

Annual Report – Activities Conducted under Wisconsin Endangered and Threatened Species Permit No. 581

Phil Delphey¹, Jorge Buening¹, Nathan Eckert¹, Mark Hove², Byron Karns³, Nick Rowse¹, Ann Runstrom¹, Tamara Smith¹, Robert Whaley³, and Scott Yess¹

January 14, 2011

¹ U.S. Fish and Wildlife Service

² Macalester College

³ National Park Service

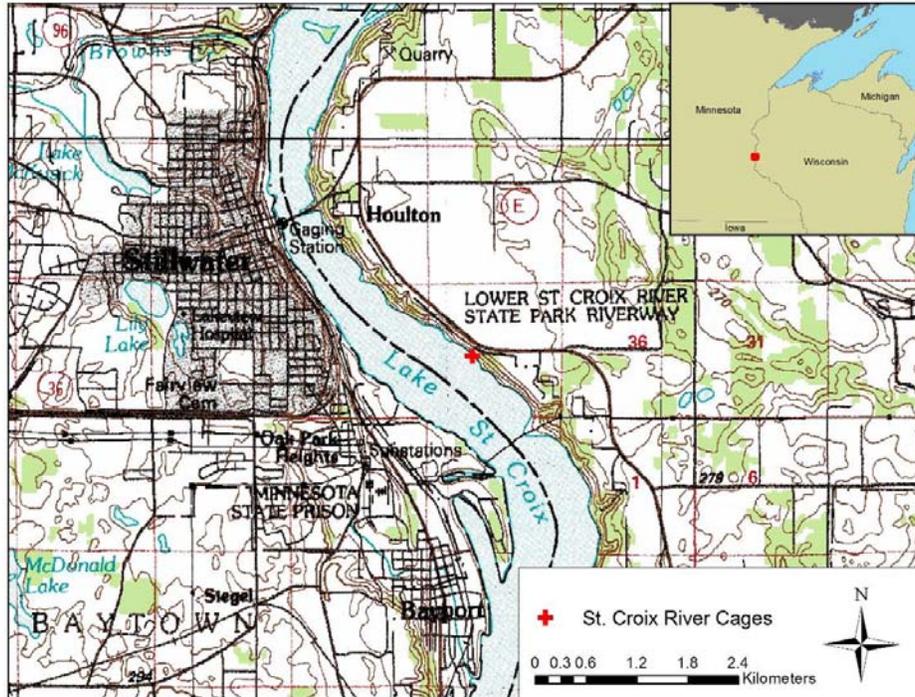


Figure 2. Locations of cages containing *Q. fragosa* in St. Croix River.

Status of Juvenile *Q. fragosa* in Silos and Cage

On 3 July 2008 we took ten juvenile *Q. fragosa* from a cage in the St. Croix River and placed them into “silos” (Fig. 3) in the Mississippi River in St. Paul, MN, at a site referred to as “Hidden Falls” (Fig. 1). In both 2008 and 2009 we measured and counted live/dead mussels in the silos three times; in 2010, we were only able to retrieve the silos twice due to high water. During the second 2010 visit we were only able to count live/dead mussels because we could not remove the PVC insert, which was stuck inside the silo.



Figure 3. *Q. fragosa* in “silos” – an *in situ* grow-out device designed by Dr. Chris Barnhart, Missouri State University – in the Mississippi River, St. Paul, MN (Fig. 1).

All ten mussels were alive in the silos during the last visit in 2009 (30 October) and had grown at a rate similar to the juveniles left in the cage in the St. Croix River (Fig. 4). High water in spring 2010 prevented us from checking the silos until 3 June when we found that two of the *Q. fragosa* had died since the previous autumn. On that date we moved the eight live mussels to three new silos. During the next visit on 28 July 2010 we could not remove the PVC insert and could only look in to see that another *Q. fragosa* had died, but that seven were still alive. High water prevented a final visit during the fall of 2010. We plan to check these silos as soon as water levels are safe for diving in 2011.

