Central Valley Joint Venture Monitoring & Evaluation Plan

CENTRAL VALLEY JOINT VENTURE
CONSERVING BIRD HABITAT

Wintering Waterfowl

May 2009

Introduction

The Central Valley of California is the most important waterfowl wintering area in the Pacific Flyway, supporting up to 60% of the total Flyway population in some years (Heitmeyer 1989) and higher proportions of certain populations. Food availability is a key factor limiting waterfowl populations during migration and winter (Miller 1986, Conroy et al. 1989, Reinecke et al. 1989), and habitat conditions on the wintering grounds may influence reproductive success (Heitmeyer and Fredrickson 1981, Kaminski and Gluesing 1987, Raveling and Heitmeyer 1989). As a result, the CVJV assumes that food energy is the primary need of waterfowl during migration and winter, and uses a bio-energetic model that links population and habitat objectives for wintering waterfowl (Central Valley Joint Venture 2006). There are a number of additional assumptions and data inputs in the model that need to be refined through monitoring and evaluation. CVJV partners have been very successful in developing and implementing habitat programs directed at the objectives identified in the 2006 Implementation Plan (IP). Evaluating the impacts of these programs and addressing issues and challenges faced by wildlife managers is a critical component of this chapter. To minimize overlap in attempting to categorize monitoring and evaluation activities, we define them as:

Monitoring: Data collected on a regular basis to assess validity of current assumptions underlying CVJV objectives. Monitoring provides data inputs to the planning models (e.g. food demands and availability) or data for tracking other changes to the physical and social environment (e.g., rice availability, water availability, hunter numbers).

Evaluation: Data collected periodically to measure results of specific CVJV habitat activities in meeting waterfowl objectives or affecting the social environment. A second type of Evaluation consists of development of information through Directed Studies to assess underlying assumptions of CVJV objectives or to address information gaps in response to changing biological, physical, or social conditions.

Four primary sources of information were used to develop the list of monitoring, and evaluation needs: (1) assumptions from the wintering waterfowl chapter of the CVJV 2006 IP; (2) the prioritized list of information needs from the CVJV 2004 waterfowl research meeting; (3) new information needs that have arisen since the 2004 meeting and identified by the Waterfowl Working Group and CVJV partners; and (4) the 2007 North American Waterfowl Management Plan (NAWMP) Continental Assessment Final Report (NAWMP 2007).

An underlying assumption of the NAWMP is that efforts to secure, restore, and enhance the quantity and quality of non-breeding habitats influence breeding probability and success, and ultimately, population size. If these cross-seasonal effects do occur, then variation in food supply or other characteristics of winter habitats should yield consistent variation in recruitment in subsequent breeding periods. This basic NAWMP assumption led to the delineation of continental areas of significance in non-breeding regions, which in turn became Joint Ventures. More specific assumptions are made by Joint Ventures through their individual approaches to biological planning.

We reviewed the IP to develop a list of explicit and implicit assumptions on which the goals and objectives for wintering waterfowl were based. The purpose is two-fold: 1) explicitly state the assumptions and data inputs that underlie our planning process; and, 2) provide a background for critical thinking on which assumptions will be prioritized for evaluation. The comprehensive list of assumptions is found in Appendix 1.

In 2004 the CVJV Technical Committee held a two day waterfowl research meeting to develop and prioritize a comprehensive list of information needs for both wintering and breeding waterfowl in the Central Valley. The CVJV hired a professional facilitator to help focus the group on wintering waterfowl needs on the first day. Subsequent to the meeting the list was organized by category and sent back to the participants for prioritization. Individual ranks were combined and the final product was a list prioritized overall and within sub-groupings (Appendix 2).

In 2005, the NAWMP Committee (PC) commissioned the first ever continental assessment of the NAWMP's goals and accomplishments. From this assessment the NAWMP Continental Assessment Final Report was released February, 2007 (http://www.fws.gov/birdhabitat/NAWMP/files/FinalAssessmentReport.pdf). We reviewed recommendations of this report and considered these when developing our Monitoring and Evaluation issues.

The following series of five Monitoring and Evaluation issues collectively contribute to strengthening the CVJV's biological foundation by: (1) testing key assumptions; (2) refining the bio-energetic model; (3) informing management; and, (4) evaluating program effectiveness. These are not intended to be a complete list of all important questions related to wintering waterfowl, but should address the highest priority needs with direct feedback into CVJV activities. Each issue contains a statement of the issue(s) followed by a background section, a bulleted list of desired products, and an explanation of how the expected outcomes relate to CVJV activities. Table 1 provides a reference that links the monitoring and evaluation issues from this plan to assumptions from the CVJV 2006 IP (found in Appendix 1) and information needs from the CVJV 2004 waterfowl research meeting (found in Appendix 2). Table 2 contains status and expected frequency of monitoring and evaluation activities identified in this plan, as well as other operational surveys relative to wintering waterfowl. Appendix 3 contains a list of participants from the 2004 waterfowl research meeting.

