Supporting Information

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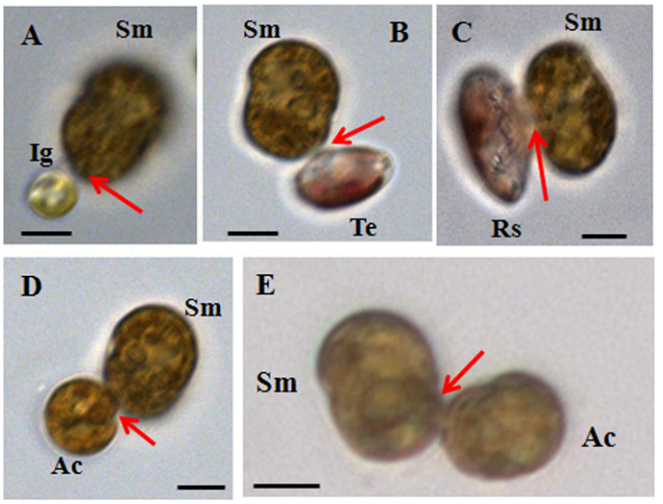

Fig. S1. Feeding of free-living *Symbiodinium* cells on diverse prey. Light microscopy images showing *Symbiodinium* cells (Sm) feeding on the haptophyte *Isochrysis galbana* (Ig; *A*), the cryptophyte *Teleaulax* sp. (Te; *B*), the cryptophyte *Rhodomonas salina* (Rs; *C*), and the dinoflagellate *Amphidinium carterae* (Ac; *D* and *E*) using a peduncle (arrows). (Scale bars: 5 μm.)

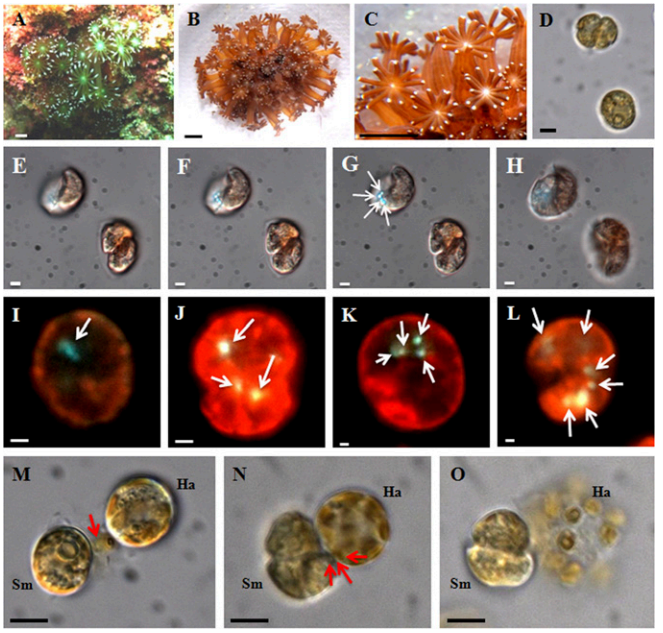

Fig. S2. Host coral and feeding of cultured *Symbiodinium* acquired from the tissues of the coral *Alveopora japonica* on diverse prey. (*A–C*) *A. japonica* with many polyps collected by a diver at a depth of ~6 m off Sindo, Jeju Island, Korea, in August 2011. Photos were taken with a digital camera. (*D*) Motile cells of cultured *Symbiodinium* originally isolated from the coral. (*E–H*) Scanning images obtained from the upper and lower surfaces by epifluorescence microscopy (EFM), showing a *Symbiodinium* cell containing four ingested bacterium-sized fluorescent beads (1 μm diameter; bright-blue inclusion, arrows). EFM was used to ensure that the beads were located inside the protoplasm of the *Symbiodinium* cell. (*I* and *J*) Between one and three ingested fluorescently labeled bacteria (bright-yellow or greenish inclusions, arrows) inside the protoplasm of *Symbiodinium* cells observed under EFM. (*K* and *L*) Ingested fluorescently labeled *Synechococcus* sp. (bright-yellow or greenish inclusions, arrows) inside the protoplasm of *Symbiodinium* cells observed under EFM. (*M–O*) Feeding by *Symbiodinium* cells (Sm) on an *Heterosigma akashiwo* cell (Ha). (*M*) A chloroplast of *H. akashiwo* (Ha) was sucked by a *Symbiodinium* cell (Sm) through a peduncle (arrow). (*N*) A *Symbiodinium* cell (Sm) sucking materials (arrows) from an *H. akashiwo* cell (Ha) through a peduncle. (*O*) Collapse and bursting of the prey cell. (Scale bars: 5 mm for *A–C*, 5 μm for *D* and *M–O*, 2 μm for *I* and *J*, and 1 μm for *E–H, K*, and *L*.)