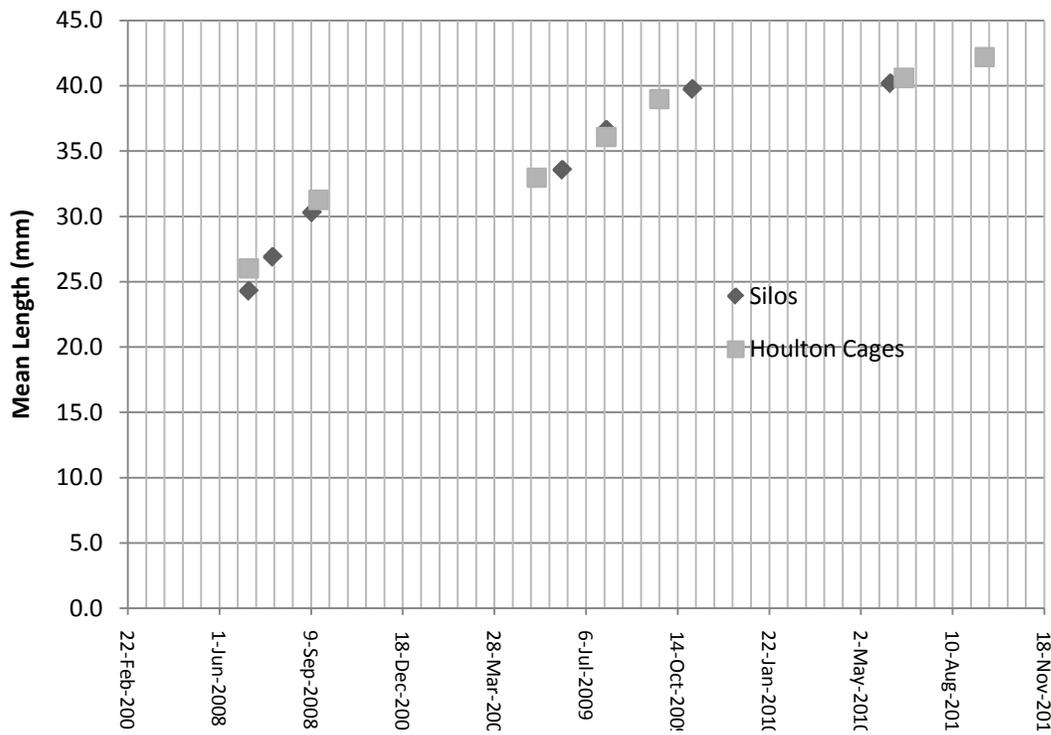


Figure 4. Mean length (mm) of *Q. fragosa* in silos (Mississippi River) and cage (St. Croix River), 2008-2010. Note that seven of the original ten *Q. fragosa* were still alive in silos upon the last visit on 28 July 2010 – ten of the eleven 2007 cohort of *Q. fragosa* left in the cage in the St. Croix River near Houlton, WI were alive when last checked on 14 September 2010. Two *Q. fragosa* from the 2007 cohort are also in the cage, but only the mean length of the 2005 cohort is represented in the graph above.

We found ten live and one dead *Q. fragosa* from the 2005 cohort and both *Q. fragosa* from the 2007 cohort alive in the cage in the St. Croix River near Houlton, WI on 14 September 2010 – the last check of 2010. On that date we also checked three of the four cages that were placed in the river on 13 May 2009 – we could find no *Q. fragosa* in any of these cages.

Aggregation and Propagation – 2010 Summary

Aggregation

In July 2010 divers searched for *Q. fragosa* on 14, 21, and 22 July, primarily near Folsom Island (Fig. 5), to place into aggregations in preparation for searches for brooding mussels in August. On those dates, we found and placed 84 *Q. fragosa* into aggregations 1, 2, and 8 (Fig. 6) – also near Folsom Island (Fig. 5). Aggregations consist of anchored lines – approximately 10 meters long – placed parallel to flow. We measured, photographed, recorded any existing markings (shell etchings or ‘shellfish tags’), and placed tags on any unmarked *Q. fragosa* – eleven that were found on 14 July were not marked when workers ran out of glue.

