

# 2023 HYBRID MONITORING PLAN PILOT –

*for piping plovers on the Gavins Point segment of the Missouri River*



S.Owens



US Army Corps  
of Engineers®

C.Hofer, US Army Corps of Engineers, Threatened & Endangered Species  
Section, Yankton, SD, and C. Schwarz, ESSA Technologies, Ltd.,  
Vancouver, B.C.

## History of Tern & Plover Monitoring Program (TPMP):

- 1986-1992 – USFWS and SDSU developed protocol & conducted bird monitoring on the Missouri
- 1993- Present – USACE implements Missouri R. tern & plover monitoring

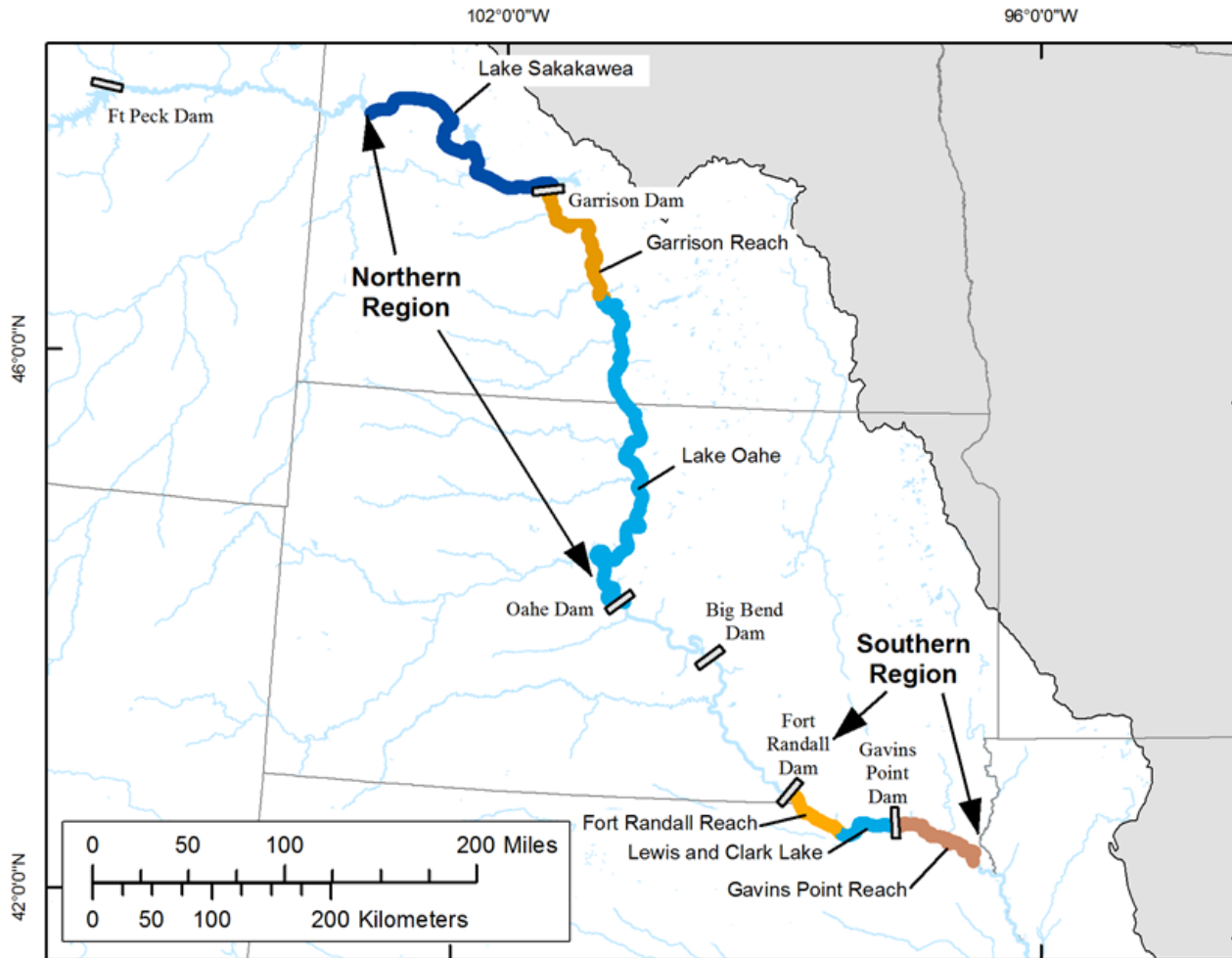
### TPMP includes:

- ✓ **Adult Survey:** Census all 'suitable' map-units to count adults during two weeks in June.
- ✓ **Productivity Surveys:** survey sites weekly to find and track Nests through hatch or fail; find & track Chicks through fledging to determine productivity (fledge ratio).