Rather than rank the five issues, the CVJV Waterfowl Working Group elected to rank the 19 individual products. The overall rank for each product is listed in parentheses as well as in Table 1. Issues are ordered based on average rank of their products.

1. Tracking Net Landscape Change

Issues:

Estimates of habitat gains and losses at landscape scales are essential to estimate true conservation progress and to set appropriate habitat objectives relative to wintering waterfowl population levels and distribution.

The CVJV currently lacks the capability to track both habitat gains and losses at the scale(s) necessary to evaluate the net impact of CVJV programs.

Background:

Traditional wildlife habitat programs such as acquisition, restoration and enhancement of wetlands have been a cornerstone of the CVJV's conservation delivery since its inception. The CVJV 1990 and 2006 implementation plans contain habitat objectives for wetlands and wetland-associated uplands for a suite of migratory birds. To track accomplishments toward JV habitat protection, enhancement, and restoration goals, the CVJV maintains an online project database. Habitat acreage goals are tracked by habitat category (palustrine, riverine, upland, agriculture, etc.), habitat type (emergent shrub-scrub, forested, etc.), and water regime (perennial, seasonal, tidal/non-tidal, etc.) The system allows partners to input and track project information in a timely manner, which provides JV staff and partners up-to-date information on their progress toward JV habitat goals at any time, and provides a measure of habitat "gain". However, landscape changes related to urban development and changing agricultural economies are largely beyond the control of the CVJV. The cumulative impacts of these changes require changes in planning objectives. The JV's habitat tracking system was not designed to track habitat loss, but it is important for the JV to do so nonetheless, because the IP objectives are based on the assumption that JV activities are additive.

In 2005, the PC commissioned the first ever continental assessment of the NAWMP's goals and accomplishments. From this assessment the NAWMP Continental Assessment Final Report was released February, 2007 (http://www.fws.gov/birdhabitat/NAWMP/files/FinalAssessmentReport.pdf). One of the primary conclusions of this report was that at the continental scale, most JVs could not critically evaluate progress toward attaining NAWMP population objectives, and could not with confidence describe landscape conditions needed to achieve those objectives. This is partially attributable to the limited ability to assess ongoing net landscape change and the lack of a direct relationship of habitat changes to bird vital rates and population sizes. Therefore, the assessment report recommends that JVs do a better job of monitoring key habitat trends, such as the extent of wetlands (all JVs), nesting habitat (breeding JVs), or foraging habitat (wintering JVs).

The continental assessment requires that JVs report to the PC triennially on progress towards meeting the goals and objectives of their implementation plans. A component of this will be demonstrating the effect of JV activities on net landscape change. Although the JV's will be reporting triennially, the appropriate interval for change assessment will likely be 5-10 years, because the cost of obtaining some data sets may be quite large, and the ability to detect changes at the landscape scale may vary by habitat type.

Desired Products:

- Data listing habitat gains, losses, and net change in each basin for the following habitat types: seasonal wetlands, permanent/semi-permanent wetlands, rice[1], corn[2], and other

crops that provide foraging habitat (wheat, tomatoes, cotton in appropriate basins). **(rank:2)**

- Spatial products depicting gains and losses for each of the above habitat types, and changes in the food production capabilities of those habitats. **(rank: 11)**

Expected Outcomes:

Net habitat gain or loss data will allow the CVJV to adjust wetland and agricultural land restoration and enhancement programs to better meet plan objectives. Trend data for rice and corn fields and field status (flooded, plowed, etc.) will directly provide data inputs for the JV bio-energetic model to allow fine-tuning of programs to achieve IP objectives.

[1]rice includes the following sub-categories (in acres)s: total rice grown, total winter-flooded rice for hunting and straw decomposition, total rice plowed , total rice untreated post-harvest, total baled and burned.

[2]corn includes the following sub-categories from the Delta Basin (in acres): total corn grown, total winter-flooded corn, total un-flooded corn, total corn plowed.

2. Food Availability to Wintering Waterfowl in Central Valley Agricultural Fields

Issues:

Estimates of food resources available to waterfowl from Central Valley rice fields are 15+ years old; current data inputs are needed to refine the bio-energetic model; methods used to make these estimates have been labor- and machine-intensive.

Estimates of corn densities in harvested fields are based on crop yield and harvest efficiency estimates, rather than actual sampling of food availability.

Crops other than rice and corn are assumed to provide no food resources, however waterfowl regularly forage in other crops (wheat, tomato, cotton) in the Delta and Tulare Basins.

Examination of current post-harvest treatment practices in Central Valley rice fields is needed.

Future trends in the Central Valley's rice industry are unknown, but could have significant negative or positive impacts on wintering waterfowl.

