TECHNIQUES FOR CAPTURE AND RADIO TAGGING OF MARBLED MURRELETS

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Abstract. Dip nets, spotlights, a gill net, and a net gun were used in attempts to capture Marbled Murrelets at sea in southeastern Alaska. Murrelets were captured only with the net gun. We tested harnesses, sutures, surgical implantation, and epoxy glue as techniques for attaching radio tags, but only murrelets with glue-attached radio tags behaved normally and survived. Seven of nine birds with glue-attached radio tags were relocated at least once at distances of 1.6–9.6 km from their tagging locations from 8 hours to 22 days after release. One bird was relocated on a nest in a tree, 1.2 km inland.

Key words: Brachyramphus marmoratus; *Marbled Murrelet; nest; radio tagging.*

INTRODUCTION

The secretive nesting habits of the Marbled Murrelet have prevented ornithologists from adequately documenting its nesting habitat requirements. Less than 10 nests had been documented when this study began, and all were located fortuitously, rather than by deliberate searching (Day et al. 1983). Sealy (1974) suggested radio telemetry as a possible means for locating nest sites of Marbled Murrelets. Radio telemetry has been used as a tool in a wide variety of wildlife studies, but until recently little telemetry work had been done with seabirds (Wanless et al. 1988). Thus, before radio telemetry could be used to locate nest sites of Marbled Murrelets, we had to develop capture techniques and determine a suitable method of attaching radio tags. This paper reports the details of the successful and unsuccessful methods we tried in capturing and radio tagging Marbled Murrelets in southeastern Alaska in 1983 and 1984.

STUDY AREA

This study was conducted at Kelp Bay (57°18′N, 134°55′W), located on the northeastern side of Baranof Island in southeastern Alaska. The bay consists of three major fiord arms and an outer sound and is approximately 70 km^2 in area. It is surrounded by steep mountains rising 610–1280 m above sea level. The bases and sides of the mountains are forested by old-growth Sitka spruce (*Picea sitchensis*), western (*Tsuga heterophylla*) and mountain hemlock (*T. mertensiana*), and Alaska cedar (*Chamaecyparis nootkatensis*). Large trees occur below an elevation of about 365 m, with small stunted trees extending to the treeline at 460–760 m elevation. Alpine tundra is covered with snow for most or all of the year. The coastal climate of the area exhibits moderate temperatures (mean annual temperature 4.4°C), frequent overcast skies, mists, fog, and an annual precipitation of 4060–7620 mm (Hartman and Johnson 1978).

Field work was conducted from 11 May to 17 June 1983 and from 4 May to 13 June 1984 during the egg laying and incubation period of Marbled Murrelets as estimated by Sealy (1974) for northern British Columbia. The number of Marbled Murrelets in Kelp Bay during the study varied from 240 in late May 1983 to 31 in early June 1983. In both years of the study, we observed that the number of murrelets in the bay increased to a peak in late May, and then declined quickly in early June.

CAPTURE TECHNIQUES

We attempted to capture murrelets using a dip net, a gill net, spot lights, and a capture net gun. We were able to approach murrelets closely enough on the water with an inflatable boat powered by an outboard engine to make use of a dip net on a 3-m pole appear feasible. However, the murrelets dived faster than we could maneuver the net. We abandoned this method after about 20 attempts on 1 day.

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We set out a lightly weighted 30-m long by 3-m deep section of monofilament gill net in the smallest cove frequented by murrelets. We watched the murrelets and the net through binoculars from about 100 m away. Over a 3-hour period, we observed several murrelets swimming in and around the net, but none became entangled possibly because the net was easily visible in the clear water. Murrelets are known to become tangled in gill nets in Alaska and British Columbia, but only at night (Carter and Sealy 1984).

In 1984, we searched Kelp Bay in an inflatable boat with a 250,000 candlepower spot light run by a portable generator, which brightly illuminated an area of about 20 m ahead of the boat. We searched the bay between 2230 and 2400 hours on 2 nights. Although we visited areas where murrelets were abundant in late evening, we did not see any murrelets during 5 hours of searching. Murrelets may have avoided the spotlight as they have been observed diving in lakes at night with a spot light (Carter and Sealy 1986).

The net gun was the only successful capture method. The net gun was built by a local welder based on a design by Mechlin and Shaiffer (1979). The gun used blank charges in three EZ Liner Launchers to propel three soft missile floats attached to the corners of a triangular-shaped, mesh gill net. The twine net was 2 m on a side and had 75 mm mesh openings. We modified the gun design so that the base of the triangle formed by the floats was parallel to the water, and we added an upright, forearm handle for easier handling of the gun in the boat. Only murrelets in flight could be captured with this gun. Murrelets on the water were approached in the boat (propelled by a 25 hp outboard) and provoked into flight. The net gun was fired if capture seemed possible. Capture teams consisted of a boat operator, shooter, and a bird spotter in 1983; in 1984, capture teams did not include a spotter.