# GEOGRAPHIC SCOPE – USACE PIPING PLOVER MONITORING

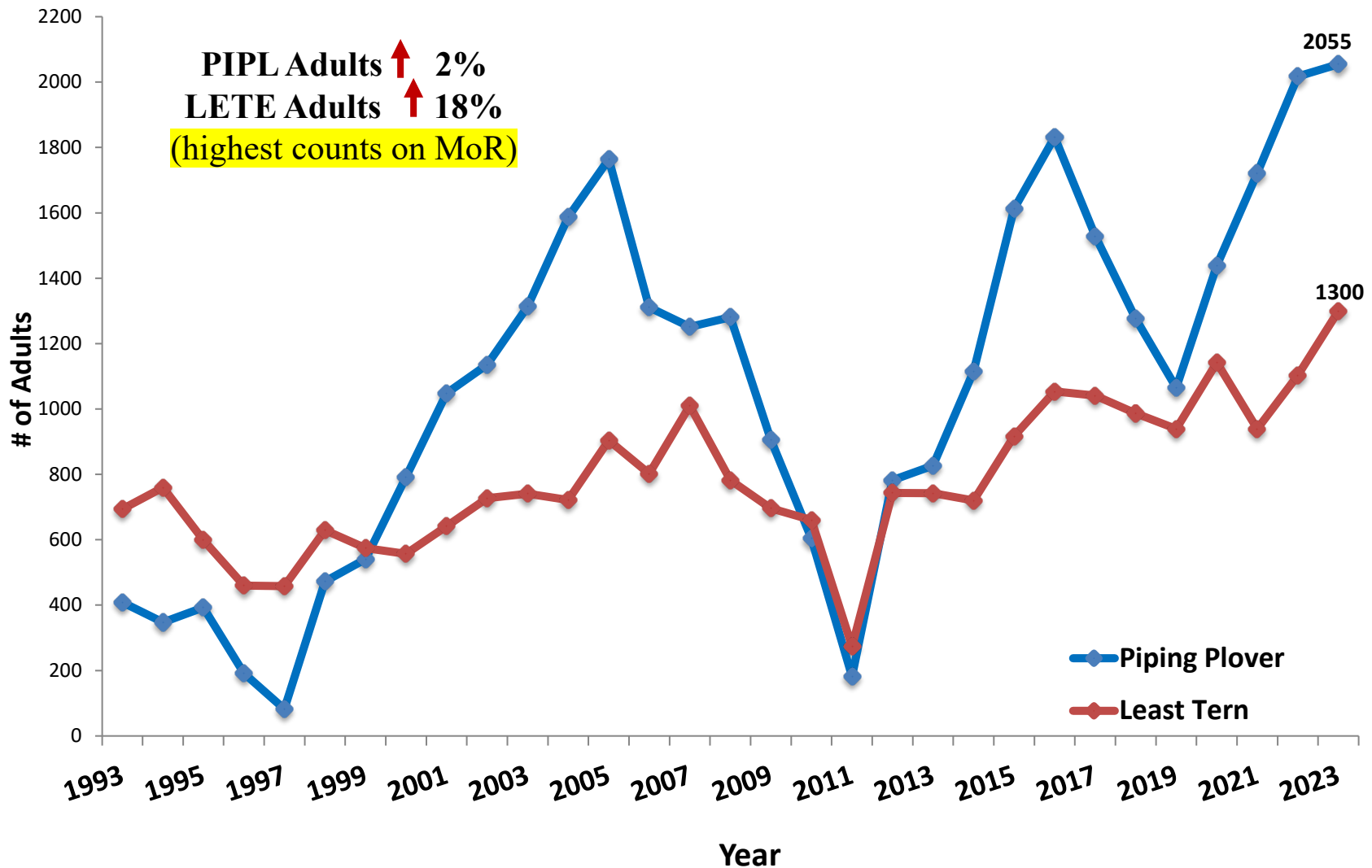


Source: U.S.G.S. digital basemap data  
Universal Transverse Mercator, Zone 15

- Cover ~ 565 of habitat miles (weekly)
- Requires ~ 32 seasonal hires and 8 permanent staff (5 of them full time) for bird and habitat (ESH) monitoring
- Cost ~ \$1.3 M to implement TPMP annually.



