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Duration and drift of larval lake sturgeon in the Sturgeon River, Michigan

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Summary

Recovery of lake sturgeon populations in the Great Lakes basin is now a focus of binational, federal, provincial, state and tribal management agencies; however, efforts to restore and rehabilitate stocks will be ineffective until early life history strategies are understood. Defining the extent and duration of larval drift will help to protect and re-establish populations of lake sturgeon, *Acipenser fulvescens*. The stages of early-life, from egg to about 250 mm total length (TL), are believed to be the most vulnerable to factors affecting survival. Drift of larvae was monitored during 8 of the 9 years between 1992 and 2000 using drift nets set 14, 26, 35, 45 and 61 km below the spawning site on the Sturgeon River, Michigan. Natural river water levels varied between years and influenced drift sampling and success of spawning and hatch. Between 1992 and 2000, total annual catch of drifting larval lake sturgeon varied from three to 423 individuals, with 978 larvae collected over the 8 years. Larvae drifted as a 'plug' and became more dilute and spread out over time with distance downstream. This study has shown that (i) lake sturgeon larvae drift to 26 river kilometers (rkm) below the spawning site within 15 to 27 days after spawning and to 45 rkm within 25 to 40 days after spawning; (ii) the average size of the larvae increases with distance downstream; (iii) drifting larvae are not distributed uniformly in space or time; (iv) two peaks in spawning were common and spawning seems to be related to the phase of the new moon in years without heavy spring flows; and (v) that the lower river may be an important habitat for young-of-the-year sturgeons.

Introduction

In most Great Lake states and provinces, lake sturgeons *Acipenser fulvescens* are regarded as endangered, threatened or of special concern due to low abundance. Identifying habitat, critical for the many life stages of this species, but especially for the vulnerable early life stages, will be important for current protection and future rehabilitation efforts throughout the historic range of the species. In the Great Lakes region, most life history research has focused on the movements and habitat needs of adult lake sturgeons (Hay-Chmielewski, 1987; Lyons and Kempinger, 1992; Fortin et al., 1993; Auer, 1996, 1999) with a much more limited number of studies devoted to juveniles or newly-hatched lake sturgeon (Kempinger, 1988, 1996; Thuemler, 1988; Kurz unpubl. data). The habitat and movements of newly-hatched to young-of-the-year (YOY) lake sturgeon remain poorly investigated because the number of lake sturgeon in the Great Lakes is much reduced from historic levels (Harkness and Dymond, 1961), therefore finding and following young is difficult and mortality resulting from research assessment must also be minimized.

Adult lake sturgeons congregate and spawn at a set of rapids in the Sturgeon River, Michigan, USA when water temperatures approach 11°C each spring. Spawned eggs adhere to the undersides of rocks and clean sandstone bedrock and take about 8–10 days to hatch. Once the young hatch, they spend a short period, 3–5 days, in gravel or cracks in the bedrock absorbing yolk. Once the yolk-sac has been utilized, at about 16–18 mm total length (TL), the young begin to rise out of the gravel, most often at dusk, and drift downstream. This period, between hatch and development of the sharp bony plates and scutes that cover the exterior of the young sturgeon, is the most vulnerable stage in the life of a lake sturgeon. During this time, small lake sturgeon have little defense except through predator avoidance behavior such as drifting at dusk and staying in gravel during daylight. It is not until the bony scutes with their razor sharp edges develop and the fish become more efficient swimmers, beginning at about 40 cm TL, that mortality due to predation may decrease.

In the US waters of Lake Superior only two self-sustaining stocks of lake sturgeon remain (J. W. Slade and N. A. Auer unpubl. data); one of these stocks uses the Sturgeon River, Michigan for spawning (Auer, 1999). Drift of newly-hatched larvae from this population was monitored from 1992 through 2000 to determine duration and extent of larval movement and implications for sea lamprey treatment programs, irrigation, stocking of non-native sport fishes and road construction activities on the river. Lake sturgeon juveniles were found to be sensitive to the sea lamprey treatment chemical TFM, (Johnson et al., 1999). This sensitivity was determined for hatchery-reared, 175 mm lake sturgeon used in a flow-through toxicity test in 1989. Testing for sensitivity to smaller, newly-hatched larvae (20–35 mm TL) drifting after hatch has not been done. Our research focused on determining the extent and duration of lake sturgeon larval drift and the instream location of larvae and their relation to water flow. We also identify a period during the year when sea lamprey chemical treatments, fish stocking, and road construction activities can be conducted with the lowest threat to spawning lake sturgeon adults, eggs, newly-hatched, drifting and YOY lake sturgeon. To insure survival, all life stages of the lake sturgeon must be safeguarded.

