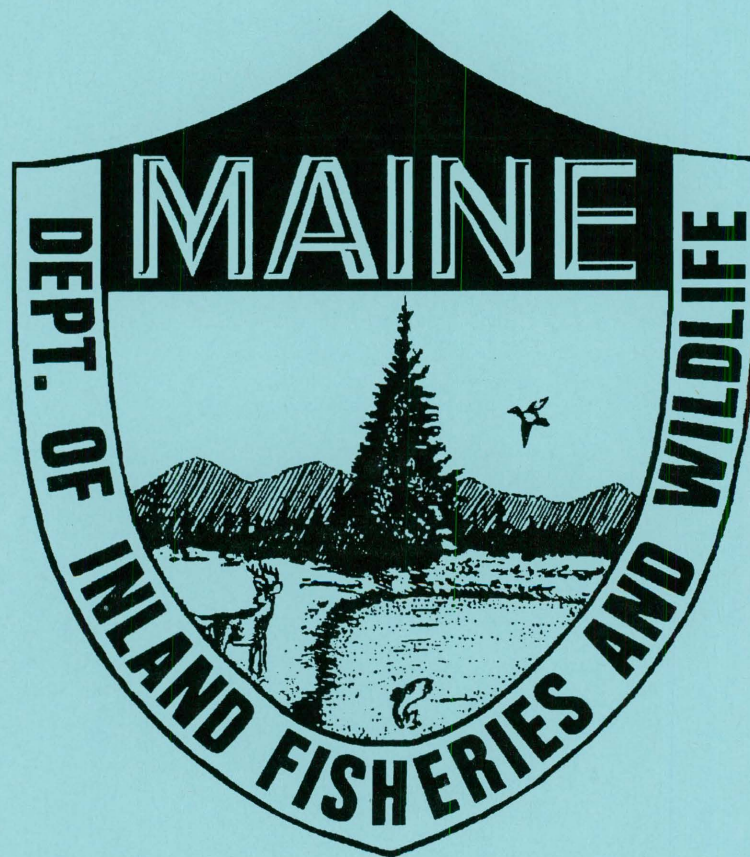


Fishery Final Report Series No. 08-01

Seasonal Movements and Habitat Use of Brook Trout in the Magalloway River, Maine

By David P. Boucher
Dianne Timmins



Caring for Maine's Outdoor Future



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MAGALLOWAY RIVER, MAINE

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JANUARY 2008

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ABSTRACT

A radio telemetry study was conducted on the Magalloway River below Aziscohos Lake in Oxford County, Maine to describe the timing of movements and identify important seasonal habitats for brook trout (*Salvelinus fontinalis*). Tagged brook trout moved only short distances, or not at all, from their original tagging locations during the summer and early autumn months. They moved primarily downstream short distances (1.6-2.4 km or 1-1.5 mi) to reach a major spawning site. Post-spawning dispersal occurred rapidly and in a downstream direction, with some tagged trout traveling up to 37 km (23 mi) to reach overwintering areas in deeper reaches of the Magalloway and Androscoggin Rivers, and in Umbagog Lake. Movement of trout from overwintering areas toward summer habitat occurred from late March to late April, invariably in an upstream direction. Returning tagged fish took positions in close proximity to their original tagging sites from previous year. Tagged brook trout traveled least during the summer period (mean movement of 0.48 km or 0.30 mi). Greatest movements occurred in the fall (mean of 10.5 km or 6.5 mi) to reach overwintering habitat, and in the spring (mean of 18.8 km or 11.7 mi) upon return to their summer range. Greatest distances traveled by individual trout ranged from 56 km (35 mi) to 116 km (72 miles). Telemetry data from this study and from two nearby rivers indicated the importance of Umbagog Lake as overwintering habitat for all three populations. These studies also confirmed the need to maintain the connectivity of all waters in this portion of the upper Androscoggin River drainage in order to assure the long-term sustainability of wild brook trout.

KEYWORDS: BKT, BEHAVIOR, MIGRATION, MOVEMENT, TELEMETRY

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SUMMARY

Brook trout are native to waters of the Upper Androscoggin River drainage in western Maine, where they are highly valued for their ecological, cultural, and recreational attributes. The species is sensitive to impacts associated with human activities such as logging, dams, and urban or agricultural development. Brook trout are especially sensitive to competition from other fish species, and they are easily over-exploited by sport anglers because even novices readily catch them.

Brook trout have become the focus of intense investigation in western Maine in response to the recent establishment of smallmouth bass through an unauthorized introduction. Smallmouth bass are severe competitors with brook trout and they can reduce brook trout production in waters where the two species co-occur. The principal goal of this study was to provide information to guide management and maximize the protection of wild brook trout in the Magalloway River in Oxford County. We used radio telemetry techniques to define seasonal movements of brook trout within the Magalloway River and connecting waters in Maine and New Hampshire. Specific objectives were to describe the timing of movements, and to determine the locations of key seasonal habitats, such as summer foraging, temperature refuges, prespawning and spawning, and overwintering areas.

The Magalloway River is a major tributary to the upper Androscoggin River, originating near the Canadian border in western Maine and eastern New Hampshire. Aziscohos Dam, located 17.7 miles above its confluence with Umbagog Lake and the Androscoggin River, impounds a portion of the river. This study was conducted in this lowest reach below Aziscohos Dam.

Twenty-three brook trout from the Magalloway River were radio-tagged in June 2005 and tracked until mid-July 2006 by foot, small watercraft, aircraft, and snowmobile. Tagged brook trout moved only short distances, or not at all, from their tagging locations during the July-August 2005 period. By mid to late October, the height of the spawning period for most Maine brook trout populations, five tagged trout moved a short distance downstream to the confluence of Abbott Brook, or ascended the brook a short distance. Several other tagged fish took positions either near the mouth of Clark Brook, located a short distance below the lowermost tag site, or in discrete areas about one mile below Abbott Brook. Most movements of brook trout during the autumn period were in a downstream direction.

Post-spawning dispersal occurred rapidly and generally in a downstream direction. Tagged trout overwintered in upstream areas of the Magalloway River in deep, slow moving reaches, in the lower Magalloway River, in the Androscoggin River above Errol Dam, or in Umbagog Lake. Movement of trout from overwintering areas toward summer habitat occurred principally from late March to late April, invariably in an upstream

direction. By late May 2006, the remaining tagged fish took positions in close proximity to locations from which they were originally captured and tagged during the previous June. Two tagged fish traveled upstream 24.6 and 25.1 miles to reach summer range in an approximate 30-day period.

Brook trout traveled least during the summer period (average of 0.30 miles), then generally moved short distances (average of 0.72 miles) to spawning areas. Greatest movements occurred in the fall to reach overwintering habitat (average of 6.5 miles) and in the spring (average of 11.7 miles) as they returned to their summer range. The greatest distances traveled by individual trout during the entire study period (late June 2005 to mid July 2006) ranged from 35 to 72 miles.

There were no recorded movements of Magalloway River fish into either the Dead Diamond or Rapid Rivers, and neither adult nor juvenile trout from the Rapid River migrated to the Magalloway or Dead Diamond Rivers. Two tagged brook trout from the Dead Diamond River moved to the upper Magalloway River during the 2005 summer period, presumably to seek temperature refuge. This behavior was less apparent in 2006, probably because temperatures and flows in the Dead Diamond were more suitable than in 2005. These same trout remained in the Magalloway River during the 2005 and 2006 fall seasons, but it could not be determined if they spawned in the same locations as the Magalloway fish. Tagged brook trout from all three rivers overwintered in the north basin of Umbagog Lake.

This study provided information on seasonal habitat use, and identified critical habitat features that support Magalloway River wild brook trout. Our telemetry data and similar work conducted on the nearby Rapid and Dead Diamond Rivers clearly indicate the importance of Umbagog Lake to brook trout in the upper Androscoggin River drainage. These studies also confirmed the need to maintain free passage of brook trout throughout this subdrainage, because fish from all three populations travel long distances to reach habitat critical to their life history.