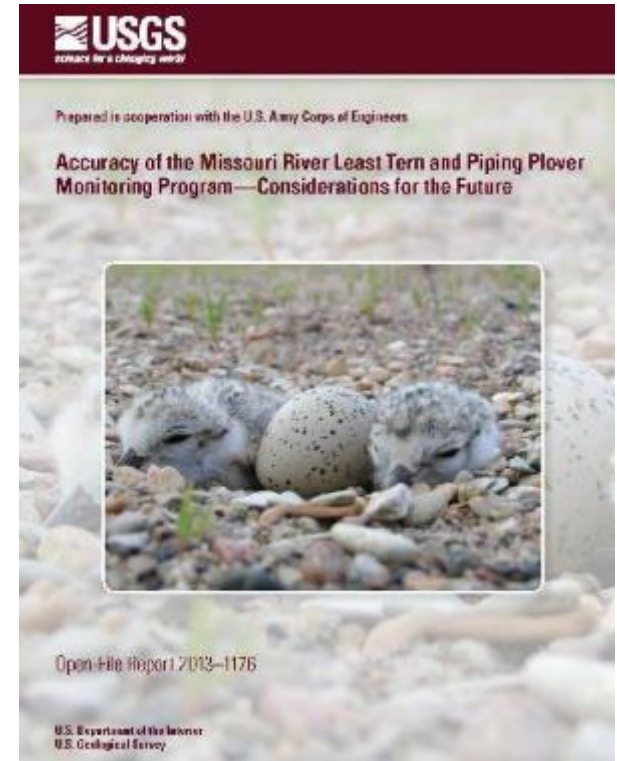
# USACE MISSOURI RIVER LEAST TERN AND PIPING PLOVER ADULT CENSUS





# WHY CHANGE MONITORING?

1. TPMP designed as a complete census of plover adults, nests, and chicks.
  - Mo. River too massive for all potential habitat to be effectively surveyed within a compressed time window.
  - Late start & long return intervals bias detection toward successful nests & potentially underestimate initiated nests & nest loss
2. Lack of a formal underlying sampling design makes it difficult to deal with biases or generate reliable measures of uncertainty.
  - data cannot be combined with other monitoring efforts in the Northern Great Plains for a population estimate.
3. Difficult to respond to budget (or habitat) fluctuations or both (2022) – no ability to scale down without sacrificing data integrity.





# HYBRID OPTION MONITORING PLAN



Four options for Missouri River plover monitoring were evaluated in 2018 (Schwarz et al. 2018).

- all designed to improve data quality and provide more defensible data to inform Adaptive Management decisions on the river.
- **the hybrid plan (Option 3)** was chosen for further evaluation
  - ✓ maintains a tie to the historic Tern and Plover Monitoring Program (TPMP) dataset,
  - ✓ meets implementation & cost considerations,
  - ✓ improves data quality/generates error estimates to address management objectives.

## **The hybrid option monitoring plan (Schwarz et al. 2019) is a 2-phase sampling approach:**

1. Each Missouri River segment is partitioned into spatially-defined map-units.
2. Phase 1: an imperfect measure (e.g. a count of adult plovers (TPMP adult census)) is obtained on all map-units in the segment.
3. Phase 2: a stratified random set of map-units within the segment is intensively monitored to locate nests and chicks and estimate breeding adults and fledgling production using a protocol that reduces and measures observation error.
4. The relationship between the Phase 1 and 2 measures for the selected map-units is used to estimate the total number of breeding adults and productivity for the segment.



# Objectives of the Hybrid Option Piping Plover Monitoring Pilot Study, Gavins Point - 2023



- 1) Test protocol implementation / evaluate logistics of intensive nest and chick searches occurring 2-3 times weekly; include cost, staffing, stratification using previous years' data,
- 2) Evaluate differences in data quality and quantity by collecting plover data using the Hybrid protocol separately, but alongside, the current TPMP on the Gavins Point segment -
  - Compare estimates for population and productivity generated by both methods,
  - evaluate data 'not collected' (i.e. outside the Hybrid protocol's selected map-units) by reviewing/comparing TPMP data collected on entire segment,
    - e.g. human disturbance issues, nest and chick predation, and nest inundation due to release increases or water level rise
  - evaluate data 'gained' thru intensive productivity searches on Hybrid protocol's selected map-units vs. TPMP weekly return on entire segment,
    - e.g. nests that are initiated and fail in a short period of time, accuracy of nest fating, differences in the number of hatchlings, and fledglings.



# ACTION AREA FOR THE PILOT STUDY



Missouri River PIPL are a sub-population of the Northern Great Plains breeding population



