North American Waterfowl Management Plan Science Support Team
Technical Report No. 2008-1

Continental Progress Assessment Report Recommendation A.1 – NSST Scoping Document A Report to the Plan Committee from the NSST

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ABSTRACT
At their meeting at Savannah, GA during January 9-11, 2007 the North American Waterfowl Management Plan Committee identified top priorities distilled form the Continental Progress Assessment Report which included Recommendation A.1: The Plan Committee should ensure development of a clearer and more robust accountability framework for the achievement of NAWMP biological objectives involving all organizational levels in the Plan Community.

Subsequently, the Plan Committee developed management responses to the Assessment including a response to Recommendation A.1 as follows:

> *The Plan Committee will work with the JVs and the NSST to develop and maintain an accountability framework for the achievement of Plan goals. Necessary components will include coherent objectives at continental, national, regional (JV), and sub-regional scales and regular reporting among the committees and organizations responsible for Plan implementation.*
>
> *Estimates of regional habitat gains (including NAWMP accomplishments) and losses are essential for estimating net conservation progress. Combined with improved understanding of how landscape conditions affect waterfowl vital rates, plan partners will be better able to set adequate habitat objectives and assess biological progress.*

The Plan Committee expects the NAWMP Science Support Team to develop and report recommendations for Plan Committee endorsement. This scoping document was developed in response to the Plan Committee's request for NAWMP Science Support Team recommendations to address the charges within Recommendation A.1 and will contribute to the development of NAWMP Science Support Team efforts to address priorities.

The NAWMP Science Support Team provided a summary review of the issues associated with each sub-element of recommendation A.1, discussed pros and cons for each sub-element, and developed NAWMP Science Support Team recommendations addressing each sub-element of recommendation A.1 to present to the Plan Committee.

Logical sequencing of NAWMP Science Support Team recommendations addressing each of the sub-elements reflected the NAWMP Science Support Team perspective for urgency and need.

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NSST Scoping Document

A report to the Plan Committee form the NSST

Executive Summary

At their meeting at Savannah, GA during January 9-11, the North American Waterfowl Management Plan (NAWMP or Plan) Committee (PC) identified top priorities distilled form the Continental Progress Assessment (Assessment) Report which included Recommendation A.1: *The PC should ensure development of a clearer and more robust accountability framework for the achievement of NAWMP biological objectives involving all organizational levels in the Plan Community.*

Subsequently, the PC developed management responses to the Assessment including a response to Recommendation A.1 as follows:

The Plan Committee will work with the JVs and the NSST to develop and maintain an accountability framework for the achievement of Plan goals. Necessary components will include coherent objectives at continental, national, regional (JV), and sub-regional scales and regular reporting among the committees and organizations responsible for Plan implementation.

Estimates of regional habitat gains (including NAWMP accomplishments) and losses are essential for estimating net conservation progress. Combined with improved understanding of how landscape conditions affect waterfowl vital rates, plan partners will be better able to set adequate habitat objectives and assess biological progress.

The PC expects the NAWMP Science Support Team (NSST) to develop and report recommendations for PC endorsement. This scoping document was developed in response to the PC's request for NSST recommendations to address the charges within Recommendation A.1 and will contribute to the development of NSST efforts to address priorities.

The NSST provided a summary review of the issues associated with each sub-element of recommendation A.1, discussed pros and cons for each sub-element, and developed NSST recommendations addressing each sub-element of recommendation A.1 to present to the PC.

Logical sequencing of NSST recommendations addressing each of the sub-elements will reflect the NSST perspective for urgency and need. These recommendations are presented below:

a.) Better monitoring of key habitat trends such as extent of wetlands, all nesting habitat (breeding JVs), or foraging habitat (wintering JVs)	
Recommendation #	Recommendation
A.1a.1	The NWI remapping effort should focus first on priority waterfowl areas.
A.1a.2	The NSST should explore the potential of building on initial landscape models of wetland change developed by Koneff and Royle (2004).
A.1a.3	The NSST and JVs should assess the potential of monitoring short term (3 – 5 year) changes in key habitat features using aerial or video imagery under a stratified landscape monitoring scheme.
A.1a.4	Canvass all JVs to identify the major habitats that need to be monitored for net change in their JV.
A.1a.5	JVs need to develop population-habitat models and statistically valid monitoring programs that feed their population-habitat models. Mature JVs should assist adjacent developing JVs to ease the process. Once models are in place, key habitat features we need to model over time at scale of JV (and even at macro-scales) need to be identified.
b.) Improved biological understanding of how landscape variation and habitat accomplishments influence waterfowl vital rates.	
Recommendation #	Recommendation
A1b.1	We recommend that an annual cycle model of vital rate variation, incorporating various environmental and landscape covariates based on recent research, be built and used to help examine the feasibility and design features of possible future coordinated multi-season field studies. Such modeling would also help address needs identified in the Joint Task Group report and we suggest that the NSST and AHMWG both contribute to this modeling work as a matter of high priority.
A1b.2	We recommend that additional JVs make progress on this important topic as soon as possible, focusing on their most critical geographic regions, and we urge JVs with relevant experience to help by sharing their knowledge of study approaches.
c.) The approaches and assumptions used to derive regional habitat goals should be reviewed and, if needed, revised. These habitat goals must be designed, in aggregate, to attain the Plan's continental population goals.	
Recommendation #	Recommendation

A.1c.1	The NSST will assemble a larger group to develop a techniques document or a white paper for approaching this issue more holistically, possibly looking at approaches that incorporate annual cycle models. **This should occur prior to implementing recommendation A.1b.1.**
d.) Improved tracking of habitat accomplishments in many JVs	
Recommendation #	Recommendation
A.1d.1	We recommend that the national secretariats be charged with conducting a comprehensive review of stakeholder reporting needs and existing JV/national tracking systems and make recommendations to the PC and the NAWCA Councils for desired improvements. These recommendations should be reviewed at multiple points during their development by a small task group of the NSST (including Canadian and U.S. members from breeding and non-breeding areas) to ensure that the new system will provide accomplishment data in forms that will be useful for planning and impact-analysis purposes. Major delivery agencies (e.g., DU Canada) will need to be fully engaged in such a review as well.
e.) Development of more informative performance metrics	
Recommendation #	Recommendation
A.1e.1	JVs encompassing ranges of target populations should use objectives (e.g., population size, vital rates) that can be used to assess progress of program activities at large scales (i.e., population, continental).
A.1e.2	Science coordinators from JVs that share target populations should convene to discuss appropriate objectives and performance metrics for priority populations. Coordinators should pay particular attention to recommendations from the JTG and the Continental Progress Assessment reports when formulating the objectives and metrics. This discussion should include individuals representing harvest management community.
A.1e.3	Once appropriate objectives are developed, monitoring programs and models need to be developed that relate habitat actions to bird responses.
f.) Enhanced communication among all Plan partners around biological objectives, accomplishments and efforts at improving biological foundations	
Recommendation #	Recommendation
A.1f.1	The Plan community should repeat comprehensive assessments of the Plan at approximately 10-year intervals. Between those assessments the JV's should report triennially to

	the Plan Committee on 3 topics; namely: 1) progress toward accomplishment of biological goals; 2) progress with adaptive management and testing key planning assumptions; and 3) ideas about how the different levels of the NAWMP enterprise (e.g., PC, JV, among JVs) might assist each other in making progress with their collective mission. Additional information on the state of the JV partnership would be a helpful complement to the science focus of the other three topics. One-third of the JVs should report each year to help spread out the work load (the PC will work out a schedule). One option would be to do Pacific and Atlantic Flyway habitat JVs one year; the Central and Mississippi Flyway habitat JVs another year; and the Species JVs the third year. Reporting will begin in July, 2008, two years out from the first assessment report. **This is a high priority and should be instituted immediately.**
A.1f.2	To ensure focus on important biological matters and consistency in reporting, the NSST will develop a draft template for these reports for review and approval by the JVs and the PC. **This is a high priority and should be accomplished before the initial request for reports is sent out by the PC.**
A.1f.3	JV reports should be submitted in writing to the PC and the NSST two months before the designated PC meeting. The NSST should review these and pass on any additional comments and observations to the PC and the JV prior to the meeting. The JVs will then be offered the opportunity to present their reports in person to the PC at the designated meeting. The PC will respond in writing to each JV report following the meeting.
A.1f.4	Annually, the Plan Committee will report to the JVs and the Flyway Councils on progress with its own work plan objectives and matters of broad interest to the JVs.
A.1f.5	The PC and the NSST will report to each other at each meeting of each committee. This will be facilitated by the NSST Coordinator and members common to the two committees.

Introduction:

At their meeting at Savannah, GA during January 9-11, the PC organized the Assessment recommendations by work group categories. The PC identified the top priority for the "Science" category as Recommendation A.1: *The PC should ensure development of a clearer and more robust accountability framework for the achievement of NAWMP biological objectives involving all organizational levels in the Plan Community.*

Subsequently, the PC developed a management response to the Assessment including a response to Recommendation A.1 as follows:

> *The PC will work with the JVs and the NSST to develop and maintain an accountability framework for the achievement of Plan goals. Necessary components will include coherent objectives at continental, national, regional (JV), and sub-regional scales and regular reporting among the committees and organizations responsible for Plan implementation.*
>
> *Estimates of regional habitat gains (including NAWMP accomplishments) and losses are essential for estimating net conservation progress. Combined with improved understanding of how landscape conditions affect waterfowl vital rates, plan partners will be better able to set adequate habitat objectives and assess biological progress.*

The PC expects the NSST to develop and report recommendations for PC endorsement. This scoping document represents a response to the PC's request for NSST recommendations to address the charges within Recommendation A.1 and will contribute to the development of NSST efforts to address priorities.

The NSST provided a summary review of the issues associated with each sub-element of recommendation A.1, discussed pros and cons for each sub-element, and developed NSST recommendations addressing each sub-element of recommendation A.1 to present to the PC.

Logical sequencing of NSST recommendations addressing each of the sub-elements will reflect the NSST perspective for urgency and need.