INTRODUCTION

Brook trout (*Salvelinus fontinalis*) are native to waters of the Upper Androscoggin River drainage in western Maine (Figure 1), where they are highly valued for their ecological, cultural, and recreational attributes. The species is well adapted to live in the varied habitats provided by this large water system, including the Magalloway River, but they are sensitive to impacts associated with human activities such as logging, dams, and urban or agricultural development. Brook trout are especially sensitive to competition from other fish species, and they are easily over-exploited by anglers because even novices readily catch them.

Brook trout have become the focus of intense investigation in western Maine (Castric et al. 2001, FPLE 2004, Fraser et al. 2004, Boucher 2005a and 2005b, Danner and Boucher 2005, Kleinschmidt Assoc. 2007, and Jackson and Zydlewski 2007). Much of this work has been in response to the recent establishment of smallmouth bass (*Micropterus dolomieu*) through unauthorized introduction. Smallmouth bass are severe competitors with brook trout, and they can reduce brook trout production in waters where the two species co-occur (Bonney 2006). The principal goal of the aforementioned studies was to provide information to guide management and maximize the protection of wild brook trout in the presence of well-established smallmouth bass populations.

The goal of this project was to define seasonal movements of brook trout within the Magalloway River and connecting waters in Maine and New Hampshire. Specific objectives were to describe the timing of movements and to determine the locations of critical seasonal habitats, such as summer foraging, temperature refuges, prespawning and spawning, and overwintering.

STUDY AREA

The Magalloway River is a major tributary to the upper Androscoggin River, originating near the Canadian border in western Maine and eastern New Hampshire (Figure 1). Aziscohos Dam, located 17.7 miles above its confluence with Umbagog Lake and the Androscoggin River, impounds a portion of the river. The study was conducted in the reach below Aziscohos Dam, which is not passable to fish moving upstream.

Aziscohos Dam, constructed in 1910, forms Aziscohos Lake and regulates flow to the lower Magalloway River. Total drainage area at the dam is 214 square miles. Federal licensing requires that minimum flows be maintained at 130 cfs from the start of the refill of Aziscohos Lake to September 15, then a minimum of 214 cfs is maintained from September 16 to the beginning of the next refill period. Cool hypolimnetic water is discharged from the dam and from a 2,000-foot long penstock. Consequently, summer water temperatures in this reach of the Magalloway rarely exceed 68°F (Figure 2).

The uppermost 1.7 miles below the dam flows through a spectacular steep-sided valley, dropping about 200 feet over that distance. The channel in this reach averages about 60 feet wide, and forms a series of riffles (60.1%), runs (18.6%), and pools (21.3%) falling over substrates that are primarily large boulders and bedrock (Union Water Power Co. 1997). Below this reach the river slows, forming a meandering channel that deepens and

widens before entering the Androscoggin River near the outlet of Umbagog Lake. Umbagog Lake, 7,850 acres in size, is impounded by Errol Dam in New Hampshire. Mean and maximum depths in Umbagog Lake at full pond are 14 and 48 feet, respectively.

Several tributaries enter the Magalloway River below Aziscohos Dam, the largest of which include Clark Brook, Abbott Brook, Meadow Brook, Diamond River, and Sturtevant Stream.

Brook trout and landlocked salmon (*Salmo salar*) provide the principal sport fisheries in the Magalloway River. Rainbow smelts (*Osmerus mordax*) occur as drift from Aziscohos Lake, and appear to be an important food item for both brook trout and salmon (MDIFW, unpublished data). Other fish known to be present in the river include smallmouth bass (*Micropterus dolomieu*), chain pickerel (*Esox niger*), yellow perch (*Perca flavescens*), brown bullhead (*Ameiurus nebulosus*), slimy sculpin (*Cottus cognatus*), white sucker (*Catastomus commersoni*), fallfish (*Semotilus corporalis*) golden shiner (*Notemigonus crysoleucas*), common shiner (*Luxilus cornutus*), and lake chub (*Couesius plumbeus*).

The brook trout fishery in the Maine reach is regulated with a 6 to 12-inch harvest slot (8-12 inches from 1998 to 2005), with one trout permitted in this size range. Landlocked salmon have a 14-inch minimum length limit and one fish per day bag limit, and unlimited harvest of smallmouth bass is permitted. Fishing is restricted to fly fishing during the period from April 1 to September 30. All brook trout and salmon must be released after August 15.

Prior to 2006, the brook trout fishery in the New Hampshire segment of the Magalloway River was regulated with a 10-inch minimum length limit and two fish per day bag limit, with no gear restrictions. Since 2006, brook trout in the New Hampshire reach have been regulated with an 18-inch minimum length limit and a one fish per day bag limit. These same rules currently apply to Umbagog Lake and the Androscoggin River upstream of Errol Dam. During the study period Umbagog Lake was open to ice fishing from January 1 to March 31, except the eastern portion of the north basin was closed.

The Magalloway River below Aziscohos Lake can be accessed easily from several road crossings, roadside turnouts, and footpaths

METHODS

Fish tagging:

All tagged fish were captured by angling with light spinning gear from two large pools located about 0.7 and 1.2 miles below Aziscohos Dam (Figure 3). The fish were anesthetized and a small incision was made into the abdominal cavity between the pelvic and pectoral girdles. Radio transmitters were inserted through the incision, and the transmitter antenna was fed into a 16-gauge opening made posterior to the pelvic fins. Incisions were stitched using absorbable monofilament material, then measured, weighed and sampled for scales. The fish recovered in aerated tubs prior to release at the capture

sites. Radio-tagged brook trout were 2 and 3 years of age, ranged in length from 11.9 to 19.1 inches, and averaged 14.3 inches long (Tables 1 and 2).

Radio transmitters were manufactured by Lotek (Model MCFT-3BM), and were 43 mm long with a 300mm external antenna. The tags weighed 3.7 grams in water and featured a 12-hour on/off cycle with a 376-day battery life.

Tracking:

Tagged brook trout were tracked with a Lotek SRX-400 receiver and Yagi directional antennae. Fish were relocated using a combination of foot, boat, fixed-wing aircraft, and snowmobile surveys. Tracking surveys began within 7 days after the tags were implanted, then occurred every two weeks until the spawning season approached. Surveys occurred weekly during the pre-spawning and spawning periods (September-October), then monthly during the post-spawning and winter periods. Tagged fish locations were identified by a written description and geospatial coordinates determined with handheld GPS units.

Data analysis:

Geographical analysis of fish movements was completed using ESRI ArcMap 9.0 software. Spatially referenced fish locations were snapped to the nearest proximity to the NHDplus stream network (<http://erg.usgs.gov/isb/pubs/factsheets/fs10699.html>). NHDplus line features were then split at the fish point locations with SplitLinesAtPoints 1.0 utility (ESRI-Charlotte 2007). Distances traveled by each fish between observations were calculated by summing the line features within each travel path. Location and path data were separated into four time periods thought to coincide with major life history events: summer foraging (June 1 to August 31); pre-spawning and spawning (September 1 to October 31); post-spawning dispersal and overwintering (November 1 to March 31); and post-wintering dispersal (April 1 to May 31).

RESULTS

Fate of tagged brook trout:

Twenty-three brook trout from the Magalloway River were radio-tagged in June 2005. Two tags appeared to malfunction immediately, as these fish were never located again (Table 3). Two tagged fish apparently succumbed to the surgical procedure; radio signals were located at sites slightly downstream of the tagging sites and never moved. Two tagged fish appeared to be victims of avian predators because signals were detected adjacent to or in bald eagle and osprey nests located near Umbagog Lake. An ice angler from Umbagog Lake harvested one tagged fish in January 2006 (tag recovered). Four additional mortalities were recorded that were likely angling related. Their signals became suddenly stationary in the Magalloway River at positions downstream of heavily fished reaches at random times during the open water fishing season. One tag was found on the stream bank adjacent to a known spawning site, so it's likely that the fish succumbed to a predator. Signals from five tagged fish became stationary at positions downstream of likely spawning areas and may have been post-spawning mortalities. A

total of 14 surviving tagged trout were available to estimate summer range and locate spawning habitat. Nine tags remained viable long enough to locate winter habitat and to determine the time of return to summer habitat (Table 3).

