
16  
17

## 18 286 **Discussion**

19  
20  
21 287 In general, the salinity shifts identified here correspond well to those identified in Kotthoff et al.  
22  
23 288 (2017). The most notable exception is the lowermost analyzed portion of the core, DAZ 1 (7,800 – 7,500  
24  
25 289 cal. a BP). This interval is interpreted as freshwater in Kotthoff et al. (2017) and van Helmond et al.  
26  
27 290 (2017) but is interpreted as slightly brackish here based on diatom species analysis (Fig. 3, 4). It  
28  
29  
30 291 corresponds to the slightly brackish transitional stage of the Initial Littorina Sea (cf. Andrén et al., 2000a)  
31  
32 292 and indicates that a freshwater phase similar to the Ancylus Lake stage was not captured in this record.  
33  
34 293 The weakly brackish conditions are followed by a rapid increase in salinity in DAZ 2, which lasts  
35  
36 294 approximately 340 years. High resolution sampling allows for the timing of this transition to be captured  
37  
38  
39 295 in greater detail than has been previously reported. DAZ 3 and DAZ 4 correspond to the brackish  
40  
41 296 Littorina Sea stage within the Baltic basin, while DAZ 5 is associated with the post-Littorina stage in the  
42  
43 297 Baltic Sea. DAZ 6 contains sediments representing the modern Little Belt, corresponding to the modern  
44  
45 298 Baltic Sea stage within the Baltic Basin.  
46  
47

### 48 299 Initial Littorina Sea

49  
50  
51 300 Based on diatom assemblage composition, DAZ 1, (~7,800 to 7,500 cal. a BP), represents a mesotrophic,  
52  
53 301 slightly brackish system. The two most dominant diatom taxa, *Aulacoseira islandica* and *Stephanodiscus*  
54  
55  
56 302 *neoastraea*, are typically found in large freshwater lakes, e.g. the Ancylus Lake (Andrén et al., 2000a;  
57  
58  
59  
60

1  
2  
3 303 McCabe and Cyr 2006). The presence of brackish-fresh and brackish diatoms (average DI-salinity inferred  
4  
5 304 for DAZ-1 = 5 g L<sup>-1</sup>; Fig. 3) indicate that this is not a true freshwater system which post-dates the Ancyclus  
6  
7 305 Lake stage. Poor planktonic diatom preservation implies rapid recycling of nutrients within the water  
8  
9 306 column in this lightly brackish environment (Fig. 6). However, the benthic diatom community is likely  
10  
11 307 sourced from nearby littoral regions and transported to deeper water, which will cause increased  
12  
13 308 dissolution of the benthic taxa. Based on ADA, diatom primary production is lower in DAZ 1 (and DAZ 2)  
14  
15 309 compared to the rest of the diatom record, and largely restricted to the upper water column based on  
16  
17 310 the low B:P ratio, as observed in other studies (e.g. Andrén et al., 2000a). However, the sedimentation  
18  
19 311 rate is high compared to the other DAZ (van Helmond et al., 2017) which can significantly reduce ADA.  
20  
21 312 Additionally, benthic diatom preservation, (assessed via *Cocconeis scutellum*) is worse than pelagic  
22  
23 313 diatom preservation. This evidence, in addition to laminated sediments (Andrén et al., 2015b), indicates  
24  
25 314 a strong halocline is present throughout this interval, with a freshwater pelagic lens overlying a more  
26  
27 315 saline lower part of the water column.  
28  
29  
30  
31  
32

33 316 van Helmond et al. (2017) describe this interval as a freshwater lake, corresponding to the  
34  
35 317 Ancyclus Lake, with well oxygenated bottom water. Conversely, Bennike and Jensen (2011) report fully  
36  
37 318 marine conditions in the Little Belt region at 8,000 cal. a BP. However, both of these hypotheses are  
38  
39 319 contradicted by a brackish water benthic diatom community (and brackish water DI-inference; Fig. 7)  
40  
41 320 observed here. Furthermore, the presence of laminated sediments and low rates of benthic primary  
42  
43 321 productivity indicate poorly oxygenated bottom water conditions. The unconformity seen from 51.68 -  
44  
45 322 51.73 mcd (Andrén et al., 2015b), therefore, represents a sea-level low stand, with lack of deposition  
46  
47 323 and likely erosion, separating a glacial lake from a slightly brackish, well stratified environment rather  
48  
49 324 than a large freshwater lake system. The marine inflows required to create this halocline, as well as the  
50  
51 325 stratification itself, must contribute to the widespread hypoxia seen in the Baltic basin at this time (Zillén  
52  
53 326 et al., 2008). The long and narrow northern entrance into the Little Belt was probably too shallow to  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 327 allow for any significant inflows of marine water at this time and it's therefore reasonable to assume  
4  
5 328 that marine water entered from south via Great Belt and the Kiel Bay.  
6  
7

8 329 Transition to a brackish system  
9

10  
11 330 DAZ 2, (~7,500 to 7,150 cal. a BP), records a jump in salinity that corresponds to a previously  
12  
13 331 identified transgression at the southeastern Swedish Baltic coast (e.g. Yu et al., 2007). Yu et al. (2007)  
14  
15 332 infer a c. 4.5 m rapid sea level rise at 7,600 cal. a BP. This sea level rise probably resulted in a flooding of  
16  
17 333 the northern threshold and opened this entrance into Little Belt for the first time since the deglaciation  
18  
19 334 of the area. Furthermore, this transgression is observed in Mecklenburg Bay from 7,700 to 7,500 cal. a  
20  
21 335 BP (Kostecki et al., 2015). Decadally-resolved diatom assemblages imply a  $\sim >25 \text{ g L}^{-1}$  rise in salinity (Fig.  
22  
23 336 7) over  $\sim 350$  years ( $\sim 7,500$  to  $\sim 7,150$  cal. a BP). Changes in the diatom assemblages seen in the upper  
24  
25 337 samples of DAZ 1, continuing through DAZ2, also indicate an increase in nutrient concentrations.  
26  
27 338 Improved diatom preservation (i.e. less dissolution of valves) could imply higher (pelagic) production  
28  
29 339 and slower breakdown of valves (hence slower nutrient recycling), both of which would follow from an  
30  
31 340 increase in nutrient content of the water column. Diatom preservation remains good throughout the  
32  
33 341 remainder of the core, implying better conditions for preservation in the brackish system than the  
34  
35 342 fresher environment represented by DAZ 1. DAZ 2 is also the first zone with abundant CRS (Fig. 5).  
36  
37 343 Elevated abundances of *Chaetoceros* resting spores are typically used as indicators of high levels of  
38  
39 344 primary productivity, as they are formed at the termination of large seasonal blooms (Leventer et al.,  
40  
41 345 1996; Denis et al., 2009). However, they are also restricted to brackish/marine conditions (Snoeijs et al.,  
42  
43 346 1993-1998). As such, their increased abundance in DAZ 2 is not associated solely with increased primary  
44  
45 347 productivity, but increased salinity over the core site. Benthic primary productivity increases with  
46  
47 348 salinity, as shown by an increase in B:P. Furthermore, the benthic species which increase in abundance  
48  
49 349 are not freshwater associated. Therefore, this increase in B:P ratio is interpreted as a consequence of  
50  
51 350 increased salinity and an increase in suitable benthic habitats. Most of the benthic taxa increasing in DAZ  
52  
53  
54  
55  
56  
57  
58  
59  
60



1  
2  
3 351 2 are epiphytes (e.g. *Cocconeis pediculus*, *C.scutellum*, *Epithemia turgida* var. *westermannii*), i.e. growing  
4  
5 352 on submerged plants, or tychoplanktonic species (e.g. *Hyalodiscus scoticus* and *Melosira moniliformis*),  
6  
7 353 which are often found as epiphytes leading to an interpretation that the flood resulted in large shallow  
8  
9 354 habitat areas available for macrophyte growth. Changing basin morphometry with water level rise is key  
10  
11 355 for explaining changes in habitat availability that drive diatom assemblage composition, as seen in some  
12  
13 356 lake studies (e.g. Stone and Fritz 2004).  
14  
15  
16

17 357 Littorina Sea stage  
18  
19

20 358 The most marine phase of the Littorina Sea stage begins in DAZ 3, (~7,150 to 5,500 cal. a BP),  
21  
22 359 represented by a cosmopolitan marine diatom assemblage and salinities consistently around 25 g L<sup>-1</sup>. At  
23  
24 360 c. 7,100 cal. a BP, sea level was still rising; e.g. Yu et al. (2007) document sea level rise culminating at  
25  
26 361 6,500 cal. a BP. This interval, which occurs contemporary to the Holocene Thermal Maximum, contains  
27  
28 362 the highest salinity found in our record, therefore, sea level rise and associated flooding of the Little Belt  
29  
30 363 with Atlantic water drove salinity increase. Diatom assemblage data implies a return to oligotrophic  
31  
32 364 conditions and an increase in hydrodynamic regime, also likely driven by the influence of Atlantic water  
33  
34 365 at the core site. This increased mixing of the upper water column likely leads to the observed decrease  
35  
36 366 in diatom preservation and associated increase in nutrient recycling rates as has been observed in other  
37  
38 367 Holocene records (Warnock and Scherer, 2016).  
39  
40  
41  
42

43 368 During DAZ 4, (~5,500 to 3,850 cal. a BP), which is ecologically similar to DAZ 3, we infer a slight  
44  
45 369 decrease in primary productivity compared to the average ADA in DAZ 3 (there is no concurrent change  
46  
47 370 in sedimentation rates, van Helmond et al., 2017). Taken together with further declines in abundance of  
48  
49 371 eutrophic diatoms seen in earlier DAZ, this implies a decrease in nutrient concentrations. Brackish  
50  
51 372 diatoms increase clearly in DAZ 4, though the DI-salinity suggests little change until after ~3,900 cal. a BP  
52  
53 373 (Fig. 3, 4). In Snoeys *et al.* (1993-1998) the brackish category consists of diatoms occurring everywhere in  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 374 the Baltic, with no marked changes along the extensive salinity gradient, hence their increase does not  
4  
5 375 necessarily translate into a freshening of the water column. Despite the increase in brackish-tolerant  
6  
7 376 diatoms, DAZ 4, like DAZ 3, is still dominated by cosmopolitan marine diatoms *Paralia sulcata*,  
8  
9  
10 377 *Thalassionema nitzschioides* and *Shionodiscus oestrupii*. A high wave energy water column is potentially  
11  
12 378 even more significant in the Little Belt at this time.  
13  
14

15 379 While the diol-index used in Kotthoff *et al.* (2017) (Fig. 7G) shows an overall agreement with the  
16  
17 380 DI-salinity, there is a clear deviation during this zone (beginning already in DAZ 3), as the diol-index  
18  
19 381 suggests lower salinities compared to the diatom-based quantitative inference. As the source organisms  
20  
21 382 behind the diol index are still uncertain, and as this index is not yet an established salinity proxy  
22  
23 383 (Rampen *et al.* 2012, 2014), it is difficult to assess what causes the inferred difference in these proxy  
24  
25 384 records. Given the uncertainties associated with the diol index, the diatom-inferred salinity presented  
26  
27 385 here likely provides a more reliable record of changes in the Baltic system relative to that of Kotthoff *et*  
28  
29 386 *al.* (2017).  
30  
31  
32

33 387 The tychopelagic-dominated system seen in DAZ 3 and 4 is replaced with calmer water and  
34  
35 388 higher benthic and pelagic primary production in DAZ 5, (~3,850 to 1000 cal. a BP). *Paralia sulcata*  
36  
37 389 declines rapidly in abundance, as has been recorded previously in the Bornholm Basin (Andrén *et al.*,  
38  
39 390 2000a). It is replaced by increases in *Thalassionema nitzschioides* and *Skeletonema marinoi*. *Skeletonema*  
40  
41 391 *marinoi* has been described as part of an open sea planktonic diatom assemblage in Baltic Sea cores  
42  
43 392 previously (Witak, 2013). The increase in abundance of *Thalassionema nitzschioides*, a cosmopolitan  
44  
45 393 marine diatom, also indicates increased influence of North Sea waters on the Little Belt region.  
46  
47 394 Furthermore, CRS peaks frequently during this timeframe. *Chaetoceros* is also a common open ocean  
48  
49 395 planktonic genus. Furthermore, all of these diatoms are known to increase in populations with increased  
50  
51 396 nutrients.  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 397 The DI-salinity suggests a decline in salinity after ~3,900 cal. a BP and lower, relatively stable  
4  
5 398 conditions up until ~1,000 years BP. This decline is likely driven by an increase in freshwater input as  
6  
7 399 suggested by the pollen-inferred annual precipitation reconstruction at the study site and the  $\delta^{18}\text{O}$ -  
8  
9  
10 400 record of lacustrine carbonates from Lake Igelsjön in southern Sweden (Gustafsson and Westman, 2002;  
11  
12 401 Seppä et al., 2005; Kotthoff et al., 2017; Fig. 7). However, it is possible that both an increased input of  
13  
14 402 marine water from the North Sea is occurring simultaneously with increased freshwater input due to  
15  
16 403 wetter conditions (Seppä et al. 2005; Kotthoff et al. 2017; Fig. 7).  
17  
18

19 404 In addition, a number of benthic diatom species increase in abundance within DAZ 5, possibly in  
20  
21 405 response to the inferred decrease in wave action or an increase in nutrient input due to rainier  
22  
23 406 conditions. Benthic diatoms from within the genera *Fragilaria*, *Staurosirella* and *Pseudostaurosira* fill the  
24  
25 407 available benthic niches. These diatoms have been identified as opportunistic colonizers in shallow Baltic  
26  
27 408 coastal areas previously (Witkowski et al., 2009). A transition to calmer water and increased benthic  
28  
29 409 primary production is further evidenced by the significant increase in the B:P ratio and species richness  
30  
31 410 between zones 4 and 5. Both B:P and richness are high throughout DAZ 5, 3,850 to 980 cal. a BP.  
32  
33 411 Interestingly, pelagic and benthic diatom preservation diverge in DAZ 5, which given their similarity prior  
34  
35 412 to ~4,000 cal. a BP, suggests distinct differences in the taphonomy of benthic and pelagic habitats at this  
36  
37 413 time. After DAZ 5, pelagic preservation increases slightly, whereas benthic preservation declines. As well  
38  
39 414 as differences in nutrient utilization and recycling, this might reflect greater littoral turbulence relative  
40  
41 415 to calmer open water conditions found at the cores site.. As discussed earlier, transport of benthic  
42  
43 416 species from the littoral zone also contributes to dissolution of benthic diatoms.  
44  
45  
46  
47  
48

49 417 Finally, DAZ 5 marks the beginning of an increased relative abundance of sea ice diatoms (Fig 6),  
50  
51 418 implying a longer ice cover duration, which is consistent with the onset of Neoglacial cooling after the  
52  
53 419 Holocene Thermal Maximum, and is seen as colder and wetter conditions in several proxy records (Fig.  
54  
55 420 3, 6)  
56  
57  
58  
59  
60

1  
2  
3 421 The lower portion of the DAZ 6, 5.7 mcd to 2.1 mcd (c. 980 to c. 300 cal. a BP), shows a return to  
4  
5 422 tythropelagic productivity seen in DAZ 3 and 4, implying increased wave action and mixing. This period  
6  
7 423 corresponds to the brackish Recent Baltic Sea stage in the Baltic Basin (e.g. Andrén et al. 2000a). The  
8  
9 424 quantitative DI-salinity suggests a continuation of brackish-marine conditions, punctuated by occasional  
10  
11 425 higher salinity events, particularly associated with high *Paralia sulcata* abundance.  
12  
13  
14

#### 15 426 Medieval Climate Anomaly

16  
17  
18 427 Contrary to some proxy-based studies from the western Baltic Sea, the Medieval Climate  
19  
20 428 Anomaly (MCA ca. 1000-700 cal a BP; Mann et al., 2009) does not clearly stand out as a period of  
21  
22 429 increased primary production in our data. Andrén et al. (2000a) identified a high primary productivity  
23  
24 430 event in the Bornholm basin during the MCA, while others have associated it with increased organic  
25  
26 431 carbon burial, warmer temperatures and reducing conditions in the Belt Sea (Kotthoff et al., 2017; van  
27  
28 432 Helmond et al., 2017). While we do observe a sharp spike in CRS abundance at c. 950 cal. a BP implying a  
29  
30 433 high primary productivity event, such events were also relatively frequent during DAZ 5.  
31  
32  
33

34 434 Instead, our diatom data shows some signs of freshening before, during and after the MCA,  
35  
36 435 indicated by the moderate increase of freshwater species such as *Staurosirella pinnata* and *S. lapponica*.  
37  
38 436 This is in line with modelling studies from the Baltic Sea region (e.g. Schimanke et al., 2012), which  
39  
40 437 suggest increased precipitation and runoff in the Baltic Sea region during the time. Southern  
41  
42 438 Scandinavian proxy-based precipitation records vary over this timeframe, with pollen-inferred  
43  
44 439 precipitation from core M0059 indicating a decrease, whereas  $\delta^{18}\text{O}$  values from Lake Igelsjön in  
45  
46 440 southern Sweden indicate increased precipitation, agreeing with modelling results and our  
47  
48 441 reconstruction (Fig. 7).  
49  
50  
51

