NSST Demographic Objectives Workshop

June 14-15, 2011

Omni Hotel, Corpus Christi, TX

Workshop Notes

Tuesday, June 14

NSST Demographics Workshop attendance	
NAME	**ORGANIZATION**
Jorge L. Coppen	USFWS - NAWMP
Tim Jones	ACJV
Rex Johnson	USFWS – R3 HAPET
Mike Brasher	DU- GCJV
Todd Jones-Farrand	CHJV
Luke Naylor	AR GFC
Stuart Slattery	DUC - PHJV
Kevin Doherty	PPJV
Carol Beardmore	SJV
Christina Sloop	SFBJV
Bob Clark	EC – Science Branch
Steve Cordts	MN DNR – MF Rep.
Anne Bartuszevige	PLJV
Dave Howerter	PHJV - DUC
Greg Soulliere	UMRGL JV
Mark Petrie	PCJV, CVJV & IWJV (Remotely)
Other Attendees	
Dave Gordon	USFWS - DBHC
Steve Brock	LMVJV
John Eadie	UC-Davis
Steve DeMaso	GCJV

Introduction: (Anne B.)

Reporting $ and acres is no longer sufficient to assess progress. Need to be more sophisticated in addressing accountability.

The 2007 NAWMP Continental Assessment stated: "*To move forward, every JV should develop explicit, biologically-based planning model(s) that predict how on-the-ground habitat actions will affect vital rates or population responses. Such an approach would, minimally, oblige JVs to articulate key assumptions or uncertainties, develop appropriate evaluation plans and provide a basis for further refinement of planning models*."

Joint Task Group Report stated: "*We urge that the waterfowl community focus more scientific efforts on reducing the key ecological uncertainties surrounding current models of population* *dynamics (e.g., density dependence) and the relationships between waterfowl vital rates, carrying capacity (K), and landscape properties that habitat managers strive to manipulate. Researchers should strive to create shared monitoring and assessment programs that help inform both harvest and habitat management decisions."*

NSST Alternative Metrics Workshop (2008) provided 6 recommendations:

1. JVs should frame their accomplishments in terms of changes in demographic parameters (i.e., season specific vital rates). The vital rate discussed most for the breeding period was recruitment and for the non-breeding period (migration and winter) was survival. They were both reviewed in the context of population sustainability and how individual JVs contribute to continental carrying capacity. Framing accomplishments in terms of vital rates creates a common currency across all JVs and enables roll up from the regional to the continental scale.

2. All JVs should adopt the annual life cycle model (Fig. 1) as the basis of their monitoring program. This framework explicitly links ecologically similar JVs (i.e., breeding JVs or wintering JVs) and links JVs temporally throughout the year.

3. Individual JVs should develop conceptual models or use previously developed empirical models to relate how habitat management actions influence vital rate(s). These models and contrasting hypotheses will inform the "what" and "how" of the monitoring program. For example, during the winter JVs may be able to impact survival directly or productivity indirectly through a "cross seasonal effect." If the JV hypothesizes winter survival (within that region) has a greater impact (relative to the cross seasonal effect) on continental population growth they would develop a monitoring program to track the influence of their management actions on winter survival. For example, if the JV hypothesized that winter survival is limited by food availability through some functional relationship (Fig. 2), then the JV would develop a protocol to monitor changes in food availability. The resulting monitoring data would serve as model input to estimate 1) impact of management on food abundance, and 2) winter survival. The resulting estimates then provide information on local impacts of JV actions and can be rolled up across JVs to estimate cumulative impacts on waterfowl population dynamics and carrying capacity at the continental scale.

4. At the JV scale this framework should be used to complement traditional metrics including number of acres protected, enhanced, or restored, dollars spent, and dollars leveraged.

5. At the continental scale, this framework will complement the current metric of comparing continental population size to the population goal.

6. In the long-term, JVs should incorporate the influence of both their management actions and population size (Fig. 3) on vital rates. This next step will allow managers and researchers to understand the impact of density-dependence on management actions and vital rates.

Winter Waterfowl Work Group concluded that:

Explore considerations for assessing survival rates related to habitat on wintering grounds

- Data needs
- Assumptions
- Cost estimates

Conclusions –

- Need to meet goals of NAWMP and AHM

- Need to use a common metric across JVs
- Assumptions regarding survival estimate
- Efforts will be spendy!

The NSST 5-year Work Plan calls upon us to develop approaches for establishing regional-scale, quantitative objectives for demographic rates of focal waterfowl species.

This workshop should lead to formulation of specific recommendations for improving existing efforts and provide springboard for subsequent work of this committee.

Key Outcomes:

- Feedback to JVs on presentations
- Leave with new ideas on how to move forward with planning in your JV
- New set of resources to draw on other JVs with similar challenges
- Commitment to developing demographic objectives in the next 5 years
    - Clear map on how to get there

Gulf Coast JV:

Availability of foraging habitat is the primary limiting factor for wintering waterfowl.

Bioenergetic model (Daily Ration Model) links habitat objectives to popln objectives.

$$HabObj_{CM} = \left(\sum_{i=1}^{m} \sum_{j=1}^{n} \left(\left(N_{ij} * \frac{mass_i}{mass_{MALL}} \right) * days_j * prop\_use_{CM\,i} \right) * 330kcal \right) * \left(kcal \cdot ac^{-1} \right)^{-1}$$

$$habitat\ objective\,(acres) = \frac{energy\ demand\ (kcal)}{per\ acre\ energy\ avail.(kcal)}$$

Semi-monthly popln targets are established (early & late planning periods)

Calculate cumulative energy demand value for waterfowl popln targets.

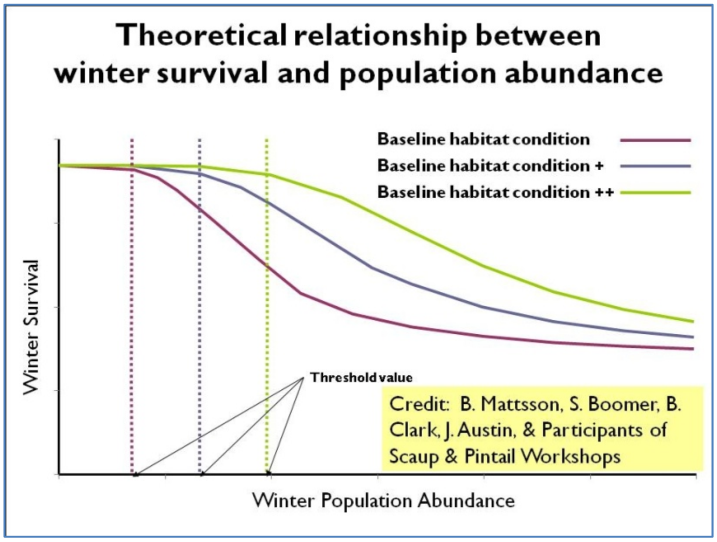
Priority habitat types of GCJV:
- Forested wetlands
- Coastal marsh
- Seagrass beds
- Rice

Energy demands by habitat types are estimated.

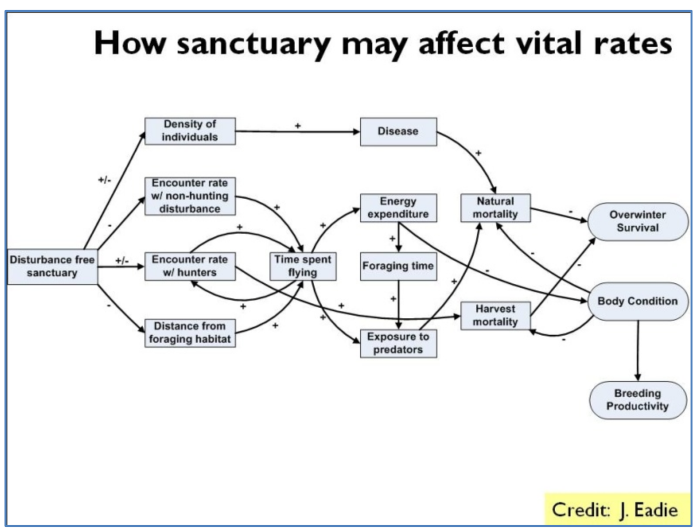
Linkages between habitat conservation & demographic rates with metrics for:
- Seasonal survival
- Body condition trends

GCJV supports efforts to develop methods for establishing demographic objectives, but note several obstacles.

Theoretical relationship between winter survival and popln abundance. Improvements to habitat moves threshold value out to where the decreasing rate of survival begins a decline (density dependent component occurs).



Sanctuary may have a positive influence vital rates changes given evidence that disturbance limits availability of foraging habitats to waterfowl.



GCJV inter-JV collaboration and support for various efforts relevant to demographic objectives

- Wintering Waterfowl Workshop
- Scaup Conservation Plan
- Pintail Annual Cycle Model
- Inter-JV science collaborations

Local habitat conservation actions have minimal incremental impact to continental population growth but in theory there is a link (measurement & scale issue).

No single most abundant species across GCJV Initiative Areas (multiple species approach?).

Inability to ID regionally meaningful & continentally appropriate quantitative objective for demographic rates

Numerous logistical challenges to collecting data for articulating baseline relationships.

Do benefits outweigh costs?

Post-presentation Discussion:

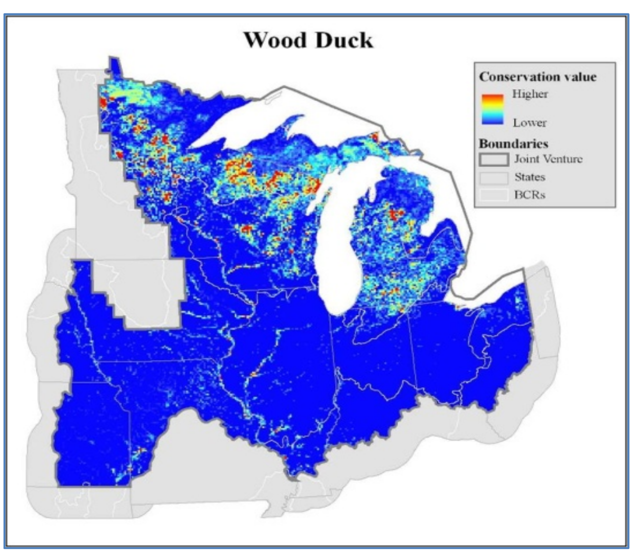
- Key issue is ascertaining how habitat mgmt. changes the slope of the curves of relationship between winter survival & popln abundance.
- Distinguishing between the influence of habitat quality & habitat quantity is "tricky."
- Travel time to & from foraging patches may influence this.
- Was foraging habitat limiting 15 years ago? We have not assessed that. Whether foraging habitat quantity or quality is currently limiting likely varies by region and temporally
- Assessing the "movement" between curves on the graph will be the true challenge.

Upper Mississippi River and Great Lakes Region JV:

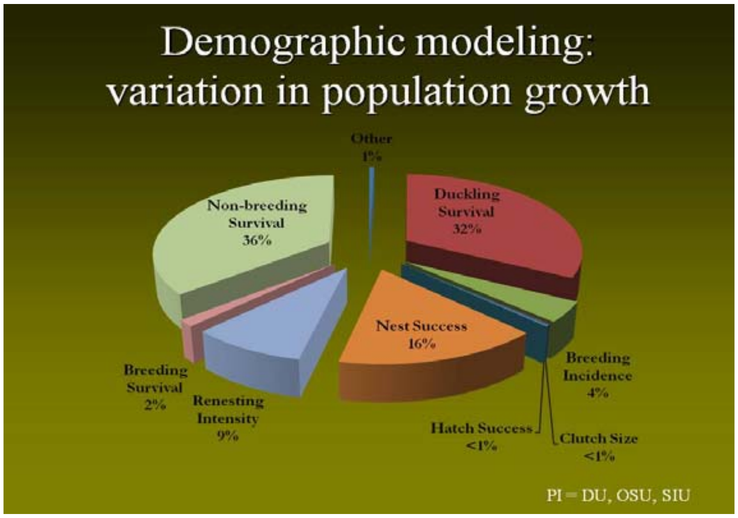
Population surveys (area is outside TSA) revealed the region has had higher waterfowl numbers in recent years than in the 1970s and JV population objectives for priority waterfowl species were tied to years 1997-2007.

