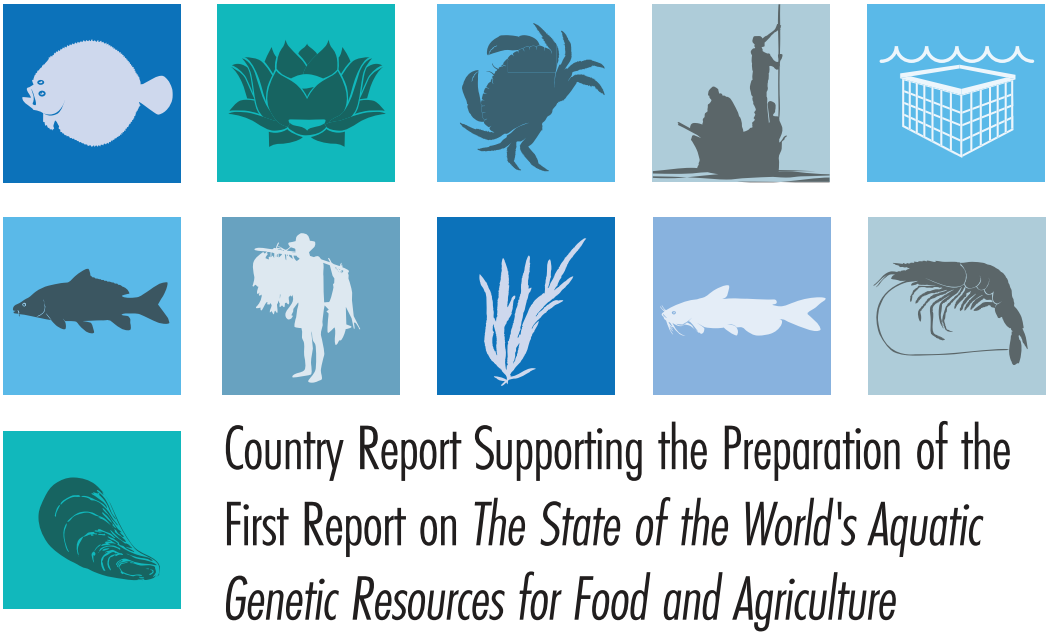
Food and Agriculture Organization of the United Nations

COUNTRY REPORTS

United States of America



Country Report Supporting the Preparation of the First Report on *The State of the World's Aquatic Genetic Resources for Food and Agriculture*

Food and Agriculture Organization of the United Nations

COMMISSION ON GENETIC RESOURCES FOR FOOD AND AGRICULTURE

Questionnaire for the Preparation of Country Reports for *the First State of the World's Aquatic Genetic Resources for Food and Agriculture*

COMMISSION ON GENETIC RESOURCES FOR FOOD AND AGRICULTURE

INSTRUCTIONS FOR COMPLETING THE DYNAMIC GUIDELINES

How do I complete the dynamic guidelines?

1. You will require Adobe Reader to open the dynamic guidelines. Adobe Reader can be downloaded free of charge from: http://get.adobe.com/uk/reader/otherversions/. Use Adobe Reader Version 10 or higher.
2. Open the dynamic guidelines and save it (save as a pdf) on your hard drive.
3. Please rename it <name of your country>.pdf.
4. You may forward the dynamic guidelines to stakeholders you would like to involve or inform by e-mail. You may also print and/or save the dynamic guidelines.
5. It is advisable to prepare textual responses (including any formatting such as bullet points) first in a separate document and then to copy and paste them into the form. Please use font Arial 10. Acronyms and abbreviations should be avoided if possible. If included, they must be introduced (i.e. written out in full) the first time they are used. Note that the text boxes are expandable. Once text has been entered, the box will automatically enlarge to make its content fully visible when you click outside its border. To delete a row you have added, click on the "X" on the far right of the table
6. When you have finished completing the dynamic guidelines, click the “Submit form” button at the end of the form and send the completed dynamic guidelines to Devin.Bartely@fao.org; Matthias.Halwart@fao.org; and ruth.garciagomez@fao.org.
7. This should automatically attach the document to an email that you can then send. Otherwise, please attach the completed dynamic guidelines manually to an e-mail and send it to Devin.Bartely@fao.org; Matthias.Halwart@fao.org; and ruth.garciagomez@fao.org.
8. A letter confirming official endorsement by relevant authorities should also be attached to the email.
9. You will receive a confirmation that the submission was successful.

Where can I get further assistance?
If you have any questions regarding the dynamic guidelines, please contact
Devin.Bartely@fao.org; Matthias.Halwart@fao.org; ruth.garciagomez@fao.org

Several websites provide useful information on aquatic species that can be consulted for proper species names and for information on aquatic genetic resources: AlgaeBase, Aquamaps, Barcode of Life, Census of Marine Life, FishBase, Frozen Ark, GenBank, Global Biodiversity Information Facility, International Union for Conservation of Nature, National Institutes of Health Database on Genomes and Bioinformatics, Ornamental Fish International, SealifeBase, Sea Around Us, and World Register of Marine Species.

How, by whom and by when must the completed dynamic guidelines be submitted?
Once officially endorsed by the relevant authorities, the completed dynamic guidelines should be submitted (click the “Submit form” button on the header banner) by the National Focal Point. **Completed dynamic guidelines should be sent by December 31st 2015.**

www.algaebase.org
www.aquamaps.org
www.barcodeoflife.org
www.coml.org
www.fishbase.org
www.frozenark.org
www.genbank.org
www.gbif.org
www.iucn.org
http://discover.nci.nih.gov/
www.ornamental-fish-int.org
www.sealifebase.org
www.seaaroundus.org
www.marinespecies.org

I. INTRODUCTION

At its Thirteenth Regular Session, the Commission noted that the preparation of a country-driven *State of the World's Aquatic Genetic Resources for Food and Agriculture* would provide countries with opportunities for assessing the status of their aquatic genetic resources for food and agriculture and enhancing the contributions of aquatic genetic resources to food security and rural development. Additionally the process of producing Country Reports will assist countries in determining their needs and priorities for the conservation and sustainable use of aquatic genetic resources for food and agriculture, and will help raise awareness among policy-makers.

II. COUNTRY REPORTS

As with the other sectors, *The State of the World's Aquatic Genetic Resources for Food and Agriculture (SoWAqGR)* will be compiled from Country Reports. It is recognized that guidance is necessary in order to assist countries in completing those reports under a common framework. The Country Reports will become official government documents submitted to FAO.

The following questionnaire is the suggested format for the preparation and submission of Country Reports. The questionnaire has been prepared by FAO to assist in the preparation of Country Reports contributing to the SoWAqGR Report. It has been designed to assist countries to undertake a strategic assessment of their aquatic genetic resources for food and agriculture.

The scope of the first State of the World's Aquatic Genetic Resources for Food and Agriculture, and therefore the emphasis in the Country Reports, is farmed aquatic species and their wild relatives within national jurisdiction.

Country Reports should:

- become powerful tools for improving the conservation, sustainable use and development of aquatic genetic resources for food and agriculture, at national and regional levels;
- identify threats to aquatic genetic resources, gaps in information about aquatic genetic resources and needs for the strengthening of national capacity to manage aquatic genetic resources effectively;
- inform the development of national policies, legislation, research and development, education, training and extension concerning the conservation, sustainable use and development of aquatic genetic resources for food and agriculture;
- contribute to raising public awareness about the importance of aquatic genetic resources for food and agriculture;
- complement other national reporting activities on the conservation, sustainable use and development of aquatic genetic resources.

Timeline and process

In line with the overall process, as established by the Commission, the Director-General of FAO sent a Circular State Letter on 19 April 2012 to countries requesting them to identify National Focal Points for the preparation of Country Reports by 31 December, 2015.

The following steps are recommended in preparing the Country Report, using a participatory approach:

- Each participating country should appoint a National Focal Point for the coordination of the preparation of the Country Report who will also act as focal point to FAO. National Focal Points should be communicated to the Secretary, Commission on Genetic Resources for Food and Agriculture (cgrfa@fao.org) immediatly.
- Countries are encouraged to establish a national committee to oversee the preparation of the Country Report. The national committee should consist of as many representative stakeholders as practical (representing government, industry, research and civil society).
- The national committee should meet frequently to review progress and consult widely with key stakeholders.

- The National Focal Point should coordinate the preparation of the first draft of the Country Report, which should be reviewed by the national committee. The National Focal Point should facilitate a consultative process for broader stakeholder review.
- Following the stakeholder review, the National Focal Point should coordinate the finalization of the Country Report, submit it to the government for official endorsement and transmit it to FAO in one of the Organization's official languages (Arabic, Chinese, English, French, Russian and Spanish) by 31 December 2015.
- The Country Report will be an official government report.
- If countries are unable to submit final Country Reports by the set deadline, preliminary reports of findings should be provided to FAO to contribute to the identification of global priorities for inclusion in the SoWAqGR Report.

QUESTIONNAIRE FOR PREPARATION OF COUNTRY REPORTS FOR *THE STATE OF THE WORLD'S AQUATIC GENETIC RESOURCES FOR FOOD AND AGRICULTURE*

Country report supporting the preparation of

The State of the World's Aquatic Genetic Resources for Food and Agriculture

Country	United States of America
Prepared By	Caird Rexroad
Date	Jun 16, 2017

TABLE OF CONTENTS

I. EXECUTIVE SUMMARY

The Country Report should contain an executive summary of 2-3 pages highlighting the main findings of the analysis and providing an overview of key issues, constraints and existing capacity to address the issues and challenges. The executive summary should indicate trends and driving forces and present an overview of the proposed strategic directions for future actions aimed at the national, regional and global levels.

Please include the Executive Summary here.

