

Science

FINDINGS

INSIDE

Conservation Out On a Limb	2
Routine Murrelet Surveillance	3
The Number-One Priority	3
What Have We Learned?	5

issue ninety / february 2007

"Science affects the way we think together."

Lewis Thomas

THE SECRET LIFE OF MARBLED MURRELETS: MONITORING POPULATIONS AND HABITATS



Andrew Horton

Radio tracking marbled murrelets is the only efficient way to locate their hidden nest sites.

*"It is not only fine feathers
that make fine birds."*

—Aesop

The marbled murrelet, an outwardly unassuming seabird, maintained a secret identity for over a century. Then, in 1974, a tree climber in Santa Cruz county California nearly stepped on a peculiar bird's nest and blew its cover. It was the last North American bird species to have its nest discovered.

You'd never guess that murrelets had a secret life in the forest by seeing them on the ocean, where they seem like typical seabirds. Like their evolutionary cousins, common murres and puffins, murrelets dive for small fish

and invertebrates in ocean waters less than 100 feet deep, usually keeping within a mile or two of shore. It's not until the discussion turns to nesting that their life history departs from the norm. Whereas most seabirds nest in colonies on rocky shoals or seaside cliffs, marbled murrelets are solitary nesters in the extreme. They often fly in excess of 20 miles inland, deep into evergreen forests, to locate a nest tree. Presumably, the secrecy is meant to dissuade predators.

"Murrelets nest a hundred or so feet off the ground and the nest branch is usually surrounded by foliage. That, and their usual habit of flying to and from their nest in darkness, is why their nesting behavior escaped the notebooks of birders and

IN SUMMARY

The marbled murrelet is a small diving seabird that occupies coastal waters from Alaska to central California. Murrelets have a unique nesting strategy that requires them to commute tens of miles inland, where they use large mossy branches on older conifers as platforms to balance their solitary egg. Populations have been declining for decades as the amount of nesting habitat has been reduced through logging. The murrelet was listed under the Endangered Species Act in 1992. Two years later, Pacific Northwest federal forests were brought under the management of the Northwest Forest Plan, which identified the conservation of marbled murrelet nesting habitat as a primary objective.

Scientists at the PNW Research Station have recently completed a 10-year review of the plan's effectiveness at meeting its goals for the murrelet. The murrelet population within the plan area was estimated at approximately 21,200 birds. Although, the population appears stable, there is still not enough data to say conclusively. Federal forests contained more than 2.1 million acres of high-quality potential nesting habitat in 1994, and less than 2 percent of that appears to have been lost to harvest and fire. The researchers estimate that almost 90 percent of the best habitat is already in reserves. Overall, the plan has been quite successful at meeting its short-term objective of conserving the best remaining habitat on federal lands, while also setting into motion restoration of lesser quality habitat.

naturalists for so long,” says Martin Raphael, a research biologist with the PNW Research Station in Olympia, Washington. “Sometimes it seems that everything in their behavior is meant to be cryptic.”

More amazing still, murrelet nests aren’t really nests at all, at least not in the conventional sense. The birds simply tamp the moss on a wide branch and balance their single egg atop the indentation. No supplemental nest material is required. Of

course, for this precarious arrangement to succeed, murrelets require large trees with fat branches, preferably with a deep carpet of moss. Needless to say, old-growth conifer forests provide optimal nesting habitat.

During incubation of the egg, one adult sits on the nest while the other forages at sea. Every 24 hours at dawn they exchange incubation duties. Once hatched, the parents commute to the ocean, often several times per day, carrying back fish for their chick. But after

only a month of doting, the chick is left to find its own way to sea, often over tens of miles of forest.

Even after years of murrelet research, the improbable life history of marbled murrelets continues to impress Raphael. “It is a wonder that these small birds, which aren’t particularly efficient flyers, are able to travel so far inland and repeatedly locate their nest site,” he says. “Then, for the young chick to navigate its own way to sea—well, that’s amazing.”

CONSERVATION OUT ON A LIMB

Murrelets are put at risk by the very same traits that make them so unique. Populations of marbled murrelets in Washington, Oregon, and northern California have been in decline for decades. Loss of old-growth forest, critical for nesting habitat, is the likely explanation. Fifty to 90 percent of older forest habitat in the Pacific Northwest has been lost to logging and development, and much of what remains is highly fragmented.

