Vasse-Wonnerup Integrated Ecological Monitoring Summary 2017-22: Benthic macroinvertebrate component

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Final Report

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VASSE taskFORCE

Background

This project is part of the Revitalising Geographe Waterways' Integrated Ecological Monitoring Study (IEM) which aims to better understand the relationships between water regime, food sources and abundance of benthic macroinvertebrates (> 500 µm), fish and birds utilising the range of habitats (regions) present in the Vasse-Wonnerup (see https://rgw.dwer.wa.gov.au/applying-science/vasse-wonnerup-science/).

This benthic macroinvertebrate component is a subset of the larger IEM study and aims to:

a) Determine the characteristics of the benthic macroinvertebrate fauna (*i.e.* number of species, abundance, diversity and faunal composition), within the six regions of the wetlands at seasonal and annual scales between March 2017 and March 2020. Assess the key environmental drivers (*e.g.* water quality and depth) that influence invertebrate communities.

b) Investigate the characteristics of the benthic macroinvertebrate fauna at different depths within the most upstream regions of the wetlands (subtidal, intertidal and drying sediments).

c) Help to better understand the potential ecological consequences of changing water regime (water quality and depth) on macroinvertebrate fauna across the different spatial and temporal scales in wetlands.

Samples of the benthic macroinvertebrate fauna from the nearshore waters of six regions of the system (i.e. Upper and Lower Vasse and Wonnerup estuaries, Vasse Exit Channel and Wonnerup Inlet; Figure 1) were collected in 13 seasons between March 2017 and March 2020 using an Ekman grab that collected substrata from an area of 225 cm^2 and sampled to a depth of 15 cm. Samples were sieved through a 500 µm mesh and any invertebrates identified to the lowest possible taxonomic level. Additional sampling was conducted in November 2020 and 2021 and January 2021 and 2022 as part of a project to develop an index of benthic health for the Vasse-Wonnerup (Cronin-O'Reilly and Tweedley, 2021).

The overall composition of the invertebrate fauna was determined and the characteristics (*i.e.* number of species, total density (225 cm^{-2}), Simpson's (Diversity) Index, taxonomic distinctiveness, contribution to functional and taxonomic groups and faunal composition) calculated. Additional sampling was conducted in the Upper Vasse and Upper Wonnerup regions in January and March of each year, to determine whether the characteristics of the benthic macroinvertebrate fauna in the subtidal (> 50 cm deep) and intertidal waters (< 15 cm deep) and recently exposed sediment (drying) were different (Figure 2). This summary details the results of the benthic macroinvertebrate fauna only. Full details and explanation of the trends in each year individually can be found in Tweedley et al. (2019, 2020a,b) and across the three years in Tweedley et al. (2021).

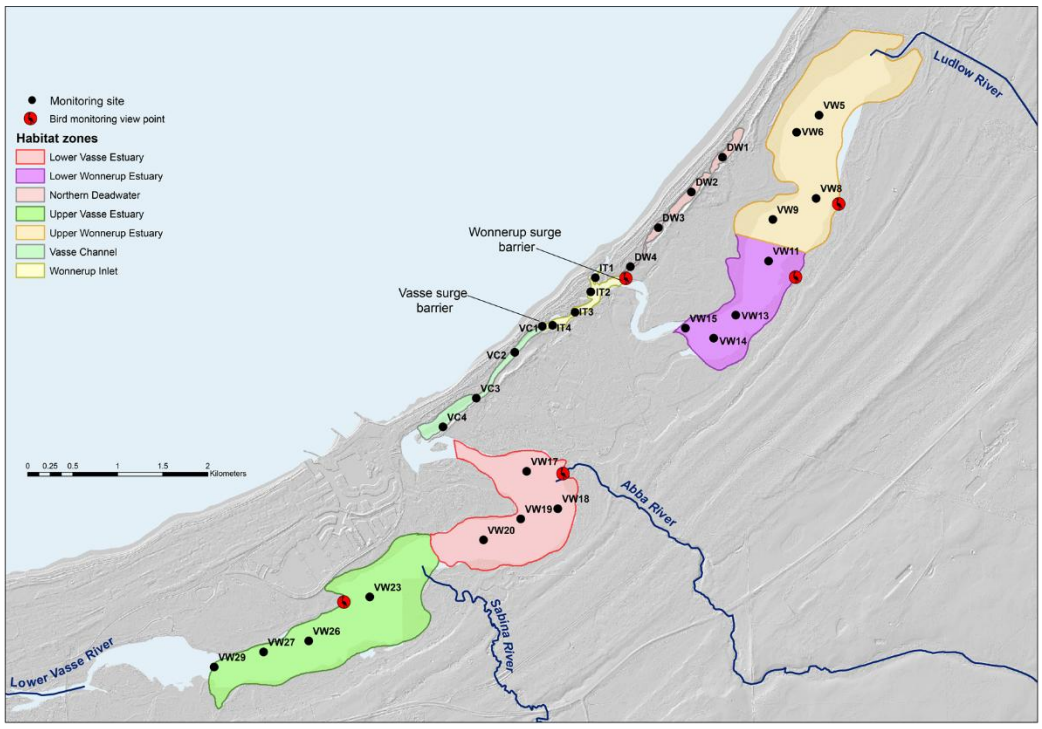

Figure 1. Map of the Vasse-Wonnerup showing the four sites sampled in each of the six regions in each season between March 2017 and March 2020 and also in November 2020 and 2021 and January 2021 and 2022. No sampling occurred in the Deadwater during the current study. Map supplied by the Department of Water and Environmental Regulation.

