MONTEREY BAY AQUARIUM

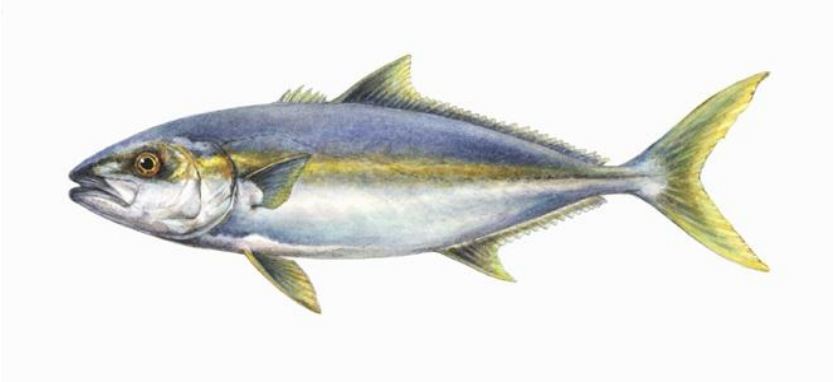
Introduction to Seriola Aquaculture Issues

Pete Bridson – Aquaculture Research Manager
Monterey Bay Aquarium

MONTEREY BAY AQUARIUM

Introduction to Seriola Aquaculture Issues

- Use of marine resources
- Impacts on wild fish populations
- Local/regional pollution
- Effectiveness of management
- How the industry can meet strong standards



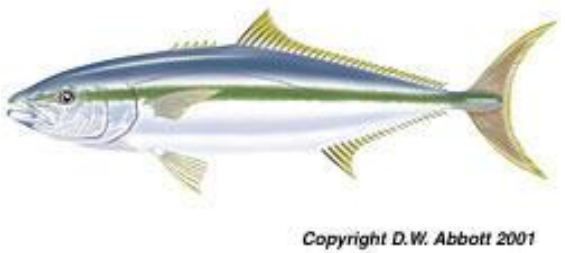
MONTEREY BAY AQUARIUM

- *Seriola quinqueradiata*
  - **Japanese Yellowtail**, Gold striped amberjack, Mojaka, Hamachi, Buri
- *Seriola lalandi*
  - Yellowtail Kingfish, **Kingfish**, Gold striped amberjack, Hiramasa
- *Seriola rivoliana*
  - Pacific Yellowtail, long-fin amberjack, Almaco Jack, Kahala, **Kampachi**
- *Seriola dumerili*
  - **Amberjack**, Greater Amberjack, kampachi

- *Sushi – Hamachi, Kampachi, Hiramasa*

MONTEREY BAY AQUARIUM

Production



- 150,000t worldwide
  - 150,000t Japan/Korea
    - *S. quinqueradiata, S. dumerili, S.lalandi*
  - 2,000 – 5,000 t Australia/New Zealand
    - *S. lalandi*
  - 750-1000t USA
    - *S.rivoliana*
- Japanese Yellowtail (*S.quinquradiata*) accounts for >80% of global production

Differing methods

Basic nearshore net pens

High-tech offshore submersible cages

Wild caught juveniles

Hatcheries (wild or domesticated broodstock)

Trash fish feeds

Basic compund feeds

Complex formulated compound feeds

Different countries and management/regulatory structures

MONTEREY BAY AQUARIUM

Major Impact Categories

1. Sustainable use of marine resources
2. Impacts on wild fish populations
3. Local/regional pollution and habitat effects
4. Effectiveness of management

- Not salmon, but inevitable similarities to other dialogues and species
- Standards must allow for cumulative impacts from multiple sites or farms
- Regulation is the baseline minimum

MONTEREY BAY AQUARIUM

1 – Sustainable use of marine resources

- Two key issues
  - Collection of wild juveniles or broodstock
  - Provision of feeds for a cultured carnivorous or piscivorous species

- Use of wild yellowtail
  - Wild juvenile collection, e.g potentially large numbers in Japan
  - Wild broodstock for hatcheries – relatively low numbers and increasing use of semi-domesticated lines
  - Capture has direct impacts on associated populations and ecosystems
  - Translocation of fish – potential for disease or parasite introduction and genetic drift associated with escapes.

