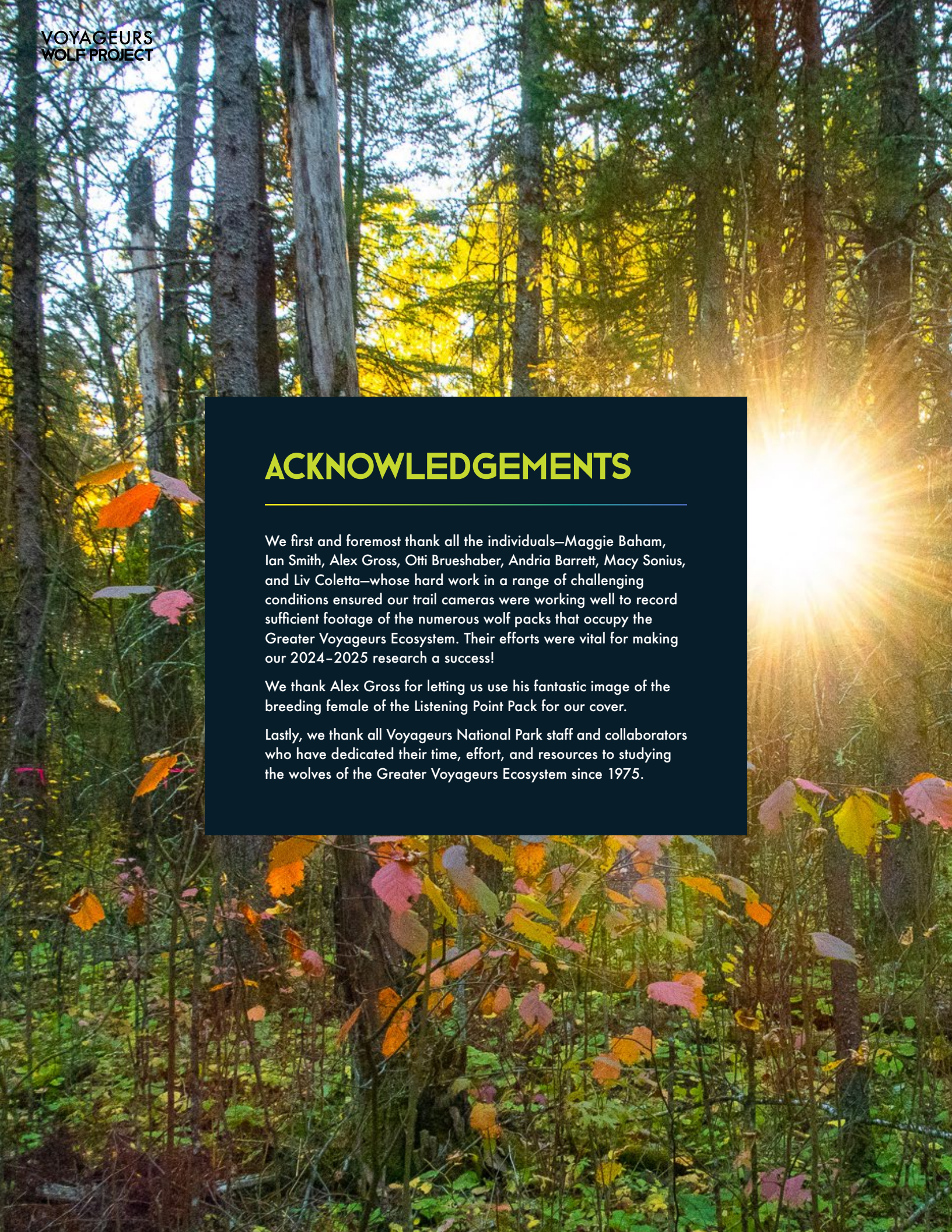
2024-2025

GREATER VOYAGEURS ECOSYSTEM WOLF POPULATION REPORT

by Thomas Gable, Austin Homkes, Sophie Heny, and Joseph Bump



ACKNOWLEDGEMENTS

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We thank Alex Gross for letting us use his fantastic image of the breeding female of the Listening Point Pack for our cover.

Lastly, we thank all Voyageurs National Park staff and collaborators who have dedicated their time, effort, and resources to studying the wolves of the Greater Voyageurs Ecosystem since 1975.

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ENVIRONMENT
AND NATURAL RESOURCES
TRUST FUND

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by Thomas Gable, Austin Homkes, Sophie Heny, and Joseph Bump

Report designed by Kimberly Boustead

VOYAGEURS
WOLF PROJECT

2024-2025 WOLF POPULATION ESTIMATE

OVERVIEW

During April 2024–April 2025, we studied the wolf population in the Greater Voyageurs Ecosystem (GVE), Minnesota to understand wolf population dynamics and how changes in population dynamics are connected to or influence predation behavior, wolf pup survival, and changes in prey density. Although our primary objective was to estimate wolf population density, we also wanted to estimate key population parameters including pack size, pack composition, recruitment of wolf pups, and territory size.

Our primary tools to study the wolf population were GPS-collars and remote trail cameras. We used locations from GPS-collared wolves to estimate the size and distribution of wolf territories in the GVE. After delineating the territories of almost half the packs in the GVE, we then calculated how much neighboring wolf pack territories overlap one another and, on average, how many neighboring packs surround a single pack's territory. Calculating these metrics are important for accurately estimating wolf population density.

To estimate pack size, pack composition, and the number of surviving pups in each pack, we deployed 378 trail cameras across the GVE from December 1, 2024 to April 10, 2025—we refer to this timeframe as our "winter survey period"— to record repeated video observations of wolf packs during winter. In particular, we sought to record repeated, independent observations of each pack during the monitoring period. We considered observations to be independent if they were on a different day than any other observations of that pack. Multiple independent observations of a pack with the same number of members provides highly-reliable and accurate pack size estimates (Gable et al. 2024). Additionally, high-quality, repeated observations allow us to determine pack composition (number of breeding individuals, subordinate adults, and pups in pack) and to identify most—and often all—the individual wolves in a pack based on physical characteristics.

Our objective during Winter 2024–2025 was to deploy cameras in every wolf pack territory (22 packs) in or partially overlapping the GVE to get detailed data on each pack that occupies the GVE. We

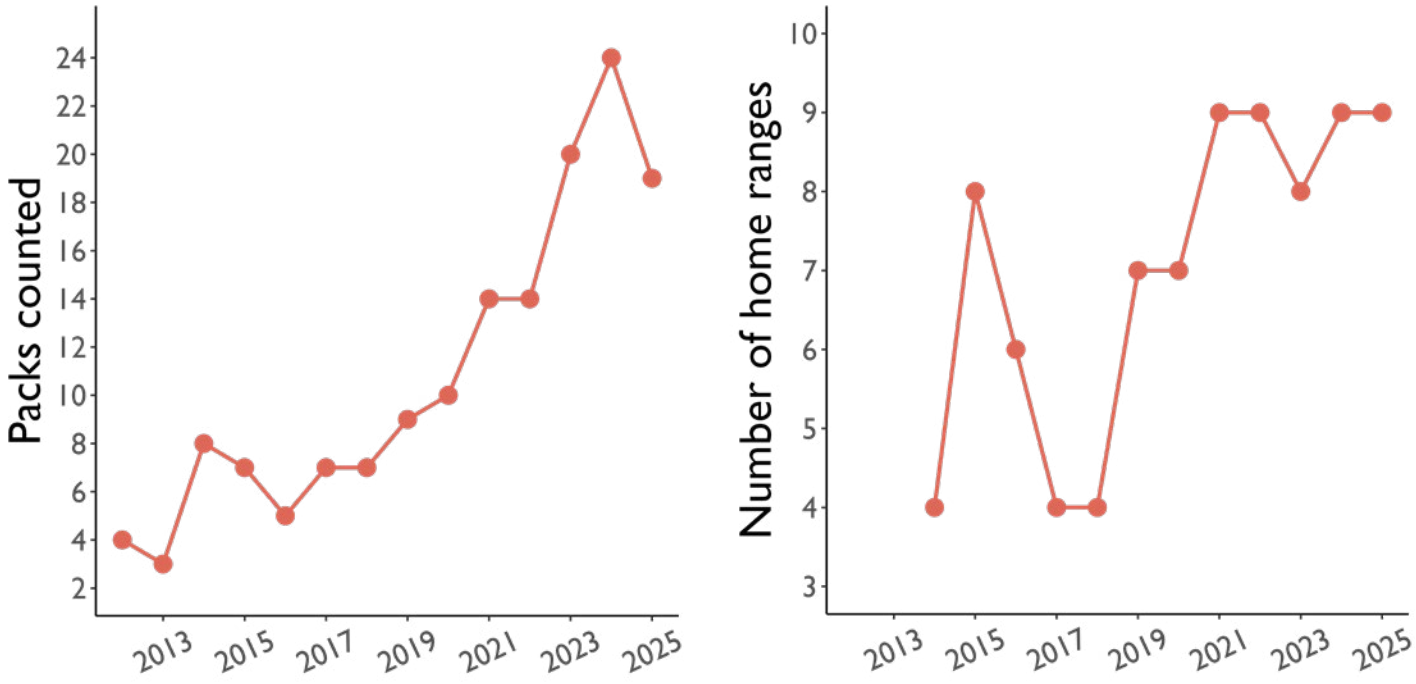


Figure 1A. *Sample sizes from the annual winter wolf pack and population surveys in the Greater Voyageurs Ecosystem from 2012 to 2025. These two panels show the number of wolf packs studied (left) and pack territories estimated from GPS-collared wolves (right).*

successfully did this during the Winter 2022–2023 survey—the first year we attempted this—when we estimated the size of 20 wolf packs. During the 2023– 2024 Winter Survey, we expanded and formalized the boundaries of the GVE using geographical landmarks such as prominent roads, rivers, and lakes, and to include two large winter deer yarding complexes—the Elephant Lake Deer Yard and the Beaver Brook Deer Yard, a large deer yarding complex ~15 km south of Ray, Minnesota off the Haney Road—that previously were on the edge of the GVE boundary. In doing so, we increased the size of the GVE by 372 km² (144 mi²), resulting in a total area of 2,338 km² (902 mi²). As such, the number of packs we surveyed in 2023–2024 increased from 20 in 2022–2023 to 24 in 2023–2024. Importantly, this increase in the number of packs studied was not due to an actual increase in the number of packs in the study area but rather because of an increase in the area of the GVE (Fig. 1 & 2). In 2024–2025, only 22 packs had territories in or overlapping the GVE, a decrease of two packs (8%) from the previous winter. This decrease was indicative of a real change in pack and population dynamics in the GVE as described in detail below.

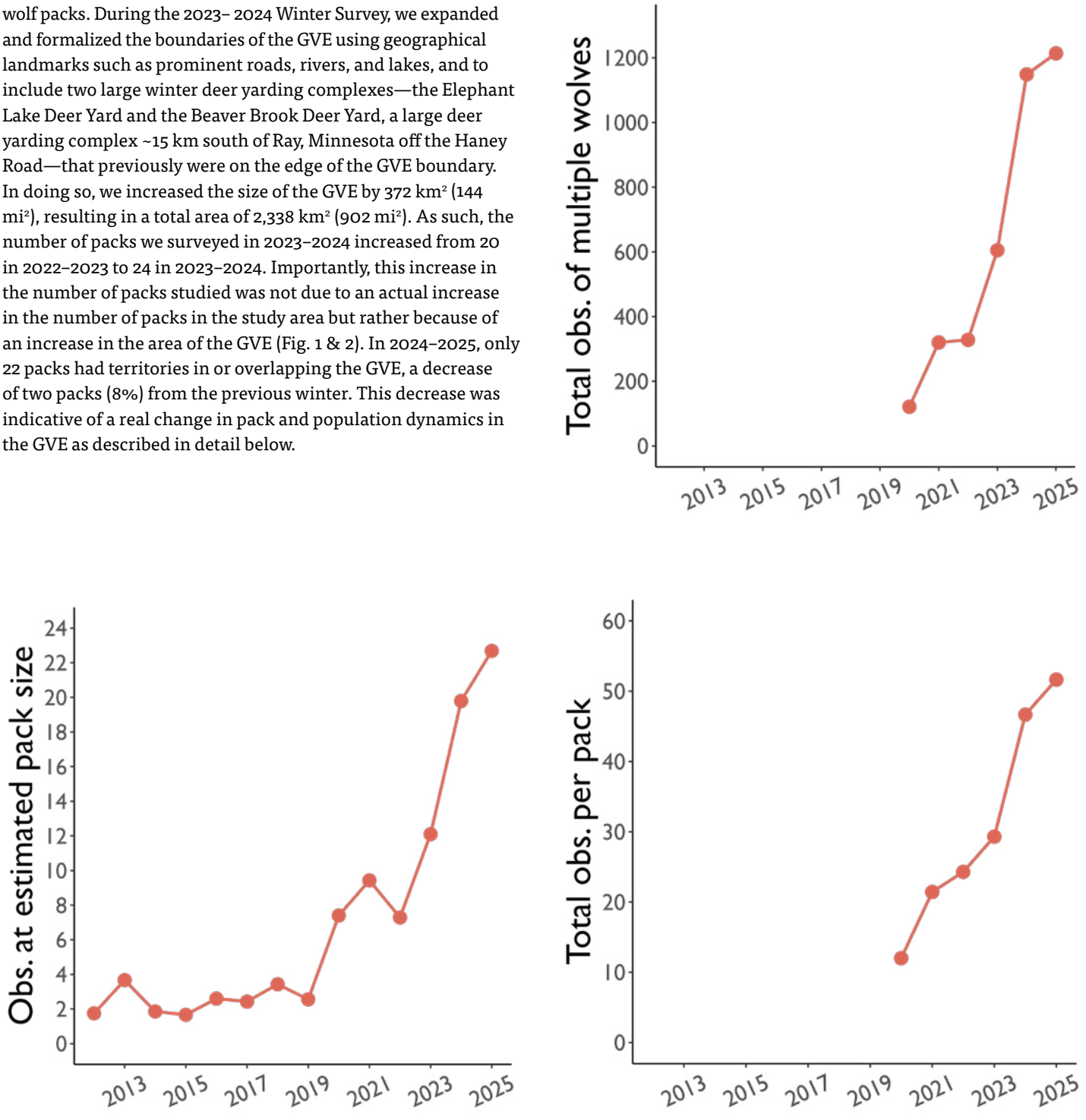


Figure 1B. *Sample sizes from the annual winter wolf pack and population surveys in the Greater Voyageurs Ecosystem from 2012 to 2025. The bottom two panels show the quality of our pack size estimates each year with the bottom right showing the average number of observations of ≥2 wolves from a specific pack during the winter survey period (Dec. 1 to Apr 10; a period of 131 days), and the bottom left showing the number of independent observations of each pack at their estimated size. For example, a value of 22.7 in 2024 indicates that, on average, we observed each pack at their estimated size on 22.7 different days during the winter survey period, or once every 5.8 days during the winter survey period.*

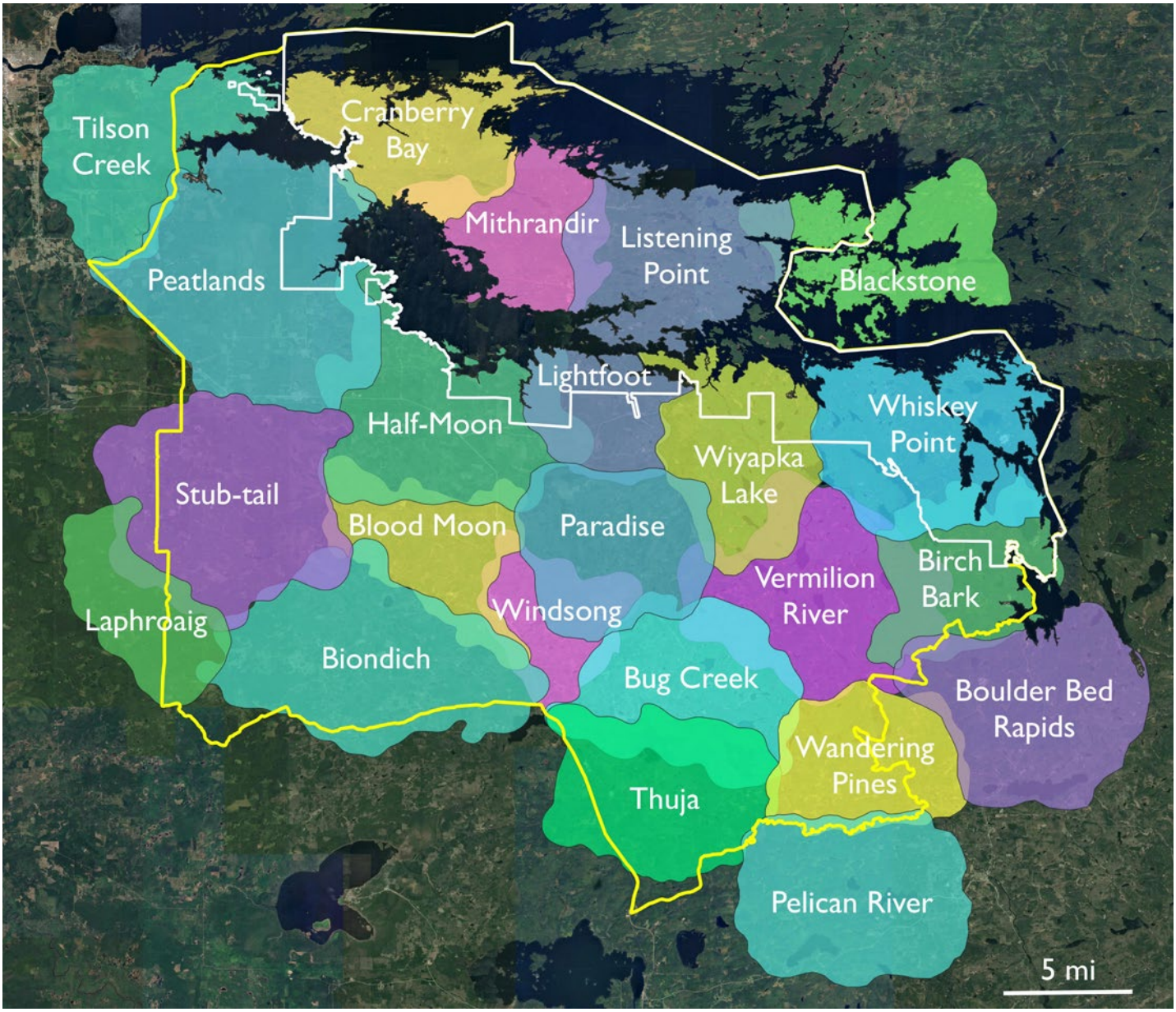
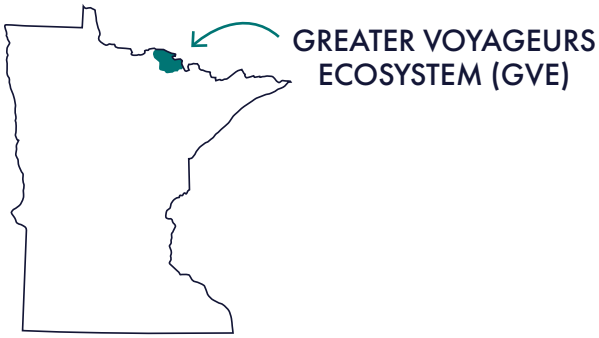


Figure 2. *The known and estimated territories of the wolf packs in the Greater Voyageurs Ecosystem, Minnesota, USA from April 2024 to April 2025. The white outline represents the border of Voyageurs National Park, and the yellow outline is the border of the Greater Voyageurs Ecosystem. The territories of Mithrandir, Half-Moon, Stub-tail, Biondich, Blood Moon, Windsong, Bug Creek, Thuja, Vermilion River, and Birch Bark Packs were estimated from GPS-collar data. We approximated all other territories using historical territory locations in combination with remote camera data. Note: the Vermilion River Pack territory was occupied by the Vermilion River Pack until November 2024, when the pack dissolved. The territory was then absorbed primarily by the Birch Bark Pack, and to a lesser extent the Bug Creek Pack.*

We used detailed data on wolf pack territories and wolf pack size to then estimate the size of the wolf population in the GVE and how population size changed relative to previous years. We measure population size as the density of wolves per 1000 km^2, a standard metric used by most wolf biologists to measure the size of wolf populations. For a detailed description of how we calculated density and the other methods we briefly described above, please see the methods section at the end of this report, which provides a more technical description of our approach.



