To: Reclamation District 108

From: Ducks Unlimited Inc.

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Floodplains Reimagined

Impacts of Flood Depth, Frequency, Area, and Duration on Recreational Hunting and Wetland Management Under Baseline Conditions

Introduction

Proposed Project

The Floodplains Reimagined Project being led by RD 108 seeks to advance floodplain reactivation in a 77,507-hectare project area that includes the Butte Sink, Colusa Drain, and Sutter Bypass to benefit anadromous fish, wildlife, and people. Project objectives include enhancing floodplain functional connectivity for fish and birds while respecting existing land uses, local communities, and culture. The project area contains approximately 23,000 hectares of managed wetlands, or 27% of the managed wetlands that remain in the Central Valley (Reid et al. 2018), and more than 50,000 hectares of rice agriculture. Most of these wetlands are privately-owned and managed for waterfowl habitat and hunting. Additionally, many rice fields are flooded in winter and provide waterfowl hunting opportunities. A potential outcome of floodplain reactivation in this area is additional deep flooding during the waterfowl hunting season, which would reduce access and hunting opportunities while also possibly impacting wetland management in the spring. To determine how deep flooding impacts recreational hunting and wetland management between October and March under baseline conditions, we used data produced by CBEC's hydrodynamic models to examine flood depth, frequency, area, and duration for five water years (2003, 2011, 2013, 2015, 2019; see Hydrodynamic Modeling Memorandum, Appendix 5). This evaluation of current conditions provides a benchmark that will aid in the assessment of how future voluntary measures to increase flooding depth, frequency, area, and duration will impact recreational hunting and wetland management.

Importance of Project Area to Waterfowl

Nearly 90% of California's historic seasonal and floodplain wetlands within the Central Valley have been lost due to agricultural conversion, development, and flood control efforts (Mitsch and Gosselink 2007; Frayer et al. 1989; Hanak et al. 2011). The loss of these wetlands has negatively impacted wetland dependent species and led to population declines in waterfowl and native freshwater and pelagic fish species (Mount 1995; Reid and Heitmeyer 1995; Sommer et al. 2007). Reductions in wintering waterfowl numbers – from 50 million historically to 6 million currently – motivated actions to protect wetlands in California starting in 1908 with the establishment of the Lower Klamath National Wildlife Refuge (Reid and Heitmeyer 1995). The Sacramento Valley is one of the most important wintering areas for migratory waterfowl, supporting approximately 30% of all ducks in the Pacific Flyway, and the majority of geese in the Central Valley (CJVJ 2020, Fleskes et al. 2018). The continued abundance of waterfowl within the project area is due in large part to the long history of both public and private waterfowl hunting areas, which provide and maintain key wetland habitats required by non-breeding waterfowl.

Importance of Hunting and Wetland Management in Wetland Conservation

Hunters played a significant role in early wildlife conservation efforts, from rallying political support to create wildlife protection laws, to acquiring land to create or restore wetlands to benefit waterfowl (Gilmer et al. 1982; Kramer and Helvie 1983; Geist et al. 2001). Private groups currently own and maintain approximately 66% of the Central Valley's 83,000 hectares of seasonal wetlands, most of which are used as duck clubs (Gilmer et al. 1982, Reid et al. 2018) and are permanently protected through wetland conservation easements. In addition to these private areas, many publicly owned wetlands were acquired specifically to provide wintering habitat for waterfowl and other migratory birds and alternate foraging habitat to reduce crop damage from these birds and are managed by State or Federal agencies to primarily support waterfowl (Gilmer et al. 1982; Kramer and Helvie 1983). These public lands also provide waterfowl hunting opportunities, including seven areas that are staffed by state of federal employees. These seven areas provided an average of approximately 27,000 hunter days (averaged across 2020-2023) during each waterfowl season.

Sustainability has been important to hunters in North America for over 120 years, as hunters want to ensure future generations have the same opportunity to build strong emotional connections with wildlife and their habitats (Sanger 1897). Concerns for future generations were a major motivator for hunting and naturalist organizations to campaign for the closure of legal markets for wildlife products that were driving wildlife population declines, culminating with the passing of highly impactful legislation such as the Lacy Act in 1900, and the Migratory Bird Treaty Act in 1918 (Dorsey 1998; Geist et al. 2001; Anderson and Padding 2015). Hunters continue to play a key role in ensuring wildlife populations are well managed by providing data to scientific monitoring programs (Geist 1995; Geist et al. 2001; Organ et al. 2012). Hunters provide wildlife researchers and managers with information such as band recoveries and harvest reports which are used to inform demographic models and estimate wildlife population sizes to ensure hunting mortalities do not result in population declines (Raftovich et al. 2023).

Self-imposed tax and fee initiatives developed by hunters continue to generate funds for wetland conservation and waterfowl management across North America. The Migratory Bird Hunting Stamp Act of 1934 requires hunters to purchase a federally issued stamp to legally hunt waterfowl. The revenue generated from the sales of these stamps is used to acquire and protect waterfowl habitat. To date, the stamp act has generated more than 1 billion dollars and preserved over 2.4 million hectares of waterfowl habitat. The state of California passed their own duck stamp law in 1971, which has raised over 20 million dollars to enhance wetlands and fund research. The Pittman-Roberston Act – passed in 1937 – placed an 11 percent excise tax on firearms, ammunition, and archery equipment, which has generated more than 12 billion dollars for state fish and wildlife agencies to use on habitat management. Hunters are the only group that has contributed this level of financial support to habitat conservation.

Efforts to manage wintering waterfowl at the local level are accomplished through wetland management activities. Waterfowl concentrate in seasonal wetlands, which are shallowly (typically less than 12 inches deep) flooded from fall to early spring, where food resources are abundant (Fredrickson and Taylor 1982). Management practices manipulate the timing and depth of water, as well as providing mechanical disturbance, to improve conditions for the production of annual plant seeds and invertebrates that waterfowl favor (Fredrickson and Taylor 1982; Euliss and Harris 1987; Baldassarre and Bolen 2006). Wetland management is expensive and time-intensive, which adds to the background costs associated with maintaining water control structures and other infrastructure to ensure proper wetland function. Private land managers typically shoulder these annual costs due to the benefits they provide waterfowl, although these management actions also benefit other wetland dependent wildlife species, including listed species such as the giant garter snake (*Thamnophis gigas*), and greater sandhill crane (*Antigone canadensis*) (Gilmer et al. 1982; Gildo et al. 2002; DiGaudio et al. 2015).

