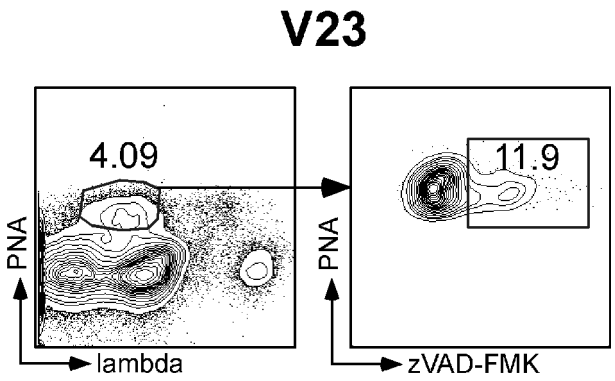
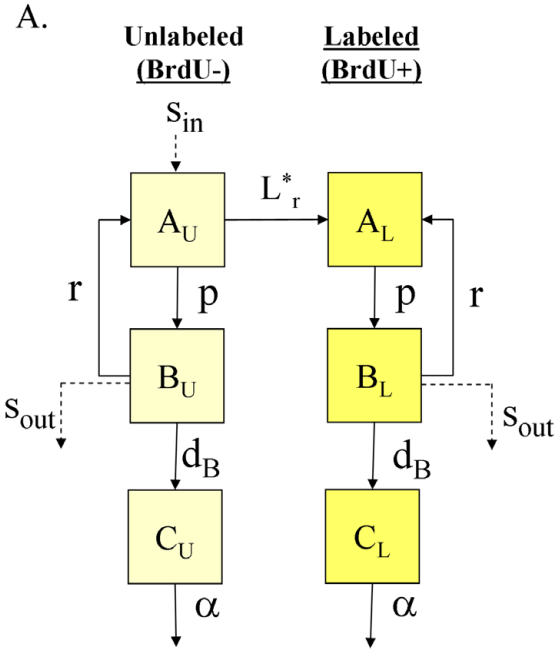
Supplementary Figure 1



Supplementary Figure 1. The frequency of V23 λ- (i.e. κ+) GC B cells undergoing apoptosis is ~3-fold lower than λ+ B cells in the same animals and similar to λ+ B cells in B1-8 GCs. Representative flow cytometric profile of spleen cells from a V23 mouse that had been immunized with NP-CGG 13 days earlier stained with PNA, λ, and ZVAD-FMK-FITC. The λ-/PNA+ population is gated in the left histogram and presumably contains ϰ+ B cells specific for CGG epitopes. The percentage of zVAD-FMK binding cells (i.e. apoptotic cells) was determined by the plot on the right. The average (n=3) was 9.3 +/- 1.2%, with the mouse depicted having 11.9% positive cells.

Supplementary Figure 2

A.



B.

$$\frac{dA_U}{dt} = s_{in} + rB_U - \left(p + d_A + L_r^*\right) A_U$$

$$\frac{dB_U}{dt} = 2pA_U - \left(r + d_B + s_{out}\right) B_U$$

$$\frac{dC_U}{dt} = d_A A_U + d_B B_U - \alpha C_U$$

$$\frac{dA_L}{dt} = rB_L + L_r^* A_U - \left(p + d_A\right) A_L$$

$$\frac{dB_L}{dt} = 2pA_L - \left(r + d_B + s_{out}\right) B_L$$

$$\frac{dC_L}{dt} = d_A A_L + d_B B_L - \alpha C_L$$

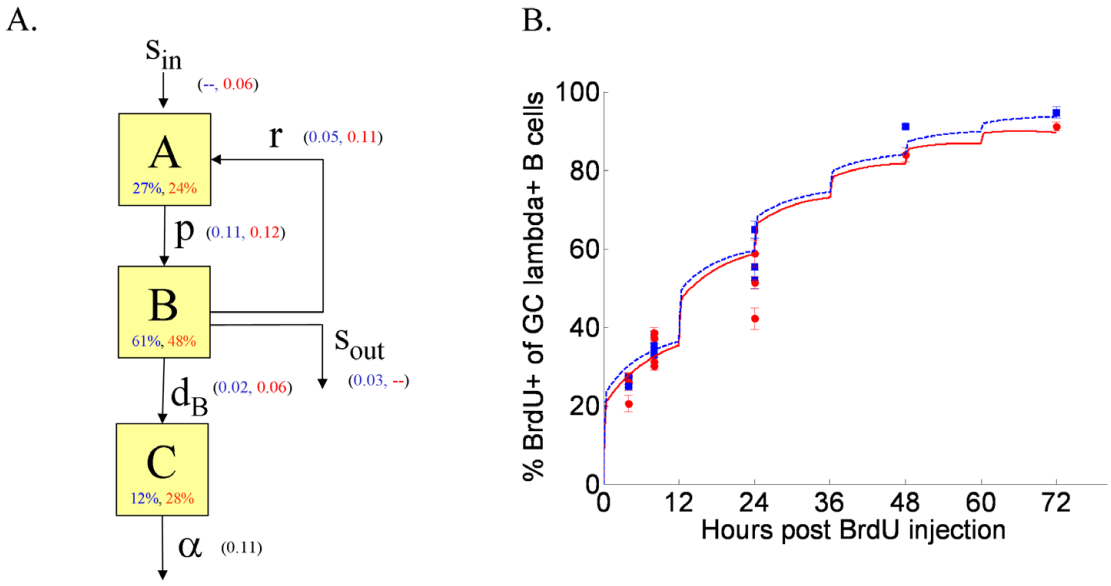
$$L_r^* = \begin{cases} L_r \text{ if } T_i \le t \le \left(T_i + L_t\right) \\ \text{for some BrdU injection } T_i \\ 0 \text{ otherwise} \end{cases}$$