Background:

Rice present in harvested fields is a major contributor to meeting the food energy requirements of wintering waterfowl in the Central Valley. The CVJV bio-energetic model estimates that 68% of all food resources are currently provided by agricultural habitats, primarily rice. Food densities assigned to rice fields in the CVJV IP reflect 20-year old estimates (CVJV 2006). Changes in acres of rice planted, harvest efficiency, rice yields, and changing post-harvest practices due to the Rice Straw Burning Reduction Act of 1991 since the 1980s and 1990s, when the first estimates were obtained (Miller et al. 1989, Miller and Wylie 1996), probably have changed the amount of waste grain now available to waterfowl. These uncertainties have compromised the JV's estimates of the availability of food in rice fields and the role that rice should play in future wetland habitat planning efforts. In response to growing concern over observed changes in post-harvest treatment of rice fields, Miller and Garr (2008) conducted a survey of Sacramento Valley rice fields from December 2007 to January 2008. This survey replicated work done in the mid-1980s. They found increases in total acres of rice grown as well as increases in acres post-harvest plowed and flooded. Baling appeared as a new post-harvest treatment over the past 20 years. Collecting food availability data for each post-harvest treatment is needed to accurately estimate the true contribution of rice fields to meeting the energy requirements of wintering waterfowl. Ideally, estimates of food availability in rice fields should be sampled more frequently. To accomplish this, a more rapid sampling methodology is needed. The CVJV recognizes that wintering waterfowl rely on a mixture of agricultural and wetland habitats. However, changing agricultural practices and markets that are largely beyond the control of the JV could significantly reduce the food resources provided by rice. In order to better understand the changing landscape of rice and its influence on migratory waterfowl, a review of current trends and future projections of rice agriculture in the Central Valley is needed to ascertain if wetland habitat planning objectives are still sufficient.

While rice provides most of the agricultural habitat for waterfowl in the Central Valley, waterfowl rely on other crops as foraging habitat, particularly in the Delta and Tulare Basins.

Corn, wheat, and tomato seeds are important food sources in the Delta Basin. For the 2006 IP, estimates of average corn yields for the Central Valley and harvest efficiency were used to determine food availability. Foraging threshold and non-waterfowl consumption of corn were assumed to be the same as for rice. In the Tulare Basin, waterfowl rely heavily on waste agricultural seeds and invertebrates in post-harvest flooded fields (tomato, wheat, corn, cotton; Fleskes et al. 2003). Moss et al. (2006) investigated availability of these foods, and their findings will be incorporated into future energetic modeling exercises.

Desired Products:

- New estimates of food availability in rice fields (rice and moist-soil seeds) under the range of observed agricultural practices. **(rank: 3)**

- Development of a rapid, accurate sampling method to allow frequent assessment of rice availability in harvested fields under a range of post-harvest treatments. **(rank: 5t)**

- Estimates of food availability in harvested corn, tomato, wheat, and cotton fields (crop and moist-soil seeds) in the Delta, San Joaquin, and/or Tulare Basins under the range of observed agricultural practices. **(rank: 10t)**

- A study of trends in agronomic practices in Central Valley rice production that have the potential to impact waterfowl food availability. This report should also examine future trends in the California rice and corn industry relative to changes in land use and competition for water. **(rank: 7t)**

Expected Outcomes:

Estimates of food availability in agricultural fields coupled with industry trend analysis will allow the JV to refine the bio-energetic model with current data. Subsequently, adjustments to agricultural and wetland habitat objectives can be made for each Central Valley basin. Development of a more rapid sampling protocol will allow the JV to stay current with changes in agricultural practices impacting habitat quality for wintering waterfowl.

3. Effects of Wetland Management on Moist-soil Plant Productivity

Issues:

The effectiveness of wetland management practices to boost moist soil plant productivity in the Central Valley has not been adequately evaluated.

The impacts of various regulatory restrictions (water quality mandates, mosquito abatement, etc.) on the effectiveness of wetland management practices are unknown.

Information on invertebrate productivity in Central Valley wetlands is limited.

Background:

Over 95% of the historic wetlands in the Central Valley have been destroyed or modified (CVJV 2006), and the hydrology of the Central Valley has been dramatically altered for the purposes of flood control and water delivery for cities and irrigated agriculture. Since 1990, CVJV partners have made significant strides in protecting remaining wetlands, and restoring and enhancing degraded wetlands. Even so, wintering waterfowl still rely on remnant wetlands that are intensively managed as well as food resources from agriculture. Naylor (2002) discovered that Central Valley wetlands produce highly variable amounts of moist-soil seeds, and generally in quantities less than previously assumed and used in previous JV planning efforts. Additionally, management practices such as drawdown timing and rate, and disking and irrigation can significantly affect moist-soil seed production. Examining the effect of various habitat management regimes on seed production could allow us to examine invertebrate production, food depletion rates, and foraging thresholds. Regulatory constraints that restrict water management may have significant negative effects on habitat quality. Current concerns include mosquito abatement and water quality mandates that affect timing and duration of flooding and drawdown on managed wetlands. Limited quantities, restrictions on the timing of use, and increasing costs of wetland water supplies may provide similar constraints. Knowledge of the potential impacts to seasonal wetland habitat quality (i.e., changes in food production) as a result of changes in timing and duration of water management events, decreased irrigation, and other impediments to management are needed to accurately predict the impact of these actions on food supplies for wintering waterfowl. A series of well designed experiments would allow us to examine a range of wetland management regimes, as well as judge the impacts of regulatory constraints on water use. The IP assumes that all managed wetlands are flooded annually, but resource managers have questioned this assumption. To gain a better understanding of variation in flooding practices and to more accurately estimate food resources at planning scales and have a baseline against what to assess the result of management activities, information is needed on existing wetland management practices.

