Pacific Seabird Group

DEDICATED TO THE STUDY AND CONSERVATION OF PACIFIC SEABIRDS AND THEIR ENVIRONMENT

METHODS OF SURVEYING MARBLED MURRELETS AT INLAND FORESTED SITES

by the Pacific Seabird Group
Marbled Murrelet Technical Committee[1]

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INTRODUCTION

In North America, the Marbled Murrelet (*Brachyramphus marmoratus*) nests in forested stands from Alaska south to Santa Cruz, California. Because this seabird is closely associated with old-growth and mature forests, it has become important to determine murrelet distribution and habitat use patterns.

The Pacific Seabird Group, a professional scientific organization, has taken a lead role in coordinating and promoting research on Marbled Murrelets. This guide is a revision of the survey methods handbook produced in 1990 (Paton et al. 1990) and has been designed to provide researchers and land managers with

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[1] Members of the Marbled Murrelet Survey Protocol Subcommittee were: Eric B. Cummins, Thomas E. Hamer, Janet G. Hardin, Kathy A. Kuletz, Sarah Madsen, Sherri L. Miller, Nancy L. Naslund, Brian P. O'Donnell, Peter W. C. Paton, Bill Ritchie, Meg M. Shaughnessy, Steven W. Singer, and David L. Suddjian. Others who contributed comments to the final product were: James Baldwin, Charlie Bruce, Colin Dillingham, Gary S. Miller, Mike Horton, Kevin McKelvey, Randy Miller, Ken C. Moore, Steven M. Speich, Janet Stein, and Bradley E. Valentine.

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standardized techniques to determine murrelet use of inland stands. The methods are based on the best available information on murrelet biology. As new information becomes available, the protocol will be subject to further revisions.

The objectives of this protocol include determining the location of occupied stands, determining geographic distribution, long-term monitoring of activity levels, and evaluating occupied forested stands. While applicable in Washington, Oregon, and California, the described methods may require modification for use in British Columbia and Alaska, and may not be applicable under all conditions (e.g. in a year of unusually warm offshore waters, such as an El Nino year).

BACKGROUND ON THE SPECIES

Marbled Murrelets have been shown to be closely associated with older-aged coniferous forests of the Pacific Northwest (Sealy and Carter 1984, Carter and Erickson 1988, Paton and Ralph 1988, Nelson 1989, 1990, Hamer and Cummins 1990, 1991). The species has been listed as endangered in California threatened in British Columbia, and is under consideration for state endangered status in Oregon. Marbled Murrelets are on the Category II list of the U.S. Fish and Wildlife Service and are proposed to be listed as a threatened species.

Unlike most members of the seabird family Alcidae, Marbled Murrelets nest in trees. Twenty-six tree nests have been located: three in Siberia (Kuzyakin 1963, Nechaev 1986, Labzyuk 1987); and the rest in North America (Binford et al. 1975; Quinlan and Hughes 1990; Singer et al. 1991, 1992; Nelson et al., in prep.; Kuletz et al., unpubl. data). Although much information still needs to be learned about the species, data gathered over the past 10 years shows that murrelets nest in old-growth and mature coniferous forests in most of their range. The only exception includes areas of south-central and western Alaska where large trees do not grow.

Murrelet surveys at inland stands were limited prior to 1984. Paton et al. (in press) and Nelson et al. (in press) detected Marbled Murrelets during field work in 1985-86 to quantify the abundances of all diurnal birds in selected stands throughout northwestern California and Oregon. Surveyors stood at fixed census points and counted all birds for 8-minute periods, then moved on. Each surveyor visited 12 census points per morning. Censuses often started as late as 15 to 20 minutes after official sunrise. H. Carter and T. Sander (pers. comm.) tested a survey method in 1987 designed solely for censusing Marbled Murrelets at a fixed point in the morning and evening during the breeding and non-breeding seasons in Prairie Creek Redwoods State Park, Humboldt County, California. The technique was standardized so that detection rates could be compared between days, time of day, seasons, and years.

In California and Oregon, a series of walking and road

transects were established using l0-minute counts at 8 to 12 stations per transect to determine the distribution of murrelets throughout the states in 1988-89 (Paton and Ralph 1988, 1990; Nelson 1989, 1990; Ralph et al. 1990). In California murrelets had a patchy distribution corresponding to the distribution of remnant old-growth stands, with murrelets detected on 44% of 170 transects. In Oregon, birds were detected on 20 of 30 (67%) transects in 1988 (Nelson 1989) and on 88 of 137 (64%) transects surveyed in 1989 (Nelson 1990). Murrelets used mature and old-growth stands, but were absent from young stands and clearcuts (Nelson 1989, 1990).

METHODS

Definitions

For purposes of this handbook, the following definitions will apply. A **survey** is the process of determining murrelet presence, absence, and occupancy of a stand by conducting survey visits. A **survey visit** is a single morning's survey. A **station** is the location where the observer stands to conduct the survey. A **site** is an area of 120 acres or less that contains one or more stations. A **stand** is a contiguous, relatively homogenous group of trees, made up of one or more sites. **Contiguous habitat** includes stands linked together with no gaps of unsuitable habitat wider than 100 m (328 feet), depending on topography and other site specific factors. **Suitable habitat** is defined as mature and old-growth forests.

Choosing a Survey Type

There are two types of surveys, Intensive and General. To decide which type of survey to use, one must determine what information is needed.