The effective range of the net gun was 10–15 m using Heavy load charges. Under 10 m away, the net did not open fully and the bird could avoid it. In addition, the shooter tended to aim low and hit the water with a float. Over 15 m away, murrelets were able to avoid the net by changing direction or diving from mid-air into the water. We spent 28 capture-team days in 1983 and 23 capture-team days in 1984 using the net gun. About one bird was caught per 3–4 days of effort (involving 7–12 hours each) in 1983. When an experienced boat operator and shooter were combined in 1984, we caught about one bird per day involving 7–12 hours of effort. Capture teams with even one inexperienced individual (i.e., did not assist in 1983) never captured birds. We made 8–58 approaches and took 3–12 shots per day in 1983, depending on weather. In 1984, experienced teams made fewer, but more carefully planned, approaches and took 3–7 shots per day.

Murrelets were captured most frequently when pairs were approached obliquely from an upwind direction. A 5–10 knot (9–18 km/hour) wind with a small chop on the water surface worked best for flushing birds into flight while still being acceptable for taking accurate aim. The driver aimed the boat to the far right or left of the swimming birds (rather than steering directly toward the birds). When 7–10 m abreast of the birds, the driver turned the boat sharply to direct the swimming birds into the wind. Often birds flushed immediately with this approach, whereas other approaches resulted in birds diving. We were most successful in approaching and flushing murrelets in groups of two, presumably mated pairs for the most part (Sealy 1975). Single birds were nearly impossible to follow, and groups of three or more confused the driver and shooter such that few shots were fired. After discovering this, we pursued pairs only. Sixteen of the 17 birds captured were paired with another bird when flushed. Capturing murrelets became increasingly difficult in early June when more birds were alone or in large groups rather than pairs, and the total number of murrelets in the bay declined.

Handling Of Murrelets

We found that use of surgical gloves at all times while handling the birds was necessary to prevent damage to the water repellency of their feathers (from invisible residues of human skin oil or gun lubricant). Of 17 birds captured, only the nine birds handled in this manner dove and flew normally after release. The birds handled without gloves floated low in the water, flapped their wings frequently, and continually rolled on their sides to preen. This behavior appeared to provoke Bald Eagle (*Haliaetus leucocephalus*) attacks on at least four of the eight birds handled without gloves. We found the remains of a fifth in an eagle nest (by radio tracking). We observed no eagle attacks on nine birds handled with gloves, although one was attacked, unsuccessfully, immediately after release, by a Merlin (*Falco columbarius*), and the

remains of another tagged murrelet were found below a raptor perch.

Radio Tags

We used radio tags (transmitter, lithium battery, antenna, and epoxy coating filed flat on one side) developed by Advance Telemetry Systems, Minnesota. The transmitters had pulse widths of 18–28 m/s and pulse rates of 48–92/minute. The radio tags varied from 12–20 mm in diameter and 40–60 mm long and weighed about 10 g. In 1983, we fitted three birds with radio tags with an external, flexible, 200 mm whip antenna of plastic-coated wire, and four birds with radio tags with an enclosed coiled antenna. We did not notice any difference in range of the two antenna types when each was attached externally to the bird. Murrelets fitted with external whip antenna frequently pecked at the antenna. The one murrelet fitted with an external coiled antennae appeared more tolerant of the radio tag than any of the three birds fitted with whip antennae. Thus, we used only the coiled antenna model in 1984.

Radio Tag Attachment

Radio tags were attached to murrelets using backpack harnesses of polyethylene tubing, surgical implantation, sutures, and epoxy glue. Although backpacks attached with harnesses of polyethylene tubing have been used successfully on a variety of birds (Cochran 1980), the two Marbled Murrelets fitted loosely with harnesses were unable to fly. We followed one bird fitted with a harness for 8 hours after release. It never flew, although it attempted to take off several times; it died 8 hours after release, presumably owing to hypothermia caused by wet feathers. Murrelets with sutured backpacks appeared to fly and dive normally. One survived for three days before we traced its signal to an eagle nest; the other disappeared 6 days after release and was never relocated.

