Supplementary information

Background data

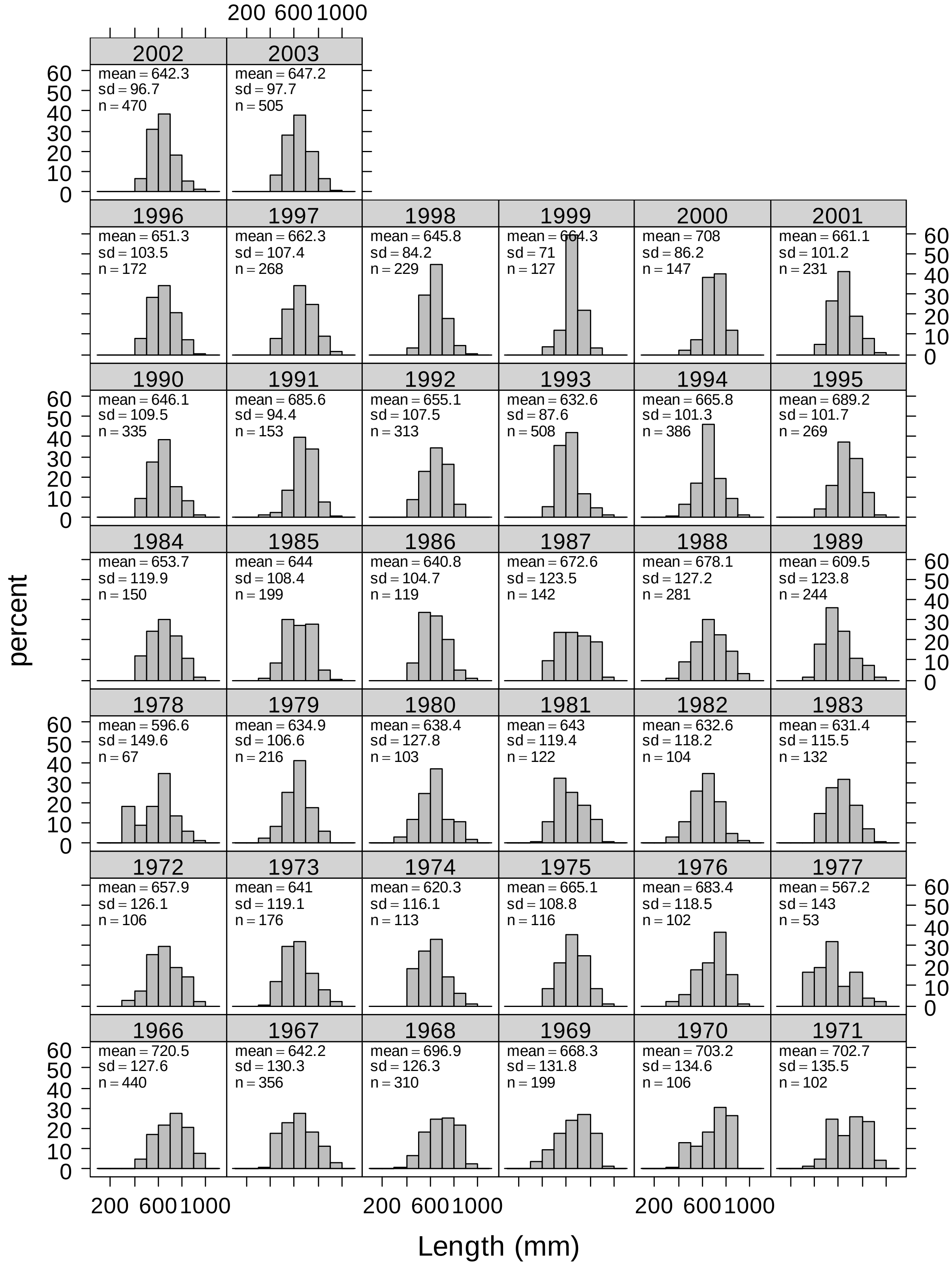

Fig. S1. Annual length distributions of mature fish caught in the Hunderfossen fish trap over the 1965 to 2003 period. There has been a significant (P<0.00001) decrease of 0.64 ±0.11 mm per year in mean spawning size over time. Furthermore, the variation coeffcient has decreased by more than 50% over the study period.