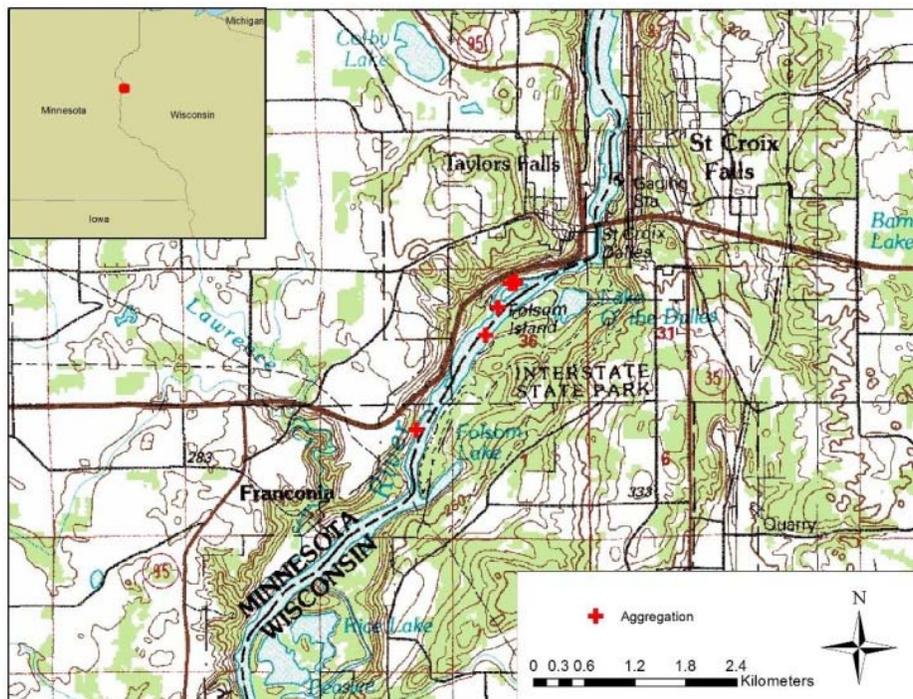


Figure 5. Locations of *Q. fragosa* aggregations on St. Croix River, Minnesota and Wisconsin. All *Q. fragosa* collected and placed into aggregations between 14 and 22 July 2010 (App. A) were collected in the reach of the river bounded by these aggregations.

