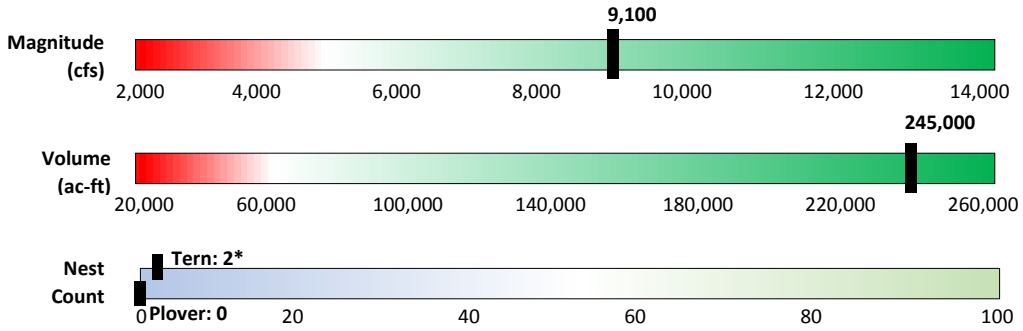
Implementation – Program Management Actions and Habitat

BQ #1 – Will implementation of Short-Duration High Flow releases produce suitable tern and plover riverine nesting habitat on an annual or near-annual basis?

2014 Assessment for BQ #1:

No change from 2013. Program monitoring and research continue to indicate that SDHF will likely not build sandbars to a height suitable for tern and plover nesting with or without sediment balance. Fall 2013 peak flow statistics and 2014 species response provided below:



*The two tern nests were inundated on 6/10/2014 at a discharge of approximately 3,000 cfs.

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What Does the Science Say in 2014?

The Adaptive Management Plan hypothesizes that Short-Duration High Flow (SDHF) releases of 5,000 to 8,000 cfs for three days (50,000 – 75,000 acre-ft) will build sandbars to an elevation suitable for tern and plover nesting. Recent Program analyses of sandbar height and stage-discharge relationships (*in peer review*[1]) indicate that sandbars created by SDHF releases will not be suitable given they will be inundated during the nesting season in roughly two out of three years.

In the fall of 2013, the Associated Habitat Reach (AHR) experienced a natural high flow event exceeding SDHF in magnitude and duration. Following that event, two least tern nests were initiated in the channel at River Mile 180.6 in May of 2014. Both nests were inundated in June during the late-spring runoff at a discharge of approximately 3,000 cfs. The Program sandbar height and stage-discharge analysis (Chapter 3) predicts sandbars created at RM 180.6 by the fall 2013 event would be inundated at 3,400 cfs[2].

[1] See PRRIP Tern/Plover Habitat Synthesis Chapters 1-6; now in peer review, expected to be finalized by March 2015.

[2] The three-day mean peak discharge for the fall event was 9,100 cfs and channel width at RM 180.6 is approximately 1,200 ft. The bar height analysis indicated mean sandbar heights of 1.5 ft below peak stage. Per Figure 12 (Chapter 3), bars created at a peak of 9,100 cfs in a 1,200 ft channel would be inundated at 3,400 cfs.

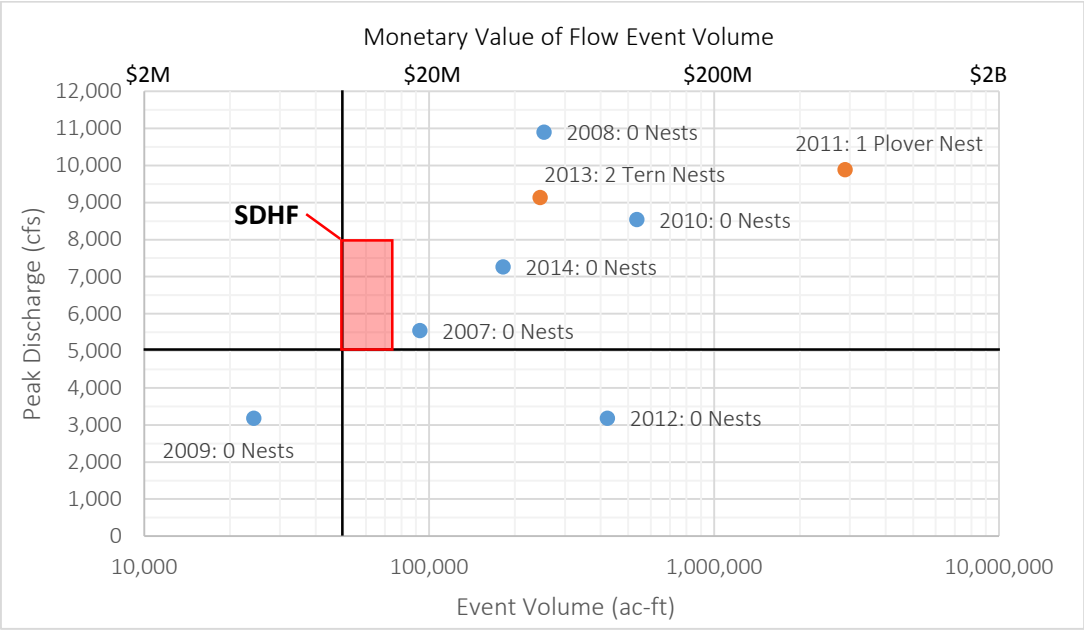


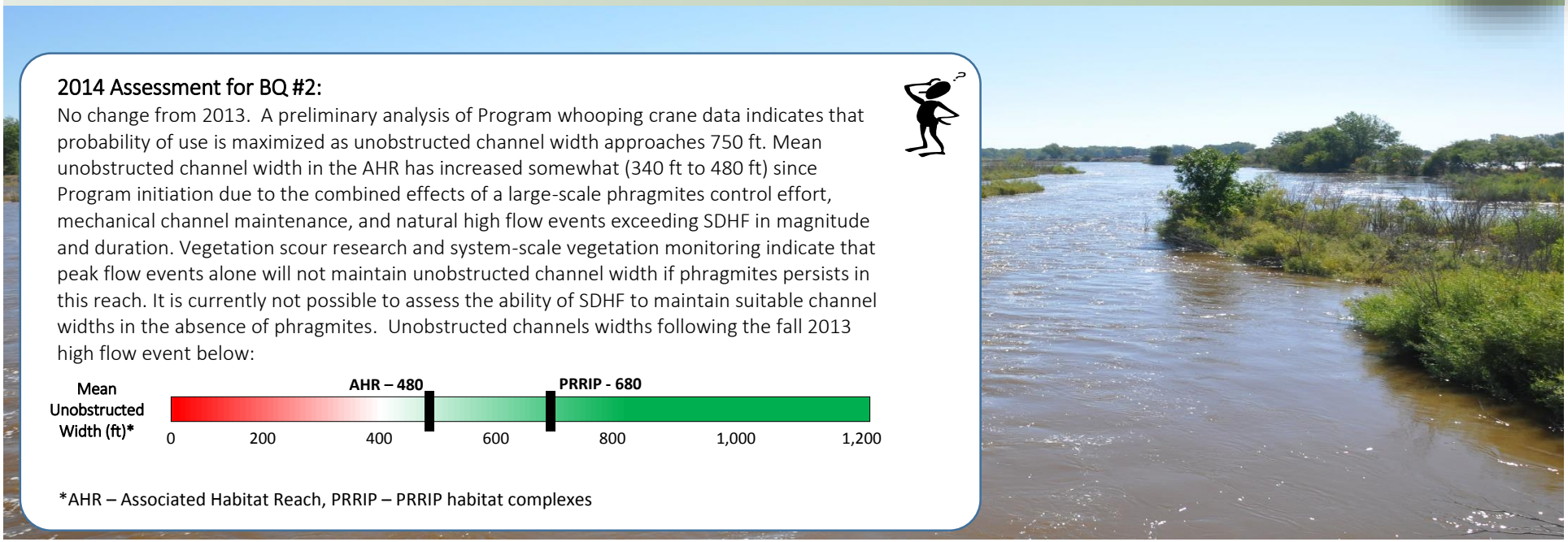
Figure 1. Annual peak flow magnitudes, volumes, and species nesting response for the period of 2007-2014. Monetary estimate of flow event volumes assume value of $200 per ac-ft, which is consistent with recent Program water acquisitions.

Overall, there have been six high flow events since Program initiation in 2007 that have exceeded minimum SDHF magnitude and volume. A total of two least tern and one piping plover nests have been initiated on sandbars formed or reworked during those events (Figure 1). The lack of species response is consistent with Program analyses which indicate that flow magnitudes of at least 15,000 cfs would be necessary to produce suitably-high sandbar habitat in wide channels selected by the species (Chapter 3).