$$\%\text{BrdU+} = \frac{A_L + B_L + C_L}{A_U + B_U + C_U + A_L + B_L + C_L} \times 100\%$$

$$\%\text{CaspGLOW+} = \frac{C_U + C_L}{A_U + B_U + C_U + A_L + B_L + C_L} \times 100\%$$

Supplementary Figure 2. Mathematical model of GC cell turnover. (A) Overview of model structure showing the three B cell subsets: Subset A (dividing cells, ~S/G2/M phases), Subset B (non-dividing cells, ~G0/G1 phases) and Subset C (CaspGLOW+, dying cells). The subscripts in each subset name indicate if the cells are unlabeled (U) or BrdU labeled (L). Descriptions for each parameter are provided in Supplementary Table 2. (B) Differential equations implementing the model of GC population dynamics.

Supplementary Figure 3



Supplementary Figure 3. Mathematical modeling of GC cell turnover including inflow and outflow. (A) Depiction of model scheme and parameters. Estimated parameter values are shown in parenthesis (B1-8, V23), as are the steady-state relative population sizes for each of the compartments. As discussed in the text, this extends the basic model by allowing for either inflow or outflow of cells from the GC. (B) Optimal fit of the model to the experimental BrdU and CaspGLOW labeling data (see Supplementary Table 2 for parameter values). Red squares are the B1-8 experimental data, while blue circles are the V23 experimental data (from Figure 4). The total population size was constrained to be constant (i.e., the population is at steady-state).