Intensive Survey

An Intensive Survey is designed to: determine occupancy of a specific stand; monitor murrelet activity levels at specific forest stands (e.g., for a pre-harvest inspection); and establish murrelet use patterns. Intensive surveys are recommended for use in all timber sales. They can also be used for surveys in rugged or roadless areas.

Murrelet activity over a *series* of years can be compared for research purposes. Because murrelet activity varies somewhat from day to day, especially in relation to weather and light levels, a series of intensive inventories allows for comparison of murrelet activity within the breeding season, between the breeding and non-breeding season, and between years.

General Survey

The General Survey is a transect method designed to determine the geographic distribution over large areas, e.g., a state, county, basin, or drainage. General surveys are exploratory in nature, and are not effective for determining site-specific stand use.

Detections

The unit of measure in both the Intensive and General Surveys is the "detection" of a single bird or flock, defined as the **sighting or hearing of one or more birds acting in a similar manner.** For example, a bird flying around in a circle overhead for 3 minutes continuously calling would be a single detection. If that bird stopped calling, or was out of sight, for more than five seconds (this time might vary with each situation, such as visibility), and then started to call or was seen again in a different area, the observer should count it as two detections. This is because the observer would be uncertain if it was the same bird or a different bird calling. Only when the observer is reasonably certain that it is the same individual, should it be counted as a single detection. When a flock splits into two groups, the observation is treated as a single detection. If two flocks coalesce, the flocks should be counted as two detections.

Currently, there is no method for estimating the number of birds from the number of detections. Therefore, we can only measure levels of murrelet activity (detection rates) and hypothesize that areas with low detection levels probably have fewer birds than areas with high detection levels, when compared during the same time of the year, the same time of day, and same weather conditions.

Where to Survey

Habitat

We recommend that observers survey all mature and old-growth stands. In North America, murrelets have been found to nest in mature and old-growth stands containing Douglas-fir, coast redwood, western red cedar, mountain hemlock, Sitka spruce, and western hemlock (Binford et al. 1975; Quinlan and Hughes 1990; Hamer and Cummins 1991; Singer et al. 1991, 1992; Nelson et al., in press; Nelson et al., in prep.; K. Kuletz, pers. comm.). Murrelets may also occur in stands that have not been surveyed that contain other tree species.

Distance From Salt Water for Surveys

Marbled Murrelets have been recorded as far as 50 miles (80 km) inland in British Columbia and Washington (Carter and Sealy 1986, 1987; Hamer and Cummins 1991), 35 miles (56 km) inland in Oregon (Nelson 1990), 22 miles (37 km) inland in northern

California (Carter and Erickson 1988, Paton and Ralph 1990), and 11 miles (18 km) inland in central California (Paton and Ralph 1990). These distances are in part a reflection of how far inland surveys have been conducted to date. Murrelets may occur farther inland. If the intent of a survey is to include all potential murrelet use areas, surveys should be conducted up to 50 miles (80 km) inland in suitable habitat. In Alaska, not enough research has been conducted farther than 8 miles (5 km) from salt water to estimate the appropriate distance inland for surveys (K. Kuletz, pers. comm).

We recommend that evaluating agencies determine the distance inland to conduct Intensive and General Surveys.

When to survey

Murrelets can be heard at some sites during most months of the year, but they are most effectively surveyed during the spring and summer, when activity levels are greater, and attendance is more consistent and longer in duration. In spring, murrelet detectability at inland sites appears to increase to moderate intensity (possibly during incubation) and reach a peak level of activity in mid-summer (possibly during the chick period) (Paton and Ralph 1988, Nelson 1989). After this peak, the number of detections decreases markedly, presumably because birds are undergoing a flightless molt at sea. Although surveys can be conducted into August in most areas, numbers of detections are more variable later in the season.

In California and Oregon, the best season for surveying extends from 15 April to 31 July (Carter and Erickson 1988; Paton and Ralph 1988; Nelson 1989, unpubl. data; N. Naslund, pers. comm.; S. Singer, pers. comm.). In Washington, the period is 1 May until 5 August (Hamer and Cummins 1990; T. Hamer pers. comm.). In Alaska, the period is 15 May to 5 August (N. Naslund, pers. comm.; K. Kuletz, pers. comm.), although few surveys have been conducted earlier than mid-May.

Surveys should be conducted at regular periods throughout the season, and spread out as much as possible. We recommend a minimum of six days between survey visits and that two survey visits be conducted during the first half of the survey season, and the remaining visits be conducted during the latter half of the survey season. We recommend that at least one survey visit occur in July.

During the winter months, murrelets can be heard prior to sunrise on some days. The duration of detections is shorter than during the breeding season, and calling can start as much as an hour earlier than in the summer. Due to the short detectability period at dawn during the winter months, only the Intensive Survey Method should be used from fall through spring. Winter surveys can detect a potentially occupied site, but can not be used as a criterion of absence from a site, nor would winter surveys be counted towards surveys required in a given year.

Time of day to conduct surveys

Begin surveys 45 minutes before official sunrise and continue until 75 minutes after sunrise for a 120-minute survey visit. Results from past research has shown that this period includes much more than 90% of all detections of birds at a stand (Paton and Ralph 1988, Nelson 1989). In addition to this minimum of two hours, we also suggest that the survey continue for 15 minutes after the last detection, whichever is longer. Therefore, some surveys may continue beyond 75 minutes after sunrise, especially in overcast or poor weather days when detections generally continue longer. Because of changes in light levels with changes in latitude, morning surveys will start earlier at higher latitudes (Hamer and Cummins 1990). In Alaska, surveys should begin 90 minutes before official sunrise (K. Kuletz, pers. comm.).