Seasonal movements:

Tagged brook trout moved only short distances, or not at all, from their tagging locations during the July-August 2005 period (Figure 4). Ten trout made minor movements, generally less 0.5 miles, to locations upstream or downstream of their tag sites. Two of these fish moved into and out of Abbott Brook, located about 1 mile below the tag sites, then returned to their pools of original capture. Six fish remained in the pools where they were tagged during the entire two-month period. Only one trout made an extensive migration during the summer months. This fish was located about 9 miles below the capture site less than two weeks after it was tagged. Two days later it had descended downstream another 3.5 miles; that same day, about 6 hours later, the fish had moved upstream 3.6 miles. Two weeks later this fish had moved upstream 9 miles to its original tagging site and remained there until late September.

Tagged trout continued to remain near the original tagging sites through mid-September 2005. By the end of September most began to move towards suspected spawning sites, but five fish remained near their capture locations through the end of October. By mid to late October, the height of the spawning for most Maine brook trout populations (Bonney 2006), five tagged trout moved a short distance downstream to the confluence of Abbott Brook (Figure 5), or ascended the brook a short distance. Brook trout redds were identified in the lower reaches of Abbott Brook, confirming this site as a spawning area for Magalloway River brook trout. Several other tagged fish took positions either near the mouth of Clark Brook, located a short distance below the lowermost tag site, or in discrete areas about one mile below Abbott Brook. We were unable to survey these sites for the presence of brook trout redds, but the timing of the fishes' presence (mid-late October) suggests spawning may have occurred here as well. Most movements of brook trout during this period were in a downstream direction.

Post-spawning dispersal occurred rapidly and generally in a downstream direction (Figure 6). For example, during a two-week period from late October to mid-November, one trout traveled nearly 18 miles from the upper river to a position in the Androscoggin River just above Errol Dam. Another fish moved 12.7 miles downstream during a one-week period in early November, then moved upstream 9.2 miles. Two months later this same fish was located in Sturtevant Cove of Umbagog Lake, 23 miles downstream from its previous location. Tagged trout overwintered in upstream areas of the Magalloway River in deep, slow moving reaches, in the lower Magalloway, in the Androscoggin River above Errol Dam, or in Umbagog Lake (Figure 7).

Movement of trout from overwintering areas toward summer habitat occurred principally from late March to late April, invariably in an upstream direction. By late May 2006, the remaining tagged fish took positions in close proximity to locations from which they were originally captured and tagged during the previous June (Figures 4 and 8). Two tagged fish traveled upstream 24.6 and 25.1 miles to reach summer range in an approximate 30-day period.

Distances traveled by tagged trout during the four seasonal periods are summarized in Table 4. Brook trout traveled least during the summer period (mean movement=0.30 miles), then generally moved short distances (mean=0.72 miles) to spawning areas. Greatest movements occurred in the fall to reach overwintering habitat (mean=6.5 miles) and in the spring (mean=11.7 miles) as they returned to their summer territory. The greatest distances traveled by individual trout during the entire study period (late June 2005 to mid July 2006) ranged from 35 to 72 miles.

Inter-river migration:

Figure 9 summarizes habitat use of radio-tagged brook trout from three sub-drainages of the upper Androscoggin River basin – the Magalloway River, the Dead Diamond River, and the Rapid River. There were no recorded movements of Magalloway River fish into either the Dead Diamond or Rapid Rivers, although one tagged Magalloway River trout was located within 1.3 miles of the Rapid River in Umbagog Lake in March 2006. This same fish was located 25.1 miles upstream in the Magalloway one month later. Neither adult (FPLE 2004) nor juvenile trout (Jackson and Zydlewski 2007) from the Rapid River migrated to the Magalloway or Dead Diamond Rivers

Two tagged brook trout from the Dead Diamond River moved to the upper Magalloway River during the 2005 summer period, presumably to seek temperature refuge. This behavior was less apparent in 2006, probably because temperatures and flows in the Dead Diamond were more suitable than in 2005 (D. Timmins, NHFG, unpublished data). These same trout remained in the Magalloway River during the 2005 and 2006 fall seasons, but it could not be determined if they spawned in the same locations as the Magalloway fish.

Tagged brook from all three rivers overwintered in the north basin of Umbagog Lake (Figure 10). Rapid River fish also utilized Umbagog Lake during portions of the spring and summer seasons, but only transiently (FPLE 2004, Jackson and Zydlewski 2007).

DISCUSSION

Radio tag malfunction and mortality associated with the tagging procedure (17%) were probably within the range observed during other local telemetry studies (FPLE 2004 and NH Fish and Game, unpublished data).

This study provided estimates of both natural and fishing mortality for wild riverine brook trout. Annual mortalities attributed to raptors and other predators (11%), the stresses of spawning (32%), and angling (26%) were rough estimations because few of the moribund tags were actually recovered. Angler mortality rates from this study were similar to estimates made for adult brook trout from the Rapid River (FPLE 2004) and Chamberlain Lake in north-central Maine (T. Obrey, MDIFW, unpublished data).

Although radio tag failures, natural mortality, and anglers substantially reduced the number of study fish, we believe sufficient data were obtained from the remaining tags to adequately describe the adult behavior of this trout population. Future telemetry studies

conducted under similar conditions should consider our tag failure and mortality rates when setting study objectives and sampling requirements.

This study provided information on seasonal habitat use, and identified critical habitat features that support Magalloway River wild brook trout. As discussed below, these data have already been applied by fishery managers to maximize the protection of these important fish.

The sedentary movement patterns observed from July to mid-September 2005 were likely related to the presence of good instream cover, ideal thermal conditions, and excellent food resources. During the summer period, all Magalloway River tagged fish were positioned in one of several large pools, or in deep runs and riffles located just upstream or downstream of the pools. While the depth of the pools is unknown, they clearly provide excellent cover in the form of large boulders. Summer water temperatures are highly suited to brook trout in this reach because of the hypolimnetic discharge from Azischohos Lake (Figure 2). cursory inspections of brook trout stomach contents confirmed that smelts are a predominant food item, at least during the period we sampled (mid-late June). The robust condition of the trout is also suggestive of a diet consisting of smelts.

Confinement of trout to this short river segment during the summer months is clearly recognized by recreational anglers - recent creel surveys indicate from 77 to 100 percent of annual angler use occurs in this reach (Boucher 2005b). Restrictive fishing regulations, imposed in 1996 and revised in 2006, provide adequate protection to juvenile and adult trout and minimize impacts from intensive angling.

Tagged brook trout moved only short distances (1-1.5 mi), mostly downstream, to reach a major spawning site in the lower reaches of Abbott Brook (Figure 5). This site is vulnerable to disturbance from existing cultural developments (major roads, permanent homes, logging, etc.) and high angler use. Future developments should be closely monitored, and existing fishing regulations for Abbott Brook are under review to assure pre-spawning and spawning brook trout receive adequate protection.

Molecular genetic analysis of brook trout from the Magalloway (Castric et al. 2001) and Rapid Rivers (Fraser et al. 2004) suggested that the two populations were not reproductively isolated. We did not observe movements of Magalloway fish into the Rapid River during the October spawning season, nor have radio-tagged Rapid River fish been observed to ascend the Magalloway to spawn (FPLE 2004), so the genetic assessment has not been confirmed. Several years of telemetry studies may be necessary to establish the occurrence and degree of spawning overlap between these two populations. There were no recorded movements of Magalloway River fish into the Dead Diamond River. Two tagged brook trout from the Dead Diamond River remained in the Magalloway River during the 2005 and 2006 fall seasons (D. Timmins, NHFG, unpublished data), but it could not be determined if they spawned in the same locations as the Magalloway fish.

Magalloway River brook trout dispersed downstream quickly after spawning and overwintered in deep, slow moving reaches of the Magalloway and Androscoggin Rivers,

or in Umbagog Lake (Figures 6 and 7). These migrations ranged from about 2 to 25 miles. Selection of these habitat types for overwintering has been observed for other Maine brook trout populations in Maine (EPRO 1999, FPLE 2004, and T. Obrey, MDIFW, unpublished data). These deep-water habitats likely reduce the physiological stress on trout because stream velocities are less and temperatures may be slightly higher (Cunjak 1988).

