Supporting information

Figure S1. Schematic illustration of the mutagenesis and screening strategy used to isolate antenna mutants.

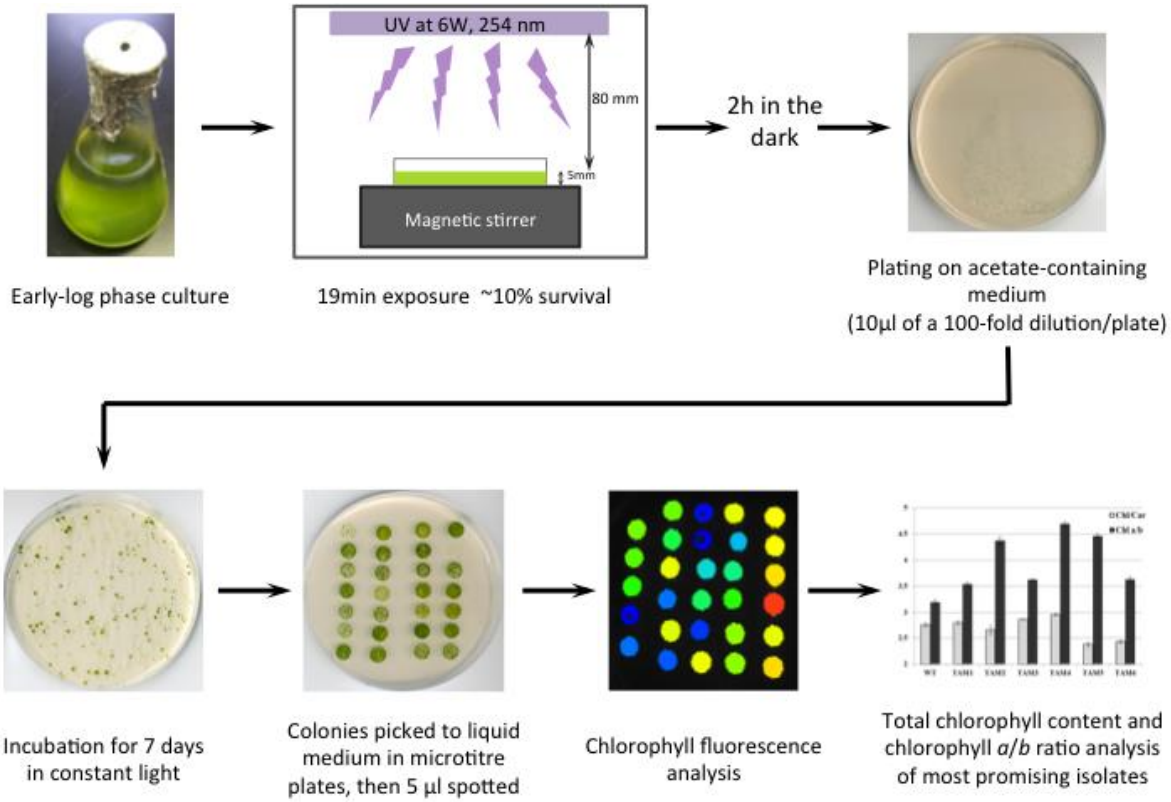

Figure S2. Functional antenna size of PSII and PSI measured in wild-type and TAM mutants (A) Variable Chl fluorescence was induced with a green light of 15 µmol photons m^{-2} s^{-1}, on dark-adapted cells (~$1.0 \cdot 10^7$ cells/ml) in BG-11 medium supplemented with 50 µM DCMU. The reciprocal of time corresponding to two-thirds of the fluorescence rise ($T_{2/3}$) was taken as a measure of the PSII functional antenna size. (B) The kinetics of P700 oxidation (ΔAbs at 705 nm) were measured on thylakoids suspension (75 µg Chl/ml) treated with 50 µM DBMIB and 1 mM methylviologen, upon illumination with a 10 s pulse of red actinic light (λ = 630 nm, 560 µmol photons m^{-2} s^{-1}). Data are expressed as mean ± SD, n = 7.