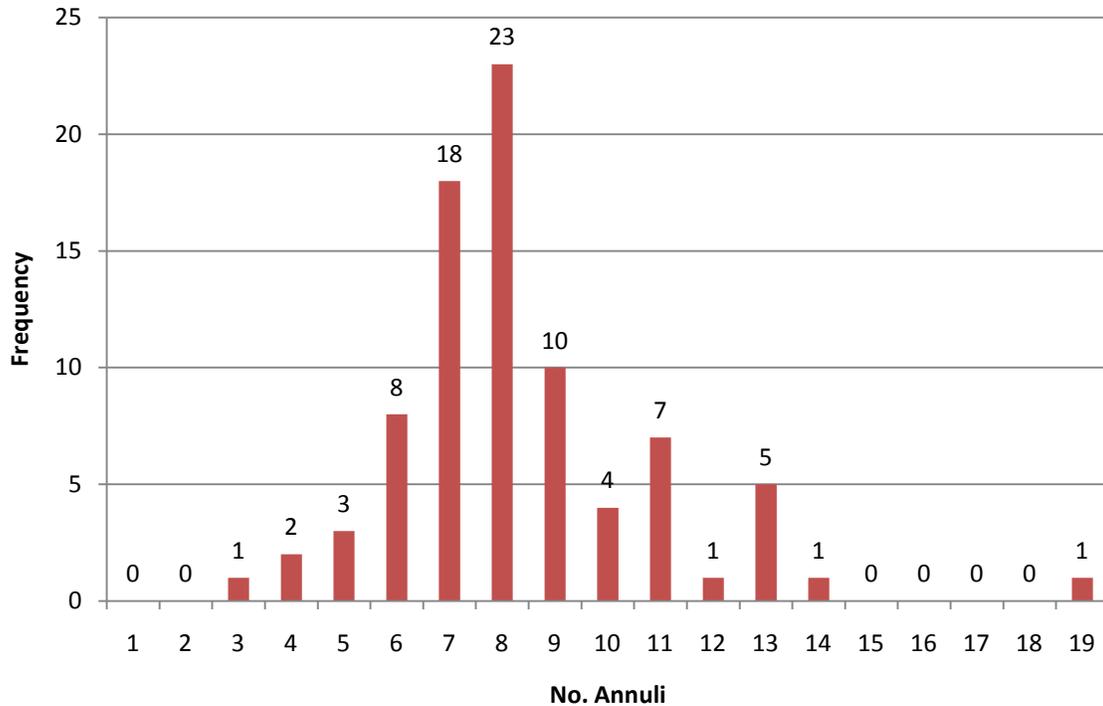


Figure 6. Frequency of annuli counts among 84 *Q. fragosa* found during haphazard searches and placed into aggregations in St. Croix River 14-22 July 2010.

Searches for Brooding Q. fragosa and Infestation

From 1 September to 18 October 2010 we searched aggregations systematically for brooding *Q. fragosa* on ten dates (see day-by-day summary notes below). On seven of ten dates we recorded whether any *Q. fragosa* along aggregations were showing signs of brooding, based on visual observations (i.e., without disturbing the mussels). We also attempted to record identifying marks (tags or etched numbers).

Early signs of display were first recorded on 7 September. On that date, four *Q. fragosa* were removed from the river and taken to Genoa National Fish Hatchery to see if they would develop full displays while at the hatchery. All four were returned to the St. Croix River near Folsom Island on 4 October 2010 – each was marked with a shellfish tag (numbers C892, C893, C894, and A023 – A023 was marked previously – all C-numbered tags were applied by project personnel. None of these four *Q. fragosa* were used to infest channel catfish.

A total of five brooding *Q. fragosa* were collected on 17 (1), 20 (2), and 22 (2) September. One of the two brooding mussels found on 20 September did not release conglutinates; therefore, only four *Q. fragosa* were used to infest channel catfish at Genoa National Fish Hatchery (GNFH). After 22 September, high water levels precluded diving until 5 October. On that date, when water temperature had fallen to 11 degrees C, it appeared that all displaying had ceased for the year.

Salvaged Specimens

Two *Q. fragosa* specimens (unmarked) were salvaged during searches for gravid *Q. fragosa* on 1 September 2010. One is at Genoa National Fish Hatchery and the other one is in the possession of Roger Gordon, assistant manager of Jordan River Fish Hatchery in Michigan. Ten other *Q. fragosa* were salvaged during aggregation work in July, during searches for gravid females, or from silos and the cage – these are being held at U.S. Fish and Wildlife Service, Twin Cities Field Office (TCFO), 4101 American Blvd. E., Bloomington, MN. Four of the specimens held at TCFO were marked – green tag 82, green tag A026, white tag C897, and (etched) 363.

Summary Notes of 2010 Activities

3 June 2010

We checked silos at Hidden Falls (Fig. 1) and found eight live and two dead *Quadrula fragosa*. Silos were about two-thirds filled with sandy silt. We removed all *Quadrula fragosa* from two old silos and split them (3, 3, and 2) among three new silos and then placed them back into the same location. The dead specimens were salvaged and are being held at USFWS – TCFO.

