

Aquaculture Product Safety ?

Essential Concern with
Reasonable Solutions



Steve Otwell
Professor Emeritus





Aquaculture products as consumed in the United States remain one of the safest sources of healthful muscle food eating in the world,

YET, food safety remains one of the most often questioned concerns for aquaculture products

Multiple Misperceptions imply or assume aquaculture products are unsafe

- New, different, foreign sources (suspect)
- Sustainability and environmental problems
- Species substitution



Persistent issue Illegal or improper use of therapeutic drugs (antibiotics)



- Current aquaculture production is comparatively young and lacks experience and control options
- Diseases are persistent and anticipated due to some current practices and predicted environmental consequences
- New species and new areas mean more issues

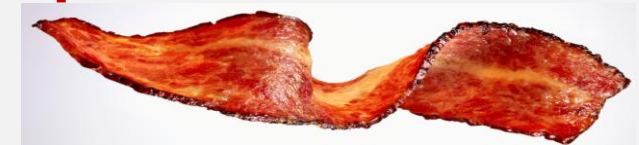
Thoughtless claims to gain notice and perceived advantages in research and markets

Competition errantly using food safety to get advantage (no regulation, contaminated, less fatty acids, PCB's, drugs, etc...)

Calls for alternative regulation and efforts to prove a more effective agency



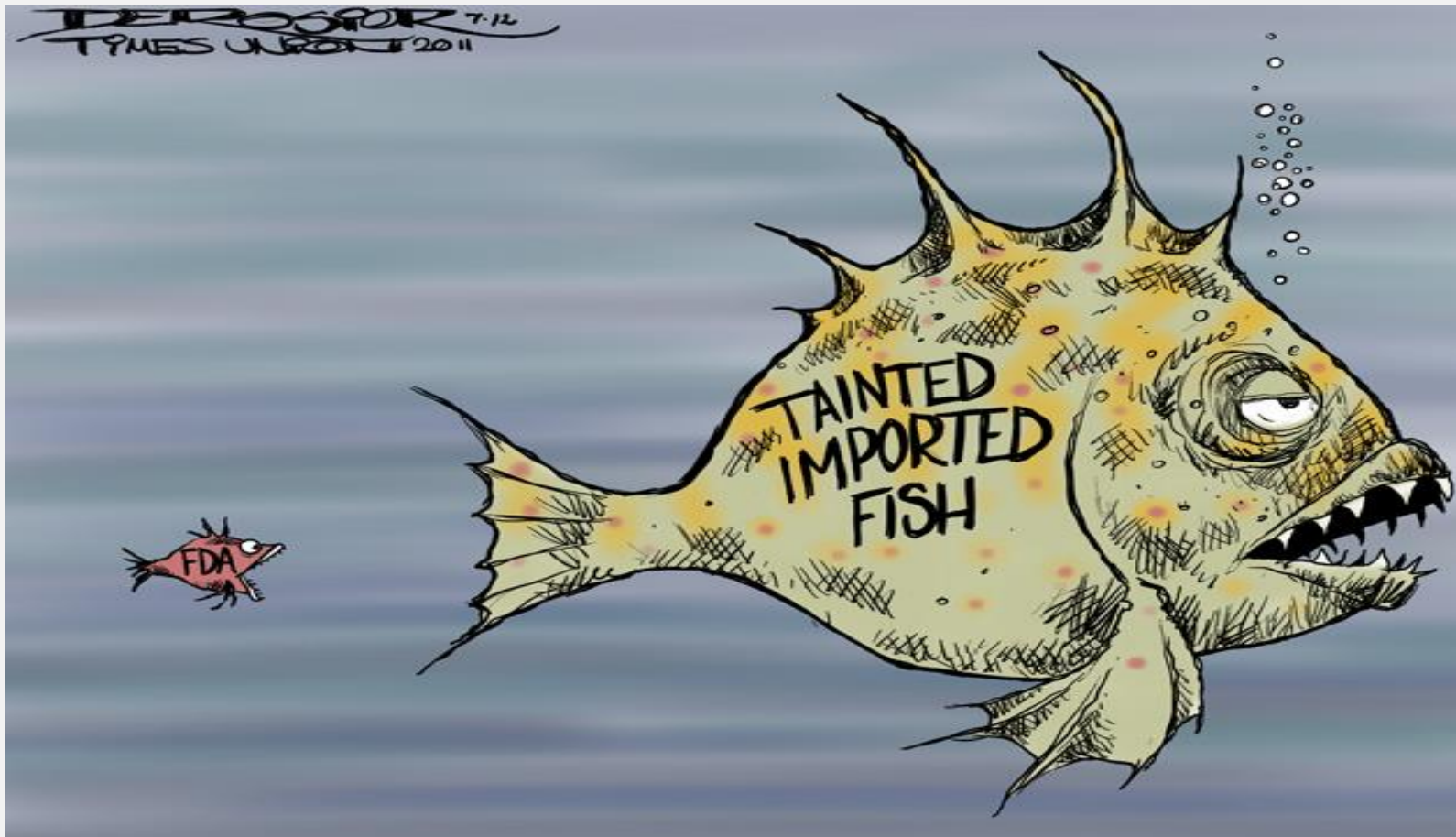
Tilapia worse than Bacon



vs.