2024–2025 WOLF POPULATION SUMMARY

The 2024–2025 survey effort was the most intensive survey effort to date in the Greater Voyageurs Ecosystem, Minnesota (Fig. 1). From December 1, 2024 to April 10, 2025, we deployed 378 remote cameras across 22 wolf pack territories and in doing so recorded 1,214 observations of ≥2 wolves (i.e., social groups or packs) traveling together (Table 1).

We averaged 54 observations of ≥2 wolves from each pack during our winter survey period, which means we observed members of each pack once every 2.3 days on average (winter survey period=131 days). However, in many instances we did not observe all pack members traveling together but rather a subset of pack members. Nonetheless, we recorded an average of 22.7 independent observations of each pack at its estimated size during our winter study period (detailed descriptions of each pack below). We used GPS-collar data from wolves in 9 of the 22 (41%) wolf packs that use the GVE to estimate territory size and to estimate average territory overlap between neighboring packs. Notably, of the 22 packs that use the GVE, only 19 have territories that are entirely or largely within the GVE (Fig. 2). Thus, we had territory size estimates for 47% (9/19 packs) of the packs residing entirely or largely within the boundaries of the GVE.

We estimate wolf population density in the Greater Voyageurs Ecosystem was 44.7 wolves/1000 km² in 2024–2025 (Fig. 3), a 19% decrease in wolf population density from last year (2023–2024 density: 55.1 wolves/1000 km²) and a 31% decrease from two years ago (2022–2023 density: 64.8 wolves/1000 km²). Average pack size in 2024–2025 was 4.05 wolves/pack (Table 2), a slight decrease from 2022–2023 and 2023–2024 when average pack size

THE NUMBERS

Packs studied	22 packs
Territories delineated	9 territories
Total observations of ≥2 wolves	1,214 observations
Average number of observations per pack	54 observations
Average number of independent observations of packs at their estimated size	22.7 observations
Total pack wolves counted	77 wolves
Unique lone wolves observed	22 wolves
Percent of population that were estimated to be lone wolves	20.2%
Packs that produced pups	77% of packs
Average territory size	146 km²
Average pack size	4.1 wolves
Average recruitment	1.0 pups
Average pack-on-pack overlap	16.8 km²
Average number of neighboring packs	4.3 packs
Population density	44.7 wolves/1000 km²
Percent change in population from previous year	-19%

Table 1. *The key metrics of the wolf population in the Greater Voyageurs Ecosystem during 2024-2025.*

was 4.2 wolves/pack and 4.3 wolves/pack respectively (Fig. 4). Thus, the decrease in wolf population density can be attributed predominantly to a substantial increase in territory size.

Average territory size in 2024–2025 increased to 146.2 km², the largest annual territory size we have documented during our 11 year study by a substantial margin (the next largest estimate was in 2018–2019 when territory size averaged 122.8 km²). This represents a 27% increase in average territory size from 2023–2024 when territory size was 115.6 km², and a 54% increase from 2022–2023 when territory size was 95.5 km² (Fig. 5). The substantial increase in territory size consequently decreased the number of wolf packs that occupied the GVE in 2024–2025 because fewer packs could sustain, defend, and maintain territories as neighboring packs expanded their territories. For example, in biological year 2024-2025 (April 11, 2024 to April 10, 2025), three packs—Bluebird Lake, Vermilion River, and Nashata Packs—disappeared, and their territories were absorbed by neighboring packs.

Notably, with the increase in territory size came a 5.8 km² increase, on average, in territory overlap (Fig. 6)—the amount each pack's territory overlaps a neighboring pack's territory—from 2023-2024 that reduced, to a small degree, the effects

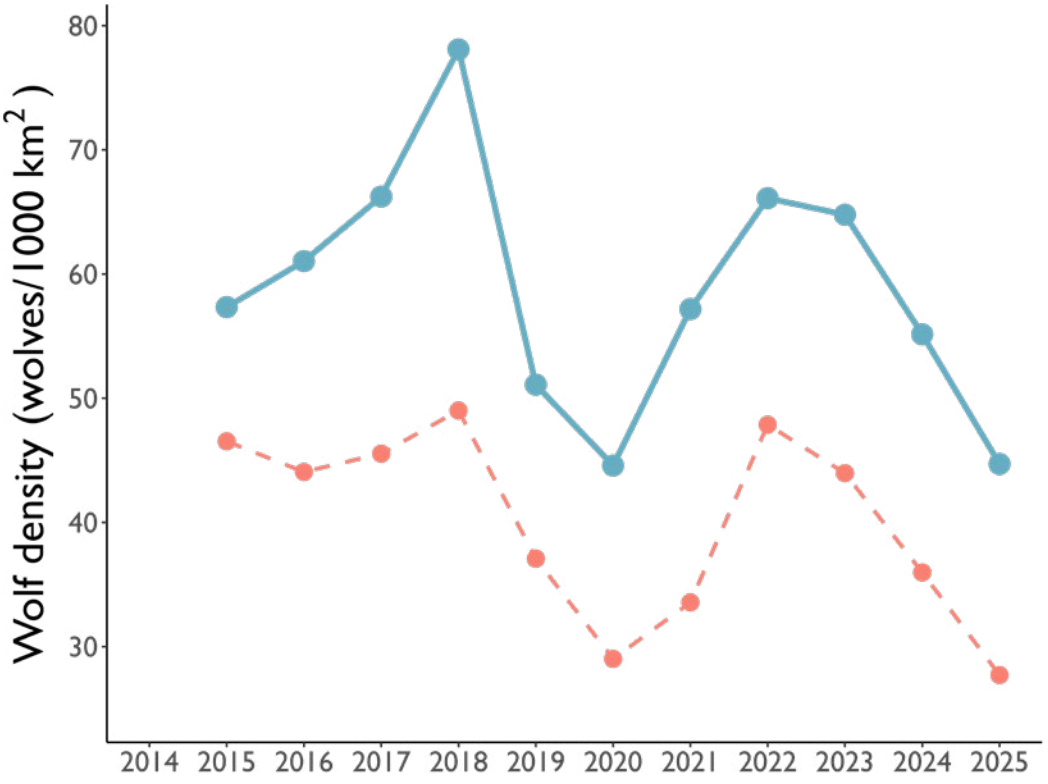


Figure 3.

Wolf density estimates (blue points) for the Greater Voyageurs Ecosystem, Minnesota, USA from 2015 to 2025. The red points and dashed red line represent wolf pack density if density was calculated solely by dividing mean wolf pack size by mean territory size (i.e., if density estimates did not account for pack territory overlap or lone wolves).

of increased territory size on overall population density; i.e., territory size increased by 27% but population density only decreased by 19%. Regardless, average territory overlap was 17.6 km² (Fig. 6), the largest we have documented to date, and a striking 112% increase from two years ago when territory overlap was 8.3 km². The increase in pack territory size and pack territory overlap both indicate that wolf packs were likely attempting to adjust to recent decreases in deer densities by occupying larger areas, which almost certainly increased competition between wolf packs.

Accompanying territorial changes were changes in several aspects of wolf pack dynamics; specifically, reproduction, recruitment and pack composition (Table 2). As noted above, pack size only decreased slightly (6%) in 2024-2025 to 4.05 wolves/pack, which was admittedly surprising, as recruitment decreased substantially in 2024-2025 to 1.0 pups/pack, a 42% decrease in recruitment from 2022-2023 and 2023-2024 when recruitment was 1.7 pups/pack and 1.7 pups/packs, respectively. The decrease in recruitment stemmed, in part, from the fact that 23% of packs (5/22) in Spring 2024 did not produce pups (Table 2), a slight increase from Spring 2023 when 18% of packs did not produce pups. However, the most substantial factor driving decreased recruitment was undoubtedly decreased pup survival. We estimate ~20% of pups survived in 2024-2025, meaning four out of every five pups born in Spring 2024 died before Winter 2024-2025. Of the 17 packs that produced pups in Spring 2024, only 47% of packs (8/17 packs) raised any pups to adulthood with 53% of packs losing all of their pups before winter.

Substantial changes in pup recruitment typically drive substantial changes in wolf pack size in our area. For example, in 2019–2020 and 2020–2021 when recruitment was 0.43 pups/pack and 0.42 pups/pack, respectively, average pack size was the lowest we have ever observed at 3.10 and 3.14 wolves/pack. The reason the decrease in recruitment in 2024–2025 did not decrease pack size considerably appears to be that there was a considerable increase, relative to previous years, in the number of subordinate adults (generally 1–2 year old adults) in wolf packs. The average number of subordinate adults per pack in Winter 2024–2025 was 1.05 wolves/pack, a 94% increase from Winter 2023–2024 when the average number of subordinate adults per pack was 0.54 subordinate adults/pack.

This change is readily apparent when examining changes in pack composition in 2024–2025 compared to the previous two years. In 2024–2025, pack composition was 49% breeding wolves, 26% subordinate adults, and 12% pups. By contrast, in the previous two years, pack composition was 47–49% breeding wolves, 12–14% subordinate wolves, and 37–41% pups. In other words, in Winter 2024–2025, we observed a substantial decrease in the percent of pups in packs and a substantial increase in the percent of subordinate adults.

Figure 4. *Wolf pack size estimates for the Greater Voyageurs Ecosystem, Minnesota, USA from 2012 to 2025.*

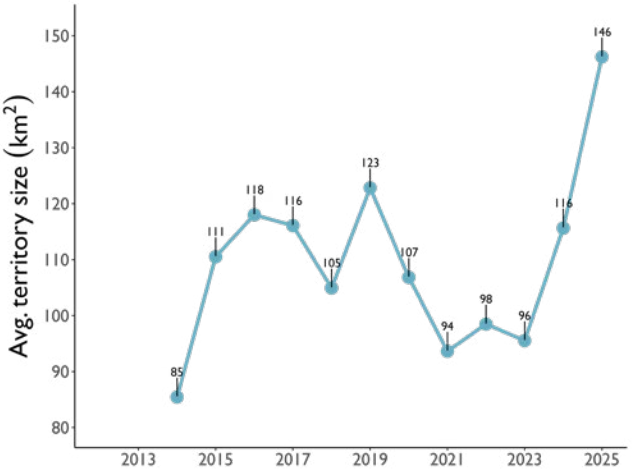


Figure 5. *Wolf territory size estimates for the Greater Voyageurs Ecosystem, Minnesota, USA from 2012 to 2025.*

Figure 6. *Wolf pack overlap estimates for the Greater Voyageurs Ecosystem, Minnesota, USA from 2012 to 2025. We considered pack-on-pack overlap to be the average territory overlap of each wolf pack territory with each neighboring pack. For instance, in 2024-2025, each wolf pack territory overlapped each neighboring pack territory by 16.8 km². Quantifying the overlap of wolf pack territories is crucial for deriving accurate wolf population density estimates.*

Lone wolves constitute a meaningful proportion of any wolf population but estimating the percent of the population that are lone wolves is difficult for myriad reasons. To account for the abundance of lone wolves in our population estimates, we calculated the percent of GPS-collared wolves that were lone wolves during Winters 2014–2025, and assumed that this number was representative of the annual abundance of lone wolves in the GVE during this period. Thus, we assumed that lone wolves constituted 20.2% of the wolf population in the GVE in Winter 2024–2025 as well in all previous years because 21 of 104 wolves that wore functional collars during the winter survey period during Winters 2014–2025 were lone wolves (Table 3). Notably, we update our 'lone wolf estimate' each year by adding data from the most recent year into our estimate (i.e., increasing our sample size), and then using the updated estimate to calculate population density for the current year and all subsequent years. As such, previous population density estimates, as reported in our previous reports, often change from year to year as we collect more data. For example, we estimated the wolf population density in 2022–2023 to be 65.2 wolves/1000 km^2 when all data

Pack	Pack size	Total Observations	Number of Independent Observations	Have pups in Spring 2024?	Recruitment
Biondich	6	19	7	No	0
Birch Bark	3	83	33	No	0
Blackstone**	UNK	18	NA	Yes	UNK
Blood Moon	2	26	13	Yes	0
Bluebird Lake*	NA	9	NA	No	0
Boulder Bed Rapids**	UNK	4	NA	UNK	UNK
Bug Creek	7	58	16	Yes	2
Cranberry Bay	2	43	32	Yes	0
Half-Moon*	NA	NA	NA	No	0
Laphroaig	5	37	20	Yes	2
Lightfoot	2	33	21	Yes	0
Listening Point	4	41	20	Yes	2
Mithrandir	2	96	52	Yes	0
Nashata*	NA	NA	NA	Yes	0
Paradise	4	109	31	Yes	2
Peatlands	8	97	5	Yes	3
Pelican River**	UNK	15	NA	Yes	UNK
Stub-tail	6	115	26	Yes	2
Thuja	8	90	9	Yes	4
Tilson	5	90	12	Yes	2
Vermilion River*	NA	NA	NA	Yes	0
Wandering Pines	2	31	22	No	0
Whiskey Point	4	31	13	Yes	0
Windsong	2	31	27	Yes	0
Wiyapka Lake	2	66	44	Yes	0
TOTAL	**74**	**1142**	**403**	**0**	**19**

* Indicates packs that occupied territories in Spring/Summer 2024 but that then dissolved by Winter 2024-2025 survey period. The Vermilion River territory was predominantly absorbed by the Birch Bark territory, the Nashata territory was taken over by Mithrandir, and the Bluebird Lake territory taken over by Wiyapka Lake. Notably, the Bluebird Lake Pack remained together until January 2025 before dissolving.

** Indicates packs on the periphery of the Greater Voyageurs Ecosystem for which we did not have sufficient data to determine pack size or recruitment

Table 2. *Pack size and pup recruitment estimates for all wolf packs in the Greater Voyageurs Ecosystem, Minnesota, USA during our 2024-2025 winter survey period (December 1, 2024 to April 10, 2025). Total observations refer to the number of times we observed 2 or more members of a given pack together during the winter survey period. By contrast, the number of independent observations indicates the number of different days we observed a given pack at their estimated size during our winter survey period. For example, we observed 3 wolves together in the Half-Moon Pack on 28 different days during our winter survey period.*

Year	Lone wolves that were collared during winter period	Total wolves collared during winter period	Percent of collared wolves that were lone wolves	Unique lone wolves observed on camera during winter period	Number of pack wolves observed on camera during winter period	Minimum percent of population that are lone wolves based on cameras
2014-2015	4	14	28.6			
2015-2016	1	9	11.1			
2016-2017	0	2	0.0			
2017-2018	0	3	0.0			
2018-2019	1	8	12.5			
2019-2020	3	12	25.0			
2020-2021	1	10	10.0			
2021-2022	3	12	25.0			
2022-2023	3	12	25.0	9	85	9.6
2023-2024	3	10	30.0	17	104	14.0
2024-2025	2	12	16.7	22	77	22.2
TOTAL	**21**	**104**	**20.2**			

Table 3. *Prevalence of lone wolves in the Greater Voyageurs Ecosystem, Minnesota, USA during the winter survey period (December 1, 2024 to April 10, 2025) based on collared wolves and remote cameras. We did not have a sufficient number of remote cameras deployed during 2014-2022 to estimate number of lone wolves using this approach.*

from 2014–2023 indicated lone wolves constituted 19.5% of the population during the 2014–2023 period (Gable et al. 2023a). However, because all data from 2014–2025 indicates lone wolves actually constitute 20.2% of the population during this time period, we now estimate that wolf density during 2022–2023 was 64.7 wolves/1000 km^2 (a 0.7% change in our 2022–2023 estimate).

We also used remote camera data to provide a minimum estimate of the number of lone wolves in the GVE during Winter 2024–2025 as a means to validate the approach described above (Table 3). More specifically, we identified and counted lone wolves we observed on camera during the winter survey period. To be counted as a lone wolf, we had to observe the wolf multiple times over the survey period, be able to readily identify the wolf based on physical characteristics, and be confident the wolf was not part of any pack in the GVE based on regular observations of each pack during the same period. Because of these criteria, there were likely several lone wolves that we did not "count" via this approach (i.e. this approach is conservative and yields a minimum estimate). During the 2024–2025 winter survey period, we could confidently identify 22 lone wolves in the GVE (Table 3). Because we counted the number of wolves in all 19 packs with territories entirely in or largely overlapping the GVE (77 wolves), we estimated lone wolves constituted at least 22% of the wolf population in the GVE (22 lone wolves/[22 lone wolves + 77 pack wolves]*100). Although this approach provides a minimum estimate of the number of lone wolves in an area, our lone wolf estimates from our trail camera data in Winter 2024–2025 were fairly similar to our long-term GPS-collar data (22.2% from remote cameras vs. 20.2% from GPS-collar data). These data indicate lone wolves in the GVE in Winter 2024–2025 were greater than the estimate of 15% that many biologists use when estimating wolf density (e.g., Erb and Humpal 2020)—and that our long-term estimate derived from GPS collared wolves of 20.2% seems appropriate when estimating population density.

POPULATION TREND

Wolf density during 2024–2025 (44.7 wolves/1000 km^2) was the 2nd lowest wolf population estimate in the GVE in the last 11 years (Fig. 4); the only year with lower population density was 2020–2021 (44.6 wolves/1000 km^2). Granted, wolf densities in both 2020-2021 and 2024-2025 were effectively the same, indicating the wolf population is currently at the lowest levels we have observed during our 11-year study. Because wolf density is largely driven by prey density (McRoberts and Mech 2014, Mech and Barber-Meyer 2015, Mech 2024), the recent decrease in the wolf population is not surprising given the recent decline in deer populations in the GVE and northern Minnesota after the severe winters of 2021–2022 and 2022–2023. One of the mechanisms by which wolf populations adjust to decreases in prey density is by increasing territory size, which provides access to an increased number of prey (Sells et al. 2021, 2022)—a pattern documented in several ecosystems including Montana (Sells et al. 2021), Ontario (Kittle et al. 2015), and Northwestern Canada (Dickie et al. 2022). Increases in territory size inevitably decrease wolf density because fewer packs can fit in a specified area. For instance, we documented the disappearance of 3 wolf packs in the GVE during this period of territorial expansion by resident packs.

