NAWMP Science Support Team 5-Year Work Plan
2012- 2016

Executive Summary

This 5-year work plan (Work Plan) lays out priority science and technology needs to be acted on by the North American Waterfowl Management Plan (NAWMP) Science Support Team (NSST) through US Federal Fiscal Year 2016. Many of these high priority needs will inform actions identified in the 2012 NAWMP Revision. Our projected period of performance is 5 years (Summer 2012 – Sept. 2016). However, our initial focus will be on tasks relevant to the timeline of the NAWMP Revision (2012-13). The NSST will remain flexible enough to address other high priority information needs as they emerge.

Priority tasks in this work plan were identified in the 2007 NAWMP Continental Progress Assessment (Assessment), the 2007 Joint Task Group Report, and the 2008 Future of Waterfowl Management Workshop. The threads that tie NSST priority science and technology needs together is that they are waterfowl-focused and transcend the boundaries of individual joint ventures (JV); that is, they require or at least benefit from a flyway, national or international approach. This will continue to be the standard by which we will identify future priorities.

To succeed in meeting the aggressive demands of this Work Plan in a timely manner, the NSST will require assistance from focused, dedicated staff to accomplish certain elements of this Work Plan. We offer 2 approaches to acquiring this capacity:

1. Contract with external sources on a task-by-task basis to conduct activities in consultation with NSST members, or
2. Hire a small number (2-3) of dedicated staff as term employees (e.g., post-docs) to complete the bulk of tasks for NSST working groups.

If option 1 is adopted, NSST members will develop action plans (with timelines and budgets to be negotiated) and solicit proposals, first from NSST representatives and their agencies, and secondly from external sources. If option 2 is adopted, dedicated NSST staff or contractors will develop action plans for NSST approval. Unsolicited proposals will not be entertained.

Furthermore, addressing priority science and information needs in this Work Plan will require a reliable source of annual funding. Thus, the NSST has considered options for procuring dedicated funding to ensure timely completion of Work Plan tasks. Options for funding may include, but not be limited to, the following:

1. Receive annual funding from each JV to address Work Plan tasks that benefit the entire NAWMP and migratory bird community. For example, each JV could contribute $10,000 annually to be held by DBHC for use by the NSST. Funds not dedicated within 3 months before the end of the Canadian and U.S. Federal fiscal year could be reverted in equal amounts to each contributing JV.
2. Receive annual appropriation of Federal funds for use in accomplishing Work Plan items. Under this option, the NSST could be viewed analogous to another JV for receiving DBHC funds.

Regardless of its source or the process by which it is allocated, dedicated funding will be essential if priority tasks of the NSST are to be completed in a timely manner.

This Work Plan serves as a report to the NAWMP Committee of planned NSST activities and supports requests for financial & logistical resources necessary to complete Work Plan tasks. Recognizing that financial resources will be limited, the NSST established a priority ranking for individual Work Plan tasks. Within this Work Plan, the Task Number associated with a given Task represents its relative priority ranking among all Work Plan Tasks (Table 1). The anticipated start and end dates for Work Plan Tasks are shown schematically in Figure 1.

The total cost of activities outlined in this Work Plan is expected to exceed $2,546,000, including in-kind support, funds already procured, and funds not yet requested. We are seeking assistance from the Plan Committee in procuring approximately half (i.e., $1,341,500; Table 1) of this total cost. However, we recognize that funding will be limited, especially in the near-term (FY 2012-2014). Consequently, we present in Table 2 only the 6 highest priority Work Plan Tasks and the funding necessary to complete activities proposed to occur during the next 2 years (FY 2012 and 2014) for these Work Plan Tasks. *Although we believe successful and timely completion of all tasks within this Work Plan are necessary to advance science-based habitat conservation as prescribed by the NAWMP, we emphasize that funding the near-term needs of the top five priority tasks is essential for maintaining momentum achieved over the past few years in quantifying impacts of conservation actions on waterfowl demographic rates and population sustainability. Specifically, $355,000 is requested to enable completion of activities during FYs 2012 and 2013 associated with the 5 of the highest priority tasks of the NSST Work Plan.*

Table 1. Tasks of the NSST 5-year Work Plan and funding requests needed to complete activities proposed for 2012 – 2016.

Task No.	Description	Funding Request[a]
1	Develop methods for setting demographic population objectives (i.e., vital rates) at BCR/JV-scales for focal species based on recommendations of the NSST Alternative Performance Metrics Subcommittee.	TBD
1a	Design and evaluate alternative monitoring programs to assess migratory bird distribution, movement and residency times during migration and winter seasons to support integrated habitat and population management frameworks.	$0
2	Develop approaches for generating regional waterfowl habitat conservation objectives that account for spatio-temporal variation in environmental and habitat conditions.	$0
3	Develop methods to aggregate regional-scale (i.e., JV/BCR) estimates of *K* across multiple species into an assessment of net progress toward NAWMP continental goals.	TBD
4	Establish comparable approaches to estimating *K* in the main breeding areas of North America.	$120,000
5	Evaluate the extent to which Daily Ration Models reliably reflect functional carrying capacity of habitats and landscapes for migrating and wintering waterfowl.	$10,000
6	Develop migration models parameterized for focal species, groups of species, and migration corridors to support regional habitat conservation decision-making.	$180,000
7	Identify non-breeding habitat needs and develop inputs to habitat models for sea duck and diving duck populations.	$145,000
8	Develop estimates of waterfowl residency times (in spring and fall) and factors affecting them.	$10,000
9	Contribute to the development or updating of spatial data by USGS and Environment Canada by organizing a network of on-the-ground observers and an on-line data logging system.	-
	9.1 Land Cover	TBD
	9.2 Wetland Data	$0
	9.3 Spatial Data on Hunting Distribution	TBD
10	Integrate down-scaled climate change predictions into BCR/JV scale population-habitat models to estimate likely impacts on waterfowl populations and inform development of adaptation strategies for waterfowl habitat conservation.	$151,500
Total	**Excludes items TBD**	**$1,341,500**

[a] Budget request excludes funds currently held and in-kind contributions.

Table 2. Six highest priority tasks of the NSST 2012 – 2016 Work Plan and funding request needed to complete activities proposed to occur over the next 2 years (US Federal Fiscal Years 2012 & 2013).

Task No.	Description	Funding Request[a]
1	Develop methods for setting demographic population objectives (i.e., vital rates) at BCR/JV-scales for focal species based on recommendations of the NSST Alternative Performance Metrics Subcommittee.	TBD
1a	Design and evaluate alternative monitoring programs to assess migratory bird distribution, movement and residency times during migration and winter seasons to support integrated habitat and population management frameworks.	$0
2	Develop approaches for generating regional waterfowl habitat conservation objectives that account for spatio-temporal variation in environmental and habitat conditions.	$0
3	Develop methods to aggregate regional-scale (i.e., JV/BCR) estimates of *K* across multiple species into an assessment of net progress toward NAWMP continental goals.	TBD
4	Establish comparable approaches to estimating *K* in the main breeding areas of North America.	$120,000
5	Evaluate the extent to which Daily Ration Models reliably reflect functional carrying capacity of habitats and landscapes for migrating and wintering waterfowl.	$10,000
Total	**Excludes items TBD**	**$355,000**

[a] Budget request excludes funds currently held and in-kind contributions.

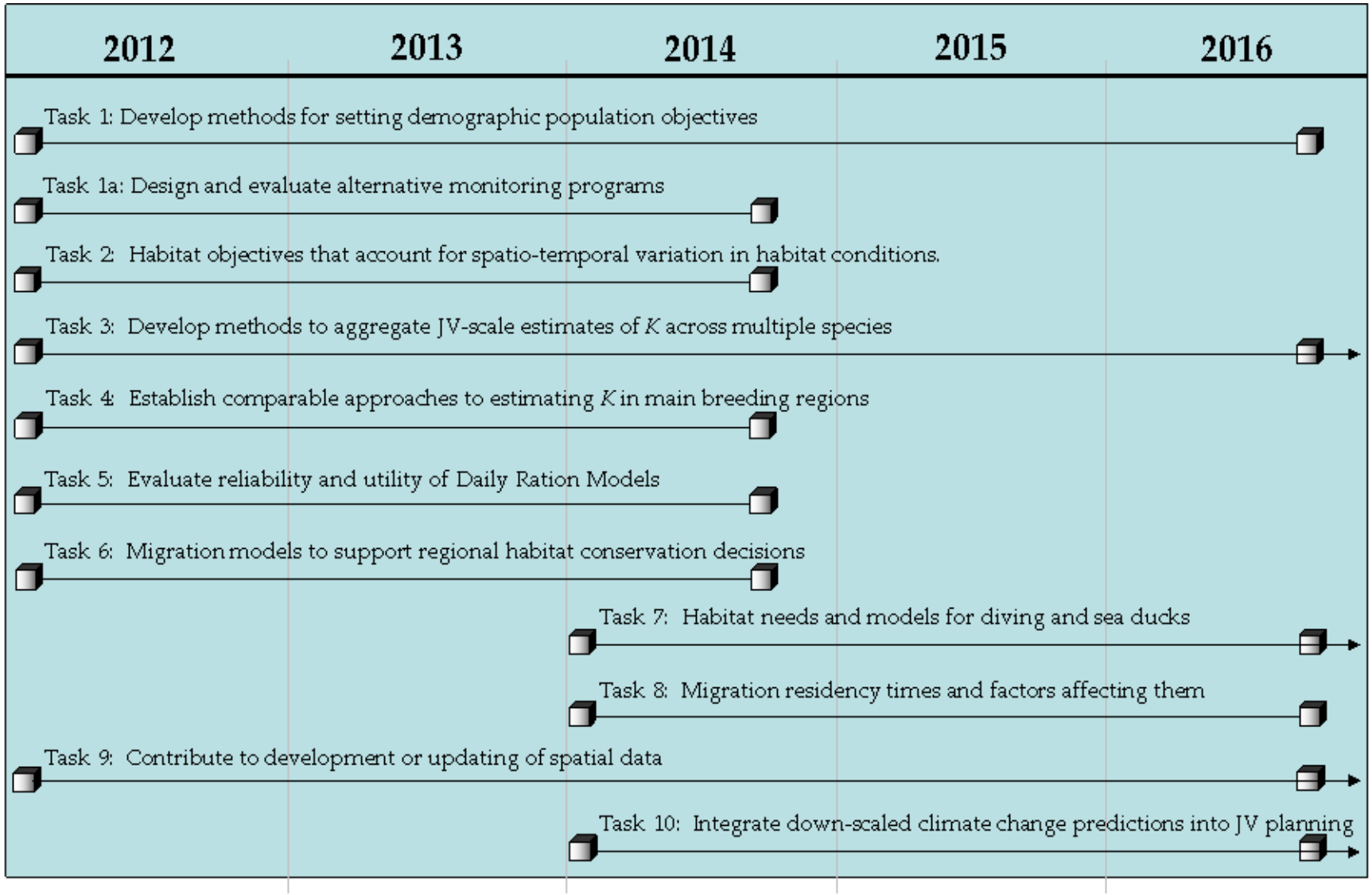
2012
2013
2014
2015
2016
Task 1: Develop methods for setting demographic population objectives
Task 1a: Design and evaluate alternative monitoring programs
Task 2: Habitat objectives that account for spatio-temporal variation in habitat conditions.
Task 3: Develop methods to aggregate JV-scale estimates of K across multiple species
Task 4: Establish comparable approaches to estimating K in main breeding regions
Task 5: Evaluate reliability and utility of Daily Ration Models
Task 6: Migration models to support regional habitat conservation decisions
Task 7: Habitat needs and models for diving and sea ducks
Task 8: Migration residency times and factors affecting them
Task 9: Contribute to development or updating of spatial data
Task 10: Integrate down-scaled climate change predictions into JV planning