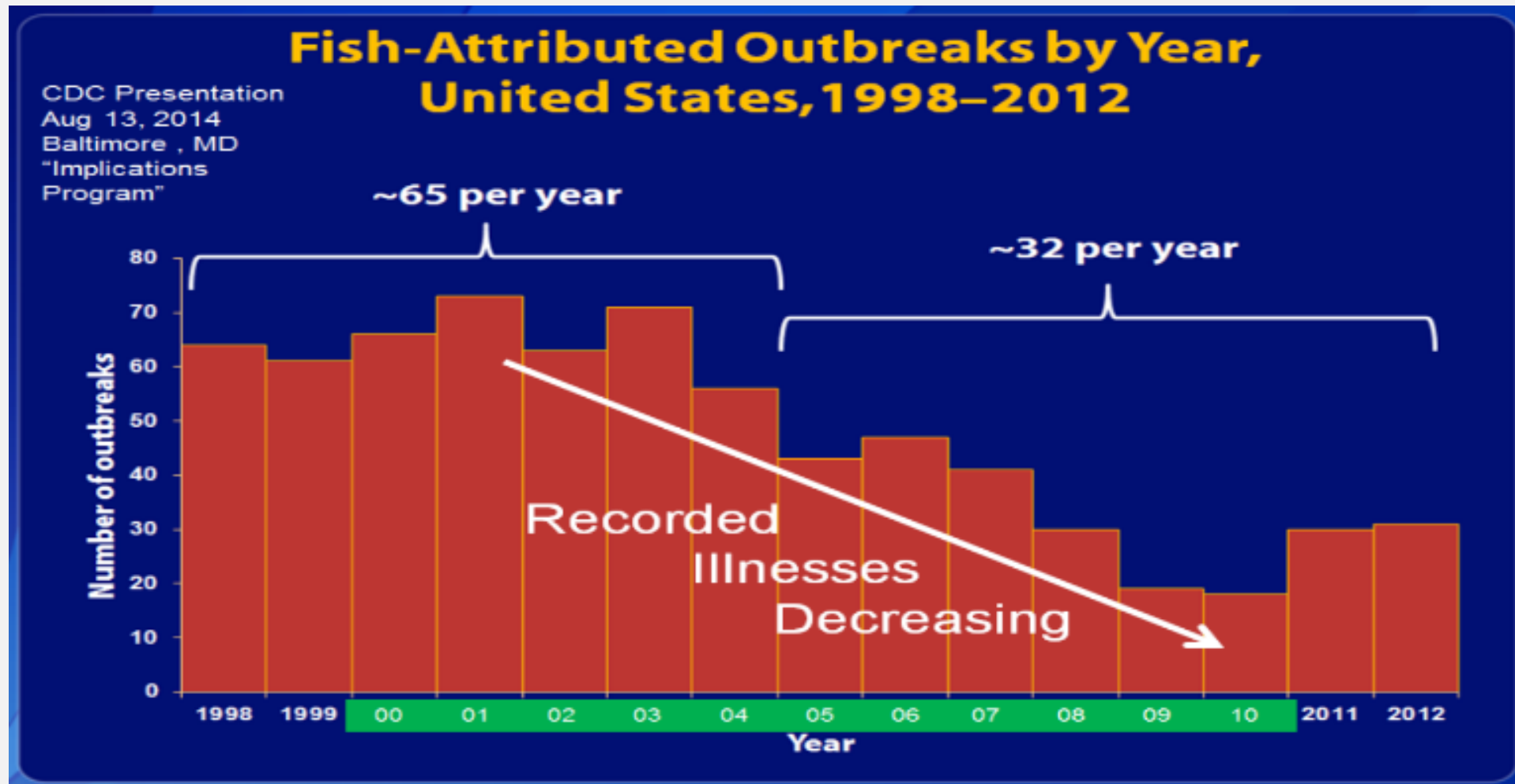


Public Perceptions and Expectations are calling for More Response



EDUCATION

Based on actual illnesses, aquaculture products have not and should not pose more significant food safety problems



USA Per Captia Consumption

Rank	1990		2000		2010		2016	
1	Tuna, C	3.7	Tuna, C	3.5	Shrimp	4.0	Shrimp	4.1
2	Shrimp	2.2	Shrimp	3.2	Tuna, C	2.7	Salmon	2.2
3	Cod	1.4	Pollock	1.6	Salmon	2.0	Tuna, C	2.1
4	Pollock	1.3	Salmon	1.6	Tilapia	1.5	Tilapia	1.2
5	Salmon	0.7	Catfish	1.1	Pollock	1.2	Pollock	1.0
6	Catfish	0.7	Cod	0.8	Catfish	0.8	Pang.+	0.9
7	Clams	0.6	Clam	0.5	Crab	0.6	Cod	0.5
8	Flatfish	0.6	Crab	0.4	Cod	0.4	Crab	0.5
9	Crabs	0.3	Flatfish	0.4	Pang.+	0.4	Catfish	0.5
10	Scallops	0.3	Scallops	0.3	Clams	0.3	Clam	0.3

Tuna, C = Canned Tuna; Pang.+ = Pangasius (Basa and Swai)

USA Per Captia Consumption

Rank	1990		2000		2010		2016	
1	Tuna, C	3.7	Tuna, C	3.5	Shrimp	4.0	Shrimp	4.1
2	Shrimp	2.2	Shrimp	3.2	Tuna, C	2.7	Salmon	2.2
3	Cod	1.4	Pollock	1.6	Salmon	2.0	Tuna, C	2.1
4	Pollock	1.3	Salmon	1.6	Tilapia	1.5	Tilapia	1.2
5	Salmon	0.7	Catfish	1.1	Pollock	1.2	Pollock	1.0
6	Catfish	0.7	Cod	0.8	Catfish	0.8	Pang.+	0.9
7	Clams	0.6	Clam	0.5	Crab	0.6	Cod	0.5
8	Flatfish	0.6	Crab	0.4	Cod	0.4	Crab	0.5
9	Crabs	0.3	Flatfish	0.4	Pang.+	0.4	Catfish	0.5
10	Scallops	0.3	Scallops	0.3	Clams	0.3	Clam	0.3

Tuna, C = Canned Tuna; Pang.+ = Pangasius (Basa and Swai)