The other ways wolf populations adjust to changes in prey populations are via changes in pup survival/recruitment and dispersal patterns. As prey become less abundant, wolves have an increasingly difficult time finding and killing vulnerable prey. This, in turn, reduces wolves' ability to obtain enough food to provision their pups throughout the summer, which decreases pup survival and recruitment (Gable et al. 2023b). As pup survival decreases, pack size generally does as well. The low pup survival rate (~20%) in 2024–2025 highlights the fact that most packs presumably struggled to obtain sufficient food to provision their pups during the pup rearing season of 2024.

Interestingly, as mentioned above, the substantial reduction in pup survival/recruitment did not lead to a substantial decrease in pack size, largely because of an increase in subordinate adults remaining with their pack's through winter. Most subordinate adults are the offspring of the breeding pair of the pack, and typically most of these offspring disperse from their pack when they are 1-2 years old. As such, from 2019 to 2024, wolf packs in the GVE, on average, had 0.58 subordinate adults/pack (the highest value we have documented was 0.71 subordinate adults/pack in 2020–2021). In Winter 2024–2025, packs had an average of 1.05 subordinate adults/pack, the largest number of adult subordinates per pack documented to date and a 94% increase compared to Winter 2023–2024, when packs only had, on average, 0.54 subordinate adults. The increase in subordinate adults seems to suggest a decrease in dispersal by subordinate adults. That is, instead of dispersing from their pack, more subordinates decided to remain with their natal pack for a longer period of time than is typical.

Dispersal rates of subordinate adults generally exhibit a non-linear pattern with the highest dispersal rates occurring when wolf population density is low or high, and the lowest dispersal rates occurring at medium densities (Morales-González et al. 2021). Although wolf population density during Winter 2024–2025 was high, wolf population density was considerably lower than typical wolf population density in the GVE, and was approaching moderate/medium densities (~25–40 wolves/1000 km^2). The decline in population density could have been associated with what appears to be delayed dispersal by subordinate adults.

Specifically, we suspect the low recruitment of wolf pups in 2024-2025 may have reduced competition for resources within wolf packs in the GVE, and consequently decreased dispersal rates. Typically, during fall and winter, dominant breeding wolves control access to kills (food), and such wolves prioritize feeding themselves and their pups, meaning subordinate adults often have reduced access to kills because dominant wolves (i.e., the pups' parents) can aggressively prevent subordinate adults from feeding (Mech 1999, 2020). The reduced access to kills is thought to stimulate dispersal of many young wolves because young wolves decide the benefits of dispersing (reduced competition for kills) outweigh the costs of remaining with the pack (increased competition for/decreased access to kills) (Nordli et al. 2023). Because many packs in the GVE did not recruit any pups in 2024–2025, subordinate adults may have had increased access to kills because of reduced intra-pack competition—i.e., they did not have to compete as intensively with pups and their parents for food (Mech 2000). As a result, an increased number of subordinate wolves may have decided it was more advantageous

to remain with their packs over winter rather than disperse. Either way, the increase in subordinate wolves per pack undoubtedly kept pack sizes fairly stable, despite the decrease in wolf pup survival/recruitment.

Despite the recent decrease in the population, all evidence indicates that the wolf population in the Greater Voyageurs Ecosystem is a fairly stable, high-density wolf population (Fig. 7-9). Certainly, wolf density has varied annually over the past 11 years, and there appears to be a slightly decreasing trend in wolf density over time in the GVE. However, we do not think this decrease is due to long-term population decline in the wolf population. Rather, we think this recent decrease is simply the natural ebb and flow of wolf populations as they adjust to changes in prey populations. Even with the recent decreases in wolf populations, the GVE has sustained an average density of 58.8 wolves/1000 km² for the past 11 years, and likely much longer (Fig. 7-9; see Gable et al. 2022 for more details regarding historical patterns). Notably, the average density of wolves in the GVE during this 11-year period represents some of the highest sustained densities of gray wolves reported (Mech and Barber-Meyer 2015, Gable et al. 2022).

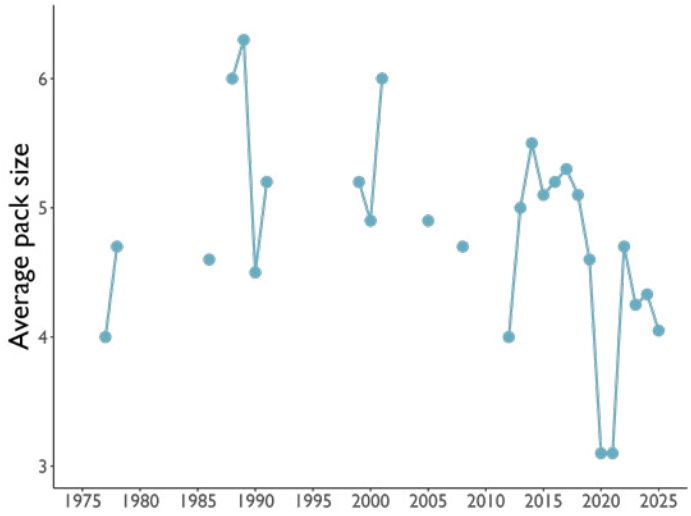


Figure 7. *Mean wolf pack size in the Greater Voyageurs Ecosystem (GVE), Minnesota, USA from 1975 to 2025. Historical data on wolf pack sizes in the GVE were from 1976-1978 (Hardwig 1978), 1985-1986 (archived map by Voyageurs National Park biologist Glen Cole), 1987-1991 (Gogan et al. 2004), 1998-2001(Fox et al. 2001), 2005 (Fox 2006), and 2008 (Ethier and Sayers 2008).*

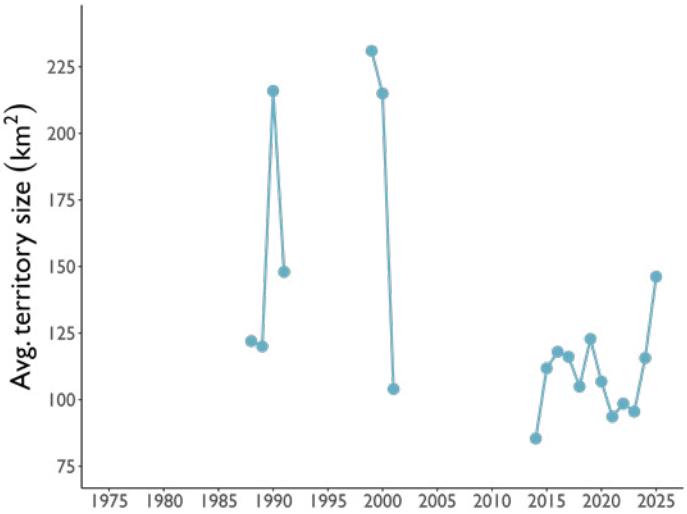


Figure 8. *Mean territory size in the Greater Voyageurs Ecosystem, Minnesota, USA from 1975 to 2025. Data from 1987-1991 and 1998-2001 are from Gogan et al. (2004) and Fox et al. (2001), respectively. Territories from 1987 to 2001 were estimated using telemetry data and minimum convex polygons whereas territories from 2014-2025 were estimated using GPS-location data and kernel density estimators. Estimates from 1987 to 2001 almost certainly overestimate territory size substantially (see Gable et al. 2022 for detailed discussion) but we have included them here for posterity.*

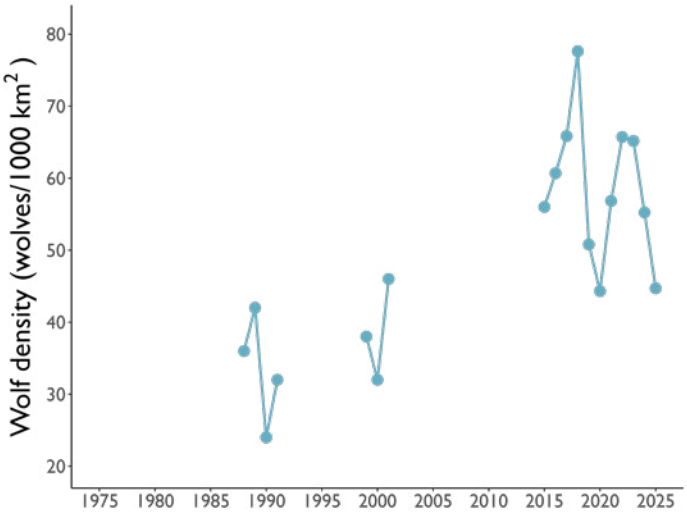
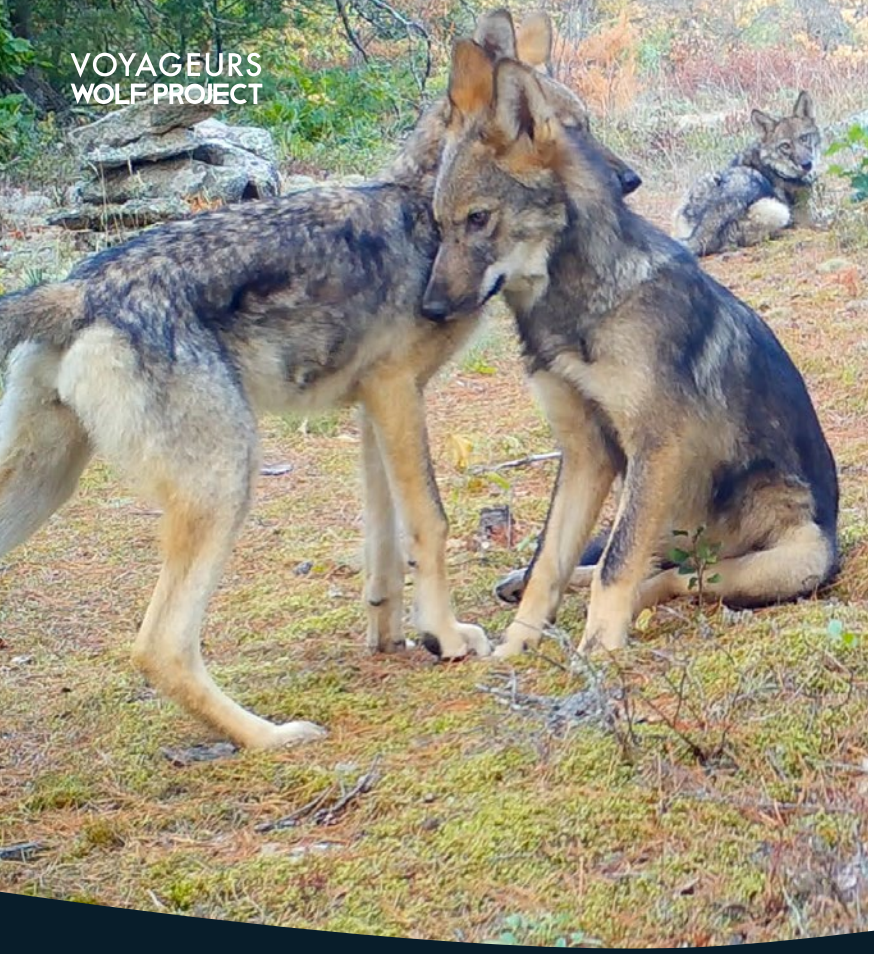


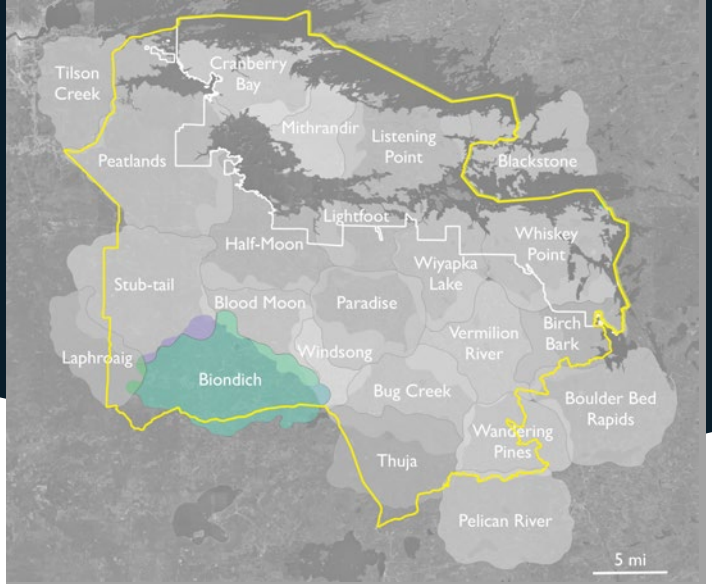
Figure 9. *Wolf density in the Greater Voyageurs Ecosystem, Minnesota, USA from 1975 to 2025. Data from 1987-1991 and 1998-2001 are from Gogan et al. (2004) and Fox et al. (2001), respectively. Although wolf density during 2015-2025 was substantially higher than that reported in previous studies, we do not think wolf population density has increased–or at least increased substantially– over the past 35 years. Instead, the disparity in density from previous studies and ours likely stems from the coarser survey methods used in previous studies. For detailed discussion on this point, see Gable et al. (2022).*



INDIVIDUAL WOLF PACK SUMMARIES

The following pages are summaries regarding the data collected on each wolf pack during the 2024–2025 winter survey period. The summaries provide an explanation of the size of each pack, pack composition, and any other pertinent details on that pack during 2024–2025. When possible, we refer to known wolves by their ID. Known wolves are either those we have tagged and collared or those that have distinctive physical appearances that allow us to identify them when they are observed on our remote cameras. Collared and ear-tagged wolves have IDs that either begin with a "V" (e.g., "V085") or are a three or four digit code (e.g., "Y1T" or "B11D"). Wolves we have identified solely based on physical appearance have IDs based on their pack affiliation when first identified on camera (e.g., CB = Cranberry Bay, LP = Listening Point) and social status (e.g., BM = breeding male, BF = breeding female, SUB = subordinate). For instance, the breeding female of the Stub-tail Pack, who has never been collared but has a distinctive short tail from which we can easily identify her on camera, was assigned the ID: ST_BF. When we can readily identify multiple subordinate wolves in a pack, we include a number at the end of the ID so that each ID is unique (e.g., LP_SUB1, LP_SUB2).

BIONDICH



In Winter 2023–2024, the Biondich Pack was 7 wolves: a breeding pair and five pups. For some reason, the pack did not produce pups in Spring 2024. We had several high-quality observations of the breeding female of the Biondich Pack (Wolf BD_BF) in April and May 2024 demonstrating she was not pregnant and never nursed pups.

In May 2024, we collared two of the five now yearling wolves from the Biondich Pack. These two wolves (Wolves R5E and R6D) were the first wolves we have collared in the Biondich Pack. From these collared individuals, we quickly learned the Biondich Pack has an expansive and large territory relative to many of the packs we have studied in the GVE.

Although we deployed a substantial number of cameras throughout the Biondich Pack territory, we did not get as many observations as we had hoped. Perplexingly, the wolves did not use many of the roads, trails, and other linear features we had set cameras along—a stark contrast from wolves in most other packs who readily travel in such areas during winter. As such, we only recorded 17 independent observations of the Biondich Pack during our winter survey period. In addition, we captured 4 high-quality observations of the pack in November 2024, just before the winter survey period.

Most observations showed 6 or 7 wolves traveling together. Most of the observations of 7 wolves occurred in the first half of the winter survey period and with observations of 6 generally in the second half of the winter survey period, though we did have a few observations of 6 in late fall and early winter. In total, we had 5 independent observations of 7 wolves and 7 independent observations of 6 wolves. Given this, we concluded 6 wolves was likely the best estimate for the number of wolves in the Biondich Pack.

We suspect that the pack likely had a wolf (i.e., the 7th wolf) that loosely associated with the pack during late fall and early winter before dispersing sometime in early-to-mid winter as we saw with several other wolves in other packs (e.g., Wolf B9T in the Stub-tail Pack). Such behavior is fairly common with young wolves in the GVE.

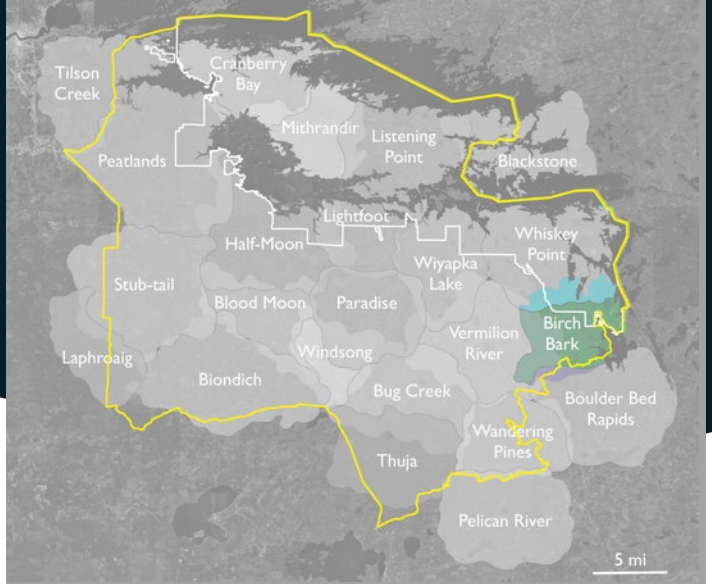
Wolf R5E traveling on a logging road in late winter.

1 *Wolf R5E in May 2024.*

2 *The breeding female of the Biondich Pack, Wolf BI_BF, in Winter 2024-2025.*

A count of 6 wolves means the Biondich Pack consisted of a breeding pair and 4 subordinate adults. We know two of the subordinate adults were Wolves R5E and R6D, both yearlings. The other two wolves were undoubtedly the yearlings from the previous spring's litter, meaning that 4 of the 5 pups from the previous winter remained with the pack as yearlings. We have not documented 4 yearling wolves remaining with their natal pack for a second winter to date. The fact that the Biondich Pack did not have any pups in Spring 2024 likely facilitated this but it is still unusual that more of these yearlings did not disperse during or prior to Winter 2024–2025.

BIRCH BARK



The Birch Bark Pack consisted of three wolves in Winter 2023–2024—a grizzled, old breeding male (Wolf BB_BM), a whitish-gray old breeding female (Wolf BB_BF), and a subordinate adult male. The pack did not have pups in Spring 2024 as the breeding female clearly was never nursing pups (i.e., never had distended nipples in spring) and never appeared pregnant. Notably, we had numerous high-quality daylight observations of her in spring so we feel confident in this assessment.

Then, in late June 2024, Wolf BB_BF disappeared and a new younger female was observed traveling periodically with Wolf BB_BM and the subordinate adult male. Clearly, this new female had taken the place of Wolf BB_BF. We do not know if Wolf BB_BF was simply ousted from the pack by this new female or if Wolf BB_BF died and this new female was filling the vacancy left by Wolf BB_BF's death. Either way, this new female (Wolf BB_BF2) became the new breeding female of the pack.

In July 2024, we collared the subordinate adult male in the pack (Wolf W4D), the first wolf collared in this area of the Greater Voyageurs Ecosystem (territory on the western side of Crane Lake) since 2013, when this area was occupied by the Crane Lake Pack. As such, Wolf W4D's movements provided valuable data on the extent of the Birch Bark Pack territory, and its relationship to other known pack territories.

In Winter 2024–2025, the Birch Bark Pack was 3 wolves: the old grizzled male (Wolf BB_BM), the new breeding female (Wolf BB_BF2), and Wolf W4D. We observed these 3 wolves traveling together on 32 different occasions (i.e., we observed them once every 5 days) during the winter survey period. Thus, we had excellent data on the size and composition of this pack during the winter.

