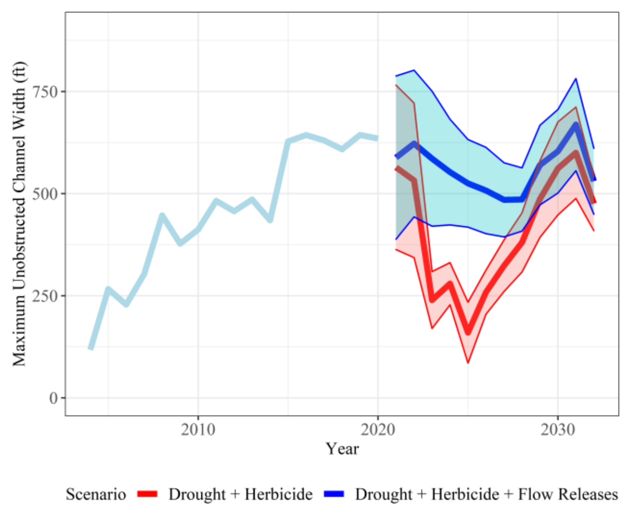
Extension Big Question #1: How effective is it to use Program water to maintain [suitable](#)* whooping crane roosting habitat?

**Channels with ≥ 650 ft maximum width unobstructed by dense vegetation (MUCW) are highly suitable for whooping crane roosting.*

Management Hypothesis: Releases to achieve a 30-day minimum flow target of 1,500 cfs between June 1 – July 15 will suppress germination, slow vegetation expansion into the channel, and increase the percent of AHR channel that remains highly suitable for whooping crane roosting (germination suppression release).

Assumes ongoing Phragmites spraying. Program science strongly indicates that natural peak flow events exceeding 13,000 cfs or mechanical vegetation clearing are necessary to remove vegetation and increase MUCW. Germination suppression releases are only hypothesized to maintain unvegetated width.

X-Y Graph



Based upon the Program's machine learning model, it is hypothesized that channel-inundating flow releases for at least 30 days (June 1-July 15; target 1,500 cfs) will suppress seed germination and slow loss of MUCW during drought periods absent natural peak flows of sufficient magnitude (>13,000 cfs) to naturally maintain and/or increase MUCW.

Alternative Hypotheses:

- 30-day inundation between June 1 – July 15 is insufficient – must maintain release throughout growing season
- The 1,500 cfs target is too much or too little to maintain suitable MUCWs.
- Hydrocycling increases/decreases effectiveness of germination suppression release
- Insufficient water and/or conveyance capacity to implement release.
- Ongoing *Phragmites* spraying (herbicide application) is primarily responsible for channel width maintenance by controlling rate of vegetation establishment. Herbicide kills vegetation and flow subsequently removes islands/dead standing biomass via lateral erosion.
- Mechanical vegetation clearing is necessary to maintain suitable MUCWs.
- Fall SDHF will scour < 1 year old seedlings and maintain suitable MUCWs.

Second Increment management decision-making context:

- Research during the First Increment indicated that periodic long-duration peak flows exceeding 13,000 cfs are necessary to scour vegetation and create highly suitable MUCW for whooping crane roosting. This flow magnitude and volume far exceed Program water management capacity.
- Instead, the Program is focusing on assessing our ability to **maintain** highly suitable MUCWs (created via natural peak flows or mechanical clearing) by preventing vegetation from germinating and growing in the channel.
- Preliminary assessments of effectiveness (1,500 cfs for 30-days) are cautiously positive indicating that germination suppression releases may be an effective tool for unobstructed width maintenance.

Extension research/monitoring was expected to address the following negotiation-related questions:

- What is the tradeoff of using water for germination suppression versus whooping crane roosting? (*for reference, there may be insufficient water for both in as many as 50% of years*)
  - How does the rate of vegetation expansion into the channel vary with discharge during June?
    - How much MUCW is lost and how much $ necessary to treat and remove in-channel vegetation with and without germination suppression flows?
- Do channel capacity limitations at the North Platte Choke Point in late June reduce the effectiveness of germination suppression flow releases and what are the trade-offs of investing in additional water versus increasing conveyance capacity at that location?

How is ongoing research intended to address these uncertainties?

- Develop estimates of the effectiveness of germination suppression flow releases (relative to spraying, disking, and natural peak flows) for maintenance of highly suitable MUCWs for whooping crane roosting.
- Develop estimates of vegetation establishment (and subsequent mechanical clearing effort) in years without natural peak flows or gemination suppression releases.

Do we know enough already to estimate relationships (with confidence) and stop focusing on this question?

- EDO assessment:
  - Collected 3 years of data (2022-2024) in years with germination suppression release.
    - High variability in magnitude and duration of release across years.
  - Expect variable response to channel inundation depending upon highly variable physical and hydrological conditions across the reach each year.
  - Can estimate vegetation expansion rate with incomplete germination suppression in dry years with low confidence.
  - Can estimate vegetation expansion rate with germination suppression release in normal years with high confidence.
  - Can estimate expansion rates in past dry years with no germination suppression release with low confidence.

- TAC Assessment?
- ISAC Assessment?

Potential surprises:

- What happens if Platte Valley Weed Management Area can't spray *Phragmites*?
- What happens if effectiveness of herbicide declines through time or contractors unable/willing to disk the channel?