Use the Nautical Almanac to determine sunrise times for the area. Do not rely on tide tables, the local newspaper, or the local television station, because they can vary up to 15 minutes from the Nautical Almanac.

Station Location

Locate stations in openings.

Murrelets generally remain unseen to the observer. About 75-95% of the detections in California and Oregon are audio detections (Paton and Ralph 1988, Nelson 1989). Therefore it is most desirable to place survey stations in areas that have an unobstructed view of the sky and a maximum view of the canopy or stand being surveyed. It is easier to see the silhouette of a bird flying directly overhead against the sky, than looking down on birds from a high point. Stations can be placed in forest clearings, at the edge of a stand, or on logging roads. However, behaviors indicating occupied sites are derived almost exclusively from visual observations, therefore stations should not be located farther than 50 m (164 feet) from the edge of the site being surveyed. Stations in areas of closed canopy or poor visibility may require greater survey effort to determine murrelet presence, absence, or occupancy at the site.

Set up one station per 30 acres.

At each survey site, establish a minimum of one station per 30 acres (12 ha) of habitat. At each station, the observer can usually only see birds within 100 m (328 feet) or hear birds within 200 m (656 feet). This should be considered the maximum area surveyed from a single station, Observers can detect birds at greater distances, perhaps as far as 500 m (1640 feet) or more, but many are missed at these ranges.

The number of stations needed to survey a site also will vary with topography and station placement. For example, a 12 ha (30 acre) stand might be surveyed easily with a single station,

but two stations may be required to survey an 8 ha (20 acre) stand if the stand is on a ridge. In addition, if the station is placed on the edge of a stand, the area surveyed within the stand may only be 6 ha (15 acres).

Procedures for Intensive Surveys.

Survey only one station per site per morning. Each visit should remain independent from other visits, therefore only one observer's effort at one station on a given morning would be counted as a survey visit. If surveying a large area (e.g. 375 acres [153 ha]), the area can be divided into 120 acre blocks, or survey sites, with a minimum of 4 stations in each site. Stations in adjacent survey sites can be surveyed on the same or consecutive days, but we recommend that stations within a site be separated by a minimum of 6 days. To maximize the observer's chance of seeing birds, the observer may move up to 50 m (164 feet) from the station, if necessary, during the survey visit. Movement should be minimized, however, since it could affect detection rates. Travel time should be less than a one minute walk, and the observer should note time and direction of movement. In subsequent visits to a station, the precise location of a station can be moved within the 30 acre area. For example, if birds were heard in a nearby gully during the first survey, the observer could move the station into the gully to have a higher probability of observing occupied behavior. However, stations should remain evenly distributed within the survey site, with a minimum of one per 30 acres.

Procedures for General Surveys.

Census 8 to 10 stations each morning during the 120-minute census period. Survey each transect station for 10 minutes, then move on to the next station. Try to maximize the number of stations visited on the transect, being sure to visit the same number of stations on each visit to the transect. In areas where there is inadequate suitable habitat to establish a transect with 8 to 10 stations, there are two options: conduct intensive surveys or establish fewer road stations and increase the time spent at each station so the total survey is a minimum of 2 hours in length.

Maximize the distance between stations. Along road transects accessible by automobile, stations should be placed 0.3 to 0.6 mi (0.5 to 1.0 km) apart, depending on road conditions and travel speed. Time between stations should not exceed five minutes. For transects placed along good foot trails, stations should be located with a spacing of 250 m (820 feet) between stations, to minimize detecting the same birds from different stations. Surveyors should report all murrelets detected while the observer is travelling between survey stations.

Vary station order between visits to avoid surveying stations at the same time of day. Reversing station order is the best way to avoid this problem. If birds are detected at a station during a l0-minute census, and more detailed information

on murrelet activity in the area is needed, repeat the survey(s) using the Intensive Survey Method.