Yet, one question remained: who was the breeding male of the pack? Was it Wolf W4D or his presumed father, Wolf BB_BM? Both of these wolves acted dominantly when traveling around together with tails held high, but we had the impression, though we could not quantify it, that Wolf W4D had recently taken the breeding role from his father. This impression was substantiated in April 2025 when W4D's movements to and from the pack's den resembled the movements of a breeding male—that is, he made brief, direct forays away from the den, presumably acquired food, and then promptly returned to the den.

All three Birch Bark Pack members. Wolf W4D is on the left, Wolf BB_BF2 in the middle, and Wolf BB_BM to the right.

1 The Birch Bark Pack: Wolf BB_BF2 is on the right, Wolf BB_BM in the middle, and Wolf W4D to the left.

2 Wolf BB_BM, the old grizzled male of the Birch Bark Pack, followed by the new breeding female of the pack, Wolf BB_BF2.

1

2

1 *The longstanding breeding male of the Birch Bark Pack, Wolf BB_BM, in Winter 2024-2025.*

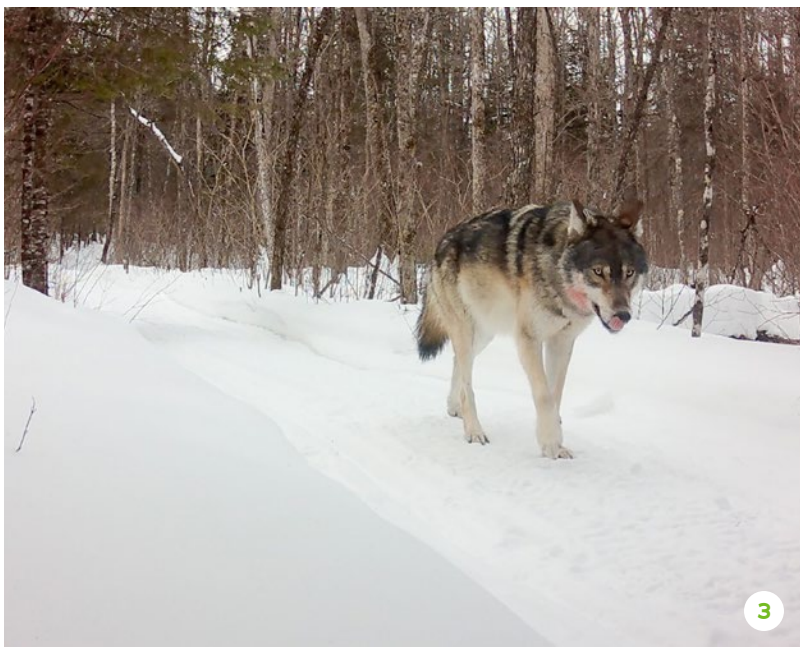
2 *The new breeding female of the Birch Bark Pack, Wolf BB_BF2, followed by Wolf W4D in Winter 2024-2025.*

3 *Wolf W4D with some blood on his fur, likely from a fresh kill he was consuming.*

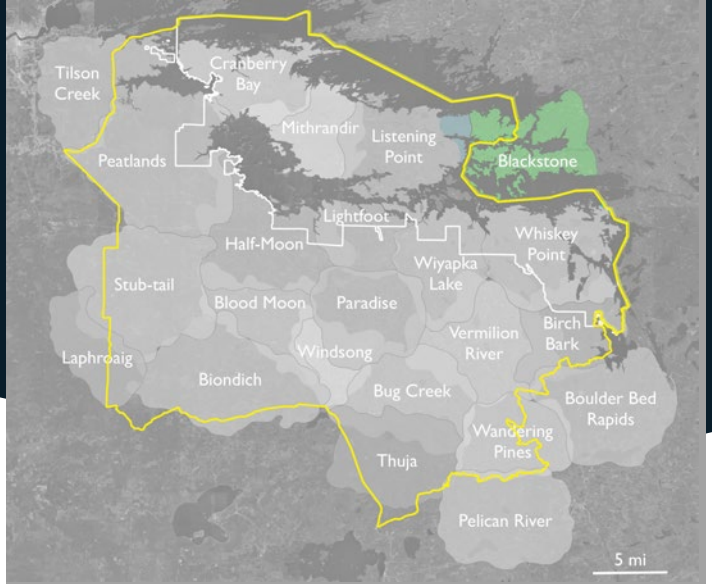
Unfortunately, W4D's collar dropped off in mid-April 2025. We visited the pack's den the week after in hopes of tagging the pups and collecting genetic samples, but the pups had been moved to another den before we arrived. As such, who sired the litter remains a mystery for now.

The Birch Bark Pack exhibited a substantial increase in territory size during Winter 2024–2025. This increase was no doubt facilitated by the dissolution of the Vermilion River Pack, which was the western neighbor of the Birch Bark Pack. Shortly after the Vermilion River territory was vacated, the Birch Bark Pack began traveling extensively throughout the territory. Specifically, the Birch Bark Pack spent substantial time around the Long Lake area during winter, likely taking advantage of deer wintering in the coniferous forests around the lake.

Insofar as we could tell, the Birch Bark Pack occupied their former territory as well as the majority of the Vermilion River territory in Winter 2024–2025. Whether they will continue to occupy such a large area throughout the coming year is unknown but it would be surprising given the size of such a territory.



BLACKSTONE



The Blackstone Pack was once again observed several times on cameras in the central and eastern portions of the Kabetogama Peninsula, areas that are occupied by the Listening Point Pack. Notably, we could readily determine this was the Blackstone Pack, which we first observed during the Winter 2023–2024 study period, because of the breeding pair, Wolves BS_BF and BS_BM, which both have very distinctive appearances. As best as we can tell, the Blackstone Pack likely occupies the territory directly to the east of the Kabetogama Peninsula in Ontario, Canada, and it is possible the pack occupies the peninsula that stretches from the north side of Mica Bay to Kettle Falls on the northeastern tip of the Kabetogama Peninsula in Voyageurs National Park. Without a GPS-collared individual in the pack we cannot know for certain.

Although we had 17 independent observations of the Blackstone Pack, we do not have sufficient data to generate a reliable pack size estimate. For instance, we had five observations of nine wolves in December and early January, and two of ten wolves during this period. Yet, in the nine observations after early January, we observed three to seven wolves, and had no observations of nine or ten wolves.

Such patterns could mean the pack was large in early winter but then lost several pack members to dispersal or mortality (e.g., wolves legally trapped or hunted in Ontario), resulting in a smaller pack for much of the winter survey period. Alternatively, the pack could have remained at 9 or 10 wolves all winter and we simply did not observe all 9 or 10 together after early January. Both possibilities are plausible, and we do not have sufficient data to determine which is most likely. Given the uncertainty, we did not use data from the Blackstone Pack for our population estimates.

1 *A pup from the Blackstone Pack staring at our camera while another pup scent rolls in the snow while several pack members gather to investigate a scent in the background.*

2 *Wolf BS_BF, the breeding female of the Blackstone Pack.*

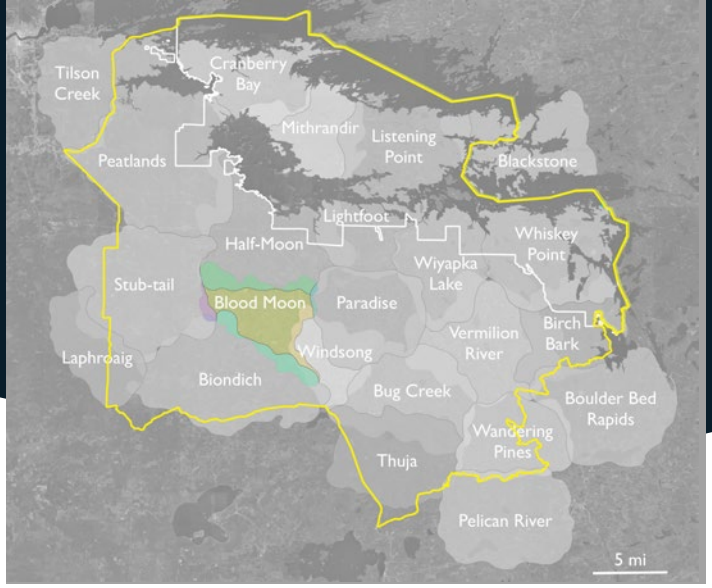
3 *A Blackstone Pack pup with four pack members in the background.*

1 The Blackstone Pack on Nashata Beach. A subordinate male walks by the camera while seven pack members travel across the frozen lake ice.

2 Wolf BP_BM, the breeding male of the Blackstone Pack.

3 The Blackstone Pack traveling the portage from Shoepack to Little Shoepack Lake.

BLOOD MOON



During December 2024–January 2025, the Blood Moon Pack was comprised of the same two individuals as it had been for the previous two winters: Wolf Y1T, the formerly collared breeding male, and Wolf Y5E, the breeding female, who we collared in June 2024. Wolf Y5E's ID before she was collared was Wolf BM_BF.

Although the pack did produce a litter of pups in Spring 2024, all pups had died as of July 2024 (we found remains of one of these pups in June while doing other fieldwork). As a result, the pack continued to be just a breeding pair throughout the fall and early winter.

In late January, the Blood Moon Pack traveled south of the Ash Lake Road on the northern edge of the Nett Lake Reservation, a place where they, along with other packs such as Biondich and Stub-tail, occasionally visit during winters presumably because of deer congregated in this area.

On January 31, 2025, we received a mortality signal from Wolf Y5E's collars indicating she had died. Because she died on the northern edge of the Nett Lake Reservation, we could not collect her carcass for a necropsy. However, just before her death, Wolf R5E and the Biondich Pack were at precisely the spot where Wolf Y5E was when she died. Thus, the cause of death is almost certainly intraspecific strife—i.e., the Biondich Pack killed Wolf Y5E.

Wolf Y1T escaped this encounter, and 19 days after Y5E's death, we observed Y1T traveling with two other uncollared wolves near the Blood Moon Pack territory on February 18 and 19, 2025. Then, from February 20 to March 6, we observed Y1T traveling with one other wolf on four different days. The next observation of Y1T was on March 10 of Y1T traveling with two other wolves, an uncollared wolf and Wolf Y2L, a female that has been a lone wolf since we collared her in Spring 2022. We observed Y1T traveling with these same wolves on March 15, the last time we observed him traveling with two other wolves during the winter survey period. However, we had five different observations of Y1T traveling with an uncollared wolf during March 19 to April 10, 2025.

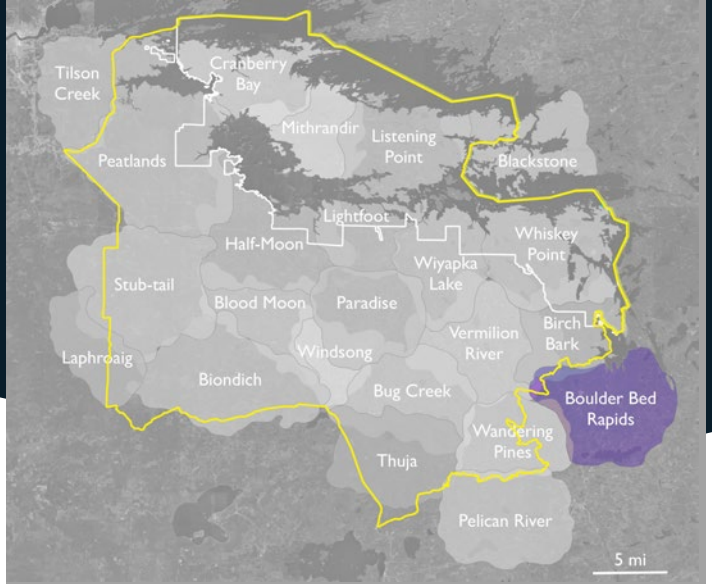
Although few of these observations of Y1T were in the Blood Moon Pack territory, most were within a few miles of the territory, and all were in the GVE. In other words, for most of the winter, the Blood Moon Pack (i.e., Y1T and another wolf) occupied some part of the GVE, and thus we consider the Blood Moon Pack to be a functional wolf pack in Winter 2024–2025. We considered the pack to be two wolves because for the vast majority of the winter the pack was only two wolves. We only observed three wolves in the territory during two short periods.

1 Wolf Y5E, the breeding female of the Blood Moon Pack, shortly before she was killed by the Biondich Pack in January 2025.

1 Wolf Y1T, the breeding male of the Blood Moon Pack.

2 Wolf Y1T, the breeding male of the Blood Moon Pack.

BOULDER BED RAPIDS

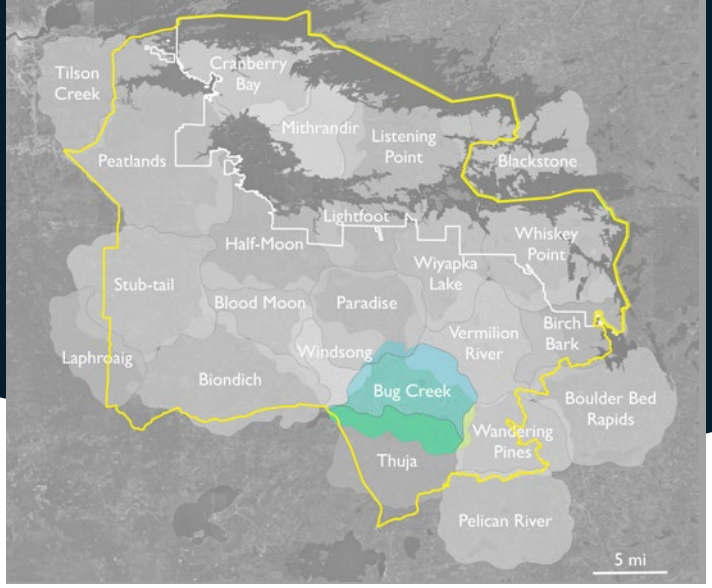


The Boulder Bed Rapids Pack occupies a territory that may just marginally overlap the far eastern edge of the Greater Voyageurs Ecosystem (Fig. 2). In Winter 2023-2024, we recorded several observations of this pack on cameras in the Birch Bark and Vermilion River territories. In Winter 2024-2025, we recorded five observations of what we presume is this same pack in the Birch Bark territory. All five observations occurred in February (February 4, 8, 17, and 18; two of the observations occurred on February 18). All observations were of two wolves that appeared to be a dominant breeding pair, and we could tell for certain these wolves were not Birch Bark wolves. However, all observations occurred at night and we could not say with certainty that we observed the same two wolves in all five observations.

Additionally, all observations occurred during an 11-day period in winter and we had no other observations of these wolves before or after that period so we were not sure whether this pack was indeed just a pair or if there were other pack members. Given the uncertainty, we do not have a pack size estimate for Boulder Bed Rapids and did not use any data from this pack in our population estimates.

1 & 2 A pair of dominant wolves from the Boulder Bed Rapids Pack in February 2025.

BUG CREEK



We observed the Bug Creek Pack on remote cameras frequently during the winter survey period with 57 observations of two or more wolves from the pack traveling together throughout the winter survey period. Based on this data, the pack was seven wolves during this time, and consisted of the breeding pair, three adult subordinates, and two pups (we had 16 independent observations of seven wolves in this pack).

Wolf BC_BF has remained the breeding female of the pack since we first started studying this pack in 2021. This female is easily recognizable due her white-tipped tail which, in our area, is unique to her as we have yet to document another wolf with a white-tipped tail. However, the pack has experienced substantial turnover in the breeding male position over the past few years. In Fall 2023, Wolf B5E, the original breeding male of the pack, disappeared (we suspect likely died) and a new breeding male (Wolf BC_BM2) quickly replaced him. This new breeding male sired a litter of pups in April 2024, two of which survived to adulthood. The tenure of this breeding male was short-lived, though.

By late Fall 2024, Wolf BC_BM2 had disappeared and another wolf, Wolf BC_BM3, had taken the position of breeding male. We do not know where this wolf came from or what precisely happened to Wolf BC_BM2. We suspect he likely died as we did not observe him on any other remote camera in our study area, though it is possible he was forcibly removed from the pack by Wolf BC_BM3. Either way, the Bug Creek Pack has now had three different breeding males in the past three years.

The pack had three subordinate adult wolves in the pack that we could readily identify. The most interesting of which is Wolf BC_SUB1, a 4-year-old female wolf who has remained in the pack since 2021. Most subordinate adults only remain in their natal pack for 1–2 years before dispersing so the fact that Wolf BC_SUB1 has remained in the pack for 4 years is atypical. Yet, this does appear to be a more common occurrence with subordinate females who remain in their natal pack waiting to take the breeding female role from their mother. For example, Wolf B3S in the Lightfoot Pack and Wolf R7S in Wiyapka Lake Pack remained in their natal pack for several years before usurping their mother for the breeding female role. We suspect Wolf BC_SUB1 is likely doing something similar.

The other two known subordinate wolves were Wolf P6T, a yearling female wolf, who was collared for most of the winter survey period, and Wolf BC_SUB3, a yearling wolf who does not have a tail (this wolf lost its tail somehow as a young pup). And then the pack had two pups that survived through the winter (we collared one of these pups in May 2025, who is now dubbed "Wolf P7C").

1 The new breeding male of the Bug Creek Pack, Wolf BB_BM2, carrying part of a beaver back to the pack's den in April 2025.

2 Wolf BC_SUB1, a 4 year-old subordinate female, who has remained in the Bug Creek Pack for several years.

1 The breeding male of the Bug Creek Pack, Wolf BC_BM2, followed by Wolf BC_SUB1, a 4-year-old subordinate female.

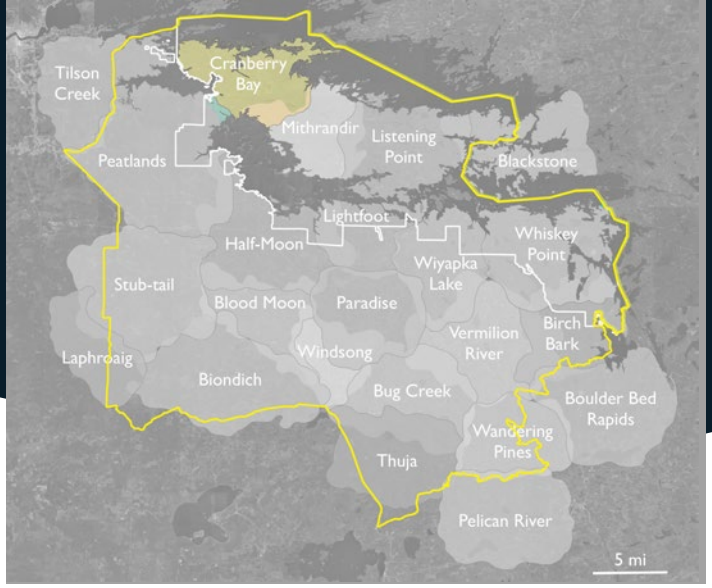
2 Several Bug Creek Pack members in early 2025 including Wolf P6T (front and center), Wolf BC_BM2 (behind P6T), and two other pack members in the background.

1 The breeding pair of the Bug Creek Pack. The breeding male, Wolf BC_BM2, is on the left, and the breeding female, Wolf BC_BF, is on the right.

2 Wolf P6T (front), a yearling female, followed by a pup in Fall 2024.

3 Four members of the Bug Creek Pack. The two wolves on the right are pups, the wolf behind them is the breeding female (Wolf BC_BF), and the wolf behind her is Wolf BC_SUB1, a 4-year-old subordinate female wolf.

