1999
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Behavior and Habitat Of A Family Of Bald Eagles In Northern Wisconsin

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Abstract.

An observational study of a pair of breeding Bald Eagles and their young was conducted from May 25 until July 20, 1999. The pair nested in a large pine tree, the largest in the vicinity, on the east shore of a large lake on the border of Wisconsin and the Michigan Upper Peninsula. The main focus of this study was the territoriality of the pair, the effect of human disturbances, and the growth of the juveniles as they prepared to leave the nest for the first time. There was a second pair of nesting bald eagles less than a mile from the study nest, and the data suggests that although the territories of the two pairs slightly overlapped, territorial disputes were mild if they occurred at all. The pair in this study also responded to noise generated from gas powered motors, although they did not seem to change their behavior in the presence of an observer or even the presence of fishermen passing through. The juveniles were estimated at five or six weeks of age at the beginning of the study, and showed a remarkably fast progression from spending most of their time in the nest and moving weak wings to spending most of their time perched while producing strong, coordinated wing beats. The juveniles finally flew out of the nest on the last day of the study, and were about twelve or thirteen weeks old.

Introduction.

Haliaeetus leucocephalus, the American Bald Eagle, is a large diurnal raptor that is typically found near water, either coasts or large inland lakes. The population of this species was decimated in the 1960s as a result of the pesticide DDT, which caused the shells of their eggs to be extremely thin. The subsequent comeback of this species, which was recently taken off of the endangered species list, makes monitoring of their behaviors and breeding successes important.

Bald Eagles generally prefer to live near water where there is a lot of shoreline and prey is concentrated (Palmer, 1988). They require a large food base of medium to large sized prey, especially during breeding season, and tend to be very territorial. A pair's

home range may extend for as much as 660 hectares, with a mean distance of 3.2 km between nesting territories (Johnsgard, 1990). Nests are generally reused yearly and attain an enormous size. Some nests have been reported reused for up to 35 consecutive years, by several different nesting pairs.

In most birds of prey, the syrinx is not very well developed, and calls are therefore limited to screams, cackles, whistles, and other basic sounds (Newton, 1990). Bald Eagles are no different. Adults primarily use visual communication, but vocal calls include a descending, high-pitched, cackling sound (referred to in this paper as the "traditional call"), and a high-pitched, gull-like, guttural scream (referred to in this paper as the "gull call"). The young often make a thin peeping sound (referred to in this paper as "feeding squeals") when they are hungry, cold, or in some way unhappy. As they get older, this calling slowly gives way to a variant of the gull-like call made by the adults.

The eaglets require much attention from the parents as they grow, and are usually able to fly ten to thirteen weeks after hatching. At around four or five weeks of age, they are able to stand, and by the sixth week are almost as large as the adults. After eight weeks, the eaglets may begin to stretch their wings, and the wings grow in strength until finally the eaglets make their first flight.

In 1972, J. R. Haugh published a fall migration schedule for many Falconiforms and other birds of prey (Johnsgard, 1990). According to the study, some Bald Eagles begin migration in mid-August, with peak numbers migrating in early September. It is interesting to note that the breeding season ends in mid-May, and that eaglets generally leave the nest after thirteen weeks, as mentioned before. This nestling period would therefore end at around the last week in August at the latest, coinciding with the start of migration.

Materials and Methods.

Research was conducted at the University of Notre Dame's UNDERC field station on the border of Wisconsin and the Upper Peninsula of Michigan. The family of Bald Eagles in this study nested in a cove on the east shore of Tenderfoot Lake (see Appendix A). Tenderfoot Lake has a surface area of 194.24 hectares with 5.87 miles of shoreline, and is located at the southern end of the property. The study began on May 25, 1999, and

involved a surveillance of the nest from out on the lake, and an examination of the area beneath the nest as well as a short distance inland. It is conceivable that my presence, out in the open on the lake below the nest, may have had an effect on the behavior on the eagles, but I think this is highly unlikely. The family is constantly exposed to people fishing and boating around the lake, so it is unlikely that the presence of an observer would bother them.

After the first day, I approached the nest via canoe and anchored about 50 to 100 feet west of the base of the nesting tree. A pair of standard field binoculars, as well as unaided eyes, was used to observe the nest. A digital watch was used to keep a record of the eagles' pertinent actions, and a compass was used to aid in tracking the eagles' movements. A thermometer was used to record the air temperature from day to day, and weather conditions were noted. A Canon Rebel 2000 camera with a Quantaray 70 – 300mm F4-5.6 automatic zoom lens was used in order to photo-document the family.

On June 20 I began using a gas-powered motor attached to a rowboat in order to get to my observation site. The rest of my observation techniques remained the same.

While observing the nest, I sat at the anchoring point ("observation point") mentioned above and wrote down observations. This was how the great majority of the notes were taken. There were occasions, however, when I altered my technique. For example, on many days I went ashore underneath the nesting tree and observed the area under the nest, usually after I had concluded my lake-based observations for the day. There were also a few instances where I followed one of the adults around the lake in order to get an idea of their range and preferred perches on the lake.

Results.

Habitat.

The nest is located near the top of a tall pine tree, approximately 70 feet up, in the nook created where two large branches split. There are several large branches protruding outward near the nest, and one that sticks out to the north is a favorite perching branch. As is common of this species, the nest itself has been used for many years, and there is a lot of debris under the tree from past years. The Nesting Tree itself is located in a cove on the east side of the lake (see appendix A), which I called Eagle Cove. To the south of

Eagle Cove is Next Cove, and to the north is Duck Cove. Between Duck and Eagle Coves is Duck Cove Point, and between Eagle and Next Coves is Next Cove Point.

