United States
Department of
Agriculture

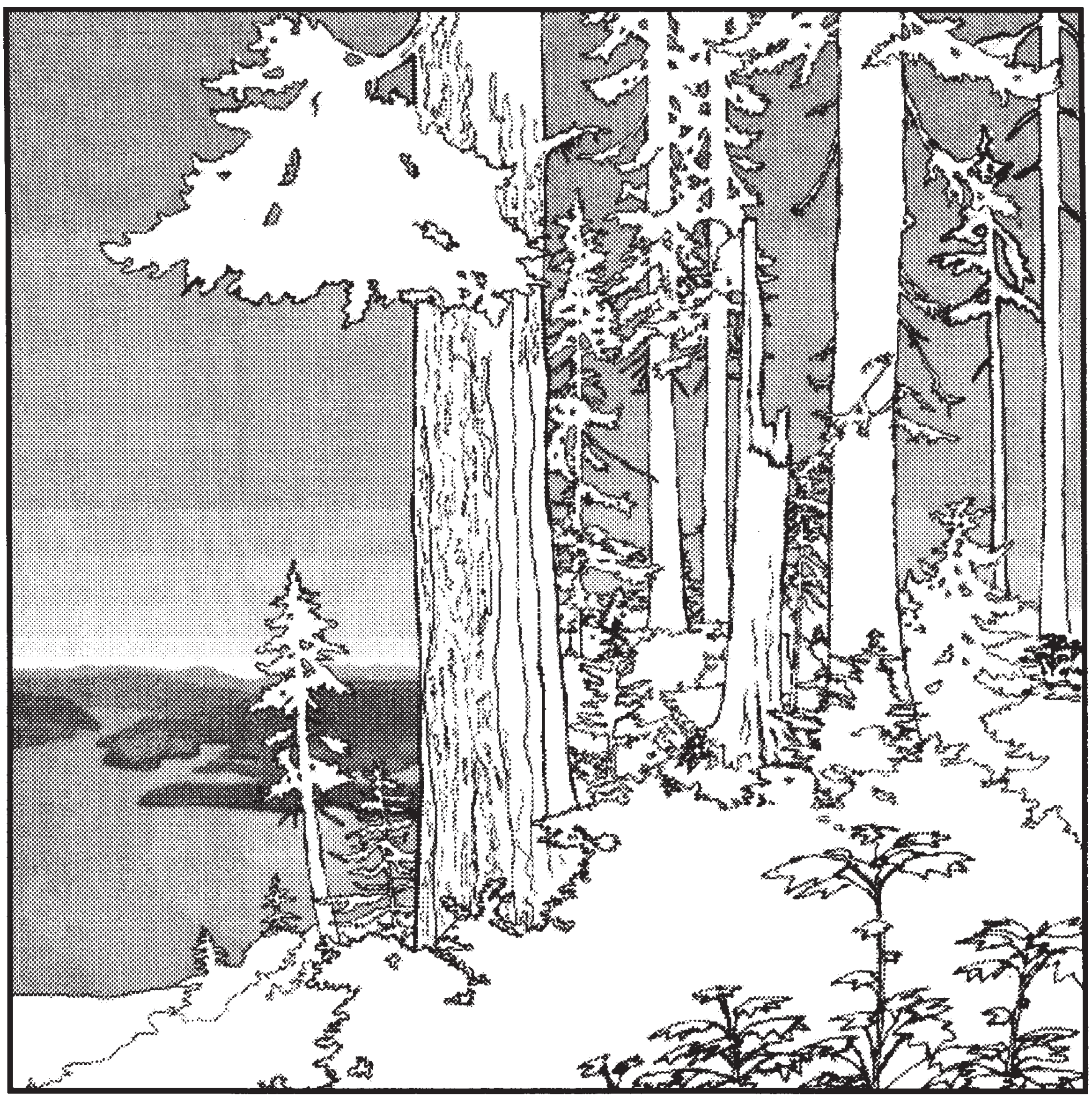
Forest Service

Pacific Northwest
Research Station

General Technical
Report
PNW-GTR-386
November 1996

Scientific information and the Tongass Land Management Plan: Key Findings From the Scientific Literature, Species Assessments, Resource Analyses, Workshops, and Risk Assessment Panels

Douglas N. Swanston, Charles G. Shaw III, Winston P. Smith, Kent R. Julin, Guy A. Cellier, and Fred H. Everest



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Conservation and Resource Assessments for the Tongass Land Management Plan Revision

Charles G. Shaw III, Technical Coordinator

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Published by:
U.S. Department of Agriculture
Forest Service
Pacific Northwest Research Station
Portland, Oregon
General Technical Report PNW-GTR-386
November 1996

Abstract

Swanston, Douglas, N.; Shaw, Charles G., III; Smith, Winston P.; Julin, Kent R.; Cellier, Guy A.; Everest, Fred H. 1996. Scientific information and the Tongass land management plan: key findings derived from the scientific literature, species assessments, resource analyses, workshops, and risk assessment panels. Gen. Tech. Rep. PNW-GTR-386. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 30 p. (Shaw, Charles G., III, tech. coord.; Conservation and resource assessments for the Tongass land management plan revision).

This document highlights key items of information obtained from the published literature and from specific assessments, workshops, resource analyses, and various risk assessment panels conducted as part of the Tongass land management planning process. None of this information dictates any particular decision; however, it is important to consider during decisionmaking or when the consequences of any particular decision are evaluated.

Keywords: Risk assessment panels, Delphi, resource analyses, science policy, Tongass National Forest, Alaska.

Introduction

In late summer 1994, a new approach to forest planning was initiated for the Tongass National Forest in southeast Alaska, with senior research scientists from the Pacific Northwest Research Station (PNW) incorporated directly into the planning team. This change from the traditional makeup of a planning team was intended to bring objective, independent thinking into the planning process and to maximize development and application of the most up-to-date science in the plan. Together, these objectives were designed to increase the likelihood that a scientifically credible, legally defensible, and resource sustainable Forest plan could be developed in a timely manner.

Primary responsibilities of the scientists on the planning team were to (a) gather and develop currently available data and information on critical issues addressed in the plan, (b) assess the scientific rigor of this information, (c) analyze the information in the context of Tongass National Forest needs, (d) develop estimates of risks to resources that might result from various proposed management activities, (e) review various assumptions and strategies currently used in the Forest plan, and (f) present the information to the full team as an aid in formulating alternatives and developing the effects analysis. An important additional responsibility has been the documentation and publication of pertinent data, analyses, and procedures developed by various components of the team.

This document annotates key items of information viewed as important to the Tongass Land Management Planning (TLMP) process. The information has been assembled by the TLMP Interdisciplinary Team, including the PNW scientists and the Tongass National Forest staff assigned to the team.

Information is highlighted from the literature and from specific assessments, workshops, resource analyses, and the various risk assessment panels that were components of this TLMP process. None of this information dictates a decision; however, it is important to consider during decisionmaking or when the consequences of any particular decision are evaluated. Only those items in which the authors have considerable confidence have been included.

Information Sources Supporting Key Findings

Key findings were developed from four primary sources: (1) assessment and analysis of current scientific information, (2) critical review and analysis of items currently used in the Forest plan, (3) synthesis of current and new information into scientifically sound strategies for formulation of alternatives, and (4) estimations of risk for various issues and resources through implementation of different management alternatives.

Conservation assessments for the Alexander Archipelago wolf (36),[1] Queen Charlotte goshawk (28), marbled murrelet (13), and karst and caves (5) are currently being prepared for publication as PNW General Technical Reports.

The results of resource analyses addressing slope stability, timber volume estimation, forested wetlands, the distribution of remaining blocks of old-growth forest, wildlife viability, wind disturbance, young-growth yield projections, alternatives to clearcutting, and timber price and demand projections, will be published in a combined document as a separate General Technical Report (41). A detailed explanation of the panel process and results also will appear in a separate PNW document (42).

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[1] Literature is referred to by number; see “References.”

The information developed and used in these assessments and resource analyses has received extensive internal review by research scientists and resource specialists in the USDA Forest Service and cooperating agencies, including the U.S. Fish and Wildlife Service, the U.S. Environmental Protection Agency, the National Marine Fisheries Service, and the State of Alaska. In addition, the assessments have undergone independent, blind peer review.

