NOAA 2013 Protected Species Studies of Green Sturgeon along the West Coast of the U.S. to Guide the Design and to Implement a Monitoring Program to Track Coast-Wide Status and Trends for Future Population Viability Assessments

PROGRESS REPORT

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Prepared by: **Christine Mallette**, Program Leader
Oregon Department of Fish and Wildlife (ODFW)
Columbia River Investigations Program
17330 SE Evelyn Street
Clackamas, OR 97015

Project accomplishments by objective are:

A) Database Development

This objective has been curtailed due to budget reductions during Year 2 of project implementation. An in-house database has been developed to house historic data from WDFW and ODFW, and data associated with the current project.

During this performance period, acoustic tag and receiver information from 2010-2013 ODFW and WDFW tagging operations were successfully uploaded to the new HYDRA 3.0 tag repository (http://hydra3.sound-data.com/login/?next=/data_overview/) . In addition, a portion of the acoustic tag information was uploaded to the Ocean Tracking Network (OTN; http://members.oceantrack.org/login_form). The accelerometer tags of NMFS/NWFSC, and the temperature depth sensor tags of USGS/WFRC, that were among the 363 acoustic tags deployed during the 2010-2012 WDFW and ODFW Green Sturgeon operations, were excluded due to the collaborators uncertainty to allow OTN to get tag metadata directly from the vendor VEMCO. While HYDRA covers most receiver sites from California to Washington, the OTN data repository allows us to search additional receiver arrays not covered by the HYDRA system; in particular the former POST arrays that cover the Strait of Juan de Fuca, and areas in British Columbia and Alaska. WDFW has been participating in the teleconferences and workshops on Improving Access to Animal Acoustic Telemetry Observations Project run by National

Oceanic and Atmospheric Administration's Integrated Ocean Observing System Program Office (NOAA/IOOS). Green Sturgeon acoustic data were featured during the demo workshop held at the University of Washington, Applied Physics Laboratory on June 13, 2013.

During this performance period, Passive Integrated Transponder (PIT) tag data from ODFW and WDFW 2002-2013 sturgeon tagging operations were gathered, validated and entered into Pacific States Marine Fish Commission's (PSMFC) PIT Tag Information System (PTAGIS; http://www.psmfc.org/program/pit-tag-information-systems-ptagis?pid=17). Most of the 3,400 plus records have been accepted and are available to the public; however, there is still a fair number of PIT tag codes that came back as duplicates. WDFW will be working to resolve the duplicate issue during the next performance period.

A green sturgeon collaboration site was established on the NWFSC Oracle Beehive-based system. The test users did not have time to explore the usefulness of this tool for data exchange and coordination between projects before the scheduled switch by NWFSC to the Google-based system. Further evaluation of collaborative website usefulness was eliminated due to time and manpower constraints.

1. *Solicit and select a contractor to oversee the development of the database by August 31, 2010.*
   (See past progress reports for periods of July 1 through December 31, 2010 and January 1 through June 30, 2011.)

2. *Convene a conference to define needs and standards by November 30, 2010.*
   (See past progress reports for periods of January 1 through June 30, 2011 and January 1 through June 30, 2012 and July 1 through December 31, 2012.)

3. *Build a beta-version of the database system by March 31, 2011.*
   (See past progress report for January 1 through June 30, 2012 and July 1 through December 31, 2012.)

4. *Incorporate feedback from researchers by April 30, 2011.*
   (See past progress report for January 1 through June 30, 2012 and July 1 through December 31, 2012.)

5. *Complete the database with sample/historical data by August 31, 2011.*
   The project local database has been undergoing some improvements and additional data have been included from earlier tagging operations (e.g., the 2007 Rouge River study by Erickson et al.), so that there is a complete data set for all green sturgeon PIT and/or Acoustic tagged in Washington and Oregon waters.

6. *Input tagging information until web application is completed.*
   Any future green sturgeon tagging data will be entered into the appropriate shared data repository (PTAGIS, HYDRA, or OTN).

7. *Roll out green sturgeon tagging data website for accessing coast-wide data by February 29, 2012.*
   This task has been curtailed due to budget reductions.

8. *Roll out enhanced green sturgeon tagging data website for input and access to coast-wide data (including interface to other databases) by October 31, 2012.*
   This task has been curtailed due to budget reductions.

9. *Develop a maintenance plan for the website by October 31, 2012.*
   This task has been curtailed due to budget reductions.