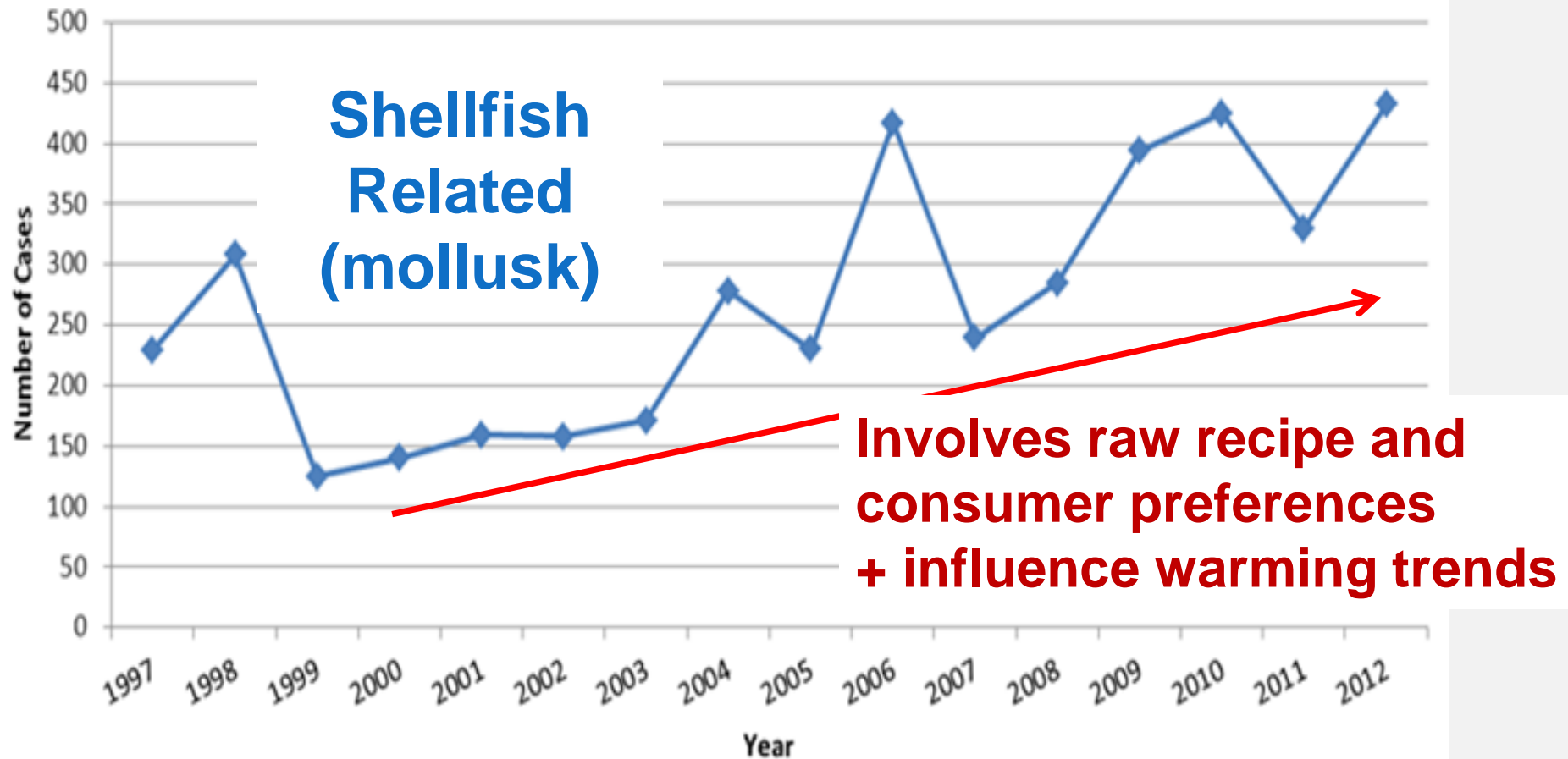
USA Per Captia Consumption

Rank	1990		2000		2010		2016	
	1	Tuna, C	3.7	Tuna, C	3.5	Shrimp	4.0	Shrimp
2	Shrimp	2.2	Shrimp	3.2	Tuna, C	2.7	Salmon	2.2
3	Cod	1.4	Pollock	1.6	Salmon	2.0	Tuna, C	2.1
4	Pollock	1.3	Salmon	1.6	Tilapia	1.5	Tilapia	1.2
5	Salmon	0.7	Catfish	1.1	Pollock	1.2	Pollock	1.0
6	Catfish	0.7	Cod	0.8	Catfish	0.8	Pang.+	0.9
7	Clams	0.6	Clam	0.5	Crab	0.6	Cod	0.5
8	Flatfish	0.6	Crab	0.4	Cod	0.4	Crab	0.5
9	Crabs	0.3	Flatfish	0.4	Pang.+	0.4	Catfish	0.5
10	Scallops	0.3	Scallops	0.3	Clams	0.3	Clam	0.3

Tuna, C = Canned Tuna; Pang.+ = Pangasius (Basa and Swai)

Critics will suggest otherwise ...

Total *Vibrio parahaemolyticus* Infections, 1997-2012, USA



Critics will suggest otherwise ...



SEAFOOD* IMPORT REFUSALS

*wild & farm raised

REFUSAL CHARGES	ENTRIES REFUSED
FILTH	695
SALMONELLA	503
VET DRUGS	144
MFR HACCP ISSUE	135
LISTERIA	85
INSANITARY	60
HISTAMINE	50

- Most not aquaculture specific
- Most not resulting in illnesses

Based on actual illnesses, aquaculture products have not and should not pose more significant food safety problems



- Likely hazards (species-related) are known and most are similar to wild seafood in terms of occurrence prior to or during harvest
- Aquaculture can offer more controls prior to harvest
- Processing hazards are similar for all seafood and HACCP controls have proven effective