Figure 1. Proposed timeline for initiating and completing tasks of the NSST 2012-2016 Work Plan. Arrows at right of figure indicate work on given task is expected to continue beyond the period of planning for this Work Plan (2016).

NAWMP Science Support Team 5-Year Work Plan
2012- 2016

Introduction

The purpose of this document is to identify priority science and technology needs to be acted on by the North American Waterfowl Management Plan (NAWMP) Science Support Team (NSST) through 2016. Many of these high priority needs will inform actions identified in the 2012 NAWMP Revision Our projected period of performance is 5 years (Summer 2012 – Sept. 2016), but the NSST recognizes the need to be flexible and address other high priority information needs as they emerge.

The activities in this 5-year work plan (Work Plan) were identified in the 2007 NAWMP Continental Progress Assessment (Assessment), the 2007 Joint Task Group Report, and the 2008 Future of Waterfowl Management Workshop. The threads that tie NSST priority science and technology needs together is that they are waterfowl-focused and transcend the boundaries of individual joint ventures (JV); that is, they require or at least benefit from a flyway, national or international approach. This will continue to be the standard by which we will identify future priorities.

Capacity to Complete a Work Plan

Although the NSST made great strides in completing tasks identified in previous Work Plans (e.g., Alternative Performance Metrics, Regional Population Abundance Objectives, and Migration Modeling), its productivity was sometimes hindered by additional work responsibilities of its members. We believe dedicated staff will be required to accomplish certain elements of this Work Plan, and we offer 2 approaches to acquiring this capacity: 1) contract with external sources on a task-by-task basis to conduct activities in consultation with NSST members, or 2) hire a small number (2-3) of dedicated staff as term employees (e.g., post-docs) to complete the bulk of tasks for NSST working groups). Both options will require dedicated funding akin to that spent by most JVs on science and technology needs.

If option 1 is adopted, NSST members will develop the action plan (with timelines and budgets to be negotiated) and solicit proposals, first from NSST representatives and their agencies and secondly from external sources. If option 2 is adopted, dedicated NSST staff will develop action plans for approval by the full NSST. Unsolicited proposals will not be entertained.

General Protocols for Addressing Priority Science and Technology Needs

Prior to commencing work on any element of this Work Plan, an action plan will be developed that includes (minimally) the following elements:

- Scope
- Objectives
- Linkages to Other Work Plan Tasks
- Action Items
- Deliverables and Timelines (*i.e., Project outcomes and a dissemination plan through the NSST and project completion date as well as dates for significant intermediate accomplishments)*
- Budget

Addressing priority science and information needs in this Work Plan will require a reliable source of annual funding. Past events have indicated funding from USFWS-Division of Bird Habitat Conservation (DBHC) is frequently needed for activities like Assessments, contracting with Human Dimensions specialists, and hiring coordinators for NAWMP Updates or Revisions, leaving little funding available for NSST priorities. Thus, the NSST is working with the NAWMP Committee to consider options for procuring dedicated funding to ensure timely completion of Work Plan items. Options for funding may include, but not be limited to, the following:

1. Request annual funding from each JV for the purpose of addressing Work Plan items related to science and information needs that would benefit the entire NAWMP and migratory bird community.
2. Receive annual appropriation of Federal funds for use in accomplishing Work Plan items. The NSST could be viewed analogous to another JV when DBHC funds are allocated.

Regardless of its source or process by which allocated, dedicated funding will be essential if priority tasks of the NSST are to be completed in a comprehensive manner and within a time frame that ensures their contemporary relevance to landscape-scale habitat conservation for migratory birds.

The Structure of this Work Plan

Work undertaken by the NSST should culminate in a periodic (e.g., 5-years) report on the state of waterfowl science to enhance conservation of North American waterfowl and their habitats. In the interim, the NSST will produce annual reports describing recent accomplishments and ongoing activities of the NSST. Achieving NAWMP goals and addressing recommendations of the 2007 Assessment will require that each JV develop models relating limiting factors (almost always habitat features) to focal waterfowl species populations. Model outputs should be population metrics that can be rolled up to a continental (or range-wide) scale. The value of individual Work Plan tasks may vary among JVs, but each should contribute to an ultimate goal that is valued equally by all JVs

2012-2016 Work Plan Tasks, listed in order of decreasing priority

1. **Develop methods for setting demographic population objectives (i.e., vital rates) at BCR/JV-scales for focal species based on recommendations of the NSST Alternative Performance Metrics Committee. These objectives must relate to measurable population metrics or facilitate rolling-up to continental objectives from BCR/JV scales.**

   Scope

   Identifying demographic objectives for gauging and reporting the status of continental waterfowl populations and their habitats is essential to the accountability of the NAWMP. Aggregating regional-scale estimates of landscape conditions and waterfowl carrying capacity to continental scales will likely require empirical models that relate remotely-sensed data to common biological metrics. Presently, many JVs have models for estimating *K* in terms of simplistic metrics (e.g., potential pair habitat, duck energy-days), yet few have developed models for translating landscape conditions into demographic rates (e.g., recruitment, seasonal survival) for describing population impacts.

   A key recommendation of the NAWMP Continental Assessment was for JVs to identify performance metrics that reflect biological impacts of conservation activities on continental waterfowl populations. Following from this recommendation, the NSST Alternative Performance Metrics (APM) Committee developed the following guidance:

   - JVs should frame their accomplishments in terms of changes in demographic parameters (i.e., season specific vital rates).
   - All JVs should adopt the annual life cycle model as the basis of their monitoring program.
   - Individual JVs should develop conceptual models or, where data exist, empirical models to explicitly describe how habitat management actions influence vital rate(s).
   - In the long-term, JVs should incorporate the influence of both their management actions and population size on vital rates, as this will enable managers and researchers to understand the impact of density-dependence on management actions and vital rates.

   Now that recommendations have been made, it is the responsibility of the NSST to facilitate JV implementation of the guidance. One path forward is continued improvement and ultimate adoption of the several efforts underway to develop annual cycle models for selected duck species (i.e., lesser scaup, American black duck, and northern pintail). However, additional guidance may be needed for JVs to make meaningful progress toward implementing the recommendations of the APM Committee. For example, models for describing annual cycle events or predicting the capacity of JVs to sustain populations are often difficult to develop and update. Thus, it may be advantageous to select a subset of species whose range and resource requirements cover the full scope of waterfowl habitats across the continent. Ultimately, JVs will be asked to report accomplishments for only those species for which they have a primary responsibility.

Objectives=

- Identify 3-4 focal waterfowl species whose collective habitats, distribution, and = resource requirements are representative of those for all North American waterfowl.=
- Develop approaches for establishing regional-scale, quantitative objectives for = demographic rates of focal waterfowl species.=
- Achieve consistency among JVs of similar spatial, temporal, or biological importance = to waterfowl in selection of demographic rates to be used as biological performance = metrics.=

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Linkages to Other Work Plan Tasks=

Demographic metrics recommended through this work should be considered in modeling = efforts of Work Plan Tasks 2, 4, and 6. These metrics should ideally be included as primary = or intermediate response variables to ensure compatibility among otherwise independent = models, thus promoting efficiencies in measuring habitat impacts at continental scales. = Annual cycle models mentioned in Work Plan Task 3 should be examined for their utility in = providing the modeling framework for these efforts.=

Action Items

- Establish NSST committee to accomplish, or develop recommendations for = accomplishing, the following activities:=
    a. Develop and distribute a survey to JV science staff to query current progress = and impediments to measuring accomplishments via demographic rate = objectives. Redistribute the Alternative Performance Metrics Subcommittee = report as part of this survey.=
        i. To be completed by NSST committee by February 2011. Cost = $0=
    b. Convene JV science workshop to gather information, share details, and = enable peer-review of current efforts to measure JV accomplishments = via demographic rates. Workshop should lead to formulation of specific = recommendations for improving existing efforts and provide springboard for = subsequent work of this committee.=
        i. To be held in conjunction with spring NSST meeting. Cost = $0=
        ii. Development of document summarizing workshop discussions and = findings. Cost if writing assignment is contracted out = $5,000 = (preferred). Cost if developed by NSST committee = $0 =
    c. In collaboration with the Task 3 Committee, draft a list of North American = focal waterfowl species for review and approval by full NSST.=
        i. To be completed by NSST committee by June 2011. Cost = $0=
    d. Develop a general framework/application for decomposing annual life cycle = models into regional sub-models for quantifying relationships between = habitat conditions, waterfowl density, and waterfowl demographic rates. This = framework should enable JV specificity while retaining sufficient consistency = to facilitate “rolling up” regional accomplishments to measure JV effects at = continental scale.=
        i. Preferred and most effective scenario would be to complete work via 6 = month post-doc position. Cost = $45,000=

ii. Alternate, yet less effective, scenarios include short-term contract = position or graduate students. Cost = $30,000 - $45,000=

e. Develop recommendations for using annual cycle and regional sub-models to = establish quantitative objectives for waterfowl demographic rates among JVs = and time periods.=
   i. To be completed via 12 month post-doc or contract position in = collaboration with NSST committee members. Cost = $90,000=

f. Use a series of JV case studies to demonstrate and evaluate the utility = of annual cycle and regional sub-models for establishing quantitative = demographic rate objectives and measuring accomplishments via = demographic rates. Model validation should be an important consideration = when evaluating the utility of these models. Methodologies and results to be = shared via NSST website.=
   i. Case studies and model validation to be completed via 6 month = collaboration between post-doc or contractor and NSST committee = members. Cost = $45,000=
   ii. Web development to be completed via contract. Cost = $5,000=

g. Develop a computer-based application derived from annual life cycle models = for use by JVs to determine demographic rate objectives.=

h. Develop comprehensive final report describing activities, results, conclusions, = and final products.=
   i. To be completed via collaboration between post-doc, contractors, and = NSST committee members.=