We implanted radio tags in three birds using techniques developed for diving ducks by C. E. Korschgen (pers. comm.) of the Northern Prairie Wildlife Research Station in Jamestown, North Dakota. The 30-minute operation involved anesthetizing the bird, making an abdominal incision, inserting the radio tag (with coiled antennae), then suturing the incision. Murrelets responded poorly to the anesthetic Ketaset. We found that doses of 0.4–0.6 ml (40–60 mg) were required to immobilize a murrelet sufficiently for surgery. Recovery from these dosages required 8–14 hours and required restraint of the bird to prevent it from injuring itself. None of the birds with implanted radio transmitters behaved normally upon release. Two suffered feather wetting, and the wing of the third was injured during capture or recovery from the drug.

We adapted a technique used successfully for gluing radio tags on Common Murres (*Uria aalge*) and Razorbills (*Alca torda*) in Scotland (Wanless et al. 1988; M. P. Harris, pers. comm.). We spread waterproof "Devcon two-ton expoxy" on the flattened side of the radio tag and on the feathers of the bird in the center of the back between the wings, over an area equivalent to the size of the radio tag. The epoxy was allowed to dry slightly, then the radio tag was placed on the bird's back. We then dried the epoxy completely with a 300-w hairdryer (powered by a portable generator). The radio tag was held in place for 1 hour or more of blow-drying to complete drying of the epoxy.

We conducted all work with captured birds (except surgery) in the boat near the capture site to allow separated birds of a pair (presumably mates) to call back and forth and to promote prompt reunions upon release. Surgical implantations were performed in our field camp cabin; upon recovery from the effects of the drug, the murrelets were released at their capture site.

Radio Tracking

We attempted to follow radio-tagged birds by boat for several hours after release and daily efforts were made to relocate them. After we radio tagged one bird, one capture team spent part of each day attempting to relocate the tagged bird(s) throughout Kelp Bay from a boat using a Telonics TR-2 receiver with an H-Adcock antenna mounted on a 2 m pole. Observers stopped the boat to listen for signals at intervals of 0.8–1.6 km. In 1984, we conducted seven air surveys (totalling 20 hours over 7 days) searching over and around the Kelp Bay area from a Cessna 185 aircraft, using an H-Adcock antenna mounted on a wing strut and a TR-2 receiver/scanner. Three surveys were conducted at 150–300 m altitude in and around the three arms of Kelp Bay and around Catherine Island. Four surveys were made at altitudes of 900 to 1100 m, along transects spaced 1.6 km apart on a 505 km^2 grid. We surveyed additional areas on Admiralty Island and south of Kelp Bay on Baranof Island on 7 and 9 June at altitudes of 900–1100 m along transects spaced 3.2 km apart.

Signals from externally-mounted tags were detected up to a maximum of 4.8 km away by boat under ideal conditions (clear, warm [5° C or higher]). Under average weather conditions (overcast, less than 5° C), the tags were detected from the boat at distances of up to a maximum of 1.2 km, but this was reduced to 0.4 km during misty or rainy weather. Implanted radio tags had a maximum range (as detected from the boat) of 1.2 km although this was reduced to 0.4–0.8 km under average and poor weather conditions. Signals could only be picked up from birds on the water if the implanted radio tag was placed in the body cavity with the antenna pointing toward the bird's head. We did not measure ground to air ranges of implanted radio tags as we did not use them in 1984 when we did aerial surveys. Maximum ground to air ranges of externally-mounted radio tags (and a radio tag placed on the ground in the forest near camp) were 2–5 km at both 300 and 900 m altitudes. Signals from this distance were not picked up in all directions, probably due to the mountainous terrain of the area. Aerial surveys were conducted only on clear or high overcast days.

Seven birds released with radio tags in 1983 survived from 8 hours to at least 6 days. Birds that were unable to fly moved up to 3.2 km from the capture site by swimming and diving. Two birds that could fly (with sutured backpack radio tags) moved 9.6 km from their respective capture sites.

Movements of tagged birds in 1984 probably were more representative of undisturbed murrelet movements. All birds were able to fly and seven of eight paired birds rejoined their presumed mates within 5–60 minutes after release. Six birds were relocated 1, 2, 9, 15, 20, and 22 days after release. The radio tag on the bird located 22 days after its release had variations in signal intensity and pulse rate on the last relocation. Thus, our failure to locate the bird again may have ben due to tag failure, even though the predicted life of the radio tags used was 34–40 days. Of the seven birds relocated, four birds returned to their capture sites on 1 or more days. All relocations were within Kelp Bay, possibly reflecting greater search effort in this area. The greatest distances between capture sites and relocation sites were 1.6–9.6 km (1.6, 3.2, 4.8, 6.4, 6.4, 7.2, 9.6 km), assuming that birds did not travel over land. Maximal straight-line distances were 1.6–6.4 km.