10. *Maintain the website, and make improvements November 1, 2012 – June 30, 2013.*
    This task has been curtailed due to budget reductions.

B) Critical Habitat

This objective has been eliminated to address reduced federal funding. Biotelemetry elements that were in common with objectives 1 and 3 are described below.

1. *Deploy acoustic receivers at the entrance to the main estuaries (in concert with Abundance/Survival objective) by July 15.*

   Gateway receiver sites in Grays Harbor, Willapa Bay, Columbia River estuary, Tillamook Bay, and Umpqua River were maintained from late spring through early fall up through the 2012 season. Only the four Umpqua River and one Tillamook Bay receiver sites have been maintained during the 2013 season (Table 1).

   Table 1. The 2010-2013 receiver deployment records entered into HYDRA 3.0.

Serial_Number	Receiver_Type	Start_date	End_date	Latitude	Longitude	Location
100128	VR2W	6/11/2012	8/22/2012	46.23638	-123.99262	Columbia Estuary_MC1
103265	VR2W	6/11/2012	6/11/2012	46.23664	-123.98281	Columbia Estuary_MC2
103268	VR2W	6/11/2012	6/11/2012	46.25154	-123.97761	Columbia Estuary_MC3
103268	VR2W	7/12/2012	8/22/2012	46.25154	-123.97761	Columbia Estuary_MC3
103269	VR2W	6/11/2012	8/22/2012	46.24508	-123.97987	Columbia Estuary_MC4
103270	VR2W	6/11/2012	6/11/2012	46.24500	-123.99444	Columbia Estuary_NOAA2
103271	VR2W	6/11/2012	8/22/2012	46.25417	-123.98722	Columbia Estuary_NOAA3
105354	VR2W	6/11/2012	11/7/2012	46.25639	-123.97167	Columbia Estuary_NOAA4
105363	VR2W	6/11/2012	6/11/2012	46.24722	-123.98222	Columbia Estuary_NOAA5
107387	VR2W	5/6/2011	6/8/2011	43.67308	-124.19205	Umpqua River_Umpqua1
107388	VR2W	5/6/2011	6/8/2011	43.74225	-124.12963	Umpqua River_Umpqua2
107388	VR2W	6/1/2012	1/16/2013	46.54020	-123.93300	Willapa Bay_WB7
107389	VR2W	7/18/2012	2/20/2013	46.59510	-123.98200	Willapa Bay_WB5
107390	VR2W	10/27/2010	10/27/2010	46.92984	-124.09849	Grays Harbor_GH 4
107391	VR2W	10/12/2010	4/13/2011	46.92349	-124.10258	Grays Harbor_GH 3
107391	VR2W	5/6/2011	6/8/2011	43.68133	-123.93756	Umpqua River_Umpqua4
107391	VR2W	6/1/2012	1/16/2013	46.57910	-123.95200	Willapa Bay_WB6
107392	VR2W	10/27/2010	12/3/2010	46.92102	-124.10549	Grays Harbor_GH 2
110259	VR2W	7/18/2012	12/22/2012	46.69520	-123.97800	Willapa Bay_WB2
110259	VR2W	12/6/2011	7/2/2012	46.64440	-123.99000	Willapa Bay_WB4
110261	VR2W	6/1/2012	6/1/2012	46.43280	-123.99200	Willapa Bay_WB12
110264	VR2W	6/1/2012	2/20/2013	46.51322	-124.01591	Willapa Bay_WB13
110266	VR2W	6/1/2012	2/20/2013	46.47850	-124.01700	Willapa Bay_WB11