Supplementary Table 1

Tree Name	Mouse Type	Sampling Method	Day	Tree notation
L2039_6p3t.1	V23	Laser	10	(~1:LV1J1;CACAGCTGG~(~4:A353T~(~1:C233G~(~1:A164T~1:G166A,1:C12T:C38T)),1:C348T))
L2039_6p3t.2	V23	Laser	10	(~3:REA02+LV1J1;CATGGCTGG~1:A179G:G148A:G145A)
L2039_7p.2	V23	Laser	10	(~1:LV1J1;CATAGCTGG~2:A353T:G232A:G145A)
L2039_7p.3	V23	Laser	10	(~1:LV1J1;CATTTCGGCTGG~2:C357T:A139C)
L2079_5p.1	V23	Laser	10	(~10:KC02+KC03+KC04+KC05+KC07+KC09+KC10+KC12+LV1J1;CACTGG~1:A289T)
L2079_8p.1	V23	Laser	10	(~1:LV1J1;CACAGCTGG~1:C354A:T323A:A268T:T216A:C140T)
L2079_8p.2	V23	Laser	10	(~4:KD09+KD12+LV1J1;CATTTCTGG~1:C335G:C233T:C113T,1:A154G,1:G368A:G347A:C244T:T71C:G49A,1:A164G,1:A97G)
L2081_5p.1	V23	Laser	10	(~4:KE04+KE07+LV1J1;CATTGG~1:C168A:C167T)
L2081_5p.2	V23	Laser	10	(~1:LV1J1;CATTTAAGCTGG~(~0:A358G~1:A321T,(~0:C167T~(~1:A213G~(~1:C187G:T167C:T126C~2:C140T)),3:C168A)))
L2081_7p.1	V23	Laser	10	(~1:LV1J1;CATTGGGACTGG~1:A326T:A210C,1:A350G)
L2081_7p.2	V23	Laser	10	(~1:LV1J1;CATTGGGGCTGG~1:C348T,1:A210C)
L2081_7p.3	V23	Laser	10	(~3:KF12+LV1J1;CTCTCCTGG~1:G347T:A202T:A154C:G70A:A34C)
L2086_6p.1	V23	Laser	10	(~1:LV1J1;CACAGCTGG~(~0:C354A~4:A349G,1:G145A:A112G))
L2086_6p.2	V23	Laser	10	(~1:LV1J1;CATAGCTGG~(~2:A353T~1:G301A:G347A))
L2086_6p.3	V23	Laser	10	(~1:LV1J1;CATTTCTGG~1:T343G)
L11920d10_2Bprint.1	V23	Laser	10	(~2:LV1J1;CACTGG~(~1:C284T:T219A:G218C~(~1:C167T:G158A:G148A~5:T39C)))
L11920d10_2Bprint.2	V23	Laser	10	(~1:LV1J1;CTTTGG~1:A349T)
L11920d10_3A1print.1	V23	Laser	10	(~2:LV1J1;CATGGGGGCTGG~2:G232C,2:A170G,2:A224G:G137A,1:T105A:G67T:T36C)
L11920d10_3A2print.1	V23	Laser	10	(~1:LV1J1;CATATG~4:A355G:G232C:A227T:T156A:G145T:A111C:G75T)
L11922d10_1A2print.1	V23	Laser	10	(~2:LV1J1;ATTTGG~(~3:A349T~1:A139G))
L11922d10_1A2print.2	V23	Laser	10	(~1:LV1J1;ATTTGG~2:A139G)
L11922d10_5Bprint.2	V23	Laser	10	(~1:LV1J1;ATTTGG~10:A349T)
L11922d10_5Bprint.3	V23	Laser	10	(~1:LV1J1;CTTTGG~1:A349T)
11929d16_2print.1	V23	Laser	16	(~1:LV1J1;CTCTGG~1:C351T:A349T:C335T:A223G:A183G:A170G:C140T)
11929d16_2print.2	V23	Laser	16	(~1:LV1J1;CTTTGG~(~0:A349T~1:G70A,(~0:A114G~1:C348T,2:A170G:C121G),(~0:A170C~1:C225A:A182G,1:A227G:C171T,(~1:G347A:G158C:A154T:A124T~1:A278G:A372G))))
11929d16_2print.3	V23	Laser	16	(~1:LV1J1;CTTTGG~1:G347A:G241A:G238A:A213T)
11929d16_2print.4	V23	Laser	16	(~1:LV1J1;CTTTGG~1:G215C:G137A:G70A:G32A:G19A)