In the United States, the 2015–2020 Dietary Guidelines for Americans serves as a resource for health professionals, policy makers, and families to encourage healthy eating choices and reduce diet-related chronic diseases that affect the U.S. population. The Guidelines recommend Americans double their seafood intake, from an average of about 4.8 ounces to 8 ounces or more of seafood per week (8 to 12 ounces is recommended for pregnant or breastfeeding women). If Americans heed this advice, aquaculture would represent their most readily available, safe, and sustainable source of seafood. Since the 1980s, capture fisheries production has been relatively static; therefore, increases in seafood supply must come largely from aquaculture production. In fact, aquaculture now produces about half of all fish produced for human consumption, and this contribution likely will increase to meet seafood demand.

In 2014, consumers in the United States spent an estimated $91.7 billion on fishery products, making it one of the top three seafood markets worldwide. Yet, U.S. marine and freshwater aquaculture production ranks 14th worldwide, producing 275,695 metric tons (MT) with a farm gate value approaching $1.3 billion annually. Thus, 90 percent of seafood consumed in the United States (by value) is imported. The main domestically produced aquaculture species are catfish, crawfish, trout, tilapia, striped bass, salmon, shrimp, oysters, mussels, and clams. By volume, most of U.S. aquaculture (81 percent) is comprised of a few freshwater species (catfish, crawfish, and trout). By contrast, by value, most of U.S. aquaculture (78 percent) is more diverse and comprised of both freshwater and marine species (catfish, crawfish, oysters, clams, trout, salmon, tilapia, striped bass, shrimp, and mussels). Although marine species make up a small proportion of aquaculture production by volume, they are a disproportionately large part of the value of U.S. aquaculture. Shellfish, in particular, are produced in relatively smaller quantities, but are higher-value products. Additional U.S. production includes baitfish, ornamental/tropical fish, alligators, algae, aquatic plants, scallops, crabs, and marine and other freshwater fish.

In addition to contributing to the seafood supply, U.S. aquaculture also plays important roles in supporting commercial and recreational fisheries, conserving genetic diversity, and restoring threatened and endangered species and habitats. Aquaculture is an important component of U.S. decision-making in maintaining healthy and productive freshwater, coastal, and marine ecosystems; protecting special aquatic areas; rebuilding overfished wild stocks; restoring populations of endangered species; restoring and conserving freshwater, coastal, and marine habitat; balancing competing uses of aquatic environments; creating employment and business opportunities in rural inland and coastal communities; and enabling the production of safe and sustainable seafood.

The United States has established a global standard for regulating genetically engineered animals. Concerning farm-raised fish, a tropical aquarium fish, zebrafish (Danio rerio), was commercialized in 2003 that included gene constructs derived from marine invertebrates that alter proteins to reflect light in a variety of colors. Additional aquarium tropical species, tiger barb (Puntigrus tetrazona) and tetra (Gymnocorymbus ternetzi), have been similarly modified and produced since that date. A genetically modified Atlantic salmon that includes a growth hormone regulating gene from a Pacific chinook salmon and a promoter from an ocean pout were approved by the Food and Drug Administration for human consumption in 2015. Marketing in the United States is pending product labeling.

Despite the multiple applications of aquaculture technologies, this survey response is limited in scope to domestically cultured species of economic importance in the food supply as supported by data from the U.S. Departments of Agriculture and Commerce. Although ornamental fish and invertebrates, baitfish, and algae aquaculture undoubtedly have significant economic impact, there is a lack of public information on their aquatic genetic resources.

Meeting the increasing demand for seafood products will require management strategies for aquatic genetic resources that support both aquaculture and capture fisheries, as well as protect wild populations. To this end, current aquaculture productivity in the United States is supported by Federal, State and private research and development, including the characterization and conservation of wild and domesticated aquatic genetic resources. For the major U.S. species, traditional breeding programs have been established to improve traits associated with yields, production efficiency, product quality, animal health, animal welfare, and nutritional content for human health.

Technological advances that support expansion of aquaculture will require continued investments in genetic improvement programs, including those that apply to state of the art breeding strategies originally developed for plants and terrestrial animals. Currently, the approaches to broodstock development are species-specific and range from sourcing gametes from wild stocks, mass selection based on individual performance, family based quantitative genetic selection, and marker-assisted and genome-enabled selection. In addition to selective breeding, some species take advantage of other approaches to optimize production efficiency, such as cross-breeding for hybrids; chromosome set manipulation to produce triploids that focus energy towards growth compared to sexually maturing diploids; and monosex populations that avoid sexual

dimorphism in growth characteristics. Similarly, the ability to conserve genetic resources through cryopreservation or other methods is species-dependent. All of these approaches have demonstrated varying levels of effectiveness for adapting populations to production systems that provide consumers with quality seafood and non-food products. These and similar approaches are increasingly important as we seek to reduce antibiotic usage and production costs, formulate fish feeds with sustainably produced ingredients that maintain the health benefits provided by seafood, and adapt to stresses associated with changing climates. Continued development and application of these and newer technologies to additional species will enable responsible production of aquatic animals and enhance economic opportunities for the United States.

The United States is well-positioned to expand aquaculture production and therefore the use of aquatic genetic resources. Although consumers primarily use discretionary income to purchase seafood based on price, they also value food safety, health and nutrition, and sustainable and local production. Opportunities for increasing aquaculture production would be consistent with these values as: 1) the Dietary Guidelines recommend increasing seafood consumption; 2) the United States is a major producer of plant-based fish feeds and feed ingredients; 3) there is an abundance of underutilized water resources, including the Exclusive Economic Zone and the Great Lakes; 4) Recirculating Aquaculture Systems support local production of native and non-native species; and 5) the regulatory framework ensures environmental protection and food safety. The U.S. capacity for innovation and technology development will enable the use of science-based approaches to expand responsible use of the Nation's natural resources and contribute towards meeting the nutritional demands of a growing global population.

II. INTRODUCTION

The main objective of the Introduction is to present an overview that will allow a person who is unfamiliar with the country to appreciate the context for the Country Report. The Introduction should present a broad overview and present background information from your country on farmed aquatic species, their wild relatives and culture based fisheries. Detailed information should be provided in the main body of the Country Report. Countries may wish to consider developing their Introductions after completing the main body of their Country Reports.

Please write the overview here

In the United States, aquatic animal, plant, and algal species are bred, reared, and harvested in all types of aquatic environments, including land-based tanks or raceways, ponds, coastal submerged land, and oceans, to produce seafood for human consumption; enhance stock of wild fishes, shellfish, and plants; restore threatened and endangered species; rebuild ecologically important shellfish habitats; produce nutritional and industrial compounds; provide fish as bait for recreational fishing; and produce fish, aquatic plants, coral, and other invertebrates for aquarium hobbyists.

As a net importer of seafood, the United States recognizes that wild-caught fisheries are producing at their peak capacity, therefore aquaculture must make a critical contribution towards meeting the nutritional requirements of a growing global population and protecting natural resources.

As stated in the National Aquaculture Act of 1980,

"Congress declares that aquaculture has the potential for reducing the United States trade deficit in fisheries products, for augmenting existing commercial and recreational fisheries, and for producing other renewable resources, thereby assisting the United States in meeting its future food needs and contributing to the solution of world resource problems. It is, therefore, in the national interest, and it is the national policy, to encourage the development of aquaculture in the United States."

This act authorized the Office of Science and Technology Policy to establish an Interagency Working Group on Aquaculture (IWG-A) to coordinate Federal activities. The IWG-A is a statutory committee that operates under the Life Sciences Subcommittee (LSSC) of the Committee on Science (CoS) of the National Science and Technology Council (NSTC) in the Office of the Science Advisor to the President. The IWG-A reports to the CoS, which is one of five research and development (R&D) committees established by NSTC to prepare coordinated R&D strategies and budget recommendations for accomplishing national goals. This country report has been assembled under the oversight of the IWG-A, in partnership with National Aquaculture Association, which represents the private sector, to provide a unified national public and private voice for aquaculture toward ensuring its sustainability, protecting its profitability, and encouraging its development in an environmentally responsible manner.

In the United States, aquatic genetic resources are managed by Federal, State, and Tribal governments and/or the commercial sector. Authorities and responsibilities for oversight of aquatic genetic resources are distributed throughout various departments and agencies within these governments. In many cases, public-private research partnerships have been formed to establish breeding or research programs to improve production efficiency, animal welfare, or product quality, or to conserve genetic diversity in support of protecting or enhancing natural populations. At the national level Federal Agencies lead efforts towards conservation. For instance, in 2016 58 fish species (listed and non-listed) and 25 species of amphibians, arthropods, mollusks, plants, and others were propagated and distributed from 67 National Fish Hatchery System facilities. Among this network, 53 facilities implemented 404 recovery actions as called for in approved

Recovery Plans and Biological Opinions, benefitting 78 federally-listed species. These facilities also provided Refugia for 30 listed species facing catastrophic events such as wildfires, droughts, or floods.

Federal agencies whose missions relate to aquatic genetic resources include:

1) Department of Commerce, National Oceanic and Atmospheric Administration (NOAA)

a. National Marine Fisheries Service (NMFS): Stewardship of the nation's ocean resources and their habitats to ensure productive and sustainable fisheries, safe sources of seafood, the recovery and conservation of protected resources, and healthy ecosystems.

b. Office of Aquaculture (within NMFS): Fosters marine aquaculture to create employment and business opportunities in coastal communities; provide safe, sustainable seafood; and complement NOAA's comprehensive strategy for maintaining healthy and productive marine populations, species, and ecosystems and vibrant coastal communities. Integrates and coordinates NMFS aquaculture policies, research, outreach, and international obligations.

c. National Ocean Service (NOS) National Centers for Coastal Ocean Sciences (NCCOS): Formed in March 1999 as the focal point for coastal ocean science, ecological forecasting, water quality monitoring, status and trends assessments, and science to management (technology transfer and capacity building). Works directly with managers, industry, regulators, and scientists to deliver relevant, timely, and accurate scientific information and tools.