Materials and methods

Study site

The Sturgeon River flows for over 130 km through mostly forested land in Baraga and Houghton counties, Michigan

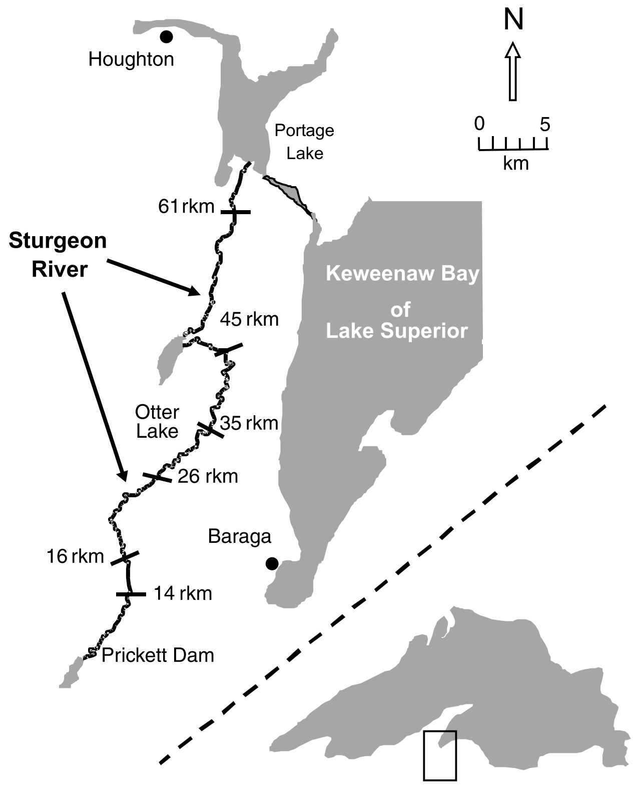

Fig. 1. Location of Sturgeon River, Houghton and Baraga counties, Michigan, and location of six drift net sampling sites in the lower 69 km of the river from 1992 to 2000

(Fig. 1). It drains an area of over 1900 km^2 within the Lake Superior basin. A small hydroelectric station and reservoir located 69 km above the river mouth precludes movement of lake sturgeon further upstream. Above the hydroelectric facility the river drains mostly forested lands, while below the facility the river is bordered by some agricultural land; however, most of the watershed remains undisturbed by human activity. The river varies in width from 30 to 60 m and in depth from riffle areas <0.3 m to deep pools >3 m. Substrate varies between sand, sandstone bedrock, gravel and boulders to deep pools with silt. The Otter River, which contributes 31% of the Sturgeon River flow, converges with the Sturgeon River at 58 rkm below the spawning site (Fig. 1). The population of lake sturgeon which spawns in the Sturgeon River, Michigan, has been the subject of study for over 12 years as changes in hydroelectric facility operation were negotiated for relicensing in 1990 (Auer, 1999). Lake sturgeon spawn in rapids below the powerhouse. The facility began operating near run-of-the-river (ROR) in 1990, after almost 60 years as a peaking facility (Auer, 1996). A survey of the lower 69 km has revealed no other suitable spawning substrate within the river system. Research on drift has been based on this assumption and would be confirmed by (i) the average size of larvae increasing as they drift downstream and (ii) a peak or 'plug' of larvae passing each sampling station. A peak for each period of spawning should spread out over time and daily catches should reduce in number as the peak passes each lower station. Drift net sampling was conducted at one or more of six stations in the lower 69 km of river over the eight study years. These sites were located at 14, 16, 26, 35, 45 and 61 km below the hydroelectric facility, usually at bridge crossings (Fig. 1).

From 1992 to 2000, water temperature monitoring began in mid-April at the spawning site and visual surveys and netting for adults was conducted to identify spawning activity and assess stock size. Once spawning dates were identified, drift sampling started 8 to 10 days later at a site either 14 or 26 km downstream. Information on spawning dates, water temperature at spawning, and location, dates and hours of drift net sets are shown in Table 1. Each year, sampling began at one of the two stations closest to the spawning site (14 and 26 rkm) and sampling continued nightly, every other night or as flow conditions allowed, at a station until none or few larvae were captured at which time the nets were moved, leapfrog style, to the next site. For example, if set at 14 and 26 rkm and no larvae appeared in the 14 rkm nets, these nets were then moved to either the 35 or 45 rkm site. Once no larvae were recovered at the 26 rkm site, nets were moved to the 61 rkm site. Drift at the station 16 rkm below the spawning site was only sampled for a 7-h duration in 1992, resulting in the capture of only one lake sturgeon larvae. These data have not been included and the one year of sampling at station 16 rkm is not included in the Results or Discussion.