113814	VR2W	6/8/2011	8/24/2012	43.67308	-124.19205	Umpqua River_Umpqua1a
113815	VR2W	6/8/2011	8/24/2012	43.73511	-124.13087	Umpqua River_Umpqua2a
113816	VR2W	6/8/2011	8/24/2012	43.73816	-124.11773	Umpqua River_Umpqua3a
113817	VR2W	6/8/2011	8/24/2012	43.68133	-123.93756	Umpqua River_Umpqua4a
113818	VR2W	6/8/2011	7/9/2011	46.91589	-124.11428	Grays Harbor_GraysHarbor1
113818	VR2W	7/10/2011	12/1/2011	46.91589	-124.11428	Grays Harbor_GraysHarbor1
113818	VR2W	5/8/2012	12/23/2012	46.92984	-124.09849	Grays Harbor_GraysHarbor4
113819	VR2W	6/8/2011	7/6/2011	46.92102	-124.10549	Grays Harbor_GraysHarbor2
113819	VR2W	7/7/2011	9/2/2011	46.92102	-124.10549	Grays Harbor_GraysHarbor2
113819	VR2W	10/13/2011	8/31/2012	46.92102	-124.10549	Grays Harbor_GraysHarbor2
113820	VR2W	6/8/2011	7/9/2011	46.92349	-124.10258	Grays Harbor_GraysHarbor3
113820	VR2W	7/10/2011	10/25/2011	46.92349	-124.10258	Grays Harbor_GraysHarbor3
113820	VR2W	12/1/2011	7/18/2012	46.92349	-124.10258	Grays Harbor_GraysHarbor3
113821	VR2W	6/8/2011	7/6/2011	46.92984	-124.09849	Grays Harbor_GraysHarbor4
113821	VR2W	7/7/2011	9/12/2011	46.92984	-124.09849	Grays Harbor_GraysHarbor4
113821	VR2W	9/17/2011	12/1/2011	46.92984	-124.09849	Grays Harbor_GraysHarbor4
113823	VR2W	5/8/2012	8/31/2012	46.91393	-124.10753	Grays Harbor_Dolfin7
113824	VR2W	6/19/2012	11/7/2012	46.26559	-124.03480	Columbia Estuary_150
113825	VR2W	7/18/2012	7/18/2012	46.64440	-123.99000	Willapa Bay_WB4
113826	VR2W	8/22/2012	11/7/2012	46.23638	-123.99262	Columbia Estuary_MC1
113827	VR2W	8/22/2012	9/27/2012	46.23664	-123.98281	Columbia Estuary_MC2
113828	VR2W	8/22/2012	11/7/2012	46.25154	-123.97761	Columbia Estuary_MC3
113829	VR2W	8/31/2012	12/23/2012	46.92102	-124.10549	Grays Harbor_GrayHarbor2
113830	VR2W	8/22/2012	11/7/2012	46.24500	-123.99444	Columbia Estuary_NOAA2
113831	VR2W	8/22/2012	11/7/2012	46.25417	-123.98722	Columbia Estuary_NOAA3
113832	VR2W	10/17/2012	12/23/2012	46.92349	-124.10258	Grays Harbor_GraysHarbor3
113833	VR2W	8/22/2012	9/27/2012	46.24722	-123.98222	Columbia Estuary_NOAA5
113834	VR2W	8/25/2011	12/5/2012	45.55770	-123.93415	Tillamook Bay_Tillamook1
113835	VR2W	6/1/2012	1/16/2013	46.48390	-123.96500	Willapa Bay_WB9
113836	VR2W	6/1/2012	1/16/2013	46.53860	-123.97600	Willapa Bay_WB8
119879	VR2W	8/24/2012		43.67308	-124.19205	Umpqua River_Umpqua1a
119880	VR2W	8/24/2012		43.73511	-124.13087	Umpqua River_Umpqua2a
119881	VR2W	8/24/2012		43.73816	-124.11773	Umpqua River_Umpqua3a
119878	VR2W	8/24/2012		43.68133	-123.93756	Umpqua River_Umpqua4a
119876	VR2W	12/15/2012		45.55770	-123.93415	Tillamook Bay_Tillamook Bay