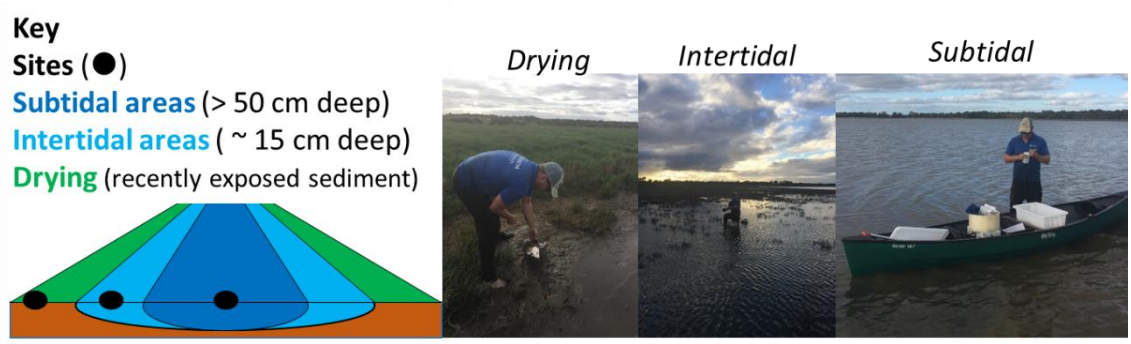

Figure 2. Conceptual diagram and photographs of the three water depths sampled at each site in the Upper Vasse Estuary and Upper Wonnerup Estuary regions during January and March of each year. Photos taken by Dr Linda Kalnejais.

Results

Table 1. Summary of the mean number of species, density (invertebrates 225 cm^{-2}), Simpson's (Diversity) Index and quantitative taxonomic distinctness and the proportion of infaunal and epifaunal species and individuals to the total invertebrate fauna in the subtidal waters of each region of the Vasse-Wonnerup in each of the 13 seasons between March 2017 and March 2020 and also in November 2020 and 2021 and January 2021 and 2022. The values for the first four metrics separately are reflected in their colour shading from red (low) through yellow (intermediate) to green (high values). Light blue shading denotes that the values for the percentage contribution for epifaunal species or individuals were greater the corresponding values for infauna and dark blue shading the reverse. The subphyla and species most abundant and speciose in each region and season combination are provided. . NS = No sampling conducted.

		Region					
Metric	Season	Up. Vasse	L. Vasse	Vasse Chan.	W. Inlet	L. Wonn.	Up. Wonn.
Number of species	March 2017	4.50	6.25	2.25	7.50	3.50	5.50
	July 2017	10.00	4.00	7.75	10.00	2.00	4.00
	October 2017	10.00	7.25	9.00	10.00	9.50	8.50
	January 2018	6.00	6.00	2.75	6.00	3.75	4.25
	March 2018	4.25	4.25	3.25	4.25	2.00	3.25
	July 2018	4.25	3.75	2.25	4.75	3.75	3.50
	October 2018	12.25	6.25	4.50	6.25	9.25	7.50
	January 2019	2.50	5.00	1.50	7.25	7.75	8.25
	March 2019	3.00	2.00	1.25	5.00	0.25	1.25
	July 2019	4.00	2.00	4.00	7.75	4.50	3.25
	October 2019	3.75	5.75	5.00	6.50	4.50	7.50
	January 2020	5.00	3.50	2.25	5.50	4.00	2.50
	March 2020	3.75	2.25	2.25	4.75	2.50	1.25
	November 2020	7.13	9.63	2.75	9.75	7.00	7.13
	January 2021	2.50	4.25	0.63	7.00	4.50	6.25
	November 2021	11.13	11.63	5.38	NS	13.00	13.88
	January 2022	2.75	2.13	1.13	NS	6.00	5.88
Density (invertebrates 225 cm^2)	March 2017	24.25	239.75	8.00	288.50	21.50	50.00
	July 2017	254.00	329.50	183.75	254.00	26.50	170.50
	October 2017	237.00	80.50	89.25	237.00	76.50	137.50
	January 2018	43.25	113.50	19.50	43.25	250.50	17.75
	March 2018	83.25	24.75	129.00	83.25	702.75	8.75
	July 2018	136.25	181.25	95.25	73.00	48.00	11.00
	October 2018	207.00	133.25	145.00	45.75	76.75	61.75
	January 2019	291.00	179.25	9.50	158.50	103.25	53.50
	March 2019	156.00	791.00	112.00	93.00	0.25	1.75
	July 2019	201.75	906.75	390.75	140.75	338.25	36.50
	October 2019	13.00	263.25	52.25	89.75	290.75	169.25
	January 2020	23.25	572.50	4.75	224.50	326.50	31.25
	March 2020	24.75	1644.00	35.50	31.00	785.75	1.75
	November 2020	75.75	210.13	9.75	269.63	148.25	55.75
	January 2021	17.00	84.13	4.50	81.63	39.88	31.38
	November 2021	288.38	440.63	103.38	NS	425.63	772.75
	January 2022	6.88	33.25	4.38	NS	295.50	306.13