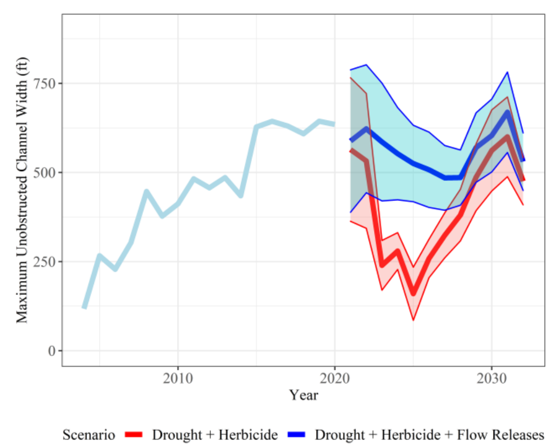
Extension Big Question #2: How effective is Program management of Phragmites for maintaining [suitable](#)* whooping crane roosting habitat?

*Channels with ≥ 650 ft maximum width unobstructed by dense vegetation (MUCW) are highly suitable for whooping crane roosting.

Management Hypothesis: Releases to achieve a 30-day minimum flow target of 1,500 cfs between June 1 – July 15 in combination with continued herbicide spraying will slow *Phragmites* rhizome/stolon expansion into the channel and increase the percent of AHR channel that remains highly suitable for whooping crane roosting.

Assumes ongoing Phragmites spraying. Program science strongly indicates that natural peak flow events exceeding 13,000 cfs or mechanical vegetation clearing are necessary to remove vegetation and increase MUCW. Channel-inundating flow releases are only hypothesized to maintain unvegetated width.

X-Y Graph



Based upon the Program's machine learning model, it is hypothesized that channel-inundating flow releases for at least 30 days (June 1-July 15; target 1,500 cfs) will slow *Phragmites* expansion into the river channel during the period of inundation, slowing the loss of MUCW during drought periods absent natural peak flows of sufficient magnitude (>13,000 cfs) to naturally maintain and/or increase MUCW, thus providing incremental benefits in controlling *Phragmites* above those provided by herbicide application alone.

Alternative Hypotheses:

- 30-day inundation between June 1 – July 15 is insufficient – must maintain release throughout growing season
- The 1,500 cfs target is too much or too little to control *Phragmites* expansion and maintain suitable MUCWs.
- Hydrocycling increases/decreases effectiveness of inundating flow release
- Insufficient water and/or conveyance capacity to implement release.
- Ongoing *Phragmites* spraying (herbicide application) is primarily responsible for channel width maintenance by controlling rate of vegetation expansion. Herbicide kills vegetation and flow subsequently removes islands/dead standing biomass via lateral erosion.
- Mechanical vegetation clearing is necessary to control *Phragmites* expansion and maintain suitable MUCWs.
- Fall SDHF will scour *Phragmites* from in-channel sandbars and channel banks and maintain suitable MUCWs.

Second Increment management decision-making context:

- *Phragmites* is THE single biggest threat to maintaining suitable whooping crane roosting habitat into the future.
- In absence of flow (and/or herbicide) *Phragmites* rapidly expands into the channel via stolons.
- *Phragmites* expansion directly reduces MUCW. During early 2000s, >50% of channel transitioned to *Phragmites* in under 5 years.
- Took another 5+ years of intensive spraying, mechanical removal & peak flows to restore UOCW.
- PVWMA now spends $600,000 a year spraying to manage infestation, 30% - 50% is provided by PRRIP.

Extension research/monitoring was expected to address the following negotiation-related questions:

- What is the tradeoff of using water for germination suppression versus whooping crane roosting? (*for reference, there may be insufficient water for both in as many as 50% of years*)
  - How does the rate of *Phragmites* expansion into the channel vary with discharge during June?
    - How much MUCW is lost and how much $ necessary to treat and remove *Phragmites* with and without germination suppression flows?
- Does channel inundation in June cause expansion of *Phragmites?* If so, does this outweigh the benefits of suppressing cottonwood and willow germination?

How is ongoing research intended to address these uncertainties?

- Develop estimates of patch expansion patterns and rates in different physical/hydrologic scenarios.
- Develop estimates of expansion with and without spraying (spray efficiency)

Do we know enough already to estimate relationships (with confidence) and stop focusing on this question?

- EDO assessment:
  - Collected 3 years of data (2022-2024) in years with germination suppression release.
    - High variability in magnitude and duration of release across years.
    - Year 1 with less information on patch expansion into the channel. Years 2-3 focused on in-channel patch expansion.
    - All years concurrent with full-scale implementation of *Phragmites* spraying program, but herbicide application did not adhere to experimental design.
  - Expect highly variable *Phragmites* response to channel inundation depending upon highly variable physical and hydrological conditions across the reach each year.
  - Can estimate expansion rate with incomplete germination suppression in dry years with low confidence.
  - Can estimate expansion rate with germination suppression release in normal years with high confidence.
  - Can estimate expansion rates in past dry years with no germination suppression release and/or *Phragmites* spraying with low confidence.
    - High uncertainty about future scenario where spraying lapses or becomes less effective.

- TAC Assessment?
- ISAC Assessment?

