PHJV ASSESSMENT STUDY UPDATE

NAWMP Prairie Habitat Joint Venture Evaluation Program *January 2002*

We are resuming publication of the PHJV Assessment Newsletter in order to keep our conservation partners informed of progress in processing and analyzing data and reporting results from this major evaluation project. News about closely related studies will also be included. New issues will be published every 3-4 months in electronic form and will contain:

- Condensed reports of advanced data analyses;
- Preliminary discussions about conservation implications of results;
- Updates on progress with manuscripts;
- Short reports from closely-related studies;
- Plans for subsequent analyses

While this first electronic newsletter is only available in pdf format, we plan to make future newsletters more easily accessible using html. Your suggestions for improving this newsletter will be welcome. Please send your ideas to b_joynt@ducks.ca

In This Issue...

The Assessment team members have been focusing their efforts on comprehensive data analyses and manuscript preparation rather than on producing a traditional (as in 1993-1999) detailed annual report of results for the 2000 field season. Presented here for the first time, is a summary table of vital rate estimates for all 27 Assessment sites. This will allow readers to place the 2000 season core results in broader perspective.

Summary Table of Vital Rates for 1993-2000 PHJV Assessment Sites

Study Area	Year	Mallard Pairs/ Mile[2]	Percent Mayfield Nest Success: All *Anas* Species Non-Treat.		Percent Mayfield Nest Success: All *Anas* Species Treatment	Percent Mayfield Nest Success: Mallards [a]	Nests Per Hen	Hen Success (%)	Hen Mortality (%)	30 Day Duckling Survival (%)	Fledging Rate [b]
Low Treated Sites											
Hamiota, MB	1993	6	8		-	7	1.8	23	19	42	0.31
Erskine, AB	1994	15	16		-	15	1.4	24	19	61	0.51
Shoal Lake, MB	1995	14	4		-	3	2.9	17	34	57	0.33
Kutawa Lake, SK	1995	9	7	[c]	27	4	2.3	14	18	60	0.32
Parkside, SK	1996	12	10		-	6	1.8	18	21	49	0.31
Pine Lake, AB	1996	15	11		-	9	1.9	24	32	55	0.47
Elnora, AB	1997	15	14		35	13	1.6	26	46	62	0.72
Farrerdale, SK	1998	16	4		-	4	1.6	15	35	69	0.39
Leask, SK	2000	9	8		12	6	1.5	16	23	54	0.28
Medium Treated Sites											
Punnichy, SK	1993	13	5		8	6	1.6	12	26	32	0.09
Belmont, MB	1994	12	16	[c]	34	17	1.9	39	15	47	0.59
Davis, SK	1994	18	16		18	17	1.6	39	22	62	0.80
Camp Lake, AB	1995	13	11	[c]	22	12	1.6	21	33	52	0.39
Baldur, MB	1996	19	7		10	5	2.0	15	27	59	0.32
Willowbrook, SK	1997	17	7	[c]	15	4	2.1	21	24	62	0.49
Donalda, AB	1998	37	7	[c]	18	6	1.5	19	24	45	0.29
Hay Lake, AB	1999	20	8		14	7	1.7	21	30	40	0.24
Allan Hills North, SK	2000	35	5		9	6	1.5	17	23	50	0.29
High Treated Sites											
Allan Hills West, SK	1997	36	17	[c]	34	36	1.4	49	23	53	0.86
Mixburn, AB	1997	14	21		29	23	1.7	44	29	64	1.05
Jumping Deer Ck., SK	1998	26	2	[c]	8	4	1.9	17	15	58	0.34
Minnedosa, MB	1998	27	2	[c]	6	1	2.3	16	20	43	0.23
Allan Hills East, SK	1999	42	6		10	6	1.9	19	34	39	0.20
Kinsella, AB	1999	22	7		13	7	1.4	15	37	35	0.15
Red Willow, AB	1999	27	15	[c]	28	9	1.6	31	33	51	0.50
Holmfield, MB	2000	26	24		19	21	1.6	39	12	36	0.46
Prince Albert, SK	2000	24	3		4	2	2.3	15	24	30	0.15

[a] Excludes nests in over water nesting structures.
[b] Females fledged per female in the spring population
[c] Statistically significant: those for which the confidence interval of the difference (not shown) did not include 0 as a plausible value for the true difference in nest success rates. A Bonferroni correction was used to control the family-wise error rate at alpha = 0.10.

