Reports from DNR Inland Marbled Murrelet Surveys
(As part of the "Invitation to Marbled Murrelet Scientific Summit" information packet
October 21-22, 2003)

The following reports have been compiled individually and do not follow similar format. Three reports summarize the marbled murrelet surveys from the four planning units. South Coast and Columbia reports have been combined and summarized for the first time. The OESF Planning Unit report has the most complete and detailed analysis per Scott Horton's Ph.D. research. The Straits Planning Unit report was presented as a poster at the 2003 Pacific Seabird Group Meeting and contains some thoughtful insight to the issues that could play an important part of a long-term marbled murrelet conservation strategy.

Summary of HCP-directed Murrelet Surveys in the South Coast and Columbia Planning Units, 1998-2002

Introduction – Surveys were conducted in both planning units simultaneously between 1998 and 2002. Unlike in the Straits planning unit (reported later in this section), survey site boundaries were established without regards for model-derived predicted probabilities of occupancy.

Methods – All surveys were conducted according to protocols developed and updated by the Pacific Seabird Group (PSG), Marbled Murrelet Technical Committee. Surveys were conducted until murrelets were observed flying within the forest canopy (i.e., occupied behavior) or until the correct number of protocol surveys were achieved.

The layout of survey sites and stations was shared by DNR and contract staff using aerial photography and GIS mapping techniques. Field-location of survey stations were located by DNR or contract staff. Two private consulting firms, Hamer Environmental L.P. and Turnstone Environmental Consultants, Inc. conducted the actual murrelet surveys with substantial contractor and DNR review.

Results – DNR and its contractors delineated 450 survey sites comprising 23,861 acres. Effort was distributed over the project as reported in the table below for surveys initiated in each of 4 years.

Start Year	1998	1999	2000	2001
Sites (N)	166	55	98	131
Acres	8,159	3,245	5,239	7,218

DNR's contractors completed 3,332 murrelet surveys to PSG protocol standards, during which they recorded 1,124 murrelet detections during 6% (213) of those surveys. Subcanopy (occupied) behavior was recorded at 20% (89) of sites, presence was recorded at 10% (45), while no murrelet detections were recorded at 70% (316) of sites. Survey sites with occupied detections comprised 5,406 acres, sites with presence totaled 1,871 acres, while most of the area surveyed (16,583 acres) was without murrelet detections. The locations of these sites, their status and context are illustrated on Maps 2 and 3.

Summary of HCP-directed Murrelet Surveys in the OESF Planning Unit, 1996-2001

Introduction -- DNR departed from its stepwise, linear process of developing an interim marbled murrelet conservation strategy in the Olympic Experimental State Forest (OESF) Planning Unit. The OESF contains the majority of DNR-managed old-growth forests, and preliminary analyses of data collected for developing the predictive model suggested that approximately 40,000 acres of structurally-complex, old, natural stands had a rather high probability of being used, i.e., occupied, by murrelets. DNR believed that there were other stands of potential murrelet habitat in addition to these old-growth stands, and that they would be identified by the modeling process. Thus in 1995, DNR decided to begin an inventory of murrelet use in the OESF ahead of a statistical model predicting that use, because a very large area of clearly good potential habitat obviously needed to be surveyed and because DNR wished to move rapidly towards full implementation of the murrelet strategy. The inventory surveys were planned to be initiated over a three-year period beginning in 1996, with surveys initiated in approximately 1/3 of the 40,000 acres each year, reserving the stands of uncertain potential as habitat to be screened against the predictive model. Because surveys are conducted over two years, the old-growth portion of the project was planned to be completed in 1999.

Methods - Survey Areas -- In 1995, DNR's forest inventory did not contain sufficient resolution to estimate structural complexity from database searches. Thus, experienced staff used aerial photos to identify stands with deeply-textured canopies and abundant trees with large-diameter crowns. From among these, stands that were at least 20 acres and with fairly compact shapes (e.g., excluding riparian leave areas) were designated for murrelet surveys. Almost invariably, these were older stands that originated after natural disturbances, and that would be described as "old-growth" or as mixed-age stands with a significant old-growth component. Areas of the landscape that were disturbed by the hurricane-force, '21-Blow windstorm now consist of a mosaic of fairly uniform-structured, naturally-regenerated 80 year-old stands and structurally complex old-growth stands with a variety of intergradations among those types. In these areas, only the more "old-growth like" portions of larger stands that may

have been entirely potential habitat, were designated for survey while awaiting the predictive model.

Methods - Murrelet Surveys -- All surveys were conducted according to protocols developed and updated by the Pacific Seabird Group (PSG), Marbled Murrelet Technical Committee. Surveys were conducted for two years (usually 5 visits per year) or until murrelets were observed flying within the forest canopy (i.e., occupied behavior), whichever was sooner. The layout of survey sites and stations was planned by DNR staff using aerial photography and GIS mapping techniques. Field-location of survey stations, and the actual murrelet surveys were conducted by several private consulting firms (Resources Northwest, Inc.; Hamer Environmental; and Turnstone Environmental Consultants, Inc.) with substantial review by contractor and DNR staff.

Results -- DNR delineated 600 survey sites comprising 39,286 acres. The survey project was quite expensive ($1.3 million in contract costs) and thus took longer to complete than anticipated, with the final year of surveys in 2001. Effort was distributed over the project as reported in the table below for surveys initiated in each of 5 years.

Start Year	1996	1997	1998	1999	2000
Sites (N)	235	192	63	31	79
Acres	13,826	13,304	4,142	2,151	5,864

DNR's contractors completed 4,584 murrelet surveys to PSG protocol standards, during which they recorded 6,909 murrelet detections on about one-third (1,561) of those surveys. Subcanopy (occupied) behavior was recorded on 601 occasions during fewer than 10% of surveys (333). No murrelet detections were recorded at fewer than 10% of the sites (51); murrelet presence was recorded at 237 sites; murrelet occupancy was recorded at the majority (312) of sites. Survey sites without murrelet detections comprised 3,017 acres, sites with presence totaled 14,686 acres, while most of the area surveyed (21,583 acres) was within occupied sites. The locations of these sites, their status and context are illustrated on Map 4.

