UNDERSTANDING THE INTERIM OPERATION PLAN IN THE APALACHICOLA-CHATTAHOOCHEE-FLINT RIVER BASIN

Wei Zeng and Menghong Wen

AUTHORS: Principal Environmental Engineers, Georgia Environmental Protection Division, 2 Martin Luther King Jr. Dr., Suite 1058 East, Atlanta, Georgia 30334
REFERENCE: *Proceedings of the 2007 Georgia Water Resources Conference*, held March 27–29, 2007, at the University of Georgia.

Abstract: On March 7, 2006, the Army Corps of Engineers (Corps) initiated formal consultation with the U.S. Fish and Wildlife Service (Service) in order to determine flow regimes that are beneficial to federally endangered species in the Apalachicola River downstream of Jim Woodruff Lock and Dam. As part of the consultation, the Corps proposed and implemented a set of operation rules for the federal reservoirs in the Apalachicola-Chattahoochee-Flint River Basin. This set of rules is called the Interim Operation Plan (IOP). The IOP was designed to provide suitable conditions for the spawning of Gulf Sturgeon in its spawning season (March through May) and to provide adequate flow in the non-spawning season for other endangered species (Fat three ridge, Purple bankclimber, and Chipola slabshell). In the spring and summer of 2006, hydrological conditions across the Basin resemble those of previous droughts. Under such dry conditions, the implementation of the IOP caused historical decline of system storage. This paper discusses elements of the IOP, the negative impact it had on the system, and ways to improve it.

Keywords: ACF, Interim Operation Plan, Jim Woodruff Lock and Dam, Biological Opinion, endangered species, flow regime

INTRODUCTION

The IOP is structured so that a calendar year is separated into two different periods, the spawning season for Gulf Sturgeon (March through May), and the non-spawning season (June through the next February). For both the spawning season and the non-spawning season, there are three flow thresholds, the high, the middle, and the low.

The release decision at Jim Woodruff Lock and Dam is made based on the amount of Basin Inflow (BI), which is computed as the sum of all water flowing into the four federal reservoirs. When BI is greater than the high flow threshold, a release at the high threshold level is maintained, and any water in excess of the threshold can be stored in the reservoirs. When BI is less than the high threshold but greater than the middle threshold, at least 70% of BI is released, and up to 30% of BI can be stored. When BI is less than the middle threshold but greater than the low threshold, then the release must be the same as BI. When BI is less than the low threshold, then release must be made to maintain the low threshold, using storage for augmentation if needed.

For the spawning season, the high, middle, and low flow thresholds are 37,400 cfs, 20,400 cfs, and 5,000 cfs. For the non-spawning season, the flow thresholds were initially set at 37,400 cfs, 8,000 cfs, and 5,000 cfs. The 37,400 cfs high flow threshold in the non-spawning season was revised to 23,000 cfs in June 2006. Per the requirement of Biological Opinion (BO) issued by the U.S. Fish and Wildlife Service (Service), the middle flow threshold in the non-spawning season was revised to 10,000 cfs. These flow thresholds are shown in Fig. 1.

Besides specific flow requirements, there is also a ramp down limitation requirement that the water surface (stage) at Apalachicola River at Chattahoochee, Florida does not recede too fast so that the species be left stranded at higher places as the water recedes (Corps of Engineers, 2006).

Origins of the Flow Thresholds in the IOP

In the spring of 2005, there was an effort to monitor whether Gulf Sturgeon can spawn and flow conditions under which spawning can take place. Egg collection pads were placed on rock ledges between April 22 and May 16, 2005 (Fig. 2). Sturgeon eggs were collected in four days during this period. The highest flow at which sturgeon eggs were collected during the 2005 data collection effort was 37,400 cfs, and the lowest flow was 20,400 cfs (Corps of Engineers, 2006 – enclosure 30 of IOP).

So, these two flow rates have been serving as the high and middle flow thresholds in the IOP. When BI is greater than 37,400 cfs, the IOP allows flow in excess of 37,400 cfs to be stored. When BI is less than 37,400 cfs but greater than 20,400 cfs, the IOP prescribes that 70% of the BI (not less than 20,400 cfs) be released, and up to 30% of it can be stored, given that this does not violate other provisions (such as the recession rate) of the IOP. When BI is less than 20,400 cfs, then the entire amount of the BI would have to be released.

