Supplementary Material

**1 Location and layout of the experiment**

The *Portunus trituberculatus* polyculture experiment was conducted using the land-based experimental enclosures in a pond. The experimental pond used in this study, located in Ganyu County, Jiangsu Province, China (34°58′17.3″N, 119°11′53.7″E), had an area of 2 ha, with water column depth of 1.6–1.7 m at the study site. Four land-based enclosures, representing four replicates of the same size (length × width × depth = 5 × 5 × 2 m), were constructed in the pond, and were lined with polyethylene (water-proofing materials) and supported with wood poles. At the bottom of the enclosure, the walls were covered with mud from the same pond, and supported by posts at 2.5-m intervals. The cultured animals of swimming crab *P. trituberculatus*, white shrimp *Litopenaeus vannamei*, and short-necked clam *Ruditapes philippinarum* were cultured in the four enclosures in the pond. The location and layout of the experiment were showed in Fig. S1, Fig. S2, respectively.

**2 Input data of B, P/B, Q/B, unassimilated consumption rate, biomass accumulation, detritus import, and detritus fate**

**2.1 Phytoplankton and periphyton**

**(1) Biomass**

The biomass of phytoplankton and periphyton were measured every 15 days. The biomass of phytoplankton was divided into micro-phytoplankton, pico-phytoplankton and nano-phytoplankton. The mixed water (1L) of the phytoplankton samples were taken from surface layer, middle layer and bottom layer of the enclosure pond using a water sampler. The phytoplankton samples were first filtered through a 100 mesh sieve to remove mesozooplankton, then filtered through a 400 mesh sieve and a 1200 mesh sieve, respectively to separate the phytoplankton with different particle size. The 400 mesh sieve and the 1200 mesh sieve were rinsed with 1L no granular seawater to collect the phytoplankton with the particle size of 10~38um and smaller than 10 um, respectively. Both the filtered water and the rinsed water were fixed with 1% Lugol's solution (Nauwerck, 1963). The separated phytoplankton samples were enumerated using the methods of Lund et al. (1958). The volume of the different type of phytoplankton was calculated according to Hillebrand et al. (1999). The volume of phytoplankton was converted to the organic carbon of phytoplankton using following equations (Eppley et al. 1970):

(Diatoms) S1,

(Non-diatomaceous algae) S2,

Where C was the organic carbon content (pg) of phytoplankton. The V was the volume (um3) of phytoplankton. The biomass of phytoplankton was then converted from organic carbon to energy content. The conversion relationship was: 1g organic carbon = 46 kJ energy (Salonen et al. 1976)

The biomass of periphyton: At the beginning of the experiment, polyvinyl plastic rectangles (25 × 150 cm) were set in each enclosure to collect the periphyton. At each sampling time, the polyvinyl plastic (2 × 20 cm) which was situated 20cm under the water surface was cut and brought back to the lab. The attached algae on the polyvinyl plastic (2 × 20 cm) were scraped and smashed with the ultrasonic wave. Took the water sample of 50 cm3, filtered it through the membrane of 0.45 um and determined its chlorophyll value by Spectrophotometry (Jeffrey, 1975). The biomass of periphyton was converted from chlorophyll to organic carbon content according to the ratio of chlorophyll to organic carbon as 1:50 (Harris, 1986). The biomass of periphyton was then converted from organic carbon to energy content. The conversion relationship was: 1 g organic carbon = 46 kJ energy (Salonen et al. 1976).

**(2) P/B ratio**

The P/B ratios of phytoplankton groups and periphyton were estimated by using “light and dark bottle” oxygen method. The P/B ratios were measured every 15 days.

Primary production of phytoplankton was measured using the “light and dark bottle” oxygen method (Diana et al. 1991). Water samples from the upper (25 cm), middle (50 cm) and lower (150 cm) layers were collected on five occasions of the enclosure pond during the culture period. Two light and two dark bottles (250 mL) filled with water samples of each phytoplankton size (>38 um, 10~38 um, <10 um) were incubated at the water depth in each enclosure (Johnson et al. 1981). The dissolved oxygen was measured with Winkler titration method (Griffiths & Jackman, 1957). The net primary production of phytoplankton was calculated as:

PG = DOL - DOD

R = DOO - DOD

Pn = PG - R

Where PG is the gross primary production, R is the respiration, DOo is the amount of initial dissolved oxygen, DOL is the amount of dissolved oxygen in the light bottles, and DOD is the amount of dissolved oxygen in the dark bottles, Pn is net primary production. The units of Pn, [(mg O2) L-1], was converted to (mg C) L-1 according to Winberg (1 mg O2 = 0.375 mg C; Winberg, 1980).