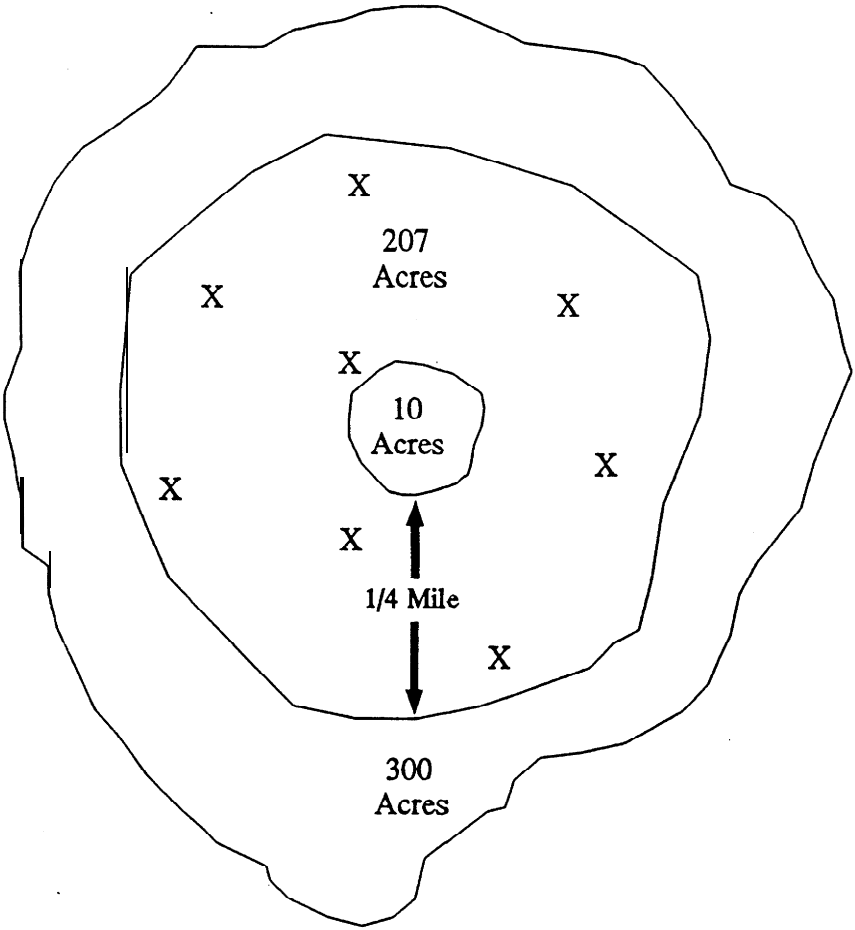
Survey layout

Because we believe that harvesting a portion of a contiguous stand will affect the suitability of the entire stand as murrelet habitat, we suggest that an entire contiguous stand be surveyed. An area within a one-quarter mile (402 m) radius or 125 acres (51 ha), whichever is greater, is the minimum area we suggest be surveyed in the contiguous habitat surrounding each proposed sale unit. Our recommendation is based on several factors: (1) studies have shown that larger stands have more detections (Paton and Ralph 1988, Nelson, unpubl. data) and presumably support larger murrelet populations. While the link between larger stand size and greater murrelet numbers is not clearly understood, this relationship is an important component which should be taken into consideration; (2) since detections from a station are an assessment of birds within approximately 200 m (30 acres), the nest itself may be a considerable distance from the station; (3) all other alcids are at least loosely colonial, and one murrelet detection in a stand is indicative that other birds may be present; and (4) murrelets are not yet known to reuse nest trees, and may use other parts of the stand for nesting in subsequent years.

We offer the two following examples of layout for surveys: The first involves a 300-acre (121 ha) stand of suitable habitat, with a planned sale of 10 acres (4 ha) located in the center of the habitat (Fig. l). A one-quarter mile (402 m) radius circle around the edge of a 10 acre area would include 207 acres (84 ha) Depending upon the configuration and topography of the stand, a minimum of seven survey stations would be necessary to survey the area, with a minimum of one station per 30 acres.

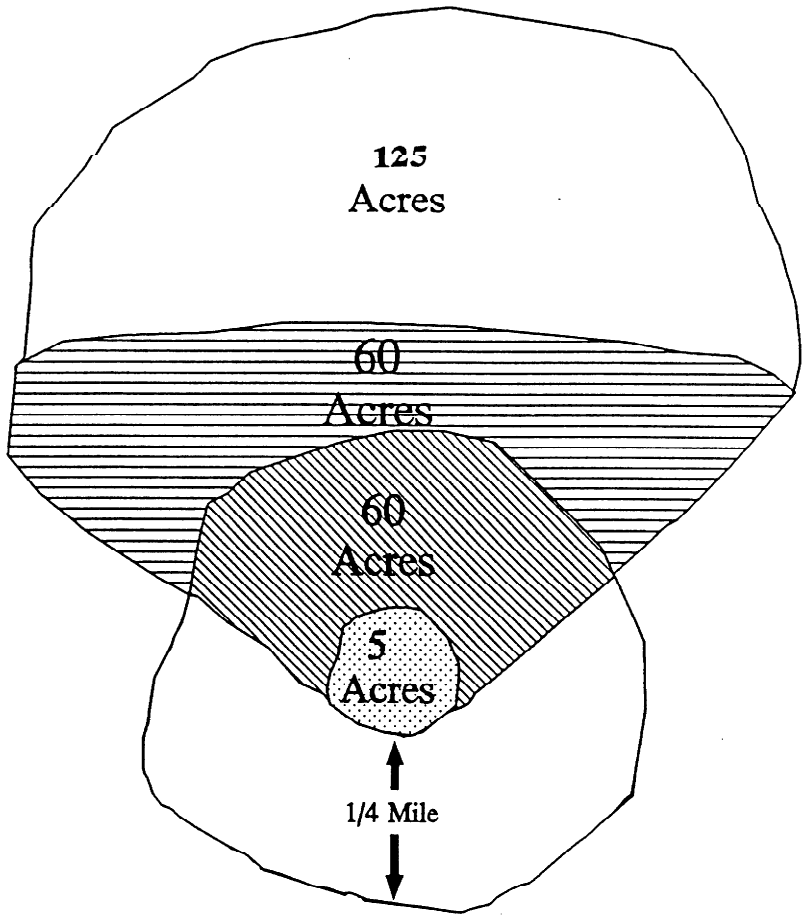
The second example involves a 250 acre (101 ha) stand, with a planned sale of 5 acres (2 ha) located on the edge (Fig. 2). A one-quarter mile radius circle around the 5 acre sale would encompass a total area of 180 acres (72 ha). However, a one-quarter mile radius circle around the proposed sale would include only about 60 acres (24 ha) of the suitable habitat. Since we suggest the minimum area to be surveyed is one-quarter mile or 125 acres, whichever is greater, the survey should include 125 acres (51 ha) of the suitable habitat, including and adjacent to, the proposed sale area. In this example, half of the 250 acres of suitable habitat would be surveyed.

Figure 1.