Desired Products:

- Changes in available waterfowl foods, including both seed and invertebrate food resources, under a range of management regimes. **(rank: 1)**

- Information on management practices currently being used by public and private wetland managers. **(rank: 8)**

- Estimates of food depletion rates and foraging thresholds (energy/food density below which waterfowl will cease to forage). **(rank: 9t)**

- Estimates of the ratio of flooded:unflooded managed wetlands for years of dry, wet, and average rainfall. **(rank: 10t)**

- Predictive model(s) that estimate waterfowl food production under a range of water use regimes. **(rank: 5t)**

Expected Outcomes:

With more accurate estimates of actual and potential waterfowl food availability, food depletion rates, and foraging thresholds relative to waterfowl species and actual management practices, the CVJV will be able to refine the bio-energetic model and more accurately assess the actual and potential carrying capacity of Central Valley wetlands. Predictive models will also provide managers a tool to assess the impacts of regulatory mandates on waterfowl foods. Collectively, these data will allow the CVJV to adjust conservation efforts and planning activities accordingly in a true adaptive system.

4. Evaluation of CVJV Activities

Issues:

The NAWMP Continental Assessment Final Report charges Joint Ventures with improving the biological understanding of how landscape variation and habitat accomplishments influence waterfowl vital rates.

The CVJV has actively pursued wetland acquisition, restoration, and enhancement activities since its inception and is now uniquely positioned to evaluate the results of those activities over a 1-2 decade time frame. Periodic evaluation of the biological impact of JV efforts is critical to refining and adapting management policies and objectives.

The CVJV lacks sufficient capability to track landscape use by wintering waterfowl (e.g. annual midwinter surveys show only a single day distribution of wintering waterfowl that are not likely reflective of winter-long distributions) and currently has no method to tie changes in landscapes with wintering waterfowl vital rates.

The NAWMP Science Support Team (NSST) is working with JV's to develop more informative performance metrics.

Background:

Performance evaluation is a critical, but often overlooked, aspect of adaptive resource management. The U.S. Fish & Wildlife Service (FWS) is increasingly promoting the strategic planning cycle of "Plan-Implement-Evaluate" that JVs have refined. Similar to JV strategic planning, increasing accountability, efficiency, and effectiveness is captured in the theme of Strategic Habitat Conservation, a new FWS initiative with agency administrative and financial support.

The primary assumption of most wintering ground JV's is that providing adequate habitat during winter will ensure adequate over-winter survival and that ducks return to the breeding grounds in good condition. To date JVs have struggled with developing appropriate measures to determine if habitat actions are accomplishing intended results. Whereas change in population size and recruitment have been useful measures of breeding habitat success, direct performance measures for conservation effort on wintering and migration areas has been more challenging and, thus far, slow to develop. The CVJV is unique among non-breeding JVs in that we have historic (pre-JV) information that has allowed us to conduct well designed, periodic assessments (e.g., every 10 + years) to compare various biological parameters (survival, body condition, movement and distribution and hunter satisfaction) with earlier studies in order to track our accomplishments using a series of composite (i.e. valley-wide) and relevant metrics. Most recently, Fleskes et al. (2005) compared waterfowl distribution, movement patterns, and habitat use between pre- and post- NAWMP. Currently, CVJV partners are currently conducting a study comparing of waterfowl body condition pre- and post-CVJV.

The issue of measuring performance is also being addressed at a national level, and consensus is building around non-breeding survival as the most desirable metric. A group of migrating and wintering JVs recently held a workshop to explore the potential for a large scale (multiple JVs) experiment to link over-winter survival to changes in habitat in wintering and migration areas. Secondly, the NSST's recent workshop on developing alternative performance metrics identified survival as the recommended vital rate for measuring performance in non-breeding areas. While our strategy for evaluating the success of CVJV

activities is based on periodic comparative assessments, we should continue to stay engaged as these national level efforts evolve. Growing support at the national level for tying non-breeding survival to wintering ground habitat conditions may provide an opportunity for the CVJV to participate in larger scale evaluation activities in the near future.

Because of the important role wetlands managed for waterfowl hunting have in meeting the habitat requirements of waterfowl in the Central Valley, we are also interested in evaluating sociological impacts of CVJV activities. Previous studies on waterfowl hunting success should be repeated and expanded to evaluate how our programs are influencing hunter satisfaction.