Done Like Dinner – Data Collection Ends

Well, the Assessment fieldwork wrapped up in August 2000, but the data collection ended just last month. Confused? Don't be. Its been some time since we counted our last brood, but an enormous effort to collect essential habitat information from aerial photographs culminated recently when the final assessment site, in digital form, was stored within a Geographic Information System (GIS). The strength of a GIS is that it allows complicated analyses of how spatial factors interact to affect the system under study—in this case waterfowl production. In addition to capturing different habitat classes, we also created layers that represent land use information (e.g., hay cutting dates, whether a parcel of land was grazed or idle, etc). The location of all duck nests were mapped using satellite-based Global Positioning System (GPS) technology and stored within another GIS layer. Specific areas searched for duck nests make up yet another layer. Detailed information about each wetland on each study area is electronically linked to the digital map, as are all raptor nests encountered during the study and telemetry locations for radio-marked birds. Finally, management histories for each DU habitat project, including information such as when the project was completed, the project's most recent management activity, or even what seed mix was used in a given parcel of planted cover is linked to our GIS maps.

The process of creating the digital maps has a number of steps. First, high-resolution aerial photos were taken of each site during the year we were studying it. Next, these photos were corrected to remove the distortion caused by the yaw, pitch, and roll of the aircraft at the moment the photo was taken. The correction uses a combination of GPS-generated locations of recognizable features collected while in the field, and a complex mathematical model to generate a single seamless image. Photos of each site were taken at intervals so that they overlapped each other by about 30% in both the north-south and east-west directions. This overlap was needed during the classification stage. A stereoscope was used to delineate different habitat types on each photo. The stereoscope allows the interpreter to simultaneously view the same part of the study area imaged on 2 different photos. Because each photo captured the image from a slightly different angle as the aircraft moved along, these "stereo pairs" of photographs make the image on the ground appear to be 3 dimensional, thereby allowing the interpreter to distinguish between similar habitat types. For example, this technique allows the interpreter to determine where the shrubs end and where the trees begin. Finally, the delineated habitats were meticulously digitized to make the final GIS-ready map.

After classifying over 4,700 photos, and digitizing nearly ¾ of a million line segments making up almost 300,000 individual habitat patches we end up with one of the most detailed yet extensive spatially-explicit data sets ever compiled for a wildlife study. When combined with the mountains of duck production data collected during the course of the Assessment, we have a very powerful tool with which to examine how habitat factors affect waterfowl duck population dynamics. This data set will form the backdrop against which many of our analyses will be assembled. Just within this issue, we have examples of how landscape attributes affect nest success, mallard hen survival, and how these data are being used extensively in the development of vital new planning tools. This is just the tip of the iceberg, many (if not most) upcoming analyses will use this potent source of information to better understand the complex relationships between ducks and their habitats. *Dave Howerter*

PHJV Assessment Study UPDATE *(www.ducks.ca/research/pub/phjv/index.html)*
is produced by Ducks Unlimited's Institute for Wetland and Waterfowl Research, Stonewall, Manitoba, Canada, iwwr@ducks.ca

Incorporation of Assessment data into the Prairie Pothole Region Decision Support System

In 1999, Ducks Unlimited Canada unveiled the first component of the Prairie Pothole Region-Decision Support System (PPR-DSS). The PPR-DSS provides a landscape level prediction of waterfowl pair densities across the Canadian PPR based on USFWS/CWS population survey data, remotely sensed wetland information, Canada Land Inventory-waterfowl capability data, and ecoregion (Prairie vs. Parkland). This product helps Ducks Unlimited focus our conservation efforts geographically to affect the most waterfowl.

How has the PHJV Assessment data become part of the PPR-DSS? While the initial PPR-DSS model predicts where the ducks are, it does not tell us much about the waterfowl production potential of the landscape those ducks settle in. Reproductive capability is determined by the combined factors of 1) *what habitats make up the landscape,* 2) *what habitat/landscape a hen chooses to nest in*, and 3) the *reproductive success she experiences in that habitat/landscape.* This is where the PHJV Assessment Study has provided valuable insight. Using nesting data from radio-marked mallard hens and from nest searches (for blue-winged teal, northern shoveler, gadwall, and northern pintail), habitat preferences have been determined for major habitat types and land uses typically encountered in parkland habitats. As well, long-term expected nest success in these habitats, and landscape level 'perennial cover' effects on nest success have been estimated. Thus, given a particular landscape composition, predictions can now be made about how the 5 dabbling duck species will distribute their nests among habitats and how many nests would be expected to hatch (Table 1; mallard only example). This provides a powerful biologically based tool for comparisons among alternative conservation actions in a specific landscape context. Applications for Ducks Unlimited program planning are foreseen at both regional and local scales. *Jim Devries*

