Field Deployment

Structural Integrity and Buoyancy

All structures deployed at Mandalay Refuge have remained intact, with no loss of structural integrity. After all structures were deployed in early June, we found a few (<1%) PVC structures that lost buoyancy because one of the PVC buoyancy tubes was not water tight. This was most likely caused by incomplete gluing of the PVC caps or hairline fractures in the PVC from transport. Each of these structures was repaired by adding an additional PVC tube to the structure. These repairs restored buoyancy of the affected structures to the same level as the buoyancy of structures that did not require repair. These repairs are considered quality control repairs as part of the construction period. None of the monitored structures required repairs in June. In October 2006, two of the monitored unfenced PVC structures, developed leakage in one of their buoyancy tubes. However, even with the leaking buoyancy tubes, the majority of the two structures remained floating at the surface. These structures were repaired by attaching a new PVC buoyancy tube to the failing tube to fully restore their buoyancy. These repairs were performed to give all structures a complete first growing season with full buoyancy. No structural failure was observed during the first growing season and all structures remained in buoyancy class 1 (majority of the structure floating on the water surface).

Nutrient Availability

Ammonium in the surface water in July ranged from 0.31 to 2.88 mg/l, with the highest average ammonium concentrations occurring at sites 1 and 4 and the lowest at site 3 (Table 6). Ammonium concentrations in the surface water declined as the growing season progressed. Nitrate-nitrite in the surface water in July ranged from 0.16 to 5.80 mg/l, with the highest average nitrate-nitrate concentrations occurring at site 1 and lowest at site 4 (Table 6). Nitrate-nitrite concentrations also declined as the growing season progressed. Phosphate in the surface water in July ranged from 0.10 to 0.86 mg/l, with the highest average phosphate concentrations occurring at site 1 and lowest at site 4 (Table 6). Like the other nutrients, phosphate concentrations declined as the growing season progressed. September nutrient concentrations were very similar for the average fall surface water concentrations in the Penchant basin (Sasser et al. 2005). The nutrient concentrations in July were sufficient for *P. hemitomon* growth and no fertilization of the structures was necessary.

Vegetation Cover

Initial structure performance was evaluated on July 11, 2006 approximately 1 month after the final structure was deployed. Initial cover was highly interrelated with time since deployment (Figure 25). PVC structures at sites 1 and 2 had the highest cover, followed by PVC structures at sites 3 and 4, followed by bamboo structures at sites 1 and 2, with the lowest cover on bamboo structures at sites 3 and 4. On average the structures planted with pots had higher cover than the structures planted with stems.
Illustration 18. Pictures on left represent condition after all structures were deployed (May 30, 2006). Picture on right represents condition on September 11, 2006. Note that structures are mostly invisible in September at sites 1 and 2 due to the rapid growth of \textit{P. hemitomon}.
Table 6. Average nutrient concentrations (mg/l ± 1 standard error) recorded at the 4 sites.

<table>
<thead>
<tr>
<th>Month</th>
<th>Site</th>
<th>Ammonium</th>
<th>Nitrate-Nitrite</th>
<th>Phosphate</th>
</tr>
</thead>
<tbody>
<tr>
<td>July</td>
<td>1</td>
<td>1.54 ± 0.44</td>
<td>4.34 ± 1.39</td>
<td>0.77 ± 0.10</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>1.06 ± 0.04</td>
<td>1.19 ± 0.10</td>
<td>0.71 ± 0.06</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>0.39 ± 0.08</td>
<td>0.68 ± 0.25</td>
<td>0.41 ± 0.04</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>1.54 ± 0.67</td>
<td>0.32 ± 0.12</td>
<td>0.34 ± 0.12</td>
</tr>
<tr>
<td></td>
<td>All</td>
<td>1.13 ± 0.22</td>
<td>1.63 ± 0.57</td>
<td>0.56 ± 0.07</td>
</tr>
<tr>
<td>September</td>
<td>1</td>
<td>0.31 ± 0.05</td>
<td>0.23 ± 0.09</td>
<td>1.07 ± 0.01</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>0.67 ± 0.22</td>
<td>0.21 ± 0.08</td>
<td>0.95 ± 0.15</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>0.41 ± 0.08</td>
<td>0.23 ± 0.05</td>
<td>0.62 ± 0.14</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>1.54 ± 1.10</td>
<td>0.43 ± 0.09</td>
<td>0.71 ± 0.22</td>
</tr>
<tr>
<td></td>
<td>All</td>
<td>0.73 ± 0.28</td>
<td>0.27 ± 0.04</td>
<td>0.84 ± 0.08</td>
</tr>
<tr>
<td>October</td>
<td>1</td>
<td>0.24 ± 0.23</td>
<td>0.21 ± 0.11</td>
<td>0.60 ± 0.30</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>0.02 ± 0.00</td>
<td>0.08 ± 0.02</td>
<td>0.80 ± 0.27</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>0.29 ± 0.08</td>
<td>0.32 ± 0.04</td>
<td>0.51 ± 0.02</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>0.08 ± 0.01</td>
<td>0.14 ± 0.00</td>
<td>0.32 ± 0.11</td>
</tr>
<tr>
<td></td>
<td>All</td>
<td>0.17 ± 0.07</td>
<td>0.20 ± 0.04</td>
<td>0.54 ± 0.10</td>
</tr>
</tbody>
</table>