In 1992, the U.S. Fish and Wildlife Service listed marbled murrelets as “threatened” under the federal Endangered Species Act. Around this same time, public attention in the Pacific Northwest was focused on the fate of another “threatened” bird, similarly linked to old-growth forests: the northern spotted owl. Lawsuits protesting the impact of Forest Service timber sales on endangered species led to court injunctions and federal forest management ground to a halt. In response, President Clinton convened a forest summit to put an end to the “timber wars.” The outcome was the Northwest Forest Plan, a sweeping ecosystem management plan that governed

all federal forests within western Washington, Oregon, and northern California. The plan provided for extensive habitat protection while also permitting some harvest to support timber-dependent communities.

“The Northwest Forest Plan remains the boldest effort ever undertaken by federal agencies to meet large-scale biodiversity objectives,” says Raphael. “To meet murrelet conservation goals, the plan used a system of congressionally reserved forest land, late-successional reserves, and other lands withdrawn from timber harvest. These forests encompassed a high proportion of murrelet nesting habitat thought to exist on federal land.”

The plan also set into motion an extensive monitoring program designed to gauge the success of the plan at meeting biodiversity and social objectives. Scientists at the PNW Research Station have recently completed an assessment of the plan’s effectiveness to date. Raphael helped lead the analysis of murrelet



Nick Hatch

Marbled murrelets need large branched trees on which to balance their solitary egg.

monitoring data, which culminated in the publication of “Northwest Forest Plan—the first 10 years (1994–2003): status and trends of populations and nesting habitat for the marbled murrelet.”

It is the most comprehensive analysis of marbled murrelet population status and habitat trends ever completed.

KEY FINDINGS	
•	The total estimated marbled murrelet population offshore of Washington, Oregon, and northern California has averaged about 21,200 birds over 6 years of surveys.
•	Marbled murrelet population size is correlated with the amount of higher-suitability nesting habitat in inland conifer forests.
•	Higher suitability nesting habitat for the murrelet is in large forested stands with larger average tree diameters, complex structures, a higher percentage of conifer cover, and a lower percentage of hardwood cover.
•	Rates of loss of habitat to stand-replacing fire and harvest have been slow on federal lands (less than 2 percent over the past 10 years), but the rate has been greater on nonfederal lands (12 percent in 10 years).

Science Findings is online at: <http://www.fs.fed.us/pnw/>
The site includes **Science Update**—scientific knowledge for pressing decisions about controversial natural resource and environmental issues.

Purpose of PNW Science Findings

To provide scientific information to people who make and influence decisions about managing land.

PNW Science Findings is published monthly by:

Pacific Northwest Research Station
USDA Forest Service
P.O. Box 3890
Portland, Oregon 97208
(503) 808-2137

Send new subscriptions and change of address information to pnw_pnwpubs@fs.fed.us

Sherri Richardson Dodge, editor
srichardsondodge@fs.fed.us

Keith Routman, layout
kroutman@fs.fed.us



United States
Department
of Agriculture



Forest
Service

ROUTINE MURRELET SURVEILLANCE

Nesting murrelets are nearly impossible to find. That's why surveying begins at sea. On a typical spring evening, Raphael and two colleagues will cruise offshore under the cover of darkness searching for resting murrelets. Using powerful spotlights to probe the ocean surface, they navigate a pre-set route searching for what looks like a black ball bobbing in the darkness. Raphael's specialty is leaning over the bow of the inflatable motorboat while scooping up individual murrelets with a giant salmon net. "It's hit or miss," he says, "sometimes the birds just move away from the boat when they hear you coming."

Once a murrelet is landed, it is measured and weighed, and blood is taken to establish the bird's gender (the male and female are indistinguishable without the help of DNA). Finally, a tiny transmitter with a dangling antenna is affixed between its wings. This delicate procedure is reserved for the head Forest Service field biologist, Tom Bloxton; only he among them is licensed to fit the transmitter.

With so much ocean and so few birds, a night's work may yield only a handful of successes. But that's okay; their research permit limits them to 40 captures per year. And keeping tabs on 40 murrelets—any of which may fly 100 miles or more in a single day to find better forage—is plenty of work.