Scoping Document Objectives:

1. Provide a summary review of the issues associated with each sub-element of recommendation A.1.
2. Discuss pros and cons for each sub-element of recommendation A.1.
3. Develop NSST recommendations to address each sub-element of recommendation A.1 to present to the PC for endorsement.
4. Identify resources needed to address recommendations.

Recommendation A.1: The PC should ensure development of a clearer and more robust accountability framework for the achievement of NAWMP biological objectives involving all organizational levels in the Plan Community.

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a) ***Better monitoring of key habitat trends such as extent of wetlands, all nesting habitat (breeding JVs), or foraging habitat (wintering JVs)***

Summary Review:

In their Assessment, the NAWMP Assessment Steering Committee (ASC) concluded that "*estimating changes in areas of important upland and wetland habitat must be implemented to provide greater certainty about the overall net impact of the Plan on North American landscapes". Currently our capacity to assess net landscape change is limited and is typically only possible at small scales.*

Tracking efforts should provide increased accountability, but also provide a format by which success can be shared among the Plan partners. Tracking with respect to habitat gains and losses is important to assessing overall program impact. This is particularly germane as the conservation community expands its use of explicit waterfowl population-habitat models.

The ASC found that most JVs could not estimate net change in habitat conditions; with only three able to do this "well" and only three doing "moderately well." This limits our capacity to demonstrate the landscape-level impact of NAWMP programs. This will be increasingly important as conservation actions expand to embrace nontraditional extensive and policy approaches to conservation.

The ACJV, LMVJV and CVJV all rated "well" in their ability to track net landscape change, with PHJV ranking "moderately well." Generally, the JVs that were able to track net landscape change had a reasonable understanding of the link between habitat and waterfowl vital rates, linked waterfowl population goals to habitat goals, were some of the first JVs established, and had well-developed evaluation processes.

Wintering JVs (LMVJV and CVJV) are both relatively small and partners worked collectively to assemble detailed habitat information from existing and new databases including satellite imagery to develop explicit waterfowl population-habitat models. The PHJV used the best available imagery, long-term waterfowl survey data, results of large-scale assessments of waterfowl-habitat relationships, and existing agriculture census data in the development of a waterfowl productivity model. These three JVs have invested substantial time and resources in developing an understanding of landscape change. A similar level of modeling effort is underway in the PPJV. This level of investment of time and effort is beyond the scope of many JV's, so broad-scale approaches and use of existing census data are likely a significant part of the solution to assessing net landscape change at continental scale.

The ACJV provides an example of a broad-scale approach. They used existing Land Use Land Cover (LULC) and National Land Cover Data (NLCD) to characterize general habitat change over a large multi-state area (x mile^2). Their approach acknowledges limitations in the comparison, but nonetheless was informative in terms of identifying the magnitude of the change in landscape conditions between time periods. This approach evolved from the modeling of wetland change along the Atlantic Coast by Koneff and Royle (2004) and provides a broad-scale sense of change and has helped guide their development of landscape-level programs.

Twelve JVs responded to a request for updates on progress in assessing net landscape change since their meetings with the ASC. Most indicated that they had not advanced in addressing this issue. Generally JVs have attempted to utilize existing NLCD and NWI information. This information is often supplemented with other data sources. Most indicate that a new NWI is needed. However, it was recognized that this would provide insights regarding habitat changes at the 30-year time scale and that NWI habitat categories may not accurately reflect the necessary habitat conditions that influence waterfowl vital rates. In addition, this approach requires considerable refinement to address issues of relatively local, yet potentially important habitat changes.

In Canada, wetland inventories vary between provinces and range from detailed, highly classified inventories to a complete lack of wetland inventory. A proposal is currently under development to secure the funding for a national wetland inventory. The proposed inventory will evolve from detailed pilot projects that have been completed over the past several years.

The Issues:

One of the most pervasive issues involves scale. Monitoring programs will have to be developed that are relevant at a spatial scale larger than the JV. This means individual JV monitoring programs will have to be developed in concert with other JVs to provide the necessary resolution to roll up to the continental scale. However, each JV will be required to implement monitoring efforts within their boundaries. Conversely, negative impacts on critical waterfowl habitats can also be localized to segments of a JV, or the rate of change can vary across the JV. Both these factors require finer scale monitoring. Reconciling these two competing issues is a challenge, especially given the need for ensuring an adequate sample size at the finer scale - thus the big issue is funding. Essentially we need to ensure that we are able to answer the questions of what we want to monitor and why we should monitor these net changes in landscape conditions.

We need to identify appropriate metrics to measure progress and success. This will most likely be one of the most difficult and contentious aspects of the effort. Ideally, we would identify common metrics within each stage of the annual cycle (i.e., wintering, migration, and breeding) with the ability of translating and summing these metrics into an estimate of carrying capacity that would contribute to and support waterfowl population goals on the breeding grounds.

Approaches to monitoring net landscape change:

Below we provide several options to improve our capacity to track net landscape change over time. We recognize that some combination of approaches will likely evolve depending on resource availability and alignment of our needs with those of other agencies collecting information across the landscape.

1) Continental scale: National Wetland Inventories

Tracking habitat losses and gains to assess the status of breeding, migration and wintering habitats will require updated NWI data codified with a universal classification system to allow seamless, regional planning applications. A national level coordinated effort to collect current spatial wetlands data must therefore emerge. A first wetlands inventory in Canada is also a critical step.

The USFWS has had a legal mandate since 1986 to monitor the characteristics, extent and status of wetlands, and to create a digital database of this information. Hence, revitalizing the NWI is a logical next step to develop a comprehensive inventory, updated with current remote imagery in priority areas. Existing hardcopy NWI maps should be converted to digital format in areas without digital data that are not scheduled for remapping.

- Pros

  - Completion of seamless national digital wetlands database consistent with the Emergency Wetlands Resources Act of 1986, including remapping wetlands in ecoregions that have been subject to significant wetland losses or gains since 1980 and that are priorities for Service trust resource conservation.

  - NWI data have been instrumental in developing concepts collectively known as strategic habitat conservation (SHC). These concepts are leading to significant advancements in conservation efficiency and partnership effectiveness. SHC is increasingly being accepted as elemental to a broader renaissance in the conservation business model of joint ventures, the USFWS, and states. Demand for digital wetland data will continue to increase as joint ventures, the Service, states resource management agencies and others increase their capacity to deliver SHC.

- Cons-

  - It has been estimated that $25 million will be required annually to complete 10% of the U.S. each year. Overall cost will likely be in excess of $300 million accounting for inflation. Less funding would result in slower progress. Canadian cost estimates also are substantial.

  - Provides a 30-year change scale, and in some instances will be the first coverage in an area. Thus, this approach will provide limited ability to detect change over short-term time scales as we move forward. Although an important step, we need more frequently updated land cover data to track change over the short-term time scale in which landscapes are changing.

We assumed that the NWI and the Canadian wetland inventory will proceed. The NWI re-mapping effort will be implemented over at least 10 years and we have a critical need to relate net landscape change to waterfowl populations. Practically, this represents too long a time frame for relating to waterfowl demographics. The value is in the baseline it

provides for assessing landscape changes. Also, the USGS Regional GAP Analysis effort charged with producing periodic updates of land cover estimates for the United States represents another helpful avenue if they manage to produce results faster than every 10-15 years.

- ***Recommendation A.1a.1*** **The NWI remapping effort should focus first on priority waterfowl areas.**

  (Who: JV & NSST Science Coordinators)

Given the need to expand current waterfowl population-habitat models beyond the boundaries of JVs, models must include existing landscape-scale information.

- ***Recommendation A.1a.2*** **The NSST should explore the potential of building on initial landscape models of wetland change developed by Koneff and Royle (2004).**

  (Who: JV & NSST Science Coordinators)

2) JV or flyway scale: Intensive stratified sampling:

While the NWI provided the opportunity to track long-term trends in landscape conditions across large geographic areas, we need the capability for monitoring at finer temporal and geographic scales. Habitat conditions can change rapidly and can be relatively local in scope, yet can still impact waterfowl populations when changes occur in priority waterfowl areas. As such, the time interval of the NWI will not enable the conservation community to respond to rapidly changing habitat conditions. For example, limited information on the extent of change can constrain the capacity to mobilize resources (human and financial) to address the issue. A key example is the potential conversion of CRP acres over the next 5 years.

Many JVs acknowledged that they need help in tracking habitat changes in a way that is affordable. Several JV's have started monitoring habitat conditions using a variety of stratified landscape sampling protocols that focus on change of key landscape variables related to waterfowl vital rates. Essentially, they are using a variety of habitat assessment approaches on representative plots across key landscape, including periodic aerial photography, low-level videography, and similar technologies. Sampling can be at various time intervals depending on the perceived rate of change and resource availability. Standardization of JV-specific techniques would promote the ability to extrapolate results to large landscapes.

- Pros

- Can detect short-term changes in habitat conditions.

- Can monitor habitats that have most impact on waterfowl vital rates.

- The surveys can be developed such that they compliment the NWI data and enable extrapolation across broader geographic areas.

- Will support regionally relevant conservation efforts.

- Depending on approach, can be relatively cost effective.

- Can be used in conjunction with waterfowl surveys to help inform population-habitat models.

o Cons

- Considerable testing is required to extend information beyond boundaries of survey plots.

- Recurring cost and effort of frequent surveys.

- Habitat categories must line up with other surveys like the NWI. This may present challenges.

Several JV's have started using stratified sampling to assess net landscape change over short temporal scales. This has the potential to provide more time sensitive information on landscape change in priority waterfowl areas.