Primary production of periphyton: At the beginning of the experiment, polyvinyl plastic rectangles (25 × 150 cm) were set in each enclosure to collect periphyton. Sections of these instruments (1 × 1 cm) which positioned 25, 50, and 150 cm below the water surface were scraped into two light and two dark bottles (250 mL) filled with the same column water (Zhang et al. 2011). Meanwhile, one light and one dark bottle (250 mL) without periphyton filled with the same column water was used as the control to adjust the data for the primary production of phytoplankton and the respiration of water. The net primary production of periphyton was calculated as:

PG1 = DOL1 - DOD1

R1 = DOO1 - DOD1

PG2 = PG1 - PG

R2 = R1 - R

Pn = PG2 - R2

Where PG1 is the gross primary production of phytoplankton and periphyton, R1 is the respiration of water and periphyton; PG is the gross primary production of phytoplankton, R is the respiration of water; PG2 is the gross primary production of periphyton, R2 is the respiration of periphyton; Pn is the net primary production of periphyton; DOO1 is the amount of initial dissolved oxygen, DOL1 is the amount of dissolved oxygen in the light bottles with periphyton, and DOD1 is the amount of dissolved oxygen in the dark bottles with periphyton. The units of Pn [(mg O2 L-1], were converted to (mg C) L-1 according to Winberg (1 mg O2 = 0.375 mg C; Winberg, 1980). The production of phytoplankton and periphyton was then converted from organic carbon to energy content. The conversion relation was: 1g organic carbon = 46 kJ energy (Salonen et al. 1976).

**2.2 Swimming crab *P. trituberculatus***

**(1) Biomass**

The biomass of *P. trituberculatus* were calculated as the average value of the biomass of each sample measurement in each culture period. The crabs were sampled at 10-day intervals, which were caught with a cage net in each enclosure. The full carapace width, carapace length, carapace width and body height of crabs were measured by a vernier caliper, the body weight of crabs was measured by a balance.

The total mortality of *P. trituberculatus* in the 90-days culturing period was calculated as 66.27% according to our field experiment. The natural mortality (M) of *P. trituberculatus* during the whole culture period was obtained using empirical formula from Gislason et al. (2008):

S5,

where *M* is an annual instantaneous rate (y-1), is the asymptotic total carapace width of *P. trituberculatus*, which is 16.44 cm (Gao et al. 2016). *L* (cm) is the total carapace width of *P. trituberculatus* for which the M estimate would apply, *K* (0.28) is the rate at which the rate of growth of *P. trituberculatus* in the total carapace width declines as the total carapace width approaches (y-1) (Lee et al. 2006), T is absolute temperature (⁰[kelvin](http://xueshu.baidu.com/s?wd=paperuri%3A%28b61b3ee3503af9619b51c369d13b423a%29&filter=sc_long_sign&sc_ks_para=q%3DThe%20saturation%20magnetic%20moment%20of%20iron%20osmium%20solid%20solutions%20between%2077%20%CC%8Akelvin%20and%20300%20%CC%8Akelvin&sc_us=3995758491356714614&tn=SE_baiduxueshu_c1gjeupa&ie=utf-8)).

The averaged total carapace width of *P. trituberculatus* in the early, middle, and late culture period was measured as 2.90 cm, 5.60 cm, and 10.40 cm, respectively. The mean water temperature of the cultured pond in the early, middle, and late culture period was measured as 303.16 K, 299.66 K, and 296.25 K, respectively. As a result, the natural mortality of *P. trituberculatus* in the early, middle, and late culture period was calculated as 40.10%, 13.10%, and 4.57%, respectively. The total calculated natural mortality was 57.78%. On account of that the stocking of *P. trituberculatus* may lead to a mortality of 8.00% in the polyculture ecosystem, and the actual total mortality of *P. trituberculatus* in this polyculture ecosystem was 66.27%. The natural mortality of *P. trituberculatus* in the early, middle, and late culture period was increased to 40.44%, 13.21%, and 4.61%, respectively (The mortalities were decreased according to the size of the estimated national mortality of the early, middle, and late culture period, respectively).