Desired Products:

Comparative estimates of changes in the following parameters on a 10-15 year cycle:

- Waterfowl distribution and species composition within the CVJV region **(rank: 4)**
- Waterfowl body condition **(rank: 6)**
- Waterfowl survival (hunting/non-hunting mortality) during non-breeding season **(rank: 7t)**
- Waterfowl hunter satisfaction **(rank: 9t)**
- Waterfowl use of wetland and agricultural habitats **(rank: 10t)**
- Waterfowl movement patterns and roosting/feeding sites **(rank: 12)**

Expected Outcomes:

Information on wintering waterfowl distribution and species composition will provide data inputs to the bio-energetic model that could affect future planning objectives. The CVJV will be able to strengthen linkages between landscape scale habitat activities and waterfowl population response(s). This will allow JVs to adapt assessment, planning, and delivery activities accordingly, and result in more biologically informed accomplishment reporting to the FWS. Information on how our programs are influencing hunter satisfaction will allow us to tailor program delivery in ways to maintain privately managed wetlands as critical waterfowl habitat.

5. Effects of Climate Change on Wintering Waterfowl Populations

Issues:

Potential impacts of climate change on wintering waterfowl habitat must be evaluated.

Many entities are currently involved in climate change modeling; our efforts should take full advantage of existing information and models.

The CVJV Management Board has tasked the chairs of all standing committees to report how climate change is being addressed by their respective committee.

Background:

Wetland habitats in the Central Valley could be particularly impacted by climate change. Changes in rates of evaporation, precipitation, snow melt, stream flow, sea level rise and various other processes will likely reduce predictability of water availability for wetland management and rice and corn agriculture in California. These impacts could be exacerbated by rapid landscape changes associated with human population increases and urbanization, invasive plant species, and reductions in deliverable water quality and quantity. We know relatively little about potential impacts of climate change on wintering waterfowl and their habitats. A primary assumption is that changes to wintering waterfowl habitat will include changes in quantity, quality, and availability of water supplies, and further, that such changes may lead to changes in the distribution and abundance of wintering waterfowl. Modeling expertise of existing and new partners will help us understand the predicted effects of climate change on Central Valley waterfowl, and a first step will be to thoroughly review climate change science and planning by state and federal agencies (DWR, CDFG, USBR, NOAA, etc.). This understanding will enable the JV to proactively adjust conservation and management actions. The results of these models will support biological planning, conservation design, and program implementation. These joint efforts will improve our ability to characterize, assess, and predict habitat changes and population responses.

Desired Products:

- Models to predict impacts of climate change on quantity, availability, and cost of wetland water supplies given a range of climate change scenarios. **(rank: 9t)**
- Scoping document that reviews ongoing efforts and identifies and prioritizes immediate planning needs relative to potential impacts of climate change to wintering waterfowl and their habitats in the Central Valley. **(rank: 13)**

Expected Outcomes:

A strategy for responding to anticipated changes, including recommendations for priority conservation actions by CVJV partners.

Table 1. Central Valley Joint Venture monitoring and evaluation issues and products.

Issue	*Product*	*Rank*	*Monitoring[1] or Evaluation[2]*	*CVJV Planning Assumptions (Appendix 1)*	*Wintering Waterfowl Research Topics (Appendix 2)*
Tracking Landscape Change	Habitat gains & losses	2	M, E	3.11;4.5	B.4;C.1;C.2;G.1;G.2
	Spatial products – habitat availability	11	E	4.1;4.2	B.1;B.5;E.1;E.2;E.4-E.6
Food Availability in Agriculture	Rice availability	3	M, E	1.3;3.5;3.8;4.3	B.1;E.4;E.5;E.6
	Rapid Rice Assessment Protocol	5t	E		B.1
	Food availability in other crops	10t	M, E	1.3;3.2;3.9;3.10;4.3;4.4	E.4;E.5;E.6
	Trends in rice agriculture	7t	M	3.8	B.1
Wetland Management Effectiveness	Management effects on food production	1	E	1.3;3.2;3.3;3.4;4.1;4.2	B.2;B.3;B.5;E.1;E.2;E.4;G.3
	Survey of management practices	8	M	3.3; 3.11	A.1; A.2; B.2;C.3;D.2; G.1; G.2; G.3
	Food depletion-foraging thresholds	9t	E	2.3; 3.98; 3.9; 4.3; 4.4	E.4; E.5; E.6
	Flooded vs. unflooded habitats	10t	M	3.11	D.2; G.1; G.2; G.3
	Management constraint models	5t	E	3.1	A.1;A.2;D.1;D.2
CVJV Evaluation	Waterfowl distribution & spp. composition	4	M, E	1.1;4.5	C.3;C.4;F.1-F.6
	Changes in body condition	6	M, E	2.1;2.2	F.1
	Changes in winter survival	7t	M, E	2.1;2.3	F.1F.4
	Changes in hunting success/satisfaction	9t	M, E		H.1;H.2
	Changes in habitat use	10t	M, E	3.1-3.3;3.5-3.7	C.1-C.3;F.1
	Changes in movement patterns	12	M, E		F.1;F.3-F.6
Climate Change	Predictive water supply model	9t	E	3.3; 3.11	
	Scoping document	13	E		

[1] Monitoring: operational surveys or regular ongoing data collection

[2] Evaluation: occasional assessments to update plans, document trends in biological and social environment

Table 2. Current status and expected frequency of Central Valley Joint Venture monitoring and evaluation activities.