The logic behind this set of rules seems to be: when inflow is abundant (greater than the highest flow when

sturgeon eggs were collected in 2005), then everyone is happy, and water in excess of the high flow threshold can be stored without restraints; when inflow is in the range of flow where sturgeon eggs were collected, then flow inside the range will be preserved while some moderate storage can theoretically be achieved; when inflow is less than the lowest flow when sturgeon eggs were collected, then the system is run in a run-of-river mode (you can fault Mother Nature for not providing the sturgeon the supposedly preferred flow in the golden range of flow observed in 2005).

Year 2005 turned out to be one of the wetter years with flows during the spawning season well above median levels (Fig. 3). The effect of this fact is that a set of flow thresholds has been developed with hydrological events that do not happen in many of the not-so-wet years. In fact, according to the Corps' computed Basin Inflow, there is not a single day in the spawning season of years 1999 and 2000 when BI is higher than 37,400 cfs, and there are only 9 and 18 days in the spawning season in these years respectively when BI is higher than 20,400 cfs.

At the time when the IOP was initially developed, a rather similar monitoring and data collection campaign was under way in the spring of 2006. The IOP did not incorporate or reflect any data collected in 2006, which happened to be a rather dry year. When the 2006 data became available, it became clear that the same level of spawning activities were present at flow magnitudes that are much lower than those in 2005. Most of the Sturgeon eggs collected in 2006 correspond to flow rates outside the golden range prescribed by the IOP. It turns out one does not have to blame Mother Nature for not providing enough flow in the range we (human being) prescribed in the IOP. Gulf Sturgeon can and did spawn in flows much lower than the IOP thresholds.

Elements of the Biological Opinion

On September 5, 2006, the U.S. Fish and Wildlife Service issued its Biological Opinion (BO) on the IOP. Other than requiring the Corps to raise its non-spawning season middle threshold from 8,000 cfs to 10,000 cfs and a few Reasonable and Prudent Measures suggesting revisions, the Biological Opinion basically endorsed the IOP as beneficial to the endangered species.

While the author does not in any ways endorse the views of the BO, he would like to use some of the analyses presented to illustrate problems of the IOP, especially the high flow thresholds in the spawning season. According to the BO, there are three important factors that affect Sturgeon spawn, availability of hard substrate, depth, and flow velocity. The Service states in the BO that it does not have the resources to carry out a hydraulic analysis for the effect of flow velocity, and that its focus was on the other two factors, substrate availability and depth.

Even though the 2006 data have not be incorporated in the development of the IOP, the Service did use both 2005 and 2006 data in its analysis for depth needed by Gulf Sturgeon to spawn. By removing 10% of the data from both ends, the Service concludes that a depth between 8.5 and 17.8 feet is appropriate for sturgeon spawning. The curves in Fig. 4 were developed based on this analysis.

Fig. 4 shows the individual and combined acreage of available spawning habitat at known spawning sites at River Mile 105 and 99. The curves show how the acreage changes as flow increase from 5,000 cfs to 50,000 cfs. It is clear from this figure that (1) the total acreage of habitat increases sharply as flow increases from 5,000 cfs to about 10,000 cfs; (2) the total acreage levels off after flow reaches 10,000 cfs until it increases to about 20,000 cfs (Area A); (3) there is an increase of about 3 acres as flow increases to about 23,000 cfs (Area B); (4) as flow continues to increase past 23,000 cfs, the total acreage of available habitat decreases (Area C); and (5) when flow is in the range between about 27,000 cfs to 38,000 cfs, the total acreage of available habitat is less than when flow is at the 10,000 cfs level (Area D).

Given this analysis, even when one believes that more habitat is more beneficial to sturgeon spawning, which is not scientifically verified, one would argue against the flow thresholds set up in the IOP. It is obvious that the golden range initially provided by the IOP is not a golden at all. A big portion of that range falls in the counterproductive flow range between 23,000 cfs and 38,000 cfs.

Effects of the IOP

The spawning season (March through May) happens to be the period when the top of conservation pool (rule curve) of the federal reservoirs in the ACF Basin raises from the winter level to the higher summer level. The need for water to refill the reservoirs is persistent throughout this period.