These findings, combined with those in the viable populations committee report (44), a peer review by the Pacific Northwest Research Station of the viable populations committee report (30), and the Anadromous Fish Habitat Assessment (3) represent the most comprehensive scientific evaluation of these resources to date for the Tongass National Forest.

Sources of Information

Science assessments—Assessments of the current and most applicable scientific information involved national and international literature searches; consultation with recognized experts in private industry, in the Federal government, and at universities; and application of professional knowledge and experience. Analysis of assessment results provided an improved database and a measure of quantity, quality, and scientific significance of available data and theory for addressing the focal issues in this revision of the Forest plan.

Resource analyses—A review and analysis of data, information, and assumptions previously used in the TLMP process identified important information gaps, shortcomings of model assumptions, and areas where data analyses and theory needed to be revised to reflect current levels of knowledge.

Workshops—Workshops provided a forum where results of science assessments and resource analyses were synthesized into scientifically sound strategies for development of viable alternatives to manage the Tongass National Forest.

Risk assessment panels—A modified “Delphi” approach (31) using panels of experts was employed to estimate the level of risk to wildlife resources and socioeconomic conditions from implementing various management alternatives. Panelists were given a thorough briefing on the purpose of the panels, the rating system to be used, species distribution, habitat issues specific to the Tongass National Forest (e.g., island geography, land ownership patterns, past cutting practices), and an overview of the draft alternatives including their design components and pertinent standards and guidelines. Specific questions were answered by local resource specialists, but no direct interaction among evaluators through discussion was allowed initially. For the fish and wildlife panels, each panel member was asked to individually assign, without consultation, a level of risk or “likelihood” (as defined by specific outcomes) to the continued persistence of the species’ population, well-distributed across its historic range within the Tongass National Forest, for each alternative implemented over 100 years.

Following the independent evaluations, a discussion occurred and was recorded to clarify why particular assignments of likelihood were given, the reasons for any differing interpretations of available knowledge, what knowledge gaps existed, and how this lack of information influenced likelihood scores. Each alternative was evaluated independently, and no attempt was made to compare alternatives; evaluators were asked, however, to indicate specific components of alternatives that could be modified to improve their rating. Results of the discussions were used to clarify reasons for likelihood scores, what particular changes in an alternative might increase an assignment of likelihood scores, and where major levels of concern exist. Panel results are summarized in the appendix; further explanation is provided by Smith and Shaw (42).

Various Delphi methods have been used previously in natural resource management to evaluate habitat quality or develop habitat suitability indices (31). Both types of applications require assigning cardinal values to likelihood scores and then analyzing these cardinal values to interpret results. The Forest Ecosystem Management Assessment Team (FEMAT) in the Pacific Northwest (18) also used assigned scores in a cardinal fashion to assess risk to viability. The results for the Tongass rely heavily on empirical components supportable by pertinent data from within and outside southeast Alaska and on extensive local knowledge and experience. The approach is credible within the scientific community.

Key Findings From Science Assessments, Workshops and Resource Analyses

Results

The science assessments and resource analyses assembled by the TLMP team and their cooperators have consolidated the available information on the issues emphasized in the revised supplement to the draft environmental impact statement (49). The following short statements highlight key findings from each resource by document.

Science assessments—

1. Assessment of karst and cave resources:

   - The Tongass National Forest contains the largest concentration of solution caves known in the State of Alaska (2, 4, 6).
   - The Tongass National Forest contains world-class karst terrain features, particularly epikarst or surface karst (2, 5, 6).
   - Karst terrain supports a highly productive terrestrial ecosystem coupled with well-developed subsurface drainage important to aquatic communities (5, 6).
   - Some of the most highly evolved karst terrain, the most fragile and sensitive to management disturbance, is concentrated in the alpine and subalpine zones and on slopes greater than 70 percent; these areas are identified as such in the TLMP data base (5, 6; TLMP geographic data base).
   - The karst landscape has developed from the sea to the top of some of the highest peaks in the Alexander Archipelago. Of the karst lands found at lower elevations, about 30 to 50 percent in the Ketchikan Area and 10 to 20 percent in the Chatham and Stikine Areas are believed to be highly sensitivity to human disturbances (5; TLMP geographic database).
   - Protocols for assessing levels of risk from timber harvesting and road construction to karst landscape, associated resources, and significant caves at lower elevations are part of the assessment and are available for use at the Administrative Area (Chatham, Ketchikan, and Stikine) and project level (5, 6).

2. Conservation assessment for the northern goshawk:

- In November 1991, the northern goshawk (*Accipiter gentilis atricapillus*) was designated as a category 2 species in southeast Alaska by the U.S. Fish and Wildlife Service, thereby indicating a heightened concern for its long-term viability. The Fish and Wildlife Service concluded that past logging activity in southeast Alaska has adversely affected goshawk habitat (7).
- In response to a petition, the Fish and Wildlife Service did not list the goshawk as a threatened or endangered species, in part because of the commitment by the USDA Forest Service to address the issue in the TLMP process. This decision was challenged in court and the judge recently returned the petition to the Fish and Wildlife Service for reconsideration (7, 28).
- Productive old-growth forest is an important and selected habitat component of goshawk use patterns (1, 11, 12, 27, 28).
- All habitat types other than productive old growth (e.g., alpine, subalpine, peatland, clearcuts, etc.) are used less than would be predicted by their availability (1, 11, 12, 27, 28; unpublished field data on file with Alaska Department of Fish and Game).
- The beach fringe is preferentially used by goshawks, particularly females (1, 11, 12, 27, 28; unpublished field data on file with Alaska Department of Fish and Game).
- Riparian buffer areas are preferentially used by goshawks (28).
- Goshawk habitat capability has declined in southeast Alaska over the last 4 decades following the predominantly clearcut timber harvesting of 1 million or more acres (400 000 or more ha) of productive old growth on private, State, and Federal lands (1, 11, 12, 28).
- Single-tree, small-group selection or other harvest methods that maintain old-growth character, rather than clearcutting, may provide stand structure conducive to maintaining goshawk habitat (16, 28, 50).
- A combination of reserve-based and dynamic landscape approaches increases the likelihood of sustaining well-distributed, viable populations of goshawks in southeast Alaska. This approach involves establishment of habitat reserves and management of the intervening forest lands through single-tree, small-group selection or other harvest methods that maintain old-growth character coupled with an extended rotation (≥300 years) (16, 28, 50).
- In comparison to shorter periods, a 300-year rotation may better allow the harvested forest to develop the type of structure well suited to goshawk use (16, 28, 50).

3. Conservation assessment for the Alexander Archipelago wolf:

   - Wolf (*Canis lupus ligoni*) densities are generally lower on the mainland and higher on islands in the southern half of the Tongass National Forest (35, 36).
   - Wolves are absent from Admiralty, Baranof, and Chichagof Islands (36).
   - Continued viability of wolves is an issue on Prince of Wales and Kosciusko Islands, where past timber harvest has reduced the capability of the habitat to support deer and also resulted in high road densities (i.e., > 0.9 mile per square mile [0.6 kilometer per square kilometer]) (35, 36).
   - Mortality rates of radio-collared wolves averaged 50 percent annually between 1993 and 1995 on Prince of Wales Island, in large part the result of legal and illegal hunting and trapping (35, 36).
   - Trapping and hunting harvest rates correlate positively with road density on Prince of Wales Island (35, 36). Long-term wolf conservation would be enhanced by maintaining virtually unroaded core areas of habitat—each large enough to encompass the primary activities of one pack, managing wolf harvest within sustainable limits through regulations, and providing long-term deer habitat capability to support an abundant and stable deer population (35, 36).

4. Conservation assessment for the marbled murrelet:

   - Marbled murrelets (*Brachyrampus marmoratus*) are numerous and widespread throughout the coastal waters of southeast Alaska (13, 38).
   - Although population trends for marbled murrelets in southeast Alaska are not well documented, there has been an estimated 50-percent decline over the last 20 years State-wide (37, 38, 39, 43).
   - A similar estimated 60-percent decline is reported for Clayoquot Sound, British Columbia, during a 10-year period (8).
   - Habitat requirements for nesting are poorly understood, but data from forested areas elsewhere within the range of the marbled murrelet indicate that high-volume stands of old-growth coniferous forests near the coast are important nesting habitat. In southeast Alaska, six nests have been located to date; one on rock talus, one on overturned tree roots, and four in trees. All nests were at relatively low elevation, relatively close to salt water, and within moderate to high volume old-growth forest (8, 13, 43).
   - Single-tree, small-group selection, or other harvest methods that maintain characteristics of old-growth forest structure, rather than clearcutting, may maintain the types of stand structures within harvested areas that will support nesting murrelets (13, 50).
   - Long timber harvest rotations (>200 years) also may sustain murrelet nesting habitat (13, 50).
   - Implementing a reserve-based strategy, particularly in those biogeographic provinces where past timber harvest has been concentrated and is projected to continue, should enhance the likelihood of maintaining well-distributed marbled murrelet habitat (13, 50).