11929d16_2print.5	V23	Laser	16 (~1:LV1J1;CTTTGG~1:G232A:C178T:A22T)
11929d16_3print.1	V23	Laser	16 (~1:LV1J1;CTTTGG~(~4:G241A~2:A344G))
11929d16_3print.2	V23	Laser	16 (~1:LV1J1;CTTTGG~1:A373G:G145A) (~1:LV1J1;CTTTGG~(~1:A170C:G158C~(~1:C233G~1:C9
11929d16_3print.3	V23	Laser	16 8T:A349T:C345T:A273C:C228T:G233T)))
11930d16_4print.1	V23	Laser	16 (~1:LV1J1;CTTTGG~1:T315C:G232A:A164T) (~1:LV1J1;ATTTGG~(~0:A349T~1:G347A:A297C:A170G: A34T,(~0:A170C:G158C~1:G45A,(~0:G145C~1:A202T:A1 57G:T105G,1:A180G),(~1:A237G:C233A:C229A:C228T:A
11930d16_4print.2	V23	Laser	16 213C:A29C~2:A211G)))) (~1:LV1J1;CTTTGG~1:A349T:A185G:G145A:A139C:G73
11930d16_4print.3	V23	Laser	16 A)
11953d16_2Aprint.1	V23	Laser	16 (~1:LV1J1;CTCTGG~2:A349T:C345T:C187G) (~1:LV1J1;CTTGGG~(~0:A349T~1:A258C:A182G,(~0:A2 10G:A170C~1:C235T,1:G19A,1:T197C:C167T:T85G:A84
11953d16_2Aprint.2	V23	Laser	16 G))) (~1:LV1J1;CCTGGGGGCTGG~(~1:G334A:A278G~1:A27
11953d16_2Aprint.3	V23	Laser	16 5T))
11953d16_2Aprint.4	V23	Laser	16 (~1:LV1J1;CATTTG~(~1:G362T~1:A170C:A210G)) (~1:LV1J1;CTCTGG~(~0:A349T~1:G334C:T150G,1:C228
11953d16_9Aprint.1	V23	Laser	16 G,(~1:A170G~1:A112G:C374T:C291A:G45A))) (~1:LV1J1;CTTTGG~(~0:A349T~1:G49A,(~1:A170G~1:G 106A:A157G,1:T150C,1:A183G,1:G145A:C296A:G170C))
11953d16_9Aprint.2	V23	Laser	16)
11953d16_9Aprint.3	V23	Laser	16 (~1:LV1J1;CTTTGG~1:C345T:C335T:G238C:T219G) (~1:LV1J1;CTTTGG~(~0:G319A~5:G158A,1:T219A:C121
L11929d16_1print.1	V23	Laser	16 T:G19C))
L11929d16_1print.2	V23	Laser	16 (~1:LV1J1;CTTTGG~2:G232A) (~1:LV1J1;CTTTGG~5:C352T:A349T:G312A:G301A:C22
L11930_3bprint.1	V23	Laser	16 1G:C201G) (~1:LV1J1;CTTTGG~1:A349T:A339C:A303G:A164T:G49
L11930d16_3print.1	V23	Laser	16 A)
L11930d16_3print.2	V23	Laser	16 (~1:LV1J1;CTTTGG~2:G232A:A170G) (~1:LV1J1;ATTTGG~1:T393A:A349T:G347A:G217A:G158
L11930d16_3print.3	V23	Laser	16 C:A99T:G1A)
M1d10_2print.1	B1-8	Laser	10 (~2:LV1J1;CACTGG~1:G158A:G45A) (~3:E09+LV1J1;CATTGG~(~4:G158A~1:G218A,1:G271A)
M1d10_2print.2	B1-8	Laser	10)
M1d10_2print.3	B1-8	Laser	10 (~1:LV1J1;CATTGG~1:A258G)
M1d10_3print.2	B1-8	Laser	10 (~4:F05+F12+LV1J1;CATTGG~2:G137A)
M1d10_3print.3	B1-8	Laser	10 (~1:LV1J1;CATTGG~1:G232C)
M1d10_3print.4	B1-8	Laser	10 (~1:LV1J1;CATTGG~1:G19T)
M1d10_3print.5	B1-8	Laser	10 (~1:LV1J1;CATTGG~1:G88T)
M1d10_3print.6	B1-8	Laser	10 (~1:LV1J1;CATTGG~1:A211G) (~4:A8+A10+LV1J1;CACTGG~1:A170G:G158A:G145A:C
M2.3_d10print.1	B1-8	Laser	10 140T)
M2.3_d10print.2	B1-8	Laser	10 (~5:A6+A11+A12+LV1J1;CATTGG~1:C171T)
M2.3_d10print.3	B1-8	Laser	10 (~1:LV1J1;CATTGG~1:G67A)
M2.3_d10print.4	B1-8	Laser	10 (~1:LV1J1;CATTGG~1:G175A)