When the averaged individual wet weightand the total mortality of *P. trituberculatus* during each culture period were known, the biomass of the *P. trituberculatus* during each culture periodcan be calculated as: biomass = individual wet weight \* (1-total mortality).

The biomass of the crabs expressed in wet weight (g m-2) was then converted to energy (kJ m-2). The dry weight was measured as 21.05% of the wet weight of the crabs, the energy content of the dry weight of the crabs was measured as 16.63 kJ g-1.

The dry weight of *P. trituberculatus* was obtained by oven-drying specimens for 48 h at 60℃. The energy content of the dried samples was measured by an oxygen bomb calorimeter (PARR-1281, America).

**(2) P/B ratio**

The P/B ratio of *P. trituberculatus* was calculated as the averaged individual production to the averaged individual biomass of crabs expressed in energy (kJ m-2) during each culture period. The averaged individual production of the crabs was calculated as the difference between the averaged final individual biomass and the averaged initial individual biomass of the crabs during each culture period.

**(3) Q/B ratio**

The Q/B ratio of *P. trituberculatus* was obtained from Yang et al. (2010).

**(4)** **Unassimilated consumption rate**

The unassimilated consumption rate of *P. trituberculatus* (0.2)was obtained from Winberg (1960).

**(5) Biomass accumulation**

The biomass accumulation of *P. trituberculatus* during each culture period was calculated according to the following relation:

Biomass accumulation = biomass \* P/B ratio \* (1- total mortality).

**2.3 White shrimp** ***L. vannamei***

**(1) Biomass**

The biomass of *L. vannamei* were calculated as the averaged value of the biomass of each sample measurement in each culture period. The shrimps were sampled at 10-day intervals, which were caught with a cage net in each enclosure. The total length of shrimps was measured by a vernier caliper. the body weight of shrimps was measured by a balance.

The total mortality of *L. vannamei* in the 90-days culturing period was calculated as 36.43% according to our field experiment. According to Ye et al. (1994), we assumed that the mortality of the shrimps associated with stocking was 10%. The natural mortality (M) of *L. vannamei* during the whole culturing period was obtained using empirical formula from (Gislason et al. 2008):

S5,

where *M* is an annual instantaneous rate (y-1), is the asymptotic total length of *L. vannamei*, which is 12.88 cm (Aragón-Noriega & Alberto, 2016). *L* (cm) is the total length of *L. vannamei* for which the M estimate would apply, *K* (0.21) is the rate at which the rate of growth of *L. vannamei* in length declines as length approaches (y-1) (Li et al. 2015), T is absolute temperature (⁰Kelvin).

The averaged total length of *L. vannamei* in the early, middle, and late culture period was measured as 2.21 cm, 5.41 cm, and 7.83 cm, respectively. The mean water temperature of the cultured pond in the first, second and third month of the 90-days culturing period was measured as 303.16 K, 299.66 K, and 296.25 K, respectively. As a result, the natural mortality of *L. vannamei* in the early, middle, and late culture period was estimated as 31.58%, 7.12%, and 3.89%, respectively. The total natural mortality was calculated as 42.59%. On account of that the stocking of *L. vannamei* may lead to a mortality of 10.00% in the polyculture ecosystem, and the actual total mortality of *L. vannamei* in this polyculture ecosystem was 49.51%. The natural mortality of *L. vannamei* in the early, middle, and late culture period was decreased to 29.30%, 6.61%, and 3.61%, respectively (The mortalities were increased according to the size of the estimated national mortality of the early, middle, and late culture period, respectively).

When the averaged individual wet weightand the total mortality of *L. vannamei* during each culture period were known, the biomass of the *L. vannamei* during each culture periodcan be calculated as: biomass = individual wet weight \* (1-total mortality).