Answering BQ #1 during the First Increment

Program staff expect Big Question #1 to be answered with a definitive "two thumbs down" in 2015. The six tern/plover habitat synthesis chapters now in peer review will serve as the best source for synthesized reference data for this question and the results of the analyses in those chapters indicate that SDHF will not produce suitable tern and plover riverine nesting habitat on an annual or near-annual basis in the AHR. Once peer review is complete, the six chapters will be used to develop an expected two thumbs down assessment in 2015 and the Governance Committee will be presented information suggesting that decision-making should move into the final "Adapt" stage of adaptive management.

BQ #2 – Will implementation of Short-Duration High Flow releases produce and/or maintain suitable whooping crane riverine roosting habitat on an annual or near-annual basis?



2014 Assessment for BQ #2:

No change from 2013. A preliminary analysis of Program whooping crane data indicates that probability of use is maximized as unobstructed channel width approaches 750 ft. Mean unobstructed channel width in the AHR has increased somewhat (340 ft to 480 ft) since Program initiation due to the combined effects of a large-scale phragmites control effort, mechanical channel maintenance, and natural high flow events exceeding SDHF in magnitude and duration. Vegetation scour research and system-scale vegetation monitoring indicate that peak flow events alone will not maintain unobstructed channel width if phragmites persists in this reach. It is currently not possible to assess the ability of SDHF to maintain suitable channel widths in the absence of phragmites. Unobstructed channels widths following the fall 2013 high flow event below:

*AHR – Associated Habitat Reach, PRRIP – PRRIP habitat complexes

What Does the Science Say in 2014?

Channel narrowing in the Associated Habitat Reach (AHR) has historically been episodic, occurring during prolonged periods of drought through the expansion of woody vegetation (primarily cottonwood) into the formerly active channel[3]. The latest episode of channel narrowing occurred during the drought period of 2001-2007. Unlike previous episodes, expansion of an invasive perennial grass (*Phragmites australis*) was the mechanism of narrowing. Since 2008, the Program participated in a large-scale phragmites control program consisting of annual herbicide treatments and mechanical biomass removal.

Past studies[1] and Program research[4] indicate cottonwood seedlings are somewhat susceptible to erosion by peak flows, especially in the year they germinate. However, Program scour research indicates phragmites is extremely erosion resistant[5]. This finding is supported by analysis of system-scale monitoring data that indicates herbicide

[3] Johnson W. Carter. 1994. Woodland expansion in the Platte River, Nebraska: patterns and causes. In Ecological Monographs 64(1): 45-84.

[4] PRRIP lateral erosion research. Manuscript in development.

[5] PRRIP vegetation scour research. Manuscript in development.

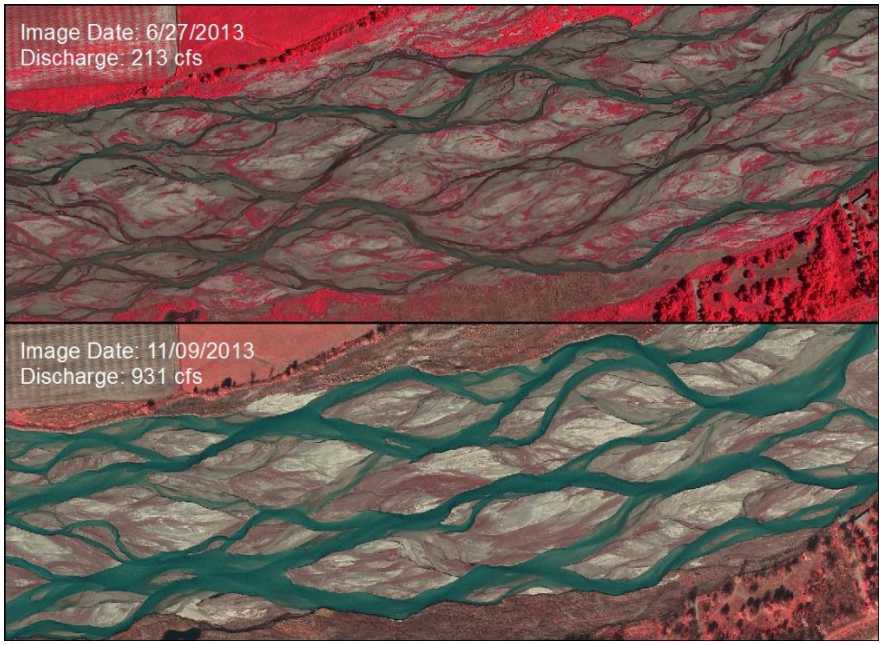


Figure 2. Comparison of channel bedforms at River Mile 205 prior to and immediately after the fall 2013 natural high flow event. Note the persistence of previously existing vegetated bedforms following the high flow event.

application, not high flows, has been effective in reducing phragmites occurrence in the AHR[6].

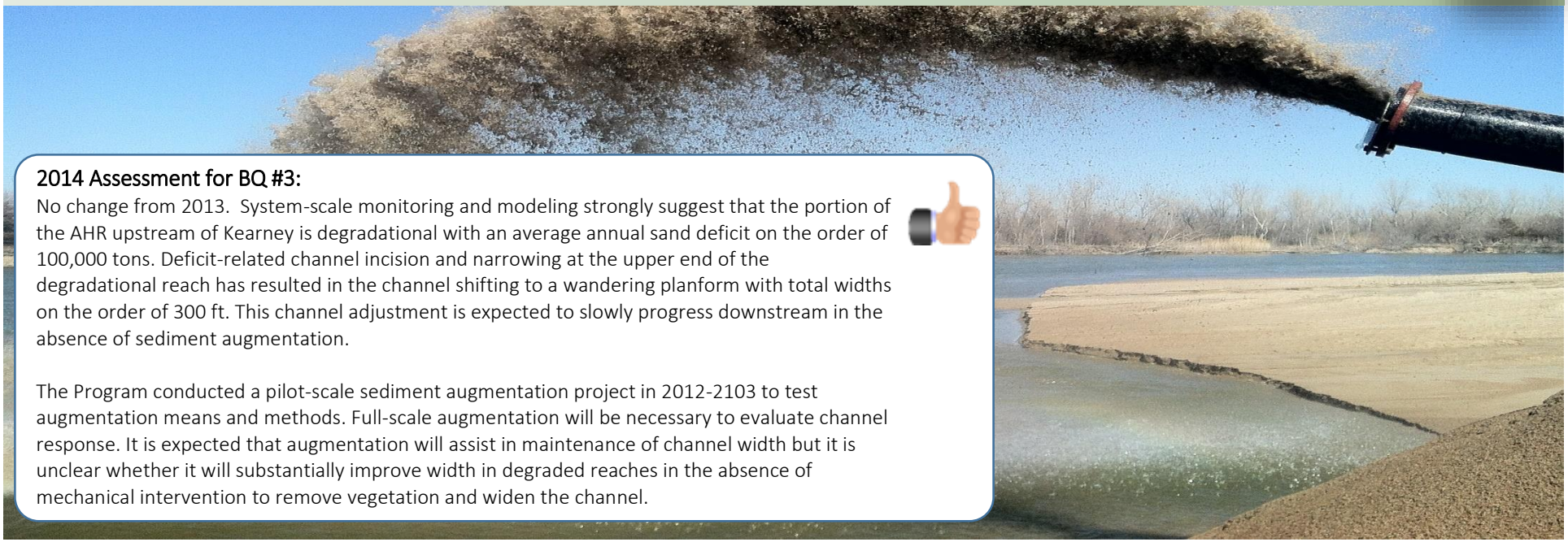
In order for SDHF releases to maintain unvegetated channel widths of 750 ft during drought conditions when narrowing occurs, the release must be capable of scouring and reworking the entire active channel bed. If phragmites persists in the AHR, flow releases alone will almost certainly not maintain channel width. In absence of phragmites, the proportion of channel reworked by a SDHF release will depend on channel topography and the type, density, and age-class of in-channel vegetation. As an example, the fall 2013 event occurred at the end of two drought years when much of the channel was colonized by vegetation (Figure 2). In wide reaches that were not disked prior to the event, the peak flow incised unvegetated portions of the bed but did not rework many of the heavily vegetated bedforms.

Answering BQ #2 during the First Increment

If phragmites persists and is not actively managed, SDHF will almost certainly not maintain channel width. If phragmites is adequately controlled, conclusively answering this question may require implementation and evaluation of multiple SDHF releases under a range of antecedent drought conditions.

[6] Analysis of 2009-2013 geomorphology and vegetation monitoring data.

BQ #3 – Is sediment augmentation necessary for the creation and/or maintenance of suitable riverine tern, plover, and whooping crane habitat?



2014 Assessment for BQ #3:

No change from 2013. System-scale monitoring and modeling strongly suggest that the portion of the AHR upstream of Kearney is degradational with an average annual sand deficit on the order of 100,000 tons. Deficit-related channel incision and narrowing at the upper end of the degradational reach has resulted in the channel shifting to a wandering planform with total widths on the order of 300 ft. This channel adjustment is expected to slowly progress downstream in the absence of sediment augmentation.