Discussion -- This report summarizes only a part of the DNR's commitment to a murrelet inventory in the OESF, thus it is instructive to briefly discuss four related projects that will bring additional information to the conservation planning effort: 1) These surveys were only in old-growth forests selected by photo-interpretation, in advance of the statistical model that predicted stands estimated to contained 95% of the occupied sites in the planning unit. That model has since been developed and applied to the OESF landscape. 2) The HCP conservation strategy for spotted owls in the OESF made specific commitments for landscape-level retention and restoration of threshold amounts of old forest. These commitments are without regard to marbled murrelet survey findings. 3) Scott Horton, DNR's Olympic Region wildlife biologist, is currently a Ph.D. candidate at University of Washington studying the landscape ecology of marbled murrelets with regard to their conservation in the OESF. 4) Marbled murrelet surveys were funded by the *Tenyo Maru* oil spill settlement and conducted by Washington Department of Fish and Wildlife (WDFW) at 22 sites in the OESF where DNR did not detect murrelet use.

The predictive model was developed for the DNR-managed lands on the entire Olympic Peninsula as described in the section *Predicting Stands Likely to be Occupied by Marbled Murrelets* of this information packet. The model includes a binary variable for whether or not the site was in the western vs. northern/eastern Olympic Peninsula; elevation above sea level in feet; stream network density within the stand; and numbers of conifer trees ∃32" dbh per acre. Applying the logistic transformation to model output for stands in DNR's inventory gives the predicted the probability of occupancy for each stand. Following the process described in the *Predicting Stands Likely to be Occupied by Marbled Murrelets* section, DNR estimated the stands predicted to contain 95% of the occupied sites in the OESF Planning Unit were those at or above the probability threshold of 0.3805, i.e., stands with a predicted probability of occupancy by murrelets of 38.05%. These stands in total comprise 54,452 acres, which after the old-growth surveys reported above leave (nominally) 15,166 acres of unsurveyed, reclassified habitat. DNR predicts lower rates of murrelet activity and use in these areas which lack the stature and structural complexity that characterized the stands surveyed in advance of the model.

DNR agreed upon an "unzoned" approach to spotted owl conservation in the OESF. This strategy is implemented at the scale of "Landscape Planning Units" (LPU), mid-scale (15,000 - 50,000 acre) areas of DNR-managed lands that are organized around watershed boundaries.

DNR committed to maintain or restore at least 20% of each LPU to "old forest spotted owl habitat" and at least an additional 20% to "young forest habitat". DNR's landscape planning efforts to date have shown that old forest habitat and the "old-growth" murrelet survey areas discussed in this report are almost entirely coincident. No LPUs currently have a "harvestable surplus" of old forest owl habitat, and forest growth modeling suggests that restoration of these LPUs to supra-threshold levels will not occur until after the HCP agreement has run its course (70-100 years). Thus DNR is committed to conserving and adding to its inventory of old-growth forests that can serve murrelet conservation, merely through implementing its spotted owl conservation strategy. This provides an opportunity to achieve a synergistic effect for conservation of old forest ecosystem functions through the upland (owl and murrelet) as well as the riparian conservation strategies of the HCP.

Scott Horton, Olympic Region wildlife biologist, is currently engaged in a program of research using the murrelet survey results summarized above to: 1) develop a better understanding of murrelet inland activity patterns; 2) discover associations between mid-scale (appropriate to management of the OESF) landscape patterns and murrelet activity, in order to index the "attractiveness" of particular landscapes to potentially nesting murrelets; 3) integrate this index with the model developed through research funded in part by DNR that relates predation rates at murrelet nests to landscape characteristics (e.g., Raphael et al. 2002. Studies in Avian Biology 25:221-235), in order to model the "productive capacity" of particular landscapes for murrelets; and 4) explore the efficacy of a variety of forest management scenarios in providing for outcomes in achieving HCP conservation and other land management objectives. This research will probably not be complete for at least one year, thus it may not be able to fully inform the conservation planning process. This exemplifies a greater challenge in developing the long-term conservation strategy, i.e., constructing a strategy that is adaptable to new knowledge in a way that enables effective murrelet conservation and efficient forest management for DNR's other objectives.

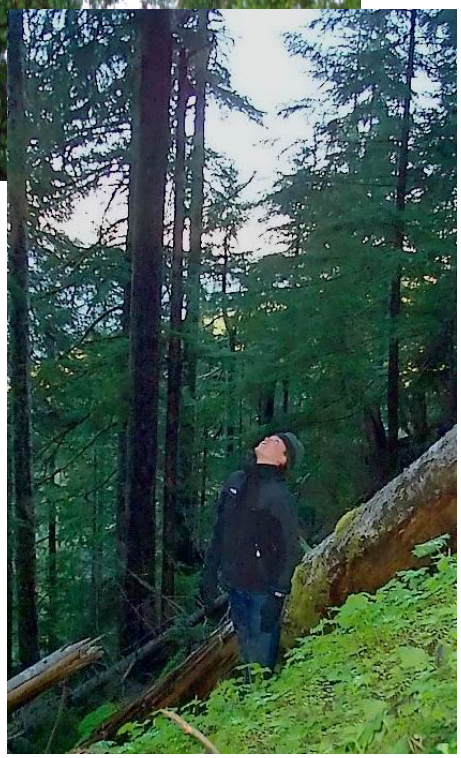
Marbled murrelet surveys in 2001 and 2002, funded by the *Tenyo Maru* settlement, found subcanopy (occupied) behavior at 21 of 22 sites which DNR surveys did not find to be occupied. The objectives of this survey program differed from those of DNR's HCP-directed inventory, in that these surveys had the objective of finding occupied sites in order to assure their conservation. Thus, survey effort and timing were directed specifically by those objectives

rather than the broader spatial and temporal survey coverage prescribed in the PSG protocol. However, their findings point out that a binary notion of murrelet inland ecology, i.e., "occupied" vs. "not occupied", overlooks much of relevance to a long-term conservation strategy. DNR believes that further surveys at other apparently unoccupied sites would produce similar results throughout the OESF landscape where murrelet activity is abundant and widespread. But an effective, efficient conservation strategy will require a much broader understanding of the importance of the structure, composition, and context of forest stands at multiple spatial scales to murrelet population biology.