In the spring of 2006, when BI was mostly in the range between the middle threshold and the low threshold, effective storage of any inflow is virtually prohibited by the IOP. The ramp-down-limitation posts a unique requirement on the system of reservoirs. It requires the reservoirs to augment in the falling limb of a peak flow in order to provide an unnaturally mild slop of falling flow. As a result, not only did the reservoirs fail to gain any storage, they actually lost storage during this period. The extent and rate of decline in system storage from spring to fall of 2006 surpasses those of other drought years (Fig. 5).

The association of release decision with BI in the ACF Basin has an intrinsic shortcoming. The underlying

assumption seems to be that the system is a big container of water and its operators can practically store any portion of the total amount of inflow to the container. In reality, the system is not a container. It is the collection of four reservoirs, with the overwhelming majority (over 95%) of the storage controlling only 45% of the entire drainage area upstream of Jim Woodruff Lock and Dam. This physical setting of the system renders the operators very limited ability in effectively storing inflow to the system downstream of Walter F. George on the Chattahoochee River and in the Flint River Basin. Thus, in many instances, a moderately high BI caused by high inflows from those areas would only provide an illusion of chances for storage.

On the other hand, the need for augmentation is real and burdensome. There are 73 and 140 days in the years 1999 and 2000 respectively when BI is less than the low threshold (5,000 cfs). This means storage would have to be used to augment for a release from Jim Woodruff Lock and Dam of at least 5,000 cfs.

The combination of the intrinsic shortcoming of the IOP, the lack of chance for storage and refilling of reservoirs caused by high flow thresholds in both the spawning and non-spawning seasons, and the need for prolonged augmentation caused the system to be run in a year-round augmentation mode, leaving little chance for the system to replenish its storage. In a multi-year drought, such operations cannot be sustained.

U.S Army Corps of Engineers, Mobile District
Interim Operations Plan at Jim Woodruff Dam
and Releases to the Apalachicola River
In Support of Listed Mussels and Gulf Sturgeon

Minimum Releases

Months	Basin Inflow (BI) (cfs)	Releases from JWLD (cfs)
March - May	>= 37,400	not less than 37,400
	>= 20,400 and < 37,400	>= 70% BI; not less than 20,400
	< 20,400	>= BI; not less than 5,000
June - February	>= 23,000	not less than 16,000
	>=10,000 and < 23,000	>= 70% BI; not less than 10,000
	< 10,000	>= BI; not less than 5,000

Down Ramping Rates

Release Range	Maximum Fall Rate (ft/day), measured at Chattahoochee gage
Flows greater than 30,000 cfs*	No ramping restriction**
Flows greater than 20,000 cfs but <= 30,000*	1.0 to 2.0 ft/day
Exceeds Powerhouse Capacity (~16,000 cfs) but <= 20,000 cfs*	0.5 to 1.0 ft/day
Within Powerhouse Capacity and > 8,000 cfs*	0.25 to 0.5 ft/day
Within Powerhouse Capacity and <=8,000 cfs*	0.25 ft/day or less

*Consistent with safety requirements, flood control purposes, equipment cabability.
**For flows greater than 30,000 cfs, it is not reasonable or prudent to attempt to control down ramping rate, and no ramping rate is required.