Two types of drift nets were employed in this study. Depending on water flow conditions, nets were set either nightly, every other night or as conditions permitted. Total net hours and sampling duration each year are summarized in Table 2. During 1992 and 1993 only rectangular stainless-steel frames, with a 950 μm Nitex net (58 × 81 cm and 3 m long with detachable cod-end) were set within an iron frame which was deployed manually by setting the frame and net into the river, flush along the substrate. In 1992 and 1993, these nets were set overnight, from dusk to dawn. At dawn, the cod-end was washed into a 5-L pail, large debris rinsed and removed

Table 1
Dates ripe-running female lake sturgeon were tagged, water temperature at spawning site, projected first egg hatch date, date of first drift sampling and river flow conditions near Prickett Station on the Sturgeon River 1992–2000

Year	Date ripe-running females	Number of ripe-running females	Water temperature (°C)	Projected first hatch date	Date of start of drift sampling
1992	May 8–9	17	13–15	May 16–17	May 22
	May 18–20		14–16	May 26–28	
1993	May 10–12	9	14–15	May 18–20	May 20
1995	May 8–15, 19	13	10–12.5, 12	May 16–21, 27	May 19
1996	May 30, June 11	5	14–16	June 7, 19	May 29
1997	May 10, May 26	No adult survey	–	May 18–20, June 3–5	June 5
1998	April 30	2	15	May 7	May 13
1999	May 1–3, 15	5	13–15	May 8–11, 23	May 12
2000	May 3–7	4	11–18	May 11–15	May 16

Table 2
Distance from spawning site and year of drift net study on the Sturgeon River, Michigan. For each year below each point below the spawning site is a block of data containing water temperature, total net hours, and number of larvae

Year	14 rkm	26 rkm	35 rkm	45 rkm	61 rkm	Total net hours	Total larvae	Catch per hour	Dates sampled
1992	12–15°C	15–18°C	16–19°C	13–19°C	–			0.15	5/22–6/30
	19 h	61 h	109 h	172 h	49.5 h	418			
	n = 3	n = 27	n = 24	n = 8	n = 0		63		
1993	10.5–19°C	11–16°C		13–17.5°C	–			0.26	5/20–7/2
	107 h	63 h		77.5 h	54 h	301.25			
	n = 29	n = 41		n = 10	n = 0		80		
1995	12–20°C		–					0.05	5/19–6/21
	30 h		25 h			55			
	n = 3		n = 0				3		
1996		17.5–22°C						2.09	5/29–6/26
		127 h				126.5			
		n = 264					264		
1997		16–22°C		16–22°C	17–21°C			1.05	6/5–7/21
		128 h		111 h	162 h	401			
		n = 279		n = 139	n = 5		423		
1998	14–16°C	–	–					0.06	5/13–6/2
	58 h	2 h	11.5 h			71.25			
	n = 4	n = 0	n = 0				4		
1999	14–17°C	–	–	21°C				0.05	5/12–6/10
	79 h	10 h	3 h	22 h		114			
	n = 5	n = 0	n = 0	n = 1			6		
2000	14–16°C	14.5–17.5°C						1.25	5/16–6/1
	27 h	87 h				108			
	n = 9	n = 126					135		

and the remainder of the sample poured into a shallow white enamel pan. Captured lake sturgeon larvae were counted, measured and released. In 1992 and 1993, sampling was conducted with drift nets set overnight in the river at points accessible to an individual wading into the river. These steel frame nets were never deployed in the main current or deep water. Most lake sturgeon larvae were alive when recovered in the morning but the nets were severely clogged with debris.

From 1995 to 2000 either two or three D-frame drift nets, (76 cm across the base, 54 cm high with a knotless 1600 μm mesh nylon bag 317.5 cm long and detachable cod-end), were used exclusively (1996, 1997, 1998 and 2000) or in combination with the one or two steel frame nets (1995 and 1999). The D-frame nets were deployed using a triple point bridle attached to the net for deploying off bridges or by walking the net into the river and using anchors and ropes to assure that the net rested on the bottom of the river. The D-frame and steel frame nets used in combination years were set at dusk and monitored for 2 or 3 h. The nets were lifted every hour, cod-ends washed into a 5-L pail, large debris rinsed and removed, and then subsamples poured into white enamel pans for examination. Head lamps and flash lights were used to search for larval lake sturgeon; these were removed with a baster, measured and immediately returned to the river below the nets. In 1996, all sampling effort was focused at the station 26 rkm below the spawning site to define drift across the river. Four D-frame nets were deployed at this station and monitored almost nightly. The nets were placed at equal distances across the river from slow, shoreline flow to deep main channel flow.

Current was measured in 1997, 1998 and 1999 using either a Marsh-McBirney model 2000 (1 cm s^{-1} threshold) flow meter or General Oceanics Model 2030R flow meter (10 cm s^{-1} threshold) placed in the center of the net, when possible. Flows measured in 1993 were determined by timing a float passing a known distance. River cross sections were measured in 1997 using a weighted rope to measure depth every 3 m. Water temperature was taken using a hand-held thermometer and substrate components determined visually and with the weighted anchor used to measure river depth.