Each morning from May to August, a Cessna takes off from Port Angeles Airport with radiotelemetry equipment tuned to the murrelet's transmitters. Day after day, researchers note the location of each bird and wait for the tell-tale signal of nesting: day one = ocean, day two = absent, day three = ocean and so on. This indicates that the bird is alternating egg incubation duties with its mate. The plane is then instructed to head inland in search of the nest.

"After a tagged murrelet is detected inland by aircraft, radio tracking on foot to locate the nest becomes our highest priority," says Raphael. "We monitor nesting birds using a digital video recorder fitted with a zoom lens and attached to a tree adjacent to the nest. We have collected some excellent footage of incubation, brooding, and parental feeding."

These last steps happen infrequently. In 3 years of monitoring, very few birds have actually nested. Last year, only 2 of 40 tagged birds ever nested. Eight of 40 nested the year before, and only 3 of 27 the year before that. The low nesting rate, coupled with very low nest success, is undoubtedly keeping populations low.



Researchers must capture murrelets at night while the mysterious seabirds are resting or foraging.



The population of murrelets within northern California, Oregon, and Washington was estimated from visual survey data collected over 6 years.

This intense research protocol—including radio tracking and video recording—has been focused on the Olympic Peninsula in Washington. Meanwhile, throughout the rest of the plan area, federal and state agencies have been monitoring murrelets at sea, where the murrelets can reliably be found and counted. The coast has been broken into five zones throughout the plan area and teams of biologists have been sampling along systematic transects, using a rigorous statistical design, which permits an overall estimate of murrelet numbers.

"The total estimated marbled murrelet population offshore of the plan area has averaged about 21,200 birds over the 6 years of surveys," says Raphael. "From 2000 to 2005,

the largest population (total numbers of birds) was in the Puget Sound and Strait of Juan de Fuca of Washington; the highest densities (numbers of birds per mile of coast) were along the coast of Oregon and California north of the Humboldt-Mendocino county line, and the smallest population and lowest density were from the Humboldt-Mendocino county line south to San Francisco Bay, California."

Thus far, the population appears stable. But with only 6 years of reliable monitoring data, Raphael and his colleagues are reluctant to say for sure. Statistically speaking, given the size and variability of the population data, it will take 9 years of monitoring to detect a 5 percent annual change in the rangewide population with 95 percent certainty.

Martin Raphael

Martin Raphael

THE NUMBER-ONE PRIORITY

Population monitoring doesn't fully address the effectiveness of the Northwest Forest Plan's conservation strategy. After all, murrelet populations are affected by a variety of things, some of which are outside of the plan's influence. The plan has no influence, for example, on marine conditions—including food sources—or on sources of mortality at sea, such as oil spills and gill netting. These conditions can influence year-to-year variation in distribution and abundance of murrelets. Therefore, it is difficult to relate annual changes in murrelet populations to forest management. Raphael believes that population size of murrelets, averaged over several years, is related to the amount of suitable nesting habitat even if annual variation in population size is affected by these other factors.

Therefore, the plan's real contribution to murrelet conservation is through the protection of nesting habitat, mainly old and mature forests. "Nesting habitat sets the carrying capacity for murrelet populations. It is the number-one priority. Once you get that, then several other factors need to fall in line," says Raphael, who led the effort to map the potential nesting habitat at the inception of the plan.

To delineate the extent of potential nesting habitat, he and his colleagues relied on satellite data combined with information from the field. Raphael is quick to point out that they only mapped potential habitat—and there is no way of knowing what portion of potential habitat is actually used for nesting.

"We used a relatively new procedure, ecological niche factor analysis, to develop the habitat suitability map," says Raphael. "The procedure uses forest attributes surrounding known murrelet nest sites to train a computer algorithm, which then searches millions of mapped acres looking for similar sites. The procedure assumes that true nest sites offer the best estimation of what high-quality habitat looks like."