M3d10_1print.1	B1-8	Laser	10	(~1:LV1J1;CACTGG~1:C167G:G158A)
M3d10_1print.2	B1-8	Laser	10	(~1:LV1J1;CATTGG~5:G158A)
M3d10_1print.3	B1-8	Laser	10	(~1:LV1J1;CATTGG~1:A154G:G70A)
M3d10_1print.4	B1-8	Laser	10	(~1:LV1J1;CATTGG~(~1:C221T:T195A:T133G:T59C~(~2:G158A:T159G~1:G342T)))
M3d10_2print.1	B1-8	Laser	10	(~2:LV1J1;CACTGG~(~0:G158A~2:A164T:A160T:G137A,2:G347A:C233G:A153G:G148A))
M3d10_2print.2	B1-8	Laser	10	(~2:LV1J1;CATTGG~(~1:C233T:C225T:T204C~1:T159G))
M3d10_2print.3	B1-8	Laser	10	(~1:LV1J1;CGCTGG~(~0:G342A~1:G301A:A80G,1:C121T))
M3d10_2print.4	B1-8	Laser	10	(~1:LV1J1;CATTGG~1:C330A)
M3d10_2print.5	B1-8	Laser	10	(~1:LV1J1;CATTGG~1:G274T)
M1.1_d16print.1	B1-8	Laser	16	(~1:LV1J1;CATGGG~1:G347A:T343A:C167T:A164T:G158A)
M1.1_d16print.2	B1-8	Laser	16	(~1:LV1J1;CATTGG~(~5:C345T:A303G:C225A~1:G342C,1:G217T:G272T,(~0:C255T~1:A278G,(~1:T59A~1:G259T)))
M1.2_d16print.1	B1-8	Laser	16	(~1:LV1J1;CATTGG~(~1:A164T:G158A~1:G334A:T323C:G312A,1:C255T,(~1:C155G~1:C337G),1:G358A,1:A369C,1:C335T:G241A:G67T:G49A))
M1.2_d16print.2	B1-8	Laser	16	(~1:LV1J1;CATTGG~1:A322C:A213G)
M1.3_d16print.1	B1-8	Laser	16	(~1:LV1J1;CATTGG~(~0:G347A:G158A~1:C171T:C155A,(~0:A164T~1:A202T:A139T:A135T,(~1:G145A~1:A112G:A346T:C155G:G67A,1:A268C:A339C))))
M1.3_d16print.2	B1-8	Laser	16	(~1:LV1J1;CATTGG~1:A344G:A324G:A297C:G232C:C228A:A154C)
M1.3_d16print.3	B1-8	Laser	16	(~1:LV1J1;CATTGG~4:C225A:A160T:G148A)
M1.3_d16print.4	B1-8	Laser	16	(~1:LV1J1;CATTGG~1:A344G:A324G:A297C:G232C:C228A:A154C)
M1.3_d16print.5	B1-8	Laser	16	(~1:LV1J1;CATTGG~1:G347A:C171T:G158A:C155A)
M2.6_day16print.1	B1-8	Laser	16	(~1:LV1J1;CACTGG~1:G347C:A339C:G267A:G232C:G67T)
M2.6_day16print.2	B1-8	Laser	16	(~1:LV1J1;CACTGG~(~0:A164T:G158A~(~0:A139G:A90C~1:C335G,1:C354G:C351T:G319A:C5G),1:C140T))
M2.6_day16print.3	B1-8	Laser	16	(~1:LV1J1;CATTGG~(~1:C235T~1:A157C))
M2.6_day16print.4	B1-8	Laser	16	(~1:LV1J1;CATTGG~(~0:A164T:G158A~1:G347A:A339T:C337A:C335G:A210C:C201T:G137A:C79T:C77T,1:A344C))
M2.7_d16print.1	B1-8	Laser	16	(~1:LV1J1;CATTGG~(~0:A164T:G158A~1:G239T:G232A,1:A213C,(~1:G347A~1:C294A:T359C:G218C:G137C),(~2:G148A~1:T323A),1:A321G:G301A:C233G:C117T,1:C162T:G1A))
M2.7_d16print.2	B1-8	Laser	16	(~1:LV1J1;CATTGG~2:G301C:A223T:A139T)
M3.1_d16print.1	B1-8	Laser	16	(~1:LV1J1;CACTGG~(~0:G158A~2:C155G,(~1:A154T~1:A164T,1:A111C),(~1:T150G:A139G~(~1:T156A:C167G~1:C375A))))