In 1997 a larval fish seine was deployed to sample a greater area in the lower river. It was deployed on 10 nights from June 30 to July 17 for a total of 30 net hours of sampling effort. The larval seine had a bag of 500 μm mesh Nitex (102 × 102 cm and 190 cm long with a detachable cod-end). This seine possessed two 127 cm long wings of 1000 μm mesh. The seine was usually set from a bridge with the bottom edge resting at the river bottom. An adult fish seine of 0.64 cm mesh measuring 22.9 m across, 183 cm deep with a 183 × 183 cm bag was also deployed on two nights in 1997 for a total of 4.5 net hours. It was set using ropes to stretch the seine across almost the entire river in an attempt to trap larger drifting young at station 61 rkm. Larval lake sturgeon were measured to the nearest millimeter and returned immediately to the river, below the net or seine deployment. When a large number of larvae were captured, a subsample was taken for measurements. Newly-hatched lake sturgeon are defined as those from hatch at about 16–18 mm TL to 40 mm TL and YOY are those > 40 to 200 mm TL.

Results

Adult spawning

Over the 8 years of study, adult lake sturgeon moved onto the spawning site below Prickett station most often between the end of April through mid-June, depending on flow and water temperature conditions (Table 1 and Fig. 1). Two spawnings were documented in 1992, 1996 and 1999, and may have occurred in other years as well. Adult survey effort was not equal during the 8-year period. In 1997, no adult survey work was completed but lake sturgeon may have spawned twice that year, the first time on May 10 when the river water temperature first rose above 10°C. Water temperatures dropped sharply the next day after a heavy snowfall and did not rise again above 10°C until May 26, 1997, when spawning is believed to have resumed. Dates of spawning and new moon are included in river flow conditions presented in Fig. 2. Lake sturgeon did spawn near the new moon in May 1992, 1997, 1999 and 2000, but there was no relationship in other years. Adequate water temperature, combined with a gradual decrease in river flow, seemed to be the more important trigger for spawning; this occurred in all years except 1995 and

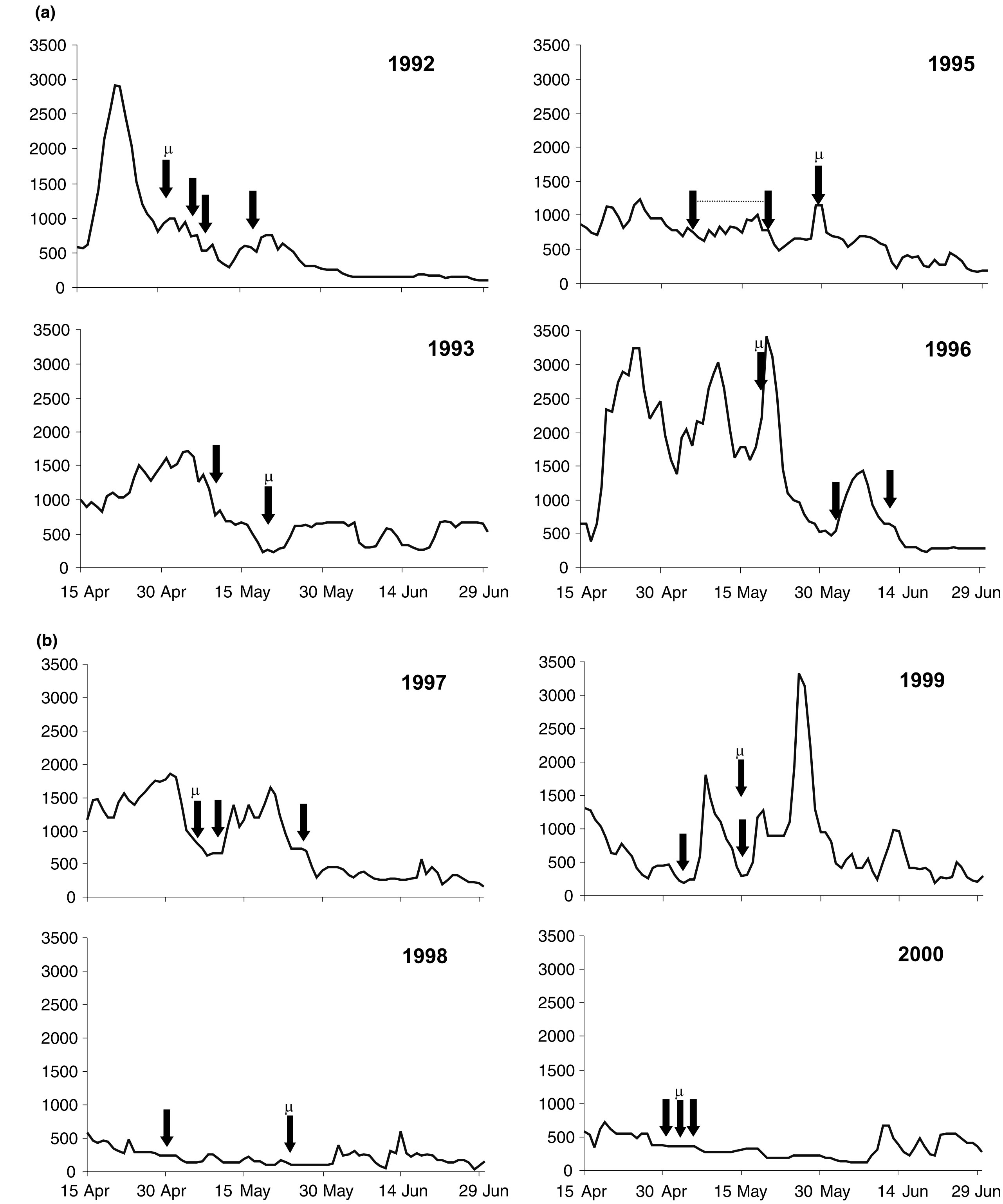

Fig. 2. River water flows in the Sturgeon River, Michigan, April 15 to June 30, 1992–2000 (except 1994). Single arrows point to spawning events, arrow with moon above it points to date of new moon