The biomass of the shrimps expressed in wet weight (g m-2) was converted to energy (kJ m-2). The dry weight was measured as 22.08% of the wet weight of the shrimps, the energy content of the dry weight of the shrimps was measured as 19.81 kJ g-1.

The dry weight of *L. vannamei* was obtained by oven-drying specimens for 48 h at 60℃. The energy content of the dried samples was measured by an oxygen bomb calorimeter (PARR-1281, America).

**(2) P/B ratio**

The P/Bratio of *L. vannamei* was calculated as the averaged individual production to the averaged individual biomass of shrimps expressed in energy (kJ m-2) during each culture period. The averaged individual production of the shrimps was calculated as the difference between the averaged final individual biomass and the averaged initial individual biomass of the shrimps during each culture period.

**(3) Q/B ratio**

The Q/Bratios of *L. vannamei* was obtained from Qi et al. (2010).

**(4) Unassimilated consumption rate**

The unassimilated consumption rate of *L. vannamei* (0.2) was obtained from Winberg (1960).

**(5) Biomass accumulation**

The biomass accumulation of *L. vannamei* during each culture period was calculated according to the following relation:

Biomass accumulation = biomass \* P/B ratio \* (1- total mortality).

**2.4 Short-necked clam*****R. philippinarum***

**(1) Biomass**

The biomass of *R. philippinarum* were calculated as the averaged value of the biomass of each sample measurement in each culture period. The biomass was measured every 10 days. The Shell length, shell width, and shell height of clams were measured by a vernier caliper. the body weight of clams was measured by a balance. The mortalities of clams during each culture period were measured directly by checking the number of dead shells. The biomass of clams during each culture period was calculated as: biomass = individual wet weight \* (1-total mortality).

The biomass of the clams expressed in wet weight (g m-2) were converted to energy. The conversion equation of the *R. philippinarum* was:

Biomass (kJ m-2) = Biomass (g m-2) × meat weight to total clam weight (%) × dry matter content of meat (%) × energy content of the dry matter of the meat (kJ g-1). Where the ratio of meat weight to total clam weight (%) was measured as 28.37%, the dry matter content of the meat (%) was 20.48%, the energy content of the dry matter of the meat was 20.53 kJ g-1.

The dry weight of the *R. philippinarum* was obtained by oven-drying specimens for 48 h at 60℃. The energy content of the dried samples was measured by an oxygen bomb calorimeter (PARR-1281, America).

**(2) P/B ratio**

The P/Bratio of *R. philippinarum* was calculated as the averaged individual production to the averaged individual biomass of clams expressed in energy (kJ m-2) during each culture period. The averaged individual production of the clams was calculated as the difference between the averaged final individual biomass and the averaged initial individual biomass of the clams during each culture period.

**(3) Q/B ratio**

The Q/B ratios of *R. philippinarum* was obtained from Zhang & Yan (2010).

**(4) Unassimilated consumption rate**

The unassimilated consumption rate of *R. philippinarum* (0.2)was obtained from Winberg (1960).

**(5) Biomass accumulation**

The biomass accumulation of *R. philippinarum* during each culture period was calculated according to the following relation:

Biomass accumulation = biomass \* P/B ratio \* (1- total mortality).

**2.5 Macrobenthos and microbenthos**

**(1) Biomass**

The biomass of macrobenthos and microbenthos were measured every 15 days.

The biomass of macrobenthos and microbenthos were measured by collecting the sediment of the pond enclosure with a sediment sampler. The collected sediment samples were filtered through a 0.5 mm mesh screen. The benthos with the size larger than 0.5 mm was collected as macrobenthos. The sampling of macrobenthos was conducted following the specification for oceanographic survey of China (State oceanic administration People's Republic of China, 2007). The energy content of the biomass of macrobenthos was measured by an oxygen bomb calorimeter (PARR-1281, America). The benthos with the size smaller than 0.5 mm was collected as microbenthos. The sampling of microbenthos was conducted following Liu et al. (2014). The biomass of the microbenthos expressed in organic carbon was measured by Vario ELIII Elemental Analyzer (Elementar, Dortmund, Germany). The biomass of the microbenthos expressed in organic carbon was converted to energy content. The conversion relationship was: 1g organic carbon = 46 kJ energy (Salonen et al. 1976).