				(~1:LV1J1;CATTGG~(~0:G158A~1:C155G,(~0:C233T:C1
M3.1_d16print.2	B1-8	Laser	16	67T~1:G145A:A22G,1:G274T:A164T)))
M3.1_d16print.3	B1-8	Laser	16	(~1:LV1J1;CATTGG~1:A303G:G232C:G55A)
				(~1:LV1J1;CATTGG~(~0:G158A~2:C155A:G145A,1:A223 T,1:G347A:G319A:G247C:G205A:G181A,(~0:A164T~(~0: C140A~1:G232A:A210G:C162T:T159A,1:C155G:A120T), 1:A311G,1:G232T:A220G:A184G:C155G,1:A224G,1:C23
M3.2_d16print.1	B1-8	Laser	16	3G:A154T:A153T:A139T:T4G)))
M3.2_d16print.2	B1-8	Laser	16	(~1:LV1J1;CATTGG~1:G215C:T159C)
M3.2_d16print.3	B1-8	Laser	16	(~1:LV1J1;CATTGG~1:G347A:A295G:G251C)
				(~3:G2+LV1J1;CATTGG~(~1:A164T:G158A~(~2:G49A~(~
M3.3_d16print.1	B1-8	Laser	16	2:A118T~1:G367A),1:G232A:A154T:A139T:A102T)))
M3.3_d16print.2	B1-8	Laser	16	(~1:LV1J1;CATTGG~1:G1A)
				(~1:LV1J1;CACTGG~(~0:G158A:A124T~1:A372G:G347A,
L3N1o.nex.1	V23	Micromanipulation	10	(~5:A349T~1:A170G,3:T163A:C348A,1:G259T)))
L3N1o.nex.2	V23	Micromanipulation	10	(~1:LV1J1;CATTGG~1:A252G:G158A:A124T)
				(~1:LV1J1;CTTTGG~(~0:A349T~1:G55A,(~1:A227T:A157
L3So.nex.1	V23	Micromanipulation	10	G~(~0:G145A~1:A90T,1:C352A))))
L3To.nex.2	V23	Micromanipulation	10	(~1:LV1J1;CATTTCGGCTGG~1:C357T:C221A)
L3To.nex.3	V23	Micromanipulation	10	(~4:REVB11+REVB12+LV1J1;CTTTGG~1:G347A)
L3To.nex.4	V23	Micromanipulation	10	(~1:LV1J1;CTTTGG~1:G218A)
L3To.nex.5	V23	Micromanipulation	10	(~1:LV1J1;CTTTGG~1:C265T)
L4Uo.nex.1	V23	Micromanipulation	10	(~1:LV1J1;CTTTGG~8:G232A:C162A)
L4Vo.nex.2	V23	Micromanipulation	10	(~1:LV1J1;CTTTGG~(~2:C335G~1:G218A))
				(~9:REVD03+REVD04+REVD06+REVD07+REVD09+D11 +REVD12+LV1J1;CATTTCGGCTGG~1:C221T:C155T:A3
L5G1o.nex.1	V23	Micromanipulation	10	4C)
				(~1:LV1J1;CATTGG~(~3:A349T:G347A:A186C:A183G:G7 0A~1:T6A:C284T:T240A,(~2:C228A~1:C155G:G298C),3:
L5G2o.nex.1	V23	Micromanipulation	10	A139G:G148T:A26C,1:A372G,1:C248T))
				(~2:LV1J1;CATTTCGGCTGG~4:A311C:A161C,2:C248T:
L5G3o.nex.1	V23	Micromanipulation	10	A151T,1:C255A)
				(~1:LV1J1;CCCGGCAGCTGG~2:G280T,2:G334T,(~1:G3
L6Xo.nex.1	V23	Micromanipulation	10	47T~1:A164T:G148A:G88A),1:T323C:A322C)
L6Xo.nex.2	V23	Micromanipulation	10	(~1:LV1J1;CATTTG~1:A164T)
				(~2:LV1J1;CATGGGGGCTGG~1:G137A,1:A223T:T150A:
L1Mo.nex.1	V23	Micromanipulation	16	G88A,(~0:G49A~1:G241A,1:A353C:G232A))
				(~1:LV1J1;CTTTGG~1:C352G:G347A:G298C:G232A:A16
L1Mo.nex.3	V23	Micromanipulation	16	4C:G49A)
				(~1:LV1J1;CTTTGG~1:G347C:G232T:A224G:C221T:C18
L1No.nex.1	V23	Micromanipulation	16	7A:A170C:C162T)
L1No.nex.2	V23	Micromanipulation	16	(~1:LV1J1;ATTTGG~1:A349T:T159C:A157G:A90G)
				(~1:LV1J1;CTTTGG~(~3:A349T~1:G232C,1:C86A:G241C
L1Oo.nex.1	V23	Micromanipulation	16	:A226C,1:C162T))
L1Oo.nex.2	V23	Micromanipulation	16	(~1:LV1J1;CATTGG~1:A344T)
				(~1:LV1J1;CTTTGG~(~1:A349T~(~1:A170G~1:G283A),(~ 1:A170C~1:G283A:C352A:C351T:A198T:C140T),(~1:C15
L2Po.nex.1	V23	Micromanipulation	16	5A:T156A~(~0:G137A~1:G301A,1:T219C))))