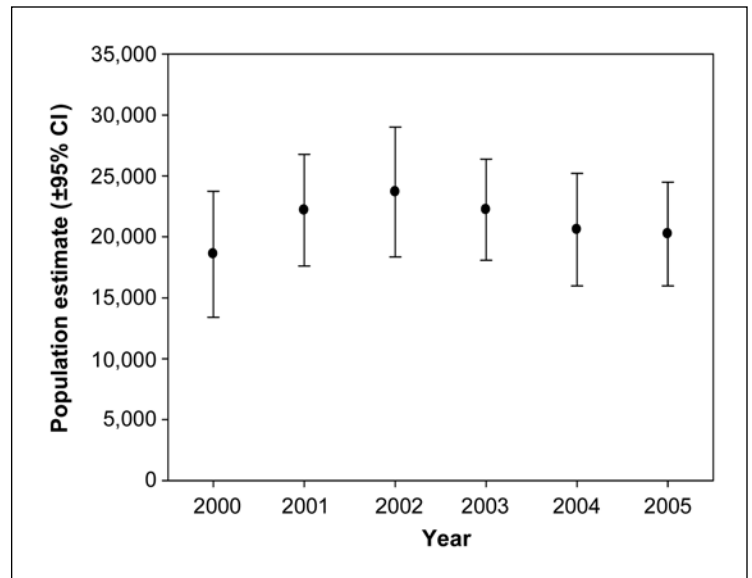
"Our analysis predicted that murrelet nesting habitat is more likely at sites that have larger, more contiguous patches of larger diameter forest, have higher percentages of conifer canopy cover, and have multilayered canopy structure," explains Raphael.

They estimated 1.9 million acres of higher-suitability nesting habitat existed on federal lands in 1994 and less than 2 percent of that habitat has been lost to harvest or fire during the 10 years since the plan has been implemented. And, in what is good news for murrelet conservation, they estimated that nearly 90 percent of the potential nesting habitat on federal land has already been protected in forest reserves.

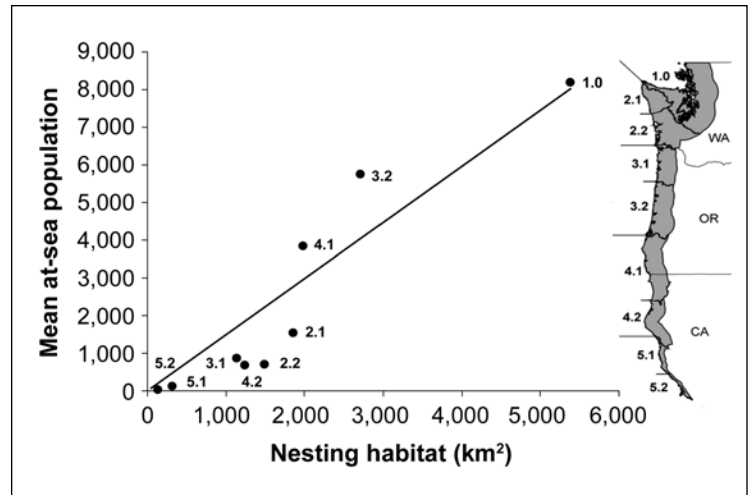
In reserved federal lands including national parks, Washington had the highest amount of higher suitability habitat, 55 percent of the total; Oregon had 36 percent and California had 9 percent. On federal lands outside national parks, Oregon had the most higher-suitability habitat.

"Of course, murrelets don't know or care much about property boundaries, so we also examined potential nesting habitat across all lands: federal, state, and private," says Raphael. "We were surprised to find that just over half (2.1 million acres) of the higher-quality nesting habitat in Washington, Oregon, and northern California is on nonfederal lands."

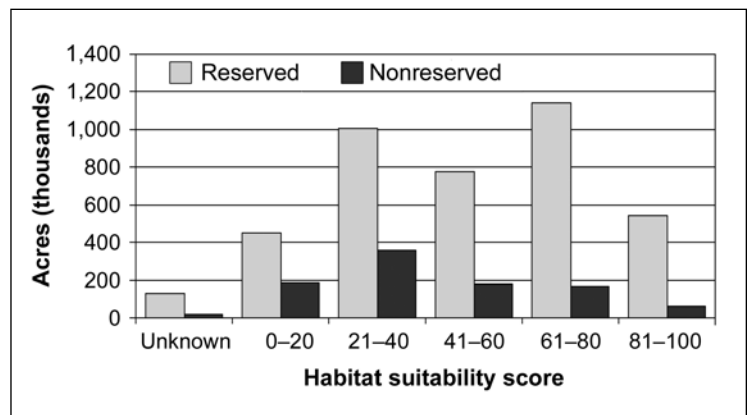
This is a mixed blessing as far as murrelets are concerned. More habitat is certainly a good thing but the evidence from this analysis also suggests that the rate of habitat loss, almost all owing to timber harvest, is relatively higher on nonfederal lands—12 percent in the past decade.