X = Survey Stations

Figure 2.



= Proposed Cut

= Suitable habitat within 1/4 mile.

+ + = Total area to be surveyed = 125 Acres.

EVALUATING OBSERVATIONS AT A STAND

Since Marbled Murrelet nests are extremely difficult to find, a set of behavioral criteria has been established to determine if a stand is likely to be occupied by murrelets. When reporting data from surveys, the criteria should be clearly outlined and documented. These criteria are based on the best available research. We suggest three categories of sites based on the birds' behavior.

Occupied sites

The first category of sites is an "occupied site", which can be defined as a forest stand where at least one of the following behaviors or conditions occurs:

* discovery of an active nest or a recent nest site as evidenced by a fecal ring or eggshell fragments.
* discovery of a chick or eggshell fragments on the forest floor.
* birds flying through, into or out of, the forest canopy.
* birds flying below the top of the canopy within or adjacent to a stand (this includes birds flying over logging roads, young stands, or recently-harvested areas adjacent to suitable habitat).
* birds perching, landing, or attempting to land on branches.
* birds calling from a stationary location within the stand. We recommend that a detection be considered "stationary" when three or more calls are heard at less than 100 m (328 feet) from the observer, and the position of the bird appears not to have changed.

If occupied behavior is observed over a road, clearcut, or young stand next to a mature or old-growth stand, only the adjacent stand of suitable habitat would be classified as occupied.

Circling murrelets

The second category includes behaviors that are an extremely strong indication of an occupied site. Stands with circling birds should be treated as occupied sites unless very persuasive evidence indicates otherwise.

This category includes birds flying in small or large radius circles over the canopy. These behaviors are common over occupied sites (Nelson, unpubl. data). At times murrelets have been seen circling over young or non-forest habitats. In most cases, however, these areas have been near or adjacent to old-growth trees (Nelson 1989, 1990; Hamer 1990, 1991). Observers should note the flight behavior (e.g., circling) of birds and their flight altitude.

Presence

The third category is "presence" which is defined as a stand of appropriate habitat where murrelets have been seen or heard calling. This category includes all behaviors not listed above.

Determining the association of calling (an audio detection) with a stand is difficult. If the station that the observer is using is unavoidably located where visibility is impaired, for instance, by being within a closed canopy forest or in a dense understory, the observer will see fewer birds and therefore fewer "occupied" behaviors. In an open site, Ralph (unpubl. data) found that about 30% of detections were "occupied" behaviors, while at a closed canopy site, only 3% were such behaviors.

Extra survey effort is recommended at a site with birds present to determine if a stand is occupied. (Fig. 3). In some cases, an occupied stand may have to be identified based solely on audio detections.

Number of survey visits

To establish presence or absence of murrelets at a site, we recommend conducting a minimum of four survey visits per year for two consecutive years, unless the site is determined to be occupied with fewer survey visits. There is evidence that one year of surveys is inadequate to determine absence, presence, or occupancy (Nelson, unpubl. data; Naslund, unpubl. data). Ralph, O'Donnell, and Miller (unpubl. data) analyzed data from two sites with moderate (85%) and open (60%) canopy cover and relatively low detection rates of five or fewer detections per morning. They found that it would require between two and five survey visits to determine, with a 95% certainty level, that murrelets were absent from the sites. This, coupled with the extreme variation between survey visits, and the potential for between-year variation due to changes in ocean conditions and food supplies (e.g., El Nino Southern Oscillation), indicates that probable absence of murrelets in a survey site is difficult to determine. Therefore, four survey visits per year for two consecutive years is a conservative recommendation.

The number of visits per station will vary with the number of stations established at a survey site. If one to three stations are established, divide the number of visits among stations so the effort within the survey site equals four visits per year for two consecutive years to determine presence or absence (i.e., 1 station = 4 visits per year; 2 stations = 2 visits per station per year; 3 stations = 1 visit to 2 of the stations and 2 visits to the third station per year). If four or more stations are established in a contiguous stand, one visit per station per year for two consecutive years is recommended for determining murrelet absence or presence. If murrelets are present at a site, but occupied behaviors have not been observed, we suggest more visits per station per year in two consecutive years. The effort required to determine occupancy should be

based on recommendations from the regulating or evaluating agencies involved.

For purposes of evaluating observations at a stand, we offer a decision tree (Fig. 3). The following example demonstrates the use of the branching choices. There is an isolated 12 ha (30 acre) stand of older forest where surveys are to be conducted to assess whether the stand has murrelets. One or perhaps two stations are established in the stand, depending upon topography and station location, and one survey is conducted. If no murrelets are detected, or if no occupied behaviors are seen, the stand must be surveyed again, alternating stations between visits if more than one station is being used. As the decision tree illustrates, a minimum of eight survey visits (four each year for two consecutive years) with no detections will be required to determine if the stand is "unoccupied" If, however, murrelets are detected on the first survey visit (or any subsequent visit), another path is followed in the tree. If the detection(s) include(s) observations of occupied behaviors, the stand is determined to be occupied, and no further survey visits are required, unless the surveyor needs to determine the level of occupancy. If murrelets are detected, but no occupied behaviors were observed, a second survey visit will be necessary and the decision process begins again. Caution: a "presence" detection near the end of the survey year might require an additional two years of surveys to determine if the site is occupied. We suggest that increased survey effort begin immediately following presence documentation to avoid adding additional years to the survey effort.