MONTEREY BAY AQUARIUM

1 - Sustainable use of marine resources

- Supply of nutrients, principally proteins and lipids to carnivorous/piscivorous fish
  - Industrial reduction fisheries
    - Location, fishery status, ecosystem impacts of ‘forage’ fisheries
  - Use of by-product (trimmings) fishmeal or oil
    - The same fishery/ecosystem issues plus quality concerns – FCR and pollution. LCA costs.
  - Use of terrestrial plant and animal substitutes
  - Life Cycle Assessment models
  - Use of ‘trash’ fish in Japan

- Conversion efficiency
  - FCR: biological or economic
  - Wild fish to farmed fish ratio (WI:FO)
  - Ongoing progress, e.g. Tacon (2008)

MONTEREY BAY AQUARIUM

2 – Impacts on wild fish populations

- Two key issues: Disease and Escapes
  - Introduction and/or amplification of pathogens and parasites and subsequent infection of wild fish
  - Escape of farmed fish

- Additional factors
  - Open or ‘closed’ production systems
  - Presence of relevant wild populations
  - Status of the affected wild populations – vulnerable or robust

MONTEREY BAY AQUARIUM

Disease and parasites

- Potential impacts
  - Amplification and clinical outbreaks of diseases endemic to the farm environment
  - Introduction of exotic pathogens from fish movements
  - Transfer of pathogens from farm-farm
  - Development of new strains or sub-groups, e.g. antibiotic resistance
  - Empirical evidence of transfer to wild fish populations

- Reality
  - Severe disease and parasite problems in Japan, and parasite issues in other production regions (skin and gill flukes, and copepod lice)
  - Endless examples of disease proliferation in all types of farming and food production
  - Empirical evidence of parasite transfer from farmed Seriola to wild stocks

MONTEREY BAY AQUARIUM

Escapes

- Potential impacts
  - Competition for food or breeding
  - Predation on wild fish
  - Genetic – loss of fitness, hatchery ‘’unnatural’ selection
- Other factors
  - Wild or domesticated genetic stock status
  - Age or size of escapees and their behavior
  - Ratio of escaped to wild fish Vulnerability of wild fish (stock status, genetic identity)
  - Trickle or catastrophic losses
  - Management – cage design, materials, , maintenace, siting

MONTEREY BAY AQUARIUM

3 – Pollution and habitat effects

3 – Pollution and habitat effects

- Nutrient loss
  - Soluble
  - Particulate (feces, feeds and fines)
- Chemical
  - Veterinary treatments
  - Antifoulants
- Factors
  - Production site's hydrogaphic dispersion characteristics
  - Habitat sensitivity - benthic and pelagic
  - Feeding techniques, FCR, stocking density, fallowing
  - Coastal or offshore location

MONTEREY BAY AQUARIUM

4 - Management

- Regulation
  - May be cumbersome, but no guarantee of effectiveness
  - Regionally highly variable
  - Must be considered as baseline on which to build higher standards and robust certification
  - Third party monitoring and public access to records
  - Open ocean regulation – US and elsewhere

- Good farm practice
  - Location and siting, feeds, feeding, biosecurity, cage maintenance, animal welfare, monitoring, record keeping

MONTEREY BAY AQUARIUM

Seafood Watch ranking

	Conservation Concern			
Sustainability Criteria	**Low**	**Moderate**	**High**	**Critical**
Use of Marine Resources		**U.S.**	**Australia**	**Japan**
Risk of Escaped Fish to Wild Stocks		**Australia U.S.**		**Japan**
Risk of Disease and Parasite Transfer to Wild Stocks			**Australia U.S.**	**Japan**
Risk of Pollution and Habitat Effects		**Australia U.S.**	**Japan**	
Management Effectiveness	**U.S. Australia**		**Japan**	

MONTEREY BAY AQUARIUM

Introduction to Seriola aquaculture issues

- Issues – Principle – Criteria - Indicators
- Use of marine resources
- Risk of escaped fish to wild stocks
- Risk of disease and parasite transfer to wild stocks
- Risk of pollution and habitat effects
- Management effectiveness

Life Cycle Analysis

• Pelletier & Tyedmers (2008) '*such efforts must also address the wider range of biophysical, ecological, and socioeconomic impacts stemming from the material and energetic throughput associated with these industries*'

•LCA – ISO standardized 'cradle-to-grave' analysis

MONTEREY BAY AQUARIUM

LCA Factors

Impact Category	Description
Global warming	Contributes to atmospheric absorption of infrared radiation
Acidification	Contributes to acid deposition
Eutrophication	Provision of nutrients contributes to biological oxygen demand
Photochemical oxidant formation	Contributes to photochemical smog
Aquatic/terrestrial ecotoxicity	Creates conditions toxic to aquatic or terrestrial flora and fauna
Human toxicity	Creates conditions toxic to humans
Energy use	Depletes nonrenewable energy resources
Abiotic resource use	Depletes nonrenewable resources
Biotic resource use	Appropriates the products of primary production
Ozone depletion	Contributes to depletion of stratospheric ozone