The Program conducted a pilot-scale sediment augmentation project in 2012-2103 to test augmentation means and methods. Full-scale augmentation will be necessary to evaluate channel response. It is expected that augmentation will assist in maintenance of channel width but it is unclear whether it will substantially improve width in degraded reaches in the absence of mechanical intervention to remove vegetation and widen the channel.

What Does the Science Say in 2014?

Program efforts have focused on completion of a pilot-scale sediment augmentation study to test augmentation means and methods. The study included evaluation of augmentation via sand pumping at the Plum Creek habitat complex and mechanical augmentation at the Cottonwood Ranch habitat complex. In total, approximately 180,000 tons of sediment (80,000 at Plum Creek and 100,000 at Cottonwood Ranch) were augmented during the fall of 2012 and spring of 2013.

Study results indicate that mechanical augmentation of sediment via island leveling and channel widening will be the most cost-efficient and flexible means of augmentation as long as suitable augmentation sites are available. Sand pumping requires less land and provides the additional ability to manipulate material gradation. However, operational complexity and cost of handling sediment multiple times make it uneconomical in most situations. Both augmentation methods provide the opportunity for multiple benefits. Mechanical augmentation specifically, provides the ability to combine augmentation with species habitat actions like channel widening and nesting island construction.

The pilot project identified several uncertainties that will need to be addressed in the design of a full scale augmentation program:

Figure 3. Example of mechanical augmentation (left) and sand pumping augmentation (right). Mechanical augmentation provides the ability to distribute sediment evenly across the channel. Point-source sand pumping produces limited capacity to entrain augmented material.

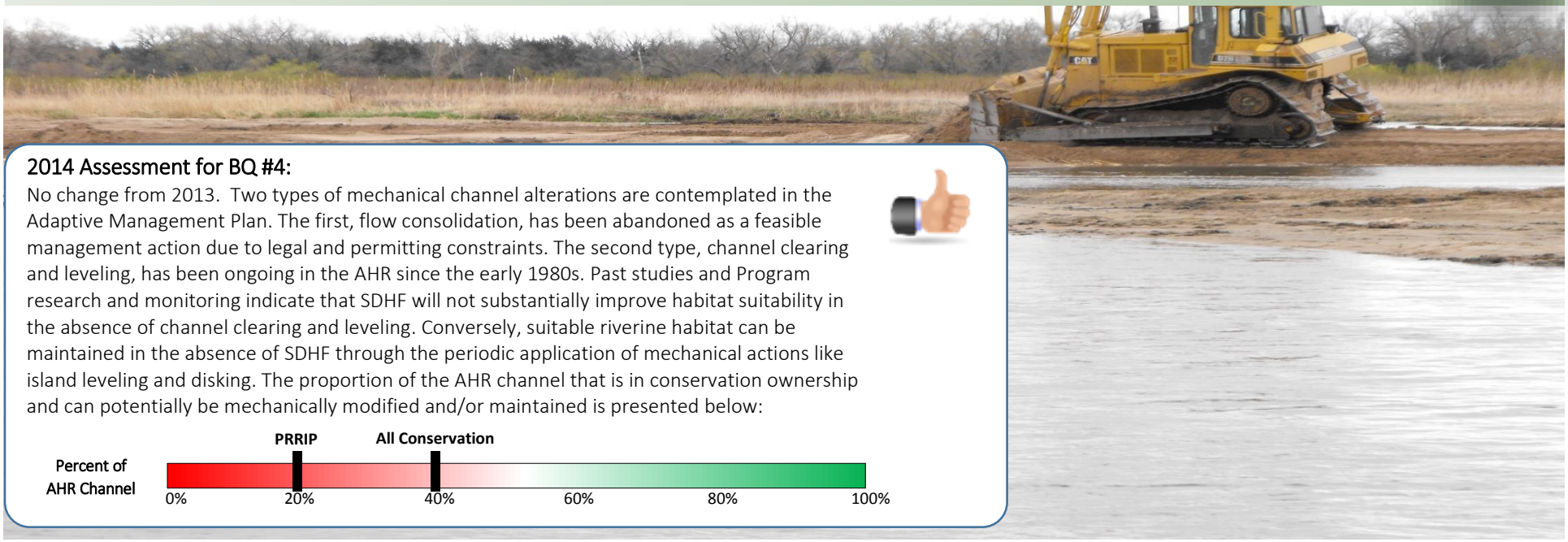
1) Augmentation to offset the average sediment deficit may not provide the desired results. Sediment transport and associated deficit are directly related to discharge, which is highly variable. Accordingly, annual deficits may range from almost 0 tons to 400,000 tons depending on hydrologic conditions.
2) The entire sediment deficit cannot be offset by augmentation at the Plum Creek Complex. Sediment transport capacity in the south channel at the Plum Creek Complex is limited due to the exclusion of natural flows upstream of the J-2 return. As such, augmentation downstream of the Overton bridge will be necessary.
3) Channel conditions throughout the reach affect sediment transport capacity and the ability to offset the deficit. For example, mechanically-widened reaches like the Cottonwood Ranch Complex have a reduced transport capacity and “trap” sediment augmented upstream. Reach-scale variability in transport capacity may make it difficult to offset the deficit in all reaches and/or require augmentation locations throughout the AHR.
4) The speed and magnitude of channel response to augmentation is still unknown. Minor changes in channel geometry were observed during the pilot project but long-term augmentation will be necessary to better evaluate response.

Answering BQ #3 during the First Increment

The Program is currently preparing to develop a full-scale sediment augmentation design and obtain the necessary permits and authorizations. Full scale operations and response monitoring will likely begin in 2015.

Implementation – Program Management Actions and Habitat

BQ #4 – Are mechanical channel alterations necessary for the creation and/or maintenance of suitable riverine tern, plover and whooping crane habitat?



2014 Assessment for BQ #4:

No change from 2013. Two types of mechanical channel alterations are contemplated in the Adaptive Management Plan. The first, flow consolidation, has been abandoned as a feasible management action due to legal and permitting constraints. The second type, channel clearing and leveling, has been ongoing in the AHR since the early 1980s. Past studies and Program research and monitoring indicate that SDHF will not substantially improve habitat suitability in the absence of channel clearing and leveling. Conversely, suitable riverine habitat can be maintained in the absence of SDHF through the periodic application of mechanical actions like island leveling and disking. The proportion of the AHR channel that is in conservation ownership and can potentially be mechanically modified and/or maintained is presented below:

What Does the Science Say in 2014?

System-scale geomorphology and vegetation monitoring data demonstrate a statistically significant positive relationship between total unvegetated channel width and the percent of flow consolidated in the main channel. This indicates that consolidating flow may increase habitat suitability. However, consultations with the United States Corps of Engineers (USACE) indicate they will not authorize any consolidation activities that result in a change in side channel hydrology or function. Consolidation would, by definition, cause such changes. As a result, the Program decided to terminate design of a flow consolidation pilot project at the Cottonwood Ranch habitat Complex.

Mechanical channel clearing and leveling has historically been the main tool employed by AHR conservation organizations to improve and maintain in-channel habitat suitability. It has been necessary, in part, due to the “vegetation ratchet” effect. As discussed in the BQ#2 assessment, vegetation-induced channel narrowing in the AHR has been episodic, occurring during drought periods. During subsequent wet periods with higher peak flows and associated stream power, the channel has historically not adjusted back to its previous width.

This has been dubbed the "vegetation ratchet" effect[7]. Figure 4 provides an example of the ratchet effect in Shelton to Wood River bridge segment, a reach with little mechanical management. In contrast, mechanically maintained reaches such as Audubon's Rowe Sanctuary in the Minden to Gibbon bridge segment retained habitat suitability during drought periods despite, in that case, only conveying 60% of total river flow (Figure 5).

Overall, conservation organizations control on the order of 40% of the main channel length in the AHR with the Program managing approximately half of that total. Given the limited potential for SDHF to improve habitat suitability in absence of mechanical actions, implementation may have little effect in the 60% to 80% of the AHR that is either not mechanically managed or is managed by other entities.

Answering BQ #4 during the First Increment

Program staff expect Big Question #4 to be answered with a definitive "two thumbs up" in 2015. Chester Watson, the Program's special advisor in geomorphology, developed a planform management manuscript focusing on the issues presented in this assessment. If published in a peer reviewed journal, it will be used to develop an expected two thumbs up assessment in 2015 and the Governance Committee will be presented information suggesting that decision-making should move into the final "Adapt" stage of adaptive management.