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Deliverables and Timelines=

- Establish NSST committee (October 2010)=
- Distribute survey to JV science staff (20 January 2011)=
- Convene JV Science workshop (May – June 2011)=
- Submit list of North American focal waterfowl species with justification and explanation for PC approval (June 2011)
- Finalize JV science workshop summary document (May 2012)=
- Begin developing framework to decompose annual cycle models into regional sub-= models (August 2012)=
- Begin developing recommendations for using annual cycle and regional sub-models to = establish quantitative objectives for waterfowl demographic rates (August 2013)=
- Begin development of computer-based application for deriving demographic rate = objectives (August 2013)=
- Begin work on series of JV case studies to demonstrate approaches for establishing = regional-scale demographic rate objectives (initiate work August 2014)=
- Finalize results from JV case studies (February 2015)=
- Submit final report(s) (December 2015)

Budget=

Although certain elements of this Task will be completed by NSST committee members, = effective and timely completion will require filling a post-Doctoral position to work full time = on the most challenging problems in collaboration with NSST members. This post-Doctoral =

position should be filled for at least 2 years at the GS-12 level, or approximately $180,000 ($90,000/year). Another $10,000 is requested for contract work related to the workshop and website development.

1a. Design and evaluate alternative monitoring programs to assess migratory bird distribution, movement and residency times during migration and winter seasons to support integrated habitat and population management frameworks.

Scope

Currently, partners in the waterfowl management community are developing new frameworks to inform habitat conservation planning and delivery for waterfowl: integrated waterfowl habitat and population management as envisioned by the NAWMP Revision. These frameworks are designed to inform habitat managers about how migratory waterfowl respond to landscape conditions, weather and climate, and habitat management at multiple scales, thus enabling managers to set regional population and habitat objectives and make optimal decisions regarding the allocation of resources across time and space.

Specifically, there are on-going efforts to develop northern pintail, American black duck, and scaup life-cycle models designed to inform the NAWMP Revision's goal of habitat and population (harvest) management in a unified framework. One goal of these models is to inform decisions regarding the optimal allocation of habitat delivery at the continental, Joint Venture, and local scale to increase carrying capacity for these three species of waterfowl. The foundations of these frameworks are integrated life-cycle population and habitat models that 1) explicitly describe spatial and temporal dynamics, including functional forms of density dependence and transition probabilities among breeding, migration, and wintering ranges; 2) link population demographics to spatial variation in climate and habitat quantity/ quality; 3) incorporate effects of management on landscapes and populations; 4) reduce key uncertainties by comparing model predictions to observed data; and 5) inform recurring management decisions. These frameworks are being developed using the structured decision making process with valuable participation from USFWS Division of Migratory Bird Management, USFWS National Wildlife Refuges, State and Provincial agencies, the Canadian Wildlife Service, Joint Ventures, and non-government organizations.

To be successful, these efforts must be implemented within an adaptive management framework (e.g., Strategic Habitat Conservation [SHC]). Perhaps the most critical component of an effective SHC program is the development and implementation of monitoring programs that provide the data needed to evaluate system response to management, contrast performance of competing models, and inform subsequent management decisions. As a prerequisite, required elements of the data and monitoring programs must be identified, including 1) what variables must be measured; 2) the appropriate spatial and temporal scale for estimating the target variables; 3) the most cost-effective design to estimate target variables; and 4) how the migratory bird community can achieve added value with the monitoring programs. The migratory bird community will need new monitoring to provide data on the seasonal distribution, movement, and residency times of birds in response to landscape and climate conditions and habitat delivery at the local, regional, and continental scales. The challenge facing the migratory bird community

is deciding what is the most appropriate and cost effective method for achieving these monitoring needs.

Objectives

- Identify monitoring data needs shared among the evolving models for northern pintails, American black ducks, greater/lesser scaup, and waterbirds with particular emphasis on distribution, movement, and residency times of birds during the migration and winter periods.

- Assess new technologies including geolocators, passive integrated transponders, satellite telemetry, remotely sensed imagery, high-resolution videography, and others to provide the necessary data in a cost effective manner;

- Draw on the science of wildlife monitoring (published literature and knowledge of experts) to evaluate alternative monitoring programs that would provide priority data to support integrated population and habitat management:

    a. Specify appropriate variables;
    b. Specify appropriate spatial and temporal scales;
    c. Specify sampling design(s);
    d. Specify required sample sizes;
    e. Specify data collection, storage, and sharing protocols;
    f. Identify cooperating partners and responsibilities; and
    g. Describe costs, logistical challenges, advantages, and limitations of each alternative in a standardized manner to allow objective comparisons of the proposed alternatives.

- Engage the migratory bird community in structured decision making processes as a means for adopting suitable monitoring programs from among the alternatives offered.

Linkages to Other Work Plan Tasks

The goal of this project is to design and evaluate various alternative monitoring programs that would provide priority data needed to support integrated population and habitat management for migratory birds, and recommend which of those alternatives should be implemented. Hence there are direct links totask elements 5 & 7.

Action Items

- A planning exercise is needed to clearly identify information needs and collection methods to inform a decision process prior to initiating data collection. The majority of this project will be accomplished through a combination of structured decision making workshops, literature review, monitoring design, and modeling. All this work will commence in Summer 2012.

- Work is slated to commence in Summer 2012 and will be conducted by a post-doctoral position administered through the U.S. Geological Survey Biological Research Branch or Cooperative Research Unit. To ensure that the development of alternative monitoring programs serves the needs of land managers and supports developing SHC

frameworks, the post-doctoral employee will be advised by a subcommittee of the NSST.

Deliverables

- Report: assessment of common data needs across frameworks, new technologies, and alternative monitoring designs to support integrated habitat and population management frameworks for waterfowl and waterbirds. This report will identify the most promising designs, expected costs, and potential for implementation allowing the migratory bird community to assess some of the logistical and financial challenges to implement these ambitious programs.

- Report: recommendations resulting from structured decision making meetings engaging the waterfowl and waterbird management communities to evaluate alternative monitoring programs. This report will provide a final recommendation for the most appropriate sampling design(s), including protocols and cost estimates, to support the implementation of integrated habitat and population management for waterfowl and waterbirds.

Time Line:

- Months 1-3: Consultation with representatives from pintail, black duck, scaup and waterbird teams to identify common monitoring needs, with emphasis on migration and wintering periods.
- Months 1-6: Assessment of existing and new techniques and technologies available to provide necessary monitoring data.
- Months 6-12: Draft alternative (3-5) monitoring designs and protocols to obtain necessary data to support developing SHC frameworks, and provide report.
- Months 12-15: Workshops to gather expert input on draft proposed alternative designs.
- Months 15-18: Revision of alternative monitoring designs, evaluation and comparison of revised alternatives.
- Months 18-24: Structured decision making meetings to inform final recommendations on monitoring programs that should be implemented; completion of final report.

Budget

A total of $233,800 has been budgeted for a two-year period commencing in Summer 2012. Effective and timely completion will require filling a post-Doctoral position to work full time on the most challenging problems in collaboration with NSST members. This post-Doctoral position should be filled for at least 2 years at the GS-12 level, or approximately $189,000 ($94,500/year). Another $44,800 is requested for contract work related to travel, conferences, workshops, publications and direct / indirect costs (see **Appendix A**).

2. Develop approaches for generating regional waterfowl habitat conservation objectives that account for spatio-temporal variation in environmental and habitat conditions.

Scope

Joint Ventures typically calculate waterfowl habitat objectives based on long-term, average indices of population abundance and distribution, yet environmental conditions and waterfowl populations are rarely at average levels. A fundamental question facing North

American waterfowl habitat managers is whether habitat objectives based on measures of central tendency (e.g., mean population abundance) can produce landscapes necessary for achievement of NAWMP goals. Most waterfowl are highly mobile and have adapted to exploit regional and temporal variation in environmental and habitat conditions; thus, within a given year, poor habitat conditions in one area may be compensated by excellent habitat conditions in adjacent regions with minimal consequences to populations. Indeed, it stands to reason that sustaining *average* populations over the long-term depends on habitat conditions and populations levels exceeding average values during some years.

Habitat objectives based on measures of central tendency may be interpreted as landscape conditions necessary to support average waterfowl abundances expected when NAWMP goals have been achieved. Similarly, these objectives imply the ability to support above average waterfowl abundance when coupled with above average environmental conditions. Although logical, this sentiment rests on the unstated assumption that landscape composition is such that above average environmental conditions (e.g., precipitation) will produce above average habitat conditions (e.g., foraging habitat, breeding pair ponds). North American landscapes important to waterfowl continue to experience land use changes, frequently to types not suitable as waterfowl habitat. Followed to its logical conclusion, habitat objectives based on measures of population central tendency that fail to acknowledge current and projected changes in broad landscape composition may constrain future waterfowl populations at levels below historic averages and NAWMP goals.

Additionally, climate change models suggest regional-scale habitats for some bird species will substantially contract while others expand. Without a clear understanding of how changes in climate will affect habitats, some waterfowl managers believe "conservation safeguards" (i.e., habitat beyond model calculations) are necessary to reduce risks of habitat deficits due to extreme environmental events (i.e., severe drought) not captured by deterministic models. Although conservation safeguards may gain support under the guise of achieving resiliency as an adaptation to climate change or other landscape stressors, the waterfowl conservation community will be challenged to reconcile this planning philosophy with a desire to have collective JV regional habitat objectives sum to a measure consistent with NAWMP population goals.