DNR is generally encouraged by the apparent situation in the OESF. The relatively abundant potential murrelet habitat, and the apparently high rates of murrelet use of that habitat should increase the numbers of options for murrelet conservation, land management, and research in the OESF.

Inland Marbled Murrelet Surveys in the Straits Planning Unit 2000-2002

Washington Department of Natural Resources



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Introduction

The Washington State Department of Natural Resources (DNR) manages approximately 3 million acres of trust lands to contribute financial support to designated public beneficiaries, e.g., public schools, state universities, and county governments. Nearly half of these trust lands are state forests within the range of the threatened marbled murrelet (*Brachyramphus marmoratus*). DNR is conducting inland surveys for marbled murrelets to develop an inventory of murrelet use of state forests and to provide information for developing a long-term conservation plan. This effort was agreed upon in DNR's Habitat Conservation Plan (HCP, DNR 1997), to address state trust land management issues relating to compliance with the U.S. Endangered Species Act. We have substantially completed this work along the northern and eastern Olympic Peninsula, and present those results in this report. Our objective is to present results from those extensive inland surveys, planned and conducted under a common protocol between 2000 and 2002, and to discuss them in the context of other information about murrelet distribution, activity, and abundance on the Olympic Peninsula and Puget Sound, and as they might be used in full implementation of DNR's HCP.

Methods - Study Area

This work was conducted on state forest lands in the narrow, non-federal periphery (generally a 4 to 9 mile-wide strip) of the northern and eastern Olympic Peninsula. The Straits Planning Unit is one of six large, watershed-based planning units for which unique murrelet conservation plans (for state forest lands) will be developed and independently implemented following a step-wise process that serves to focus knowledge and conservation measures (DNR 1997). DNR-managed forests (116,800 acres) comprise approximately one-fourth of the non-federal land base in the planning unit (Figure 1). They are almost exclusively second- and third-growth forests that regenerated after commercial timber harvest, land-clearing, and associated wildfires in the late 19th and early 20th centuries, and from subsequent commercial harvests and reforestation. Commercial forestry is the dominant land use in the non-federal lands, with low-density residential, several small cities, and limited agriculture making up the remainder. Federal lands in Olympic National Park and Olympic National Forest make up nearly 60% of the 1.2 million acre planning unit. The 2000 U.S. Census counted approximately 100,000 people in the planning unit (http://www.ofm.wa.gov/census2000/sf3/stcopl/pop_hh_c.xls).

Methods - Sites and Surveys

We planned to conduct murrelet surveys in forest stands estimated to contain 95% of the occupied sites on DNR-managed lands within the planning unit, consistent with the HCP agreement (DNR 1997). Based on research at 108 DNR-managed stands across the Olympic Peninsula (field work conducted 1994-1996), we identified forest stand and landscape characteristics associated with murrelet occupancy (following Ralph et al. 1994, 1995), using multiple logistic regression techniques to estimate the probability that each DNR-managed mature forest stand was occupied by murrelets (Escene unpublished). Probability of occupancy was predicted for all stands that were estimated to be within the structural threshold used to

define the sample of research sites. Variables selected for the final model include a binary variable for whether or not the site was in the western vs. northern/eastern Olympic Peninsula (NCOAST); elevation above sea level in feet (ELEV); stream network density within the stand, estimated from the state regulatory GIS database as linear feet of Types 1, 2, & 3 water per acre (WATER1_3); and numbers of conifer trees 32" dbh per acre (CNTPA32). The model equation is g(x) = !4.3940 + 1.4138 NCOAST + 0.00103 ELEV + 0.0471 WATER1_3 + 0.2249 CNTPA32. The logistic transformation, $e^{g(x)} / [1+e^{g(x)}]$, predicts the probability of occupancy. We assumed that a stand's size multiplied by its model-derived probability of occupancy was a reasonable estimate of its "overall probability" of occupancy. Thus, we sorted stands in the Straits Planning Unit in descending order based on their model-derived probabilities, then calculated the cumulative total of the overall probabilities from the top of the list. The stands at and above the level at which 95% of this total occurred were estimated to contain 95% of the "occupied sites" in the Straits Planning Unit, and were designated to be inventoried for murrelet occupancy. The probability threshold at this level is 0.0512, i.e., stands with a predicted probability of occupancy by murrelets of 5.12% were surveyed in this study.

We used stereoscopic analyses of 1:12,000 aerial photography to identify topographic features, canopy gaps, roads, and logging landings to help locate survey stations and define site boundaries. Surveys were conducted from 2000 through 2002, following protocols developed by the Pacific Seabird Group, Marbled Murrelet Technical Committee (Ralph et al. 1994, 1995, Evans et al. 2000). Sites were defined as: "occupied" following observation of sub-canopy behavior (Ralph et al. 1994); "presence" after two years of protocol surveys failed to observe sub-canopy behavior, but murrelets were detected; "no detections" if none were recorded after two years of protocol surveys. We arbitrarily classified survey sites by geography, *post hoc*, as Elwha (N=113), Dungeness (N=110), and Hood Canal (N=46), Figures 2a,2b,2c,2d. Surveys were conducted for DNR under contract by Hamer Environmental.

Methods - Model Validation

We examined the raw and area-weighted frequency distributions of model-derived probabilities of murrelet occupancy in order to classify survey sites based on their predicted probabilities of occupancy. Natural breaks occurred in these distributions such that we felt comfortable selecting the arbitrary-sounding probability classes: Class 1, 5-25%; Class 2, 26-50%; Class 3, 51-75%, and Class 4, 76-99.9%. We delineated murrelet survey sites to include only stands within the same probability class in order to test the null hypothesis: murrelet occupancy occurs without regard to model-based probability class. We used the chi-square statistic for this test.