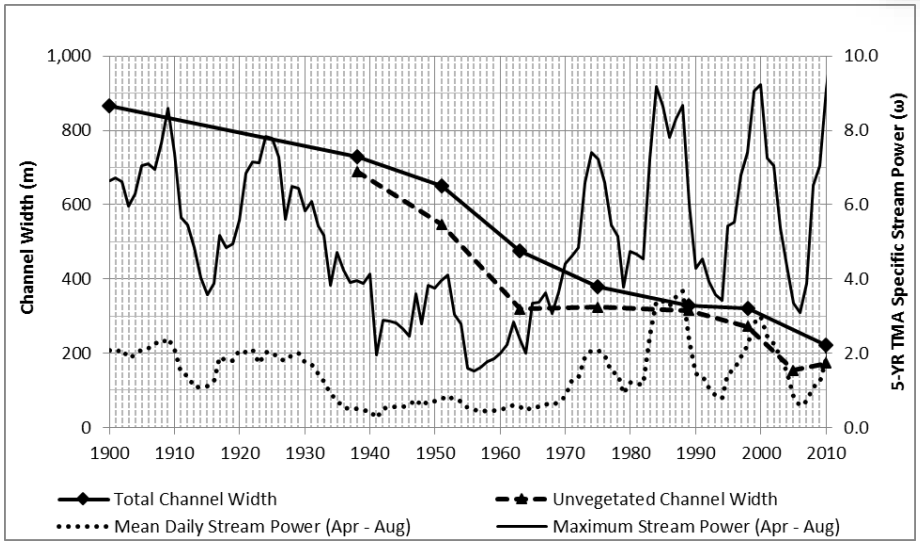


Figure 4. Reproduction from Program planform management manuscript. Figure demonstrates relationship between stream power and channel width in the Shelton to Wood River bridge segment 1900-2010.

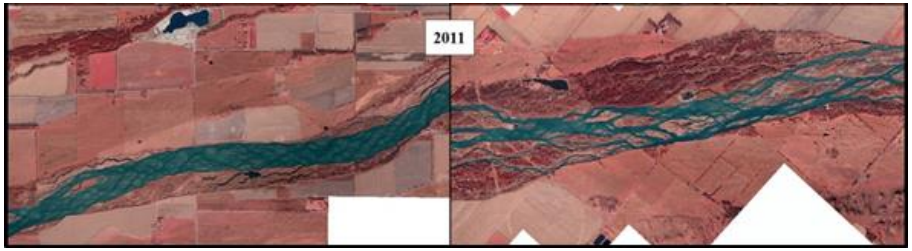
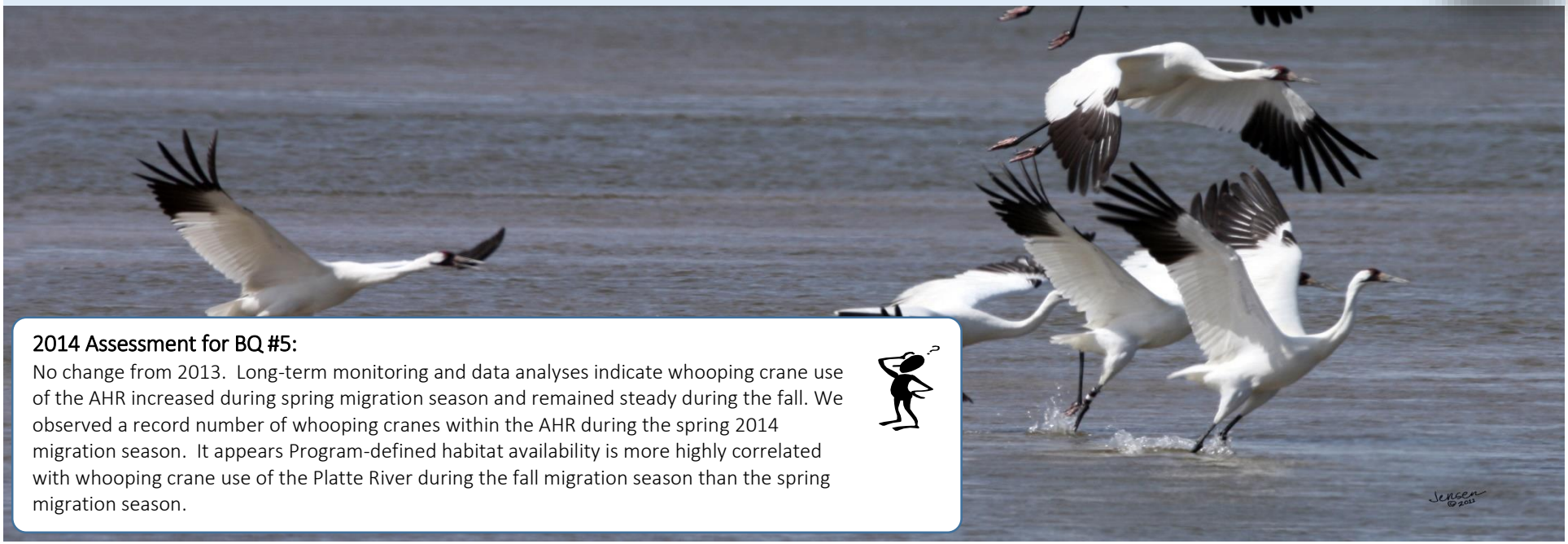


Figure 5. Two segment comparison of channel conditions following the drought of the 2000s. The mechanically managed Rowe Sanctuary segment (left) retained high habitat suitability. The unmanaged segment in the Grand Island to Chapman bridge segment (right) transitioned to an island braided planform during the drought. Mechanical clearing and leveling will be necessary to improve width suitability.

[7] Tal M, Gran K, Murray A, Paola C, and Hicks D. 2004. Riparian Vegetation as a Primary Control on Channel Characteristics in Multi-thread Rivers. Pages 43-58 in Riparian Vegetation and Fluvial Geomorphology, Sean Bennett, Andrew Simon, editors.

BQ #5 – Do whooping cranes select riverine roosting habitat in proportions equal to its availability?



2014 Assessment for BQ #5:

No change from 2013. Long-term monitoring and data analyses indicate whooping crane use of the AHR increased during spring migration season and remained steady during the fall. We observed a record number of whooping cranes within the AHR during the spring 2014 migration season. It appears Program-defined habitat availability is more highly correlated with whooping crane use of the Platte River during the fall migration season than the spring migration season.

What Does the Science Say in 2014?

First Increment Habitat management efforts implemented by the Program to date include, but are not limited to, tree removal and bank line disking to increase unobstructed view widths, channel disking and widening to increase unobstructed channel widths, and flow releases and sediment augmentation to test hypotheses related to increasing river braiding and areas of suitable depth for whooping crane roosting.

Though variable, the proportion of the whooping crane population documented within the AHR during the spring migration increased significantly over the past 14 years (see Figure 6 below). In spring 2014, a record number of individuals (41) including four radio-marked whooping cranes were documented using the Platte River, both of which represent 12.5% of the population.[8]

Fall use of the Platte River, however, remained fairly constant over the past 13 years.[9] Comparisons between crane use and Program-defined habitat availability indicate a stronger correlation between fall use and habitat availability than spring use and habitat availability.

[8] PRRIP Spring 2014 Whooping Crane Monitoring Report.

[9] PRRIP Fall 2013 Whooping Crane Monitoring Report.