		Region					
Metric	Season	Up. Vasse	L. Vasse	Vasse Chan.	W. Inlet	L. Wonn.	Up. Wonn.
Simpson's Diversity	March 2017	0.77	0.36	0.18	0.57	0.62	0.65
	July 2017	0.59	0.34	0.45	0.59	0.12	0.10
	October 2017	0.38	0.63	0.53	0.38	0.83	0.49
	January 2018	0.76	0.42	0.28	0.76	0.36	0.68
	March 2018	0.34	0.61	0.12	0.34	0.00	0.64
	July 2018	0.58	0.47	0.13	0.47	0.52	0.56
	October 2018	0.66	0.57	0.37	0.68	0.78	0.69
	January 2019	0.02	0.34	0.10	0.55	0.37	0.77
	March 2019	0.29	0.01	0.23	0.50	0.00	0.38
	July 2019	0.30	0.01	0.06	0.69	0.37	0.46
	October 2019	0.62	0.23	0.35	0.66	0.49	0.48
	January 2020	0.59	0.05	0.72	0.52	0.21	0.23
	March 2020	0.52	0.02	0.18	0.52	0.17	0.33
	November 2020	0.63	0.72	0.48	0.70	0.48	0.66
	January 2021	0.43	0.29	0.01	0.63	0.60	0.75
	November 2021	0.61	0.60	0.55	NS	0.60	0.68
	January 2022	0.59	0.38	0.44	NS	0.41	0.57
Quantitative taxonomic distinctness	March 2017	76.55	85.99	16.25	86.23	36.49	65.15
	July 2017	85.30	97.62	56.67	85.30	46.17	51.77
	October 2017	73.35	88.19	93.13	73.35	85.17	74.72
	January 2018	89.82	98.02	84.03	89.82	99.97	74.60
	March 2018	98.97	90.03	78.49	98.97	50.00	99.18
	July 2018	94.36	96.36	42.43	63.49	88.70	66.12
	October 2018	76.69	87.53	98.39	87.54	80.44	80.11
	January 2019	89.29	99.28	24.96	81.04	96.37	65.28
	March 2019	100.00	100.00	50.00	90.27	0.00	50.00
	July 2019	69.44	75.00	47.69	83.64	94.99	49.32
	October 2019	46.67	93.19	73.33	90.63	93.01	74.97
	January 2020	82.43	89.25	49.03	87.84	82.70	72.51
	March 2020	71.26	100.00	69.72	79.87	57.61	25.00
	November 2020	69.41	50.87	59.73	84.61	77.40	82.17
	January 2021	77.77	96.83	12.50	70.62	62.35	80.27
	November 2021	52.64	67.15	62.62	NS	83.13	82.76
	January 2022	41.02	52.75	24.17	NS	83.72	78.86

		Region					
Metric	Season	Up. Vasse	L. Vasse	Vasse Chan.	W. Inlet	L. Wonn.	Up. Wonn.
% Infaunal/(epifaunal) species	March 2017	15 (85)	8 (92)	37 (63)	65 (35)	13 (88)	13 (87)
	July 2017	14(86)	17 (83)	37 (63)	53 (47)	50 (50)	60 (40)
	October 2017	23 (77)	13 (88)	15 (85)	54 (46)	8 (92)	17 (83)
	January 2018	15 (85)	21 (79)	37 (63)	69 (31)	11 (89)	13 (88)
	March 2018	25 (75)	12 (88)	83 (17)	86 (14)	25 (75)	20 (80)
	July 2018	30 (70)	22 (78)	60 (40)	50 (50)	10 (90)	11 (89)
	October 2018	16 (84)	7 (93)	11 (89)	53 (47)	10 (90)	17 (83)
	January 2019	50 (50)	25 (75)	50 (50)	77 (23)	7 (93)	18 (82)
	March 2019	33(67)	25 (75)	67 (33)	100 (0)	0 (100)	33 (67)
	July 2019	14 (86)	25 (75)	89 (11)	61 (39)	22 (78)	14 (86)
	October 2019	11 (89)	10 (90)	18 (82)	58 (42)	18 (82)	14 (86)
	January 2020	20 (80)	43 (57)	40 (60)	64 (36)	33 (67)	25 (75)
	March 2020	13 (88)	33 (67)	67 (33)	82 (18)	60 (40)	33 (67)
	November 2020	11 (89)	15 (85)	45 (55)	68 (32)	10 (90)	13 (88)
	January 2021	17 (83)	22 (78)	67 (33)	76 (24)	8 (92)	8 (92)
	November 2021	7 (93)	7 (93)	6 (95)	NS	13 (87)	16 (84)
	January 2022	20 (80)	17 (83)	40 (60)	NS	25 (75)	15 (85)
% Infaunal/(epifaunal) abundance	March 2017	3 (97)	1 (99)	13 (88)	93 (7)	9 (91)	24 (76)
	July 2017	53 (47)	83 (17)	92 (8)	69 (31)	89 (11)	2 (98)
	October 2017	19 (81)	15 (85)	3 (97)	88 (12)	27 (73)	8 (92)
	January 2018	33 (67)	27(73)	18 (82)	88 (12)	60 (40)	10 (90)
	March 2018	79 (21)	14 (86)	96 (4)	99 (1)	100 (0)	29 (71)
	July 2018	35 (65)	34 (66)	98 (2)	62 (38)	51 (49)	2 (98)
	October 2018	6 (94)	8 (92)	75 (25)	76 (24)	3 (97)	23 (77)
	January 2019	99 (1)	24 (76)	5 (95)	90 (10)	1 (99)	3 (97)
	March 2019	96 (4)	100 (0)	98 (2)	100 (0)	0 (100)	14 (86)
	July 2019	64 (36)	100 (0)	100 (0)	85 (15)	73 (27)	2 (98)
	October 2019	23 (77)	94 (6)	41 (59)	72 (28)	72 (28)	3 (97)
	January 2020	58 (42)	97 (3)	42 (58)	99 (1)	98 (2)	78 (22)
	March 2020	66 (34)	99 (1)	96 (4)	98 (2)	100 (0)	71 (29)
	November 2020	14 (86)	5 (95)	73 (27)	62 (38)	51 (49)	30 (70)
	January 2021	81 (19)	86 (14)	97 (3)	94 (6)	64 (36)	22 (78)
	November 2021	0 (100)	2 (98)	4 (96)	NS	58 (42)	40 (60)
	January 2022	27 (73)	1 (99)	9 (91)	NS	74 (26)	54 (46)