➢ ***Recommendation A.1a.3*** **The NSST and JV's should assess the potential of monitoring short term (3 – 5 year) changes in key habitat features using aerial or video imagery under a stratified landscape monitoring scheme.**

(Who: JV & NSST Science Coordinators)

3) Life-cycle approach: Waterfowl population-habitat modeling:

One of the goals of monitoring landscape change is not necessarily to develop national datasets, but instead to develop national estimates of change in habitat capacity to sustain waterfowl populations at goal levels. It is imperative that we understand key waterfowl limiting factors and how these link to habitat conditions. For example, we should develop understanding of the most important landscape features that we need to assess because they limit waterfowl populations. There is a clear need for explicit models to relate changes in waterfowl demographic parameters to changes in habitat quality, quantity and distribution. This is an essential step in determining critical habitat priority areas to monitor and will require coordinated efforts to ensure that models are standardized to the extent possible. However, key habitat variables vary from breeding to wintering grounds. As such, critical habitat features monitored will need to reflect the importance of an area in the annual waterfowl life cycle (i.e., breeding/wintering). At a continental scale, we need to ensure that we are monitoring the most relevant habitat

features and accept that these will be different between breeding, wintering and migration areas.

For any meaningful effort by JVs in increasing efforts to monitor changes in habitat conditions it is essential that JVs decide on what they need to monitor. This should relate directly to the key habitats that they have identified as essential to conserve and restore. However, issues of scale need to be considered and adjacent JVs would benefit from development of common habitat features. The NSST should assist in the process by assisting in the development of capacity to monitor habitat and provide some level of standardization of habitat variables and methodologies to facilitate roll-up at the WCR, flyway or continental scale. A first step in the process should involve a detailed survey of all JVs to identify the major habitats that they are currently monitoring and additional habitats that they feel they need to monitor in the future.

- ***Recommendation A1a.4*** **Canvass all JVs to identify the major habitats that need to be monitored for net change in their JV.**

3a. Breeding Grounds

For breeding areas, standards are needed to develop waterfowl productivity models that can be used in conjunction with relevant data on landscape compositions. For example, in the PHJV, the *Waterfowl Productivity Model* has been used to establish a baseline estimate of waterfowl production from habitat (upland/wetland) conditions of the 1970s. This baseline served as the productivity objective against which current productivity is judged after accounting for changes in habitat. Landscape change was assessed using data from the Census of Agriculture to provide estimates of landscape composition in 1971 (productivity objective) and 2001 (current landscape objective). Changes in wetland area were used to simulate changes in *K* for breeding duck pairs using wetland basin – duck pair models (Cowardin et al. 1995).

The consideration of data currently collected by national departments of agriculture and forestry are essential to the long-term ability to track net change. Working with these agencies to obtain access to this information is a key activity for conservation planners. As such a key action should be the development of data sharing MOU's with national agriculture and forestry departments for use of their landscape assessment data.

- Pros-

- Uses existing data of landscape composition attained at lower cost than NWI digital data.

- Promotes objective, consistent, science-based regional conservation planning.

- Facilitates identification of a suite of habitat actions that optimize incremental hatched nests over a spatially explicit context.

- Should use existing information from diverse sources in addition to collaboration with others to influence the types of information collected (i.e. agriculture census). This should be a relatively cost-effective means of securing relevant information.

- Larger JVs can help facilitate the development of models across the breeding ground, thereby promoting inter-JV collaboration.

o Cons-

- Need better information on past and ongoing landscape change.

- May not account well for differential impacts from the intensities of land uses.

- Modeling wetland/upland change impacts on waterfowl productivity is limited by assumptions and generalizations made in the process.

- Time and cost to collect the waterfowl productivity information relevant to the modeled area. This is a challenge outside the prairies with relatively low waterfowl densities and more poorly understood waterfowl species.

3b. Wintering Grounds

For wintering areas (foraging and loafing habitat) it must first be stated that waterfowl population objectives are practically useful only in terms of developing habitat objectives. Goals for waterfowl in the NAWMP are stated as breeding populations and no clear relationships exist to predict the number of birds on certain wintering grounds based on breeding populations. Practically, bird abundances could be useful as performance metrics as well as for developing habitat objectives, but doing so entails a lot of work and monitoring. The intent of developing population objectives using 1970s data is to provide a basis, in conjunction with assumptions on limiting factors in a JV, for the formulation of habitat goals.

To date, the assumption of winter food limitation has not been proven where such assessments have been attempted (e.g., LMVJV, PLJV, CVJV). Other aspects of habitat (e.g., wetland surface acres) may also be limiting. Assuming that foraging habitat may be limiting, knowledge of spatially explicit habitat change must be specific enough to estimate waterfowl foraging *K* via quantifying "Duck Use Days" or some other measure. Quantifying available food can be conducted by using "constants", direct estimation or predictive models. Representative samples of habitat types must be sampled to arrive at JV-wide TME.

The need to access data from national departments of agriculture and forestry is perhaps of even greater importance than on breeding grounds.

o Pros

- Focus on key limiting factors will scale conservation actions to biological needs.
- Link of TME to cultivation/management practices is relatively simple to model and can be tracked using agriculture census information.
- Relatively easy to extend information across JV and flyway boundaries.
- Relatively cost-effective once link between TME and cultivation/management practice complete.

o Cons

- Using "constants" to quantify available food may result in overestimates, are not site-specific, and cannot be used to evaluate management.
- Constants must be verified.
- Direct estimation is costly.
- Predictive models developed to date show little utility across regions.

➢ ***Recommendation A.1a.5:*** **JVs need to develop population-habitat models and statistically valid monitoring programs that feed their population-habitat models. Mature JVs should assist adjacent developing JVs to ease the process. Once models are in place, key habitat features we need to model over time at scale of JV (and even at macro-scales) need to be identified.**

(Who: JV & NSST Science Coordinators)

Resources Needed:

The following commitments will be required:

1.) Commitment to national (US and Canada) wetland inventories.
2.) Commitment by JVs for more frequent stratified sampling in priority waterfowl habitats.
3.) Commitment from NSST to support survey standardization.

Beyond these commitments, the management community needs a centralized capacity to provide modeling expertise by establishing an *ad hoc* committee composed of NSST science coordinators and USGS modeling experts or hiring/appointing an NSST modeling coordinator. This will be needed to assist JVs in implementing explicit, biologically-based planning models that predict how habitat management affects vital rates/population responses; develop properly structured habitat monitoring efforts that include information on cumulative landscape change in key habitat areas and key variables; identify large-scale key habitat monitoring variables to address net landscape change; address limiting factors & population change in models that describe explicit risks and assumptions that facilitate identification of key landscape features that need to be monitored; developing multi-stage, annual cycle models that address large-scale issues.

We need to consider partnerships and funding that will enable changes in existing surveys that will provide meaningful input into models and tracking net habitat change (e.g., agriculture census, forest inventory survey) – or perhaps collaboration to find common ground/needs to attain efficiencies as opposed to attempting changes.

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b) ***Improved biological understanding of how landscape variation and habitat accomplishments influence waterfowl vital rates.***

Summary Review:

There are important linkages between this issue from the NAWMP Assessment and the recommendations of the Joint Task Group on development of better population models to help guide both habitat and harvest management. Progress in this area could also contribute substantially to assessing the effects of large-scale or long-term habitat changes such as the impacts of changing climate on waterfowl and their habitats.

This topic has a long history on the NSST "to do list" stretching back to the original NSST proposal in 1999. We recognize that it is a tough issue to address, but needs to be a priority now to enable critical translation of population goals to habitat goals and to assess progress toward objectives. Note that substantive progress with elements 1c and 1e depend critically on improving our understanding of the linkages described here.

While some studies of landscape variation and vital rates will develop JV-by-JV, we urge that such studies move forward with overall guidance from NSST and involvement by national science partners like USFWS, USGS, CWS and DU. Particularly for non-breeding areas, inter-JV coordination may be vital for meaningful progress.

Approaches:

Would it be most useful first to expand such studies in the breeding JVs where they have not been undertaken vs. focusing on non-breeding areas where we know less about the connection between landscape features and vital rates?

- Pros:

- Considerable progress has been made recently in the PHJV, the UMRGLJV and the southwestern Ontario portion of the EHJV. For several dabbling ducks, various sensitivity analyses suggest that population growth rates are most sensitive to variation in breeding-season vital rates. It is also easier, logistically, to associate landscape features with variation in vital rates for breeding birds because they are relatively sedentary. Consequently, more rapid progress may be possible in other breeding areas leading to more rapid adaptations of programs. Moreover, there is little empirical evidence to date, other than perhaps for northern pintails on the Gulf Coast, that winter food is limiting

over-winter survival or breeding condition.

- Cons:

- On the other hand, there is new evidence (PHJV Assessment data) that spring arrival condition of hen mallards does have some effect on some breeding parameters. The strongest evidence pointing towards the importance of "surplus" winter food is from the Central Valley and the Mississippi Alluvial Valley, but we don't know how widely true this is for wintering or spring migration areas. Other potential limiting factors like disturbance or disease have been little studied and could be important in places. Finally, we need to determine how to execute a study of the relationship between landscape conditions and vital rates on non-breeding areas and collectively we have shied away from this for a long time.

Should studies on wintering areas be next or studies involving wintering, staging and breeding areas in a joint design to test cross-seasonal hypotheses? The latter approach would require a multiple-JV effort. A useful first step might be to build on a few previous attempts (e.g., those of the Adaptive Management and Assessment Team [Jim Dubovsky], Rex Johnson, and the Joint Task Group) to develop annual cycle models of vital rates and population change. Simulation studies using such models that explore plausible ranges of variation in important environmental or demographic variables might be informative. Then we also would be in a better position to judge the feasibility of a coordinated multi-season field study. Mid-continent mallards or northern pintail populations might be good candidates for this because we already know something about variation in certain vital rates.

Another possibility for prioritizing such research would be to let future assessments of net landscape change (e.g., loss of rice agriculture along the East Texas coast) drive the choice of where these field studies are carried out. Logically, we may want to encourage this where current or expected rates of net habitat loss are greatest, thus preparing those JVs to make the most efficient possible conservation investments. Flexible national level resources for directed studies would enable such strategic evaluation programming.

A related information need, not specifically identified in the NAWMP Assessment, is evaluating whether our management actions result in substantial changes in landscape composition or conditions. In other words, there should be another part to recommendation A.1b – Do NAWMP management efforts result in the kinds of landscape change needed to affect populations? These are more programmatic than biological evaluations and hopefully should be a part of every JV's adaptive management framework.