Umbagog Lake was also used by wintering brook trout originating from the Rapid River (FPLE 2004) and the Dead Diamond River (D. Timmins, NHFG, unpublished data). All tagged trout from the three river systems seemed confined to the lake's north basin (Figure 8). Closure to ice fishing of a portion of the lake's north basin in 1998, and expanded in 2008, eliminated some winter fishing mortality. Likewise, highly restrictive fishing rules imposed in 2006 protect brook trout that migrate between Umbagog Lake and the Magalloway and Dead Diamond Rivers.

Migration of tagged brook trout from overwintering areas to the upper Magalloway River occurred from late March to late April, with all fish returning to their original tagging sites by late May 2006. This spring migration occurred during the open fishing seasons in both New Hampshire and Maine. Restrictive regulations recently imposed in New Hampshire provide additional protection to these fish during this important life history event.

Telemetry data from this study, the Dead Diamond River (D. Timmins, NHFG, unpublished), and the Rapid River (FPLE 2004, Jackson and Zydlewski 2007) clearly indicate the importance of Umbagog Lake to brook trout in the upper Androscoggin River drainage. These studies also confirm the need to maintain free passage of brook trout throughout this subdrainage, because fish from all three populations travel long distances to reach habitat critical to their life history.

ACKNOWLEDGEMENTS

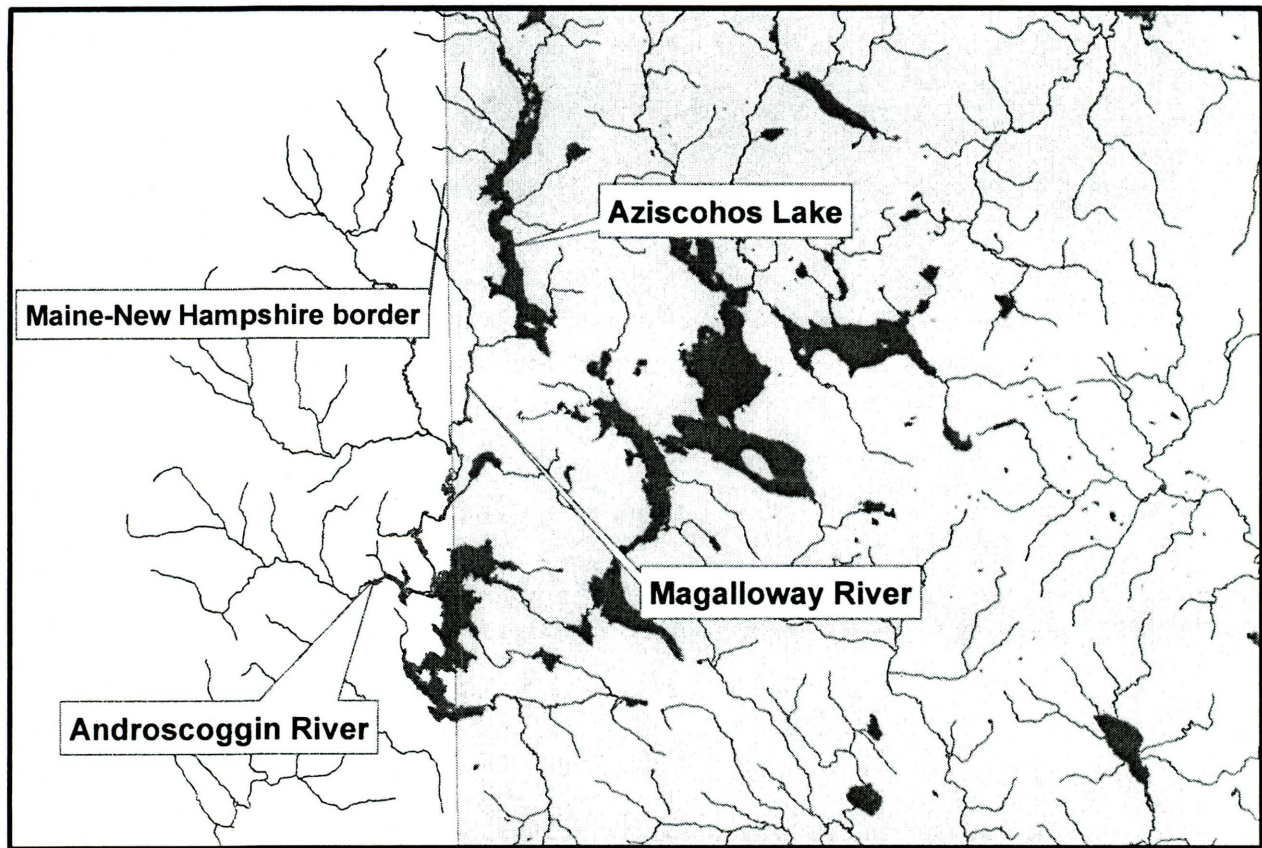
We gratefully acknowledge Dartmouth College and New Hampshire chapters of Trout Unlimited for funding this project. Maine fishery biologist Merry Gallagher deserves special thanks for assisting us with tagging and tracking logistics, and for her help with GIS analysis. We also thank the following individuals for their participation in various phases of the project. From the Maine Department of Inland Fisheries and Wildlife: Gene Arsenault, Forrest Bonney, Keith Carpenter, Joe Dembeck, Dr. Russ Danner, Dan Dufault, Dave Howatt, Charlie Later, Dennis McNeish, Tim Obrey, Steve Raye (retired), and Chip Wick. From the New Hampshire Department of Fish and Game: Andy Schafermeyer, Bryan Comeau, Jaclyn Comeau, Benjamin Nugent, and Cory Vander-Hayden. From FPL Energy Maine Hydro: Bill Hanson and Kyle Murphy. From Trout Unlimited: Dan Hall and Jeff Reardon. Steve Kasprzak, Jack Noon, and Roger Verrill (deceased) provided outstanding voluntary assistance.

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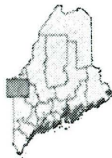
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Figure 1. The upper Androscoggin River drainage, showing the lower reach of the Magalloway River below Aziscohos Lake.



μ



0 2 4 8 12 16 Miles

A horizontal scale bar with tick marks at intervals of 2 miles, labeled with the numbers 0, 2, 4, 8, 12, and 16.

Figure 2. Water temperature in the Magalloway River below Aziscohos Dam, 2004.

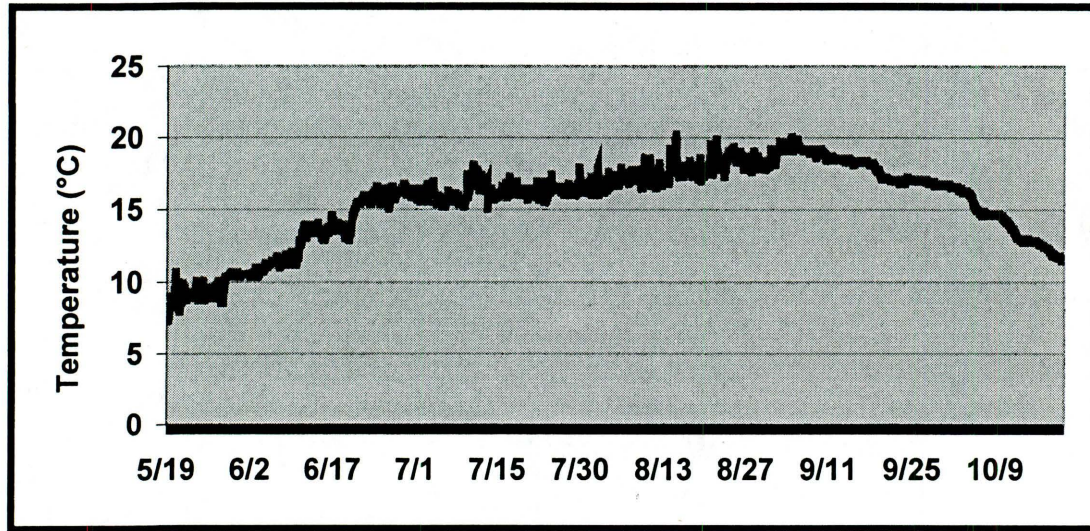


Figure 3. Capture sites of radio-tagged brook trout, 2005.