Potential surprises:

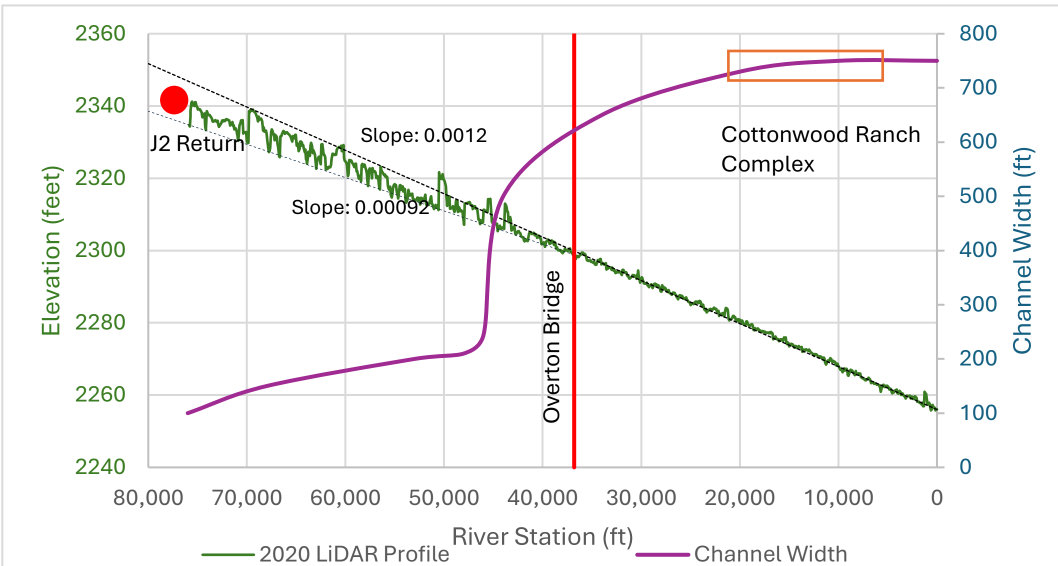
- What happens if PVWMA can't spray *Phragmites*?
- What happens if effectiveness of herbicide declines through time?

Extension Big Question #3: Is sediment augmentation necessary to create and/or maintain suitable whooping crane habitat?

*Channels with ≥ 650 ft maximum width unobstructed by dense vegetation (MUCW) are highly suitable for whooping crane roosting.

Management Hypothesis: Sediment augmentation is necessary to halt narrowing and incision in the south channel downstream of the J-2 Return.

X-Y Graph



Full scale sediment augmentation (60,000 – 80,000 tons annually in south channel below J-2 Return) is necessary to offset the sediment deficit and halt narrowing and incision that has caused the upper portion of the south channel to transition to a narrow meandering planform, which is much less suitable for WC roosting. If incision is not halted, the affected reach will continue to expand downstream past the Overton bridge, reducing habitat suitability at the Cottonwood Ranch complex.

Alternative Hypotheses:

- More or less sediment must be augmented to offset the south channel deficit.
- Augmentation at alternative locations will halt narrowing and incision.
- Full scale augmentation is not feasible over the long term – not enough supply.
- Incision and narrowing progresses downstream so slowly that augmentation is not necessary.
- Mechanical channel widening will halt narrowing and incision at habitat complexes.

Second Increment management decision-making context:

- A portion of the south channel downstream of the J-2 Return has incised, narrowed and shifted from a braided planform to a meandering planform, which is much less suitable for whooping crane roosting.
- This shift has progressed part way down the south channel but is moving much slower than originally hypothesized due to the large volume of sediment introduced via lateral erosion of meander bends in the reach that is actively meandering.
- The rate of progression of incision and risk of impacts downstream of Overton at Program habitat complexes are important in deciding if/where/how much sediment augmentation is necessary into the future.

Extension research/monitoring was expected to address the following negotiation-related questions:

- How quickly (and under what conditions) does incision and narrowing progress downstream with and without mechanical sediment augmentation into the south channel downstream of the J-2 Return?
- If rate of incision and narrowing are unacceptable, how much sediment augmentation is necessary (volume and frequency) to prevent downstream impacts to habitat?
- Are there viable alternatives to active mechanical augmentation that could achieve the same objective?

How is ongoing research intended to address these uncertainties?

- Develop estimates of rates of incision and narrowing (under varying hydrologic conditions) with and without mechanical augmentation.
- Estimate the volume and frequency of mechanical augmentation necessary to arrest downstream progression of incision and narrowing and compare to volume of sediment that can be augmented.
- Evaluate the feasibility and effectiveness of passive alternatives to mechanical augmentation.

Do we know enough already to estimate relationships (with confidence) and stop focusing on this question?

- EDO assessment:
    - We can assess channel response to full-scale augmentation with some confidence as a result of the full-scale augmentation experiment conducted from 2017-2022. Uncertainty remains in the quantification of results directly resulting from mechanical augmentation as opposed to inputs from lateral erosion and incoming sediment from the breakthrough channel.
    - We have low confidence in the rate of incision and narrowing without augmentation due to data limitations before 2017. The ongoing no-augmentation experiment is designed to address this uncertainty.
    - We have low confidence in the feasibility and effectiveness of passive augmentation alternatives. A new exploration into passive augmentation options is expected to address this issue.

- TAC Assessment?
- ISAC Assessment?