CRANBERRY BAY



The Cranberry Bay Pack was a pair of wolves in Winter 2024–2025. We had 33 independent observations of these two wolves during the winter survey period which equates to an observation of this pair every five days during the survey period. The breeding pair appears to be the same individuals (Wolves CB_BF and CB_BM3) as the breeding pair at the end of Winter 2023-2024 (see our 2023-2024 Population Report for more details on the substantial changes in the Cranberry Bay Pack last winter).

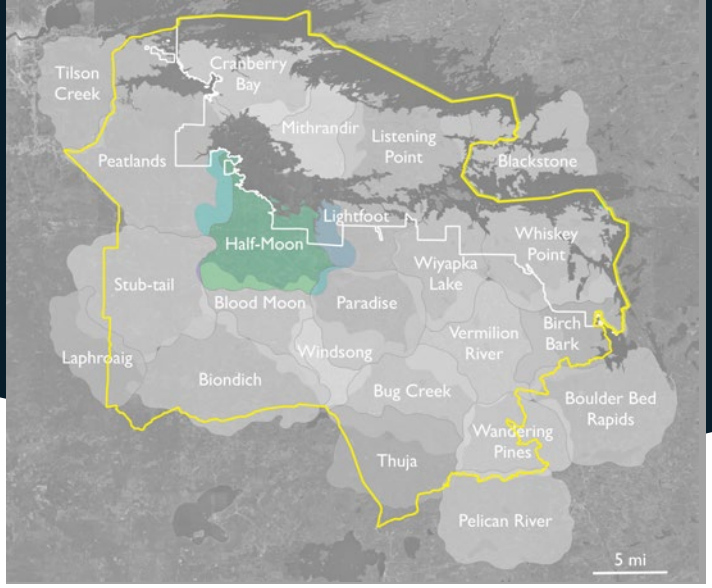
The Cranberry Bay Pack did produce pups in April 2024, at least one of which survived into late summer. However, we did not have any observations of pups in the winter survey period indicating none of the pups survived the fall. Thus, 2024–2025 marked the first time in several years that the Cranberry Bay Pack did not rear any pups to adulthood.

1 The breeding female of the Cranberry Bay Pack, Wolf CB_BF.

2 Wolf CB_BM3, the breeding male of the Cranberry Bay Pack.

3 Wolf CB_BF, the breeding female of the Cranberry Bay Pack, chasing a deer.

HALF-MOON



The Half-Moon Pack underwent substantial change around late summer or early fall of 2024, when several Half-Moon Pack wolves were ousted from the territory, specifically Wolf V094, the breeding male of the Half-Moon Pack for the previous five years, and his 2-year-old son, Wolf O6C.

This change occurred around the time we started to observe a subordinate female in the Half-Moon Pack (Wolf HM_SUB1) traveling with a new dominant male, who became the new breeding male of the pack. In other words, it appears Wolf HM_SUB1 and her new mate likely ousted Wolves V094 and O6C. Interestingly, Wolf HM_SUB1, who was a 2 year old female at the time, is almost certainly Wolf V094's daughter and Wolf O6C's sister.

After Wolves V094 and O6C were ousted, the Half-Moon Pack was predominantly 3 wolves—a breeding pair and an adult subordinate, likely a yearling from Half-Moon—and the pack remained that size through winter. We collared the breeding male of the pack, Wolf Y15C, in early May 2025. We observed Wolf O8C, a yearling female from the Half-Moon Pack that we collared in May 2024, traveling with the Wolves Y15C and HM_SUB1 on a handful of occasions in Fall 2024. This association was short-lived, though, as we had no observations of Wolf O8C with the pack during the winter survey period.

We collected genetic samples from a Half-Moon Pack pup in May 2025, which should be helpful for understanding relatedness of the HM_SUB1 to other Half-Moon Pack wolves. We think it is possible that Wolf HM_SUB1 might have done something similar with her mother, Pup 2217, who was not observed after Spring 2024. We have noted several examples of offspring usurping the breeding role from their parents, such as Wolf R7S usurping her mother, Wolf V076, as breeding female of the Wiyapka Lake Pack and Wolf B3S usurping her mother, Wolf LF_BF, as the breeding female of the Lightfoot Pack.

Either way, the change in the Half-Moon Pack ended the long tenure of Wolf V094 who was the breeding male of the Half-Moon Pack since Fall 2019 and occupied the territory for 5 years. He had two mates during his tenure, Wolf HM_BF, who was his mate through 2022, and Pup 2217, an adult female from the Bowman Bay Pack who was his mate from 2022 to 2024.

Although Pup 2217 was alive and traveled with the pack in Winter 2023-2024, she was not observed after Spring 2024. The footage of Pup 2217 in March and April 2024 shows she clearly was not pregnant and did not have pups. Corroborating this were the movements of Wolves O6C and V094 in Spring and Summer 2024, which showed no localization around homesites where pups were kept. The lack of reproduction, the lack of observations of Pup 2217 after Spring 2024, and the old age of Wolf V094 all seemed to indicate a change to pack dynamics was imminent.

Once Wolves Y15C and HM_SUB1 took over, Wolf V094, who was collared, started to wander around the periphery of the Half-Moon Pack territory as well as throughout the Lightfoot Pack territory and portions of the Wiyapka Lake and Paradise Pack territories. He continued this wandering throughout the winter, and was periodically observed traveling with Wolf O6C, his son, who became the breeding male of the Lightfoot Pack in Winter 2024–2025 and with Wolf B3S, the new breeding female of the Lightfoot Pack (see Lightfoot Pack section).

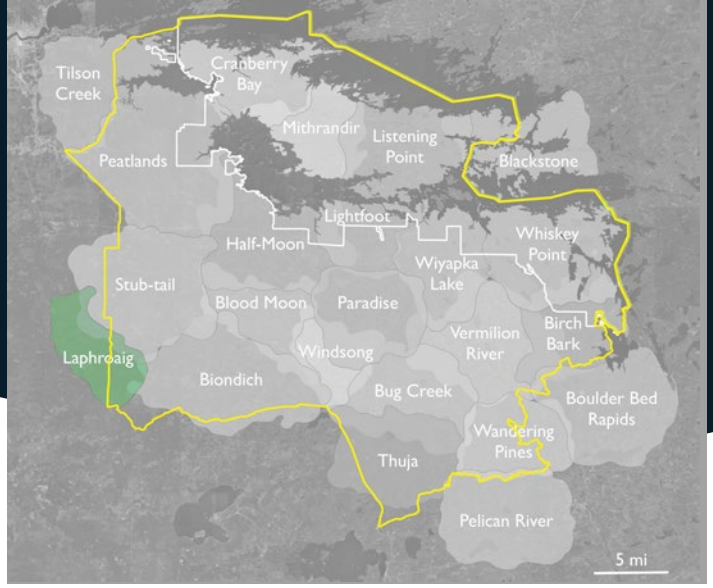
Wolf O8C, a yearling female from the Half-Moon Pack that we collared in May 2024.

1 A yearling female (front left) traveling with the breeding female, Wolf HM_SUB1, of the pack.

2 Wolf Y15C, the new breeding male of the Half-Moon Pack, followed by the breeding female, Wolf HM_SUB1, who is in the background.

1 Wolf V094, the former breeding male of the Half-Moon Pack, when we re-collared him in June 2024.
2 Wolf Y15C, the new breeding male of the Half-Moon Pack, when we collared him in May 2025.
3 The new breeding female of the Half-Moon Pack, HM_SUB1, who has a distinctive scar on the right size of her muzzle by her nose.

LAPHROAIG



In June 2024, we collared Wolf W7D, a yearling male in the Stub-tail Pack. Wolf W7D remained in the Stub-tail Pack until late summer when he started to travel more regularly on the periphery or just outside of the Stub-tail Pack territory and disassociate to a degree from other Stub-tail Pack members (we had 3 other subordinate adults [Wolves B9T, B10E, and B11D] collared in the Stub-tail territory during this period).

By late Fall 2024, Wolf W7D had clearly left the Stub-tail Pack and started occupying a new territory that was southwesterly adjacent to the Stub-tail Pack territory (see Fig. 2). Because half of this new territory was in the GVE, we were keen to study this pack in an area where we previously had only detected the Stub-tail and Biondich Packs. We called this 'new' pack the Laphroaig Pack, so named for the abundance of boggy peatlands throughout this pack's territory.

Fortunately, we had many observations of the Laphroaig wolves during the winter survey period, and readily determined the pack was five wolves: three adults and two pups. Initially, we assumed Wolf W7D was the breeding male because every time a collared subordinate male wolf has joined a new pack in the GVE, he has become the breeding male (e.g., Wolves V077, O3S, B2L, and O6C). Further, the movements of Wolf W7D around the pack's den in April–May 2025 were consistent with how breeding males move during the denning period (short, direct forays away from the den to get food, with prompt returns to the den after acquiring food).

However, after reviewing the footage of the Laphroaig Pack in detail, the evidence indicates Wolf W7D was not the breeding male but rather a subordinate male. Indeed, the pack appeared to be led by a breeding pair that were routinely leading the pack and acting as the dominant individuals (scent-marking, hold their tails high when moving). Wolf W7D almost never led the pack when traveling and his body language did not appear consistent with a breeding male. We suspect the breeding pair were the parents of the two pups in the pack.

The Laphroaig Pack did produce a litter of pups in April 2025 and we collected genetic samples from of the pups. We will be able to determine parentage of the pups once we analyze these samples.

1 A Laphroaig Pack pup checking out one of our cameras.

2 The breeding female of the Laphroaig Pack (left) traveling with one of her pups (right).

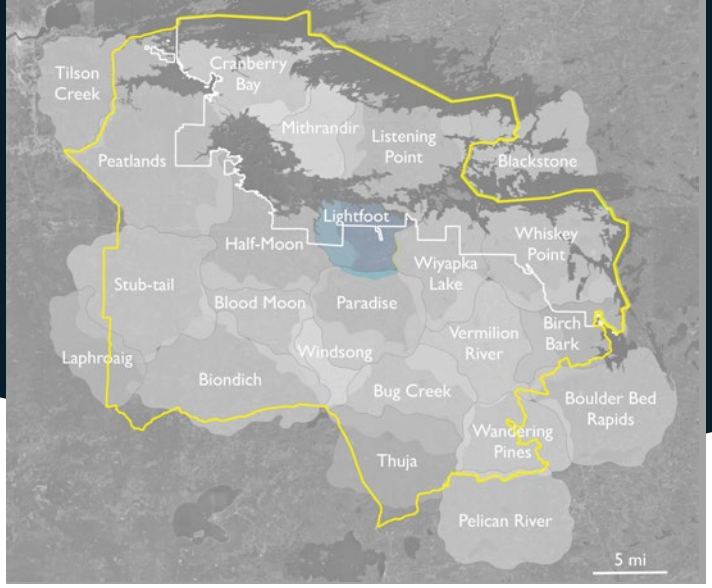
1 *Wolf W7D, a subordinate wolf in the Laphroaig Pack, in Fall 2024.*

2 *The breeding male of the Laphroaig Pack in early 2025.*

3 *The two Laphroaig Pack pups in Winter 2024-2025.*

4 *The breeding female of the Laphroaig Pack in early 2025.*

LIGHTFOOT



In Spring 2024, the Lightfoot Pack produced a litter of pups for the first time in three years. Prior to 2024, the pack had gone two years without producing pups because the breeding female of the pack (Wolf LF_BF) had not found a new mate after her first mate, Wolf V071, the former breeding male of the pack, was killed by other wolves in January 2022.

But by Winter 2023–2024, she found a mate (Wolf LF_BM) and the pair produced pups. Two of these pups survived until early Fall 2024, when we had several observations of the pups. However, we did not have any observations of these pups or their parents after fall. It was as if the Lightfoot Pack had vanished—except for one individual, Wolf B3S, a 3-year-old female who was collared in Spring 2022.

Wolf B3S was the daughter of Wolf LF_BF and had remained in the pack territory since her birth in 2021. In Fall 2024, Wolf B3S was observed regularly on camera. Similarly, we observed Wolves V094 and O6C, both former Half-Moon Pack wolves, traveling together in the Lightfoot territory. By at least November 12, 2024, Wolves V094, O6C, and B3S were traveling together in the Lightfoot territory.

Although we will never know for certain what occurred in the Lightfoot Pack territory in Fall 2024, we doubt it is a coincidence that many of the Lightfoot Pack members disappeared around the time these Half-Moon Pack wolves moved in. We suspect Wolf B3S likely played a role in ousting her mother and replacing her as the breeding female, and Wolves V094 and O6C could have also exerted pressure on Lightfoot Pack members as well. We did have several observations during winter of a lone wolf that we are fairly certain was Wolf LF_BF, indicating she was alive but no longer part of a pack.

Regardless, for most of December, the 'new' Lightfoot Pack consisted of the same three wolves: V094, O6C, and B3S. But by early January, the Lightfoot Pack was only two wolves: Wolves O6C and B3S. Wolf V094 was no longer part of the pack and had transitioned to life as a lone wolf. Indeed, the last observation of all 3 wolves together was January 4, 2025.

Interestingly, although Wolf V094 was clearly not part of the Lightfoot Pack, most of his time was spent largely in and around the Lightfoot territory, and in March 2025, Wolf V094 remained almost exclusively in the territory. Despite this, we never observed Wolf V094 traveling with the Lightfoot Pack during this time. Because Wolf V094 was not with the pack for the majority of the winter survey period, we considered the Lightfoot Pack to be two wolves, a breeding pair, and Wolf V094 to be a lone wolf.

1 The Lightfoot Pack crossing a frozen beaver pond. Wolf O6C in on the right and Wolf B3S on the left.

2 The Lightfoot Pack crossing a frozen beaver pond in late winter.

1 The Lightfoot Pack on a frozen beaver pond. Wolf B3S is in front and Wolf O6C in the back.

2 Wolf O6C, the new breeding male of the Lightfoot Pack, with his father, Wolf V094, in the background.

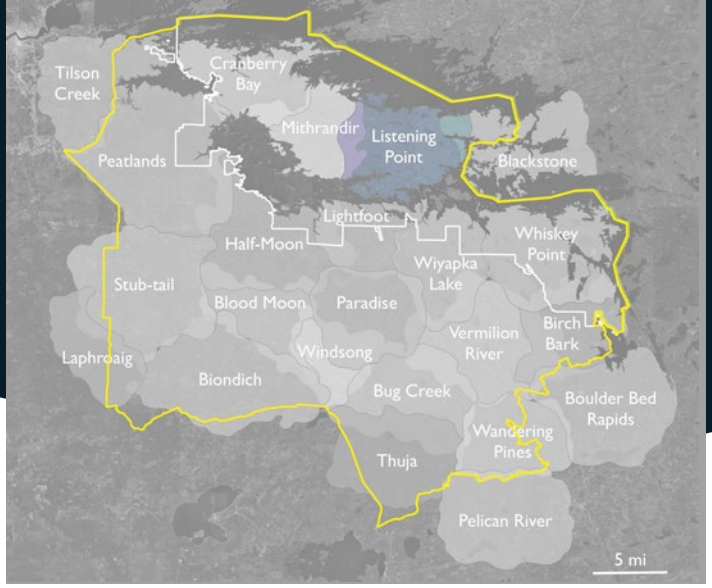
3 Wolf B3S, the breeding female of the Lightfoot Pack.

1 Wolf V094, the former breeding male of the Half-Moon Pack, with Wolf B3S, the new breeding female of the Lightfoot Pack, on a frozen beaver pond in December 2024.

2 Wolf B3S, the breeding female of the Lightfoot Pack, in March 2025.

3 Wolf B3S, the breeding female of the Lightfoot Pack.

LISTENING POINT



The Listening Point Pack has historically been a very difficult pack for us to get high-quality data on because they occupy a remote territory on the eastern third of the Kabetogama Peninsula that has relatively few trails and other linear features. In an effort to increase our understanding of this pack, we have deployed an increasing number of cameras in this territory over the past few years in hopes of increasing the number of observations of this pack. This effort has paid off tremendously!

During the winter survey period, we observed two or more members of the Listening Point Pack together 47 times, and had 20 independent observations of the entire pack—an observation of the entire pack roughly every 6 days of the survey period. The pack consisted of four wolves: a breeding pair (LP_BF, LP_BM) and two pups. Although the breeding pair is the same as last winter (Winter 2023–2024), the subordinate adult male (LP_SM) who was with the pack last winter either died or dispersed during Spring/Summer 2024 as did the two pups in the pack last year.

The Listening Point Pack had 5 pups alive as of late Summer 2024 but by November 2024 only 3 pups were alive (we had two observations of three pups on November 2, 2024 and November 26, 2024). We only observed two pups in December 2024 and beyond, indicating that at least 60% of the pack's pups did not survive. We do not know the size of the 2024 litter but if it was >5 pups then the mortality rate of pups would be greater than 60%.

One of the surviving pups in the Listening Point Pack was notable because the pup did not seem to have very much pigment in its eyes. Thus, instead of the pup having the typical yellow/orange eye color, the pup had a steely gaze because its eyes were a blueish-silver color. We do not know whether it will retain this appearance into adulthood but if so, this pup should be fairly easy to identify on remote cameras.

Interestingly, the Listening Point Pack had fairly regular incursions from the Blackstone Pack during the winter survey period. Indeed, the Blackstone Pack made ~10-12 forays throughout the Listening Point territory based on our remote camera data. And many of these forays were travels to the interior parts of the Listening Point Pack territory such as Shoepack and Ek Lakes (i.e., not just brief forays on the edge of the territory).

1 Wolf LP_BF, the breeding female of the Listening Point Pack.
2 The two pups of the Listening Point Pack in early 2025.

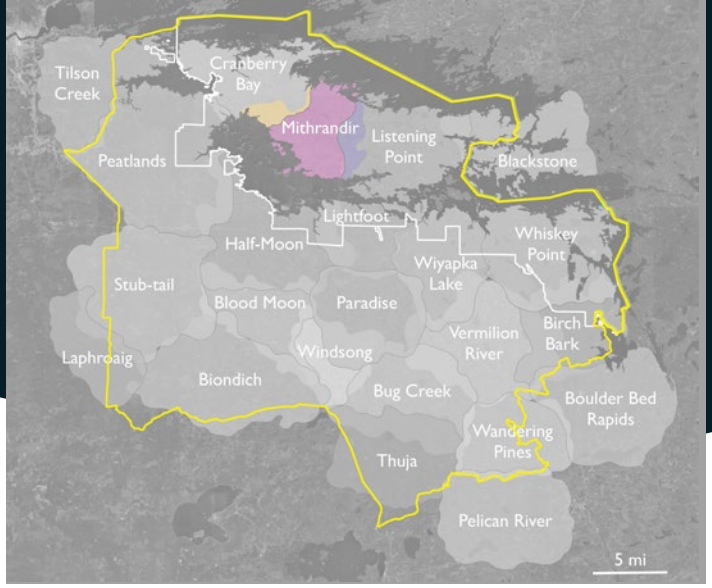
The Listening Point Pack territory appears to be the largest territory on the Kabetogama Peninsula currently based on remote camera footage. Indeed, on several occasions we observed the pack as far west as Loiten Lake and as far east as Johnson Bay/Weir Lake, indicating their territory includes about half of the Kabetogama Peninsula. On the eastern edge of their territory near Mica Bay, the Listening Point Pack clearly overlaps with the Blackstone Pack. Notably, we did not observe Listening Point on a camera northeast of Mica Island, where we observed the Blackstone Pack on 8 occasions, indicating that the territory does not extend that far east. Similarly, Listening Point has substantial overlap on the western edge of their territory, near Shoepack Lake, with the Mithrandir Pack whose territory appears to be roughly from Shoepack Lake westward to Quill Lake/Warclub Lake.