#### 52 442 Anthropogenic influence

53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 443 Upcore of this assemblage, 2.1 mcd to the coretop (c. 300 cal. a BP to present), eutrophy-related  
4  
5 444 diatoms increase in abundance. *Cyclotella atomus*, *C. choctawhatcheeana*, *Thalassiosira proschkiniae* and  
6  
7 445 *T. levanderi* become more abundant in this zone and have all been associated with anthropogenic  
8  
9 446 disturbance in the Baltic (Andrén et al., 1999; Weckström 2006). Furthermore, a similar assemblage has  
10  
11 447 been identified by Andrén et al. (2000b) in the Gotland region and was associated with anthropogenic  
12  
13 448 eutrophication. In addition, an increase in cereal pollen is seen after 800 cal. a BP (Kotthoff et al., 2017),  
14  
15 449 representing the large-scale development of agriculture across the region. Therefore, we interpret this  
16  
17 450 assemblage to reflect substantial anthropogenic input of nutrients to the Little Belt region, primarily  
18  
19 451 from land use changes (e.g. conversion of land for agriculture). Nitrogen load to the Baltic Sea has  
20  
21 452 increased by four times since the turn of the 20<sup>th</sup> century and phosphorus has increased by eight times  
22  
23 453 (Elmgren 1989), with the majority of input increasing since 1950 (Rosenberg et al., 1990; Clarke et al.,  
24  
25 454 2003; Clarke et al., 2006; Gustafsson et al., 2012). These conditions favour small centric diatoms, such as  
26  
27 455 seen here. The DI-salinity suggests that salinity declines over the last 300 years, though due to intense  
28  
29 456 nutrient changes and other human impact, isolating a salinity signal is difficult in the uppermost part of  
30  
31 457 the record. However, the true sediment water interface was not likely captured, hampering the  
32  
33 458 assessment of the modern diatom assemblages..  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44

## 460 **Conclusions**

45 461 The Little Belt region has experienced salinity shifts similar to those previously observed in the  
46  
47 462 Baltic Sea. While the studied record does not include a freshwater phase, corresponding to the Ancylus  
48  
49 463 Lake stage in the Baltic proper, due to a hiatus in sedimentation, a slightly brackish interval  
50  
51 464 corresponding to the Initial Littorina Sea phase is detected, from 7,800 to 7,500 cal. a BP. An elevated  
52  
53 465 nutrient content is also detected through this interval, which continues during the rapid salinity increase  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 466 from 7,500 to 7,150 cal. a BP, after which brackish conditions prevail. The maximum observed salinity,  
4  
5 467  $35 \text{ g L}^{-1}$ , occurs within the tythropelagic phase, from 7,100 to ca. 3,900 cal. a BP, during the Holocene  
6  
7 468 Climate Optimum, after which, with the onset of Neoglacial cooling a calmer hydrodynamic regime and  
8  
9  
10 469 higher primary production prevail The diatom assemblages indicate a return to tythropelagic productivity  
11  
12 470 from 1000 cal. a BP to the coretop, corresponding to the Modern Baltic Sea phase within the Baltic basin  
13  
14 471 proper. This interval contains the Medieval Climate Anomaly, which does not clearly stand out in our  
15  
16 472 data set. The last ~300 years reveal anthropogenic eutrophication of the Little Belt region.  
17  
18  
19  
20 473

## 22 474 **Acknowledgements**

25 475 We would like to thank the Captain and crew of the *Greatship Manisha* and the British  
26  
27 476 Geological Survey for logistic support and providing the coring equipment; we would not be able to do  
28  
29  
30 477 this work without them. A further thanks goes to the other expedition scientists. Martin Jakobsson is  
31  
32 478 kindly acknowledged for making the GIS map used in Fig. 1. We are grateful to our reviewers for their  
33  
34 479 helpful comments. TA and EA were financially supported by grant 2207/3.1.1/2014 provided by The  
35  
36 480 Foundation for Baltic and East European Studies. The data that support the findings of this study are  
37  
38 481 available from the corresponding author upon reasonable request.  
39  
40  
41

## 42 482 **References**

44 483 Andersen, J. H., Carstensen, J., Conley, D. J., Dromph, K., Fleming-Lehtinen, V., Gustafsson, B. G.,  
45  
46 484 Josefson, A. B., Norkko, A., Villnäs, A. & Murray, C. 2017: Long-term temporal and spatial trends in  
47  
48 485 eutrophication status of the Baltic Sea. *Biological Reviews* 92, 135–149. doi: 10.1111/brv.12221  
49  
50  
51 486 Andrén E., Shimmield, G. & Brand, T. 1999: Environmental changes of the last three centuries indicated  
52  
53 487 by siliceous microfossil records from the southwestern Baltic Sea. *The Holocene* 9, 25-38.  
54  
55  
56  
57  
58  
59  
60

- 1  
2  
3 488 Andrén E., Andrén T. & Sohlenius G. 2000a: The Holocene history of the southwestern Baltic Sea as  
4  
5 489 reflected in a sediment core from the Bornholm Basin. *Boreas* 29, 233–250.  
6  
7  
8 490 Andrén, E., Andrén, T., & Kunzendorf, H. 2000b: Holocene history of the Baltic Sea as a background for  
9  
10 491 assessing records of human impact in the sediments of the Gotland Basin. *The Holocene* 10, 687-702.  
11  
12  
13 492 Andrén, T., Andrén, E., Berglund, B.E., & Yu, S-Y. 2007: New insights on the Yoldia Sea low stand in the  
14  
15 493 Blekinge archipelago, southern Baltic Sea. *GFF* 129 (4), 277-285.  
16  
17  
18 494 Andrén, T., Björck, S., Andrén, E., Conley, D. J., Zillén, L. & Anjar, J. 2011: The development of the Baltic  
19  
20 495 Sea basin during the last 130 ka. In: *The Baltic Sea Basin*. Harff, J., Björck, S. & Hoth., P. (eds) 75-98.  
21  
22 496 Springer.  
23  
24  
25 497 Andrén, T., Jørgensen, B. B., Cotterill, C., Green, S., Andrén, E., Ash, J., Bauersachs, T., Cragg, B., Fanget,  
26  
27 498 A.-S., Fehr, A., Granoszewski, W., Groeneveld, J., Hardisty, D., Herrero-Bervera, E., Hyttinen, O., Jensen,  
28  
29 499 J. B., Johnson, S., Kenzler, M., Kotilainen, A., Kotthoff, U., Marshall, I. P. G., Martin, E., Obrochta, S.,  
30  
31 500 Passchier, S., Quintana Krupinski, N., Riedinger, N., Slomp, C., Snowball, I., Stepanova, A., Strano, S.,  
32  
33 501 Torti, A., Warnock, J., Xiao, N. & Zhang, R. 2015a: Site M0059. In Andrén, T., Jørgensen, B. B., Cotterill,  
34  
35 502 C., Green, S. & the Expedition 347 Scientists, *Proceedings of the IODP 347*: College Station, TX  
36  
37 503 (Integrated Ocean Drilling Program). [doi:10.2204/iodp.proc.347.105.2015](https://doi.org/10.2204/iodp.proc.347.105.2015)  
38  
39  
40  
41  
42 504 Andrén, T., Jørgensen, B.B., Cotterill, C., Green, S. & the IODP expedition 347 scientific party. 2015b.  
43  
44 505 IODP expedition 347: Baltic Sea basin paleoenvironment and biosphere. *Scientific Drilling* 20, 1–12.  
45  
46 506 [doi:10.5194/sd-20-1-2015](https://doi.org/10.5194/sd-20-1-2015)  
47  
48  
49 507 Andrén, E., Telford, R J., & Jonsson, P. 2017: Reconstructing the history of eutrophication and  
50  
51 508 quantifying total nitrogen reference conditions in Bothnian Sea coastal waters. *Estuarine, Coastal and*  
52  
53 509 *Shelf Science* 198, 320-328.  
54  
55  
56  
57  
58  
59  
60

- 1  
2  
3 510 Antonsson, K., & Seppä, H. 2007: Holocene temperatures in Bohuslän, southwest Sweden: a quantitative  
4  
5 511 reconstruction from fossil pollen data. *Boreas* 36, 400-410.  
6  
7  
8 512 Armand, L. K., Crosta, X., Romero, O. & Pichon, J.-J. 2005: The biogeography of major diatom taxa in  
9  
10 513 Southern Ocean sediments: 1. Sea ice related species. *Palaeogeography, Palaeoclimatology,*  
11  
12 514 *Palaeoecology* 223, 93-126.  
13  
14  
15 515 Armand, L., Ferry, A., & Leventer, A. 2017: Advances in palaeo sea ice estimation. In: *Sea ice* Third  
16  
17 516 Edition. D.N. Thomas, ed. John Wiley & Sons, Ltd.  
18  
19  
20  
21 517 Bennike, O., Andreasen, M.S., Jenson, J.B., Moros, M., & Noe-Nygaard, N. 2012: Early Holocene sea-level  
22  
23 518 changes in Øresund, southern Scandinavia. *Geological Survey of Denmark and Greenland Bulletin* 26, 29-  
24  
25 519 32.  
26  
27  
28 520 Bennike, O., & Jensen, J.B. 2011: Postglacial, relative shore-level changes in the Lillebælt, Denmark.  
29  
30 521 *Geological Survey of Denmark and Greenland Bulletin* 23, 37-40.  
31  
32  
33 522 Bennike, O., Jensen, J.B., Lemke, W., Kuijpers, A., & Lomholt, S. 2004: Late- and postglacial history of the  
34  
35 523 Great Belt, Denmark. *Boreas* 33, 18-33.  
36  
37  
38 524 Berglund, B. E., Sandgren, P., Barnekow, L., Hannon, G., Jiang, H., Skog, G. & Yu, S. 2005: Early Holocene  
39  
40 525 history of the Baltic Sea, as reflected in coastal sediments in Blekinge, southeastern Sweden. *Quaternary*  
41  
42 526 *International* 130, 111–139.  
43  
44  
45  
46 527 Björck, S. 2008: The late Quaternary development of the Baltic Sea basin. In: The BACC Author Team  
47  
48 528 (eds) *Assessment of climate change for the Baltic Sea Basin*. 377 pp. Springer, Berlin, Heidelberg.  
49  
50  
51 529 Blaauw, M. 2010: Methods and code for “classical” age-modelling of radiocarbon sequences. *Quaternary*  
52  
53 530 *Geochronology* 5, 5512–5518.  
54  
55  
56  
57  
58  
59  
60



- 1  
2  
3 531 Brown, K.J., Seppä, H., Schoups, G., Fausto, R., Rasmussen, P., & Birks, H.J.B. 2012: A spatio-temporal  
4  
5 532 reconstruction of Holocene temperature change in southern Scandinavia. *The Holocene* 22, 165-177.  
6  
7  
8 533 Burman, P., Chow, E. & Nolan, D. 1994. A cross-validatory method for dependent data. *Biometrika*, 81,  
9  
10 534 351-358.  
11  
12  
13 535 Carstensen, J., Andersen, J. H., Gustafsson, B. G. & Conley, D. J. 2014: Deoxygenation of the Baltic Sea  
14  
15 536 during the last century. *Proceedings of the National Academy of Sciences* 111, 5628-5633.  
16  
17  
18 537 Christensen, C., 2001: Coastal settlement and sea level change in the Stone Age., In: Jensen, O.L.,  
19  
20 538 Sørensen, S.A., Hansen, K.M. (Eds.), *Denmarks Hunting Stone Age – status and perspectives*, Hoersholm  
21  
22 539 Egns Museum, pp. 183-193.  
23  
24  
25  
26 540 Clarke A., Juggins S. & Conley D. 2003: A 150-year reconstruction of the history of coastal eutrophication  
27  
28 541 in Roskilde Fjord, Denmark. *Marine Pollution Bulletin* 46, 1615–1618.  
29  
30  
31 542 Clarke, A.L., Weckström, K., Conley, D.J., Anderson, N.J., Adser, F., Andrén, E., de Jonge, V.N., Ellegaard,  
32  
33 543 M., Juggins, S., Kauppila, P., Korhola, A., Reuss, N., Telford, R.J., & Vaalgamaa, S. 2006: Long-term trends  
34  
35 544 in eutrophication and nutrients in the coastal zone. *Limnology & Oceanography* 51, 385-397.  
36  
37  
38 545 Clemmensen, L.B., Murray, A.S., & Nielsen, L. 2012: Quantitative constraints on the sea-level fall that  
39  
40 546 terminated the Littorina Sea Stage, southern Scandinavia. *Quaternary Science Reviews* 40, 54-63.  
41  
42  
43 547 Cleve-Euler, A. 1951: Die Diatomeen von Schweden und Finland. 163 pp. *Kungliga Svenska*  
44  
45 548 *Vetenskapsakademiens Handlingar Fjärde Serien*, 2.  
46  
47  
48 549 Cortese, G., & Gersonde, R. 2007: Morphometric variability in the diatom *Fragilariopsis kerguelensis*:  
49  
50 550 Implications for Southern Ocean paleoceanography. *Earth and Planetary Science Letters* 257, 526-544.  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

- 1  
2  
3 551 Denis, D., Crosta, X., Schmidt, S., Carson, D.S., Ganeshram, R.S., Renssen, H., Crespin, J., Ther, O., Billy, I.,  
4  
5 552 & Gireadeau, J. 2009: Holocene productivity changes of Adélie Land (East Antarctica). *Paleoceanography*  
6  
7 553 24. doi: 10.1029/2008PA001689.
- 9  
10 554 Elmgren, R., 1989: Man's impact on the ecosystem of the Baltic Sea: energy flows today and at the turn  
11  
12 555 of the century. *Ambio* 18, 326-332.
- 14  
15 556 Fryxell, G. A., & Hasle, G. R. 1972: *Thalassiosira eccentrica* (Ehrenb.) Cleve, *T. symmetrica* sp. nov., and  
16  
17 557 some related centric diatoms. *Journal of Phycology* 8, 297–317.
- 19  
20 558 Fryxell, G. A. & Hasle, G. R. 1980: The marine diatom *Thalassiosira oestrupii*: structure, taxonomy and  
21  
22 559 distribution. *American Journal of Botany* 67, 804–814.
- 24  
25 560 Gustafsson, B.G., Schenk, F., Blenckner, T., Eilola, K., Meier, H.E.M., Müller-Karulis, B., Neumann, T.,  
26  
27 561 Ruoho-Airola, T., Savchuk, O.P., & Zorita, E. 2012: Reconstructing the Development of Baltic Sea  
28  
29 562 Eutrophication 1850-2006. *Ambio* 41, 534-548.
- 31  
32 563 Gustafsson, B. G. & Westman, P. 2002: On the causes of salinity variations in the Baltic Sea during the  
33  
34 564 last 8500 years. *Paleoceanography* 17, 1-14.
- 36  
37 565 Hammer, Ě., Harper, D. A. T. & Ryan, P. D. 2001: PAST: Paleontological statistics software package for  
38  
39 566 education and data analysis. *Palaeontologia Electronica* 4, 9pp.
- 41  
42 567 Hasle, G.R. & Lange, C.B. 1992: Morphology and distribution of *Coscinodiscus* species from the Oslofjord,  
43  
44 568 Norway, and the Skagerrak, North Atlantic. *Diatom Research* 7 (1), 37-68.
- 46  
47 569 Hasle, G. R. 1978a: Some freshwater and brackish water species of the diatom genus *Thalassiosira* Cleve.  
48  
49 570 *Phycologia* 17, 263–292.
- 51  
52  
53  
54  
55  
56  
57  
58  
59  
60

- 1  
2  
3 571 Hasle, G. R. 1978b: Some *Thalassiosira* species with one central process (Bacillariophyceae). *Norwegian*  
4  
5 572 *Journal of Botany* 25, 77–110.  
6  
7 573 Heier-Nielsen, S., Heinemeir, J., Nielsen, H.L., Rud, N., 1995. Recent reservoir ages for Danish fjords and  
8  
9 574 marine waters. *Radiocarbon* 37, 875–882.  
10  
11 575 Hustedt, F. 1930: Die Kieselalgen Deutschlands, Österreichs und der Schweiz: unter Berücksichtigung der  
12  
13 576 übrigen Länder Europas sowie der angrenzenden Meeresgebiete (Vol. 1 and 2). 920 pp. *In* Rabenhorst, L.  
14  
15 577 (Ed.), *Kryptogamen-Flora von Deutschland, Österreich und der Schweiz*: Leipzig (Akad. Verlag).  
16  
17  
18  
19 578 ICES: Hydrochemistry, CTD and Bottle data portal, ICES, Copenhagen, 2017.  
20  
21  
22 579 Karlson, B., Eilola, K., Johansson, J., Linders, J., Mohlin, M., Wranne, A.W., & Wåhlström, I. 2017:  
23  
24 580 Distribution of cyanobacterial blooms in the Baltic Sea. In: Proença, L.A.O and Hallengraeff, G.M. (eds).  
25  
26 581 *Marine and Fresh-Water Harmful Algae*. Proceedings of the 17<sup>th</sup> International Conference on Harmful  
27  
28 582 Algae. International Society for the Study of Harmful Algae.  
29  
30  
31  
32 583 Kostecki, R., Janczak-Kostecka, B., Endler, M., & Moros, M. 2015: The evolution of the Mecklenburg Bay  
33  
34 584 environment in the Holocene in light of multidisciplinary investigations of the sediment cores.  
35  
36 585 *Quaternary International* 386, 226-238.  
37  
38  
39 586 Kotthoff, U., Groeneveld, J., Ash, J.L., Fanget, A.-S., Krupinski, N.Q., Peyron, O., Stepanova, A., Warnock,  
40  
41 587 J., van Helmond, N.A.G.M., Passey, B.H., Clausen, O.R., Bennike, O., Andrén, E., Granoszewski, W.,  
42  
43 588 Andrén, T., Filipsson, H.L., Seidenkrantz, M.-S., Slomp, C.P., & Bauersachs, T. 2017: Reconstructing  
44  
45 589 Holocene temperature and salinity variations in the western Baltic Sea region: a multi-proxy comparison  
46  
47 590 from the Little Belt (IODP Expedition 347, Site M0059). *Biogeosciences* 14 (23), 5607-5632. doi:  
48  
49 591 10.5194/bg-14-5607-2017  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