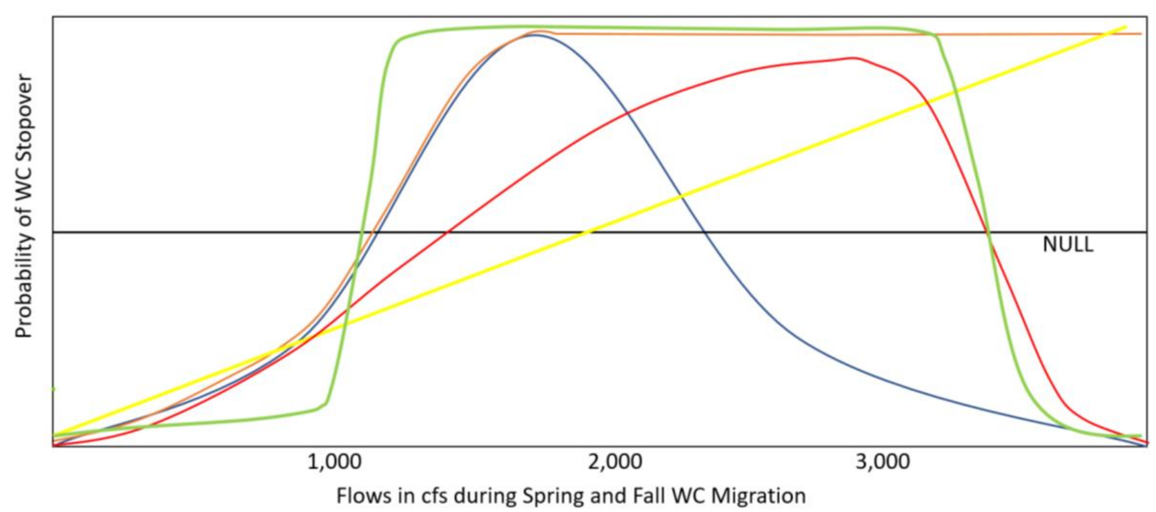
Potential surprises:

- Any unexpected change in the rate of lateral erosion (up or down) could substantially change the risk of incision and narrowing downstream of the Overton bridge.

Extension Big Question #4: *What factors influence WC decision to stop or fly over the AHR?*

Management Hypothesis: Probability of WC stopping within the AHR is a function of discharge.

X-Y Graph



Hypothetical probability of a whooping crane stopping and roosting within the AHR (vs. flying over) is a function of discharge. The relationship could take a number of forms (represented by different colors).

Alternative Hypotheses:

- Time of day is the primary driver of WC stopovers with probability of use increasing with decreasing time until dark.
- The probability of WC stopping over is a function of MUCW and unforested corridor width.
- The probability of WC stopping over is a function of land cover or habitat suitability within a biologically relevant radius of flyover location.
- Weather (wind speed and direction, precipitation, temperature) encountered since the last stopover is an important predictor of WC stopovers with the probability of use of the AHR increasing as weather conditions become less favorable for flight.
- Length of stay at previous stopover (inverse relationship) and distance traveled since last stopover (direct relationship) are important predictors of WC stopovers.
- Point in migration (proportion of migration completed) is an important predictor of WC stopovers with the probability of use of the AHR demonstrating a quadratic relationship with proportion of migration completed.

Second Increment management decision-making context

- Whooping crane use of the AHR is highly variable through space and time. One metric thought to be important for stopover decisions is flow. The Program has historically been unable to assess this relationship due to lack of information on flow conditions when cranes encounter the AHR and are deciding to stop or not and lack of information for cranes that do not stop.
- Cellular telemetry data will allow us to compare conditions when whooping cranes stop versus fly over – the information we need to address this uncertainty.
- Factors that are important may be manageable such as flow and channel width, unmanageable like weather or time of day birds encounter the Platte, or a mix of both.

Extension research/monitoring was expected to address the following negotiation-related questions:

- Which management metrics (MUCW, unforested width, discharge) influence whooping crane decisions to stop on the AHR and how important are those metrics relative to unmanageable metrics like weather or time of day?
- How much does discharge influence stopovers relative to other metrics and what is the form of the relationship?
- What is the tradeoff of using water for whooping crane roosting versus germination suppression? (*for reference, there may be insufficient water for both in as many as 50% of years*)
  - Which metric has the greatest influence on stopover decisions and are there differences in selection in the spring and fall migrations?
    - In water short years, how much EA should be reserved for whooping crane releases and how much does that increase the need and cost of mechanical channel maintenance during periods of drought?

How is ongoing research intended to address these uncertainties?

- Identify drivers of whooping crane stopovers and develop functional forms for those relationships.
- Identify any differences in drivers between spring and fall migrations.
- Compare/contrast selection of the AHR with other sand bed rivers in NE (Loup and Niobrara).

Do we know enough already to estimate relationships (with confidence) and stop focusing on this question?

- EDO assessment:
  - No. Development of assessment methods has just begun. Assume it will take two rounds of analysis. One to establish and refine methods (now) and a full analysis two or three years from now.

- TAC Assessment?
- ISAC Assessment?

