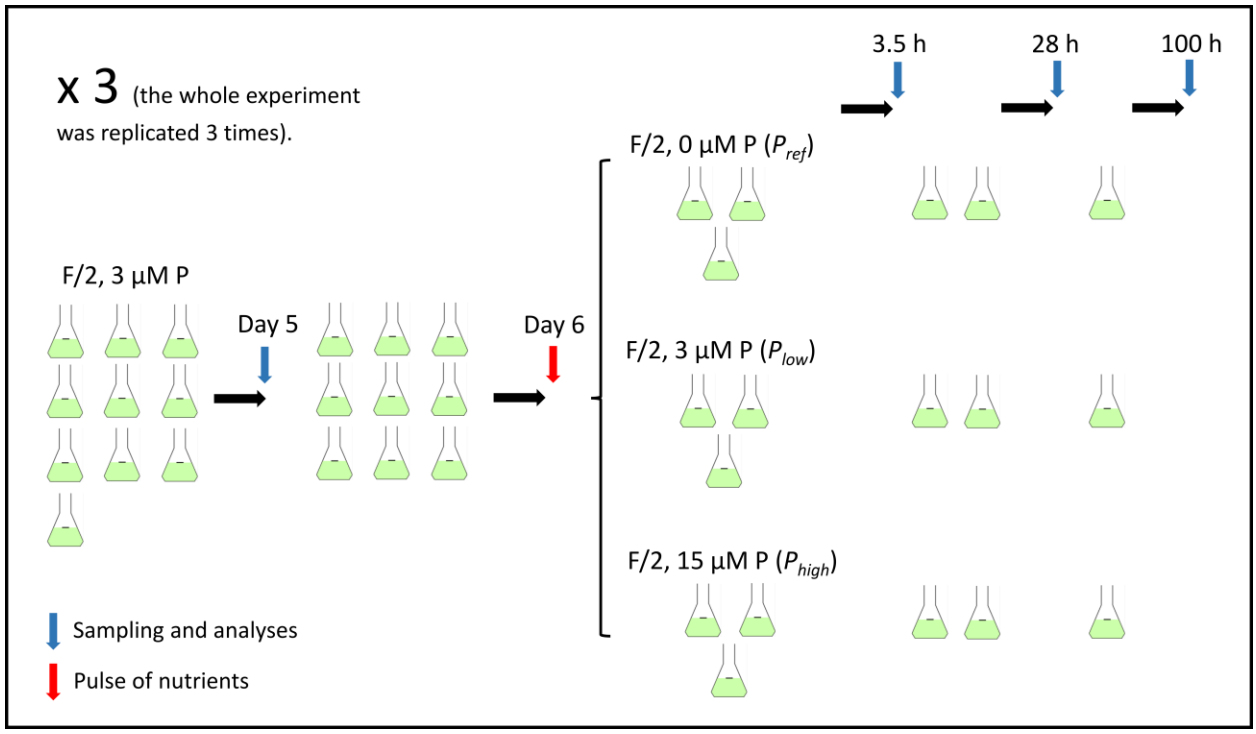

Fig. S1 Schematic figure representing the experimental design. Note that after P pulses the time is expressed in hours (h) after the P pulses. Maximum uptake rate and half saturation constant for phosphate uptake (both measured in bioassays), intracellular phosphorus content, and gene expression were measured at the times indicated by blue arrows

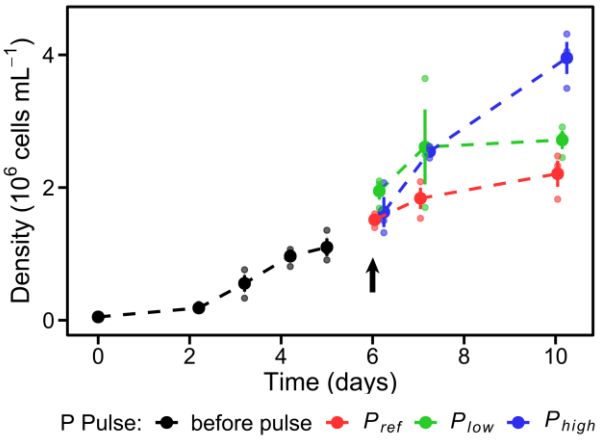

Fig. S2 Cell abundances along the experiments. Big dots indicate the mean from observations (small dots) obtained in the three experiments. Error bars indicate the standard error. The black arrow points out the time when nutrient pulses were added. The horizontal position of the dots is slightly adjusted to avoid overlapping.

