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Science FINDINGS

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INSIDE

"Science affects the way we think together."
Lewis Thomas

Inside Their Hidden World: Tracking the Elusive Marbled Murrelet

Nick Hatch

A single marbled murrelet egg. Murrelets do not build nests; instead they use naturally occurring nesting platforms that are typically found on wide, mossy branches of old conifers.

"Birds are the most popular group in the animal kingdom. We feed them and tame them and think we know them. And yet they inhabit a world which is really rather mysterious."
–David Attenborough

One of the best ways to gauge the health of an ecosystem is to study the organisms that inhabit it. When they're healthy, when their numbers are robust, when their population is in balance with their competitors, chances are the ecosystem as a whole is healthy.

The marbled murrelet (*Brachyramphus marmoratus*), a small seabird about the size of a robin, is an excellent species to judge the

IN SUMMARY

*The marbled murrelet (*Brachyramphus marmoratus*) is a threatened coastal bird that feeds on fish and nests in old-growth forests. In northwest Washington, murrelet populations are declining despite protections provided by the Northwest Forest Plan.*

Wildlife biologists Martin Raphael and Tom Bloxton, with the USDA Forest Service Pacific Northwest Research Station, used radio telemetry—the first study of its kind in Washington—to develop a detailed picture of the challenges faced by marbled murrelets. Teresa Lorenz analyzed the resulting data to gain further insights into the ecology of these elusive birds.

Between 2004 and 2008, the scientists captured 157 murrelets in their marine feeding grounds, fitted them with transmitters, and tracked their movements. They wanted to gain a better understanding of the birds' nesting habitat, and as a result, be able to provide information that can contribute to conservation plans.

They found that factors on land and on water may be responsible for murrelet decline. Human activity on the water, coupled with the changing ocean conditions, likely affected the abundance of fish in the water. On land, a continuing decrease in nesting habitat is resulting in fewer nests, leading to lower rates of reproduction and a smaller population size. Although murrelet habitat in federal forests is protected, these areas tend to be farther inland than unprotected private and state forests in northwest Washington.

health of both coastal forests and the nearby ocean. They nest high in old-growth conifers, and they feed at sea, diving underwater to capture their prey, using their wings to swim. Where murrelet populations are robust, chances are the forests and marine waters in those areas are healthy too.

But in northwest Washington, murrelet numbers are declining, despite federal conservation efforts. The marbled murrelet is a threatened species protected by the Endangered Species Act. Conservation of murrelet habitat is also an explicit goal of the Northwest Forest Plan. Logging and development of forested nesting habitat are considered the greatest threats to the species. Significant portions of nesting areas–especially in California, Oregon, and Washington (the murrelet's range extends northward all the way along the Aleutian Islands)–have already been lost.

Because murrelets rely on both forest and marine environments, scientists have been grappling with the question of whether–and how much–decreases in nesting habitat on federal and nonfederal lands or changes in the marine habitat are to blame. Overfishing, oil spills and other pollution, unattended fishing gear, and entanglement in gill nets are some of the marine factors that may threaten them. Changing ocean conditions, and thus changes in abundance of marine prey driven by climate change and other factors, may also be important.