18 June 2010

We retrieved cage containing 13 juvenile *Quadrula fragosa* at Houlton, WI; two cohorts were represented in the cage – one with four visible annuli (n=11) and one with two annuli (growth rings), the latter suggesting they were from gravid *Q. fragosa* collected in fall 2007. All were alive, but each had one to several zebra mussels (*Dreissena polymorpha*) attached. We removed all zebra mussels and placed cage back into river.



Figure 7. Juvenile winged mapleleaf in cage, St. Croix River near Houlton, WI – 18 June 2010. Note attached zebra mussels in photo on left. Juveniles are grouped in photo at right after removal of zebra mussels. Note distinct differences in size between group of eleven at top with four annuli and two at bottom with two annuli – these represent two different cohorts (2005 and 2007).

14-22 July 2010

We found and placed 84 *Q. fragosa* into aggregations in the St. Croix River (Fig. 4) between 14 and 22 July 2010 (App. A). During these searches, we salvaged five dead *Q. fragosa* – one bee tagged C897 (white) and one 82 (green); a buccal swab had been collected from C897 on 8 July 2009. Photographs were taken of all live *Q. fragosa* collected on 21-22 July. Photos and field data sheets are on file at Twin Cities Field Office, U.S. Fish and Wildlife Service, Bloomington, MN and are available upon request.

1 September 2010

Divers checked aggregations 1, 2, 7, 8, and 9. Several winged mapleleaf were observed at the surface (some bee tags recorded – see below) except at Aggregations 7 and 9, where no winged mapleleaf were observed by divers. None of the winged mapleleaf observed were displaying. Bee tag numbers were not recorded for winged mapleleaf observed at Aggregation 2. Water temperature was 25.0 C (obtained from depth finder; 25.2 at USGS gauge⁴). Flow at 1200 hours was 5010 cubic feet per second at the USGS gauge just downstream of St. Croix Falls dam and just upstream of the project area.

7 September 2010

Divers checked aggregations 1, 2, 3, 5, 6, 8, and 9. No *Q. fragosa* were in full display, but a few appeared to be in early stages of display. Flow at 1200 hours was 4300 cfs at the USGS gauge; water temperature (obtained from boat's depth finder) ranged from 18.2 to 18.4 – it varied at the USGS gauge, but was 18.1 C when we started (1100) and when we quit (1400). Four *Quadrula fragosa* were collected and transported for observation to Genoa National Fish Hatchery (GNFH) – one was partially displaying and three were not displaying.

9 September 2010

Divers checked aggregations 1, 2, 3, 5, 6, 7, 8, and 9. Flows during work (11:38 am to 2:40 pm) ranged from 4490 to 4510 cfs. Temperatures (depth finder) ranged from 16.9 – 17.6 (17.2 to 17.6 at USGS gauge). Observations are summarized in Table 1.

⁴ USGS gauge temperature and discharge data were obtained from the Internet site, <http://waterdata.usgs.gov/nwis/uv?05340500>.

Table 1. Observations at aggregations on 9 September 2010. Divers did not disturb mussels to confirm species identification – therefore, number of *Q. fragosa* observed at Aggregation 3 was unclear.

Aggregation	Number <i>Q. fragosa</i> observed	number displaying	comments
1	13	0-1	one may have been in partial display – if so, it was at a very early stage
2	23	0	two with readable bee tags – see data sheet
7	5	0-1	one may have been in partial display
9	0		
6	2	0	collected two dead – 363 and 384 (both etched); the two live mussels observed were small – unlikely to be gravid
8	13	0-1	one was “a little open”
3	3-4	0	
5	0		

13 September 2010

Began day at 11:58 am – water temperature (18.3 C – depth finder; 19.4 at USGS gauge); discharge – 4070 cfs).

- Aggregation 2 – observed 17 *Q. fragosa*; none in display.
- Aggregation 8 – observed 10; none in display.
- Aggregation 1 – observed 13; one in partial display
- Aggregation 6 – observed 2 – both with bee tags and both photographed – neither in display
- Aggregation 3 – observed two – both with bee tags that were not legible underwater – neither in display
- Aggregation 7 – zero or one observed – not in display.