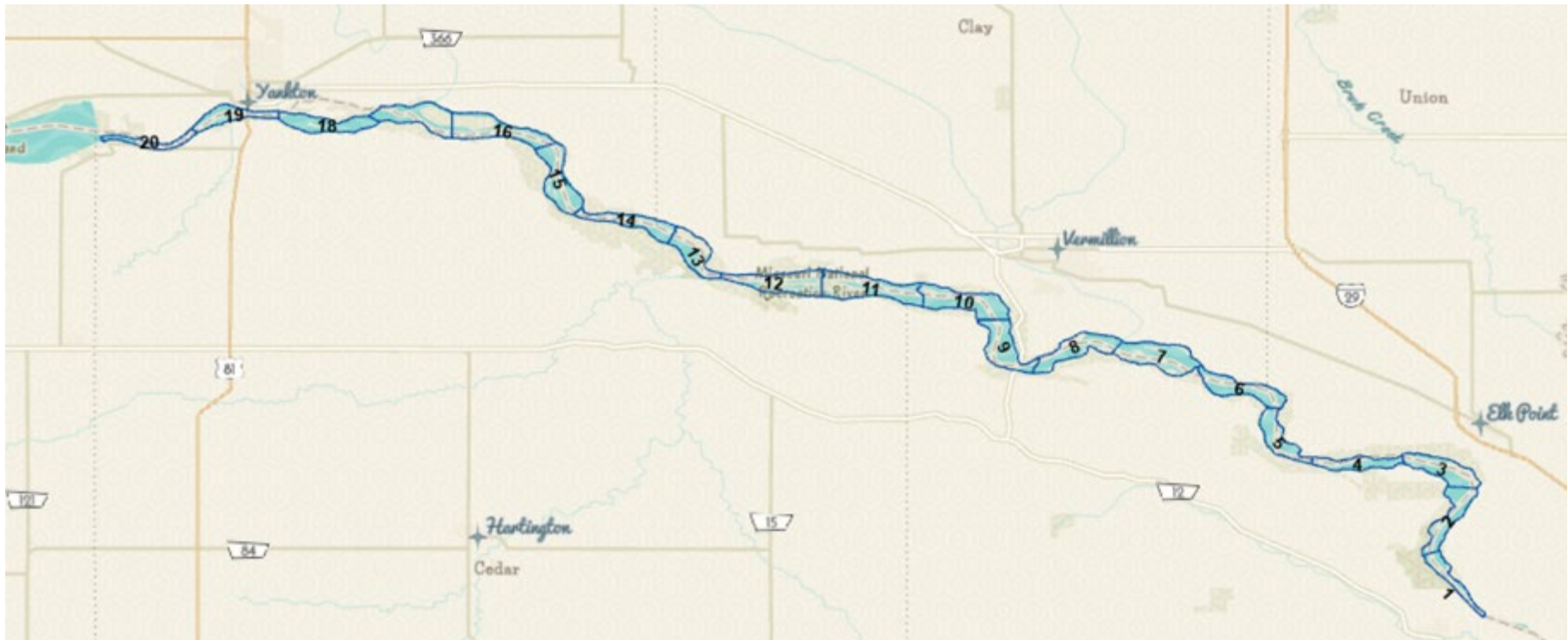




# HYBRID OPTION MONITORING PLAN



1. Each monitoring segment on the Missouri (reservoir & river) is divided into uniform sampling areas, or map-units, which are then stratified by plover use.
  - **Riverine segments** (Garrison, Fort Randall, Lewis & Clark Lake, Gavins Point) are divided into 3-river mile (RM) map-units,
  - **Reservoir segments** (Lake Sakakawea and Lake Oahe) are divided into 2-kilometer (km) map-units of shoreline or groups of islands in the reservoir also with 2 km of shoreline





## Stratification of Gavins Point map-units using plover total adults and plover nests + broods from the years 2020-2022.



RM Range	Map-Unit	PIPL Adults	Rank (Adults)	Stratification -Adults	PIPL Nests + Broods	Rank (N+B)	Stratification- Nest +Brood	Available ESH Acres 2022
781_784	11	159	1	H	133	1	H	365.3
778_781	10	157	2	H	108	2	H	421.1
772_775	8	150	3	H	88	3	H	124.7
769_772	7	132	4	H	82	4	H	124.7
775_778	9	115	5	H	82	5	H	269.2
802_805	18	94	9	M	72	6	M	168.6
790_793	14	87	10	M	72	7	M	143.6
754_757	2	106	7	M	69	8	M	157.8
793_796	15	107	6	M	60	9	M	212.0
757_760	3	95	8	M	57	10	M	151.4
766_769	6	87	11	M	55	11	M	137.3
796_799	16	43	12	L	31	12	L	83.3
787_790	13	36	15	L	26	13	L	74.9
760_763	4	40	13	L	26	14	L	49.0
799_802	17	38	14	L	22	15	L	77.8
763_766	5	34	16	L	20	16	L	136.3
805_808	19	7	17	L	5	17	L	90.7
784_787	12	6	18	L	3	18	L	69.8
751_754	1	0	19	L	0	19	L	0.5

*Dark green, yellow, and orange highlighted rows indicate units that were randomly selected for 2023 survey.*