2) Department of the Interior
a. Fish and Wildlife Service: The Fish and Wildlife Service's (FWS) National Fish Hatchery System (NFHS) consists of 72 National Fish Hatcheries, one historic National Fish Hatchery, nine Fish Health Centers (FHC), seven Fish Technology Centers (FTC), and the Aquatic Animal Drug Approval Partnership Program (AADAP). With the support of applied research and development programs, hatchery-propagation of animals and plants is critical to maintain fisheries by acting to conserve federally-listed and non-listed aquatic species, through use as a management tool to bolster or re-establish self-sustaining populations in the wild, and by mitigating impacts to fisheries associated with federal water projects.

b. US Geological Survey: Provides unbiased science, tools, and decision support to the Nation's natural resource managers, with particular focus on conserving species, lands, and priority ecosystems.

3) Department of Agriculture

a. Agricultural Research Service: Conducts intramural fundamental and applied research to improve systems for raising domesticated aquaculture species and enhance the productivity and efficiency of U.S. producers and the quality of seafood and other aquatic animal products. Genetic improvement and conservation of genetic resources is a significant portion of the research portfolio.

b. National Institute of Food and Agriculture: Provides extramural support for aquaculture research and extension programs; provide leadership, on behalf of the Secretary of Agriculture, to facilitate the coordination of all Federal programs in aquaculture (IWGA).

c. National Agriculture Statistics Service: Provides timely, accurate, and useful statistics in service to U.S. agriculture.

d. Economic Research Service: Anticipates trends and emerging issues in agriculture, food, the environment, and rural America and conducts high-quality, objective economic research to inform and enhance public and private decision-making.

e. Animal Plant Health Inspection Service: Provides oversight of aquatic animal health, welfare, and wildlife predation programs; regulates policy for imports and exports.

4) Department of Health and Human Services

a. Food and Drug Administration: Protects the public health by assuring the safety, effectiveness, quality, and security of human and veterinary drugs, vaccines and other biological products, and medical devices. Regulates the use of animal biotechnology in the food supply.

In addition to Federal agencies, each State, Territory, and Tribal nation has one or more entities delegated with oversight of various aspects of aquatic genetic resources for their locale.

In 1862, the Federal Government created a national university based program to assist farm production and management with applied research and educational outreach. In 1966, a similar program for marine fisheries was created. Both programs have resulted in approximately 106 State and Territorial universities and institutions of higher learner focused on advancing technology, biotechnology, production practices, farm and fishery management, and related topics. Each of these institutions includes theoretical or applied genetic research as well as the granting of undergraduate and graduate degrees in molecular or cellular biology, bioinformatics and genomics, genetic modeling, genetic engineering, and evolutionary or molecular genetics.

Given this complexity, this Country Report will solely address Federal efforts to manage, conserve, and enhance aquatic animal genetic resources, with an emphasis on the primary species of economic interest for food and agriculture. Survey answers for the Country Report were based on the professional knowledge of subject matter experts and the following documents:

• Fourth Annual Report on Aquaculture and Policy in the United States of America for the 2016 United States-Japan Natural Resources Panel on Aquaculture (UJNR). Office of Aquaculture, National Oceanic and Atmospheric Administration, National Marine Fisheries Service.

• Fisheries of the United States 2015, National Marine Fisheries Service, National Oceanic and Atmospheric Administration.

• Census of Aquaculture 2013, Volume 3, Special Studies Part 2. U.S. Department of Agriculture, National Agriculture Statistics Service.

• The 2015 – 2020 U.S. Dietary Guidelines https://health.gov/dietaryguidelines/2015/guidelines/table-of-contents/.

• The National Aquaculture Association http://thenaa.net/.

• Aquaculture genomics, genetics and breeding in the United States: current status, challenges, and priorities for future research. BMC Genomics 2017 18:191

The FWS has seven Fish Technology Centers (FTCs) that provide applied research and development for recovery, restoration, and mitigation programs that enable fisheries managers to more effectively carry out their work. The bulk genetic management stems from these facilities and is executed at production facilities and in wild populations. For this survey, the USFWS provided information on wild relatives of aquatic species that undergo intensive commercial aquaculture aimed at food production. This includes salmonid species such as rainbow trout, sea-run Atlantic salmon, Chinook salmon, and lake trout.

This report was prepared by the committee below, with contributions from additional colleagues in the U.S. public and private sectors. The committee was not able to provide answers for all questions, as relevant data and/or information are not recorded or centralized by the Federal government.

Caird Rexroad
Committee Chair and National Focal Point for Aquatic Genetic Resources
USDA ARS, National Program Leader for Aquaculture

Gene Kim
USDA NIFA, National Program Leader for Aquaculture

Harvey Blackburn
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Kristen Gruenthal
NOAA NMFS Office of Aquaculture, ERT Consultant

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USFWS, Chief, Branch of Hatchery Operations and Applied Sciences

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National Aquaculture Association, Executive Director

Eric Silberhorn,
FDA, Regulator Review Scientist

Eric Landis
FDA, Biologist, Aquaculture Drugs Team

Charles C. Brinkman
Department of State, Foreign Affairs Officer

III. MAIN BODY OF THE COUNTRY REPORT

Aquaculture, culture-based fisheries and capture fisheries, have differing importance among countries. The structure of chapters in each Country Report will reflect those differences. Countries which do not have a well-developed aquaculture sector but where wild relatives of farmed aquatic species are located, should report on these resources. Countries should decide how to prioritize the coverage of their Country Reports depending on their aquatic genetic resources.

Chapter 1: The Use and Exchange of Aquatic Genetic Resources of Farmed Aquatic Species and their Wild Relatives within National Jurisdiction

The main objective of Chapter 1 is to provide annotated inventories of aquatic genetic resources (AqGR) of farmed aquatic species and their wild relatives.

Farmed aquatic species

1. Over the last 10 years, has production been: ***Please mark appropriate box.***

- ◯ Increasing
- ◯ Stable
- ◯ Decreasing
- ◯ Stopped
- ◯ Still in Research and Development
- ◉ Fluctuating
- ◯ Not known

2. What is the expected trend over the next 10 years? ***Please mark appropriate box.***

- (●) Increasing
- ( ) Stable
- ( ) Decreasing
- ( ) Stopped
- ( ) Still in Research and Development
- ( ) Fluctuating
- ( ) Not known

3. Is the identification and naming of farmed species, subspecies, hybrids, crossbreeds, strains, triploids, other distinct types accurate and up- to-date? ***Please mark appropriate box.***

- (●) Yes
- ( ) No
- ( ) Mostly Yes
- ( ) Mostly No

Please include any explanation or additional information here.

Strong integration between producers, researchers and government agencies is important; these communities value the need for a common language.

4. To what extent are genetic data for farmed aquatic organisms

a) Available? ***Please mark appropriate box.***

- ( ) Not at all
- ( ) To a minor extent
- (●) To some extent
- ( ) To a great extent

b) Used in management? ***Please mark appropriate box.***

- ( ) Not at all
- ( ) To a minor extent
- (●) To some extent
- ( ) To a great extent

Please add any explanation here.

The extents to which genetic data are available and used in management vary with species. Genetic data can be considered at the level of the population, use of pedigree information in breeding, and use of genomic information to aid in genetic improvement of important traits.

Most species that are farmed have populations that have been characterized for their performance in aquaculture. This may include analyses with DNA markers that establish their relatedness to wild relatives and other farmed populations.

The major species that are farmed in the US employ pedigree information into breeding programs, such as those for rainbow trout, Atlantic salmon, Pacific and eastern oysters, and tilapia. Some of these are private-public partnerships.

Only the most advanced breeding programs are recently incorporating genome information into breeding through various approaches to marker assisted selection or genomic selection. All of these programs have a public component.

5. To what extent are the aquatic organisms farmed in your country sourced as wild seed or from wild brood stock*?*

Please mark appropriate box.

- ○ Not at all
- ○ To a minor extent
- ◉ To some extent
- ○ To a great extent

Please add any explanation here.

Major species farmed in the US such as rainbow trout, Atlantic salmon, and channel catfish have closed breeding programs and do not incorporate wild stocks. However, some minor species and those which are only recently cultured have recently or continually incorporated wild seed into their programs. Examples include hybrid striped bass production and marine species under development as new commercial species. Conservation programs regularly incorporate wild seed.

6. What proportions (%) of breeding programmes and efforts for the genetic improvement of farmed aquatic species in your country are being managed by the public sector (government research, universities etc.), the private sector, and public-private partnerships?

- Percent managed by public sector. **Please Enter Percentage Here** 50
- Percent managed by private sector**.** **Please Enter Percentage Here** 20
- Percent managed by private /public partnership. **Please Enter Percentage Here** 30

Total 100

Please add any explanation here.

The extent to which breeding programs are managed by the public or private sectors is dependent on the species and industry. Many public programs seek to develop a new species for industry or provide research in partnership with industry to enhance established approaches to genetic improvement. The public sector has many unique populations bred for research objectives, some of which are commercially relevant and transferable to industry.

These percentages were developed in terms of numbers of species and not volume of production.

7. To what extent do genetically improved aquatic organisms, including hybrids, crossbreeds, strains, triploids and other distinct types contribute to national aquaculture production in terms of volume ?

Please mark appropriate box.

- ○ Not at all
- ○ To a minor extent
- ○ To some extent
- ◉ To a great extent

8. Please list most significant examples where genetic improvement contributed to increased production and indicate whether they were developed by public, private or public/private partnerships.

