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Yukon Flats National Wildlife Refuge Report – 2016

Production of Lesser Scaup and other waterbirds at four locations within Yukon Flats National Wildlife Refuge, 2014-2016

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ABSTRACT

A waterbird production survey was implemented in 2014 and conducted through 2016 at four locations across the Yukon Flats National Wildlife Refuge. Timing of the survey was for peak emergence of Lesser Scaup broods. Teams of two observers counted waterbirds and recorded age class. Wetlands were counted twice, once by each observer. Differences between observers in counts of the same wetlands were evident, but the magnitude of this noise was less than an annual signal for late-nesting species. For such species (Lesser Scaup, Canvasback, White-winged Scoter), production was consistently reduced across locations in 2014 and 2016 relative to 2015. This was not as evident for earlier-nesting species, such as American Wigeon or Green-winged Teal.

INTRODUCTION

North of the White Mountains and south of the Brooks Range in eastern interior Alaska lies a vast complex of wetlands through which the Yukon River flows. Stretching approximately 300km from west to east, these wetlands provide breeding habitat in summer for waterbirds that come from wintering locations throughout the four North American flyways and beyond. Highly productive wetlands (Heglund and Jones 2003, Lewis et al. 2016) necessary for providing invertebrate food to newly hatched broods are the attraction, and each spring flocks of paired birds arrive to nest and rear their young. In recognition of the unique contribution of the wetlands along this flat section of the Yukon River to production of North American waterfowl, this region was designated a National Wildlife Refuge (NWR) in 1980 (ANILCA) and given the name Yukon Flats National Wildlife Refuge (YFNWR). For wildlife managers, documenting the contribution of the region's wetlands to annual production of waterbirds has long been a priority.

The first ground surveys of waterbird broods on YFNWR were by James King and Calvin Lensink, beginning in 1965 and continuing until 1971, then occurring inconsistently from 1973 to 1981 (Shively and Lake 2009). During the early to mid-1980s, Bruce Conant and Jack Hodges (and others) expanded these surveys to include other regions of Alaska (Hodges and Conant 1987). Concurrently, on the YFNWR, staff also surveyed 11 plots for broods (Vivion 1988, Heglund 1992). This Refuge survey was disbanded in the late 1980s while the office of Migratory Bird Management experimented with the use of airplanes and helicopters to survey waterbirds (Conant et al. 1988). These aerial efforts were discontinued after 1990 for various reasons. YFNWR staff again surveyed broods during 1998 using helicopter methods (Person and Bertram 1999). Lewis (2016) replicated the waterbird surveys of Heglund (1992) during 2010 to 2012, but on a subset of the original plots. Roach and Griffith (2015) surveyed broods on 123 wetlands during 2010 and 2011. In 2014, in response to recommendations from a biological program review (Martin and Bertram 2010), YFNWR staff once again began an annual index survey of waterbird production.

Unlike prior efforts, this most recent survey was timed for peak hatch of Lesser Scaup, a species whose density in Alaska is highest on the Yukon Flats NWR (Mallek and Groves 2011, Guldager et al. 2016), and whose population numbers throughout North America have declined (Zimpfer et al. 2013). In addition, in 2013, Lesser Scaup were designated a priority species by the Alaska USFWS (Region 7); thus, efforts to monitor this species are of heightened regional interest. Finally, in 2015, a team of USFWS biologists developed a conservation framework for Lesser Scaup that identified population threats, information needs, and management recommendations. Among those recommendations was an annual survey of production.

Objectives

1) Monitor annual trend in an index of brood production.
2) Monitor annual trend in brood age class.
3) Relate brood productivity over the long-term to landscape characteristics, consistent with strategic habitat conservation (SHC).
4) Relate duckling age class over the long-term to phenology.

METHODS

Study Area
Duck broods have been surveyed at 5 locations (Figures 1-4). A wetland complex by Track Lake (66.88900, -145.20400), Echoing Lake (66.27500, -149.34400), Plot F (66.61400, -146.80700), and Canvasback Lake (66.38500, -146.37900). The fifth location (Plot C) was surveyed in 2014, but has been discontinued from future consideration because of the marginal length of the landing lake for floatplane take off.

Sampling units and sample frame
The sampling frame included federal (non-private) lands with wetlands large enough to operate a float plane on (Cessna 185, Found Bush Hawk), and the sampling unit included surrounding satellite wetlands and the landing wetland. Note: the design of this study was primarily driven by limited funding (<$10K annually). Consequently, inference should be limited to the wetlands sampled and primary objectives were focused on temporal rather than spatial trends. With more available funding, wetlands could be sampled more efficiently from a helicopter using a probabilistic design (non-zero probability of selection), sample sizes could be increased, and inference could be made at a broader scale (see protocol developed by Walker and Lake 2012). Due also to fiscal reality, a goal of the survey design was to develop a simple protocol that could be implemented by permanent Refuge staff and volunteers with a wide range of experience and motivation in counting duck broods. Sample size recommendations were described in a brood survey protocol (Lake 2014).

Survey timing
Crew deployment (3-4 crews of 2) began approximately 21 July. Deployment date was based on: 1) numbers of ducklings on wetlands increasing just before that date on YFNWR (Lewis et al. 2014), and 2) hatch dates of Lesser Scaup nests on YFNWR from 2001-2008 (Lake 2014). Surveying was concurrent rather than by one or two crews that moved to different locations over a two to four week period, as was done in the past. Concurrent surveying was to minimize or eliminate spatial and temporal confounding.

Data collection
The general approach was that broods (≥1 duckling accompanied by a female, or chick accompanied by an adult in the case of Horned Grebes) of Lesser Scaup and other waterbirds were counted and age class recorded by two observers conducting replicate surveys (Pagano and Arnold 2009, Walker et al. 2013, Lewis et al. 2014). Wetland covariates were recorded, such as wind speed, survey duration, and percent emergent vegetation. Replicate surveys were conducted closely in time in an attempt to satisfy the assumption of closure. Observers were provided laminated maps of each landing area (Figures 1-4). Each wetland was marked with a unique number, which was referenced while conducting a survey.

For wetlands small enough to survey at a single point (i.e., the entire wetland was visible), observers generally surveyed back to back (an exception was at Wetland by Track Lake where were small wetlands were surveyed on different days because of logistical efficiencies). That is, an observer recorded observations, and upon finishing, the other observer rotated in and conducted their survey (observers sometimes used a spotting scope at such small wetlands; otherwise, binoculars were used). The second observer was instructed to turn their back or otherwise not watch the actions of the first observer. This was necessary for independence. It

was also important that the first observer did not disturb the wetland. Therefore, it was necessary to survey from a point that permitted observation while minimizing disturbance. For large wetlands where multiple survey points were necessary, replicate visits were conducted on subsequent days. That is, the first observer conducted a survey on day 1 and the second observer conducted their survey on day 2. For such large wetlands, observers moved between survey points using a small pak boat. At a survey point, observers were instructed to spend as long as necessary to identify and record all visible broods, surveying a minimum of 10 minutes. Broods seen while transiting with a boat were recorded when it was clear the brood would not be visible at a survey point. Observers sampled all wetlands on a first round of surveying, and then conducted a second round of surveying as time permitted.

Each brood was recorded as a separate line on the data sheet. Each brood observation included an adult female count and duckling/gosling/chick count by age class. Broody hens were also counted. Broody hens were hens without a visible brood, making a distraction display. All species of duck or goose broods were recorded, in addition to loon and grebe chicks. If observers were unsure of species, they recorded notes, consulted a field guide, or took a photo. Broods comprised of multiple species and/or age classes were occasionally observed. Observers were instructed to break those out by species/age class using separate lines on the data sheet. Photos of large broods (up to ~60 ducklings) aided those counts.

Data analysis

Counts of ducklings, goslings, and chicks were summed by species, location (wetland landing area), year, and observer. Counts were summed only for the first round of surveying, as not all wetlands were surveyed during the second round. Only locations with >1 year of surveying were included (i.e., Plot C in 2014 and Echoing Lake in 2016 were not included in this report). Median brood size was estimated for broods attended by ≥1 female; broods without a female were omitted because brood counts may have been incomplete. Counts were summarized for the following species: Lesser Scaup, Canvasback, White-winged Scoter, Horned Grebe, American Wigeon, and Green-winged Teal; for the remaining species, data were sparse.

RESULTS

Survey dates and wetlands sampled

In 2014, surveying was from 23 July to 26 July (Plot C), 22 July to 29 July (Canvasback Lake), and 22 July to 27 July (Wetland by Track Lake). In 2015, surveying was from 22 July to 27 July (Plot F), 21 July to 27 July (Canvasback Lake), and 22 July to 30 July (Wetland by Track Lake). In 2016, surveying was from 24 July to 29 July (Plot F), 21 July to 26 July (Canvasback Lake), 24 July to 31 July (Wetland by Track Lake), and 20 July to 25 July (Echoing Lake).

Total wetlands sampled were 32 in 2014, 35 in 2015, and 44 in 2016 (Table 1). Specific ID's of wetlands sampled were in Table 1.

Lesser Scaup

In 2015, the duckling production index was 2 to 11 times greater than 2014 or 2016, and this was consistent across the three locations. Similarly, median brood sizes trended toward larger broods in 2015. Observer differences were present, but with the exception of Track Lake in 2015, observer differences were less than annual differences. Age classes trended toward younger ducklings.

White-winged Scoter
In 2015, the duckling production index was 2 to 4 times greater than 2014 or 2016, and this was consistent across the three locations. Notably, at Plot F, there were zero ducklings observed in 2016 while in 2015, 61 were observed. There was no clear trend in median brood sizes. Observer differences were present, but were minimal relative to annual differences. Age classes were heavily skewed toward younger ducklings.

Canvasback
In 2015, the duckling production index was 2 to 3 times greater than 2014 or 2016 and this was consistent at two locations. At Plot F, 31 ducklings were observed by a single observer and zero by the other in 2015; thus, observer differences muddied the picture. In 2016 at Plot F, zero ducklings were observed by both observers. There was no clear trend in median brood sizes. Observer differences were present, but not as great relative to annual differences. Observer differences for Canvasback were greater than for the other diving ducks, Lesser Scaup and White-winged Scoter. Age classes were spread across the range of ages, but trended toward the younger.

American Wigeon
A signal of greater duckling production in 2015 was less pronounced. Observer differences were evident; there was a wide range between observers with some locations exhibiting little difference and others with extreme differences. Some observer differences were on par with annual differences. Median brood sizes did not exhibit any clear trend. Age classes trended toward the moderate age classes (1b-2b), with few 1a ducklings.

Green-winged Teal
At plot F, a lack of data prevented much inference. For the other 2 locations, production seemed greatest in 2014 (Wetland by Track Lake) or generally constant across years (Canvasback Lake). No clear trend in brood sizes was evident. Observer differences were evident, and in some cases of similar magnitude to annual differences. Age classes trended toward older ducklings.