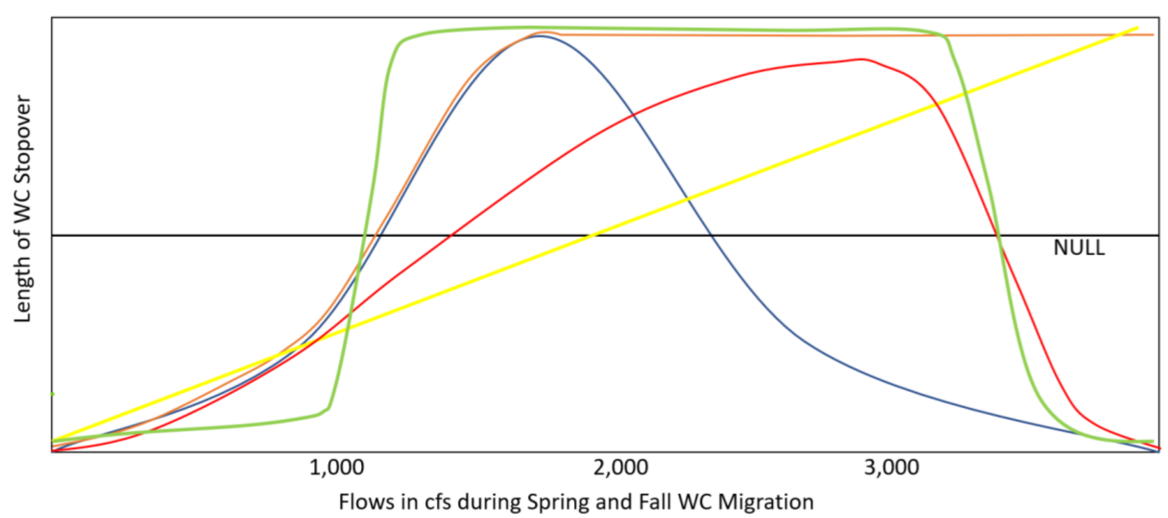
Potential surprises:

- Program currently has limited ability to make releases during fall whooping crane migration due to irrigation district outages. If discharge is a major driver of fall selection, may necessitate a broader discussion of fall operations.
- Small sample size (# of stopovers) could reduce our confidence in results.

Extension Big Question #5: *What factors influence WC stopover length within the AHR?*

Management Hypothesis: Length of WC stopover within the AHR is a function of discharge.

X-Y Graph



Hypothetical length of WC stopover within the AHR is a function of discharge. The relationship could take a number of forms (represented by different colors).

Alternative Hypotheses:

- Length of stay within the AHR has an inverse relationship with length of stay at the previous stopover and a direct relationship with distance traveled since last stopover.
- WC stopover length is inversely related to daily variability in flow.
- WC stopover length is a function of MUCW and unforested corridor width.
- WC stopover length is a function of land cover or habitat suitability within a biologically relevant radius of use location.
- Weather (wind speed and direction, precipitation, temperature) is an important predictor of WC stopover length with the length of stay within the AHR increasing as weather conditions become less favorable for flight.
- The length of a WC stopover within the AHR is longer during the Fall migration. Stopover length within the AHR recapitulates the overall migratory pattern with longer Fall stopovers than Spring stopovers.
- Point in migration (proportion of migration completed) is an important predictor of WC stopover length with stopover length demonstrating a quadratic relationship with proportion of migration completed.
- WC group size, composition (adults, sub-adults, juveniles), and whether or not they are associated with sandhill cranes are important predictors of WC stopover length.

Second Increment management decision-making context:

- Whooping crane use of the AHR is highly variable through space and time. One metric thought to be important for stopover stay length is flow.
- Cellular telemetry data in combination with system-scale monitoring will allow us to compare conditions relative to whooping crane stay length – the information we need to address this uncertainty.
- Factors that are important may be manageable such as daily variability in flow or channel width, unmanageable like weather, or a mix of both.

Extension research/monitoring was expected to address the following negotiation-related questions:

- Which management metrics (MUCW, unforested width, variability in discharge) influence whooping crane stay length and how important are those metrics relative to unmanageable metrics like weather?
- How much do discharge-related metrics influence stopover length relative to other metrics and what is the form of the relationship?
- What is the tradeoff of using water for whooping crane roosting versus germination suppression? (*for reference, there may be insufficient water for both in as many as 50% of years*)
  - Which metric has the greatest influence on stopover decisions (including stay length) and are there differences in the factors influencing stay length in the spring and fall migrations?
    - In water short years, how much EA should be reserved for whooping crane releases and how much does that increase the need and cost of mechanical channel maintenance during periods of drought?

How is ongoing research intended to address these uncertainties?

- Identify drivers of whooping crane stopover stay length and develop functional forms for those relationships.
- Identify any differences in drivers between spring and fall migrations.
- Compare/contrast stay length within the AHR with other sand bed rivers in NE (Loup and Niobrara).

Do we know enough already to estimate relationships (with confidence) and stop focusing on this question?

- EDO assessment:
  - No. Development of assessment methods has just begun. Assume it will take two rounds of analysis. One to establish and refine methods (now) and a full analysis two or three years from now.

- TAC Assessment?
- ISAC Assessment)

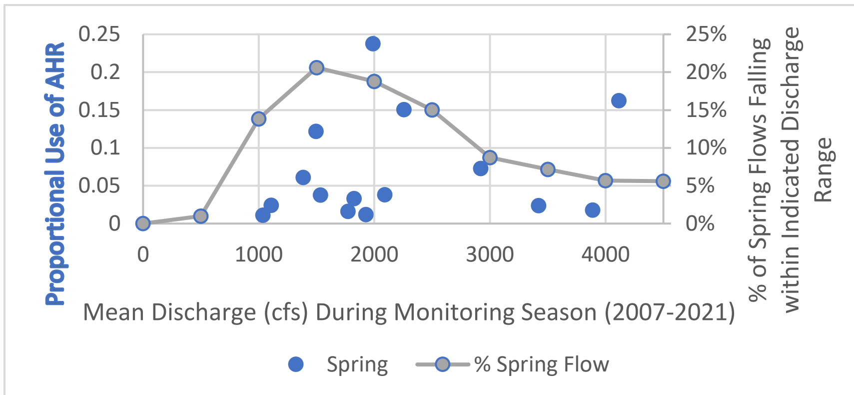
Potential surprises:

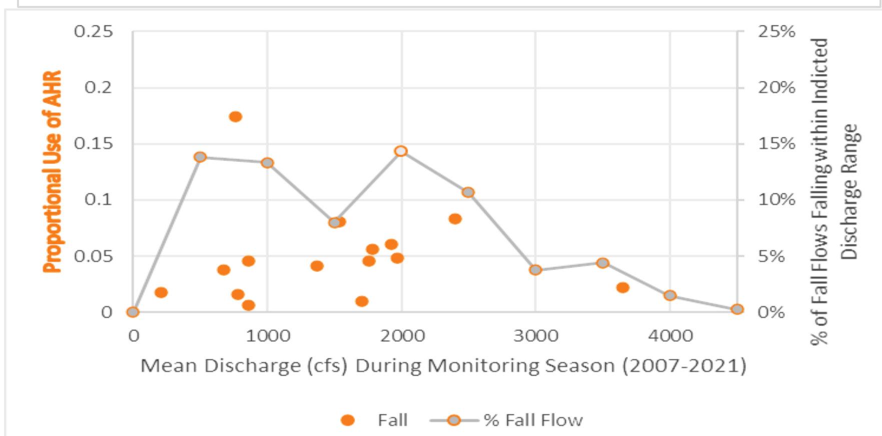
- Program currently has limited ability to make releases during fall whooping crane migration due to irrigation district outages. If discharge is a major driver of fall selection, may necessitate a broader discussion of fall operations.
- Small sample size (# of stopovers) could reduce our confidence in results.

Extension Big Question #6: Why is Spring WC use of the AHR greater than Fall use?

Management Hypothesis: WC use of the AHR in the Spring is greater than during the Fall due to higher flows during the Spring.

X-Y Graph





The proportion of the Aransas-Wood Buffalo WC population that uses the AHR in the Spring vs. the Fall is a function of discharge, with higher proportional use occurring in the Spring concurrently with higher discharge.

Alternative Hypotheses:

- WC use of the AHR in the Spring is greater because WC do not stage in other areas prior to reaching the Platte, WC are further along in migration when they arrive, distance traveled since last stopover is longer, and stay length at previous stopovers is shorter when compared to Fall migration.
- WC stay longer in the AHR during Spring migration because daily variability in flow is lower.
- WC use of the AHR in the Spring is greater because proportional wetland landcover is greater.
- WC use of the AHR in the Spring is greater due to more expansive unobstructed views (wider MUCW, reduced vegetation cover, lower vegetation heights, trees without leaves) that together increase perceived area of both on and off-channel suitable habitat during this period when compared with the Fall.
- WC use of the AHR in the Spring is greater because they encounter the AHR later in the day during this migratory season than they do during the Fall migratory season, increasing the probability of a stopover.
- WC use of the AHR in the Spring is greater because weather (wind speed and direction, precipitation, temperature) conditions are less favorable for flight (heading into colder conditions, not away from them).
- WC use of the AHR in the Spring is greater because group sizes are larger, more numerous and longer stopovers by juveniles and subadults (non-reproductive), and because of the presence of sandhill cranes (more abundant with longer stopovers within the AHR in the Spring).

Second Increment management decision-making context

- Whooping crane use of the AHR is highly variable through space and time. One metric thought to be important in stopover decisions (including differences in spring and fall use) is flow. The Program has historically been unable to assess how flow might play a different role in stopover decisions in the spring versus the fall due to lack of information on flow conditions when cranes encounter the AHR and are deciding to stop or not and lack of information for cranes that do not stop.
- The Program has not examined the factors associated with differences in seasonal patterns of use once the decision to stop has been made using data collected from system-scale monitoring either.
- Cellular telemetry data will allow us to compare conditions when whooping cranes stop versus fly over – the information we need to address this uncertainty. In combination with system-scale monitoring data we can evaluate long-term patterns in seasonal use of the AHR for a larger number of birds.
- Factors that are important drivers in differences between seasons may be manageable such as flow and channel width, unmanageable like weather or time of day birds encounter the Platte, or a mix of both.

Extension research/monitoring was expected to address the following negotiation-related questions: Second Increment management decision-making context:

- Which management metrics (MUCW, unforested width, discharge) influence whooping crane decisions to stop, stay, and use the AHR in the spring and fall and how important are those metrics relative to unmanageable metrics like weather or time of day?
- How much does discharge influence seasonal stopovers relative to other metrics and what is the form of the relationship?
- What is the tradeoff of using water for whooping crane roosting versus germination suppression? (*for reference, there may be insufficient water for both in as many as 50% of years*)
    - Which metric has the greatest influence on stopover decisions and are there differences in selection in the spring and fall migrations?
        - In water short years, how much EA should be reserved for WC releases and how much does that increase the need and cost of mechanical channel maintenance during periods of drought?

How is ongoing research intended to address these uncertainties?

- Identify drivers of whooping crane stopovers, stay length, and patterns of habitat use and develop functional forms for those relationships.
- Identify any differences in drivers between spring and fall migrations.
- Compare/contrast use of the AHR with other sand bed rivers in NE (Loup and Niobrara).

Do we know enough already to estimate relationships (with confidence) and stop focusing on this question?

- EDO assessment:
    - No. Development of assessment methods has just begun. Assume it will take two rounds of analysis. One to establish and refine methods (now) and a full analysis two or three years from now.
- TAC Assessment?
- ISAC Assessment?