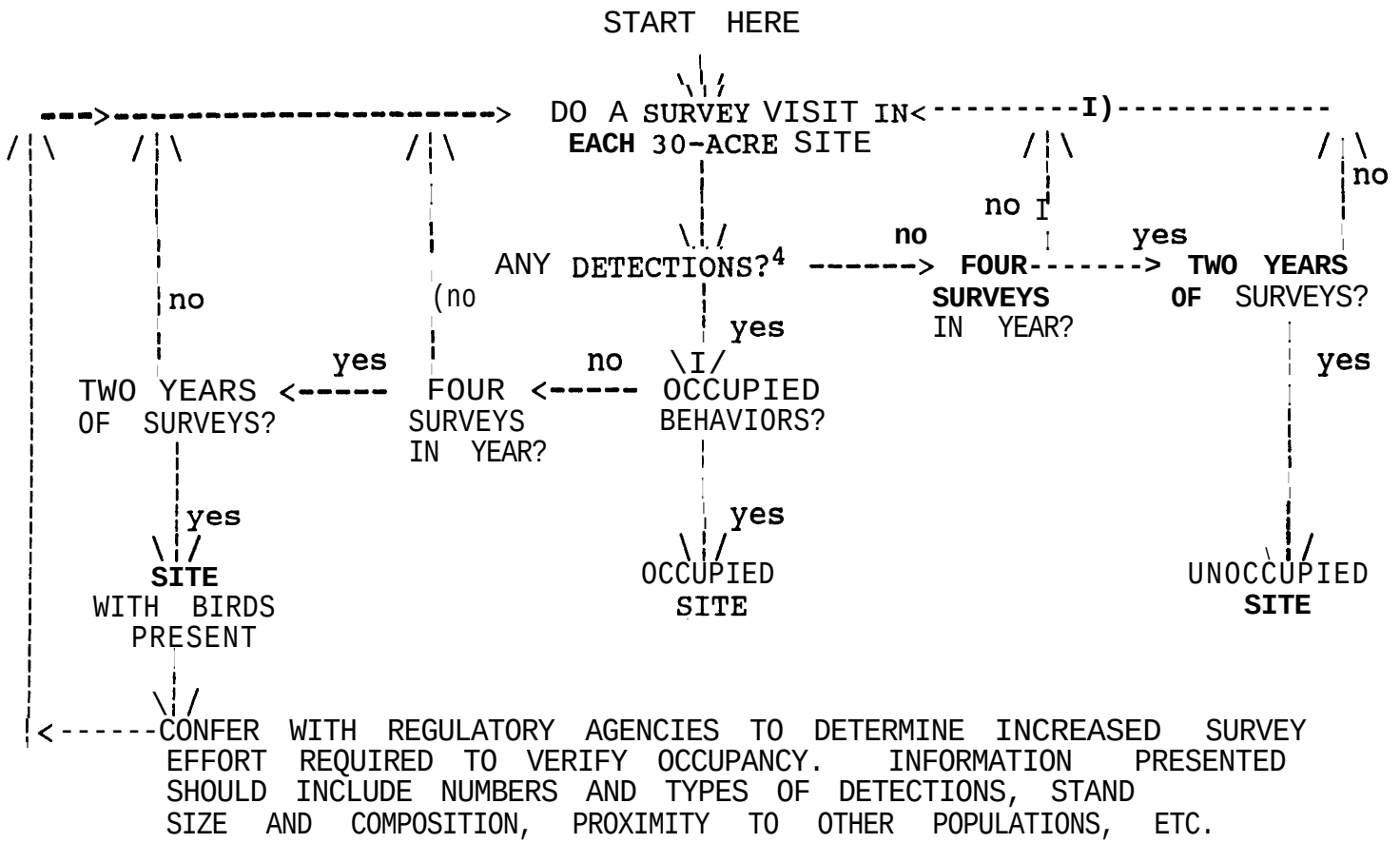
Upon completion of four surveys per year for two consecutive years, stands with detections, but no occupied behaviors, can be determined to be stands with birds "present". The lack of adequate viewing locations or other environmental factors may limit opportunities to see occupied behaviors in these areas. Establish stations in more open areas if possible. In addition, these sites should be surveyed with increased effort to determine if the site is occupied. Regulating or evaluating agencies will suggest the amount of increased effort,