Horned Grebe
Production may have been greater in 2015 than 2014 or 2016, but a clear trend was not present. Instead, observer differences may have obscured any trend. Brood sizes tended to be low, likely because this species didn’t forage as a group like with waterfowl. Age classes were moderate.

DISCUSSION
This simple waterbird production survey evolved from a more rigorous protocol that was developed, but not implemented because of funding shortfalls (Walker and Lake 2012). The current version costs less than $10K annually and provides managers with a coarse-level index of annual waterbird production. Information is probably adequate for day-to-day management of the YFNWR, and for presentation to the public, such as at regional advisory council meetings. If finer-scale resolution or more reliable inference is required, for instance to inform controversial decision making, then the more expensive protocol of Walker and Lake (2012) or similar should be implemented.

For late nesting species, such as Lesser Scaup, Canvasback, and White-winged Scoter, production was reduced in 2014 and 2016 relative to 2015. Most striking was the consistency of this pattern across the 3 locations, implying a large-scale influence(s). Summer 2014 was characterized by above-average rainfall (6.1 and 8.5 inches in June and July, respectively, in Fort Yukon; http://wcc.sc.egov.usda.gov/nwcc/site?sitenum=961). Perhaps the pattern of lower production reflected flooding of nests and mortality of newly hatched ducklings from precipitation. Another possibility was nest depredation and alternate prey. Anecdotal observations suggested mesopredator numbers were on the rise. At some locations, small mammals were observed in 2015, but not 2016. While all this was speculative and the possibility existed that unexplained factors were responsible, one factor seemed unlikely. Delayed nesting in 2014 and 2016, resulting in later brood emergence. In 2016, Yukon River ice breakup was the earliest recorded (1 May; 12 May 2015; 6 May 2014; http://w2.weather.gov/aprfc/breakupDB?site=472). Furthermore, observations at some locations of flighted female Lesser Scaup in groups ranging from two to twelve reinforced that nest and/or early brood loss occurred in 2016. Also in 2016 at Plot F and Wetland by Track Lake, it was worth mentioning that molting birds were absent unlike prior years, though the reason for this was not clear.

As brood counts were replicated at the same wetland by different observers, this provided an opportunity to explore observer differences. Two things seemed evident. First, some of the most extreme variation was when an experienced observer was paired with an inexperienced observer. Second, species differences in sightability were probably reflected as some observer differences through an interaction with experience. On a continuum of sightability from easiest to hardest, White-winged Scoter was probably the easiest to detect, then Lesser Scaup, Horned Grebe, Canvasback, with American Wigeon and Green-winged Teal being the hardest. Some of the variability between observers in production of American Wigeon and Green-winged Teal was probably because of more difficult sightability. This contributed to more noise in the data. Conversely, the clearer signal for Lesser Scaup and White winged Scoter was probably from less noise in the data owing to easier and more consistent detection. These species usually stay on the wetland instead of seeking cover in emergent vegetation. For the latter species, it is noteworthy that while observer differences were evident, the magnitude was less than annual differences.

Perhaps one day information such as this could be used in the adaptive management process to inform waterfowl harvest regulations. In the past, a criticism of brood surveys in Alaska was the information came too late to be used in setting the fall's waterfowl hunting regulations. However, a new approach to setting harvest regulations that makes use of lagged information has been developed and will be implemented shortly (Johnson et al. 2016).

Shortcomings and future improvements

When interpreting or sharing these results, it cannot be stressed enough that abundance was confounded with sightability or detection. In other words, a count might not have been high (or low) simply because there were actually many (or few) waterbird broods. Instead, an alternate explanation could have been that a brood(s) was easier (or harder) to detect. Replicate surveys of the same wetland by different observers provided an idea of the magnitude of observer differences described above, but did not explicitly correct for these differences. Disentangling abundance from observer differences can be accomplished, but is more expensive, requiring a

greater sample size of wetlands surveyed (150 at a minimum). With the current sample size (32 to 44 wetlands), observer difference could probably be decoupled from the probability that a wetland was occupied by a particular species (i.e., occupancy models). In the future, if there were a management need to estimate wetland occupancy of a species, this survey could be a first step to address that need.

The data bear out the value of experienced surveyors, and such individuals should be enlisted in data collection whenever possible.

It is likely that just one airplane will be available for future crew deployment, whereas in the past two airplanes were used. In order to make the 600 pound limit in one load, it might be worth considering storing pak boats and other camp gear in the metal bear barrels that remain in the field.

Beginning in 2017, a time-lapse camera will be deployed at each landing lake in late winter to document phenology of breakup and fluctuations in water.

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Table 1. Surveyed wetland ID's by year and location.

	Plot F	Canvasback Lake	Wetland by Track Lake	Plot C	Echoing Lake
2014	not surveyed	3,4,6,11,13,14,16,30,31,32,33,34,35,36	1,2,6,9,10,11,12,13,15,16	9, 10, 11, 16, 18, 19, 22, 23	not surveyed
2015	1,2,3,4,6,7,8,9,10,11,12	3,4,6,11,13,14,16,30,31,32,33,34,35,36	1,2,6,9,10,11,12,13,15,16	not surveyed	not surveyed
2016	1,2,3,4,6,7,8,9,10,11,12	3,4,6,11,13,14,16,30,31,32,33,34,35,36	2,6,9,10,11,12,13,15,16	not surveyed	1, 9, 10, 12, 13, 14, 16, 17, 18, 19

Figure 1. Echoing Lake survey area.

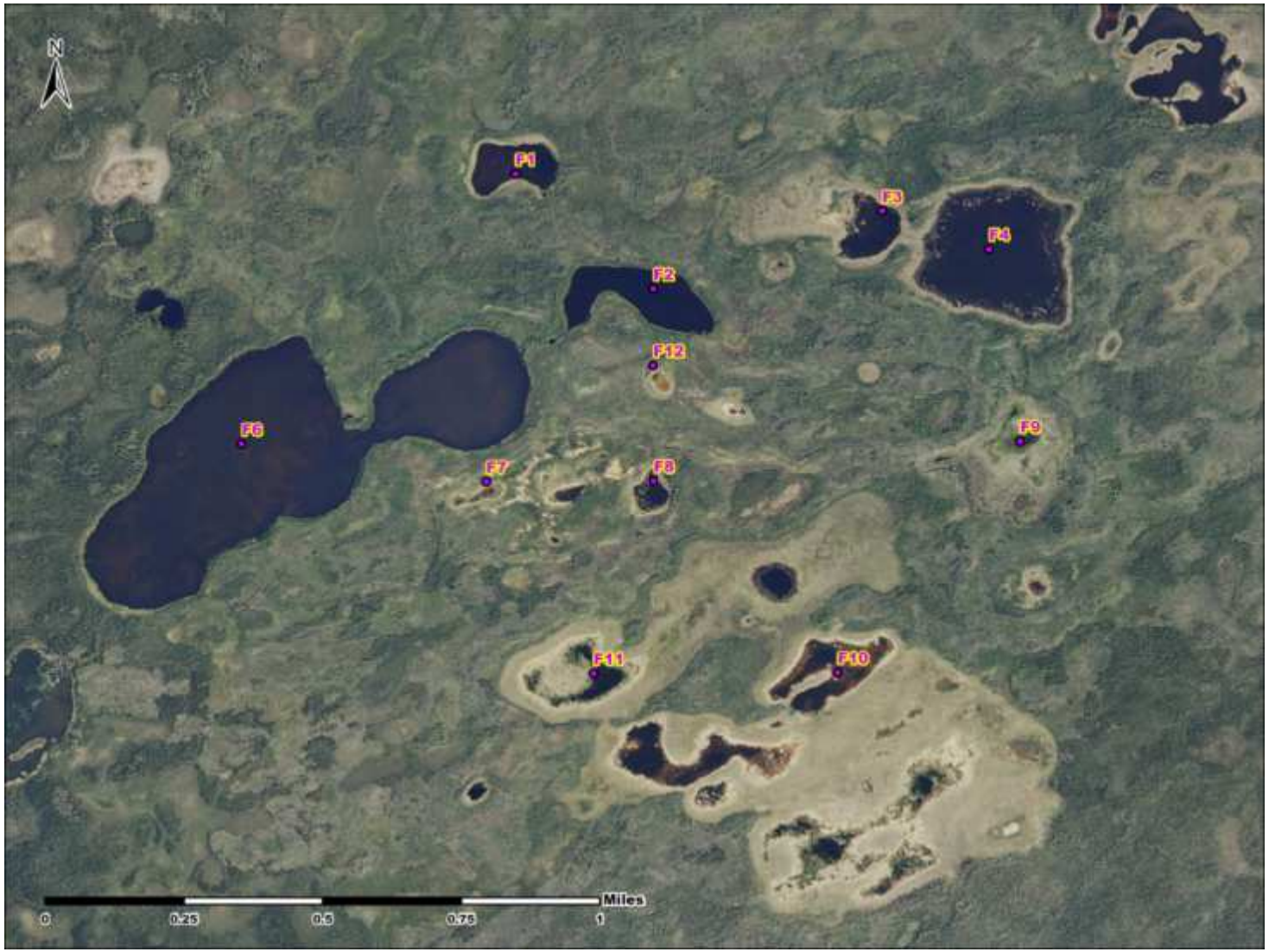


Figure 2. Plot F survey area.

Figure 3. Canvasback Lake survey area.