1 A Listening Point pup that appears to be lacking pigment in its eyes.

2 Wolf LP_BM, the breeding male of the Listening Point Pack.

3 The breeding pair of the Listening Point Pack. The breeding male, Wolf LP_BM, is in front and the breeding female, Wolf LP_BF, is in the back.

MITHRANDIR/NASHATA



The complicated saga of the Cranberry Bay, Mithrandir, and Nashata Packs has slowly unfolded over the past few years. And the happenings of Winter 2024–2025 only added to the saga, one that has highlighted the complex and ever-changing social dynamics of wolf packs (see our 2022–2023 and 2023–2024 population reports for a detailed history on these pack dynamics). Below is a brief history of these packs to help place the findings of 2024–2025 in context.

Two winters ago (Winter 2023–2024), the Mithrandir and Nashata Packs where each a breeding pair but the packs had territories that largely overlapped one another. The Nashata Pack consisted of Wolf NS_BF, the original breeding female of the Nashata Pack for several years, and Wolf V083, the former breeding male of the Cranberry Bay Pack and then the Mithrandir Pack.

The Mithrandir Pack consisted of Wolf MI_BM, the breeding male, and Wolf NS_SF, a 3-year-old breeding female originally from the Nashata Pack (her mother was Wolf NS_BF). Importantly, Wolf NS_SF was the mate of Wolf V083 in Winter 2022–2023 so in Winter 2023-2024 Wolf NS_SF's mother and former mate paired up together.

In April 2024, both the Nashata and Mithrandir Packs produced pups. Mithrandir did not have any pups alive, insofar as we could tell, by mid-summer. Nashata, on the other hand, had one pup alive late into 2024. But by late Summer 2024, the Nashata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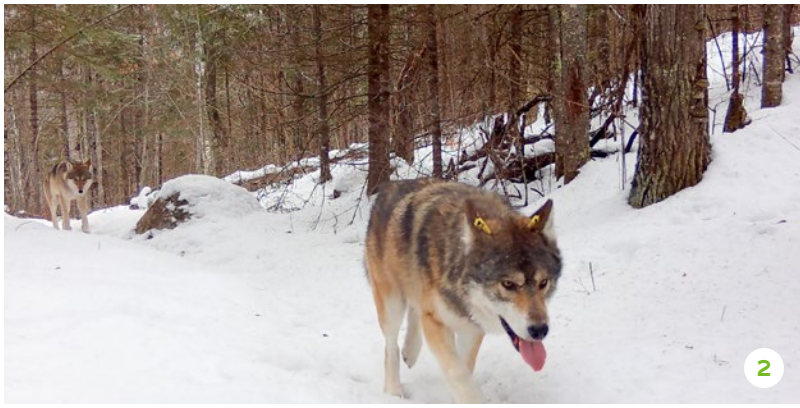
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1 Wolf B2L, the new breeding male of the Mithrandir Pack.

2 The Mithrandir Pack. Wolf B2L, the breeding male, is in front, and the breeding female, Wolf NS_SF, is in the back.

3 Wolf V083 (front) traveling with Wolf NS_SF (back), the breeding female of the Mithrandir Pack, in late 2024.

1 *Wolf B2L in mid-winter.*
2 *Wolf NS_SF, the breeding female.*
3 *Wolf B2L, the breeding male.*

breeding female, Wolf NS_BF, disappeared even though we had several observations of Wolf V083 traveling with a single pup. Because Wolf NS_BF was never observed again on camera and no other female took her place (i.e., she was not ousted by another wolf), we assume she likely died during summer leaving the Nashata Pack to consist of Wolf V083 and a pup.

Similarly, the breeding male of the Mithrandir Pack (Wolf MI_BM) disappeared sometime during the summer and we never observed him on camera in the fall or winter, despite several observations of his mate, Wolf NS_SF. We think it likely he also died but we will never know for sure.

Where things get interesting is that in late October and November 2024, the breeding female of Mithrandir (Wolf NS_SF) was traveling frequently with the breeding male of Nashata (Wolf V083) and his pup. A fascinating "merger" of these two packs, and a reunion of Wolves NS_SF and V083 who were mates in Winter 2022-2023. Yet, by early December something had clearly changed. Wolf NS_SF was traveling around with a pup but Wolf V083 was gone, and he never reappeared. Again, we surmise Wolf V083 likely died, which is not surprising as he was an old wolf who appeared to be in rough shape (thin and bony) in late Fall 2024.

Then, starting in mid-December, we observed Wolf NS_SF traveling with a new male wolf we did not recognize. She traveled with this male for the next 6 weeks as we had numerous observations of the pair together until the end of January 2025. Notably, we never observed Wolf NS_SF traveling with Wolf V083's pup after December 6, 2024. We suspect the pup died sometime in early December.

On January 30, 2025, another shake-up in the Mithrandir Pack occurred. The new uncollared male that had been traveling with Wolf NS_SF was usurped by Wolf B2L, the former breeding male of the Vermilion River Pack, who was wearing a functional GPS-collar.

We determined the specific date this change occurred because of the high-quality remote camera data we had in the Mithrandir territory during this period. Specifically, during the morning of January 30, we had an observation of Wolf NS_SF and the uncollared male traveling together but then we had three observations in the afternoon and evening of January 30 of Wolf NS_SF traveling with Wolf B2L. We then had 26 independent observations of Wolves NS_SF and B2L together from January 31, 2025 to April 4, 2025, an observation of the pair almost every other day during this period. In other words, once Wolf B2L showed up, the other male disappeared. The pack remained two wolves, a breeding pair, for the remainder of the winter.

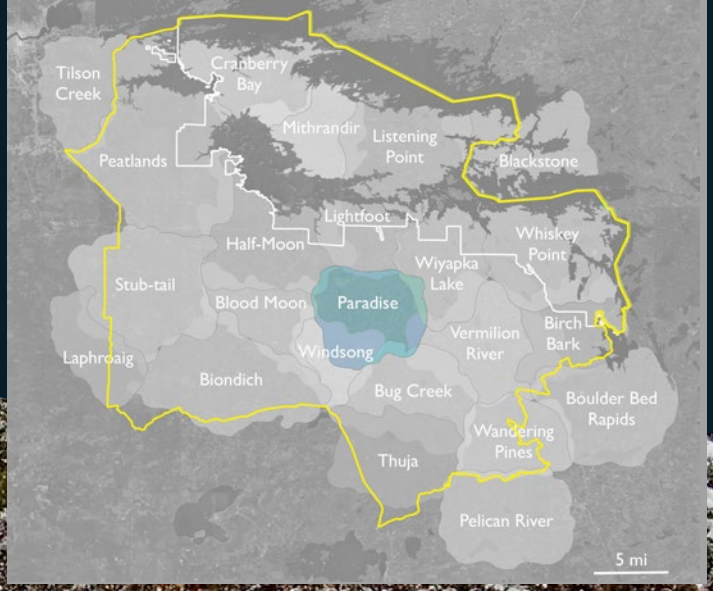
Nonetheless, we thought it fascinating how the same female spent considerable time with 4 different males from Summer 2024 to Winter 2025: the 1st being Wolf MI_BM in Spring/Summer 2024, the 2nd being Wolf V083 from late October, 2024 to the end of November 2024, the 3rd being the uncollared male from mid-December 2024 to January 30, 2025, and the 4th being Wolf B2L from January 30, 2025 to present.

1 *The Mithrandir Pack. Wolf B2L, the breeding male, is in front, and the breeding female, Wolf NS_SF, is in the back.*

2 *Wolf B2L.*

3 *Wolf NS_SF, the breeding female of the Mithrandir Pack.*

PARADISE



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The Paradise Pack continues to be one of the easiest pack's to observe in the Greater Voyageurs Ecosystem given their extensive use of linear features, especially logging roads and ATV trails. We had a total of 113 observations of two or more Paradise Pack wolves traveling together during the winter survey period. From this, we readily determined the pack was four wolves: a breeding pair and two pups. Indeed, we had 32 independent observations of four wolves traveling together during this time—effectively an observation of the entire pack together once every five days during the survey period.

The breeding male of the Paradise Pack was Wolf V077, who has now been the breeding male of the Paradise Pack since it formed in Winter 2019-2020, a tenure of 6 years and one of the longest tenures of any breeding animal we have documented thus far. The breeding female of the pack was Wolf V090, who joined Wolf V077 in Summer 2023 shortly after Wolf V077's original mate, Wolf V085, disappeared in Spring 2023. To our knowledge, the two pups that the Paradise Pack successfully reared are the first pups that Wolf V090 raised to adulthood. In May 2025, we collared one of these two pups, who is now dubbed 'Wolf W5E'.

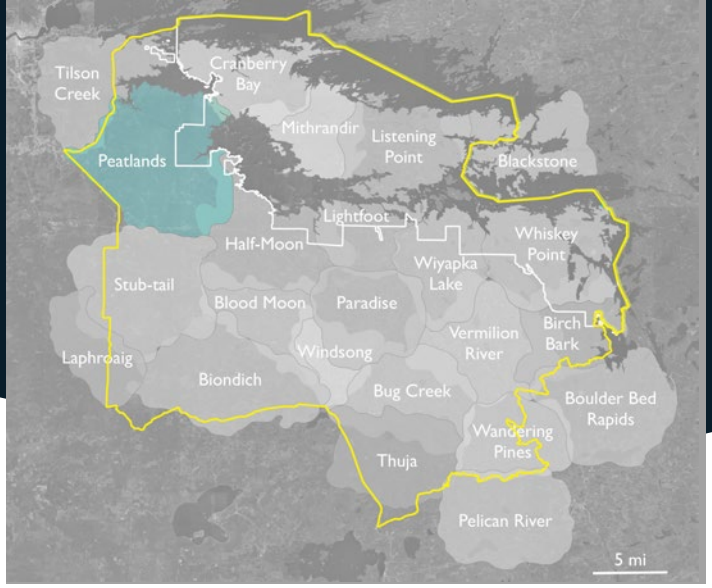
2

3

1 Wolf V077, the breeding male.
2 Wolf V077 (left), the breeding male, followed by two pups.
3 Wolf V090 (right), the breeding female, with a pup (left).

1 & 2 Wolf V090, the breeding female.
3 The two surviving Paradise Pack pups in early Winter 2025.

PEATLANDS



The Peatlands Pack was a large pack this past winter (2024–2025). Like most large packs we have studied, the wolves in the pack often travel in smaller groups, and capturing footage of the entire pack traveling together can be difficult. This pattern appears to be the result of some type of inherent instability or reduced cohesion when packs are this large. We speculate this is because a large pack cannot feed on the same deer kill and meet their energetic demands, and as a result, the pack splits up more often, perhaps as a way to reduce competition for food.

Additionally, it seems large packs often have subordinate adult wolves that often only loosely associate with the pack during the winter. In other words, these are subordinates who have effectively dispersed and become lone wolves. However, these subordinates periodically join the pack for short periods throughout the winter.

All of these factors can make it difficult to determine the size of large packs during winter, despite an abundance of observations of wolves in the pack—and the Peatlands Pack is a perfect example of this. We estimated the Peatlands Pack to be eight wolves this past winter because we had five independent observations of eight wolves traveling together from January to March (the observations were on Jan 16, Jan 19, Feb 25, Feb 28, and Mar 15), the core months of the winter survey period. However, we had 48 independent observations throughout the survey period of two to seven pack members traveling together, an observation every three days throughout the winter survey period.

1 Wolf PL_BF, the breeding female of the Peatlands Pack.

2 Wolf PL_BM, the breeding male of the Peatlands Pack.

Additionally, we had six independent observations of nine wolves traveling together during the winter survey, with most of those observations (4/6) occurring before January 6, 2025, with only two occurring after that (one on Jan 22 and Mar 6).

We debated whether we should consider the pack to be eight or nine wolves given the handful of observations at both sizes. However, because most of the observations of nine wolves occurred early in the winter survey period, and observations of eight occurred over an extended period in the middle of the survey period, we thought eight wolves was the most appropriate estimate of pack size. Notably, we had an observation of ten wolves in the pack in late October 2024 but never had another observation of that size.

The pack consisted of a breeding pair (Wolves PL_BF and PL_BM), 3 subordinates, and 3 pups. Winter 2024–2025 marks the 2nd consecutive year that the Peatlands Pack has been large, with several surviving pups and several subordinate adults that remained with the pack.

We did not have a GPS-collared wolf in the Peatlands Pack during the 2024–2025 biological year, and so we do not have a precise territory estimate. However, based on remote camera data, the territory appears to be quite large. The southern boundary of the territory appears to be Highway 53 from roughly Gateway General, Kabetogama to Ericsburg, with the western boundary being Rat Root Lake. The northern boundary appears to be Black Bay and Gold Portage on Rainy Lake and the eastern boundary the western shoreline of Lake Kabetogama. Gold Portage, in particular, appears to be the territorial boundary between the Peatlands and Cranberry Bay Packs. That said, we had a handful of observations of the Peatlands Pack trespassing into the southwestern portion of the Cranberry Bay Pack territory.

1 *A few Peatlands Pack wolves in April 2025.*

2 *Four Peatlands Pack wolves.*

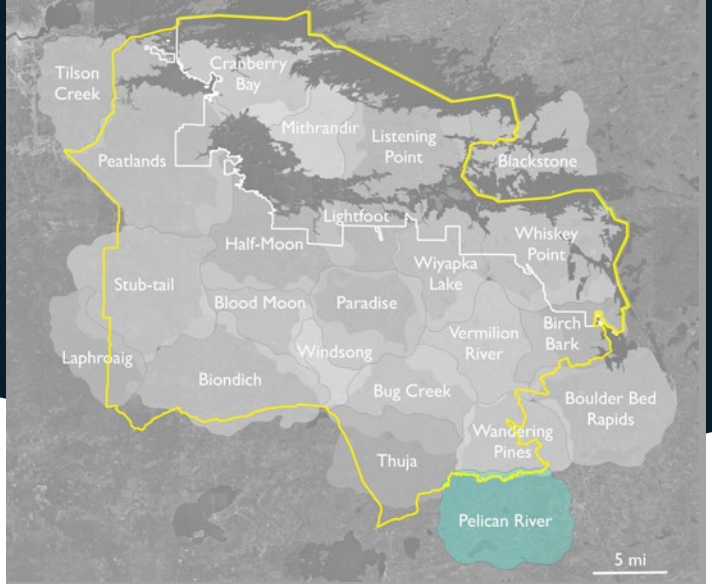
3 *The breeding female of the Peatlands Pack, Wolf PL_BF, followed by seven pack members.*

4 *Wolf PL_BF, the breeding female of the Peatlands Pack. We can easily identify her in footage based on the notch in her left ear and the large scar on her left leg.*

1 Three Peatland Pack wolves. On the right is a subordinate adult and the other two wolves are pups.

2 An observation of nine Peatland Pack wolves traveling together in the early part of the Winter 2024-2025 survey period.

PELICAN RIVER



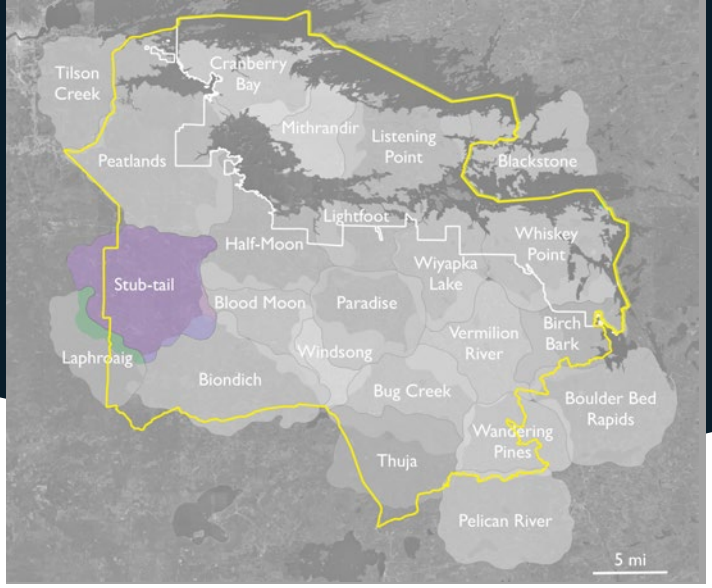
We observed a social group comprised of 3-5 wolves on the edge of the Thuja and Wandering Pines Packs' territories. We readily determined all of these observations were of the same social group because the breeding individuals in this group have a distinctive appearance. However, we did not get enough observations to determine conclusively the number of wolves in the pack. In total, we had 15 independent observations of two or more wolves that were affiliated with this social group: four observations of five wolves (all during late December to late January), four observations of four wolves (all during late December to early February), four observations of three wolves (all during March and April), and two observations of two wolves (one in February and one in April). This pack likely occupies the territory southerly adjacent to the Wandering Pines Pack, and we suspect the Pelican River is likely the boundary between the Wandering Pines and Pelican River Pack, with the Wandering Pines Pack north of the river and Pelican River Pack to the south. As such, the territory is almost entirely outside of the Greater Voyageurs Ecosystem (GVE). Thus, the Pelican River Pack is not a pack we expend any resources studying but we do keep record and document any observations of the pack that occur inside the boundaries of the GVE.

1 The breeding male of the Pelican River Pack (Wolf PR_BM).

2 The breeding pair of the Pelican River Pack. The breeding male, Wolf PR_BM, is on the left and the breeding female, Wolf PR_BF, on the right.

3 The breeding pair of the Pelican River Pack. The breeding male, Wolf PR_BM, is on the left and the breeding female, Wolf PR_BF, on the right.

STUB-TAIL



We had excellent data on the Stub-tail Pack during the biological year of 2024–2025, in large part, because we had four GPS-collared wolves in the pack for the majority of the year—the first time we have had four collared wolves in the same pack. Those four wolves were: Wolf B9T, a 2-year-old female; Wolf B10E, a yearling female, Wolf B11D, a yearling male, and Wolf W7D, a yearling male. Further, we observed the Stub-tail Pack regularly as we had 115 observations of two or more pack members traveling together during the winter survey period.

The Stub-tail Pack was initially eight wolves in November 2024 and early December 2024: the breeding pair (Wolves ST_BF and ST_BM), four adult subordinates (Wolves B9T, B10E, B11D, and another uncollared subordinate), and two pups. Notably, Wolf W7D dispersed from the pack in Fall 2024 and by the winter survey period had joined the Laphroaig Pack (see the Laphroaig Pack description for more details).

By early January 2025, Wolf B9T dispersed from the pack (we observed her traveling alone on several occasions in late January and February 2025) and the pack decreased to seven wolves.

Around this same time, the other uncollared subordinate adult only loosely associated with the pack. We occasionally had observations of seven wolves during January to March (six independent observations) but had substantially more observations of six wolves during this period (21 independent observations). As such, we think the pack was predominantly six wolves for the majority of the winter survey period.