Table S1. Taxa, sizes, and concentrations of prey species offered as food to free-living *Symbiodinium* sp. (clade E) and microbeads in experiment 1

Species	Equivalent spherical diameter, μm (± SD)	Initial prey concentration, cells mL^{-1}	Feeding by *Symbiodinium*
Bacteria			
Heterotrophic bacteria	0.9 (0.3)	7,000,000	Y
Synechococcus sp.	1.0 (0.2)	7,000,000	Y
Diatoms			
Skeletonema costatum	5.9 (1.1)	150,000	N
Prymnesiophyceae			
Isochrysis galbana	4.8 (0.2)	150,000	Y
Cryptophytes			
Teleaulex sp.	5.6 (1.5)	100,000	Y
Rhodomonas salina	8.8 (1.5)	50,000	Y
Rhaphidophytes			
Heterosigma akashiwo	11.5 (1.9)	30,000	Y
Mixotrophic dinoflagellates			
Heterocapsa rotundata (T)	5.8 (0.4)	100,000	Y
Amphidinium carterae (NT)	9.7 (1.6)	30,000	Y
Prorocentrum minimum (T)	12.1 (2.5)	15,000–20,000	N
Heterocapsa triquetra (T)	15.0 (4.3)	15,000–20,000	N
Scrippsiella trochoidea (T)	22.8 (2.7)	10,000–20,000	N
Cochlodinium polykrikoides (NT)	25.9 (2.9)	1,000–3,000	N
Prorocentrum micans (T)	26.6 (2.8)	1,000–3,000	N
Akashiwo sanguinea (NT)	30.8 (3.5)	1,000–3,000	N
Gonyaulax polygramma (T)	32.5 (5.4)	1,500–3,000	N
Alexandrium tamarense (T)	32.6 (2.7)	1,000–3,000	N
Lingulodinium polyedrum (T)	38.2 (3.6)	1,000–3,000	N
Microbeads			
0.5-μm bead	0.5	1,000,000	Y
1-μm bead	1	1,000,000	Y
2-μm bead	2	1,000,000	Y
3-μm bead	3	1,000,000	N
4-μm bead	4	1,000,000	N

To confirm that the predators did not ingest certain prey species, additional higher prey concentrations were provided. Y, *Symbiodinium* fed on a living food cell; N, *Symbiodinium* did not feed on a living food cell. The mean equivalent spherical diameters for algae and bacteria were measured with an electronic particle counter (Coulter Multisizer II) and under an epifluorescence microscope, respectively (n >2,000 for each algal species and n >30 for each bacterium). The abundance of the predator for each target prey was 2,000–5,000 cells mL^{-1}. T, thecate; NT, nonthecate.

Table S2. Duration of each stage of the feeding process of free-living *Symbiodinium* on *H. akashiwo* prey

Stage	*n*	Time, s, range	Time, s, mean ± SE
1	10	2.0–4.0	3.1 ± 0.2
2	10	540–1,140	812 ± 53
3	10	50–470	260 ± 31
4	5	185–520	315 ± 50

Stage 1: The *Symbiodinium* cell deployed a tow filament and attached a peduncle to a prey cell. Stage 2: The *Symbiodinium* cell fed on the prey cell with spinning. Stage 3: The *Symbiodinium* cell stopped spinning, continued to suck chloroplasts from prey cell, and caused the prey cell to burst. Stage 4: The *Symbiodinium* cell sucked more chloroplasts from the burst *H. akashiwo* cell.

Table S3. Nitrogen acquisition of free-living *Symbiodinium* from the algal prey *Synechococcus* sp. and *Heterosigma akashiwo*

Prey species	Nutrition condition	I_{max} , prey cells *Symbiodinium*$^{-1}$d^{-1}	NPA, pg N cell^{-1}	ANPD, pg N *Symbiodinium*$^{-1}$d^{-1}	NPP, pg N *Symbiodinium*$^{-1}$	% body N of *Symbiodinium*	Reference
Synechococcus sp.	Replete	**127**	0.05	6.4	21	30	This study
H. akashiwo	Replete	**1.2**	13	15.6	21	74	This study
H. akashiwo	F-N	**3.7**	13	48.1	21	229	This study
H. akashiwo	F-NP	**1.7**	13	22.1	21	105	This study

ANPD, acquired nitrogen by a predator cell per day; F-N, nitrate depletion; F-NP, both nitrate and phosphate depletion; I_{max}, maximum ingestion rate; NPA, nitrogen content per algal prey cell; NPP, nitrogen content per predator cell used in each experiment; % body N of *Symbiodinium*, percentage of daily acquired nitrogen to the predator's body nitrogen. NPA and NPP for *Synechococcus* sp. and *Symbiodinim* sp. were obtained from Bertilsson et al. (1) and Domotor and D'Elia (2). Bold: Measured value.