- 1  
2  
3 592 Krammer, K., & Lange-Bertalot, H. 1988: Bacillariophyceae, Part 2. Bacillariaceae, Epithemiaceae,  
4  
5 593 Surirellaceae. 611 pp. *In* Ettl, H., Gerloff, J., Heynig, H., & Mollenhauer, D. (Eds.), *Süßwasserflora von*  
6  
7 594 *Mitteleuropa* (Vol. 2/2): Stuttgart, Germany (Gustav Fischer Verlag).  
8  
9  
10 595 Krammer, K., & Lange-Bertalot, H. 1991a: Bacillariophyceae, Part 3. Centrales, Fragilariaceae,  
11  
12 596 Eunotiaceae. 598 pp. *In* Ettl, H., Gerloff, J., Heynig, H., & Mollenhauer, D. (Eds.), *Süßwasserflora von*  
13  
14 597 *Mitteleuropa* (Vol. 2/3): Stuttgart, Germany (Gustav Fischer Verlag).  
15  
16  
17  
18 598 Krammer, K., & Lange-Bertalot, H. 1991b: Bacillariophyceae, Part 4. Achnantaceae. 468 pp. *In* Ettl, H.,  
19  
20 599 Gärtner, J.G., Gerloff, J., Heynig, H., & Mollenhauer, D. (Eds.), *Süßwasserflora von Mitteleuropa* (Vol. 2/4):  
21  
22 600 Stuttgart, Germany (Gustav Fischer Verlag).  
23  
24  
25 601 Leventer, A. and Dunbar, R.B. 1996. Factors influencing the distribution of diatoms and other algae in  
26  
27 602 the Ross Sea. *Journal of Geophysical Research* 101 (8), 18489-18500.  
28  
29  
30 603 Lewis, J.P., Ryves, D.B., Rasmussen, P., Knudsen, K.L., Petersen, K.S., Olsen, J., Leng, M.J., Kristensen, P.,  
31  
32 604 McGowan, S., Phillipsen, B., 2013: Environmental change in the Limfjord, Denmark (ca. 7,500e1500 cal  
33  
34 605 yrs BP): a multiproxy study. *Quaternary Science Reviews* 78, 126-140.  
35  
36  
37 606 Lewis, J.P., Ryves, D.B., Rasmussen, P., Olsen, J., Knudsen, K.-L., Andersen S.H., Weckström, K., Clarke,  
38  
39 607 A.L., Andrén, E., & Juggins, S. 2016: The shellfish enigma across the Mesolithic-Neolithic transition in  
40  
41 608 southern Scandinavia. *Quaternary Science Reviews* 151, 315-320.  
42  
43  
44 609 Loughheed, B.C., Filipsson, H.L., Snowball, I., 2013. Large spatial variations in coastal <sup>14</sup>C reservoir age - a  
45  
46 610 case study from the Baltic Sea. *Clim. Past* 9, 1015–1028.  
47  
48  
49 611 Mann, M.E., Zhang, Z., Rutherford, S., Bradley, R.S., Hughes, M.K., Shindell, D., Ammann, C., Faluvegi, G.,  
50  
51 612 & Ni, Fenbiao. 2009: Global signatures and dynamical origins of the Little Ice Age and Medieval Climate  
52  
53 613 Anomaly. *Science* 326 (5957), 1256-1260.  
54  
55  
56  
57  
58  
59  
60

- 1  
2  
3 614 McCabe, S. & Cyr, H. 2006: Environmental variability influences the structure of benthic algal  
4  
5 615 communities in an oligotrophic lake. *Oikos* 115, 197-206.  
6  
7  
8 616 McQuoid, M.R. & Nordberg, K. 2003: The diatom *Paralia sulcata* as an environmental indicator species in  
9  
10 617 coastal sediments. *Estuarine, Coastal and Shelf Science* 56 (2), 339-354.  
11  
12  
13 618 Mölder, K. & Tynni, R. 1967: Über Finnlands rezente und subfossile Diatomeen, *Bulletin of the Geological*  
14  
15 619 *Society of Finland* 39, 199–217.  
16  
17  
18 620 Mölder, K. & Tynni, R. 1968: Über Finnlands rezente und subfossile Diatomeen, II. *Bulletin of the*  
19  
20 621 *Geological Society of Finland* 40, 151–170.  
21  
22  
23 622 Mölder, K. & Tynni, R. 1969: Über Finnlands rezente und subfossile Diatomeen, III. *Bulletin of the*  
24  
25 623 *Geological Society of Finland* 41, 235–251.  
26  
27  
28 624 Mölder, K. & Tynni, R. 1970: Über Finnlands rezente und subfossile Diatomeen, IV. *Bulletin of the*  
29  
30 625 *Geological Society of Finland* 42, 129–144.  
31  
32  
33 626 Mölder, K. & Tynni, R. 1971: Über Finnlands rezente und subfossile Diatomeen, V. *Bulletin of the*  
34  
35 627 *Geological Society of Finland* 43, 203–220.  
36  
37  
38 628 Mölder, K. & Tynni, R. 1972: Über Finnlands rezente und subfossile Diatomeen, VI. *Bulletin of the*  
39  
40 629 *Geological Society of Finland* 44, 141–149.  
41  
42  
43 630 Mölder, K. & Tynni, R. 1973: Über Finnlands rezente und subfossile Diatomeen, VII. *Bulletin of the*  
44  
45 631 *Geological Society of Finland* 45, 159–179.  
46  
47  
48 632 Mundy, C. J., Gosselin, M., Ehn, J. K., Belzile, C., Poulin, M., Alou, E., Roy, S., Hop, H., Lessard, S.,  
49  
50 633 Papakyriakou, T. N., Barber, D. G. & Stewart, J. 2011: Characteristics of two distinct high-light acclimated  
51  
52 634 algal communities during advanced stages of sea ice melt. *Polar Biology* 34, 1869-1886.  
53  
54  
55  
56  
57  
58  
59  
60

- 1  
2  
3 635 Muylaert, K. & Sabbe, K. 1996: The diatom genus *Thalassiosira* (Bacillariophyta) in the estuaries of the  
4  
5 636 Schelde (Belgium/The Netherlands) and the Elbe (Germany). *Botanica Marina* 39, 103–115.  
6  
7  
8 637 Okolodkov, Y. B. 1993: A checklist of algal species found in the East Siberian Sea in May 1987. *Polar*  
9  
10 638 *Biology* 13, 7-11.  
11  
12  
13 639 Poulin, M. & Cardinal, A. 1982: Sea ice diatoms from Manitounuk Sound, southeastern Hudson Bay  
14  
15 640 (Quebec, Canada). I. Family Naviculaceae. *Canadian Journal of Botany* 60, 1263-1278.  
16  
17  
18 641 Rampen, S.W., Willmott, V., Kim, J.-H., Uliana, E., Mollenhauer, G., Schefuß, E., Sinninghe Damsté, J.S. &  
19  
20 642 Schouten, S., 2012. Long chain 1,13- and 1,15-diols as a potential proxy for palaeotemperature  
21  
22 643 reconstruction. *Geochimica et Cosmochimica Acta* 84, 204–216.  
23  
24  
25 644 Rampen, S.W., Willmott, V., Kim, J.-H., Rodrigo-Gámiz, M., Uliana, E., Mollenhauer, G., Schefuß, E.,  
26  
27 645 Sinninghe Damsté, J.S. & Schouten, S. 2014: Evaluation of long chain 1,14-alkyl diols in marine sediments  
28  
29 646 as indicators for upwelling and temperature. *Organic Geochemistry* 76, 39–47.  
30  
31  
32 647 Reimer, P.J., Bard, E., Bayliss, A., Beck, J.W., Blackwell, P.G., Bronk Ramsey, C., Buck, C.E., Cheng, H.,  
33  
34 648 Edwards, R.L., Friedrich, M., Grootes, P.M., Guilderson, T.P., Haflidason, H., Hajdas, I., Hatté, C., Heaton,  
35  
36 649 T.J., Hoffmann, D.L., Hogg, A.G., Hughen, K.A., Kaiser, K.F., Kromer, B., Manning, S.W., Niu, M., Reimer,  
37  
38 650 R.W., Richards, D.A., Scott, E.M., Southon, J.R., Staff, R.A., Turney, C.S.M., & van der Plicht, J. 2013:  
39  
40 651 IntCal13 and Marine13 radiocarbon age calibration curves 0–50,000 years cal BP. *Radiocarbon* 55, 1869–  
41  
42 652 1887.  
43  
44  
45  
46  
47 653 Rosenberg, R., Elmgren, R., Fleisher, S., Jonsson, P., Persson, G. & Dahlin, H. 1990: Marine eutrophication  
48  
49 654 case studies in Sweden. *Ambio* 19 (3), 102-108.  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

- 1  
2  
3 655 Ryves, D.B., Battarbee, R.W., & Fritz, S.C. 2009: The dilemma of disappearing diatoms: Incorporating  
4  
5 656 diatom dissolution data into palaeoenvironmental modelling and reconstruction. *Quaternary Science*  
6  
7 657 *Reviews* 28, 120-135.  
8  
9  
10 658 Ryves, D.B., Juggins, J., Fritz, S.C. & Battarbee, R.W. 2001: Experimental diatom dissolution and the  
11  
12 659 quantification of microfossil preservation in sediments. *Palaeogeography, Palaeoclimatology,*  
13  
14 660 *Palaeoecology* 172: 99–113.  
15  
16  
17  
18 661 Sabbe, K. & Vyverman, W. 1995: Taxonomy, morphology and ecology of some widespread  
19  
20 662 representatives of the diatom genus *Opephora*. *European Journal of Phycology* 30, 235–249.  
21  
22  
23 663 Schimanke, S., Meier, H.E.M., Kjellström, E., Strandberg, G., & Hordoir, R. 2012. The climate in the Baltic  
24  
25 664 Sea region during the last millennium simulated with a regional climate model. *Climates of the Past* 8,  
26  
27 665 1419-1433.  
28  
29  
30 666 Seppä, H., Hammarlund, D., & Antonsson, K., 2005. Low-frequency and high-frequency changes in  
31  
32 667 temperature and effective humidity during the Holocene in south-central Sweden: implicatons for  
33  
34 668 atmospheric and oceanic forcings of climate. *Climate Dynamics* 25, 285-297.  
35  
36  
37  
38 669 Snoeijs, P. 1992: Studies in the *Tabularia fasciculata* complex. *Diatom Research* 7, 313–344.  
39  
40  
41 670 Snoeijs, P., Vilbaste, S., Potapova, M., Kasperoviciene, J. & Balashova, J. (Eds.), 1993-1998.  
42  
43 671 *Intercalibration and Distribution of Diatom Species in the Baltic Sea* (Vol. 1–5): Uppsala, Sweden (Opulus  
44  
45 672 Press).  
46  
47  
48 673 Snoeijs-Leijonmalm, P. & Andrén, E. 2017. Why is the Baltic Sea so special for organisms to live in?  
49  
50 674 *Biological Oceanography of the Baltic Sea*. In: Snoeijs-Leijonmalm, P., Schubert, H. & Radziejewska, T.  
51  
52 675 (eds). Springer, Dordrecht, 23- 84 pp.  
53  
54  
55  
56  
57  
58  
59  
60

- 1  
2  
3 676 Stone, J.R. & Fritz, S.C. 2004. Three-dimensional modeling of lacustrine diatom habitat areas: Improving  
4  
5 677 paleolimnological interpretation of planktic : benthic ratios. *Limnology & Oceanography* 49, 1540–1548.  
6  
7  
8 678 ter Braak, C.J.F. & Juggins, S. 1993. Weighted Averaging Partial Least-Squares Regression (WA-PLS) - an  
9  
10 679 Improved Method for Reconstructing Environmental Variables from Species Assemblages.  
11  
12 680 *Hydrobiologia*, 269, 485-502.  
13  
14  
15 681 Trachsel, M. & Telford, R.J. 2016. Technical Note: Estimating unbiased transfer-function performances in  
16  
17 682 spatially structured environments. *Climate of the Past* 12, 1215-1223.  
18  
19  
20 683 Tynni, R. 1975: Über Finnlands rezente und subfossile Diatomeen, VIII. 274 pp. *Bulletin of the Geological*  
21  
22 684 *Society of Finland*.  
23  
24  
25 685 Tynni, R. 1976: Über Finnlands rezente und subfossile Diatomeen, IX. 284 pp. *Bulletin of the Geological*  
26  
27 686 *Society of Finland*.  
28  
29  
30 687 Tynni, R. 1978: Über Finnlands rezente und subfossile Diatomeen, X. 296 pp. *Bulletin of the Geological*  
31  
32 688 *Society of Finland*.  
33  
34  
35 689 Tynni, R. 1980: Über Finnlands rezente und subfossile Diatomeen, XI. 312 pp. *Bulletin of the Geological*  
36  
37 690 *Society of Finland*. Van Helmond, N.A.G.M, Krupinski, N.A., Lougheed, B.C., Obrochta, S.P., Andrén, T.,  
38  
39 691 and Slomp, C.P. 2017. Seasonal hypoxia was a natural feature of the coastal zone in the Little Belt,  
40  
41 692 Denmark, during the past 8 ka. *Marine Geology*, 387, 45-57.  
42  
43  
44  
45 693 van der Voet, H. 1994. Comparing the predictive accuracy of models using a simple randomization test.  
46  
47 694 *Chemometrics and Intelligent Laboratory Systems* 25, 313-323.  
48  
49  
50 695 van Helmond, N.A.G.M., Quintana Krupinski, N.B., Lougheed, B.C., Obrochta, S.P., Andrén, T., & Slomp,  
51  
52 696 C.P. 2017: Seasonal hypoxia was a natural feature of the coastal zone in the Little Belt, Denmark, during  
53  
54 697 the past 8 ka. *Marine Geology* 387; 45-57. <http://dx.doi.org/10.1016/j.margeo.2017.03.008>  
55  
56  
57  
58  
59  
60



- 1  
2  
3 698 Warnock, J. P., & Scherer, R. P. 2014: A revised method for determining the absolute abundance of  
4  
5 699 diatoms. *Journal of Paleolimnology*. DOI 10.1007/s10933-014-9808-0  
6  
7  
8 700 Warnock, J.P., & Scherer, R.P. 2016: Increased diatom dissolution in Prydz Bay, East Antarctica linked to  
9  
10 701 inception of the Prydz Bay gyre. *Diatom Research* doi: 10.1080/0269249X.2016.1182075  
11  
12  
13 702 Warnock, J.P., Scherer, R.P. & Konfirst, M.A. 2015: A record of Pleistocene diatom preservation in the  
14  
15 703 Amundsen Sea, West Antarctica with possible implications on silica leakage. *Marine Micropaleontology*  
16  
17 704 117, 40-45.  
18  
19  
20  
21 705 Warnock, J.P., Bauersachs, T., Kotthoff, U., Brandt, H.-T. & Andrén, E. 2017: Holocene environmental  
22  
23 706 history of the Ångermanälven Estuary, northern Baltic Sea. *Boreas*. doi: 10.1111/bor.12281  
24  
25  
26 707 Weckström, K., Lewis, J.P., Andrén, E., Ellegaard, M., Rasmussen, P., Ryves, D.B. and Telford, R. (2017)  
27  
28 708 The Baltic Sea – one of the largest brackish water systems in the world. In *Applications of*  
29  
30 709 *paleoenvironmental techniques in estuarine studies* (Eds. K. Weckström, K. Saunders, P. Gell and G.  
31  
32 710 Skilbeck) *Developments in Palaeoenvironmental Research Series*. Springer, pp. 615–662.  
33  
34  
35 711 Weckström, K., Korhola, A. & Weckström, J. 2007: Impacts of eutrophication on diatom life forms and  
36  
37 712 species richness in the coastal waters of the Baltic Sea. *AMBIO: A Journal of the Human Environment* 36,  
38  
39 713 155-160.  
40  
41  
42  
43 714 Weckström, K. 2006: Assessing recent eutrophication in coastal waters of the Gulf of Finland (Baltic Sea)  
44  
45 715 using subfossil diatoms. *Journal of Paleolimnology* 35, 571-592.  
46  
47  
48 716 Witak, M. 2013: Diatom biofacies in the SW Gulf of Gdańsk and the Vistula Lagoon (the southern Baltic  
49  
50 717 Sea) as indicators of the basin evolution in the Middle and Late Holocene. *International Journal of*  
51  
52 718 *Oceanography and Hydrobiology* 42 (1), 70-88.  
53  
54  
55  
56  
57  
58  
59  
60

