

Attachment B

Previous reviews of Dr Hardy's work

2005, Klamath River:

From <http://digitallib.oit.edu/cdm/ref/collection/kwl/id/3705>, bottom of page 4 (of the PDF), written by Dr Dave Vogel, for the Water Report, 2005 on the Klamath River: (emphasis added)

"The NRC [National Research Council] committee read and discussed the draft Hardy Phase II report. The committee saw the modeling approach as flawed by heavy reliance on analogies between habitat requirements for Chinook salmon and habitat requirements for coho salmon.

From middle of page 5 (of PDF): (emphasis added) **2015, San Marcos River:**

In fact, the National Research Council's Advisory Committee on Restoration of Aquatic Ecosystems **cautioned: "Restoration is different from habitat creation, reclamation, and rehabilitation — it is a holistic process not achieved through the isolated manipulation of individual elements."** (NRC 1992)

From [2015 National Academy of Sciences Review of EAHCP](#), page 93 (of the PDF): (emphasis added)

The HCP repeatedly refers to the two Hardy habitat suitability analyses with statements **that are not easy to trace back to the reports.** ... An example of a statement that the Committee was **unable to find supporting analyses** for was "A review of the Hardy (2010) fountain darter **modeling** shows that there would be sufficient quality and quantity of habitat in all four reaches at long-term average flows (i.e., 225 cfs) to support the long-term biological goals for the fountain darter in the Comal system" (pp. 4-9, EARIP, 2012).

The HCP's apparent reliance on the third habitat suitability analysis to assess the effects of various spring flow scenarios on fountain darter abundances is questionable because of methodological and interpretation issues....

From page 110 (of PDF): (emphasis added)

"Given the absence of a planned ecological model for Texas wild rice, the current habitat suitability analysis **should be treated as an hypothesis and tested for robustness** throughout the San Marcos River....

The ongoing effort to build an individual-based model for fountain darter is a scientifically sound approach for modeling population dynamics that **will require extensive data for model formulation, calibration, and validation.** Ensuring that the **model results are properly interpreted** (i. e., viewed with appropriate confidence) **will be critical to the success** of these efforts."

From page 111 (of PDF): (emphasis added)

"**The habitat suitability analyses** done for the fountain darter could act as a **"back-up"** to the [Hardy's] individual-based **modeling** and provide additional quasi-independent results to support a weight of evidence approach for the fountain darter."



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May 12th, 2016

Hi Chad & Nathan,

It was a pleasure meeting both of you on Tuesday at the EAA open meeting, and I am happy that you are both receptive to hearing more about this situation. I'd like to share with you a more detailed summary of how I came to my conclusions that the recommendation to remove Cape's Dam is currently a biological gamble for the Fountain Darter.

Before I get into the nitty-gritty science bits, I would like to make 3 caveats: (1) While I am a fish biologist who is able to weed through the currently available data regarding Capes Dam and the Fountain Darter, I am not interested in devoting much more of my scientific effort into this (I am not interested in an EAA contract, as my research focuses more on decision-making processes in the brain and camouflage strategies in the ocean). (2) IMPORTANTLY, the *National Academy of Sciences* reviewed Dr. Hardy's report and recommendation and came out with a conclusion that further science (and scientific verification) was required before the San Marcos City Council should proceed with his recommendations for dam removal. They noted both the value of his research to date as well as the deficiencies. I am told that the report came out in March 2015, and I believe that this was instigated by the EAA (so you may be able to track down a digital copy). (3) The URGENCY of this matter is that the San Marcos City Council may attempt to remove the dam as early as this JULY 2016. Hence, early attention to this matter is required.

Problem in a nutshell: There is not enough Biology included in Dr. Tom Hardy's modelling estimates to make accurate predictions on the effect of Capes Dam removal on Fountain Darter Habitat. (Extensive sampling by BIOWEST for the past 15 years suggests that key biological parameters such as vegetation cover, and more importantly vegetation type, are critical in creating suitable Fountain Darter habitat.)

Main Deficiencies Identified:

- (1) Dr. Tom Hardy's most recent report to the San Marcos City Council (October 2015, see attached) produces estimates of Fountain Darter (FD) habitats "*based only on depth and velocity for each flow rate and dam scenario*" (p. 24)
- (2) Correct inconsistencies regarding the inclusion of vegetation in the modelling. The modelling for FD is introduced as including vegetation (see. P. 12), yet when the results are presented (p. 24) they are based only on depth and velocity.
- (3) Report needs to be more explicit about the criteria defining the "Combined Suitability" habitat quality for each level (p. 26; Fig 20-22. E.g. what velocity/depth combination constitutes a 0.2 habitat vs a 0.6 habitat)
- (4) Simulation of changes in Fountain Darter habitat Quality should be shown with spatial information