Collecting data

Training

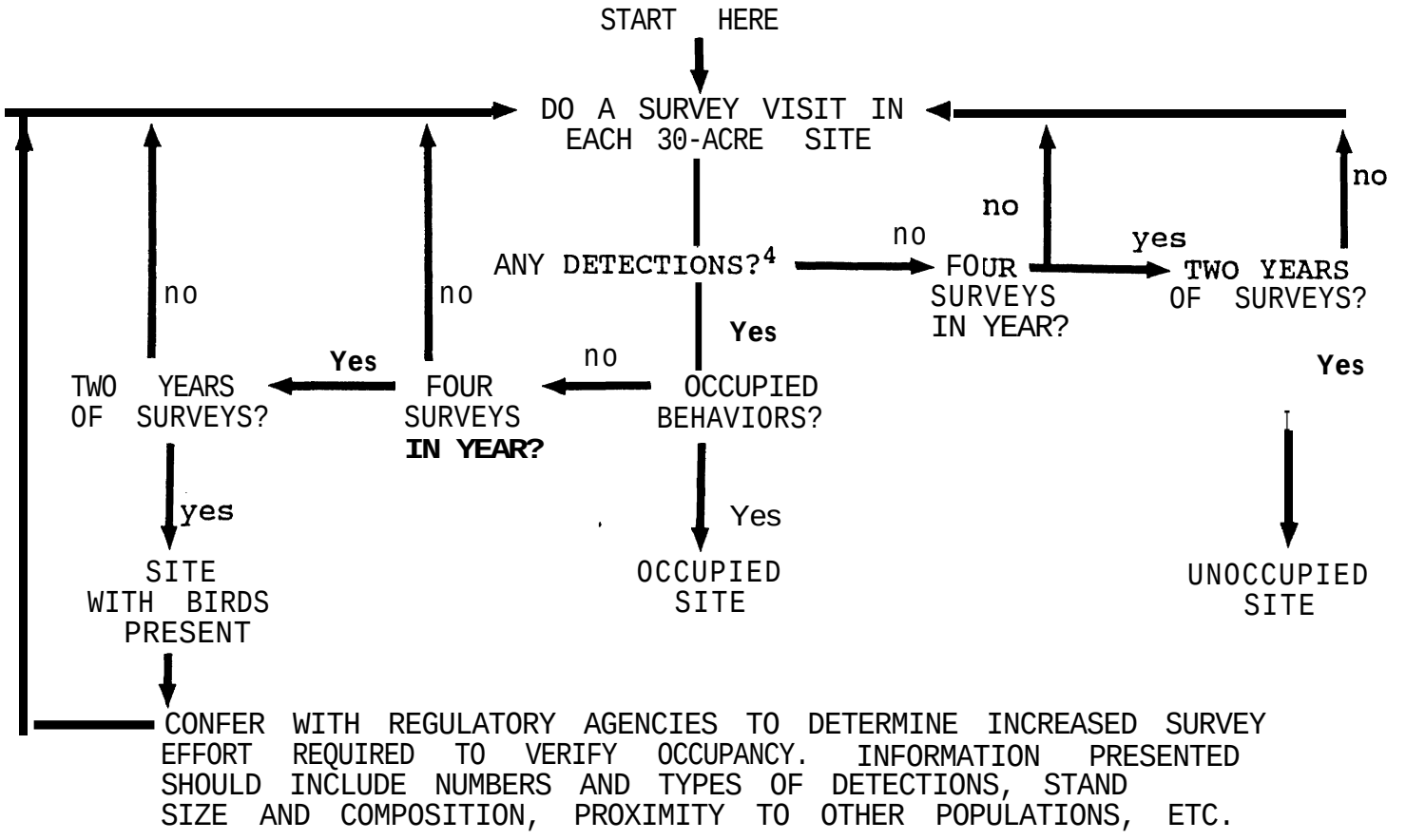
Intensive training in detecting and identifying Marbled Murrelets and their vocalizations is necessary, since most murrelets remain unseen to the observer. We suggest an intensive instructional period, with a minimum of four training mornings. Training should be conducted at a site with high activity levels to expose trainees to a wide range of vocalizations and activity levels during the morning. Trainees should be provided a tape

Figure 3. Decision tree to evaluate stands for occupancy of Marbled Murrelets.



[4] For the purpose of timber harvest evaluation, increased survey effort should begin immediately after presence is documented at a survey site.

Figure 3. Decision tree to evaluate stands for occupancy of Marbled Murrelets.



[4] For the purpose of timber harvest evaluation, increased survey effort should begin immediately after presence is documented at a survey site.

with the full range of vocalizations of known murrelet calls, and be able to compare them with similar calls of other species, such as American Robin, Varied Thrush, Evening Grosbeak, and Red-shouldered Hawk. We recommend that all trainees have their hearing and vision tested by a professional. See Emlen and DeJong (1981) and Faanes and Bystrack (1981) for discussions on counting birds and variable hearing abilities.

An evaluation session on the last day of training should include evaluation of the observers' detections of audio and visual observations, species identification, distance estimates, and ability to record data during both high and low activity periods. Data from the trainee will be compared with the simultaneous observations of a very experienced observer for accuracy. We suggest that as a general rule, the trainees should detect at least 70% of the detections recorded by the experienced observer, and the data have a high degree of accuracy.

Environmental Conditions

Because of the high proportion of audio detections during most surveys, try to avoid placing stations near sources of loud noises, such as fast-flowing creeks or busy roads. Surveys should not be conducted during rainy or windy conditions when it becomes difficult to hear birds, or in very thick fog which limits visibility. Surveys can be conducted on overcast days with a light rain or moderate fog, as murrelets tend to call for longer periods and at higher rates during these conditions (Paton and Ralph 1988, Nelson 1989).

Equipment needed

Equipment for surveying should include: a clipboard, pencil, data forms, wrist watch, a light source (i.e., a headlamp or a flashlight), binoculars and a compass. A tape recorder is recommended for all surveys and is extremely useful in areas of high activity. Use of a tape recorder helps to prevent missed murrelet detections, as the observer can continuously watch the sky, and assists in recording simultaneous detections.

SURVEY FORM

We suggest that the following data be taken at every survey station using a standardized form (Figs. 4 and 5).