1998, when flows remained fairly constant all spring, and in 1996 when spring flooding conditions occurred late in the season (Fig. 2). River flows after peak spawning were below 21 $m^3\ s^{-1}$ (750 cubic feet per second) in 1992, 1993, 1997, 1998 and 2000 (Fig. 2).

River flow conditions

Water level and flow conditions influence lake sturgeon spawning. In three sampling years, 1995, 1998 and 1999, the total capture of larvae was less than 10 individuals each year (Table 2). The years 1995 and 1998 were low water years and few adult sturgeon were seen at the spawning site. In 1999, numerous adults were observed to spawn successfully on May 1–3 and May 15 but an unusual storm event on May 25–26 (Fig. 2) produced flood stage flows (96 $m^3\ s^{-1}$ – 3400 cfs); few larvae could be found after this event even though sampling effort continued (Table 1). In the years 1992, 1993, 1996, 1997 and 2000, sampling effort and larvae recovery were greatest (Table 2) and drift from these years will be the focus of this manuscript.

Yearly drift

Over the 8-year period, 978 lake sturgeon larvae were captured in drift samples on the Sturgeon River, Michigan. The most successful efforts occurred in 1992, 1993, 1996, 1997 and 2000 (Table 2). In 1992 and 1993, sampling was conducted at five stations, one net per station, and drift of a plug of larvae was clearly evident (Fig. 3). In 1992, this plug clearly spread over time as it moved downstream and the daily number of larvae caught decreased. In both 1992 and 1993, lake sturgeon larvae