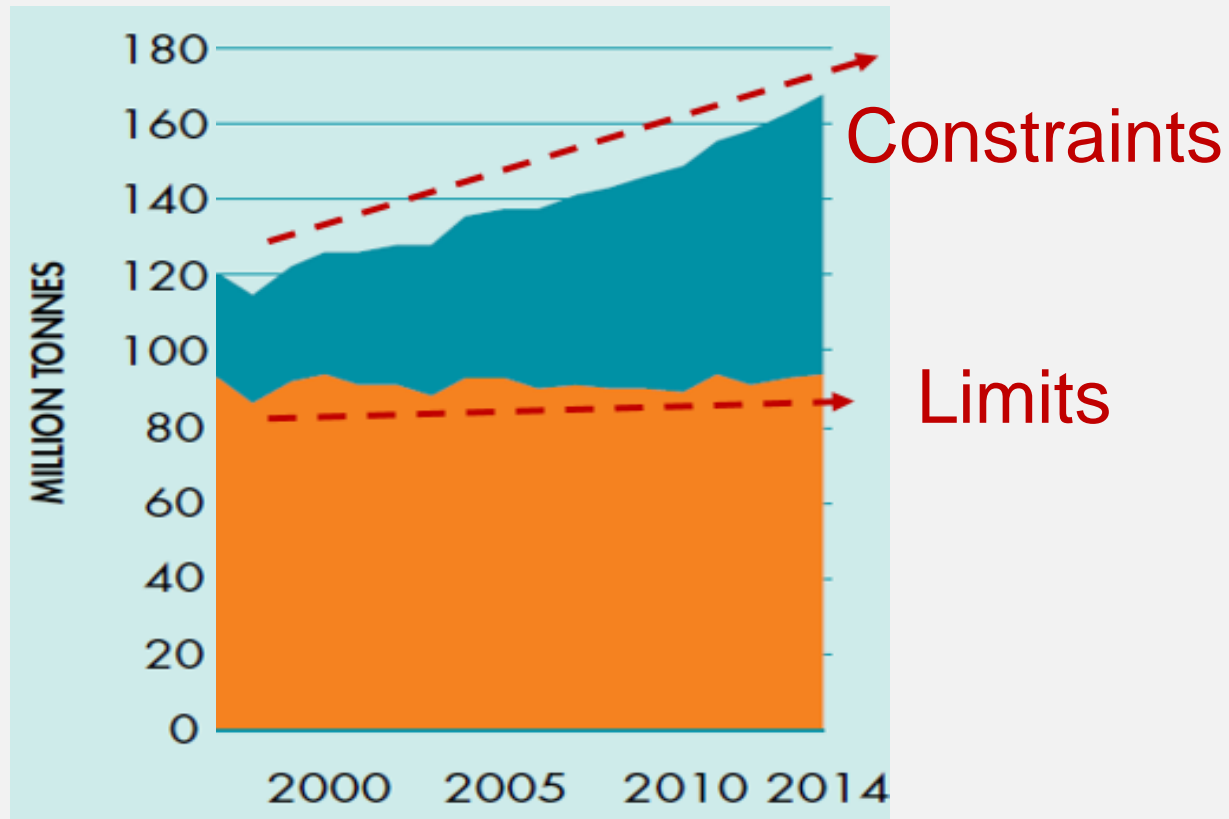
“The number one seafood safety problem in the world is product availability and access ... not enough”

Otwell, Sarasota June 2019

Aquaculture is the best answer,
but 'potential' problems prevail ...



Henceforth, aquaculture will be the primary source for the majority of seafood consumed, and seafood demand will exceed supply



Demand >> Supply

'Supplier' Driven situation favors:

- Competition for supply
- Indifference to details
- Temptations
- Less incentives to comply



Prevailing Regulation - 21 CFR Part 123 FDA Seafood HACCP Regulation

Any fish or fishery products destined for commerce in the United States that are processed or imported in violation of this regulation can be considered adulterated and subject to regulatory action

Obligations for regulatory compliance involves Primary Processors and Importers of fish and fishery products, including farm-raised products

What are Fish and Fishery Products?

- Fish means: fresh or salt water finfish, crustaceans, mollusks, other forms of aquatic animal life (e.g., alligator, frog, aquatic turtle, jellyfish, sea cucumber, sea urchin, roe), other than birds or mammals.

harvested or farmed

- Fishery Product means: any food product where fish is a characterizing ingredient.



Pathogens Present

- Bacterial
- Viral

Chemical Contamination

- Environmental (pesticides, herbicides, fertilizers, etc.)
- Product Treatments (sulfites, etc..)

Natural Toxins

- Algal Blooms

Parasites

- Water origin
- Feed origin

Aquaculture Drugs

- Illegal
- Improper Use

Physical Contamination

- Metal, glass, debris,

Thermal Abuse

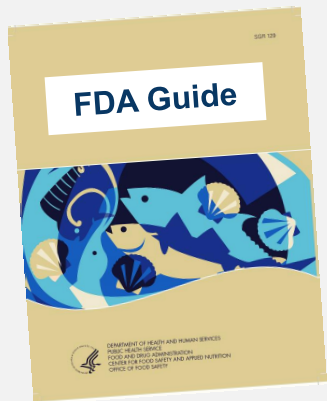
- Elevated histamines
- Pathogen growth

Processing Errors

- Pathogen Growth
- C. botulinum
- Food Additives
- Allergens
- Improper cooking
- Physical contaminants

Likely problems are known,
and experience has shown
that methods to prevent
problems are more effective
than trying
to catch problems ...

... yet, knowledge for
prevention is lacking



Kampachi

Seriola rivoliana

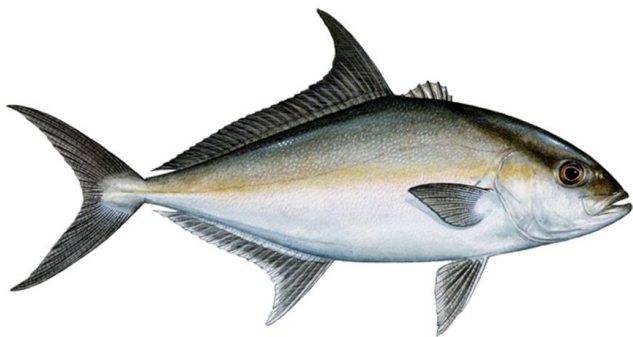


TABLE 3-2

POTENTIAL VERTEBRATE SPECIES-RELATED HAZARDS

Note: You should identify pathogens from the harvest area as a potential species-related hazard if you know or have reason to know that the fish will be consumed without a process sufficient to kill pathogens, or if you represent, label, or intend for the product to be so consumed. (See Chapter 4 for guidance on controlling pathogens from the harvest area.)

MARKET NAMES	LATIN NAMES	HAZARDS				
		PARASITES	NATURAL TOXINS	SCOMBROTOXIN (HISTAMINE)	ENVIRONMENTAL CHEMICALS	AQUACULTURE DRUGS
		CHP 5	CHP 6	CHP 7	CHP 9	CHP 11
AMBERJACK	<i>Seriola spp.</i>		CFP	√		
AMBERJACK OR YELLOWTAIL	<i>Seriola lalandi</i>			√		
AMBERJACK OR YELLOWTAIL, AQUACULTURED	<i>Seriola lalandi</i>			√	√	√



Coryphaena hippurus



Trachinotus blochii

TABLE 3-2

POTENTIAL VERTEBRATE SPECIES-RELATED HAZARDS

Note: You should identify pathogens from the harvest area as a potential species-related hazard if you know or have reason to know that the fish will be consumed without a process sufficient to kill pathogens, or if you represent, label, or intend for the product to be so consumed. (See Chapter 4 for guidance on controlling pathogens from the harvest area.)