Potential surprises:

- Program currently has limited ability to make releases during fall whooping crane migration due to irrigation district outages. If discharge is a major driver of fall selection, may necessitate a broader discussion of fall operations.
- Small sample size (# of stopovers) could reduce our confidence in results.

Extension Big Question #7: What effect do Program flow management actions to benefit WC, PP, and LT in the central Platte River have on pallid sturgeon use of the lower Platte River?
Pallid sturgeon genetics research **<u>Learning Objective*$_1$</u>:** Establish new genetic baselines for species identification and addressing hybridization. **<u>Learning Objective$_2$</u>:** Identify spawning pallid sturgeon adults and age-0 pallid sturgeon collected on the lower Platte River and its confluence with the Missouri River to evaluate whether or not successful spawning and annual recruitment into the Missouri River has occurred. **<u>Learning Objective$_3$</u>:** Reassess pallid sturgeon population dynamics and estimate effective population size within the Great Plains Management Unit (upper Missouri River) and Central Lowlands Management Unit (lower Missouri River).
Pallid sturgeon habitat and spawning research **<u>Learning Objective$_1$</u>:** Assess pallid sturgeon use of the lower Platte River and its tributaries. **<u>Learning Objective$_2$</u>:** Relate pallid sturgeon seasonal movements and spawning behavior to environmental patterns on the lower Platte River and its tributaries. **<u>Learning Objective$_3$</u>:** Identify and describe pallid sturgeon spawning habitat on the lower Platte River and its tributaries. **<u>Learning Objective$_4$</u>:** Verify successful pallid sturgeon spawning in the lower Platte River and its tributaries and annual recruitment from the lower Platte River to the Missouri River.

Second Increment management decision-making context
- The Program's obligation to pallid sturgeon in a Second Increment is twofold. First, we must minimize/avoid impacts of AHR flow management (for target bird species) on pallid sturgeon in the lower Platte. The Program must also document any benefits provided for pallid sturgeon.
- We are currently focused on habitat and spawning and genetic research to inform future analyses of impacts and benefits of AHR flow management to pallid sturgeon in the lower Platte.
- Ongoing habitat research focuses on the factors associated with pallid sturgeon use of and spawning within the lower Platte River. A future analysis will focus on quantifying the potential magnitude of change in lower Platte habitat metrics resulting from AHR flow management.
- These analyses will be integrated to minimize/avoid flow-related pallid sturgeon impacts during the Second Increment as well as quantify benefits to this species.

Extension research/monitoring was expected to address the following negotiation-related questions:
- Does water management to benefit target species in the AHR negatively impact use and spawning of pallid sturgeon in the lower Platte? If so, how do we minimize or mitigate those impacts?
- Does water management to benefit target species in the AHR provide benefits to pallid sturgeon in terms of use and spawning in the lower Platte? If so, how might those benefits vary for alternative uses of Program water during a Second Increment?

How is ongoing research intended to address these uncertainties?
- Identify extent and timing of pallid sturgeon use of the lower Platte River.
- Identify habitat metrics (depth, velocity, temperature, etc.) that affect pallid sturgeon use and spawning behavior in the lower Platte and its tributaries.
- Identify the expected timing and magnitude of changes in flow-related metrics in the lower Platte due to Second Increment flow management in the AHR to benefit target bird species.
- Note: Genetic research undertaken primarily to provide defined benefits for this species during the Extension. The results of this research will likely not influence habitat-related questions with the exception that genetics are being used to distinguish pallids from shovelnose and hybrids that are tagged as part of the habitat/spawning research to ensure habitat data are pallid-specific

Do we know enough already to estimate relationships (with confidence) and stop focusing on this question?
- EDO assessment:
  - No. Habitat and spawning research is ongoing and development of a hydraulic model for the lower Platte is ongoing. We are several years from having the information necessary to estimate impacts/benefits with any level of confidence.

- TAC Assessment?
- ISAC Assessment?

Potential surprises:
- Spawning may occur as far up the lower Platte as the Loup River confluence (or in the Loup River itself).

Maintenance Learning – Improving and Sustaining Ongoing Program Management Actions

Extension Big Question #8: How much of an effect does predation have on PP productivity (fledging)?
<u>Learning Objective*$_1$</u>: Quantify the impact of predation on PP productivity. **<u>Learning Objective$_2$</u>:** Identify predator species responsible for losses. **<u>Learning Objective$_3$</u>:** Determine when losses are incurred, at the nest or during brood rearing. **<u>Learning Objective$_4$</u>:** Utilize population viability models to predict what effect decreases in fledge ratios due to predation may mean in terms of future PP breeding pairs on the central Platte River.

Extension Big Question #9: How effective is Program management at mitigating losses of PP productivity due to predation?
<u>Learning Objective$_1$</u>: Evaluate effectiveness of trapping, fencing, and/or predator deterrent lighting at reducing nest/brood failure due to predation. **<u>Learning Objective$_2$</u>:** Develop predator management alternatives based upon learning through remote camera/video monitoring. **<u>Learning Objective$_3$</u>:** Evaluate the necessity for additional predator management based upon PP response to predation over time.

Implementation Notes:
*Summarized for EBQ #8 and #9 are learning objectives for data collection necessary to answer these questions. They are written as learning objectives here rather than priority hypotheses to reflect that EBQ #8 and #9 are considered a lower tier of importance for science learning when compared to EQB #1-7.