Flooding rice fields in winter benefits growers by reducing organic matter, primarily rice straw, which must be removed before the next crop can be planted (Bird et al. 2000). Waterfowl, particularly dabbling ducks, are attracted to these flooded fields which have favorable water depths and contain waste grain and invertebrates that waterfowl forage on (Elphick and Oring 1998; Petrie et al. 2016; Matthews et al. 2022). Dry rice fields are beneficial to geese and provide an estimated 95 percent of food resources available to wintering geese in the Central Valley (CVJV 2020). Benefits flow both ways, as waterfowl foraging activities in flooded fields increase the breakdown of rice straw (Bird et al. 2000). Rice growers also receive financial compensation from hunters by providing access to these flooded rice fields during the waterfowl hunting season. Many hunters and rice growers have formed long-term relationships through these agreements, resulting in a tradition of waterfowl hunting in rice fields in the Sacramento Valley.

Because of the importance of waterfowl hunting to wetland conservation, and the project's objective to respect existing land uses and culture, it is critical to consider the potential impacts of floodplain reactivation on waterfowl hunting and wetland management. There were several efforts underway prior to the Floodplains Reimagined project that set the stage for our analysis. Before Floodplains Reimagined became an actual project, discussions were had between water managers and conservation practitioners regarding the importance of integrating the needs of managed wetlands, wetland owners, and waterfowl hunters in any floodplain reactivation scenarios being contemplated. Similarly, the larger Floodplain Forward Coalition came together to build momentum to advance floodplain reactivation in the Sacramento River Basin. The Coalition developed a portfolio of approximately 30 early implementation projects to improve habitat conditions for fish, birds, and other wildlife. That portfolio includes a proposed project developed by DU titled "Integrating the Needs of Managed Wetlands and Wetland Owners in Floodplain Reactivation". In anticipation of a landscape-scale floodplain reactivation planning effort eventually being initiated, DU tried to secure funding for that proposed project from the Central Valley Joint Venture twice before the Floodplains Reimagined project was initiated and was unsuccessful both times. To ensure that the potential impacts to waterfowl hunting and wetland management resulting from floodplain reactivation efforts are sufficiently understood an evaluation of current, or baseline conditions, is required. This baseline assessment will allow for us to better understand how potential reactivation scenarios may impact waterfowl hunting and wetland management.

Methods

To respect current land uses and the cultural and conservation importance of waterfowl hunting within the project area, we conducted outreach to wetland managers and hunters to develop criteria which can be used to assess how these factors might be impacted by changes in flood depth, frequency, area, and duration. We used the results from a large-scale hydrodynamic model that simulated the depth, frequency, area, and duration of water within the project area for five baseline years (Appendix 5). The five baseline years (2003, 2011, 2013, 2015, 2019) capture a range of water year types, ranging from critically dry to wet, allowing for the natural variation on conditions to be represented (Appendix 5). Combined with these data on flooding, we used the criteria we identified, combined with evaluations of biological data to formulate an equation that can be used to assign an impact score on waterfowl hunting and wetland management during flood events which occur between fall and early spring under baseline conditions. The scores produced by the equation capture the direct impacts of flooding on a range of important factors for waterfowl hunting, while a separate score for wetland management describes the impacts of modifying the hydrological cycle in the period following hunting season (i.e., after mid-February) as this is the desired time to draw down wetlands to begin the spring growth cycle for desirable wetland plans that produce seed for waterfowl in the fall.

Criteria Identification

We identified four primary criteria – bird use, landowner/hunter access, infrastructure maintenance, and wetland management for waterfowl food production – to be used to determine how flood events between fall and early spring impact hunting and wetland management activities. Each of these criteria are influenced by water depth, flood timing, and flood duration. Water depth is correlated with waterfowl use, and dabbling ducks favor shallowly flooded wetlands (Taft et al. 2002; Baldassarre and Bolen 2006; Baschuk et al. 2011). Managed wetlands and winter flooded rice fields are designed to maintain a specific water depth that corresponds to peak waterfowl use. Dabbling ducks are unable to forage effectively in deeper water (beyond 12 inches), resulting in lower abundance of dabbling ducks in deeper wetlands (Colwell and Taft 2000; Baschuk et al. 2011). This project considered water depths of less than 12 inches suitable for waterfowl foraging (See Bird Habitat Suitability Criteria Technical Memorandum, Appendix 10). Similarly, increased water depth reduces the ability of hunters to access hunting areas and hunting and water management infrastructure. If water depth exceeds these target water depths, blinds, walking paths, and club houses can become inaccessible, or unusable by hunters. Wetland infrastructure, such as water control structures, levees, and pumps, can be damaged if flood waters are deep. Indirect impacts from flooding also impact hunting activities, as equipment within managed wetlands and winter flooded rice fields often needs to be removed or relocated to avoid damage or destruction given an impending flood event. Similarly, there are post-flood impacts, as waterfowl do not immediately return to areas once favorable water depths (less than 12 inches) return. The extent of these direct and indirect impacts primarily depends on the depth and duration of flooding.

We used depth multipliers (for hunting and wetland management) that increased in magnitude with increasing depth, to capture the greater impact caused by deeper water. The specific depth classifications and their assigned impact categories (Table 1) were developed during outreach events, and landowner working groups. The structural design of managed wetlands and rice fields, regarding levee height and water control structures, were the main factors that lead to the different depth classes in both winter-flooded rice and managed wetlands. These depth classes were then presented to and accepted by both the project advisory committee and steering committee.

Table 1. Overall impacts for each habitat type (winter flooded rice, and managed wetlands) based on flood depth. A total of four impact classes (*c*) were defined, each with a unique multiplier (ω) based on the severity of impacts on recreational hunting and wetland management actions following waterfowl hunting season. *Loss of foraging habitat is captured with bioenergetic models (see Waterfowl Bioenergetics Technical Memorandum, Appendix 7) during this period.