5. Assessment of wind disturbance as a fundamental ecosystem process:

   - Windthrow is the predominant natural disturbance process in the forests of southeast Alaska (22, 32, 33, 34).
   - Biodiversity and retention of old-growth forest characteristics are linked to historic disturbance conditions (22, 34).
   - Forests in southeast Alaska span a gradient from old-growth conditions dominated by small-scale gap dynamics to single-cohort or multicohort conditions driven by periodic, large-scale disturbances (22, 32, 33, 34).
   - When large-scale blowdowns occur, a portion of the forest stand usually survives and provides a natural legacy of (a) large-tree habitat for wildlife; (b) seed sources; and (c) structural diversity (22, 32, 33, 34).
   - The size, frequency, and configuration of past clearcut timber harvesting, typically done in blocks of 20 acres (8 ha) or more on a 100-year harvest rotation, contrasts sharply with the natural disturbance regime, may reduce the likelihood of conserving fish and wildlife habitats and populations, and may decrease the occurrence and distribution of old-growth ecosystems and their component parts and processes (32, 34).
   - Natural disturbance regimes may be emulated through harvesting by increasing rotation lengths, decreasing patch sizes, increasing shape complexities, and using single-tree, small-group selection or other harvest methods that maintain characteristics of old-growth forest structure (15, 32, 34).

6. Wildlife viability synthesis workshop:

   - The habitat requirements of an array of birds and various terrestrial mammals, notably goshawks (*Accipiter gentilis atricapillus*), wolves (*Canis lupus ligoni*), murrelets (*Brachyrampus marmoratus*), marten (*Martes americana*), brown bears (*Ursus arctos*), and several small mammals, the quality of fisheries habitat, and the distribution and condition of old-growth ecosystems are primary factors in defining Forest-wide wildlife viability (16, 17, 23, 24, 25, 26, 27, 29, 50).
   - Management practices and land allocations useful in developing Forest-wide approaches to maintain viable wildlife populations across the Forest include:

a. Existing retentions (wilderness, research natural areas, etc.).

b. Riparian habitat protection.

c. Silvicultural systems that emulate natural disturbances, such as small-scale, even-aged or uneven-aged long rotations rather than large-scale, short-rotation clearcutting.

d. Old-growth reserves appropriately spaced and stratified across the Forest (e.g., habitat conservation areas as proposed by the Interagency Viable Populations Committee [44]).

e. Retention of current vegetation in the beach and estuary fringe.

f. Species-specific standards and guides (50).

7. Analysis of slope stability and mass movement hazards:

   - Landslides are a dominant natural process of hillslope erosion and sediment delivery to stream systems in the Tongass National Forest (45, 46).
   - This erosion process is a primary source of gravels and an important source of large woody debris necessary for fish habitat (3, 17, 45).
   - Accelerated landslide activity can reduce both forest site productivity and fish habitat capability by removing soil horizons and introducing excessive sediment into salmon streams (45, 46).
   - Published research documents a threefold increase in the frequency of landslides (debris avalanche and debris flow) >135 cubic yards (100 m^3) in volume from clearcut areas versus uncut areas in southeast Alaska. These clearcut landslides are smaller in volume, travel shorter distances, and tend to dissipate energy and deposit in the lower reaches of class II and class III streams before reaching class I streams, although suspended sediment often is transported into class I streams (46).
   - Gradient is a key variable in slope stability (40, 45, 46).
   - Forested lands in southeast Alaska with gradients steeper than 36 degrees (72 percent) are naturally unstable and subject to accelerated landslide activity when disturbed by either natural or management-related events (40, 45).

8. Analysis of growth and yield projections:

   - Growth and yield model projections for young, even-aged stands give results consistent with data in published yield tables; however, empirical data are limited (21).
   - For a specific CMAI (cumulative mean annual incriment), variations in volume per acre of young growth has minimal influence on calculations of the available sale quantity (ASQ) of timber when calculations are made over 100 years or more (21).
   - The young-growth model and inventory data do not provide reliable projections of yields from the partial cutting of old growth through many cycles (21).
   - Changes in the estimated age at which young-growth stands reach 95 percent culmination of mean annual increment can markedly affect ASQ calculations (21).
   - An obstacle to accurate growth projections in existing old growth is the lack of long-term yield estimates for stands of old-growth Sitka spruce (*Picea stichensis* (Bong.) Carr.) and western hemlock (*Tsuga heterophylla* (Raf.) Sarg.) (21).

9. Timber “falldown” during plan implementation—an analysis:

   - “Hard” falldown results when unmapped features, such as high-hazard soils and streams requiring buffers, are not identified at the Forest planning level but are found during field inspection for project planning and implementation (20).
   - “Soft” falldown results from economic considerations; it also results from project level emphasis on “other” resource issues, on logging infeasibilities, or from addressing data errors (20).

- A primary cause of soft falldown is a lack of knowledge about site conditions until they are clarified during field implementation of a project (20).
- Even with the current attempts to address falldown issues, some uncertainty (e.g., budgets, actual implementation of standards and guidelines, appeals) exists with ASQ estimates (20).

Risk assessment panels and workshops—

Following are salient points derived from the discussions and ratings of the various risk assessment panels. These panels were used as an integral component of the effects analysis for the draft alternatives evaluated in the Revised Supplement to the Draft Environmental Impact Statement (49). The purpose of conducting these panels was to provide decisionmakers and the public with information on the relative risk that implementation of each alternative would pose to the continuing persistence throughout the landscape of the species or resource in question. A more detailed explanation of the panel process is given by Smith and Shaw (42).

Risk is reported in terms of the likelihood that populations will remain well distributed across the planning area. The reporting of likelihood levels is for reference only. It is not an endorsement of this or any other level as an appropriate measure of risk. In the appendix, a summary of mean scores adapted from Smith and Shaw (42) is presented for each species by alternative. The range of scores for each species also is included to reflect dispersion of likelihood points (42).

General findings of the fish habitat and wildlife viability panels (14, 17, 23, 24, 25, 26, 27, 29, 42)—

- The wildlife and old-growth panel results are generally consistent with the findings of the Alaska Region Viable Populations Committee report (44), the PNW peer review of the Viable Populations Committee report (30) and the wildlife assessments (13, 28, 36). Along with the Anadromous Fish Habitat Assessment (3), these documents represent the best available information on fish and wildlife habitat needs in southeast Alaska.
- The panel results indicate differential effects of alternatives on individual species and resources as well as the likelihood that several alternatives will have detrimental effects after 100 years of implementation.
- Results of all viability and fish panels indicate an inverse relation between planned acres (hectares) of timber to be cut and miles (kilometers) of road to be constructed, and the likelihood that well-distributed habitat or populations will be maintained.
- Using the mean of the scores assigned by panelists to outcomes I and II combined (see appendix for outcome descriptions) from the five individual wildlife species panels, only alternatives 1, 4, and 5 have a 55-percent or greater likelihood of maintaining well-distributed populations of all five species across the planning area in 100 years. Alternatives 1 and 5 have a 65-percent or greater likelihood of meeting this outcome. At a 75-percent likelihood, only alternative 1 meets this outcome. For the “other mammals” panel, none of the alternatives has a 55-percent or greater likelihood of maintaining well-distributed populations. These likelihood levels are used only for reference and are not an endorsement of any level as an appropriate measure of risk.