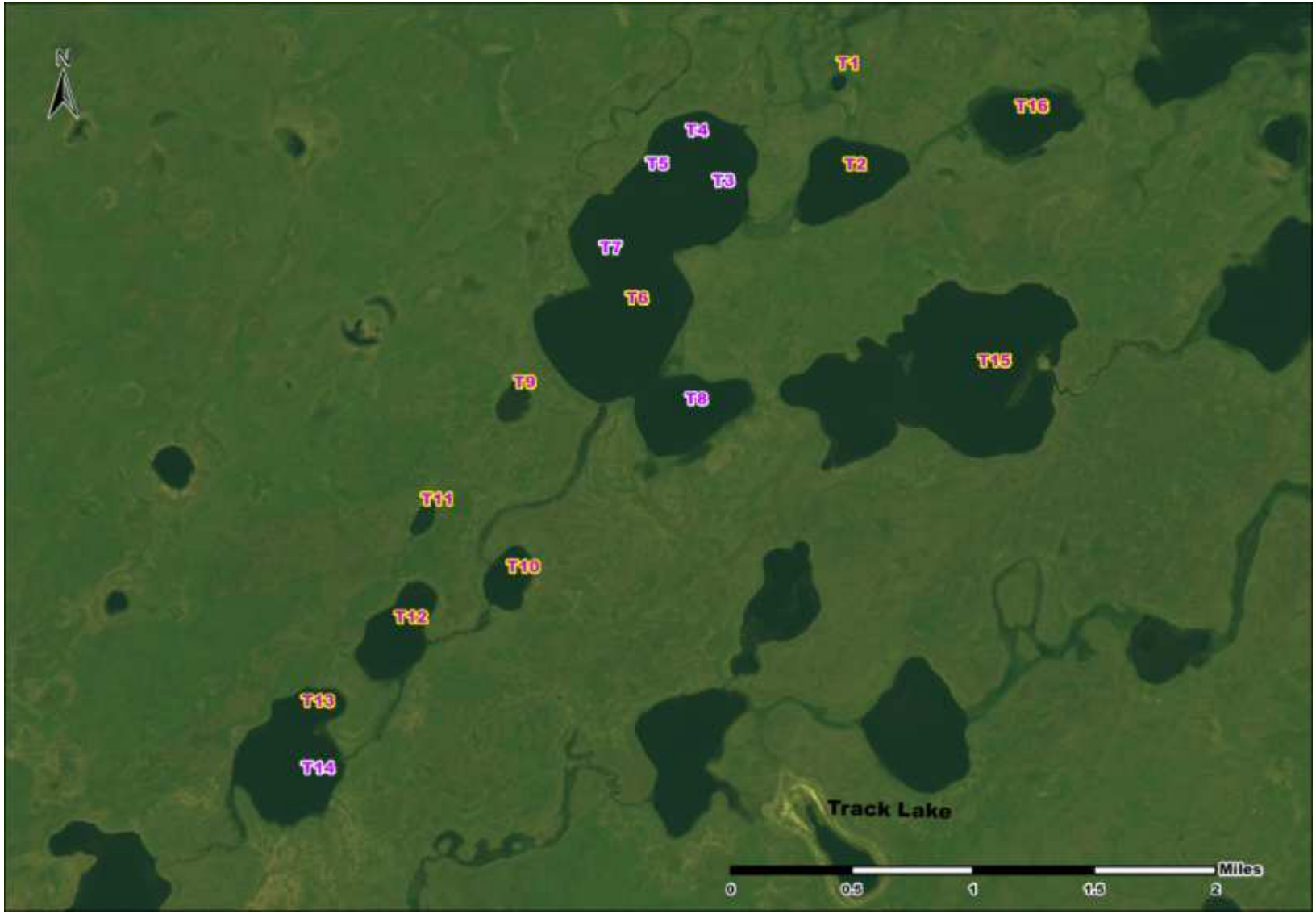
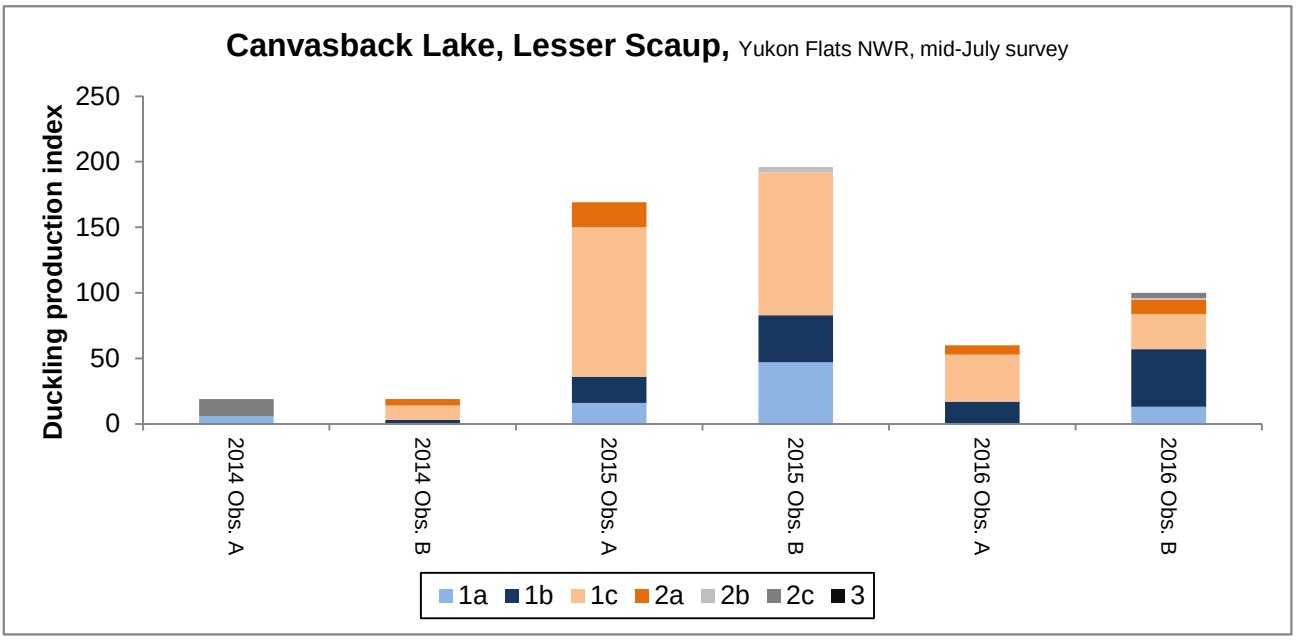
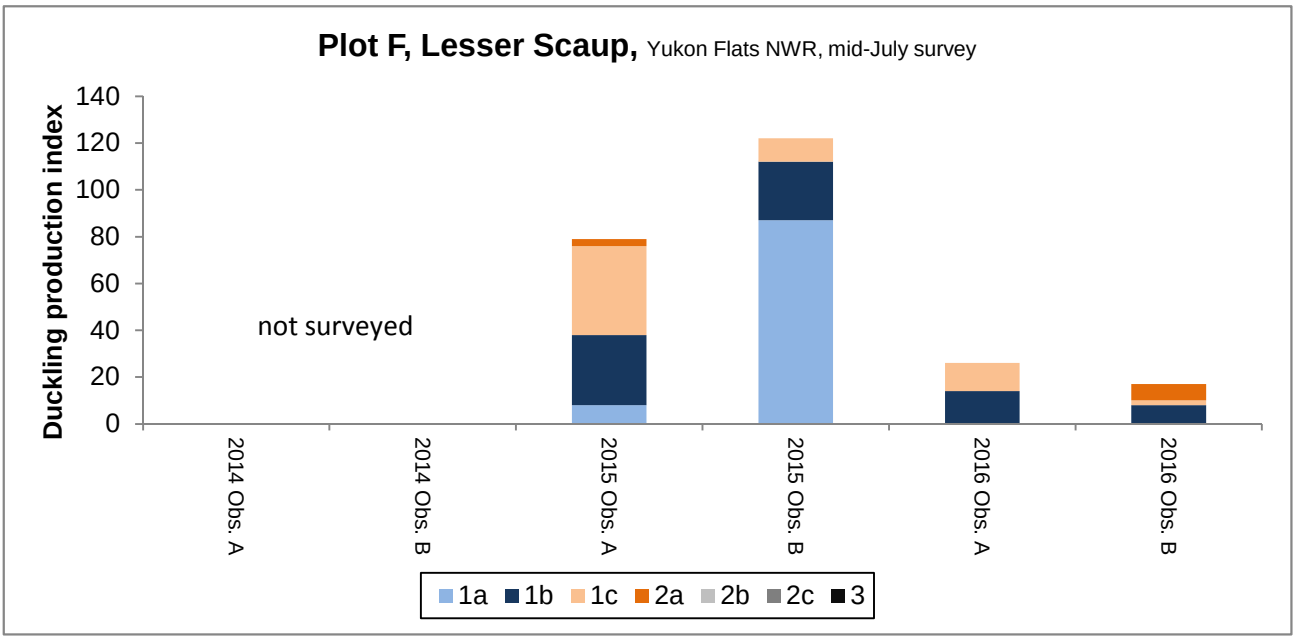


Figure 4. Wetland by track lake survey area. Red/yellow numbers refer to current (higher water) wetland ID's. Pink/white numbers refer to lower water wetland ID's.



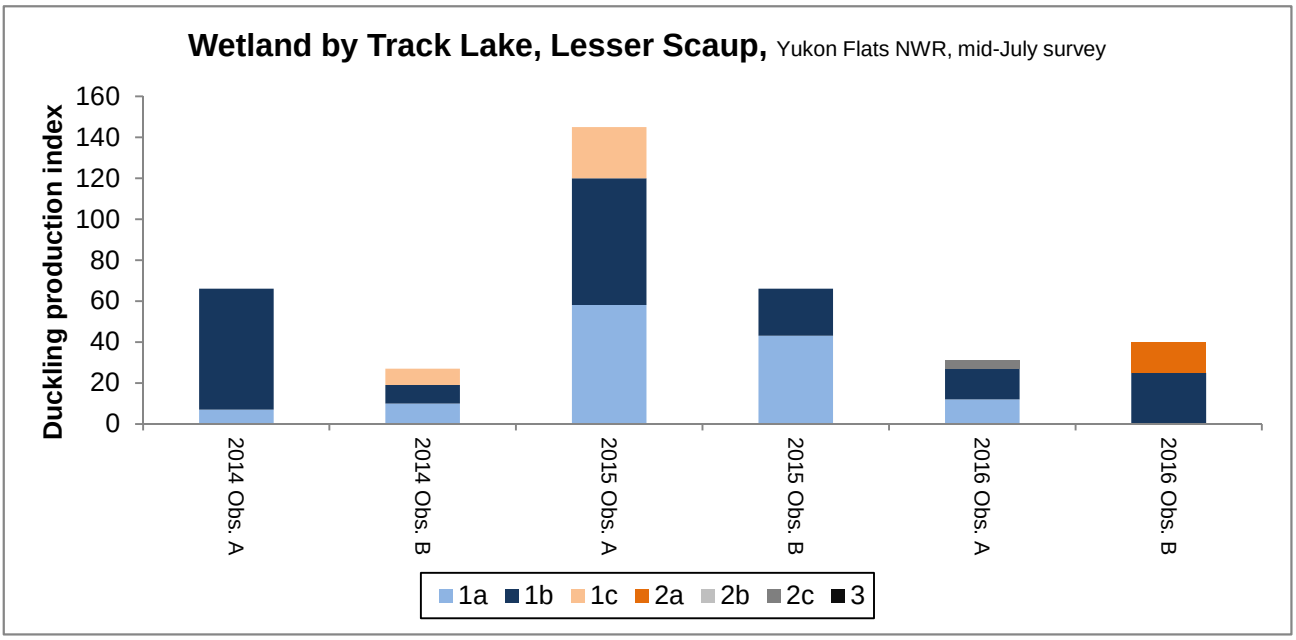
	1a	1b	1c	2a	2b	2c	3	total	n wetlands	median brood size (n)
2014 Obs. A	6	0	0	0	0	13	0	19	14	6.0 (3)
2014 Obs. B	0	3	11	5	0	0	0	19	14	5.0 (4)
2015 Obs. A	16	20	114	19	0	0	0	169	14	8.0 (18)
2015 Obs. B	47	36	109	0	4	0	0	196	14	8.0 (19)
2016 Obs. A	0	17	36	7	0	0	0	60	14	6.5 (10)
2016 Obs. B	13	44	27	11	1	4	0	100	14	7.0 (13)

Duckling production index for Lesser Scaup on Yukon Flats National Wildlife Refuge, Canvasback Lake. Counts by age class are represented, along with the corresponding total and number of wetlands sampled. Wetlands are sampled twice and counts are reported for each observer. Median brood size for broods attended by a hen is presented, with sample size in parentheses.