Impact Category	Depth		Depth Multiplier(ω) **Hunting** (Oct.1 – Feb.11)	Depth Multiplier(ω) **Management** (Feb.12 – Mar.31)
	Winter Flooded Rice	Managed Wetlands		
No impact	< 12"	< 12"	0	0
Bird use declines	12"-14"	12"-22"	1.5	0*
Access reduced	14"-20"	22"-28"	2.5	2.5
Infrastructure damage	>20"	>28"	5.0	5.0

Figure 1. Each day, between Oct. 1 – Mar. 31 was assigned a value (weighted hunt impact or wetland management impact). Waterfowl hunting season (shaded blue) occurs from Oct. 21 – Feb. 11, and the weighted hunt impact value during this time was based on waterfowl numbers, hunter success trends, and cultural importance. The wetland management period (shaded yellow) of consideration occurs from Feb. 12 – Mar. 31 and the weighted management impact value during this time was based managers accessing wetlands and achieve their target drawdown date.

Impact Equation Development

We developed an equation that utilizes data describing total flooded depth, frequency, area, and duration to assign a numerical score to a given period (Eq.1). Larger scores are given to flooding events that have a larger impact on recreational hunting and wetland management actions. Scores assigned to recreational hunting impacts and wetland management impacts were derived using the same equation, but those impacts are assessed during different time periods. We calculated waterfowl hunting impacts for all managed wetlands and rice fields due to the potential for all these areas to be hunted and the difficulty in identifying specific individual fields that are hunted. We did not account for spatial variation in where waterfowl hunting occurs both within a single hunting season, and across years. The relative value of each day during waterfowl season depends on waterfowl numbers, hunter success, and cultural importance. Traditionally, highly valued hunting days include opening weekend, extending over the following weekend, and the last three weeks of December and all of January. To capture this variation in hunting value, we used a weighted day approach in our calculation (Fig. 1). The exact calendar dates of the waterfowl hunting season can change between years and future changes in the regulatory structure of waterfowl season may occur, requiring the specific dates that this equation is applied in future years to be adjusted to account for these changes. Wetland management impacts were considered to occur following the end of hunting season through the start of desired drawdown, or when managers target draining seasonal wetlands to begin the next growing cycle. The weighted day approach also includes a fixed value for the days following the waterfowl hunting season to capture the impacts of deep flooding prior to drawdown. We chose a drawdown date of March 31 in this evaluation of baseline years as it is a commonly referenced date for desired drawdown in the wetland management literature (Smith et al. 1993). We excluded rice fields in our wetland management impacts after waterfowl hunting season ended, as impacts to agricultural practices are being evaluated through a separate process (See Agricultural Suitability Technical Memorandum Appendix 13).

Three inputs were used to calculate scores: (1) the daily total number of hectares flooded at each specific depth class for each habitat type (managed wetlands, and flooded rice), produced by a CBEC hydrological model, (2) a depth multiplier specific to the hunting and post hunting (wetland management) periods (Table 1), and (3) the relative hunting value of each day (Fig. 1). To produce the score assigned to flooding over the hunting period, the number of hectares flooded during each day, at each depth class, were multiplied by the corresponding hunting-specific depth multiplier and by the relative hunting value of that specific day. (Eq. 1). The resulting daily scores for each depth class, on each day during the hunting impact period (Oct. 1 – Feb. 11 in our example) were then summed. Summed day scores were then summed across the entire time period, (Oct. 1 – Feb. 11 for hunting impacts, Feb. 12 – Mar. 31 for wetland management impacts) to produce an annual score. We then standardized the annual score by dividing by a fixed value (the area being evaluated, in hectares, times three to match the number of depth classes) to scale the score and improve interpretability. We assigned a zero-value depth multiplier (Table 1) to bird use for wetland management calculations, as bird use is a primary concern during the hunting season. Moreover, any impacts to waterfowl caused by a loss of foraging habitat resulting from deep flooding would be captured in the waterfowl bioenergetic and waterfowl habitat suitability criteria analyses (see Habitat Suitability Criteria and Waterfowl Bioenergetics Technical Memoranda Appendices 7 and 10).

Equation 1: Daily impact scores are calculated by summing the products of the total number of hectares flooded within each class,

A_c = Number of hectares flooded at each class (*c*)

ω_c = Class (*c*) specific multiplier

Eq. 1 $$Daily\ impact\ score = \sum_{c=1}^{4} A_c * day\ weight * \ \omega_c$$

$$Scaled\ annual\ impact\ score = \frac{\sum Daily\ impact\ score}{Total\ area * 3}$$

We conducted a sensitivity analysis to determine how modifying day weights, depth category multipliers, and the structure of the equation influenced impact scores. We examined a range of day values, from 0.5 to 24, to determine if these changes resulted in better capturing flood impacts on high value days. We found that increasing the difference between low value days and high value days produced a minimal change in overall impact scores, primarily due to standardizing summed scores. Similarly, we tested depth class weights from 1.5 to 12 and found only minor changes once scores were standardized. We also examined how using exponential and logarithmic relationships between depth and area influenced impact scores but determined that a simplistic multiplicative approach was effective at capturing potential impacts of flood events.

Results

We applied the impact equation to data CBEC produced from a hydraulic model that tracked flood depth, timing, and duration for each of the three subareas of the project area (i.e., Butte Sink, Colusa Drain, and Sutter Bypass) during baseline years (2003, 2011, 2013, 2015, 2019; see Appendix 5 and 13). The equation produced a penalty score such that years which experienced increased water depths for longer periods during hunting season received larger scores. Scores produced for flooding events that impacted flooded rice and managed wetlands were similar, however flooded rice scores were consistently lower, except in Sutter Bypass during 2011. These lower scores in rice fields correspond with a faster return time to target water depths, as managed wetlands saw water depths return to pre-flood levels more slowly (Table 2, Fig. 2-6). Wetland management scores were significantly lower than hunting scores due to number of days included in the calculation of these two scores, 133 days for hunting versus 48 days for management, and a lower day value being applied during the management period.