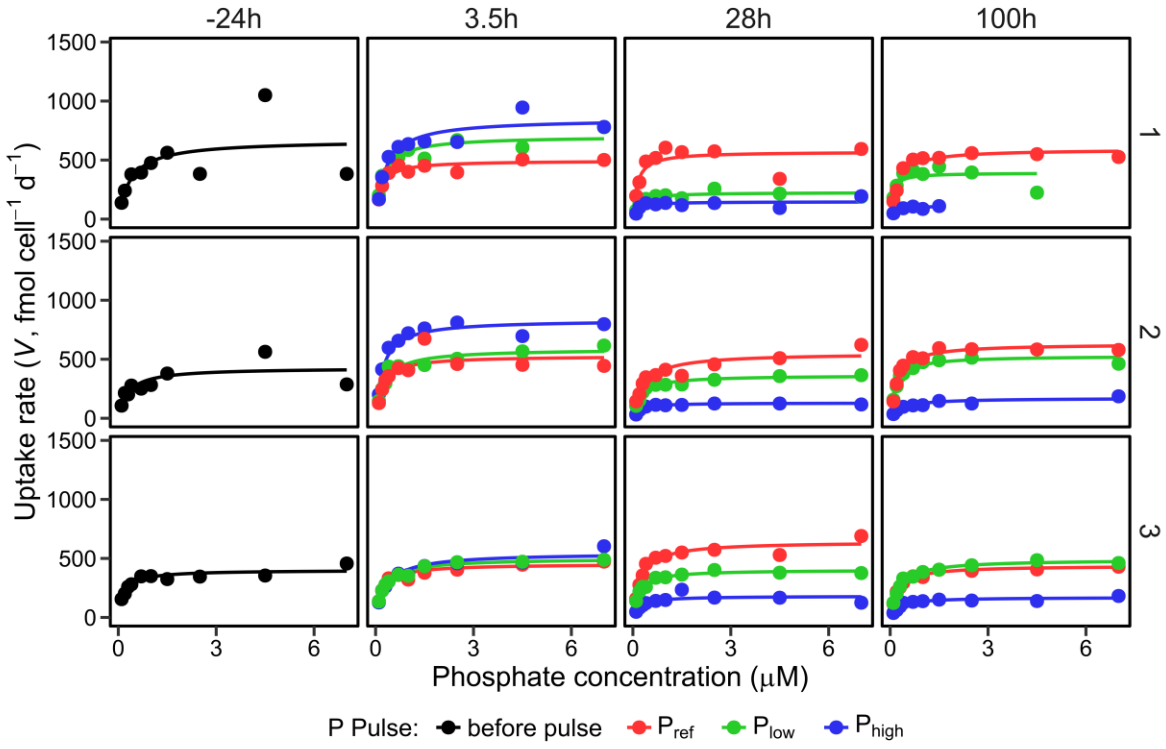

Fig. S3 Phosphate uptake rates and curves estimated from bioassays and the fitting of the Michaelis-Menten function. Numbers on the top of the panels indicate the time (hours) after the P pulse. Numbers on the right side of the panels point out the experiment replicate. Spurious negative uptake rates at 100 h in Experiment 1 were excluded from the analysis.