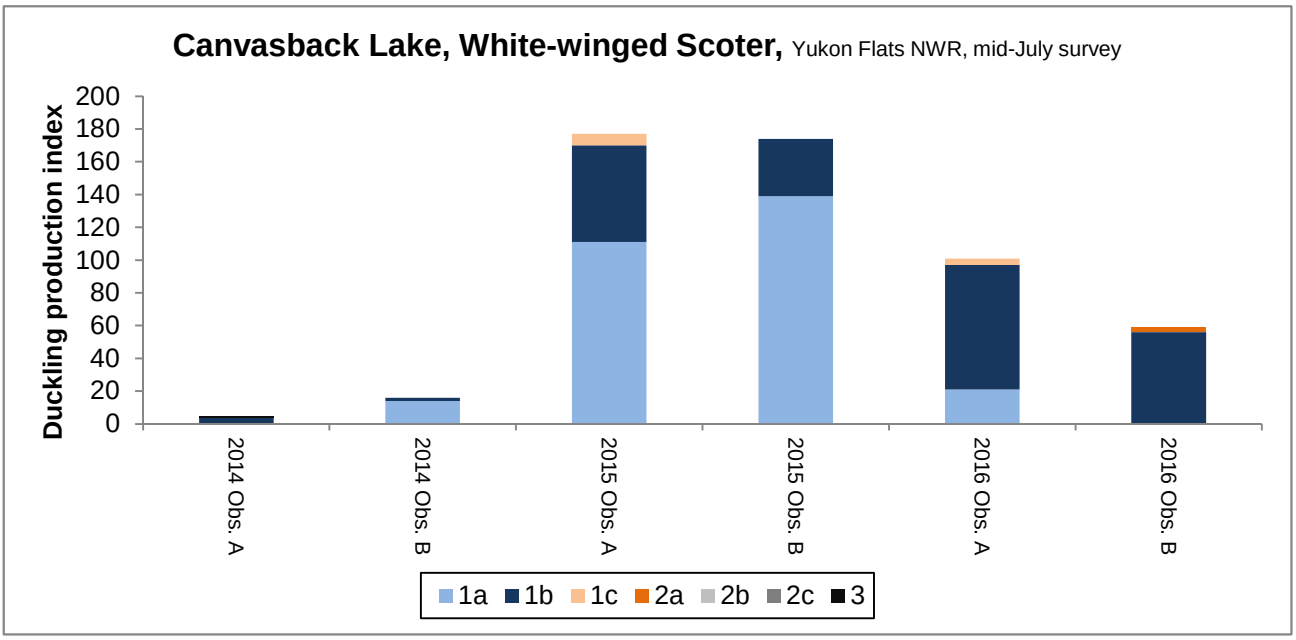
	1a	1b	1c	2a	2b	2c	3	total	n wetlands	median brood size (n)
2014 Obs. A	not surveyed									
2014 Obs. B	not surveyed									
2015 Obs. A	8	30	38	3	0	0	0	79	11	4.0 (13)
2015 Obs. B	87	25	10	0	0	0	0	122	9	7.0 (15)
2016 Obs. A	0	14	12	0	0	0	0	26	11	4.0 (6)
2016 Obs. B	0	8	2	7	0	0	0	17	11	3.5 (4)

Duckling production index for Lesser Scaup on Yukon Flats National Wildlife Refuge, Plot F. Counts by age class are presented, along with the corresponding total and number of wetlands sampled. Wetlands are sampled twice and counts are reported for each observer. Median brood size for broods attended by a hen is presented, with sample size in parentheses.



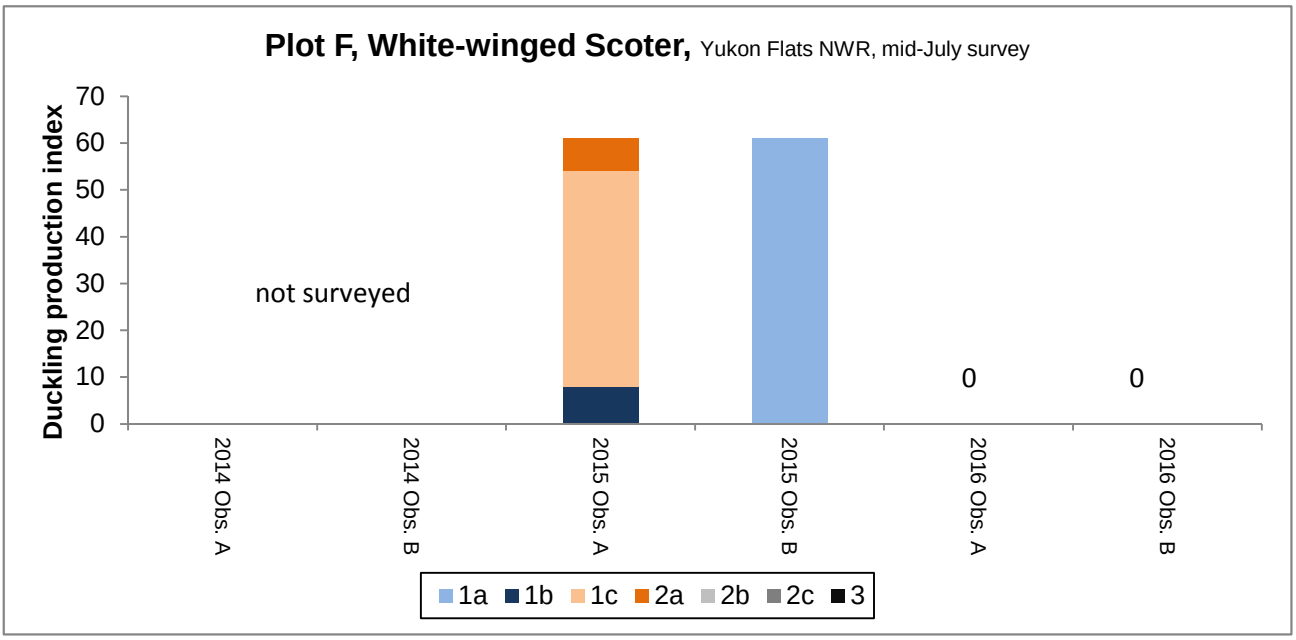
	1a	1b	1c	2a	2b	2c	3	total	n wetlands	median brood size (n)
2014 Obs. A	7	59	0	0	0	0	0	66	10	8.0 (6)
2014 Obs. B	10	9	8	0	0	0	0	27	10	5.0 (4)
2015 Obs. A	58	62	25	0	0	0	0	145	10	7.0 (17)
2015 Obs. B	43	23	0	0	0	0	0	66	10	6.0 (10)
2016 Obs. A	12	15	0	0	0	4	0	31	9	4.0 (5)
2016 Obs. B	0	25	0	15	0	0	0	40	9	6.0 (7)

Duckling production index for Lesser Scaup on Yukon Flats National Wildlife Refuge, Wetland by Track Lake. Counts by age class are represented, along with the corresponding total and number of wetlands sampled. Wetlands are sampled twice and counts are reported for each observer. Median brood size for broods attended by a hen is presented, with sample size in parentheses.



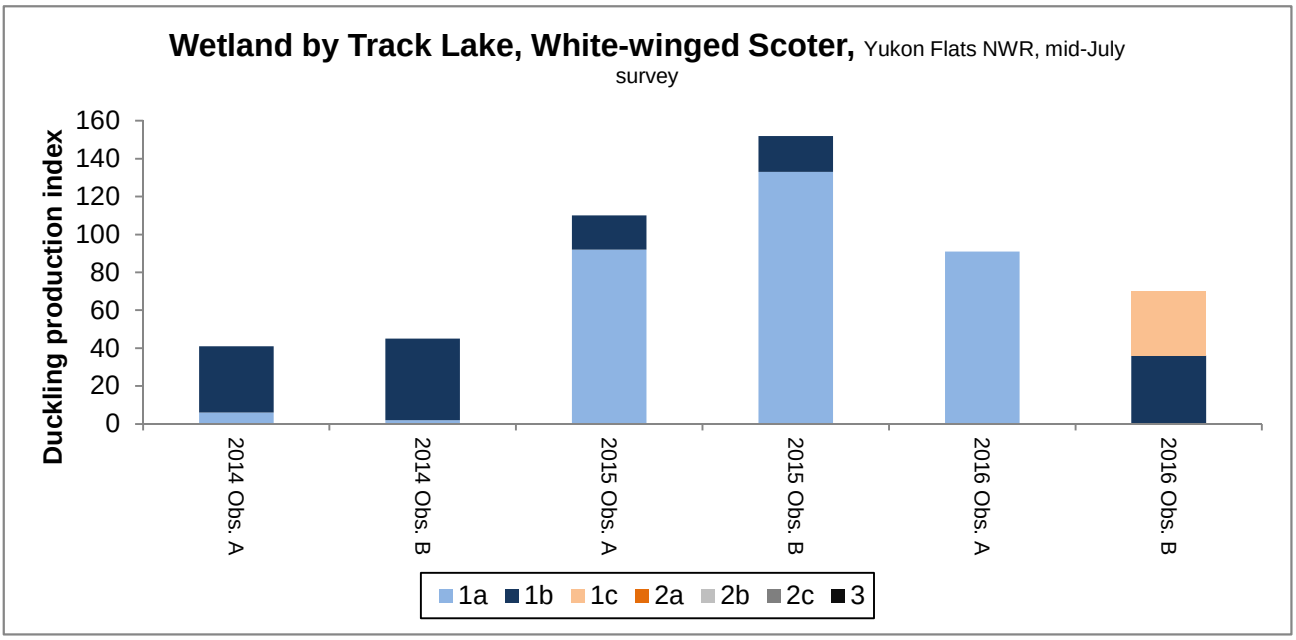
	1a	1b	1c	2a	2b	2c	3	total	n wetlands	median brood size (n)
2014 Obs. A	0	4	0	0	0	0	1	5	14	2.5 (2)
2014 Obs. B	14	2	0	0	0	0	0	16	14	3.0 (4)
2015 Obs. A	111	59	7	0	0	0	0	177	14	10.0 (11)
2015 Obs. B	139	35	0	0	0	0	0	174	14	11.0 (11)
2016 Obs. A	21	76	4	0	0	0	0	101	14	6.0 (9)
2016 Obs. B	0	56	0	3	0	0	0	59	14	3.0 (3)

Duckling production index for White-winged Scoter on Yukon Flats National Wildlife Refuge, Canvasback Lake. Counts by age class are represented, along with the corresponding total and number of wetlands sampled. Wetlands are sampled twice and counts are reported for each observer. Median brood size for broods attended by a hen is presented, with sample size in parentheses.