The largest impact to hunting in both habitats for all three subareas occurred in 2003, as flood events occurred over a large area during days with peak waterfowl hunting value (Fig. 2, Fig. 7). Unlike the Butte Sink and Sutter Bypass subareas, which saw three distinct peaks in managed wetland flooding in 2003, the Colusa Drain subarea included 2,500 hectares that continued to be impacted by flooding without much attenuation until late January. Flooding during 2011 produced the lowest hunting impact score (for both rice and managed wetlands) in the Butte Sink and Colusa Drain subareas (Fig. 7). The low impact on hunting during 2011 was largely due to limited flooding extent, and the areas that did flood saw minor increases in water depth which remained primarily in the bird use impacts depth class. Sutter

Bypass experienced the smallest hunting impact score in 2011, however rice saw significant flooding. The lowest hunting impact score for winter flooded rice in Sutter Bypass subarea occurred in 2019. Despite multiple flooding events occurring in 2019, most of the impacts occurred after waterfowl hunting season.

We observed subarea-specific flooding characteristics. The Sutter Bypass subarea appeared to have the fastest return to target water depths, indicated by a rapid decline in flooded hectares following a flood event. Flooded rice and managed wetlands saw the slowest return to target water levels in the Colusa Drain subarea, denoted by a slow decline in flooded area (Fig. 2-8). Sutter Bypass also experienced a much higher proportion of the total area that flooded, often at the deepest depth class. In nearly every year Sutter Bypass experienced at least one day during which the entire managed wetland and managed rice area was inundated at the maintenance impact depth class. The high proportion of the total area falling within at least one impact class resulted in high standardized hunting impact scores (> 80).

Wetland management impact scores were only calculated for managed wetlands. Flooding on rice fields that could impact rice growing operations in the spring were calculated through a separate analysis (see Appendix 13). The smallest wetland management impact score occurred in 2013, where virtually no hectares fell into any of the three impact categories in the three subareas. The largest impact score for wetland management occurred in 2019, where all subareas experienced a significant portion of managed wetlands flooded deeper than 28 inches throughout late February and March.

Conclusions and future considerations

The scores produced by the impact equation can be used to compare how different flooding events impact hunting and wetland management quickly and accurately. Flooding events that occur under baseline conditions can impact waterfowl hunting and wetland management activities within the project area. We observed that hunting and wetland management impacts were similar across subareas within the same water-year, however some subarea specific trends were apparent. Flood events impacted a large proportion of Sutter Bypass, likely due to the smaller size of the subarea and its location within the bypass. As a result, nearly the total area of rice fields within the Sutter Bypass subarea experienced maintenance impacts during each water-year. Despite the extensive flooding that occurred in this subarea, the area also returned to target water depths more rapidly than the other subareas. Overall, we found that flooding events that occur under baseline conditions can occasionally generate large impacts to both waterfowl hunting and wetland management activities.

We caution that scores cannot be directly compared across subareas to determine which subarea experienced the largest flooding impacts, as the acreages of the subareas were summed in the calculation and impact scores were standardized. Wetland management impact scores should only be compared to other wetland management impact scores, not hunting impact scores. A major benefit of these unitless scores is how they effectively capture how variations in water depth and flood timing and duration can impact waterfowl hunting activities and wetland management actions. The structure of the equation and inclusion of depth and day value multipliers allow for future modifications to improve the applicability of this approach for scenario planning. We also chose to not include the impacts that flooding may have on dry field hunting, or the late goose season, since these hunting activities comprise only a small portion of the total hunter days within the project area.

The accuracy of our estimated impact scores depends on the accuracy of the hydraulic models used to derive data on flooding depth, frequency, area, and duration. We did not include a spatial component to our estimates of hunting impacts and wetland management impacts as the specific locations of hunting activities often change over time. Similarly, we assumed a target drawdown date of March 31 in our estimates of wetland management impacts. The precise drawdown targets of managed wetlands can vary from year to year based on the amount of precipitation received in the winter and spring, expected water allocations for the summer growing season, and plant species targeted. Therefore, the impact equations provide general estimates of impacts caused by flooding, which can be applied to any water year or future flooding scenario.

Current wetland management efforts within the project area allow the region to continue to support goal level populations of ducks and geese under baseline conditions. Increased deep flooding that could occur under various floodplain reactivation scenarios is likely to result in increased costs associated with wetland management and infrastructure maintenance and private landowners may choose or be forced to forego wetland management activities. The loss of the private investment in wetland management is likely to have a major impact on the total number of waterfowl the project area can support over winter. Declines in waterfowl use within the region associated with deeper flooding is likely to reduce hunting interest in the area. The combination of high wetland management costs and poor hunting opportunities may result in the loss of wetland acres on private lands. The potential feedback loop of wetland quality degradation, loss of hunting opportunity, and decline in wetland areas would negatively impact a variety of wetland dependent species, in addition to waterfowl, that are currently supported within the project area.

Many private wetland owners aim to maximize the benefits their wetlands provide to waterfowl which in turn improves hunting opportunities. These efforts have been supported by research examining the effects of management strategies on the production of waterfowl foods, and results have been distilled into management guidebooks and made available to interested wetland managers (Rollins 1981, Fredrickson and Taylor 1982, Smith et al. 1993). Wetland managers typically combine general management guidelines with the system and conditions their wetlands encounter to build localized best management practices. This process has generated wetland managers with a wealth of knowledge on wetland management within the context of the area they work in. It will be critical to incorporate this local knowledge in any potential floodplain reactivation scenarios to provide multi-species benefits in wetland systems.

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Fig. 2 Total area (hectares) of each habitat type (managed rice, and managed wetlands) within each depth class for each of the day within the three basins in 2003. Each time period is shaded (waterfowl hunting season = blue, wetland management period = orange).

