

Guidelines For The Ecological Risk Assessment Of Marine Fish Aquaculture

Prepared by an International Workshop
coordinated by the NOAA Marine Fisheries
Service, Manchester, WA

THE WORKSHOP

- A project proposed by:
 - Member countries of the FAO-COFI sub-committee on aquaculture
 - Delegations of the United States and the European Union, and seconded by many others
 - at Trondheim, Norway in October, 2003

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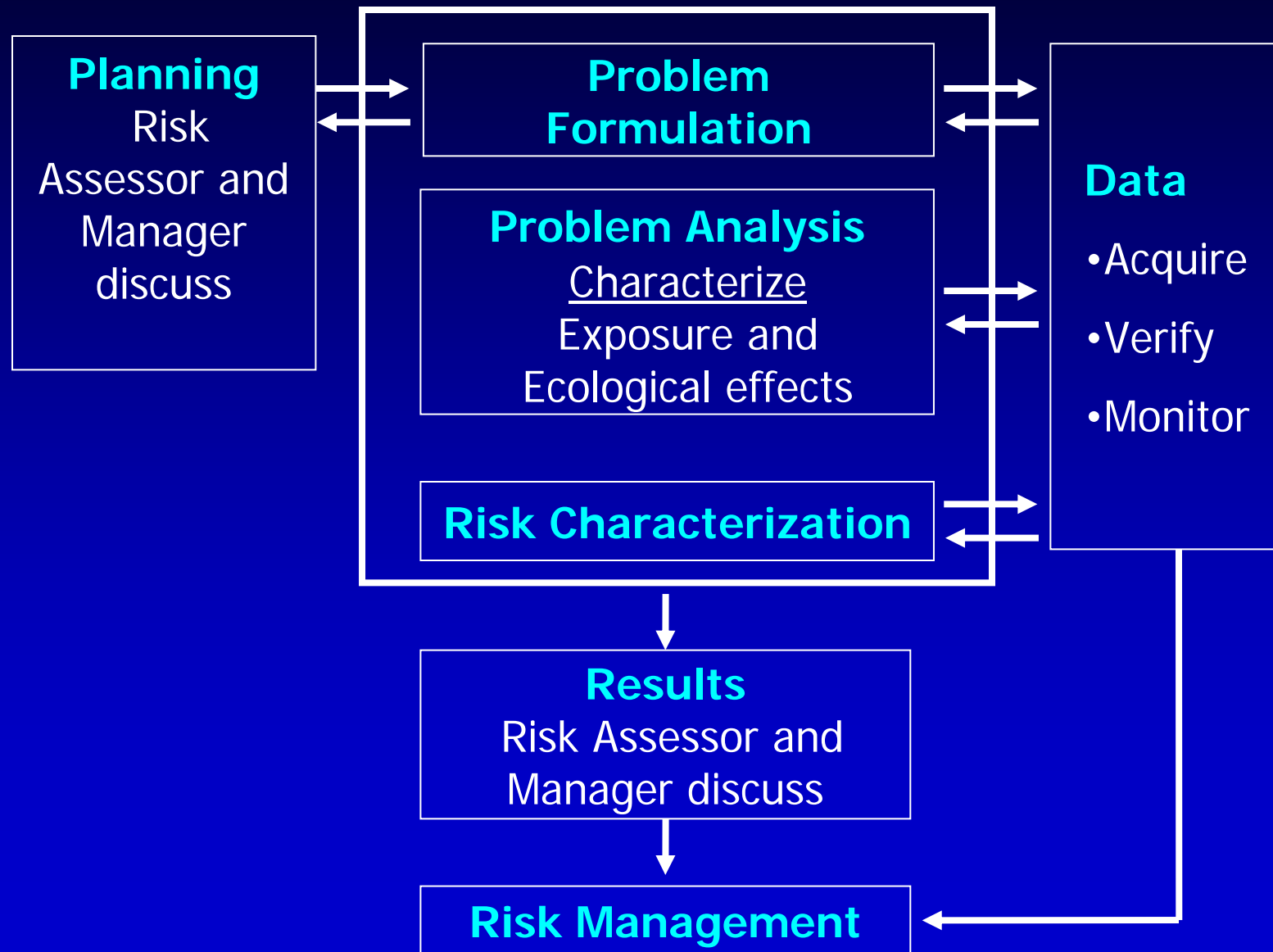
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FIVE OBJECTIVES OF RISK ASSESSMENT GUIDELINES