The Eagles appeared to perch on many trees around Eagle Cove, but there are a few that they were seen on quite often. These are marked on the map in appendix A. Two favorite perches are located on the northern side of the cove, and there was a large pine that I called Fishing Perch tree located at the tip of Next Cove Point that the adults often sat on.

The areas surrounding the nest consisted of mostly pine trees, with occasional deciduous species. There was a lot of deadfall, with an increasing amount after the storms that came through throughout the summer. To the east of the Nesting Tree was a swampy clearing, and the adults were spotted perching there occasionally.

Growth of juveniles.

On May 25 eggshells were found under the nest, and on May 26 the first visual contact of the juveniles was made. There were two juveniles, and both were already rather large. They had feathers, not down, and there was no sign of molted down beneath the nest.

As early as May 31 the juveniles were stretching their wings outward, and were making attempts to flap them. However, the wings were not fully stretched, and the "flaps" were more like a dropping of the outstretched wings and then a slow recovery to the stretched position. This behavior did not occur often at first, and both juveniles spent most of their time out of view in the nest. The wings were fully feathered.

On June 3 it was noted that during most observation periods, one juvenile would be visible from the stomach up, sitting in the nest, while the other is always in the background, lower in the nest, or not visible at all. One juvenile always seemed to be calling while the other was more or less quiet, except at feeding time when both made feeding squeals.

On June 4, one juvenile made flapping movements with its wings in the morning, just after feeding. Shortly afterwards it retired to the nest's interior with the other juvenile.

On June 6, one juvenile spread its wings fully for the first time, and weakly flapped them. They were full flaps, but were slow, weak, and uncoordinated. Less than a minute later, the same juvenile fully spread its wings, held them there, and then retires to the nest's interior.

One juvenile again fully stretched its wings on June 10, and held them there for a short time as it stood on the nest's edge. This behavior was repeated several times. There was no sign of the other juvenile.

On June 12, one juvenile again spread its wings and flapped them briefly at 11:24 a.m., just after feeding. The flaps were a little quicker, but still awkward and uncoordinated. At 11:37 a.m., the juvenile standing on the edge of the nest stretched its wings before retiring into the nest. At 12:37 p.m., both juveniles were hidden in the nest, and a wing suddenly jutted upwards into view, stretched, and then disappeared again. At 12:50, one juvenile again stretched its wing from inside the nest. At 1:19 p.m., both juveniles were stretching their wings. At 1:20, one juvenile briefly flapped its wings and began to hop while making gull calls. The flaps were still awkward, though stronger than previously. At 1:29 p.m., both juveniles were casually shifted about in the nest and stretching their wings before settling into the nest out of sight.

On June 13 at 3:54 p.m., one juvenile walked to the edge of the nest and looked downward. It flapped its wings several times. It then turned around, facing the nest interior, and began flapping its wings again. The flapping was very clumsy, but the juvenile did not rest its wings after a bout of flapping. Instead, it flapped a few times until it became unbalanced, held its wings outward to regain its balance, and then flapped again. The wind was very strong, and the juvenile was fighting the breeze and trying to remain balanced. The flapping was very unbalanced and awkward, and it appeared that a good gust would have knocked the teetering juvenile off of the nest. After five full minutes of continuously spread or flapping wings, the juvenile settled into the nest.

On June 19, a juvenile briefly flapped its wings on the nest as I arrived at the observation site at 9:12 a.m. Both juveniles were standing in full view on the nest. They began preening their feathers. From this time until the end of the study, if the juveniles were not hidden in the nest or doing anything noteworthy (such as feeding or flapping), they often divided their downtime fairly evenly between just sitting, and either preening

their feathers or stretching their wings. Such behavior will therefore not be specifically noted in this paper. At 10:11 a.m., one of the juveniles stood up and flapped its wings. The flapping was very coordinated and balanced compared to previous attempts, and there was some strength behind the flaps as well. This went on for less than a minute before the juvenile sat down again. At 10:33, just after feeding, both juveniles flapped their wings a few times. One juvenile flapped them again 2 minutes later, after the other juvenile had disappeared into the nest. At 10:54, one of the juveniles flapped its wings three times, and then began stretched and preening.

At 5:31 p.m. on June 20, a juvenile was perched on a branch next to the nest as I approached with the gas motor. It quickly hopped back into the nest as I approached and set up my observation. At 5:46, the juvenile slowly sidestepped out of the nest onto a branch and resumed its perch. The juvenile moved back into the nest to feed at 5:55 as an adult brought food. At 6:03 p.m., after feeding, the juvenile moved back onto its perch on the same branch.

On June 21 at 11:16 a.m., when observation began, one juvenile was again perched on a branch next to the nest and the other was sitting in the center of the nest. At 11:37, the perched juvenile hops back into nest and stretches its wings. A minute later, the same juvenile stretched its wings again and then hopped back onto its perch. At 11:43, the juvenile in the nest flapped its wings for several seconds, paused, and then flapped them again. The flapping for this juvenile was not weak, but was still a little awkward.

On June 23, at 8:25 p.m., the smaller of the juveniles walked to the edge of the nest after stretching and peered downward. It stretched its wings fully and then began flapping while shuffling back and forth, nearly tipping over. The flapping is still very awkward and while it is not weak, it is not too forceful. It returned to the middle of the nest and began stretching and preening.

On June 26 at 7:11 a.m., the larger of the two juveniles hopped up and down twice and flapped its wings briefly as it stood at the edge of the nest.