15 September 2010

- Aggregation 2 – observed 19; a few in partial display – took photos (one each) of each that was exhibiting what appeared to be partial display.
- Aggregation 8 – observed 4 – none exhibiting display
- Aggregation 1 – saw 20 – one photo of each that was in partial display
- Aggregation 7 – none observed

Time in field – 11:22 am until 12:30 pm; water temp. (depth finder) = 16.7 C; Mussel A026 (green bee tag) found fresh dead in aggregation 2.

17 September 2010

One brooding female collected – outside of an aggregation – and taken to GNFH.

20 September 2010

Two brooding *Q. fragosa* found and taken to GNFH. Water temperature ranged from 14.4 to 14.5 degrees C during diving and discharge ranged from 5140 – 5150 cfs (USGS gauge). One brooding *Q. fragosa* (A023 – green) was found in aggregation 1 or 2 (divers were uncertain which aggregation they were on) – four additional *Q. fragosa* were observed on this aggregation that were not brooding. The second brooding mussel was untagged and was found outside of an aggregation.

22 September 2010

Table 2. Activities and observations on 22 September 2010.

Aggregation	Number <i>Q. fragosa</i> observed	number displaying	comments
1	18	None	
2	8	None	
7	6	2	Both in full display and just upstream of aggregation line; both taken to Genoa NFH
9	3	None	
6	5	0	
8	4	None	
3	2	None	
5	n/a		Did not visit

4 October 2010

- Aggregation 8 – no *Q. fragosa* displaying
- Aggregation 1 – 14 *Q. fragosa* observed – none displaying
- Aggregation 2 – 6 *Q. fragosa* observed – none displaying
- Aggregation 6 – 5 *Q. fragosa* observed – none displaying
- Aggregation 3 – 1 *Q. fragosa* observed – none displaying

Water temperature on depth finder was 11.0 degrees C at start of dive.

18 October 2010

A final dive was conducted on 18 October. No *Q. fragosa* in aggregations were displaying, nor were two observed outside of aggregations.

Cooperators

Minnesota Department of Natural Resources
National Park Service – Mississippi National River and Recreation Area
National Park Service – St. Croix National Scenic Riverway
U.S. Army Corps of Engineers – St. Paul District
U.S. Geological Survey Upper Midwest Environmental Sciences Center
Wisconsin Department of Natural Resources

Appendix A. Summary information for *Q. fragosa* found in the St. Croix River near Interstate State Park in 2010 and placed into aggregations (Fig. 5).