Add Row

Species	Type of genetic improvement *mark all that apply*		Developed By *mark all that apply*	
Salmo salar	☒ Traditional selective breeding		☒ Private Sector ☒ Public Sector ☒ Private/Public partnership	X
	☐ Hybrids		☐ Private Sector ☐ Public Sector ☐ Private/Public partnership	
	☒ Triploids and other polyploids		☒ Private Sector ☐ Public Sector ☐ Private/Public partnership	
	☐ Mono-sex production		☐ Private Sector ☐ Public Sector ☐ Private/Public partnership	
	☒ Other		☒ Private Sector ☐ Public Sector ☐ Private/Public partnership	
Morone spp	☒ Traditional selective breeding		☐ Private Sector ☒ Public Sector ☐ Private/Public partnership	X
	☒ Hybrids	Specify parental species in the box below Morone chrysops Morone saxatilis	☒ Private Sector ☒ Public Sector ☒ Private/Public partnership	
	☐ Triploids and other polyploids		☐ Private Sector ☐ Public Sector ☐ Private/Public partnership	
	☐ Mono-sex production		☐ Private Sector ☐ Public Sector ☐ Private/Public partnership	
	☐ Other		☐ Private Sector ☐ Public Sector ☐ Private/Public partnership	

	☒ Traditional selective breeding		☐ Private Sector ☒ Public Sector ☐ Private/Public partnership	
	☒ Hybrids	Specify parental species in the box below Ictalurus furcatus Ictalurus punctatus	☒ Private Sector ☒ Public Sector ☐ Private/Public partnership	
Ictalurus spp	☐ Triploids and other polyploids		☐ Private Sector ☐ Public Sector ☐ Private/Public partnership	X
	☐ Mono-sex production		☐ Private Sector ☐ Public Sector ☐ Private/Public partnership	
	☐ Other		☐ Private Sector ☐ Public Sector ☐ Private/Public partnership	
	☒ Traditional selective breeding		☒ Private Sector ☐ Public Sector ☒ Private/Public partnership	
	☒ Hybrids	Specify parental species in the box below Crassostrea gigas (inbred line crossbreeding)	☒ Private Sector ☐ Public Sector ☐ Private/Public partnership	
Crassostrea gigas	☒ Triploids and other polyploids		☒ Private Sector ☐ Public Sector ☐ Private/Public partnership	X
	☐ Mono-sex production		☐ Private Sector ☐ Public Sector ☐ Private/Public partnership	
	☐ Other		☐ Private Sector ☐ Public Sector ☐ Private/Public partnership	

	☒ Traditional selective breeding	☐ Private Sector ☒ Public Sector ☒ Private/Public partnership	
	☐ Hybrids	☐ Private Sector ☐ Public Sector ☐ Private/Public partnership	
Crassostrea virginica	☒ Triploids and other polyploids	☒ Private Sector ☒ Public Sector ☒ Private/Public partnership	X
	☐ Mono-sex production	☐ Private Sector ☐ Public Sector ☐ Private/Public partnership	
	☐ Other	☐ Private Sector ☐ Public Sector ☐ Private/Public partnership	
	☒ Traditional selective breeding	☒ Private Sector ☒ Public Sector ☒ Private/Public partnership	
	☐ Hybrids	☐ Private Sector ☐ Public Sector ☐ Private/Public partnership	
Oncorhynchus mykiss	☒ Triploids and other polyploids	☒ Private Sector ☒ Public Sector ☒ Private/Public partnership	X
	☒ Mono-sex production	☒ Private Sector ☒ Public Sector ☒ Private/Public partnership	
	☐ Other	☐ Private Sector ☐ Public Sector ☐ Private/Public partnership	

9. Please fill in table 1.1

Table 1.1 Aquatic genetic resources (AqGR) of farmed aquatic species in your country

Add Row

Farmed species	Genetic type	Availability of genetic data	Trends in production	Future trends in production	Genetic improvement	Future genetic improvement	Comments	
List species (scientific names), strains and varieties as scientific names (put in brackets the most widely used national common name or names) and indicate whether native or introduced	*Indicate all genetic types that apply to the species*	Are genetic data available for farmed populations? If yes, give summary details in comments	Over the last 10 years, production has been ***(mark one)***	Expected trend over the next 10 years is that production will ***(mark one)***	Which genetic technologies are currently being used on the species ***(mark all that apply)***	***mark all that apply***	For example important traits improved, how data are used in management or name of breed, source of information, etc.	
◉ Native ○ Introduced Salmo salar	☐ Wild Type ☒ Selective bred type ☐ Hybrids ☐ Cross breeds ☐ Strains ☐ Varieties ☒ Polyploids	◉ Yes ○ No ○ Not Known	◉ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Stopped ○ Not known	◉ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Stopped ○ Not known	☒ Selective breeding ☐ Hybridization ☒ Polyploidy (chromosome set manipulation) ☐ Monosex ☒ Marker assisted selection ☐ Other (specify in comment)	☒ Selective breeding ☐ Hybridization ☒ Polyploidy (chromosome set manipulation) ☐ Monosex ☒ Marker assisted selection ☐ Other (specify in comment)	Atlantic salmon. Breeding for carcass weight, cold tolerance, fillet color, fat content, and sea lice resistance by a public/private partnership. Employing marker assisted selection for traits where information is available.	X

◉ Native ○ Introduced Morone spp	☒ Wild Type ☒ Selective bred type ☒ Hybrids ☐ Cross breeds ☐ Strains ☐ Varieties ☐ Polyploids	◉ Yes ○ No ○ Not Known	○ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Stopped ○ Not known	○ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Stopped ○ Not known	☒ Selective breeding ☒ Hybridization ☐ Polyploidy (chromosome set manipulation) ☐ Monosex ☐ Marker assisted selection ☐ Other (specify in comment)	☒ Selective breeding ☒ Hybridization ☐ Polyploidy (chromosome set manipulation) ☐ Monosex ☒ Marker assisted selection ☐ Other (specify in comment)	Striped bass Morone saxitilis, white bass Morone chrysops and their hybrids. White bass females still sampled from the wild for commercial production. Public breeding programs for striped bass and white bass to improve hybrid performance for growth traits.	X
◉ Native ○ Introduced Ictalurus spp	☒ Wild Type ☒ Selective bred type ☒ Hybrids ☐ Cross breeds ☐ Strains ☐ Varieties ☐ Polyploids	◉ Yes ○ No ○ Not Known	◉ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Stopped ○ Not known	◉ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Stopped ○ Not known	☒ Selective breeding ☒ Hybridization ☐ Polyploidy (chromosome set manipulation) ☐ Monosex ☐ Marker assisted selection ☐ Other (specify in comment)	☒ Selective breeding ☒ Hybridization ☐ Polyploidy (chromosome set manipulation) ☐ Monosex ☒ Marker assisted selection ☐ Other (specify in comment)	Channel catfish Ictalurus punctatus, Blue catfish Ictalurus furcatus and their hybrids. Hybrids now ~60% of catfish industry. Public breeding programs for blue and channel catfish for growth, fillet yield and disease resistance.	X

◯ Native ◉ Introduced Crassostrea gigas	☒ Wild Type ☒ Selective bred type ☐ Hybrids ☒ Cross breeds ☒ Strains ☐ Varieties ☒ Polyploids	◉ Yes ◯ No ◯ Not Known	◯ Increasing ◉ Stable ◯ Fluctuating ◯ Decreasing ◯ Stopped ◯ Not known	◯ Increasing ◯ Stable ◯ Fluctuating ◯ Decreasing ◯ Stopped ◉ Not known	☒ Selective breeding ☒ Hybridization ☒ Polyploidy (chromosome set manipulation) ☐ Monosex ☐ Marker assisted selection ☐ Other (specify in comment)	☒ Selective breeding ☒ Hybridization ☒ Polyploidy (chromosome set manipulation) ☒ Monosex ☐ Marker assisted selection ☐ Other (specify in comment)	Pacific oyster. Introduced from Japan in the early 1900s; now considered an established non-native species. Bred in a public/ private partnership for disease resistance (herpes virus) and survival, growth and yield including exposure to acidified seawater. Crosses between inbred lines show heterosis for yield. Selection among wild parents families and inbred families incorporating GCA (general combining ability, additive genetic variance) in selection of winning hybrids and parent lines. Crossbreeding can use both GCA and SCA (special combining ability), whereas traditional selection uses only GCA. Induction of triploid or tetraploid states is one-time manipulation with advantageous physiological effects. Genetic improvement of polyploid stocks only recently considered. Little confirmation of pedigrees with molecular markers; evidence suggests contamination among families and lines is rampant. Private hatchery production is probably at least 75% wild. Production peaked in 2001 at 54,222 tons and declined 50% by 2013, attributable to the impact of ocean acidification on hatchery production. OsHV-1 is another (existential) threat, as is ocean warming. Seed supply remains tight for many independent growers because the large, vertically	X

							integrated companies are increasing production and market share. (Dennis Hedgecock and Sheila Stiles, personal communication)	
◉ Native ○ Introduced Crassostrea virginica	☒ Wild Type ☒ Selective bred type ☐ Hybrids ☐ Cross breeds ☒ Strains ☐ Varieties ☒ Polyploids	◉ Yes ○ No ○ Not Known	○ Increasing ◉ Stable ○ Fluctuating ○ Decreasing ○ Stopped ○ Not known	○ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Stopped ◉ Not known	☒ Selective breeding ☐ Hybridization ☒ Polyploidy (chromosome set manipulation) ☐ Monosex ☐ Marker assisted selection ☐ Other (specify in comment)	☒ Selective breeding ☒ Hybridization ☒ Polyploidy (chromosome set manipulation) ☒ Monosex ☐ Marker assisted selection ☐ Other (specify in comment)	Eastern oyster. Public breeding programs that support the commercial sector, breeding for MSX and dermo resistance, adn growth traits. Commercial sector uses triploids. Chesapeake Bay breeding program exists, but there are still a lot of hatchery-propagated wild type released. Geographic "strains" of C. virginica from along the Atlantic Coast and from the Gulf Coast have been used at various times. (Dennis Hedgecock and Sheila Stiles, personal communication)	X
◉ Native ○ Introduced Oncorhynchus mykiss	☐ Wild Type ☒ Selective bred type ☐ Hybrids ☐ Cross breeds ☐ Strains ☐ Varieties ☐ Polyploids	◉ Yes ○ No ○ Not Known	◉ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Stopped ○ Not known	◉ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Stopped ○ Not known	☒ Selective breeding ☐ Hybridization ☒ Polyploidy (chromosome set manipulation) ☒ Monosex ☒ Marker assisted selection ☐ Other (specify in comment)	☒ Selective breeding ☐ Hybridization ☒ Polyploidy (chromosome set manipulation) ☒ Monosex ☒ Marker assisted selection ☐ Other (specify in comment)	Rainbow trout. Many breeding programs in the public and private sectors, including partnerships, that seek to improve resistance to bacterial cold water disease, columnare, IHNV, growth, growth on diets based on plant proteins and alternative lipid sources, and fillet yield. All females populations are the majority of production, a significant portion is triploids.	X