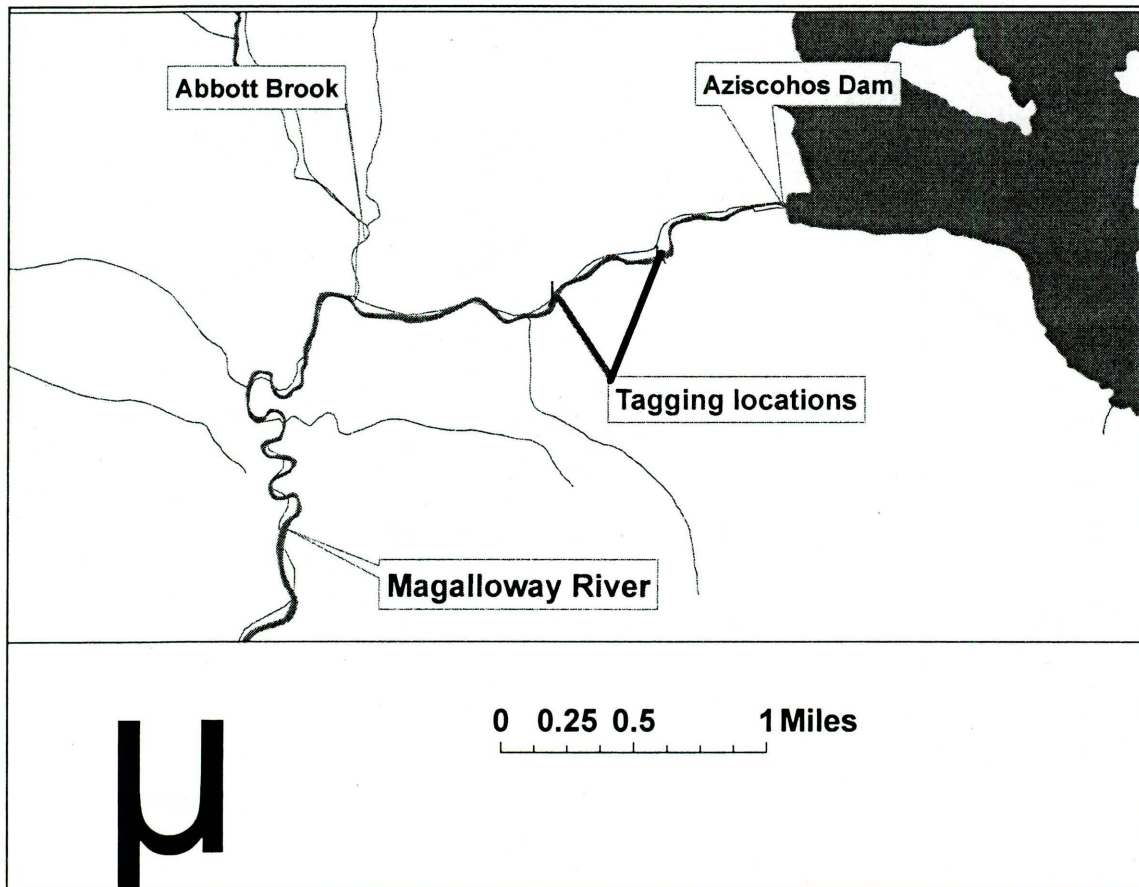


Table 1. Radio tagging summary for Magalloway River brook trout study, 2005-2006.

Tag frequency/code	Length (mm)	Weight (g)	Age	Date tagged	Tagging location (UTM)		Location description
					Easting	Northing	
149.320.21	413	908	III+	6/16/05	341077	4978199	Mailbox (Warden's) Pool
149.320.22	364	690	III+	6/16/05	341077	4978199	Mailbox (Warden's) Pool
149.320.36	342	500	II+	6/28/05	341525	4978332	Split Rock Pool
149.360.21	351	579	III+	6/16/05	341077	4978199	Mailbox (Warden's) Pool
149.360.22	485	1555	III+	6/16/05	341077	4978199	Mailbox (Warden's) Pool
149.360.29	440	1300	III+	6/17/05	341525	4978332	Split Rock Pool
149.360.32	422	1050	III+	6/17/05	341077	4978199	Mailbox (Warden's) Pool
149.360.33	319	431	II+	6/28/05	341077	4978199	Mailbox (Warden's) Pool
149.360.34	427	935	Unknown	6/28/05	341525	4978332	Split Rock Pool
149.360.35	310	305	II+	6/28/05	341077	4978199	Mailbox (Warden's) Pool
149.360.36	339	478	II+	6/28/05	341077	4978199	Mailbox (Warden's) Pool
149.380.21	392	1010	Unknown	6/16/05	341077	4978199	Mailbox (Warden's) Pool
149.380.22	311	317	II+	6/16/05	341077	4978199	Mailbox (Warden's) Pool
149.380.23	340	543	III+	6/16/05	341077	4978199	Mailbox (Warden's) Pool
149.380.29	301	325	II+	6/30/05	341077	4978199	Mailbox (Warden's) Pool
149.380.30	391	875	III+	6/17/05	341077	4978199	Mailbox (Warden's) Pool
149.380.31	327	400	II+	6/17/05	341077	4978199	Mailbox (Warden's) Pool
149.380.32	308	420	II+	6/17/05	341077	4978199	Mailbox (Warden's) Pool
149.380.33	356	491	III+	6/28/05	341525	4978332	Split Rock Pool
149.380.34	304	341	Unknown	6/28/05	341077	4978199	Mailbox (Warden's) Pool
149.380.35	357	551	Unknown	6/28/05	341525	4978332	Split Rock Pool
149.380.36	303	320	II+	6/17/05	341525	4978332	Split Rock Pool
149.380.37	338	425	II+	6/17/05	341077	4978199	Mailbox (Warden's) Pool

Table 2. Size and age summary of Magalloway River radio-tagged brook trout.

Age	Number of fish	Mean length±SE (mm)	Mean weight±SE (g)
II+	10	320±5	392±23
III+	9	396±16	888±121
Unknown	4	370±26	709±159
All fish	23	358±11	641±72

Table 3. Fate of Magalloway River radio-tagged brook trout, 2005,2006.

Number tagged:	23
Tag failures:	2
Mortality likely associated with tagging:	2
Mortality associated with raptors:¹	2
Harvested by anglers:²	1
Other possible angling mortalities:³	4
Probable post-spawning mortalities:⁴	6
Reported caught and released by anglers:	3
No. tagged fish available to estimate summer range and locations of spawning habitat:	14
No. tagged fish available to estimate over-wintering range and/or time of return to summer habitat:	9

¹ Signals detected in or near Bald Eagle and Osprey nests.

² Harvested by winter angler from Umbagog Lake (tag recovered).

³ Signals either stopped entirely, or signals were stationary at positions downstream of most heavily fished reaches at random times during the open angling season.

⁴ Signals either stopped entirely, or signals were stationary at positions downstream of likely spawning areas after late October 2005 (one tag recovered).

Figure 4. Summer habitat use of radio-tagged brook trout in the Magalloway River.