Activity	*Expected Frequency*	*Current Status*
Products from M&E Plan		
Habitat gains & losses	every 10 years	estimate from 2003 (CVJV 2006)
Spatial products – habitat availability	every 10 years	no data
Rice availability	every 3-5 years	last data from 1983-86 (conventional) and 1993 (stripped)
Rapid Rice Assessment Protocol	new info	planned for 2009 (M. Miller USGS)
Food availability in other crops	every 5 years	estimated using harvest statistics (CVJV 2006)
Trends in rice agriculture	every 5 years	new info; also last data from 2007 (Miller 2008, in draft)
Management effects on food production	new info	in progress – B. Olson, UC-Davis
Survey of management practices	every 5 years	in progress - M. Brown, UC-Davis
Food depletion-foraging thresholds	new info	estimate from Naylor et al. (2002)
Flooded vs. unflooded habitats	every 5 years	no data
Management constraint models	new info	no data, but see Olson, UC-Davis
Waterfowl distribution & spp. composition	every 10 years	last data on all waterfowl from 1973-1982;last data for MALL, NOPI,
Changes in body condition	every 10 years	GFWG from 1998-2000
Changes in winter survival	every 10 years	(Fleskes et al. 2005)
Changes in hunting success/satisfaction	every 10 years	last report in 1996 (hunting success)
Changes in movement patterns	every 10 years	last data on all waterfowl from 1973-1982; last data for MALL, NOPI,
Changes in habitat use	every 10 years	GFWG from 1998-2000 (Fleskes et al. 2005)
Predictive water supply model(s)	new info	review needed – may exist
Climate change scoping document	new info	
Other ongoing & operational activities		
Mid-winter waterfowl survey	annually	operational
White goose survey	annually	operational
White goose species composition survey	every 3-5 years	operational
White-fronted goose survey	annually	operational
Aleutian Canada goose pop monitoring	annually	operational
Hunting information (#hunters, harvest, regulations)	annually	operational
CVJV Waterfowl Research Meeting	every 3-5 years	last conducted 2005

Literature Cited

Central Valley Joint Venture, 2006. Central Valley Joint Venture Implementation Plan – Conserving Bird Habitat. U.S. Fish and Wildlife Service, Sacramento, CA. 261 pp.

Conroy, M. J., G. R. Costanzo, and D. B. Stotts. 1989. Winter survival of female American black ducks on the Atlantic Coast. J. Wildl. Manage. 53:99-109.

Fleskes, J.P., R.L. Jarvis, and D.S. Gilmer. 2003. Selection of flooded agricultural fields and other landscapes by female northern pintails wintering in the Tulare Basin, California. Wildlife Society Bulletin 31: 793-803.

Fleskes, J.P., J.L. Yee, M.L. Casazza, M.R. Miller, J.Y. Takekawa, and D.L. Orthmeyer. 2005. Waterfowl distribution, movements, and habitat use relative to recent changes in the Central Valley of California: A cooperative project to investigate impacts of the Central Valley Joint Venture and changing agricultural practices on the ecology of wintering waterfowl. Final Report. U.S. Geological Survey – Western Ecological Research Center, Dixon Field Station, Dixon, California.

Fleskes, J.P., J.L. Yee, G.S. Yarris, M.R. Miller, and M.L. Casazza. 2007. Pintail and mallard survival in California relative to habitat, abundance, and hunting. Journal of Wildlife Management 71(7): 2238-2248.

Heitmeyer, M. E. 1989. Agriculture/wildlife enhancement in California: The Central Valley Habitat Joint Venture. Transactions of the North American Wildlife and Natural Resources Conference 54:391-402.

Heitmeyer, M.E. and L.H. Fredrickson. 1981. Do wetland conditions in the Mississippi Delta hardwoods influence mallard recruitment? Trans. 46th N.A. Wildl. & Natur. Resour. Conf. 46:44-57.

Kaminski, R. M., and E.A. Gluesing. 1987. Density and habitat related recruitment in mallards. Journal of Wildlife Management 51:141-148.

Miller M.R. and J.D. Garr. 2008. The status of rice fields during midwinter in the Sacramento Valley, California: Final Report 2008. Unpublished Report. U.S.G.S. Western Ecological Research Center. Dixon, CA. 14 pp.