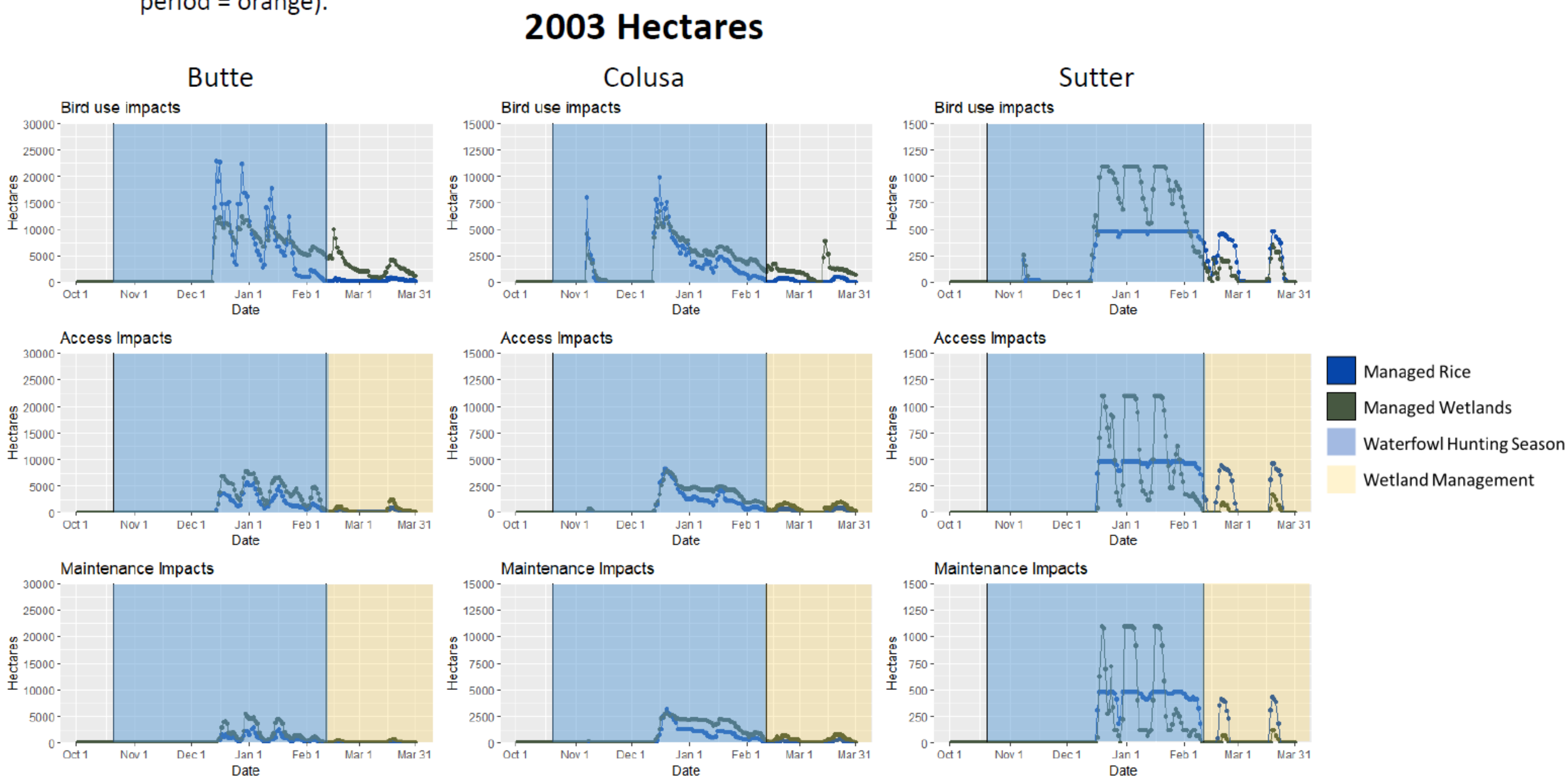


Fig. 3 Total area (hectares) of each habitat type (managed rice, and managed wetlands) within each depth class for each of the day within the three basins in 2011. Each time period is shaded (waterfowl hunting season = blue, wetland management period = orange).