**(2) P/B ratio**

The P/B ratio of macrobenthos was obtained from Zhou & Xie (1995), the P/B ratio of microbenthos was obtained from Schwinghamer et al. (1986).

**(3) Q/B ratio**

The Q/B ratios macrobenthos, and microbenthos were both adopted from Lin (2012).

**(4) Unassimilated consumption rate**

The unassimilated consumption rate of macrobenthos(0.4) and microbenthos(0.3)were obtained from Bradford-Grieve et al. (2003)

**2.6 Macrozooplankton and microzooplankton**

**(1) Biomass**

The biomass of macrozooplankton and microzooplankton were measured every 15 days.

The biomass of macrozooplankton and microzooplankton were obtained from the field experiment. A total of 30 L of the surface layer, middle layer and bottom layer water samples were filtered through a 150 μm plankton net to collect the macrozooplankton. The water samples of macrozoopalnkton were condensed to 30 ml, preserved with 5% buffered formalin and examined in the laboratory (Nauwerck, 1963). The macrozooplankton samples were enumerated and length measured with a stereo dissecting microscope. The wet weight of cladocera and copepods were calculated according to the body length-body weight regression equation from Zhang & Huang (1991). The volume of planktonic mollusks was calculated according to its geometric shape, and the volumes were converted to wet weight assuming that 1 mm3 of the volume was equivalent to 1 mg of wet weight biomass (Zhang et al. 2014). The microzooplankton was collected by taking the mixed water 1 L of the surface layer, middle layer and bottom layer water samples of the enclosure pond. The water samples were filtered through a 100 mesh sieve. The filtrates were fixed with 5% buffered formalin (Nauwerck, 1963). The biomass of the microzooplankton was measured under 100×microscope. The volume of protozoa and rotifers were calculated according to their geometric shape, the volumes were converted to wet weight assuming that 1 mm3 of volume was equivalent to 1 mg of wet weight biomass (Zhang et al. 2014).

Biomass of macrozooplankton and microzooplankton expressed in wet weight was converted to energy content using the following relationships: the dry weight of the macrozooplankton and microzooplankton were about 20% of their wet weight, and the carbon content were about 40% of their dry weight (Omori, 1969). Meanwhile, it was assumed that 33% of the dry weight of the macrozoopalnkton and microzooplankton were lost due to [fixation](http://xueshu.baidu.com/s?wd=paperuri%3A%286722110aaef23ef719018f8e709e32ee%29&filter=sc_long_sign&sc_ks_para=q%3DAntigen%20preservation%20in%20microwave-irradiated%20tissues%3A%20a%20comparison%20with%20formaldehyde%20fixation.&sc_us=3696272693586728525&tn=SE_baiduxueshu_c1gjeupa&ie=utf-8) (Giguere, 1989). The organic carbon of the macozooplankton and microzooplankton were then converted to energy content as 1 g organic carbon = 46 kJ energy (Salonen et al. 1976).

**(2) P/B ratio, Q/B ratio**

The P/B and Q/B ratios of macrozooplankton and microzooplankton were calculated according to the P/Q ratios from Straile (1997) and the measurement of zooplankton respiration. The respiration of mcrozooplankton and microzooplankton was measured following Williams (1983). When the P/Q ratio, respiration, and unassimilated consumption (Winberg, 1960) were known, the value of P and Q of macrozooplankton and microzooplankton, can be calculated according to the equation: Q/B = P/B + R/B + U/B, respectively.

**(3) Unassimilated consumption rate**

The unassimilated consumption rate of macrozooplankton(0.4) and microzooplankton(0.4)were obtained from Winberg (1960).

**2.7 Bacterioplankton and benthic bacteria**

**(1) Biomass**

The biomass of bacterioplankton and benthic bacteria were measured every 15 days.

The biomass of bacterioplankton and benthic bacteria was analyzed using acridine orange direct count method (AODC). The volume of bacteria was calculated with the measured length of the long and short axes of the bacteria by fluorescence microscopy software Image Pro-Plus 5.1. The relationship between bacterial volume and biomass of organic carbon was: B (C) =5.6 × 10-13 g of C um-3 (Bratbak, 1985). The relation of organic carbon and energy of the biomass of bacterioplankton and benthic bacteria were: 1 g organic carbon = 46 kJ energy (Salonen et al. 1976).