2. *Complete download of all gateway receivers yearly in November-December.*

Weather and other scheduling issues prevented WDFW from removing the Willapa Bay receivers during fall 2012. Some of those receivers were lost, but subsequently retrieved by divers. As reported in Table 1, some of the Willapa Bay receivers remained active up through late February of 2013. Data from the still active Umpqua River receivers were downloaded on January 17, 2013 and subsequently uploaded to HYDRA 3.0 Both Umpqua River and Tillamook Bay receivers will be downloaded and data will be uploaded to HYDRA 3.0 during the next performance period.

3. *Complete year one acoustic tagging of fish (in concert with Abundance/Survival objective) by mid-September 2010.*
   (See previous progress report for period of July through December 2010.)

4. *Deploy and monitor non-gateway receivers in the Columbia River July 16 – November 30.*
   (Task is not scheduled for completion during this reporting period.) Receiver arrays established by other researchers throughout the lower Columbia River have generally been dispersed in the wrong locations at the wrong times to detect green sturgeon, so the ability to assess use of the estuary or the lower Columbia River is limited.

5. *Complete year two acoustic tagging of fish September 2011.*
   (See previous progress report for period of July through December 2011.)

6. *Deploy and monitor non-gateway receivers in Willapa Bay May 1-November 30.*
   (Task is not scheduled for completion during this reporting period.) Most of the original acoustic array established by Mary Moser of NMFS/NWFSC has been maintained. While some of the locations serve as a gateway to the estuary, there are other receivers throughout the estuary that can inform critical habitat issues.

7. *Complete year three acoustic tagging of fish (in concert with Abundance/Survival objective) by mid-September 2012.*
   (See previous progress report for period of July through December 2012.)

8. *Deploy and monitor non-gateway receivers in Grays Harbor May 2-November 30.*
   (Task is not scheduled for completion during this reporting period.) Beyond a few mobile tracking events, there has not been any means to track Green Sturgeon movements within Grays Harbor. No other research projects have acoustic arrays in this area.

9. *Complete assessment of fine scale critical habitat use in the three estuaries by January 2013.*
   This task has been curtailed due to budget reductions.

C) Abundance/Survival

1. *Complete year one tagging of fish (in concert with Critical Habitat objective) by mid-September 2010.*
   (See previous progress report for period of July through December 2010.)

2. *Present a stratified sampling approach for the mark-recapture study to the green sturgeon steering committee for their critical review by January 2011. (This will be informed by year one acoustic tagging and other distribution information).*
   (See previous progress report for period of January through June 2012.)

3. *Complete year two tagging and recovery of fish by mid-September 2011.*
   (See previous progress report for period of July through December 2011.)

4. *Complete initial (year two) abundance estimates by January 2012.*
   (See previous progress report for period of January through June 2012.)

5. *Complete year three tagging and recovery of fish by mid-September 2012.*
   (See previous progress report for period of July through December 2012.)

6. *Complete assessment of alternative survival and abundance estimates by January 2013.*
   Given the reduction in funding and subsequent changes in manpower, this task has been delayed. During this performance period, encounter history tables were constructed to facilitate maximum likelihood estimates using Program MARK. On July 22, 2013, Olaf Langness (co-authors Phillip Dionne, Chris Wagemann, Peter Mc Hugh, and Daniel Warren; all from WDFW) made an oral presentation entitled "Estimating the abundance and survival of North American green sturgeon (Acipenser medirostris)" at the 7th International Symposium on Sturgeon, held in Nanaimo, British Columbia. Preliminary estimates of the sub-adult and post-spawn adult "Super Population" (Columbia River, Willapa Bay, and Grays Harbor combined) were presented and critiqued.

   One approach presented was the Jolly-Seber POPAN formulation. The best fit model used time varying survival and recapture probabilities, and data from 2008, 2010, 2011, and 2012 (the years when all estuaries sampled within the same year). For comparison we also considered values of 2003-2012 (green sturgeon PIT tagged from 2000-2002 were not recaptured). That model was less than 6 ΔAIC units worse than the best model. The best model produced a high annual survival estimate of 84%. The POPAN estimate for abundance was 40,445 (95% CI 25,273 to 65,274).

   The second approach presented was the Robust Design. The best fit model evaluated using this approach held survival constant and capture and recapture probabilities equal within encounters, and allowed emigration and immigration to

vary with time. Encounter histories were based on data from 2003-2012 with two encounter events per year (9 year 18 events, 2006 no data). This model produced a 95% survival estimate (95% CI; 68% to 99%). The annual abundance estimates from this model ranged from 4,027 to 39,959.

These two approaches produced annual survival estimates that were reasonable considering Green Sturgeon are long-lived, and the values are not vastly different from the 95 % survival rate accepted for White Sturgeon modeling. The sub-adult and post-spawn adult abundance estimates also seem reasonable, based on the estimated 1,000 to 1,500 Green Sturgeon spawning in all natal rivers (ratio similar to what is seen in healthy White Sturgeon populations in the Columbia River). None the less, these are preliminary attempts, and not all parameters were estimable. Other approaches may be more appropriate. During the next performance period WDFW will:

- Increase the size of the dataset by incorporating the spaghetti tag released fish that were subsequently tagged with PIT tags
- Revisit the analyses with more explicit considerations of the sampling/spatial structure that underlies the data (which estuaries were sampled in which years)
- Consider incorporating the acoustic detections where possible
- Use the acoustic tag data to inform the models of immigration and emigration rates between open and closed periods, and
- Develop DPS specific estimates using information from genetic mixed stock analyses.