<u>Objectives</u>

- Develop recommendations for translating regional population objectives into habitat objectives that account for spatial and temporal dynamics of waterfowl populations and habitats.
- Develop recommendations for restating NAWMP population goals to more effectively acknowledge temporal dynamics of waterfowl populations (e.g., achieve population goals during 7 of 10 years).

<u>Linkages to Other Work Plan Tasks</u>

Discussions and findings of this effort will likely have implications for and/or interactions with Work Plan Tasks 1, 4, 5, 6, and 7, as it relates to whether a transition from deterministic to stochastic planning is needed or valuable. Additionally, a "conservation safeguards" philosophy may require explicitly linking regional habitat or population models, such

as those developed or considered in Work Plan Tasks 1, 4, 5, and 6. This may directly compliment Work Plan Task 3.

Action Items

- Establish NSST committee to accomplish, or develop recommendations for accomplishing, the following tasks:
    a. Construct conceptual model to identify key relationships among regional waterfowl abundance, habitat conditions, environmental conditions, and other external factors (e.g., waterfowl hunting regulations, agriculture policies and programs). Develop white paper regarding construction of conceptual model.
        i. To be completed by NSST sub-committee by autumn 2011. Potential cost = $5,000 for meeting or workshop expenses.
    b. Develop empirical model to explore strength of conceptualized relationships affecting temporal variation in regional waterfowl abundance.
        i. Explore implications of establishing habitat objectives based on measures of "central tendency."
        ii. Evaluate competing approaches for establishing habitat objectives that account for temporal dynamics of regional waterfowl abundance.
        iii. Currently proposed that this work be conducted by a contracted post-doc for a period of 6 months. Estimated cost = $45,000 (including benefits and travel).
    c. Develop conservation planning optimization model to balance ecological, sociological, financial, and logistical implications of habitat objectives that account for temporal variation in regional waterfowl abundance. This model should also enable assessments of the social and ecological implications of uncertainties related to climate change and a "conservation safeguards" philosophy for establishing habitat objectives.
        i. This work will be conducted by a contracted post-doc for a period of 1 year (not including 6 months for empirical model development). Estimated cost = $90,000 (including benefits and travel).
    d. Develop white paper summarizing discussions, conclusions, and recommendations. In each case, implications from ecological and social considerations should be addressed.

Deliverables and Timelines

- Establish NSST committee (October 2010)
- Develop conceptual model (October 2011)
- Hire post-doc (January 2012)
- Submit final white paper (October 2013)

Budget

$140,000 over 2.5 years requested from NAWMP/NSST; 2010-11 ($5,000); 2011-12 ($67,500); 2012-13 ($67,500) (See matrix in **Appendix A**)

3. **Develop methods to aggregate regional-scale (i.e., JV/BCR) estimates of *K* across multiple species into an assessment of net progress toward NAWMP continental goals.**

Scope

In response to recommendations from the Joint Task Group and Assessment reports, efforts are underway to assemble annual life-cycle models for several focal species. Development and refinement of these models will rely strongly on participation of JVs having clear responsibilities for these focal species. Different approaches have been used to assemble these models, but all have several common features in that they (1) relate variation in vital rates to landscape attributes, (2) incorporate some degree of spatial structure, (3) are, in part, designed to inform resource allocation decisions both within and among regions of North America and (4) consider simultaneously impacts of harvest and habitat management decisions. While these models show great promise to link harvest and habitat management decisions for individual species at regional to continental scales, managing simultaneously for multiple species will require additional future synthesis, consideration and effort. Current efforts are underway for the following species:

- **Northern pintail**
- **Lesser and greater scaup**
- **American black duck**

Objectives

- Provide support, as needed, to complete annual life-cycle models for the 3 species identified above in consultation with relevant JVs.
- Determine which additional species or suites of species (e.g., guilds) should be modeled.
- Develop Decision Support Tools (DST) to integrate outputs for multiple species to inform management actions.
- Design infrastructure to monitor progress and facilitate learning about the relative cost-effectiveness of various habitat and harvest management alternatives in achieving NAWMP population goals.

Action Items

- Establish an NSST working group to consider additional focal species or guilds to be modeled. Considerations should include: (1) for which species are vital rate data readily available, and (2) based on a scan of life history characteristics, which species are most dissimilar from species already being modeled and, therefore, will maximize new information for allocation decisions. For focal species where a lack of vital rate information precludes building annual life cycle models, develop a prioritized list of research topics to inform future modeling efforts.
- Determine how to generalize or simultaneously optimize management actions for multiple species:
    a. Review existing approaches.
    b. Identify an individual(s) with the quantitative skills to develop alternative solution(s) for the optimization problem.
    c. Identify funding mechanisms.

- Prioritize evaluation needs for reducing uncertainty about the cost effectiveness of management activities identified by the models. This should include uncertainties related to the biological impact and costs of management activities.
- Recommend a consistent accomplishment and expenditure tracking system to allow evaluation of management actions among multiple JVs and partners.

Deliverables and Timelines

- Complete ongoing black duck (end date: December 2013), pintail (end date: December 2014) and scaup (end date: December 2014) life-cycle models, including detailed reports covering all facets of model structures, parameterizations and performances (e.g., sensitivity analyses); conservation and management implications; analytical code.
- Prioritized list of additional focal species (or groups of species, i.e., "guilds") to model and, where necessary, recommendations for research that relates landscape attributes to vital rates. (Start: September 2011; End: March 2012)
- Prepare a report outlining: 1) conceptual framework to synthesize life cycle models for multiple species; 2) job description for individual to complete modeling work; 3) identify and secure potential sources of funding (Start: January 2012; End: December 2016)
- Develop an evaluation plan identifying efforts needed to reduce uncertainties, specifically related to cost-effectiveness of management activities. (Start: September 2011; End: December 2011)
- Report providing recommendations for an accomplishment and expenditure tracking framework (Start: October 2010; End: June 2011)

Budget

$435,000 over 5 years requested from NAWMP/NSST (initially 2 PDFs; assumes all deliverables are cost-shared): 2011-12 ($80,000); 2012-13 ($140,000); 2013-14 ($125,000); 2014-15 ($50,000); 2015-16 ($50,000) (See **Appendix A**).

4. Establish comparable approaches to estimating *K* in the main breeding areas of North America.

Scope

A key recommendation arising from the NAWMP Assessment was to revisit and refine, if necessary, methods for stepping-down continental population objectives to smaller scales. Furthermore, attaining coherence between harvest and habitat management, and evaluating and refining population models based on vital rates, would be greatly facilitated by having independent estimates of regional *K* for a variety of focal species (Task # 1). Estimating *K* for specific regions will require a sound understanding of how ducks settle in response to varying wetland and upland conditions in diverse biomes (e.g., prairies, boreal forest, taiga-tundra) and regional populations (i.e., density dependence), necessitating reliable monitoring of populations and landscape conditions. Thus, successful establishment of comparable approaches to estimating *K* is also contingent on the success of other work plan components. Finally, implementing approaches for calculating *K* in specific breeding regions would

provide guidance for developing individual JV-based models and generating independent estimates of combined JV impacts on breeding population *K*.

Objectives

- Develop reliable, methods for estimating *K* for focal species in selected North American breeding regions (e.g., prairies, boreal forest, Arctic).
- Compare estimates of *K* to estimates derived with predictive models and, where spatial overlap exists, population monitoring results.
- Periodically (e.g., 5 year cycle) evaluate and refine estimation methods on the basis of feedback from monitoring programs and model projections.

Linkages to Other Work Plan Tasks

Lessons learned from this Task will link to modeling efforts associated with Work Plan Tasks 5, 6, and 7. These efforts will likely also contribute to advancing Work Plan Task 10.

Action Items

- Examine existing approaches and develop a prioritized list of regions for which common approaches should be developed (Time required: 1 meeting; Lead: Task Team)
- Prioritize list of focal species (e.g., all ducks, selected duck species, or all waterfowl) (Time required: 1 meeting; Lead: Task Team)
- Examine data and approaches used to develop existing regional models and develop a consistent approach to merge and model data from prioritized regions and species (Time required: 1 year; Lead Task Team/ Contractor; Estimated cost: $120,000)
- Assess predictive model performance within and among regions over time, and by comparison with results of other models. Update models as additional data become available (Update interval: 5 years)

Deliverables

- Report describing (1) prioritization of species-specific and regional priorities, and (2) plan for building comparable models
- Model describing K across breeding regions of North America

Budget

$120,000 for contractor salary, benefits, and travel in FY2011. (See **Appendix A**)

5. Evaluate the extent to which Daily Ration Models and alternative model frameworks reliably reflect functional carrying capacity of habitats and landscapes for migrating and wintering waterfowl.

Scope

Habitat conservation for migrating and wintering waterfowl is guided by the assumption that availability of dietary energy is the primary limiting factor during non-breeding periods. As a result, many Joint Ventures use resource depletion models, most often in the form of Daily Ration Models (DRMs), to calculate habitat objectives necessary to satisfy energy demands of target waterfowl populations. However, these DRMs typically rely on relatively simplistic

assumptions of waterfowl foraging behavior and habitat quality to describe waterfowl habitat use. Although predictions from DRMs on the temporal and spatial distribution of waterfowl at local scales have been supported by empirical data, recent research suggests these models are less reliable at capturing the dynamics of bird use at larger spatial scales. Thus, the NSST should evaluate the potential of alternative model frameworks (e.g., individual-based) to improve our understanding of waterfowl ecology and guide management decisions. Additionally, the NSST should identify limitations to the use of more complex or explicit DRMs (e.g., spatial depletion models). As part of this assessment, the NSST should identify the shortcomings or challenges of these alternative approaches and offer guidance on how key uncertainties and priority research needs for evaluating and improving the reliability of these models should be addressed. Tradeoffs among complexity, parsimony, reality, and utility need to be explicitly addressed to better align the planning, management, and research communities of waterfowl conservation.