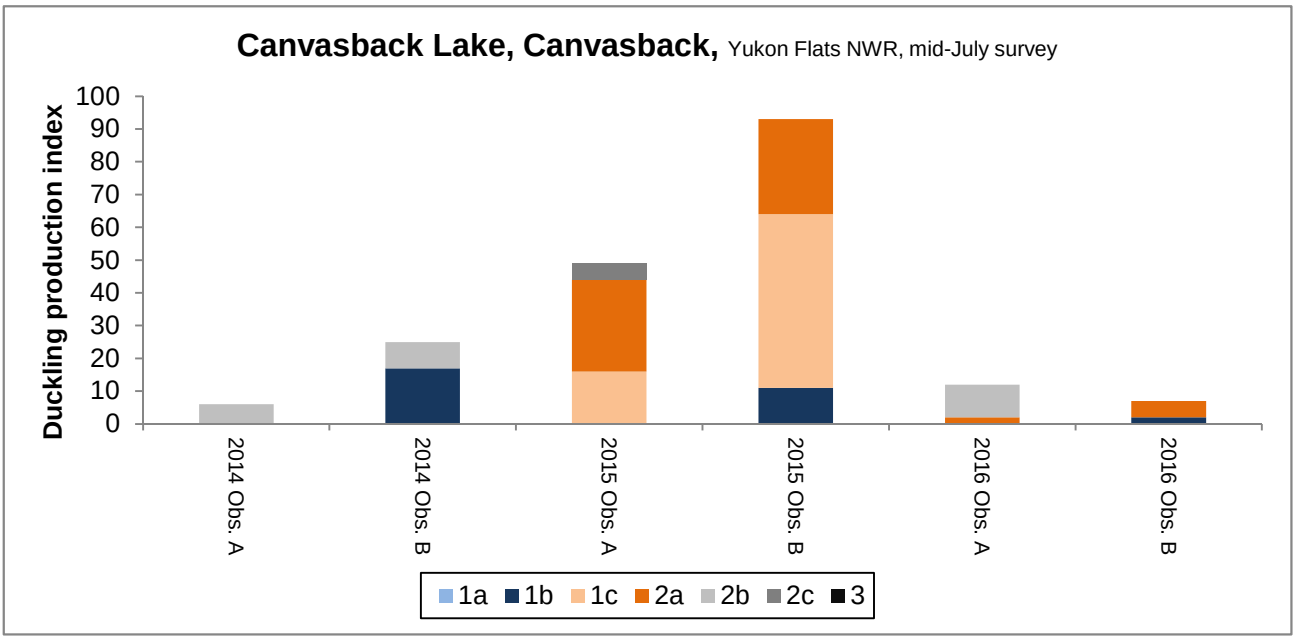
	1a	1b	1c	2a	2b	2c	3	total	n wetlands	median brood size (n)
2014 Obs. A		not surveyed								
2014 Obs. B		not surveyed								
2015 Obs. A	0	8	46	7	0	0	0	61	11	8.0 (3)
2015 Obs. B	61	0	0	0	0	0	0	61	9	30.5 (2)
2016 Obs. A	0	0	0	0	0	0	0	0	11	
2016 Obs. B	0	0	0	0	0	0	0	0	11	

Duckling production index for White-winged Scoter on Yukon Flats National Wildlife Refuge, Plot F. Counts by age class are represented, along with the corresponding total and number of wetlands sampled. Wetlands are sampled twice and counts are reported for each observer. Median brood size for broods attended by a hen is presented, with sample size in parentheses.



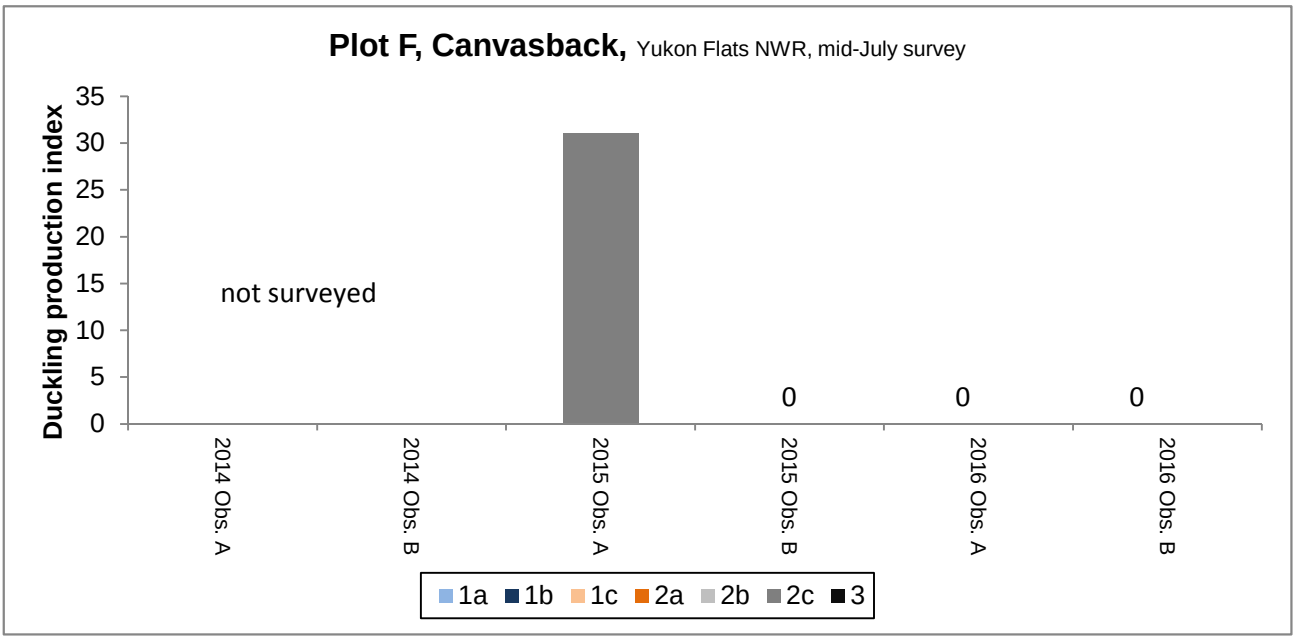
	1a	1b	1c	2a	2b	2c	3	total	n wetlands	median brood size (n)
2014 Obs. A	6	35	0	0	0	0	0	41	10	19.5 (2)
2014 Obs. B	2	43	0	0	0	0	0	45	10	4.0 (3)
2015 Obs. A	92	18	0	0	0	0	0	110	10	8.5 (10)
2015 Obs. B	133	19	0	0	0	0	0	152	10	8.0 (13)
2016 Obs. A	91	0	0	0	0	0	0	91	9	17.0 (5)
2016 Obs. B	0	36	34	0	0	0	0	70	9	10.0 (5)

Duckling production index for White-winged Scoter on Yukon Flats National Wildlife Refuge, Wetland by Track Lake. Counts by age class are represented, along with the corresponding total and number of wetlands sampled. Wetlands are sampled twice and counts are reported for each observer. Median brood size for broods attended by a hen is presented, with sample size in parentheses.



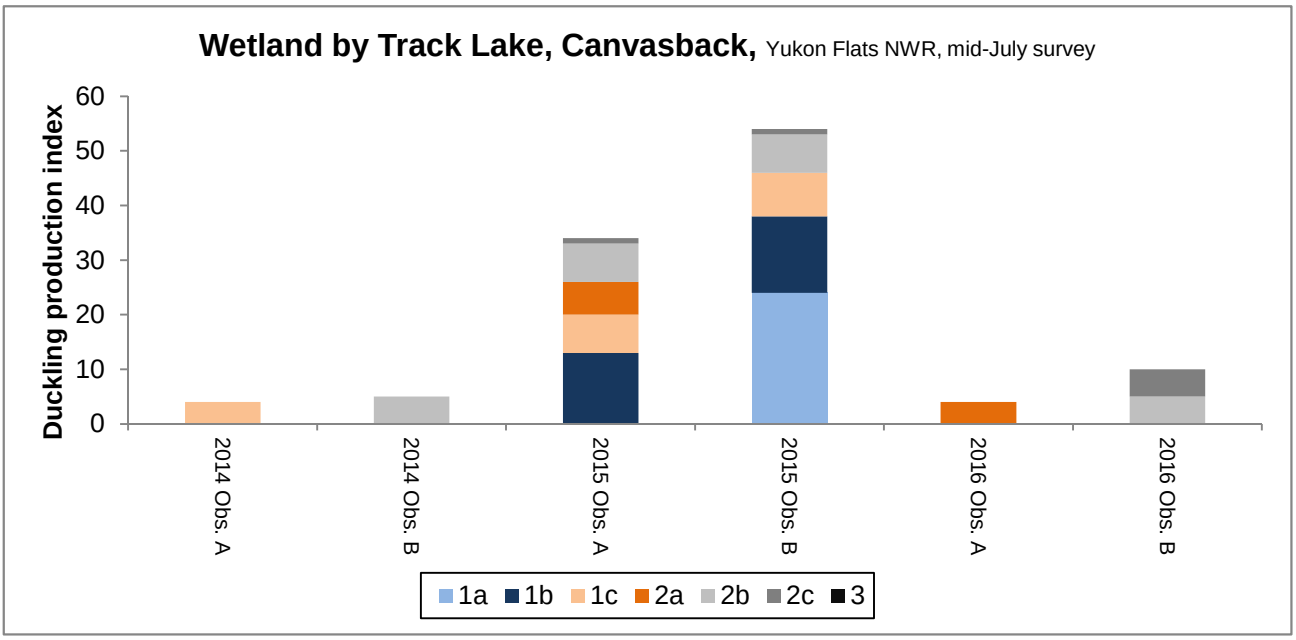
	1a	1b	1c	2a	2b	2c	3	total	n wetlands	median brood size (n)
2014 Obs. A	0	0	0	0	6	0	0	6	14	6.0 (1)
2014 Obs. B	0	17	0	0	8	0	0	25	14	6.0 (4)
2015 Obs. A	0	0	16	28	0	5	0	49	14	5.5 (6)
2015 Obs. B	0	11	53	29	0	0	0	93	14	8.5 (12)
2016 Obs. A	0	0	0	2	10	0	0	12	14	3.0 (4)
2016 Obs. B	0	2	0	5	0	0	0	7	14	2.0 (3)

Duckling production index for Canvasback on Yukon Flats National Wildlife Refuge, Canvasback Lake. Counts by age class are represented, along with the corresponding total and number of wetlands sampled. Wetlands are sampled twice and counts are reported for each observer. Median brood size for broods attended by a hen is presented, with sample size in parentheses.