Results - Surveys

DNR-managed lands contained approximately 18,800 acres that met the structural threshold for consideration with the logistic regression model. Of these, approximately 15,600 acres (83%) had model-derived probabilities greater than or equal to 0.0512 and were considered for the murrelet inventory. Approximately 600 scattered acres of the lowest probability class will

receive their second year of survey in 2003 and are not included in the summaries presented here; approximately 650 acres were research sites and surveyed in that project; and the remainder were isolated patches of forest smaller than 5 acres, or other anomalies and were not surveyed. Thus, we report survey results from 2,599 protocol surveys, conducted from 2000 to 2002, to 269 sites comprising 14,134 acres (Table 1). There were geographic differences in occupancy rates and activity levels between northern (Elwha and Dungeness) and eastern (Hood Canal) sites (Table 1, Figure 2a,2b,2c). Proportion of occupied sites did not differ between Elwha (0.283) and Dungeness (0.227), Z_{CORR}=0.80, P=0.42; but was strikingly different between the northern (Elwha plus Dungeness, 0.256) vs. Hood Canal (0.065) sites, Z_{CORR}=2.63, P<0.01. Activity (average number of detections per survey) also differed geographically (F=8.63; d.f.=2, 2596 surveys; P<0.01), again Hood Canal sites differed from Elwha and Dungeness sites which were similar (Tukey's HSD, P<0.05).

	Occupied (ac)	Presence (ac)	No Detections (ac)	Detections/Survey (95% CI)
Elwha (N=113)	32 (2,050)	48 (2,640)	33 (2,182)	0.479 (0.392-0.551)
Dungeness (N=110)	25 (1,294)	47 (2,474)	38(2,156)	0.375 (0.303-0.462)
Hood Canal (N=46)	3 (40)	8 (344)	35 (954)	0.133 (0.061-0.164)
Total (N=269)	60 (3,384)	103 (5,458)	106 (5,292)	

Table 1. Two-year marbled murrelet survey results from 2,599 survey visits to 269 survey sites on DNR-managed lands in the Straits HCP Planning Unit, Olympic Peninsula, Washington, conducted from 2000 to 2002.

Results - Model Validation

We delineated 267 of 269 survey sites based on the classified probabilities, because this delineation scheme was not practical at 2 sites. Class 1 sites were most abundant (N=218), while in total, Classes 2-4 had only 49 sites. Thus we combined all 3 of the higher probability classes for analysis. Observed site status (occupied, presence, no detections) differed from expectations under the null hypothesis as predicted by the logistic regression model (χ^2=7.289, d.f.=2, P=0.026, Figure 3). That is, Class 1 sites (with lower predicted probability of occupancy) had a final status of "no detections" more frequently than expected under the null hypothesis, and fewer than expected sites with "presence" or "occupied" status. Classes 2-4, with higher predicted probabilities, showed the opposite pattern - greater than expected "presence" and "occupancy", and less than expected "no detections".

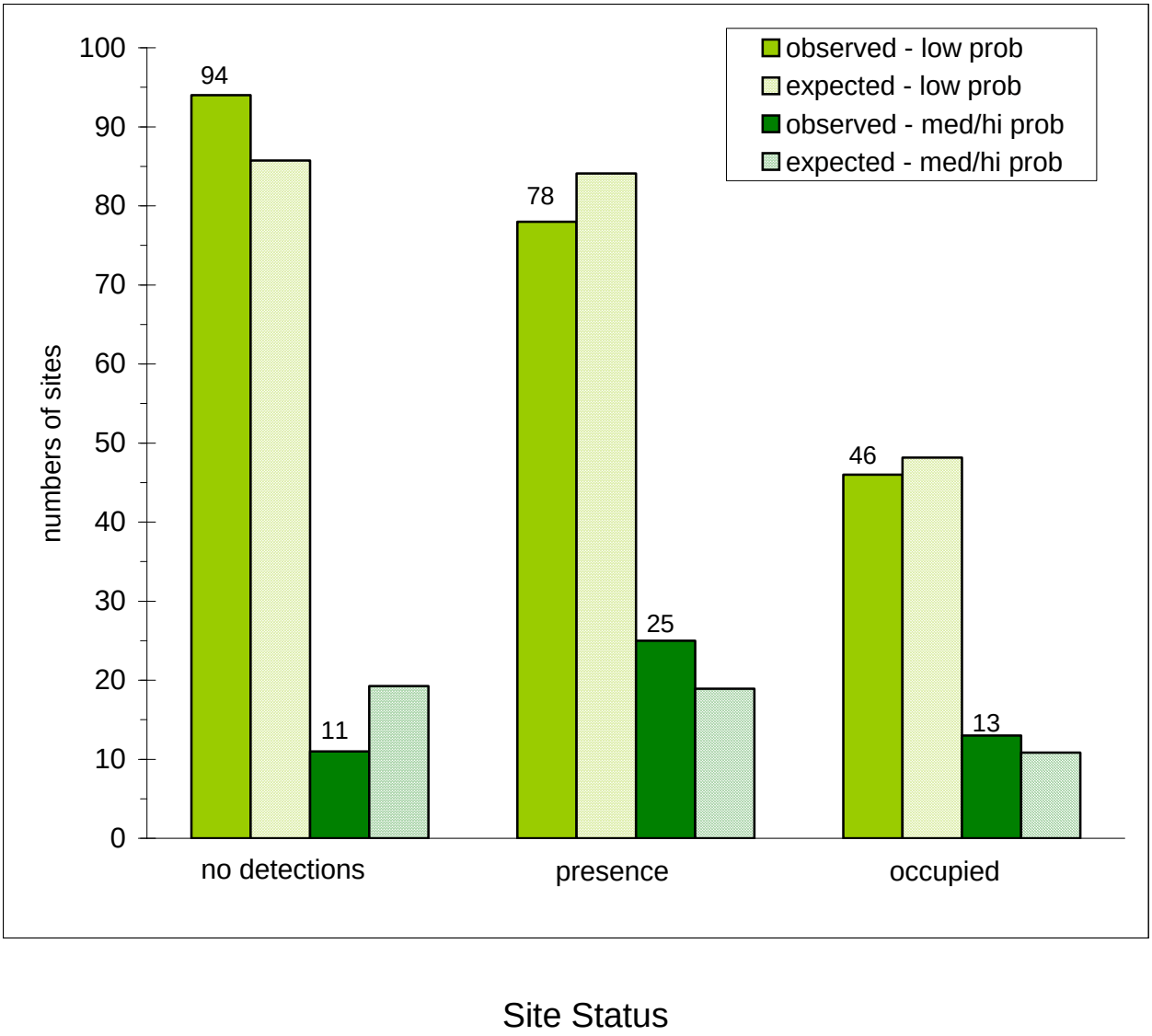

Figure 3. Observed versus expected status of murrelet survey sites as determined by PSG protocol surveys to 267 survey sites, classified by predicted probability of occupancy, on DNR-managed forests in the Straits Planning Unit, Olympic Peninsula, Washington, U.S.A.