**(2) P/B ratio**

The P/B value of baterioplankton was obtained from the field experiment by following the method of Schwaerter et al. (1988).

The P/B value of benthic bacteriawas calculated according to P/Q ratios of benthic bacteria from Moriarty (1986) and the measurement of benthic bacteria respiration. According to Hagrave (1972), the respiration of benthic bacteria accounted for 0.64 of the sediment respiration. The respiration of sediment was determined by a sediment respirator which was made of Plexiglas with a diameter of 7.0 cm. The structure of the sediment respirator was described in detail by Zheng et al. (2011). Surface sediment (0–5 cm) was collected by the sediment respirator, and then brought to the laboratory within an hour. In the laboratory, the sediment was put aside for 2 h to recover equilibrium. Overlying water in each respirator was carefully replaced by the bottom water using rubber pipes. Incubations were conducted in water baths for 4 h in darkness at in-situ temperature. Initial and final water samples were taken from respirators and measured for dissolved oxygen with Winkler titration method. Respirators filled with water (without sediment) were used as the control to adjust the data for the respiration of the overlying water. Sediment oxygen demand [SOD, (mg O2)/ (m2·d)] was calculated as:

Where DOO (mg O2 L-1) is the initial dissolved oxygen. DOt (mg O2 L-1) is the final dissolved oxygen. V (liters) is the volume of the overlying water. A (m2) is the area of the respirator cross-section and t (d) is the duration of the sediment respiration experiment. The unit of SOD, [(mg O2)/ (m2·d)], was converted to (mg C)/ (m2·d) according to Winberg (1 mg O2 = 0.375 mg C; Winberg, 1980), and then converted to kJ/ (m2·d) according to Salonen (1g organic carbon = 46 kJ energy; Salonen et al. 1976). When the P/Q ratio, respiration, unassimilated consumption (Winberg, 1960) of benthic bacteria were known, the P value can be calculated according to equation: Q/B = P/B + R/B + U/B.

**(3) Q/B ratio**

The Q/B ratios of bacterioplankton, benthic bacteria were calculated according to their P/B values and the measurement of their respiration. The respiration of bacterioplankton was measured according to Schwaerter et al. (1988). When the P/B value, respiration and unassimilated consumption of bacterioplankton and benthic bacteria were known, the Q/B values of bacterioplankton and benthic bacteria can be calculated according to equation: Q/B = P/B + R/B + U/B, respectively.

**(4) Unassimilated consumption rate**

The unassimilated consumption rate of bacterioplankton and benthic bacteriawere obtained from Winberg (1960).

**2.8 Detritus groups (detritus in the water, detritus in the sediment, *Aloidis laevis* and shrimp feed)**

**(1) Biomass**

The biomass of detritus: the biomass of detritus in the water was obtained by determining the total organic carbon of the mixed water samples taken from the surface layer, middle layer and bottom layer of the enclosure pond using a water sampler. The total organic carbon of the mixed water samples was measured by TOC automatic analyser (Multi N/C 2100S, Analytik Jena AG, Germany). The organic carbon of detritus in water was converted to energy content according to Salonen et al. (1976) (1g organic carbon = 46 kJ energy.

The surface layer of 5 cm of the benthic sediment was sampled by a bottom sampler. After drying and grinding the sediment samples, the energy content of the sediment samples was measured by an oxygen bomb calorimeter (PARR-1281, America).

**(2) Detritus import**

The detritus import of artificial feeds of shrimp feed and blue clam *A. laevis* were recorded every day. After drying and grinding the energy content of the samples of shrimp feed and *A. laevis*，the energy content of shrimp feed and *A. laevis* were measured by an oxygen bomb calorimeter (PARR-1281, America).