# HYBRID OPTION MONITORING PLAN

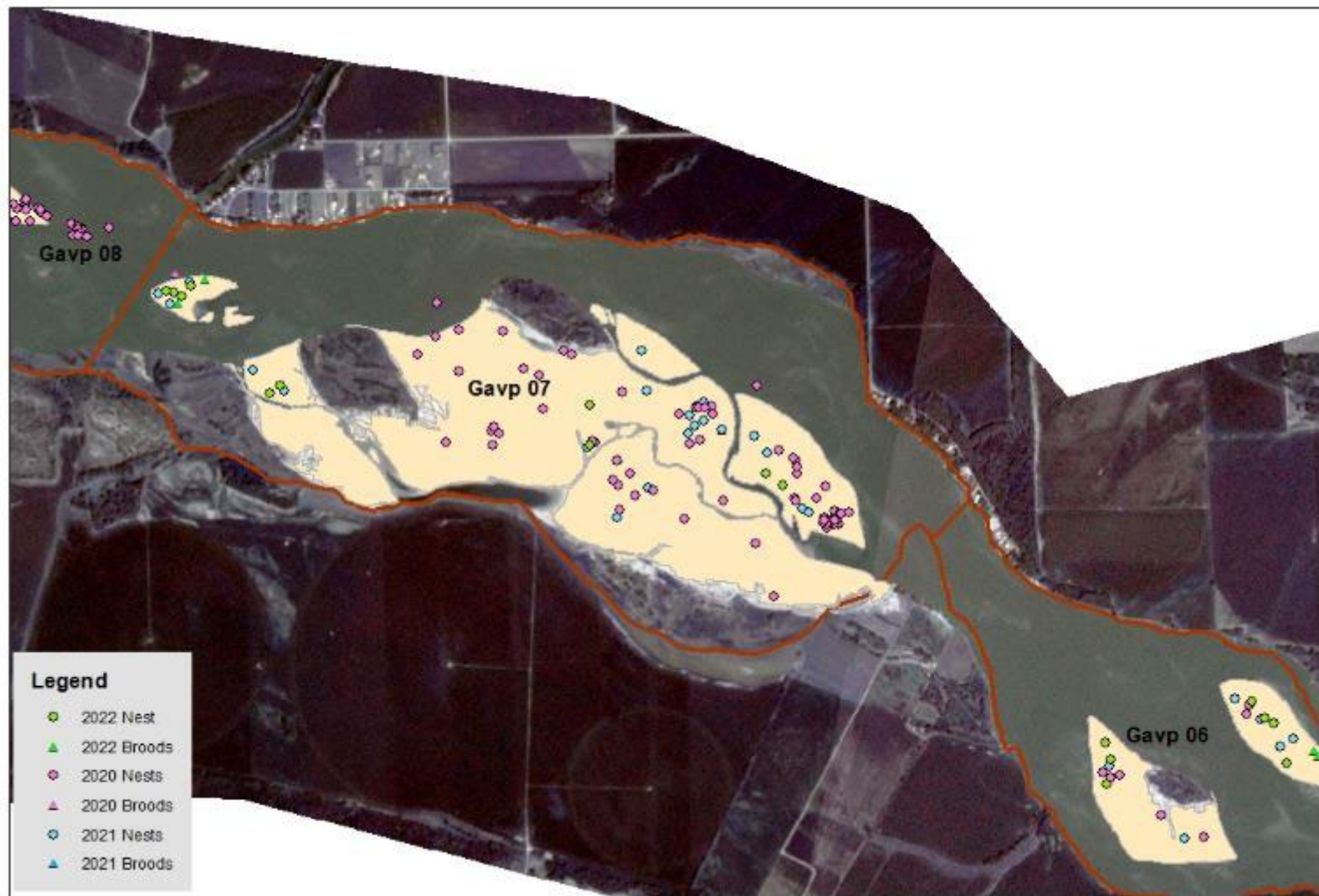


Stratified and randomly selected map-units on the Gavins Point segment.