Locate the survey stations on a 7-l/2 minute U.S. Geological Survey map, write the station numbers on the map, and indicate the locations with a "X". Write the following on the top of each form:

Figure 4,

MARBLED MURRELET FOREST SURVEY FORM

Circle one: Intensive Survey General Survey Observer's name _____ Site of transect: _____ Pg ___ of ___

Observers Initials	Month	Day	Year	St / Prov	Survey site	Official Sunrise of Sunset	Percent Cloud Cover	Prec.	Time	
										Begin
										End

Distances and heights recorded in (please check one): ☐ Meters ☐ Feet

Max. tree height within 100 m: ☐☐☐

Sta No.	Time	Num. Birds	Initial Det. Direct.	Beh	Voc.	Typ	Bird Height	Depart. Direction	Closest Dist. to Bird	Notes

Prec. (precipitation): N = None, **F = Fog,** D = Drizzle, R = Rain

Beh. (behavior): **F = Fly over canopy, C = Circle, B =** circle in **or** Below canopy, **T =** fly Through or below canopy, **L = Land** in or depart from tree, S = Stationary, **U** = Unknown.

Voc. (vocalization): V **= Visual/silent, 1** - 9 = number of calls, **M** = Multiple calls (> 9), **K = Keer calls, A = Alternate** calls, **W** = Wings, **J** = Jet Sound.

Type: **H = Heard, S** = Seen, **B** = Both seen and heard.

MARBLED MURRELET FOREST SURVEY FORM

Intensive Survey / General Survey Observer's name: PETER PATON Site or transect: CLEAR CREEK Pg 1 of 1

Month	Day	Year	St / Prov	Survey site	Official Sunrise or Sunset	Percent Cloud Cover	Prec.	Time	
04	15	92	0		0629	100	N	0544	Begin
						50	N	0744	End

Distances and heights recorded in (please check one): [✓] Meters [ ] Feet

Max. tree height within 100 m: 60

Time	No. Birds	Initial Det. Direct.	Beh	Voc.	Typ	Bird Height	Depart. Direction	Closest Dist. to Bird	Notes
610	1	090	U	MK	H	—	045	25	flew NE up Clear Creek
613	I	340	B	2K 1A	B	15	160	5	also wingbeats
619	2	200	U	MK	H	—	090	—	
624	1	300	T	W	B	40	180	10	
641	3	120	F	7K 3A	B	200	270	30	
645	1	045	F	V	S	125	090	50	↖ Joined up with bird in previous detection.
645	1	135	F	3K	B	125	090	25	

Prec. (precipitation): N = None, F = Fog, D = Drizzle, R = Rain

Beh. (behaviour): F = Fly over canopy, C = Circle, B = circle in or dep[ar]t canopy, T = fly Through or below canopy, L = Land in or on tree, S = Stationary, U = Unknown.

Voc. (vocalization): V = visual/silent, 1 - 9 = number of calls, M = Multiple calls (>9), K = Keer calls, A = Alternate calls, W = Wings, J = Jet Sound.

Type: H = Heard, S = Seen, B = Both seen and heard.

Circle one: Intensive Inventory or General Survey.
Observer's Name: Full name of the observer.
Name of the site or transect.
Page number of the total pages of data for the survey.

First line:

Columns

1-3 First, middle, and last initials of observer.
4-9 Month, day, and year in numbers.
10 State/Province: A=Alaska, C=California, O=Oregon, W=Washington, B=British Columbia.
11-14 Four letter code for location of survey site or transect.
15-18 Official sunrise for that date and location (24-hour clock, e.g., 5:00 a.m. = 0500, or 6 p.m. = 1800).
19-21 Percent cloud cover at beginning of survey period: 0 = none, 100 = all cloudy.
22 Precipitation at beginning of survey period: N = none, F = low fog, M = mist/drizzle, R = rain (survey should be discontinued).
23-26 Time survey began.
27-28 Check one box to indicate if distances and heights are recorded in meters or feet.
29-31 Percent cloud cover recorded at end of survey period.
32 Precipitation at end of survey period.
33-36 Time survey ended.
37-39 Estimated maximum tree height within 100 meters (330 feet) of survey station.

Second and remaining lines (each line represents one detection):

Columns

40-41 Survey station number. For general survey transects you will have more than one survey Station, Number each station and mark each with a flag or stake for future reference.
42-45 Time of each detection and, for general surveys, the time observer arrived at and departed from each station,
46-47 The best estimate of the number of birds in the detection.
48-50 Direction in degrees from the observer to where the murrelet(s) were first detected.
51 The birds' behavior (Beh.) during the detection; F = fly over canopy; C = circle stand above the canopy, B = circle in or below canopy, T = fly through the stand in or below the canopy, L = landing in or departing from a tree (seen), S = call from a stationary point, U = unknown. Record the behavior

which might best describe murrelet use in the stand, for instance, if the birds land in a tree record, L, rather than T.

52-53 Vocalizations (Voc.) Two columns are provided. Observers may use both to most accurately describe "vocalizations". The number of call notes heard during the detection: l-9 calls or M (multiple) for more than 9 call notes heard; V = visual with no calls; A = "alternate" calls (not a "keer" call); K = keer calls; W = wings heard; and J = jet sound.

54 Type (Typ.) H = heard (vocalizations) only; V = visual with no calls; B = both seen and heard.

55-57 Lowest height the bird(s) are observed flying above the ground (only to be used for visual detections). If recorded in feet, indicate this at the top of form.

58-60 The flight path, the final direction the murrelets were headed, in degrees.

61-63 Closest horizontal distance from the observer to the murrelet, a bird flying directly overhead at 100 m height would have a horizontal distance of zero.

64 Notes : Any additional information can be placed here. For example, groups which split or join other birds, disturbances, predators (jays, crows, ravens, owls), etc.

Observers should also make notes and later mark on maps areas which were most extensively used (e.g., "lots of flying NE up gap in forest above streams"). Mark paths of bird travel on maps using arrows (----->) to indicate direction of flight.

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