These six wolves included the breeding pair (Wolves ST_BF and ST_BM), two yearling subordinates (Wolves B10E and B11D), and two pups. The two pups were readily recognizable because one of the pups had a broken back leg all winter and hobbled around, and the other pup had distinctive dark coloration on his muzzle (we collared this pup, who is now dubbed Wolf Y16T, in May 2025).

The breeding female of the Stub-tail Pack (Wolf ST_BF, left) playing with her yearling daughter, Wolf B10E (right).

In early March, Wolves B10E and B11D dispersed from the pack. Wolf B11D wandered to an area southwest of Red Lake, Minnesota shortly after dispersing, and has lingered in this area since. Wolf B10E headed directly to an area just north of Grand Rapids, Minnesota, where, approximately 3 weeks after she dispersed, she was illegally shot. Thus, by the end of the winter survey period the Stub-tail Pack was down to four pack members (the breeding pair and two pups).


1

1 *Wolf B10E (left), a yearling female, traveling with two Stub-tail Pack members.*

2 *Wolf ST_BM, the breeding male of the Stub-tail Pack. This male has had a large seemingly open wound on his front right leg since Summer 2024.*

3 *Wolf ST_BF, the breeding female of the Stub-tail Pack.*

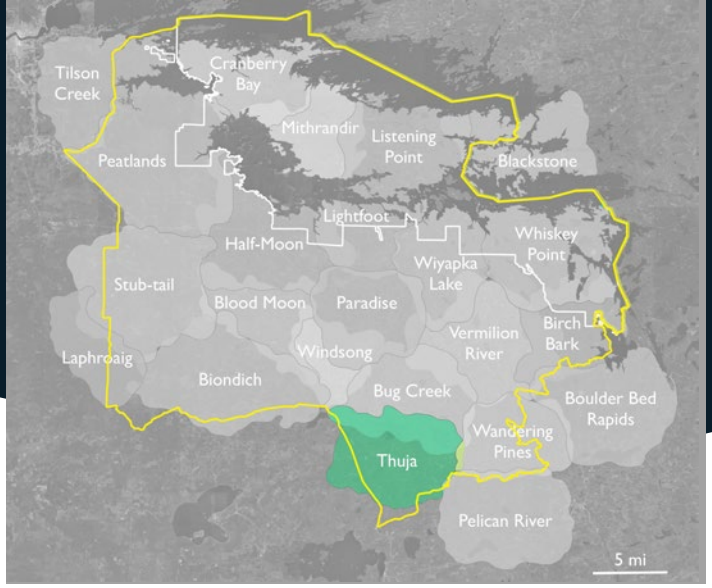

2


3

1 Wolf B10E (left), a yearling female, traveling with two Stub-tail Pack members.

2 A Stub-tail pup investigating our camera. We collared this pup as a yearling in May 2025 and this wolf is now dubbed "Wolf Y16T".

THUJA



The Thuja Pack was a large pack in Winter 2024–2025 with 8 wolves. The pack consisted of the breeding pair (Wolves O3S and TJ_BF), two subordinate yearlings (Wolf W8T and Wolf TJ_SUB1), and four pups. Wolf W8T, a yearling male, wore a GPS-collar during the winter survey period and he remained with the pack until early March 2025 when he dispersed northward into Ontario, Canada. He ventured to the north side of Lake of the Woods before settling in a territory a bit northwest of the northwestern arm of Rainy Lake within a few months of dispersing.

The Thuja Pack had five pups in April 2024, and we tagged all five pups with microchips when they were three weeks old. All five pups were alive as of October 23, 2024. However, by mid-to-late November, only four pups were observed with the pack indicating one of the pups had almost certainly died. Nonetheless, a pup survival rate of 80% is much higher than the average survival rate of pups in the Greater Voyageurs Ecosystem. In June 2025, we collared one of these pups, who is now dubbed Wolf W17D.

The Thuja Pack had a distinctive uncollared yearling subordinate, Wolf TJ_SUB1, who sustained a large laceration/gash on its front right leg in Fall 2024. Although the wound has healed, the wolf has a highly-visible scar on that leg from which it can be readily identified.

Wolf TJ_BF, the breeding female of the Thuja Pack.

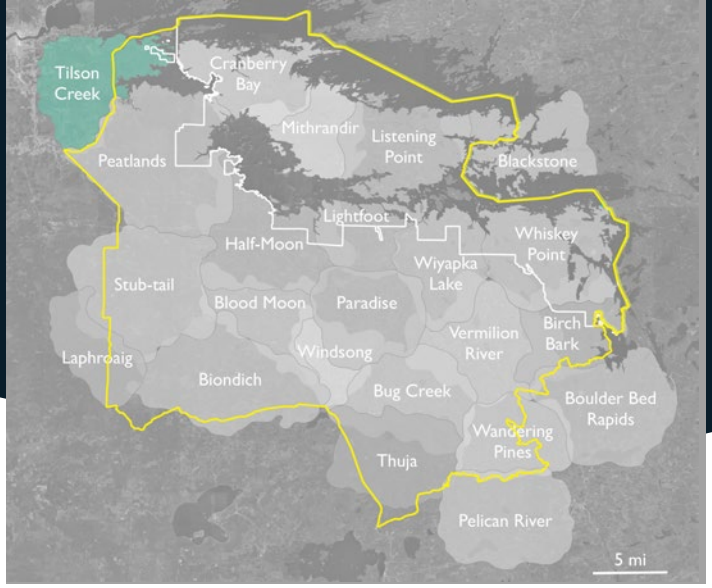
1 A Thuja Pack pup in December 2024.

2 Wolf W8T, a yearling male of the Thuja Pack, who dispersed from the pack in March 2025.

1 Wolf O3S, the breeding male of the Thuja Pack, carrying the head of a white-tailed deer in November 2024.
2 Two Thuja Pack pups in early Winter 2025.

1 Two Thuja Pack pups running while their father, Wolf O3S (back), watches in the background.
2 Wolf O3S, the breeding male of the Thuja Pack.

TILSON CREEK



The Tilson Creek Pack was intriguing during our winter survey period. In Winter 2023–2024, the pack was a breeding pair, though occasionally a subordinate adult associated with the breeding pair during the winter. Given the loose association of this subordinate with the breeding pair during this period, we assumed this subordinate was a floater (largely a lone wolf that sort of "floats" in and around its former pack's territory) and would most certainly leave the area in Spring/Summer 2024.

Yet this past winter, Winter 2024-2025, the Tilson Creek Pack was five wolves, which included the breeding pair (Wolves TC_BM and TC_BF), an subordinate adult, and two pups. We, unfortunately, could not conclude with certainty that the adult subordinate was the same wolf that was "floating" around the previous winter. However, that seems like the most parsimonious explanation.

But more interestingly was the fact that on three occasions (Dec 18, Jan 24, and Feb 18), another unknown adult wolf was observed traveling with the pack (i.e., there were six wolves together). Where this 6th wolf came from is a mystery, and clearly this individual did not associate with the pack regularly. Indeed, we had 12 independent observations of five wolves together throughout the survey period.

Regardless, the Tilson Creek breeding pair are the same two individuals that have been leading the pack for the past three years (2022 to 2025). Both individuals are very distinctive and easily identified on remote cameras.

1 A Tilson Creek Pack pup.

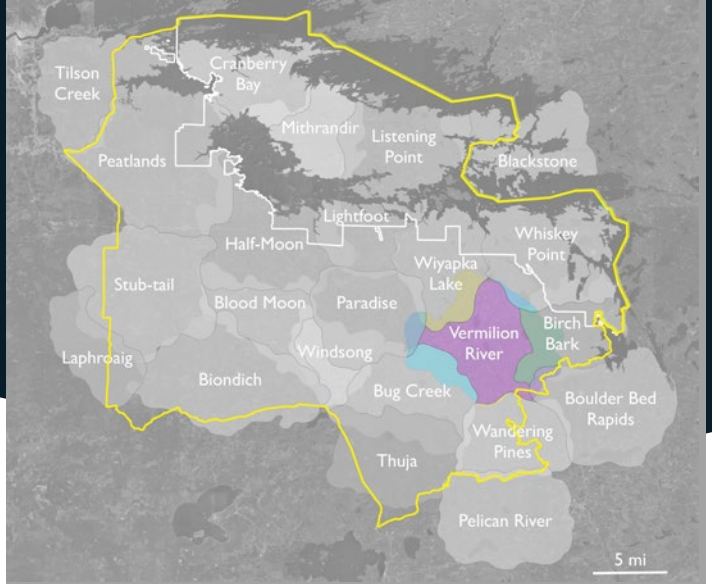
2 Three Tilson Creek Pack wolves running down a snowmobile trail. The breeding male (Wolf TC_BM) is on the right, the breeding female (Wolf TC_BF) in the middle, and a subordinate pack member on the left.

1 *Four Tilson Creek Pack members: two pups and two subordinate adults.*

2 *TC_BM, the breeding male of the Tilson Creek Pack.*

3 *TC_BF, the breeding female of the Tilson Creek Pack.*

VERMILION RIVER



The Vermilion River Pack breeding pair—Wolves B2L and Y7S—produced a litter of pups in April 2024. We do not know how many pups were born but we saw four pups alive in early July 2024, when the pack had a rendezvous site literally on the side of Forest Road 203. The pups looked very thin and emaciated.

In July 2024, we re-collared Wolf B2L, the breeding male of the pack, and collared his mate, Wolf Y7S (formerly called Wolf VR_BF). Insofar as we could tell, all the pups had perished by the end of July as both Wolf B2L and Wolf Y7S had stopped attending any homesite where the pups could have been.

Then, on August 15, 2024, Wolf Y7S left the territory, followed Forest Road 203 south to Elephant Lake, and then laid, almost entirely unresponsive, a few feet from Forest Road 203 where it wraps around Elephant Lake. She did this for about two days and was clearly emaciated and unwell. Because she was not moving even with people a few feet away from her and clearly was suffering, she was euthanized by a conservation officer. Once euthanized, we immediately collected and froze her carcass, and then transported her to the University of Minnesota's Veterinary Diagnostic Laboratory for a necropsy to determine why she was unwell.

The necropsy turned up no disease, parasites, or injuries that could explain her behavior. Instead, all signs indicated she simply was unable to acquire enough food and starved to death. This inability to acquire sufficient food also likely explains why her pups also looked emaciated and likely perished, presumably from starvation.

After the death of Wolf Y7S, Wolf B2L remained in the Vermilion River Pack territory until November 2024. We have observations of Wolf B2L traveling with an uncollared wolf in the territory in Fall 2024, and at one point in late Fall 2024, he traveled for a short period with Wolf R7S, the breeding female of the Wiyapka Lake Pack, before she settled back down in the Wiyapka Lake Pack territory (see the Wiyapka Lake Pack description for more details).

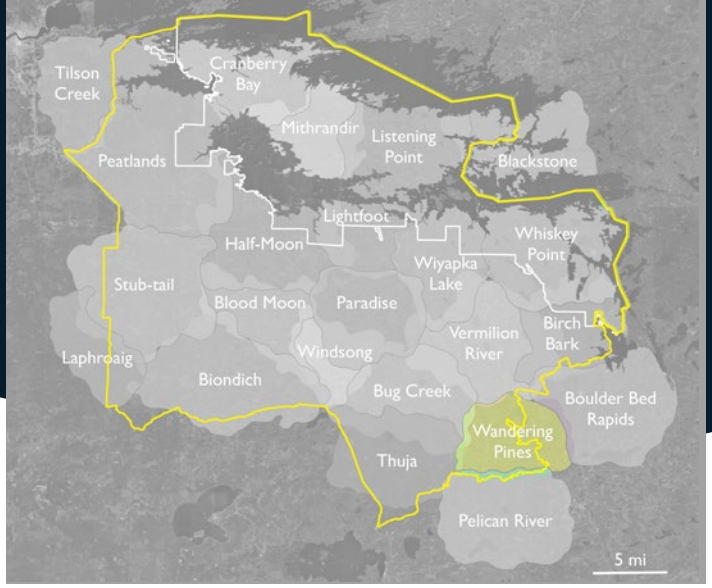
By December 2024, however, Wolf B2L left the territory and wandered northward. By January 2025, he was on the Kabetogama Peninsula and appeared to be remaining in a territory in the central part of the Kabetogama Peninsula. On January 30, 2025, he usurped the dominant male in the Mithrandir Pack, and in turn, became the breeding male of the Mithrandir Pack (see Mithrandir Pack description for more details).

After Wolf B2L left the Vermilion River territory, another pack did not move in and take over the territory. Instead, the Birch Bark Pack simply absorbed much of the Vermilion River territory, and the Bug Creek Pack took over some of the western portion of the territory.

1 A thin, emaciated Vermilion River Pup howling in the middle of the road in mid-July 2024.

2 Two Vermilion River Pack pups at a rendezvous site along a well-traveled gravel road in mid-July 2024. One pup was looking at the camera and the other was just behind the tree.

WANDERING PINES

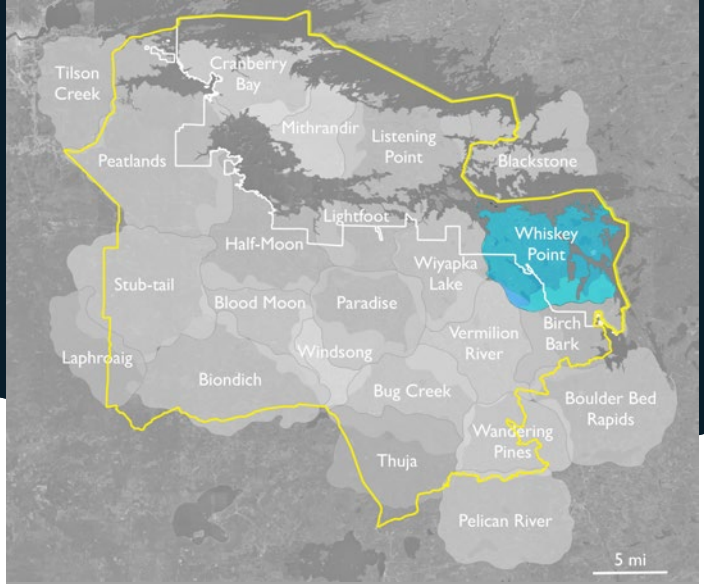


The Wandering Pines Pack was two wolves, a breeding pair, during Winter 2024–2025. We had 19 independent observations of this pair traveling around during the winter survey period. We collared the breeding male of the pack in July 2025 and he is now dubbed "Wolf G10T" (his former ID was WA_BM. The breeding pair appears to be the same wolves (Wolves G10T and WA_BF) as last year based on physical appearance. The pack did not recruit any pups because the female did not give birth to pups in Spring 2024. In all remote camera footage from April 2024, the breeding female did not appear pregnant and was never observed with distended nipples (i.e., she was not nursing pups).

1 & 2 WA_BF, the breeding female of the Wandering Pines Pack.

1 WA_BF, the breeding female of the Wandering Pines Pack.
2 & 3 Wolf G10T, the breeding male of the Wandering Pines Pack.

WHISKEY POINT



1 A yearling wolf in the Whiskey Point Pack whose fur is covered in frozen bloody snow, likely from a recent kill.

2 Wolf WP_SUB1, a yearling wolf in the Whiskey Point Pack.

The Whiskey Point Pack, like the Listening Point Pack, has been a challenging pack to observe in winter given the lack of linear features in its territory. In Fall 2024, we deployed several more cameras throughout the pack's territory in hopes of observing the pack more frequently. This approach worked well for the first part of the winter survey period, when we observed the pack frequently, when snow was minimal and wolves could readily travel down wildlife trails and frozen ponds, lakes, and waterways. When the snow became deeper, though, we only had occasional observations of the entire pack. For example, we had eight independent observations of four wolves in December 2024 but only five additional independent observations of four wolves from January 1 to April 10.

Much of this is likely because we do not have great information on where this pack spends most of its time during mid-to-late winter, and what features they primarily use to travel. Probably the best way to figure this out is simply to deploy cameras in a variety of other areas in future efforts to determine what areas are regular travel corridors for the pack.

Nonetheless, despite the challenges, we still had sufficient data to determine the size of the pack, in part, because the pack was small and often traveling together when we observed them. If the pack had been larger like the Peatlands or Blackstone Pack, we would have almost certainly struggled to determine the size of the pack.

The Whiskey Point Pack was four wolves in Winter 2024-2025: the breeding pair (Wolves WP_BM and WP_BF2) and two adult subordinates. One of the two adult subordinates was Wolf WP_SUB1, a yearling wolf that is easily identified because it is missing the top of its right ear. The other subordinate is almost certainly a yearling as well.

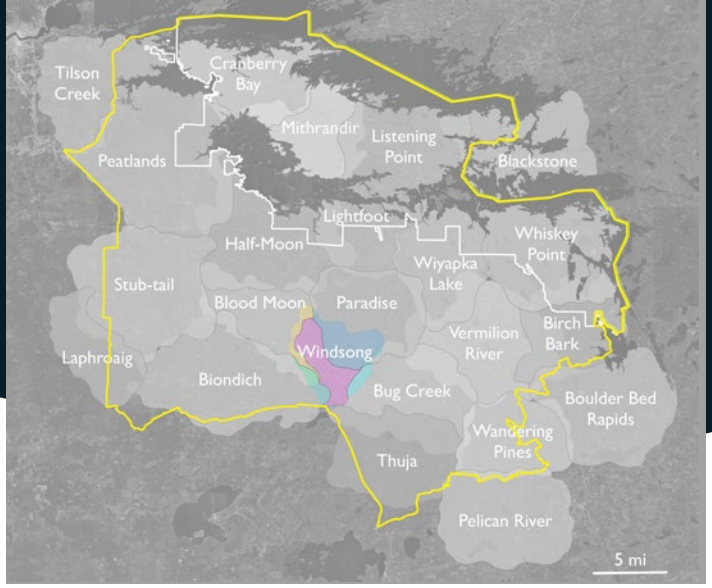
The Whiskey Point Pack had pups in April 2024 and one of the pups was still alive on November 29, 2024 when we observed five wolves (the breeding pair, the two subordinate adults, and a pup) traveling together. However, we never observed the pup again after November, despite observing the other four pack members traveling together on eight different days in December 2024. Thus, we think it likely the pup died at some point in late November or early December.

1 Wolf WP_BF2, the breeding female of the Whiskey Point Pack.
2 Wolf WP_BM, the breeding male of the Whiskey Point Pack.
3 A yearling wolf followed by Wolf WP_BM, the breeding male.

1 *The breeding pair of the Whiskey Point Pack: the breeding female, Wolf WP_BF2, is leading with the breeding male, Wolf WP_BM, following.*

2 *The two yearling wolves of the Whiskey Point Pack in Winter 2024-2025. Wolf WP_SUB1 is on the left.*

WINDSONG



In April 2024, the Windsong Pack, which was just a breeding pair (Wolves V087 and O4D), had a litter of 3 pups. We tagged all 3 pups with microchips when the pups were 4 weeks old. In late June 2024, the breeding female, Wolf O4D was hit by a vehicle on Highway 53, which shattered her pelvis and broke several other bones. After the collision, Wolf O4D's movements changed substantially and she no longer returned to a homesite to provision the pack's three pups.

Toward the end of July 2024, Wolf O4D died. When we recovered her carcass, she was extremely emaciated, though no clear injuries were visible at the time. We submitted her carcass for a necropsy and learned of the trauma she had experienced from the collision. Although her proximate cause of death was starvation, the ultimate cause of death was a vehicle collision, which reduced Wolf O4D's ability to move and obtain food.