○ Native ◉ Introduced Crassostrea sikamea	☒ Wild Type ☐ Selective bred type ☐ Hybrids ☐ Cross breeds ☐ Strains ☐ Varieties ☐ Polyploids	◉ Yes ○ No ○ Not Known	○ Increasing ◉ Stable ○ Fluctuating ○ Decreasing ○ Stopped ○ Not known	○ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Stopped ◉ Not known	☒ Selective breeding ☐ Hybridization ☐ Polyploidy (chromosome set manipulation) ☐ Monosex ☐ Marker assisted selection ☐ Other (specify in comment)	☒ Selective breeding ☒ Hybridization ☒ Polyploidy (chromosome set manipulation) ☒ Monosex ☐ Marker assisted selection ☐ Other (specify in comment)	Kumamoto oysters. Brought to US from Japan in 1945, initial stages of inclusion into a traditional breeding program. Third and fourth generation pedigreed families exist but no selection yet. Species diagnostic markers only; C. gigas genome could probably serve as a reference. Production is not increasing; it may be stable or even decreasing because of the very limited seed supply. (Dennis Hedgecock, personal communication)	X
◉ Native ○ Introduced Ostrea lurida	☒ Wild Type ☐ Selective bred type ☐ Hybrids ☐ Cross breeds ☐ Strains ☐ Varieties ☐ Polyploids	◉ Yes ○ No ○ Not Known	◉ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Stopped ○ Not known	○ Increasing ◉ Stable ○ Fluctuating ○ Decreasing ○ Stopped ○ Not known	☐ Selective breeding ☐ Hybridization ☐ Polyploidy (chromosome set manipulation) ☐ Monosex ☐ Marker assisted selection ☐ Other (specify in comment)	☐ Selective breeding ☐ Hybridization ☐ Polyploidy (chromosome set manipulation) ☐ Monosex ☐ Marker assisted selection ☐ Other (specify in comment)	Olympia oysters. Work to date more focused on stock restoration. Draft genome and transcriptomes available. Genes associated with thermal, mechanical, and oxidative stress and immune function described. Other genetic data are in a mostly unpublished dissertation on microsatellite DNA markers and population structure. Increasing production likely only from restoration efforts and not commercial production. No genetic improvement now or in the foreseeable future. (Dennis Hedgecock, personal communication)	X

◉ Native ○ Introduced Perca flavescens	☒ Wild Type ☒ Selective bred type ☐ Hybrids ☐ Cross breeds ☐ Strains ☐ Varieties ☐ Polyploids	◉ Yes ○ No ○ Not Known	○ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Stopped ○ Not known	○ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Stopped ○ Not known	☒ Selective breeding ☐ Hybridization ☐ Polyploidy (chromosome set manipulation) ☐ Monosex ☐ Marker assisted selection ☐ Other (specify in comment)	☒ Selective breeding ☐ Hybridization ☐ Polyploidy (chromosome set manipulation) ☒ Monosex ☒ Marker assisted selection ☐ Other (specify in comment)	Yellow perch. Public breeding program for growth and survival. Development of monosex female populations may significantly improve growth rates.	X
◉ Native ○ Introduced Sciaenops ocellatus	☒ Wild Type ☐ Selective bred type ☐ Hybrids ☐ Cross breeds ☐ Strains ☐ Varieties ☐ Polyploids	◉ Yes ○ No ○ Not Known	◉ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Stopped ○ Not known	◉ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Stopped ○ Not known	☐ Selective breeding ☐ Hybridization ☐ Polyploidy (chromosome set manipulation) ☐ Monosex ☐ Marker assisted selection ☐ Other (specify in comment)	☒ Selective breeding ☐ Hybridization ☐ Polyploidy (chromosome set manipulation) ☐ Monosex ☐ Marker assisted selection ☐ Other (specify in comment)	Red drum. Bred by state agencies and the private sector. Selection for cold tolerance in initial stages. Sex-specific genetic linkage maps available.	X

◉ Native ○ Introduced Haliotis spp	☒ Wild Type ☐ Selective bred type ☐ Hybrids ☐ Cross breeds ☐ Strains ☐ Varieties ☐ Polyploids	◉ Yes ○ No ○ Not Known	○ Increasing ○ Stable ◉ Fluctuating ○ Decreasing ○ Stopped ○ Not known	◉ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Stopped ○ Not known	☐ Selective breeding ☐ Hybridization ☐ Polyploidy (chromosome set manipulation) ☐ Monosex ☐ Marker assisted selection ☐ Other (specify in comment)	☒ Selective breeding ☐ Hybridization ☐ Polyploidy (chromosome set manipulation) ☐ Monosex ☐ Marker assisted selection ☐ Other (specify in comment)	Abalone. Multiple species bred by state and federal agencies for restoration. Red, green, pink, and pinto abalone bred by private sector for sale. Red abalone transcriptome available and draft genome in progress. Ocean acidification resistant red abalone strain development in progress by private sector. Warm-water tolerance of pink abalone an attractive candidate trait for aquaculture.	X
○ Native ◉ Introduced Macrobrachium rosenbergii	☒ Wild Type ☐ Selective bred type ☐ Hybrids ☐ Cross breeds ☒ Strains ☐ Varieties ☐ Polyploids	○ Yes ○ No ◉ Not Known	○ Increasing ○ Stable ◉ Fluctuating ○ Decreasing ○ Stopped ○ Not known	◉ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Stopped ○ Not known	☐ Selective breeding ☐ Hybridization ☐ Polyploidy (chromosome set manipulation) ☐ Monosex ☐ Marker assisted selection ☒ Other (specify in comment)	☐ Selective breeding ☐ Hybridization ☐ Polyploidy (chromosome set manipulation) ☐ Monosex ☐ Marker assisted selection ☒ Other (specify in comment)	Freshwater prawn. Tidwell et al. 2014 - "Many cultured stocks used today in the USA are still derived directly or indirectly from the 36 individuals imported [from Penang, Malaysia,] to Hawaii in the 1960s. Additionally, hatcheries are typically initiated with small numbers of individual brood animals and broodstock are often sourced directly from production ponds stocked with their own juveniles."	X

○ Native ◉ Introduced Penaeus vannamei	☒ Wild Type ☒ Selective bred type ☐ Hybrids ☐ Cross breeds ☒ Strains ☐ Varieties ☐ Polyploids	◉ Yes ○ No ○ Not Known	○ Increasing ○ Stable ◉ Fluctuating ○ Decreasing ○ Stopped ○ Not known	◉ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Stopped ○ Not known	☒ Selective breeding ☐ Hybridization ☐ Polyploidy (chromosome set manipulation) ☐ Monosex ☐ Marker assisted selection ☐ Other (specify in comment)	☒ Selective breeding ☐ Hybridization ☐ Polyploidy (chromosome set manipulation) ☐ Monosex ☐ Marker assisted selection ☐ Other (specify in comment)	Pacific whiteleg shrimp. Brought to South Carolina in 1985; production peaked around 2003, then decreased due to Taura Syndrome Virus (TSV) and low-farm-gate, and began rising again around 2011. Disease-free and -resistant strains, domesticated specific pathogen-free and -resistant stocks critical to US shrimp biosecurity programs. TSV-resistant strains stocked exclusively on mainland; only Hawaii has non-TSV-resistant strains. Current focus on growth and reproductive improvement. Other genetically improved species include giant tiger prawn (Penaeus monodon) and blue shrimp (L. stylirostris).	X
○ Native ◉ Introduced Oreochromis (=Tilapia) spp	☒ Wild Type ☒ Selective bred type ☒ Hybrids ☐ Cross breeds ☒ Strains ☐ Varieties ☐ Polyploids	◉ Yes ○ No ○ Not Known	○ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Stopped ○ Not known	○ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Stopped ○ Not known	☒ Selective breeding ☒ Hybridization ☐ Polyploidy (chromosome set manipulation) ☒ Monosex ☐ Marker assisted selection ☒ Other (specify in comment)	☐ Selective breeding ☐ Hybridization ☐ Polyploidy (chromosome set manipulation) ☐ Monosex ☐ Marker assisted selection ☐ Other (specify in comment)	Tilapia (primarily O. niloticus and O. mossambicus). Public/private partnership seeks to improve growth and disease resistance. Past research into GMOs, selective breeding for color morphs, work on all-male hybrid progeny.	X

○ Native ◉ Introduced Ctenopharyngodon idellus	☒ Wild Type ☐ Selective bred type ☐ Hybrids ☐ Cross breeds ☐ Strains ☐ Varieties ☒ Polyploids	◉ Yes ○ No ○ Not Known	○ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Stopped ◉ Not known	○ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Stopped ◉ Not known	☐ Selective breeding ☐ Hybridization ☒ Polyploidy (chromosome set manipulation) ☐ Monosex ☐ Marker assisted selection ☐ Other (specify in comment)	☐ Selective breeding ☐ Hybridization ☒ Polyploidy (chromosome set manipulation) ☐ Monosex ☐ Marker assisted selection ☐ Other (specify in comment)	Grass carp. Introduced in Alabama and Arkansas in 1963. Sterile triploids often stocked to control nuisance aquatic plants. Draft genome available.	X
◉ Native ○ Introduced Acipenser transmontanus	☒ Wild Type ☐ Selective bred type ☐ Hybrids ☐ Cross breeds ☐ Strains ☐ Varieties ☒ Polyploids	◉ Yes ○ No ○ Not Known	◉ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Stopped ○ Not known	◉ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Stopped ○ Not known	☐ Selective breeding ☐ Hybridization ☐ Polyploidy (chromosome set manipulation) ☐ Monosex ☐ Marker assisted selection ☒ Other (specify in comment)	☒ Selective breeding ☐ Hybridization ☐ Polyploidy (chromosome set manipulation) ☐ Monosex ☐ Marker assisted selection ☒ Other (specify in comment)	White Sturgeon. Ongoing experimental and commercial land-based marine finfish culture operations in Pacific Northwest. Evidence for spontaneous autopolyploidy; of concern to caviar farmers, preliminary evidence 10n sturgeon have abnormal reproductive development. Public/private study looked into heritability of growth rate, caviar yield, and age at sexual maturity.	X