Miller, M.R. and G.D. Wylie. 1996. Preliminary estimates of rice present in strip-harvested fields in the Sacramento Valley, California. California Fish and Game 82:187-191.

Miller, M.R., D.E. Sharp, D.S. Gilmer, and W.R. Mulvaney. 1989. Rice available to waterfowl in harvested fields in the Sacramento Valley, California. California Fish and Game 75(2):113-123.

Miller, M.R. 1986. Northern pintail body condition during wet and dry winters in the Sacramento Valley, California. Journal of Wildlife Management. 50:189-198.

Moss, R.C., S.C. Blumenshine and J.P. Fleskes. 2006. Aquatic insects and waste agricultural seeds in post-harvest flooded agricultural fields in the southern San Joaquin Valley, California. Final Report. USGS, Western Ecological Field Station. Dixon, CA.

NAWMP. 2007. North American Waterfowl Management Plan Continental Progress Assessment. Final Report of the Assessment Steering Committee submitted to the North American Waterfowl Management Plan Committee, February 20, 2007. 98pp.

Naylor, L, E. 2002. Evaluating moist-soil seed production and management in Central Valley wetlands to determine habitat needs for waterfowl. M.S. Thesis. University of California, Davis. 80pp.

Raveling, D.G. and M.E. Heitmeyer. 1989. Relationships of population size and recruitment of pintails to habitat conditions and harvest. Journal of Wildlife Management 53:1088-1103.

Reinecke, K. J., R. M. Kaminski, D. J. Moorehead, J. D. Hodges, and J. R. Nassar. 1989. Mississippi Alluvial Valley. Pages 203-247 in L. M. Smith, R. L. Pederson, and R. M. Kaminski, eds. Habitat management for migrating and wintering waterfowl in North America. Texas Tech Univ. Press, Lubbock.

Severson, D.J. 1987. Macroinvertebrate populations in seasonally flooded marshes in the northern San Joaquin Valley of California. M.S. Thesis. Humboldt State University. 113pp.

Appendix 1. Planning Assumptions.

The JV assumes that food is the primary need of waterfowl during migration and winter, and that food limits waterfowl populations during those times. Specifically, adequate foraging habitat will ensure that survival outside of the breeding season will not limit population growth.

Population Objectives

Assumption 1.1: Populations were assumed to increase from August and September to a peak in late December or early January in each Central Valley basin and decline thereafter.

Assumption 1.2: To make diet-based adjustments to population objectives for gadwall and widgeon, the JV assumed that gadwall and widgeon were observed with equal probability during the 1998 and 1999 surveys. The ratio of gadwall to widgeon averaged 0.35 during these two years, with widgeon populations at or near NAWMP goals.

Assumption 1.3: Correcting population objectives based on diet assumes that food sources not included in the energy model are available to the birds. For example, the JV assumes that plant materials other than seeds are available in quantities > 30% of widgeon energy needs. This assumption could potentially lead to an underestimate of habitat needs.

Assumption 1.4: Swans and white geese were assumed to rely on similar habitats in the Central Valley.

Daily Energy Requirements

Assumption 2.1: Energy is the most important food constituent required by migrating and wintering waterfowl.

Assumption 2.2: Food requirements are met by foraging in wetlands, grain fields, and ad hoc areas.

Assumption 2.3: Energy requirements of ducks, geese, and swans potentially affect food energy available to other bird groups, and vice versa.

Habitat Types and Acreage

Assumption 3.1: Ducks rely on seed resources in managed wetlands, waste grain in rice fields that are winter-flooded, and waste grain in harvested cornfields, regardless if these fields are flooded.

Assumption 3.2 Crops other than rice and corn are assumed to provide no food resources.

Assumption 3.3: Unmanaged aquatic habitats provide no food resources for waterfowl, as it is not clear how reliable unmanaged habitats are from one year to the next.

Assumption 3.4: Ducks consume macro-invertebrate food resources in managed wetlands in late winter and early spring.

Assumption 3.5: Dark geese rely on seed resources in managed wetlands and waste grain in winter-flooded rice fields, dry rice fields and harvested cornfields.

Assumption 3.6: It was assumed that white geese and swans use the same agricultural habitats as dark geese, though swans are largely restricted to flooded agricultural habitats.

Assumption 3.7: The JV also assumed that white geese and swans did not exploit food resources in managed wetlands.

Assumption 3.8: As with the 1990 Plan, the JV assumed that 25% of all unflooded rice is unavailable to waterfowl because of post-harvest practices.

Assumption 3.9: The JV also assumed that 50% of all unflooded corn is unavailable to waterfowl because of post-harvest practices.

Assumption 3.10: Due to post harvest practices, all corn on private lands in the San Joaquin and Tulare basins was assumed to be unavailable to waterfowl.

Assumption 3.11: All managed wetlands are flooded annually.

Habitat Foraging Values

Assumption 4.1: The plan assumes invertebrate consumption by most Central Valley ducks is minimal prior to January, based on seasonal shifts in diet.