Date	Length (mm)	Width (Height) (mm)	No. Annuli	ID#	ID Type
14-Jul-10	41	26	4	none	
14-Jul-10	48	38	5	68	Bee Tag - Red
14-Jul-10	44	29	5	none	
14-Jul-10	52	32	6	60	Bee Tag - Red
14-Jul-10	58	31	6	87	Bee Tag - Red
14-Jul-10	57	35	6	70	Bee Tag - Red
14-Jul-10	68	37	7	83	Bee Tag - White
14-Jul-10	50	33	7	none	
14-Jul-10	58	36	7	none	
14-Jul-10	59	37	7	none	
14-Jul-10	56	35	7	none	
14-Jul-10	64	38	7	none	
14-Jul-10	55	34	7	none	
14-Jul-10	48	30	8	66	Bee Tag - Red
14-Jul-10	62	40	8	67	Bee Tag - Red
14-Jul-10	60	40	8	69	Bee Tag - Red
14-Jul-10	62	38	8	none	
14-Jul-10	70	40	8	none	
14-Jul-10	87	49	11	61	Bee Tag - Red
14-Jul-10	86	47	11	none	
21-Jul-10	20	17	3	none	none
21-Jul-10	48	46	5	C947	Bee Tag - White
21-Jul-10	44	41	6	C943	Bee Tag - White
21-Jul-10	40	36	6	C958	Bee Tag - White
21-Jul-10	48	46	6	C963	Bee Tag - White
21-Jul-10	35	33	6	C910	Bee Tag - White
21-Jul-10	59	54	7	C944	Bee Tag - White
21-Jul-10	40	38	7	C949	Bee Tag - White
21-Jul-10	44	41	7	C950	Bee Tag - White
21-Jul-10	48	46	7	C951	Bee Tag - White
21-Jul-10	53	51	7	C952	Bee Tag - White
21-Jul-10	50	50	7	C960	Bee Tag - White
21-Jul-10	57	56	7	C962	Bee Tag - White
21-Jul-10	42	39	7	C909	Bee Tag - White
21-Jul-10	68	68	8	C946	Bee Tag - White
21-Jul-10	63	59	8	C948	Bee Tag - White
21-Jul-10	49	47	8	C953	Bee Tag - White
21-Jul-10	61	56	8	C956	Bee Tag - White
21-Jul-10	51	48	8	C907	Bee Tag - White
21-Jul-10	48	47	8	C898	Bee Tag - White
21-Jul-10	46	45	8	C900	Bee Tag - White
21-Jul-10	49	47	8	C903	Bee Tag - White
21-Jul-10	49	48	8	C899	Bee Tag - White
21-Jul-10	50	48	8	C906	Bee Tag - White
21-Jul-10	45	42	9	C957	Bee Tag - White
21-Jul-10	53	45	9	C901	Bee Tag - White
21-Jul-10	50	46	9	C904	Bee Tag - White
21-Jul-10	52	48	9	C905	Bee Tag - White
21-Jul-10	51	48	9	C908	Bee Tag - White
21-Jul-10	51	48	9	C907	Bee Tag - White
21-Jul-10	52	48	9	C902	Bee Tag - White
21-Jul-10	74	71	10	C939	Bee Tag - White
21-Jul-10	71	68	10	C490	Bee Tag - White
21-Jul-10	75	71	10	C941	Bee Tag - White
21-Jul-10	65	56	11	C954	Bee Tag - White
21-Jul-10	71	68	11	C955	Bee Tag - White
21-Jul-10	72	68	11	C959	Bee Tag - White
21-Jul-10	82	76	12	C942	Bee Tag - White
21-Jul-10	85	85	13	C945	Bee Tag - White
21-Jul-10	84	79	13	C961	Bee Tag - White
21-Jul-10	67	65	13	C965	Bee Tag - White

Date	Length (mm)	Width (Height) (mm)	No. Annuli	ID#	ID Type
21-Jul-10	74	73	14	C964	Bee Tag - White
22-Jul-10	24	28	4	C918	Bee Tag - White
22-Jul-10	48	43	6	C929	Bee Tag - White
22-Jul-10	54	54	7	C924	Bee Tag - White
22-Jul-10	41	39	7	C925	Bee Tag - White
22-Jul-10	49	48	7	C930	Bee Tag - White
22-Jul-10	55	53	8	C919	Bee Tag - White
22-Jul-10	59	56	8	C920	Bee Tag - White
22-Jul-10	49	49	8	C921	Bee Tag - White
22-Jul-10	55	52	8	C922	Bee Tag - White
22-Jul-10	57	52	8	C923	Bee Tag - White
22-Jul-10	49	48	8	C927	Bee Tag - White
22-Jul-10	44	43	8	C928	Bee Tag - White
22-Jul-10	59	53	8	C931	Bee Tag - White
22-Jul-10	54	49	9	C915	Bee Tag - White
22-Jul-10	54	48	9	C917	Bee Tag - White
22-Jul-10	57	52	9	C926	Bee Tag - White
22-Jul-10	72	66	10	C911	Bee Tag - White
22-Jul-10	67	63	11	C913	Bee Tag - White
22-Jul-10	61	56	11	C916	Bee Tag - White
22-Jul-10	101	79	13	C912	Bee Tag - White
22-Jul-10	81	66	13	A026	Bee Tag - Green
22-Jul-10	100	78	19	C914	Bee Tag - White