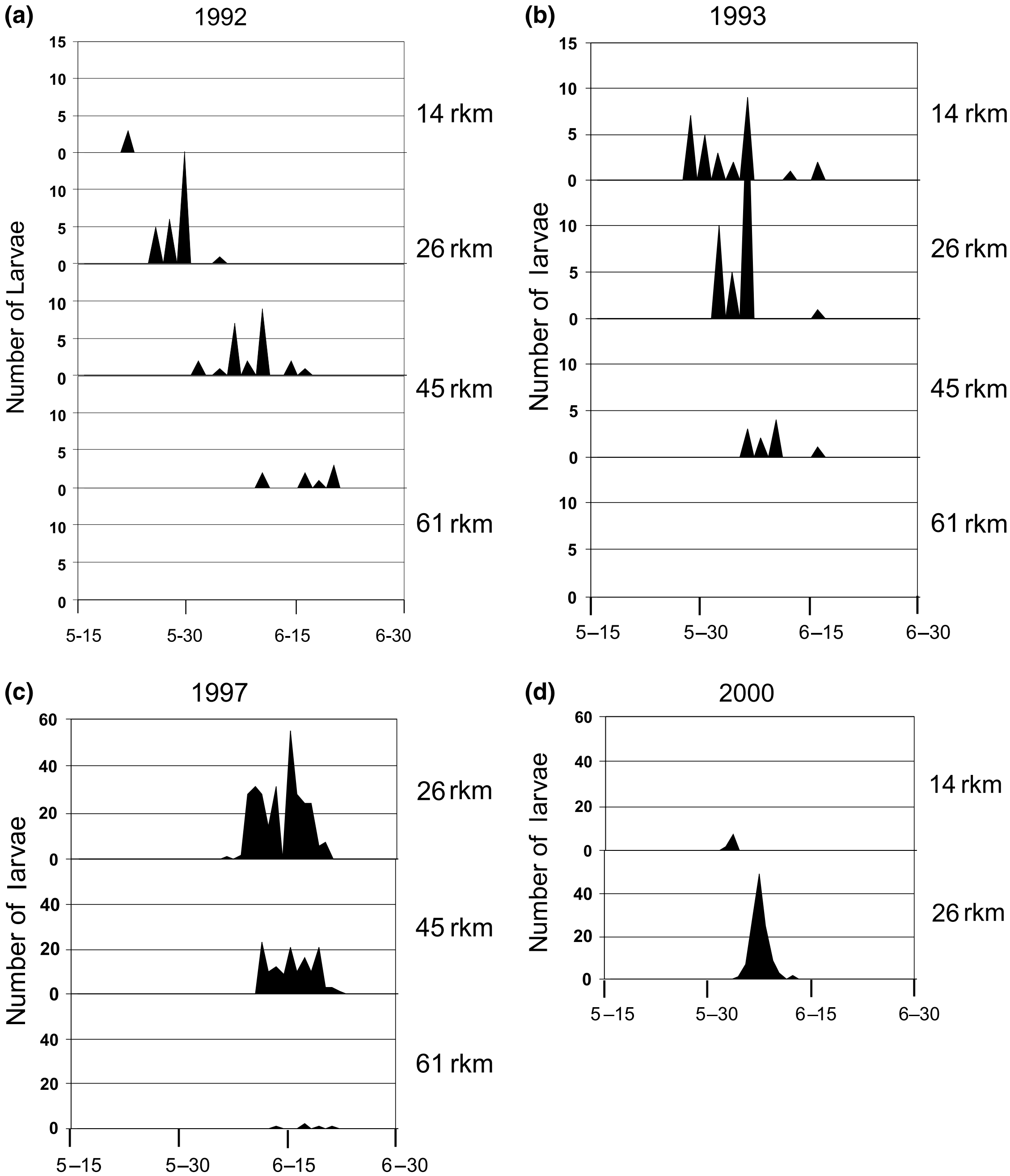

Fig. 3. Total number of lake sturgeon larvae collected in 1992, 1993, 1997, and 2000 in the Sturgeon River, Michigan, at five stations below the spawning site. Sampling window extends from May 15 to June 30 each year

drifted to 45 rkm below the spawning site approximately 30 days after adult spawning (Fig. 3).

In 1995, 1998 and 1999 few larvae were recovered due to unusual water conditions. In 1995, river flows remained too high to sample with drift nets for much of the drift season; in 1998, river water levels were unusually low and adult spawning success was believed to be poor, while in 1999, adults successfully spawned but rains contributed to flood stage flows 3–8 days after spawnings and few larvae could be found after that event (Fig. 2).

In 1996, all drift effort was focused at the station 26 rkm below the spawning site to determine uniformity of drift. In cross section, the portion of the river at station 26 rkm included a variety of channel depths (Fig. 4). Lake sturgeon larvae collected in 1993, 1997, 1998 and 1999 were captured in flows between 21 and 73 cm s^{-1} (Table 3). Of the four nets set across the river in 1996 and the three set in 1997 and 2000, most larvae were collected in nets set on gradual slopes over sand, or sand and gravel substrate, approximately 130–180 cm deep, usually within the last of the three-hourly periods sampled, 23.00–24.00 hours (Tables 4–6). Of the 835 larvae collected between 1995 and 2000, 3% were collected between 21.00 and 22.00 hours, 31% between 22.00 and 23.00 hours and 66% between 23.00 and 24.00 hours (Table 5). Very few larvae were collected in fast, main channel flows or over rubble, rock substrate; most were collected in slower currents over sandy, gradually sloping substrate (Table 4).

During 1997, drift nets were set at three stations, 26, 45 and 61 rkm, from June 5 to July 17, in an effort to find larvae farther down the river. Drift during this period can be seen in Fig. 3. In 1997, five larvae were captured at 61 rkm below the spawning site and were evenly distributed in three nets set across the river (Fig. 4). Although no sturgeon larvae or YOY were collected in the larval seine, this equipment did capture YOY of small mouth bass *Micropterus dolomieui* and white sucker *Catostomus commersoni* 17–30 mm TL. The adult seine also captured small redhorse *Moxostoma* spp. (25 cm) and troutperch *Percopsis omiscomaycus* (7 cm), but no lake sturgeon. In 2000, netting was again concentrated at the station 26 rkm to confirm drift (Table 2; Fig. 3).

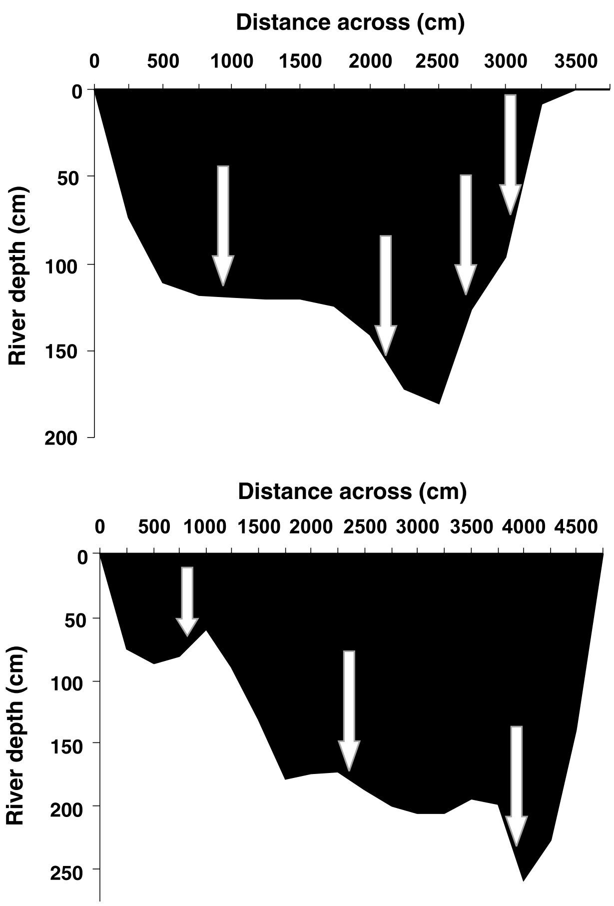

Fig. 4. Cross section of the 26 rkm (top) and 61 rkm (bottom) stations below the spawning site on the Sturgeon River, Michigan. Arrows indicate placement of drift nets