Focal species and simple species-habitat models were used to general breeding habitat objectives, and species guilds and an energetic model were used for setting habitat objectives for the non-breeding period. Habitat objectives included both maintenance (current populations) and restoration (to eliminate population deficits).

Relative distribution and abundance maps for focal spp. were developed with population survey data and landscape suitability index models. These Decision Support Tools provide a means to target conservation delivery.



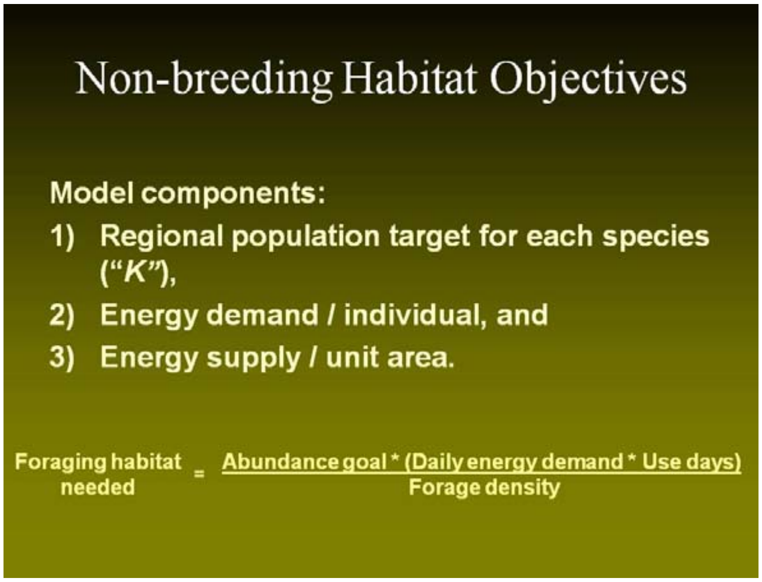
Great Lakes MALL Study coordinated by DU with several partners including the JV is best example of improving our understanding of a species vital rates.
Variation in MALL population growth most related to brood survival (32%), non-breeding season survival (36%) and nest success (16%).



Population assessment was also completed for the non-breeding period – distribution & abundance of birds established for fall migration (county level harvest data) and winter (MWI).

- Applied a bioenergetics model
- Identified uncertainties, planning assumptions, & evaluation (research & monitoring) needs
- Maintenance/protection goals established
- Restoration /enhancement to reduce habitat deficits

Diving duck (open water guild) example ensued… Use-day goals (K) established

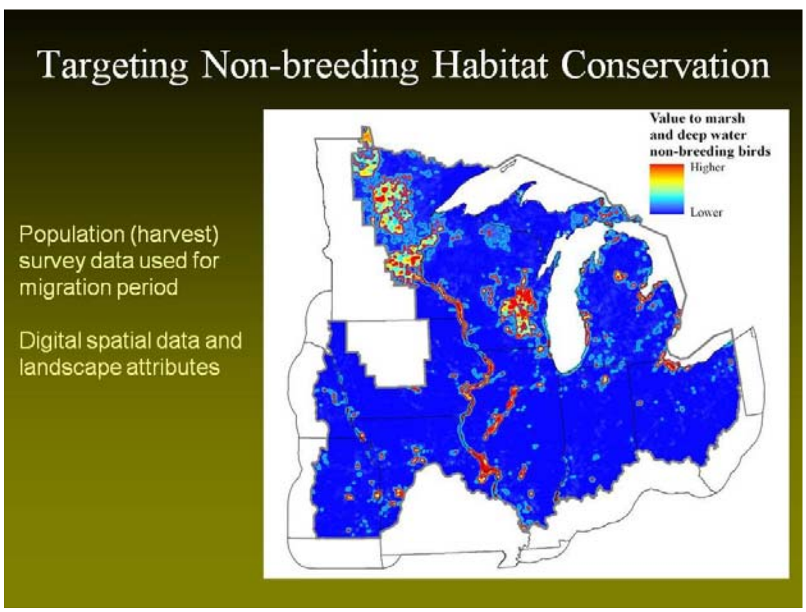


	Use days		
Species	Spring	Winter	Total
Canvasback	7,443,585	11,702,970	19,146,555
Redhead	12,849,990	7,121,070	19,971,060
Greater Scaup	14,301,019	3,996,135	18,297,154
Lesser Scaup	60,578,203	23,400,009	83,978,212
Total	95,172,797	46,220,184	141,392,981

A key model component was forage density or energy supply / unit area, and we found limited information to estimate energy available to divers in open water habitats during the non-breeding period.

Giving-up density estimates (thresholds where birds stop foraging due to lack of food) were lacking so established a rule of thumb of a giving-up at 50% of energy available.

Similar to the breeding period, abundance and distribution data coupled with digital spatial data and guild-specific landscape attributes were used to generate decision-support maps to target habitat maintenance and restoration.



Recent projects have been completed or are ongoing to help establish energy values for spring migrating waterfowl in the UMRGL JV region for 3 divers & 3 dabblers, plus giving up density threshold for dabblers.

Recruitment and survival are both important to UMRGL JV planning, and JV science partners have identified planning assumptions and evaluation needs to improve the next JV plan iteration. In summary, the recently completed (2007) implementation plan was:

- Challenging to develop due to sparse population and ecological information, especially for the non-breeding period.
- A means to develop a process for habitat objective-setting and identify testable assumptions and evaluation needs.
- A catalyst for completing identified plan-refinement needs currently being addressed through research and monitoring projects.

Findings will be used to improve models and subsequent iterations of the JV Waterfowl Strategy.

Post-presentation discussion:

- Would *Lambda* (λ) be a more reasonable metric to combine these (sub-annual metric). How are you defining the popln? If it represents a local breeding popln, yes perhaps you can. But birds from elsewhere may need a separate metric.

- Life stage models for an annual cycle represent conceptually where we need to go to incorporate cross-seasonal effects.

Playa Lakes JV:

Area Implemntation Plans

- BCR/State Plans
- HABS database
- Signed by each state
- Used in funding decisions

Waterfowl plan completed 2005

Population objectives established using Koneff method
Key limiting factors were foraging & roosting habitat

Bioenergetic modeling approach (calculated DUD equivalents)

Determine important habitats for foraging & roosting (assume no spatial relationship between upland & wetland habitats)

Energetic K of each habitat derived from lit. (ECC = DUDE/ac.)

Estimate carrying capacity

- Multiply ECC * amount of habitat
- Sum over all habitats

Relate to NAWMP objectives

- Estimated carrying capacity / total DUDEs
- In other words…

    - Amount of food energy available compared to amount needed to support NAWMP objectives

HABS:

- All data is in relational database (Habs)
- Can relate habitat actions to estimated K
- Not spatially explicit
- Assumes all wetlands & uplands are created equal

Post-presentation discussion:

- Does PLJV track variation in wetland condition given that estimating K is "static?" PLJV limited in information to estimate changing wetland conditions of playas.
- Roosting habitat issue was punted on by PLJV given lack of guidance at continental level (NSST).
- Each state & BCR in JV is treated separately, so no calculation for total estimate
- Seems to be a pervasive strategy that JVs "need more research" rather than making bold assumptions and then following up with testing those assumptions.
- We don't have the luxury of another 20 years of research to get there

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Central Hardwoods JV:

Focal Areas:

- Forest
- Grassland
- wetland

From 2007 NAWMP Assessment – low priority status for waterfowl

Yet, considerable amt. of waterfowl mgmt. in the BCR

If waterfowl energetic models were to be used, use parameters from neighboring JVs

CHJV Wetland Working Group

- waterfowl
- shorebird
- waterbirds
- landbirds

Existing overlap with LMVJV, UMR&GLRJV, EGCPJV
Overlap with LCC? (yet unknown)

Bioenergetic modeling approach (TRUMET) is planned for CHJV, but also hope for developing demographic modeling methods as well

Alternative metrics - Risk surface approach (S & D)

Data sources (popln) include:

- MWI survey data
- Other partner survey
- Harvest data
- Radar

Data sources (Energy) include:
- Other JV models
- Conservation estate assessment
- GIS (NWI issues – e.g., AR not included)

Modeling Assumptions :
- Food is limiting
- Winter is key period (110 days, 15% mortality)

Improvements:
- Availability & allocation (LMVJV approach)
- Spatio-temporal dynamics
- Scenarios (mgmt. changes, restoration opportunities and threats)

Post-presentation discussion:

Substantial portions of waterfowl populations for some spp. winter in CHJV in certain years (e.g., when overbank flooding of Ohio & Wabash Rivers occurs)

This JV represents a test case, under NAWMP, for two JVs to develop integrated models (LMVJV and CHJV) where CHJV becomes a subset of the LMVJV decision matrix.

Prairie Pothole JV:

Wetland & grassland conservation paradigm. Goals are in acres. PPJV sets the table for when conditions are good.

Wetness variation drives the system and impacts nest success. Driven by abundance of wetland basins and current and <u>past primary productivity</u> and wetland conditions.

Wet/dry cycles are very pronounced.

Fundamental data layers :
- NWI wetland surveys
- 4mi^2 survey
- Brood surveys

Thunderstorm maps used as the primary Decision Support Tools for conservation delivery PPJV recently expanded to include prairies of MT.

Thunderstorm map methods reviewed :

20 regression models fit:

- 5 species dabblers x 4 wetland basin types

Variables:

- Wet Area &
- Spatial Trend Surface Variables UTM X & Y
- Recent update in MT included some other habitat measures

Reynolds et al 2001 (JWM) Spatial gradient in Daily Survival Rate and nest success known but not incorporated into conservation.

It's not how much water occurs but where the water is that is key.

Unlikely to meet grasslands goals. Grassland conservation declining given existing conservation tools (approaches graph showing Cons 0.5 avg.).

Recruitment estimates $4mi^2$:

- Recruits = 2Rn
- Where R = HZB/2
- Where H = Hen success

Mathematical model very reasonable, but the estimate of recruitment depends more on model form than observation.

Parameter estiamtes have limited data and in some cases prior to CRP, mange in Red Fox, & primarily based upon Mallards

Recruitment: Currently at occupancy

- Abundance may be possible
- If not would require extensive brood work to generate more robust β estimates

Repeat visit brood surveys might be used to…

- Evaluate reproductive success?
- Understand habitat relationships?
- Develop spatially explicit decision support tools?