- Identify areas of substantive risk in the interaction between site operations and the environment
- Identify biological end points, both near and far field, that may be affected
- Identify methodologies for measuring and monitoring effects of exposure to each area of risk
- Provide a common framework to estimate level of potential adversity for each risk, and its mitigation
- Provide a concept of physical and environmental demands of the site, and a matrix to suggest orders of relevance for application of each area of risk in different ecosystems

WORLD HEALTH ORGANIZATION ECOLOGICAL RISK ASSESSMENT FRAMEWORK



PHASES OF THE RISK ASSESSMENT PROCESS

Phase I: Problem Formulation

Phase II: Problem Analysis

Phase III: Risk Characterization

PHASE I

PROBLEM FORMULATION

- Scope, focus, and sources to be considered
 - Aquaculture type and species
- Biological and ecological end-points
 - Attributes for protection
- Conceptual model
 - System organization
- Plan
 - Analysis of information
 - Conducting the assessment

PHASE II

PROBLEM ANALYSIS

Analysis of Exposure

- Predict or measure spatial and temporal distribution of a stressor or concern
 - Historic and current literature information
 - Complete baseline survey with field work

PHASE II PROBLEM ANALYSIS

- Exposure Response
 - Estimate possible impacts by considering
 - Near-field effects
 - Far-field effects

PHASE III

RISK CHARACTERIZATION

- Brings together
 - Analysis of the exposure
 - Analysis of effects (from hypothetical risks)
- Most effects of aquaculture are *interactive*
 - Complexity dealt with by *Modeling*

ONGOING ACTIVITIES

- Risk communication
- Maximize transparency
- Monitoring for subsequent risk

RISK COMMUNICATION PROCESS

**The Risk Assessment
Project**

Project Results

Risk Communication

Internal planning and preparation

External collaboration and coordination

- Peer review
- Reviews by agencies and others

Public involvement

- Stakeholder input (meetings, etc.)
- Disseminate information (media)

**Finalize decisions
and
Manage the risk**

THE MARINE FISH AQUACULTURE FRAMEWORK

- Application of the W.H.O. ecological risk assessment process to a site specific framework for marine fish aquaculture

IDENTIFICATION OF BIOLOGICAL END POINTS FOR PROTECTION

- The choice of the target (end-point) species for protection depends on:
 - The need for the best indicator of system stress or system response
 - Protection of some desirable biological attribute

SOME END-POINTS TYPICALLY IDENTIFIED FOR PROTECTION (1-4)

- Species richness and abundance of seston, nekton, and infauna
- Abundance of a specific species in the seston, nekton, and infauna
- Species richness and abundance of the epifauna
- Abundance of a specific species in the epifauna

SOME END-POINTS TYPICALLY IDENTIFIED FOR PROTECTION (5-9)

- Abundance of a specific species of marine mammal, reptile, or bird
- Immune resistance of demersal and pelagic fishes
- Number and fitness on the natural (conspecific) population
- Fitness of another fish population
- Abundance of the industrial fisheries

TEN CATEGORIES OF PERCEIVED OR OBSERVED RISK

- Increased organic loading
- Increased inorganic loading
- Residual heavy metals
- Transmission of disease organisms
- Residual therapeutants
- Biological interactions of escapees
- Physical interaction with marine wildlife
- Physical impact on marine habitat
- Using wild juveniles for grow-out
- Harvesting industrial fisheries for fish feed