◉ Native ○ Introduced Mytilus edulis	☒ Wild Type ☒ Selective bred type ☐ Hybrids ☐ Cross breeds ☐ Strains ☐ Varieties ☐ Polyploids	◉ Yes ○ No ○ Not Known	○ Increasing ○ Stable ◉ Fluctuating ○ Decreasing ○ Stopped ○ Not known	○ Increasing ○ Stable ◉ Fluctuating ○ Decreasing ○ Stopped ○ Not known	☒ Selective breeding ☐ Hybridization ☐ Polyploidy (chromosome set manipulation) ☐ Monosex ☐ Marker assisted selection ☐ Other (specify in comment)	☒ Selective breeding ☐ Hybridization ☐ Polyploidy (chromosome set manipulation) ☐ Monosex ☐ Marker assisted selection ☐ Other (specify in comment)	Blue mussel. Native to U.S. east and gulf coasts. Likely non-native on the U.S. West Coast, though it may have been introduced to the Salish Sea. Lots of genetic data on natural populations of the blue mussel species complex. (Dennis Hedgecock and Sheila Stiles, personal communications)	X
◉ Native ○ Introduced Cambarus spp	☒ Wild Type ☐ Selective bred type ☐ Hybrids ☐ Cross breeds ☐ Strains ☐ Varieties ☐ Polyploids	○ Yes ○ No ○ Not Known	○ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Stopped ○ Not known	○ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Stopped ○ Not known	☐ Selective breeding ☐ Hybridization ☐ Polyploidy (chromosome set manipulation) ☐ Monosex ☐ Marker assisted selection ☐ Other (specify in comment)	☐ Selective breeding ☐ Hybridization ☐ Polyploidy (chromosome set manipulation) ☐ Monosex ☐ Marker assisted selection ☐ Other (specify in comment)	Crayfish or crawfish.	X

○ Native ◉ Introduced Venerupis philippinarum	☒ Wild Type ☐ Selective bred type ☐ Hybrids ☐ Cross breeds ☐ Strains ☐ Varieties ☐ Polyploids	◉ Yes ○ No ○ Not Known	○ Increasing ◉ Stable ○ Fluctuating ○ Decreasing ○ Stopped ○ Not known	○ Increasing ◉ Stable ○ Fluctuating ○ Decreasing ○ Stopped ○ Not known	☒ Selective breeding ☐ Hybridization ☐ Polyploidy (chromosome set manipulation) ☐ Monosex ☐ Marker assisted selection ☐ Other (specify in comment)	☒ Selective breeding ☒ Hybridization ☒ Polyploidy (chromosome set manipulation) ☒ Monosex ☐ Marker assisted selection ☐ Other (specify in comment)	Manila clam. Introduced from Japan in the 1930s; now considered an established non-native species. Second highest production after C. gigas on the U.S. West Coast. Transcriptome and linkage maps available, doubly uniparental inheritance known, and genome coming. Formation of pedigreed families in progress, with hybridization, polyploidy, and monosex production proposed. (Dennis Hedgecock, personal communication)	X
◉ Native ○ Introduced Alligator mississippiensis	☒ Wild Type ☐ Selective bred type ☐ Hybrids ☐ Cross breeds ☐ Strains ☐ Varieties ☐ Polyploids	○ Yes ○ No ○ Not Known	○ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Stopped ○ Not known	○ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Stopped ○ Not known	☐ Selective breeding ☐ Hybridization ☐ Polyploidy (chromosome set manipulation) ☐ Monosex ☐ Marker assisted selection ☐ Other (specify in comment)	☐ Selective breeding ☐ Hybridization ☐ Polyploidy (chromosome set manipulation) ☐ Monosex ☐ Marker assisted selection ☐ Other (specify in comment)	American alligator.	X

◉ Native ○ Introduced Panopea generosa	☒ Wild Type ☐ Selective bred type ☐ Hybrids ☐ Cross breeds ☐ Strains ☐ Varieties ☐ Polyploids	◉ Yes ○ No ○ Not Known	◉ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Stopped ○ Not known	◉ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Stopped ○ Not known	☐ Selective breeding ☐ Hybridization ☒ Polyploidy (chromosome set manipulation) ☐ Monosex ☐ Marker assisted selection ☐ Other (specify in comment)	☒ Selective breeding ☐ Hybridization ☒ Polyploidy (chromosome set manipulation) ☐ Monosex ☐ Marker assisted selection ☐ Other (specify in comment)	Geoduck. Data on microsatellite variation in wild and hatchery populations; like most marine species with planktonic larvae, low Fst across the range. Future increasing production depends on seed supply. Current research on triploidy but no selection because of long generation time. (Dennis Hedgecock, personal communication)	X
◉ Native ○ Introduced Mercenaria mercenaria	☐ Wild Type ☐ Selective bred type ☐ Hybrids ☐ Cross breeds ☐ Strains ☐ Varieties ☐ Polyploids	○ Yes ○ No ○ Not Known	○ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Stopped ○ Not known	○ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Stopped ○ Not known	☐ Selective breeding ☐ Hybridization ☐ Polyploidy (chromosome set manipulation) ☐ Monosex ☐ Marker assisted selection ☐ Other (specify in comment)	☐ Selective breeding ☐ Hybridization ☐ Polyploidy (chromosome set manipulation) ☐ Monosex ☐ Marker assisted selection ☐ Other (specify in comment)	Hard clam or quahog.	X

○ Native ○ Introduced Oncorhynchus tshawytscha	☒ Wild Type ☐ Selective bred type ☐ Hybrids ☐ Cross breeds ☐ Strains ☐ Varieties ☐ Polyploids	◉ Yes ○ No ○ Not Known	○ Increasing ◉ Stable ○ Fluctuating ○ Decreasing ○ Stopped ○ Not known	◉ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Stopped ○ Not known	☐ Selective breeding ☐ Hybridization ☐ Polyploidy (chromosome set manipulation) ☐ Monosex ☐ Marker assisted selection ☒ Other (specify in comment)	☒ Selective breeding ☐ Hybridization ☐ Polyploidy (chromosome set manipulation) ☐ Monosex ☒ Marker assisted selection ☐ Other (specify in comment)	Using neutral markers to manage for minimizing impact of cultured fish on wild populations into which they are released.	X
○ Native ◉ Introduced Mytilus galloprovincialis	☒ Wild Type ☐ Selective bred type ☐ Hybrids ☐ Cross breeds ☐ Strains ☐ Varieties ☐ Polyploids	◉ Yes ○ No ○ Not Known	◉ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Stopped ○ Not known	◉ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Stopped ○ Not known	☒ Selective breeding ☐ Hybridization ☐ Polyploidy (chromosome set manipulation) ☐ Monosex ☐ Marker assisted selection ☐ Other (specify in comment)	☒ Selective breeding ☒ Hybridization ☒ Polyploidy (chromosome set manipulation) ☒ Monosex ☐ Marker assisted selection ☐ Other (specify in comment)	Blue or Mediterranean mussel. Introduced to U.S. West Coast. Transcriptome available. Formation of pedigreed families in progress. (Dennis Hedgecock, personal communication)	X

○ Native ○ Introduced Argopecten irradians	☒ Wild Type ☒ Selective bred type ☐ Hybrids ☐ Cross breeds ☐ Strains ☐ Varieties ☐ Polyploids	◉ Yes ○ No ○ Not Known	○ Increasing ○ Stable ○ Fluctuating ◉ Decreasing ○ Stopped ○ Not known	○ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Stopped ◉ Not known	☒ Selective breeding ☐ Hybridization ☐ Polyploidy (chromosome set manipulation) ☐ Monosex ☐ Marker assisted selection ☐ Other (specify in comment)	☒ Selective breeding ☐ Hybridization ☐ Polyploidy (chromosome set manipulation) ☐ Monosex ☒ Marker assisted selection ☐ Other (specify in comment)	Bay scallop subspecies are found in a discontinuous distribution along the U.S. east and gulf coasts. Populations generally are in a state of decline. Some molecular genetics data available(i.e.,mtDNA, microsatellites,).Selective breeding has been conducted for growth and shell color phenotypes with a focus on restoration. (Sheila Stiles, personal communication)	X

10. Which aquatic species in your country are thought to have potential for domestication and future use in aquaculture?

Add Row

Species ***Type and select a species***	Is the species native to your country?	Comments ***For example main sources of information***	
Seriola rivoliana	(•) Yes ( ) No ( ) Not Known	Almaco jack. Private entities based in Hawaii, with possible expansion to North America. Early stages of commercialization and/or in research and development. Wild and captive F1/F2 broodstock. Exploring options for selective breeding.	X
Gadus morhua	(•) Yes ( ) No ( ) Not Known	Atlantic cod. Public research into sustainable cod farming in Maine. Early stages of commercialization and/or in .research and development	X
Lates calcarifer	( ) Yes (•) No ( ) Not Known	Barramundi. Single private breeder in Massachusetts.	X

Centropristis striata	(•) Yes ( ) No ( ) Not Known	Black sea bass. Public research and private growers with interest in culturing the species along the United States east coast.	X
Paralichthys californicus	(•) Yes ( ) No ( ) Not Known	California halibut. Public/private and private partnerships. Early stages of commercialization and/or in research and development. Wild and captive F1 broodstock. Currently focused on stock enhancement but with potential for commercial culture.	X
Seriola lalandi	(•) Yes ( ) No ( ) Not Known	California yellowtail (f.k.a. Seriola lalandi, occasionally subspecies dorsalis). Public/private partnership in California. Early stages of commercialization and/or in research and development. Wild and captive F1 broodstock. Exploring parental associations with desirable traits, deformities, and survival.	X