MARKET NAMES	LATIN NAMES	HAZARDS				
		PARASITES	NATURAL TOXINS	SCOMBROTOXIN (HISTAMINE)	ENVIRONMENTAL CHEMICALS	AQUACULTURE DRUGS
		CHP 5	CHP 6	CHP 7	CHP 9	CHP 11
MAHI-MAHI	<i>Coryphaena spp.</i>			√		
MAHI-MAHI, AQUACULTURED	<i>Coryphaena spp.</i>			√	√	√
POMPANO	<i>Alectis ciliaris</i>		CFP			
	<i>Parastromateus niger</i>					
	<i>Trachinotus spp.</i>					
POMPANO OR PERMIT	<i>Trachinotus kennedyi</i>					
	<i>Trachinotus falcatus</i>					

Process-related Hazards

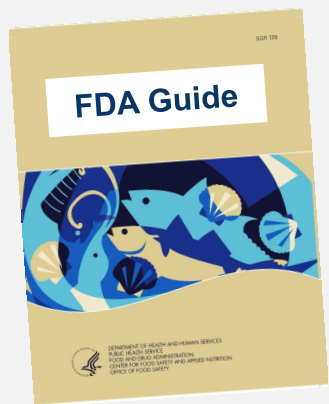
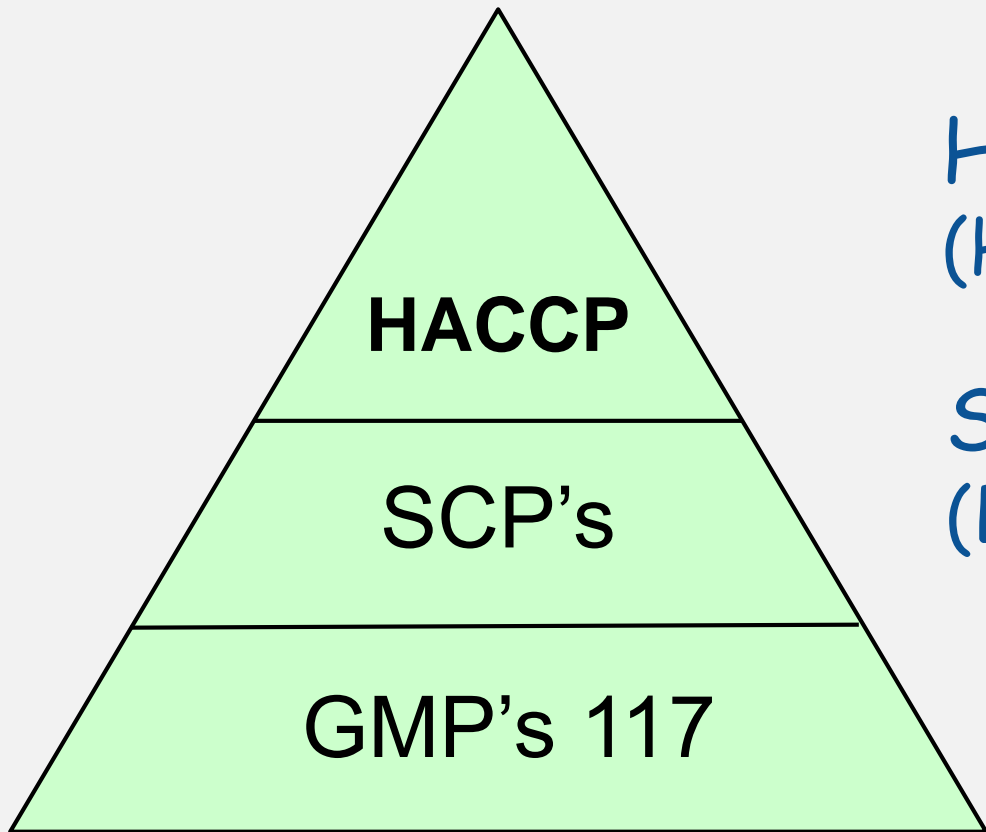


TABLE 3-4

POTENTIAL PROCESS-RELATED HAZARDS											
FINISHED PRODUCT FOOD ¹	PACKAGE TYPE	HAZARDS									
		PATHOGENIC BACTERIA GROWTH - TEMPERATURE ABUSE	C. BOTULINUM TOXIN	S. AUREUS TOXIN - DRYING	S. AUREUS TOXIN - BATTER	PATHOGENIC BACTERIA SURVIVAL THROUGH COOKING OR PASTEURIZATION	PATHOGENIC BACTERIA SURVIVAL THROUGH PROCESSES DESIGNED TO RETAIN RAW PRODUCT CHARACTERISTICS	PATHOGENIC BACTERIA CONTAMINATION AFTER PASTEURIZATION AND SPECIALIZED COOKING PROCESSES	ALLERGENS/ ADDITIVES	METAL INCLUSION	GLASS INCLUSION
		CHP 12	CHP 13	CHP 14	CHP 15	CHP 16	CHP 17	CHP 18	CHP 19	CHP 20	CHP 21
Raw fish other than oysters, clams, and mussels (finfish and non-finish)	Reduced oxygen packaged (e.g. mechanical vacuum, steam flush, hot fill, MAP, CAP, hermetically sealed, or packed in oil)	√ ²	√						√	√	
Raw fish other than oysters, clams, and mussels (finfish and non-finish)	Other than reduced oxygen packaged	√ ²							√	√	

Required Controls layers of prevention ?