At the end of the first growing season (October 2006), the differences in cover due to the length of time since deployment had decreased (Figure 25). For the structures planted with pots, no significant difference in *P. hemitomon* cover among sites was observed in October. However for the PVC structures planted with stems, *P. hemitomon* cover increased with site age (age site 1 > age site 2 > age site 4 > age site 3). The bamboo structures, which had the smallest time since deployment, with less age difference among sites, showed no difference in *P. hemitomon* cover among sites.

Overall, no significant difference in *P. hemitomon* cover was observed among treatments at the end of the first growing season (Figure 26). All treatments had average *P. hemitomon* cover exceeding 60%. We observed no signs of grazing on the unfenced structures.

Total cover (all emergent marsh species) averaged 90% across all treatments (Figure 27), with *P. hemitomon* being the dominant. Other species that colonized the structures in the first growing season (in order of frequency of occurrence) were: *Ludwigia* sp., *Limnobium spongia, Scirpus cubensis, Cyperus odoratus, Sacciolepis striata, Althernanthera philoxeroides, Bidens laevis, Aeschynomene indica, Hydrocotyle* sp., and *Paspalum* sp.
Figure 25. Average *P. hemitomon* cover estimated by site and treatment on July 11 and October 24, 2006.

Figure 26. Average *P. hemitomon* cover estimated by treatment during the 2006 growing season.
Figure 27. Average total cover estimated by treatment during the 2006 growing season.

*P. hemitomon* started spreading outside the structures through rhizome growth when its cover reached approximately 60%. At the end of the first growing season the average *P. hemitomon* spread from the structures was 10 cm (Figure 28). Early spreading from unfenced structures was mainly due to aerial stems spreading outside the structure. Very few of these stems survived. Structures that obtained higher *P. hemitomon* cover earlier in the growing season spread further (PVC structures planted with pots average spread 13.5 cm), than those who obtained cover later in the growing season. In addition to the spread of *P. hemitomon*, we observed other species that rafted up on the structures such as *Eichornia crassipes* (water hyacinth), *Oxycaryum cubense* (Cuban bulrush), and *Limnobium spongia* (frogbit).
Figure 28. Average spread of *Panicum hemitomon* by treatment during the 2006 growing season.
PRELIMINARY FINDINGS

Artificial Floating Marsh Systems Evaluation in Aquaculture Ponds

- Of the 27 structure designs evaluated, only those structures constructed with PVC or bamboo maintained buoyancy.
- *P. hemitomon* cover increased whether established from marsh plugs, whole plants (rhizome and stem material), belowground material, stems, or peat pots. Stems are the most cost effective establishment technique, followed by plants propagated in peat pots.
- Coconut, birch, and coconut-straw mats as well as chicken-wire baskets increased *P. hemitomon* cover. Chicken-wire baskets provide the most cost effective plant material support.