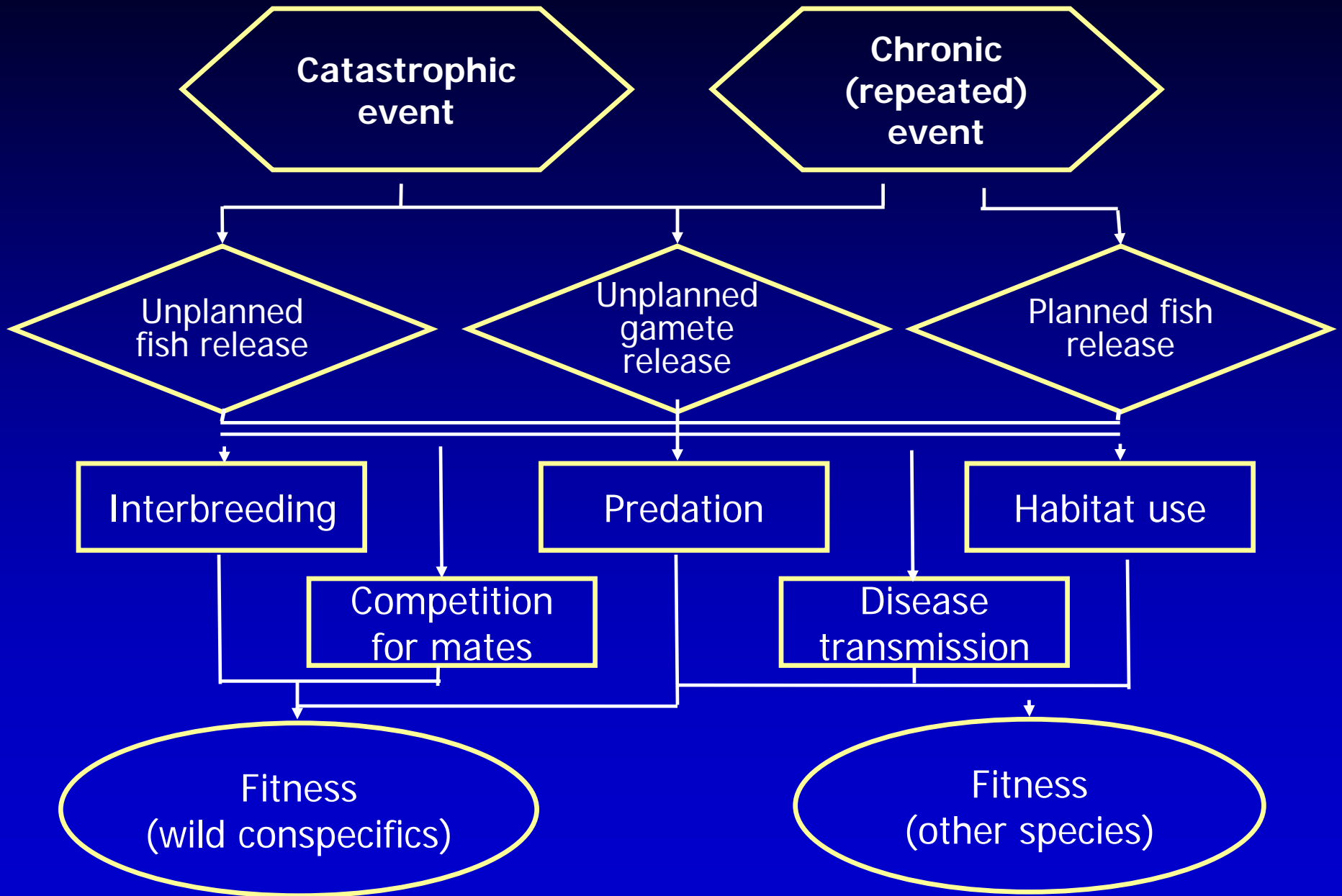
TEMPLATE #1 – INCREASED ORGANIC LOADING

- Risk Hypothesis
 - Background experience
 - Effects of enrichment
 - Spatial extent of effects
 - Temporal aspects of benthic effects
- Building the Conceptual Model
- Analysis and Characterization
 - Macrobenthic communities
 - Phyto and zooplankton
 - Benthic and pelagic fish
- Biological Opinion
- Further Information
 - References