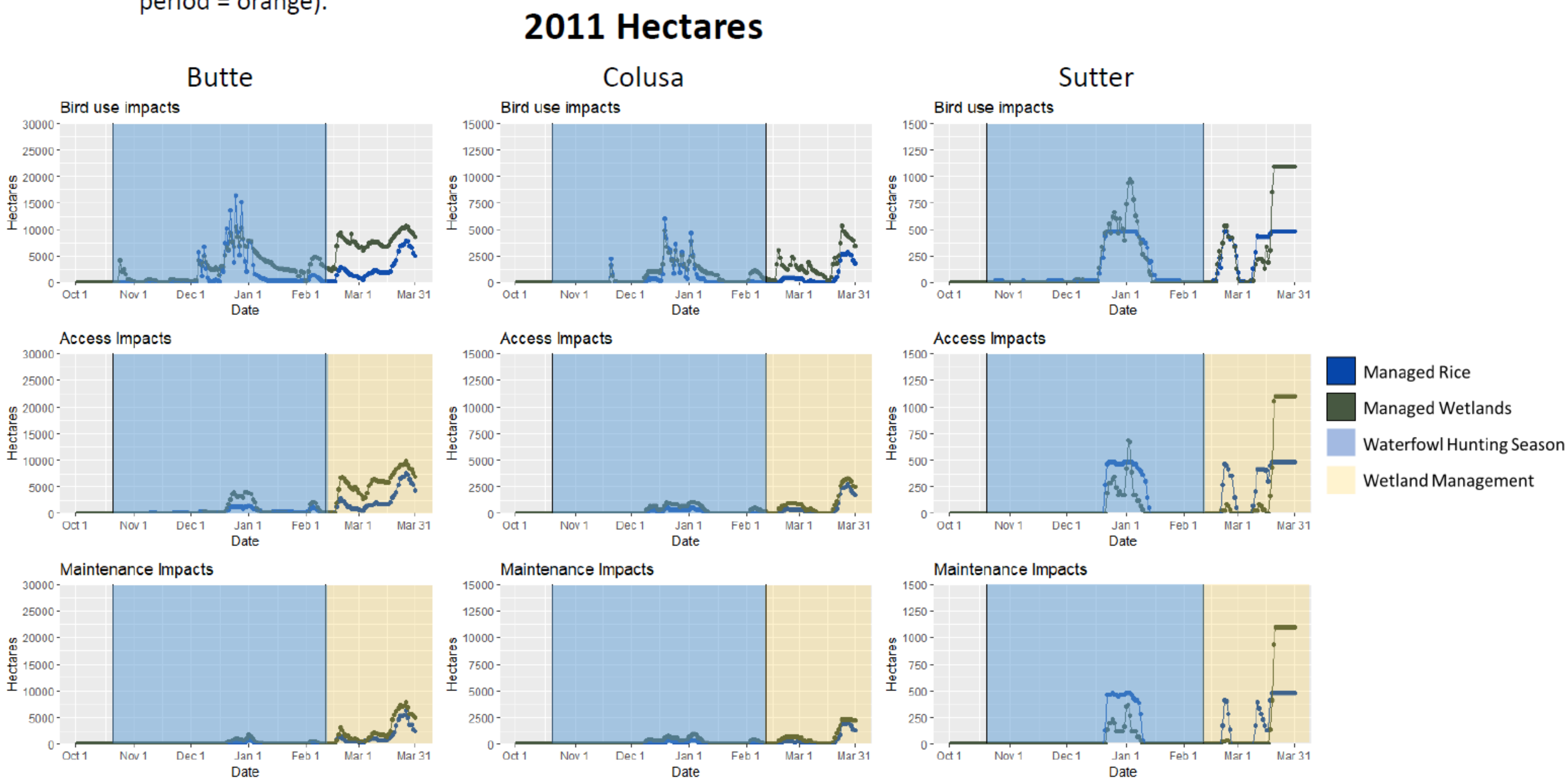


Fig. 4 Total area (hectares) of each habitat type (managed rice, and managed wetlands) within each depth class for each of the day within the three basins in 2013. Each time period is shaded (waterfowl hunting season = blue, wetland management period = orange).

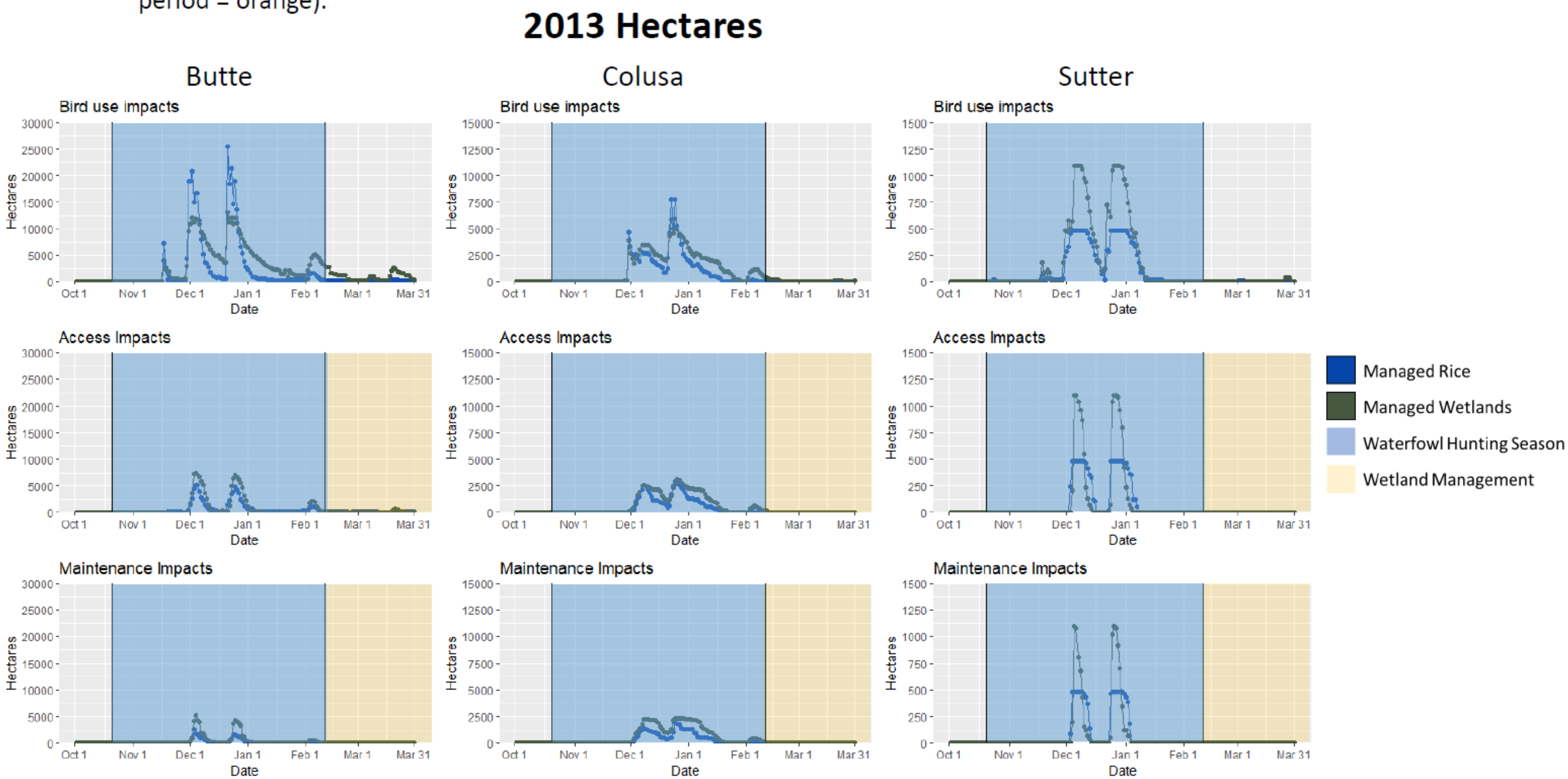


Fig. 5 Total area (hectares) of each habitat type (managed rice, and managed wetlands) within each depth class for each of the day within the three basins in 2015. Each time period is shaded (waterfowl hunting season = blue, wetland management period = orange).