Atractoscion nobilis	(•) Yes ( ) No ( ) Not Known	White seabass. Public/private and private partnerships exploring stock enhancement and offshore commercial culture. Wild broodstock.	X
Spisula solidissima	(•) Yes ( ) No ( ) Not Known	Surf clam. Public research partnerships in New Jersey.	X
Rachycentron canadum	(•) Yes ( ) No ( ) Not Known	Cobia. Multiple private and public entities throughout southeastern United States. Early stages of commercialization and/or in research and development.	X

Trachinotus carolinus	(•) Yes ( ) No ( ) Not Known	Florida pompano. Private and public entities mostly in Florida. Early stages of commercialization and/or in research and development.	X
Balistes capriscus	(•) Yes ( ) No ( ) Not Known	Grey triggerfish. Public research in North Carolina.	X
Pagrus pagrus	(•) Yes ( ) No ( ) Not Known	Red porgy. Public research in North Carolina.	X

Anoplopoma fimbria	(•) Yes ( ) No ( ) Not Known	Sablefish. Public and public/private partnerships in Washington Sate. Early stages of commercialization and/or in research and development.	X
Stenotomus chrysops	(•) Yes ( ) No ( ) Not Known	Scup. Public research in northeastern United States.	X
Argopecten irradians	(•) Yes ( ) No ( ) Not Known	Bay scallop. Public research partnerships in northeastern United States.	X

Polydactylus sexfilis	(•) Yes ( ) No ( ) Not Known	Six finger threadfin, moi. Early stages of commercialization and/or in research and development in Hawaii.	X
Acipenser gueldenstaedtii	( ) Yes (•) No ( ) Not Known	Russian sturgeon. Private experimental and commercial land-based culture operations in Florida.	X
Acipenser baerii	( ) Yes (•) No ( ) Not Known	Siberian sturgeon. Private experimental and commercial land-based culture operations in Florida.	X

Paralichthys dentatus	(•) Yes ( ) No ( ) Not Known	Summer flounder. Early stages of commercialization and/ or in research and development in southeastern United States.	X
Thunnus albacares	(•) Yes ( ) No ( ) Not Known	Yellowfin tuna. Early stages of commercialization and/or in research and development in California.	X
Crassadoma gigantea	(•) Yes ( ) No ( ) Not Known	Rock scallop. Very good potential for a high-value crop on U.S. West Coast. Public/private research on triploidy and production. (Dennis Hedgecock, personal communication)	X

11. Please list the aquatic genetic resources of farmed aquatic species your country has transferred or exchanged with other countries over the past 10 years.

Add Row

Species	Genetic alteration of exchanged material **Mark all that apply**	Details of transfer or exchange	Type of genetic material exchanged **Mark all that apply**	Country or countries involved with exchange **Hold CTRL button to select more than one country**	Comments ***Please add main purpose or objective of the exchange and main sources of information***	
Penaeus vannamei	☐ No deliberate genetic alteration ☒ Traditional selective breeding ☐ Hybrids ☐ Triploids and other polyploids ☐ Mono-sex production ☐ Other	☐ Import ☒ Export	☐ DNA ☐ Genes ☐ Gametes ☐ Tissues ☐ Embryos ☒ Living specimens ☐ Other	Afghanistan Albania Algeria Andorra Angola Antigua and Barbuda Argentina Armenia Australia Austria Azerbaijan Bahamas Bahrain Bangladesh Barbados Belarus Belgium	Sale of broodstock. Private industry; customer list unknown.	X
Penaeus monodon	☐ No deliberate genetic alteration ☒ Traditional selective breeding ☐ Hybrids ☐ Triploids and other polyploids ☐ Mono-sex production ☐ Other	☐ Import ☒ Export	☐ DNA ☐ Genes ☐ Gametes ☐ Tissues ☐ Embryos ☒ Living specimens ☐ Other	Afghanistan Albania Algeria Andorra Angola Antigua and Barbuda Argentina Armenia Australia Austria Azerbaijan Bahamas Bahrain Bangladesh Barbados Belarus Belgium	Sale of broodstock. Private industry; customer list unknown.	X

Wild relatives of farmed aquatic species

12. Please list any wild relatives of aquatic species present in your country that are farmed in another country (but not in your country) and indicate their uses.

Add Row

This question refers to aquatic genetic resources that are present in the wild in your country and that are being farmed elsewhere (but not farmed in your country), indicating any uses these resources may have in your country.

Species	Use *(mark all that apply)*	Comments	
	☐ Capture fisheries ☐ Recreational fishery ☐ Aquaria ☐ Biological control ☐ Research and develpment ☐ Other (specify in comments)		X

13. Please list the aquatic genetic resources of wild relatives of farmed aquatic species your country has transferred or exchanged with other countries over the past 10 years.

Add Row

This question refers to wild aquatic genetic resources collected from the wild, not from farming facilities as in question 11.

Species	Details of transfer or exchange ***mark all that apply***	Type of genetic material exchanged	Country **Hold CTRL button to select more than one country**	Comments ***main sources of information, if the transfer was legal or not***	
	☐ Import ☐ Export	☐ Tissues ☐ Gametes ☐ DNA ☐ Genes ☐ Embryos ☐ Living specimens ☐ Other	Afghanistan Albania Algeria Andorra Angola Antigua and Barbuda Argentina Armenia Australia Austria Azerbaijan Bahamas Bahrain Bangladesh Barbados Belarus		X

14. Please fill in table 1.2

Table 1.2 Aquatic genetic resources of wild relatives of farmed aquatic species in your country.

Add Row

Target species, stocks or other management units	Characteristics of species	Capture fisheries	Management measures	Availability of genetic data	Use of genetic data in management	Trends in catches	Future trends in catches	Ecosystem(s) where the fishery is located	Changes in ranges and habitats	Reasons for change in abundance of species	
For each row, list the species as scientific names (put in brackets the most widely used national common For each species, include the named stocks and name of other management units if known)	Is the species ***(mark as appropriate):***	Is this species targeted by capture fisheries?	Are there any management measures in place?	Are genetic data available for the fishery?	Are genetic data used in management?	Over the last 10 years, catches have been:	Expected trend over the next 10 years.	Indicate the ecosystem where the fishery is located (***mark all that apply)***	The habitat or range is	What are likely reasons for changes? (***mark all that apply)***	
Haliotis spp	☐ Straddling ☒ Transboundary ☐ Introduced ☒ Native	◉ Yes ○ No ○ Not Known	◉ Yes ○ No ○ Not Known	◉ Yes ○ No ○ Not Known	◉ Yes ○ No ○ Not Known	○ Increasing ○ Stable ○ Fluctuating ◉ Decreasing ○ Depleted ○ Not known	○ Increasing ○ Stable ○ Fluctuating ◉ Decreasing ○ Depleted ○ Not known	☒ Intertital ☒ Coastal in EEZ ☐ High seas ☐ Lake ☐ Reservoir ☐ River ☐ Swamp ☐ Other **(specify)**	○ Increasing ○ Stable ○ Decreasing ◉ Not known	☒ Habitat ☒ Climate ☐ Invasive species ☐ Pollution ☐ Rehabilitation of habitat ☒ Others ☐ Not known	X

Target species, stocks or other management units	Characteristics of species	Capture fisheries	Management measures	Availability of genetic data	Use of genetic data in management	Trends in catches	Future trends in catches	Ecosystem(s) where the fishery is located	Changes in ranges and habitats	Reasons for change in abundance of species	
Sciaenops ocellatus	☐ Straddling ☒ Transboundary ☐ Introduced ☒ Native	◉ Yes ○ No ○ Not Known	◉ Yes ○ No ○ Not Known	◉ Yes ○ No ○ Not Known	◉ Yes ○ No ○ Not Known	○ Increasing ○ Stable ◉ Fluctuating ○ Decreasing ○ Depleted ○ Not known	○ Increasing ○ Stable ◉ Fluctuating ○ Decreasing ○ Depleted ○ Not known	☒ Intertital ☒ Coastal in EEZ ☐ High seas ☐ Lake ☐ Reservoir ☒ River ☐ Swamp ☒ Other **(specify)** Estuary	○ Increasing ◉ Stable ○ Decreasing ○ Not known	☐ Habitat ☐ Climate ☐ Invasive species ☐ Pollution ☐ Rehabilitation of habitat ☒ Others ☐ Not known	X
Salmo salar	☐ Straddling ☒ Transboundary ☐ Introduced ☒ Native	○ Yes ◉ No ○ Not Known	◉ Yes ○ No ○ Not Known	◉ Yes ○ No ○ Not Known	◉ Yes ○ No ○ Not Known	○ Increasing ○ Stable ○ Fluctuating ○ Decreasing ◉ Depleted ○ Not known	○ Increasing ○ Stable ○ Fluctuating ○ Decreasing ◉ Depleted ○ Not known	☐ Intertital ☐ Coastal in EEZ ☐ High seas ☐ Lake ☐ Reservoir ☐ River ☐ Swamp ☐ Other **(specify)**	○ Increasing ○ Stable ◉ Decreasing ○ Not known	☒ Habitat ☒ Climate ☒ Invasive species ☒ Pollution ☐ Rehabilitation of habitat ☒ Others ☐ Not known	X

Target species, stocks or other management units	Characteristics of species	Capture fisheries	Management measures	Availability of genetic data	Use of genetic data in management	Trends in catches	Future trends in catches	Ecosystem(s) where the fishery is located	Changes in ranges and habitats	Reasons for change in abundance of species	
Morone spp	☐ Straddling ☐ Transboundary ☐ Introduced ☒ Native	◉ Yes ○ No ○ Not Known	○ Yes ○ No ○ Not Known	◉ Yes ○ No ○ Not Known	○ Yes ○ No ○ Not Known	○ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Depleted ○ Not known	○ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Depleted ○ Not known	☐ Intertital ☐ Coastal in EEZ ☐ High seas ☐ Lake ☐ Reservoir ☐ River ☐ Swamp ☐ Other **(specify)**	○ Increasing ○ Stable ○ Decreasing ○ Not known	☐ Habitat ☐ Climate ☐ Invasive species ☐ Pollution ☐ Rehabilitation of habitat ☐ Others ☐ Not known	X
Ictalurus spp	☐ Straddling ☐ Transboundary ☐ Introduced ☒ Native	◉ Yes ○ No ○ Not Known	○ Yes ○ No ◉ Not Known	○ Yes ◉ No ○ Not Known	○ Yes ◉ No ○ Not Known	○ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Depleted ◉ Not known	○ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Depleted ◉ Not known	☐ Intertital ☐ Coastal in EEZ ☐ High seas ☐ Lake ☐ Reservoir ☒ River ☐ Swamp ☐ Other **(specify)**	○ Increasing ○ Stable ○ Decreasing ◉ Not known	☐ Habitat ☐ Climate ☐ Invasive species ☐ Pollution ☐ Rehabilitation of habitat ☐ Others ☒ Not known	X