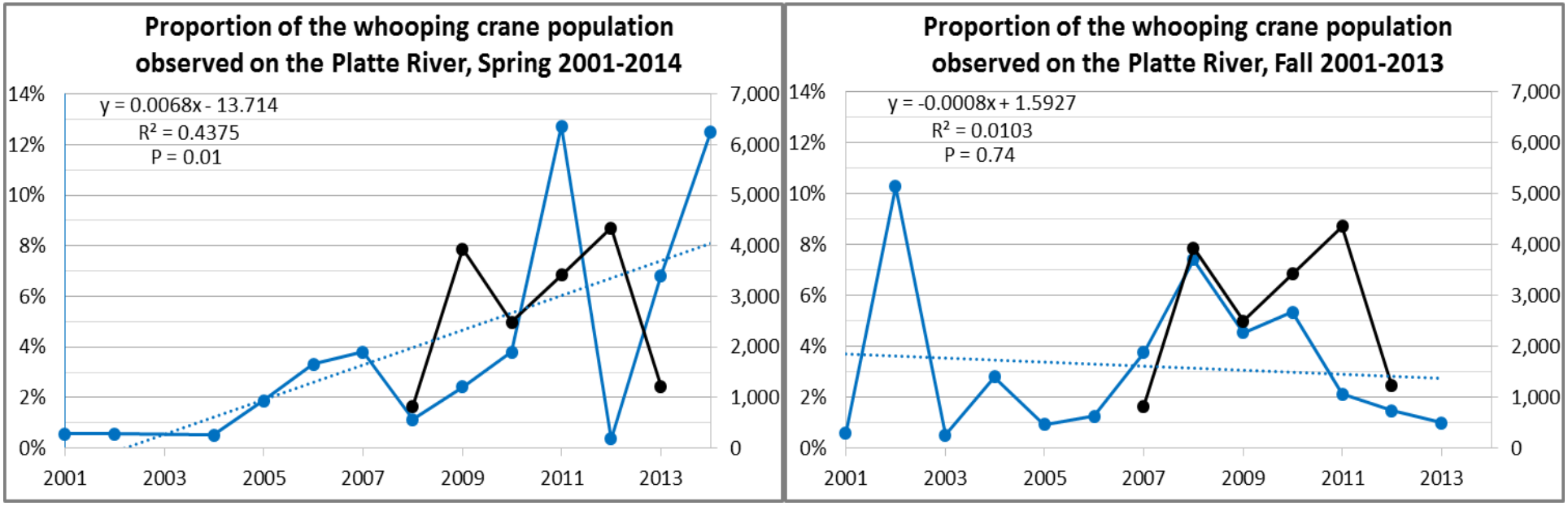


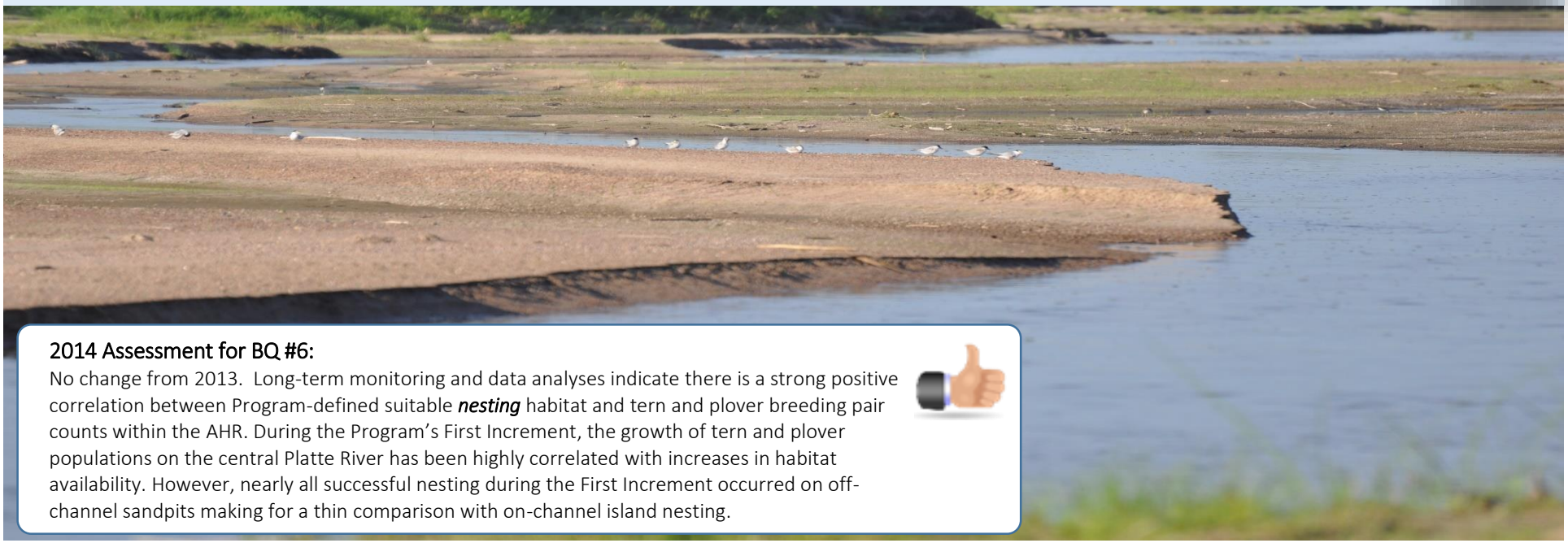
Figure 6. Trends (dashed lines) in the proportion (blue line) of the whooping crane population observed on the Platte River during spring (left) and fall (right) migration, 2001-2014. Radio-marked whooping cranes not detected are not included. Black lines represent Program-defined suitable in-channel habitat acres 2008-2013 (spring) or 2007-2012 (fall).

Answering BQ #5 during the First Increment

Detailed habitat selection analyses are now underway and will be complete in 2015. Program staff expect the results of these analyses will provide sufficient evidence to change the assessment for this Big Question in 2015. Subsequent peer review of the analyses, publication of related materials, and additional data (from annual monitoring, annual habitat availability assessments, the telemetry-tracking project, and the stopover study) should provide the key information necessary to develop a definitive assessment in 2016.

Effectiveness – Habitat and Target Species Response

BQ #6 – Does availability of suitable nesting habitat limit tern and plover use and reproductive success on the central Platte River?



2014 Assessment for BQ #6:

No change from 2013. Long-term monitoring and data analyses indicate there is a strong positive correlation between Program-defined suitable ***nesting*** habitat and tern and plover breeding pair counts within the AHR. During the Program's First Increment, the growth of tern and plover populations on the central Platte River has been highly correlated with increases in habitat availability. However, nearly all successful nesting during the First Increment occurred on off-channel sandpits making for a thin comparison with on-channel island nesting.

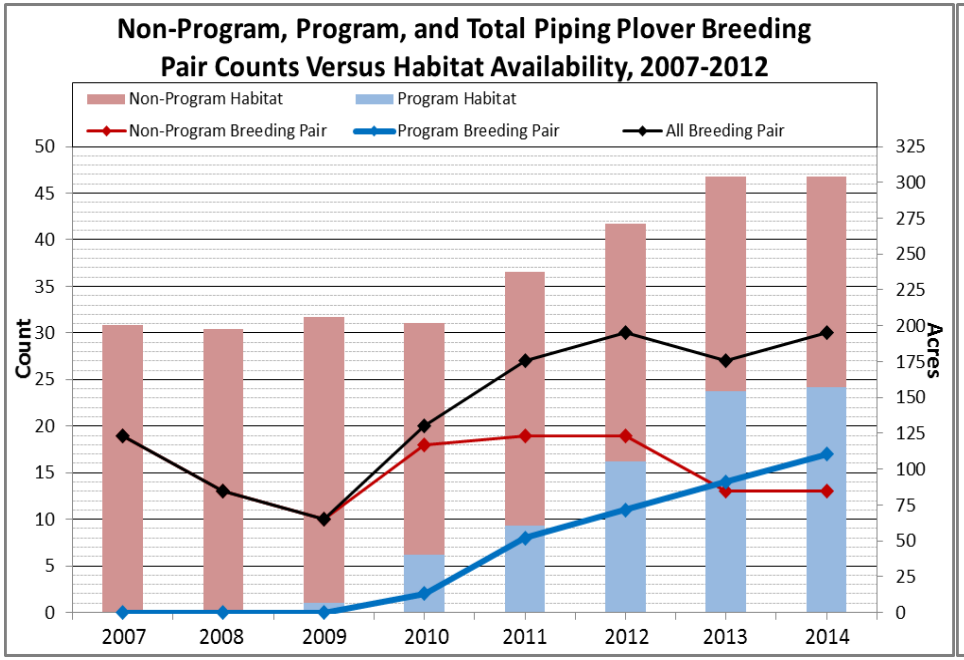
What Does the Science Say in 2014?

The Program and its partners created in-channel (sandbars) and off-channel (sandpits) nesting habitat to evaluate hypothesized relationships between habitat availability and tern and plover use and productivity within the Program Associated Habitat Area. The Program created and maintains ~90 acres of off-channel and ~65 acres of in-channel nesting habitat for terns and plovers.[10] In addition, Program partners constructed and/or managed ~60 acres of off-channel nesting habitat and 25 acres of in-channel nesting habitat.[11]

Increases in nesting habitat through Program creation and maintenance activities resulted in consistent increases in tern and plover use of the Program Associated Habitat Area since 2007. During this same timeframe, non-Program habitat availability declined as unmanaged sandpit sites were developed or became vegetated and unsuitable for tern and plover nesting. We observed a high, positive correlation between tern and plover breeding pair counts and habitat availability. Program data also indicate breeding pair counts increase at a similar rate as habitat availability.

[10] See PRRIP 2012-2013 Tern and Plover Monitoring Report; also relies on provisional 2014 monitoring data.

[11] Ibid.



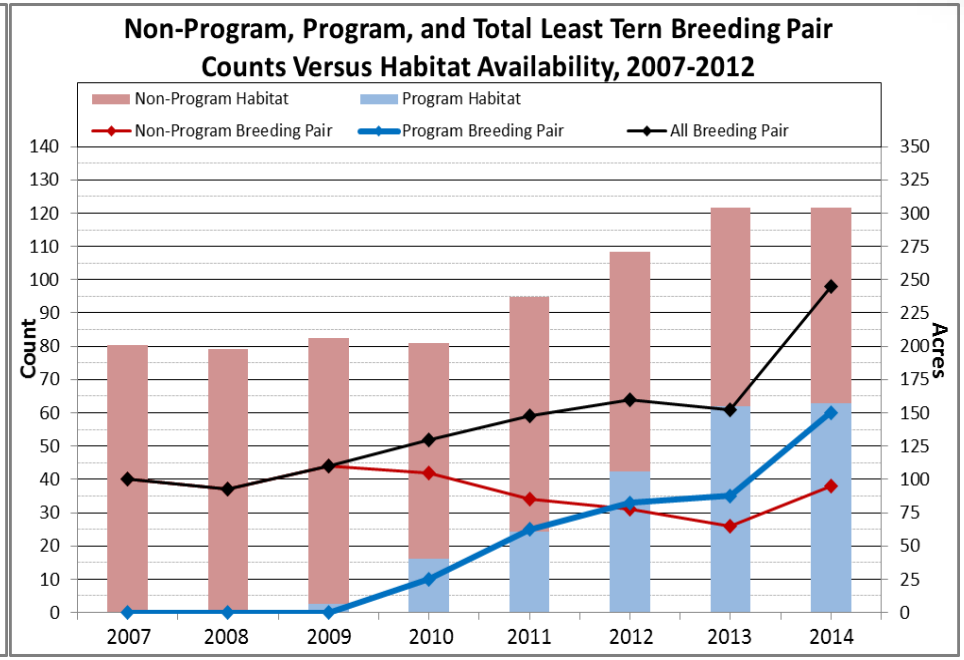


Figure 7. Tern (left plot) and plover (right plot) Program, non-Program, and total breeding pair counts (solid lines) and Program and non-Program habitat availability, 2007-2014.