TEMPLATE #4 – TRANSMISSION OF DISEASE ORGANISMS

- Risk Hypothesis
- Building the Conceptual Model
- Analysis and Characterization
 - Health of wild fish
 - Strength and diversity of wild fish
 - Natural immunity of wild fish
- Biological Opinion
- Further Information
 - References

TEMPLATE #6 - BIOLOGICAL INTERACTION OF ESCAPEES



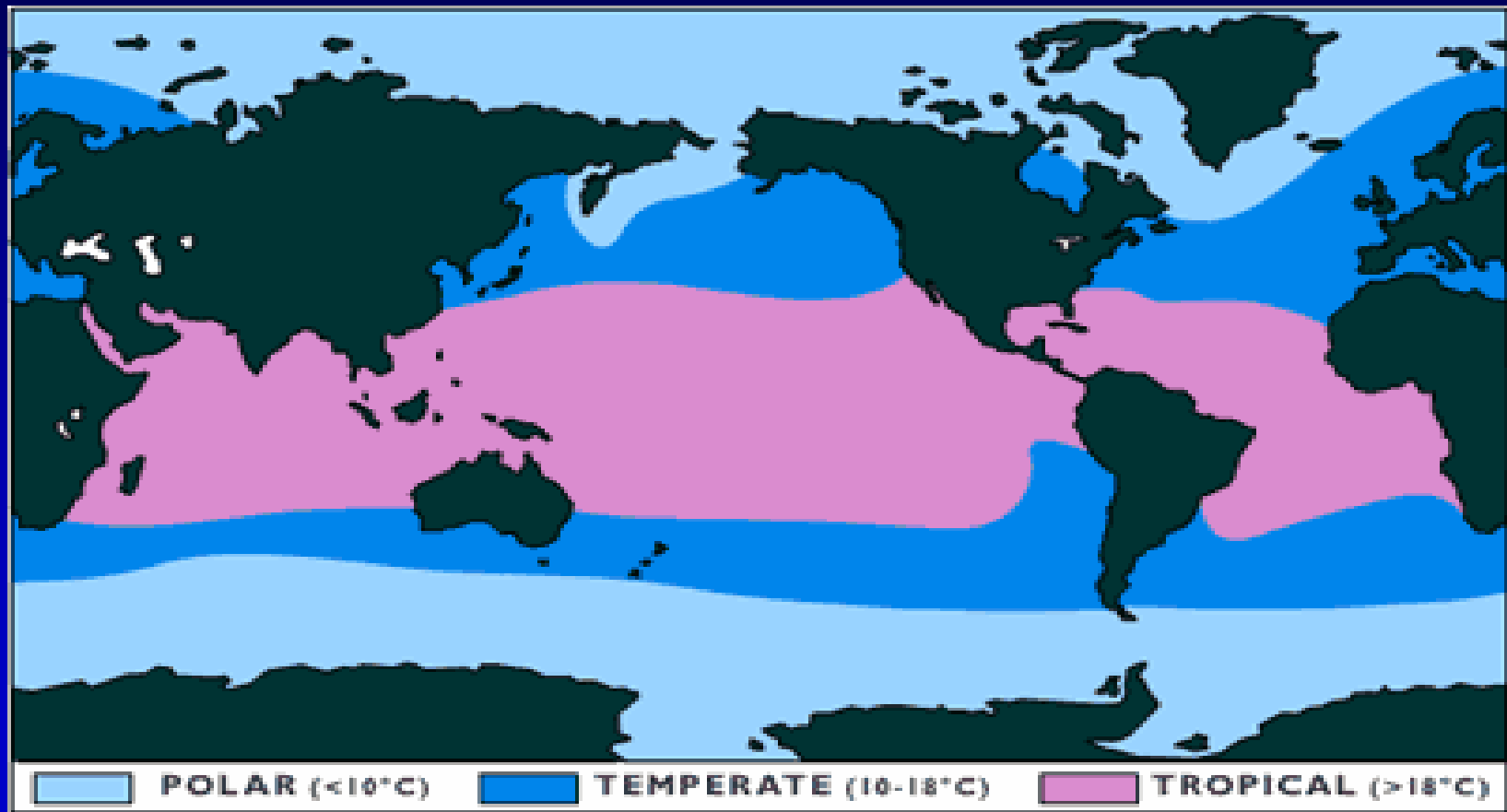
GLOBAL APPLICATION OF THE FRAMEWORK

- Identify the physical demands of the marine fish culture system before site selection
- Identify the environmental qualities and parameters of the site conducive to the intended system

GLOBAL APPLICATION OF THE FRAMEWORK

- Adopt a matrix approach to guide the application of Risk Assessments
- Three epipelagic systems
 - Offshore, coastal, and inshore
- Two bio-geographical zones
 - Temperate waters (10-18°C)
 - Tropical waters (>18°C)

BROAD GEOGRAPHICAL ZONES FOR MARINE AQUACULTURE (GMRI)



APPLICATION OF RISK ASSESSMENTS IN WATERS OF DIFFERENT BIO-GEO ZONES

CATEGORY OF OBSERVED OR PERCEIVED RISK	EPIPELAGIC ECOSYSTEM IN TEMPERATE WATERS (10 - 18°C)			EPIPELAGIC ECOSYSTEM IN TROPICAL WATERS (>18°C)		
	INSHORE	COASTAL	OFFSHORE	INSHORE	COASTAL	OFFSHORE
INCREASED ORGANIC LOADING	*****	**	*	*****	***	*
INCREASED INORGANIC LOADING	*****	**	*	*****	***	*
RESIDUAL HEAVY METALS	*	*	*	**	*	*
TRANSMISSION OF DISEASE ORGANISMS	***	**	**	***	**	**