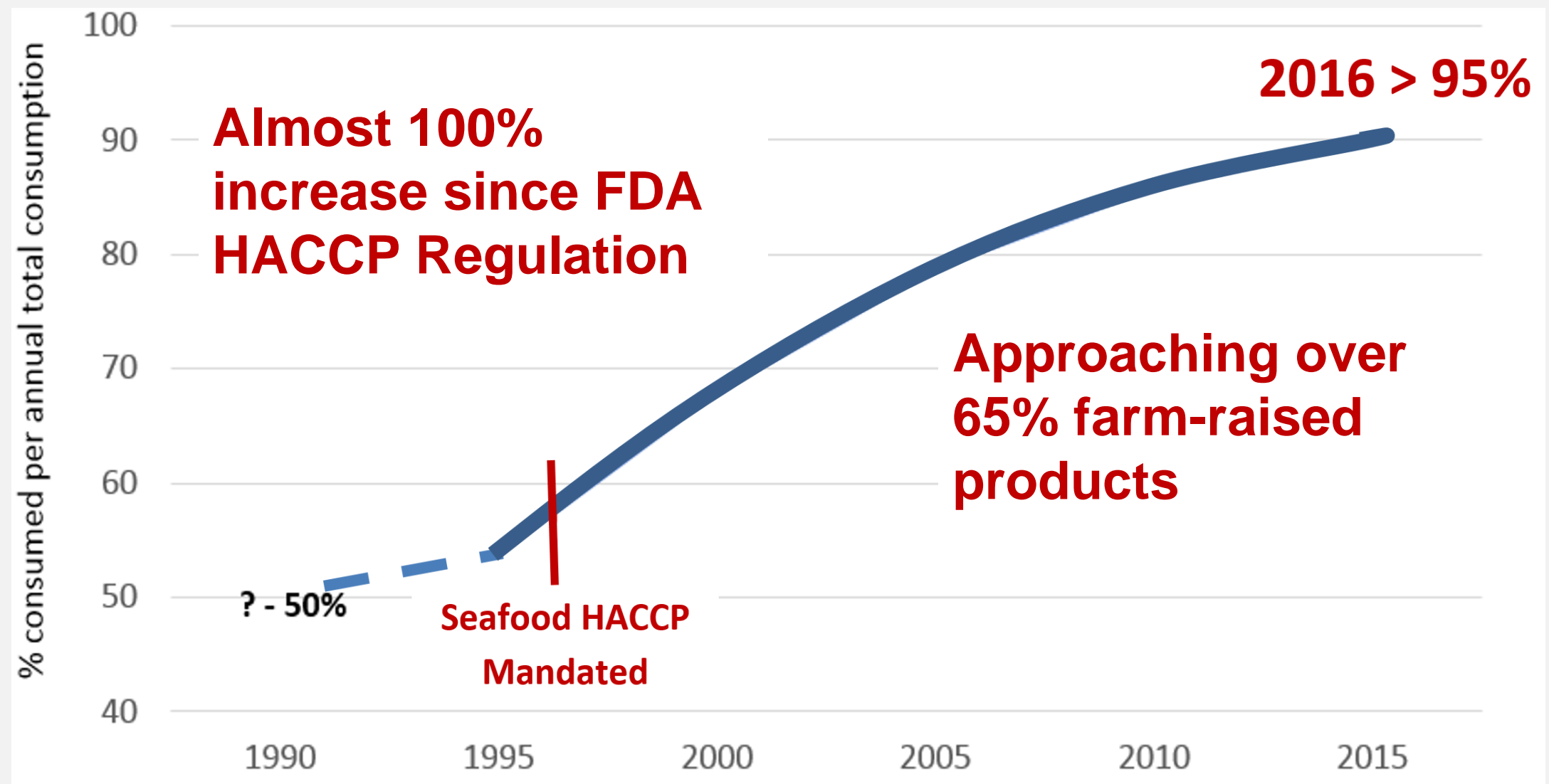


HACCP Program
(HACCP Plan based on hazard analysis)

Sanitation
(Based on Sanitation Control Procedures)

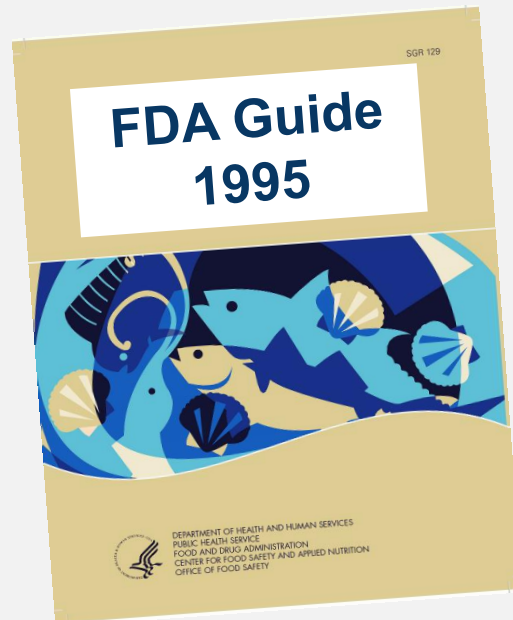
Foundation
(Good Manufacturing Practices; GMP 117)

Did the regulation anticipate Aquaculture ?



HACCP did not fully anticipate the aquaculture situation ... less ability to 'prevent'

Control Strategies ?



- On-farm visits
- Supplier Certificates
- Chemical Analysis
- Drug Use Records
- 3rd Party Certifications

Reverting to reliance on 'testing' to catch problems

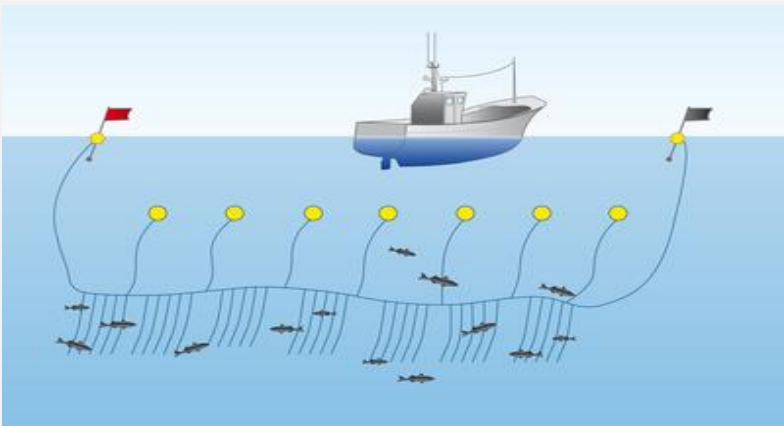
What Does Processing Include?