The 3-river mile map-units generally contain multiple sandbars/nesting areas







# Comparison of 2022 ESH, Nests, and Broods on Selected Gavins Point Map-Units



Gavins Point Map-Unit	2022 Total Site Acres	2022 Total ESH Acres	% of Total ESH	# of 2022 Broods	% of Total Broods	# of 2022 Nests	% of Total Nests	B+N
20	0.0	0.0	0.0	0	0	0	0	0
19	101.3	90.7	2.8	3	6	1	0.4	4
18	176.3	168.6	5.3	4	7	24	8.6	28
17	104.3	77.8	2.4	0	0	0	0	0
16	97.5	83.3	2.6	1	2	7	2.5	8
15	233.4	212.0	6.6	5	9	26	9.3	31
14	143.7	143.6	4.5	1	2	26	9.3	27
13	76.1	74.9	2.3	1	2	10	4	11
12	72.1	69.8	2.2	0	0	2	1	2
11	365.3	347.0	10.9	4	7	27	9.7	31
10	474.0	421.1	13.2	8	15	27	9.7	35
9	271.2	269.2	8.4	0	0	21	8	21
8	127.1	124.7	3.9	3	6	31	11	34
7	490.8	476.5	14.9	3	6	10	3.6	13
6	144.3	137.3	4.3	5	9	10	3.6	15
5	147.3	136.3	4.3	1	2	6	2.2	7
4	49.1	49.0	1.5	1	2	9	3.2	10
3	153.5	151.4	4.7	5	9	19	6.8	24
2	160.2	157.8	4.9	9	17	23	8.2	32
1	0.5	0.5	0.0	0	0	0	0	0
<b>Total</b>	<b>3388.1</b>	<b>3191.4</b>	<b>100.0%</b>	<b>54</b>		<b>279</b>		
Selected Units		1336.3	41.9%	31	57.4%	141	50.5%	





# 2023 HYBRID PROTOCOL TEST – GAVINS POINT



## 1. Phase 1 – Adult Census in June

- on entire segment (all map-units, 1 – 19)
- Use TPMP methods; Adult census is 3<sup>rd</sup> – 4<sup>th</sup> week in June during peak nesting
- Data collection and documentation same as for TPMP

## 2. Phase 2 – intensive nest and productivity monitoring on selected map-units

- Start adult surveys late April; search for adults, nests, chicks using TPMP survey methods.
- Adhere to all USFWS monitoring permit restrictions/Terms & Conditions.
- Return interval shortened to 2 – 3 days.
- Nests will not be physically marked with tongue depressor; GPS only.
- GPS ArcPad data collection same as TPMP, except Hybrid Pilot data are collected and stored separately; no data sharing with Gavins TPMP crew (& vice versa).
- If Gavins TPMP crew finds and marks a nest, record nest # in Nest Comment.



# EVALUATION OF THE PROTOCOL





# POST-SEASON EVALUATION



1. **Evaluate logistics of Hybrid Option protocol –**
  - Was the return interval maintained?
  - Was the planned level of staff/effort workable?
  - For unmarked nests, were the methods for nest finding/refinding effective, etc.?
2. **Compare the two protocols (Hybrid Option and TPMP),**
  - Was the error of Hybrid adult and fledgling estimates w/in the target RSE? How did the estimates compare to metrics calculated with TPMP data?
  - Did the new protocol reduce uncertainty in nest fates, esp. better determination of predation, vs. unknown cause ratio, reduction of brood records and undetermined nest fate?
  - What did we miss in only visiting selected map-units, vs. what did we gain?
  - What was the cost difference, if any?
3. **Are the differences in data quality enough to make a difference in bird model/AM decisions?**
4. **Where to next? Continue evaluation of protocol, incorporating a reservoir?**







# POST-SEASON EVALUATION



## 1. Evaluate logistics of Hybrid Option protocol –

- Hired 7 seasonals for the pilot study, and they split into 2 crews to survey the smaller sites and worked together on the larger sites. Required 2 boats/trucks, 4 spotting scopes, Trimble GPS. When dam release increased in July, habitat decreased; fewer seasonals (5) would have been ok.
- High use map-units (and most medium use) were consistently visited 2-3 times a week; low use (MU13) at least 2 times a week. Return intervals were maintained even during adult census week.
- Hybrid crew was able to start monitoring ~ 2 weeks before Gavins TPMP crew. We had 2 crew members who had been working with us for several years and were boat operators, so they were able to hit the ground running.





# POST-SEASON EVALUATION



## 2. Compare the two protocols (Hybrid Option and TPMP) on sites surveyed by both crews:

- Overall, Hybrid crew found more nests on sites than TPMP crew
- Hybrid crew found more nests that failed, so nest success on sites was generally lower than what the TPMP crew observed
- Hybrid crew observed more fledglings

Crew	Total Nests	Total Broods	Successful Nests	Failed Nests	Total Fledged	Total Adults (census)
Hybrid	276 nests <i>49% laying</i>	12	187	83	241	370
TPMP	179 nests <i>29% laying</i>	18	130	37	135	369
Difference	<b>54% more nests found by Hybrid crew</b>	<b>fewer broods for Hybrid crew</b>	<b>44% more Successful nests found by Hybrid crew</b>	<b>124% more failed nests found by Hybrid crew</b>	<b>79% more fledglings obs. by Hybrid crew</b>	<b>&lt;1% difference in adult census counts</b>





# POST-SEASON EVALUATION



## 2. Compare the two protocols (Hybrid Option and TPMP) on sites surveyed by both crews:

- Did the new protocol reduce uncertainty in nest fates, esp. better determination of predation, vs. unknown cause ratio, reduction of brood records and undetermined nest fate?
- What did we miss in only visiting selected map-units, vs. what did we gain?