In order to properly develop the DPS specific estimates, the UC Davis Genomic Variation Laboratory has been contracted to do a mixed stock analysis of 180 of the few hundred genetic samples collected during the 2010-2012 field seasons. This will complement the similar work conducted in 2006, and will provide a DPS designation for approximately one-half of the green sturgeon tagged with acoustic transmitters.

D) FMEP

1. *Complete a review of what Washington fisheries would benefit from having an FMEP.*
   (See previous progress report for period from July through December 2010.)

2. *Determine how WDFW can meet the essential elements of the FMEP.*
   (See previous progress report for period from July through December 2010.)

3. *Gather or generate supporting documentation.*
   (See previous progress report for period from July through December 2010.)

4. *Complete and circulate a draft of the [WDFW] FMEP.*

(See previous progress report for period from July through December 2010.)

5. *Complete revisions and submit a final [WDFW] FMEP to NMFS by the 120-day deadline.*
   (See previous progress report for period from July through December 2012.) The final Twin Harbors Region FMEP was submitted by WDFW on January 7, 2011, thereby meeting the 120-day deadline. As of this date, there has been no final determination by NMFS on the submitted FMEP.

6. *Complete the review of what Oregon fisheries would benefit from having an FMEP and determine how ODFW can meet the essential elements of the FMEP.*
   The review conducted by ODFW staff has been delayed due to unforeseen and substantial reductions in funding during years 2 and 3 of project implementation. Currently, information and materials continue to be compiled.

7. *Gather and generate supporting documentation to complete and circulate a draft FMEP by 30 June 2012.*
   The preparation of a draft FMEP has been delayed due to unforeseen and substantial reductions in funding during years 2 and 3 of project implementation. Completion of a draft FMEP is currently estimated to occur in 2014.

8. *Complete revisions and submit a final FMEP to NMFS by 30 June 2013*
   For reasons described above, the deadline for the completion of a final FMEP and subsequent submittal to NMFS has been extended to 30 June 2014.

E) Reporting and coordination

1. *Form, and convene at least semiannually, the green sturgeon steering committee, July 2010, January & June 2011, January & June 2012, and January & June 2013.*
   The steering committee has not met during the past two performance periods. When the abundance and survival analyses are completed at the end of the calendar year, they will be distributed to experts recommended by the steering committee for review and comment. The recommendations of the reviewers will be incorporated in the final analyses before being published in the final project report.

2. *Complete annual progress report for each objective by June 2011-2013.*
   As per instruction of the contract manager, the progress reports are done on a semi-annual basis in June and January each year. This is the sixth semi-annual

progress report. Given that the project has been given a one-year no-cost extension a progress report will be submitted in January 2014.

3. *Complete a comprehensive report of the three-year study by December 2013.* (Task is not scheduled for completion during this reporting period.) With the no-cost extension of this project, the completion date for the comprehensive report will be June 31, 2014.

4. *Document and distribute datasets from the study by December 2013.* (Task is not scheduled for completion during this reporting period.) With the no-cost extension of this project, the distribution of datasets will be completed by June 31, 2014. Most of the tagging information is already housed in various electronic data sharing systems (PTAGIS, HYDRA, and OTN).

5. *Complete submission of articles to peer-reviewed journals by December 2013.* (Task is not scheduled for completion during this reporting period.) With the no-cost extension of this project, the completion date for submitting articles to peer-reviewed journals will be June 31, 2014. As mentioned above, WDFW staff (Olaf Langness and Chris Wagemann) attended the 7th International Symposium on Sturgeon. While the oral presentation could be published as part of the proceedings in the Journal of Applied Ichthyology, a manuscript was not submitted at the time of the presentation. If allowed to submit later, we may attempt to publish the final results of the abundance and survival estimates in the ISS7 Proceedings. In addition to the oral presentation, WDFW staff presented a poster at the conference entitled; “A decade of North American green sturgeon (*Acipenser medirostris*) research in the Pacific Northwest” (coauthors Olaf Langness, Phillip Dionne, and Chris Wagemann).

F) Expenditures (Estimated)

ODFW:	January 1 to June 30, 2013	$ 19,825
Subcontract to WDFW:	January 1 to June 30, 2013	$ 63,379
Total expenditures:	January 1 to June 30, 2013	**$ 83,204**