Discussion

We have two objectives for this section, one more technical and objective, and the other more broadly philosophical. First, we wish to supplement the statistical examination of the habitat model with a discussion of our very extensive and intensive field experience in the study area. Second, and more importantly, we provide an interpretive discussion of our findings in the context of other information and hypotheses about murrelet populations in Washington, in hopes of stimulating thoughtful dialogue that can be helpful to DNR in developing and implementing an effective, efficient long-term murrelet conservation strategy.

The logistic regression model predicting murrelet occupancy struck us as somewhat lacking in heuristic value, given that stand structure (e.g., Hamer and Nelson 1995) and landscape composition (e.g., Raphael et al. 1995, Meyer et al. 2002) are most commonly presented in the literature as correlates of murrelet occupancy. Our own experience on the western Olympic Peninsula is consistent with findings of these studies (Harrison et al. 1999). We are somewhat comforted by the results of testing the null hypothesis, but wish to complement that with a summary of our extensive and intensive field and detailed photo-interpretation experience in the study area. This experience, gained during more general work in the study area since 1990 and in the very detailed, intensive planning and implementation of this study leads us to conclude that the habitat model made no substantive errors of omission. However, many of the stands selected by the model appeared to be lacking in the structural elements associated with murrelet nest sites, i.e., large trees with very large limbs or other structural features capable of supporting a murrelet platform nest (Hamer and Nelson 1995). We do not view this as necessarily compromising the study, given the desirability of a conservative approach to habitat conservation. But the apparent lack of suitable nesting structures in and near at least one-third of our occupied sites leads us to search for other explanations, i.e., hypotheses, that can be useful for conservation planning.

A structured, logical approach to defining and addressing management issues is essential to being able to intentionally manage for desired, or necessary, levels of wildlife population response (Hilborn and Ludwig 1993). In the absence of such an approach, we will never know if success or failure resulted from our design or from happenstance. Similarly, we could only guess as to ways to improve upon our outcomes. Unlike DNR's current interim approach, where some unknown level of murrelet conservation results from not harvesting forest stands where murrelets are suspected of nesting, an approach as noted above can lead to *intentional* conservation (Carey et al. 1999) with measurable objectives for habitat conservation and restoration linked to objectives for murrelet demographic responses. Thoughtful consideration of murrelet population biology and the mechanisms linking it with the environment is a necessary precursor to such an approach (Marzluff et al. 2000). To that end, we provide a brief summary of the population and habitat context in which we suggest our results be viewed.

Standardized monitoring of the breeding season murrelet population in Washington (Jodice et al. 2002) suggests that the majority of the estimated ~10,000 murrelets on Washington waters are within commuting distance of old-growth forests on the Olympic Peninsula (Figure 1). Hull et al. (2001) found an average distance of 38.8 miles (mean plus standard deviation) between 23 nest sites and 640 on-water relocations of the radio-tagged parent birds in Desolation Sound, B.C. We found relatively high activity and occupancy levels in fragmented old-growth forests in the commercial forests of the western Olympic Peninsula (Harrison et al. 1999, Horton and Harrison 2001), while Hall (2000) found very high activity and occupancy in unfragmented old-growth in Olympic National Park. The murrelet activity depicted in Figure 1 reflects this, although detections are mapped without reference to survey effort. Raphael et al. (2002) found radar counts of numbers of murrelets flying inland correlated with amounts of old-growth forests in the Olympic Peninsula drainages they were visiting. In light of this background, are our observations of murrelets exhibiting occupied behaviors at apparently anomalous sites: 1) a reflection of birds actually nesting in these areas; 2) observations of birds en route to the nearby,

contiguous old-growth forests of Olympic National Park; or 3) simply a reflection of our lack of understanding of the ecological significance of these observations?

How should DNR consider this new information on the distribution of murrelet activity and occupancy on state forests, in planning and implementing a long-term conservation strategy for its HCP Straits Planning Unit? Consider the following questions, for example. Should DNR make a serious effort to discover whether or not murrelets are actually nesting in these structurally-simple second-growth stands in hopes this can lead to an efficient silvicultural approach to restoring murrelet habitat capability? Should DNR try to restore particular landscape patterns around these occupied sites in hopes this improves their capability to support productive murrelet nests? We suggest that this new information will be most productive for HCP planning and implementation when considered in light of an intellectual model constructed of a series of scientific hypotheses that describe the mechanisms that link murrelet population biology with the characteristics of forest stands and landscapes. Such a model will provide the basis for implementing a habitat conservation plan, the results of which can be measured and potentially improved through a program of monitoring and adaptive management.