Objectives

- Establish recommended standards for reliable use of DRMs and alternative models in Joint Venture planning for wintering and migrating waterfowl
- Identify alternative model frameworks for describing landscape carrying capacity for wintering and migrating waterfowl and guiding management decisions
- Determine the key uncertainties in DRMs and alternative modeling approaches in relation to Joint Venture planning in support of the NAWMP
- Prioritize specific research needs based on explicit consideration of the costs and benefits associated with acquiring and incorporating additional data to fully parameterize DRMs and alternative models

Action Items

- Establish NSST committee to address these objectives via the following tasks:
    a. Organize a symposium (Option 1) or workshop (Option 2) to serve as a forum for describing current use of DRMs and alternative model frameworks for estimating landscape-scale carrying capacity for migrating and wintering waterfowl, documenting benefits and limitations of DRMs and alternative model frameworks, highlighting recent advances in understanding the utility and reliability of DRMs and alternative model frameworks, and identifying research priorities to advance our understanding of the most appropriate models to use in Joint Venture planning for wintering and migrating waterfowl. The choice between a symposium or workshop format will depend partly on the level of interest and potential participation by the waterfowl research and conservation community, which has not yet been determined.

    b. Synthesize literature and symposium/workshop findings into a "State of the Science" or "Proceedings" document describing current understanding of the reliability and utility of resource depletion models and other modeling approaches for estimating landscape-scale *K* and habitat objectives for migrating and wintering waterfowl. This document will:
        i. Establish recommended standards for use of DRM and other models

ii. Identify and prioritize research needs for improving application of DRM and other models
iii. Be suitable for publication in a peer-reviewed or peer-refereed outlet

- Distribute "State of the Science and Research Priorities" document to waterfowl research and conservation community.

Deliverables and Timelines

- Establish an NSST Committee (November 2010)
- Determine structure of DRM forum (May 2011) – Consult with modelers, JV science staff, and academics to gauge interest in convening a symposium on the use of DRMs and alternative modeling frameworks for conservation planning in wintering and migratory JVs. If sufficient interest is not present, we will plan for a smaller, more focused workshop.
- Host a symposium/workshop outlining current and potential use of alternative models (including DRMs) for estimating landscape-scale *K* and habitat objectives for migrating and wintering waterfowl (Spring – Fall 2012)
- Complete and distribute "State of the Science and Research Priorities" document addressing reliability of resource depletion models for estimating landscape-scale *K* and waterfowl habitat objectives (Spring – Summer 2013)

Budget

Minimal budget request due to expectation that majority of work will be conducted by members of NSST Committee. Request $10,000 from NSST during FY12 or FY13 to offset symposium/workshop expenses. No other budget request expected (See **Appendix A).**

6. **Develop migration models parameterized for focal species, groups of species, and migration corridors to support regional habitat conservation decision-making.**

Scope

The original concept of the National Wildlife Refuge System was described as a "string of pearls" – a series of staging areas where waterfowl concentrated as the moved along migration corridors. Early prospective wildlife refuges established in the 1930s and 1940s were readily identified by these concentrations of ducks and geese. Today, much of the conservation estate is comprised of smaller State and Provincial wildlife management areas, and private lands that occasionally support large numbers of waterfowl or that support moderate numbers annually. Some are open to hunting and other public uses and some are inviolate sanctuaries.

Despite a general understanding of the factors that birds respond to during migration, we lack a detailed understanding of the factors that stimulate movement, determine where birds settle, how long they reside there, and the factors that affect vulnerability to hunting and natural mortality. This understanding is important for sustaining populations and public satisfaction.

Long-term, broad-scale telemetry projects could be used to gain insight into these factors; however, these types of projects are very costly. Simulation modeling-- based on a general understanding of migration-- may provide an objective foundation for allocating resources where habitat is insufficient to attain abundance, residency time and survival objectives for migrating waterfowl. Furthermore, in areas where habitat quantity or quality is most limiting, we want to determine which management factors can have the greatest effect. Simulation models, ultimately parameterized with data from telemetry or other observation studies will begin to provide this information. Models also can help identify the most critical uncertainties about migration.

Objectives

- Finalize conceptual migration model for mallards and develop narrative documentation that enables users to 1) understand model structure, assumptions and the source of parameter estimates; and 2) modify these factors as needed to enhance model performance;
- Stimulate and coordinate model runs for groups of JVs that share stocks of birds and evaluate the outcome using collateral data. Suggest alternative model covariates when necessary;
- Ensure that JVs are using most current, available data on wetlands, land cover, and human use (e.g., hunter distribution); and
- Develop summary paper on the results of initial model runs in conjunction with JVs and discuss limiting factors within migration corridors including potential habitat bottlenecks, as well as model deficiencies.

Action Items

- Disseminate the model and metadata to JVs. Develop a team from each JV, with emphasis on non-breeding JVs, to conduct model runs and revisions (hereafter the Migration Modeling Team).
- JVs and NSST members (Task 10) develop geospatial data of model covariates.
- Conduct initial model runs.
- Host a workshop of the Migration Modeling team and other interested NSST and PC members to discuss model run outcomes, model assumptions, revisions, and monitoring/research for parameter validation.
- Compare and attempt to reconcile population estimates (in standard objective units) with annual life cycle model estimates.
- Conduct telemetry studies to validate and refine parameter estimates and interactions of model covariates.

Deliverables and Timelines

- Complete current prototype of migration model and "users guide" and distribute to JVs. (Start 1 May 2011; Completion, 1 July 2011)
- Develop GIS spatial data layers of model covariates for at least one groups of JVs covering one major migration corridor. (Start, 1 July, 2011 Completion, 30 Sept. 2011)
- Develop GIS spatial data layers of model covariates for all habitat JVs in the US and Canada. (Start, 1 July, 2011 Completion, 30 June 2012)

- Host workshop (coordinated and facilitated by migration team) to discuss model performance, revisions and monitoring/assumption driven research to re-parameterize model (March 2012)
- Institute model revisions and monitoring/assumption-based research with period model reruns (Start August 2012; Completion, on-going).

Budget
See **Appendix A**

7. Identify non-breeding habitat needs and develop inputs to habitat models for sea duck and diving duck populations.

Scope
Populations of several sea duck and one diving duck species are in long-term decline or below NAWMP goals. While limiting factors and their impact on demographic rates of these species are uncertain, competing hypotheses emphasize energetic constraints on reproduction, including cross-seasonal effects related to conditions experienced on non-breeding areas. Even if non-breeding habitat is currently not the greatest limitation, apparent degradation or conversion of preferred habitats of sea and diving ducks continues to occur in key migration and wintering areas. If unchecked, cumulative effects of negative habitat influences may render landscapes unable to support sea or diving duck populations at NAWMP goal levels.

Unfortunately, we lack measures of *K* for non-breeding habitat for these species at regional or continental levels, and changes in sea and diving duck habitats are not adequately monitored. We also do not fully understand how existing NAMWP programs, which have focused largely on dabbling duck habitat, may benefit sea and diving ducks. Therefore, to better position the NAMWP community in meeting habitat needs of these species during non-breeding periods, the NSST should facilitate direct collaboration between the Sea Duck JV (SDJV), Scaup Action Team (SAT), and relevant habitat JVs. Sea and diving ducks are generally underrepresented in current JV planning, and this collaboration over the next 5 years will increase JV awareness of and planning efforts for these ducks. This effort will focus on priority species.

Objectives
- Develop criteria defining key non-breeding habitat, considering sexual segregation as needed. This effort should be led by the SDJV and SAT, with assistance from the NSST. Where habitat criteria cannot be defined or require substantial refinement, research and monitoring agendas should be developed or modified to iteratively improve subsequent modeling efforts.
- Integrate initial habitat criteria into geospatial mapping exercises to identify and quantify the potential extent of non-breeding habitat. This analysis should seek to complement or build on existing wetland mapping initiatives, and novel efforts may be necessary to explore and develop coastal habitat data sets.
- Assess energetic value of key non-breeding habitats, and evaluate landscape *K* relative to continental and regional NAWMP population goals. This effort may be "crude" in

its first iteration due to data limitations but is directly relevant to and should benefit from progress on other NSST Work Plan items.
- Assess current and future threats to *K* for priority sea and diving ducks species.
- Develop recommendations to the NAWMP Committee and JVs for building sea and diving duck habitat requirements into biological planning and conservation delivery. These recommendations should include non-breeding habitat objectives linked directly to regional population abundance objectives.

Linkages to Other Work Plan Tasks

Efforts to establish habitat objectives for sea and diving ducks will benefit from findings and recommendations of Work Plan Tasks 2, 5, 8, and 9. Various aspects of this work should contribute meaningfully to scaup modeling efforts (Work Plan Task 3), or alternatively, benefit from work already conducted by the scaup modeling group.

Obstacles and challenges

a. *Data availability.* Data are currently lacking to populate biological models with habitat parameter estimates, such as forage values of different habitats. An initial solution would be to review available information, then adopt an adaptive approach of developing models based on best available data, testing critical assumptions, and refining models accordingly. Testing assumptions is outside the scope of this work plan.

b. *Human and financial resources within current partnerships appear limited to complete these objectives*. A solution is to hire a contractor or post doc position to lead core components. Oversight of the position could be provided by the NSST committee responsible for this work plan element or member(s) therein, perhaps someone where the position will be located. Until preliminary action items are completed, it is difficult to predict how long such a dedicated person would be required.

c. *Work plan element is very ambitious*. Objectives of this element have the potential to expand beyond the 5 year scope of this work plan. A solution is to keep this work plan element focused on the spatial aspects of this project, i.e. mapping key habitats and threats to those habitats, and deriving JV level habitat goals only for priority species. Filling key information gaps with new research or monitoring will not be within the scope of this work plan. As well, action items are staged so that useful outcomes are obtained even if the full project cannot be carried out.

Action Items

- Establish NSST committee to address objectives listed above. Committee should comprise representatives from the SDJV, SAT, and habitat JVs of particular importance to sea and diving duck species.
- Convene experts in workshop with the following objectives:
    a. Determine priority species for subsequent focus, e.g. species of concern or representatives of guilds.
    b. Review, briefly, the state of knowledge on habitat requirements and food availability pertinent to objectives.

c. Identify and prioritize key information gaps that might impede progress on each priority species.
d. Assess ways that immediate collaboration on research or monitoring can advance objectives.
e. Develop a strategy for more thorough review of available data, exploration of modeling approaches, evaluation and mapping of threats relative to areas identified as key habitats, and completion of project objectives.
f. Report workshop outcomes in a brief white paper for submission to NSST, PC, and relevant JVs.