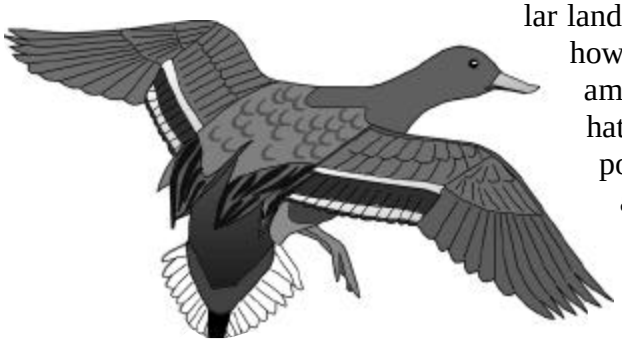


Table 1. Predicted performance of 300 mallard hens breeding in a hypothetical landscape.

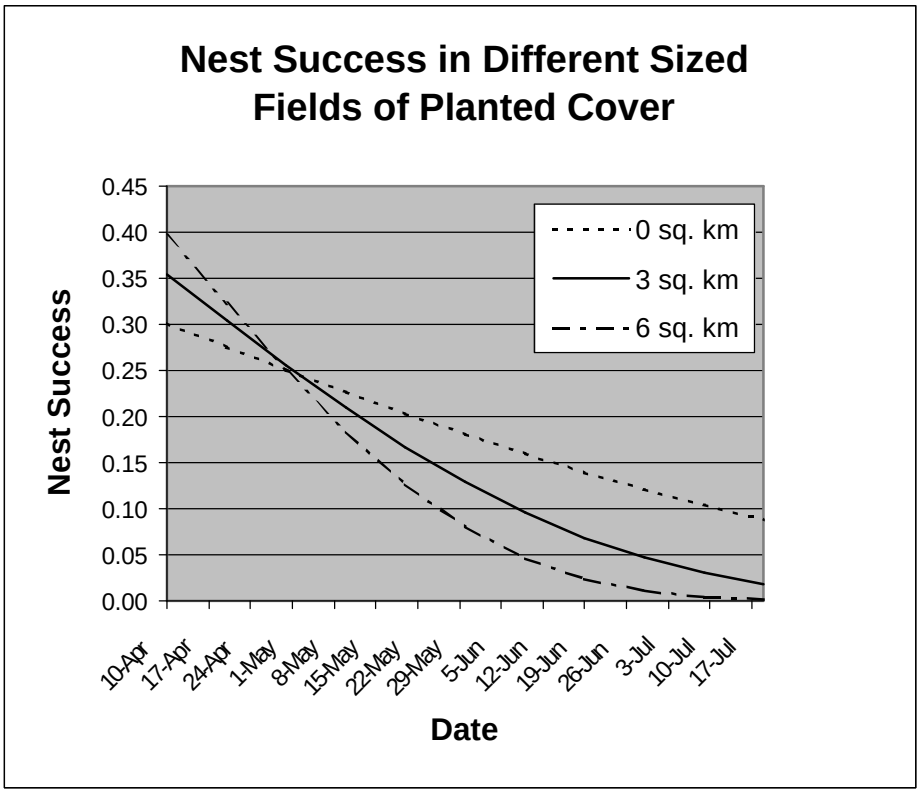
Habitat Type	Available (%)	Relative Preference	Number of Nests	Nest Success	Hatched Nests
Spring Seeded Crop	55	0.4	18	11	2
Fall Seeded Crop	5	6.5	28	26	6
Regular Hay	10	8.1	68	12	9
Delayed Hay	5	2.5	10	17	2
Grazed DNC	0	8.1	0	18	0
DNC	5	21.4	90	17	15
Grazed Parkland	15	19.6	246	12	22
Idled Parkland	5	33.4	140	13	19
Totals	**100**	**100**	**600**		**85**

The Complexities of Nest Success

Nest success is the single most important component controlling prairie-nesting duck population dynamics (see Nov. 1998 *UPDATE* Newsletter). This isn't news; biologists suspected this since before the onset of the North American Waterfowl Management Plan and, as a result, most of the habitat programs designed under the auspices of NAWMP's Prairie Habitat Joint Venture were designed to bolster nest success. The basic underlying tenet of these programs was that massive human-caused alterations to the prairies had resulted in a highly fragmented landscape where ducks were forced to nest in the small remnants of what was once a vast expanse of prairie grasses, forbs and wetlands. It was thought that these concentrated nests tipped the scales in the favor of nest predators by making them easier to find, thereby reducing nest success. These ideas had support from studies on other types of birds, that found reduced nest success in small patches of habitat and along habitat "edges" where 2 different habitats met, but these ideas had rarely been tested on nesting ducks.