- ***Recommendation A.1b.1:*** **We recommend that an annual cycle model of vital rate variation, incorporating various environmental and landscape covariates based on recent research, be built and used to help examine the feasibility and design features of possible future coordinated multi-season field studies. Such modeling would also help address needs identified in the**

Joint Task Group report and we suggest that the NSST and AHMWG both contribute to this modeling work as a matter of high priority.

- ***Recommendation A.1b.2:*** **We recommend that additional JVs make progress on this important topic of landscape variation and vital rate effects as soon as possible, and we urge JVs with relevant experience to help by sharing their knowledge of study approaches.**

Resources Needed:

This will be expensive work but it is necessary to ensure cost-effective expenditure of NAWMP resources. The PHJV Assessment cost some $8 Million over nine years. Building on that experience subsequent studies in Ontario and the Great Lakes' States were conducted more economically. Combining resources among closely related JVs might make such work even more affordable. A more meaningful estimation of financial needs for this work can be made only after the questions and major design features are roughed out.

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c) ***The approaches and assumptions used to derive regional habitat goals should be reviewed and, if needed, revised. These habitat goals must be designed, in aggregate, to attain the Plan's continental population goals.***

Summary Review:

The North American Waterfowl Management Plan (Plan) is predicated on the premise that the cumulative effects of many targeted local-scale management actions will ultimately affect continental waterfowl populations through improvements in recruitment and survival processes. The ultimate objective of Plan management actions is to provide sufficient habitat to maintain continental waterfowl populations at objective levels during periods characterized by "average environmental conditions."

Joint Ventures attempt to utilize the best available quantitative data and expert opinion to develop explicit assumptions about their regional role in sustaining continental waterfowl populations. These assumptions are critical as they provide the foundation for establishing habitat objectives and implementation strategies. In non-breeding Joint Ventures, particularly those which are important wintering areas, a three-step process has been employed in development and evaluation of habitat objectives and conservation strategies. First, it is necessary to estimate the proportion of continental waterfowl populations which would be expected to occupy a particular Joint Venture during the non-breeding season, and the duration and timing of that occupancy, when continental populations are at objective levels. This process is often referred to as a "step-down" of continental goals to regional scales. Second, it is the responsibility of the Joint Venture to explicitly state assumptions about physiological needs of waterfowl during their residency period and about regional factors influencing availability of and access to important resources, assess resource status and trends, and utilize this information to

develop habitat objectives and conservation strategies in a landscape context. Lastly, Joint Ventures seek to evaluate the validity of explicitly-stated assumptions made during planning phases. In Joint Venture areas where little evidence of resource limitation exists, it may be difficult to evaluate certain primary planning assumptions regarding the role of regional habitats in continental population dynamics; however, many secondary assumptions (e.g., resource availability in particular habitat types, seasonal changes in resource availability, etc.) can be the focus of evaluation efforts to refine habitat objectives and strategies.

The Issues:

Our objective is to address the first of these three steps, the "stepping down" of continental objectives to regional (i.e., Joint Venture) scales. We examine a range of alternatives available to Joint Ventures for developing stepped-down population objectives, discuss potential strengths and weaknesses of each approach, and develop recommendations for Joint Ventures to use based on their geographic setting and available data. It is important to note that many factors influence the number of waterfowl that occupy a Joint Venture in any given year. Some of these factors are not determined by habitat availability and condition within the Joint Venture. Regional waterfowl planning objectives then are best viewed as baselines for the establishment of habitat objectives, not as performance metrics. During our review we developed several questions that should be addressed or considered by the NSST and Joint Ventures as they move forward on this issue:

Considerations:

1. Is it necessary for all Joint Ventures to link their habitat objectives to 1970s waterfowl population levels, especially given the anticipated revision of population objectives during the next NAWMP update – given that the 1970s did not represent "average environmental conditions?"

This question is largely directed at JV's that primarily meet the life history needs of migrating and wintering waterfowl. It's our understanding that the PPJV and PHJV already have a strong connection to NAWMP goals in terms of planning, though their approach may differ somewhat.

In theory, the sum efforts of non-breeding JV's should meet the needs of continental waterfowl populations when these populations are at NAWMP goals. Without a coordinated approach to establishing population objectives, JV's at the Flyway scale run the risk of providing insufficient habitat for migrating and wintering waterfowl or of overestimating actual habitat needs. Without a coordinated approach it will be difficult if not impossible to scale-up progress to regional or continental scale

2. Does the need to link habitat objectives to 1970s populations differ for ducks and geese?

Duck populations of the 1970s represent a reasonable conservation target (especially since some species remain well below goal). However, many if not most managed goose

populations have increased in size since the 1970s. Moreover, the distribution of many of these populations has substantially changed. Should we be using more recent data for geese?

3. If we do agree that 1970s population levels should be the benchmark, at least for ducks from the mid-continent region, do we need a standardized approach for stepping down populations for all JVs? Or can / should JVs use a customized approach as long as it provides a meaningful connection to the 1970s?

4. What about JVs outside of the PPR that have experienced large growth of resident breeding populations (e.g. breeding mallard populations in the Great Lakes and parts of the Atlantic Flyway appear to have significantly increased since the 1970s). If JV's choose to establish breeding population objectives, should they be based on the recent size of these populations? Arguably, this may matter little, provided that all the JVs that share the stocks of birds agree to the same objective(s).

Options Available to Joint Ventures for Stepping Down Continental Population Objectives

We reviewed existing methods used by a range of Joint Ventures to step down continental population objectives. Three primary sources of data upon which to base objectives for migrating and wintering waterfowl were: (1) the Mid-Winter Inventory, (2) U.S. Fish and Wildlife Service harvest data, and (3) Local/regional waterfowl surveys, typically conducted by state wildlife agencies. A fourth "hybrid" option was developed by Koneff (2003). Rather than discuss these individually, we offer examples of how different regions have used these data sets to develop stepped down objectives. A major consideration that should be considered is whether the planning region is primarily used by migrating waterfowl or as a terminal wintering area.

Examples from different Regions:

Central Valley Joint Venture: Mark Koneff (2003) stepped down NAWMP population objectives to every county in the U.S. by using harvest data and Mid-winter Inventory results. Counties were then combined to develop JV population objectives (see Koneff 2003). However, these population objectives only apply to the late December-early January period (which corresponds with the timing of most mid-winter surveys). The CVJV combined Koneff's mid-winter objective with information on migration chronology for Central Valley ducks to develop population objectives for each 2-week interval between late August and late March. For example, Koneff's step-down objective for the mid-winter period (assumed to be January 1) totaled 6 million ducks for the Central Valley. Data on migration chronology indicated that duck numbers in the Valley on November 1 were typically 50% that of January 1. Thus, population objectives for the November 1 period were assumed to be 3,000,000 (6,000,000 X 0.5). The Pacific Coast JV has just established monthly population objectives between September and March using the same approach.

Intermountain West Joint Venture - Klamath Basin Refuges: The step-down approach used by the CVJV and PCJV seem to produce reasonable period-specific population objectives. However, migration data for the CVJV and PCJV indicate that for both JVs peak duck numbers typically coincide with the mid-winter. Where peak populations occur before or after the mid-winter period (e.g. fall staging areas), the method doesn't seem to work as well. This was true for the Klamath Basin refuge complex where using this approach generated period-specific population objectives that didn't agree well with refuge counts from the 1970s. As a result, population objectives established for the Klamath Basin refuges were based solely on refuge counts from the 1970s. More work needs to be done to determine how useful Koneff's mid-winter objectives are for establishing population objectives – from the NAWMP – in JVs that experience peak populations in fall or spring.

Gulf Coast Joint Venture: To establish duck population objectives tied to the NAWMP, the GCJV first determined what % of all ducks counted in mid-winter surveys across the U.S. occurred within the JV's boundaries. This % was applied to the NAWMP breeding objective of 62 million birds and was done on a species by species basis. This is similar to the Koneff approach to stepping down population goals from the NAWMP, but the JV did not incorporate harvest data in the step-down process. These mid-winter objectives were then combined with information on migration chronology to develop semi-monthly population objectives as was done in the CVJV and PCJV.

The following section offers some of the pros and cons of using each source of data.

Mid-Winter Inventory (MWI)-

- Pros:

  - Long term standardized data set at large geographic scales.
  - For many areas (particularly wintering areas) survey is done at or near peak of waterfowl use.

- Cons:

  - Not as useful for migration areas where peak populations occur earlier.
  - "Snap-shot" that does not allow temporal scale objectives to be set.
  - Limitations for certain species (mottled duck, blue-wing teal, etc.)
  - May be difficult to partition survey data at smaller scales that planning regions need (i.e., county level).
  - Issues related to MWI coverage/protocols, etc.

- No estimate of effort and sometimes even coverage, which may be variable over time.

- No visibility correction factors for birds present but not seen by aerial crews (which also likely changes over time with different observers), which calls into question the MWI's usefulness even as an index.

Harvest Data-

- Pros:

- Long term standardized data set at large geographic scale

- Allows data to be partitioned at smaller spatial scales (county level), but also needs to be used in conjunction with abundance data to derive abundance objectives.

- Cons:

- Assumed species composition of harvest is representative of actual relative proportion (i.e., no hunter selectivity for certain species; if such selectivity occurs, the proportions of various species in the harvest will not be proportional to their abundance in the wild, which will translate into biased species-abundance objectives).

- Temporal scale objectives are limited to hunting seasons – late winter/early spring objectives would be difficult to set.

Koneff's (2003) Approach-

This approach is based upon both the MWI and harvest data, so the pro's and con's of each of these data sources apply. However, by factoring in harvest data, population objectives are apportioned at the county level, which is not feasible using only MWI. Additional pros and cons are:

- Pros:

- Relies upon two long term standardized data sets at large geographic scale. Objectives are developed at small scale (county level) which can be assigned to regional planning scales (Joint Ventures).

- Cons:

- Does not perform well for several species of waterfowl (Mottled Duck, Whistling Ducks, Blue-winged and Cinnamon Teal, Wood Duck and American Black Duck).