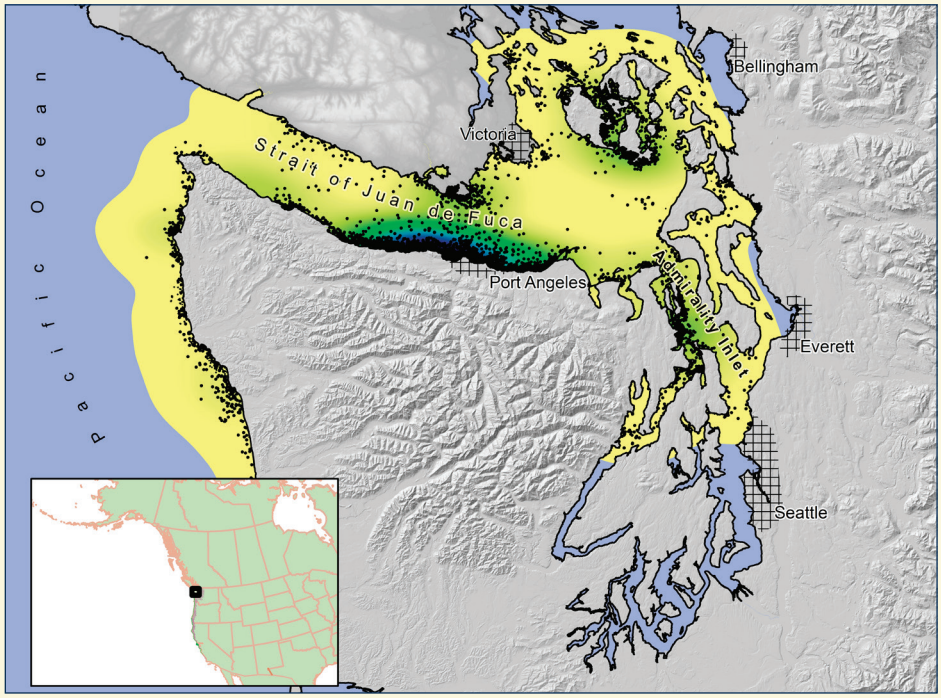
KEY FINDINGS

- Researchers in a 5-year study of marbled murrelets in Washington found extremely low rates of nesting attempts and breeding success. The low rates are likely contributing to population declines in Washington.
- Breeding-season home ranges in the Washington study area were almost an order of magnitude larger than the ranges of murrelets in Alaska, where they are not considered a threatened species. This wide-ranging behavior points to subpar marine feeding conditions in Washington.
- For the murrelets that attempted breeding, researchers observed one-way nest-to-sea commutes of up to 90 miles. Commutes were equally long over water as over land.
- The murrelets in the study selected marine habitats with cooler waters, suggesting that warming temperatures associated with climate change may negatively affect this species.

"Elusive" is a term often used to describe the murrelet, which makes it challenging to study. It commutes between forest and the marine feeding environment, and when it returns to its nest, it does so under the cover of darkness. Their nests are so hard to find that it wasn't until 1974 that the first one was discovered when a tree climber doing some pruning happened to stumble upon one.

"All their behavior is designed to be as cryptic as possible," says Martin Raphael, an emeritus senior scientist with the Pacific Northwest Research Station. To learn more about the murrelets use of their environment, Raphael and Tom Bloxton, wildlife biologists with the station, used radio telemetry to track murrelets in northwest Washington, where murrelet populations have declined substantially since 2001. The result was the most detailed observation of murrelets ever done in Washington, and the only murrelet study in that state to use radio telemetry.

"Prior to our study, such basic natural history information had been lacking due to the secretive nesting habits of murrelets, and the difficulties associated with capturing and tracking them in the marine environment," says Teresa Lorenz. Lorenz, also a wildlife biologist with the station, joined the study team and took the lead analyzing the telemetry data.



Lorenz et al. 2016

Study area used to examine resource selection by marbled murrelets in northwest Washington and southwest British Columbia, 2004–2008. Darker shading indicates areas with a high probability of use and lighter shading highlights areas with a lower probability of use by the population of tagged murrelets. Black dots represent 5,388 marine telemetry locations from all murrelets tracked in this study.

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Raphael and his team tagged 157 murrelets—both male and female—and for 5 years tracked them to and from their nests and their marine feeding grounds. The study area encompassed the northern Pacific side of the Olympic Peninsula, all of the Strait of Juan de Fuca, and Puget Sound from Everett down to Seattle.

What they found painted a picture of a species struggling to survive, especially compared to murrelets just to the north in British Columbia.

Tagging and Tracking

Getting all this information would not have been possible without the use of radio telemetry, a technology that scientists have used to study everything from whales to bumblebees. Radio telemetry requires scientists to capture or at least make contact with the animal they are studying, attach a transmitter, and use a very high frequency (VHF) radio receiver to track the animal's movements.

"Radio telemetry shows movement patterns and habitat selection," says Raphael. "It's a big advance in providing unbiased data; you're not imposing your own beliefs."

The technology has been used since the 1960s, and has become more versatile as equipment has improved. Part of the improvement has been the development of lighter materials.

Marbled murrelets weigh only 200 grams–about the same as a roll of nickels–and the transmitters the scientists used were only 3.5 grams, which was well below the recommended 3 percent of body weight threshold to avoid interference with the birds ability to move. The researchers followed all protocols for working with animals protected by the Endangered Species Act and the Ornithological Council guidelines for research on wild birds. For each murrelet, Raphael and his team threaded a small wire through the skin between the wings, and attached the VHS transmitter, which would stay attached for several months up to a few years. Although there are many different methods for attaching transmitters to birds, Lorenz says they used this one because it reduced drag when the birds dove underwater for fish.

Threading the wire was challenging enough, but even more so was capturing the murrelets in the first place. To do this, Bloxton led teams that ventured out on the water at night in 12-foot inflatable boats and captured birds with long-handled dip nets. Each bird was released within an hour of capture.