Metric	Season	Up. Vasse	L. Vasse	Vasse Chan.	W. Inlet	L. Wonn.	Up. Wonn.
Most speciose subphyla	March 2017	Insecta	Crustacea	Insecta	Annelida	Insecta	Insecta
	July 2017	Crustacea	Crustacea / Insecta	Annelida	Annelida / Crustacea	Annelida	Annelida / Insecta
	October 2017	Insecta	Insecta	Insecta	Annelida / Crustacea	Insecta	Crustacea / Insecta
	January 2018	Insecta	Crustacea	Crustacea	Annelida	Insecta	Crustacea / Insecta
	March 2018	Insecta	Crustacea	Annelida	Annelida	None	Crustacea
	July 2018	Insecta	Crustacea / Insecta	Annelida / Mollusca	Annelida	Insecta	Crustacea
	October 2018	Insecta	Crustacea / Insecta	Crustacea	Annelida	Insecta	Insecta
	January 2019	Annelida	Crustacea / Insecta	Annelida	Annelida	Insecta	Insecta
	March 2019	None	Crustacea / Insecta	Mollusca	Annelida	Insecta	None
	July 2019	Insecta	Insecta	Annelida	Annelida	Insecta	Insecta
	October 2019	Insecta	Insecta	Insecta	Annelida	Crustacea / Insecta	Insecta
	January 2020	Insecta	Annelida / Crustacea	Crustacea	Annelida	Crustacea	Insecta
	March 2020	Insecta	None	Annelida	Annelida	Annelida	None
	November 2020	Insecta	Insecta	Annelida / Insecta	Annelida	Insecta	Insecta
	January 2021	Crustacea / Insecta	Insecta	None	Annelida	Insecta	Insecta
	November 2021	Insecta	Insecta	Crustacea	NS	Insecta	Insecta
	January 2022	Insecta	Insecta	Mollusca	NS	Insecta	Crustacea
Most abundant subphyla	March 2017	Crustacea	Mollusca	Insecta	Mollusca	Mollusca	Insecta
	July 2017	Annelida	Annelida	Annelida	Annelida	Annelida	Insecta
	October 2017	Crustacea	Crustacea	Mollusca	Annelida	Insecta	Crustacea
	January 2018	Annelida	Annelida	Mollusca	Mollusca	Annelida	Insecta
	March 2018	Annelida	Mollusca	Annelida	Mollusca	Annelida	Insecta
	July 2018	Insecta	Mollusca	Annelida	Crustacea / Annelida	Annelida	Insecta
	October 2018	Crustacea	Mollusca	Annelida	Annelida	Crustacea	Crustacea
	January 2019	Annelida	Mollusca	Mollusca	Annelida	Mollusca	Insecta
	March 2019	Annelida	Annelida	Mollusca	Annelida	Insecta	Mollusca
	July 2019	Annelida	Annelida	Annelida	Annelida	Annelida	Insecta
	October 2019	Crustacea	Annelida	Annelida	Annelida	Annelida	Crustacea
	January 2020	Annelida	Annelida	Crustacea	Annelida	Annelida	Annelida
	March 2020	Annelida	Annelida	Annelida	Annelida	Annelida	Annelida
	November 2020	Crustacea	Insecta	Annelida	Annelida	Annelida	Crustacea
	January 2021	Annelida	Annelida	Annelida	Annelida	Annelida	Insecta
	November 2021	Insecta	Insecta	Insecta	NS	Annelida	Crustacea / Annelida
	January 2022	Insecta	Mollusca	Mollusca	NS	Annelida	Annelida