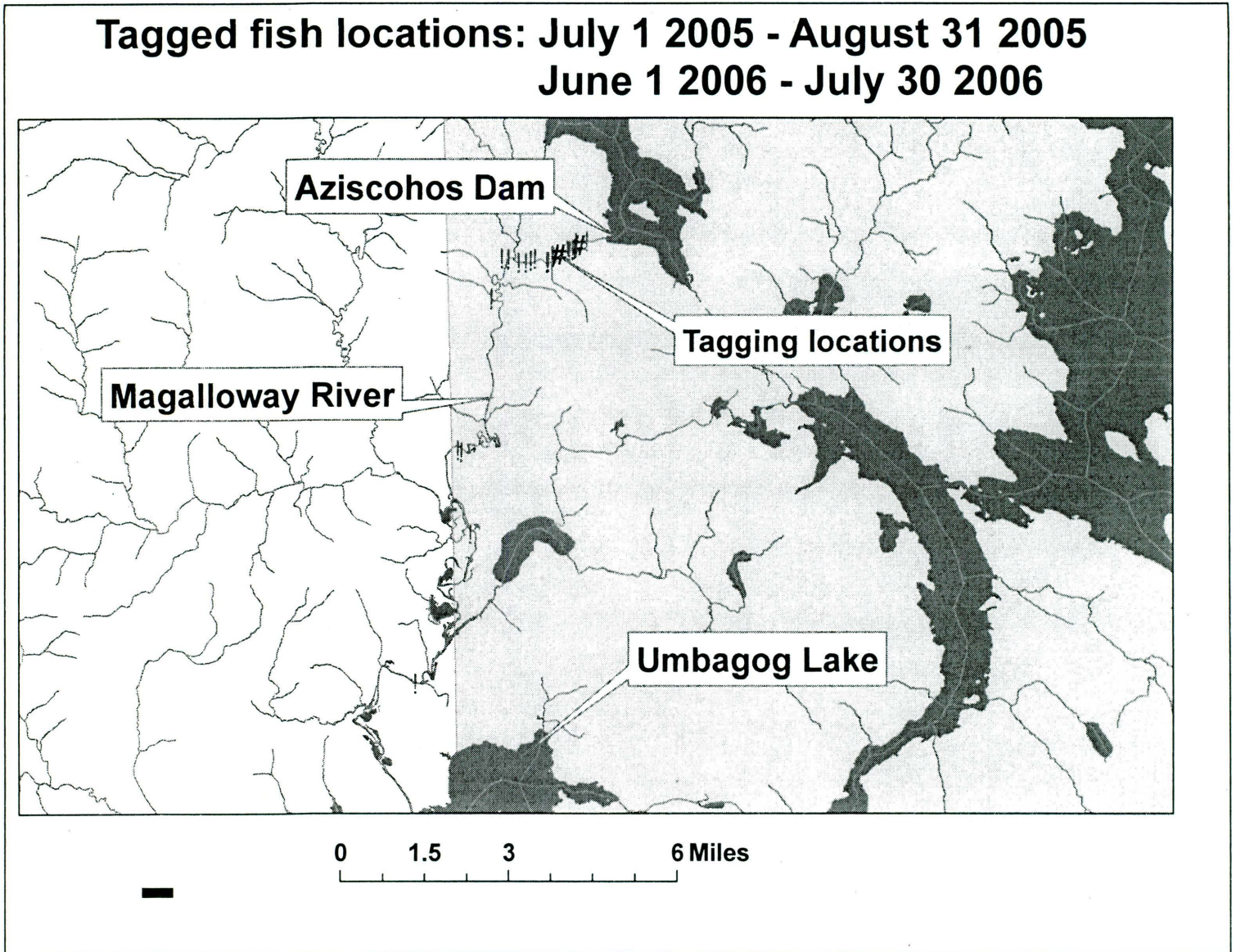


Figure 5. Locations of radio-tagged brook trout in the Magalloway River during the pre-spawning and spawning periods.

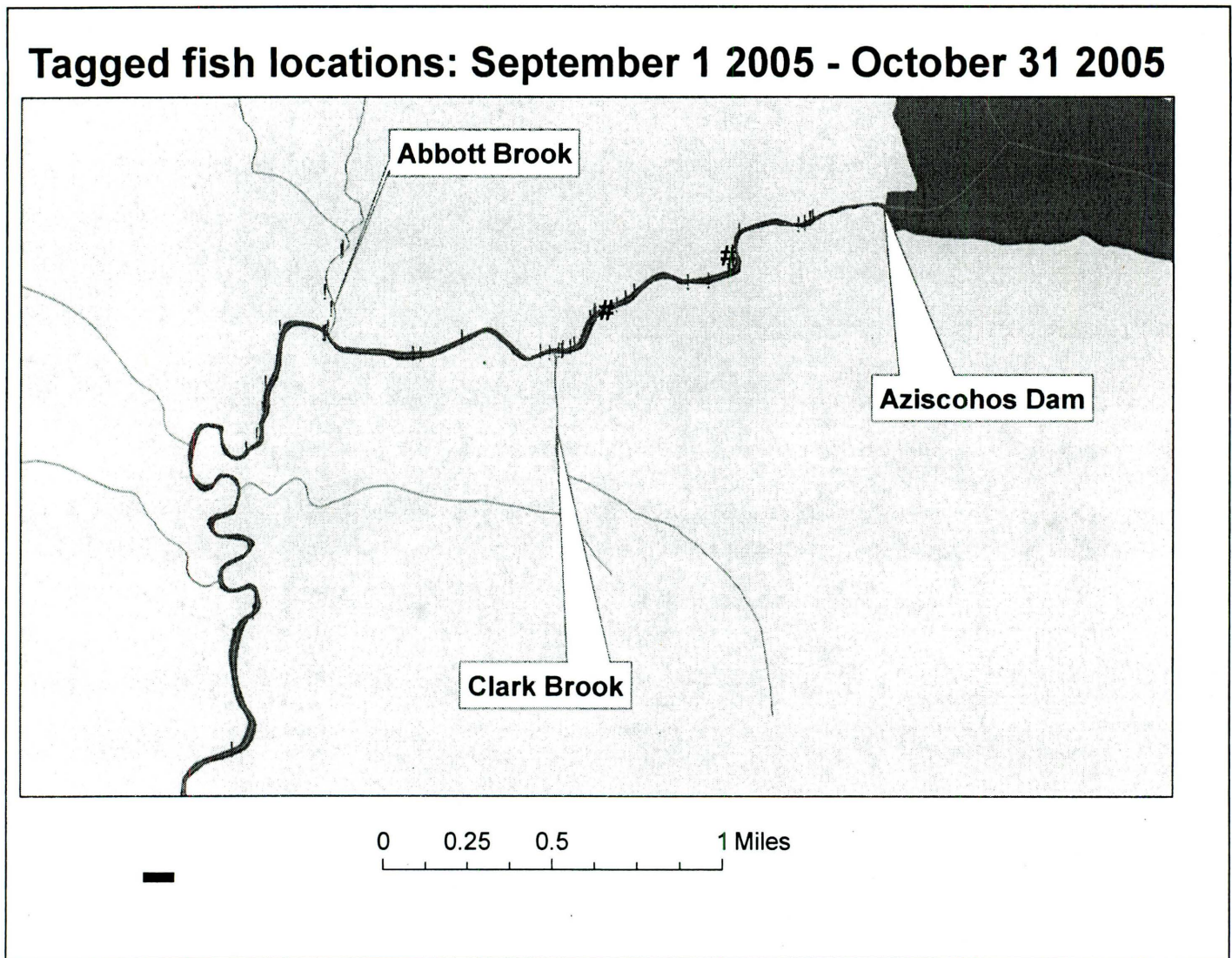


Figure 6. Post-spawning dispersal of radio-tagged brook trout in the Magalloway River.