- Results from the fish and riparian panel (17) agreed with results in the Anadromous Fish Habitat Assessment (3).
- Panel results support considering past cumulative management activities on all land ownerships in planning for future management of the Tongass National Forest to ensure well-distributed populations of wildlife across the entire Alexander Archipelago.
- Panel results indicate that alternatives 1, 3, 4, 5, and 6 have a higher likelihood of maintaining habitat to support well-distributed, viable wildlife populations than do alternatives 2, 7, 8, and 9.
- Overall results from the panels and assessments suggest that alternatives 2, 7, and 9 are unlikely to maintain suitable, well-distributed habitats to ensure wildlife viability Forest-wide for the long term.

Specific findings of individual risk assessment panels—

1. The brown bear panel identified the following key points (25):
   - An undisturbed buffer (no harvest, no roads) along salmon-bearing streams where bears concentrate and feed helps to maintain brown bear habitat. Such buffers provide some isolation of bear feeding sites from humans and other bears. The panel identified 500 feet (152 m) along each side of salmon bearing-streams as an appropriate buffer width.
   - The presence of roads affects bears by (a) increasing sediment delivery to salmon streams, which can reduce salmon productivity and thus feeding opportunities for bears; and (b) increasing human access to bear habitat, which can increase hunting pressure, illegal kills, and actions by people to defend life and property.
   - From the mean of the scores assigned by panelists to outcomes I and II combined (see appendix for outcome descriptions), alternatives 1, 3, 4, and 5 have a 55-percent or greater likelihood of maintaining a well-distributed population of brown bears across their historic range in the Tongass National Forest in 100 years. Alternatives 1 and 5 meet the above conditions at a 65-percent or greater likelihood, and only alternative 1 does so at a 75-percent or greater likelihood.
2. The socioeconomic panel identified the following key points (10):
   - Some panelists indicated that reduced timber harvest levels could result in serious effects on communities; other panelists indicated that there could be short-term job losses, but reduced timber harvesting would ultimately lead to long-term economic diversity.
   - Reduced timber harvest could result in short-term job losses and economic hardship in a number of communities (e.g., Ketchikan, Wrangell, Thorne Bay, Craig, and other Prince of Wales Island communities).
   - Land use designations that allow increased timber harvest around communities could change the type of recreation in those areas, in that primitive and semi-primitive recreation opportunities could be reduced while road-related activities (e.g., camping with recreational vehicles and driving for pleasure) could increase. The demand for semiprimitive, motorized (e.g., airplane or boat accessible) opportunities is projected to exceed supply by 2000. For primitive opportunities, supply exceeds demand into the foreseeable future.

- Panelists indicated a need to query individual communities to obtain their judgments on the factors evaluated by the panel.

3. The fish and riparian panel identified the following key points (17):

- Increased levels of timber harvest generally result in increased risk of degradation to fish habitat.
- The greatest risk of degradation to fish habitat is caused by the presence of roads, because they serve as a source of sediment input to streams.
- Future timber harvest and road construction likely will occur on steeper slopes than many past harvests, which could increase the amount of sediment reaching streams.
- Higher levels of riparian protection (options 1 and 2) provide less risk to fish habitat capability than does option 3. See chapter 3 in reference (49) for descriptions of the riparian options.
- Although the lower level of riparian protection (option 3) increases the risk to fish resources in comparison with options 1 or 2, it does offer less risk than current practices (47).
- Some watersheds likely will not have returned to prelogging condition in 100 years, primarily because of impacts resulting from past timber harvesting and road construction in riparian zones.
- Universal and consistent application of best management practices (48) reduces the risk of fish habitat degradation. At present, however, best management practices are merely guidelines and thus may not be fully applied and implemented.
- Longer rotations (≥200 years) with correspondingly reduced ASQ, reduce risks to degradation of fish habitat by reducing the overall rate of sediment input.
- In all alternatives except alternative 1, the miles of road to be constructed and total acres of timber to be harvested during the next 100 years can be expected to degrade channel conditions if fully implemented.
- During the next 100 years, in all alternatives, watersheds previously subjected to timber harvest in riparian areas will not have recovered from depletion of large woody debris. Planned additional harvest in these watersheds would further delay recovery in all alternatives except alternative 1.
- From the mean of the scores assigned by panelists to outcomes I and II combined (see appendix for outcome descriptions), alternatives 1, 3, 4, 5, and 6 have a 55-percent or greater likelihood of maintaining adequately distributed, productive fish habitat in the Tongass National Forest and causing minor or no additional degradation of habitat, with currently degraded habitats recovered or moving towards recovery in 100 years. Alternatives 1, 3, 4, and 5 meet the above conditions at 65-percent or greater likelihood. Alternatives 1, 3, 4, and 5 also meet these conditions at a 75-percent or greater likelihood.

4. The “other mammals” panel identified the following key points (29):

  - The archipelago nature of southeast Alaska, coupled with the often dramatic topographic relief, contributes to isolation of the “other mammal” populations by dissecting habitats and restricting migration of individuals.
  - The isolation of small mammal populations and lack of connectivity among similar habitats increases the risk that timber harvest will markedly reduce or further fragment large portions of existing habitats and also decreases the likelihood of maintaining the long-term viability of local populations after extensive clearcut timber harvesting.
  - Geographically, the level of risk to viability from any management activity increases as the size of individual islands decreases.
  - Information on many small mammals is limited. Where more information is available (e.g., the northern flying squirrel [*Glaucomys sabrinus griseifrons*]), evidence indicates that past forest management has fragmented habitat such that some populations probably became isolated because of their limited dispersal range.
  - Endemic “other mammals” were the most sensitive of all wildlife species paneled to future landscape disturbances, such as that resulting from clearcut timber harvesting. Such disturbances affect the likelihood of maintaining well-distributed populations of endemic “other mammals” across the planning area.
  - Information to date indicates that past management has adversely affected some populations of endemic “other mammals” (e.g., populations of the northern flying squirrel on Prince of Wales Island).
  - From the mean of the scores assigned by panelists to outcomes I and II combined (see appendix for outcome descriptions), none of the alternatives exceeds a 55-percent or greater likelihood of maintaining a well-distributed population of either group (widely distributed and endemic) of “other mammals” across their historic range in the Tongass National Forest in 100 years.

5. The deer panel identified the following key points (14):

  - The habitat capability model for Sitka black-tailed deer (*Odocoileus hemionus sitkensis*) was revised by using the new timber volume strata and physiographic features.
  - Discussion among panelists supported past modeling efforts and approaches and reinforced the importance of maintaining habitat capability by protecting critical deer winter range.
  - Small-scale, uneven-aged silvicultural prescriptions, or other harvest methods consistent with natural disturbance regimes, are most likely to be compatible with the conservation of deer habitat.

6. The old-growth ecosystems panel identified the following key points (15):

- An inventory of old-growth habitat within the Tongass National Forest identified the size and distribution of remaining blocks, potentially allowing for more accurate location of representitive habitat reserves.
- Past harvest of old growth has been spatially clumped with concentrated activity on islands such as Prince of Wales, Kosciusko, Zarembo, and northeast Chichagof.
- Reserves of any kind by themselves do not appear to be adequate to maintain interconnected, functionally interrelated old-growth ecosystems.
- Past harvest of productive old growth in the Tongass National Forest has been concentrated in higher volume stands at lower elevations. Between 1952 and 1995, an average of more than 40,000 board feet per acre (688 m^3/ha) was harvested from about 414,000 acres (165 000 ha). About 83 percent of this harvested acreage is below 800 feet (244 m) in elevation; 60 percent of it is below 500 feet (152 m).
- About 16 percent of the high-volume old growth in the Tongass National Forest has already been harvested. If the draft preferred alternative were to be implemented for 100 years, then about 28 percent of the high-volume old growth would be harvested.
- Leaving legacy trees in harvest units helps to maintain important parts of old-growth ecosystems such as lichens, fungi, and other taxa. Two-aged management, as proposed in alternatives 3, 4, 5, 6, and 8, will retain such legacy trees.
- Wide beach fringes and uncut riparian buffers enhance connectivity among otherwise isolated old-growth blocks by providing elevational and horizontal corridors.
- Wide beach fringes also provide improved habitat for bald eagles (*Haliaeetus leucocephalus*) and goshawks owing to increased screening from management disturbance and increased prey diversity and abundance (19, 27).
- Recent research findings (19) indicate that buffer zones around bald eagle nests should be at least 984 feet (300 m), a distance that is most consistent with the extended (1000-foot [305-m]) beach fringe specified in alternatives 1, 2, 4, 5, 6, and 8.
- Alternatives 1, 3, 4, 5, and 6 conserve more old-growth ecosystem elements then do alternatives 2, 7, 8, and 9.
- From the mean of the scores assigned by panelists to outcomes I and II combined (see appendix for outcome descriptions), alternatives 1, 3, 4, 5, and 6 have a 55-percent or greater likelihood of achieving an overall ecosystem condition in 100 years that is hypothesized to fall within the typical range of conditions that have occurred over previous centuries. Alternatives 1, 4, 5, and 6 meet the above conditions at a 65-percent or greater likelihood, whereas only alternatives 1, 4, and 5 do so at a 75-percent or greater likelihood.