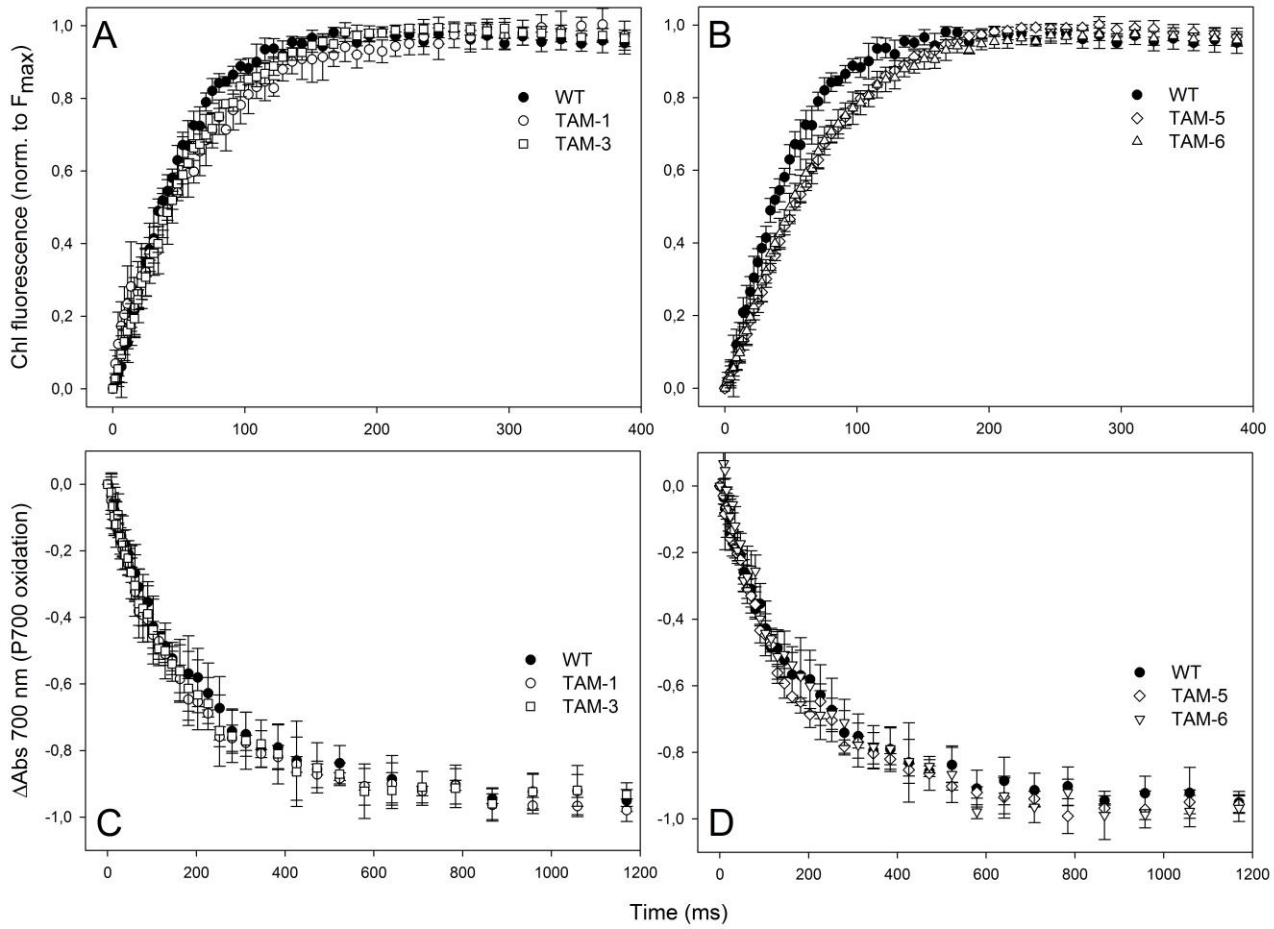

Figure S3. Light-saturation curves of photosynthesis. Curves were obtained with the *C. sorokiniana* wild-type and TAM mutants. Data are expressed as mean ± SD, n = 4.