At 7:50 a.m. on June 28, one of the juveniles stretched its wings back and then flapped them twice while walking around, and then crouched down into the nest. The other juvenile poked its head up briefly, and then also disappeared. 3 minutes later, the juvenile that had poked its head up stood and flapped its wings a few times. It then stood

still for almost two minutes. Then at 7:55 a.m., this same juvenile produced eleven powerful, controlled flaps. It flapped its wings so strongly that I could hear a crisp snap with each beat form down in the boat. It then began preening.

Later that day (still June 28), at 8:14 a.m., a juvenile moved out onto a perch next to the nest. It flapped its wings a few times from the perch and then hopped back into the nest. At 8:18, one of the juveniles fully extended its wings and held them there for 30 seconds. During this time, it flapped its wings strongly while hopping out to a perch next to the nest, where it held them outstretched for a few seconds before folding them in. It then began to rain very heavily, and shortly after this the juvenile returned to the nest and continued to flap its wings for about another 30 seconds.

On July 5 at 2:18 p.m. both juveniles were perched on a branch above the nest. An adult arrived with a fish at 2:22, and the juvenile closer to the nest (juvenile B) flapped its wings and jumped into the nest, while the other did not move. The adult had left 3 minutes later, and juvenile A is still perched while juvenile B is still in the nest. It was extremely windy that day, and juvenile A stretched out its wings for a short time as if gliding, and flapped them a few times. There were no significant changes until 2:46 p.m., when juvenile A again briefly stretched its wings as though gliding in the strong winds. It did this again 9 seconds later. At 2:55, juvenile B hopped up onto the same branch as juvenile A. Juvenile A flapped its wings lightly 2 minutes later, and again a minute after that, although this time it hopped while flapping and shook the branch. At 3:01 p.m., juvenile A flapped its wings again, but much more heavily and for a longer period of time (30 seconds). At 3:07, this juvenile flapped its wings again and hopped onto a lower branch from which he walked into the nest. When observation stopped for the day, juvenile A was in the nest and juvenile B was still perched.

On July 6 at 5:00 a.m., a juvenile standing in the nest flapped its wings strongly for about 20 seconds and hopped at least a foot up into the air. The other juvenile was perched to the right of the nest.

From this point until the end of the study, it was common for the juveniles to be perched on a branch near the nest. They also began lightly flapping their wings with much more frequency, to the point where it was as commonplace as stretching or preening. Both juveniles began to flap their wings harder and with more control, and for

longer duration. They also began to hop between branches, sometimes while flapping, much more often.

On July 20 at 9:00 a.m., I did a search of the entire cove on foot, looking for feathers or any signs of the eagles. The nest was very quiet. A short while later I returned to the boat and noticed a single juvenile perched by the nest. As I approached the nest, the juvenile took off and effortlessly flew inland out of site. It was obvious that there were no juveniles in or around the nest.

Territory and territoriality.

Unknown juveniles. On June 12, at 11:47 a.m., an immature Bald Eagle flew into the cove, over Nesting Tree, and away to the northeast. Both of the Eagle Cove juveniles were accounted for at the time, sitting in the nest. Later that day, at 12:58 p.m., I spotted two eagles circling above me at high altitude. One was the adult Eagle Cove female, and the other was an unknown immature. The adult Eagle Cove male was perched in a tree between Nesting Tree and Fishing Perch Tree. At 1:00 p.m., there were several traditional calls from the gliding eagles, and then a second immature soared in from the east and joined them. The three eagles continued to circle above me, and the newer immature had a noticeably higher pitched gull call. By 1:03, the Eagle Cove female and the first immature glided north and disappeared over the trees, while the newer immature continued gliding at high altitude just east/southeast of Nesting Tree. At 1:06, the three gliders were back over the cove, slowly circling around each other. The situation can best be described as three eagles lazily riding updrafts at high altitude. There was no hint of antagonism. At 1:10 p.m., the Eagle Cove female glided low to the south/southeast, over the tree line at the edge of the cove, and circled there. The two gliding immatures soared out of sight. The perched male gave several traditional calls, and a minute later the female landed next to her mate, inches away on the same branch. There were many traditional calls at first, and then the two sat there side by side for nine or ten minutes.

On June 26, at 6:58 a.m., I sighted an immature bald eagle across the lake, circling to the west/southwest of the Nesting Tree with its head down, as if searching for fish. It continued its circling, and eventually passed into Eagle Cove, over the Nesting Tree, and

then inland out of sight. On July 6 at 5:41 a.m., an immature bald eagle flew by the Nesting Tree at about the level of the nest, from north to south, and then disappeared.

Killarney Cove intruders. Less than a mile across the water from the nest I studied, in a cove at the north end of the lake (see appendix A: Killarney Cove), was the nest of another pair of breeding Bald Eagles that also had two juveniles.

On June 9 at 9:39 a.m., I observed an adult coming from behind First Point (see appendix A) and headed northwest towards Killarney Point at high velocity, skimming the water. It disappeared over the Killarney Point tree line.

On July 5, I saw an adult over Duck Cove at 2:26 p.m., and watched it return to Killarney Cove shortly after.

On July 6 at 4:34 a.m., I observed an adult flying from the direction of Duck Cove, over the Wet Lab (see appendix A), and then towards Killarney Cove.

On July 7 at 11:39 a.m., an adult appeared over Duck Cove Point, and I heard a distant traditional call. At 11:40 and 44 seconds, the adult had begun circling over the northern end of Eagle Cove, and then immediately moved way out over the western side of the lake at a very high altitude. At 11:43, the same adult swooped low over the water by Killarney Point and disappeared into the cove.

Disturbances.