7. The goshawk panel identified the following key points (27):

   - Even in the reserve approach, as proposed in alternatives 3 and 8, the large reserves are likely too small to support well-distributed populations of goshawks across the planning area.
   - Extended rotations (>200 years) offer an approach to maintaining well-distributed goshawk populations.
   - The extended rotation matrix approach in alternative 4, or the matrix-reserve approach in alternative 5, increases the likelihood of maintaining the species well-distributed across the planning area.
   - Management of the intervening forest matrix between reserves under a 100-year harvest rotation is less likely to sustain goshawks than management under longer rotations (200 or 300 years).
   - Goshawks likely can persist in a managed, dynamic landscape with a variety of conifer age classes. This management scenario likely can be obtained under a 300-year rotation.
   - Extended riparian and beach buffers maintain important habitat components owing to prey diversity and abundance available in these habitats.
   - Goshawk panel findings are generally consistent with findings in the goshawk conservation assessment (28).
   - From the mean of the scores assigned by panelists to outcomes I and II combined (see appendix for outcome descriptions), alternatives 1, 4, and 5 have a 55-percent or greater likelihood of maintaining a well-distributed population of goshawks across their historic range on the Tongass National Forest in 100 years. Alternatives 1, 4, and 5 also meet the above conditions at a 65-percent or greater likelihood, and only alternative 1 does so at a 75-percent or greater likelihood.

8. The marten panel identified the following key points (24):

   - Three subspecies of marten are native to southeast Alaska. Marten were released on several islands, including Baranof, Chichagof, and Prince of Wales; whether natural populations also occurred on these islands remains unclear.
   - Marten are considered to be a desirable, fur-bearing species by the Alaska Department of Fish and Game.
   - An extended rotation matrix approach (alternative 4) or a matrix-reserve approach (alternative 5) increases the likelihood of marten maintaining well-distributed populations across the planning area.
   - The full reserve approach as proposed in alternatives 3 and 8 may not fully support species persistence without an extended rotation in the matrix lands, because the sizes of individual reserves are likely too small to independently support viable populations.

- A landscape approach that adopts an entire set of habitat reserves, connected by elevational and horizontal corridors, and uses a 200-year or longer rotation in the matrix provides a high likelihood of maintaining persistent and well-distributed marten populations.

- From the mean of the scores assigned by panelists to outcomes I and II combined (see appendix for outcome descriptions), alternatives 1, 4, and 5 have a 55-percent or greater likelihood of maintaining a well-distributed population of marten across their historic range on the Tongass National Forest in 100 years. Alternatives 1 and 5 also meet the above conditions at a 65-percent or greater likelihood, and only alternative 1 does so at a 75-percent or greater likelihood.

9. The marbled murrelet panel identified the following key points (26):

   - Although nesting and habitat data are scarce for marbled murrelets in southeast Alaska, behavior and habitat needs seem to be similar to those observed in coastal British Columbia, Washington, Oregon, and California.

   - Without a watershed-based old-growth reserve system with a minimum of 1600 spatially explicit, contiguous acres (640 ha; the size of a small habitat reserve) per watershed (value comparison unit), the likelihood of maintaining well-distributed breeding populations may be reduced.

   - From the mean of the scores assigned by panelists to outcomes I and II combined (see appendix for outcome descriptions), alternatives 1, 3, 4, 5, 6, and 8 have a 55-percent or greater likelihood of maintaining a well-distributed population of marbled murrelets across their historic range on the Tongass National Forest in 100 years. Alternatives 1, 3, 4, and 5 meet the above conditions at a 65-percent or greater likelihood. Alternatives 1, 3, and 5 meet the above conditions at a 75-percent or greater likelihood.

10. The Alexander Archipelago wolf panel identified the following key points (23):

    - Maintaining deer habitat capability to support adequate numbers of deer is a key factor in maintaining long-term wolf viability on islands in the Alexander Archipelago.

    - Limiting road access to wolf habitat reduces both legal and illegal hunting and trapping, and controlling seasons and bag limits helps assure sustainability.

    - From the mean of the scores assigned by panelists to outcomes I and II combined (see appendix for outcome descriptions), alternatives 1, 2, 3, 4, 5, and 6 have a 55-percent or greater likelihood of maintaining a well-distributed population of wolves across their historic range in the Tongass National Forest in 100 years. Alternatives 1, 3, 4, and 5 meet the above conditions at a 65-percent or greater likelihood. Alternatives 1, 3, and 5 meet the above conditions at a 75-percent or greater likelihood.

11. The subsistence working group identified the following key points (9):

   - Adequate deer populations are a key element of subsistence lifestyles.
   - Protecting important deer winter range sustains habitat for subsistence hunting.
   - The presence of substantial old-growth blocks and reserves preserves deer habitat and winter range.
   - Alternatives 1, 3, 4, and 5 have a higher likelihood than other alternatives of supporting a sustainable subsistence harvest of deer.
   - A reserve close to a community has a higher likelihood of maintaining readily accessible habitat of important subsistence species and availability of old-growth forest products such as moss, bark, spruce roots, and mushrooms, than does timber harvest, even that with a long rotation.
   - The highest levels of riparian protection (options 1 and 2) are important to subsistence users because these people have a high dependence on subsistence use of fish.
   - Maintenance of minimally disturbed beach and estuary fringes is important for subsistence users because of the important habitat they offer to deer, waterfowl, and bear as well as for salmon and shellfish in tidal areas. Berries and bark also are collected in fringe areas.
   - The crossing of fish streams by roads increases the likelihood of degradation to streams with resulting reductions in fish production and availability to subsistence users.
   - Roads increase access for subsistence users.

Information Gaps

The science assessments, resource analyses, workshops, and panels have identified several important information gaps that need to be addressed to aid completion of the next revision of the Tongass Forest Plan. The priority issues for which additional quantitative information is needed include:

- Economic feasibility and effects on old-growth ecology of silvicultural alternatives to clearcutting.
- Young-growth forest response on wetland soils.
- Influence of resource use on economic and social values at regional and community levels in southeast Alaska.
- Response and productivity of young-growth forest stands.
- Product recovery from young-growth forest stands.
- Distribution, abundance, and taxonomic status of endemic small mammal populations in southeast Alaska.
- Site quality indicators, not based on standing volume, to better represent the site potential of old-growth forest stands.
- Culmination of cumulative mean annual increment for young-growth stands on various sites under various management regimes and how best to use this information in Forest plan modeling.

- Additional information on timber volume classes; currently this information is being used in Forest plan modeling at a geographic scale two levels beyond its recognized statistical validity.
- Effects of gaps (natural and human induced) in habitat within islands on the distribution and survival of old-growth associated species.
- Role of high-gradient contained channels in routing of sediment and large woody debris to downstream fish habitat.
- Effects of land management activities on geomorphic processes in high-gradient channels.
- Fish habitat relations to salmonid populations in old-growth-dominated (unlogged) watersheds and watersheds that have had various levels of timber harvest and road development. Riparian management objectives should be a product of the evaluation.
- Effects of various management actions on natural processes in karst terrain.
- Evaluation of road drainage structures within the Tongass National Forest, primarily culverts and bridges, which currently are designed to withstand 25- and 50-year frequency flood events, respectively. Consequently, in all alternatives, without substantial reconstruction and upgrading, nearly all culverts can be expected to fail during the next 100 years. Even though impacts of these failures on the fisheries resource and water quality are not quantified, some habitat degradation is anticipated.
- Further clarification of old-growth habitat needs and use of harvested lands by the marbled murrelet.
- Further clarification of old-growth habitat needs and use of harvested lands by the northern goshawk.

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Appendix

This appendix includes individual risk assessment panel scores with means for each alternative for selected old-growth-associated wildlife species, fisheries resources, and the old-growth ecosystem. See Smith and Shaw (42) for further details.