- Implement work plan strategy.
- Write up project phases in a format appropriate for peer reviewed publication. Includes review and interpretation of results at various stages by NSST committee.
- Based on results, provide PC with regional habitat objectives and target areas required for conservation of priority species, plus a prioritized list of information gaps and any other recommendations that arise.

Deliverables and Timelines

- Establish NSST committee (January - February 2011).
- Organizational Workshop (April 2011).
- White paper summarizing workshop results, including implementation plan (Dec 2011).
- Manuscript(s) summarizing results of project (2014).
- Final report to PC identifying critical information gaps and recommendations for conservation planning (2015).

Budget
See **Appendix A**.

8. Estimation of migratory waterfowl residency times and factors affecting them.

Scope
Migration is a critical component of the annual life cycle for waterfowl. During migration, waterfowl transition between life cycle events (i.e., breeding and wintering) and generally alternate between periods of flight and foraging at stopover sites. Estimation of residency times during migration is of interest to waterfowl managers and Joint Venture (JV) habitat planning efforts because it partly determines the energetic demands placed on a region by a target population. Estimates of residency times consequently play a critical role in the development of JV habitat objectives. However, relatively few studies (4) have attempted to estimate stopover duration by waterfowl, especially during spring. Conservation planners often apply fixed estimates of residency time to calculate foraging habitat requirements necessary to meet population energy demands. For waterfowl managers to fully understand linkages between physiological requirements and habitat use during migration, reliable estimates of average residency time (at appropriate spatial and temporal scales) are necessary. Ultimately, relationships between physiological demands, habitat use, and residency time may be linked to cross-seasonal effects (e.g., fecundity) and annual survival rates. The NSST should synthesize current knowledge regarding factors affecting waterfowl

residency time and current estimates within migration JVs, identify bias and limitations of current techniques and their implications for JV planning, and identify emerging or untested technologies. As part of this assessment, the NSST should explore and address tradeoffs among complexity, utility, and reliability of techniques to estimate waterfowl residency time to provide guidance for JV planning efforts and partners. Finally, the NSST should identify priority research needs based on these findings.

Objectives

- Review and summarize available information regarding demographic and environmental factors affecting residency time and techniques used to derive residency time estimates for focal waterfowl species.
- Identify current and emerging tools, technologies, and methods to estimate residency times of migrating waterfowl. Develop list or summaries of assumptions, potential bias, advantages, and disadvantages for respective techniques to help guide selection of methods at appropriate spatial scales.
- Identify priority research needs to improve current understanding of the factors influencing residency time and tools and technologies to improve estimation of waterfowl residency time.

Linkages to Other Work Plan Tasks

In combination with efforts of Work Plan Task 1, this work will improve our ability to calculate quantitative habitat objectives for migration regions. These efforts should assist efforts to parameterize or validate various elements of the migration model described in Work Plan Task 6. A more comprehensive understanding of waterfowl migration rates, transition probabilities, and residency time may prove useful in addressing objectives of Work Plan Task 4.

Action Items

- Establish a NSST Steering Committee to address these objectives via the following tasks:
    a. Identify and recruit NSST members to committee
    b. Designate committee chair
    c. Identify and recruit to the committee key science partners external to NSST
- Synthesize literature and committee materials into a "State of the Science" document regarding current knowledge of waterfowl residency time, techniques and their associated biases/limitations as well as advantages, an assessment of tradeoffs among techniques based on their complexity, utility, and reliability, and identification of priority information and research needs to develop reliable estimates at appropriate or desired spatial scales. This action item will be completed through conference calls and webinars. The committee should determine the need for a focused workshop. Communicate document development and components to NSST Executive Council and related Work Plan Task Committees (e.g., Work Plan Tasks 5 & 7)
- Distribute "State of Science and Research Priorities" document to waterfowl research and conservation community.

Deliverables and Timelines

- Establish NSST Steering Committee (October 2010)
    a. Recruit key science partners to Steering Committee (January 2011)
    b. Synthesize existing literature
- Draft Synthesis Report (Spring 2012)
- Report summarizing available data on waterfowl residency times, technologies, and/or methods for its estimation. Report also should identify assumptions and uncertainties associated with various techniques and priority research needs for improving estimates of waterfowl stopover duration during migration (Spring 2013 NSST meeting).

Budget
Funding to offset potential workshop costs not expected to exceed $10,000.

9. Contribute to the development or updating of spatial data by USGS and Environment Canada by organizing a network of on-the-ground observers and an on-line data logging system.

Spatial data are often costly and should be acquired judiciously. Spatial data needs are defined largely by their utility in JV models relating focal species populations to habitats within a landscape context. Two types of spatial data have proven essential in nearly every case: 1) digital land cover with adequate classification accuracy and spatial and taxonomic resolution and 2) digital wetlands data.

Linkages to Other Work Plan Tasks
Accurate and contemporary spatial datasets are essential for developing reliable population and habitat models, such as those addressed in Work Plan Tasks 2, 3, 5, 6, and 7.

9.1 - Land cover data.

Scope
Most JVs use USGS National Land Cover Dataset for site scale conservation planning despite recommendations by USGS that NLCD not be used to make inferences about land cover at scales finer than states. The NSST has been advised that USGS intends to create NLCD at 5-year intervals but requires ground truth data sets (observations of actual land cover in the field at known locations) for training classification routines and assessing the accuracy of classified land cover imagery. JVs are a logical source to acquire ground-truthed data sets. Finally, a comparable needs assessment and strategy will be required in Canada.

Objectives
- Identify priority land cover classes for updating at 5-year intervals.
- Collect web of ground-truth points for training classification algorithms and accuracy assessment.

Action Items
- Enter into a land cover data development cooperative image analysis and field data collection.

- Establish an NSST committee consisting of regular NSST members and additional land cover data users to 1) identify land cover classes critical for use in conservation planning for migratory birds and other trust species 2) develop a system by which JVs and other landscape conservation partnerships (e.g., LCCs) will collect and aggregate ground truth data points.
- Provide guidelines for collecting and reporting ground truth data points for use in NLCD training algorithms and accuracy assessment.

Deliverables and Timelines

- Digital land cover data sets at 30-m resolution with >80% users accuracy, <1 ha minimum mapping unit size, and a taxonomic classification agreed to by JVs.
    a. A pilot study is underway in the PPJV and will be completed by 2012. If the PPJV pilot yields successful accuracy, we suggest the NAWMP Committee and NSST representatives, and others, engage USGS and work toward a less costly partnership with broader responsibility for funding.

Budget

TBD; Costs in Canada are unknown, and we suggest the creation of a NSST Canadian subcommittee to develop comparable estimates.

9.2 – Update and Complete Digital Spatial Wetland data for areas of the US and Canada of High Importance to Waterfowl.

Scope

The National Wetlands Inventory (NWI), within the US Fish and Wildlife Service, has been the source of almost all digital wetland data in the US for nearly three decades. Recently, continued production and updating of NWI data has been threatened by budget cuts. The consequence has been for states to develop their own inventory, often using their own wetland classification systems or mapping standards even when NWI could facilitate the mapping process. This is leading to a progressively fragmented data set with limited value to regional scale planning. For example, one state is mapping shallow glacial wetlands using July USDA compliance imagery as a cost saving measure, despite these data likely being inadequate to effectively identify temporary and seasonal wetlands in croplands or under tree canopies. Thus new generation NWI data may be less reliable for conservation planning than the data we already have. Furthermore, a wetland inventory in Canada has been through a proof of concept but lacks funding to become an operational program.

Objectives

- Promote awareness of the critical importance of reliable geospatial wetland data for biological planning and conservation design.
- Provide the NWI and Environment Canada with regions of particularly high importance to waterfowl as priorities for mapping or remapping.

Action Items

- NSST and NAWMP Committee should continue working with state and NGO partners to increase awareness of the importance of digital NWI data and enlist their support for

the program. For example, recently the Plan Committee sent a memo to the USFWS Assistant Director for Fisheries and Habitat Conservation who oversees the NWI requesting assistance with mapping and remapping NAWMP priority areas. Several of these areas are now being mapped or remapped and others are being considered for next year.
- Identify priority areas in Canada for wetland mapping based on their importance to waterfowl as well as other ecological goods and services.
- Periodically review the mapping status in areas identified as priorities and identify new priority areas as original areas are completed. Special attention should be given to regions with coastal wetlands and other wetlands at high risk of loss or alteration.

Deliverables and Timelines
- Priority areas for a Canadian wetland inventory should be developed by Canadian JVs (Start, July 2011; Complete, June 2012)
- Priorities for US and Canadian digital wetland mapping reassessed at 5-year intervals and forwarded to NWI staff beginning in 2014.

Budget
See **Appendix A**

9.3 – Spatial data on hunting distribution.

Scope
As we use models to understand the mechanisms of waterfowl migration and predict where the protection, restoration, or creation of migration habitat will have the greatest benefits, we must consider the effects of disturbance on habitat quality and waterfowl use of habitats, particularly during the fall.

Objectives
- Develop and/or improve accuracy and precision of spatial data on hunting distribution as a measure of disturbance to aid in modeling and understanding patterns of waterfowl migration during fall.

Action Items
- Establish NSST committee to work with USFWS Population and Habitat Assessment Branch, Parts Collection Survey staff, Canadian Wildlife Service, and Flyways to assess accuracy and precision currently afforded by harvest distribution data. If deemed necessary, means for increasing this precision should be explored and recommended.

Deliverables and Timelines
- Establish NSST committee. (March 2011)
- Develop protocols to determine areas of waterfowl hunting activity, rather than where hunters reside or where migratory bird hunting stamps were purchased. Resolution should be at least at county scales, although greater spatial resolution is preferred.

If hunting pressure in Canada is believed to influence waterfowl distribution and migration, it would be desirable to have data at the scale of Rural Municipalities.

Budget:
TBD, but possibly zero for the NAWMP, depending on current data and needs of other entities in the USFWS, CWS, and Flyways.