Optimization of Plant Response

- Higher N and P loading rates resulted in:
  - greater aboveground *P. hemitomon* production.
  - greater belowground *P. hemitomon* production.
  - smaller root/shoot ratios (less root allocation per unit of leaf allocation).
  - higher root specific gravity (less buoyant).
- Flooded (15 cm depth) versus flooded to mat surface (0 cm) conditions resulted in:
  - decreased aboveground *P. hemitomon* production.
  - decreased belowground *P. hemitomon* production.
  - higher root specific gravity (less buoyant).
- *P. hemitomon* biomass production was highest on substrates that contained peat.
- *P. hemitomon* biomass production was significantly lower on the birch mat.
- *P. hemitomon* biomass production decreased slightly when planted in combination with other species.

Field Deployment

- Based on the findings above, two structure designs were approved for field testing. The first structure design is a 4 ft x 10 ft PVC Terrace with a wire basket. The second structure design is a 4 ft x 4 ft Bamboo Square with a wire basket.
- 200 PVC Terrace structures and 100 Bamboo Square structures were deployed at Mandalay Refuge in the spring of 2006. All structures remained buoyant and structurally intact in the first growing season.
- Establishment with potted plants results in quicker cover increases than establishment from stems. However by the end of the first growing season, differences in cover between establishment techniques were small, especially in the sites that had the longest growing season.
LITERATURE CITED


APPENDIX A

Overview of Artificial Floating Systems
Tested at Ben Hur Aquaculture Ponds
July 2004 - October 2005
Artificial Floating Structure 1

The design for this AFS provides a structure that evenly spaces “large” (~ 5 gallon bucket) plugs of *P. hemitomon*. This AFS is approximately 3 m (10 ft) on each side and contains 9 large plugs. The frame was constructed with buoyant wooden planks and plugs were evenly distributed within the frame using cotton ropes. The plugs will be kept in place using burlap sacks that are attached to the ropes.

This picture shows AFS 1 near the peak of its performance on September 22, 2004. Soon after, all plugs were heavily grazed. No living vegetation was observed in these structures from early November 2004. Four of the structures have remained floating. One structure partially submerged during the winter months. By the end of February, the burlap bags and some of the ropes were starting to deteriorate. It is not possible to fence these structures to exclude nutria and muskrat, due to the large holes on the bottom that provide easy access for aquatic herbivores. These structures were removed from the ponds in March 2005.
Artificial Floating Structure 2

The design for this AFS provides a structure that supports small plugs of *P. hemitomon* marsh. This AFS is approximately 3 m (10 feet) on each side and contains 16 small plugs. The frame was constructed with buoyant wooden planks and plugs were evenly distributed within the frame using a loosely woven jute material.

At the time of deployment it became apparent that additional bracing was necessary because of excessive sagging of the jute netting. This cross bracing can be seen in the picture. Vegetation never really established in these structures and the jute netting started to deteriorate approximately 2 months after deployment and no material was left by the end of February. Four of the structures remained floating and one has been submerged floating since early September. Because of the poor performance these structures were removed from the ponds in March 2005.
Artificial Floating Structure 3

The design for this AFS consists of a hammock like containment system, filled with substrate and planted with nursery grown *P. hemitomon*. This AFS is approximately 3 m (10 ft) long and 1 m (3 ft) wide. The hammock was constructed using North American Green SC250, a 70% straw-30% coconut fiber matrix incorporated into a permanent three-dimensional turf reinforcement matting. Each side of the straw-coconut fiber hammock was made buoyant using a buoyancy tube (PVC pipe filled with marine foam). The hammock was filled with a 5 cm (2 in) layer of organic soil material and planted with 10 *P. hemitomon* plants (small nursery stock).

All of these structures have been floating at the surface. The coconut-straw mat has remained in place although some of the organic mat material is disappearing. These structures were relatively well vegetated during the early fall of 2004. Although these structures were grazed, grazing pressure seemed lower than on some of the other structures. However, to improve vegetation establishment, these structures were replanted with 10 marsh plugs and fences were added to the structures in March 2005. The added plugs remained in good condition through the end of the growing season and *P. hemitomon* cover has increased from 5% on April 1 to a maximum of 46% on September 15, 2005.
Artificial Floating Structure 4

This design used commercially available buoyancy billets (for floating dock construction) for flotation that are kept separated with wooden planks with a burlap hammock topped with 5 cm (2 in) of organic soil and planted with 20 *P. hemitomon* plants.