The absence of signals from radio tagged murrelets outside of Kelp Bay could have resulted if tagged murrelets moved outside of the 505 km^2 aerial search area, or moved to sites where the radio signal was attenuated (e.g., rock crevices or hollow trees; see Johnston and Carter [1985]). Murrelets would have had to travel more than 9.6–14.5 km over water or land from their capture sites to have been outside the survey area. Moving greater distances inland on Baranof Island would have required them to fly over high (760–1500 m) snow-packed mountain passes. Murrelets have been recorded up to 75 km inland in more southerly parts of their range (Carter and Sealy 1986, 1987).

In 1984, we tracked one bird to a nest site located in a mountain hemlock tree 1.2 km inland on Baranof Island. As further described in Quinlan and Hughes (in press), we detected the signal emanating from land on 22 May from the boat. We then searched for the signal on foot, using an H-Adcock antenna mounted on a 2-m pole. We located the specific nest tree on 30 May, but were not able to climb the tree and see the nest until 11 June. On that day, another bird, presumably the tagged bird's mate, was sitting on a moss-covered limb, 15.5 m up in the 25-m tall tree.

Another tagged bird was located repeatedly in one cove of Kelp Bay on 23, 27, 29, and 31 May and 2, 6, and 8 June 1984. We were unable to locate it on alternate days, when it was presumably incubating (Simons 1980).

The discovery of a tree nest of a Marbled Murrelet using radio telemetry is important because, until 1989, no other nests were located by deliberate searching, and still less than 20 have been discovered. Few other tree nests have been discovered, even though Marbled Murrelets are thought to nest only in old-growth trees from southeastern Alaska to California. Further description of tree nest-site characteristics would improve our understanding of the nesting habitat requirements of this species. This information is urgently needed for effective management and conservation, since logging is removing tree-nesting habitat in much of the species range. The techniques described in this paper could be applied elsewhere to locate additional tree nests. Our capture technique could be improved by developing a net gun with a longer range and using a square, rather than triangular, net. We were unable to obtain 10-g radios with a greater range and longer life, but the technology for development of better radios is now available. Fur-

ther study in an area with road and trail access to large areas of forests might improve the chances of relocating tagged murrelets at their nests from the ground. To locate a large number of murrelet nests using this technique, researchers must capture and tag many more birds at sea and must have many people with radio telemetry antennae and receivers, or undertake far more extensive aerial surveys. In this way, intensive searches for tagged murrelets could be conducted over much larger areas than we were able to search in this study.

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Literature Cited

Carter, H. R., and S. G. Sealy. 1984. Marbled Murrelet mortality due to gill-net fishing in Barkley Sound, British Columbia. Pages 212–220 *in* D. N. Nettleship, G. A. Sanger, and P. F. Springer (editors). Marine birds: their feeding ecology and commercial fisheries relationships. Canadian Wildlife Service Special Publication.

Carter, H. R., and S. G. Sealy. 1986. Year-round use of coastal lakes by Marbled Murrelets. Condor 88: 473–477.

Carter, H. R., and S. G. Sealy. 1987. Inland records of downy young and fledgling Marbled Murrelets in North America. Murrelet 68:58–63.

Cochran, W. W. 1980. Wildlife Telemetry. Pages 507–520 *in* S. D. Schemnitz (editor). Wildlife Management Techniques Manual. The Wildlife Society, Washington, D.C.

Day, R. H., K. L. Oakley, and D. R. Barnard. 1983. Nest sites and eggs of Kittlitz's and Marbled murrelets. Condor 85:265–273.

Hartman, C. W., and P. R. Johnson. 1978. Environmental atlas of Alaska. Institute of Water Resources, University of Alaska, Fairbanks, Alaska.

Johnston, S., and H. R. Carter. 1985. Cavity-nesting Marbled Murrelets. Wilson Bulletin 97:1–3.

Mechlin, L. M., and C. W. Shaiffer. 1979. Net firing gun for capturing breeding waterfowl. Unpublished report, U.S. Fish and Wildlife Service, Northern Prairie Wildlife Research Center, Jamestown, North Dakota. Mimeograph.

Quinlan, S. E., and J. H. Hughes. *In press.* Location and description of a marbled murrelet tree nest site in Alaska. Condor.

Sealy, S. G. 1974. Breeding phenology and clutch size in the Marbled Murrelet. Auk 91:10–23.

Sealy, S. G. 1975. Aspects of the breeding biology of the Marbled Murrelet in British Columbia. Bird-Banding 46:141–154.

Simons, T. R. 1980. Discovery of a ground-nesting Marbled Murrelet. Condor 82:1–9.

Wanless, S., M. P. Harris, and J. A. Morris. 1988. The effect of radio transmitters on the behavior of Common Murres and Razorbills during chick rearing. Condor 90:816–823.