		Region					
Metric	**Season**	**Up. Vasse**	**L. Vasse**	**Vasse Chan.**	**W. Inlet**	**L. Wonn.**	**Up. Wonn.**
Key species	**March 2017**	*A. worooa*, Cyclopodia spp. Dytiscidae sp.	*Potamopyrgus* sp., *C. novazelandae*, *Procladius* sp.	*M. robusta*, *Zygoptera* spp., Naididae sp.	*A. semen, S. aequisetis, C. capitata*	*Potamopyrgus* sp., *Procladius* sp., Chironominae sp.	Chironominae sp., *Procladius* sp., *C. capitata*
	July 2017	Oligochaete spp., *C. capitata, M. tas. chapmani*	C. *capitata, Potamopyrgus* sp., *Procladius* sp.	*P. cirrifera, P. kempi, C. capitata*	*A. semen, S. aequisetis, C. capitata*	*C. capitata, Potamopyrgus* sp., *A. semen*	*Procladius* sp., Chironominae sp., *C. capitata*
	October 2017	*M. tas. chapmani, M. ambiguosa, A. subtenuis*	*A. worooa, M. tas. chapmani, Potamopyrgus* sp.	*Potamopyrgus sp., A. subtenuis*, *Procladius* sp.	*S. aequisetis, S. normalis, A. semen*	*Procladius* sp., Dytiscidae sp., Chironominae sp.	*Perthia* sp., *M. tas. chapmani*, *Procladius* sp.
	January 2018	*C. capitata*, *Procladius* sp. *Berosus* sp.	*C. capitata, Potamopyrgus* sp., *M. tas. chapmani*	*Potamopyrgus* sp., *A. subtenuis*	*A. semen, S. aequisetis, C. capitata*	Chironominae sp., *Procladius* sp.	Chironominae sp., *Procladius* sp., *Perthia* sp.
	March 2018	*C. capitata, Berosus* sp. *Potamopyrgus* sp.	*Potamopyrgus* sp., *C. novazelandae, A. worooa*	*P. cirrifera, C. capitata, Potamopyrgus sp.*	*A. semen, C. capitata*	*C. capitata,* Lepidoptera sp., *A. worooa*	*C. capitata,* Lepidoptera sp.
	July 2018	Chironominae sp., *Potamopyrgus* sp., *C. capitata*	*C. capitata, Potamopyrgus* sp., *Procladius* sp.	*C. capitata, S. aequisetis, C. minor*	*S. aequisetis, P. excavatum, C. minor*	*C. capitata, Potamopyrgus* sp., *C. striatula*	Chironominae spp., *Potamopyrgus* sp., *M. tas. chapmani*
	October 2018	*Berosus* sp., *M. tas. chapmani, A. subtenuis*	Chironominae sp., *Potamopyrgus* sp., *Procladius* sp.	*C. capitata, Potamopyrgus* sp., *M. tas. chapmani*	*C. capitata, S. aequisetis, P. kempi*	*A. subtenuis*, *M. ambiguosa, A. worooa*	*M. ambiguosa*, *A. subtenuis*, *Berosus* sp.
	January 2019	*C. capitata,* Chironominae sp., *P. kempi*	*Potamopyrgus* sp., *C. capitata, Procladius* sp.	*Potamopyrgus* sp., *S. aequisetis, C. minor*	*C. capitata, S. aequisetis, S. normalis*	*Potamopyrgus* sp., *Berosus* sp., *A. subtenuis*	*Perthia* sp, *Procladius* sp. Tanypodinae sp.
	March 2019	*C. capitata,* Chironominae sp., *Potamopyrgus* sp.	*C. capitata*	*A. semen, Potamopyrgus* sp., *C. capitata*	*C. capitata, S. aequisetis, S. normalis*	Hydrophilidae sp.	Hydrophilidae sp., *Potamopyrgus* sp.
	July 2019	Chironnominae sp., Culicidae spp., *Procladius* sp.	*C. capitata,* Chironominae sp., *Procladius* sp.	*P. cirrifera, C. capitata, P. kempi*	*S. aequisetis, S. normalis, C. minor*	Chironomidae sp., *C. capitata,* Culicidae sp.	Culicidae sp., Chironomidae sp.
	October 2019	*M. ambigousa, M. tas. chapmani*	Culicidae spp., *C. capitata, M. tas. chapmani*	*C. occidentalis,* Culicidae spp.	*S. aequisetis, B. limnicola, C. minor*	*M. tas. chapmani, C. capitata, A. subtenuis*	*M. tas. chapmani, A. subtenuis*