- 1  
2  
3 719 Witak, M. & Dunder, J. 2007: Holocene diatom biostratigraphy of the SW Gulf of Gdańsk, Southern Baltic  
4  
5 720 Sea (part II). *Oceanological and Hydrobiological Studies* 36, 3-20.  
6  
7  
8 721 Witkowski, A., Cedro, B., Kierzek, A. & Baranowski, D. 2009: Diatoms as a proxy in reconstructing  
9  
10 722 Holocene environmental changes in the south-western Baltic Sea: the lower Rega River Valley  
11  
12 723 sedimentary record. *Hydrobiologia* 631, 115-172.  
13  
14  
15 724 Witkowski, A., Lange-Bertalot, H. & Metzeltin, D. 2000: Diatom flora of marine coasts (Vol. 1). 925  
16  
17 725 pp. In Lange-Bertalot, H. (Ed.), *Iconographia Diatomologica* (Vol. 7): *Annotated Diatom Micrographs—*  
18  
19 726 *Diversity—Taxonomy—Identification*: Königstein, Germany (Koeltz Scientific Books).  
20  
21  
22  
23 727 Yu, S-Y., Berglund, B., Sandgren, P., & Lambeck, K. 2007: Evidence for a rapid sea-level rise 7600 yr ago.  
24  
25 728 *Geology* 35 (10), 891-894.  
26  
27  
28 729 Zheng, S., Wang, G., Zhang, F., Cai, M. & He, J. 2011: Dominant diatom species in the Canadian Basin in  
29  
30 730 summer 2003, a reported serious melting season. *Polar Record* 47, 244-261.  
31  
32  
33 731 Zillén, L., D. J. Conley, T. Andrén, E. Andrén, and S. Björck. 2008. Past occurrences of hypoxia in  
34  
35 732 the Baltic Sea and role of climate variability, environmental change and human impact. *Earth-*  
36  
37 733 *Science Reviews* 91: 77-92.  
38  
39  
40  
41 734  
42  
43  
44 735 The data that support the findings of this study are available from the corresponding author  
45  
46 736 upon reasonable request.  
47  
48  
49  
50 737  
51  
52  
53 738  
54  
55  
56 739  
57  
58  
59  
60

1  
2  
3 **740 Figure Captions**  
4  
5

6 741 Figure 1: Map of the study region in the Little Belt in between the Baltic Sea and Kattegat. A: Map of the  
7  
8 742 Baltic Sea. B: Belt Sea region. The red dot represents the location of the drill site M0059 (55°0.29'N,  
9  
10 743 10°6.19'E). Geographical locations of names used in the text; 1. Mecklenburg Bay, 2. Darss sill, 3.  
11  
12 744 Drogden sill, 4. Vedbæk, 5. Anholt. Bathymetric data from EMODnet 2018.  
13  
14

15  
16 745 Figure 2: Sedimentation rates. Approximations of the sampling resolution, presented as the number of  
17  
18 746 years per 20 cm of core, are provided.  
19

20  
21 747 Figure 3: Diatom relative abundance (%) for core M0059 Units 1a and 1b. Relative abundances are  
22  
23 748 presented as a percent of the assemblage within each interval. Species that occurred with > 5% total  
24  
25 749 abundance in at least one sample are included. Diatom species are sorted by salinity preference  
26  
27 750 following Snoeijs et al. (1993-1998). DAZ are given on the right, separated by horizontal lines.  
28  
29

30 751 Figure 4: Diatom-based salinity reconstruction for core M0059 Units 1a and 1b. Diatoms were identified  
31  
32 752 to the species or variety level and subsequently assigned to one of five salinity preferences (Snoeijs et  
33  
34 753 al., 1993-1998) or a sea ice preference. At least 300 individuals were identified in each sample. The  
35  
36 754 "Unknown" grouping consists of diatoms viewed in girdle view which could not be identified to the  
37  
38 755 species level. DAZ are given on the right, separated by horizontal lines. Depth is plotted as meters  
39  
40  
41 756 composite depth and ages given are in cal. a BP. Abbreviations are as follows: F – freshwater; BF –  
42  
43 757 brackish-fresh; B – brackish, BM – brackish-marine; M – marine; SI – sea ice; Un – unknown. Diatom-  
44  
45 758 inferred salinity in g L<sup>-1</sup> includes the p = 0.95 confidence interval.  
46  
47

48 759 Figure 5: Diatom ecological metrics for core M0059 Units 1a and 1b. Absolute diatom abundance (ADA)  
49  
50 760 and *Chaetoceros* resting spore (crs) abundance are presented in valves/gram dry weight of sediment  
51  
52 761 \*10<sup>6</sup>. Species richness (R) and the ratio of benthic to pelagic diatoms (B:P) are also presented. DAZ are  
53  
54 762 given on the left, separated by horizontal lines.  
55  
56  
57  
58  
59  
60

1  
2  
3 763 Figure 6: Diatom preservation indices within core M0059 Units 1a and 1b. Diatom preservation (as valve  
4  
5 764 dissolution) was quantitatively assessed using two species, *Cocconeis scutellum* and *Paralia sulcata* (see  
6  
7  
8 765 Methods). Higher values (%) represent better diatom preservation.  
9

10 766 Figure 7: Comparison of the core M0059 data presented here with other site data (from Kotthoff et al.,  
11  
12 767 2017) and regional parameters. A. Mean pollen-inferred annual temperature from M0059 (Kotthoff et  
13  
14 768 al., 2017) and Lake Trehörningen, SE Sweden (Antonsson and Seppä, 2007). B. Mean January and July  
15  
16 769 temperature from Denmark (Brown et al., 2012). HTM = Holocene Thermal Maximum, MCA = Medieval  
17  
18 770 Climate Anomaly. C. Mean coldest and warmest month temperatures inferred from pollen and D.  
19  
20 771 summer surface water temperatures reconstructed from LDI and TEX 86 (L) biomarkers from site M0059  
21  
22 772 (Kotthoff et al., 2017). E. Proxies for precipitation/wetness including pollen-inferred precipitation from  
23  
24 773 M0059 and oxygen isotope analysis ( $\delta^{18}\text{O}$ ) of lacustrine carbonates from Lake Igelsjön (Seppä et al.,  
25  
26 774 2005). F. Sea-level change from three nearby sites; Vedbæk, Sealand, Denmark (Øresund; Christensen,  
27  
28 775 2001), Anholt in the Central Kattegat (Clemmensen et al., 2012) and Blekinge, SE Sweden (Berglund et  
29  
30 776 al., 2005). G-H. Salinity proxies for M0059. G. diatom-inferred salinity presented here and Diol index  
31  
32 777 from Kotthoff et al. (2017). H. Diatom salinity affinities based on the Baltic Marine Biologists  
33  
34 778 classification system (Snoeijs et al., 1993-1998). DAZ = Diatom assemblage zone.  
35  
36  
37  
38  
39

#### 40 779 **Table Captions**

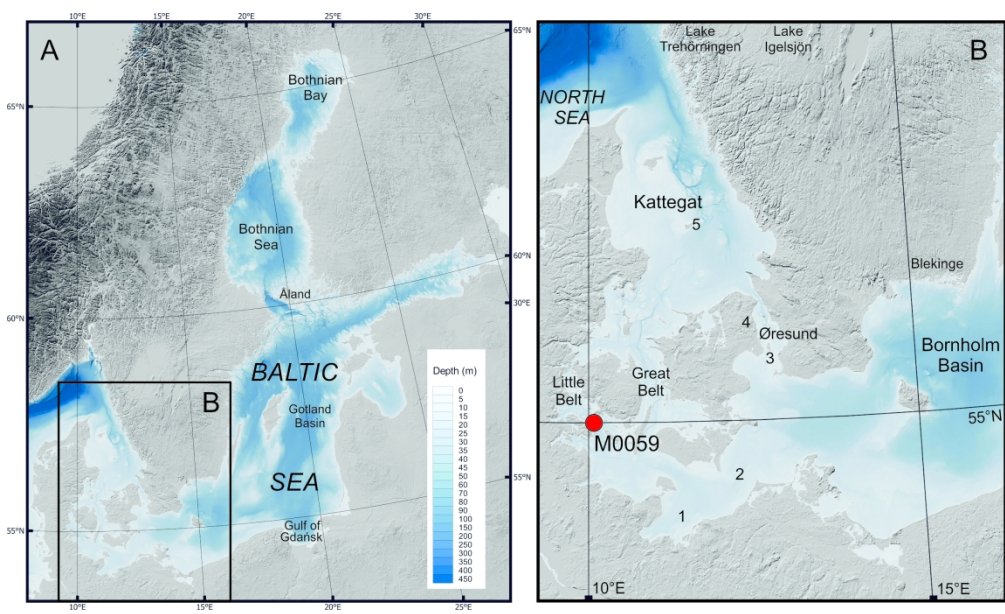
41  
42  
43 780 Table 1: This table provides the means (A) and ranges (B) of all computed diatom ecological metrics.  
44  
45 781 Abbreviations are as follows: ADA – absolute diatom abundance; CRS – *Chaetoceros* resting spore  
46  
47 782 absolute abundance; v gdw<sup>-1</sup> – valves per gram dry weight; R – richness; B:P – Benthic to pelagic ratio; F  
48  
49 783 – freshwater; BF – brackish-fresh; B – brackish, BM – brackish-marine; M – marine; SI – sea ice.  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 784 Table 2: Relative abundances of diatom species. The relative abundances (%) for all species which have  
4  
5 785 an abundance of at least 3% in at least one sample are provided. Abbreviations follow table 1. In  
6  
7 786 addition, P – pelagic and B – benthic in the Lifeform column.  
8  
9

10 787 Table 3: This table provides the results of Tukey-Kramer pairwise statistical tests. “+” represents a  
11  
12 788 statistically significant change ( $p \leq 0.05$ ) comparing adjacent diatom abundance zones, whereas “-”  
13  
14  
15 789 represents no significant change. Abbreviations follow Table 1.  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

For Review Only

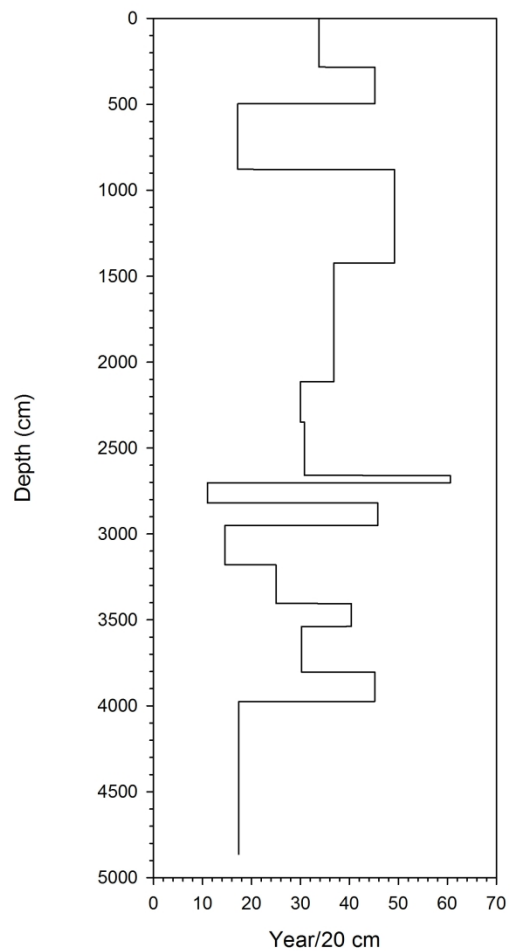
1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60



231x138mm (300 x 300 DPI)

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

**M0059 sedimentationrates**

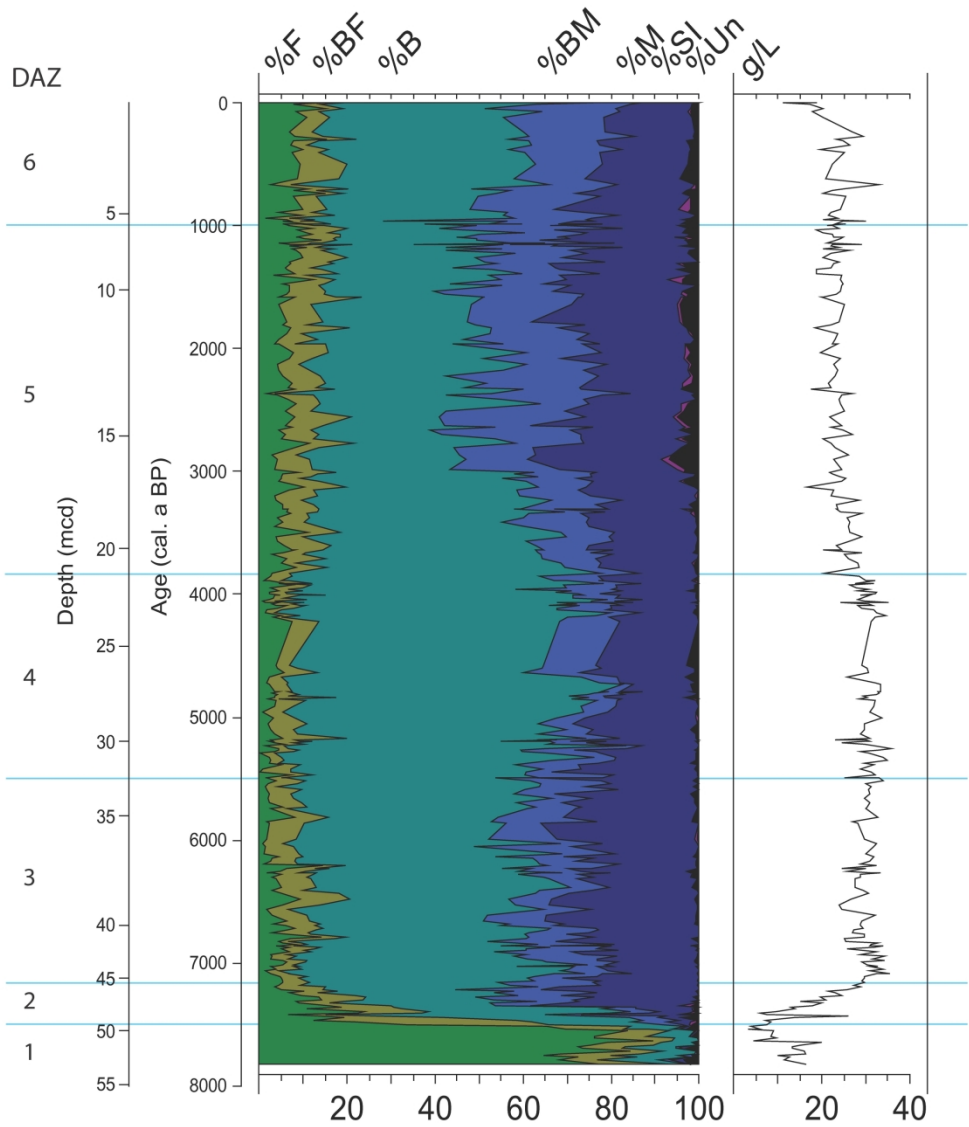


214x279mm (300 x 300 DPI)



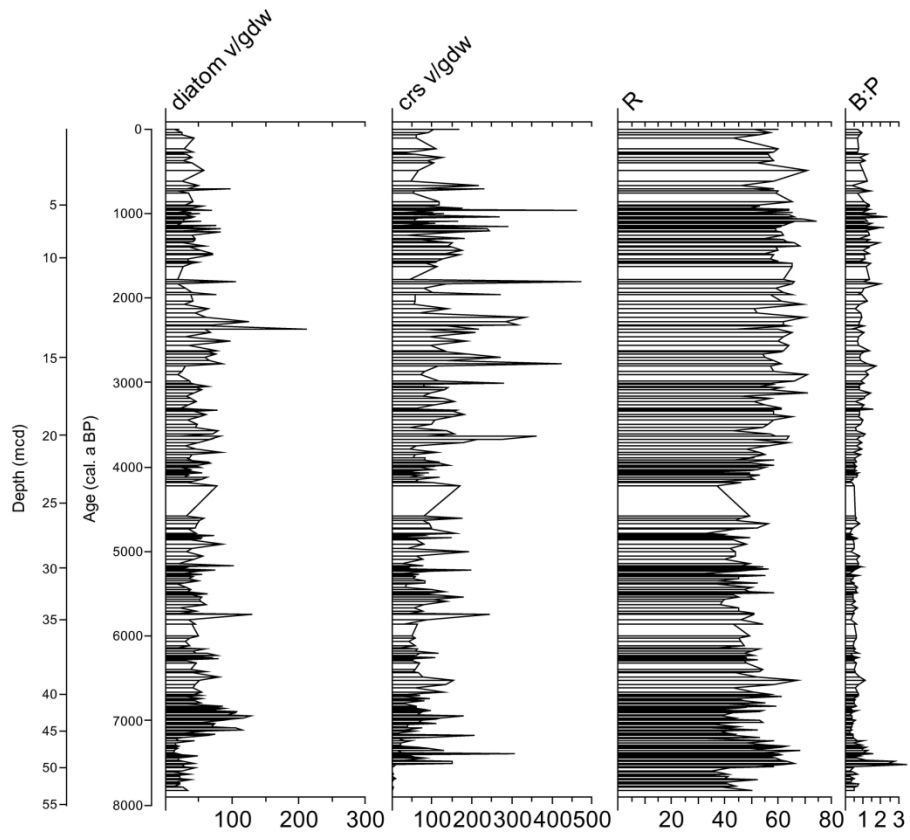


1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60



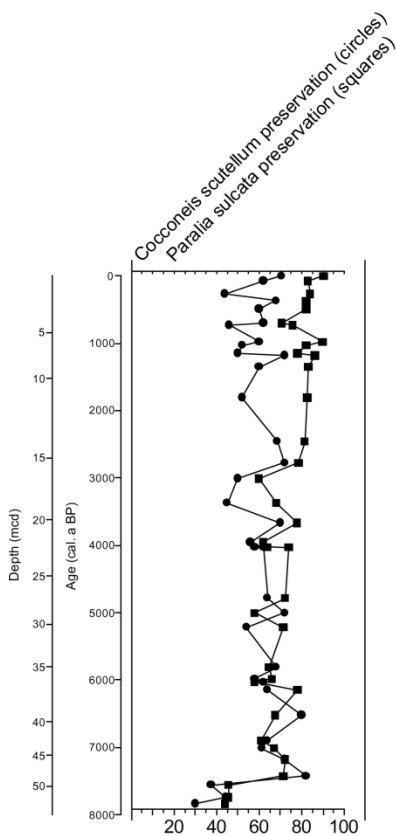
254x304mm (300 x 300 DPI)