Table 3
Sturgeon River, Michigan flow conditions 1993, 1998 and 1999 for days when larval lake sturgeon were captured

Date of measures (month/day)	Flows when larvae captured	Range of flows netted
1993 – 5/20–6/16	46.3–73.2 cm s^{-1}	32.6–73.2 cm s^{-1}
1997 – 6/11–6/19	21–65.5 cm s^{-1}	21–65.5 cm s^{-1}
1998 – 5/13–6/2	31.1–67.4 cm s^{-1}	31.1–74.7 cm s^{-1}
1999 – 5/12–6/8	40.4–65.5 cm s^{-1}	< 10–79.0 cm s^{-1}

Table 4
Number of larvae collected in four nets set across the river at station 26 rkm, Sturgeon River, Michigan, 1996

Net number	Depth (cm)	21:000–22:30 (hours)	22:30–24:00 (hours)	Location
1	127–165	7	193	Shallow, sand
2	175–185	21	30	Mid-channel, sand gravel
3	264–274	3	3	Deep, main channel, fast,
4	127–142	1	6	Shallow, fast, rocks

Table 5
Number of lake sturgeon larvae captured during each of three-hourly sampling periods on the Sturgeon River, Michigan, 1995–2000

Year	21:00–22:00	22:00–23:00	23:00–24:00	Total
1995	0	1	2	3
1996	0	32	232	264
1997	25	162	236	423
1998	0	1	3	4
1999	1	3	2	6
2000	3	60	72	135
Total	29	259	547	

Table 6
Number of lake sturgeon larvae collected in each of the D-frame drift nets set at station 26 rkm in the Sturgeon River Michigan, 1996, 1997 and 2000

Year	Net 1	Net 2	Net 3	Net 4
1996	200	51	6	7
1997	169	97	13	–
2000	46	73	11	–
Total	415	221	30	–

Size of lake sturgeon larvae

In each year when catches of larval lake sturgeon were greater than 10 individuals (1992, 1993, 1996, 1997 and 2000), the average size of the larvae increased with distance downstream and a plug of larvae was observed moving past each station (Figs 3 and 5). This observation was consistent for each year and the plug often spread out over time and the number of larvae captured became smaller on a daily basis. Average growth was small during drift, with the average size of larvae increasing from about 20 mm near the station 14 rkm below the spawning site to 22 mm at the 45 rkm station in approximately 5–20 days, depending on flow conditions (Table 7; Fig. 5). Two spawning events in 1997 may be evident in the daily TL of larvae collected at stations 25 and 45 rkm (Table 8). Some smaller fish were encountered later in the year at the station 45 rkm below the spawning site.

Table 7
Average total length of larval lake sturgeon collected at each station for each year of sampling 1992–2000, on the Sturgeon River, Michigan

Year	14 rkm	25 rkm	35 rkm	45 rkm	61 rkm
1992	16	21.3	22	22.25	–
1993	20.7	21.5	–	22.5	–
1995	21.3				
1996	–	21.9			
1997	–	21.8		22.1	24.4
1998	21.2				
1999	19.4			22	
2000	19.8	21.1			

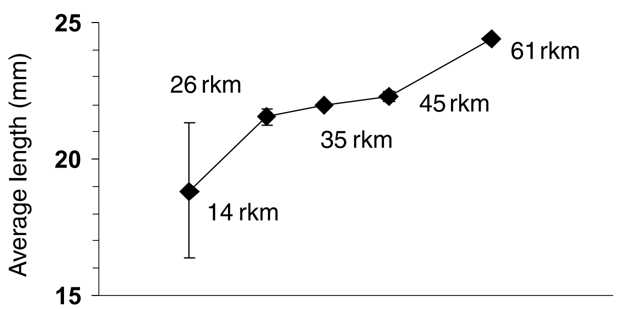

Fig. 5. Combined average total length of larval lake sturgeon that were sampled as they drifted downstream in the Sturgeon River, Michigan, 1992, 1993, 1996, 1997 and 2000

Discussion

Our observations on spawning events confirm the work of others indicating that lake sturgeon may spawn in two or more peaks of activity in a single river system (Kempinger, 1988; LaHaye et al., 1992). Although water temperature will influence hatch dates, the possibility of two or more hatches of larvae is something to look for in drift work. During this 8-year study, one peak of drifting larvae was usually observed as it moved past each station. However, sampling began late in 1992 and 1997 and may have missed larvae from an earlier hatching. In 1993 and 1996, the number of spawning females was low and there may have been only one spawning event (Table 1). Sulak and Clugston (1998) also noted more than one spawning for Gulf sturgeon, *A. oxyrhynchus desotoi*, and correlated spawning times with phases of the new moon. Our study confirms this possible relationship except in years when water flows at the time of a new moon were too great to allow fish access to the site (Table 1 and Fig. 2).