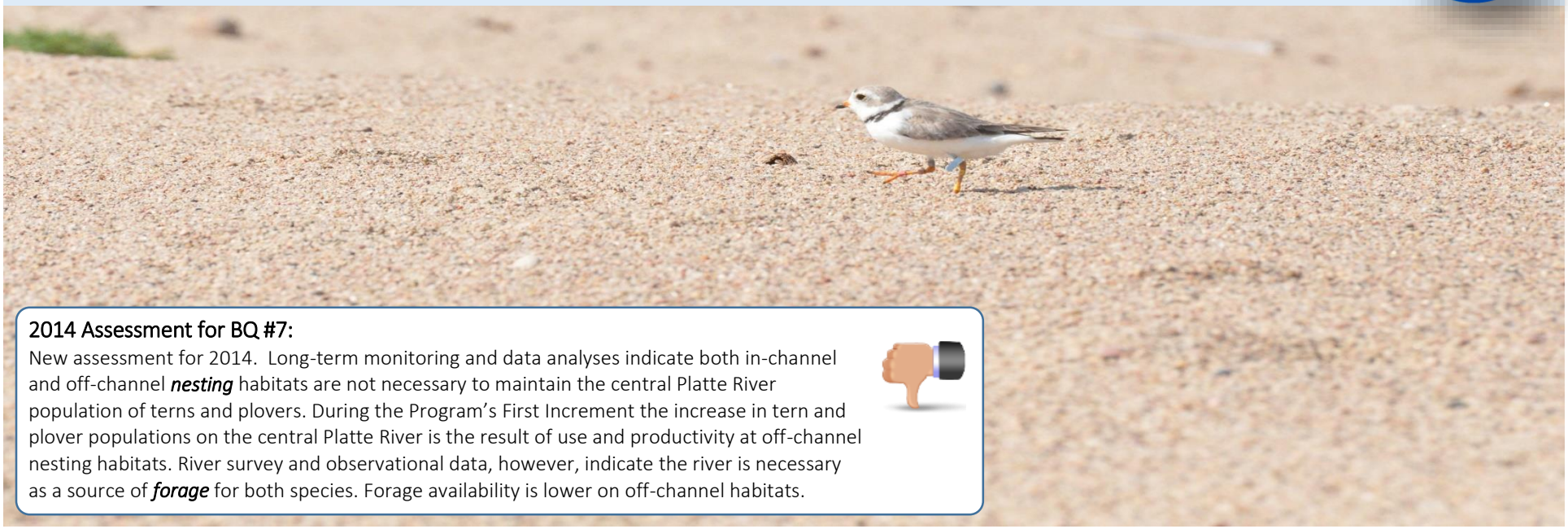
We observed significant increases in the numbers of tern and plover breeding pairs within the Program Associated Habitats from 2001-2014.[12] Banding data indicate increases in breeding pairs observed to date are the result of consistently high use and productivity within the Program Associated Habitat Area rather than immigration events or a redistribution of birds across multiple systems.

Answering BQ #6 during the First Increment

Program staff are in the process of conducting breeding pair analyses and developing a manuscript for peer review and/or publication that likely will be used as key information necessary to warrant a definitive two-thumbs up assessment in 2015.

[12] Ibid.

BQ #7 – Are both suitable in-channel and off-channel nesting habitats required to maintain central Platte River tern and plover populations?



2014 Assessment for BQ #7:

New assessment for 2014. Long-term monitoring and data analyses indicate both in-channel and off-channel ***nesting*** habitats are not necessary to maintain the central Platte River population of terns and plovers. During the Program's First Increment the increase in tern and plover populations on the central Platte River is the result of use and productivity at off-channel nesting habitats. River survey and observational data, however, indicate the river is necessary as a source of ***forage*** for both species. Forage availability is lower on off-channel habitats.

What Does the Science Say in 2014?

The Program and its partners created in-channel (sandbars) and off-channel (sandpits) nesting habitat to evaluate hypothesized relationships between in- and off-channel habitat availability and selection of terns and plovers. Early Program efforts largely focused on off-channel nesting sites as flows and permitting challenges precluded construction of in-channel nesting islands. Program efforts in recent years were directed at maintaining off-channel nesting habitat and constructing and maintaining suitable in-channel habitat.

The creation and maintenance of off-channel nesting habitat has resulted in consistent use and productivity since 2001. During this same timeframe, in-channel habitat availability and tern and plover nesting and productivity have been sporadic and thus contributed little to the maintenance of the central Platte River populations. Despite the limited use and productivity of in-channel nesting habitat, we have observed significant increases in the numbers of tern and plover breeding pairs within the Program Associated Habitats from 2001-2014. Banding data indicate increases in breeding pairs observed to date are the result of consistently high use and productivity at off-channel nesting sites within the AHR rather than immigration events or a redistribution of birds across multiple systems.

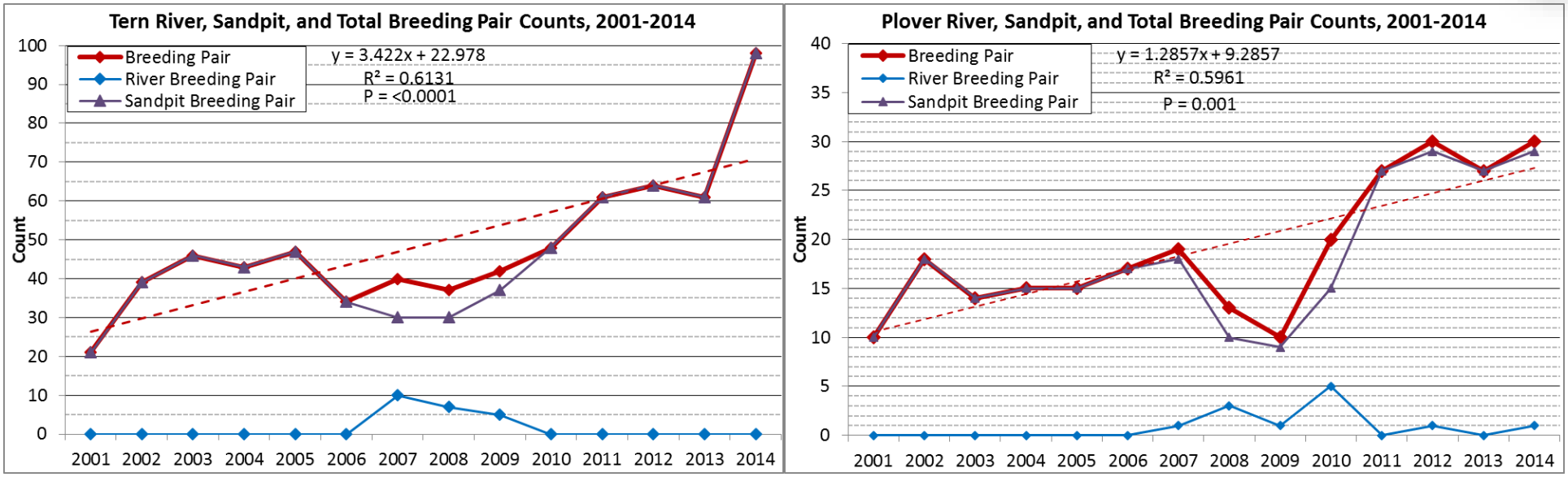


Figure 8. Annual tern (left plot) and plover (right plot) total, riverine, and sandpit breeding pair counts, 2001-2014. Trend lines (dashed lines) represent significant increases in tern and plover breeding pair counts during 2001-2014 with the most substantial increases occurring since inception of the Program.

Efforts to create and maintain suitable in-channel nesting habitat have necessarily been opportunistic but fairly extensive. Since 2001, breeding pair counts for terns increased nearly 5-fold (21 to 98) while plover counts tripled (10 to 30), both of which represent significant increases.[13] Though populations of both species increased during this timeframe, increases of similar magnitude have not been observed throughout the species' ranges.