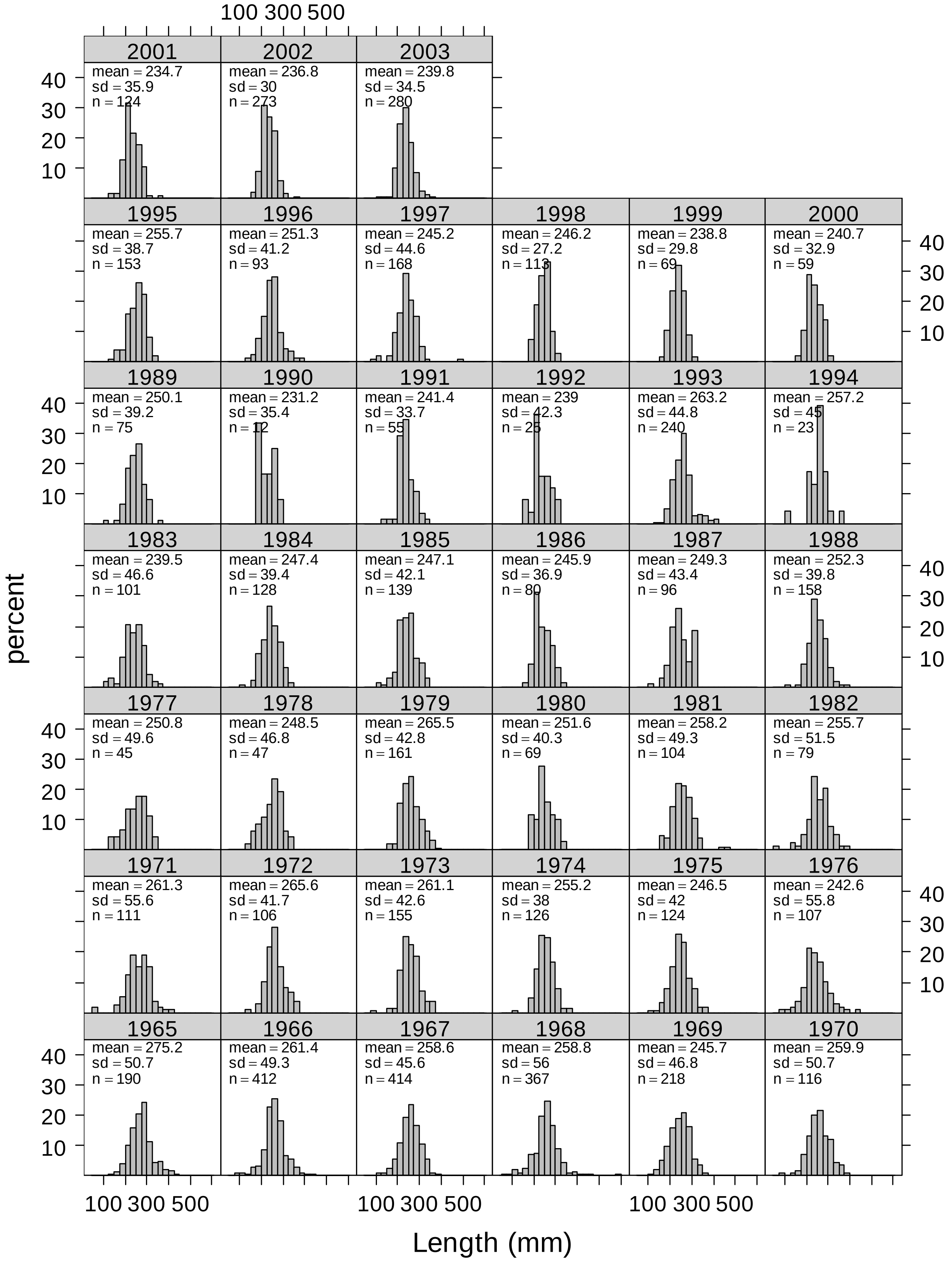

Fig S2. Annual back-calculated smolt length distributions for brown trout caught in the Hunderfossen fish trap over the 1965 to 2003 period. There has been a significant negative linear trend over the period with the smolt size decreasing by 0.52 ±0.05 mm per year (P<0.00001).

Supplementary Tables

Table S1. Parameter estimates for vital rates (dependent variables) as function of individual covariates. The maturation model has been fitted using GAMM (only fixed effects are provided), whereas the lower ones all have been derived from the most supported Burnham model (see model 1, Table S1). All covariates have been standardised to mean =0 and sd=1 ($mean_{length}$ = 658.5, $s.d._{length}$=115.4; $mean_{length}{}^2$ = 446967, $s.d._{length}{}^2$=154621), and all parameters are estimated on a logit-scale. χ^2 is the test statistics for estimated degrees of freedom (edf) which is estimated for the GAM smoothing functions (s()).