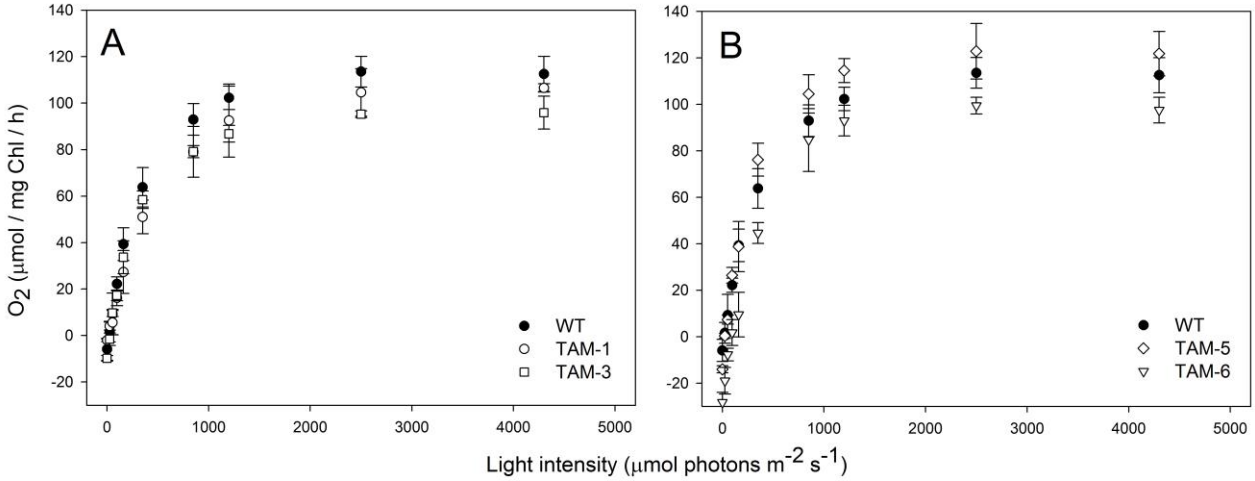

Figure S4. Kinetics of formation and relaxation of photoprotective energy dissipation in wild-type and TAM mutants. NPQ kinetics were measured on wild-type, TAM-2 and TAM-4 cells, grown photoautotrophically, upon illumination with 500 µmol photons m^{-2} s^{-1} of white actinic light. Symbols and error bars show means ± standard deviation (n = 3).