Assessment nesting data combined with spatially-explicit habitat data allowed us to examine how a number of landscape features affected duck nesting success throughout the Parklands at a variety of spatial scales. Factors we considered included habitat type, habitat patch size, how far the nest was from a habitat edge, the amount of cropland in the vicinity of the nest, and how far the nest was from a wetland or farm.

Generally, nest success was higher in large habitat patches than in small patches; however, this relationship was more complex than anticipated—varying both seasonally and with habitat type. For example, in planted cover, early in the nesting season, nests in large patches tend to hatch more often than nests in small patches. Later in the season, this pattern is reversed (see Figure). The reasons for this switch aren't apparent, but likely are related to seasonal changes in how predators forage. Distance from wetlands and distance from a habitat edge were other important predictors of nest success. Nests farther from a habitat edge tended to have a better chance of hatching than nests close to the edge. Similarly, nests farther from a wetland were more likely to hatch than nests close to a wetland.



While uncertainties remain and the relationships are complex, new insights about how landscape configurations affect important demographic parameters like nest success will allow Ducks Unlimited to custom-design habitat programs to maximize the efficiency of our conservation investments.

Dave Howerter

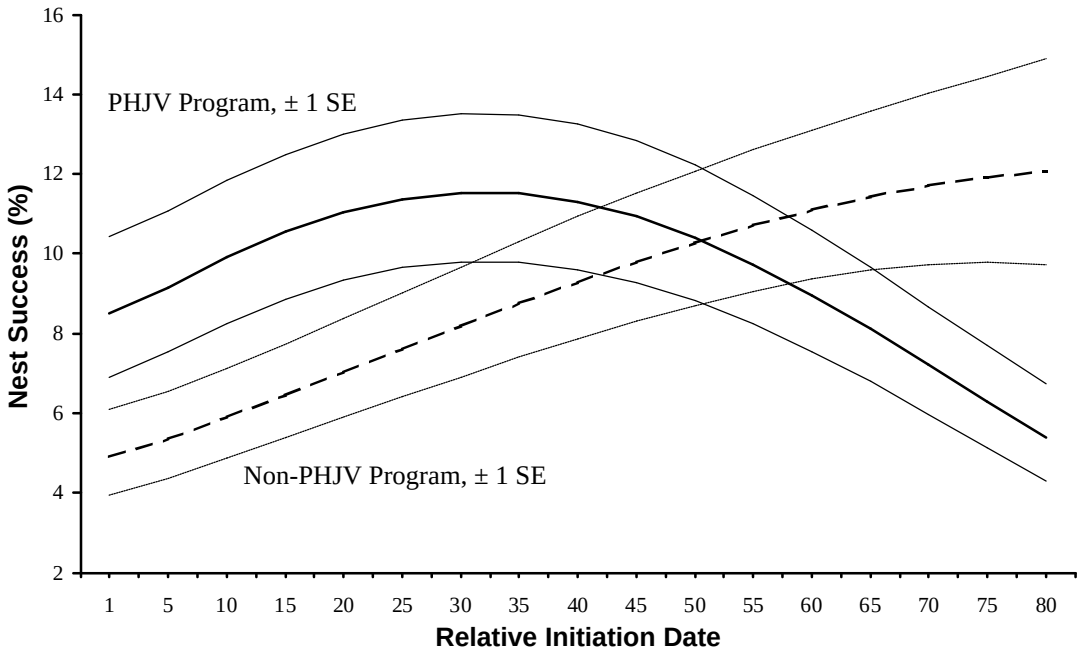
Seasonal Variation in Waterfowl Nesting Success: The Importance of Managed Habitats

A growing body of literature suggests that early-hatched females have significantly higher recruitment to local breeding populations as yearlings than do later hatching birds. To investigate what role habitat management might play in increasing early nest success we modeled nest success for nests in both managed PHJV habitat and unmanaged non-PHJV habitat using >15,000 duck nests monitored during the Assessment Study. Seasonal variation in nest success by habitat type has not previously been investigated. We developed and contrasted 59 *a priori* models. Explanatory variables included relative initiation date, habitat type, and species.