Summary :

Primary program is protection of wetland & grasslands habitat (SHC + thunderstorm maps)

Sonoran JV:

- 15% of continental waterfowl winter in the west coast of Mexico
- JV supports 1/3 of wintering waterfowl in Mexico.
- 80% of Pacific Brant winter on the coasts of NW Mexico
- 70% of Pacific Flyway wintering Redheads
- 25% of the Pacific Flyway wintering Surf Scoters
- 50% of the Ruddy Ducks winter at the Salton Sea

14 of 28 Mexican priority wetlands are in the SJV

Abundance-based popln objective for winter

- Don’t have winter waterfowl use days
- Don’t have monthly waterfowl surveys
- Do have MWI surveys (US & Mexico) Both 70s & 90s objectives were provided
- With some modification we have adopted the Koneff (unpublished) objectives
- County-level objectives aggregated to SJV boundaries
- Objectives for Mexico given only for entire country so % of spp. range in SJV was calculated using Nature Serve maps
- Added Mexican duck – of interest/concern to Mexican partners

Total winter objectives:

- Total US wintering ducks = ~1, 000,000
- Total Mexico wintering ducks = ~1,000,000
- Combined SJV objective for geese is 230,000
- Mid-winter counts are a true reflection of waterfowl distribution and numbers

Model improvement requires:

- Migration chronology and abundances
- Winter survival rates
- Estimate the distribution and rate of harvest in Mexico
- Assess threats in Mexico
- Continue winter counts in US and Mexico and increase coverage
- Determine carrying capacity of primary wintering sites

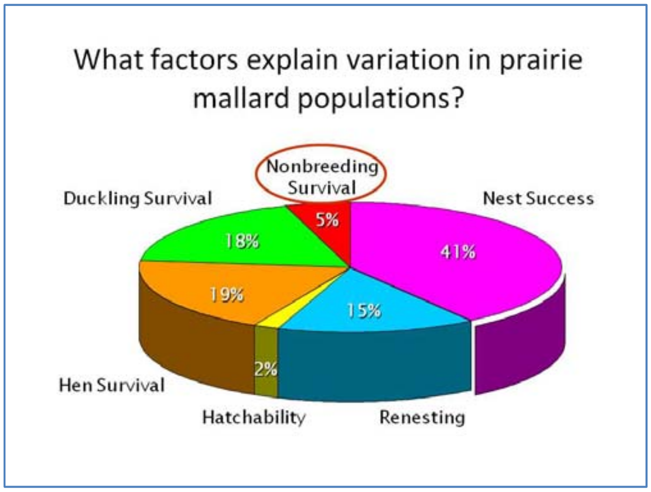
Post-presentation discussion:

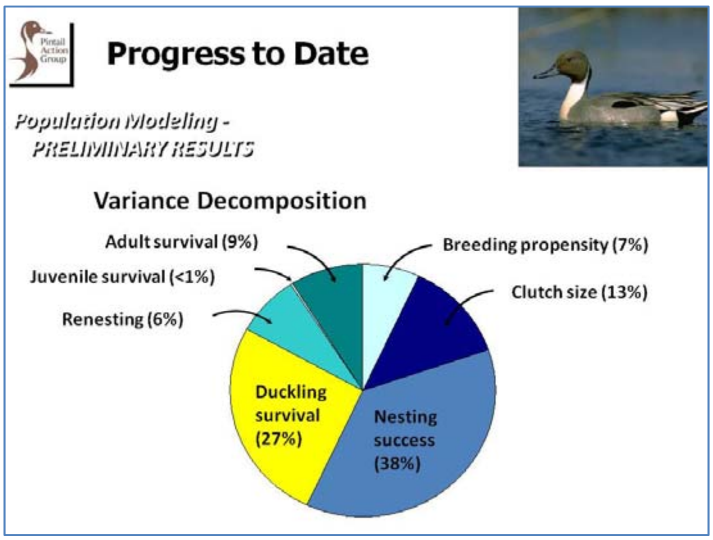
Seems there is a “mental model” representing the importance of Mexican wetlands conservation (plus Salton Sea) for the SJV. The potential for Mexican collaborations to achieve conservation results seems encouraging.

Pacific Coast, Intermountain West & Central Valley JVs:

Habitat objectives for migrating & wintering waterfowl poplns at NAWMP goals – These are at variable stages of development with some hotspots of emphasis.

Nonbreeding survival rates are non-limiting for focal spp. of waterfowl (and likely other spp.)





- Prevent "Non-Breeding Survival" from becoming a limiting vital rate.
- Primary biological requirement of non-breeding waterfowl is food.
- Provide adequate foraging habitat to meet waterfowl needs at NAWMP goals
- Develop species-habitat models that translate population objectives into foraging habitat objectives
- Little emphasis to relate JV accomplishments to changes in vital rates
- More emphasis on testing assumptions associated with species-habitat models, and the data used to populate these models

Linking vital rate objectives to habitat changes - Does quantifying foraging habitat needs do this?

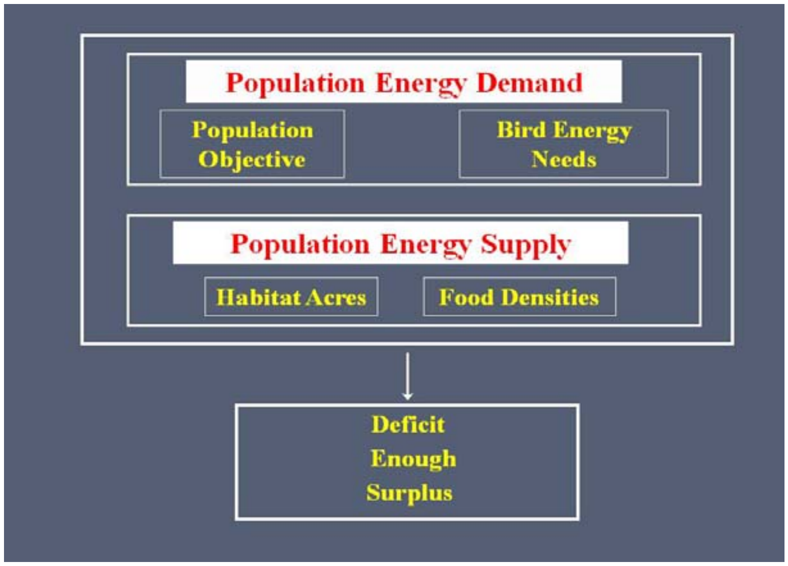
1) Establish a non-breeding survival rate objective as input to modeling to establish habitat conditions to achieve targets
2) Non-breeding survival established, with assumptions that adequate foraging habitat will achieve an adequate non-breeding survival rate. Food energy based *K* models used in this case.

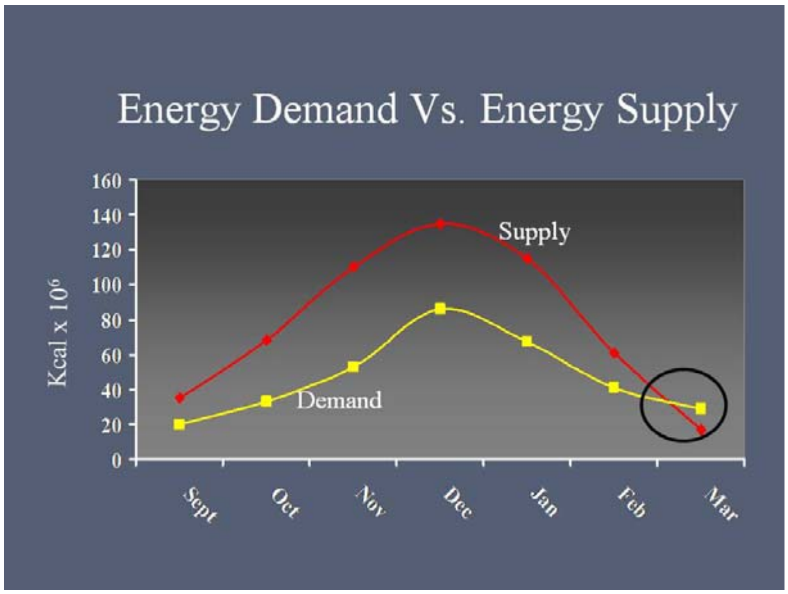
Daily Ration Model (TRUMET) Assumptions:

- Individuals are identical and equal. They respond to changes in food supply in a similar manner and are equally efficient in obtaining food.
- No spatial dimension. Foraging "patches" are assumed to be equally accessible regardless of their location.
- No travel costs for movement among patches.

Popln energy demand vs. Popln energy supply

This biological premise is typically incorporated into the biological planning process using an energy based model that calculates both energy demand and energy supply





For the current model, efforts to improve the data fall into one of four basic areas (habitat, habitat type foraging value, bird energy needs, and population objectives). All are important components of the current modeling process and failure to generate reasonably accurate estimates for any of these boxes can lead to bias in estimating K. As the models currently being used are accounting models, the risk of failing to accurately estimate each of these parameters is easy to understand and potentially serious.

Determines if deficit – enough – surplus exists

Habitat availability calculations for estimates by type, amount & seasonal availability

- Model deals with seasonal changes in availability (i.e., Seasonal wetland flooding).
- Literature values used for foraging value by habitat, and energy need per individual.

- Model can adjust for non-waterbird effects such as decomposition of foods (seasonal effects).

Conservation objectives for CVJV established via TRUMET. Estimates also calculated at smaller scales (Lower Klamath & Tule Lake)

Puget Sound supply 7 demand graphs (examples given)

Future Improvements:

- Better estimates for food availability
- Establish popln objectives with strong link to NAWMP
- New model version is stochastic & allows greater user flexibility
- Adding a watershed subroutines to address water issues in west

Post-presentation discussion:

Have not established a non-breeding vital rate given non-breeding survival is not considered limiting.

Food-energy based approach of TRUMET does not prevent user from imposing some external constraints (ie, meeting some needs such as molting energy needs).

Considered forage depletion as a causal factor for changes in the path of migration? Need fall & spring migration objectives that reflect those phenomena. User has to reflect those differences as a supplement to the model (e.g., NOPI in the PF is an example).

R. Johnson recommended ignoring survival rate in non-breeding periods as portion of the annual cycle model and instead to impose Human Dimension objectives for duck use in fall

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San Francisco Bay JV:

- One of the most important wintering and staging areas for benthic foraging ducks in Pacific Flyway
- Most abundant species include greater and lesser scaup, surf scoters
- SFB supports over 40% of scaup and scoters counted in the Pacific flyway during annual FWS midwinter surveys
- An important estuary for canvasback, but numbers have declined in SFB in recent years

Current SFBJV Objectives:

- "Provide enough high quality open bay (subtidal), intertidal, and pond habitat throughout the JV region to consistently support wintering populations of **key Bay waterfowl species** (Diving ducks: *Canvasback, Scaup (Greater and Lesser), and Surf Scoters*) at recent peak population levels"
- Levels obtained from the annual FWS midwinter aerial counts along transects flown generally over open water
  - *Canvasback* – highest count 29,818 in 1990
  - *Surf Scoter* – highest count in SFB 61,248 in 1990
  - *Greater & Lesser Scaup* – highest count in SFB 139,214 in 1990

Diving ducks:

- Habitat Goals for these species do not yet specifically outline subtidal habitat types utilized by diving ducks
- Current Habitat Goals do not specifically outline subtidal habitat types utilized by diving ducks & do not yet link them geographically to high value or high use areas

To better estimate K of San Francisco Bay habitats for diving duck species, science partners investigated and modeled the foraging energetics of diving benthivores on San Pablo Bay Shoals - Simulation model of energy balance to estimate BUDs supportable by food base in northern reach of estuary (San Pablo Bay).

The model answers: "*Above what threshold food density can an individual bird of each species achieve a positive energy balance*?"