Risk assessment panels were used as an integral component of the effects analysis of the draft alternatives evaluated in the revised supplement to the draft environmental impact statement (RS-DEIS) (49). The purpose of conducting these panels was to provide decisionmakers and the public with further information on the relative risk that implementation of each alternative would pose to the continuing persistance throughout the landscape of the species or resource in question.

A "likelihood" approach, similar to that used by the Forest Ecosystem Management Assessment Team [FEMAT] (18), was used in assessing the level of risk. Scientists with recognized expertise in the particular species or resource were organized into panels, instructed on the issues and alternatives, and provided with the most up-to-date scientific information available. Individual scientists on each panel were then given 100 likelihood points to assign to each alternative when considering a set of projected outcomes. Assignment of points was made independently without interaction or consultation among panel members. The panel was then reconvened and the point assignments of each panel member discussed and recorded. Allocation of all 100 points to a single outcome expressed complete certainty in that particular outcome. Uncertainty was expressed by the spread of points across outcomes.

The wildlife panels assessed the likelihood that an alternative would maintain sufficient, well-distributed habitat to ensure continued persistence of a species population, well-distributed across its historic range in the Tongass National Forest. The outcomes considered by the panel were:

1. Habitat is of sufficient quality, distribution, and abundance to allow species to maintain well-distributed breeding populations across the Tongass.

2. Habitat is of sufficient quality, distribution, and abundance to allow the species to maintain well-distributed breeding populations across the Tongass—however, some local populations are more ephemeral because of reduced population levels and increased susceptibility to environmental extremes and events associated with reduced habitat abundance and distribution.

3. Habitat is of sufficient quality, distribution, and abundance to allow species to maintain some breeding populations but with significant gaps in the historic distribution across the forest.

4. Habitat allows continued species existence only in refugia, with strong limitations on interactions among local populations.

5. Habitat conditions result in species extirpation from Federal land.

The fisheries resource panels assessed the likelihood that an alternative would maintain productive habitat for the range of anadromous and resident fish species in the Tongass, including distribution of populations, levels of degradation of habitat, and recovery of habitat from currently degrading conditions. One panel assessed the likely effect of each alternative on habitat condition. A separate panel assessed the likely effect of each alternative on channel condition, including maintenance of large woody debris, pool depth, area, stream width-to-depth ratios, and streambed stability. The outcomes considered by the panel assessing habitat condition were:

1. New management activities will not cause additional degradation of freshwater habitat for the species, productive habitat will be well distributed across the Forest, or the historic range of the species within the Forest, and habitats currently degraded will recover or be moving toward recovery after 100 years.

2. New management activities will result in minor additional degradation of freshwater habitat for the species, productive habitat will be adequately distributed across the Tongass National Forest, or the historic range of the species within the Forest, and most habitats currently degraded will recover or will be moving toward recovery after 100 years.

3. New management activities will result in moderate additional degradation of freshwater habitat for the species, distribution of productive habitat across the Tongass National Forest, or the historic range of the species within the Forest, will contain some gaps where the species will not occur or where populations will be severely reduced, and many habitats currently degraded will neither recover nor be moving toward recovery after 100 years.

4. New management activities will result in major additional degradation of freshwater habitat for the species, distribution of productive habitat across the Tongass National Forest, or the historic range of the species within the Forest, will contain large gaps where the species will not occur or where populations will be severely reduced, and most habitats currently degraded will neither recover nor be moving toward recovery after 100 years.

5. New management activities will result in severe additional degradation of freshwater habitat for the species, the species will be extirpated or populations will be decimated over much of its historic range in the Tongass National Forest, and habitats currently degraded will neither recover nor be moving toward recovery after 100 years.

The outcomes considered by the panel for assessing channel condition were:

1. Riparian objectives will be met throughout the Tongass National Forest, there will be little or no additional degradation from existing conditions owing to new management activities, and areas currently not meeting riparian objectives will recover or be moving toward recovery in 100 years.

2. Riparian objectives will be met throughout most of the Tongass National Forest, there will be minor additional degradation from existing conditions due to new management activities, and most areas not currently meeting riparian objectives will recover or be moving toward recovery in 100 years.

3. Riparian objectives will be met across the Tongass National Forest but there will be a substantial area where they are not met, there will be moderate additional degradation from existing conditions due to new management activities, and many areas currently not meeting riparian objectives will neither recover nor be moving toward recovery in 100 years.

4. Riparian objectives will be met across a small part of the Tongass National Forest but they will not be met over the majority of the Forest, there will be major additional degradation from existing conditions owing to new management activities, and most areas not currently meeting riparian objectives will neither recover nor be moving toward recovery in 100 years.

5. Riparian objectives will be met on a very small part of the Tongass National Forest, almost all areas will not meet riparian objectives, there will be severe additional degradation from existing conditions owing to new management objectives, and areas currently not meeting riparian objectives will neither recover nor be moving toward recovery in 100 years.

The old-growth ecosystem panel assessed the likelihood that an alternative would influence the overall ecosystem condition in the remaining old-growth blocks within the Tongass National Forest by evaluating the abundance and ecological diversity (the acreage and variety of plant communities and environments); ecosystem process, structure, and function (the ecological actions that lead to the development and maintenance of ecosystems, and the values of the ecosystem for species and populations); and connectivity (the extent to which the landscape pattern of the ecosystem provides for biological flows that sustain animal and plant populations).

The outcomes considered by the panel for abundance and diversity were:

1. Old growth is equal to or greater then the long-term average (100 years) and is well distributed across environmental gradients, provinces, and community types.

2. Old growth is somewhat less than the long-term average in forest types of some provinces; representation occurs in all major forest types but is well underrepresented in some areas (may be within range of variability).

3. Old growth is below the long-term average in most forest types and examples of a few old-growth types are eliminated.

4. Old growth is well below long-term averages in all provinces, and examples of several old-growth types are eliminated in some provinces.

The outcomes considered by the panel for ecosystem process, structure, and function were:

1. The full range of disturbance processes are represented; stand structure and dynamics and landscape structure, dynamics, and age attributes occur across all provinces.

2. A moderately wide range of disturbance processes are represented, old-growth processes and functions dependent on large unaltered landscapes are limited, and old-growth processes, structures, or functions dependent on a wide range of ages are moderately limited.

3. Old-growth processes, structures, and functions are limited in many provinces; many landscapes and stands are too small or too young to sustain old-growth processes, structures, and functions, or stand structure does not develop.

4. Old-growth processes, structures, or functions are extremely limited or absent in some provinces.

The outcomes considered by the panel for connectivity were:

1. Connectivity is as strong as before large-scale timber harvest occurred.

2. Connectivity is strong, characterized by moderate distances between old-growth areas, and the matrix contains high levels of old-growth elements and riparian corridors.

3. Connectivity is moderate, characterized by moderately wide distances between old growth and elements of old growth in the matrix (retention patches, riparian corridors, etc.).

4. Connectivity is weak with wide distances and limited presence of connectivity elements in matrix.

GOSHAWK

Outcome	ALT 1 1,2	ALT 1 3-5	ALT 2 1,2	ALT 2 3-5	ALT 3 1,2	ALT 3 3-5	ALT-4 1,2	ALT-4 3-5	ALT 5 1,2	ALT 5 3-5	ALT 6 1,2	ALT 6 3-5	ALT 7 1,2	ALT 7 3-5	ALT 8 1,2	ALT 8 3-5	ALT 9 1,2	ALT 9 3-5
Evaluator																		
1	90	10	30	70	40	60	80	20	85	15	55	45	10	90	50	50	20	80
2	100	0	0	100	40	60	40	60	50	50	0	100	0	100	0	100	0	100
3	100	0	45	55	60	40	80	20	80	20	75	25	30	70	40	60	60	40
4	100	0	20	80	70	30	60	40	80	20	70	30	10	90	20	80	10	90
Mean	98	3	24	76	53	48	65	35	74	26	50	50	13	88	28	73	23	78