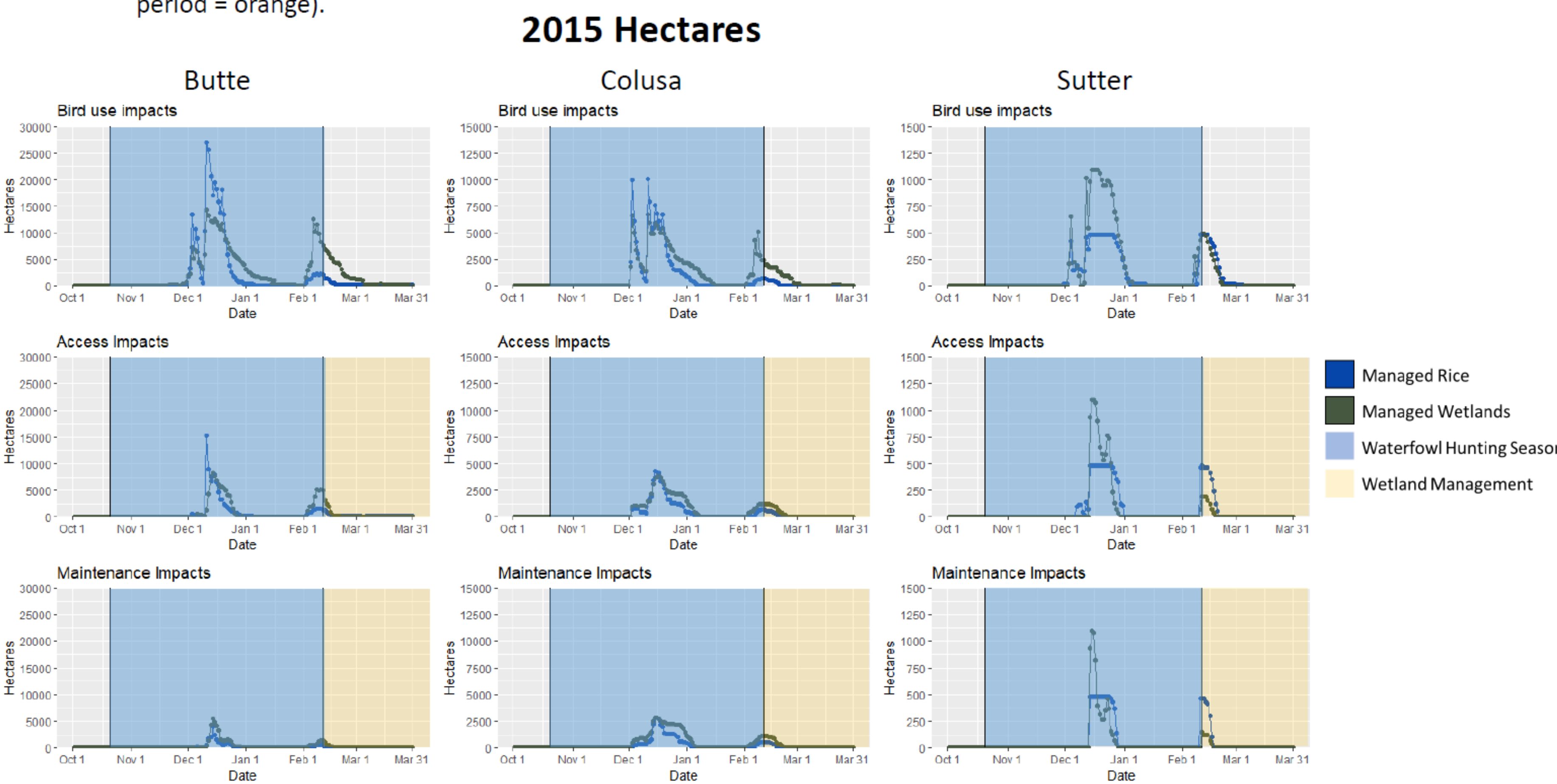


Fig. 6 Total area (hectares) of each habitat type (managed rice, and managed wetlands) within each depth class for each of the day within the three basins in 2019. Each time period is shaded (waterfowl hunting season = blue, wetland management period = orange).