		Region					
Metric	**Season**	**Up. Vasse**	**L. Vasse**	**Vasse Chan.**	**W. Inlet**	**L. Wonn.**	**Up. Wonn.**
Key species	**January 2020**	*C. capitata*, *Procladius* sp., *Potamopyrgus* sp.	*C. capitata*, *Potamopyrgus* sp.	*A. worooa*, Nematode spp., *B. australis*	*A. semen*, *S. aequisetis*, *C. capitata*	*S. aequisetis*, *C. capitata*, *Procladius* sp.	*C. capitata*, *Procladius* sp., *Potamopyrgus* sp.
	March 2020	*Procladius* sp., *Potamopyrgus* sp., *C. capitata*	*C. capitata*, *Procladius* sp., *Potamopyrgus* sp.,	*C. capitata*, *Procladius* sp.	*A. semen*, *H. filliformis*	*S. aequisetis*, *C. capitata*	*Perthia* sp.
	November 2020	*Procladius* sp., *Potamopyrgus* sp., *C. capitata*	Chironominae sp., *Procladius* sp., Culicudae spp.	Ceratopogonidae *sp.*, *Potamopyrgus sp.* *Berosus sp.*	*Perthia* sp.	*Potamopyrgus* sp., *C. striatula*	*Potamopyrgus* sp., *C. striatula*, Hydrophilldae sp.
	January 2021	*C. capitata*, *Procladius* sp., *Chironominae sp.*	*Procladius* sp., *C. capitata*	*Procladius* sp., *C. capitata*, Lepidoptera *spp.*	*Procladius sp.*, *Potamopyrgus sp., C. striatula*	*Procladius sp.*, *Potamopyrgus sp.*, *C. striatula*	*Procladius sp.*, *Potamopyrgus sp.*, *C. striatula*
	November 2021	*M. ambiguosa*, *O. occidentalis*, *M. mytiloides*	*Procladius* sp., Chironominae sp., *Potamopyrgus* sp.	*P. australis*, *C. occidentalis*, *C. alterans*	NS	*Procladius* sp., *C. capitata*, *Berosus* sp.	*Berosus* sp., *Procladius* sp., *A. subtenuis*
	January 2022	*Procladius* sp.	*Potamopyrgus* sp.	*Potamopyrgus* sp.	NS	*Procladius* sp., *C. capitata*	*Procladius* sp., Chironominae sp.

Annelida (segmented worms); Polychaeta = *Boccardiella limnicola, Capitella capitata, Heteromastus filiformis, Prionospio cirrifera, Pseudopolydora kempi, Scoloplos normalis, Simplisetia aequisetis*. Oligochaeta = Naididae sp., Oligochaete spp..

Arthropoda; Crustacea; Amphipoda = *Austrochiltonia subtenuis, Corophium minor, Paracorophium excavatum, Perthia* sp.. Copepoda = Cyclopoida spp.. Ostracoda = *Alboa worooa, Bennelongia australis, Canonocypris novazelandae, Mytilocypris ambiguosa, Mytilocypris tasmanica chapmani*. Insecta; Coleoptera = *Berosus* sp., Dytiscidae sp., Hydrophilidae sp.. Diptera = Chironominae sp., Culicidae spp., *Procladius* sp., Tanypodinae sp.. Odonata = Zygoptera sp..

Mollusca; Bivalvia = *Arthritica semen*. Gastropoda = *Coxiella striatula*, *Potamopyrgus* sp..

Nematoda (round worms); Nematode spp..

Table 2. Summary of the mean number of species, density (invertebrates 225 cm^{-2}), Simpson's (Diversity) Index and quantitative taxonomic distinctness and the proportion of infaunal and epifaunal species and individuals to the total invertebrate fauna in the subtidal and intertidal water and recently exposed sediment (drying) of the Upper Vasse and Upper Wonnerup estuaries during March 2017 and January and March of 2018, 2019 and 2020 and January 2021. The values for the first four metrics separately are reflected in their colour shading from red (low) through yellow (intermediate) to green (high values). Light blue shading denotes that the values for the percentage contribution for epifaunal species or individuals were greater the corresponding values for infauna and dark blue shading the reverse. The subphyla and species most abundant and speciose in each region and season combination are provided.

		Region and water depth					
Metric	**Season**	**Subtidal: Up. Vasse**	**Intertidal: Up. Vasse**	**Drying: Up. Vasse**	**Subtidal: Up. Wonn.**	**Intertidal: Up. Wonn.**	**Drying: Up. Wonn.**
Number of species	**March 2017**	5.13	3.25	7.75	6.00	4.63	8.00
	January 2018	6.00	6.25	5.75	4.25	7.25	7.50
	March 2018	4.25	3.75	7.00	3.25	3.50	2.25
	January 2019	2.50	5.50	5.75	8.25	9.75	7.25
	March 2019	3.00	3.00	3.50	1.25	1.75	4.25
	January 2020	5.00	5.50	5.75	2.50	2.00	2.75
	March 2020	3.75	3.50	3.50	1.25	1.75	2.00
	January 2021	2.50	1.88	1.38	6.25	4.38	4.25
Density (invertebrates 225 cm^2)	**March 2017**	27.38	24.13	32.38	52.25	47.00	24.38
	January 2018	43.25	29.75	19.00	17.75	22.00	20.50
	March 2018	83.25	419.50	78.00	8.75	14.75	6.75
	January 2019	291.00	300.25	51.25	53.50	117.50	25.25
	March 2019	156.00	94.50	10.25	1.75	5.25	24.50
	January 2020	23.25	20.50	21.25	31.25	94.75	26.00
	March 2020	24.75	20.50	14.75	1.75	5.00	15.50
	January 2021	17.00	7.38	2.88	31.38	50.63	85.13
Simpson's Diversity	**March 2017**	0.64	0.41	0.67	0.67	0.43	0.71
	January 2018	0.76	0.72	0.77	0.68	0.71	0.84
	March 2018	0.34	0.07	0.52	0.64	0.66	0.36
	January 2019	0.02	0.24	0.74	0.77	0.72	0.71
	March 2019	0.29	0.34	0.65	0.38	0.33	0.39
	January 2020	0.59	0.72	0.80	0.23	0.32	0.38
	March 2020	0.52	0.56	0.72	0.33	0.36	0.30
	January 2021	0.43	0.34	0.24	0.75	0.56	0.38
Quantitative taxonomic distinctness	**March 2017**	70.64	60.40	76.80	69.42	77.26	76.97
	January 2018	91.64	87.93	53.25	81.24	86.92	86.29
	March 2018	99.17	99.88	93.93	99.57	97.83	72.35
	January 2019	89.29	98.68	77.16	65.28	64.92	86.66
	March 2019	100.00	99.94	92.79	50.00	75.00	91.00
	January 2020	82.43	90.75	84.79	72.51	74.73	84.62
	March 2020	71.26	91.83	83.13	25.00	60.71	68.41
	January 2021	77.77	47.26	21.81	80.27	92.82	73.33