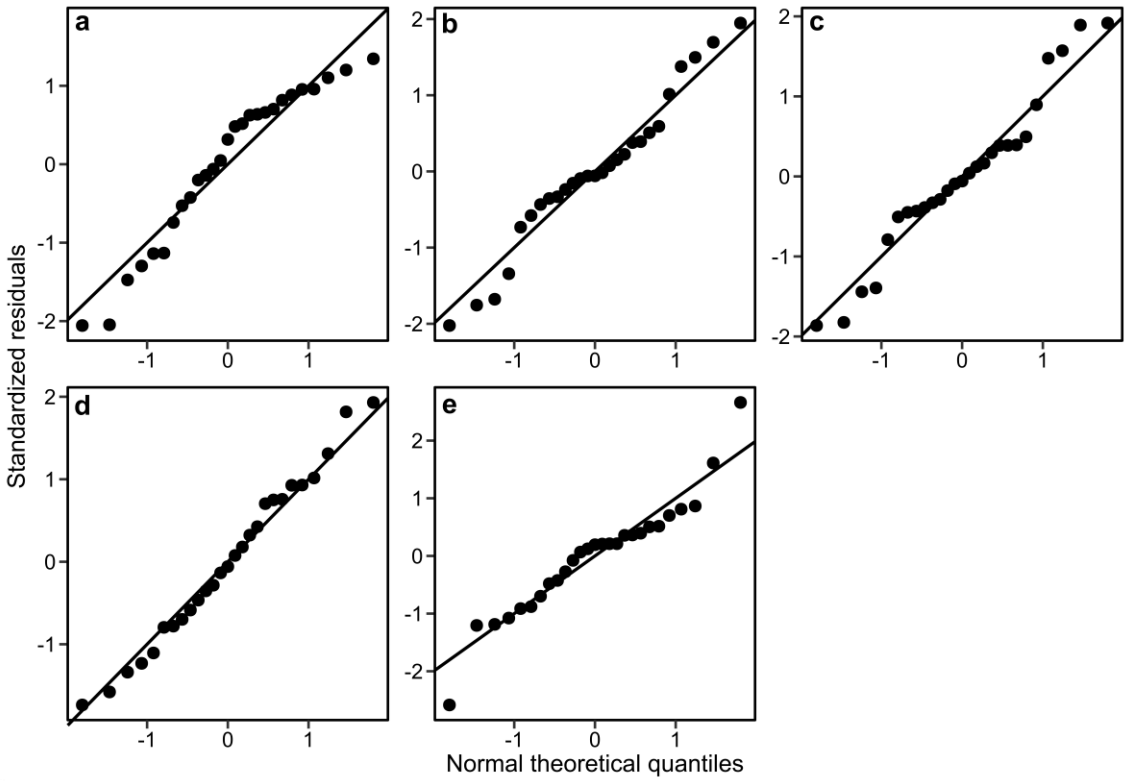

Fig. S4 Normal quantile-quantile plots of model residuals. (a) Maximum phosphate uptake rate (V_{max}), (b) effective half saturation constant for P uptake (K_{eff}), (c) V_{max}: K_{eff} ratio, (d) intracellular phosphorus, and (e) abundance.

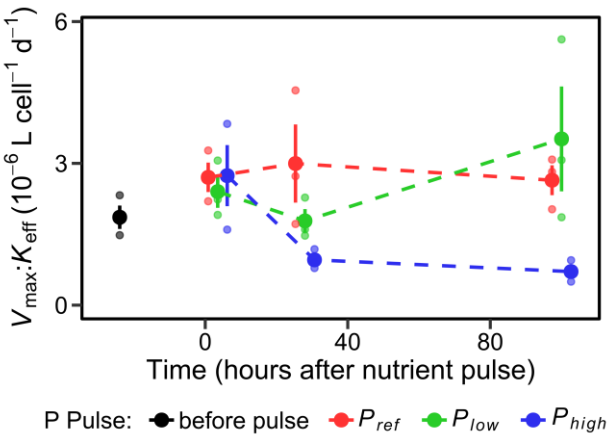

Fig. S5. Ratio between maximum phosphate uptake rate and effective half saturation constant (V_{max}: K_{eff}) obtained from empirical measurements. Big dots indicate the mean from observations (small dots) obtained in the three experiments. Error bars indicate the standard error. The horizontal position of the dots is slightly adjusted to avoid overlapping.

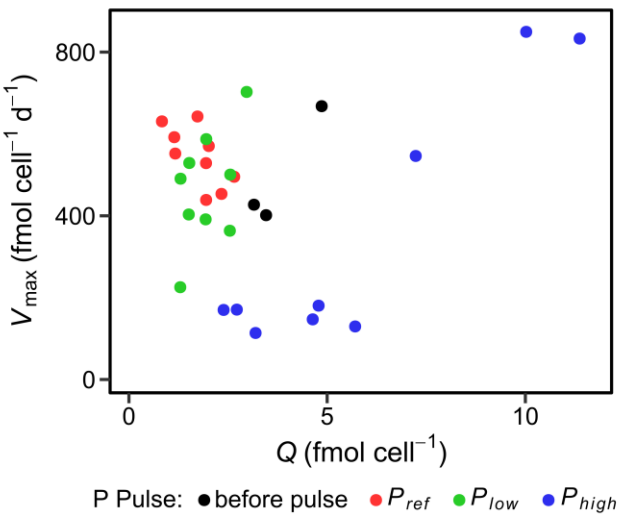

Fig. S6 Relationship between maximum phosphate uptake rate (V_{max}) and intracellular phosphorus (Q) from empirical measurements conducted for the different P pulse treatments.