10. **Integrate down-scaled climate change predictions into BCR/JV scale population-habitat models to estimate likely impacts on waterfowl populations and inform development of adaptation strategies for waterfowl habitat conservation. Collaborate with entities having related needs (e.g., USFWS, CWS) to achieve maximum efficiency, particularly pursuing synergies with Landscape Conservation Cooperatives and Climate Science Centers.**

Background
Evidence of climate change impacts on waterfowl habitats is growing and the cumulative effects of these impacts on waterfowl populations are likely to be profound – particularly in the Arctic, prairies, boreal forest, and coastal wetlands (Inkley 2004, Alley et al. 2007). Few JVs have attempted to explicitly incorporate climate change predictions into their regional planning models. The large uncertainty associated with climate predictions at the relatively small scales of JVs and BCRs have significantly impeded progress on this front. Nevertheless, JV planners are being asked to identify habitats and populations that are most vulnerable to future climatic change so managers can invest accordingly to mitigate or adapt to these effects. As the international forum for addressing the scientific foundation of continental waterfowl habitat conservation issues, the **NSST is uniquely positioned to lead cross-scale integration and planning efforts to address the effects of climate change on waterfowl habitats and populations at individual and aggregate JV/BCR scales.**

Recommendation 10 of the NAWMP Continental Progress Assessment (2007) noted that "***Global climate change must be given more consideration in JV regional targeting, program emphasis, and project design"*** and identified JVs as responsible for meeting this challenge. The Plan Committee fully endorsed this recommendation and agreed to sponsor a workshop on this topic.

Joint ventures face numerous challenges in integrating downscaled climate change model predictions into JV/BCR scale population-habitat models. The ability to develop downscaled model predictions of relevant variables, project those changes onto habitat conditions, and effectively handle the cascading uncertainty of model predictions (both in the climate models and the population-habitat models they feed into) will require highly technical skill sets of staff that do not currently exist within the JV community (e.g., atmospheric dynamicists, ecosystem simulation modelers). Collaboration with conservation partners that can offer these skill sets (but lack the waterfowl habitat expertise) will be critical to link regional-scale waterfowl habitat use and phenology to predicted changes in key habitat conditions. The NSST must be able to effectively communicate with these non-traditional partners to ensure the planning and monitoring needs of the waterfowl habitat conservation community are adequately addressed.

Scope

Landscape-scale planning based on alternative climate models are needed to assess the potential response of waterfowl populations and habitats to climate change. Given the nearly infinite options for conducting these assessments, broad-based, multi-scale coordinated efforts across JVs are needed to meaningfully predict and track spatio-temporal impacts to the abundance and distribution of waterfowl populations and habitat conditions.

Objectives

To build a solid foundation supporting JV efforts to integrate climate change predictions into regional planning efforts, JVs will need to make progress in:

- Understanding the climatic drivers of the spatial and temporal abundance and distribution of waterfowl populations and the habitats on which they depend.
- Identifying limiting factors affecting key annual life cycle events for priority waterfowl species and how they may be affected by climatic conditions (e.g., nesting success and brood survival relationships to spring precipitation; impacts of average winter temperature on overwinter survival).
- Monitoring waterfowl populations and habitat to evaluate the effects of changing landscapes and to identify efficient and cost-effective management alternatives to promote sustainable populations at NAWMP goals.
- Coordinate with and provide information to Landscape Conservation Cooperatives (LCC) and Climate Science Centers regarding NSST climate change objectives, activities, and deliverables as outlined in this document both at the NSST level and at the individual JV level.

Action Items

- The NSST shall serve as a forum to:
    a. Perform a quick vulnerability assessment of all waterfowl to climate change predictions in order to have a product that LCCs can use initially.
    b. Identify and assess the relevance of climate change to changes in key landscape attributes for waterfowl by identifying limiting factors and providing linkages to manageable landscape attributes in models with metrics for population and habitat responses.
    c. Support development of models that relate waterfowl demographics (abundance distribution, reproduction, and survival) across the entire annual life cycle and their relationships to habitat changes predicted by climate
    d. Support coordinated monitoring efforts that operate at multi-JV or flyway scales that explicitly test the relationships of waterfowl abundance and distribution over time (i.e., phenology) to direct changes in climate or indirect climate-induced changes to habitat conditions.
    e. Support a national database for long-term phenology and demographic data that all JVs/BCAs can use and contribute to.
    f. Provide guidance to individual JVs on how to incorporate climate change impacts into their waterfowl planning and design strategies.

Deliverables and Timelines

- Models linking regional-scale waterfowl annual life cycle events to changes in climate (both directly and indirectly through changes in habitat conditions). Spatially explicit outputs of these models that offer testable predictions of waterfowl population and habitat impacts at a regional (JV or BCR) scale will be provided.
- A Workshop will be held to communicate the needs of the NSST with non-traditional partners (e.g., Landscape Conservation Cooperatives, Climate Science Centers, Inventory and Monitoring Programs [National Park Service, National Wildlife Refuge System], National Phenology Network]) that have the skill sets to help incorporate climate change impacts into the planning and monitoring efforts of JVs for waterfowl. Identify mechanisms by which waterfowl populations and their habitats are likely to be affected by climate change.
- Focus on coordinated monitoring of priority waterfowl populations and their habitats with a primary focus on attributes potentially impacted by climate change (identified from models above). A Guidance Document will be developed to provide JV planners and their partners insight on how climate change considerations can influence their planning, design, and monitoring strategies for waterfowl. Specifically, this document will:
    a. Suggest alternatives for setting population and habitat abundance and distribution objectives in light of anticipated climate change impacts
    b. Elucidate key management "triggers", and how they can be used to increase the cost effectiveness of alternative management strategies
    c. Promote the use of standardized monitoring and assessment frameworks for coordinated evaluation across multiple JVs

Budget

See **Appendix A**

APPENDIX A – Task-Specific Budgets for NSST 2012 – 2016 Work Plan

Task 1. Develop methods for setting demographic population objectives (i.e., vital rates) at BCR/JV Scales for focal species based on recommendations of the NSST Alternative Performance Metrics Committee.

Work Plan Task Activity	Funding Source	Year 1	Year 2	Year 3	Year 4	Year 5
JV science workshop	Held/In-kind	$15,000				
	New	$5,000				
	Subtotal	$20,000				
Refinement of annual cycle models	Held/In-kind		$5,000			
	New					
	Subtotal					
Translate annual cycle models into regional sub-models	Held/In-kind			$5,000		
	New			$45,000		
	Subtotal					
Develop methods for using sub-models to establish regional objectives	Held/In-kind				$10,000	
	New				$90,000	
	Subtotal					
Case studies and model validations	Held/In-kind					$5,000
	New					$45,000
	Subtotal					
Software application for establishing regional demographic objectives	Held/In-kind					$2,000
	New					$5,000
	Subtotal					
	TOTAL HELD	$15,000	$5,000	$5,000	$10,000	$7,000
	TOTAL NEW	$5,000	$0	$45,000	$90,000	$50,000
	TOTAL	$20,000	$5,000	$50,000	$100,000	$57,000

Task 1a. Design and evaluate alternative monitoring programs to assess migratory bird distribution, movement and residency times during migration and winter seasons to support integrated habitat and population management frameworks.

Work Plan Task Activity	Funding Source	Year 1	Year 2	Year 3	Year 4	Year 5
Post-doc salary & benefits	Held/In-kind	$94,500	$94,500			
	New	$0	$0			
	Subtotal	$94,500	$94,500			
StakeholderWorkshops & Conferences	Held/In-kind	$3,000	$8,000			
	New	$0	$0			
	Subtotal	$3,000	$8,000			
Publications	Held/In-kind	$0	$2,000			
	New	$0	$0			
	Subtotal	$0	$2,000			
Indirect costs (15%)	Held/In-kind	$14,625	$17,175			
	New	$0	$0			
	Subtotal	$14,625	$17,175			
	TOTAL HELD	$112,125	$121,675			
	TOTAL NEW	$0	$0			
	TOTAL	$112,125	$121,675			

Task 2. Develop approaches for generating regional waterfowl habitat conservation objectives that account for spatio-temporal variation in environmental and habitat conditions.

Work Plan Task Activity	Funding Source	Year 1	Year 2	Year 3	Year 4	Year 5
Conceptual model	Held/In-kind	$4,000				
	New	$5,000				
	Subtotal	$9,000				
Develop emperical model	Held/In-kind	$2,000				
	New	$45,000				
	Subtotal	$47,000				
Develop conservation planning model	Held/In-kind	$4,000	$6,000			
	New	$22,500	$67,500			
	Subtotal	$16,500	$73,500			
Develop summary white paper	Held/In-kind			$15,000		
	New					
	Subtotal			$15,000		
	TOTAL HELD	$10,000	$6,000	$15,000		
	TOTAL NEW	$72,500	$67,500	$0		
	TOTAL	$82,500	$73,500	$15,000		

Task 3. Develop methods to aggregate regional-scale (i.e., JV/BCR) estimates of K into an assessment of net progress toward NAWMP continental goals.

Work Plan Task Activity	Funding Source	Year 1	Year 2	Year 3	Year 4	Year 5
American black duck model (ongoing)	Held/In-kind		$70,000	$70,000		
	New		$50,000	$50,000		
	Subtotal		$120,000	$120,000		
Northern pintail model (ongoing)	Held/In-kind		$120,000	$80,000	$35,000	
	New		$0	$40,000	$25,000	
	Subtotal		$120,000	$120,000	$60,000	
Scaup model (ongoing)	Held/In-kind		$53,000	$70,000	$70,000	
	New		$30,000	$50,000	$50,000	
	Subtotal		$83,000	$120,000	$120,000	
Multi-species modeling	Held/In-kind				$70,000	$70,000
	New				$50,000	$50,000
	Subtotal				$120,000	$120,000
	TOTAL HELD	$0	$243,000	$220,000	$175,000	$70,000
	TOTAL NEW	$0	$80,000	$140,000	$125,000	$50,000
	TOTAL	$0	$323,000	$360,000	$300,000	$120,000

Task 4. Establish comparable approaches to estimating *K* in the main breeding areas of North America.						
Work Plan Task Activity	Funding Source	Year 1	Year 2	Year 3	Year 4	Year 5
Examine existing approaches and prioritize regions. Identify focal species.	Held/In-kind	$0				
	New	$0				
	Subtotal	$0				
Develop consistent approach to model data for multiple regions and species	Held/In-kind	$100,000	$60,000			
	New	$120,000				
	Subtotal	$100,000	$180,000			
	TOTAL HELD	$100,000	$60,000			
	TOTAL NEW	$120,000	$0			
	TOTAL	$220,000	$60,000			

Task 5. Evaluate the extent to which Daily Ration Models and alternative model frameworks reliably reflect functional carrying capacity of habitats and landscapes for migrating and wintering waterfowl.