Metric	Season	Subtidal: Up. Vasse	Intertidal: Up. Vasse	Drying: Up. Vasse	Subtidal: Up. Wonn.	Intertidal: Up. Wonn.	Drying: Up. Wonn.
% Infaunal/(epifaunal) species	March 2017	10 (90)	7 (93)	10 (90)	5 (95)	13 (87)	4 (96)
	January 2018	15 (85)	25 (75)	7 (93)	13 (88)	17 (83)	7 (93)
	March 2018	25 (75)	33 (67)	12 (88)	20 (80)	15 (85)	20 (80)
	January 2019	50 (50)	15 (85)	14 (86)	18 (82)	0 (100)	14 (86)
	March 2019	33(67)	20 (80)	11 (89)	33 (67)	7 (93)	10 (90)
	January 2020	20 (80)	9 (91)	18 (82)	25 (75)	25 (75)	17 (83)
	March 2020	13 (88)	14 (86)	9 (91)	33 (67)	25 (75)	25 (75)
	January 2021	17 (83)	20 (80)	17 (83)	8 (92)	10 (90)	10 (90)
% Infaunal/(epifaunal) abundance	March 2017	6 (94)	1 (99)	3 (97)	11 (89)	6 (94)	3 (97)
	January 2018	33 (67)	27 (73)	1 (99)	10 (90)	9 (94)	11 (89)
	March 2018	79 (21)	98 (2)	63 (37)	29 (71)	41 (59)	4 (96)
	January 2019	99 (1)	96 (4)	42 (58)	3 (97)	4 (96)	6 (94)
	March 2019	96 (4)	89 (11)	12 (88)	14 (86)	0 (100)	1 (99)
	January 2020	58 (42)	30 (70)	34 (66)	78 (22)	90 (10)	40 (60)
	March 2020	66 (34)	56 (44)	2 (98)	71 (29)	10 (90)	5 (95)
	January 2021	81 (19)	56 (44)	57 (43)	22 (78)	39 (61)	13 (87)
Most speciose subphyla	March 2017	Insecta	Insecta	Insecta	Insecta	Insecta	Insecta
	January 2018	Insecta	Insecta	Insecta	Crustacea / Insecta	Insecta	Crustacea / Insecta
	March 2018	Insecta	Insecta / Mollusca	Insecta	Crustacea	Crustacea / Mollusca	Crustacea
	January 2019	Annelida	Insecta	Insecta	Insecta	Insecta	Insecta
	March 2019	None	Insecta	Insecta	None	Insecta	Insecta
	January 2020	Insecta	Insecta	Insecta	Insecta	None	Crustacea / Insecta
	March 2020	Insecta	Insecta	Insecta	None	Mollusca	Mollusca
	January 2021	Insecta	Insecta	Insecta	Insecta	Insecta	Insecta
Most abundant subphyla	March 2017	Crustacea	Crustacea	Crustacea	Insecta	Crustacea	Insecta
	January 2018	Annelida	Mollusca	Insecta	Insecta	Insecta	Crustacea
	March 2018	Annelida	Annelida	Annelida	Insecta	Annelida	Insecta
	January 2019	Annelida	Annelida	Annelida	Insecta	Insecta	Crustacea
	March 2019	Annelida	Annelida	Mollusca	Mollusca	Mollusca	Mollusca
	January 2020	Annelida	Annelida	Annelida	Annelida	Annelida	Mollusca
	March 2020	Annelida	Annelida	Insecta	Annelida	Mollusca	Mollusca
	January 2021	Annelida	Annelida	Annelida	Insecta	Annelida	Mollusca