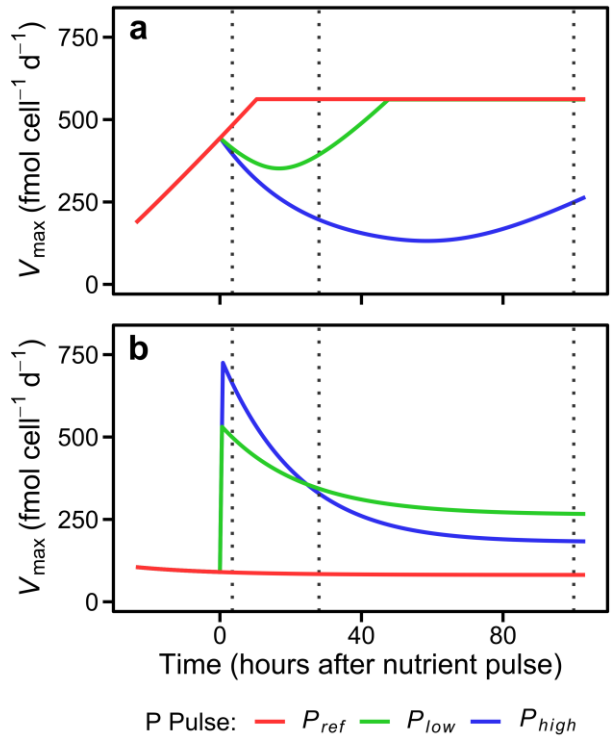

Fig. S7 Dynamics of maximum phosphate uptake rate (V_{max}) predicted by the model including just transporter$_1$ (a) or transporter$_2$ (b). Vertical dotted lines indicate the times when V_{max} was measured during the experiments.

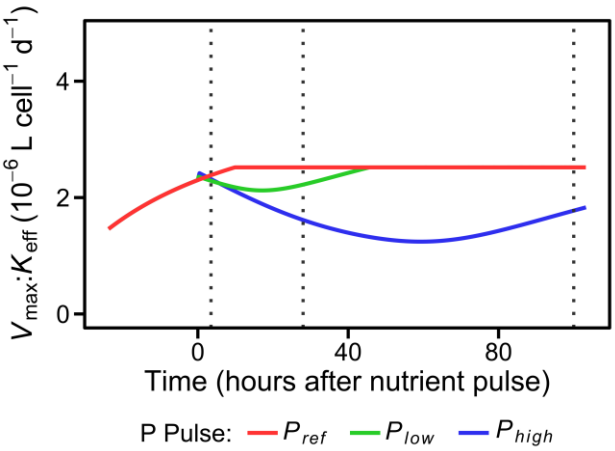

Fig. S8 Ratio between maximum phosphate uptake rate and effective half saturation constant (V_{max}: K_{eff}) predicted by our model for the three P pulse treatments.

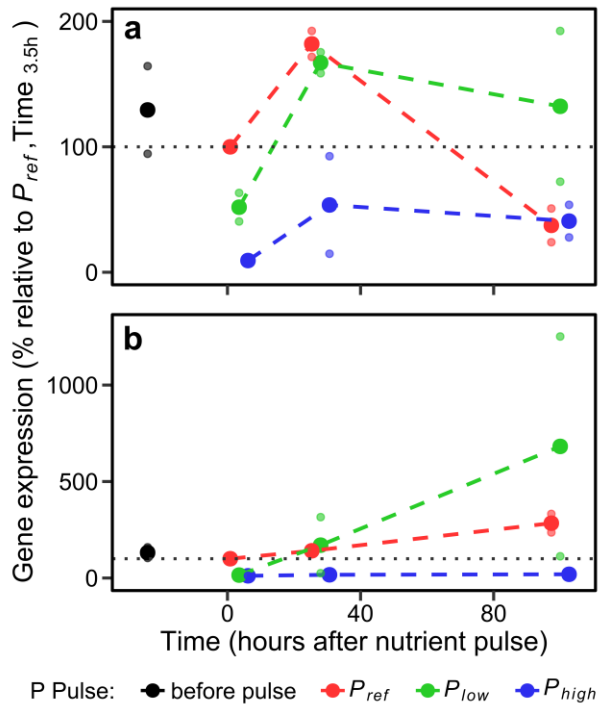

Fig. S9 Gene expression patterns in the different levels of P addition. (a) Alkaline phosphatase. (b) Carbamoyl phosphate synthetase. Big dots indicate the mean from observations (small dots) obtained in experiments 2 and 3. Grey dotted lines indicate the reference level (*i.e.* 100 %). The horizontal position of the dots is slightly adjusted to avoid overlapping.