Our best model demonstrated strong seasonal patterns of nest success but this pattern depended on both habitat type and species. We observed higher nest success in PHJV habitat than in non-PHJV habitat early in the nesting season (see Figure), but declining nest success in PHJV habitat as the season advanced. Conversely, nest success in non-PHJV habitat increased as the season advanced. Planted cover and idled parkland (both PHJV habitat programs) had the highest early nest success of all habitat types examined.

For habitat programs to be considered effective management tools for increasing early nest success they must demonstrate higher nest success rates than unmanaged habitats, and early nesting hens must select them. Early nest success (i.e., during first 30-days of nest initiation) was nearly twice as high in PHJV habitat as in non-PHJV habitat (see Figure). During these same 30-days, radio-marked mallards initiated 13 % and 37 % of nest attempts in PHJV habitat at sites with medium (4-11% of site secured in habitat program) and high (12-27% of site secured in PHJV habitat) levels of habitat programs, respectively. This suggests selection by mallards for PHJV habitat early in the nesting season.

Our finding that nest success is highest in planted cover and idled parkland suggests managers can influence early nest success, and hence increase early hatch rates. These habitats will contribute most to population growth, despite declining nest success later in the season. We speculate that levels of habitat program higher than we investigated here, and/or more strategically placed habitat programs, may lead to even higher early nest success and increased selection for nesting. *Bob Emery*



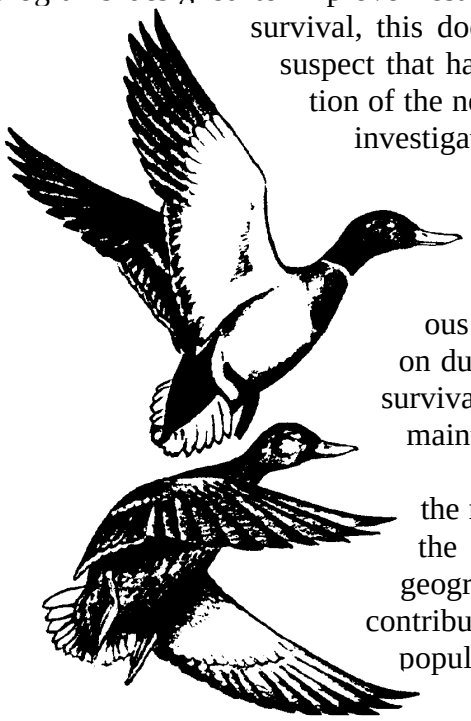
Waterfowl nest success in managed PHJV habitat (solid lines; ±1 SE) and non-PHJV habitat (dashed lines; ±1 SE), modeled in relation to relative initiation date. Includes all species. Species and habitats weighted by frequency of nests. Study area held constant at ß = 0.1150; age of nest when found was set at 1.

Mallard Hen Survival in the Canadian Aspen Parklands

As part of the PHJV Assessment Study, approximately 3500 female mallards were equipped with radio transmitters and tracked daily during the breeding seasons of 1993-2000. These hens are providing us with unprecedented information on numerous aspects of mallard breeding biology in the Aspen Parklands of Canada. The breeding season survival of mallard hens is one aspect of their biology where Assessment data has shed new light.

Using hens marked between 1993 and 1998, IWWR, in conjunction with John Citta and Mark Lindberg at the University of Montana, analyzed hen survival for the effects of hen age, period within the nesting season, level of PHJV habitat treatment, habitat composition, and location (longitude). Over the 19 site-years, female survival ranged between 63% and 84% and averaged 76%. No difference in survival was detected between age classes (second year vs. after-second year). Within the nesting season, female survival dropped dramatically during the period when most females were nesting, thus supporting previous research that female dabbling ducks are more susceptible to predation while nesting. The amount of PHJV habitat treatment on a site had no effect on hen survival. Hen survival increased with the percentage of wetland habitat on a study site and decreased from eastern parklands to western parklands. We hypothesize that reduced wetland abundance may result in more concentrated foraging near these habitats by some predators (e.g., raptors). Analysis is ongoing to try and clarify this relationship. Anecdotal data suggests that raptors may be significant agents of female mallard mortality, especially in the western Canadian Prairie Pothole Region.