Structures attracted grazers and burlap deteriorated as a result. Plants never really got established in these structures as demonstrated by the top picture from September 22, 2004. Because these designs lost their structural integrity as demonstrated in the bottom picture from October 31, 2004, they were removed from the ponds in October 2004.
Artificial Floating Structure 5

This design consists of four approximately 3 m (10 ft) PVC tubes filled with closed cell Styrofoam that support a coconut fiber fabric topped with 5 cm (2 in) of organic soil and was planted with 20 *P. hemitomon* plants (small nursery stock). The coconut fiber mat used for this design consists of two layers of the North American Green C125, a 100% coconut fiber with a functional longevity of approximately 36 months.

These structures were floating at the surface through early December, when one of them partially submerged. Vegetation did relatively well in these structures during the early fall. Fences were added to these structures in October 2004. However, by the end of February very limited resprouting of the vegetation had been observed. Because the coconut mat was still in good condition, two of these structures were replanted with plugs, and one with shredded plugs in March 2005. The fourth structure, which partially submerged was removed. All the transplanted material has remained in good condition but *P. hemitomon* cover remained more or less stable at 13% through May, but increased to 32% by June 24, 2005. Monitoring of these structures stopped in July.
Artificial Floating Structure 6

This design created a piece of floating marsh by sandwiching about 5cm (2 in) of organic soil material between two birch fiber blankets (Western Excelsior SD-3). Rigidity and buoyancy were achieved with a wooden frame that was 1m by 1 m (4 x 4 ft). The mattress was planted with 10 *P. hemitomon* plants (small nursery stock).

All structures have been floating at the surface. Structures were fenced and replanted in October 2004. The birch mat has remained in excellent condition. Vegetation died-back during the winter months, but started increasing in February 2005. However, in order to improve vegetation establishment, these structures were replanted with 5 marsh plugs in March 2005. Average *P. hemitomon* cover was 12% on April 1, 2005, and reached a peak of 35% by July 20, 2005. Other species, especially, *Ludwigia* sp. out-competed *P. hemitomon* in the late growing season.
Artificial Floating Structure 7
This design created a piece of floating marsh by sandwiching about 5cm (2 in) of organic soil material between two coconut fiber blanket (Western Excelsior CC-4). Rigidity and buoyancy were achieved with a PVC frame that was 1m by 1 m (4 x 4 ft). The mattress was planted with 10 *P. hemitomon* plants (small nursery stock).

All structures have been floating at the surface, except for one structure that sunk in September 2004 and was removed from the pond. Structures were fenced and replanted in October 2004. The coconut mat has remained in excellent condition. Vegetation died-back during the winter month, but started increasing in February 2005. However, in order to improve vegetation establishment, these structures were replanted with 5 marsh plugs in March 2005. The added plugs remained in good condition through the end of the growing season and *P. hemitomon* cover has increased from 11% on April 1 to 71%. Although other species occurred in these structures, they never out competed *P. hemitomon*.
Artificial Floating Structure 8

A bag was constructed from burlap material and filled with water-hyacinths. The bag was 1 m by 1m (4 x 4 ft) and was planted with 10 *P. hemitomon* plants (small nursery stock).

The plants on these structures were grazed and the structures showed erratic floating behavior during the fall of 2004. All structures sank with colder temperatures at the end of November 2004. None have re-emerged by March 2005.
Additional Designs Started in the Fall of 2004

Artificial Floating Structure 9

This design is similar to AFS 6 the only difference is that instead of the birch fiber blanket a coconut blanket was used. To increase the buoyancy, two pieces of Styrofoam were attached with Nylon cable ties. These structures were buoyant through most of the test period. However, grazers like to rest on the foam. Three structures were removed, because animals broke the cable ties that fasten the floats to the structure.
Artificial Floating Structure 10

This design is similar to AFS 6 the only difference is that instead of the birch fiber blanket a coconut blanket was used. Four of the five structures sank, therefore all structures were removed from the ponds. A comparison of AFS 10 with AFS 7 and AFS 9 illustrates that the coconut fiber blanket requires a support structure with higher buoyancy than that provided by wood.
Artificial Floating Structure 11

This design is a miniaturization of AFS 1. All plugs in this design were heavily grazed and no vegetation survived. Four of the structures have been floating at the surface and one sank. Because of deterioration of the burlap material and not being able to protect the structure from aquatic herbivores, these structures were removed in March 2005.
Artificial Floating Structure 12