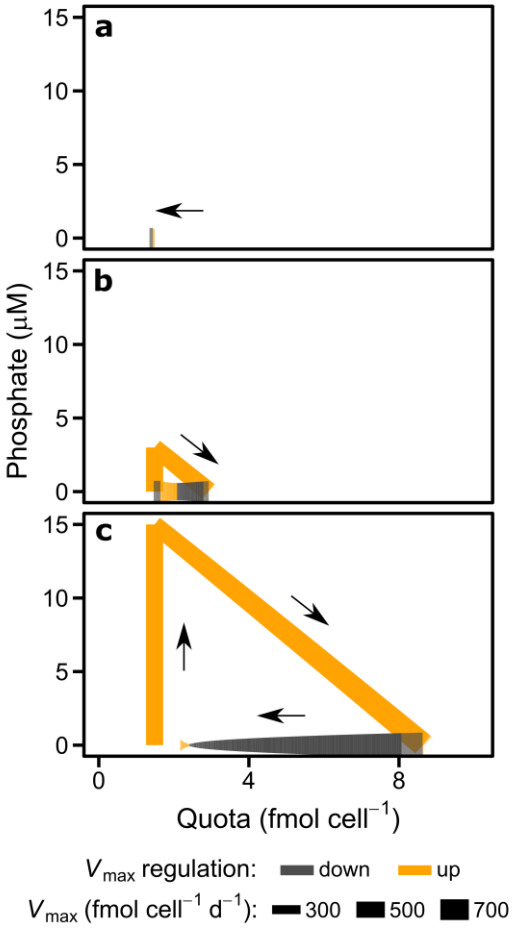

Fig. S10 Variation of maximum phosphorus uptake rate (V_{max}) along the phosphorus temporal gradient predicted by our model for P_{ref} (a) P_{low} (b) and P_{high} (c). The colours represent the sign of ($\frac{dV_{max}}{dt}$). Size scale indicates V_{max} values. Arrows indicate the direction of the temporal sequence.

Table S1. Symbols and values employed.

Symbol	Meaning	Units	Value/range
α	Density-dependent effect term	L^2 $cell^{-1}$	$5x10^{-21}$- $6x10^{-21}$
$A_{rel,i}$	Relative cell area occupied by transporters	-	-
c_H	Threshold for the maximum cell area occupied by transporters	-	0.50-0.54
$c_{F,a}$	Maximum quota proxy parameter	-	1.60
$c_{F,b}$	Shape parameter	-	2.5-7.5
D	Diffusivity constant for phosphorus in water	m^2 s^{-1}	$1.5x10^{-9}$
g_H	Threshold for the expression of transporter 2	-	10^{-1}- 10^{-10}
$k_{1,i}$	Encounter rate for transporter *i*	$(\mu mol/L)^{-1}$ x d^{-1}	-
$k_{cat,i}$	Catalytic rate of transporter *i*	d^{-1}	-
$K_{eff,i}$	Effective half saturation constant for transporter *i*	µM	-
K_1	Half saturation constant for transporter 1	µM	0.07-0.10
K_2	Half saturation constant for transporter 2	µM	0.4-0.5
n_i	Number of transporters of type *i*	transporters $cell^{-1}$	-
N	Cell concentration	cell L^{-1}	-
P_{ds}	Concentration of phosphorus in the digested solution	µM	-
P_{ds_blank}	Concentration of phosphorus in the digested solution for the blank	µM	-
Q	Phosphorus quota	fmol $cell^{-1}$	-
Q_{min}	Minimum cell quota	fmol $cell^{-1}$	1.31
R_a	Radioactivity added	µCi	0.20
R_b	Radioactivity (mean) in blank filters	µCi	-
R_f	Radioactivity in non-blank filters	µCi	-
r_{cell}	Cell radius	µm	2.50
$r_{s,i}$	Radius of transporter *i*	µm	0.0025
T	Incubation period	d	0.0139
μ	Growth rate	d^{-1}	-
μ_∞	Growth rate at infinite quota	d^{-1}	1.00
v_1	Maximum synthesis rate for transporter 1	sites $cell^{-1}$ d^{-1}	2600-3200
v_2	Maximum synthesis rate for transporter 2	sites $cell^{-1}$ d^{-1}	28000-36000
V	Phosphate uptake rate	fmol $cell^{-1}$ d^{-1}	-
V_{max}	Maximum phosphate uptake rate	fmol $cell^{-1}$ d^{-1}	-
$V_{max,i}$	Maximum phosphate uptake rate of *i*-type transporters	fmol $cell^{-1}$ d^{-1}	-
Vol_f	Volume of culture filtered	L	0.025
Vol_{flask}	Volume of the flask	L	0.10