Initial modeling effort with intent to clarify:

- conceptual and analytical approaches
- data needed to estimate subtidal habitat required by current and future wintering populations of diving ducks

Model details:

- Utilizes *10 years of studies* in San Pablo Bay
    - monitoring data of marked diving ducks and subtidal foraging on benthic invertebrates between October and January
- Based on *adequate invertebrate surveys available* during 1990, 1993, 1999-2001
- Focuses on the *highest densities of all three bird species*
- Considers resource partitioning among bird species with the invasive clam *Corbula amurensis* as the dominant bivalve prey
- Excludes intertidal areas used by shorebirds

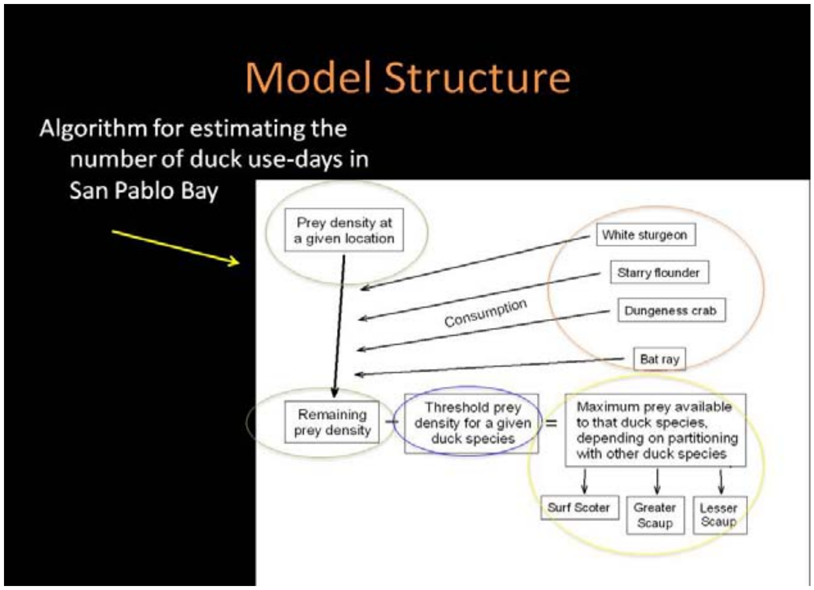
Model outcomes

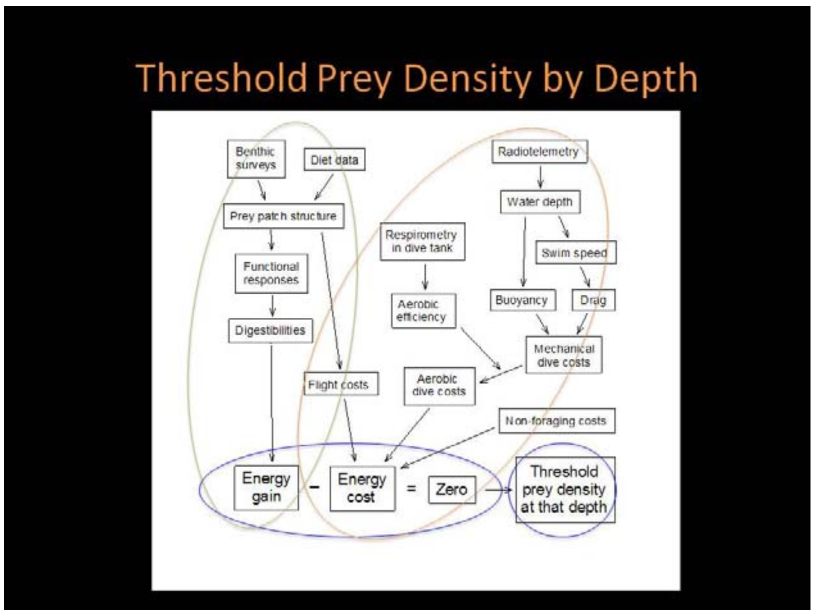
- Estimate threshold prey densities
- Estimated DUDs for San Pablo Bay

San Pablo bay chosen as study area since it had highest densities of waterfowl spp., plus there was data available.

For each species…..

- Rates of energy gain depend on:
  a) prey energy content and digestibility
  b) ingestion rates (functional responses) for different prey densities and sizes
  c) relative spatial coverage of prey
  Energy costs include:
    a) the immediate foraging costs
    b) prorated costs of all other activities (including aerial flight)





Model focuses on San Pablo Bay during Oct – Jan because:

- Highest densities of waterfowl in the estuary
- Adequate benthic surveys available during 1990, 93, and 99-01
- Waterfowl diet and movement data overlap
- Numbers of all species declines in Jan – suggesting carrying capacity is reached

Model assumptions:

- All three species eat the same size classes (>1mm) *of Corbula amurensis* (over-bite clam) in proportion to availability
- There is no partitioning of subtidal habitat by elevation among the three species
- The main competing ectotherm predators are white sturgeon, starry flounder, bat ray and dungeness crab

Also:

- Excluded intertidal areas (0 m elevation at MLLW and above) to avoid complication of competition with shorebirds

Data needed to improve model:

- Benthic prey availability and diet data from other sub-bays to expand the model to the entire estuary
- Institute standardized prey sampling program to allow for updated determination of duck use days
- More complete distribution and abundance data on competing ectotherm predators
- Baywide studies of all three scaup and scoter species during the same years to confirm overlap in space use and diet

Future questions:

- How will sea level rise and associated geomorphic changes influence habitats and *Corbula amurensis* prey densities?
- How will inclusion of data on other predators (i.e. fish data) affect current threshold projections?

Next steps:

- Integrate with models that estimate changes to benthic invertebrate populations in light of climate change (CASCaDE, Shoals)
- Check in with DFG about existing predator data (including size classes) to strengthen current model assumptions

SFBJV M&E Plan Objectives:

<u>Diving Duck Demographic Monitoring</u>

- Determine adult survival during winter in SF Bay and coastal region
- Carry out baseline demographic surveys (every 5 to 10 years) to monitor for changes in age ratios to determine the ratio of juveniles to adults using SF Bay and coastal areas

<u>Linking Population Trends and Habitat</u>

- Fund and institute long-term studies to help tease out temporal and geographic trends and understand how habitat influences adult survival during winter
- Link population parameters to causal factors (covariates that influence them: i.e. habitat extent, prey availability, contaminants, etc).

Collaborating with SDJV plus more collaboration opportunities.

Lower Mississippi Valley JV:

Reinecke & Loesch method (preceded Koneff method) used to set popln targets for MAV stepped down from continental scale.

- 6 step process
    - Identify species of concern and their continental goal
    - Calculate proportion of ducks in MAV states relative to the total number in the lower 48 states
    - Calculate proportion of ducks in MAV counties relative to the total number of ducks in MAV states
    - Calculate population goals
        - Dabblers &divers – joint probabilities

    - Calculate population goals
        - Wood ducks – 10% harvest assumed

Foraging habitat assumed as most limiting in winter

- Express species needs and habitat condition in a common currency
    - Duck Energy-Day (DED)
        - The amount of energy required to by a mallard-sized duck to conduct normal activities for a single day ≈ 1.5× BMR
        - 292 kcal d^{-1} $bird^{-1}$

Habitat objectives based on DEDs (2-step process)

- How much habitat is needed to provide sufficient DEDs to meet population objective?
    - 2 step process to determine sufficient DEDs
        - Increase population goals by 15% to account for winter mortality
            - 4,316,818 × 1.15 = 4,964,341 ducks
        - Multiply adjusted goal by 110 to account for the number of days ducks are present in the winter
            - 4,964,341 × 110 = 546,077,477 DEDs
    - Key questions
        - How many acres is that?
        - Do we have enough?

Landscape/habitat assessments:

- Reineceke et al. (1989)
    - Habitat types
        - Cropland
            - Harvested
            - Unharvested
        - Moist-soil
        - Bottomland hardwoods
    - Habitat sources
        - "Natural" flood
        - Public Managed
        - Private Managed
            - Managed-in-Program

Estimated total of 546M DUDs:

Assessment of conservation estate

- Quantity of habitat
  - Public manager questionnaire
  - Private land aerial survey
  - Remotely sensed natural floods

Decision Support Tools

- Allocation = Proportional distribution of DEDs among habitat sources

Assumption: Managed habitats are safety net to meet waterfowl requirements not met by natural flood

- Requires knowledge of available habitat
- Acres of each habitat (ac/habitat type)
- Quality of habitat type (DEDs/ac)

Spp.-Habitat model Assumptions

- Habitat use
  - Relationship to energy
  - Disturbance
  - Survival
- Food abundance
  - Gross energy
  - Giving-up density
  - Decomposition rates

Key Factor/Sensitivity Analyses:

- Questions about usefulness of LMVJV's planning model
  - DED = *f* (water, habitat)
    - Specifics on water
      - Frequency
      - Depth
      - Duration
    - Specifics on habitat
      - Quality (DED values)
      - Giving up density
  - Disturbance
  - Decomposition

Spatial Data Analyses:

- Questions about usefulness of existing datasets
  - Value of satellite imagery
  - Delineation of WMUs
    - Could we flood all acres?
  - Private lands
    - Managed-out-of-program

Restarting the Objective-setting Process

- Waterfowl Working Group

<u>Conclusions</u>

1. A transparent, defensible, and replicable allocation process is needed
2. Significant uncertainty exists in the ability of different habitat sources to provide DEDs

Natural Flood	**Private Managed**	**Public Managed**
Frequency	Reliability	Performance
Depth	State change	Sanctuary
Duration	Sanctuary	Habitat quality
Quality	Habitat quality	
Scale	Accountability	

Goal: develop an allocation process

- establish clear objectives for allocation process
- draft allocation philosophy
- refine estimate of DEDs for each habitat source
    - Develop conceptual model
    - Estimate parameters in conceptual model

The following functions were described in heavy detail:

$DED_{natural\ flooding}$ = *f* (extent, frequency, duration ~~depth~~ habitat)
$DED_{private}$ = *f* (status, extent, reliability, disturbance, habitat)
DED_{Public} = *f*(extent, performance, disturbance, habitat)

Stochastic spreadsheet model used to determine values for each habitat source achieved in 4 out of 5 years (i.e., 80%)

The Bottom Line

Table 26. DED values associated with individual habitat sources, 80th percentile, by state, relative to habitat objectives, Mississippi Alluvial Valley, 1999-2005.

		Private Managed		Public Managed				
State	Natural Flood	MIP	MOP	Federal	State	Total	Objective	Difference
AR	42,795,026	5,473,080	10,455,043	44,227,898	10,797,180	113,748,227	219,427,337	-105,679,110
KY	31,702	30,586	51,209	1,476,541	1,875,964	3,466,002	2,636,952	829,050
LA	4,900,242	1,531,127	2,648,664	16,678,118	11,369,473	37,127,624	120,913,290	-83,785,666
MS	8,492,570	3,326,230	1,813,914	31,415,330	14,119,419	59,167,463	72,637,077	-13,469,614
MO	2,468,185	892,799	1,125,380	6,881,687	39,925,257	51,293,308	18,025,015	33,268,293
TN	652,063	85,842	80,603	5,098,012	6,636,960	12,553,480	33,625,658	-21,072,178
Total	59,339,788	11,339,664	16,174,813	105,777,586	84,724,253	277,356,104	467,265,329	-189,909,225

End goal is how to allocate habitat objectives.