On June 3 at 12:01 p.m., there were two people fishing (noted in my logbook as "annoyingly loud") in a boat using an outboard motor that gave off a small amount of blue smoke and made a dull rumbling and sputtering sound. The male Eagle Cove adult was soaring over the west side of the lake at the time, and the female moved from her perch next to the nest to another perch on a tree at the northern end of the cove. The fishers trolled over next to the female's perch and looked at her through binoculars. The female noticeably cocked her head and watched them for a short while. At 12:03, the female flew a few meters to the northwest and took a new perch on a new tree. The male had returned to the cove at this time, and made three gull calls from his position circling high above me. At 12:06, the female left her perch and landed on the north shore of the cove, then took off and joined her mate in circling above me. The fishers had left by this point. The two adults exchanged a series of traditional calls. At 12:11 p.m., the female

resumed a perch on the northern side of the cove, and the male continued circling at high altitude.

On June 20, I approached my observation point for the first time using a gas motor. It was 5:21 p.m., and there was one adult and one juvenile perched next to the nest. As I approached, the juvenile hopped back into the nest, but the adult did not move. I anchored my boat in the usual place, and began my observations. Both juveniles were in the nest, and began lazily stretching their wings. At 5:45, one juvenile made a few quiet peeps, and the adult looked at it and then away again. At 5:46 p.m. the juvenile that had been peeping returned to its perch beside the nest, and the other juvenile remained in the nest.

On June 26 I again used a gas motor to get to my observation point, arriving there at 6:55 a.m. to find no adults present. At 7:00 a.m. an adult entered the cove from the south and perched on a tall pine on the northern end of the cove.

When I entered the cove on June 28 at 6:47 a.m. with the gas motor, one adult was perched at the northern end of the cove, and both juveniles were sitting upright in the nest. None of them moved at all as I cut the engine, dropped anchor, and set up my observation. Besides some preening, this lack of motion continued. The first significant movement did not occur until 23 minutes after I arrived, when the adult changed perches.

On July 6, I had packed up my equipment at 7:54 a.m. after observing quietly for three hours twenty minutes, and prepared to leave the cove. Both juveniles had been sitting down in the nest for several minutes and were presumed to be sleeping. One adult had left the cove six minutes earlier and the other had not been seen for some time. At 7:54 I started my motor and began to leave Eagle Cove, and one juvenile made three gull calls although both remained settled in nest. At 7:59 there were two adults circled directly above me. They proceeded to follow me out of the cove in a generally straight-line flight path above and behind me. I looped around back into the cove and proceeded to do small circles in and out of the cove. Neither adult stayed directly above me, and both circled above the cove, over the center towards the south side. As I finally left the cove for good, one adult remained circling over the cove while the other followed me out, slightly to the west of me, and eventually out over the blackbird nest (see appendix A).

The blackbird promptly attacked the eagle, and it turned back as I moved north towards the Wet Lab.

On July 7 at 11:03 a.m., I had just finished repositioning my boat using the gas motor, since the wind was strong enough to blow me and my anchor towards shore and right near the base of the Nesting Tree. As soon as I started the motor, the juveniles began to make a noise that was a mix between a feeding squeal and a gull call. I had not seen an adult anywhere on the lake for 26 minutes, but shortly after I started the motor an adult darted into the cove at low altitude, circled for almost a minute, and then drifted out of view inland.

Later on July 7, at 11:32 a.m., several men in a fishing boat entered Eagle Cove using a gas-powered trolling motor. They began to fish, moving from the south side to the north side of the cove closer to the shore, and then towards the center of the cove farther out from shore. At 11:39, an adult eagle circled into Eagle Cove over the north side, and almost immediately drifted back out of the cove and over to the western side of the lake. By 11:47 the fishermen had trolled back out of the cove, towards the center of the lake.

Discussion.

Growth of juveniles.

Early in the study, the juveniles spent the greater part of many mornings hidden in the nest. Their age was estimated at five or six weeks, since they already showed dark brown feathering and were almost as large as the adults. The juveniles showed a steady increase in strength and coordination over the 7 weeks that they were studied. There was no down found under the nest, probably because most of it was shed in the nest, and any that drifted out was blown away.

The juveniles spent the greater part of many mornings sitting in the nest, not moving. They called constantly throughout the study, either gull calls or feeding squeals when the parents approached. For the first week of observation, the juveniles flapped their wings only occasionally, and it was markedly clumsy and week. One juvenile was clearly larger than the other when they sat close to each other, and this one tended to be much more visible than the other. It flapped its wings more often, called more often, and was

the first to perch off of the nest. There did not seem to be any serious antagonism, however, and the adults fed both juveniles beak to beak, alternating between them (see Appendix C) so that both were equally fed.

On June 12, one of the juveniles hopped for the first time while flapping its wings. The flapping was quicker than previously, although still uncoordinated. The juveniles began to venture to the edge of the nest when they stretched and flapped instead of simply sitting in the middle. As time passed, the juveniles improved their command of their wings at an amazing speed. The duration of the flapping increased daily, as did the speed. By June 19, stretching their wings became commonplace, and the flaps were no longer sluggish, although they were still awkward. At this time, the juveniles had the strength they needed to fly, but lacked the coordination of their wing beats.

By June 26, at least one of the juveniles was ready to fly. The wing beats, as described in the Results section, were so powerful and coordinated that I could hear the crisp snap of every beat. From that time onward, both juveniles spent an increasing amount of time perched instead of sitting on the nest, and the flapped their wings constantly, between stretching and preening. The more powerful, coordinated flapping seemed to occur just as the parents were approaching, or just after feeding when the parents were watching. The parents also began bring food to the nest with much less frequency. When they did bring food, they ate along side their young, as beak to beak feeding became less frequent. This behavior has been noted in numerous books, as the adults try to encourage the young out of the nest by not feeding them. The juveniles were estimated to be twelve or thirteen weeks old when they finally flew out of the nest.