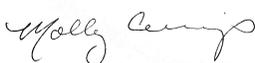
as Dr. Hardy has done for changes in river depth (p. 14-15; Figs. 11-14)

- (5) Report needs to more explicitly reconcile how removal of a partial dam and mill race (two very slow flow environments) will increase fountain darter habitat in light of the EAA velocity suitability curves (Fig 29, P. 42 in 2009_Hardy_FlowRegimeEvaluation.pdf, attached) showing that maximum densities of fountain darter are found in low (< 0.25 ft/s) flow with a precipitous drop in suitability (none > 0.5ft/s). Where are replacement and additional "low and no-flow" environments being produced by the removal of this dam and mill race? And will they have the necessary vegetation?
- (6) While the Oct. 2015 report (p. 25) acknowledges that "*darter densities are higher in aquatic vegetation*" it also acknowledges "*Modeling the expansion of aquatic vegetation under either half height or full dam removal was beyond the scope of this work*".
- (7) Omission of Vegetation cover OR type in the modelling estimates is particularly problematic given the extensive data from BIOWEST showing BOTH features play a critical role in FD habitat. As early as the 2001-2003 BIOWEST sampling of Comal and San Marcos Fountain Darter populations, these sampling efforts documented a 10-15-fold difference in FD densities based on vegetation type. Filamentous Algae had an average of 30 FD/m² whereas Hydrilla/Sagittaria/Ceratopteris ranged from 2-4 FD/m². See Fig 7 on P. 21 in the Final 2003 BIOWEST annual monitoring report to the EAA (link below).
- (8) Dr. Hardy's Oct 2015 report did not yet include more recent modelling efforts by Hardy and many other scientists (Bonner/Doyle/Grant/Swannack/Wang/Ward with BIOWEST reported in Dec. 2015) that includes modelling of flow on specific vegetation type (Predictive Ecological Model for the Comal and San Marcos Ecosystems Project, found on the EACHP website, link below).
- (9) A comparative approach to this problem may be insightful, but has not yet been invoked. Identifying the river features that promote FD abundances in the Comal River system can better inform decisions regarding river features in the San Marcos system. Outside of lake environments in both the San Marcos/Comal systems, the reach of the rivers that sustains the highest FDs is consistently the Old Channel of the Comal river. This is a portion of the river that has very well regulated flow due to culverts and other structures that prevent flooding. The Old Channel features share a great deal of similarities to the existing Capes Dam on the San Marcos.
- (10) ALSO, if we are truly interested in preserving FDs, then sometimes 'less natural' approaches are used to ensure their survival. I was informed by a USFWS scientist, that in the 1970s the Comal river population of FDs was decimated. So the USFWS transplanted 500 FDs from the San Marcos and into the Comal. I believe the Comal now supports more than the SM. If that is the case, we should closely examine the habitat features of places in the Comal where this species thrives and try to replicate them in the San Marcos.

To Find the BIOWEST 2001, 2006 and 2015 reports: see the following link at your website:

http://eahcp.org/index.php/document_library_selected?c=2&c=2

Sincerely,



Molly Cummings,
Professor

From June 13-25, 2016

<https://www.facebook.com/groups/304393306435126/permalink/520568701484251/>

Save Thompson's Island

Brian Olson

June 13 · San Marcos

Dr. Hardy has asked questions in regards to Dr. Cummings opinion on the dam removal and effected habitat. Dr. Cummings is a well respected professor of Biology at The University of Texas. Instead of speaking for Dr. Cummings we thought it would be more useful to hear directly from her on her opinion of the premature decision on Cape's Dam removal and Dr. Hardy's research efforts.

PLEASE SHARE and LIKE!!! Tell City Council to stop Capes Dam Removal before its to late.

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From June 16, 2016 FB post in the group Save Thompson's Island

<https://www.facebook.com/groups/304393306435126/permalink/522107241330397/>

Lila Knight I have a question for Thom Hardy At what date did you decide it was best to remove the dam?

Like · Reply · June 16 at 11:11pm

Thom Hardy From a pure ecological perspective probably after my initial work in San Marcos River in the late 1990s. That view was reinforced during all the modeling in the Edward Aquifer Implementation and Recovery Program in the 2008-10 period and the the intensive studies during my implementation of the San Marcos Observing System and supported research and finally more recently during the specific modeling and evaluation of the Cape's Dam alternatives over the last year.

Like · Reply · June 16 at 11:22pm

Lila Knight But, when did you make the decision - that Cape's Dam probably needed to go. As a conscious decision. One that you would recommend to others.

Like · Reply · June 16 at 11:26pm

Thom Hardy 1990s

Like · Reply · June 16 at 11:28pm