		Region and water depth					
Metric	**Season**	**Subtidal: Up. Vasse**	**Intertidal: Up. Vasse**	**Drying: Up. Vasse**	**Subtidal: Up. Wonn.**	**Intertidal: Up. Wonn.**	**Drying: Up. Wonn.**
Key species	**March 2017**	*M. tas. chapmani*, Cyclopoida spp. *Potampyrgus* sp.	*Berosus* sp. 1, *Potamopyrgus* sp., Harpacticoida spp.	Dytiscidae sp., Ceratopogonidae sp., *Berosus* sp. 1	*Procladius* sp., Chironominae spp., Potampyrgus sp.	*Berosus* sp. 1, *A. worooa, A. subtenuis*	*Berosus* sp. 1, *A. worooa, A. subtenuis*
	January 2018	*C. capitata*, *Procladius* sp. *Berosus* sp. 1	*M. tas. chapmani*, *Potampyrgus* sp., *Berosus* sp. 1	*Berosus* sp. 1, *Berosus* sp. 2 (adult), Harpacticoida spp.	Chironominae sp., *Procladius* sp., *Perthia* sp.	*Potampyrgus* sp., *M. tas. chapmani*	*M. tas. chapmani*, Ostracod sp.1, *Perthia* sp.
	March 2018	*C. capitata, Berosus* sp. 1, *Potamopyrgus* sp.	*C. capitata, Potamopyrgus* sp.	Oligochaete spp., *Potamopyrgus* sp., *C. capitata*	*C. capitata*, Lepidoptera sp.	Lepidoptera spp., *Potamopyrgus* sp.	Lepidoptera spp., *M. tas. chapmani, Potampyrgus* sp.
	January 2019	*C. capitata,* Chironominae sp., *P. kempi*	*C. capitata, Potamopyrgus* sp.	*Potamopyrgus* sp., Tipulidae sp., *C. capitata*	*Perthia* sp, *Procladius* sp. Tanypodinae sp.	*Chironominae* spp., *Procladius* sp., *Potampyrgus* sp.	Hydrochus sp.2 (adult), *Potamopyrgus* sp., *Procladius* sp.
	March 2019	*C. capitata,* Chironominae sp., *Potamopyrgus* sp.	*C. capitata, Potamopyrgus* sp., *Procladius* sp.	*Potamopyrgus* sp.	Hydrophilidae sp., *Potamopyrgus* sp.	*Potamopyrgus* sp.	*Potamopyrgus* sp.
	January 2020	*C. capitata, Procladius* sp., *Potamopyrgus* sp.	*A. worooa, M. tas. chapmani, Procladius sp.*	*A. worooa, M. tas. chapmani, Procladius sp.*	*C. capitata, Procladius* sp., *Potamopyrgus* sp.	*C. capitata, Potamopyrgus* sp., *Procladius* sp.	*Potamopyrgus* sp., *Procladius* sp., *C. striatula*
	March 2020	*Procladius* sp., *Potamopyrgus* sp., *C. capitata*	Chironominae sp., *Procladius* sp., Culicudae spp.	Ceratopogonidae *sp., Potamopyrgus sp., Berosus sp.*	*Perthia* sp.	*Potamopyrgus* sp., *C. striatula*	*Potamopyrgus* sp., *C. striatula*, Hydrophilldae sp.
	January 2021	*C. capitata, Procladius* sp., Chironominae sp.	*Procladius* sp., *C. capitata*	*Procladius* sp., *C. capitata,* Lepidoptera spp.	*Procladius* sp., *Potamopyrgus* sp., *C. striatula*	*Procladius* sp., *Potamopyrgus sp., C. striatula*	*Procladius* sp., *Potamopyrgus* sp., *C. striatula*

Annelida (segmented worms); Polychaeta = *Capitella capitata, Pseudopolydora kempi.* Oligochaeta = Oligochaete spp..

Arthropoda; Crustacea; Amphipoda = *Austrochiltonia subtenuis, Perthia* sp.. Copepoda = Cyclopoida spp., Harpacticoida spp.. Decapoda = *Palaemon australis.* Ostracoda = *Alboa worooa, Mytilocypris mytiloides, Mytilocypris* tasmanica *chapmani,* Ostracoda sp.. Insecta; Coleoptera = *Berosus* sp., Dytiscidae sp., *Hydrochus* sp., Hydrophilidae sp. Diptera = Ceratopogonidae sp., *Chironomus alternans, Chironomus occidentalis,* Chironominae sp., Culicidae spp., *Procladius* sp., Tanypodinae sp., Tipulidae sp.. Lepidoptera = Lepidoptera spp.

Mollusca; Gastropoda = *Coxiella striatula*, *Potamopyrgus* sp..

References

Cronin-O'Reilly, S., Cottingham, A., & Tweedley, J.R. (2023). Development of an index of benthic health for the Vasse-Wonnerup. Report for the Department of Water and Environmental Regulation: Murdoch University, Perth, Western Australia.

Tweedley, J.R., Cottingham, A. & Beatty, S.J. (2019). Benthic macroinvertebrate monitoring in the Vasse-Wonnerup Wetlands: March 2017. Report for the Department of Water and Environmental Regulation, Western Australia. Murdoch University, Perth, Western Australia. 47 pp.

Tweedley, J.R., Cottingham, A., Strachan, S. & Beatty, S.J. (2020a). Vasse-Wonnerup Integrated Monitoring 2017-18: Benthic macroinvertebrate component. Report for the Department of Water and Environmental Regulation, Western Australia. Murdoch University, Perth, Western Australia. 61 pp.

Tweedley, J.R., Cottingham, A. & Beatty, S.J. (2020b). Vasse-Wonnerup Integrated Monitoring 2018-19: Benthic macroinvertebrate component. Report for the Department of Water and Environmental Regulation, Western Australia. Murdoch University, Perth, Western Australia. 67 pp.

Tweedley, J.R., Cronin-O'Reilly, S., Cottingham, A. & Beatty, S.J. (2021). Vasse-Wonnerup Integrated Monitoring Review of 2017-20: Benthic macroinvertebrate component. Report for the Department of Water and Environmental Regulation: Murdoch University, Perth, Western Australia.