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

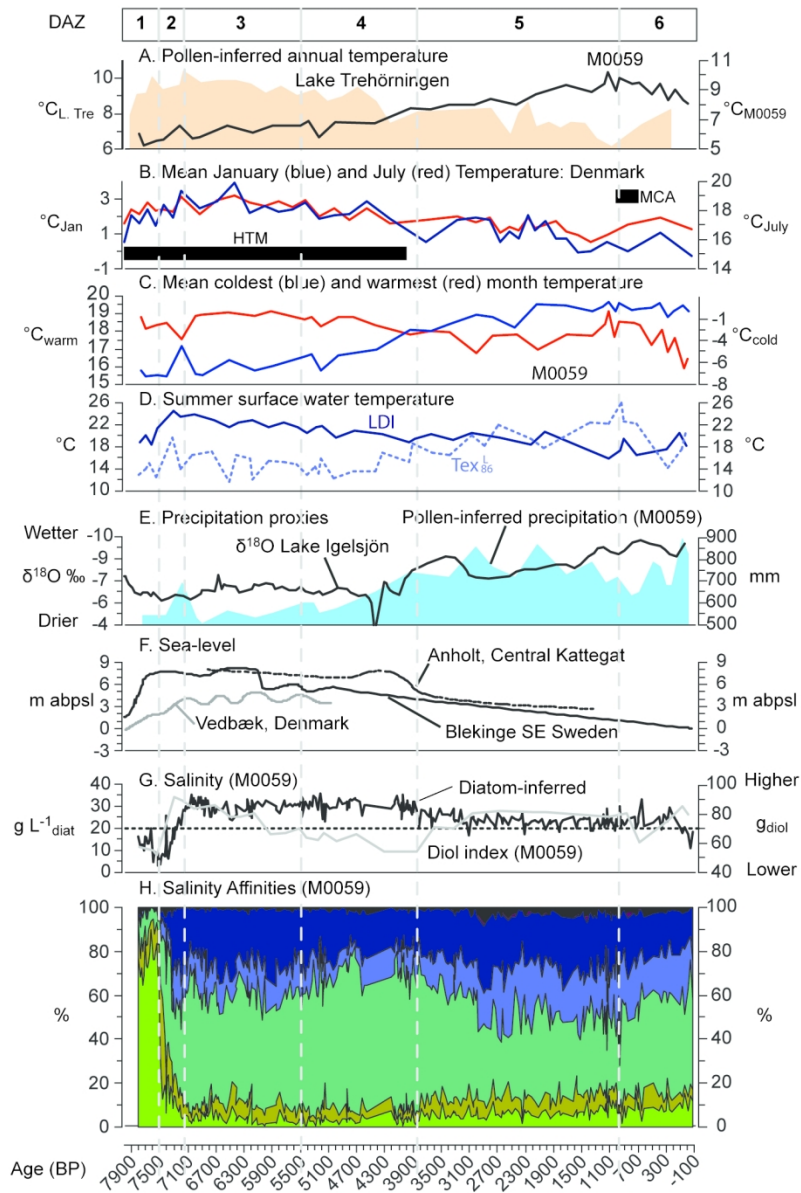


215x279mm (300 x 300 DPI)

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60



215x279mm (300 x 300 DPI)



1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

Zone	Richness	B:P	crs v/gdw	ADA v/gdw	%F	%BF	%B	%BM
6	55.97	0.90	1.08E+07	3.58E+07	8.7	5.9	41.9	20.7
5	59.66	1.05	1.41E+07	5.01E+07	6.6	7.3	39.8	19.3
4	46.37	0.54	7.68E+06	4.16E+07	3.3	4.9	61.4	9.8
3	46.81	0.50	7.31E+06	6.02E+07	4.3	6.1	50.9	13.0
2	55.13	1.00	7.20E+06	2.71E+07	12.8	14.8	39.1	12.7
1	43.76	0.46	2.22E+05	2.52E+07	74.7	12.8	9.5	0.8

means

For Review Only

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

%M	%SI	Richness	B:P	crs v/gdw	ADA v/gdw	%F	%BF	%B
20.6	0.2	41-71	0.37-1.43	2.26E+06-47.47E+06-9	1.33-15.23	2.13-10.86	19.02-58.64	
24.3	0.5	43-74	0.32-2.35	1.74E+06-41.72E+07-2	1.81-14.21	1.81-15.28	19.90-70.81	
19.7	0.1	31-58	0.23-0.95	4.97E+05-12.71E+06-1	0.33-7.48	1.45-14.67	45.47-77.74	
25.0	0.1	34-67	0.27-1.10	0-2.43E+07-1.86E+07-1	0.66-14.48	2.00-13.08	36.09-67.22	
19.5	0.4	33-68	0.41-3.47	1.20E+06-31.21E+07-7	3.67-33.50	4.83-46.09	22.80-52.08	
0.9	0.1	30-62	0.20-0.73	0-1.02E+06-1.22E+07-4	64.74-89.61	4.16-19.01	3.93-15.49	

ranges

For Review Only

%BM	%M	%SI
10.78-47.54	12.94-28.19	0.00-2.65
7.72-41.53	13.27-40.60	0.00-3.31
2.48-21.96	11.00-32.91	0.00-1.97
4.19-24.17	14.74-36.57	0.00-0.66
4.39-26.79	1.63-36.83	0.00-2.64
0.00-3.13	0.00-3.00	0.00-1.33

For Review Only

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

Zone	Richness	B:P	crs v/gdw	ADA v/gdw	%F	%BF
6	55.97	0.90	1.08E+07	3.58E+07	8.7	5.9
5	59.66	1.05	1.41E+07	5.01E+07	6.6	7.3
4	46.37	0.54	7.68E+06	4.16E+07	3.3	4.9
3	46.81	0.50	7.31E+06	6.02E+07	4.3	6.1
2	55.13	1.00	7.20E+06	2.71E+07	12.8	14.8
1	43.76	0.46	2.22E+05	2.52E+07	74.7	12.8

Zone	Richness	B:P	crs v/gdw	ADA v/gdw	%F	%BF
6	41 - 71	0.37 - 1.43	2.26E+06 - 4.61E+07	7.47E+06 - 9.71E+07	1.33 - 15.23	2.13 - 10.86
5	43 - 74	0.32 - 2.35	1.74E+06 - 4.71E+07	1.72E+07 - 2.11E+08	1.81 - 14.21	1.81 - 15.28
4	31 - 58	0.23 - 0.95	4.97E+05 - 1.97E+07	2.71E+06 - 1.02E+08	0.33 - 7.48	1.45 - 14.67
3	34 - 67	0.27 - 1.10	0 - 2.43E+07	1.86E+07 - 1.30E+08	0.66 - 14.48	2.00 - 13.08
2	33 - 68	0.41 - 3.47	1.20E+06 - 3.05E+07	1.21E+07 - 7.36E+07	3.67 - 33.50	4.83 - 46.09
1	30 - 62	0.20 - 0.73	0 - 1.02E+06	1.22E+07 - 4.49E+07	64.74 - 89.68	4.16 - 19.01

For Review Only



%B	%BM	%M	%SI
41.9	20.7	20.6	0.2
39.8	19.3	24.3	0.5
61.4	9.8	19.7	0.1
50.9	13.0	25.0	0.1
39.1	12.7	19.5	0.4
9.5	0.8	0.9	0.1
%B	%BM	%M	%SI
19.02 - 58.64	10.78 - 47.54	12.94 - 28.19	0.00 - 2.65
19.90 - 70.81	7.72 - 41.53	13.27 - 40.60	0.00 - 3.31
45.47 - 77.74	2.48 - 21.96	11.00 - 32.95	0.00 - 1.97
36.09 - 67.22	4.19 - 24.17	14.74 - 36.57	0.00 - 0.66
22.80 - 52.08	4.39 - 26.79	1.63 - 36.83	0.00 - 2.64
3.93 - 15.49	0.00 - 3.13	0.00 - 3.00	0.00 - 1.33

ranges

For Review Only

1	Depth (mcd)			0.02	0.2	0.4	0.62
2	Age (cal. a BP)	Salinity	Lifeform	-60	-29	5	42
4	<i>Achnanthes subatomoides</i>	F	B	0.67	1.33	0.00	1.66
5	<i>Cocconeis disculus</i>	F	B	2.00	1.49	0.33	3.15
6	<i>Martyana martyii</i>	F	B	1.66	2.32	1.33	2.32
8	<i>Staurosirella lapponica</i>	F	B	0.17	0.00	0.50	0.00
9	<i>Staurosirella pinnata</i>	F	B	0.00	0.00	0.00	0.00
10	<i>Tabelaria flocculosa</i>	F	B	0.00	0.00	0.00	0.00
11	<i>Amphora pediculus</i>	BF	B	0.67	1.66	0.00	1.00
12	<i>Cocconeis pediculus</i>	BF	B	0.00	0.00	0.00	0.00
14	<i>Ctenophora pulchella</i>	BF	B	0.00	0.00	0.00	0.00
15	<i>Diploneis smithii</i>	BF	B	2.00	1.49	1.67	0.33
16	<i>Epithemia turgida var. westermanni</i>	BF	B	0.00	0.00	0.00	0.00
17	<i>Navicula cincta</i>	BF	B	0.67	0.00	0.67	0.00
18	<i>Nitzschia frustulum</i>	BF	B	0.00	0.00	0.00	0.00
20	<i>Planothidium delicatum</i>	BF	B	0.00	0.00	0.00	0.00
21	<i>Psuedostaurosira brevistriata</i>	BF	B	0.67	0.00	0.67	0.00
22	<i>Achnanthes lemmermannii</i>	B	B	0.67	1.33	1.67	1.66
23	<i>Cocconeis neothumensis</i>	B	B	0.33	0.00	0.67	0.00
24	<i>Cocconeis scutellum</i>	B	B	1.50	2.82	6.17	5.64
26	<i>Fragilaria amicornum</i>	B	B	2.33	0.00	2.00	6.30
27	<i>Fragilaria gedanensis</i>	B	B	0.00	0.00	0.00	0.00
28	<i>Opephora mutabilis</i>	B	B	1.66	0.00	0.33	0.33
29	<i>Placoneis gastrum</i>	B	B	0.00	0.00	0.00	0.00
31	<i>Psuedostaurosira perminuta</i>	B	B	0.67	0.00	2.33	0.00
32	<i>Rhoicosphenia curvata</i>	B	B	0.00	0.00	2.33	0.00
33	<i>Grammatophora macilenta</i>	BM	B	1.66	0.83	0.67	1.99
34	<i>Grammatophora oceanica</i>	BM	B	2.66	4.48	3.67	4.81
35	<i>Navicula perminuta</i>	BM	B	0.00	0.00	0.00	0.00
37	<i>Rhopalodia acuminata</i>	BM	B	0.17	0.33	0.67	1.99
38	<i>Dimeregramma minor</i>	M	B	1.50	1.00	1.50	3.32
39	<i>Hyalodiscus scoticus</i>	M	B	0.00	0.00	0.00	0.00
40	<i>Nitzschia grossestriata</i>	M	B	0.00	0.00	0.00	0.00
41	<i>Opephora marina</i>	M	B	0.33	0.00	0.33	0.66
42	<i>Opephora minuta</i>	M	B	1.00	1.00	0.00	0.66
44	<i>Plagiogramma staurophorum</i>	M	B	0.67	0.00	0.17	0.33
45	<i>Tryblionella debilis</i>	M	B	0.00	0.00	0.00	0.00
46	<i>Aulacoseira ambigua</i>	F	P	0.00	0.00	0.00	0.00
47	<i>Aulacoseira granulata</i>	F	P	0.33	0.00	0.00	0.00
48	<i>Auloacoseira islandica</i>	F	P	0.00	0.00	0.00	0.00
50	<i>Cyclotella atomus</i>	F	P	3.00	7.96	2.00	5.31
51	<i>Cyclotella ocellata</i>	F	P	0.00	0.00	0.00	0.00
52	<i>Cyclotella radiosa</i>	F	P	0.00	0.00	0.33	0.33
53	<i>Cyclotella rossii</i>	F	P	0.00	0.00	0.00	0.00
55	<i>Stephanodiscus minutulus</i>	F	P	0.00	0.00	0.00	0.00
56	<i>Stephanodiscus neoastraea</i>	F	P	0.00	0.00	0.00	0.00
57	<i>Stephanodiscus parvus</i>	F	P	0.00	0.00	0.00	0.00
58	<i>Cyclotella menegheniana</i>	BF	P	0.00	0.00	0.33	0.00
59	<i>Cyclotella choctawhatcheeana</i>	B	P	4.33	0.66	3.67	4.64
60	<i>Melosira moniliformis</i>	B	P	0.33	0.00	0.00	0.33

1							
2	<i>Paralia sulcata</i>	B	P	11.65	5.31	8.67	10.61
3	<i>Skeletonema marinoi</i>	B	P	0.00	0.00	0.00	0.00
4	<i>Thalassiosira levanderi</i>	B	P	7.99	2.99	4.33	0.33
5	<i>Thalassiosira proschkiniae</i>	B	P	3.99	41.46	12.00	0.00
6	<i>Thalassionema nitzschioides</i>	BM	P	12.65	3.65	15.50	17.58
8	<i>Porosira glacialis</i>	M	P	3.33	1.66	3.00	2.32
9	<i>Proboscia alata</i>	M	P	0.33	0.00	0.00	0.00
10	<i>Pseudosolenia calcar-avis</i>	M	P	0.33	0.00	0.00	0.00
11	<i>Rhizosolenia pungens</i>	M	P	1.33	0.33	0.00	1.66
12	<i>Thalassiosira cf. angulata</i>	M	P	0.67	1.33	0.00	0.00
13	<i>Thalassiosira eccentrica</i>	M	P	3.99	0.00	0.00	0.66
14	<i>Shionodiscus oestrupii</i>	M	P	7.65	6.30	7.33	3.32
15	<i>Stauroneis radissonii</i>	SI	P	0.00	0.00	0.00	0.33
16	<i>Melosira varians</i>	SI	P	0.00	0.00	0.00	0.00
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
33							
34							
35							
36							
37							
38							
39							
40							
41							
42							
43							
44							
45							
46							
47							
48							
49							
50							
51							
52							
53							
54							
55							
56							
57							
58							
59							
60							

For Review Only



1									
2	17.24	10.23	31.67	36.33	21.52	28.29	33.61	16.00	30.67
3	0.00	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.00
4	0.33	12.21	0.00	0.33	0.00	0.00	0.00	0.00	0.33
5	0.00	0.99	0.00	0.00	0.00	0.00	0.33	1.00	0.67
6	6.02	16.83	13.17	17.33	19.37	8.82	8.40	16.50	9.50
7	0.65	0.66	0.33	0.00	8.61	0.33	0.33	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.33	1.33	0.00
9	0.00	0.00	0.00	0.00	0.99	0.00	0.33	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.99	1.33	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00	0.99	1.33	0.00
12	0.33	0.00	4.00	0.67	0.33	1.33	2.31	0.33	4.67
13	0.65	1.32	0.00	0.00	0.00	0.00	0.33	0.00	0.00
14	2.93	9.90	3.33	1.00	2.65	1.33	1.98	1.00	3.33
15	0.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									
41									
42									
43									
44									
45									
46									
47									
48									
49									
50									
51									
52									
53									
54									
55									
56									
57									
58									
59									
60									

For Review Only



1									
2	25.00	19.47	51.50	14.80	26.13	13.33	20.00	21.89	20.26
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.66	0.66	0.00	0.33	0.00	0.33	0.67	0.00	0.33
5	0.33	0.33	0.00	1.64	0.00	0.00	0.33	0.00	0.65
6	11.18	9.57	10.47	18.09	12.10	9.67	21.33	8.29	7.35
7	0.00	3.63	2.99	2.96	0.65	1.33	2.67	0.00	0.00
8	0.00	0.00	0.00	0.00	0.97	0.00	1.00	0.00	0.98
9	0.99	0.33	1.33	0.33	0.97	2.67	1.67	1.00	0.98
10	0.33	0.00	0.00	0.33	0.32	0.67	0.33	3.65	1.63
11	0.33	2.64	0.00	0.00	4.84	0.00	0.00	0.66	0.00
12	0.00	0.00	0.33	0.33	0.32	0.67	2.00	1.33	1.63
13	3.62	0.66	1.33	5.26	2.26	1.33	4.67	3.32	3.92
14	0.00	0.00	0.33	0.66	0.00	0.00	0.00	0.00	0.00
15	0.99	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									
41									
42									
43									
44									
45									
46									
47									
48									
49									
50									
51									
52									
53									
54									
55									
56									
57									
58									
59									
60									

For Review Only





1									
2	15.89	27.53	7.60	12.79	21.82	14.67	32.95	9.00	12.56
3	0.00	0.00	0.00	0.00	2.28	0.00	0.00	0.33	0.00
4	0.99	0.00	0.00	0.00	0.33	0.00	0.67	0.67	0.00
5	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6									
7	14.07	9.78	22.98	41.48	8.63	12.33	5.82	36.00	10.08
8	0.00	0.00	0.00	0.66	1.95	2.67	0.67	0.00	4.63
9	0.00	0.00	0.66	0.66	0.00	0.00	0.00	0.00	0.66
10	0.33	0.33	1.98	1.64	0.98	1.33	2.00	0.33	1.65
11	0.00	0.66	1.32	0.33	0.65	1.00	0.33	1.00	1.98
12									
13	0.33	0.00	0.33	0.98	1.30	0.00	1.66	0.00	0.33
14	1.32	0.66	0.00	0.33	0.33	4.00	0.67	0.33	0.66
15	4.64	6.30	1.98	6.56	1.95	6.33	2.33	1.33	1.65
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.00
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									
41									
42									
43									
44									
45									
46									
47									
48									
49									
50									
51									
52									
53									
54									
55									
56									
57									
58									
59									
60									