They tracked the murrelets from small planes. Each daily flight (weather permitting) was up to 5 hours long, and lasted until either all the birds had been located or the plane needed to be refueled. The goal was to track the birds as they flew back and forth from their nests to the water, and to gather information about nesting and raising young. When a murrelet's radio signal was detected from the air, pilots circled over the transmitter and used a GPS unit to mark the location from which they heard the loudest radio signal.

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A murrelet tagged with a miniature radio transmitter.

The searches ended after the last known nesting murrelet had either hatched a healthy chick or failed to do so, or when significant numbers of transmitters were no longer detectable within the study area–indicating either dispersal of the birds after breeding, or a failure of the transmitter battery. If an individual murrelet was not located at sea or on an inland nest for 2 to 3 consecutive days, they expanded the search area to find it.

Some of the work was done on land, adding to the challenge of the research. "These birds nest in the middle of nowhere," Raphael says. "Most of the nests we found were deep in the Olympic National Forest, and it required lots of hiking and camping to confirm nest sites. We had to lug heavy batteries and all kinds of equipment. It was extremely demanding."

Over the 5 years of the study, the scientists were able to mark 5,388 telemetry locations from the murrelets, each one a record of their daily flights to and from land. They measured the linear distance from each telemetry point to the shore. They also measured water depth at each marine location point because murrelets are thought to forage in shallow water. And they also noted areas of human activity, both at sea and on land. The marine footprint took into account 17 factors including fishing activity, pollution, and shipping traffic. The terrestrial footprint included human population density, light pollution, and transportation infrastructure. In addition, they considered windspeeds for the various locations because it is thought that murrelets prefer calmer fishing waters.

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A researcher in northwest Washington holds a radio receiver and listens for transmitter signals indicating the presence of tagged murrelets.

What They Found

Of the 157 murrelets tagged in the study, only 20 of them attempted to nest, and only 4 successfully fledged young. That's an extremely low rate of nesting attempts and breeding success.

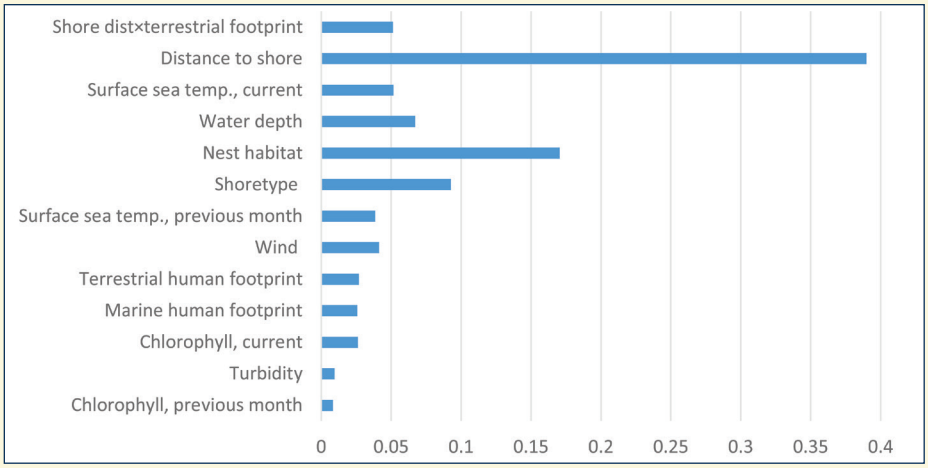
One reason may be the birds' highly selective nature. Murrelets don't actually build nests. Instead they choose a large mossy limb in the forest canopy on which they lay a single egg, which, if all goes well, will produce a healthy chick. In most cases, only large, old trees have limbs big enough for these unusual nests. Preserving those large trees on public lands has been the main focus of forest management efforts to protect the murrelets. Their low rates of breeding could indicate a decline in good nesting habitat and the need to travel farther to find it.

Drawing from previous research, the scientists found that the murrelets' forest-to-ocean commutes were nearly 10 times longer than their counterparts in Alaska, where they are not considered a threatened species. In their Washington study, Raphael and his team observed murrelets commuting up to 90 miles each day, including long flights over water to find suitable areas to feed. Raphael says suitable nesting areas were fewer and farther between in Washington, but also the marine environment was likely not as good for feeding as it is in British Columbia and Alaska, judging from other studies showing much higher densities of murrelets in those areas to the north.

Ocean conditions may have contributed to this. During the 5-year study, one year in particular—2005—had delayed ocean upwelling. Upwelling occurs when wind patterns drive surface water down, which in turn brings deep, cold, nutrient-rich water to the surface. The added nutrients attract other sea life, benefitting every link in the food chain. High upwelling produces a lot of fish, and that's what attracts birds such as the marbled murrelet.