Work Plan Task Activity	Funding Source	Year 1	Year 2	Year 3	Year 4	Year 5
Symposium / Workshop	Held/In-kind	$3,000	$3,000			
	New	$0	$10,000			
	Subtotal	$0	$13,000			
Develop symposium proceedings or workshop summary	Held/In-kind		$6,000	$6,000		
	New					
	Subtotal					
	TOTAL HELD	$3,000	$9,000	$6,000		
	TOTAL NEW	$0	$10,000	$0		
	TOTAL	$3,000	$19,000	$6,000		

Task 6. Develop migration models parameterized for focal species, groups of species, and migration corridors to support regional habitat conservation decision-making.

Work Plan Task Activity	Funding Source	Year 1	Year 2	Year 3	Year 4	Year 5
Complete current prototype & narrative	Held/In-kind	$17,000				
	New	$0				
	Subtotal	$17,000				
Develop migration modeling team	Held/In-kind	$8,800	$8,800	$8,800		
	New	$0	$0	$0		
	Subtotal	$8,800	$8,800	$8,800		
Test prototype with existing spatial data	Held/In-kind		$0	$0		
	New		$20,000	$20,000		
	Subtotal		$20,000	$20,000		
Develop spatial data for covariates	Held/In-kind		$0	$0		
	New		$20,000	$20,000		
	Subtotal		$20,000	$20,000		
Workshop(s) to coordinate JV-scale runs Conduct JV-scale model runs	Held/In-kind		$0	$0		
	New		$40,000	$40,000		
	Subtotal		$40,000	$40,000		
Work group to validate model estimates and propose model refinements	Held/In-kind			$0		
	New			$20,000		
	Subtotal			$20,000		
	TOTAL HELD	$25,800	$8,800	$8,800		
	TOTAL NEW	$0	$80,000	$100,000		
	TOTAL	$25,800	$88,800	$108,800		

Task 7. Identify non-breeding habitat needs and develop inputs to habitat models for priority sea duck and diving duck populations.						
Work Plan Task Activity	Funding Source	Year 1	Year 2	Year 3	Year 4	Year 5
Organize and host workshop	Held/In-kind	$14,000				
	New	$3,000				
	Subtotal	$17,000				
Develop workshop summary	Held/In-kind		$10,000			
	New		$0			
	Subtotal		$10,000			
Contract or post-Doc to develop and implement work plan strategy	Held/In-kind		$5,000	$5,000	$5,000	
	New		$46,000	$50,000	$21,000	
	Subtotal		$51,000	$55,000	$26,000	
Final report identifying critical gaps and recommendations for cons. planning	Held/In-kind				$4,000	$10,000
	New				$25,000	$0
	Subtotal				$29,000	$10,000
	TOTAL HELD	$14,000	$15,000	$5,000	$9,000	$10,000
	TOTAL NEW	$3,000	$46,000	$50,000	$46,000	$0
	TOTAL	$17,000	$61,000	$55,000	$55,000	$10,000

Task 8. Estimation of migratory waterfowl residency times and factors affecting them.

Work Plan Task Activity	Funding Source	Year 1	Year 2	Year 3	Year 4	Year 5
Develop "State of Science" report; possibly to include 1-2 day workshop	Held/In-kind	$5,000	$10,000	$5,000		
	New	$0	$10,000	$0		
	Subtotal	$5,000	$20,000	$5,000		
	TOTAL HELD	$5,000	$10,000	$5,000		
	TOTAL NEW	$0	$10,000	$0'		
	TOTAL	$5,000	$20,000	$5,000		

Task 9.2. Update and complete digital spatial wetland data for areas of the US and Canada of high importance to waterfowl.

Work Plan Task Activity	Funding Source	Year 1	Year 2	Year 3	Year 4	Year 5'
Review priority areas for remapping in US and Canada	Held/In-kind	*	*	*	*	*
	New	$0	$0	$0	$0	$0
	Subtotal					
Procure Mexican wetland inventory digital data from DUMAC	Held/In-kind	*	*	*	*	*
	New	$0	$0	$0	$0	$0
	Subtotal					
Workshop on current applications of digital wetlands data	Held/In-kind	*	*	*	*	*
	New	$0	$0	$0	$0	$0
	Subtotal					
	TOTAL HELD	$4,000	$4,000	$4,000	$4,000	$4,000
	TOTAL NEW	$0	$0	$0	$0	$0'
	TOTAL	$4,000	$4,000	$4,000	$4,000	$4,000

* In-kind contributions for NSST members' time estiamted at $4,000/year for all tasks combined, and is shown only in TOTAL HELD.

Task 10. Integrate down-scaled climate change predictions into BCR/JV scale population-habitat models to estimate likely impacts on waterfowl populations and inform development of adaptation strategies for waterfowl habitat conservation.

Work Plan Task Activity	Funding Source	Year 1	Year 2	Year 3	Year 4	Year 5
Vulnerability assessments	Held/In-kind	$15,000				
	New	$13,500				
	Subtotal	$28,500				
Assess relevance of climate change to key landscape attributes	Held/In-kind	$10,000				
	New	$31,500				
	Subtotal	$41,500				
Support development of models linking demographics to habitat changes	Held/In-kind		$10,000			
	New		$31,500			
	Subtotal		$41,500			
Support efforts for monitoring changes in waterfowl distribution and abundance	Held/In-kind			$15,000		
	New			$75,000		
	Subtotal			$90,000		
Guidance to JVs on incorporating climate change into models and planning	Held/In-kind		$15,000	$15,000	$15,000	$15,000
	New		$0	$0	$0	$0
	Subtotal		$15,000	$15,000	$15,000	$15,000
	TOTAL HELD	$25,000	$25,000	$30,000	$15,000	$15,000
	TOTAL NEW	$45,000	$31,500	$75,000	$0	$0
	TOTAL	$70,000	$56,500	$105,000	$15,000	$15,000

APPENDIX B – Proposed Timeline for Completion of Tasks

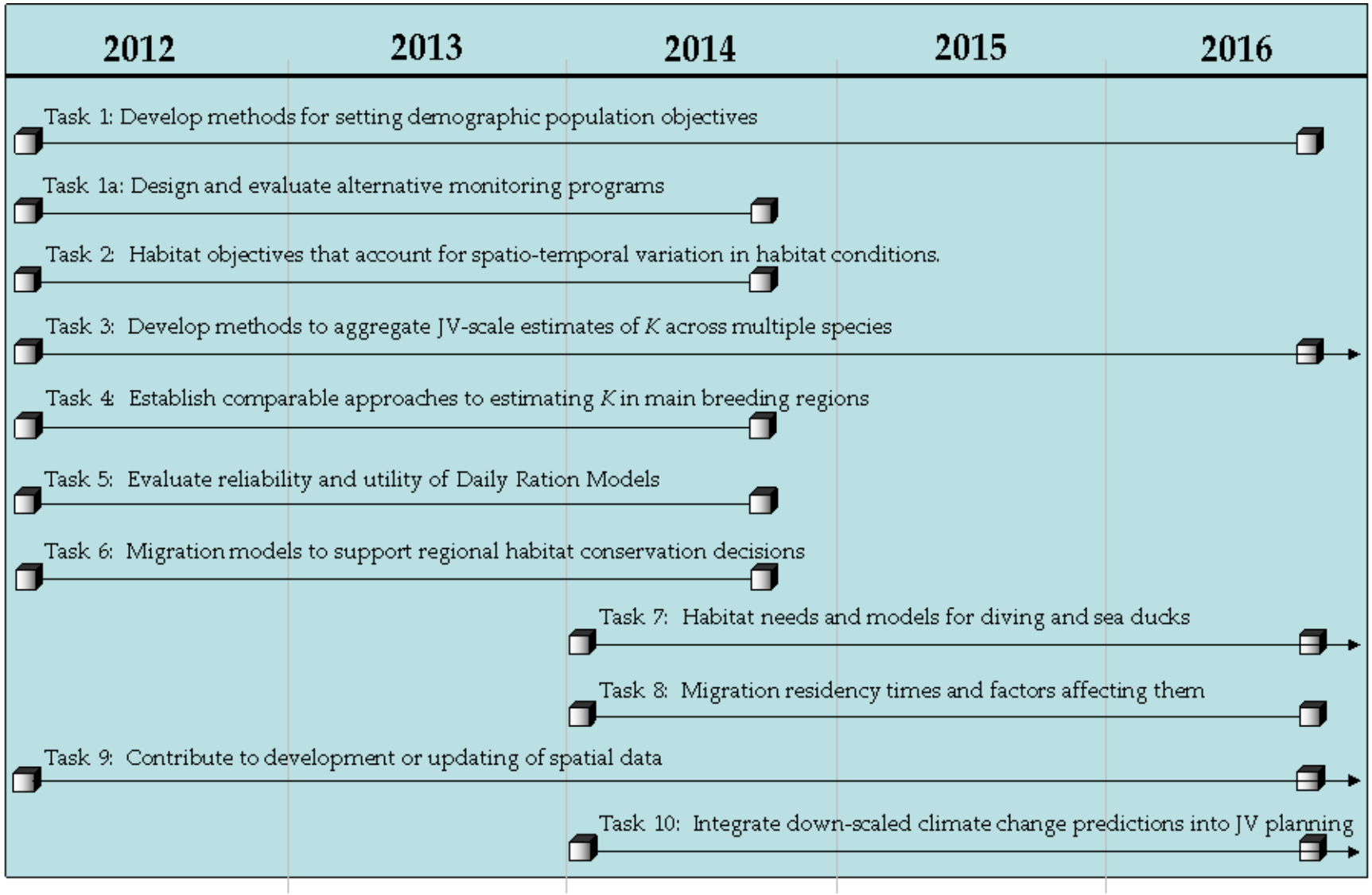

Figure 1. Proposed timeline for initiating and completing tasks of the NSST 2012-2016 Work Plan. Arrows at right of figure indicate work on given task is expected to continue beyond the period of planning for this Work Plan (2016)