Local/Regional Waterfowl Survey Data-

- Pros:

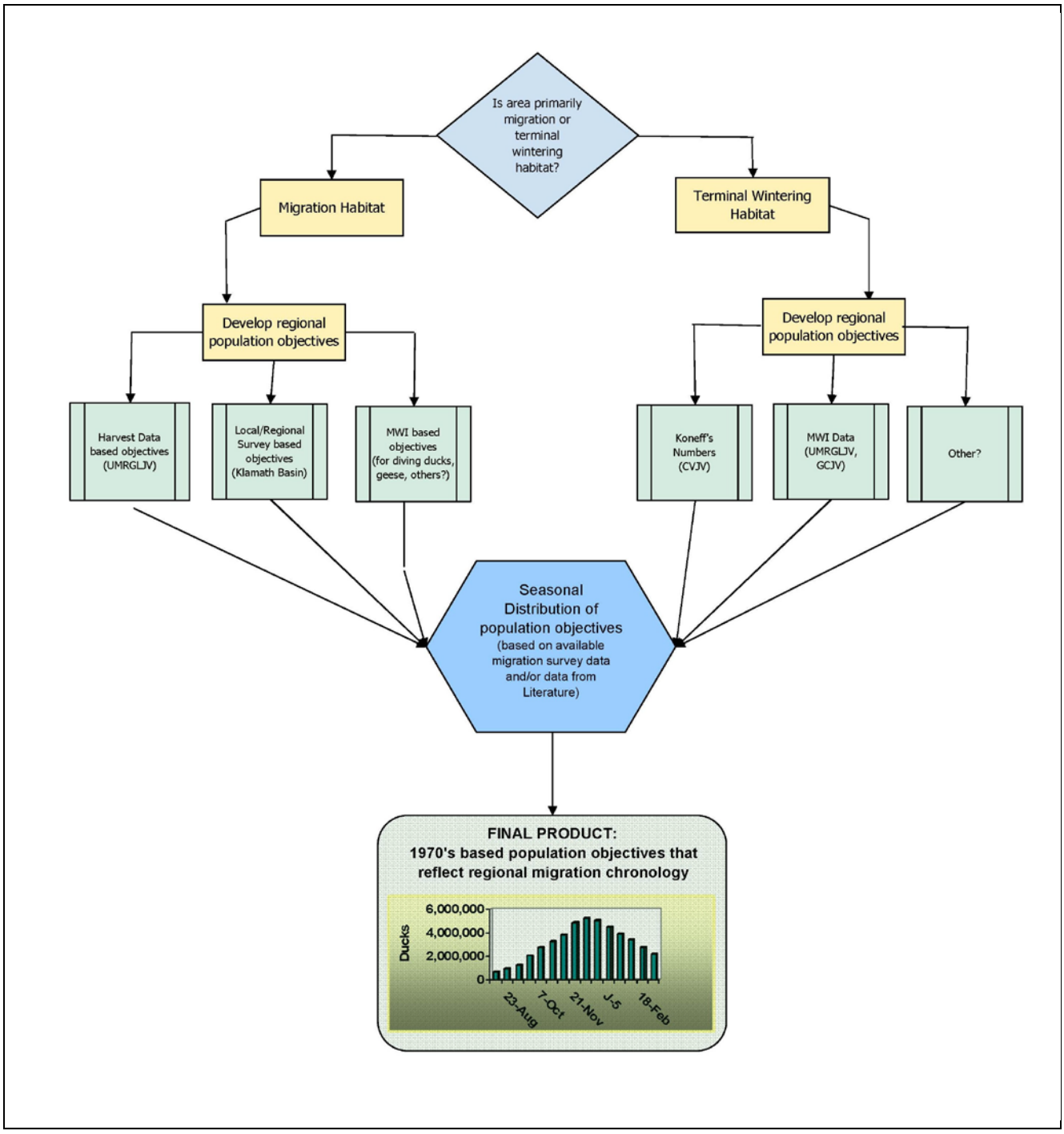
- May coincide with peak abundance
- May better target species that MWI doesn't
- Has potential to provide best information on local/regional migration chronology

- Cons:

- Not necessarily comparable across regions – as different sampling methodologies may be used. This may especially apply to larger JVs across multiple states. Surveys may be conducted infrequently; Data sets may be short-term or sporadic.
- Additional costs of developing/implementing currently non-existent surveys.

A one-size fits all approach to stepping down population objectives may not be necessary or even desirable given the wide range of waterfowl needs, available data sets, and knowledge of waterfowl life history requirements across migration and wintering areas of North America. Each of the data sets/approaches discussed above has strengths and weaknesses. A shortcoming of all of them is the lack of a temporal component, and thus is more useful for providing population objectives at a point in time, most commonly during the MWI period. One or more of these data sets may be the best option for a JV to use to develop population objectives. The link would be that each approach would be based on 1970s level populations. We believe JVs should strive to take this a step farther and develop total use-day objectives. To facilitate this we developed a simple conceptual model that JVs could use given a range of conditions and available data sets (Fig. 1). We emphasize the importance to JVs sharing stocks of using the same baseline (years, abundance values, etc.).

Figure 1. Conceptual Decision Support Model for Developing Stepped-down Population Objectives.



We assumed that step–down objectives were directed towards migrating and wintering areas, and that breeding ground JVs were already tightly linked to the NAWMP. A second assumption was that the benchmark would be the 1970s population objectives set forth in the NAWMP. The approach led us to review current strategies used by JVs, existing data sets and methodologies to develop a series of options and a "flow chart" (Fig. 1) to guide JVs in developing regional stepped-down population objectives. This process stopped short of developing regional habitat objectives.

- ***Recommendation A.1c.1:*** **The NSST will assemble a larger group to develop a techniques document or a white paper for approaching this issue more holistically, possibly looking at approaches that incorporate annual cycle models.**

Resources Needed:

A primary need is assembling a group of six to eight NSST members and/or individuals outside of the NSST with the appropriate expertise to devote time towards developing this product. Those individuals should expect to spend 40-80 hours of time developing strategies and may need to fund one face-to-face meeting. Costs might be incurred by a participant's organization and while some USFWS funds may be procured to cover time, travel and lodging for some individuals.

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d) ***Improved tracking of habitat accomplishments in many JVs***.

Summary Review:

There are essentially two major needs under this recommendation – reporting habitat accomplishments to stakeholders and providing data useful for modeling population impacts of JV work.

The first simply recognizes that those who provide funds to JVs care about what those funds accomplish. Joint Ventures individually, and the Plan community in aggregate, are responsible for being good stewards of the resources entrusted to us. We must be able to report on what we have accomplished vs. what our proposals say we intend to do. This is the minimal and most straightforward element of accountability in the NAWMP system.

To do this well, more seamless aggregation of data is needed among partners and at regional and continental scales. We need to create and enforce better national (at minimum) and international (ideally) standards for tracking accomplishments, including definitions, criteria, reporting procedures, aggregation of data, and database management. Common definitions are a long-standing and primary challenge in this regard.

Accurate tracking of accomplishments among agencies has proven difficult even for traditional wildlife programs (e.g., easements, land purchase, wetland restorations). The

challenges (e.g., what counts? who counts it?) are even greater for government policy initiatives or extension/education programs, which are increasing in importance in many JVs.

The national secretariats seem like the natural leads for this review, but extensive dialog with JVs and individual delivery partners will be needed to accomplish improvements to the tracking systems. Grassroots ownership of any tracking system will be a key to its success. JVs must see value in tracking or it is unlikely to be done well. If we are serious about improving tracking systems, then we also need to ensure cross-compliance (e.g., money only flows when appropriate data flow back to sponsors).

The main role of the NSST should be to provide oversight regarding the biological relevance of information that will be tracked to ensure that useful parameters are tracked and aggregated in ways that will be useful for biological planning models. Only essential data ought to be tracked, whether for sponsor reporting purposes or to support biological planning.

An important difference between now and the late 1980s when the original national systems were built is that we appreciate better how accomplishment data can play an important role in modeling progress toward biological objectives. Such use of the data, usually in spatially explicit ways, was not widely or fully envisioned 20 years ago.

Considerations:

- Can we develop congruence between the Canadian and U.S. tracking systems? If not, can we at least achieve coherence among JVs within countries?

- What are the tradeoffs between retaining our old systems vs. starting anew? What organizational entities can make such decisions?

- How can we eliminate the problem of double counting (or worse) as we aggregate data across activities and among partners?

- Do we conclude that data collection must become spatially explicit to allow use of accomplishment data in waterfowl productivity models and other such decision support tools?

- How can we determine what metrics are crucial to collect for decision support tools? How will such fundamental and far-reaching decisions be made? How should the NSST and JV technical teams interact in this regard?

Recommendation A.1d.1:: **Tracking accomplishments is a complex challenge because of the multiplicity of definitions and agency systems that presently exist. We recommend that the national secretariats be charged with making a comprehensive review of stakeholder reporting needs and existing JV/national tracking systems and make recommendations to the PC and the NAWCA Councils for desired improvements. These recommendations should be reviewed at multiple**

points during their development by a small task group of the NSST (including Canadian and U.S. members from breeding and non-breeding areas) to ensure that the new system will provide accomplishment data in forms that will be useful for planning and impact-analysis purposes. Major delivery agencies (e.g., DU Canada) will need to be fully engaged in such a review as well.

Contracted expertise in database management may be required to help in this review process. We think it is logical to begin with a comprehensive review of stakeholder information needs. Consideration should also be given to adapting databases over time as information needs evolve. A useful beginning to these discussions occurred at a JV meeting in Lakewood Colorado in April 2007.

Resources Needed:

The resources needed for this work can be estimated only after the recommended review/scoping work is completed and the extent of desired changes is known. The review itself may require approximately one person-year plus some travel and consulting fees – perhaps $150K in total.

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e) ***Development of more informative performance metrics.***

Summary Review:

Traditionally, Plan accomplishments have been measured in terms of acres of habitat secured, restored or enhanced, and dollars spent. While these may be useful indices of partner activity, they do not directly reflect impacts of human actions on waterfowl populations, or even net change in landscape conditions. We urge the JVs to develop more informative performance metrics that will be more useful for guiding management decisions.