Acknowledgments

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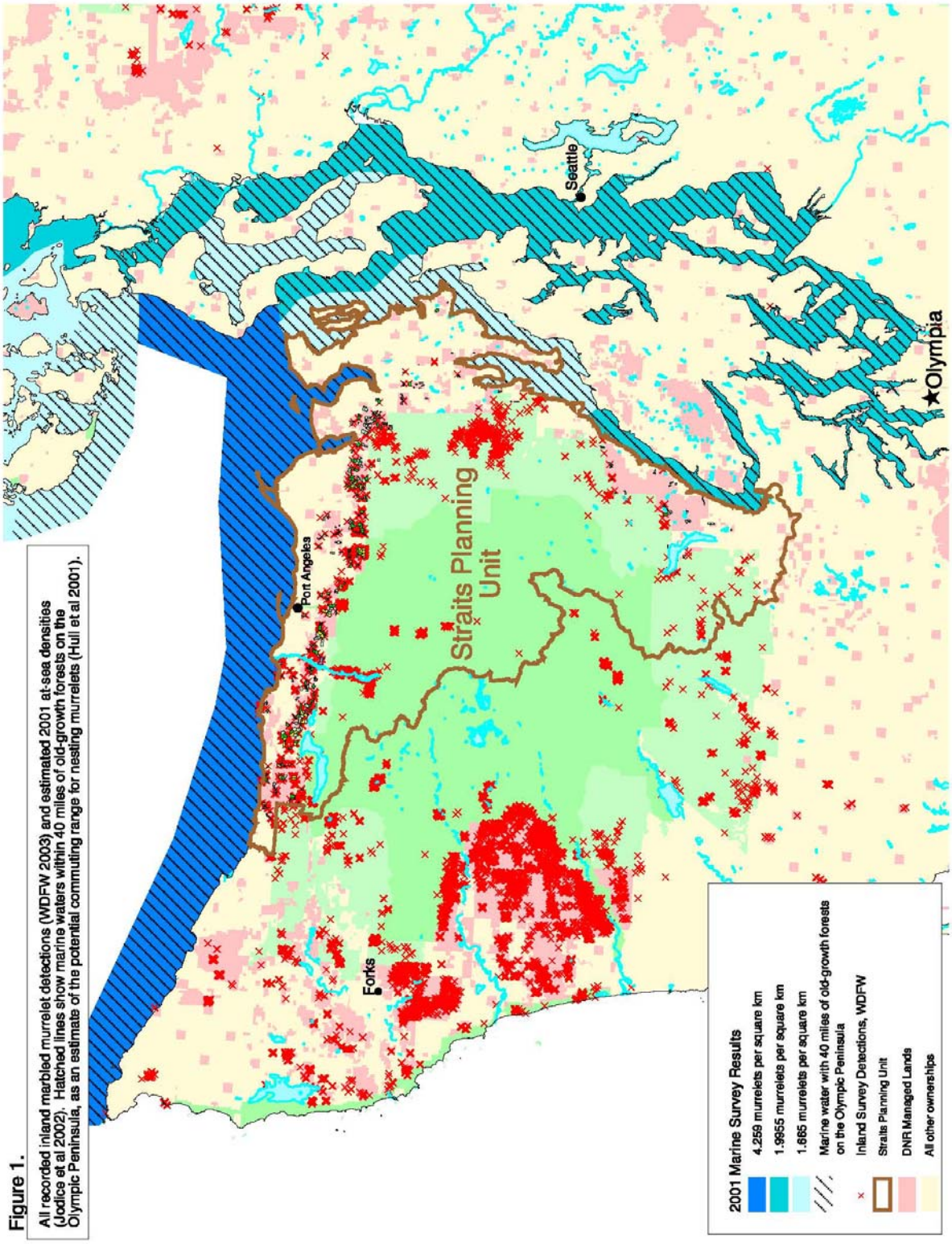

Figure 1.

All recorded inland marbled murrelet detections (WDFW 2003) and estimated 2001 at-sea densities (Jodice et al 2002). Hatched lines show marine waters within 40 miles of old-growth forests on the Olympic Peninsula, as an estimate of the potential commuting range for nesting murrelets (Hull et al 2001).

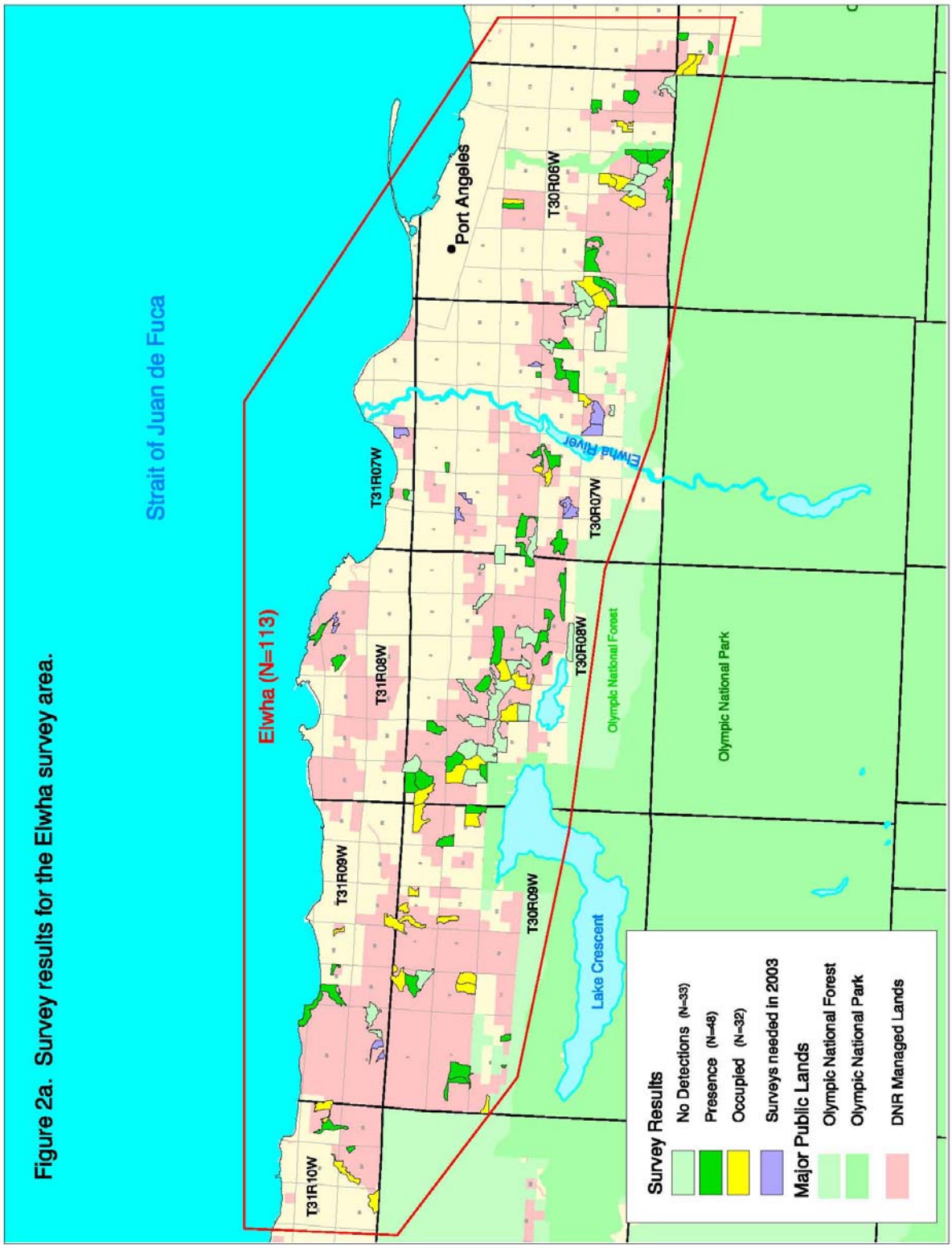

Figure 2a. Survey results for the Elwha survey area.