Crew	Undetermined Nests (could have hatched but no evidence)	Inundation of Nests & Broods (Incidental Take)	Human Disturbance
Hybrid	6 Undetermined Nests	9 flooded nests in sampled MU would qualify as IT	0 nests failed
TPMP	23 Undetermined Nests; 12 within sampled MU's	11 flooded nests in sampled MU's counted as IT 8 flooded nests outside sampled MU's	1 nest failed suspect human
Difference	<b>1 UD nest w/ same UD fate both crews;</b> 3 Hybrid UD nests fated as success by Gavins 9 Gavins UD = fated as success by Hybrid (2 with chicks in bowl) 1 Gavins UD = fail Hybrid	4 of those nests were found by both crews; 3 fated similarly, but 1 was listed as probable success by Hybrid crew due to PH on 7/4; Gavins crew found nest in water and floating eggs on 7/5	The nest failed with evidence of human tampering was outside the sampled MU's



# DATA ANALYSIS





# HYBRID POPULATION & PRODUCTIVITY ESTIMATES



## Estimating adults:

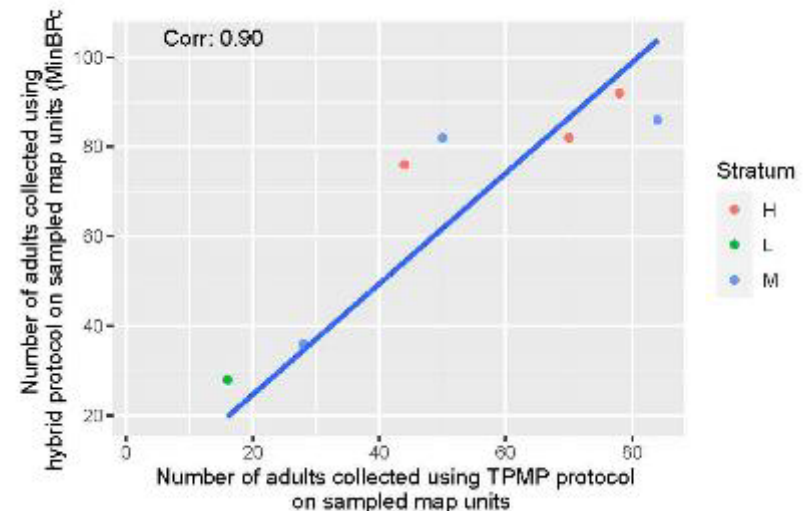
Phase 1 – Hybrid Crew Adult census count for the whole segment = **692 plover adults**

Adult Census Count on sampled map-units only = **370 adults**

Phase 2 – Minimum breeding population (minBPop; 2x nests + broods) = **482** on sampled map-units

- High correlation between the adult census count and minBPop adults
- **Ratio estimator = 1.3** (minBPop adults are, on average, 1.3 (SE 0.086) times larger than the adult census count in the sampled map-units).
- **Hybrid Adult estimate =  $1.3 \times 692 = 901$  (SE 59) adults** for the Gavins Pt segment  
This estimate has a RSE of 7%, within the limits of precision specified for this study

Figure 2: Relationship between hybrid adult count (based on minBPop) and the TPMP census adult count





# HYBRID POPULATION & PRODUCTIVITY ESTIMATES



## Estimating productivity (total number fledged):

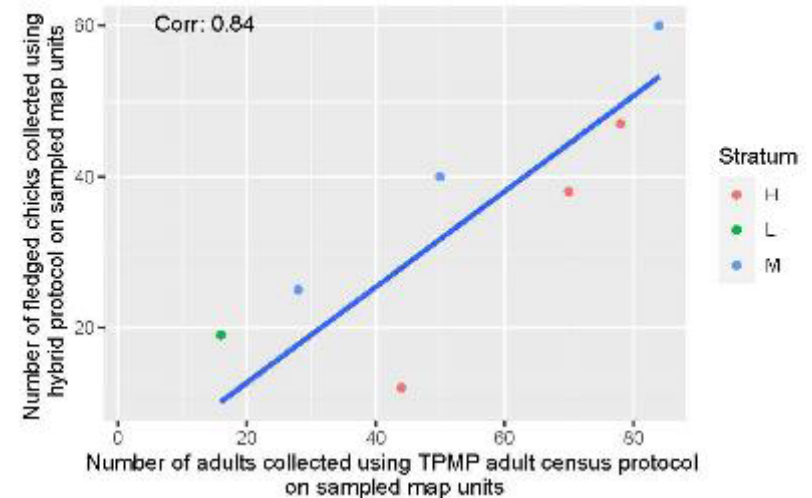
Phase 1 – Hybrid Crew Adult census count for the whole segment = **692 plover adults**

Adult Census Count on sampled map-units only = **370 adults**

Phase 2 – Number of fledglings observed on sampled map-units = **241 plover fledglings**

- High correlation between the adult census count and fledglings on the sampled map-units
- **Ratio estimator = 0.65** (fledglings are, on average, 0.65 (SE 0.054) the value of adult census count in the sampled map-units).