Table S2. ANOVA results for the different variables analyzed. numDF: numerator degrees of freedom. denDF: denominator degrees of freedom. V_{max}: Maximum P uptake rate. K_{eff}: Effective half saturation constant for P uptake. V_{max}:K_{eff}: ratio between V_{max} and K_{eff}. *Q*: Intracellular phosphorus content. *N*: Phytoplankton abundance.

			V_{max}		K_{eff}		V_{max} : K_{eff}		*Q*		*N*	
Effect	numDF	denDF	F-value	p-value	F-value	p-value	F-value	p-value	F-value	p-value	F-value	p-value
P pulse	2	16	29.556	< 0.001	0.456	0.642	15.048	< 0.001	64.247	< 0.001	8.637	0.003
Time	2	16	29.906	< 0.001	2.091	0.156	3.918	0.041	25.191	< 0.001	20.303	< 0.001
P pulse x *Time*	4	16	20.696	< 0.001	2.005	0.142	5.848	0.004	4.078	0.018	2.718	0.067

Table S3. Pairwise comparisons for the different variables analyzed. V_{max}: Maximum P uptake rate. K_{eff}: Effective half saturation constant for P uptake. V_{max}:K_{eff}: ratio between V_{max} and K_{eff}. *Q*: Intracellular phosphorus content. *N*: Phytoplankton abundance.

			V_{max}		K_{eff}		V_{max} : K_{eff}		*Q*		*N*	
Time	P pulse	comparison	t-ratio	p-value	t-ratio	p-value	t-ratio	p-value	t-ratio	p-value	t-ratio	p-value
3.5h	-	P_{ref} - P_{low}	-1.281	0.320	-1.391	0.368	0.510	0.823	-0.345	0.755	-1.587	0.226
3.5h	-	P_{ref} - P_{high}	-2.809	0.025	-1.981	0.368	0.095	0.925	-8.237	< 0.001	-0.380	0.709
28h	-	P_{ref} - P_{low}	3.891	0.003	0.710	0.597	1.901	0.181	-0.318	0.755	-2.173	0.108
28h	-	P_{ref} - P_{high}	8.076	< 0.001	1.291	0.368	4.059	0.005	-5.875	< 0.001	-2.237	0.108
100h	-	P_{ref} - P_{low}	1.085	0.353	1.388	0.368	-0.948	0.536	-0.989	0.450	-1.474	0.240
100h	-	P_{ref} - P_{high}	7.661	< 0.001	-0.253	0.876	4.708	0.003	-3.658	0.006	-4.280	0.007
-	P_{ref}	3.5 - 28	-1.220	0.320	-0.694	0.597	-0.228	0.897	1.665	0.198	-1.192	0.301
-	P_{ref}	28 - 100	0.472	0.701	0.119	0.907	0.330	0.894	1.092	0.436	-1.220	0.301
-	P_{low}	3.5 - 28	3.952	0.003	1.407	0.368	1.163	0.524	1.691	0.198	-1.778	0.189
-	P_{low}	28 - 100	-2.333	0.057	0.797	0.597	-2.518	0.069	0.421	0.755	-0.520	0.665
-	P_{high}	3.5 - 28	9.665	< 0.001	2.578	0.243	3.736	0.007	4.027	0.004	-3.049	0.031
-	P_{high}	28 - 100	0.057	0.955	-1.426	0.368	0.979	0.536	3.309	0.011	-3.263	0.029