Though in-channel nesting habitat contributed little to the sustainability of both populations, ephemeral islands and river channels appear to provide an important source of forage for both terns and plovers. The abundant forage base provided by the river likely contributed to the high productivity observed on off-channel nesting sites since 2001.

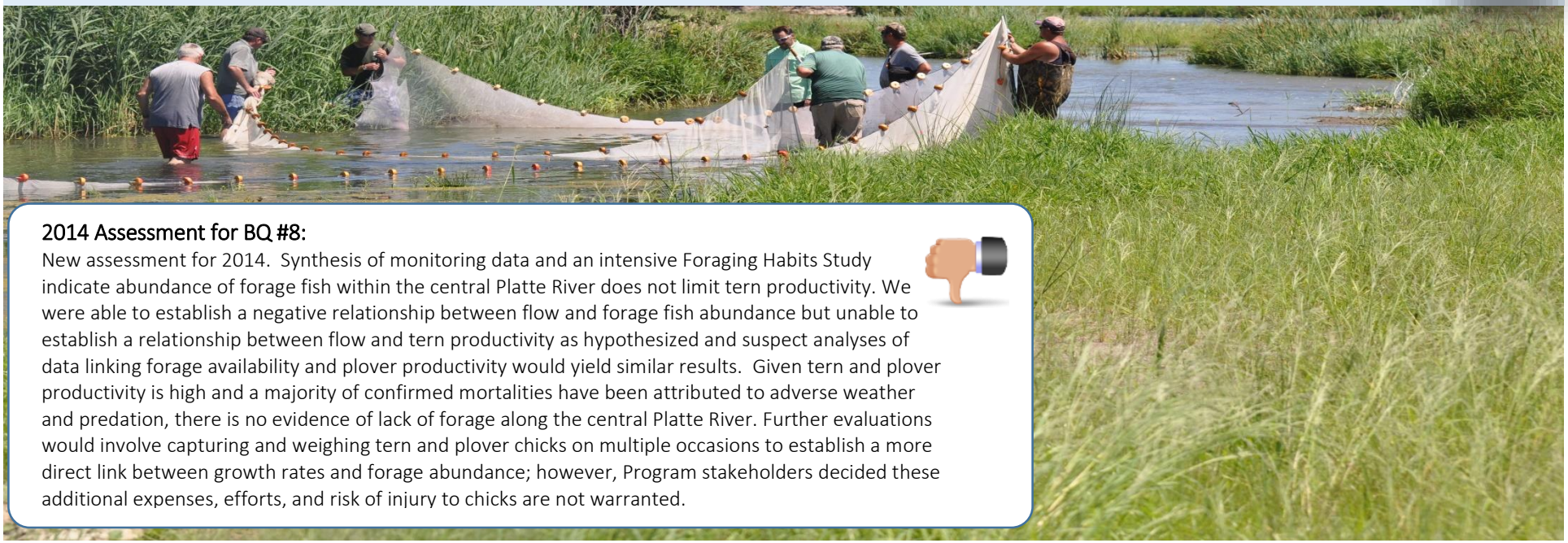
Answering BQ #7 during the First Increment

Without substantial nesting and productivity on Program defined suitable in-channel habitat during the upcoming years, further evaluations may soon warrant a two-thumbs down assessment for this Big Question. The EDO will conduct in- and off-channel habitat selection analyses in 2015 and develop a manuscript for peer review and/or publication that could be used as key information necessary to warrant a definitive two-thumbs down answer next year.

[13] See PRRIP 2012-2013 Tern and Plover Monitoring Report; also relies on provisional 2014 monitoring data.

Effectiveness – Habitat and Target Species Response

BQ #8 – Does forage availability limit tern and plover productivity on the central Platte River?



2014 Assessment for BQ #8:

New assessment for 2014. Synthesis of monitoring data and an intensive Foraging Habits Study indicate abundance of forage fish within the central Platte River does not limit tern productivity. We were able to establish a negative relationship between flow and forage fish abundance but unable to establish a relationship between flow and tern productivity as hypothesized and suspect analyses of data linking forage availability and plover productivity would yield similar results. Given tern and plover productivity is high and a majority of confirmed mortalities have been attributed to adverse weather and predation, there is no evidence of lack of forage along the central Platte River. Further evaluations would involve capturing and weighing tern and plover chicks on multiple occasions to establish a more direct link between growth rates and forage abundance; however, Program stakeholders decided these additional expenses, efforts, and risk of injury to chicks are not warranted.

What Does the Science Say in 2014?

The EDO used data and results from the USGS Foraging Habits Study and a synthesis of forage fish monitoring data[14,15] collected as part of a protocol implemented by Nebraska Public Power District and Central Nebraska Public Power and Irrigation District to assess BQ #8 with respect to terns. A draft report formatted for submission to a peer-reviewed journal is now under review by the TAC and ISAC and will be submitted to the Governance Committee for publication approval in December 2014. In the detailed report, we synthesize multiple lines of evidence and all available data, including independent data sets relating flow, forage fish abundance, foraging behavior, and productivity.

Results indicate forage fish abundance increases as flow decreases. However, foraging behavior and success were not influenced by flow and thus forage fish abundance. We were unable to establish the hypothesized link between flow and productivity. Given the high levels of productivity observed on the central Platte River, it is unlikely

[14] Initial EDO analysis of forage fish data from NPPD and CNPPID fish monitoring protocol implementation.

[15] 2011 annual fish population monitoring report from NPPD and CNPPID, as an example.

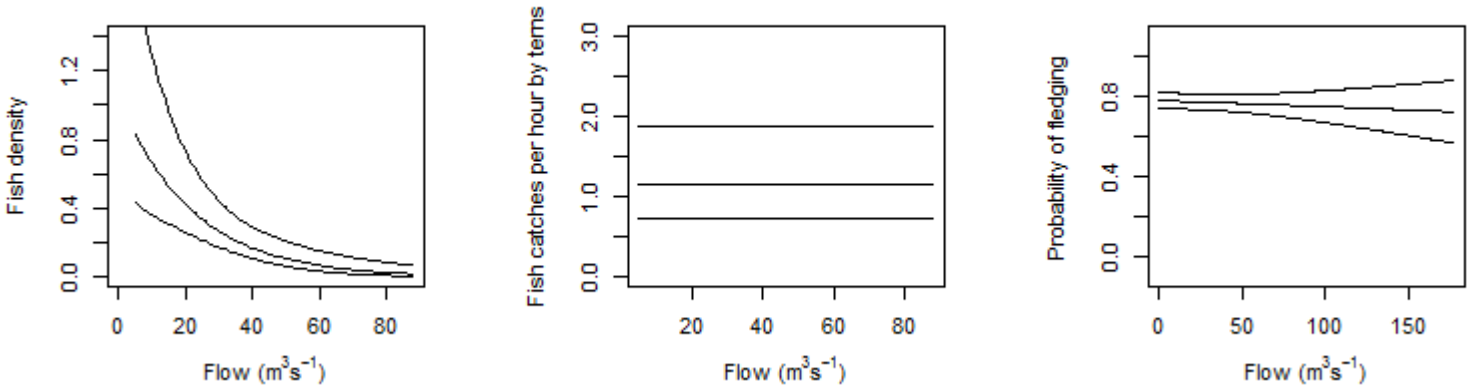


Figure 9. Results from data synthesis examining relationships between flow and forage fish density (left), flow and forage fish catch rates by terns (middle), and flow and tern productivity (right).

forage fish abundance, and thus flow, limits tern productivity.

A similar synthesis of data could be developed for plovers; however, given results of the Foraging Habits Study and high levels of productivity observed to date, there is a complete lack of evidence forage abundance limits plover productivity on the AHR.