MARTEN

Outcome	ALT 1 1,2	ALT 1 3-5	ALT 2 1,2	ALT 2 3-5	ALT 3 1,2	ALT 3 3-5	ALT-4 1,2	ALT-4 3-5	ALT 5 1,2	ALT 5 3-5	ALT 6 1,2	ALT 6 3-5	ALT 7 1,2	ALT 7 3-5	ALT 8 1,2	ALT 8 3-5	ALT 9 1,2	ALT 9 3-5
Evaluator																		
1	100	0	0	100	55	45	100	0	100	0	50	50	5	95	40	60	5	95
2	25	75	0	100	0	100	0	100	0	100	0	100	0	100	0	100	0	100
3	100	0	10	90	80	20	90	10	90	10	20	80	10	90	10	90	10	90
4	90	10	20	80	40	60	50	50	90	10	40	60	20	80	30	70	20	80
Mean	79	21	8	93	44	56	60	40	70	30	28	73	9	91	20	80	9	91

WOLF

Outcome	ALT 1 1,2	ALT 1 3-5	ALT 2 1,2	ALT 2 3-5	ALT 3 1,2	ALT 3 3-5	ALT-4 1,2	ALT-4 3-5	ALT 5 1,2	ALT 5 3-5	ALT 6 1,2	ALT 6 3-5	ALT 7 1,2	ALT 7 3-5	ALT 8 1,2	ALT 8 3-5	ALT 9 1,2	ALT 9 3-5
Evaluator																		
1	85	15	80	20	80	20	70	30	75	25	65	35	45	55	50	50	50	50
2	100	0	20	80	90	10	75	25	90	10	50	50	10	90	60	40	10	90
3	100	0	80	20	85	15	70	30	70	30	70	30	25	75	40	60	40	60
4	90	10	60	40	80	20	75	25	90	10	70	30	35	65	50	50	35	65
Mean	94	6	60	40	84	16	73	28	81	19	64	36	29	71	50	50	34	66

MURRELET

Outcome	ALT 1 1,2	ALT 1 3-5	ALT 2 1,2	ALT 2 3-5	ALT 3 1,2	ALT 3 3-5	ALT-4 1,2	ALT-4 3-5	ALT 5 1,2	ALT 5 3-5	ALT 6 1,2	ALT 6 3-5	ALT 7 1,2	ALT 7 3-5	ALT 8 1,2	ALT 8 3-5	ALT 9 1,2	ALT 9 3-5
Evaluator																		
1	100	0	15	85	70	30	65	35	85	15	40	60	10	90	40	60	20	80
2	100	0	50	50	70	30	70	30	100	0	50	50	20	80	50	50	30	70
3	100	0	70	30	95	5	90	10	100	0	85	15	60	40	90	10	70	30
4	100	0	70	30	90	10	70	30	80	20	60	40	30	70	70	30	60	40
Mean	100	0	51	49	81	19	74	26	91	9	59	41	30	70	63	38	45	55

BEAR

Outcome	ALT 1 1,2	ALT 1 3-5	ALT 2 1,2	ALT 2 3-5	ALT 3 1,2	ALT 3 3-5	ALT-4 1,2	ALT-4 3-5	ALT 5 1,2	ALT 5 3-5	ALT 6 1,2	ALT 6 3-5	ALT 7 1,2	ALT 7 3-5	ALT 8 1,2	ALT 8 3-5	ALT 9 1,2	ALT 9 3-5
Evaluator																		
1	100	0	75	25	80	20	80	20	70	30	65	35	30	70	35	65	10	90
2	90	10	40	60	65	35	50	50	65	35	50	50	0	100	10	90	10	90
3	85	15	30	70	60	40	55	45	65	35	55	45	30	70	40	60	30	70
4	95	5	10	90	35	65	35	65	65	35	35	65	5	95	30	70	5	95
Mean	93	8	39	61	60	40	55	45	66	34	51	49	16	84	29	71	14	86

OTHER MAMMALS

Outcome	ALT 1		ALT 2		ALT 3		ALT-4		ALT 5		ALT 6		ALT 7		ALT 8		ALT 9	
	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5
Evaluator																		
1	60	40	20	80	30	70	35	65	40	60	40	60	10	90	15	85	10	90
2	0	100	0	100	40	60	0	100	0	100	40	60	0	100	40	60	0	100
3	0	100	0	100	0	100	0	100	0	100	0	100	0	100	0	100	0	100
4	70	30	0	100	20	80	35	65	50	50	20	80	0	100	15	85	0	100
Mean	33	68	5	95	23	78	18	83	23	78	25	75	3	98	18	83	3	98

CHINOOK

Outcome	ALT 1		ALT 2		ALT 3		ALT-4		ALT 5		ALT 6		ALT 7		ALT 8		ALT 9	
	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5
Evaluator																		
1	100	0	100	0	100	0	100	0	100	0	100	0	100	0	100	0	100	0
2	100	0	90	10	100	0	100	0	100	0	90	10	90	10	100	0	100	0
3	100	0	100	0	100	0	100	0	100	0	100	0	100	0	100	0	100	0
4	100	0	95	5	95	5	95	5	95	5	95	5	95	5	95	5	95	5
Mean	100	0	96	4	99	1	99	1	99	1	96	4	96	4	99	1	99	1

SOCKEYE

Outcome	ALT 1		ALT 2		ALT 3		ALT-4		ALT 5		ALT 6		ALT 7		ALT 8		ALT 9	
	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5
Evaluator																		
1	100	0	100	0	100	0	100	0	100	0	100	0	100	0	100	0	100	0
2	100	0	100	0	100	0	100	0	100	0	100	0	100	0	100	0	100	0
3	100	0	15	85	80	20	75	25	85	15	25	75	10	90	20	80	10	90
Mean	100	0	72	28	93	7	92	8	95	5	75	25	70	30	73	27	70	30

COHO

Outcome	ALT 1		ALT 2		ALT 3		ALT-4		ALT 5		ALT 6		ALT 7		ALT 8		ALT 9	
	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5
Evaluator																		
1	100	0	30	70	70	30	90	10	100	0	60	40	0	100	40	60	10	90
2	100	0	80	20	80	20	90	10	90	10	80	20	70	30	70	30	70	30
3	100	0	25	75	95	5	90	10	95	5	35	65	15	85	30	70	25	75
4	100	0	80	20	90	10	85	15	85	15	75	25	60	35	75	25	60	40
Mean	100	0	54	46	84	16	89	11	93	8	63	38	36	63	54	46	41	59

CHUM

Outcome	ALT 1		ALT 2		ALT 3		ALT-4		ALT 5		ALT 6		ALT 7		ALT 8		ALT 9	
	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5
Evaluator																		
1	100	0	20	80	70	30	80	20	80	20	60	40	0	100	50	50	0	100
2	90	10	60	30	80	20	90	10	90	10	70	30	70	30	60	40	70	30
3	100	0	15	85	90	10	90	10	90	10	20	80	10	90	15	85	10	80
4	100	0	60	40	70	30	70	30	70	30	60	40	50	50	60	40	50	50
Mean	98	3	39	59	78	23	83	18	83	18	53	48	33	68	46	54	33	65

PINK

Outcome	ALT 1		ALT 2		ALT 3		ALT-4		ALT 5		ALT 6		ALT 7		ALT 8		ALT 9	
	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5
Evaluator																		
1	90	10	10	90	60	40	90	10	70	30	60	40	0	100	40	60	10	90
2	90	10	60	30	70	30	90	10	90	10	70	30	70	30	60	40	70	30
3	100	0	25	75	90	10	85	15	90	10	30	70	20	80	30	70	20	80
4	100	0	60	40	70	30	70	30	70	30	60	40	50	50	60	40	50	50
Mean	98	5	39	59	73	28	84	16	80	20	55	45	35	65	48	53	38	63

DOLLY VARDEN, Anadromous

Outcome	ALT 1		ALT 2		ALT 3		ALT-4		ALT 5		ALT 6		ALT 7		ALT 8		ALT 9	
	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5
Evaluator																		
1	100	0	30	70	60	40	95	5	100	0	70	30	0	100	40	60	10	90
2	100	0	75	25	80	20	90	10	90	10	70	30	70	30	80	20	70	30
3	100	0	35	65	80	20	80	20	90	10	35	65	15	85	25	75	15	85
4	100	0	75	25	90	10	90	10	90	10	70	30	65	35	80	20	65	30
Mean	100	0	54	46	78	23	89	11	93	8	61	39	38	63	56	44	40	59