Territory and territoriality.

Unknown juveniles. On June 12, there were three bald eagles hovering above me, an adult and two immatures, as well as an adult perched in Eagle Cove. I am positive that the two adults were the Eagle Cove pair because they perched next to each other on a typical perch within their home cove. It was at this point that I determined that the female had been previously circling since when she finally perched beside her mate at 1:11 p.m., she was noticeably larger. And of course the circling immatures were not the juveniles I was studying since they were spotted in the nest. I am unsure about the

identity of these immatures, but I would hypothesize that they were the offspring of the Eagle Cove pair from a past breeding event, since Bald Eagles usually grow their white head plumage and tail feathers after the fourth or fifth year. The immatures may have simply been passing through, and stopped at their birthplace where there is good fishing and friendly territory.

Killarney Cove intruders. As indicated by the approaches of the adults from the southwest during feeding (see Appendix C), the territory of the Eagle Cove pair seemed to extend primarily over the southern half of Tenderfoot Lake, especially the southeast, and it also seemed to cover quite a distance inland to the east of the nest. An exact determination of the size of the pair's territory was impossible to obtain through my observation techniques, and was not vital for this study. My notes show that the Eagle Cove adults never circled near Killarney Point, and only once* was an adult observed hovering any farther north than Duck Cove or any farther northwest than the area indicated in appendix A as "overlapping territory". Even when following me after I produced an intentional disturbance (see *Results: Disturbances*), the adults turned their attention away from me after I had gone past the Blackbird Nest. This seems to indicate that I was sufficiently out of their immediate nesting territory and was therefore no longer a threat. The Eagle Cove pair did not seem to violently defend this territory immediately surrounding their nest, which the literature suggested they would. There were several examples where a Killarney intruder was seemingly ignored.

The Killarney adults tended to hover over the northern half of the lake and over the apartments, especially over Fallen-Birch Hill and Killarney Point, although they also drifted as far south as Small Island and the cove to the northwest of it (see appendix A). Occasionally a Killarney adult would wander over Duck Cove and Duck Cove Point, and once even briefly into Eagle Cove on July 7.

My results are not at all as expected, considering that Bald Eagles are known to be very territorial, especially around breeding season. My data indicates that while the Eagle Cove pair had a roaming territory that is more or less constant, and which overlaps

** This one exception occurred on July 5, when the adult circled from the direction of Duck Cove to over the Wet Lab for about 15 seconds, and then headed south towards The Island and out of sight. July 5 was noted as an "extremely windy" day, so the adult may have passively drifted there with the heavy winds.*

with that of the Killarney pair, they probably only defend the area immediately around the Nesting Tree, which would be Eagle Cove, from intruders. But this leaves the incident on July 7 unexplained: I have no doubt that the adult entering Eagle Cove at 11:40 a.m. was from the Killarney Nest, yet its presence did not even draw the attention of the Eagle Cove adults. One would think that the adults would be more vigilant when an intruder entered the neighboring cove, and even violent when an intruder entered the cove with their nest.

There are several factors that may contribute to the lack of defensive posture from the Eagle Cove adults. The intrusion by the Killarney adult on July 7 was only for a few seconds, and may not have been long enough to illicit a response. The juveniles were also two weeks away from flying, and may have been old enough for the adults to loosen their defensiveness, although I think that unlikely. I strongly believe that the adults were present more often than I noted, either out of sight or at extremely high altitude (it was sometimes difficult to track the adults at these high altitudes even when I knew in general where they were), but nevertheless guarding their nest from a distance. My reasons for hypothesizing this are explained in the *Disturbance* section, below. When the Killarney intruder was in the neighboring cove, it is likely that the Eagle Cove adults, with their keen vision, were watching it, and that the intruder knew so. In summary, I would classify the Eagle Cove pair's defense of their immediate nesting territory as passive.

Disturbances.

There were very few times that I arrived at the nest to find neither parent present. Most observations were done using a canoe and paddle, and for the nine times that I arrived to find no adults present, the average response time for one to appear was 22.5 minutes. On June 21, for the hour and fifteen minutes I spent observing, there was no trace of either parent at all. Observation data shows that the parents were gone on average for no more than 30 minutes at a time anyway. The coincidence of these two times suggests that my presence was or less ignored. However, there were three times that I used the gas motor to approach the nest when neither adult was there, and the response time to my presence was 5, 1, and 12 minutes. This leads me to believe that the noise generated by the gas motor attracted the adults.

The adults may have been attracted to the sound of the motor for a couple of reasons. Perhaps such a loud sound in their home cove was perceived as a threat to their offspring. It is more likely that they associate the sound of a motor with free fish, discarded over the side of a fisher's boat. There is no way to prove which is true from my results, but it seems that a pair of eagles living in an area that is frequently disturbed by boaters would quickly learn that fisherman pose no threat.

I also hypothesize that the adults were present with much greater frequency than recorded in the observational notes. The adults were often sighted soaring at extremely high altitude, and even when their general position was known, it was often difficult to spot them. It seems likely that even when no adults were visible, they were somehow watching their nest, either from a concealed position inland or from a great height. This seems likely due to their response time to the gas motor. This hypothesis would have been tested, had time allowed it, in an experiment described next.

July 6 represented somewhat of a manipulative experiment that I attempted to repeat more formally later on. The Results section under *Disturbances* describes how I used the gas motor to create a disturbance and measure the response of the parents. The adults seemed to escort me out of their cove, either because they were waiting for discarded fish or because they perceived me as a threat. The actions of the adults seemed to indicate that, at the very least, a lot of noise annoys them. Whatever the reason, there was definitely a response to my motor, and the quickness of this response suggests that the adults are often present even when they are not visible. An experiment to further test this hypothesis is briefly outlined in the *Concluding Remarks* section.