Assumption 4.2: The JV assumes 28 lbs of macro-invertebrate matter per acre beginning January 1 based on late winter estimates of invertebrate biomass for seasonal wetlands in the Mississippi Alluvial Valley is applicable to Central Valley wetlands.

Assumption 4.3: The Plan assumes decomposition rates for rice and corn from the Mississippi Alluvial Valley are applicable to the Central Valley.

Assumption 4.4: Non-waterfowl consumption of corn was assumed to be the same as for rice, as was the 30 lb/acre foraging threshold.

Assumption 4.5: For the 2006 Plan, the JV elected to meet at least 50% of all duck energy needs through managed seasonal wetlands; hereafter this is referred to as the “wetland constraint.” This planning goal was applied to all basins.

Appendix 2. Monitoring, Evaluation & Research needs identified in the 2004 Waterfowl Research Meeting.

HABITAT MANAGEMENT & EVALUATIONS

A. MOSQUITO ABATEMENT	*Topic*	*Score*	*Overall Rank*
	1. Mosquito BMPs and foraging value	43	1
	2. Mosquito abatement vs. inverts & h2o quality	34	7
B. FOOD PRODUCTION	*Topic*	*Score*	*Overall Rank*
	1. Rice seed in harvested fields	36	5
	2. Wetland enhancement pre and post	34	7
	3. Wetland restoration pre and post	33	8
	4. Pre and post Joint Venture	32	9
	5. Irrigation effects	30	11
C. HABITAT CONFIGURATION AND BIRD USE	*Topic*	*Score*	*Overall Rank*
	1. Spatial location on habitat value	33	8
	2. Juxtaposition of rice vs. wetlands	32	9
	3. Effects of sanctuary size and location	31	10
	4 Minimum size of ag buffer around wetlands	30	11
D. WATER QUALITY	*Topic*	*Score*	*Overall Rank*
	1. Water quality mandates on food production	31	10
	2. Water quality constraints on management	30	11
E. FOOD AVAILABILITY	*Topic*	*Score*	*Overall Rank*
	1. Invertebrates - temporal variation	37	4
	2. Invertebrates - spatial variation	36	5
	3. Diets of ducks in Tulare basin	35	6
	4. Effect of flooding on seed depletion	34	7
	5. Seed decomposition by year & location	31	10
	6. Food consumption by non-waterfowl	31	10

POPULATION & HABITAT SURVEYS & INVENTORY

F. POPULATION OBJECTIVES & DISTRIBUTION	*Topic*	*Score*	*Overall Rank*
	1. General surveys to evaluate JV	42	2
	2. Utility of MWI	35	6
	3. Pintail exodus from SJV	33	8
	4. Band recovery distribution pre & post JV	31	10
	5. Decrease in waterfowl use of Delta	31	10
	6. Regional movements of bay ducks	29	12
G. HABITAT SURVEYS & DISTRIBUTION	*Topic*	*Score*	*Overall Rank*
	1. Percent of irrigated wetlands	32	9
	2. Amount of post-harvest flooding in Tulare	30	11
	3. Refined flooding curves for rice and wetlands	29	12
H. HUNTING EVALUATION	*Topic*	*Score*	*Overall Rank*
	1. Update JV hunting report	38	3
	2. Hunting success vs. sanctuary size and location	30	11
I. BIO-ENERGETIC MODEL	*Topic*	*Score*	*Overall Rank*
	1. Alternatives to using bio-energetic model	35	6
	2. Sensitivity of bio-energetic model	34	7
	3. BEM inputs for various species (mall, wig, snows)	29	12

Appendix 3. 2004 Central Valley Joint Venture Waterfowl Research Meeting Participants.

Name	***Organization***
Josh Ackerman	University of California-Davis
Dr. John Eadie	University of California-Davis
Dr. Joe Fleskes	USGS-WERC Dixon Field Station
Alan Forkey	USDA-Natural Resource Conservation Service
Greg Gerstenberg	California Department of Fish and Game
Catherine Hickey	PRBO Conservation Science
Rob Holbrook	USFWS - Central Valley Joint Venture
Dean Kwasny	California Department of Fish and Game
Dan Loughman	California Waterfowl Association
Mike Miller	USGS-WERC Dixon Field Station
Rick Morat	U.S. Fish & Wildlife Service (facilitator)
Shaun Oldenburger	University of California-Davis
Dennis Orthmeyer	California Waterfowl Association
Ruth Ostroff	USFWS - Central Valley Joint Venture
Peter Perrine	California Wildlife Conservation Board
Dr. Mark Petrie	Ducks Unlimited, Inc.
Dr. Fritz Reid	Ducks Unlimited, Inc.
Bob Shaffer	USFWS - Central Valley Joint Venture
Carley Sweet	U.S. Fish & Wildlife Service
Mike Wolder	U.S. Fish & Wildlife Service
Dennis Woolington	U.S. Fish & Wildlife Service
Dan Yparriguirre	California Department of Fish and Game