DOLLY VARDEN, Resident

Outcome	ALT 1		ALT 2		ALT 3		ALT-4		ALT 5		ALT 6		ALT 7		ALT 8		ALT 9	
	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5
Evaluator																		
1	100	0	30	70	70	30	95	5	100	0	70	30	10	90	40	60	10	90
2	100	0	80	20	80	20	90	10	90	10	70	30	70	30	70	30	70	30
3	100	0	20	80	80	20	80	20	90	10	35	65	15	85	30	70	15	85
4	100	0	75	25	90	10	90	10	90	10	70	30	65	35	70	30	65	35
Mean	100	0	51	49	80	20	89	11	93	8	61	39	40	60	53	48	40	60

CUTTHROAT, Anadromous

Outcome	ALT 1		ALT 2		ALT 3		ALT-4		ALT 5		ALT 6		ALT 7		ALT 8		ALT 9	
	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5
Evaluator																		
1	100	0	30	70	60	40	90	10	95	5	60	40	0	100	40	60	10	90
2	100	0	80	20	90	10	90	10	90	10	75	25	70	30	80	20	70	30
3	100	0	20	80	80	20	75	25	85	15	35	65	15	85	25	75	15	85
4	100	0	75	25	90	10	85	15	85	15	80	20	65	35	80	20	65	30
Mean	100	0	51	49	80	20	85	15	89	11	63	38	38	63	56	44	40	59

CUTTHROAT, Resident

Outcome	ALT 1		ALT 2		ALT 3		ALT-4		ALT 5		ALT 6		ALT 7		ALT 8		ALT 9	
	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5	1,2	3-5
Evaluator																		
1	100	0	70	30	90	10	90	10	90	10	70	30	65	35	70	30	65	35
2	90	10	70	30	80	20	90	10	90	10	70	30	70	30	70	30	70	30
3	100	0	20	80	80	20	75	25	85	15	35	65	15	85	25	75	15	85
4	100	0	20	80	70	30	95	5	95	5	70	30	0	100	50	50	10	90
Mean	98	3	45	55	80	20	88	13	90	10	61	39	38	63	54	46	40	60

STEELHEAD

Outcome	ALT 1 1,2 3-5	ALT 2 1,2 3-5	ALT 3 1,2 3-5	ALT-4 1,2 3-5	ALT 5 1,2 3-5	ALT 6 1,2 3-5	ALT 7 1,2 3-5	ALT 8 1,2 3-5	ALT 9 1,2 3-5
Evaluator									
1	100 0	70 30	90 10	85 15	85 15	70 30	60 40	70 30	60 40
2	100 0	70 30	80 20	90 10	90 10	80 20	70 20	80 20	70 20
3	100 0	5 95	85 15	80 20	85 15	15 85	5 95	10 90	10 90
4	100 0	30 70	60 40	90 10	95 5	60 40	0 100	40 60	10 90
Mean	100 0	44 56	79 21	86 14	89 11	56 44	34 64	50 50	38 60

PHYSICAL STREAM CHARACTERISTICS

Outcome	ALT 1 1,2 3-5	ALT 2 1,2 3-5	ALT 3 1,2 3-5	ALT-4 1,2 3-5	ALT 5 1,2 3-5	ALT 6 1,2 3-5	ALT 7 1,2 3-5	ALT 8 1,2 3-5	ALT 9 1,2 3-5
Evaluator									
1	90 10	0 100	50 50	60 40	60 40	60 40	0 100	0 100	0 100
2	90 10	10 90	20 80	20 80	30 70	20 80	0 100	0 100	0 100
Mean	90 10	5 95	35 65	40 60	45 55	30 70	0 100	0 100	0 100

OLD GROWTH, Connectivity

Outcome	ALT 1 1 2 3 4	ALT 2 1 2 3 4	ALT 3 1 2 3 4	ALT 4 1 2 3 4	ALT 5 1 2 3 4	ALT 6 1 2 3 4	ALT 7 1 2 3 4	ALT 8 1 2 3 4	ALT 9 1 2 3 4
Evaluator									
1	90 10 0 0	5 30 40 25	10 40 35 15	30 50 20 0	60 30 10 0	50 40 10 0	0 10 30 60	0 20 40 40	0 10 50 40
2	20 80 0 0	0 10 50 40	10 70 20 0	10 60 30 0	10 65 25 0	5 55 35 5	0 0 20 30	0 20 60 20	0 5 15 80
3	10 80 10 0	0 10 60 30	0 20 70 10	0 70 30 0	0 80 20 0	0 60 30 10	0 0 50 50	0 15 60 25	0 0 50 50
4	10 80 10 0	0 20 70 10	0 30 70 0	0 40 60 0	10 80 10 0	10 75 15 0	0 10 80 10	0 30 70 0	0 20 70 10
Mean	33 63 5 0	1 18 55 26	5 40 49 6	10 55 35 0	20 54 16 0	16 58 23 4	0 5 45 50	0 21 58 21	0 9 46 45

OLD GROWTH, Process, Structure, Function

Outcome	ALT 1 1 2 3 4	ALT 2 1 2 3 4	ALT 3 1 2 3 4	ALT 4 1 2 3 4	ALT 5 1 2 3 4	ALT 6 1 2 3 4	ALT 7 1 2 3 4	ALT 8 1 2 3 4	ALT 9 1 2 3 4
Evaluator									
1	80 20 0 0	20 40 30 10	50 30 15 5	60 30 10 0	70 30 0 0	50 40 10 0	0 0 20 80	0 0 40 60	0 0 30 70
2	70 20 10 0	0 20 70 10	30 60 10 0	20 70 10 0	40 50 10 0	30 60 10 0	0 10 20 70	20 40 30 10	0 10 25 65
3	70 30 0 0	0 0 50 50	0 0 65 35	25 60 10 5	30 55 10 5	0 45 40 5	0 0 50 50	0 0 60 40	0 0 50 50
4	40 50 10 –	0 50 50 0	10 50 40 0	20 50 30 0	30 50 20 0	10 50 40 0	0 30 60 10	20 50 30 0	0 50 40 10
Mean	65 30 5 0	5 28 50 18	23 35 33 10	31 53 15 1	43 46 10 1	23 49 25 4	0 10 38 53	10 23 40 28	0 15 36 49

OLD GROWTH, Abundance, Diversity

Outcome	ALT 1 1 2 3 4	ALT 2 1 2 3 4	ALT 3 1 2 3 4	ALT 4 1 2 3 4	ALT 5 1 2 3 4	ALT 6 1 2 3 4	ALT 7 1 2 3 4	ALT 8 1 2 3 4	ALT 9 1 2 3 4
Evaluator									
1	80 20 0 0	10 20 70 0	40 50 10 0	30 50 20 0	70 25 5 0	50 30 20 0	15 15 70 0	20 30 50 0	0 30 70 0
2	10 80 10 0	0 10 70 20	10 50 30 10	10 60 10 20	10 70 15 5	5 40 45 10	0 5 20 75	5 45 40 10	0 5 25 70
3	10 80 10 0	0 20 80 0	0 50 50 0	0 65 35 0	0 70 30 0	0 50 50 0	0 30 70 0	0 40 60 0	0 40 60 0
4	10 80 10 0	0 50 50 0	0 70 30 0	0 75 25 0	0 80 20 0	0 70 30 0	0 30 60 10	0 70 30 0	0 50 50 0
Mean	28 65 8 0	3 25 68 5	13 56 30 3	10 63 23 5	20 51 18 1	14 48 36 3	4 20 55 21	6 46 45 3	0 31 51 18

Swanston, Douglas, N.; Shaw, Charles G., III; Smith, Winston P.; Julin, Kent R.; Cellier, Guy A.; Everest, Fred H. 1996. Scientific information and the Tongass land management plan: key findings derived from the scientific literature, species assessments, resource analyses, workshops, and risk assessment panels. Gen. Tech. Rep. PNW-GTR-386. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 30 p. (Shaw, Charles G., III, tech. coord.; Conservation and resource assessments for the Tongass land management plan revision).

This document highlights key items of information obtained from the published literature and from specific assessments, workshops, resource analyses, and various risk assessment panels conducted as part of the Tongass land management planning process. None of this information dictates any particular decision; however, it is important to consider during decisionmaking or when the consequences of any particular decision are evaluated.

Keywords: Keywords: Risk assessment panels, Delphi, resource analyses, science policy, Tongass National Forest, Alaska.

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