

### Supplementary Table

**Table S1** Summary of all the oligonucleotides designed for this study against various (predicted) B cell or B cell-related markers. Oligonucleotides are divided into two groups: the first five primers target predicted (in common carp) B cell-associated markers whose expression we measured as part of Figure 4 and the Method Details section ‘Quantitative reverse transcription PCR (RT-qPCR) gene expression profiling of B cell activation and differentiation markers’; the second group includes primers targeting 18 *Cyprinus carpio* orthologues of grass carp B cell-associated genes that Pan et al. (1) identified by single-cell RNA sequencing as defining and clustering distinct head kidney IgM<sup>+</sup> B cell populations. We measured the latter group of genes as part of Figure 5 and the Method Details section ‘Multiplex qPCR gene expression profiling’. These two groups of primers are divided by a dashed line.

Gene symbol	NCBI or GenBank accession code	Gene product	Forward (F) and reverse (R) primers (5’-3’)	Primer efficiencies (%)	Amplicon length (bp)
<i>tnfrsf13b</i>	XM_042734762.1	<i>Cyprinus carpio</i> tumor necrosis factor receptor superfamily member 13B	F: CAGTGCTCCGAGCTGTGT R: AGTACAGCGCTGATCCGGA	98.68	157
<i>xbp1</i>	XM_042753507.1	<i>Cyprinus carpio</i> X-box binding protein 1	F: AAAGCACTTCGAAGGAAACTGAAG R: CGAGCTCCA ACTCCAAGACTT	97.91	109
<i>syndecan-3-like</i>	XM_042777052.1	<i>Cyprinus carpio</i> syndecan-3-like	F: GTCTCTTATGGCCACATTTACTCG R: CCCACAGCAATAATGTCCCAAAA	96.72	122

<i>pax5</i>	XM_019109396.2	<i>Cyprinus carpio</i> paired box 5, transcript variants X1, X2, X3, and X4	F: GGCTATGGCGTCTTTGGCT R: TCGCGACCAGACACAAGTG	97.06	123
	XM_019109382.2				
	XM_019109370.2				
	XM_019109360.2				
<i>cxcr5</i>	XM_042743592.1	<i>Cyprinus carpio</i> C-X-C chemokine receptor type 5, transcript variants X1 and X2	F: CTAAACGGCGGAGGAACCT R: GCCCAATAGCTTGCAGAGGA	100.51	150
	XM_042743591.1				
<i>cd22</i>	XM_042754392,	<i>Cyprinus carpio</i> cluster of differentiation 22	F: CATTCTCTTGCTGATGTCCTTCAT R: ATGAGCGTGTGTTTCAGAGGAGA	88.48	99
	XM_042726754				
<i>cd34</i>	XM_042713470	<i>Cyprinus carpio</i> cluster of differentiation 34	F: CTTACAGTTGCTGGGGACAG R: AACAGGTTCAAAAGCAGGTCCAA	85.39	109
<i>cd79b</i>	XM_042767177	<i>Cyprinus carpio</i> cluster of differentiation 79b	CCTCTCAGCTGAAGTAAATATCC, TGACATCTGATCCATCTTTGACG	92.74	109
<i>cd80</i>	XM_042740109	<i>Cyprinus carpio</i> cluster of differentiation 80	CACAGCTGAGTACAGCGTTCC, AGGTGGACGGGGCTTAATCAAA	95.26	143
<i>cd83</i>	XM_019119505	<i>Cyprinus carpio</i> cluster of differentiation 83	CCGTCATATGGTACAAGGTTTCT, TGTCTAATGTAAGTGCAGAGGAC	87.66	173

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<i>cd86</i>	XM_042778525	<i>Cyprinus carpio</i> cluster of differentiation 86	GTGCGCCATTCTTCATTAAGGG, CTACATGAGGACGTCAGACTAG	92.14	148
<i>cxcr4a</i>	XM_042725575	<i>Cyprinus carpio</i> C-X-C chemokine receptor type 4 alpha	TACGAACACATCGTCTTTGAAGAT, GAGCCAACTTTGAGGTTCCGTG	94.77	92
<i>cxcr4b</i>	XM_042763477	<i>Cyprinus carpio</i> C-X-C chemokine receptor type 4 beta	CTTCTTCATCTGTTGGTTGCCTTA, TGCTGTCTCAACCCCATCCTTA	93.73	165
<i>egr1</i>	XM_019064348	<i>Cyprinus carpio</i> early growth response protein 1	ACTGGAGACACGCTTTCAGAAAT, TCTTACACGGGCCGTTTCACC	97.00	102
<i>ier2</i>	XM_019067280	<i>Cyprinus carpio</i> immediate early response protein 2	CTCTAGAAAGCGACGGAGCAAA, CGTGCCTATGCCAAGAACAATTG	94.13	173
<i>ighm</i>	AB004106, AB004107, MH352354, MH352353	<i>Cyprinus carpio</i> immunoglobulin M heavy chain membrane-bound and secretory protein	CGAATATGCAGTTCCTATTCAAGA T AACATGTGGA ACTTGATGCCCC	97.55	216
<i>irf4</i>	XM_019126566	<i>Cyprinus carpio</i> interferon regulatory factor 4	GGCCCTCTCAGATTACCGCTTA, TAGTCCAGAGGGCTGTCAGCT	103.31	93
<i>irf8</i>	XM_042754085, XM_042743728	<i>Cyprinus carpio</i> interferon regulatory factor 8	ATCTTCAAAGCGTGGGCGATATT, ATTTTGAGGAAGTTACTGACCGAT	91.43	130

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<i>klf2</i>	XM_019065449	<i>Cyprinus carpio</i> Krüppel like factor 2 alpha	GAAAACAGGTGGAAGGAGGAAC, TTATTCTGGCCAACACTGTGGG	86.07	146
<i>mki67</i>	XM_042735109	<i>Cyprinus carpio</i> marker of proliferation Ki-67	GTTCGGAAGGAAGCTGGACTG, AGAACAAGGAGCTCATTTTGACC	100.37	103
<i>pax5</i>	XM_019109360	<i>Cyprinus carpio</i> paired box 5	CAACAGGATCATTCGCACTAAAG, GTGACCCAGGTATCTGCAGTAA	87.60	107
<i>top2a</i>	XM_042735154	<i>Cyprinus carpio</i> DNA topoisomerase II alpha	ACTCAGCAAATGTGGGTGTTTGAT, GGTTAACATTGACTCGGAGAATAA	99.96	170
<i>xbp1</i>	XM_042753507	<i>Cyprinus carpio</i> X-box binding protein 1	TTGGAGTTGGAGCTCGAGAATC, GACTGGGGTTAGATACCCTGG	93.73	121

(1) Pan Y, Wu C, Zhong Y, Zhang Y, Zhang X. An Atlas of Grass Carp IgM+ B Cells in Homeostasis and Bacterial Infection Helps to Reveal the Unique Heterogeneity of B Cells in Early Vertebrates. *J Immunol* (2023) **211**:964–980. doi: 10.4049/jimmunol.2300052.