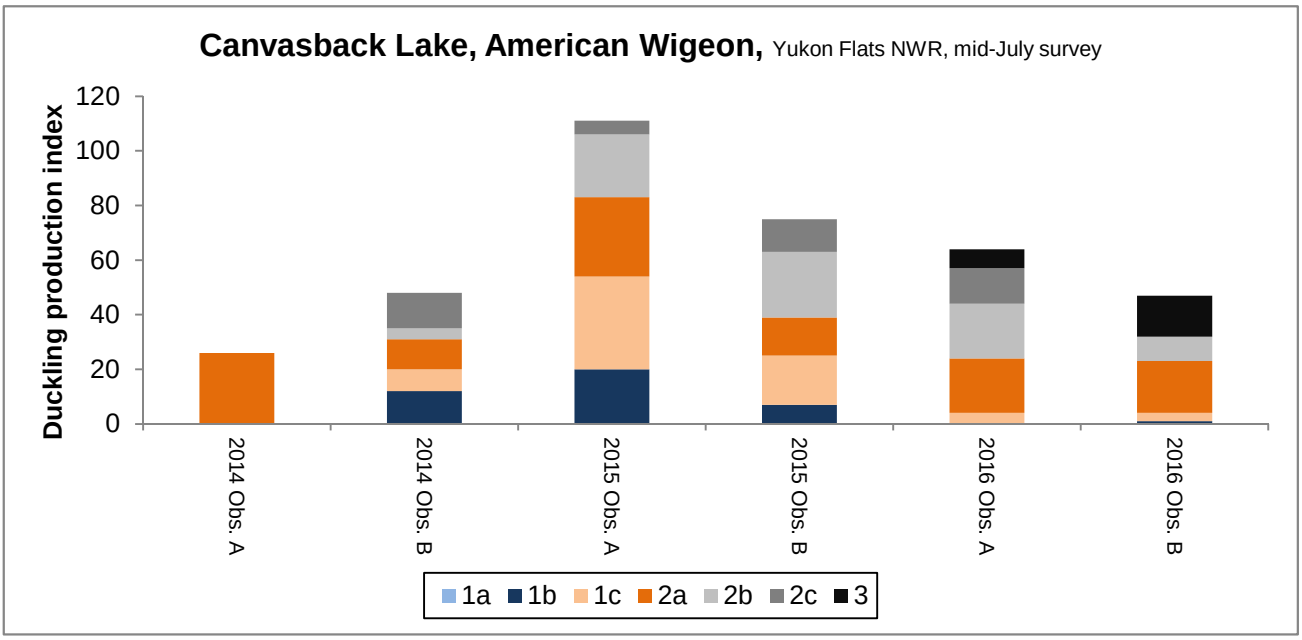
	1a	1b	1c	2a	2b	2c	3	total	n wetlands	median brood size (n)
2014 Obs. A		not surveyed								
2014 Obs. B		not surveyed								
2015 Obs. A	0	0	0	0	0	31	0	31	11	7.0 (5)
2015 Obs. B	0	0	0	0	0	0	0	0	9	
2016 Obs. A	0	0	0	0	0	0	0	0	11	
2016 Obs. B	0	0	0	0	0	0	0	0	11	

Duckling production index for Canvasback on Yukon Flats National Wildlife Refuge, Plot F. Counts by age class are represented, along with the corresponding total and number of wetlands sampled. Wetlands are sampled twice and counts are reported for each observer. Median brood size for broods attended by a hen is presented, with sample size in parentheses.



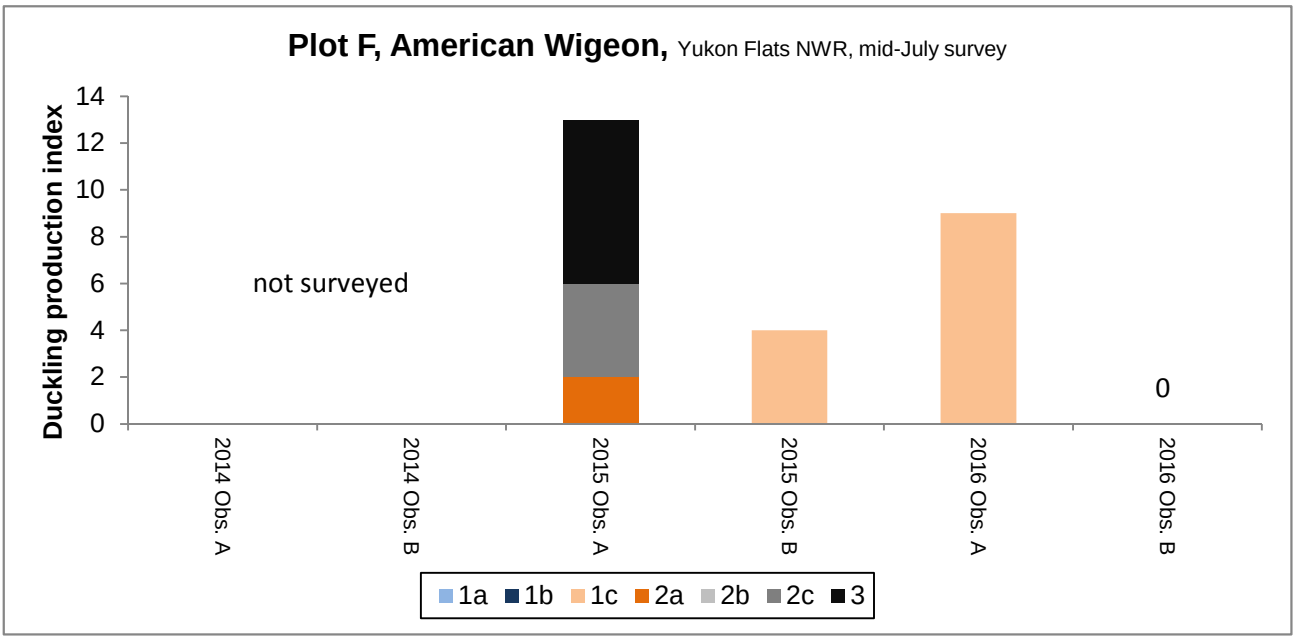
	1a	1b	1c	2a	2b	2c	3	total	n wetlands	median brood size (n)
2014 Obs. A	0	0	4	0	0	0	0	4	10	---
2014 Obs. B	0	0	0	0	5	0	0	5	10	5.0 (1)
2015 Obs. A	0	13	7	6	7	1	0	34	10	2.5 (10)
2015 Obs. B	24	14	8	0	7	1	0	54	10	3.0 (13)
2016 Obs. A	0	0	0	4	0	0	0	4	9	4.0 (1)
2016 Obs. B	0	0	0	0	5	5	0	10	9	5.0 (2)

Duckling production index for Canvasback on Yukon Flats National Wildlife Refuge, Wetland by Track Lake. Counts by age class are represented, along with the corresponding total and number of wetlands sampled. Wetlands are sampled twice and counts are reported for each observer. Median brood size for broods attended by a hen is presented, with sample size in parentheses.



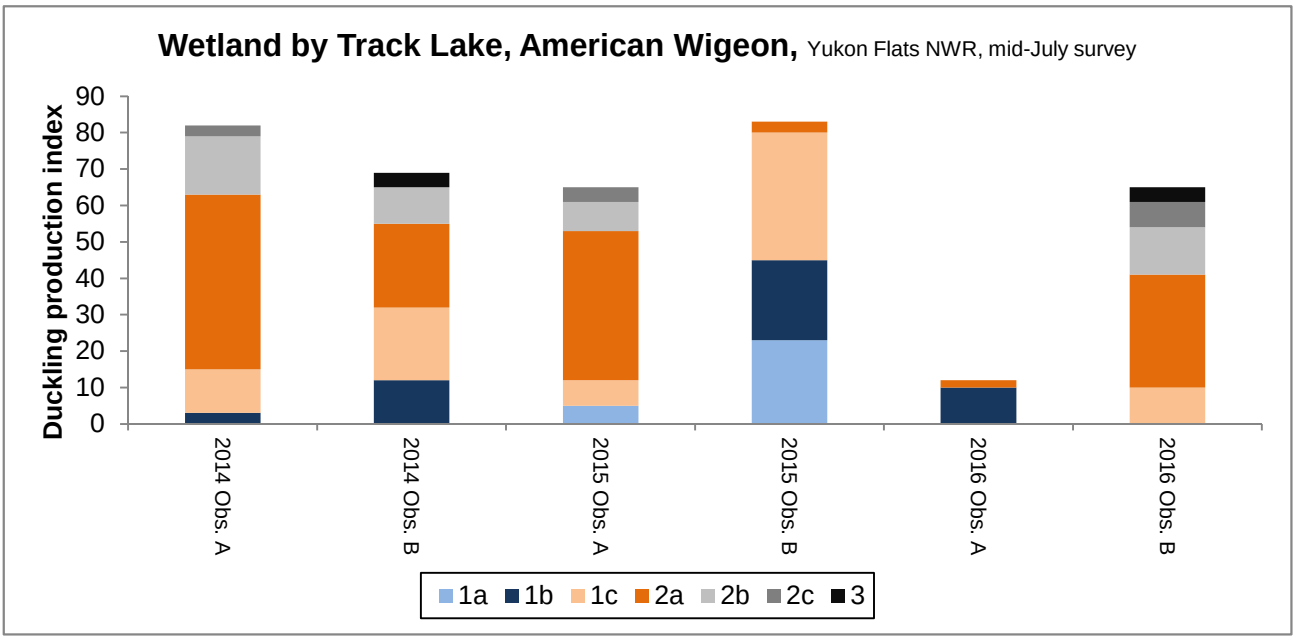
	1a	1b	1c	2a	2b	2c	3	total	n wetlands	median brood size (n)
2014 Obs. A	0	0	0	26	0	0	0	26	14	6.5 (4)
2014 Obs. B	0	12	8	11	4	13	0	48	14	3.0 (14)
2015 Obs. A	0	20	34	29	23	5	0	111	14	6.0 (17)
2015 Obs. B	0	7	18	14	24	12	0	75	14	5.0 (15)
2016 Obs. A	0	0	4	20	20	13	7	64	14	4.0 (15)
2016 Obs. B	0	1	3	19	9	0	15	47	14	3.5 (10)

Duckling production index for American Wigeon on Yukon Flats National Wildlife Refuge, Canvasback Lake. Counts by age class are represented, along with the corresponding total and number of wetlands sampled. Wetlands are sampled twice and counts are reported for each observer. Median brood size for broods attended by a hen is presented, with sample size in parentheses.