RESIDUAL THERAPEUTANTS	**	*	*	**	*	*

KEY: POTENTIAL FOR ECOLOGICAL CHANGE WITHOUT MANAGEMENT ACTION

***** Significantly high

**** High

*** Medium

** Low

* Little/none

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	INSHORE	COASTAL	OFFSHORE	INSHORE	COASTAL	OFFSHORE
BIOLOGICAL INTERACTIONS OF ESCAPES WITH WILD POPULATION	**	**	*	**	**	*
PHYSICAL INTERACTIONS WITH MARINE WILDLIFE	**	**	*	**	**	*
PHYSICAL IMPACT ON MARINE HABITAT	**	*	*	**	*	*
USING WILD JUVENILES FOR GROW-OUT	**	**	*	***	***	**
HARVESTING INDUSTRIAL FISHERIES FOR FISH FEED	**	**	***	***	***	***

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CONTENTS OF A RISK ASSESSMENT REPORT

- Description of preliminary objectives and plans
- Description of environmental setting
- Proposed practice and species
- Review of conceptual model and assessment end-points
- Major data sources and analytical procedures used
- Review of stressor response and exposure profiles
- Description of risk to assessment end-points
- Review and summary of major areas of uncertainty, their direction, and approaches to address them

REFERENCE

- GUIDELINES FOR ECOLOGICAL RISK ASSESSMENT OF MARINE FISH AQUACULTURE
- Edited by C.E. Nash, P.R. Burbridge, & J.K. Volkman
- NOAA TECHNICAL MEMORANDUM NMFS-NWFSC-71
- DOWNLOAD FROM -
<http://www.nwfsc.noaa.gov/publications>