				(~1:LV1J1;ATTTGG~(~1:A349T:A322G~1:T150G:C187T,(
				~0:A170C~1:G137A,1:C152T,1:C233T:T219G:G70A),1:A
L2Q.nex.1	V23	Micromanipulation	16	185G:G239C:G238A:A194G,1:C140T:C348T))
				(~1:LV1J1;CTCTGG~(~1:C77T~(~1:C345T~(~0:C140T~2:
L2Ro.nex.1	V23	Micromanipulation	16	C225T,1:A339G))))
				(~1:LV1J1;CTCTGG~1:C276A:G260C:G232A:A220T:A21
L2Ro.nex.2	V23	Micromanipulation	16	3G:A90T:T60A)
L2Ro.nex.3	V23	Micromanipulation	16	(~1:LV1J1;CTCTGG~1:C345T)
NP1p.1	V23	Micromanipulation	16	(~1:LV1J1;CTCTGG~4:A349T)
				(~3:SF03_021+LV1J1;ATTTGG~(~1:G342C:G247A~1:G3
NP1p.2	V23	Micromanipulation	16	41A))
NP2p.1	V23	Micromanipulation	16	(~2:LV1J1;CTCTGG~4:G232A)
NP2p.2	V23	Micromanipulation	16	(~1:LV1J1;ATTTGG~1:T219C:C155T)
NP2p.3	V23	Micromanipulation	16	(~1:LV1J1;CTCTGG~1:A324T:C155T:C152T)
				(~1:LV1J1;ATTTGG~(~0:A349T~1:T354C,1:G347A:A324
NP7p.1	V23	Micromanipulation	16	T,1:G232A:A139G))
				(~5:REVB07+REVB08+REVB12+LV1J1;CATTGG~1:G31
M1A1o.nex.1	B1-8	Micromanipulation	10	2A:T212G)
				(~5:ASKH+REVC04+REVC08+LV1J1;CATTGG~2:G347T:
M1A2.nex.1	B1-8	Micromanipulation	10	G319C)
M1A2.nex.2	B1-8	Micromanipulation	10	(~1:LV1J1;CATTGG~1:G70A:G67A)
M1Bo.nex.1	B1-8	Micromanipulation	10	(~2:LV1J1;CATTGG~1:C335T)
M1Bo.nex.2	B1-8	Micromanipulation	10	(~1:LV1J1;CATTGG~1:A161G)
M1Bo.nex.3	B1-8	Micromanipulation	10	(~1:LV1J1;CATTGG~1:G66T)
M1Bo.nex.4	B1-8	Micromanipulation	10	(~1:LV1J1;CATTGG~1:A237T)
M1Bo.nex.5	B1-8	Micromanipulation	10	(~1:LV1J1;CATTGG~1:A183C:A164T:G158A)
M1Bo.nex.6	B1-8	Micromanipulation	10	(~1:LV1J1;CATTGG~1:A213G)
M2Co.nex.1	B1-8	Micromanipulation	10	(~1:LV1J1;CACTGG~1:T150C:C119T:A110G)
				(~6:REVF07+REVF09+REVF10+REVF11+LV1J1;CATTG
M2Co.nex.2	B1-8	Micromanipulation	10	G~1:A350C:C335T)
M2Co.nex.3	B1-8	Micromanipulation	10	(~1:LV1J1;CATTGG~1:A273G)
M2Do.nex.3	B1-8	Micromanipulation	10	(~2:LV1J1;CATTGG~1:T343A:T333C:T147G)
M2Do.nex.4	B1-8	Micromanipulation	10	(~1:LV1J1;CATTGG~1:C56T)
				(~5:REVG11+REVH01+REVH03+LV1J1;CATTGG~(~1:G
M3Eo.nex.1	B1-8	Micromanipulation	10	272C~1:A202T:C233T))
M3Eo.nex.2	B1-8	Micromanipulation	10	(~1:LV1J1;CATTGG~2:G318T)
				(~1:LV1J1;CATTGG~(~0:A227T~1:A292T,1:G316T:G301
M3Fo.nex.2	B1-8	Micromanipulation	10	A))
M3Fo.nex.3	B1-8	Micromanipulation	10	(~1:LV1J1;CATTGG~1:A275C:G232A:A157C)
M3Fo.nex.4	B1-8	Micromanipulation	10	(~1:LV1J1;CATTGG~1:G218T:A213T)
M7B1o.nex.1	B1-8	Micromanipulation	10	(~1:LV1J1;CACTGG~(~2:G137A~1:A324G:G347C))
				(~3:REVH12+LV1J1;CATTGG~(~1:G145A:A139C~1:G15
M7B1o.nex.2	B1-8	Micromanipulation	10	8A:T133C:T21C))
M7B1o.nex.3	B1-8	Micromanipulation	10	(~1:LV1J1;CATTGG~1:A369G:G137A)
M7B1o.nex.4	B1-8	Micromanipulation	10	(~1:LV1J1;CATTGG~(~1:G241A~1:A344C))
M7B2o.nex.1	B1-8	Micromanipulation	10	(~1:LV1J1;CACTGG~(~1:G312A:G174A~1:A349G))
M7B2o.nex.2	B1-8	Micromanipulation	10	(~1:LV1J1;CATTGG~3:T343A)
M7B2o.nex.3	B1-8	Micromanipulation	10	(~1:LV1J1;CATTGG~1:C233T)
M7B2o.nex.4	B1-8	Micromanipulation	10	(~1:LV1J1;CATTGG~1:T156A:C140T)