Concluding remarks.

One shortcoming of this study was the time available to actually observe the nest. It proved impossible to spend entire days, or even more than six hours at a time, out on the water observing the eagles. I attempted to choose different observation times each day in order to get a spectrum of behaviors at different times of day. I also noted that a single observer is often not enough to catch every action of the family, and there were times when an adult would slip away or actually land on the nest without my noticing for a minute or two.

Also, had time permitted, I would have liked to do a follow up experiment to the spur of the moment one conducted on July 6. I had planned to approach the nest via canoe and paddle, and settle in to the observation position, where I would remain quietly until an adult arrived at the nest. After the adult left, I had planned to signal an assistant via walkie-talkie, who was waiting by the Wetlab (see appendix A) in a boat with the gas-powered motor. At that time, the assistant would move to Eagle Cove and begin circling, until an adult showed up. The response time would be noted. I would then signal the assistant to leave the cove in a certain direction, and note the reaction of the adult(s). A different direction would be chosen each time to see if there was any consideration given to territory in the adults' responses. The purpose would be to measure the response time of the adults to see if either there is indeed a quick response time to noise, or if the adults do not care about the disturbance. The speed of the response time would also indicate how close the adults are to the nest when they perceive the noise. Unfortunately, the study time had ended before this could be carried out.

Literature Cited

Birds of Prey. Newton, Ian, consulting ed. Facts on File; New York, 1990.

Handbook of North American Birds. Palmer, Ralph S., ed. Yale University Press; New Haven, 1988.

Johnsgard, Paul A. Hawks, Eagles, and Falcons of North America. Smithsonian Institution Press; Washington, 1990.

Appendices

Figure Legends for the Following Appendices

Appendix A: Map of Tenderfoot Lake with Significant Location Noted

The actual map was distributed at the UNDERC property. Most of the notes on the map were written in the field over time, as research was being conducted and notes were being taken. The circled area at the northern half of the lake indicates an estimation of the area where the territories of the two nesting pairs on the lake overlap. This estimation was based on data from *Territory and Territoriality* and was drawn in after research was completed and the data was analyzed.

Appendix B: Blow Up Map of Tenderfoot Lake with Surrounding Terrain

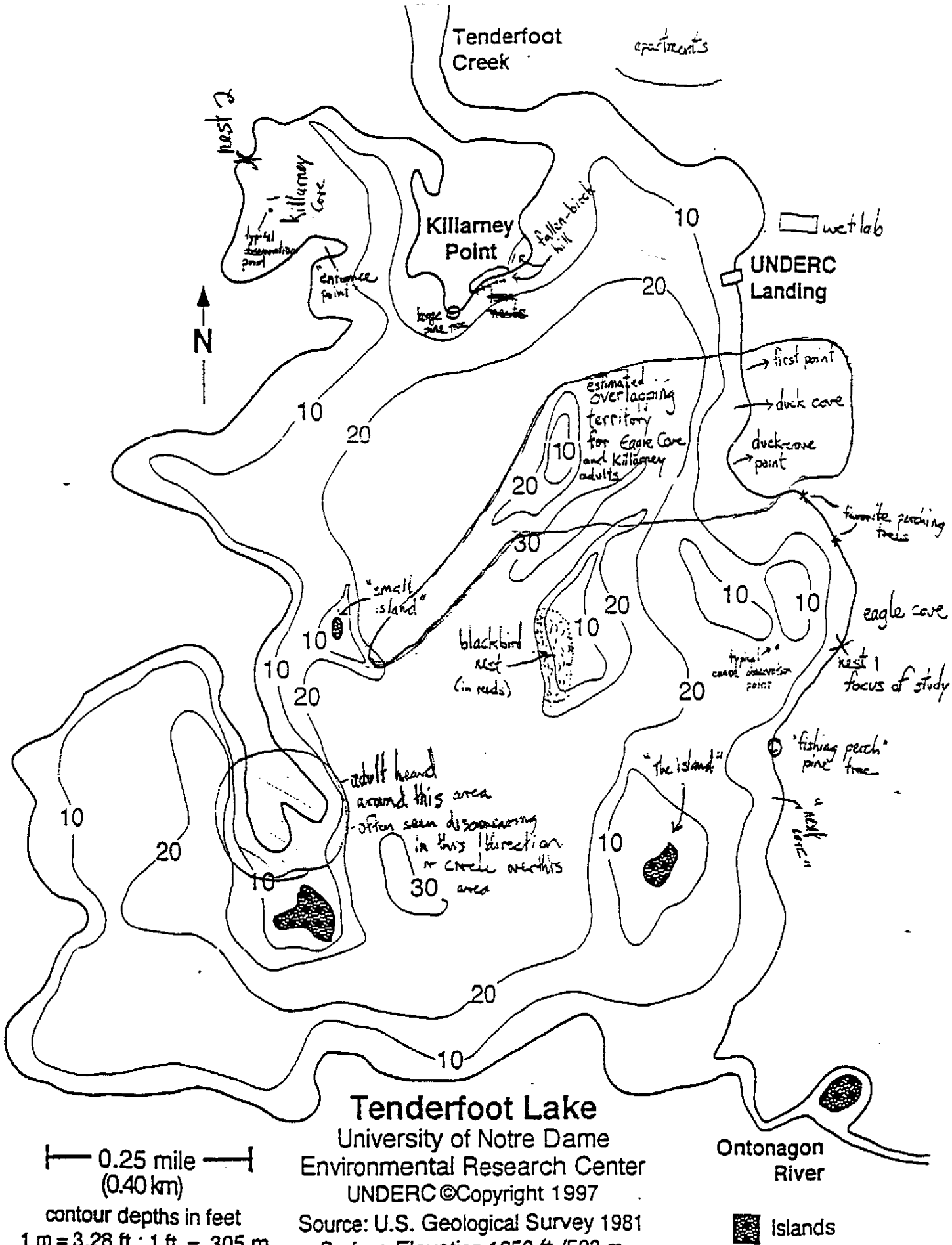
This map was created from a map of the entire UNDERC property that was distributed at the site. The area around Tenderfoot Lake enlarged.