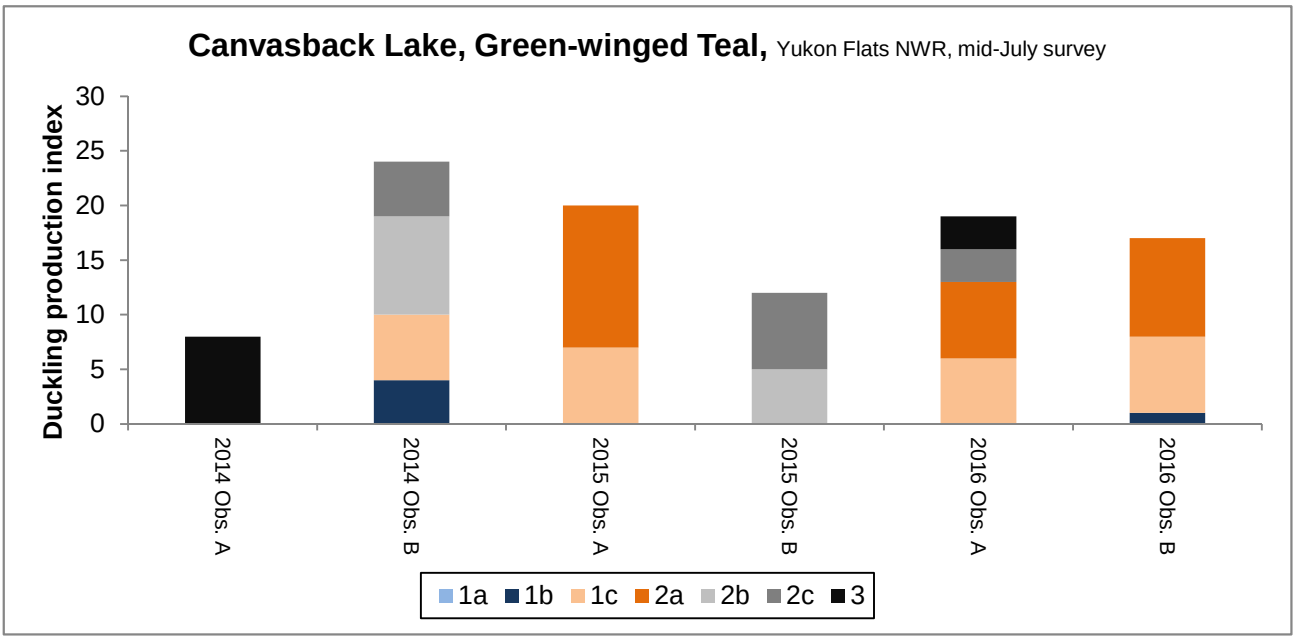
	1a	1b	1c	2a	2b	2c	3	total	n wetlands	median brood size (n)
2014 Obs. A	not surveyed							0		
2014 Obs. B	not surveyed							0		
2015 Obs. A	0	0	0	2	0	4	7	13	11	4.0 (3)
2015 Obs. B	0	0	4	0	0	0	0	4	9	4.0 (1)
2016 Obs. A	0	0	9	0	0	0	0	9	11	4.5 (2)
2016 Obs. B	0	0	0	0	0	0	0	0	11	

Duckling production index for American Wigeon on Yukon Flats National Wildlife Refuge, Plot F. Counts by age class are represented, along with the corresponding total and number of wetlands sampled. Wetlands are sampled twice and counts are reported for each observer. Median brood size for broods attended by a hen is presented, with sample size in parentheses.



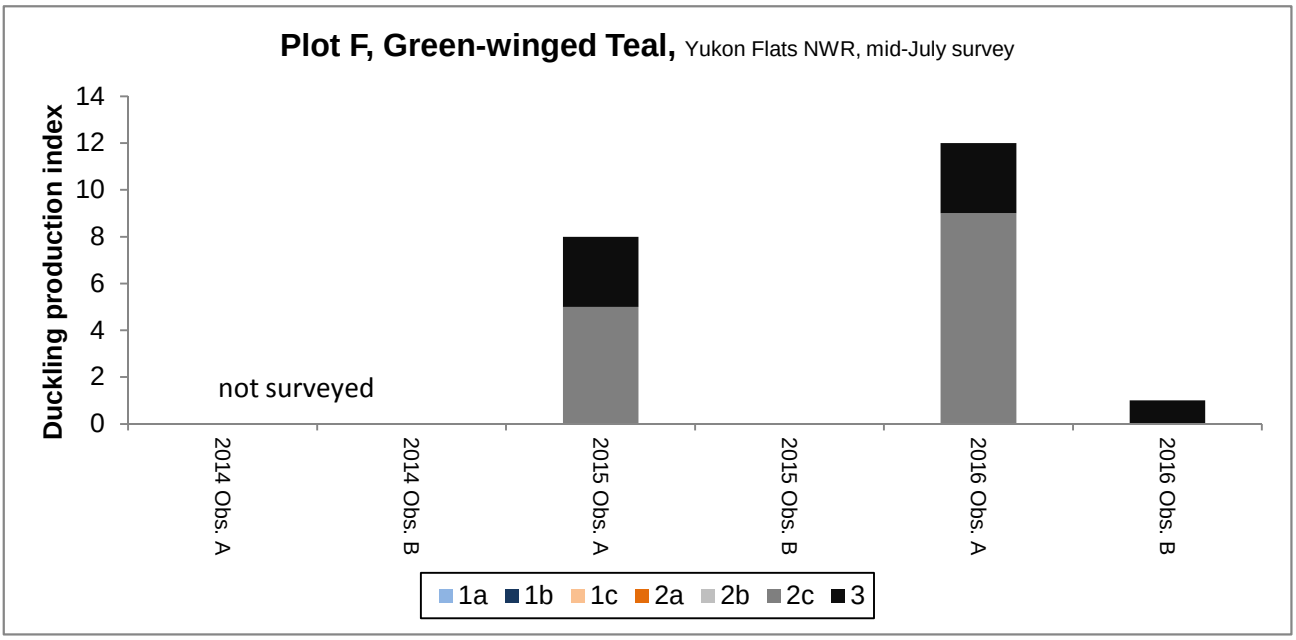
	1a	1b	1c	2a	2b	2c	3	total	n wetlands	median brood size (n)
2014 Obs. A	0	3	12	48	16	3	0	82	10	6.0 (12)
2014 Obs. B	0	12	20	23	10	0	4	69	10	5.0 (13)
2015 Obs. A	5	0	7	41	8	4	0	65	10	5.0 (13)
2015 Obs. B	23	22	35	3	0	0	0	83	10	3.0 (14)
2016 Obs. A	0	10	0	2	0	0	0	12	9	2.0 (3)
2016 Obs. B	0	0	10	31	13	7	4	65	9	4.0 (13)

Duckling production index for American Wigeon Yukon Flats National Wildlife Refuge, Wetland by Track Lake. Counts by age class are represented, along with the corresponding total and number of wetlands sampled. Wetlands are sampled twice and counts are reported for each observer. Median brood size for broods attended by a hen is presented, with sample size in parentheses.



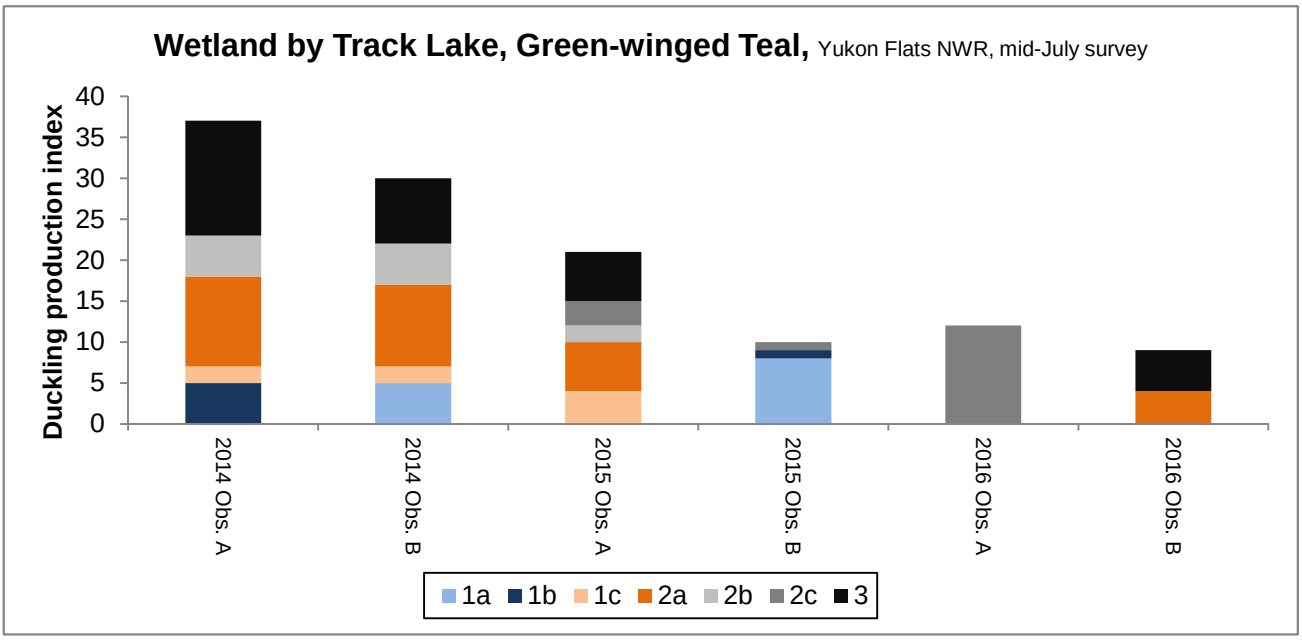
	1a	1b	1c	2a	2b	2c	3	total	n wetlands	median brood size (n)
2014 Obs. A	0	0	0	0	0	0	8	8	14	4.0 (2)
2014 Obs. B	0	4	6	0	9	5	0	24	14	3.0 (5)
2015 Obs. A	0	0	7	13	0	0	0	20	14	7.0 (3)
2015 Obs. B	0	0	0	0	5	7	0	12	14	6.0 (2)
2016 Obs. A	0	0	6	7	0	3	3	19	14	3.0 (5)
2016 Obs. B	0	1	7	9	0	0	0	17	14	4.5 (4)

Duckling production index for Green-winged teal on Yukon Flats National Wildlife Refuge, Canvasback Lake. Counts by age class are represented, along with the corresponding total and number of wetlands sampled. Wetlands are sampled twice and counts are reported for each observer. Median brood size for broods attended by a hen is presented, with sample size in parentheses.