For Review Only

	6.19	6.39	6.59	6.79	6.99	7.19	7.21	7.39	7.59
	1002	1019	1036	1054	1071	1088	1090	1105	1122
1									
2	6.19	6.39	6.59	6.79	6.99	7.19	7.21	7.39	7.59
3	1002	1019	1036	1054	1071	1088	1090	1105	1122
4	1.33	2.66	0.65	1.99	1.66	1.33	2.31	0.33	0.33
5	1.00	0.66	0.00	0.17	1.33	0.33	0.99	0.33	1.00
6	0.00	0.33	0.65	0.00	0.33	0.00	0.00	0.33	0.00
7	0.00	1.33	1.14	0.66	0.33	0.67	0.99	0.83	2.51
8	1.67	4.32	2.28	0.00	5.66	2.00	0.00	3.33	5.35
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	1.67	1.33	2.28	1.66	1.00	0.00	1.32	0.33	0.00
12	0.00	0.33	0.00	0.33	0.00	0.00	0.00	0.33	0.33
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	1.00	0.50	1.14	1.00	0.50	1.17	0.50	0.83	0.00
16	0.00	0.17	0.16	0.00	0.17	0.33	0.99	0.33	0.33
17	0.00	1.00	3.92	0.66	0.33	0.00	0.00	0.00	0.00
18	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	1.50	0.66	0.00	0.00	0.33	1.33	1.65	0.67	0.33
20	2.00	1.83	1.31	0.66	1.83	2.33	2.31	2.33	1.00
21	0.00	0.00	0.65	0.33	0.33	0.00	0.00	0.00	0.33
22	0.33	0.00	0.98	0.33	0.00	0.00	0.33	0.17	0.00
23	0.33	0.00	0.98	0.33	0.00	0.00	0.33	0.17	0.00
24	4.50	3.49	3.26	3.82	1.66	2.33	3.80	5.83	3.34
25	6.67	1.00	8.81	9.30	5.99	4.00	3.31	0.33	4.35
26	0.00	0.00	0.00	0.00	0.00	0.00	0.66	0.00	0.00
27	4.33	0.66	3.43	0.00	1.00	1.00	0.66	3.00	1.34
28	0.00	0.00	0.00	0.33	0.00	0.33	0.33	0.00	0.00
29	0.00	0.00	0.00	0.33	0.00	0.33	0.33	0.00	0.00
30	3.67	2.99	2.28	4.32	2.33	2.00	1.98	1.33	2.68
31	0.00	0.83	0.00	0.00	0.00	0.00	0.00	0.83	0.67
32	0.17	0.00	0.16	0.17	1.16	0.17	0.83	0.00	0.00
33	0.00	1.00	2.61	2.49	1.50	2.50	2.31	0.50	0.84
34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36	2.83	1.33	0.98	0.50	1.33	1.00	1.65	1.17	1.51
37	4.83	1.66	4.73	2.99	4.33	5.33	5.29	2.00	9.03
38	4.67	1.99	4.24	2.33	2.00	3.67	2.64	2.67	2.01
39	0.00	0.00	0.16	0.00	0.50	0.00	0.33	0.00	0.17
40	1.17	1.00	2.28	0.66	0.33	0.00	0.50	1.83	1.67
41	3.67	0.66	0.98	0.00	2.66	1.33	4.63	0.67	1.51
42	1.83	0.00	2.28	2.66	0.67	1.50	0.50	0.67	2.68
43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33
47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50	0.33	0.66	0.98	3.32	0.33	1.00	0.99	2.00	0.00
51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.67	0.00
54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
58	0.33	0.33	0.00	0.00	0.00	0.67	0.00	1.00	0.00
59	0.67	1.99	0.33	1.33	0.67	2.00	1.65	2.67	1.67
60	0.00	0.00	0.00	1.00	0.33	0.00	0.00	0.00	0.00

1									
2	10.33	6.64	4.89	20.27	13.64	12.67	11.57	14.67	13.38
3	0.33	0.33	0.00	0.33	1.33	0.00	1.98	0.00	1.00
4	0.33	0.00	0.00	0.33	2.00	0.00	0.00	0.00	0.33
5	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.00	0.33
6									
7	16.50	37.38	12.40	10.47	16.31	15.33	16.53	18.00	10.70
8	0.00	0.33	0.33	0.00	0.00	1.33	0.00	0.67	1.67
9	0.00	0.33	0.33	0.00	0.67	0.00	0.00	0.33	0.00
10	1.33	1.99	3.59	1.33	0.67	2.00	0.33	3.00	2.68
11	0.67	0.00	2.28	0.66	1.33	0.67	0.00	3.00	0.67
12	0.33	0.33	0.33	2.33	0.67	1.00	0.00	0.00	0.00
13	0.00	0.33	0.00	1.66	0.33	2.00	0.00	0.33	1.67
14	2.00	1.99	2.28	2.66	6.66	1.67	5.29	9.00	2.68
15	1.00	0.66	0.00	0.00	0.00	0.33	2.98	0.67	0.00
16	1.33	0.66	0.00	0.00	0.67	1.00	2.31	0.00	0.33
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									
41									
42									
43									
44									
45									
46									
47									
48									
49									
50									
51									
52									
53									
54									
55									
56									
57									
58									
59									
60									

For Review Only

1									
2	7.79	7.81	7.94	7.98	8.12	8.19	8.33	8.52	8.71
3	1139	1141	1152	1156	1168	1174	1186	1203	1218
4	1.00	0.33	0.33	2.29	1.00	2.30	1.00	0.67	1.98
5	1.16	0.00	1.83	1.15	0.67	0.00	1.17	0.33	1.16
6	0.00	0.00	0.00	0.33	0.00	0.33	0.67	0.00	0.00
7	0.00	0.00	0.00	1.31	1.00	0.33	0.00	2.83	0.00
8	1.00	0.66	1.00	4.26	1.00	2.96	1.33	0.67	1.98
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	1.00	1.31	0.67	1.64	2.00	0.00	1.33	1.33	1.32
11	0.66	0.66	0.00	0.33	0.00	0.66	0.17	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.66	0.49	0.50	1.47	0.50	0.82	1.50	2.17	0.33
14	0.33	0.00	0.17	0.00	0.00	0.00	0.00	0.17	0.00
15	0.00	0.00	0.67	0.00	0.00	0.00	2.50	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.66	1.31	0.33	1.96	0.50	0.49	0.00	0.00	0.99
18	3.99	1.64	0.00	1.31	2.67	0.00	2.67	1.17	3.47
19	0.66	0.00	0.00	0.00	0.00	0.66	0.83	0.00	0.33
20	0.33	0.00	0.33	0.65	0.00	0.33	0.00	0.33	0.66
21	3.32	2.13	4.33	2.78	4.33	4.43	1.33	3.83	3.47
22	5.98	1.97	2.33	3.93	2.33	2.96	9.00	0.67	3.97
23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	1.99	0.66	1.00	3.11	4.33	1.48	2.83	1.00	2.15
25	0.33	0.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	4.65	1.64	1.00	5.07	9.67	1.31	2.67	3.83	3.14
27	0.17	0.33	0.00	0.00	1.00	0.00	1.33	0.00	0.66
28	1.66	0.66	0.00	0.00	0.67	0.00	0.33	0.00	0.00
29	2.33	1.15	3.00	1.15	0.33	1.15	0.33	3.00	0.99
30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	0.83	0.66	0.50	1.15	3.00	0.00	1.50	2.00	2.48
32	4.82	1.97	9.32	4.91	8.50	1.97	7.00	6.33	3.80
33	3.32	2.30	4.66	1.96	3.00	1.97	2.67	4.00	3.64
34	0.00	0.66	0.17	0.00	0.00	0.00	0.00	0.00	0.00
35	0.33	0.00	0.00	1.31	2.17	0.00	0.50	1.67	0.66
36	1.66	2.63	3.00	4.91	4.00	1.31	2.83	1.67	2.64
37	1.83	0.00	2.00	0.65	1.17	0.00	1.83	1.00	0.83
38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50	1.00	2.63	0.67	0.33	0.00	1.31	0.00	1.33	1.65
51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.00
54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
59	2.33	0.99	0.00	0.98	0.33	7.88	2.00	0.00	2.98
60	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.00	0.00

1									
2	16.61	7.22	12.65	15.06	9.33	3.61	11.33	14.00	18.51
3	2.99	35.47	0.33	0.65	1.33	3.94	2.33	1.00	1.32
4	0.33	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.00
5	0.33	0.33	0.00	0.33	0.00	0.00	0.00	0.00	0.00
6									
7	13.62	9.03	16.47	8.84	9.67	37.93	14.33	21.00	10.08
8	1.00	0.00	0.67	1.64	0.00	0.33	0.33	0.67	1.32
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	2.66	2.30	3.33	0.33	2.00	1.97	2.00	0.67	0.99
11	1.00	0.66	1.00	0.65	0.00	0.66	0.33	0.33	0.33
12									
13	0.33	0.33	0.00	1.96	0.67	0.00	0.00	0.33	0.00
14	0.33	0.00	0.00	0.98	0.67	0.00	0.33	0.67	0.66
15	1.33	2.30	4.66	8.18	5.00	4.93	3.33	4.00	3.31
16	0.00	0.16	1.00	0.33	0.33	0.00	0.00	0.00	0.00
17	1.00	0.33	0.33	0.33	0.33	0.66	0.33	1.67	0.33
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									
41									
42									
43									
44									
45									
46									
47									
48									
49									
50									
51									
52									
53									
54									
55									
56									
57									
58									
59									
60									

For Review Only



1									
2	11.59	15.41	18.94	7.99	9.00	8.62	19.64	20.20	14.00
3	1.99	3.85	1.33	3.33	4.33	5.64	3.93	2.32	1.33
4	0.00	0.64	0.33	0.67	0.33	0.00	0.33	0.00	0.00
5	0.33	0.00	0.00	0.33	0.00	0.66	0.00	0.00	0.00
6									
7	14.57	19.58	6.15	17.80	9.83	14.43	7.53	10.43	14.00
8	0.99	0.32	0.66	1.33	1.33	0.66	1.31	0.00	0.67
9	0.00	0.00	0.33	0.33	0.00	0.00	0.00	0.00	0.33
10	1.66	1.93	1.00	0.33	1.00	1.00	1.31	1.66	3.33
11	0.33	0.00	0.00	0.00	0.67	0.00	0.00	0.00	0.33
12									
13	1.99	0.64	0.33	1.00	1.00	0.33	0.00	0.00	2.67
14	0.99	0.00	0.00	0.67	0.33	0.66	0.65	0.00	0.00
15	3.64	5.46	5.65	4.66	1.33	1.33	2.62	3.31	2.33
16	0.00	0.00	1.33	0.00	0.00	0.00	0.00	3.31	0.00
17	0.00	0.00	1.33	0.00	0.33	0.33	0.98	1.99	0.00
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									
41									
42									
43									
44									
45									
46									
47									
48									
49									
50									
51									
52									
53									
54									
55									
56									
57									
58									
59									
60									

For Review Only

	9.85	10.05	10.15	10.21	10.245	10.45	11.05	11.15	11.25
1									
2	9.85	10.05	10.15	10.21	10.245	10.45	11.05	11.15	11.25
3	1486	1535	1560	1575	1585	1634	1782	1806	1831
4	0.33	0.33	0.33	0.66	1.66	1.33	0.33	1.66	2.33
5	2.30	1.00	0.83	0.00	0.33	0.33	0.66	0.33	0.33
6	0.00	0.33	0.00	0.66	0.00	0.67	0.00	0.33	0.00
7	0.00	0.00	0.83	0.00	1.99	0.00	0.00	0.33	0.00
8	1.64	0.00	0.00	0.66	1.00	0.33	0.66	0.67	1.66
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.66	1.33	0.33	2.30	3.65	1.67	0.33	1.66	1.33
11	0.00	0.00	0.50	0.66	0.33	0.00	0.33	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.16	1.00	0.99	0.66	0.83	1.00	0.99	0.33	1.00
14	0.33	0.33	0.00	0.00	0.17	0.00	1.32	0.00	0.17
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.33	0.00
16	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.67
17	0.00	0.00	0.66	0.66	1.33	0.33	0.99	0.00	2.00
18	4.60	2.00	2.98	7.55	6.64	1.33	1.81	0.67	3.99
19	0.00	0.00	0.00	0.66	0.00	0.00	0.00	0.33	0.00
20	0.00	1.00	0.00	0.00	0.66	0.67	1.98	0.33	0.00
21	2.30	4.16	5.12	3.12	3.32	4.67	1.48	2.50	2.16
22	5.58	0.67	2.98	4.93	2.66	4.67	2.31	10.32	8.99
23	0.00	0.00	0.33	0.16	0.00	0.00	0.00	0.00	0.00
24	0.66	2.00	1.49	2.30	1.00	2.67	3.62	1.50	3.33
25	0.66	0.00	0.00	0.00	0.33	1.67	0.33	0.00	0.00
26	2.63	5.99	1.98	1.64	0.66	1.33	2.31	4.83	3.33
27	0.33	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	0.16	0.00	0.00	0.33	0.33	0.00	0.00	0.00	0.33
29	1.97	0.33	0.99	0.49	0.66	2.33	1.32	0.50	0.83
30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	1.48	1.66	0.83	0.99	2.49	1.33	2.80	1.16	2.66
32	12.48	9.65	2.98	4.11	2.49	6.50	5.93	4.33	7.32
33	1.64	4.33	1.65	2.96	3.65	2.00	6.59	1.00	3.00
34	0.00	0.00	0.17	0.00	0.00	0.00	0.00	0.33	0.00
35	1.31	0.67	0.99	0.66	0.83	0.33	1.81	0.67	1.33
36	0.99	1.33	0.00	2.63	2.49	1.83	1.32	1.66	3.99
37	0.99	1.66	0.66	0.99	1.16	1.50	1.32	1.00	0.00
38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.00
45	0.33	1.66	2.31	0.66	0.66	0.67	1.98	0.67	1.00
46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
53	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
58	0.00	0.67	0.00	0.00	0.33	0.00	0.00	0.00	0.67
59	2.30	0.00	1.65	3.94	2.66	0.33	0.99	1.66	2.00
60	0.00	0.00	0.33	0.33	0.00	0.00	0.00	0.00	0.00



1									
2	22.00	7.32	6.61	9.20	12.29	15.67	16.14	12.98	5.32
3	2.30	1.00	4.30	4.93	0.66	1.00	0.33	2.00	4.33
4	0.33	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.33
5	0.00	0.33	0.33	0.00	0.00	0.00	0.00	0.00	0.00
6									
7	10.51	23.29	27.11	18.06	14.45	16.67	8.73	20.47	9.32
8	0.66	0.67	0.00	0.00	0.00	0.33	0.00	0.33	0.67
9	0.00	0.00	0.33	0.00	0.00	0.00	0.33	0.00	0.00
10	0.99	2.33	0.66	1.64	3.65	1.33	2.31	0.67	3.33
11	0.00	0.33	2.31	0.33	0.66	0.33	0.00	1.00	0.00
12									
13	2.63	0.00	0.33	3.28	0.00	0.33	2.97	1.00	1.00
14	0.99	1.33	0.33	0.00	0.66	0.67	0.66	1.66	1.33
15	2.96	3.99	3.97	3.28	1.99	3.00	4.28	3.33	2.33
16	0.00	0.00	1.32	0.00	0.66	0.67	0.66	0.00	0.00
17	0.33	1.00	0.66	0.00	0.00	0.67	0.99	0.00	0.33
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									
41									
42									
43									
44									
45									
46									
47									
48									
49									
50									
51									
52									
53									
54									
55									
56									
57									
58									
59									
60									

For Review Only



1									
2	20.30	12.00	4.33	8.33	7.91	8.29	7.24	17.33	7.99
3	3.33	4.67	23.00	6.00	14.17	13.93	24.34	6.33	2.66
4	1.00	0.33	0.33	0.00	0.33	0.00	0.00	0.00	0.33
5	0.33	0.00	0.00	0.00	0.00	0.00	1.64	0.00	1.33
6									
7	15.31	20.83	17.67	22.67	9.39	14.26	15.13	15.17	28.95
8	0.00	0.33	0.00	1.00	0.00	0.33	0.33	0.00	0.00
9	0.00	0.67	0.00	1.00	0.99	0.66	0.00	0.00	0.67
10	1.00	0.67	2.00	2.00	0.66	1.66	0.99	1.33	0.33
11	0.67	0.33	0.00	0.00	0.66	0.00	0.00	0.67	0.33
12	0.67	2.00	2.00	0.33	1.32	2.99	0.00	0.00	0.00
13	0.00	1.33	0.33	1.33	0.00	0.33	0.00	0.00	0.33
14	0.00	1.33	0.33	1.33	0.00	0.33	0.00	0.00	0.33
15	2.33	4.67	2.33	3.00	1.65	4.98	3.29	3.33	2.00
16	0.50	0.00	0.00	0.00	0.99	0.50	0.66	0.33	0.67
17	0.00	0.33	0.67	0.33	0.00	1.66	0.33	0.00	0.00
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									
41									
42									
43									
44									
45									
46									
47									
48									
49									
50									
51									
52									
53									
54									
55									
56									
57									
58									
59									
60									