Estimated murrelet population size totaled across the entire Northwest Forest Plan area has remained relatively stable over the 6 years from 2000 to 2005.



Murrelet population size (averaged over several years) is correlated with the amount of higher-suitability habitat in adjacent portions of the bird's range from California to Washington, as denoted in the map (modified from Raphael 2006).



On federal lands, most of the higher-suitability potential nesting habitat (habitat suitability scores less than 60) occurs within the system of reserves.



LAND MANAGEMENT IMPLICATIONS



- Conservation of suitable nesting habitat within the reserve system of the Northwest Forest Plan is essential to the conservation of murrelet populations.
- Nonfederal lands are also important as those lands encompass about half of the total higher quality murrelet nesting habitat.
- About half of the more suitable nesting habitat occurs on federally administered lands. Almost 90 percent of that habitat on federal lands is within national parks, wilderness, and reserves under the Northwest Forest Plan.

WHAT HAVE WE LEARNED?

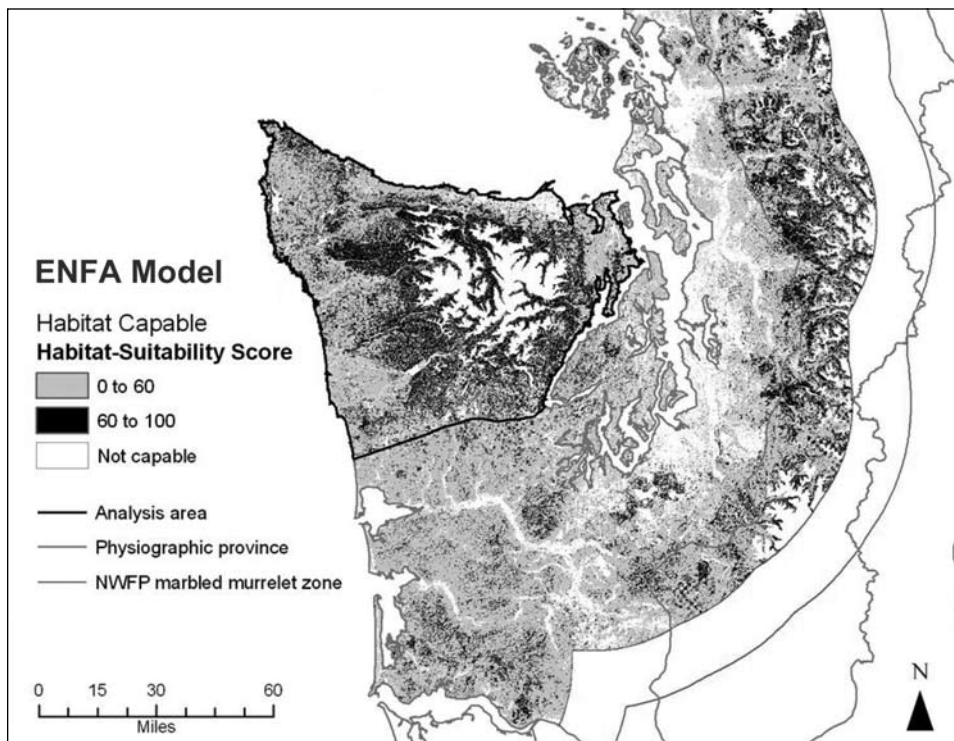
“The plan has been quite successful in meeting its short-term goals of conserving the best remaining marbled murrelet habitat on federal lands. And it has set into motion the restoration of much of the less suitable habitat within the extensive reserve system,” says Raphael.

“The plan’s long-term objective of creating a system of reserves containing desired sizes and distributions of large blocks of suitable habitat on federal lands is on course, but many more decades will be needed to judge the plan’s success. Long-term persistence of the murrelet in the area of the plan is by no means certain,” he adds.