Tagged fish locations: November 1, 2005 to December 31, 2005

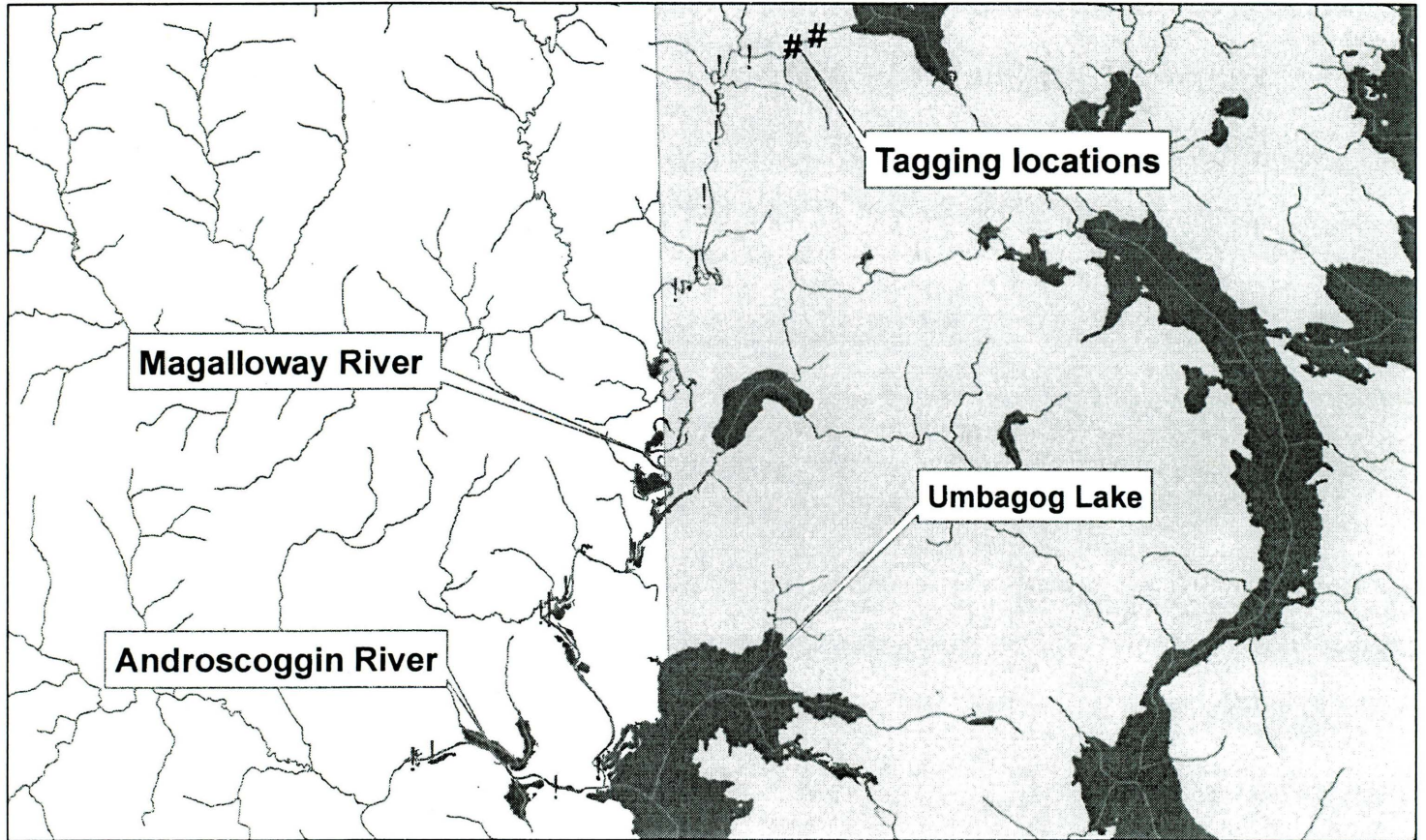


Figure 7. Overwintering habitats utilized by radio-tagged brook trout in the Magalloway River.

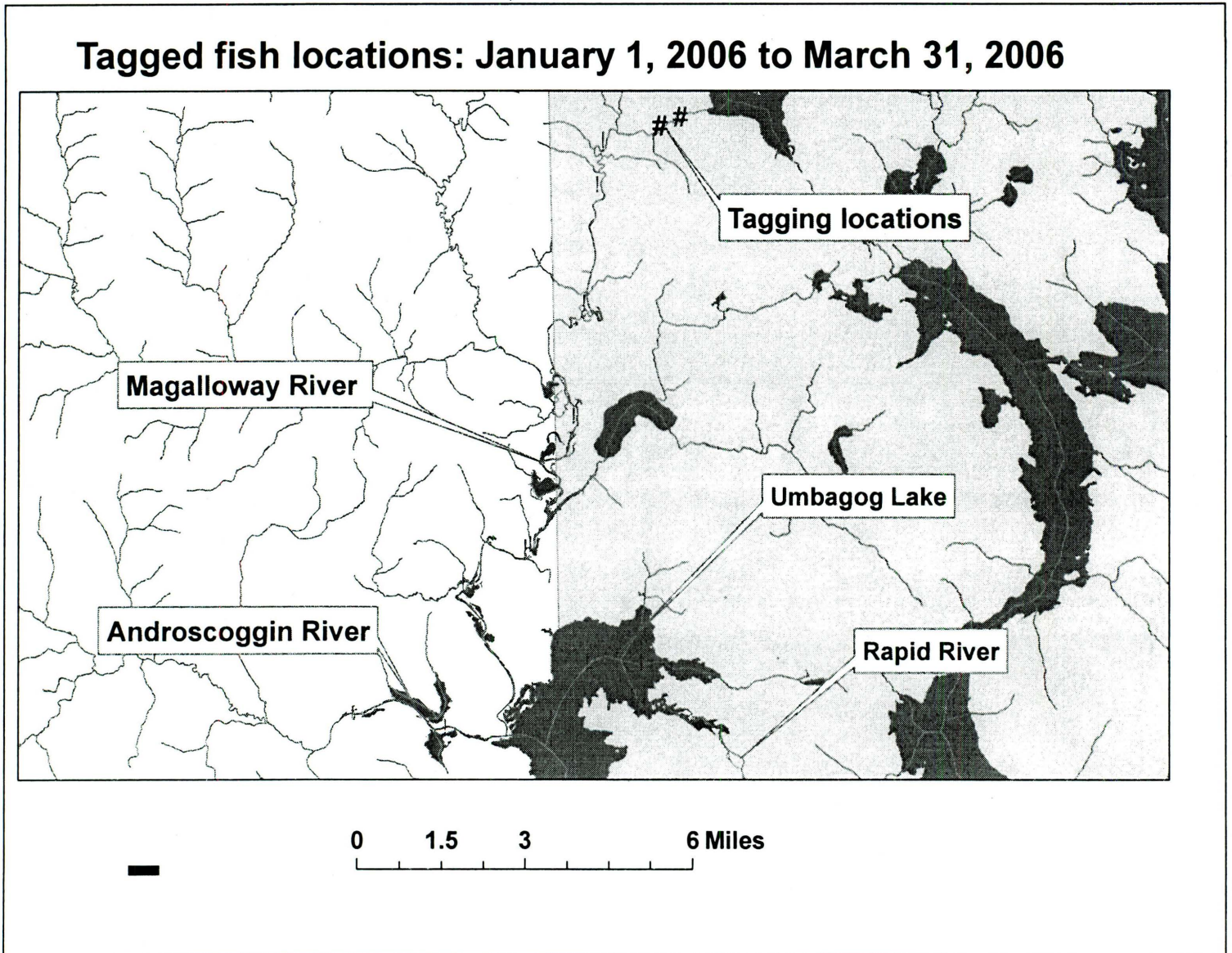


Figure 8. Post-winter dispersal of radio-tagged brook trout in the Magalloway River.