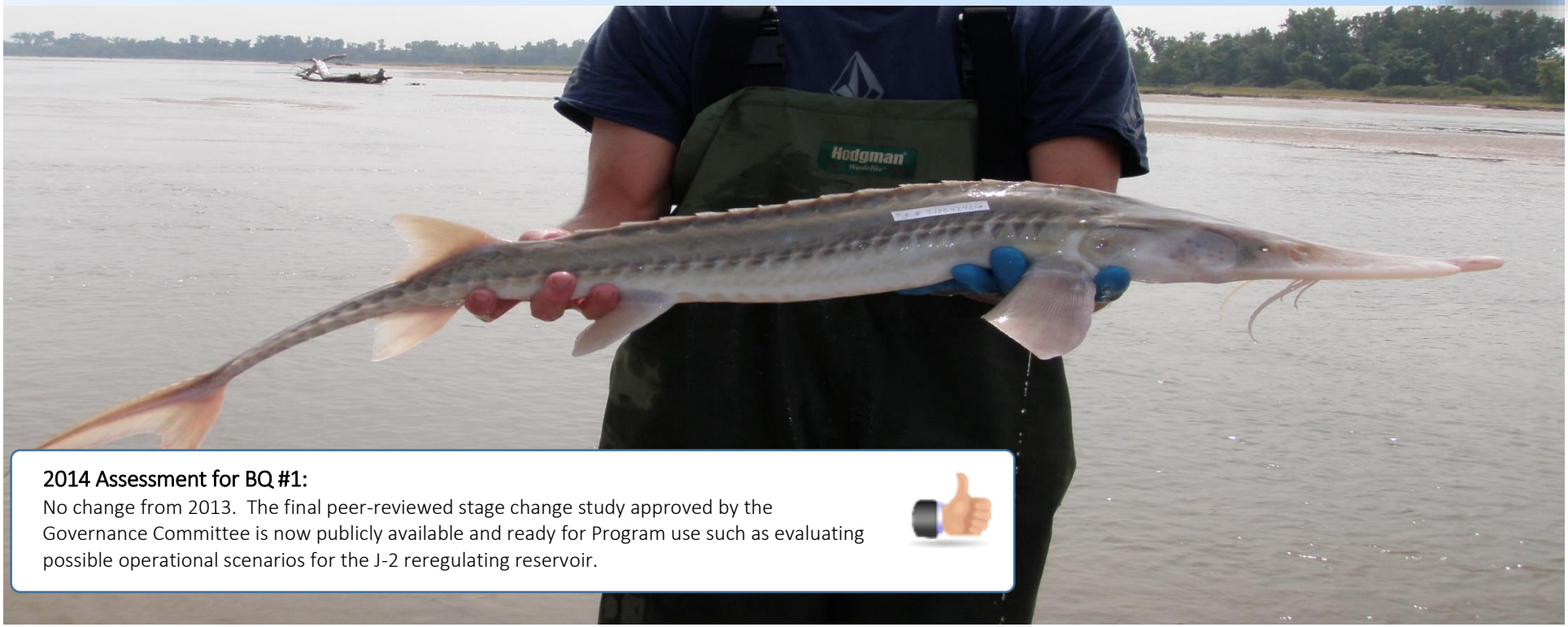
Further evaluations of BQ #8 would likely entail system-wide, intensive, summer-long forage sampling, tern and plover behavioral studies, and potentially capturing and weighing chicks on multiple occasions to attempt to establish relationships between forage abundance, flow, productivity, and long-term survival. Program stakeholders previously indicated additional expenses, efforts, and risk of injury to chicks are not warranted as it appears forage abundance and reproductive success are adequately high to support central Platte River tern and plover populations.

Answering BQ #8 during the First Increment

Program staff expect Big Question #8 to be answered with a definitive "two thumbs down" in 2015. While this question was noted as "answered" in the past, recent policy changes related to peer review and publication requirements led to a less-definitive assessment for 2014. The forage fish analysis manuscript now being reviewed by the TAC and ISAC will serve as the best source for synthesized reference data for this question and the results of that analysis indicate that forage availability does not limit tern and plover productivity on the AHR. If the GC approves seeking publication and the manuscript is accepted for publication, the analysis will be used to develop an expected two thumbs down assessment in 2015 and the GC will be presented information suggesting that decision-making should move into the final "Adapt" stage of adaptive management. In this case, the Big Question and the related priority hypothesis will be considered answered and the recommendation will be to focus Program resources on other tern and plover uncertainties in the AHR.

Effectiveness – Habitat and Target Species Response

BQ #9 – Do Program flow management actions in the central Platte River avoid adverse impacts to pallid sturgeon in the lower Platte River?



2014 Assessment for BQ #1:
No change from 2013. The final peer-reviewed stage change study approved by the Governance Committee is now publicly available and ready for Program use such as evaluating possible operational scenarios for the J-2 reregulating reservoir.

What Does the Science Say in 2014?

The general conclusion of the Program's Final Stage Change Study is that Program water management activities will not result in measurable changes on flows in the lower Platte River and thus will result in little change to the amount of habitat available to pallid sturgeon. However, given that short-term connectivity could be problematic under certain, but infrequent, hydrological conditions, and assuming the biological significance of habitat connectivity for pallid sturgeon[16] above 4,000 cfs, the study tool could be used by the Program to implement proactive measures (e.g. altering excess-to-target-flow diversion timing or duration) to prevent potential negative impacts on habitat connectivity.

[16] The "Alternative Analysis of Program Activities" in the Final Stage Change Study evaluated a hydrologic scenario against all six habitat classifications during both the spring (spawning period) and the fall (overwintering and upcoming spawning movements).

Protocol/Activity	2014 Status
1. A summary of existing information on the pallid sturgeon. • Objective is to understand the existing knowledge on pallid sturgeon biology range wide, but with particular emphasis on the Platte River	*Complete –* Pallid Sturgeon Literature Review
2. Micro- and macro-habitat use/selection by adult and juvenile pallid sturgeon, relative to conditions. • Objectives are to: 1) determine what habitats pallid sturgeon use (and select for) in the Platte River, and what are the similarities and difference with habitat use and selection in other parts of the species' range; and 2) does use and selection change with changes in river conditions, and if so how?	Not started
3. Identify the physical effects of subtly different rates of flow (stage and associated elements) over time on connection, construction, maintenance, and evolution of pallid sturgeon habitat components. Data need is pursuant to developing appropriate offsets for flow reductions stemming from implementation of the Program and New Depletions Plans. • Objective is to quantify and identify how the distribution of existing macro- and meso-habitats change over time and flow conditions.	*Complete –* Final Stage Change Study
4. Characterization of selected water quality parameters in the lower Platte and tributary conditions. • Objective is to determine what the range and variation, both spatially and temporally, of selected water quality parameters (particularly temperature, turbidity, dissolved oxygen, and specific conductivity) are in the lower Platte River under a range of flow conditions, as well as the relative contributions of the individual sub-basins.	*Complete –* Lower Platte River water quality monitoring
5. Periodic evaluation and peer review of information.	Ongoing

Table 1. Pallid sturgeon monitoring and research protocols/activities, from the Adaptive Management Plan, Integrated Monitoring & Research Plan.[17]

Answering BQ #9 during the First Increment

Further Program actions for the pallid sturgeon (e.g. pallid sturgeon habitat use/selection research[18]) are squarely a policy decision that is at the sole discretion of the Governance Committee (GC). Some Program participants requested development of a manuscript on the stage change study for publication in a refereed scientific journal. In March 2014, the GC decided to move forward with several other potential manuscripts as publication test cases in 2014. A decision to move forward on a stage change study manuscript will be re-visited in 2015. The GC could also consider additional pallid sturgeon activities as described in the Integrated Monitoring and Research Plan (Table 1) found in the Program's Adaptive Management Plan.

[17] Pallid sturgeon item V.K.3.2, Integrated Monitoring and Research Plan (IMRP), Adaptive Management Plan (Page 45).
[18] Ibid.

Larger Scale Issues – Application of Learning

BQ #10 – How do Program management actions in the central Platte River cumulatively contribute to least tern, piping plover, and whooping crane recovery?

2014 Assessment for BQ #10:

No change from 2013. Continued implementation of the Program's Land Plan, Water Plan, and Adaptive Management Plan is considered a contribution toward recovery of the target species. The Program also continues to engage with entities in other river systems and locations to assess the significance of Program management actions and the resulting bird response on the overall populations of all three target species.

What Does the Science Say in 2014?

Implementation of the Program continues to serve as the Reasonable and Prudent Alternative for the U.S. Fish and Wildlife Service's Final Biological Opinion on the Platte River and thus is helping to secure "defined benefits for the target species and their associated habitat to assist in their conservation and recovery".[19] The Program has met the First Increment Land Objective of acquiring and managing 10,000 acres, is moving forward on water projects like the J-2 reregulating reservoir, and is moving toward the final "Adjust" step of adaptive management on several key Big Questions and related hypotheses.

Through projects like the Whooping Crane Telemetry Tracking Project, the Whooping Crane Stopover Study, and synthesis of several lines of evidence related to terns and plovers on the AHR including comparisons with other river systems, the Program is also actively working with parties in other locations to develop assessment mechanisms for the significance of the central Platte River in overall recovery of the three target bird species.

[19] See Page 1 of the Final Program Document, Program Purposes.

Answering BQ #10 during the First Increment

This question was re-worded in 2014 to read "…*cumulatively* contribute…" as recommended by the ISAC. The ISAC recommended this change to ensure the language of the question is consistent with Broad Hypothesis S-1 in the Adaptive Management Plan, which reads:

> *A combination of flow management, sediment management, and land management (i.e. Clear/Level/Pulse or FSM) will/will not generate detectable changes in the channel morphology of the Platte River on Program lands, and/or habitats for whooping crane, least tern, piping plover, pallid sturgeon, and other species of concern".*[20]

In 2015, Program staff and the Technical Advisory Committee will work with the ISAC to develop a strategy for evaluating the cumulative benefits of Program management actions on scales more amenable to the scale of Program implementation and the scale of Program decision-making.

[20] PRRIP Adaptive Management Plan, page 14.