Allocation alternatives:

- Allocation proportional to current ratio of public lands to private lands after accounting for natural flooding
- Allocation to private lands proportional to difference in midcontinent MALL popln sizes (centroid) between liberal/moderate and restrictive seasons in AHM

Habitat inventory & monitoring:

- Regular surveys-
    - Water Mgmt.Units
        - public
        - private [in-program] units
    - Natural flood
        - Classified satellite imagery
    - Land Use-Landcover
        - NASS Crop Data Layer

Population monitoring program

- Traditionally used MWI survey – plans to keep the MWI
- Random transect aerial surveys
- MALL migration network

Assumption: Managed habitats are safety net to meet waterfowl requirements not met by natural flood

- Requires knowledge of available habitat
- Acres of each habitat (ac/habitat type)
- Quality of habitat type (DEDs/ac)

Post-presentation discussion:

Need more attention to strategic thinking to build redundancy of habitat capacity into the system to address habitat stochasticity (need buffering capacity)

On the one hand there is a surplus of non-breeding habitat in MAV…but how to build in buffering capacity if the MAV needs to pick up slack of Gulf Coastal plain?
Setting the table type of conservation planning – (ie, managing for variances)

For the future we need clarification of "What is sustainable?" This has implications to how future fund allocations are made, from a continental perspective, based on the "perceived" deficits in habitats across various landscapes.

Atlantic Coast JV:

Bioenergetics modeling efforts to set habitat objectives
Low food supply is a reality in ACJV not just assumption (starvation)
Post-season banding efforts for ABDU to estimate winter survival rate (as opposed to annual, survival rate). Target = 3,000 leg bands

Starvation is not solely mediated by weather events. Previously, planning for means rather than for extreme events…now it seems planning for extremes is a better strategy. ACJV has lost much of the southern habitat base for ABDU. Big shift observed from historical diets to what they are eating now.

Evidence for competition - Some competition of eastern mallards with ABDU observed for wintering period
Disturbance may need to be focused on since impact
Potential of loss to sea level rise – need new SLR modeling

____

Prairie Habitat JV:

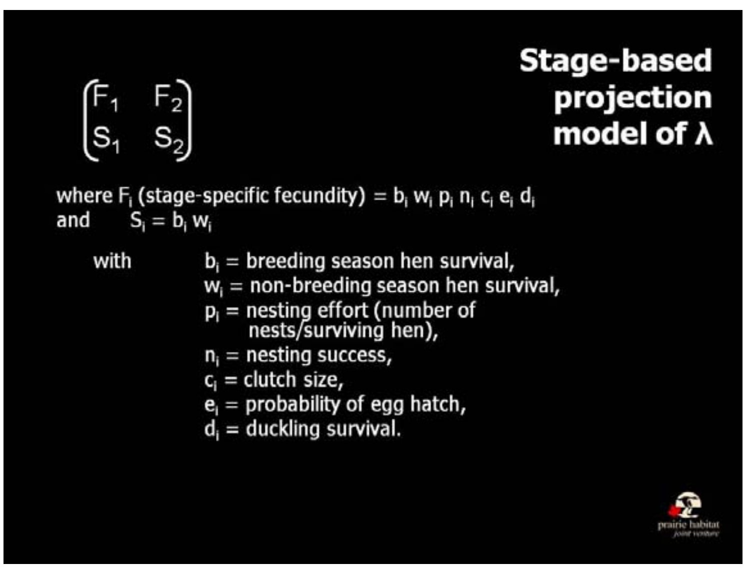
(Concepts similar to PPJV)

Primary biological assumptions:
- Duck density function of wetland density
- Nest success is primary determinant of annual recruitment
- Nest success influenced by perennial grass cover

Planning tools needed to estimate impact of mgmt. on the landscape.

Primary data sources for predicting breeding distribution in prairie Canada are:
- USFWS/CWS Waterfowl Survey Data
- DU Wetland Habitat Inventory
- Canada Land Inventory – Waterfowl Capability (CLI)

Stage-based prediction model:



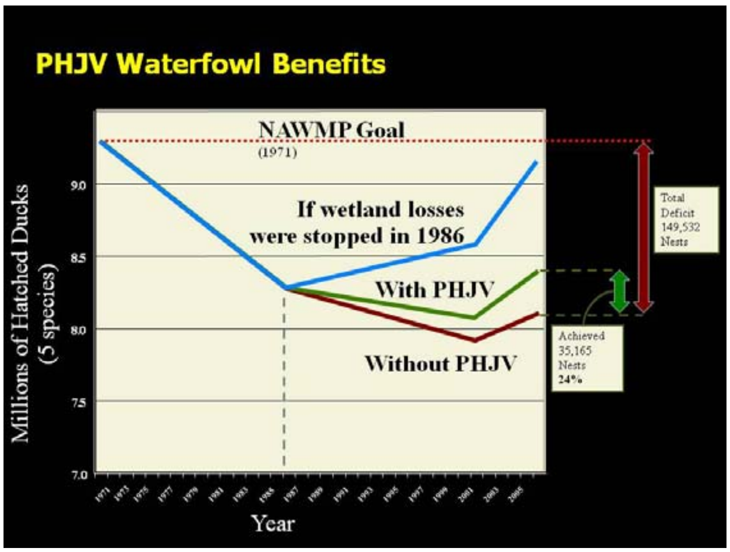
Nest success in CRP, Canadian prairies & parklands reviewed.

Predicting duck productivity: The Waterfowl Productivity Model

- Applicable in both Prairie and Parkland
- 5 main dabbling duck species (Mallard, BW Teal, N Shoveler, Gadwall, N Pintail)
- Key parameters capture behavior of landscape influences on duck productivity (run at 16 sq mi)

Results of modeling show the effect of landscape change on waterfowl productivity.

- WITHOUT PHJV - PHJV programs have achieved 25% of the NAWMP objective
- WITH PHJV - Had there been no further loss of wetlands as we had assumed in 1986, we would be at or near our NAWMP goal.(BLUE LINE)



Western Boreal Forest (WBF) sensitive to resource extraction – concern that this disturbance results in linear features for oil & gas, forestry industries - affecting hydrology which affects biological parameters extended to impacts on nest success, adult survival, etc.

Fewer stakeholders in the WBF but more difficult to work with them on conservation issues

Wetlands (open water) considered to be the most limiting landscape feature. There is a high degree of hydrological connectivity in the landscape via fens and other wetland types. Based on this working hypothesis, DUC assumes that maintenance of intact natural hydrology the key to retaining the value of open water wetlands.

Next steps:

- Prairies
  - Include other vital rates
    - Hen Survival
    - Duckling Survival
  - Include ‘risk of loss’
  - Include costs
- Boreal
  - Evaluate key hypotheses

Post-presentation discussion:

Higgins et al. work related to egg size changes as compared to historical data may provide useful observations, but linking that to influence of vital rate changes is less clear

While some observations related to the Spring Conditions Hypothesis didn't pan out. Need to consider subtle cross-seasonal effects of multiple threats as represented by multiple hypotheses.

Central Valley JV:

Does foraging model efficacy need to be better scrutinized/evaluated

Is it really about providing foraging opportunities or How we're moving birds across the Landscape?

CVJV used bioenergetic model focused on foraging habitat needs.

Patch depletion models used to estimate abundance of birds habitats can sustain over some time Period.

Evidence of food depletion

Simple bioenergetic models that do not specify foraging decision rules has implications to conservation decisions.

GIS spatially explicit model used to develop real-space landscapes to look at effects of amount and distribution of habitats

Allows for evaluation of the delineation of habitat patches but also the quality of these patches in moving birds across the landscape

What does an agent-based approach provide?

- Mechanistic link from behavior to popln response
- Spatially explicit (include distributions and juxtaposition of habitats
- Includes non-foraging component (disturbance, predation hunting risks & opportunities, water, policy, climate change)
- Can extend to other taxa

Do we need to go there?

No, don't really need to go there…

- If all we need is a simple accounting of what we have & what we need.

Yes, if we want to:

- consider spatial distribution of habitat at smaller scales
- non-foraging factors that limit bird abundance & distribution,
- to validate simpler bioenergetic models

Integrated modeling framework:
Water model → habitat model → foraging model → sustainable popln

What are the desired outcomes of this workshop so that we leave the NSST committee to enough fodder to develop recommendation for the full NSST?

Discussed our plans for the next day. What are the workshop objectives and expected outcomes? Need to clearly link to Task 1 of the NSST Work Plan and link back to the recommendations of the Alternative Performance Metrics Committee.

Adjourn.

Wednesday, June 15

IWMM Program

Integration efforts of the IWMM Program were reviewed and discussed

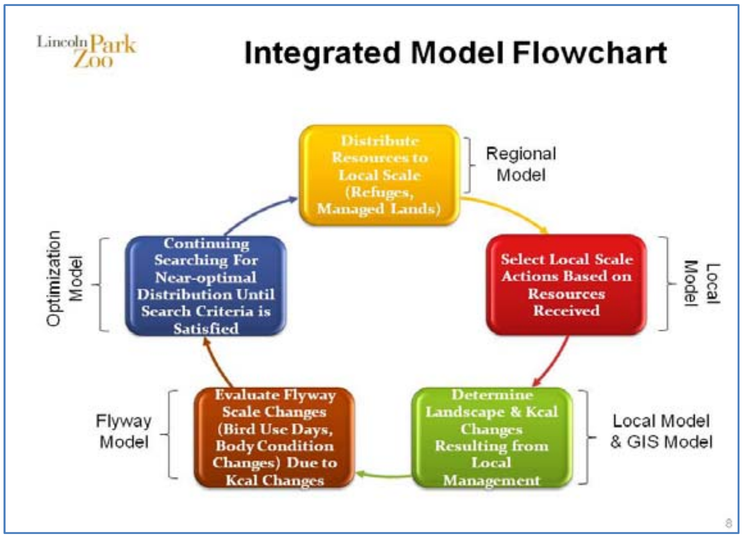
Conservation is a large scale production problem:
- Optimize allocation of resources among production sites to produce commodity
- Commodity: protected species and ecosystem services
- Apply concept to allocating resources among conservation sites to "produce" conservation commodity
- Waterbirds (waterfowl, shorebirds, wading birds) most common bird group monitored on managed wetlands
- Waterfowl considered "most prominent and economically important group of migratory birds of the North American continent"
- Key migration sites threatened
    - Real estate development
    - Biofuels industry
- Current management strategy – uncoordinated

- Problem Statement:

How do we maximize long-term average waterbird populations in North America in the face of uncertainty using limited resources?
- Our approach:
    - Develop integrated framework to determine optimal annual distribution of resources among sites within migratory flyways
    - Select best local scale management actions to maximize waterbird populations
    - Monitor and adaptively manage system

- Uncertainties:
    - Biological uncertainty about waterbird migration
    - Partial management
    - Partial observability
    - Uncertainty in the effectiveness of management actions
    - Variation from environmental stochasticity

Distribute resources regionally → Local Mgmt. planning & implementation → Monitoring to determine Δ kcal → Evaluate flyway changes → Continue Searching for Best Solution:



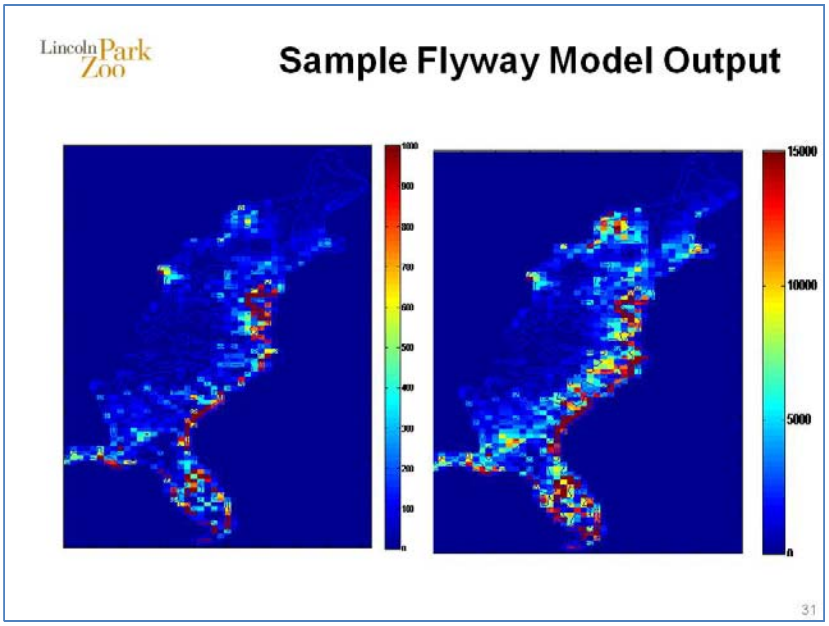
Inputs to integrated model:

- Baseline kcal map for each guild and each flyway (Atlantic and Mississippi)
- Current landcover data from NLCD
- Move over to NatureServe data
- Regional budgets
  - Fish and Wildlife Regions
  - Joint Ventures
  - States
  - Other Managed Lands
- Priority Species
  - What are we trying to protect?
  - Relative importance
- Management actions for each managed land

Flyway model reviewed..