Ultimately, the goal of the NAWMP is to improve bird status – the habitat actions taken (restoration, protection, creation and enhancement) are a means to that end. About half of the JVs have, at least in part, used some form of a step-down process from the continental abundance objectives specified in the NAWMP (e.g., 8.2 million mid-Continent mallards) using various databases (e.g., midwinter, harvest, and migration surveys) to develop their JV-specific objectives of bird abundances. These abundance objectives are necessary for development of habitat objectives. If the number of birds desired in an area is unknown, a meaningful estimate of the amount and kinds of landscapes necessary to support those abundances is not possible. Nonetheless, we must have reasonable knowledge (empirical or expert opinion) about bird/habitat relationships to develop valid habitat objectives.

The Issues:

For the most part, JVs have used the following two different measures to gauge progress of their programs: (1) abundance of birds, and (2) amount of habitat put on the landscape (secured, restored, or enhanced). However, the question is whether these abundance and habitat objectives are adequate as performance metrics. The 2004 Plan Update steering committee concluded that "*there were really no useful Plan performance metrics to assess the extent to which Plan actions were affecting waterfowl populations*" at the continental scale (from the Continental Progress Assessment, p10).

Using Bird Abundances as Performance Metrics

- Pros:

- Can be linked directly to an overall NAWMP objective(s).

- For breeding and wintering areas, generally can be readily calculated from the continental objective(s) using step-down procedures due to the existence of pre-existing surveys (e.g., breeding, midwinter, and harvest surveys), or at least the methodology and assumptions used by the JVs to derive the objectives can be clearly stated.

- For some JVs, the existing surveys could be used to detect changes over time.

- If monitoring doesn't exist, development and implementation of such surveys are relatively inexpensive.

- Cons:

- Abundance objectives are not available for many waterfowl species (at least not empirically based ones). Further, many species/stocks currently are not monitored sufficiently at scales relevant for assessing progress at the relatively small scales of JVs.

- Unless the carrying capacity (*K*) of the landscape is known, bird abundance objectives are largely subjective, value-based expressions of desired abundance to meet majority desires (this can also be the case if *K* is known, but in this instance the needed change in *K* through habitat actions can be calculated). Thus, numerical objectives may not have a biologically meaningful basis. If the overall abundance objective is not based in biology, neither are the stepped-down objectives. Attaining an objective that is not based on biology may be impossible using methods based on biological relationships, if the objectives are beyond the biological capabilities of the system being managed.

- Any stepped-down objectives need to be revised if the overall objective is changed. Because the stepped-down abundance objectives and the habitat objectives derived from them can take a considerable amount of time to derive, much time could be expended to revise the JV objectives. For example, a recent assessment of mid-continent mallards suggests that the current goal may exceed

that possible under "average environmental conditions," which will prompt discussions about lowering the goal. Some may question whether re-calculating stepped-down objectives is a wise use of limited resources.

- Unless the regional objectives are stepped-down using the same overall objective, the ability to aggregate JV-specific accomplishments is compromised (or precluded). Interestingly, 10 of the 18 habitat JVs surveyed indicated that their habitat goals were not derived from stepped-down continental objectives, meaning that a comprehensive assessment of Plan success may not be possible.

- Abundance objectives are appropriate metrics only at large scales (e.g., continental) where a population can be considered closed. If the population isn't closed (e.g., regional aggregations derived from many areas), knowledge of transition probabilities and how they might vary over time is needed to develop objectives at smaller scales. Bird abundances in a particular area are influenced by many factors, most of which are beyond the control of an individual JV. Observed changes in abundance could be a reflection of (1) changing movements of birds that may or may not be influenced by particular habitat-management actions, or (2) demographic changes influenced by off-JV areas. Thus, changes in bird abundance within JV boundaries may not be the result of management activities within that JV, biasing assessments of individual JV progress.

For these reasons, 'rolling up' regional progress to a continental scale can be difficult if not impossible, as is deconstructing continental abundance indices to determine in which JVs limiting factors may be operating.

Using Habitat Measures as Performance Metrics

- Pros:

- Acreages can be easily tracked (e.g., number of acres, habitat types, costs), at least conceptually.

- Accomplishments can be rolled up easily, provided the same tracking/reporting methods are used across JVs.

- Estimates of how much food (energy, nutrients) and space is available for birds can be calculated, enabling an estimate of how many can be supported.

- Cons:

- The ability to relate changes in waterfowl abundance to JV acreage accomplishments is impossible, especially at regional scales, absent an assessment of net landscape change. In fact, decreases in bird abundance could occur in the face of significant JV efforts, due to habitats being lost faster than JVs could add them. Twelve of the 18 JVs stated a limited ability to estimate net change in habitat conditions.

- Because the measure of progress for the NAWMP is improved abundances of birds, unless the link between habitat actions and changes in bird abundances can be verified through monitoring and assessment, changes in landscape conditions (i.e., acres added) cannot be used as a surrogate for changes in bird abundance. From the Continental Progress Assessment, only seven of 18 JVs stated their ability to track waterfowl abundance or distribution in response to JV activities as 'moderate' or 'well,' and only one JV did 'well' at estimating the effects of habitat accomplishments on survival or reproductive rates.

Considerations:

Although one of the roles of the NSST is to assist the JVs with their programs, the main focus of the group is to work at scales larger than individual JVs. As such, the NSST should work with JVs to develop assessment methods which can be scaled up to broad regions. A valid assessment will need to relate the abundance of waterfowl to the habitat base available. From the preceding discussion, if waterfowl abundances are to be used as performance metrics for large-scale (e.g., continental) objectives, both (1) consistent methodologies for stepping down large scale objectives (at least among JVs that share populations), and (2) measures of net landscape change are needed. Either one of these two in isolation will not be a sufficient performance metric, either for individual JVs or for the NAWMP as a whole. Further, these two measures collectively tell us only how many animals we want and how much land we need to sustain them. They do not tell us through what mechanism(s) we want to effect those changes in abundance (e.g., through survival rates, recruitment rates, etc.), and therefore do not provide guidance for how we could best manage the habitats to attain the abundance objective (i.e., strategic habitat delivery).

Ultimately, the NSST must find a means of reporting progress of the collective activities under the NAWMP. However, in the face of all our efforts to protect, create, and restore habitats, the potential habitat base for waterfowl continues to decline. Increasing urbanization and agricultural production, decreasing protection of isolated wetlands, and other factors result in a shrinking amount of land available for waterfowl conservation. This trend is likely to continue into the future, and some conservation partners argue that we will be fortunate to maintain current acreages enrolled in conservation programs, let alone increase them. To achieve numerical goals of the NAWMP, JV partnerships likely will need to increase the quality of remaining habitats over which we have influence (a very small proportion of the total landscape) to a sufficient degree that birds are productive enough to offset habitat fragmentation and the loss in absolute amounts of habitat.

If attaining numerical abundance goals is not possible given the shrinking habitat base, how can the NSST and Plan community show progress and justify continued support of NAWMP programs? One possibility is moving toward vital rates as performance metrics. Both the Continental Progress Assessment and the Joint Task Group reports recommend pursuing this possibility (Continental Progress Assessment recommendation A1b: *Improved biological understanding of how landscape variation and habitat*

*accomplishments influence waterfowl **vital rates***; Joint Task Group recommendation 4: *We urge that the waterfowl community focus more on reducing the key ecological uncertainties surrounding current models of population dynamics and the relationships between waterfowl **vital rates**, carrying capacity, and landscape properties that habitat managers strive to manipulate.*). Using vital rates, the waterfowl management community may be better able to report progress related to their activities, even though abundance objectives may not be met. That is, we may be able to show that regional activities to improve nesting cover have increased recruitment rates, even though the overall abundance of birds may have declined. The reason for this apparent contradiction is that we can effect these changes on a relatively small portion of the entire landscape, and the progress made by JV activities may not be detectable at the larger scales via extant monitoring programs.

Some advantages in using vital rates as performance metrics include:

1. Results in a more direct assessment of what JV activities are trying to influence (e.g., survival or recruitment rates).
2. At least for some vital rates, the ability to show progress is tied more closely to actual management actions (e.g., an increase in recruitment rate as a result of increases in vegetative cover on managed plots).
3. An estimate of the net change in habitat may not be necessary to evaluate progress.
4. Can put rates into a continental framework (model) to assess what changes in vital rates likely are needed to meet objectives.
5. Can focus on areas where success is more cost-effective (e.g., how much change in overwinter survival rate would be needed to meet objectives vs. change in recruitment rate on breeding grounds, and what are the costs to achieve those changes), and can direct resources to those areas.
6. Because all assessments are in rates, can combine regional values to determine whether a population is increasing, decreasing, or stable.

However, disadvantages include:

1. Monitoring programs to estimate S, R, body mass, etc., are more costly than programs that monitor abundances of birds. However, many JVs have not invested resources to even monitor changes in bird abundance relative to management activities (see above).
2. Annual evaluations likely will not be practical (but also may not be necessary).
3. For a continental assessment, need rates for all areas in the target population's range and a model that relates rates from various regions.
4. Must know (or have good guesses) about transition probabilities of birds from different breeding, migration, and winter areas.
5. Identifying a key rate for measurement in migration areas may be particularly difficult.

From the Joint Task Group Report, *"Our exploration of the relationship between harvest and habitat management and considerations of how habitat conservation actions might*

affect carrying capacity and thus harvest potential, has made clear that any conservation investment strategy ought to be informed by the best available estimates (or at least by explicit testable assumptions) of the effects of habitat change on vital rates. Even if the formal aggregation of joint venture effects to large spatial scales remains problematic, greater certainty around the effects of management actions on regional vital rates can provide a strong basis for regional investment decisions."