Dependent variable	Predictor variable	Estimate	S.E.	z or χ^2	P
Pr(maturing | survives to spawning)					
	Intercept	–0.8346	0.0205	-40.56	***
	s(age,length, by=dec)	2.014	-	4130.5	***
	s(temp, by=dec)	2.991	-	206.3	***
a=1 survival probability					
	intercept	1.4628	0.2768		
	length	2.2930	0.4753		
	$length^2$	–2.1472	0.5310		
	tot-P	-0.1804	0.1044		
	temperature	0.2243	0.1002		
a=2 lake fishing probability (odd year)					
	intercept	–0.3667	0.2212		
	length	–0.3308	0.0780		
a=2 lake fishing probability (even year)					
	intercept	–0.7481	0.2714		
	length	–0.2038	0.1257		
a=1 probability of using the fish ladder					
	intercept	-0.8211	0.1766		
	length	2.3112	0.7540		
	$length^2$	–2.6266	0.7223		
	temperature	0.3511	0.0628		
	discharge	0.4065	0.1322		
	length*discharge	0.6959	0.2223		

****P<0.00001
Dec = decennium

Table S2. Model ranks of Burnham models fitted combined live-dead encounter data from the Mjøsa-Hunderfossen brown trout system covering the 1966–2003 period. In total, 5346 wild trout individuals were included in the analysis. The table shows the ranking of a=1 (i.e., period at/or following the tagging occasion) models as the size-related processes were assumed to be most prominent over this period. The remaining model structure used was: $S_{a>1}$(la(dec),sp(dec) | c), $p_{a>1}$(la(dec),sp(dec) | c), $r_{a>1}$(la(dec),sp(dec) | c), *F*(la(.),sp(.). AICc = Akaike Information Criterion = deviance + 2*Np, where Np is number of estimated parameters. The model with the lowest AIC is the model that explains most of the deviance per parameter used. AIC-weight = exp(-0.5ΔQAICc$_i$)/Σexp(-0.5ΔQAICc$_i$), where ΔQAICc =QAICc$_i$–QAICc$_{min}$.

Model	AICc	AICc-weight	Np	deviance
Varying $S_{a=1}$; *p*(length+length^2+te + dis +dis*length | c), *r*(length+length^2+time | c)				
1. length+length^2+tot-P +te(L)+ sp(dec),la(dec) | c	8616.4	0.86	118	8380.4
2. length+length^2 +te(L)+ sp(dec),la(dec)| c	8620.0	0.14	116	8388
3. length+length^2+time | c	8643.2	0.00	162	8319.2
4. length	8655.7	0.00	103	8449.7
5. length+length^2+sp(dec),la(dec) | c	8658.3	0.00	114	8430.3
6. constant | c	8689.6	0.00	102	8485.6
Varying $r_{a=1}$; *S*(time | c), *p*(length+length^2+te + dis +dis*length | c)				
7. length+length^2+sp(dec),la(dec) | c	8696.6	0.91	166	8364.6
8. length | c	8701.5	0.08	156	8389.5
9. length+length^2 | c	8704.7	0.02	158	8388.7
10. time | c	8726.0	0.00	219	8288.0
11. constant | c	8742.4	0.00	156	8430.4
Varying $p_{a=1}$; *S*(time | c), *r*(time | c)				
12. length+length^2+te + dis +dis*length | c	8780.3	0.95	220	8340.3
13. length+length^2+te +te*length+ dis +dis*length | c	8786.0	0.05	223	8340.0
14. length+length^2+time | c	8807.2	0.00	262	8283.2
15. time | c	8832	0.00	252	8328
16. constant | c	8943.9	0.00	200	8336.3
All constant				
17. *S*(la(.),sp(.)),*p*(la(.),sp(.)),*r*(la(.),sp(.)),*F*(la(.),sp(.))	9461.6		8	9445.6

la = non-spawning years, i.e., when the fish are in the lake
sp = spawning years
dec = decennium
te = river temperature, te(L) = lake temperature
dis = water discharge
c = tagging cohort group, i.e., either odd or even year
a = tagging age, i.e., a=1 at the tagging occasion
(.) = constant