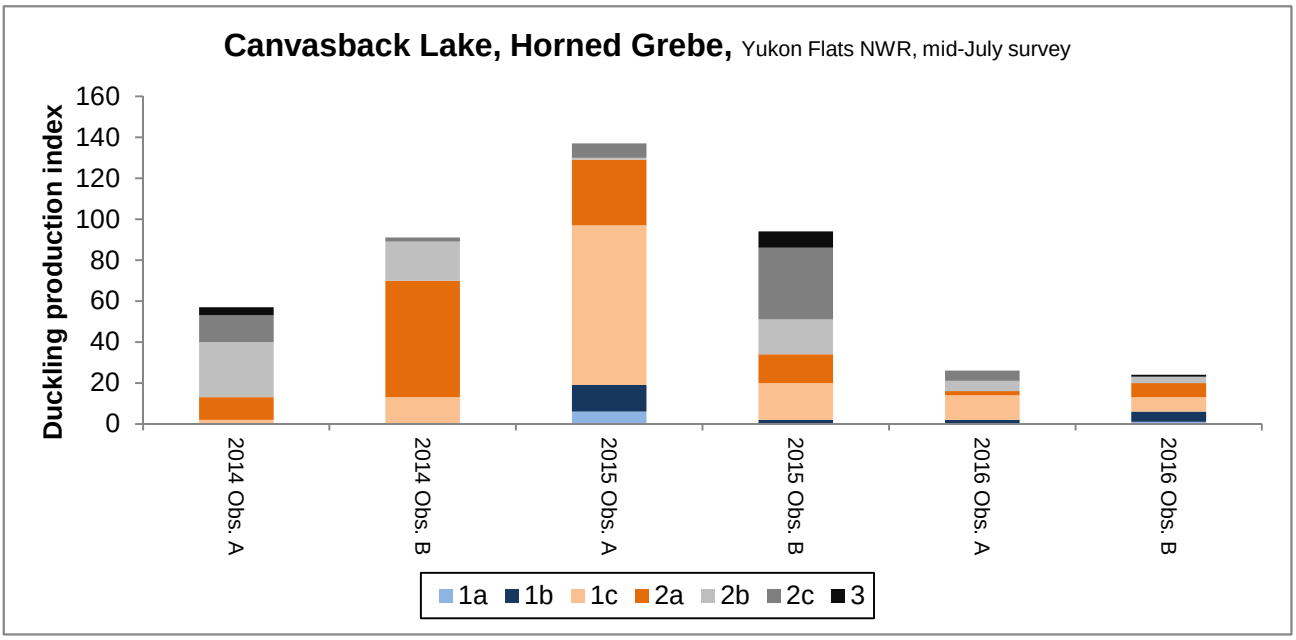
	1a	1b	1c	2a	2b	2c	3	total	n wetlands	median brood size (n)
2014 Obs. A	not surveyed									
2014 Obs. B	not surveyed									
2015 Obs. A	0	0	0	0	0	5	3	8	11	2.0 (3)
2015 Obs. B	0	0	0	0	0	0	0	0	9	
2016 Obs. A	0	0	0	0	0	9	3	12	11	3.0 (3)
2016 Obs. B	0	0	0	0	0	0	1	1	11	1.0 (1)

Duckling production index for Green-winged Teal on Yukon Flats National Wildlife Refuge, Plot F. Counts by age class are represented, along with the corresponding total and number of wetlands sampled. Wetlands are sampled twice and counts are reported for each observer. Median brood size for broods attended by a hen is presented, with sample size in parentheses.



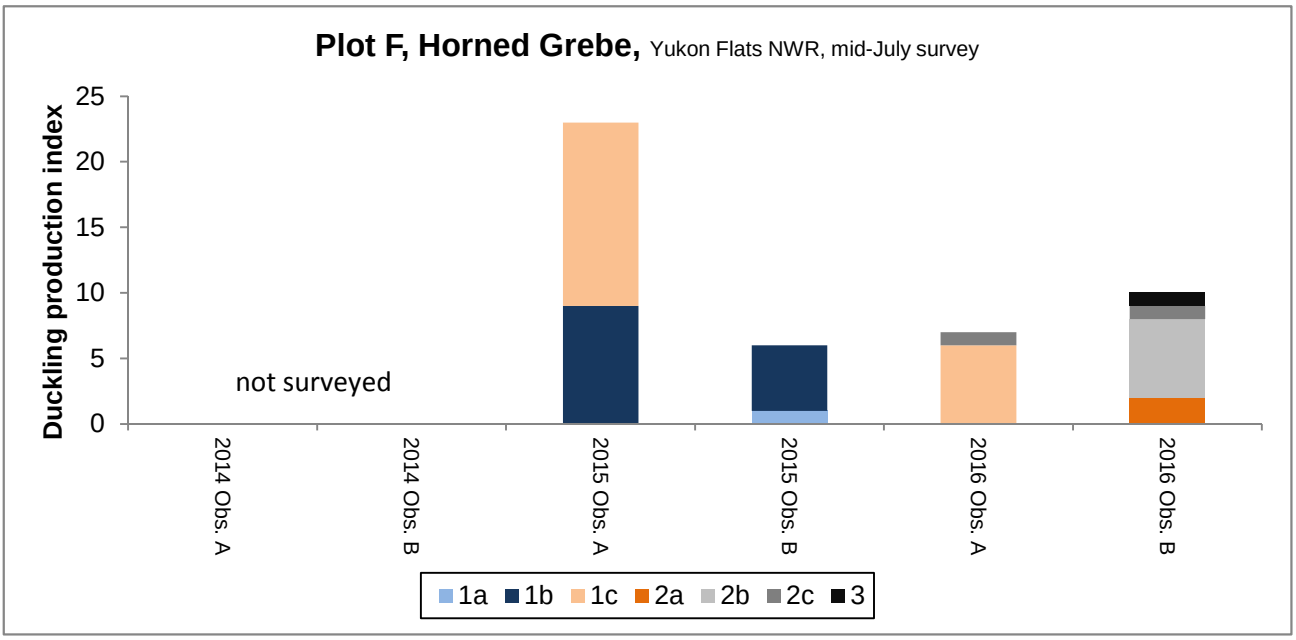
	1a	1b	1c	2a	2b	2c	3	total	n wetlands	median brood size (n)
2014 Obs. A	0	5	2	11	5	0	14	37	10	5.0 (4)
2014 Obs. B	5	0	2	10	5	0	8	30	10	4.0 (7)
2015 Obs. A	0	0	4	6	2	3	6	21	10	3.5 (6)
2015 Obs. B	8	1	0	0	0	1	0	10	10	4.5 (2)
2016 Obs. A	0	0	0	0	0	12	0	12	9	12.0 (1)
2016 Obs. B	0	0	0	4	0	0	5	9	9	3.0 (3)

Duckling production index for Green-winged Teal on Yukon Flats National Wildlife Refuge, Wetland by Track Lake. Counts by age class are represented, along with the corresponding total and number of wetlands sampled. Wetlands are sampled twice and counts are reported for each observer. Median brood size for broods attended by a hen is presented, with sample size in parentheses.



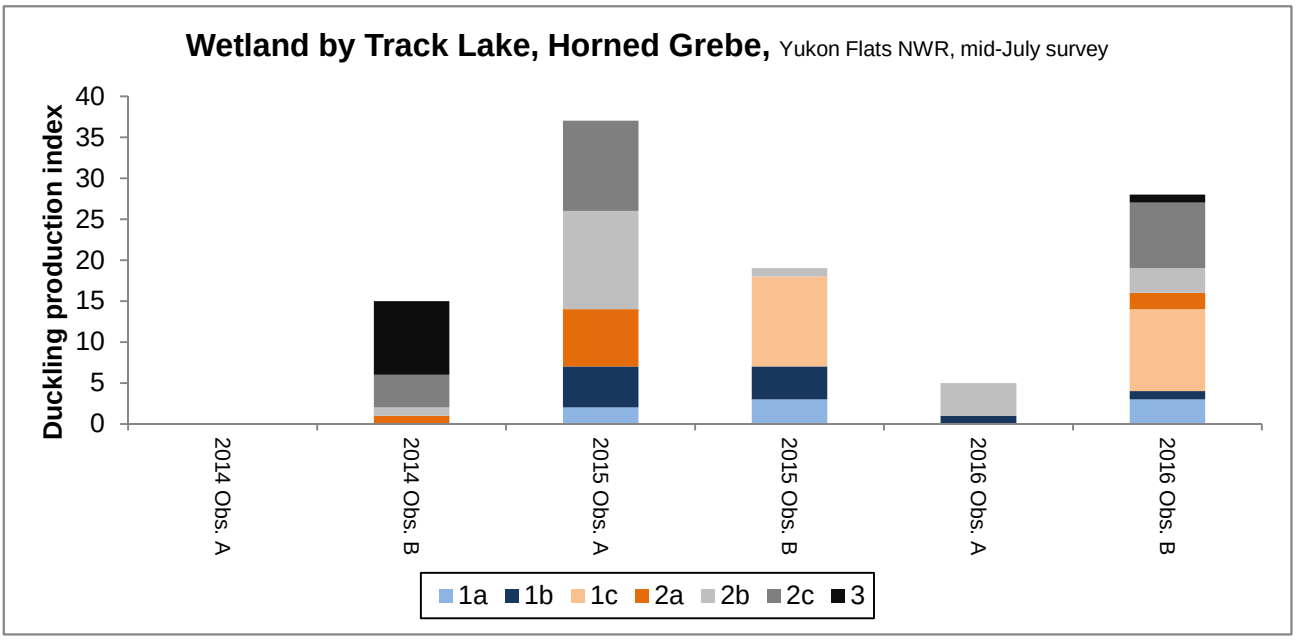
	1a	1b	1c	2a	2b	2c	3	total	n wetlands	median brood size (n)
2014 Obs. A	0	0	2	11	27	13	4	57	14	6.0 (1)
2014 Obs. B	0	0	13	57	19	2	0	91	14	2.0 (25)
2015 Obs. A	6	13	78	32	1	7	0	137	14	5.5 (6)
2015 Obs. B	0	2	18	14	17	35	8	94	14	1.0 (37)
2016 Obs. A	0	2	12	2	5	5	0	26	14	3.0 (4)
2016 Obs. B	1	5	7	7	3	0	1	24	14	1.0 (20)

Duckling production index for Horned Grebe on Yukon Flats National Wildlife Refuge, Canvasback Lake. Counts by age class are represented, along with the corresponding total and number of wetlands sampled. Wetlands are sampled twice and counts are reported for each observer. Median brood size for broods attended by a hen is presented, with sample size in parentheses.



	1a	1b	1c	2a	2b	2c	3	total	n wetlands	median brood size (n)
2014 Obs. A	not surveyed									
2014 Obs. B	not surveyed									
2015 Obs. A	0	9	14	0	0	0	0	23	11	1.5 (12)
2015 Obs. B	1	5	0	0	0	0	0	6	9	1.0 (5)
2016 Obs. A	0	0	6	0	0	1	0	7	11	1.0 (6)
2016 Obs. B	0	0	0	2	6	1	1	10	11	1.0 (9)

Duckling production index for Horned Grebe on Yukon Flats National Wildlife Refuge, Plot F. Counts by age class are represented, along with the corresponding total and number of wetlands sampled. Wetlands are sampled twice and counts are reported for each observer. Median brood size for broods attended by a hen is presented, with sample size in parentheses.



	1a	1b	1c	2a	2b	2c	3	total	n wetlands	median brood size (n)
2014 Obs. A	0	0	0	0	0	0	0	0	10	
2014 Obs. B	0	0	0	1	1	4	9	15	10	1.0 (9)
2015 Obs. A	2	5	0	7	12	11	0	37	10	2.0 (10)
2015 Obs. B	3	4	11	0	1	0	0	19	10	1.0 (7)
2016 Obs. A	0	1	0	0	4	0	0	5	9	
2016 Obs. B	3	1	10	2	3	8	1	28	9	1.0 (15)

Duckling production index Horned Grebe on Yukon Flats National Wildlife Refuge, Wetland by Track Lake. Counts by age class are represented, along with the corresponding total and number of wetlands sampled. Wetlands are sampled twice and counts are reported for each observer. Median brood size for broods attended by a hen is presented, with sample size in parentheses.