Synopsis:

From the preceding we can argue that using exclusively either bird abundance or the amount of habitat added through management activities such as enhancement and restoration will not serve as good performance metrics to measure bird responses to NAWMP accomplishments. However, measuring these two variables simultaneously, together with an assessment of net landscape change, may result in a sufficient performance metric at relatively large scales. That is, if a large enough portion of the target population's range is encompassed by habitat and bird-abundance monitoring programs so that the effects of immigration and emigration on bird counts are small, abundance relative to the net change in landscapes may sufficiently capture true responses to habitat manipulations, and provide a reasonable measure relative to an abundance goal. However, such an approach likely will not be adequate for smaller-scale assessments of accomplishments (e.g., intra-JV-level assessments), due to the confounding of natural bird movements with those that may be the result of NAWMP habitat manipulations.

Another approach could be the use of vital rates to assess progress. This approach has the advantage of more closely linking changes in bird demographics to specific habitat-management actions. This approach also is the most elegant (from an assessment perspective), because all management activities, wherever they occur, are intended to effect a change in at least one vital rate of birds. Further, linkages among JVs can be more explicitly stated through models of vital rates across the birds' range, at least compared to using absolute abundances of birds. Rates associated with manipulated habitats could be measured across the range of the birds, and the values used in annual cycle models to assess whether growth rates are increasing, decreasing, or stable. At smaller scales, rates associated with manipulated landscapes could be compared to those not manipulated to assess the effects of particular management actions and resulting habitat responses. However, logistical issues associated with vital rate monitoring are significant, and likely will be expensive even if the monitoring is conducted only periodically (e.g., measuring whether a change in survival rate occurs over a 5-year period as a result of a positive net landscape change).

Yet another alternative might be a blending of the first two. Targeted research relating vital rates to habitat actions could be conducted to develop relationships and associated variability in predicted responses of the birds to NAWMP activities (e.g., the recruitment versus percent grass cover in experimental plots of the PHJV). Using these modeled relationships, together with assessments of net landscape changes, managers could estimate population responses relative to the amount and types of habitats placed on the landscapes. This approach would have the advantage of not necessitating annual or

periodic monitoring of vital rates, and associated costs and infrastructure required to maintain such an effort. However, a significant investment of resources into investigating and identifying the relationships would be necessary. Further, models would need to be re-assessed for adequacy over time to ensure that relationships between bird responses and habitat actions have not changed, which would affect assessments of progress toward NAWMP goals.

Regardless of which of these alternatives, or others, is most appropriate as a performance metric to assess program accomplishments, it is apparent that significant resources beyond current levels are needed. Both a better assessment of net landscape change via identifying key habitats for waterfowl (element A of this report) and more accurately capturing habitat accomplishments (element D), together with either more comprehensive monitoring of waterfowl abundance or modeling of waterfowl population dynamics will be necessary.

- ***Recommendation A.1e.1:*** **JVs encompassing ranges of target populations should use objectives (e.g., population, vital rates) that can be used to assess progress of program activities at large scales (i.e., population, continental). JVs that share a target population should use the complementary metrics to facilitate such assessments.**

- ***Recommendation A.1e.2:*** **Science coordinators from JVs that share target populations should convene to discuss appropriate objectives and performance metrics for priority populations. Coordinators should pay particular attention to recommendations from the JTG and the Continental Assessment reports when formulating the objectives and metrics.**

- ***Recommendation A.1e.3:*** **Once appropriate objectives are developed, monitoring programs and models need to be developed that relate habitat actions to bird responses.**

Resources Needed:

At this point we cannot predict the resources needed to accomplish this task, because costs likely will differ depending on the performance metric(s) selected. Nonetheless, a small (~10) group of individuals well-versed in modeling and measurement of landscapes should be convened to debate alternative approaches and develop recommendations for moving forward. We believe an effective approach would be to develop models and protocols for all JVs that share a relatively discrete population of birds (e.g., mid-continent mallards), linking activities and progress within the range of that group of birds.

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f) ***Enhanced communication among all Plan partners around biological objectives, accomplishments and efforts at improving biological foundations.***

Summary Review:

To make an accountability framework function there must be strong ongoing connectivity among the entities within the Plan community. This is an area where rapid improvements could be made with minimal cost. This communication should have 3 primary foci: 1) reporting progress toward accomplishment of biological goals; 2) reporting progress with adaptive management (including tests of key planning assumptions and uncertainties); 3) sharing ideas about how the different levels of the NAWMP enterprise (e.g., PC, JV, among JVs) might assist each other in making progress with their collective mission. In the short term we also anticipate some useful dialog between the JVs and the PC around the individual letters to the JVs from the Assessment Steering Committee, and in developing a coordinated response from the Plan community to the recommendations of the JTG.

Considerations:

- How often should the JVs report on these topics to the Plan Committee – annually, biennially? If we choose every-other-year, would it make sense to group all breeding ground JVs and all non-breeding JVs annually to focus attention on common issues?

- What role should the NSST play? Should all progress reports come first to the NSST that would review them (with issues raised by the NAWMP Assessment in mind) and pass them up to the PC with added comments? Or, should they go directly to the PC and NSST together?

- Should the PC commit to responding to each such JV report? Is that necessary?

- Presumably these reports from the JVs and the PC ought to be shared with the Flyway Councils (FWCs) as well. What else should be communicated to the FWCs and from the FWCs to the PC? How will the recommendations of the Joint Task Group affect this?

- Should the NSST work with the PC and the JVs to create explicit guidance (a template?) for such progress reports?

- Should the PC be reporting annually to the JVs and FWCs on progress with its own work plan objectives and matters of broad interest to the JVs? What kinds of things would be of broad interest (e.g., current focus, progress on updates, waterfowl management integration)?

- Would PC meetings that move around the country and thus enable time face-to-face with the various JV management boards add useful connectivity of the Plan community? Should "in-person" oral reports be used to supplement regular written reports?

- The PC and NSST need to develop patterns and processes for regular communication about all their respective initiatives. Strong coordination around the annual work plans of both committees is an obvious priority. What else might be? Should the NSST provide a formal annual report to the PC, or will shorter reports at each other's meetings do? The NSST Chair and Coordinator are now invited to the PC meetings and sit as *ex officio* members. Should a PC member, perhaps from the science subcommittee, reciprocally sit on the NSST as an *ex officio* member and help ensure strong linkages?

- Should fostering stronger regular dialog among JVs on other than administrative matters (which already seems to occur within each country) be a priority? This could take the form of periodic formal workshops or less formal discussion/mentoring sessions on topics of mutual interest. If so, it seems that this should involve JV science coordinators and related staff, not just JV coordinators.

- As part of its new "Policy Work Area" the Plan Committee intends to identify a number of large-scale issues that significantly influence landscapes upon which waterfowl depend (e.g., agricultural policy, energy policy, climate change, water supply). Major advances in wildlife-friendly policies in these sectors must be achieved and the PC intends to address some of the policy-related findings and recommendations in the Assessment Report by convening workshops to explore and discuss such matters. Workshop objectives include: assisting Joint Ventures (JVs) and other Plan partners to identify opportunities and hazards in policy arenas; providing tools and techniques to be more effective in developing policy solutions; helping the JVs learn from one another; and identifying gaps in the policy capacity of NAWMP partners.

- As part of its new "Leadership and Communications Work Area" the Plan Committee will be developing comprehensive plans to better connect with its stakeholders about accomplishments, challenges, and opportunities. Whatever we develop under this heading (A.1f) will contribute significantly to those plans and actions.

We consider many of these questions open, but to get started we recommend that the PC, NSST and JVs adopt the following procedures:

Recommendation A.1f.1: **The Plan community should repeat comprehensive assessments of the Plan at approximately 10-year intervals. Between those assessments the JV's should report <u>triennially</u> to the Plan Committee on the 4 topics listed below:**

<u>Biological Foundation Elements</u>

1) Progress toward accomplishment of JV biological goals.

2) Progress with adaptive management and testing key JV planning assumptions.

Joint Venture Leadership & Administration

3) Progress in cooperating and sharing ideas outside your JV boundaries.

4) The state of your JV partnership

   i. New partners or expanded partner roles?
   ii. New or expanded funding sources?
   iii. New or expanded communication initiatives?

In general, JV progress reports for both new and established JVs should follow the sequence of guidelines in the "*NAWMP Desired Characteristics for JV Implementation Plans*" since these characteristics are organized as elements or products within the framework of Strategic Habitat Conservation (Biological Planning, Conservation Design, Habitat Delivery, Decision-based Monitoring, and Research).

One-third of the JVs should report each year to help spread out the work load (the PC will work out a schedule). One option would be to do Pacific and Atlantic Flyway habitat JVs one year; the Central and Mississippi Flyway habitat JVs another year; and the Species JVs the third year. Reporting will begin in July, 2008, two years out from the first assessment report.

This is a high priority and should be instituted immediately.

Recommendation A.1f.2: **To ensure focus on important biological matters and consistency in reporting, the NSST will develop a draft template for these reports for review and approval by the JVs and the PC.**

This is a high priority and should be accomplished before the initial request for reports is sent out by the PC.

Recommendation A.1f.3: **JV reports should be submitted in writing to the PC and the NSST two months before the designated PC meeting. The NSST should review these and pass on any additional comments and observations to the PC and the JV prior to the meeting. The JVs will then present their reports in person to the PC at the designated meeting. Full-group discussions during or immediately following a JV's presentation should encompass PC feedback opportunity. The PC will reserve the option to provide written feedback to JVs, if such a follow-up is deemed necessary, at a later date but within three months of delivery of the JV's progress report.**

Recommendation A.1f.4: **Annually, the PC will report to the JVs and the FWCs on progress with its own work plan objectives and matters of broad interest to the JVs.**

Recommendation A.1f.5: **The PC and the NSST will report to each other at each meeting of each committee. This will be facilitated by the NSST Coordinator and interlocking members on the two committees.**

Recommendations 3 – 5 are all high priority and will be executed on the schedule of the reports listed above.

Resources Needed:

Staff time will be required to produce these progress reports but they should require little work beyond reviews that JVs would be doing for themselves. Additional travel costs would be incurred every third year for JV Coordinators or science leaders to attend PC meetings.