In connection with outside monitoring of plover habitat use and productivity, track surveys around nesting peninsulas and deployment of site- and nest-level trail and video cameras will provide documentation of predator presence, plover losses due to predation, and overall productivity at a site and system level. Losses of plover nests and chicks to predation and overall productivity at OCSW sites where baseline predator control includes trapping and fencing at land entrances to nesting peninsulas will be examined over the long term and compared to responses following implementation of additional predator management including predator exclosure fencing around entire nesting peninsulas and implementation of predator deterrent lighting. Information gathered will be used to develop novel and targeted strategies for mitigating losses due to predation. A Crystal Ball population model will help determine when losses to predation (number of losses over how many years) present greater risk to local population growth, warranting implementation of additional predator management.

Further details in Attachment 3 Implementation Activities & Timeline and Attachment 4 Data Collection, Analysis, Synthesis, & Decision-Making Reference Materials

Second Increment management decision-making context
- The USFWS agreed that existing OCSW and MCA habitats are sufficient to meet the Program's existing and future obligation to benefit the piping plover <u>unless</u> use and/or productivity drops below an acceptable level (undefined).
- At the end of the First Increment, piping plover productivity at OCSW sites was lower than expected for two years in a row, leading the Program to initiate additional monitoring to identify causes as well as additional predator management actions to evaluate our ability to reduce losses.

Extension research/monitoring was expected to address the following negotiation-related questions:
- What future patterns of use and productivity (through time) could be considered unacceptable and trigger additional scrutiny by the USFWS?
  - Can predation be reduced through implementation of additional/different predator controls?
    - How much does additional predator control cost (effort & $) relative to potential benefits?

How is ongoing research intended to address these uncertainties?
- Quantify what we can expect in terms of periodicity and range of losses in plover productivity to predation.
- Predict what effect decreases in fledge ratios due to predation may mean in terms of future plover breeding population in the AHR.
- Evaluate the cost and effectiveness (through time) of predator control/management actions on plover productivity.

Do we know enough already to estimate relationships (with confidence) and stop focusing on this question?
- EDO assessment:
  - Unclear. We have implemented three years of additional predator management and predator monitoring research and have just begun analyzing the data. Given high variability in productivity on an annual and site level, gut feeling two more years would likely reduce uncertainty to an acceptable level.

- TAC Assessment?
- ISAC Assessment?

Potential surprises:
- Habitat availability in other systems can strongly influence the number of breeding pairs that nest on Program OCSW habitat. Unmanageable environmental factors like weather can strongly influence plover productivity. Factors out of our control may drive use and productivity – need to be able to identify those situations.

Extension Big Question #10: Wet meadows research (*NOTE: this is a carryover task from the First Increment to specifically address the physical processes involved in wet meadow hydrology*)
Learning Objective*$_1$: Understand relationships between hydrological and meteorological variables and groundwater levels at natural wet meadow sites. **Learning Objective$_2$:** Understand what constitutes a functional hydrological regime for wet meadows along the central Platte River valley which can be used as a reference and applied to manage other sites. **Learning Objective$_3$:** Develop a modeling tool that can be used by land managers in the central Platte River valley to inform management decisions.

Second Increment management decision-making context:

- Wet meadows were an important component of the First Increment. The Program is supposed to acquire/restore 640 acres of wet meadow habitat managed to provide foraging habitat for whooping cranes (WC) and species of concern like sandhill cranes.
- Program research has not established a strong WC selection for wet meadows in the AHR and wet meadows research indicates high quality wet meadows, such as those located on Mormon and Shoemaker Islands, have unique topography and hydrology that would be extremely difficult to replicate.
- The Program now owns and manages thousands of acres of grasslands that may (or may not) be categorized as wet meadows with little ability to improve hydrology and no strong connection to WC use.
- What is the management objective for these habitats during the Second Increment?

Extension research/monitoring was expected to address the following negotiation-related questions:

- Do WC select for wet meadows over corn or other diurnal foraging habitats? This was addressed during the First Increment (WEST Report) and reevaluated in the Extension (WEST and Ecotope collab. research).
- Can the Program replicate the topography and hydrology of high-quality wet meadows at other AHR locations?
- Can high quality wet meadow hydrology be replicated at other locations through Program flow releases or surface application of water? If so, will benefits extend to the vegetation community and to WC use?

How is ongoing research intended to address these uncertainties?

- Reevaluate WC selection for wet meadows in relation to other landcover types.
- Compare and contrast topography and groundwater/surface water hydrology at high quality wet meadows in the eastern portion of the AHR with wet meadow habitat at other habitat complexes.
- Identify spatial and temporal patterns in depth to groundwater linked to sustainability of a desired wet meadow vegetation community.
- Evaluate ability to increase water levels in wet meadows through flow releases and surface water application.
- Identify locations were topography or hydrology are similar to high quality wet meadows as a tool to identify potential future restoration sites.

Do we know enough already to estimate relationships (with confidence) and stop focusing on this question?

- EDO assessment:
    - Yes. We can assess similarities and differences in wet meadow topography and hydrology and estimate their ability to support wet meadow vegetation across the AHR. We can also estimate the feasibility, cost, and effectiveness of mechanically alternating topography or supplementing hydrology. WC selection for/against wet meadows has also been assessed and we have high confidence that WCs use wet meadows but there is no strong selection for wet meadows in terms of cranes selecting them in greater proportion than their availability.

- TAC Assessment?
- ISAC Assessment?

Potential surprises:

- New listings under the endangered species act could change the goals and objectives for management of Program grasslands and wet meadows.