Flyway model output:

- Flock trajectory based on Markovian probability distribution
- Bird Use Days
- Daily survival (based on survival function)
- Tank (body condition) of flock on each day
- Measure of variance due to stochastic weather



- There are MANY ways to distribute resources and MANY ways to chose local actions
- Develop computer program to sift through many options (Jeff Camm)
- Results tell us where to distribute resources & how to manage
- Best “bang for buck”

Continue Searching for Best Solution:
- Create heuristic (rules of thumb) to choose next resource allocation at regional scale
- “Smart search” heuristic should learn from past solutions
- For each solution, framework is repeated
- Continue until search criteria is met
    - Number of iterations
    - Improvements between solutions stall

Next steps:
- Regional Model
    - Determine regions and budgets – FWS, States, others
    - Species of concern
- Local Model
    - Identify cost of actions
    - Convert landcover to kcals at flyway scale
    - Engage non-FWS partners
- Flyway Model
    - Expand to more species (right now only Mallards)
    - Test sensitivity to bird parameters
    - Investigate variance due to weather
    - Incorporate daily survivorship

NSST Scaup Action Team:

SAT developed a plan for crafting an efficient and strategic framework to recover scaup populations.

Three factors:

- Changes in breeding grounds K
- Contaminants effects on survival or reproduction
- Spring food limitations affecting probability of breeding or reproductive success.

We have a harvest strategy – we have no equivalent strategy to manage habitat for scaup, or to link these 3 factors into one comprehensive plan.

Elements of current issue:

- Biological motivation (trigger)
    - Population declines
    - Uncertainty
- Decision maker(s)
    - Conservation investors (collective stakeholders)
- Nature of problem
    - Resource Allocation (efficiency and effectiveness)
    - ARM (learn and reduce uncertainty)
    - Decisions span multiple scales

The Problem:

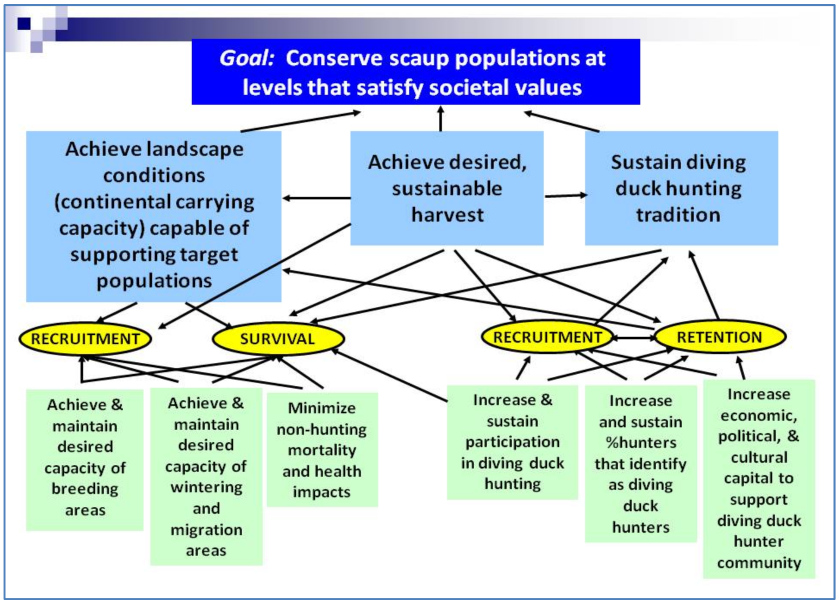
- Conservation investors need to determine how to allocate resources among management actions on an annual basis.

Plan development:

- Scope
    - Annual life cycles of greater and lesser scaup
    - Habitat management, harvest management and policy
    - Changing ecological and societal systems
- Scale: continental and regional (JV's)
- Adaptive management context
- Seek to develop coherence across habitat, harvest, and human dimensions
- Engage waterfowl management and research community in a collaborative and iterative process
- Use structured decision making approach to develop decision framework

3 fundamental objectives:

- Achieve landscape conditions to sustain target poplns levels
- Achieve sustainable harvest
- Sustain diving duck hunting tradition

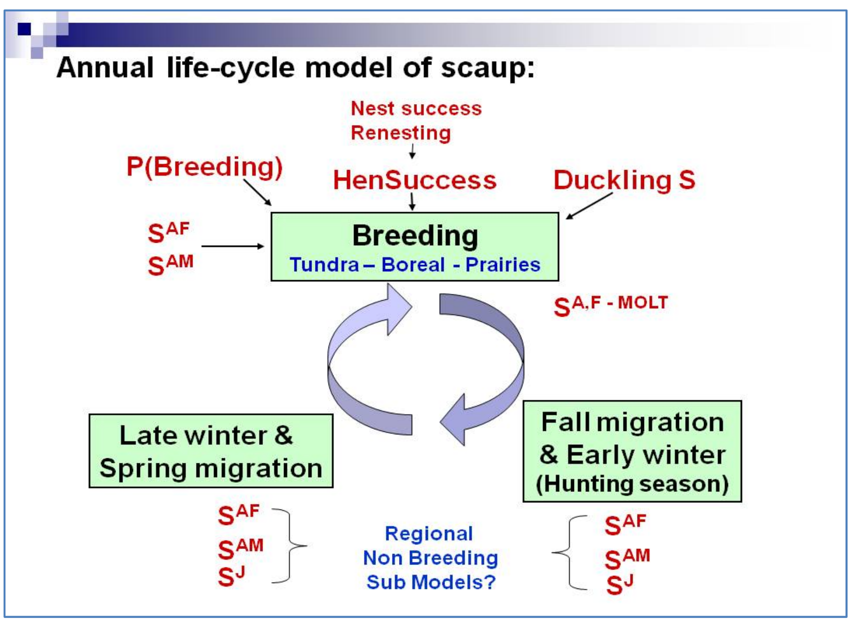


Each fundamental objectives links via recruitment and survival to means objectives (in green) – HOW we achieve those fundamental objectives....and from these we can identify possible management actions.

Two model components:

- Annual life cycle model slides
- Hunter harvest model

  These two models provide estimates of BPOP, harvest & hunters

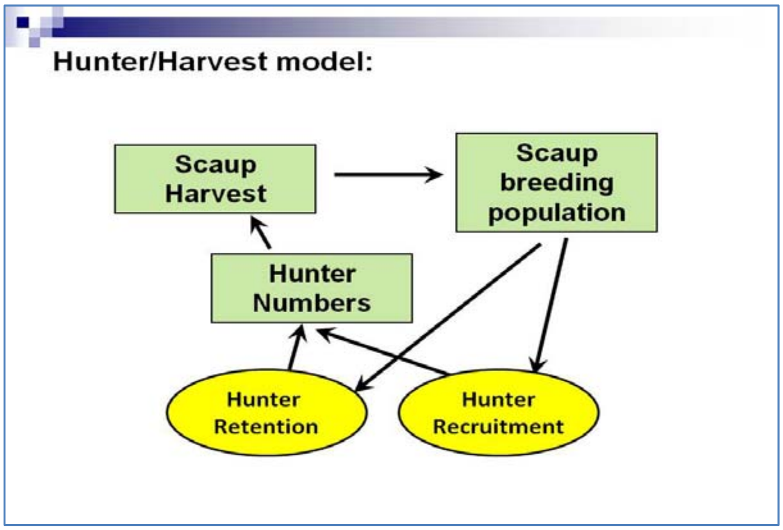


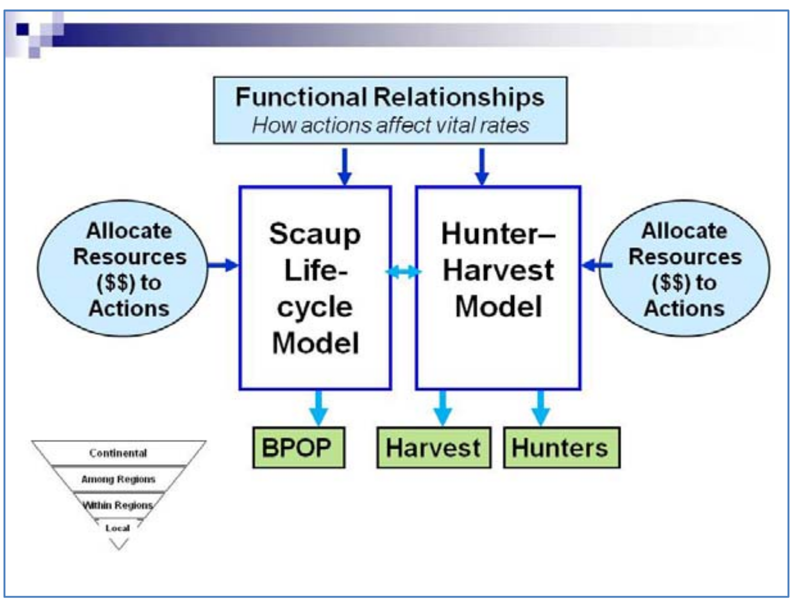
Life cycle model identifies primary vital rates (red) per season.
Model includes vital rates for 3 breeding areas (tundra, boreal forest, prairies) separately, but at this time have no such regional variation for the other seasons.

- We then asked: *What affects each vital rate?*
- Then asked -- *What actions could be taken to improve each rate?*
- For each possible action, we developed simple functional relationships.

Hunting tradition

- Formalized elements of human dimensions by specifying hunter numbers as a state variable
- Developed a “hunter” population model to project hunter dynamics forward in time in association with scaup BPOP
- Hunter retention and recruitment parameters were modeled as a function of: regulations, access, BPOP, others…
- Established formal linkages between hunter dynamics and scaup population dynamics
    - hunter recruitment/retention ~ *f(BPOP)*
    - harvest rate ~ *f(hunter numbers)*





This all feeds into resource allocation efforts. This represents a resource allocation problem so solution draws upon SDM theory to develop most cost-effective action where mgmt. actions are tied to vital rates.

Need to draft decision framework & conservation plan.
Plenty of uncertainties and interactions that need further analysis
Scale issues (model is currently a continental scale model. Need to link to regional & local models to deliver cross-scale resource allocation efficiency.

Next Steps:

- Assemble funds for a post-doc
- Sensitivity analyses
  - Assumption evaluation
  - Perturbation analysis
- Simulation and decision analyses
- Draft action plan
- Further input and reviews
- Final Conservation Action Plan

Decision framework structure:

- Linked annual life cycle models for scaup and hunters
- Demography = common currency; continental to JV-level scaling possible
- Management actions specifically linked to demography and costs
- Can apply planning tools for assessing potential trade-offs in resource allocation decisions at various spatial scales

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Black Duck JV:

Uncertainties:

- Uncertainty re: seasonality of limiting factors (winter, migration, or breeding) nor what habitat features might limit growth (winter food, nest site availability, other factors).
- Uncertainty re: how management influences such features and related vital rates.
- Uncertainty re: population response to harvest (additive vs. compensatory; is the compensatory.
- Mechanism post-season survival or productivity).
- What is the density-dependent mechanism?
- How does mgmt influence habitat and the DD mechanism?
- Which actions should be prioritized given budget constraints and threats.