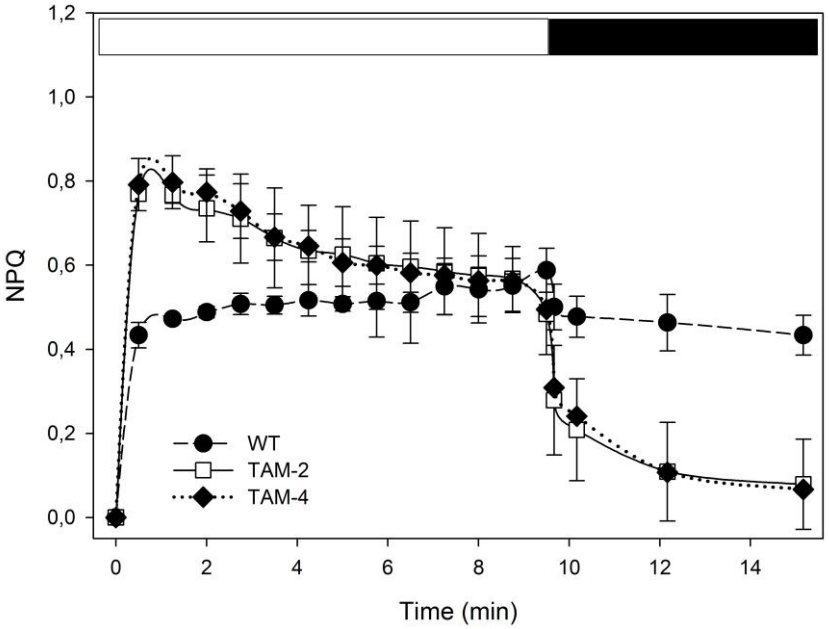

Figure S5

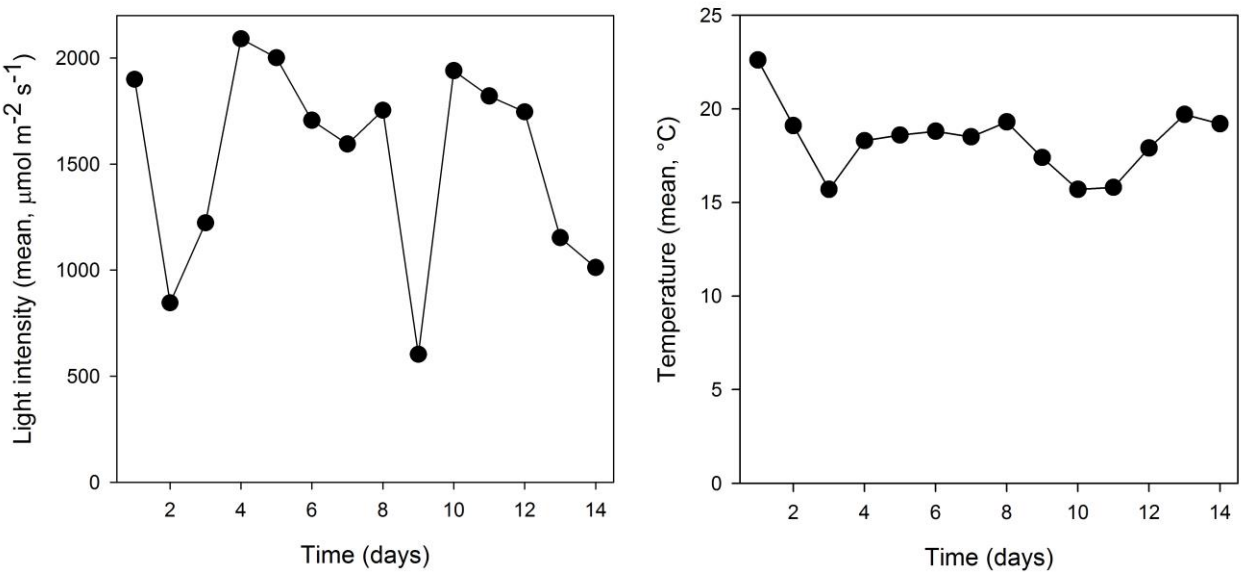

Figure S5. Daily mean irradiance on the reactors' surface (left panel) and mean atmospheric temperature (right panel) measured during the outdoor experiment.

Table S1. Pigment composition of wild-type and TAM mutants. Data are expressed as mean ± SD. Significantly different values (ANOVA, $P < 0.05$) with respect to the wild-type, within the same column, are marked with different letters.

genotype	Chl / cell (pg)	Chl *a* / *b*	Chl / Car	PSII antenna size ($T_{2/3}^{-1} \cdot 10^3$, ms^{-1})
WT	0.49 ± 0.07^{a}	2.62 ± 0.02^{a}	3.43 ± 0.02^{a}	18.2 ± 1.4^{a}
TAM-1	0.50 ± 0.09^{a}	2.92 ± 0.03^{b}	$3.16 \pm 0.02^{b,c}$	14.5 ± 1.6^{b}
TAM-2	0.30 ± 0.02^{b}	3.36 ± 0.02^{c}	3.07 ± 0.02^{b}	10.5 ± 0.5^{c}
TAM-3	0.58 ± 0.09^{a}	2.69 ± 0.12^{d}	3.47 ± 0.12^{a}	15.5 ± 0.5^{b}
TAM-4	0.34 ± 0.05^{b}	3.41 ± 0.03^{c}	$3.18 \pm 0.03^{b,c}$	9.4 ± 0.5^{c}
TAM-5	0.52 ± 0.08^{a}	2.84 ± 0.03^{b}	$3.30 \pm 0.04^{a,c}$	12.9 ± 0.5^{b}
TAM-6	0.51 ± 0.07^{a}	2.91 ± 0.02^{b}	3.35 ± 0.02^{a}	12.9 ± 0.8^{b}