Appendix C: Notes on Feeding Behaviors of the Eagle Cove Pair and Offspring

This is a complete record of significant data regarding feeding behaviors as recorded through the study period. Significant conclusions form these data include the fact that the adults seemed to consistently return to the nest from the southwest, which was important in estimating their territory.

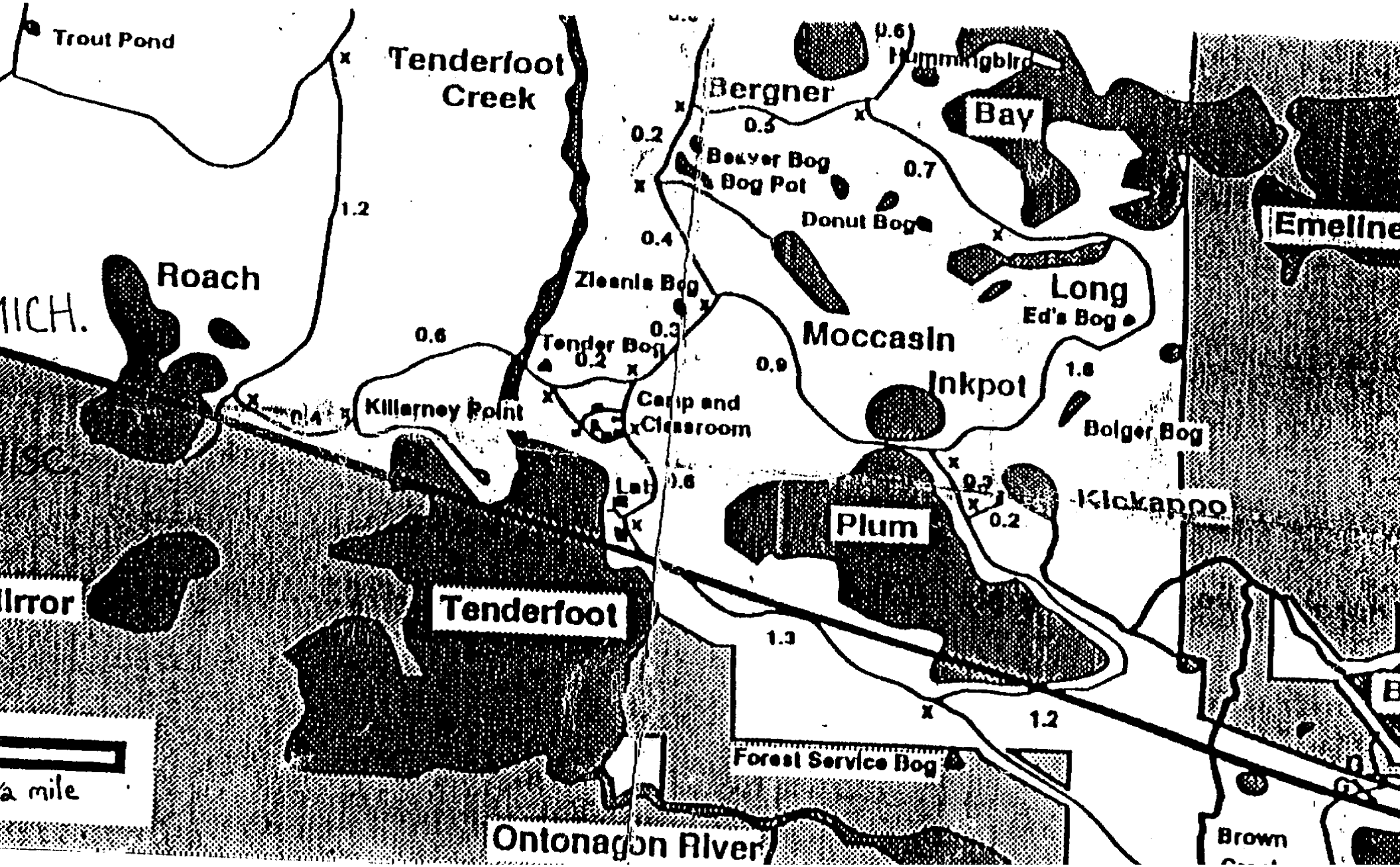
Appendix A

Map of Tenderfoot Lake with Significant Locations Noted



Appendix B

Blow Up Map of Tenderfoot Lake With Surrounding Terrain



Appendix C

Notes on Feeding Behaviors of the Eagle Cove Pair and Offspring

The remains beneath the nest consisted primarily of Northern Pike bones, although there were also many mollusk shells. The skull of a baby beaver was also found among the scattered bones of the eagles' prey. A man from the DNR reported that the remains of blue heron were also found in the nest in the past. Another researcher who was studying a family of loons on Tenderfoot Lake reported that one of the babies disappeared shortly after an adult eagle was seen hovering over the family.