Figure 3: Relationship between the hybrid number fledged and 'TPMP' census number adults



- **Hybrid Fledgling estimate =  $0.65 \times 692 = 451$  (SE 37) fledglings** for the Gavins Pt segment  
This estimate has a RSE of 8%, within the limits of precision specified for this study



# HYBRID POPULATION & PRODUCTIVITY ESTIMATES



Estimating the Fledge Ratio (number of fledglings per adult pair):

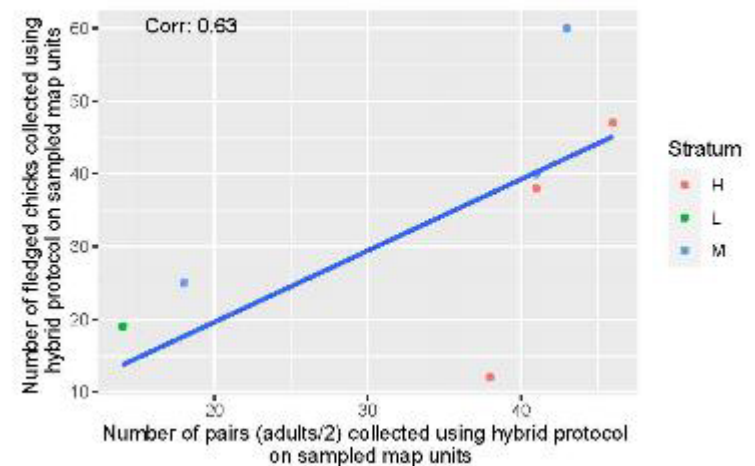
Phase 1 – Hybrid Crew Adult census count for the whole segment = **692 plover adults**

Adult Census Count on sampled map-units only = **370 adults**

Phase 2 – Number of fledglings observed on sampled map-units = **241 plover fledglings**

- Moderately high correlation between the number of fledglings and adult pairs (1/2 adult census count) on the sampled map-units
- **Estimated adults** for the segment = 901 (SE 59)
- **Estimated fledglings** for the segment = 451 (SE 37)

Figure 4: Relationship between hybrid number fledged and hybrid number of pairs (1/2 of hybrid number of adults)



- **Hybrid Fledge Ratio estimate** = 451 estimated fledglings / (901 estimated adults/2)  
= fledge ratio of 1.0 (SE 0.11) for the Gavins Pt segment





# HYBRID POPULATION & PRODUCTIVITY ESTIMATES



## Summary:

- **Estimates generated by the hybrid protocol resulted in ~ 1.3x increase over the number of total adults counted during on the TPMP adult census.** There was a very high correlation between the adults counts collected under the two protocols (adult census and minBPop) on the sampled map units which produced an estimate with a relatively small RSE with only a small number of map units sampled.
- The high correlation appears to be consistent across the strata, which obviates the need for a stratified estimator.
- The estimate of the fledge ratio is based only the data collected in the sampled map units. Here the correlation was less than the other correlations used, and so the relative standard error is larger, but still acceptable.
- **The stratified expansion estimator for the total number of adults** (summing the mean per map unit x number of map units in each stratum) **is 1171 (SE 164)** and RSE of 14%. Because of the high observed correlations, the stratified expansion estimator is more uncertain with about twice the RSE as the ratio estimator and is not recommended.



# POST-SEASON EVALUATION



2. Compare the two protocols (Hybrid Option and TPMP),
  - Overall, Hybrid crew found more nests on sites than TPMP crew
  - Hybrid crew found more nests that failed, so nest success on sites was generally lower than what the TPMP crew observed
  - Hybrid crew observed more fledglings & had a better fledge ratio overall
3. Are the differences in data quality enough to make a difference in bird model/AM decisions?



# Comparison - TPMP and Hybrid Protocol

Crew	Total Adults	Total Fledglings	Fledge Ratio	Cost to Implement	
Hybrid estimate	901 (SE 59)	451 (SE 37)	1.0 (SE 0.11)	~ \$229k (salary only)	
TPMP census	665 GPT 692 Hybrid	283 GPT	0.85	~ \$233k (salary only)	





# FUTURE PLANS



1. Continue pilot test of Hybrid Protocol on Gavins Point segment in 2024
2. Expand pilot test to include a reservoir – testing on a portion of Lake Oahe in 2024
3. Potential pilot test on Lake Sakakawea in 2025