Fig. 1 Elements of the Interim Operation Plan

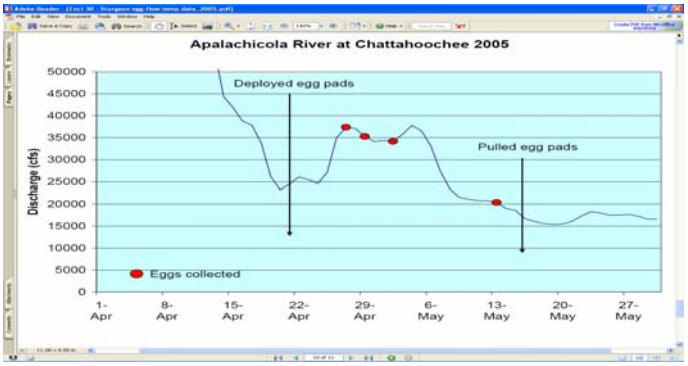

Fig.2 Flow rate corresponding to Sturgeon egg collection in 2005

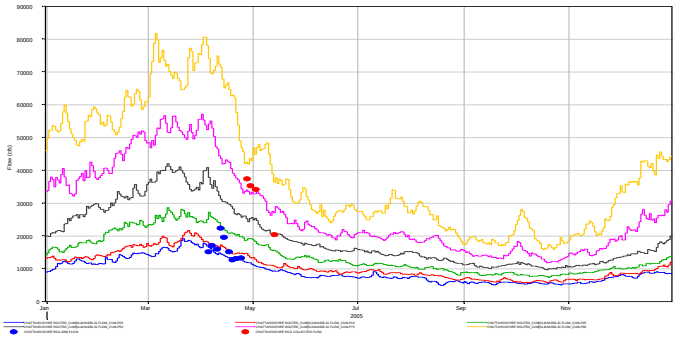

Fig. 3 Overlapping of flow corresponding to Sturgeon egg collection in 2005 (red dots) and in 2006 (blue dots)

Note:

1. The colored curves show non-exceedance level of flow during the course of a year.
2. The levels of non-exceedance is as follows: blue curve – 5%, red curve – 10%, green curve – 25%, dark curve – 50%, magenta curve – 75%, yellow curve – 90%.
3. The non-exceedance levels how often a certain magnitude of flow is not exceeded. For example, the highest red dot showing a flow level of 37,400 cfs is above the magenta curve. This means this magnitude of flow is only exceeded in less than 25% of the time at this time of the year.

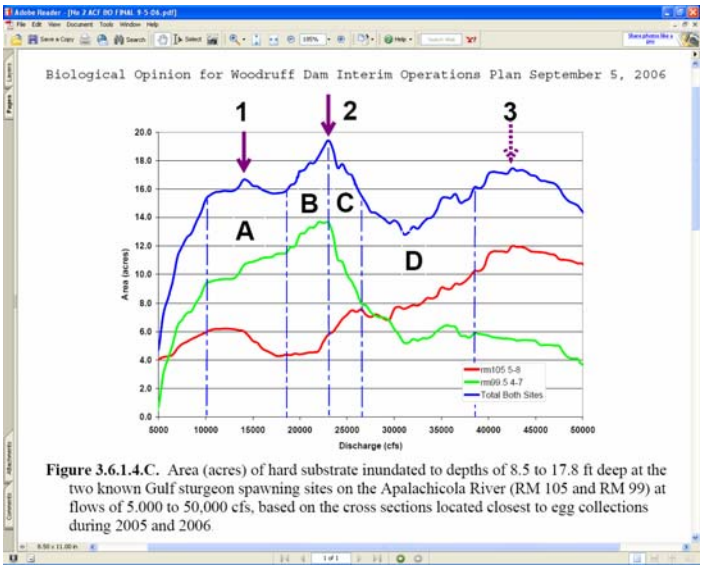

Fig. 4 A marked version of Fig. 3.6.1.4.C in the Biological Opinion

CONCLUSIONS AND SUGGESTIONS

1. It is obvious that the high and middle flow thresholds in the IOP were conceived based on partial data, unnecessarily high, counter-productive, and may even be detrimental to the very species the IOP was designed to protect. It is necessary to abolish these flow thresholds.
2. In the spawning season, to the extent permitted by BI, maintain most conservative flow level that provides substantial available habitat. At this time, this level appears to be at 10,000 cfs.
3. To the extent safety permits and practically possible, avoid release in the range from 27,000 cfs to 38,000 cfs. Flow in this range is counter-productive in achieving spawning habitat.
4. In the non-spawning season, increase chances for replenishing system storage by storing all water in excess of the minimum flow needed to protect the endangered species.

REFERENCES

U.S. Army Corps of Engineers, 2006. Letter to U.S. Fish and Wildlife Service initiating formal consultation pursuant to Section 7 of the Endangered Species Act U.S. Army Corps of Engineers, Mobile District, Mobile, Alabama

U.S. Fish and Wildlife Service, 2006. Biological Opinion and Conference Report on the U.S. Army Corps of Engineers, Mobile District, Interim Operating Plan for Jim Woodruff Dam and the Associated Releases to the Apalachicola River. U.S. Fish and Wildlife Service, Panama City Field Office, Florida.