These results provide important information to managers of waterfowl populations. Previous analysis of Assessment data has indicated *nest success* and *female survival* have the greatest impact on the population growth rate (see Nov. 1998 *UPDATE* Newsletter). While habitat programs designed to improve nest success could be expected to simultaneously improve hen survival, this does not appear to be the case at the study area scale. We suspect that habitat programs would have to affect a much greater proportion of the nesting population for hen survival benefits to accrue. Further investigation of this issue is planned.



This analysis provides another piece of the puzzle in understanding the interplay of habitat and waterfowl productivity. The presence of wetland habitats appears to influence several aspects of waterfowl productivity. Previous and ongoing analyses have identified wetland habitat impacts on duckling survival and nest success. This list now includes hen survival and further stresses the importance of protecting and maintaining these habitats.

Finally, the PHJV Assessment study has provided some of the most precise estimates of mallard breeding season survival in the Prairie Pothole Region over considerable temporal and geographic scales. This information will provide a valuable contribution to the demographic modeling of mid-continent mallard populations. *Jim Devries*

Ancillary Study

The Roles of Heterogeneity and Scale in Mallard Nest Site Selection

P.E. Joyce, Ducks Unlimited Canada, Dr. R.K. Baydack, Natural Resources Institute, University of Manitoba, Dr. N. Kenkel, Department of Botany, University of Manitoba, D.W. Howerter and Dr. T.W. Arnold, IWWR

In order to be effective, managed waterfowl nesting cover should be more attractive and "safer" than surrounding habitats. However, PHJV Assessment results have shown that waterfowl use of DNC has often been lower than expected. Little information exists regarding the influence of cover patchiness or the spatial scales at which mallards select nesting habitats. This study addresses these questions at the level of the nest site, with a view to providing new information to improve habitat management planning tools, to encourage or discourage management for "patchier" nesting cover, and to help identify the most appropriate scales at which to measure habitat variables for management purposes.

Data were collected during 1998, in conjunction with the PHJV Assessment site near Minnedosa, MB. A random sample of 64 mallard nests were chosen from all nests located on the study area. Vegetation height, visual obstruction, growth form and cover class were measured within 4 x 4 meter, 16 x 16 meter, and 32 x 32 meter sample grids, centered at each nest and at paired random points.

Nest site preferences were found to be scale dependent, and were most strongly expressed at fine scales (< 2 meters from the nest). Mallards strongly avoided very low cover heights and densities, and preferred cover with high structural heterogeneity, a low to intermediate range of cover heights and densities, and diverse vegetation that included interspersed grasses, forbs and shrubs. At broader scales (e.g. 2 – 16 meters from the nest), mallards showed a preference for interspersed grasses, forbs and shrubs, avoided cropland and other habitats with low cover height and density, and exhibited a weak preference for higher cover heights and densities. Overall mean visual obstruction was higher at nest sites than at non-nest sites at all scales.

Observed habitat preferences suggest that management for nesting cover with an intermediate height and density, a high diversity and interspersion of grasses, forbs and shrubs, and fine scale structural heterogeneity may increase its attractiveness to nesting mallards. *(These variables have all been incorporated into DUC's Planted Upland Cover Inspection Form, first used in 2000 – EDITOR).* Incorporating scale-dependent habitat preferences and heterogeneity into models of nest site selection may improve their predictive power and the efficacy of resulting management prescriptions. Further research is recommended to resolve uncertainties regarding the influences of concealment, heterogeneity and other cover characteristics on the attractiveness and productivity of various habitats.

Ancillary Study

Estimating Brood Visibility Using Sightability Models

John H. Giudice, Dr. John Ratti and Dr. E. (Oz) Garton, University of Idaho

Millions of dollars have been spent on habitat programs designed to directly or indirectly increase annual duck production. Given the long-term investment of dollars and labor in these types of programs, it is essential that habitat managers have reliable feedback data to evaluate program effectiveness and guide future management and planning. Unfortunately, there are no reliable, timely, and inexpensive methods for estimating annual production of ducks. Brood surveys should furnish simple, direct, and cost-effective data on annual duck production. However, most brood counts are inaccurate and of limited value. The most serious problem with brood surveys is visibility bias (i.e., the failure to observe all broods that were present during a survey). Visibility bias is a major cause of inaccuracy in wildlife surveys. The problem is exacerbated in brood surveys because duck broods, especially mallard and pintail, are often secretive and difficult to count.