Handling, storing, preparing, heading, freezing, eviscerating, changing to different market forms, manufacturing, shucking, preserving, packing, labeling, dockside unloading, or holding



Seafood HACCP Regulations do not apply to:

- Harvesting (*wild sources*) and Transporting without engaging in processing
- Heading, eviscerating or freezing intended solely for holding the 'fish' (*wild source*) on the harvest vessel
- Retail Operations



Seafood HACCP Regulations do not apply to:

- **Aquaculture producers** (farming operations);
.....including bleeding, washing, and icing of otherwise unprocessed 'fish' by the aquaculture producer
- **HOWEVER** heading, eviscerating, or packaging (e.g., retail or wholesale units) performed by the aquaculture producer is considered processing subject to HACCP regulations



All fish products are subject to HACCP Controls

REMEMBER!

No fish or fishery products, either harvested or farmed, can enter commerce in the USA unless they have been processed under an appropriate HACCP program for seafood safety

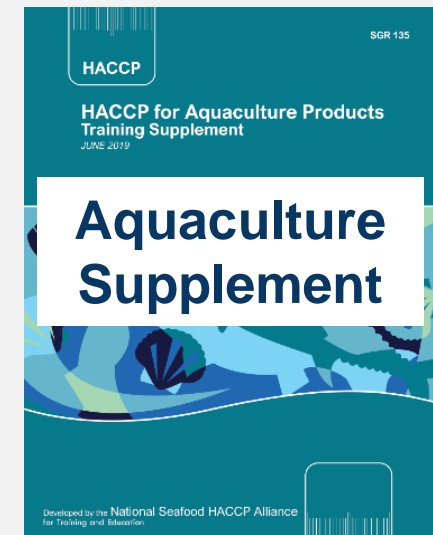
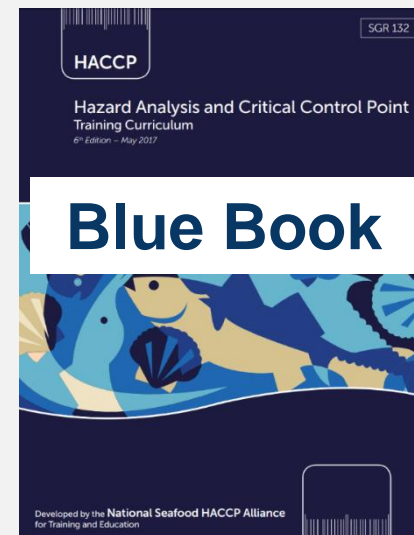
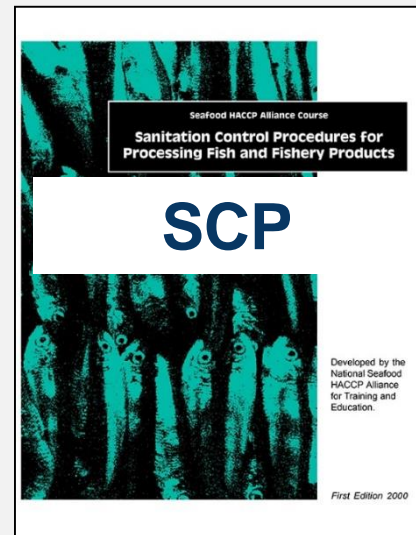
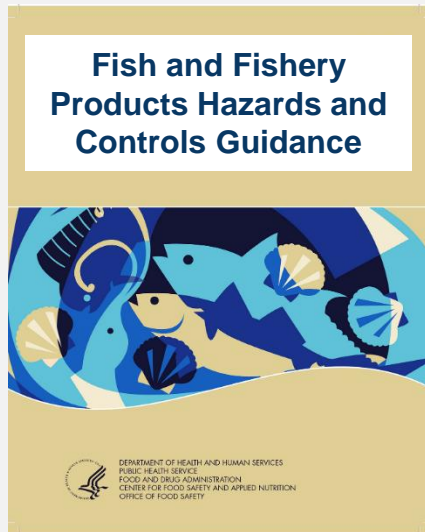
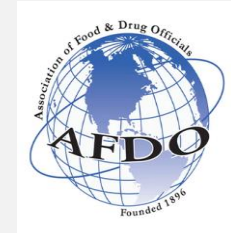
Vessels and Farms share the responsibility for food safety with Processors and Importers

What MUST all Processors do?

1. Monitor and keep records of monitoring results and corrections taken for the 8 specified areas of **Sanitation**
2. Conduct a **Hazard Analysis** to determine if there are any significant hazards associated with your products or process
(Should be written)
3. Develop and implement a **HACCP Plan** to control any significant food safety hazards that are identified
(Must be written)