This design uses a wood frame with a chicken-wire mattress. Nine small plugs marsh vegetation were placed inside these structures. These plugs were heavily grazed immediately following deployment. Structures were fenced in October 2004. However, little recovery of vegetation was observed during the winter. Four of the structures have been floating at the surface and one sank. The four floating structures were replanted with 9 plugs in March 2005. The added plugs remained in good condition through the growing season and *P. hemitomon* cover has increased from 12% on April 1 to 70%. Although other species occurred in these structures, they never outcompeted *P. hemitomon*. 
Artificial Floating Structure 13
This design uses a PVC frame with a chicken-wire hammock. The frame supports 6 marsh plugs with the root mat enclosed in a small burlap bag. This design is currently unfenced. Average *P. hemitomon* cover was 7.5% on April 1, 2005, and hovered around that value throughout the growing season. Periodically signs of grazing were observed.

Artificial Floating Structure 14
This design uses a PVC frame with a chicken-wire hammock. The frame supports 6 small burlap bags filled with a mixture of peat, bagasse, and *P. hemitomon* rhizome fragments. This design remained unfenced. Due to grazing pressure *P. hemitomon* never became established on these structures, even though they maintained buoyant through the growing season.
Artificial Floating Structure 15

This design uses a lattice of cedar planks. Thirteen marsh plugs are suspended in chicken-wire baskets in the lattice openings. To provide a medium for lateral root spread, a coconut blanket is stapled to the bottom of the lattice. This design includes a fence. Bamboo was added to increase buoyancy after these structures submerged in early May. Average *P. hemitomon* cover was 30% on April 1, 2005, and increased to 95% by the end of the 2005 growing season. This increase was despite the submergence of some of the structures.
Artificial Floating Structure 16

This design uses a lattice of cedar planks. Thirteen marsh plugs are suspended in chicken-wire baskets in the lattice openings. To provide a medium for lateral root spread, a coconut blanket is stapled to the top of the lattice. This design includes a fence. Bamboo was added to increase buoyancy after these structures submerged in early May. Average *P. hemitomon* cover was 28% on April 1, 2005, and increased to 75% on September 15, 2005. This increase was despite the submergence of some of the structures in July.
Artificial Floating Structure 17

This design uses a lattice of cedar planks. Thirteen marsh plugs are suspended in chicken-wire baskets in the lattice openings. To provide a medium for lateral root spread pieces of coconut mat are stuffed in the remaining lattice openings. This design includes a fence. Bamboo was added to increase buoyancy after these structures submerged in early May. Average P. hemitomon cover was 27% on April 1, 2005, and increased to 100% and the end of the 2005 growing season. All of these structures lost full buoyancy in July. Note: These structures were accidentally labeled as 18 in the field.
Artificial Floating Structure 18

This design uses a lattice of cedar planks. Thirteen marsh plugs are suspended in chicken-wire baskets in the lattice openings. This design includes a fence. Bamboo was added to increase buoyancy after these structures submerged in early May.

Average *P. hemitomon* cover was 28% on April 1, 2005, and increased to 70% by the end of the 2005 growing season. Several of these structures lost full buoyancy in July. Note: These structures were accidentally labeled as 17 in the field.
Artificial Floating Structure 19

This design uses a wood frame with a gabion basket. The basket is used to support hydroponic plant growth. This design includes a fence. One of these structures was planted with marsh plugs and the other two were planted with *P. hemitomon* whole plants. This design submerged in mid April and bamboo was added to get the structures to float at the surface. However, submerging of these structures continued through the growing season. Average *P. hemitomon* cover was 8% on April 1, 2005, and increased to a maximum of 25% by September 16, 2005. There was a substantial difference between the plug planted structure and the two fragment planted structures. The fragment planted structures only reached an average cover of 12% while the plug planted structure reached 50% *P. hemitomon* cover.
Artificial Floating Structure 20