Upwelling can be disrupted or delayed by a variety of factors, including the El Niño warm climate pattern that occurs in the Pacific every few years, including 2005. Global warming can also affect upwelling in much the same way by shifting the surface winds that dredge up underwater nutrients. The murrelets tracked in the study selected cold water, indicating that warming may negatively affect this species in the future.

There was also a human factor that influenced where the birds were found. The murrelets preferred areas close to shore when there was little or no human activity. Where human activity was more prevalent, murrelets ventured farther out into the water. Overall, the probability of a marine area being used by a murrelet increased where there was more nesting habitat and the terrestrial human footprint was small.



Adapted from Lorenz et al. 2016.

Relative influence of variables explaining marine resource selection by marbeled murrelets in northwest Washington and southwest British Columbia, 2004-2008 (based on ranking of standardized regression coefficients).

Lorenz and Raphael noted that the impact of on-land human activity on murrelets in sparsely populated areas such as coastal Alaska is low simply because of the low human population density.

In more densely populated areas, human activities—including boat traffic and noise disturbances—may affect murrelets, and should be examined more thoroughly in future studies.

Going Forward

Further research needs to be done to fully understand Washington's declining murrelet populations. The health of fish populations may be a factor, for example. Lorenz and Raphael used surface water temperatures in the study area as a proxy for potential murrelet prey, with the idea that cooler temperatures may point to potentially more abundant fish. But they say the impact of surface temperatures on fish abundance is complex, and that using it as an indicator is inadequate without more information.

They also encourage future work that would map the proximity of productive marine areas relative to suitable nesting habitat. Their work showed that the murrelets flew long distances between their nests and marine feeding areas, and that their successful reproduction was low. But how much of an impact did those long commutes have on their reproductive rate?

"If the proximity of nesting habitat to regions with high food production is important for the marbled murrelet, then measures to protect

Nick Hatch

At rest: telemetry data revealed that murrelets commute up to 90 miles each day from their forest habitat to marine feeding areas.

and enhance nesting habitat near productive marine areas should be prioritized," Lorenz said.

The Northwest Forest Plan, which is perhaps the most comprehensive murrelet habitat protection program to date, protects nesting habitat only on federal land such as national parks and national forests. Murrelets could potentially benefit from improved nesting habitat on state and private forests, which in northwestern Washington are often closer to marine areas.

If marine areas were to be protected as murrelet foraging area, the telemetry data indicate that the areas with the greatest potential to benefit the birds would be those closest to large tracts of nesting habitat, with little human activity, and near sand and gravel beaches, which could be favorable for the kinds of prey murrelets eat.

The study in Washington gave the researchers a glimpse of where the birds were nesting and foraging, but a larger sample size is needed to get a fuller picture, Raphael says. He is now an advisor to a project led by Oregon State University that is attempting to do just that. As more information is gathered, Raphael explains, scientists will get a better idea of whether the marine environment or the terrestrial environment is more important to the murrelets' long-term survival.

"Any device in science is a window on to nature, and each new window contributes to the breadth of our view."

—Cecil Frank Powell

LAND MANAGEMENT IMPLICATIONS

- The current emphasis in the Northwest Forest Plan on conserving only terrestrial habitat is necessary, but may not be sufficient to stem murrelet population declines. Managing and protecting marine habitats is important too.
- Protecting marine areas where murrelets often forage and the adjacent shore areas from development and disturbance may be important for breeding populations of murrelets.
- On land, murrelets may benefit from additional nesting habitat in older coniferous forests within their commuting range.

For Further Reading

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Writer's Profile

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TERESA J. LORENZ is a research wildlife biologist with the Pacific Northwest Research Station. Her current focus is on the ways that biological communities respond to fire and fuel reduction treatments in Washington and Oregon. Her projects have examined fungal, avian, small mammal, and arthropod communities in burns of different severity and age. Lorenz's work in studying the threatened marbled murrelet looks at the birds' spatial ecology, productivity, and diet in Washington. She has a Ph.D. in wildlife ecology from the University of Idaho.

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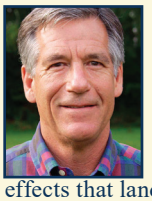

MARTIN RAPHAEL is an emeritus scientist with the Pacific Northwest Research Station, whose long research career has helped inform land managers about the potential effects that land management alternatives can have on wildlife. In addition to exploring the population ecology of the marbled murrelet, he is also investigating habitat relationships of the northern spotted owl and American marten. Raphael has a Ph.D. in wildlife ecology from the University of California, Berkeley.

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