We must make mgmt. recommendations today in the face of these uncertainties – need a decision support tool for mgmt. community.

BDJV developing a Model Framework (or decision support tool) that links habitat, vital rates, carrying capacity, and management and allows the BDJV to:

- Make informed and consistent recommendations for habitat management at multiple spatial and temporal scales (given a specified harvest policy),
- Prioritizing monitoring and research programs to:
  - evaluate management;
  - Increase understanding of limiting factors;
  - Increase understanding of influence of management on limiting factors
- Synthesize monitoring and research information to improve recommendations over time.

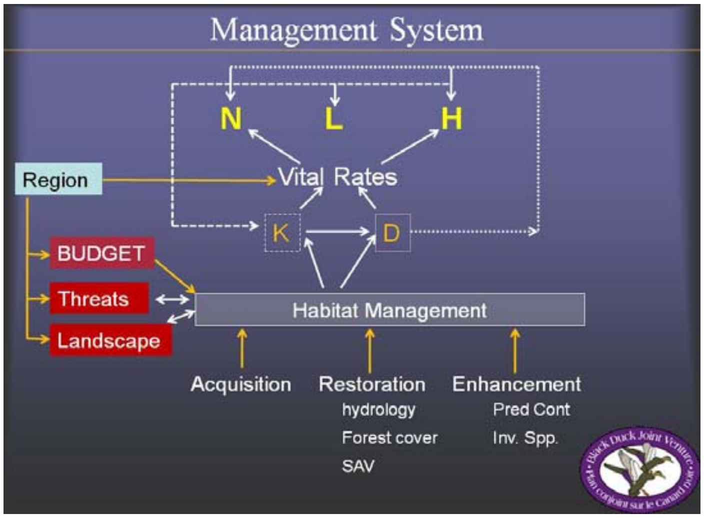
Objectives Hierarchy:

Fundamental: Maintain Populations (N)
Maintain Landscapes (L)
Maintain Hunting (H)

Means: Increase K | Harvest Policy

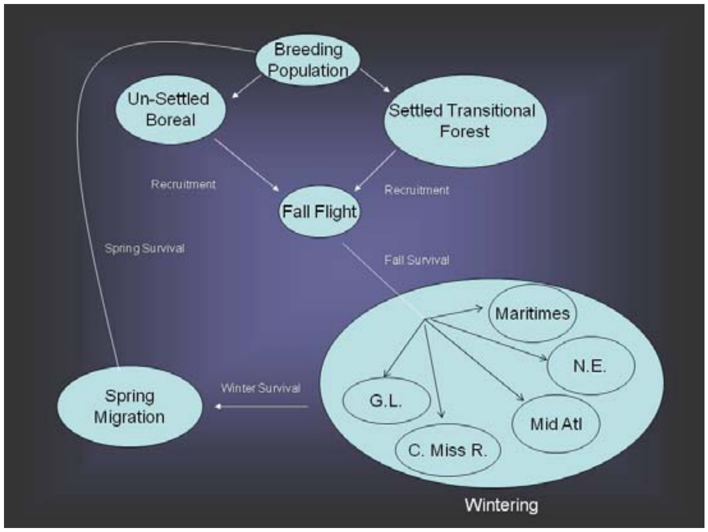
Alternatives: Make iterative mgmt recommendation
Learn
Develop DST that links habitat, vital rates, K, and mgmt.

Conceptual Model:



- ABDU abundance & harvest opportunity driven by K and density (D). These two factors influence vital rates (i.e., survival and productivity).
- Vital rates assumed to differ among regions due to environmental conditions.
- Threats, landscape conditions, and mgmt. costs also differ by regions.
- Management can influence K or D thus influencing vital rates.
  - Uncertain if ABDU respond to habitat management by changing distribution and maintaining similar densities resulting in no change in vital rates, or if density decreases following management thus increasing vital rates.
- Most appropriate type of habitat management depends on regional landscape conditions, threats, mgmt. costs, & response of black ducks to management.

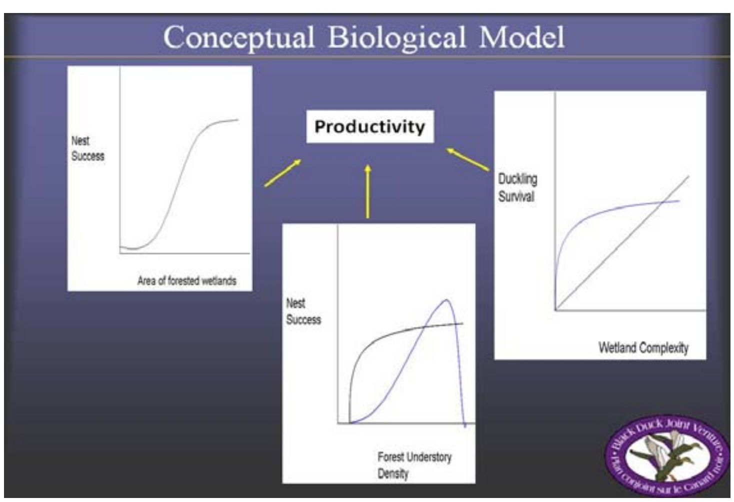
Conceptual model of how we believe ABDU population dynamics work:



Assumptions:

- Productivity differs between southern Canada (Settled transitional forest) and the "unsettled" boreal forest. Fall flight is a product of adult birds + recruited juveniles from the two breeding regions.
- Fall survival is a function of harvest policy, but may also be influenced by habitat management (e.g., increased salt marsh habitat may decrease hunting density and overall harvest rate).
- Winter survival is a function of habitat conditions, management and density in 5 regions. The 5 regions were identified in large part by difference in icing conditions and food availability.
- Spring survival is assumed to be influenced by the quality and quantity of available habitat, but habitat use is assumed to be the same during fall and winter migration.

Illustrated examples of hypotheses of how habitat characteristics may influence productivity. These form the basis of mgmt. alternatives.



Conceptual model:

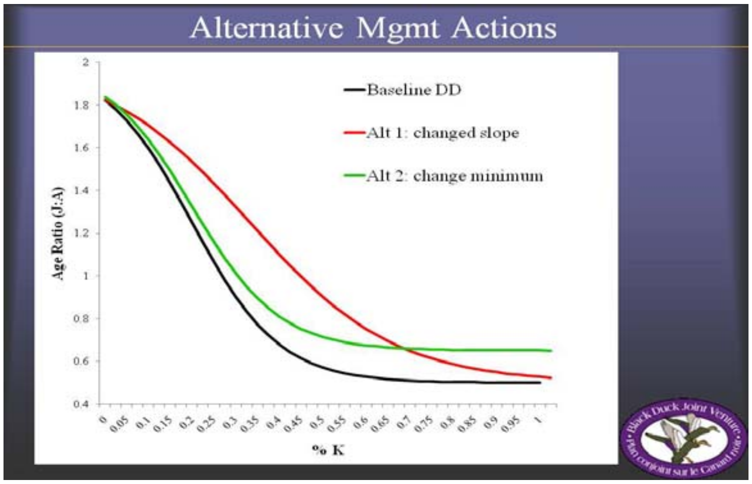
$$N \quad = \int\int N^{a,i}$$

Basic model is a balance equation that has both age structure and spatial structure.
The primary hypotheses to be compared over time are:

1. ABDU population dynamics are driven by density-dependence via productivity
2. ABDU population dynamics are driven by density-dependency in post-hunting season survival.

Initial model prototype:

- Focused on 2 breeding and 2 wintering regions each with similar assumptions about density-dependence
    - (e.g., assume post-season survival is highest in the Mid-Atlantic region compared to all other wintering regions. Otherwise, the D-D relationship is the same). Similar assumptions were made concerning productivity
- Assumed habitat management results in change to density dependent mechanism by either changing the slope or changing the max and min of the vital rate (i.e., productivity).*



**Next version of this model should not focus on "shifting" the D-D relationship, but rather dealing with how management influences density and vital rates.*

Issue of scale presents difficulty:

- Habitat management delivered at the local scale
- Monitoring programs designed at larger scales
- Challenged to link local actions to population dynamics at larger scales.

For initial model prototype they focused on evaluating habitat acquisition.

Did not incorporate the risk of habitat loss and degradation.

Developed utility functions for achieving NAWMP goal & Harvest goals (equal weights).

Conclusions:

1. Recommendations vary due to:
    1. Functional form of density dependence
    2. Hypotheses
    3. Influence of mgmt on vital rates and density
    4. Cost of mgmt actions
2. Need to reduce uncertainty via ARM and Research

Results:

- Under initial model assumptions, results indicated it's almost always best to put all available resources into securing habitat in the boreal forest.
- If we assume habitat delivery will have a greater benefit in the Mid-Atlantic region (because it is the primary winter range) and using the secondary cost utility the results change. We see a decreased effort in the boreal and greater effort in all other areas.
- By changing the D-D function and using the original cost utility we again see a change in the optimal policy.
- It is possible to derive an "average" optimal policy by running multiple version of the model (each version emphasizing 1 or 2 regions and seasons to focus habitat mgmt.

BDJV is striving for ARM framework that produces an optimal policy matrix to inform mgmt. (acquisition, restoration, and enhancement) strategy in each season/region.

BDJV will support research to evaluate ABDU response to differential mgmt. actions to refine and improve the model predictions.

Priority Information Needs:

1. ABDU response to mgmt actions
2. Regional costs of mgmt actions
3. Current conditions by region
4. Rate of habitat loss by region
5. Seasonal survival estimates
6. Winter distribution and density
7. Harvest policy
8. Agreed upon population goal (number and spatial scale)
9. Agreed upon utility functions and weights

Next steps:

1. Build a simple/effective framework to inform regional scale mgmt.
2. Commit full time person to build second version
3. 3rd workshop
4. Implement framework in1-2 yrs.
5. Refine over time

NSST Pintail Action Group:

JTG asserted that yield curves and the underlying equilibrium and harvest theory provide a useful conceptual framework for integrating harvest and habitat management.

- Meet NAWMP goals by increasing K
- Provides for greater harvest opportunity

Local and regional goals (under NAWMP) are intended to scale up to meet continental objectives.

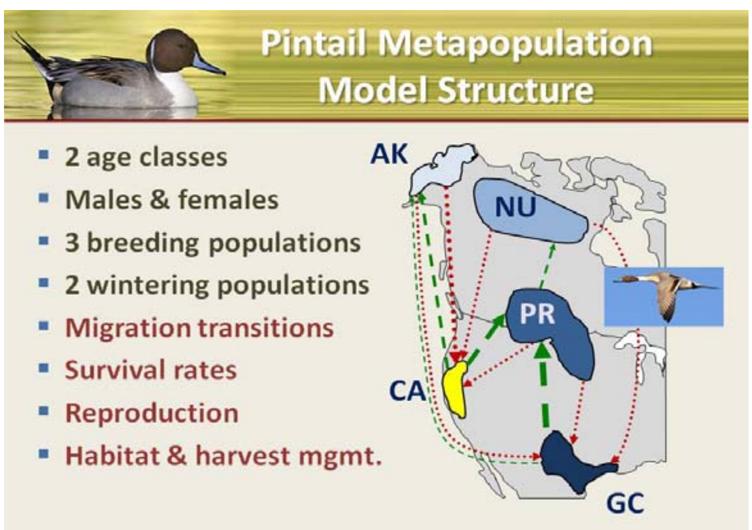
Ultimate goal is to focus at a continental level, even if much of what we implement occurs at local level.