This design uses a wood frame with a gabion basket. The basket is filled with a birch mat topped by a peat and bagasse mixture topped by another birch mattress. Two structures were planted with marsh plugs and one structure with *P. hemitomon* whole plants. This design includes a fence. Bamboo was added to this design in March to provide sufficient buoyancy. Average *P. hemitomon* cover was 12% on April 1, 2005, and increased to 48% by July 13, 2005. Growth of *Ludwigia* sp. in these structures was rapid and began overtopping *P. hemitomon* in July. The weight and uneven distribution of *Ludwigia* also contributed to the submergence of these structures in July and the overturning of one of these structures during Hurricane Katrina.
Artificial Floating Structure 21

This design uses a wood frame with a gabion basket. The basket is filled with a coconut mat topped by a peat and bagasse mixture topped by another coconut mattress. Two structures were planted with marsh plugs and one structure with *P. hemitomon* whole plants. This design includes a fence. Bamboo was added to this design in March to provide sufficient buoyancy. Average *P. hemitomon* cover was 10% on April 1, 2005, and increased to 42% by June 1, 2005. In July, *P. hemitomon* cover slowly decreased due to competition with *Ludwigia* sp. The weight and uneven distribution of *Ludwigia* also contributed to the submergence of these structures in July.
Artificial Floating Structure 22

This design uses a bamboo frame with a gabion basket. The basket supports hydroponic plant growth. This design includes a fence. Average *P. hemitomon* cover was 10% on April 1, 2005 for those structures planted with marsh plugs or whole plants in March. *P. hemitomon* reached the highest cover of 40% at the end of July. Other species mainly sedges added additional cover later in the growing season.
In mid-April, we added 3 replicates planted with aboveground material only and 3 replicates with belowground material only. The belowground material sprouted within 5 days and had an average cover of 2%. The *P. hemitomon* cover kept increasing in these structures and reached 40% at the end of the growing season.

In contrast, none of the structures planted with aboveground material showed sprouting within the first 5 days. Although a few sprouts appeared, growth in the aboveground material planted structures was very limited.
Artificial Floating Structure 23

This design uses a bamboo frame with a gabion basket. The basket is filled with a birch mat topped by a peat and bagasse mixture topped by another birch mattress. This design includes a fence. Average *P. hemitomon* cover was 12% on April 1, 2005, this increased to 85% at the end of the growing season. Although *Ludwigia* sp. appeared in the plug planted structure, no significant submergence occurred until very late in the growing season.
Artificial Floating Structure 24

This design uses a bamboo frame with a gabion basket. The basket is filled with a coconut mat topped by a peat and bagasse mixture topped by another coconut mattress. This design includes a fence. Average *P. hemitomon* cover was 15% on April 1, 2005 for those structures planted with marsh plugs or plant whole plants in March. By the end of the growing season *P. hemitomon* cover had increased to 80%.
In mid-April, we added 3 replicates planted with aboveground material and 3 replicates with belowground material. The belowground material sprouted within 5 days and had an average cover of 2%. *P. hemitomon* cover increased to a maximum of 40% in mid-July, when *P. hemitomon* cover stabilized and other species such as *Leersia oryzoides* and *Scirpus cubensis* increased in cover.

Only one of the structures planted with aboveground materials showed sprouting within the first 5 days. However within the next week all structures had sprouts and *P. hemitomon* cover soon was larger in the stem planted structures than in the belowground material planted structures. End-of-growing season cover for *P. hemitomon* was 68%.
Artificial Floating Structure 25

This design uses a PVC frame that contains free floating peat pots filled with styrofoam. The purpose of the PVC frame is to keep the pots corralled and to support a fence. These structures were deployed in late July 2005, with an average $P. \text{hemitomon}$ cover of 20%. By the end of the growing season $P. \text{hemitomon}$ cover had increased to 55%.
Artificial Floating Structure 26

This design uses a PVC frame that supports a chicken-wire basket. Peat pots planted with *P. hemitomon* are placed in slits in the top of the wire basket. This design includes a fence. These structures were deployed in late July 2005, with an average *P. hemitomon* cover of 20%. By the end of the growing season *P. hemitomon* cover had increased to 63%.
Artificial Floating Structure 27

This design uses a PVC frame that supports a chicken-wire basket. Whole plant pieces of *P. hemitomon* are placed in slits in the top of the wire basket. This design includes a fence. These structures were deployed in late July 2005, within a week the average *P. hemitomon* cover reached 20%. By the end of the growing season *P. hemitomon* cover had increased to 80%.