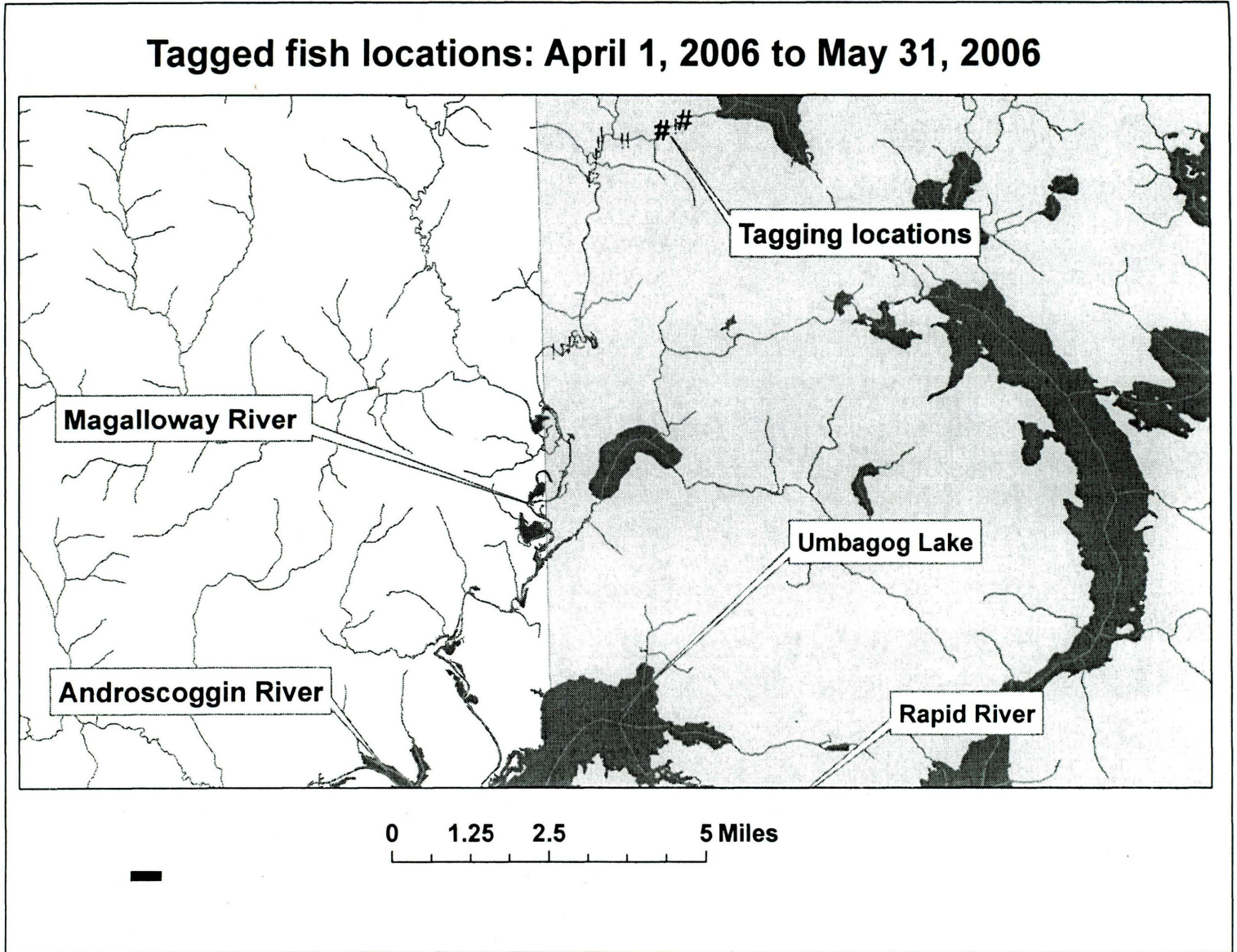


Table 4. Mean seasonal movements (miles) of Magalloway River radio-tagged brook trout, 2005-2006.

Season	No. fish tracked	No. tracking observations	Distance (mi) moved from previous location			
			Mean	SD	Minimum	Maximum
Summer ¹	19	94	0.30	0.68	0	8.9
Autumn ²	18	108	0.72	1.2	0	10.6
Winter ³	12	51	6.5	7.8	0	13.3
Spring ⁴	8	15	11.7	9.7	0.17	28.5

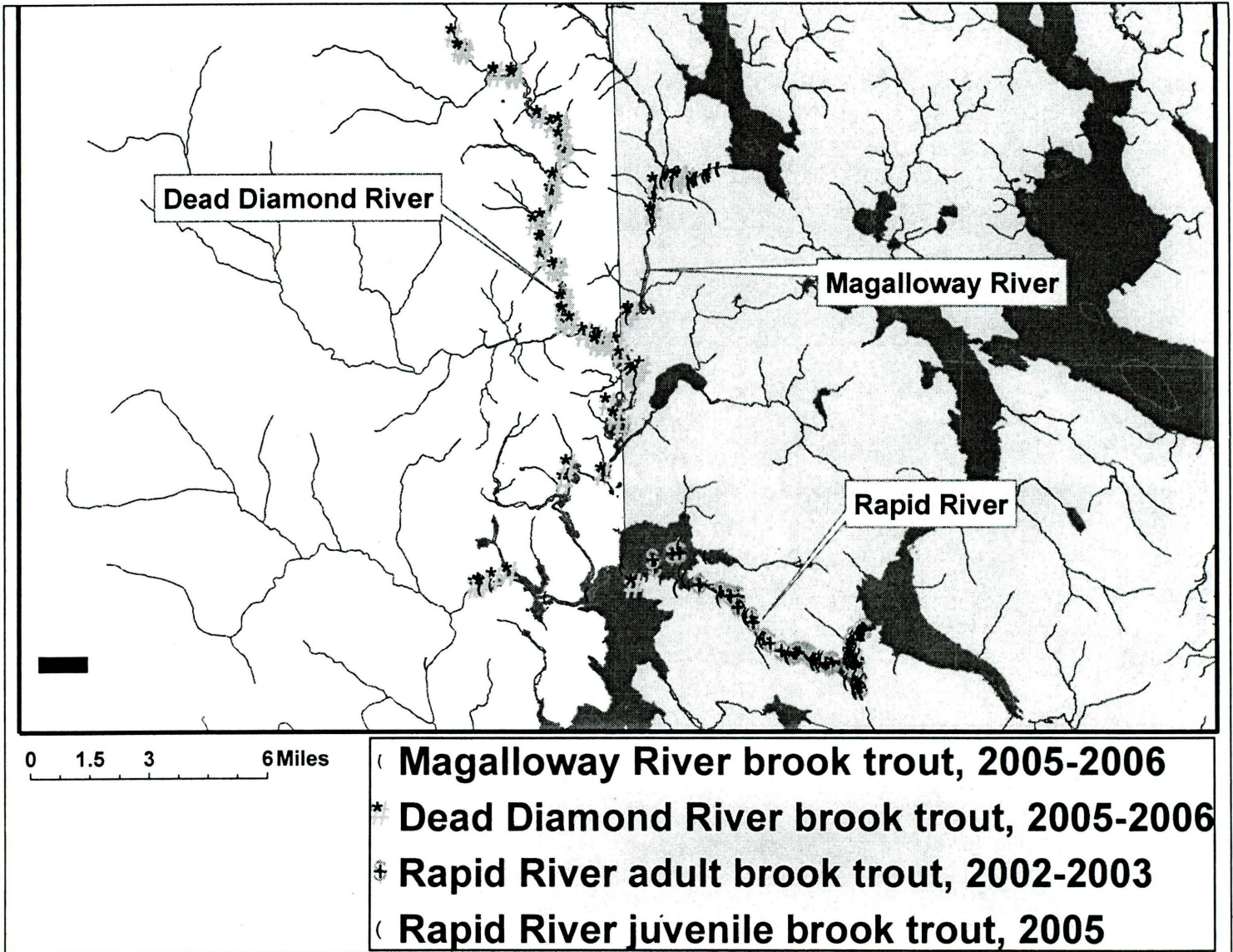
¹ Summer: June 16, 2005 to August 31, 2005, and June 1, 2006 to July 31, 2006.

² Autumn: September 1, 2005 to October 30, 2005.

³ Winter: November 1, 2005 to March 31, 2006.

⁴ Spring: April 1, 2006 to May 31, 2006.

Figure 8. Locations of radio-tagged brook trout in the Magalloway, Rapid, and Dead Diamond Rivers, 2002-2006.



COOPERATIVE STATE FEDERAL SPORT FISH RESTORATION PROJECT

This report has been funded in part by the Federal Aid in Sport Fish Restoration Program. This is a cooperative effort involving federal and state government agencies. The program is designed to increase sport fishing and boating opportunities through the wise investment of anglers' and boaters' tax dollars in state sport fishery projects. This program which was funded in 1950 was named the Dingell-Johnson Act in recognition of the congressmen who spearheaded this effort. In 1984 this act was amended through the Wallop-Breaux Amendment (also named for the congressional sponsors) and provided a threefold increase in Federal monies for sportfish restoration, aquatic education and motorboat access.

The Program is an outstanding example of a "user pays-user benefits", or "user fee" program. In this case, anglers and boaters are the users. Briefly, anglers and boaters are responsible for payment of fishing tackle excise taxes, motorboat fuel taxes, and import duties on tackle and boats. These monies are collected by the sport fishing industry, deposited in the Department of Treasury, and are allocated the year following collection to state fishery agencies for sport fisheries and boating access projects. Generally, each project must be evaluated and approved by the U.S. Fish and Wildlife Service (USFWS). The benefits provided by these projects to users complete the cycle between "user pays — user benefits".



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