Most brood surveys do not account for imperfect detection rates or the factors that contribute to visibility bias. Lack of stringent survey protocols is another serious problem with brood surveys. Multiple methods are used and, in many cases, they involve ad hoc procedures. Consequently, there is variation in how and when brood surveys are conducted and in interpretation of the data. These combined problems make it very difficult to obtain reliable, long-term data for evaluating project effectiveness or monitoring duck production. Developing standardized brood-survey procedures that incorporate statistical methods of sampling and sightability correction (sightability models or mark-resight methods) would greatly improve the reliability and usefulness of brood-count data. Therefore, the objectives of this study were: (1) identify and quantify the factors that influence brood visibility; (2) determine the feasibility of using sightability models to estimate brood visibility; and (3) design standardized survey procedures that minimize controllable sources of variation in brood surveys and are compatible with the sightability-model methods.

We used a modified point-count method and 93 radio-marked mallard broods on 7 PHJV Assessment sites (1999-2000) to develop predictive sightability models and assess the relative importance of sightability covariates. Mean visibility of mallard broods was 24%, but detection rates ranged from 13 to 51% depending on year and scale of application. Brood visibility was negatively correlated with percent visual obstruction and brood age. Observer experience (years of survey experience) and weather (temperature and wind speed) also influenced detection probability, although effects were less important than percent visual obstruction or brood age. Wind speed appeared to be more important than temperature, especially wind speeds >7 km/h. Brood visibility was not strongly correlated with wetland-basin characteristics (e.g., size, shape, and percent of basin surveyed); brood and survey-area characteristics were needed to accurately estimate detection probability. Sightability models developed at the brood and survey-area scale correctly classified 80 and 72% of mallard broods as missed or detected. However, additional research is needed to critically evaluate the bias, precision, and cost effectiveness of sightability-adjustment estimators developed in this study. In the interim, ground-based brood surveys can be improved by developing and adopting standardized survey procedures (e.g., a point-count method), restricting surveys to periods when temperature is $\leq$23 C^{o} and wind speed is $\leq$7 km/h, using trained and experienced survey personnel, using an appropriate sampling framework, and, possibly, recording % visual obstruction or % cover as a potential covariate.

Short Notes

Monograph in the Works

The Assessment team plans to report results of the project in >20 standard manuscripts. Several are well underway and described in this newsletter. One larger monograph is being prepared for reporting the PHJV context of the project, study design and site selection, treatment delivery, study methods, and basic results. These results will include study area characteristics, habitat conditions and composition, conservation treatments, predator indices, pair populations, breeding propensity, nest-site selection (via radio-marked hens), nesting success, renesting effort, hen survival and brood/duckling survival. The paper will also explore sources of variation (mainly study-area-level covariates) in mallard vital rates. All team members are contributing analyses for this paper. Our plan is to submit this manuscript to Wildlife Monographs.

Next up for Data Analysis

As described throughout this newsletter, Assessment data are currently part of many different analyses. The following are a few other current or upcoming analyses where Assessment data will be put to work:

⇒ Assessment data are being analysed at the individual field level in hopes of identifying factors influencing duck use and production from planted cover and hay fields. These analyses include information from within fields and from surrounding habitats. Hopefully this work will provide field staff with information that can be used to help optimize project locations.

⇒ Assessment data are being used to explore the importance of hen body condition on reproductive success. This analysis will help determine the importance of cross-seasonal factors to mallard recruitment.

⇒ Assessment data are being used to better understand the timing of waterfowl nesting in haylands and the effect of cutting dates on waterfowl production. This analysis should help DUC operations staff identify minimum acceptable cutting dates for hay projects throughout the prairies.

⇒ Another analysis is exploring how landscape factors influence duckling survival, while a second analysis is investigating habitat selection by mallard broods. These analyses should help managers better understand what constitutes good brood habitat.

⇒ Assessment telemetry data are being used to examine female mallard home ranges during the breeding season. This work will compare home range attributes of successful and unsuccessful hens and lead to a better understanding of habitat components important to mallard production.

⇒ Assessment data will be analyzed in a GIS to explore the interplay between mallard nest site selection and nest success within those habitats. Gaining insight into the combination of these two important factors will provide information to help guide the acquisition and management of waterfowl habitat.