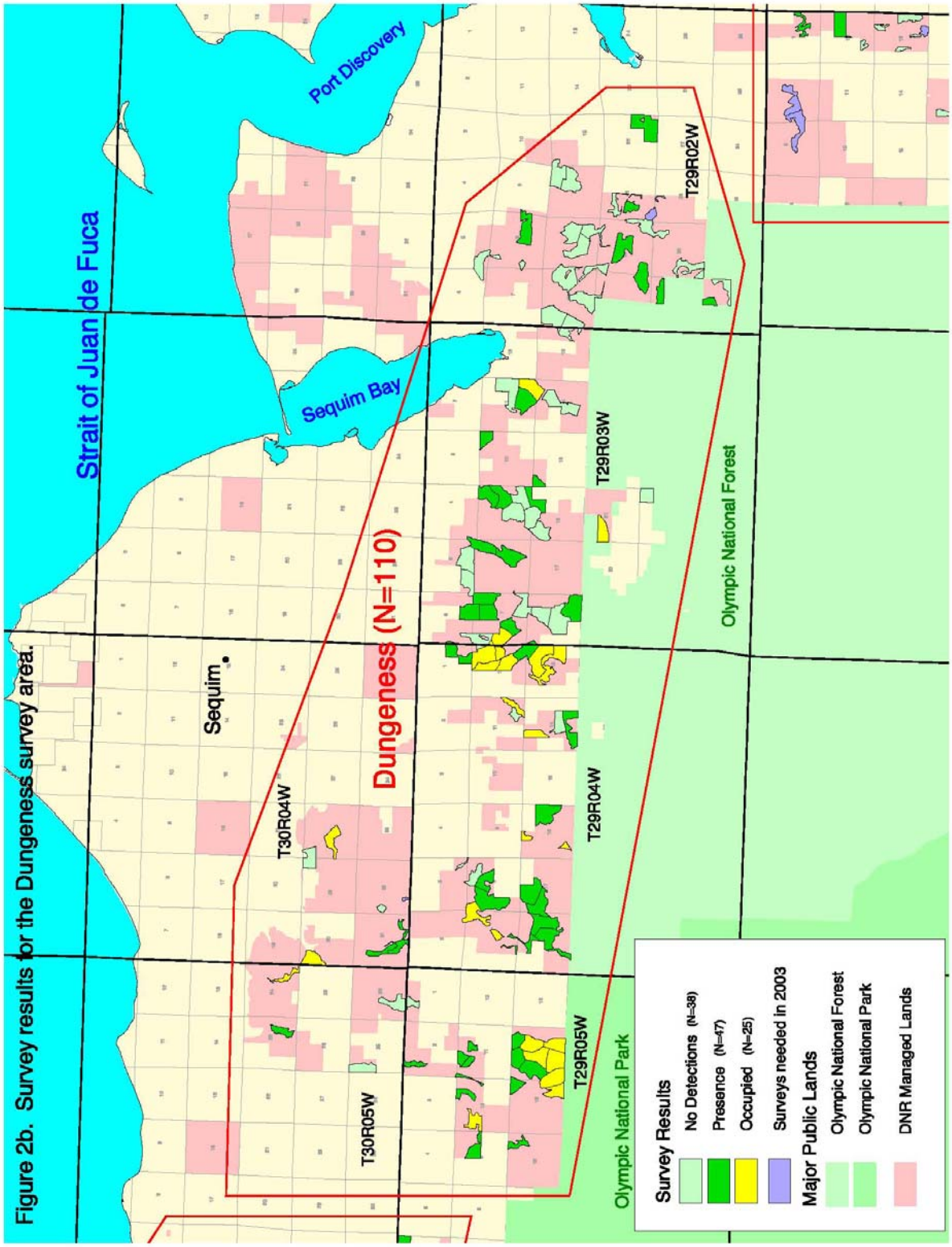

Figure 2b. Survey results for the Dungeness survey area.