Most previous work on drift has focused on collecting eggs and newly-hatched larvae immediately below spawning sites to confirm success of spawning (Kempinger, 1988; LaHaye et al., 1992; Sulak and Clugston, 1998; J. E. Kurz, unpubl. data). These investigators also found that sampling just off the bottom at night results in the collection of most of the drifting larvae (Kempinger, 1988; J. E. Kurz unpubl. data) and we followed that method. Kempinger (1988) focused his study 150 m below the spawning area on the Wolf River, Wisconsin, but did catch two larvae (30 and 31 mm) 12.8 km downstream, 32 days after peak spawning. LaHaye et al. (1992) also focused most drift effort 900 m below the spawning site on the Des Prairies River, Quebec, with some additional sampling at 16 km below the site. They found larvae averaging 20.6 mm at this site 36 days after spawning. These findings are consistent with our data of 16–21.3 mm larvae at about 14 rkm, but we saw a shorter drift time of 11–17 days post-spawning. Since relicensing, the Sturgeon River maintains flows at near ROR, whereas flows on the Wolf River and Des Prairies are more regulated and may affect drift timing. J. E. Kurz (unpubl. data) set drift nets 1097 m below the spillway of the Jim Falls Dam on the Chippewa River, Wisconsin, and caught 16 lake sturgeon larvae primarily between 23.00 and 24.00 hours in his 3-year study. These larvae were collected at 12.2–18.9°C. H. Quinlan (unpubl. data) set nets near the Bad River, Wisconsin spawning site and at two sites farther downstream, capturing 39 of 41 larvae immediately below the spawning area; the other two larvae were found at sites 7 and 18.5 km downstream.

Drifting larval lake sturgeon in the Sturgeon River, Michigan, were captured regularly at distances of 14, 26, 35 and

Table 8
Average total length of larval lake sturgeon captured in 1996 and 1997 at stations 26 and 45 rkm downstream of the spawning site on the Sturgeon River, Michigan

	Date (month/day)												
	6/8	6/9	6/10	6/11	6/12	6/13	6/14	6/15	6/16	6/17	6/18	6/19	6/20
1996													
25 rkm	–	–	21.3	21.8	22.2	21.3							
1997													
25 rkm	19.5	20.3	21.6	22.5	23	21.7	–	21.8	22.7	21.6	21.2	22	22.3
45 rkm	–	–	–	22.9	22.2	22.7	22.8	21.7	21.3	22.3	20.9	21.8	22.3

45 km below the spawning site during this study in the period May, 18 to June, 22. At 58 rkm below the spawning site, the Otter River watershed converges with the Sturgeon River and fewer larvae have been recovered from this lower river area. The Sturgeon River beyond this point becomes a larger, deeper and slower-flowing river as it meanders to Portage Lake (Fig. 1). Drift nets deployed at upstream stations 14 and 26 rkm below the spawning site inflated immediately upon placement in the river due to the strong current, yet nets deployed at the 61 rkm station often had to be straightened out manually, as water flows were not strong enough to completely inflate the netting. As larvae approach this point in the river they are also larger (25–33 mm) than when first hatched and the weaker river flows may allow these larger individuals to detect and avoid the nets.

This study confirms that lake sturgeon drift from one spawning location on the Sturgeon River, Michigan to 45 rkm below the spawning site within 25–40 days of spawning, with some young collected at 61 rkm below the spawning site. Lake sturgeon larvae and YOY may utilize the lower 10 km of the Sturgeon River as a nursery area. Capture effort, water quality determinations, and habitat assessments need to be focused between 46 and 61 rkm to better confirm and identify YOY lake sturgeon habitat. Larval lake sturgeon drift is not uniform, the majority of larvae drifting between 23.00 and 24.00 hours over sand and sand/gravel in the regions 130–180 cm deep, in flows 21–73 cm s^{-1}, and not in the main channel or over rock substrate. Because drift is not uniform in time or space, estimates of larval abundance based on drift studies must be modeled to consider the location in the river and number of nets, the time and days of sampling and the distance of the sampling site from the spawning site. Because the larval period is a vulnerable period in the life history of this species and since natural weather and water conditions may influence spawning and hatch success, protection of these young as they move downstream is critical to recovery and restoration of lake sturgeon populations throughout the Great Lakes region. Chemical treatments for sea lamprey, road and streambank construction projects and stocking of possible predatory non-native sport fishes should be delayed until larval lake sturgeon have drifted to at least 61 rkm below the spawning site, usually after July 1. The lower 10 km of the river should be considered to be a nursery area for lake sturgeon YOY, and will be the focus for future research.

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