M7B2o.nex.5	B1-8	Micromanipulation	10 (~1:LV1J1;CATTGG~1:A223T:G67A:G66A)
M7B2o.nex.6	B1-8	Micromanipulation	10 (~1:LV1J1;CATTGG~1:G232C) (~1:LV1J1;CATTGG~1:C335T:G334A:A224C:G158C:G14
M7B2o.nex.7	B1-8	Micromanipulation	10 8A) (~2:LV1J1;CATTGG~(~2:A295T~2:A344T:A350G,1:A154
M4_d16Hprint.1	B1-8	Micromanipulation	16 G:C265A,1:G301A)) (~3:REVA04+LV1J1;CATTGG~(~0:A339G~1:G347A,1:C3 45T:C335T:G232C,(~0:A139G:A112T~2:A111T,1:A164T:
M4G_print.1	B1-8	Micromanipulation	16 G158A)))
M4G_print.2	B1-8	Micromanipulation	16 (~1:LV1J1;CATTGG~1:A164T:G158A)
M5I.nex.1	B1-8	Micromanipulation	16 (~1:LV1J1;CACTGG~1:G347T:T343C:C244T:G241A) (~2:LV1J1;CATTGG~(~0:G158A~1:A231C:A210G:A164T: G137A,1:G148A:G145T,1:C167T:A58G,1:G301A:G232C:
M5I.nex.2	B1-8	Micromanipulation	16 G215T:T199C:A183G:C162T:A157C:C155G))
M5I.nex.3	B1-8	Micromanipulation	16 (~1:LV1J1;CACTGG~1:G232C) (~3:REVC03+LV1J1;CATTGG~(~0:G145A~1:A186C,1:G2
M5Jo.nex.1	B1-8	Micromanipulation	16 32A:A224G:T209C))
M5Jo.nex.2	B1-8	Micromanipulation	16 (~1:LV1J1;CATTGG~1:G45C)
M5Jo.nex.3	B1-8	Micromanipulation	16 (~1:LV1J1;CATTGG~1:T209C:T74G)
M5Jo.nex.4	B1-8	Micromanipulation	16 (~1:LV1J1;CATTGG~1:A373G)
M6Ko.nex.1	B1-8	Micromanipulation	16 (~4:REVC12+REVD04+LV1J1;CATTGG~1:C103A)
M6Ko.nex.2	B1-8	Micromanipulation	16 (~1:LV1J1;CATTGG~(~1:C233T:C225T~1:C155G))
M6Ko.nex.3	B1-8	Micromanipulation	16 (~1:LV1J1;CATTGG~1:G232C:A164T:G158A)
M6Ko.nex.4	B1-8	Micromanipulation	16 (~1:LV1J1;CATTGG~1:G148A)

Listed are all the lineage trees identified among the sequences from all picks. The first columns are descriptive information on the origins of each tree. In order to represent all of the trees, we are using the following notation: (~node information~(daughters information)) and so on recursively. The first node is the "germline sequence node", which starts '~', followed by the number of sequences that are unmutated, then ':' and the names of the un-mutated sequences. If there are no unmutated sequences only the name of the specific V and J assumed to make the germline sequences is listed. Following the germline name there is a ';' and the the exact nucleotide sequence which was determined to be the junction at the base of the clone. Following this is: '~' and the number of sequences in a node, a ':' and then the original nucleotide that underwent mutation, position of mutation, and mutated nucleotide. If there are several mutations all shared by the same sequence they are separated by ':'. Sequences that have different mutations after a common ancestor are separated by ','.

Supplementary Table 2: Optimal Model Fits

	Parameter	Description	Optimal Values[1]		Constraints[3]
			Basic Model	In/Out-flow Model	
B1-8	p	Proliferation rate	0.04	0.11	$p \leq 0.12$
	s_{out}	Outflow of cells	--[2]	0.03	$s_{in} \geq 0$ or $s_{out} \geq 0$
	d_B	Non-dividing cell death rate	0.05	0.02	
	r	Re-entry rate	0.05	0.05	$r = (d_B+s_{out})*(p+d_A)/(p-d_A)$
V23	p	Proliferation rate	0.12	0.12	$p \leq 0.12$
	s_{in}	Outflow of cells	--[2]	0.06	$s_{in} \geq 0$ or $s_{out} \geq 0$
	d_B	Non-dividing cell death rate	0.11	0.06	
	r	Re-entry rate	0.11	0.11	$r = (d_B+s_{out})*(p+d_A)/(p-d_A)$
B1-8 and V23	L_r	Labeling rate	2.00	3.50	$L_r \geq 2.00$
	L_t	Labeling period (hours)	0.41	0.50	$L_t \leq 0.50$
	α	Apoptotic cell clearance rate	0.16	0.11	$0.08 \leq \alpha \leq 1.30$

[1] All rates are per hour, unless otherwise noted in description
[2] Basic model does not include in/out-flow ($s_{in} = 0$ and $s_{out} = 0$)
[3] The constraint on r was only used for models with $s_{in} = 0$