For Review Only



1									
2	9.27	4.00	6.94	5.59	5.32	17.00	21.00	4.99	5.64
3	10.93	14.67	12.89	31.58	8.99	8.00	16.33	6.66	2.99
4	0.00	0.00	0.00	0.33	0.00	0.00	0.33	0.00	0.00
5	0.66	0.00	0.66	0.33	0.67	0.00	0.67	0.33	0.00
6									
7	19.87	20.83	8.10	28.95	30.28	12.67	5.67	23.29	27.53
8	0.33	0.67	1.32	0.00	0.00	0.33	0.00	0.00	0.66
9	0.00	0.33	0.99	0.00	0.00	0.00	0.00	1.66	0.00
10	1.66	1.67	0.66	0.66	0.33	2.00	1.67	0.33	1.66
11	0.00	0.33	0.00	0.00	0.00	0.33	0.00	0.33	0.66
12									
13	0.99	0.67	0.00	0.33	0.67	0.33	1.00	0.00	0.33
14	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
15	3.31	4.67	3.97	2.30	7.32	2.00	2.67	9.32	3.65
16	1.32	0.00	0.33	0.00	0.00	0.00	1.00	0.67	1.00
17	0.66	1.67	0.66	0.66	0.33	0.33	0.33	0.67	3.32
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									
41									
42									
43									
44									
45									
46									
47									
48									
49									
50									
51									
52									
53									
54									
55									
56									
57									
58									
59									
60									

For Review Only



1									
2	9.63	13.84	6.66	14.55	6.28	18.00	8.93	17.97	12.67
3	1.33	4.61	3.00	2.64	15.54	0.00	1.98	3.66	0.33
4	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.33	0.67
5	0.33	0.66	0.00	0.00	0.33	0.00	0.00	0.00	0.67
6									
7	14.95	16.97	26.12	24.46	11.74	12.67	11.40	9.98	7.67
8	0.00	0.33	0.00	0.33	0.00	0.00	0.00	0.67	1.00
9	0.33	0.00	0.00	0.00	0.66	0.00	0.33	0.00	0.00
10	1.33	0.66	2.66	1.32	0.99	0.33	2.64	1.66	1.67
11	0.00	0.00	1.33	0.99	0.33	0.67	0.99	0.33	0.33
12									
13	0.00	0.33	0.00	0.00	0.00	0.33	0.00	0.00	1.67
14	0.00	0.00	0.33	0.33	0.33	1.33	0.00	0.00	0.00
15	7.97	4.61	5.32	6.61	4.63	3.33	3.97	3.66	3.33
16	1.00	1.32	0.00	0.00	1.65	0.00	0.00	0.00	1.00
17	0.33	0.66	1.00	0.66	1.98	0.00	1.65	3.00	3.00
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									
41									
42									
43									
44									
45									
46									
47									
48									
49									
50									
51									
52									
53									
54									
55									
56									
57									
58									
59									
60									

For Review Only





1									
2	16.00	24.03	15.51	21.43	19.97	29.74	14.95	23.55	20.63
3	1.00	0.00	10.89	14.94	7.20	2.94	4.65	2.65	4.66
4	0.67	0.32	0.33	0.00	0.00	0.33	0.33	0.00	0.00
5	0.67	0.00	0.33	0.00	0.00	0.00	1.99	0.00	0.33
6									
7	16.67	8.77	11.88	7.47	12.44	11.76	2.99	8.46	9.65
8	0.00	0.32	0.33	0.00	0.33	0.33	0.00	0.00	0.00
9	0.33	0.32	0.99	0.00	0.65	0.33	6.64	0.00	0.00
10	0.00	1.95	2.31	0.65	1.31	1.31	0.66	3.32	0.67
11	0.67	0.32	1.98	0.32	0.65	0.65	1.00	1.00	2.00
12									
13	2.67	0.00	0.00	0.65	1.31	0.00	0.33	0.33	1.00
14	1.00	0.00	0.33	0.00	0.00	0.00	0.33	0.33	0.33
15	5.67	3.25	4.95	4.22	1.96	3.59	0.66	2.32	3.33
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.67
17	0.33	0.00	0.66	0.32	0.65	0.00	0.66	0.00	0.00
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									
41									
42									
43									
44									
45									
46									
47									
48									
49									
50									
51									
52									
53									
54									
55									
56									
57									
58									
59									
60									

For Review Only



1									
2	40.93	25.21	19.33	21.26	33.28	37.60	30.90	27.18	29.00
3	3.33	5.64	7.67	1.66	4.33	0.67	0.66	1.29	3.33
4	0.67	0.00	0.67	0.00	0.33	0.00	0.00	0.00	0.33
5	0.00	0.33	0.00	0.33	0.33	0.00	0.00	0.00	0.00
6									
7	9.98	6.97	12.83	5.15	5.66	5.99	9.80	12.30	7.67
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	1.00	0.00	0.00	0.33	0.00	0.00	0.67
10	0.33	0.66	0.33	0.66	0.67	0.33	1.99	0.65	0.67
11	0.00	1.00	0.33	0.33	1.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.33	1.33	0.00	0.00	1.00	6.47	0.00
13	0.33	0.00	0.00	0.66	0.00	0.00	0.66	0.00	0.67
14	3.33	3.65	3.00	3.65	3.00	3.99	3.32	0.97	2.67
15	0.00	0.33	0.00	0.17	0.00	0.67	0.00	0.00	0.00
16	0.00	0.33	0.67	0.00	0.00	1.00	0.00	0.32	0.00
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									
41									
42									
43									
44									
45									
46									
47									
48									
49									
50									
51									
52									
53									
54									
55									
56									
57									
58									
59									
60									

For Review Only



1									
2	36.00	31.42	32.00	25.37	30.28	20.33	39.93	27.57	33.00
3	0.33	19.64	4.00	1.98	2.00	1.67	1.33	8.97	0.00
4	0.33	0.00	0.00	0.00	0.00	0.33	0.33	0.33	0.33
5	0.00	0.33	0.33	0.00	0.00	0.00	0.00	0.00	0.33
6									
7	7.83	5.89	16.17	9.23	5.66	14.33	6.99	13.12	8.17
8	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.33	0.00
9	0.33	0.00	0.00	0.66	1.00	0.33	0.00	0.00	0.00
10	0.00	1.31	0.33	0.66	1.33	0.33	0.00	0.66	0.67
11	0.00	0.00	0.00	0.00	0.67	0.00	0.00	0.00	0.00
12									
13	0.33	0.00	0.33	0.00	0.33	0.00	0.67	2.33	3.00
14	0.33	0.00	0.00	0.33	0.33	0.00	1.33	0.00	0.33
15	2.67	2.95	1.33	2.64	2.33	2.00	3.99	0.66	2.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.33	0.00	0.00	0.00	0.67	0.00	0.67	0.00	0.00
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									
41									
42									
43									
44									
45									
46									
47									
48									
49									
50									
51									
52									
53									
54									
55									
56									
57									
58									
59									
60									

For Review Only



1									
2	43.78	38.75	17.25	37.42	45.59	52.33	50.99	58.94	41.20
3	1.00	2.63	34.83	2.98	1.00	0.67	0.00	1.93	0.33
4	0.00	0.00	0.33	0.00	0.00	0.00	0.33	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33
6									
7	5.97	4.43	3.65	5.13	5.16	4.50	5.30	5.64	7.97
8	0.66	0.00	0.00	0.00	0.67	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.33	0.00	0.00	0.33	0.00	0.00
10	1.99	0.33	0.33	0.00	0.67	0.33	0.00	0.00	0.00
11	0.66	0.00	0.00	0.00	0.33	0.00	0.00	0.00	0.66
12									
13	0.66	0.99	0.66	0.00	0.00	0.33	0.00	0.00	1.33
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	1.00	1.31	1.33	1.66	4.33	1.00	2.32	2.25	1.99
16	0.66	0.00	0.00	0.00	0.67	1.33	0.00	0.00	0.00
17	0.66	0.33	0.33	0.00	0.33	0.33	0.00	0.00	1.00
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									
41									
42									
43									
44									
45									
46									
47									
48									
49									
50									
51									
52									
53									
54									
55									
56									
57									
58									
59									
60									

For Review Only





1									
2	43.52	39.93	44.89	48.92	52.58	49.17	41.44	32.89	57.90
3	1.00	0.00	1.34	3.00	1.00	1.33	0.33	16.45	0.00
4	0.00	0.33	0.34	0.33	0.33	0.00	0.33	0.00	0.00
5	0.00	0.33	0.67	0.33	0.00	0.33	0.33	0.00	0.00
6									
7	8.64	17.64	7.71	10.15	3.00	4.65	15.17	5.26	4.99
8	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.00	0.00
9	0.00	0.00	0.34	1.66	0.00	0.00	0.00	0.33	0.00
10	0.33	0.67	0.34	1.33	0.67	1.33	1.31	0.33	1.33
11	0.33	0.33	0.00	0.67	0.00	0.33	0.00	0.00	0.00
12									
13	0.66	0.00	0.00	0.00	0.00	0.66	0.00	0.00	0.00
14	0.33	0.00	0.34	0.00	0.00	0.33	0.00	0.33	0.33
15	1.33	3.00	0.67	2.00	1.33	3.32	2.28	1.97	0.67
16	0.00	0.00	0.67	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.34	0.33	0.33	0.33	0.00	0.66	0.00
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									
41									
42									
43									
44									
45									
46									
47									
48									
49									
50									
51									
52									
53									
54									
55									
56									
57									
58									
59									
60									

For Review Only



1									
2	64.68	58.84	35.00	47.04	54.19	35.94	47.02	46.67	51.06
3	0.66	0.00	17.33	0.00	0.00	1.66	0.33	2.67	1.31
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33
5	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.33	0.33
6									
7	2.32	3.14	2.33	5.43	2.96	12.65	5.13	8.67	5.40
8	0.33	0.00	0.00	0.00	0.33	0.00	0.00	0.33	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.00
10	0.00	0.99	0.33	0.66	0.66	1.00	0.33	0.67	0.65
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33
12	0.00	0.33	0.00	0.00	0.33	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	1.99	1.65	0.33	2.63	0.33	1.66	2.98	2.33	2.95
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.33	0.00	0.00	0.00	0.33	0.98
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									
41									
42									
43									
44									
45									
46									
47									
48									
49									
50									
51									
52									
53									
54									
55									
56									
57									
58									
59									
60									

For Review Only



1									
2	67.74	56.48	51.40	45.00	45.21	44.88	28.90	52.00	61.72
3	0.32	3.99	0.33	0.33	0.66	1.65	1.64	0.00	0.00
4	0.00	0.00	0.00	0.00	0.33	0.33	0.00	0.33	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.66	0.67	0.00
6									
7	3.55	1.66	6.59	9.67	8.91	9.74	9.36	5.67	1.49
8	0.00	1.00	0.00	0.33	0.00	0.00	0.00	0.00	0.33
9	0.32	0.00	0.00	0.00	0.33	0.33	0.00	0.00	0.00
10	0.00	0.00	0.66	2.00	0.33	0.99	1.64	0.67	0.99
11	0.00	0.00	0.00	0.00	0.00	0.33	0.00	0.33	0.00
12									
13	0.00	0.66	0.00	0.00	0.00	0.00	1.31	0.00	0.00
14	0.00	0.66	0.66	0.00	0.00	0.00	0.33	0.33	0.00
15	1.61	3.65	0.99	2.33	1.32	1.98	4.60	4.00	1.65
16	0.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.65	0.00	0.00	0.00	0.66	0.99	0.33	0.00	0.33
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									
41									
42									
43									
44									
45									
46									
47									
48									
49									
50									
51									
52									
53									
54									
55									
56									
57									
58									
59									
60									

For Review Only



1									
2	64.79	61.67	62.00	57.84	48.68	49.67	47.33	55.17	56.34
3	0.00	0.00	0.00	0.33	4.93	0.00	0.67	0.66	0.00
4	0.00	0.33	0.00	0.00	0.00	0.67	0.33	0.00	0.00
5	0.00	0.00	0.33	0.33	0.00	0.33	0.00	0.33	0.00
6	0.99	2.50	6.17	3.76	3.29	5.00	2.33	5.58	1.15
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	1.98	0.67	1.33	1.96	0.66	2.67	1.00	1.31	1.32
11	0.00	0.00	0.00	0.33	0.00	0.67	0.00	0.33	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.66	0.00
13	0.00	0.00	0.67	0.33	0.33	0.00	0.00	0.00	0.00
14	0.00	0.00	0.67	0.33	0.33	0.00	0.00	0.00	0.00
15	3.31	3.33	3.33	3.92	1.97	4.00	4.33	1.64	3.95
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	1.98	0.00	1.67	0.33	0.00	0.67	0.00	0.00	0.00
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									
41									
42									
43									
44									
45									
46									
47									
48									
49									
50									
51									
52									
53									
54									
55									
56									
57									
58									
59									
60									

For Review Only





1									
2	53.33	57.28	46.67	42.05	44.41	41.79	38.28	37.60	48.60
3	0.00	0.00	0.00	0.00	0.33	0.00	0.00	3.66	0.99
4	0.33	0.00	0.33	0.00	0.00	0.00	0.32	0.33	0.00
5	0.00	0.33	0.00	0.00	0.66	0.00	0.32	1.00	0.00
6	3.17	2.78	3.83	7.28	3.45	8.13	4.47	7.65	3.97
7	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.33	0.66	0.00	0.00	0.00	0.00
9	1.67	0.33	0.00	1.66	0.99	2.32	0.96	1.00	0.99
10	0.67	0.00	0.00	0.00	0.00	0.33	0.32	0.33	0.33
11	0.00	0.00	1.00	0.33	0.66	0.00	0.32	0.00	0.00
12	0.00	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.00
13	3.33	8.84	0.33	7.28	2.63	1.66	1.59	3.00	6.28
14	0.00	0.00	0.67	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	1.32	0.00	0.00	0.00	0.00
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									
41									
42									
43									
44									
45									
46									
47									
48									
49									
50									
51									
52									
53									
54									
55									
56									
57									
58									
59									
60									

For Review Only



1									
2	35.26	31.95	46.05	48.76	72.26	49.92	35.55	42.40	51.67
3	0.66	3.99	0.33	0.00	0.32	0.00	0.33	0.67	0.00
4	0.00	0.33	0.00	0.00	0.00	0.00	0.33	0.33	0.00
5	0.66	0.00	0.00	0.00	0.32	0.00	0.66	0.33	0.33
6									
7	11.70	7.32	4.77	9.78	2.10	15.97	7.64	13.52	9.83
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	1.32	0.33	1.32	1.00	0.00	0.33	0.33	0.33	0.67
11	0.33	0.33	0.00	0.00	0.32	0.00	0.00	0.67	0.00
12									
13	0.33	0.00	0.00	0.00	0.00	0.00	5.32	0.00	0.00
14	0.33	0.33	0.33	0.00	0.32	0.00	0.00	0.00	0.33
15	3.95	2.33	3.95	4.64	1.61	2.00	2.33	6.01	1.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									
41									
42									
43									
44									
45									
46									
47									
48									
49									
50									
51									
52									
53									
54									
55									
56									
57									
58									
59									
60									

For Review Only



1									
2	64.60	44.37	44.95	34.45	45.87	42.72	31.00	51.32	40.53
3	0.00	0.33	0.33	0.67	0.33	0.33	1.33	0.00	0.33
4	0.00	0.00	0.00	0.00	0.33	0.33	0.00	0.33	0.00
5	0.00	0.65	0.00	0.33	0.00	0.00	0.00	0.00	0.00
6									
7	2.61	10.11	11.73	8.03	5.45	1.49	16.50	6.79	6.59
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.00	0.00
10	2.28	0.65	0.33	1.34	1.32	0.99	1.00	0.99	0.33
11	0.33	0.00	0.65	0.00	0.33	0.33	0.00	0.00	0.66
12									
13	0.65	0.00	0.33	0.67	0.99	2.32	0.33	1.66	0.00
14	0.00	0.00	0.00	1.00	0.00	0.00	0.33	0.00	0.00
15	3.59	4.89	4.23	6.02	4.29	9.60	3.00	8.61	16.47
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.33	0.00	0.00	0.00	0.33	0.00	0.00	0.00	0.00
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									
41									
42									
43									
44									
45									
46									
47									
48									
49									
50									
51									
52									
53									
54									
55									
56									
57									
58									
59									
60									

For Review Only



1									
2	40.20	43.38	45.07	40.86	37.17	44.33	37.24	41.85	46.81
3	0.65	1.99	0.33	0.99	0.33	3.00	0.00	0.33	0.65
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.32	0.00	0.00
6									
7	15.20	11.59	6.41	18.12	4.61	4.83	8.35	3.46	6.22
8	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.00	0.33
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.98	0.66	0.99	0.66	0.66	2.67	4.49	2.31	1.31
11	0.00	0.00	0.00	0.00	0.00	2.67	0.00	0.33	0.33
12									
13	1.96	0.00	0.00	0.00	2.30	0.33	0.00	0.33	0.98
14	0.33	0.33	0.00	0.00	1.32	0.33	0.00	0.00	0.33
15	3.92	7.28	7.89	2.97	5.59	5.33	9.95	8.24	10.80
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	0.00	0.32	0.00	0.00
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									
41									
42									
43									
44									
45									
46									
47									
48									
49									
50									
51									
52									
53									
54									
55									
56									
57									
58									
59									
60									

For Review Only





1									
2	28.24	30.79	36.93	34.49	50.00	30.82	50.00	34.67	42.57
3	0.66	0.00	0.00	0.33	0.33	0.00	0.00	0.33	0.00
4	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.33	0.00	0.00	0.00	0.00	0.32	0.00	0.33	0.00
6									
7	13.12	21.69	3.10	12.60	4.47	17.98	8.00	10.83	10.89
8	0.00	0.66	0.33	0.00	0.00	0.00	0.00	0.00	0.33
9	0.00	0.00	0.98	0.00	0.00	0.00	0.00	0.00	0.33
10	1.66	0.33	3.92	1.33	0.99	1.93	0.33	1.67	0.33
11	0.00	0.00	1.31	0.33	0.66	0.32	0.00	0.33	1.32
12									
13	2.99	0.00	0.00	0.00	0.00	0.64	0.00	0.00	0.33
14	0.00	0.66	0.33	0.00	0.00	0.64	0.00	0.00	0.66
15	4.65	4.64	6.21	7.30	2.65	10.27	3.33	8.00	7.26
16	0.00	0.00	0.00	0.66	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.00
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									
41									
42									
43									
44									
45									
46									
47									
48									
49									
50									
51									
52									
53									
54									
55									
56									
57									
58									
59									
60									