Monitoring of the second 10 years of the Northwest Forest Plan are already underway, and population and habitat estimates will certainly improve with the additional data. With a bit of luck, the new potential habitat will have some big branched trees with murrelet eggs balanced in the moss.

“A true conservationist is a man who knows that the world is not given by his fathers, but borrowed from his children.”

—John James Audubon



Researchers mapped murrelet potential habitat suitability throughout Pacific Northwest forests. Some of the best habitat was on the Olympic Peninsula in Washington.

FOR FURTHER READING

- Huff, M.; Raphael, M.; Miller S.; Nelson, S.; Baldwin, J., tech. coords. 2006. *Northwest Forest Plan—the first 10 years (1994–2003): status and trends of populations and nesting habitat for the marbled murrelet*. Gen. Tech. Rep. PNW-GTR-650. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 149 p. <http://www.fs.fed.us/pnw/pubs/pnw-gtr650.pdf>.
- Miller, S.; Ralph, C.; Raphael, M.; Strong, C.; Thompson, C.; Baldwin, J.; Huff, M.; Falxa, G. 2006. *At-sea monitoring of marbled murrelet population status and trend in the Northwest Plan area*. In: Huff, M.; Raphael, M.; Miller, S.; Nelson, S.; Baldwin J., tech. coords. Northwest Forest Plan—the first 10 years (1994–2003): status and trends of populations and nesting habitat for the marbled murrelet. Gen. Tech. Rep. PNW-GTR-650. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station: 31–60.
- Raphael, M. 2006. *Conservation of the marbled murrelet under the Northwest Forest Plan*. *Conservation Biology*. 20: 297–305.
- Raphael, M. 2006. *Conservation of listed species: the northern spotted owl and marbled murrelet*. In: Haynes, R.; Bormann, B.; Lee, D.; Martin, J., tech. eds. Northwest Forest Plan—the first 10 years (1994–2003): synthesis of monitoring and research results. Gen. Tech. Rep. PNW-GTR-651. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station: 117–144.
- Raphael, M.; Galleher, B.; Huff, M.; Miller, S.; Nelson, S.; Young, R.. 2006. *Spatially explicit estimates of potential nesting habitat for the marbled murrelet*. In: Huff, M.; Raphael, M.; Miller, S.; Nelson, S.; Baldwin, J., tech. coords. Northwest Forest Plan—the first 10 years (1994–2003): status and trends of populations and nesting habitat for the marbled murrelet. Gen. Tech. Rep. PNW-GTR-650. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station: 97–146.
- Raphael, M.; Evans Mack, D.; Marzluff, J.; Luginbuhl, J. 2002. *Effects of forest fragmentation on populations of the marbled murrelet*. *Studies in Avian Biology*. 25: 222–236.

WRITER’S PROFILE

Jonathan Thompson is an forest ecologist and science writer specializing in natural resource issues. He lives in Corvallis, Oregon.



PRSRT STD
US POSTAGE
PAID
PORTLAND OR
PERMIT N0 G-40

U.S. Department of Agriculture
Pacific Northwest Research Station
333 SW First Avenue
P.O. Box 3890
Portland, OR 97208-3890

Official Business
Penalty for Private Use, \$300

SCIENTIST PROFILE



MARTIN G. RAPHAEL is a research wildlife biologist and team leader with the U.S. Forest Service's Pacific Northwest Research Station in Olympia, Washington. He is actively involved in the development of

monitoring plans for the northern spotted owl and marbled murrelet in the Pacific Northwest. His research includes habitat relationships of forest wildlife, ecology of the marbled murrelet and American marten, and investigations into the roles of riparian habitat for terrestrial and aquatic organisms.

Raphael can be reached at:
Forestry Sciences Laboratory
3625 93rd Ave., SW
Olympia, WA 98512-9193
Phone: (360) 753-7662
E-mail: mraphael@fs.fed.us

COOPERATORS

Mark Huff, USDI National Park Service
Gary Falxa, USDI Fish and Wildlife Service
Sherri L. Miller, Jim Baldwin, USDA Forest Service, Pacific Southwest Research Station.
S. Kim Nelson, Oregon State University
Scott Pearson, Monique Lance, Washington Department of Fish and Wildlife

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write USDA, Director, Office of Civil Rights, 1400 Independence Avenue, SW, Washington, DC 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.