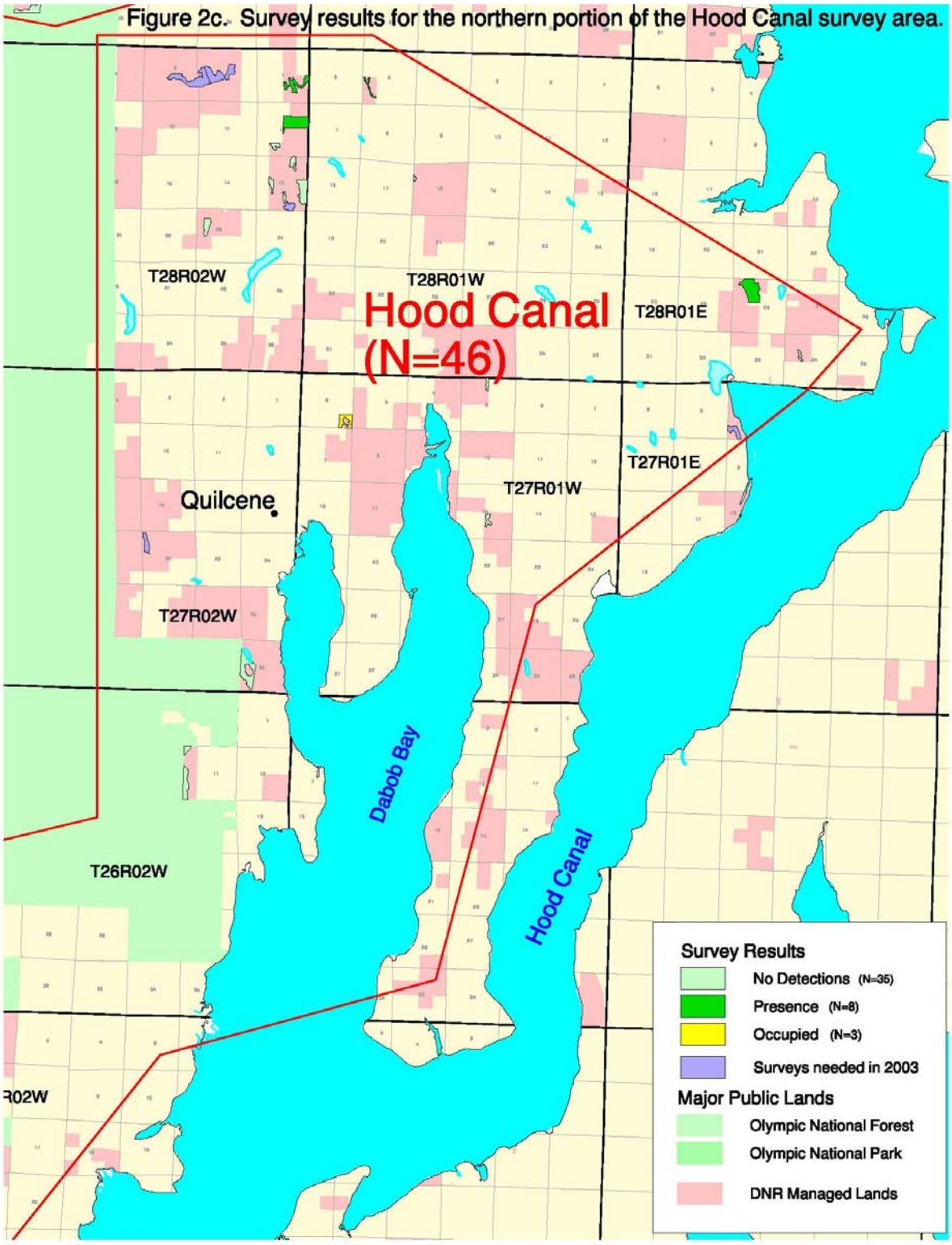
Figure 2c. Survey results for the northern portion of the Hood Canal survey area.
T28R02W
T28R01W
Hood Canal
(N=46)
T28R01E
T27R01E
T27R01W
Quilcene
T27R02W
Dabob Bay
Hood Canal
T26R02W
R02W
Survey Results
No Detections (N=35)
Presence (N=8)
Occupied (N=3)
Surveys needed in 2003
Major Public Lands
Olympic National Forest
Olympic National Park
DNR Managed Lands

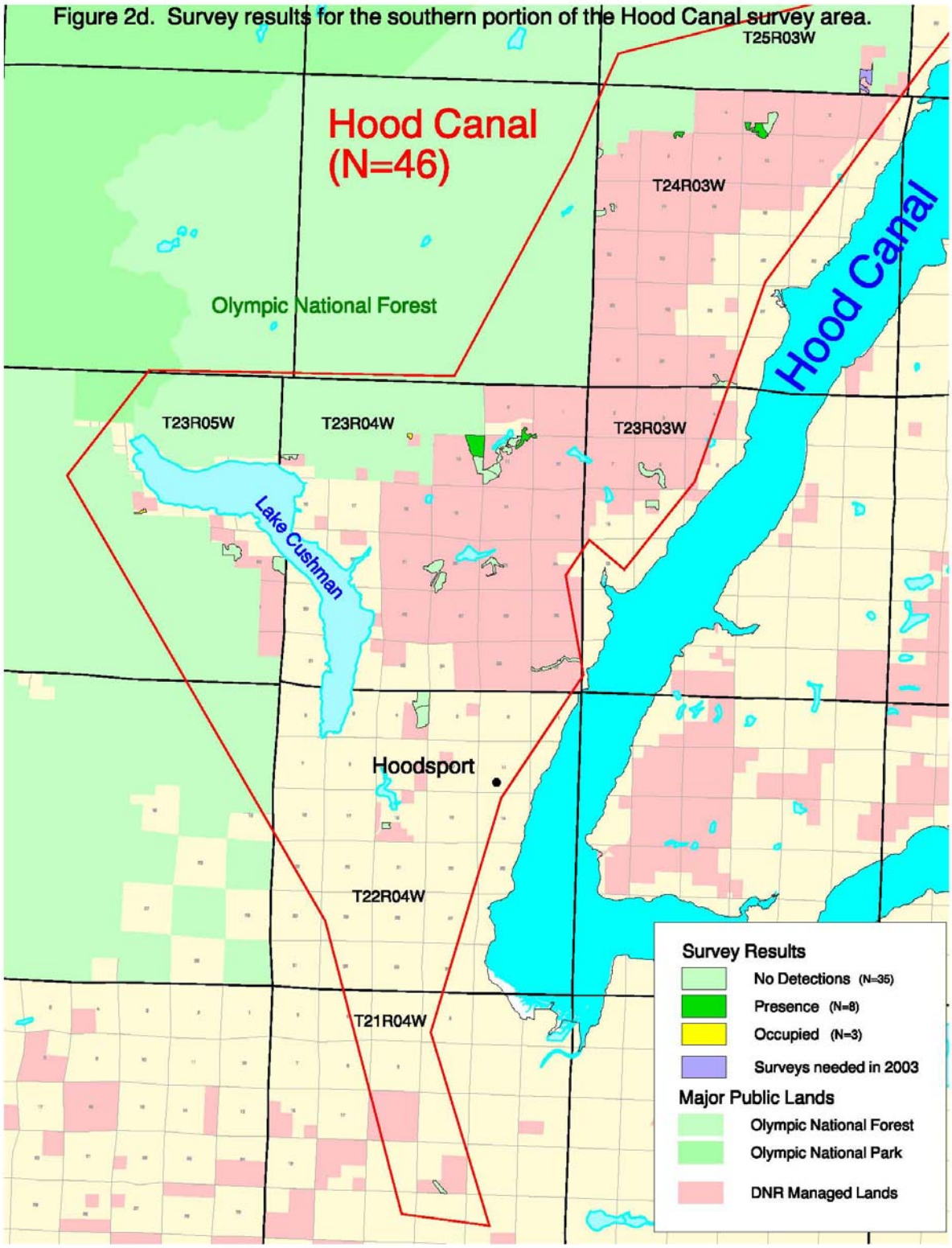

Figure 2d. Survey results for the southern portion of the Hood Canal survey area.