For Review Only

1									
2	37.34	37.51	37.54	37.71	37.74	37.86	37.91	37.95	38.01
3	6175	6201	6206	6231	6236	6255	6261	6267	6276
4	0.00	0.00	0.00	0.00	1.33	0.00	0.00	0.00	0.00
5	0.33	0.00	0.17	0.00	0.67	1.00	0.17	0.00	0.33
6	0.00	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.00
7	0.67	0.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00
8	0.33	0.00	0.33	3.53	0.00	0.33	0.66	0.33	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17
10	0.00	0.66	1.00	0.64	1.33	0.00	0.99	1.63	0.00
11	0.33	0.00	0.17	0.00	0.33	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	1.50	0.83	1.00	0.64	0.50	0.67	0.66	1.79	0.83
15	0.00	0.17	0.00	0.00	0.00	0.00	0.00	0.16	0.00
16	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.67	0.33	0.00	0.00	0.00	0.00	0.00	0.65	0.00
19	0.67	0.99	0.67	1.92	1.00	0.33	0.66	2.60	1.33
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.33	0.00	0.67	0.00	0.00	0.67	0.00	0.00	0.00
22	2.00	0.99	1.00	0.48	1.50	1.00	0.99	0.98	2.17
23	3.67	0.66	1.33	0.00	4.99	1.66	0.33	1.30	2.00
24	1.17	0.33	0.00	0.00	0.17	0.00	0.33	0.16	0.83
25	4.67	1.82	1.00	1.28	1.66	1.00	2.98	2.60	1.17
26	0.00	0.00	0.33	0.00	0.33	0.00	0.00	0.00	0.00
27	1.33	0.33	0.33	2.24	0.67	0.00	0.00	0.00	0.00
28	0.17	0.00	0.00	0.16	0.00	0.00	0.00	0.00	0.00
29	0.00	0.17	1.83	0.32	0.83	0.67	0.00	0.33	0.00
30	0.67	0.00	0.50	1.28	1.50	0.33	0.17	0.81	0.83
31	0.00	0.00	0.00	0.64	0.00	0.00	0.66	0.65	0.00
32	0.83	0.66	0.33	0.32	0.50	0.00	0.66	0.98	0.00
33	9.00	6.95	6.32	8.81	10.82	12.31	6.61	8.78	10.17
34	5.67	0.99	3.33	2.24	5.32	2.66	1.98	1.95	1.67
35	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36	0.50	0.33	0.17	0.96	0.00	0.17	0.99	0.00	0.50
37	0.67	0.66	0.00	0.00	0.00	0.67	1.32	0.00	1.33
38	0.83	0.50	0.17	0.64	0.83	0.50	0.33	0.65	0.33
39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44	0.00	0.00	0.33	0.32	0.33	0.33	0.00	0.00	0.00
45	0.33	0.00	13.31	0.32	3.00	0.33	0.00	0.98	2.00
46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33
58	0.67	3.97	1.66	2.24	3.33	3.33	3.31	1.95	5.00
59	1.33	0.00	1.66	0.96	0.67	0.00	0.00	1.30	0.67
60	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.00

1									
2	38.67	49.67	36.27	34.62	33.94	42.26	54.55	41.30	37.33
3	0.67	0.00	0.33	0.64	1.00	0.00	0.00	0.98	1.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.00
5	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.33	0.00
6									
7	6.17	14.24	10.32	16.35	3.49	11.81	3.97	11.06	11.33
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	4.67	0.33	1.66	0.32	3.00	1.00	0.66	2.60	1.33
11	0.33	0.99	1.66	0.64	1.66	0.33	0.33	0.00	0.67
12	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.33	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.66	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.66	0.00	0.00
15	4.17	4.30	2.66	7.69	5.32	3.99	5.95	3.25	7.67
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.32	0.00	0.00	0.33	0.33	0.33
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									
41									
42									
43									
44									
45									
46									
47									
48									
49									
50									
51									
52									
53									
54									
55									
56									
57									
58									
59									
60									

For Review Only

	38.11	38.21	38.52	38.63	38.71	38.91	39.11	39.31	39.51
1									
2	38.11	38.21	38.52	38.63	38.71	38.91	39.11	39.31	39.51
3	6297	6319	6390	6415	6433	6478	6523	6568	6614
4	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.00	0.00
5	0.00	0.33	0.33	0.00	0.33	0.99	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.66	0.00	0.00	0.00
7	0.00	0.00	0.00	0.66	0.00	0.00	0.33	0.00	0.00
8	0.00	0.33	1.33	0.00	0.00	0.00	0.33	0.00	0.66
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	1.67	1.65	0.00	2.81	0.65	1.99	0.00	0.00	0.00
12	0.00	0.33	0.00	0.33	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.83	1.81	1.99	1.49	1.15	2.98	1.16	1.65	2.31
16	0.00	0.49	0.00	0.50	0.00	0.00	0.33	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.00	0.66
18	0.00	0.00	0.00	0.00	0.00	0.66	0.00	0.00	0.33
19	0.00	0.00	0.00	0.33	0.33	0.99	0.00	0.00	0.00
20	0.00	0.00	0.00	0.33	0.33	0.99	0.00	0.00	0.00
21	0.00	0.00	0.83	1.32	0.33	0.17	0.33	0.00	0.00
22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.00	0.16	0.00	0.00	0.00	0.00	0.50	0.00	0.00
24	3.00	1.32	2.99	3.48	2.13	2.48	1.66	1.81	0.99
25	3.33	2.31	0.00	0.66	0.00	0.33	1.66	3.95	1.32
26	0.67	0.66	0.00	0.00	0.00	0.17	0.00	0.00	0.66
27	0.67	1.65	1.33	1.32	2.78	3.15	1.00	1.32	1.98
28	0.00	0.00	0.00	0.99	0.33	0.33	0.00	0.00	0.00
29	3.33	2.64	4.31	1.32	3.60	0.99	0.67	0.00	1.98
30	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.99
31	0.33	0.00	0.00	0.66	0.65	0.00	0.00	0.00	0.33
32	0.67	0.16	0.33	0.17	0.33	0.83	1.16	1.15	1.32
33	1.33	0.00	0.33	0.00	0.00	0.66	0.00	0.00	0.00
34	0.67	0.82	0.33	2.32	3.44	0.33	1.00	0.33	0.83
35	0.67	0.82	0.33	2.32	3.44	0.33	1.00	0.33	0.83
36	9.50	5.60	7.30	12.91	6.55	13.41	8.32	10.87	9.41
37	3.00	5.27	2.32	3.31	2.62	3.97	10.65	3.95	5.28
38	0.00	0.00	0.00	0.00	0.33	0.00	0.33	0.00	0.00
39	0.33	0.82	1.16	0.33	0.49	1.16	0.33	0.82	0.17
40	0.00	0.66	0.33	0.00	0.98	0.99	0.00	0.66	0.00
41	0.00	0.66	0.83	0.66	1.80	0.50	0.17	0.66	0.66
42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
43	0.00	0.66	0.00	0.00	0.00	0.00	0.00	0.66	0.00
44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45	0.00	0.66	0.00	0.00	0.00	0.00	0.00	0.66	0.00
46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
49	1.67	0.99	1.66	2.65	0.33	3.97	2.00	0.66	1.98
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
52	0.00	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.00
53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.00
57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
58	3.33	2.31	3.32	4.30	3.60	2.98	4.99	1.65	2.31
59	0.00	0.99	1.00	0.00	0.00	0.00	3.99	0.00	0.99
60	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.00	0.00





1									
2	29.65	34.67	35.22	41.06	39.01	41.58	39.67	30.27	31.35
3	0.00	0.00	0.65	0.33	0.00	0.00	0.00	0.32	0.66
4	0.66	0.33	0.00	0.00	0.00	0.00	0.00	0.32	0.33
5	0.00	0.67	0.32	0.00	0.33	0.00	0.00	0.32	1.98
6									
7	9.39	8.83	6.79	8.11	8.26	8.58	5.67	10.31	7.43
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.65	0.00	0.00	0.00	0.33	0.00	0.33
10	3.62	0.67	1.62	1.66	0.33	0.99	1.33	0.32	0.66
11	0.99	1.33	0.97	1.32	1.65	1.32	1.00	0.00	1.32
12									
13	0.33	0.00	0.32	0.33	1.65	0.33	0.00	0.00	0.00
14	0.00	0.33	0.00	0.00	0.00	0.00	0.67	0.00	0.33
15	5.27	3.33	5.82	5.30	6.61	6.60	10.00	5.80	5.94
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.33	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									
41									
42									
43									
44									
45									
46									
47									
48									
49									
50									
51									
52									
53									
54									
55									
56									
57									
58									
59									
60									

For Review Only





1									
2	40.00	42.33	46.20	41.00	41.98	34.91	37.14	46.33	37.42
3	0.00	0.33	0.00	0.33	0.00	0.00	0.63	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.00
5	0.00	0.00	0.00	0.33	0.66	1.31	0.95	0.00	0.97
6									
7	12.00	11.17	14.24	9.17	17.52	8.32	12.70	19.49	11.94
8	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.63	0.00	0.00
10	1.67	1.00	1.90	1.67	0.33	3.59	1.59	0.96	5.81
11	3.00	0.33	0.00	1.00	1.32	1.31	1.90	0.32	9.68
12	0.00	0.33	0.95	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.33	0.95	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	1.33	0.32	0.00	0.33	0.33	0.00	0.00	0.00
15	6.67	7.00	6.01	15.00	5.62	2.61	6.03	1.28	3.87
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									
41									
42									
43									
44									
45									
46									
47									
48									
49									
50									
51									
52									
53									
54									
55									
56									
57									
58									
59									
60									

For Review Only



1									
2	46.53	41.46	49.92	41.90	45.12	59.90	41.83	58.43	46.86
3	0.00	1.90	0.65	0.00	1.60	0.00	0.00	0.00	2.97
4	0.00	0.32	0.00	0.65	0.00	0.32	0.33	0.00	0.00
5	0.00	0.95	0.32	0.98	0.00	0.00	0.00	0.00	0.33
6									
7	9.85	18.35	14.42	9.66	9.44	2.25	18.30	2.41	5.78
8	0.00	0.00	0.00	0.00	0.00	0.64	0.00	0.00	0.00
9	0.00	0.00	0.32	0.00	0.00	0.00	0.00	0.00	0.00
10	0.32	0.95	1.62	1.64	1.28	0.97	0.33	2.25	2.31
11	1.94	1.27	2.59	0.00	0.64	0.64	0.65	0.96	0.99
12									
13	0.00	0.00	0.00	0.00	1.28	0.00	0.00	0.00	0.00
14	0.00	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.66
15	9.37	2.53	1.62	2.95	4.48	5.15	3.59	4.17	7.26
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.32	0.32	0.65	0.33	0.00	0.00	0.00	0.00	0.00
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									
41									
42									
43									
44									
45									
46									
47									
48									
49									
50									
51									
52									
53									
54									
55									
56									
57									
58									
59									
60									

For Review Only







1									
2	16.00	26.62	24.29	19.30	13.98	8.65	26.33	13.95	11.88
3	0.00	0.33	2.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.00
5	0.00	0.00	0.00	0.00	0.00	0.33	0.33	0.00	0.00
6									
7	16.83	8.82	19.80	5.66	24.96	13.98	5.33	14.45	2.81
8	0.00	0.00	0.00	0.00	0.67	0.00	0.00	0.00	3.96
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.00
10	5.67	0.67	4.99	3.99	3.00	3.99	3.00	5.65	1.98
11	9.33	0.33	3.66	3.00	1.33	1.00	0.33	1.33	0.66
12	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.33	0.00
13	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.33	0.00
14	0.33	0.00	0.33	0.00	0.00	0.33	0.67	0.00	0.66
15	2.00	2.33	2.66	6.66	2.33	0.67	0.33	1.00	1.65
16	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.00	2.64
17	0.00	0.00	0.00	0.00	0.33	0.00	1.00	0.00	0.33
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									
41									
42									
43									
44									
45									
46									
47									
48									
49									
50									
51									
52									
53									
54									
55									
56									
57									
58									
59									
60									

For Review Only

1									
2	47.71	47.91	48.11	48.31	48.46	48.55	48.72	48.99	49.2
3	7357	7374	7391	7409	7422	7429	7444.24	7467.666	7485.887
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.83	0.00	0.50	1.17	0.33	0.33	0.00	0.00	0.33
6	0.00	0.00	0.00	0.00	0.66	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.17	0.00	0.00	0.33
8	1.33	0.33	0.00	2.33	0.33	0.66	0.00	0.00	0.00
9	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	1.00	1.00	0.33	1.32	1.00	0.00	11.65	7.65
11	1.67	4.49	4.49	3.83	0.99	1.83	8.65	11.98	12.65
12	0.00	0.00	0.33	0.00	0.00	0.00	0.33	0.00	1.00
13	3.00	2.83	2.33	1.00	1.32	1.33	1.33	3.33	2.33
14	6.00	6.16	3.33	7.00	1.98	3.82	2.16	3.66	2.66
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.00
16	0.00	0.00	0.33	0.00	0.00	0.00	5.32	3.00	1.33
17	0.00	1.33	0.33	0.00	0.00	0.00	0.33	2.00	0.00
18	0.00	1.33	0.33	0.83	0.66	1.66	2.16	2.16	7.49
19	0.67	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
20	0.00	0.00	0.00	0.33	0.33	0.00	0.33	4.66	1.33
21	1.33	2.16	0.83	0.17	0.99	0.50	0.33	0.17	0.17
22	1.33	4.99	2.33	3.33	0.33	2.66	0.00	0.67	0.67
23	0.33	1.16	0.00	0.00	0.00	0.00	0.50	0.00	0.00
24	2.33	1.50	1.00	0.67	0.00	4.32	0.83	3.33	0.83
25	0.33	0.00	0.33	0.00	0.00	0.00	0.00	1.00	2.50
26	0.00	0.67	0.00	0.00	0.33	1.33	0.00	1.33	0.00
27	0.00	0.00	1.66	0.67	0.00	0.17	3.00	0.83	1.83
28	0.00	2.00	0.67	0.67	0.33	2.33	0.00	0.00	0.00
29	0.17	0.67	0.17	2.17	1.82	1.99	0.00	0.33	0.17
30	0.33	0.00	1.66	2.33	0.00	1.66	2.83	2.66	1.00
31	0.17	0.83	0.50	0.33	0.83	0.00	0.50	0.17	0.17
32	0.67	0.50	0.00	0.33	1.98	1.16	0.00	0.33	0.83
33	9.00	7.65	0.00	1.67	7.93	2.33	0.00	1.33	0.33
34	0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00	0.17
35	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.00
36	0.00	0.33	0.00	0.00	0.66	0.66	0.00	0.00	0.67
37	0.00	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.00
38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
39	0.00	0.00	0.33	0.00	0.33	0.00	0.00	0.33	0.00
40	0.33	0.00	0.00	0.67	0.00	0.00	0.33	0.00	0.00
41	0.67	1.00	0.67	3.00	0.33	0.66	1.33	0.67	0.33
42	9.67	4.66	17.30	8.33	2.31	9.30	12.31	5.66	2.00
43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
44	0.33	0.00	0.00	0.00	0.00	0.33	0.67	1.66	6.32
45	0.67	0.33	1.00	1.00	0.00	0.33	0.00	0.00	2.66
46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
47	0.00	0.67	0.33	0.00	0.33	0.33	0.67	0.67	0.00
48	0.33	0.00	0.00	1.33	0.00	0.00	0.33	0.00	0.00
49	0.67	2.33	1.33	0.67	1.32	1.33	1.00	2.66	0.00
50	7.33	6.32	26.29	22.67	5.29	11.96	12.65	0.33	2.66
51	9.67	4.99	4.33	2.67	0.33	1.99	2.00	0.33	0.33







1									
2	1.63	3.31	1.64	1.65	0.00	0.67	0.33	0.33	1.66
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.17	0.65	0.33	0.00	0.00	0.17	0.17	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.00
16	0.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									
41									
42									
43									
44									
45									
46									
47									
48									
49									
50									
51									
52									
53									
54									
55									
56									
57									
58									
59									
60									

For Review Only



1									
2	0.33	1.67	2.61	0.66	1.33	1.32	1.99	2.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.33	0.00	0.00	0.49	0.00	2.17	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.67	0.00	0.00	0.00	0.00	0.00	1.00	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.00
16	0.00	1.33	0.00	0.00	0.00	0.66	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									
41									
42									
43									
44									
45									
46									
47									
48									
49									
50									
51									
52									
53									
54									
55									
56									
57									
58									
59									
60									

For Review Only

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

	DAZ 1 v 2	DAZ 2 v 3	DAZ 3 v 4	DAZ 4 v 5	DAZ 5 v 6
R	+	+	-	+	-
BP	+	+	-	+	-
CRS	+	-	-	+	-
ADA	-	+	+	-	-
F	+	+	-	+	-
BF	-	+	-	-	-
B	+	+	+	+	-
BM	+	-	-	+	-
M	+	+	+	+	+
SI	-	+	-	-	-

+ is significant; - is not

For Review Only