Despite Wolf O4D's injury and death, Wolf V087, the breeding male, continued to rear all three pups, and did so successfully through at least early September, when a local resident observed Wolf V087 and all three pups in a trail camera photograph. Yet, sometime between early September and November 2024, all three pups perished, and no pups were observed in the territory after November 2024.

In Fall 2024, a new female, Wolf WS_BF2, joined Wolf V087 and become the second breeding female of the Windsong Pack to date. And for a second consecutive year, the Windsong Pack remained two wolves, a breeding pair. In total, we had 27 independent observations of this pair during the winter survey period—an independent observation once every five to six days from December 1, 2024 to April 10, 2025.


1


2

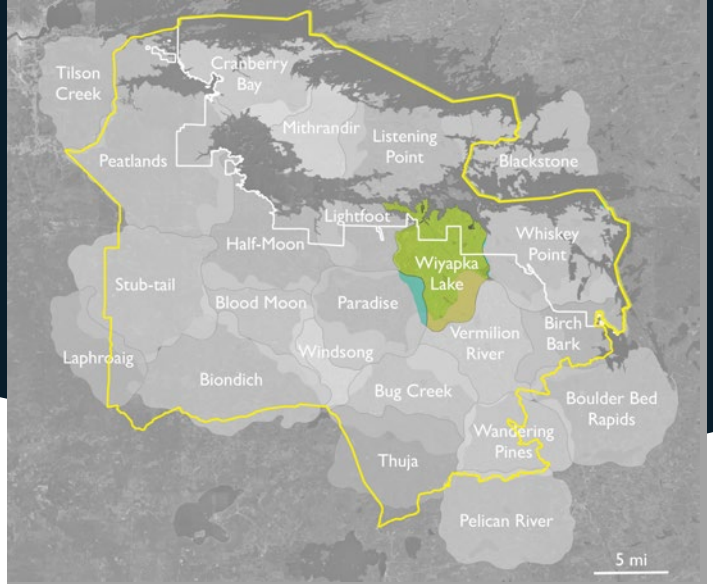
1 Wolf O4D, the breeding female of the Windsong Pack for several years.

2 How we found Wolf O4D's body in July 2024.

1 Wolf V087, the breeding male of the Windsong Pack, with the pack's 3 pups in Summer 2024.
2 The Windsong Pack. Wolf V087, the breeding male, is on the left, and Wolf WS_BF2, is on the right.

1 Wolf V087, the breeding male.
2 Wolf WS_BF2, the breeding female of the Windsong Pack.

WIYAPKA LAKE/ BLUEBIRD LAKE



The Wiyapka Lake Pack and Bluebird Lake Pack occupied adjacent territories in Spring 2024, with the Wiyapka Lake Pack to the north and Bluebird Lake Pack to the south. Both packs were comprised of just breeding pairs during this time, however, the Wiyapka Lake Pack, which consisted of Wolves R7S (formerly WL_BF) and R8E (formerly WL_BM), produced pups in April 2024 whereas the Bluebird Lake Pack, which consisted of Wolves BL_BM and B6T, did not. Indeed, Wolf B6T, the breeding female of the Bluebird Lake Pack, never appeared pregnant in trail camera footage and never localized around a den in spring (she wore a functional GPS-collar until early May when her collar failed prematurely).

The Wiyapka Lake Pack had an unknown number of pups that remained alive through late June 2024. However, in late June 2024, Wolf R8E, the breeding male of Wiyapka Lake, died for unknown reasons. Shortly thereafter, Wolf R7S began roaming a large area in and around the Wiyapka Lake territory (an area that included portions of the Whiskey Point, Vermilion River, Bluebird Lake, Bug Creek, Paradise, and Lightfoot Pack territories), and she never returned to a homesite after June 2024, indicating all of her pup's had died.

Wolf R7S continued to roam this large area through much of Fall 2024. For short periods of time, she traveled with lone collared male wolves including Wolf V094, the former breeding male of the Half-Moon Pack, and Wolf B2L, the former breeding male of the Vermilion River Pack.

During this period, the breeding pair of the Bluebird Lake Pack continued to occupy their territory and roam occasionally up to the Moose River Grade in the Wiyapka Lake territory. Sometime in late fall, Wolf B6T broke her rear leg (she hobbled around for the rest of the winter).

Then on January 5, 2025, a sudden change occurred. On the morning of January 5, the Bluebird Lake breeding pair were traveling together, as normal, but by the evening of the 5th, the Bluebird Lake breeding male, Wolf BL_BM, was traveling with Wolf R7S.

After January 5, 2025, we had 44 independent observations of Wolf BL_BM and Wolf R7S and no observations of Wolf BL_BM with Wolf B6T, though we did observe Wolf B6T traveling by herself on 12 occasions from January to April 2025. In each instance, B6T looked in very poor condition, and appeared to have a substantial infestation of lice. Through some unknown chain of events, either Wolf R7S usurped Wolf B6T and took her mate, or Wolf BL_BF left Wolf B6T to join Wolf R7S.

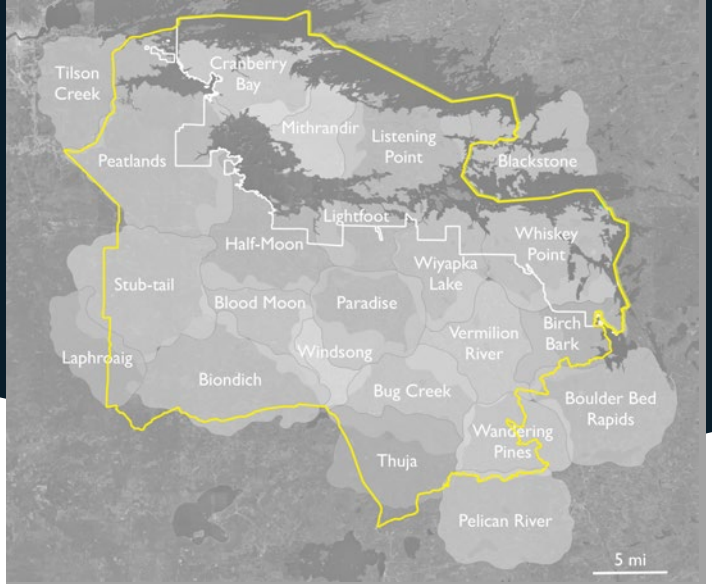
1 The Wiyapka Lake Pack. The breeding male, Wolf BL_BM, is on the right, and Wolf R7S, the breeding female, is on the right.

2 The Wiyapka Lake Pack. The breeding male, Wolf BL_BM, is in the back, and Wolf R7S, the breeding female, is in the front.

Either way, Wolves R7S and BL_BM joined up, the pair started occupying the Wiyapka Lake territory again—the Wiyapka Lake Pack became two wolves again and the Bluebird Lake Pack's tenure ended. Notably, Wolf R7S wore a functional GPS-collar from Summer 2024 to Winter 2025 so we had good information on the Wiyapka Lake Pack's movements.

1 Wolf R7S, the breeding female of the Wiyapka Lake Pack.
2 Wolf BL_BM, the breeding male of the Wiyapka Lake Pack.
3 Wolf R7S, the breeding female of the Wiyapka Lake Pack.
4 Wolf BL_BM, the breeding male of the Wiyapka Lake Pack.

W1T PAIR



We had 12 independent observations of Wolf W1T and a uncollared female wolf during the winter survey period. And we observed the pair fairly consistently throughout this period with a few observations in January, February, March and April 2025. However, we did not consider the pair to be a pack because we saw no evidence the pack was remaining in a localized area and defending a territory. Instead, the pair appeared nomadic and traversing a large area from Ray to the North Ash Lake Road to the end of Camp 90 Road. Further, the female did not produce pups in April and never appeared to be pregnant. We considered W1T and the female to be part of the lone wolf population when estimating the prevalence of lone wolves in the area. Of course, these two wolves were not "alone" but functionally their movements and behaviors were consistent with nomadic lone wolves.

1 *The female wolf that Wolf W1T traveled with for most of the Winter 2024-2025 survey period. This female had a broken back right leg for much of the winter. This photo, taken in April 2025, shows her back leg had started healing as a calcified mass had started forming around the break in her back leg.*

2 *Wolf W1T in April 2025.*

METHODS

Pack Size

We estimated pack size using remote trail cameras during our winter monitoring period which we defined as December 1, 2024 to April 10, 2025. We considered the end of the winter monitoring period as April 11 because that is average parturition date for wolves in the GVE and when we would generally expect packs to stop traveling as a cohesive social group. Our objective was to deploy remote cameras throughout all known wolf pack territories in the Greater Voyageurs Ecosystem to captured repeated independent observations of the each pack. We considered observations to be independent if they were on a different day than any other observations of that pack. Via this approach, we captured numerous observations of each pack in the GVE, allowing us to have high-confidence in the number of wolves in each pack as well as the composition of that pack (number of breeding wolves, adult subordinates, and pups). Further, repeated observations allowed us to individually identify many wolves in each pack based on unique physical features and characteristics (e.g., fur coloration, facial appearance, scars, ear notches).

Estimating territories

To estimate territories, we caught wolves via rubber-padded foothold traps and fit them with GPS-collars. All capture and handling of wolves was approved by the National Park Service's and University of Minnesota's Institutional Animal Care and Use Committee (protocols: UMN 1905-37051A).

We primarily estimated territory size for wolf packs using GPS-collar data from May 1 to October 31. Wolf pack territories in the GVE appear more stable in summer (the ice-free period) than they are in winter. During winter, wolf territories in the GVE are prone to small shifts and changes and are less stable than they are in the summer, likely because wolf movements change based on where deer congregate and on intraspecific pressures from neighboring packs. Wolf territories appear to stabilize during spring to fall because deer are likely more dispersed across their territory and intraspecific competition is lowest during the summer (Mech and Barber-Meyer 2017).

Furthermore, most wolves studied during summer were fitted with GPS-collars that took locations every 20 minutes during the summer period before the collars switch to taking either 1 hr or 6 hour locations. Wolves fitted with collars that took 20-min fixes yielded high-resolution GPS-collar data on wolf movements during summer, which was ideal for estimating territories and certainly superior to using longer fix-interval GPS data from the winter. That said, GPS-location data was limited for some wolves during summer for a variety of reasons. In these scenarios, we estimated territories using winter locations or a combination of summer and winter locations.

We used locations from GPS-collared wolves to estimate kernel territories for each pack (Fig. 2). More specifically, we used 99% kernel territories for wolves with 20-min-fix-interval GPS-collars and then 95% kernel territories for wolves with GPS-collars that had longer fix intervals (1-6 hr fix-interval collars). We calculated territories differently because the data from wolves with 20-min-fix-interval collars had substantially higher resolution than wolves fitted with collars that had longer fix intervals. Thus, the periphery of territories was much clearer for such wolves because of the amount of GPS-location data (~2,180 locations/month). As a result, kernel density territories fit the location data exceptionally well and a 99% kernel territory was more representative of the territories than a 95% territory. With longer fix-intervals, however, there was more uncertainty due to substantially fewer GPS-locations and we decided a 95% kernel territory was more appropriate. We removed locations associated with extra-territorial forays prior to developing kernel density territories (Burch et al. 2005, Powell and Mitchell 2012, Mancinelli and Ciucci 2018).

We removed the area of kernel territories that overlapped the 4 large lakes—Kabetogama, Rainy, Namakan, and Sand Point—in the Greater Voyageurs Ecosystem (Fig. 2). Wolves do not use the large lakes as part of their territory during the ice-free periods (~April to November) and rarely, if ever, swim out to the islands in these large lakes. Thus, these lakes are hard territorial boundaries for most of these packs for the majority of the year (~April to November). Even when ice forms, wolves spend relatively little time out on the ice with most activity on the ice near the shorelines of these major lakes or on the small islands close to the mainland. As such, removing any territory overlap with these major lakes seems more logical than including territory that overlaps the lakes. Notably, we did not remove the area of smaller lakes that were entirely contained within pack territories.

Quantifying territory overlap

Although wolves are highly territorial, wolf pack territories frequently overlap to some extent (Fig 2). When using metrics such as mean pack and home range size to estimate density, quantifying territory overlap is necessary to avoid underestimating density (Erb and Humpal 2020). However, for most wolf pack territories, we only had partial knowledge of neighboring packs (i.e., we did not have current territory data for each pack every year) so we used an approach that allowed us to account for overlap when estimating density without having perfect knowledge of all territory overlap in our study area (Gable et al. 2022).

Our approach consisted of calculating the average spatial overlap of one territory on another using all available home range data for a given year (we refer to this metric as 'pack-on-pack overlap'

hereafter). We then estimated the number of neighbors that known wolf pack territories likely had using a combination of known and historical wolf pack territory locations. We then multiplied pack-on-pack overlap by the average number of neighboring packs to yield the average territory area that a typical wolf pack overlaps with other wolf packs. To incorporate this into density estimates, we divided the spatial overlap by two (i.e., because two packs shared the area of overlap) and subtracted the result from the average territory size (see equation below). In a few instances, 3 pack home ranges overlapped but the area of the overlap was minor (<1-2 km^2) so we were not concerned about incorporating this into our estimates as it would have little-to-no effect (Fig. 2).

Calculating density

We calculated wolf density (wolves/1000 km^2) using data on pack size, territory size, and pack-on-pack overlap. Specifically, we used the following equation:

$$Density = \frac{PS \div \left(TR - \left(\frac{Ovlp * Nb}{2} \right) \right)}{0.798} * 1000$$

where PS is mean pack size, TR is mean territory size, Ovlp is mean pack-on-pack overlap, and Nb is the mean estimated number of neighboring packs that a typical wolf pack has. We estimated that lone wolves constituted 20.2% of the population (see detailed discussion above) and thus divided the density of pack wolves (which is calculated via the numerator in the equation above) by 0.798 to yield overall wolf density (Gogan et al. 2004, Erb and Humpal 2020).

REFERENCES

Burch, J. W., L. G. Adams, E. H. Follmann, and E. A. Rexstad. 2005. Evaluation of wolf density estimation from radiotelemetry data. Wildlife Society Bulletin 33:1225–1236.

Dickie, M., R. Serrouya, T. Avgar, P. McLoughlin, R. S. McNay, C. DeMars, S. Boutin, and A. T. Ford. 2022. Resource exploitation efficiency collapses the home range of an apex predator. Ecology 103:e3642.

Erb, J. D., and C. Humpal. 2020. Minnesota wolf population update 2020. Minnesota Department of Natural Resources.

Ethier, D., and J. Sayers. 2008. Estimating abundance and distribution of gray wolves using winter track surveys. Voyageurs National Park Report.

Fox, J. 2006. Gray wolf winter tracking survey 2004-05; Voyageurs National Park, Minnesota. Voyageurs National Park Report 5.

Fox, J., R. O. Peterson, and T. Drummer. 2001. Gray wolf biology research in Voyageurs National Park, 1998-2001. Natural Resource Preservation Program Project #197 1–73.

Gable, T. D., A. Homkes, and J. Bump. 2022. 2021-2022 Greater Voyageurs Ecosystem wolf pack and population size report. University of Minnesota Digital Conservancy.

Gable, T. D., A. T. Homkes, and J. K. Bump. 2023a. 2022-2023 Greater Voyageurs Ecosystem wolf population report. University of Minnesota Digital Conservancy. https://conservancy.umn.edu/handle/11299/256914.

Gable, T. D., A. T. Homkes, and J. K. Bump. 2024. 2023-2024 Greater Voyageurs Ecosystem wolf population report. University of Minnesota Digital Conservancy https://hdl.handle.net/11299/266457.

Gable, T. D., S. M. Johnson-Bice, A. T. Homkes, and J. K. Bump. 2023b. Differential provisioning roles, prey size, and prey abundance shape the dynamic feeding behavior of gray wolves. Communications Biology 6:1–11.

Gogan, P. J. P., W. T. Route, E. M. Olexa, N. Thomas, D. Kuehn, and K. M. Podruzny. 2004. Gray wolves in and adjacent to Voyageurs National Park, Minnesota : research and synthesis, 1987-1991. Omaha, Neb. : U.S. Dept. of the Interior, National Park Service, Midwest Regional Office.

Hardwig, J. T. 1978. Timber wolf (Canis lupus) food habits in Voyageurs National Park, 1977-1978. U.S. National Park Service Contract No. PX-6000-7-0921, Biology Department, Rainy River Community College, International Falls, MN 31.

Kittle, A. M., M. Anderson, T. Avgar, J. A. Baker, G. S. Brown, J. Hagens, E. Iwachewski, S. Moffatt, A. Mosser, B. R. Patterson, D. E. B. Reid, A. R. Rodgers, J. Shuter, G. M. Street, I. D. Thompson, L. M. Vander Vennen, and J. M. Fryxell. 2015. Wolves adapt territory size, not pack size to local habitat quality. Journal of Animal Ecology 84:1177–1186.

Mancinelli, S., and P. Ciucci. 2018. Beyond home: preliminary data on wolf extraterritorial forays and dispersal in Central Italy. Mammalian Biology 93:51–55.

McRoberts, R. E., and L. D. Mech. 2014. Wolf population regulation revisited-again. Journal of Wildlife Management 78:963–967.

Mech, L. D. 1999. Alpha status, dominance, and division of labor in wolf packs. Canadian Journal of Zoology 77:1196–1203.

Mech, L. D. 2000. Leadership in wolf, Canis lupus, packs. Canadian Field-Naturalist 114:259–263.

Mech, L. D. 2020. Unexplained patterns of grey wolf Canis lupus natal dispersal. Mammal Review mam.12198.

Mech, L. D. 2024. Wolf population density: prey biomass limits via intrinsic factors. Wildlife Biology e01358.

Mech, L. D., and S. Barber-Meyer. 2015. Yellowstone wolf (Canis lupus) density predicted by elk (Cervus elaphus) biomass. Canadian Journal of Zoology 93:499–502.

Mech, L. D., and S. M. Barber-Meyer. 2017. Seasonality of intraspecific mortality by gray wolves. Journal of Mammalogy 98:1538–1546.

Morales González, A., A. Fernández Gil, M. Quevedo, and E. Revilla. 2021. Patterns and determinants of dispersal in grey wolves (Canis lupus). Biological Reviews. https://doi.org/10.1111/brv.12807.

Nordli, K., P. Wabakken, A. Eriksen, H. Sand, C. Wikenros, E. Maartmann, and B. Zimmermann. 2023. Spatial and temporal cohesion of parents and offspring in a social large carnivore. Animal Behaviour 197:155–167.

Powell, R. A., and M. S. Mitchell. 2012. What is a home range? Journal of Mammalogy 93:948–958.

Sells, S. N., M. S. Mitchell, D. E. Ausband, A. D. Luis, D. J. Emlen, K. M. Podruzny, and J. A. Gude. 2022. Economical defence of resources structures territorial space use in a cooperative carnivore. Proceedings of the Royal Society B: Biological Sciences 289.

Sells, S. N., M. S. Mitchell, K. M. Podruzny, J. A. Gude, A. C. Keever, D. K. Boyd, T. D. Smucker, A. A. Nelson, T. W. Parks, N. J. Lance, M. S. Ross, and R. M. Inman. 2021. Evidence of economical territory selection in a cooperative carnivore. Proceedings of the Royal Society B: Biological Sciences 288:20210108.