1. Bertilsson S, Berglund O, Karl DM, Chisholm SW (2003) Elemental composition of marine *Prochlorococcus* and *Synechococcus*. Implications for the ecological stoichiometry of the sea. *Limnol Oceanogr* 48:1721–1731.
2. Domotor SL, D'Elia CF (1984) Nutrient uptake kinetics and growth of zooxanthellae maintained in laboratory culture. *Mar Biol* 80:93–101.

Table S4. Nitrogen acquisition of *Symbiodinium* spp. from dissolved inorganic nitrogen and urea

Nitrogen type	NUC-1, 10^{-16} mol N *Symbiodinium*$^{-1}$min^{-1}	NUC-2, pmol N *Symbiodinium*$^{-1}$d^{-1}	ANPD, pg N *Symbiodinium*$^{-1}$d^{-1}	NPP, pg N *Symbiodinium*$^{-1}$	% body N of *Symbiodinium*	Reference
Ammonium	**11.99**	1.727	24.2	21	115	(1)
Ammonium		**0.507**	7.1	21	34	(2)
Nitrate	**2.33**	0.336	4.7	21	22	(1)
Nitrate	**0.55**	0.079	1.1	19	6	(3)
Nitrite	**2.88**	0.415	5.8	21	28	(1)
Urea		0.0024*	0.034	21	0.2	(4)

ANPD, acquired nitrogen by a predator cell per day; NPP, nitrogen content per predator cell used in each experiment; NUC, nitrogen uptake by a *Symbiodinium* cell in a time; % body N of *Symbiodinium*, percentage of daily acquired nitrogen to the predator's body nitrogen. Bold: Measured value.
*Calculated from a maximum nitrogen uptake rate of 0.1 nmol N cm^{-2}h^{-1} obtained from Grover et al. (4).

1. D'Elia CF, Domotor SL, Webb KL (1983) Nutrient uptake kinetics of freshly isolated zooxanthellae. *Mar Biol* 75:157–167.
2. McAuley PJ, Smith VJ (1995) Effect of diel photoperiod on nitrogen metabolism of cultured and symbiotic zooxanthellae. *Mar Biol* 123:145–152.
3. Domotor SL, D'Elia CF (1984) Nutrient uptake kinetics and growth of zooxanthellae maintained in laboratory culture. *Mar Biol* 80:93–101.
4. Grover R, Maguer J-F, Allemand D, Ferrier-Pages C (2006) Urea uptake by the sceractinian coral *Stylophora pistillata*. *J Exp Mar Biol Ecol* 332:216–225.

Table S5. Estimated removal of *Synechococcus* spp. (prey) by free-living *Symbiodinium* cells (predators) over 1 h at different prey and predator densities in the waters of Lizard Island, Australia

Synechococcus density, cells mL^{-1}	*Symbiodinium* density, cells mL^{-1}	IR	PIR	% (h)
5,000	47	0.067	3	0.1
5,000	444	0.067	30	0.6
5,000	810	0.067	54	1.1
5,000	1,357	0.067	91	1.8
5,000	2,266	0.067	152	3.0
118,000	47	1.231	58	0.05
118,000	444	1.231	547	0.5
118,000	810	1.231	997	0.8
118,000	1,357	1.231	1,670	1.4
118,000	2,266	1.231	2,789	2.4
200,000	47	1.797	84	0.04
200,000	444	1.797	798	0.4
200,000	810	1.797	1,456	0.7
200,000	1,357	1.797	2,439	1.2
200,000	2,266	1.797	4,072	2.0

IR, ingestion rate (prey eaten Symbiodinium^{-1}h^{-1}); PIR, population ingestion rate (prey eaten ml^{-1} h^{-1}); % (h), percentage of removed prey cells relative to the initial prey density over 1 h. Data on densities were obtained from Moriatry et al. (1) and Littman et al. (2).

1. Moriarty DJW, Pollard PC, Hunt WG (1985) Temporal and spatial variation in bacterial production in the water column over a coral reef. *Mar Biol* 85:285–292.
2. Littman RA, van Oppen MJH, Willis BL (2008) Methods for sampling free-living *Symbiodinium* (zooxanthellae) and their distribution and abundance at Lizard Island (Great Barrier Reef). *J Exp Mar Biol Ecol* 364:48–53.