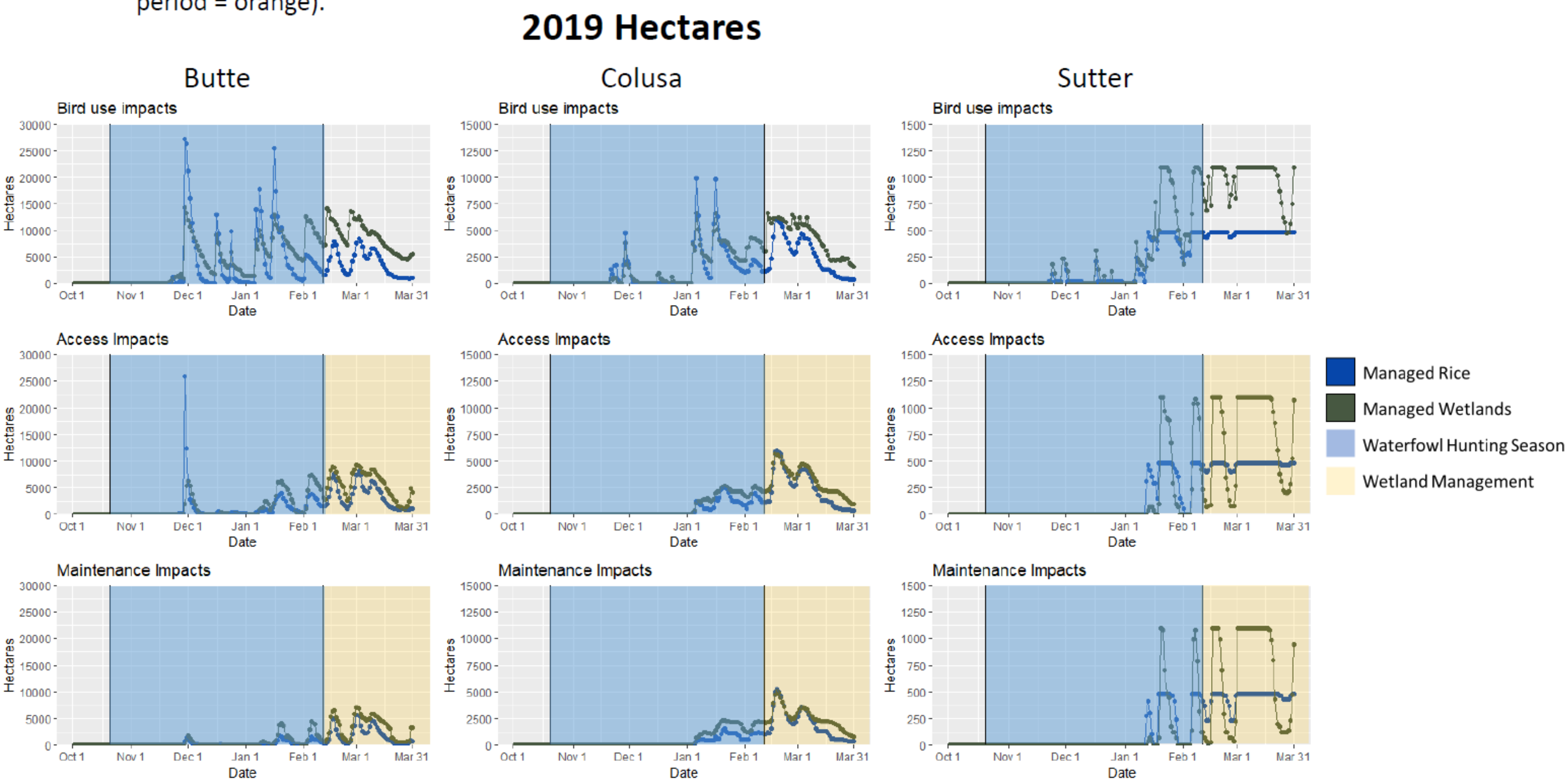
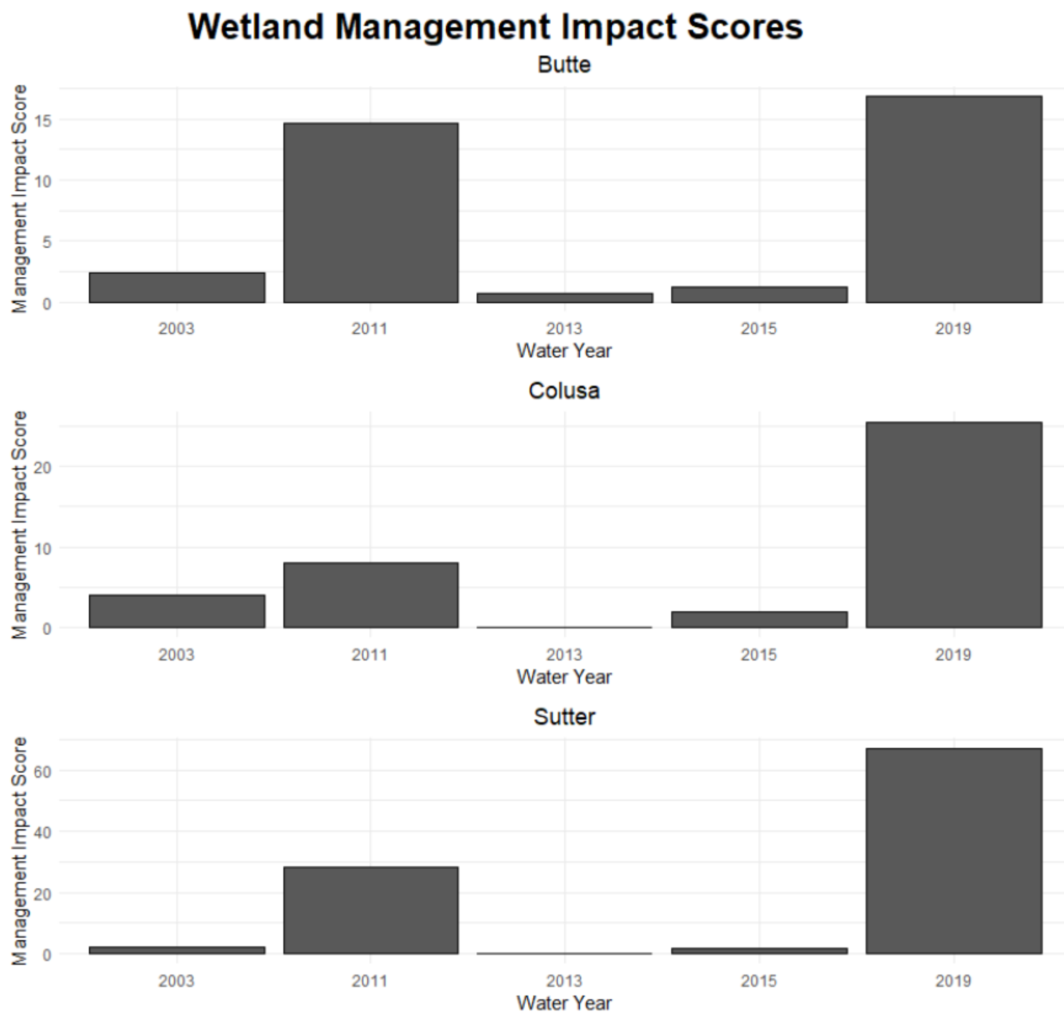


Fig. 7 Hunting impact scores for each habitat type, by water-year and basin.

Fig. 8 Wetland management impact scores by water-year and basin.



Summary table of hunting impact scores and wetland management impact scores for all years examined.

Year	Butte			Colusa			Sutter		
	Hunting Impact Score		Wetland Management Impact Score	Hunting Impact Score		Wetland Management Impact Score	Hunting Impact Score		Wetland Management Impact Score
	Flooded Rice	Managed Wetlands		Flooded Rice	Managed Wetlands		Flooded Rice	Managed Wetlands	
2003	52.4	73.5	2.4	72.2	105.7	4	217.9	275.5	2.3
2011	15.4	26.2	14.6	12.4	25.4	8	91.6	52.7	28.3
2013	25.6	37.5	0.7	46.7	78.6	0.1	91.8	116.4	0
2015	29	33.4	1.2	44	62.5	1.9	80.3	93.7	1.8
2019	30.1	39.9	16.8	36.8	57	25.4	77.3	78.7	67
Mean	30.5	42.1	7.14	42.42	65.84	7.88	111.78	123.4	19.88