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Appendix

JV responses regarding progress made in assessment of net landscape change

NGPJV (Duane B. Pool, PhD):

Mark, Ken asked me to respond to you regarding the NGPJV plans or activities for monitoring net habitat changes and data. I will tell you both or thoughts and what we have initiated or collected and have available.

There is not comprehensive wetland inventory for the NGPJV for isolated or man made wetlands. In other words NWI is not complete for the majority of our 100K Sq miles. We would like to see NWI complete their original mandate so we have a consistent and high quality baseline data set from which to work.
We have contracted with MDA-Earthsat to develop a sensor based wetlands product for the entire region based on available multi-date imagery. This data will hopefully identify sub-pixel level wetlands. It will at least give us a starting point for both modeling and net change assessments.
We have GAP land cover data for all four states but there are inconsistencies in classifications schemes and quality. The USGS reclassified the National Land Cover Data and this is consistent but is very general in categories. We plan on using both products as appropriate to the questions being asked and the scale required for our response.
The NRCS has a nearly annual point sample of habitats for each state with thousands of sample points. We envision using these data to trigger action in developing new data sets for a comprehensive analysis of change in the region. Example: If the current waterfowl nest success models are sensitive to a 5% change in grassland cover then when the NRCS monitoring data indicates we have met that threshold we will pull the partners together and try to assemble the resources to create a new landcover data product.
Since we are some what unique in that we are probably the only JV that deals with increasing wetland numbers, we will try to track the states permitting agencies for change. If the models sensitivity is surpassed we will try to update the best available inventory. I this case we still would prefer to see NWI take the lead responsibility for tracking wetland trends throughout the US not just the PPJV. If NWI is funded and set to revisit on a regular basis then we may use supplemental photo interpretation in sample areas to estimate change along with surveys of partners developing wetland for number and acres created or altered. In the case of drainage we hope to use state regulatory agency data to track this though the efficacy of this approach is yet unproven.

One of the weaknesses of this system is that the change is being measured over large areas and significant and threatening local changes could be missed entirely. I have not resolved this issue and would appreciate any ideas you may have. Once the larger area losses reach threshold values the local changes will become evident but that may be too late. I may have to look for clusters of change in the NRCS point data but the resolution of the data may still be limiting.

One of the benefits is that rather than some arbitrary 5 year or 7 year interval you are allowing the system to guide your data acquisition actions. So if the landscape is

changing quickly more resources are expended track and building tools to respond to the changes. If the landscape is slowly changing then you don't divert resources from more important programmatic implementation and monitoring.

PHJV(Pat Kehoe):

The plan is to complete our revised implementation plans by the end of May. These plans will have specific programmatic habitat objectives for each Province. Based on these objectives we will be engaging our GIS folks in April to start to identify potential monitoring strategies/programs. An inventory/monitoring Plan would then be developed for PHJV by the fall.
The challenge then will be to secure the funding or modifications to existing programs (Ag census? USFWS surveys?) to meet PHJV needs.
We have had cursory discussion with PPJV folks, and will engage more to explore commonalities in the months to come.

PLJV (Mike Carter):

The long answer is that we've attempted to summarize existing data to help us understand landscape change in our region. First, we conducted a literature review (available upon request). Second, we requested an analysis of the USDA National Resources Inventory (partly completed). Third, we requested an analysis of the USDI National Wetlands Inventory (project was not approved; proposal available upon request). Someday soon we hope to complete these last 2 tasks. We recognize that existing data likely will not give us what we need to track detailed habitat change viewed in bird context. So, we expect that a new initiative will be needed. We will be revising our M&E plan soon and we expect this issue to rise as a top priority.

PPJV (Ron Reynolds):

In the PPJV we assess habitat change in a variety of ways.

1. Four Square Mile Survey. This survey uses a stratified random sample of ~600 2 X 2 mile square blocks. This survey is the backbone of the PPJV waterfowl population monitoring program. In addition, we use this survey to annually estimate the change in ponded wetland habitat available to breeding ducks because ponded wetlands are a function of short-term precipitation patterns. We also use the sample to monitor periodic changes in upland habitat on about a 5-7 year cycle. The interval is determined by our knowledge about significant changes that might be occurring on the landscape, such as, large expirations or enrollments of CRP acres. This survey is coordinated by the HAPET Offices. Field surveys are conducted primarily by Refuge Personnel, HAPET staff and in some cases (FWS Region3) state agency personnel. This is particularly the case in Iowa where the Iowa DNR conducts the survey. The survey has a aerial photography component to delineate and digitize ponded wetland habitat.

2. Landcover Classification using Remote Sensing. Twice, since 1989, the FWS and Ducks Unlimited have combined resources to classify upland habitat across the PPR area of the Dakotas and northeasern Montana. The latest classification was completed in 2006 with 2003-2004 LandSAT imagery. We are in the process of using results from the two classification exercises to assess upland habitat change. However, while the accuracy level for the combined habitat classes is above industry standards, the error rates for some classes may be too low to detect relatively small change. This information is used primarily to help guide our conservation delivery, and determine the distribution and magnitude of priority conservation actions being employed by PPJV partners. I will refer to Rex for information about upland habitat monitoring in Minnesota and Iowa.

3. Missouri Coteau Grassland Loss Assessment. Duck Unlimited has been using LandSAT imagery, going back many years and classified annually (or nearly so), to monitor long-term loss of native grasslands in the Missouri Coteau physiographic region of the Dakotas. I will ask Jim Ringelman to provide more details on this study.

4. Conversion (loss) of wetlands mapped by National Wetlands Inventory.
The gold standard for inland wetland data over large areas is the National Wetlands Inventory (NWI). The NWI mapped wetland basins capable of holding water. In the PPJV area we have digital NWI wetland data for the entire JV with the exception of some small areas in Montana. Because the photography for this inventory was collected ~ 25+ years ago, there is a need to either update the wetland mapping or assess the validity of the current data.
Re-mapping would cost hundreds of thousands, if not millions of $. Because we believe small wetlands are at most risk to drainage, and most small wetlands in MN and IA were drained prior to the NWI, the greatest need to assess change is in the Dakotas. The Bismarck HAPET and Ducks Unlimited is nearing completion of an assessment of wetland loss due to surface drainage in the PPR of the Dakotas. Preliminary results suggest that less than 2% of wetland acres have been converted to other uses since 1979 due to surface drainage (the most common method). We also have site specific information on a large drainage project in ND. We will soon combine information about wetland restorations in the area to estimate net change in wetland area. We conclude the NWI data is still a valid database for planning and biological assessment in the PPJV.

5. USDA Conservation Lands data. The HAPET offices have been cooperating with the USDA to acquire digital data for certain conservation programs having important wildlife habitat components. This cooperative effort has allowed us to assess the impact of certain USDA conservation programs on habitat improvements that benefit waterfowl and other migratory bird populations in the PPR. We anticipate in the future, to continue to have access to this type information to track changes in habitat associated with these important conservation provision.

6. Mapping PFW Habitat Accomplishments. The HAPET offices have been developing a GIS based tracking system for mapping habitat accomplishments by the FWS, Partners for Fish and Wildlife Program. This program is supported financially by the PPJV Coordinator, Ducks Unlimited, and State's Conservation Agencies. In addition, there are numerous other partners that contribute to PFW projects. We just completed a pilot

program to map and digitize all project habitat accomplishments in one Wetland Management District in South Dakota. This will take several years to complete. All current projects are being entered into this system in the Dakotas.

7. Mapping R&W Accomplishments. The FWS National Wildlife Refuge System is the largest holder of perpetually protected key waterfowl habitats in the PPJV. The System includes over 27,000 fee and easement Waterfowl Production Areas, and more than 50 National Wildlife Refuges. The combined area includes ~ 1.5 million wetland acres and more than a 1.2 million acres of upland nesting habitat (most acquired prior to the NAWMP, but substantial increases, particularly in protected grasslands, since the NAWMP. Several years ago, in cooperation with Ducks Unlimited and State partners, the FWS PPJV and Refuge Programs mapped and digitized all parcels of land in this program. This database is updated annually.

UMVGLJV (Barb Pardo):

This response addresses the need of the NSST to evaluate the ability of the Upper Mississippi River and Great Lakes Region Joint Venture (JV) to track bird habitat change. At the time of the NAWMP assessment our ability to track habitat was very limited and in the beginning stages of establishing a habitat baseline. We have improved our ability to analyze habitat availability by increasing our technological capabilities (i.e., remote sensing and GIS), albeit our ability to assess year to year habitat changes is still only in discussion stage.

Our JV is currently in the process of updating our Implementation Plan (expected completion summer 2007) and establishing a habitat baseline and tracking system using National Wetland Inventory Data (NWI) and the National Land Cover Dataset (NLCD). We found several limitations to these datasets that will not allow us to use them to track habitat trends. NWI data currently available was collected 20-30 years ago, and spatial coverage is incomplete for this 100 million ha JV. We have invested JV funds to update this dataset using recent aerial photography for states in the Great Lakes basin, eventually allowing us to improve our current baseline estimates and crudely assess wetland habitat trends from the old data to the update. Although new NWI data will improve some habitat baseline estimates, it still will not provide us with an index of yearly change. The NLCD is also very limited in its use to track habitat change due to the restricted number of cover types identified, accuracy errors, and the timeframe between new data releases (10 years between the latest 2 datasets).

Now aware of these spatial data limitations, JV science partners are debating other possible options to track habitat trends. Two options have been briefly discussed; establishing an index based on data that is already collected (e.g., Great Lakes water levels, precipitation, or soil moisture), and purchasing yearly imagery of sample areas within the JV region and extrapolating change within those samples to the rest of the area. A limitation of using the index technique is it may track environmental change very well, but will be limited in its ability to track human influenced change (positive and negative). Purchasing and analyzing imagery for sample areas across the JV may provide

a more accurate assessment of habitat change and other useful products, but will require funding and staff resources well beyond those currently available.

Our JV will be continuing to invest in improving our ability to track bird habitat and will be searching for more accurate and efficient techniques. We would greatly appreciate feedback from the NSST and other JVs in this effort.