**(3) Detritus fate**

The production, which was not used by the ecosystem (energy of flow to detritus), from the groups of *P. trituberculatus*, *R. philippinarum*, macrobenthos, microbenthos, benthic bacteria, *A. laevis*, and shrimp feed flowed into the detritus group of detritus in sediment; the energy of flow to detritus from the groups of macrozooplankton, microzooplankton, bacterioplankton, micro-phytoplankton, nano-phytoplankton, pico-phytoplankton, and periphyton flowed into the detritus group of detritus in water. Moreover, it was set that half of the energy of flow to detritus from the group of *L. vannamei* flowed into the detritus groups of detritus in sediment and detritus in water, respectively. The energy of detritus in water, which was not used by recycling, ultimately flowed to detritus in the sediment. This assumption was set because our field observations showed almost no biomass accumulation for detritus in water at the end of the experiment in these four ecosystems.

**3 Diet composition**

The detailed information of the diet of each consumer during each culture period was showed in tables S1, S2, and S3.

**Table S1** Diet matrix of a *Portunus trituberculatus* polyculture ecosystem during the early period

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Number | Prey | Predator | | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Pot | Liv | Rup | Mab | Mib | Maz | Miz | Beb | Bap |
| 1 | Pot |  |  |  |  |  |  |  |  |  |
| 2 | Liv |  |  |  |  |  |  |  |  |  |
| 3 | Rup |  |  |  |  |  |  |  |  |  |
| 4 | Mab | 0.001 |  |  |  |  |  |  |  |  |
| 5 | Mib |  |  |  | 0.090 |  |  |  |  |  |
| 6 | Maz | 0.040 | 0.041 |  |  |  |  |  |  |  |
| 7 | Miz |  |  |  |  |  | 0.075 |  |  |  |
| 8 | Beb |  |  |  | 0.050 | 0.65 |  |  |  |  |
| 9 | Bap |  |  | 0.014 |  |  | 0.190 | 0.014 |  |  |
| 10 | Mip |  | 0.037 | 0.121 |  |  | 0.060 | 0.224 |  |  |
| 11 | Nap |  | 0.030 | 0.232 |  |  | 0.176 | 0.283 |  |  |
| 12 | Pip |  | 0.030 | 0.323 |  |  | 0.168 | 0.309 |  |  |
| 13 | Pep |  |  |  |  |  | 0.020 |  |  |  |
| 14 | All | 0.959 | 0.307 |  | 0.106 | 0.10 | 0.102 |  |  |  |
| 15 | Shf |  | 0.495 | 0.080 |  |  | 0.059 | 0.030 |  |  |
| 16 | Des |  | 0.010 | 0.060 | 0.754 | 0.25 | 0.050 | 0.060 | 0.95 | 0.05 |
| 17 | Dew |  | 0.050 | 0.170 |  |  | 0.100 | 0.080 | 0.05 | 0.95 |

Note: the diet composition of the predator is expressed as the fraction that each prey contributes to its overall consumption, and the diet composition of each predator was summed to 1(blanks = zero). Pot: *P. trituberculatus*; Liv: *Litopenaeus vannamei*; Rup: *Ruditapes philippinarum*; Mab: macrobenthos; Mib: microbenthos; Maz: macrozooplankton; Miz: microzooplankton; Beb: benthic bacteria; Bap: bacterioplankton; Mip: micro-phytoplankton; Nap: nano-phytoplankton; Pip: pico-phytoplankton; Pep: periphyton; All: *Aloidis laevis*; Shf: shrimp feeds; Des: detritus in sediment; Dew: detritus in water.