Table S2. HPLC analysis of carotenoid composition of wild-type and TAM mutants. Cells were dark-adapted before pigment extraction in DMFA. Data are expressed as mean ± SD and normalized to 100 Chls. Significantly different values (ANOVA, $P < 0.05$) with respect to the wild-type, within the same column, are marked with different letters.

genotype	mol pigment / 100 mol Chls						
	neoxanthin	violaxanthin	antheraxanthin	lutein	zeaxanthin	α-carotene	β-carotene
WT	6.6 ± 0.2^{a}	1.5 ± 0.1^{a}	0.6 ± 0.1^{a}	17.3 ± 0.3^{a}	0.8 ± 0.1^{a}	0.5 ± 0.2^{a}	2.1 ± 0.2^{a}
TAM-1	6.2 ± 0.2^{a}	2.0 ± 0.1^{a}	0.5 ± 0.1^{a}	17.3 ± 0.1^{a}	1.1 ± 0.1^{a}	0.8 ± 0.2^{a}	2.1 ± 0.1^{a}
TAM-2	5.8 ± 0.2^{b}	5.9 ± 0.1^{b}	1.9 ± 0.1^{b}	10.3 ± 0.2^{b}	2.6 ± 0.2^{b}	0.2 ± 0.1^{a}	3.7 ± 0.3^{b}
TAM-3	6.5 ± 0.1^{a}	2.1 ± 0.1^{a}	1.2 ± 0.1^{c}	14.2 ± 0.3^{c}	2.2 ± 0.1^{b}	0.4 ± 0.2^{a}	2.3 ± 0.1^{a}
TAM-4	6.0 ± 0.1^{b}	6.9 ± 0.1^{c}	1.9 ± 0.1^{b}	9.6 ± 0.1^{d}	2.4 ± 0.2^{b}	0.2 ± 0.1^{a}	3.9 ± 0.2^{b}
TAM-5	6.7 ± 0.3^{a}	3.1 ± 0.1^{d}	2.8 ± 0.1^{d}	9.4 ± 0.2^{d}	3.7 ± 0.3^{c}	0.2 ± 0.1^{a}	2.8 ± 0.2^{c}
TAM-6	6.3 ± 0.2^{a}	3.6 ± 0.1^{d}	1.4 ± 0.1^{c}	13.2 ± 0.3^{c}	2.1 ± 0.1^{b}	0.4 ± 0.1^{a}	2.4 ± 0.2^{a}

Table S3. Relative abundance of pigment-protein complex in the wild-type and TAM mutants. Amount of pigment-protein complexes per cell were calculated by densitometric analysis of native PAGE and by Chls content per cell, and expressed as a percentage of the corresponding wild-type values. Data are expressed as means ± standard deviation (n = 3). Significantly different values (ANOVA, $P < 0.05$) with respect to the wild-type, within the same column, are marked with different letters.

Genotype	Relative abundance of pigment-protein complexes per cell		
	PSI-LHCI	PSII core	Lhcb
WT	100 ± 8^{a}	100 ± 9^{a}	100 ± 7^{a}
TAM-2	66 ± 4^{b}	102 ± 4^{a}	51 ± 3^{b}
TAM-4	66 ± 11^{b}	107 ± 6^{a}	62 ± 6^{b}