How do we affect K? :

- How do we scale down from continental goals to tangible actions at the regional and local level?
- How do we ensure that local efforts influence key vital rates and population processes (i.e. link Δ habitat → Δ population)?
- How do we monitor the success of these efforts and adapt?

How do we connect regional and continental models?
How do we increase the NOPI age ratio to “expand” the yield curve?
How do we roll up from local & regional levels to continental level?

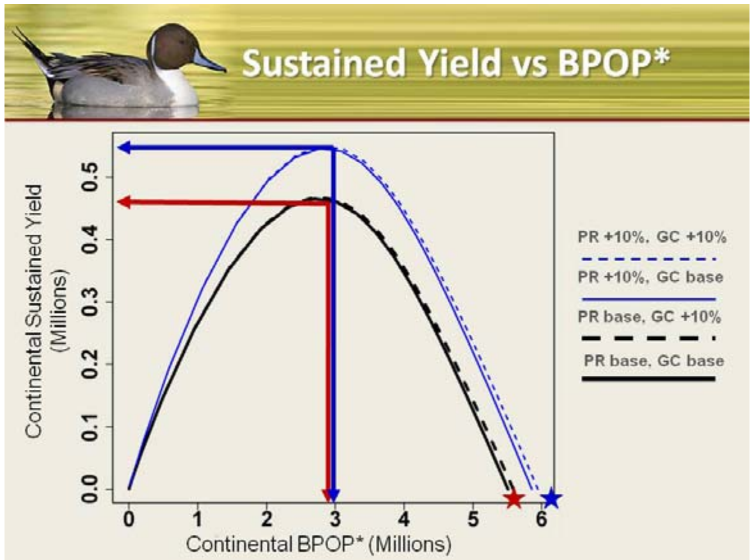
NOPI metapopulation model structure included third breeding area (not spatially fixed) and allows examination of consequences of habitat & harvest management for NOPI population dynamics.



Model represents increasing habitat quality in the PPR by increasing reproduction by 10% across densities (this function was meant to be a placeholder).

Regional density-dependent relationships in the prototype were based on our expert judgment while matching the resultant continental breeding & non-breeding density-dependent relationships to that in the current pintail harvest strategy (this function was meant to be a placeholder).

Based on prototype Density Dependent relationships, increasing reproduction in PPR by 10% would result in about 100,000 additional NOPI that could be harvested sustainably each year and 500,000 increase in continental K; whereas increasing acreage in the GC has a negligible impact on continental dynamics.



Prototype I Accomplishments:

- Integration of harvest & habitat management
- Integration across populations & spatial scales
- Prototype regional density-dependent relationships

Critical knowledge gaps:

- Regional habitat management effects
    - Acreage
    - Composition, config.
    - Density dependence
- Transition probabilities
- Climate change

A real challenge here is the lack of data at regional level, but we can leverage data at the other scales to make predictions about what's happening at the regional level

Before we can confidently make all these linkages across scales to inform management, we must first refine the regional submodels.

PPR model:
In the PPR, they developed a submodel that links specific mgmt. actions to regional fall age ratio via a "fill-and-spill hypothesis" (where NOPI first fill the prairie ecoregion, then spill over into the Parkland ecoregion.

- Assume reproduction in each PPR ecoregion is tied to upland condition, which in turn is driven by mgmt. actions and climatic variables.
- Can use the BPOP surveys in conjunction with the May pond surveys to tell us about the K in each of these ecoregions

- We can assume a linkage between mitigating contiguous grassland in the landscape through grassland protection/restoration and pintail age ratio by inserting this habitat covariate within fecundity model.
- We can surmise the consequences of reducing ecoregion-specific age ratios through hypothetical losses of contiguous grassland in each ecoregion.
    - If we reduce R in Parkland by 15%, we predict an increase in steepness of the DD relationship;
    - if we reduce R in Prairie by 15%, due to a similar loss of grassland there, we predict a wholesale downward shift in the DD relationship, setting a lower maximum R for the region.

Much work remains to refine regional models:
- Management strategies & age-ratio effects
- Relationship between PPR age ratio & survival
- Stochastic & annual environmental variation
- Carry-over effects: body condition & reproduction
- Breeding site fidelity in PPR & Prairie age ratio

Over the next year need to develop a hierarchical-modeling framework for estimating parameters from the regional submodels where we have incomplete information so that we can come up with more robust predictions of pintail popln. dynamics.

How can this framework be used?

- Integrate habitat JVs and harvest management
- Enable sensitivity analysis / scenario playing (if this, then what?)
- Begin to evaluate efficiency / effort allocation tradeoffs
- Provide a template for other species

What is the spatial scale at which these sub-models might apply?
What are the JVs we need to be collaborating with the build these models
What might those regional functional relationships look like?
- Function of popln size (density dependence)
- Effect of habitat mgmt. (changes in slopes or intercepts of these functional forms)

Pintail modeling group has been working with emergent functional relationships as they are identified. May posit some of these hypotheses in a passive adaptive mgmt. context. Design a study to learn more re: these hypotheses.

Regional resource allocations will change over time depending on where bottlenecks develop. JVs need to know how much and what kind of habitat is needed and how do you go about designing & delivering it.

These models go from continental to regional scales and we attempt to integrate them. At Regional scales we should ID targets for survival & condition levels. This provides context to JVs to develop their own models for the required specificity (to address which habitats and how much of it?).

Daily ration models do not include the details that need to be fleshed out at the JV level. It should actually entail an inter-JV effort at the regional level.

Q: Can we actually change the shape or intercepts of the curves OR are we just re-distributing birds across the landscape? Are we changing how birds are perceiving the landscape. Can we actually measure the shifts in these curves? Consider that Density Dependence is still undetectable at lower scales after 30 years of attention to this in the literature. It does show up in the popln.

Q: How do we grapple with the issue of "Is action A better than action B to effectuate this?"

Breakout Session Exercise–(1.5 hrs.)

- *Identify the other JVs you need to collaborate with given your JV spp. priorities*
- *Sketch out graphs depicting how relevant conservation actions likely affect vital rates*
- *Emphasis on demographic connectivity and therefore on relevant local demographic parameters*

There are international and JV level demands here that need to be considered
How do we deal with accountability at the multi-JV & international scale?

Ground rules:

- *Allocation to be left out of the discussion.*
- *Avoid discussion of funding needs or whom to engage in retaining resources needed*
- *Leave harvest out but if you have time – address it.*
- *Concentrate on annual cycle models and efforts of JVs to contribute to an annual model effort.*

Break out groups will work on functional relationships – "What would happen in my JV if I added some % of key habitats?

Consider what are the attributes of a good focal spp.

Putting them all together, they would begin a construct for an annual cycle model.

Breakout Groups report on relationships developed.

Do we want to do this?

Wrap-up:

Concluding on a high note…Question: Do we want to do this? Answer: Yes!

Request to Participants: I*ndividual input from the Demographics Workshop attendees on how the NSST could move this work plan task forward for developing annual life cycle models to better understand links between JV habitat conservation and impacts to key vital rates as well as the model integration work required to effectuate a roll up to continental NAWMP objectives.*

<u>Responses</u>:

Rex Johnson –

- Need to finish the annual life cycle model. However, we need a more generic life cycle model. Suggest combining Probability event chains with the form of the relationship, as illustrated by breakout group 2, as a generic teaching tool of how to build an annual life cycle model built in the absence of data.

Tim Jones –

NSST should…

- Provide technical review for regional models under development by acting as a sounding board
- Advocate use of vital rate metrics for use in conservation actions
- Provide the brain power for cross-JV monitoring & evaluation programs
- Conduct targeted research to address uncertainties in model parameters and functional forms of relationships, and that span multiple JV regions

Kevin Doherty –

- Participate in submodel development
- Review functional forms
- Plan for moving forward after finishing first 3 prototypes (ABDU, Scaup, NOPI)
- Find ways to motivate people to do the work?
- Seek opportunities to present products at JV boards to secure funding for completion.
- Participate!

Stuart Slattery –

- Seek funding at whatever level required to develop life cycle models
- Completion of all demographic models and review them for next model

Steve Cordts –

- Complete initial attempts at 3 current models (ABDU, Scaup, NOPI)
- Test assumptions – (data poor with lots of assumptions)
- Expand for mid-continent MALL
- Assess the probability that info. learned leads to changes in policy or management (if Probability of change is low – it's a low priority to complete another life cycle model)

Luke Naylor –

- Emulate "process" for developing the scaup, pintail, and black duck models - bring in postdocs to develop generic dabbling duck model.
- NSST should serve as an advisory board overseeing development of these models

Todd Jones-Farrand –

- Provide leadership and direction in advocating vital rates
- More exposure to JVMBs
- Explicit list of what we need JVs to provide to all JVMBs to conduct priority work

Carol Beardmore –

- Urge Mexican participation

- Consider how Brant modeling (Petrie's) might fit in to all this TRUMET daily ration modeling for brant in SONEC & Humboldt Bay

Christina Sloop –

- NSST role to facilitate cross-JV communication in this context + beyond
- Help provide framework to take this to JVMBs with pros and cons available to increase buy-in
- Provide dialogue and interaction needed as well as the resources to do it.

Greg Soulliere –

- NSST can formally support existing efforts and share information regarding the scaup, black duck, and pintail models with full NSST
- NSST Demographics Committee can generate a report of workshop results including generic rapid prototype models with key demographic parameters and explanation of potential hierarchical system for using linked models for individual spp. and that account for other mgmt. factors like waterfowl distribution, hunter retention, and recruitment.

Dave Howerter –

- Facilitate completion of existing models, new models (model for dissimilar spp. and/or generic) how to use this jointly of mgmt. decision making. Encourage JVs to incorporate vital rates to model s and what are the best methods to their

Anne Bartuszevige –

- Develop a series of hypotheses useful for rapid prototype models. One easy step for all to move in one direction

Mike Brasher –

- Help expedite ongoing annual cycle models
- Whether in capacity or financially, this depends on our knowledge of what they need to complete models
- Encourage participation in these workshops by NSST members via formation of working groups containing NSST members to contribute effectively

John Eadie –

- Expand the skill set of NSST via reps from social scientists, HD, economists
- Beyond report writing, there needs to be an outlet for sharing these workshop efforts to get it out to the community to get stakeholder buy-in and have them take a shot at conducting the work
- Need to keep eye on spatial & temporal scale issues and how those linkages intersect
- NSST should start thinking about habitat mgmt. experiments (more active approach) to inform more what factors are limiting
- "Postdoc" model works to move model development forward
- Need a structured workshop to really drill down on commonalities involving NSST direction (of three NSST action groups – direct involvement)
- Consider how to facilitate extending these models to other waterbird groups

Bob Clark –

- As we complete the suite of models, we need a communications plan to disseminate efforts to community (demonstrate value via papers, workshops at appropriate venues)

- New projects: MALL & other spp. sharing overlap in linking vital rates response to mgmt. actions
- Complete cluster analysis on connectivity of priority spp. for JVs to demonstrate how they are clustered together
- Provide mentorship program to JVs to have them work together in terms of habitat work
- Enable them to develop target N (for breeding, migration or wintering) to allow a bottom-up assessment to inform levels of habitat redundancy needed, info. gaps, etc
- Assess accounting for whether or not we have things covered broadly for waterfowl from bottom up.

Adjourn.