**Table S2** Diet matrix of a *Portunus trituberculatus* polyculture ecosystem during the middle period

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Number | Prey | Predator | | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Pot | Liv | Rup | Mab | Mib | Maz | Miz | Beb | Bap |
| 1 | Pot |  |  |  |  |  |  |  |  |  |
| 2 | Liv |  |  |  |  |  |  |  |  |  |
| 3 | Rup |  |  |  |  |  |  |  |  |  |
| 4 | Mab | 0.001 |  |  |  |  |  |  |  |  |
| 5 | Mib |  |  |  | 0.090 |  |  |  |  |  |
| 6 | Maz | 0.040 | 0.020 |  |  |  |  |  |  |  |
| 7 | Miz |  |  |  |  |  | 0.065 |  |  |  |
| 8 | Beb |  |  |  | 0.050 | 0.65 |  |  |  |  |
| 9 | Bap |  |  | 0.025 |  |  | 0.199 | 0.017 |  |  |
| 10 | Mip |  | 0.017 | 0.181 |  |  | 0.08 | 0.224 |  |  |
| 11 | Nap |  | 0.013 | 0.194 |  |  | 0.096 | 0.330 |  |  |
| 12 | Pip |  | 0.010 | 0.140 |  |  | 0.078 | 0.239 |  |  |
| 13 | Pep |  |  |  |  |  | 0.020 |  |  |  |
| 14 | All | 0.959 | 0.345 |  | 0.104 | 0.10 | 0.252 |  |  |  |
| 15 | Shf |  | 0.525 | 0.080 |  |  | 0.060 | 0.050 |  |  |
| 16 | Des |  | 0.020 | 0.120 | 0.756 | 0.25 | 0.050 | 0.060 | 0.95 | 0.05 |
| 17 | Dew |  | 0.050 | 0.260 |  |  | 0.100 | 0.080 | 0.05 | 0.95 |

Note: the diet composition of the predator is expressed as the fraction that each prey contributes to its overall consumption, and the diet composition of each predator was summed to 1(blanks = zero). Group abbreviations as in Table S1.

**Table S3** Diet matrix of a *Portunus trituberculatus* polyculture ecosystem during the late period

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Number | Prey | Predator | | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Pot | Liv | Rup | Mab | Mib | Maz | Miz | Beb | Bap |
| 1 | Pot |  |  |  |  |  |  |  |  |  |
| 2 | Liv |  |  |  |  |  |  |  |  |  |
| 3 | Rup |  |  |  |  |  |  |  |  |  |
| 4 | Mab | 0.0005 |  |  |  |  |  |  |  |  |
| 5 | Mib |  |  |  | 0.090 |  |  |  |  |  |
| 6 | Maz | 0.0405 | 0.018 |  |  |  |  |  |  |  |
| 7 | Miz |  |  |  |  |  | 0.075 |  |  |  |
| 8 | Beb |  |  |  | 0.050 | 0.65 |  |  |  |  |
| 9 | Bap |  |  | 0.027 |  |  | 0.169 | 0.010 |  |  |
| 10 | Mip |  | 0.016 | 0.101 |  |  | 0.100 | 0.204 |  |  |
| 11 | Nap |  | 0.010 | 0.242 |  |  | 0.116 | 0.217 |  |  |
| 12 | Pip |  | 0.032 | 0.450 |  |  | 0.088 | 0.359 |  |  |
| 13 | Pep |  |  |  |  |  | 0.020 |  |  |  |
| 14 | All | 0.9590 | 0.329 |  | 0.104 | 0.10 | 0.252 |  |  |  |
| 15 | Shf |  | 0.525 | 0.080 |  |  | 0.050 | 0.070 |  |  |
| 16 | Des |  | 0.020 | 0.060 | 0.756 | 0.25 | 0.080 | 0.060 | 0.95 | 0.05 |
| 17 | Dew |  | 0.050 | 0.040 |  |  | 0.050 | 0.080 | 0.05 | 0.95 |

Note: the diet composition of the predator is expressed as the fraction that each prey contributes to its overall consumption, and the diet composition of each predator was summed to 1(blanks = zero). Group abbreviations as in Table S1.

**4 Energy flow among different functional groups**

Energy flow among different functional groups of polyculture ecosystem during different culture periods was showed in Fig. S3.

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**Figure Legends**

**Fig. S1.** Location of the experiment.

**Fig. S2.** Layout of the experiment. Picture A shows the layout of the enclosures in pond, picture B shows the schematic diagram of the experimental enclosure (1: pond; 2: land-based enclosure; 3: charging pump; 4: PVC tube; 5: Wood pole; 6: thick bamboo pole; 7: plastic-coated polyethylene woven cloth; 8: zipper; 9: gas tube; 10: air stone; 11: thin bamboo pole).

**Fig. S3.** Energy flow among different functional groups of polyculture ecosystem during different culture periods. The thickness and color of the lines illustrate the magnitude of the flow rates. The number on the left of the picture represents trophic level. The color key (dimensionless) represents the proportion that the prey contributed to a predator’s diet. Group abbreviations as in Table S1.