May 31: At 9:25 a.m., one adult gave two loud calls from a perch next to the nest. The other adult appeared overhead with a fish in its talons at 9:28, and both adults settled into the nest. The juveniles began feeding squeals. At 9:30, the adult that brought the fish took off inland, and all calling stopped. The remaining adult then began dipping its head into the nest and coming up with shreds of fish, which it would feed alternately to each juvenile, beak to beak. At 9:32, the remaining adult hopped onto a perch by the nest, and remained there until I stopped observing at 9:52 a.m.

June 3: At 11:32 a.m., both juveniles were observed feeding on a fish, although no adult had been sighted for 22 minutes.

June 4: At 6:33 a.m., one juvenile was eating a fish although no adult had been in view since I arrived at 6:21. Later, at 6:51 a.m., an adult flew in from the north with a fish, over Duck Cove Point, and landed in the nest. Feeding squeals instantly began, and the adult and one juvenile began feeding. The adult did not feed the juvenile beak to beak. By 6:58, the adult had moved to a perch beside the nest, while both juveniles were feeding and making feeding squeals. One of the juveniles paused to flap its wings, but continued feeding until both finished at about 7:05. The adult took off to the south/southwest at 6:59 a.m. Later that same day, at 7:30 a.m., an adult returned to the nest with a fish, and feeding squeals began. The adult landed in the nest, tore up the fish, and began feeding both juveniles beak to beak, alternating between the two. At 7:38, the adult took off inland to the east, feeding squeals stopped, and the juveniles continued feeding until I stopped observing at 7:41 a.m.

June 12: I arrived at my observation point at 11:12 a.m., and there was an adult on the nest. I heard the juveniles making feeding squeals, which ceased at 11:14 when the adult moved to a perch beside the nest. Both juveniles were fully visible, and at 11:19 the feeding squeals resumed as I saw them feeding on something in the nest. They had finished feeding by 11:24 a.m.

June 13: I arrived at my observation point at 3:10 p.m. and saw an adult land in the nest with a fish. The juveniles began their feeding squeals, and the adult began dipping its head into the nest as if tearing up prey. The adult then fed the juveniles beak to beak, alternating between the two, and also ate some itself. At 3:18, one of the juveniles stretched its wings, and then walked onto a branch and perched a few inches from the edge of the nest. The adult and the other juvenile continued to feed. At 3:20, the adult, still in the nest, gave three traditional calls, and then three more a minute later. At this point the adult took off and flew inland to the east/southeast. Later that day, at 3:35 p.m., the adult returned to the nest, accompanied by feeding squeals that stopped as the adult landed. This adult is sitting on the nest in the center as though sitting on eggs. At 3:36, a second adult entered the cove from the west/southwest, hovered around the nest, and then headed back out of view to the south with a few gull cries. Two minutes later, the feeding squeals began and the adult started dipping its head in the nest, preparing the prey, and feeding the young alternately. At 3:40, a second adult soared into the cove from the south, looped around, and disappeared again past Fishing Perch tree. The adult in the nest and the juveniles continued feeding. At 3:44 p.m., the adult in the nest walked out onto a perching branch, hopped onto a higher branch, and then took off and circled away to the south of Eagle Cove over the tree line. The juveniles, their heads still visible, stopped the feeding squeals and stopped eating.

June 19: At 10:28 a.m., an adult flew into the cove at low altitude from the south/southeast, carrying a fish. It passed the nesting tree, circled around, and then landed in the nest. The juveniles began their feeding squeals, although only one was visible. The adult dipped its head into the nest as usual, but appears to be feeding itself. There was no beak to beak feeding of the juveniles. At 10:33, the feeding squeals ceased, and one juvenile flapped its wings, flapping them again at 10:36. At 10:41, the feeding squeals began again, only to cease a minute later. The second juvenile was still not

visible. At 10:45, the adult again dipped its head into the nest as if feeding, but did not feed the juveniles. Feeding squeals resume on and off for the next fourteen minutes. At 10:54, the only visible juvenile flapped its wings and then stretched them. At 10:59 a.m., the second juvenile finally became visible in the nest. The adult and two juveniles began feeding, three in a line with their backs to me, and the adult in the middle. At 11:05, the feeding squeals ceased and the adult took off towards Next Cove while the two juveniles continued feeding. The wind began to pick up, and by 11:07 the juveniles had finished feeding.

June 20: At 5:55 p.m., one juvenile was in the nest, the second was perched on a branch right beside the nest, and an adult was perched a little further away from and above the nest. The second adult came soaring into the cove from the southeast with a fish, making several gull calls. It landed on the nest as the feeding squeals began, and the previously perched adult took off out of the cove. The perched juvenile moved into the nest, and the three remaining eagles, an adult and both juveniles, began feeding with their heads dipped into the nest. At 6:00, the adult moved out onto a perch, and the feeding squeals ceased. By 6:03, feeding activity has stopped. The adult was still perched, one juvenile had moved onto a perch near the nest and the other juvenile was sitting in the center if the nest.

July 6: At 5:11 a.m., both juveniles were in the nest when an adult landed with a fish. The juveniles extended their wings a little, and began to shuffle around towards the meal. A few seconds later, the adult moved out of the nest onto a perch and the feeding squeals momentarily ceased. The squeals resumed again on and off, very quietly. At 5:12, the adult took off and left the cove. At 5:17, one of the juveniles made 5 gull calls, and both continued feeding in the nest. At 5:18, one juvenile extended its wings and walked about, and by 5:20 a.m. had moved off to the right side of the nest. The second juvenile continued feeding for a few minutes longer. Later that same day, at 7:35 a.m., an adult flew into the cove and dove for a fish at the northeast end. This adult landed in the reeds by the shore and appeared to eat its victim until 7:38 when it took off and circled out of view over Next Cove Point with nothing in its talons.