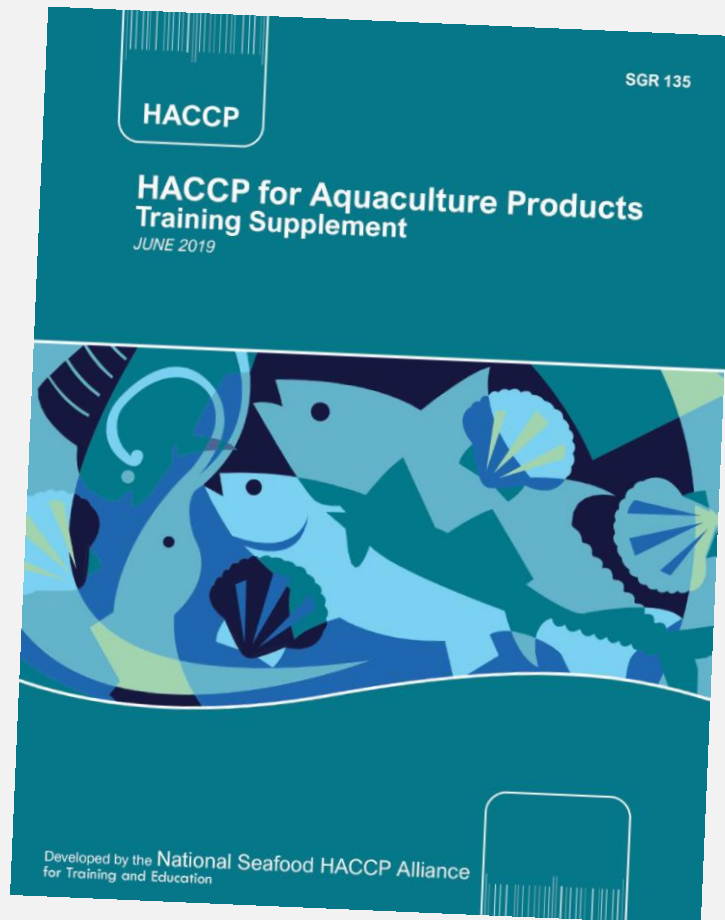


Seafood HACCP Alliance: AFDO and Sea Grant Response



June 2019

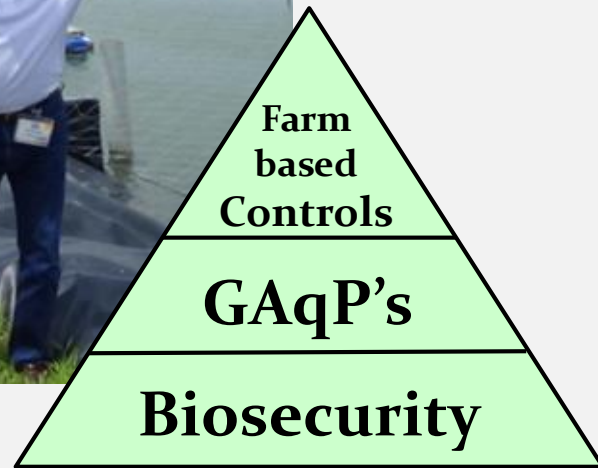
What happens if the Mahi is Farm-Raised ?



APPROACH for Primary Processors

FARMS with related obligations

PROCESSORS with HACCP obligations



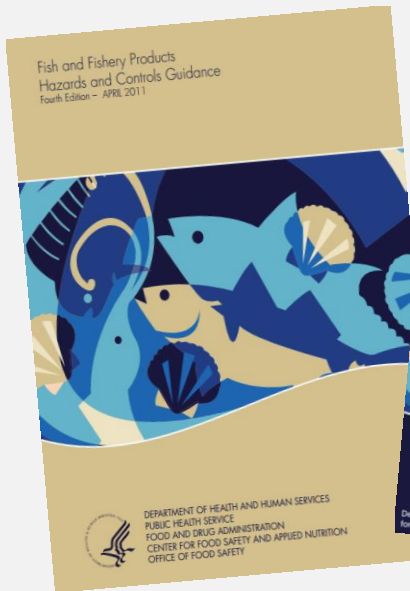
We must assure
healthful choices for
the next generation!

Aquaculture
is an answer



Steve Otwell, PhD, Emeritus
University of Florida
otwell@ufl.edu





Models

The editorial committee of the Alliance has developed a number of extra Model HACCP Plans that can be used during the third day of the basic HACCP course or the Segment Two HACCP one-day course. These models are intended to help participants understand the basic principles of HACCP by going through the process of developing their own Hazard Analysis and HACCP plan using the FDA Fish and Fishery Products Hazards and Controls Guide.

- [An Introduction to Using the Models](#) (pdf) (revised September 2017)
- [Tips for Trainers Conducting Practical Exercises Using HACCP Models](#) (pdf) (revised September 2017)
- [Shrimp \(Wild\) Cooked, Frozen](#) (pdf) (revised September 2017)
- [Shrimp \(Farm-Raised\) Raw, Frozen](#) (pdf) (revised September 2017)
- [Fish Sticks Breaded and Frozen](#) (pdf) (revised September 2017)
- [Hot Smoked Salmon Reduced Oxygen Packed](#) (pdf) (revised September 2017)
- [Shucked Oysters](#) (pdf) (revised September 2017)
- [Oyster Shellstock](#) (pdf) (revised September 2017)
- [Fresh Tuna Loins](#) (pdf) (revised September 2017)
- [Wild Salmon Sushi Rolls](#) (pdf) (revised September 2017)
- [Wholesale/Distribution/Warehouse Facilities](#) (pdf) (revised September 2017)
- [Wholesale/Distribution of Histamine Fish](#) (pdf) (revised September 2017)
- [Tilapia \(Farm-raised\), Fresh and Frozen](#) (pdf) (New! September 2017)



Program Introduction

National Seafood HACCP Alliance for Training and Education

Aquaculture Drugs: Illegal or Improper Use

Slide 31

Some controls for use of aquaculture drugs:

- When necessary, only use certain controlled drugs in the manner prescribed by a recognized veterinary expert
- Test for any excessive residuals in final products

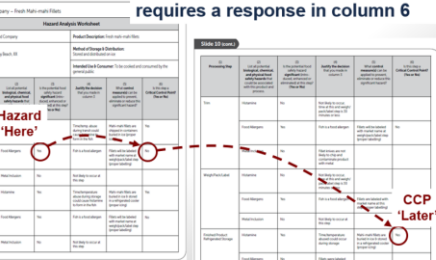
Tip “CCP Either here or later”

Every ‘Yes’ in column 3 requires a response in column 6

Slide 31	Slide 32	Slide 33	Slide 34	Slide 35	Slide 36	Slide 37
Hazard Analysis Worksheet						
Product Description: 100% Wild Salmon						
Hazard Analysis Worksheet						
Hazard	Control Measure	CCP?	Control Measure	CCP?	Control Measure	CCP?
Salmonellosis	Use of antibiotics	Yes	Use of antibiotics	Yes	Use of antibiotics	Yes
Parasitosis	Use of antibiotics	Yes	Use of antibiotics	Yes	Use of antibiotics	Yes
Chemical residues	Use of antibiotics	Yes	Use of antibiotics	Yes	Use of antibiotics	Yes

Hazard 'Here'

CCP 'Later'



What are the Food Safety Challenges with Farm Raised Seafood ?