Target species, stocks or other management units	Characteristics of species	Capture fisheries	Management measures	Availability of genetic data	Use of genetic data in management	Trends in catches	Future trends in catches	Ecosystem(s) where the fishery is located	Changes in ranges and habitats	Reasons for change in abundance of species	
Crassostrea gigas	☐ Straddling ☒ Transboundary ☒ Introduced ☐ Native	◉ Yes ○ No ○ Not Known	○ Yes ◉ No ○ Not Known	◉ Yes ○ No ○ Not Known	○ Yes ◉ No ○ Not Known	◉ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Depleted ○ Not known	◉ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Depleted ○ Not known	☐ Intertital ☐ Coastal in EEZ ☐ High seas ☐ Lake ☐ Reservoir ☐ River ☐ Swamp ☒ Other **(specify)** Estuary, bay	◉ Increasing ○ Stable ○ Decreasing ○ Not known	☐ Habitat ☐ Climate ☐ Invasive species ☐ Pollution ☐ Rehabilitation of habitat ☒ Others ☐ Not known	X
Crassostrea virginica	☐ Straddling ☒ Transboundary ☐ Introduced ☒ Native	◉ Yes ○ No ○ Not Known	◉ Yes ○ No ○ Not Known	◉ Yes ○ No ○ Not Known	◉ Yes ○ No ○ Not Known	○ Increasing ○ Stable ○ Fluctuating ◉ Decreasing ○ Depleted ○ Not known	○ Increasing ○ Stable ○ Fluctuating ◉ Decreasing ○ Depleted ○ Not known	☐ Intertital ☐ Coastal in EEZ ☐ High seas ☐ Lake ☐ Reservoir ☐ River ☐ Swamp ☒ Other **(specify)** Estuary, bay	○ Increasing ○ Stable ○ Decreasing ○ Not known	☒ Habitat ☐ Climate ☐ Invasive species ☐ Pollution ☐ Rehabilitation of habitat ☒ Others ☐ Not known	X

Target species, stocks or other management units	Characteristics of species	Capture fisheries	Management measures	Availability of genetic data	Use of genetic data in management	Trends in catches	Future trends in catches	Ecosystem(s) where the fishery is located	Changes in ranges and habitats	Reasons for change in abundance of species	
Oncorhynchus mykiss	☐ Straddling ☒ Transboundary ☐ Introduced ☒ Native	◉ Yes ○ No ○ Not Known	◉ Yes ○ No ○ Not Known	◉ Yes ○ No ○ Not Known	◉ Yes ○ No ○ Not Known	○ Increasing ○ Stable ◉ Fluctuating ○ Decreasing ○ Depleted ○ Not known	○ Increasing ○ Stable ◉ Fluctuating ○ Decreasing ○ Depleted ○ Not known	☐ Intertital ☐ Coastal in EEZ ☐ High seas ☒ Lake ☒ Reservoir ☒ River ☐ Swamp ☐ Other **(specify)**	○ Increasing ○ Stable ◉ Decreasing ○ Not known	☒ Habitat ☐ Climate ☐ Invasive species ☐ Pollution ☒ Rehabilitation of habitat ☒ Others ☐ Not known	X
Ostrea lurida	☐ Straddling ☒ Transboundary ☐ Introduced ☒ Native	◉ Yes ○ No ○ Not Known	◉ Yes ○ No ○ Not Known	◉ Yes ○ No ○ Not Known	◉ Yes ○ No ○ Not Known	○ Increasing ◉ Stable ○ Fluctuating ○ Decreasing ○ Depleted ○ Not known	○ Increasing ◉ Stable ○ Fluctuating ○ Decreasing ○ Depleted ○ Not known	☒ Intertital ☐ Coastal in EEZ ☐ High seas ☐ Lake ☐ Reservoir ☐ River ☐ Swamp ☐ Other **(specify)**	○ Increasing ◉ Stable ○ Decreasing ○ Not known	☒ Habitat ☐ Climate ☐ Invasive species ☒ Pollution ☒ Rehabilitation of habitat ☒ Others ☐ Not known	X

Target species, stocks or other management units	Characteristics of species	Capture fisheries	Management measures	Availability of genetic data	Use of genetic data in management	Trends in catches	Future trends in catches	Ecosystem(s) where the fishery is located	Changes in ranges and habitats	Reasons for change in abundance of species	
Perca flavescens	☐ Straddling ☒ Transboundary ☐ Introduced ☒ Native	◉ Yes ○ No ○ Not Known	◉ Yes ○ No ○ Not Known	◉ Yes ○ No ○ Not Known	◉ Yes ○ No ○ Not Known	○ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Depleted ○ Not known	○ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Depleted ○ Not known	☐ Intertital ☐ Coastal in EEZ ☐ High seas ☒ Lake ☒ Reservoir ☒ River ☐ Swamp ☐ Other **(specify)**	○ Increasing ○ Stable ○ Decreasing ○ Not known	☐ Habitat ☐ Climate ☐ Invasive species ☐ Pollution ☐ Rehabilitation of habitat ☐ Others ☐ Not known	X
Acipenser transmontanus	☐ Straddling ☒ Transboundary ☐ Introduced ☒ Native	◉ Yes ○ No ○ Not Known	◉ Yes ○ No ○ Not Known	◉ Yes ○ No ○ Not Known	◉ Yes ○ No ○ Not Known	○ Increasing ○ Stable ○ Fluctuating ◉ Decreasing ○ Depleted ○ Not known	○ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Depleted ○ Not known	☐ Intertital ☒ Coastal in EEZ ☐ High seas ☐ Lake ☒ Reservoir ☒ River ☐ Swamp ☒ Other **(specify)** Estuary	○ Increasing ○ Stable ○ Decreasing ○ Not known	☒ Habitat ☐ Climate ☐ Invasive species ☐ Pollution ☒ Rehabilitation of habitat ☒ Others ☐ Not known	X

Target species, stocks or other management units	Characteristics of species	Capture fisheries	Management measures	Availability of genetic data	Use of genetic data in management	Trends in catches	Future trends in catches	Ecosystem(s) where the fishery is located	Changes in ranges and habitats	Reasons for change in abundance of species	
Mytilus edulis	☐ Straddling ☒ Transboundary ☐ Introduced ☒ Native	◉ Yes ○ No ○ Not Known	◉ Yes ○ No ○ Not Known	◉ Yes ○ No ○ Not Known	○ Yes ◉ No ○ Not Known	○ Increasing ○ Stable ◉ Fluctuating ○ Decreasing ○ Depleted ○ Not known	○ Increasing ○ Stable ◉ Fluctuating ○ Decreasing ○ Depleted ○ Not known	☒ Intertital ☐ Coastal in EEZ ☐ High seas ☐ Lake ☐ Reservoir ☐ River ☐ Swamp ☐ Other **(specify)**	○ Increasing ◉ Stable ○ Decreasing ○ Not known	☒ Habitat ☒ Climate ☐ Invasive species ☐ Pollution ☐ Rehabilitation of habitat ☐ Others ☐ Not known	X
Cambarus spp	☐ Straddling ☒ Transboundary ☐ Introduced ☒ Native	◉ Yes ○ No ○ Not Known	◉ Yes ○ No ○ Not Known	○ Yes ○ No ○ Not Known	○ Yes ◉ No ○ Not Known	◉ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Depleted ○ Not known	◉ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Depleted ○ Not known	☐ Intertital ☐ Coastal in EEZ ☐ High seas ☒ Lake ☒ Reservoir ☒ River ☒ Swamp ☐ Other **(specify)**	○ Increasing ○ Stable ○ Decreasing ○ Not known	☐ Habitat ☐ Climate ☐ Invasive species ☐ Pollution ☐ Rehabilitation of habitat ☐ Others ☐ Not known	X

Target species, stocks or other management units	Characteristics of species	Capture fisheries	Management measures	Availability of genetic data	Use of genetic data in management	Trends in catches	Future trends in catches	Ecosystem(s) where the fishery is located	Changes in ranges and habitats	Reasons for change in abundance of species	
Venerupis philippinarum	☐ Straddling ☒ Transboundary ☒ Introduced ☐ Native	◉ Yes ○ No ○ Not Known	◉ Yes ○ No ○ Not Known	◉ Yes ○ No ○ Not Known	○ Yes ○ No ○ Not Known	○ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Depleted ○ Not known	○ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Depleted ○ Not known	☒ Intertital ☐ Coastal in EEZ ☐ High seas ☐ Lake ☐ Reservoir ☐ River ☐ Swamp ☐ Other **(specify)**	○ Increasing ○ Stable ○ Decreasing ○ Not known	☐ Habitat ☐ Climate ☐ Invasive species ☐ Pollution ☐ Rehabilitation of habitat ☐ Others ☐ Not known	X
Alligator mississippiensis	☐ Straddling ☐ Transboundary ☐ Introduced ☒ Native	◉ Yes ○ No ○ Not Known	○ Yes ○ No ○ Not Known	○ Yes ○ No ○ Not Known	○ Yes ○ No ○ Not Known	○ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Depleted ○ Not known	○ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Depleted ○ Not known	☐ Intertital ☐ Coastal in EEZ ☐ High seas ☒ Lake ☒ Reservoir ☒ River ☒ Swamp ☒ Other **(specify)** Estuary	○ Increasing ○ Stable ○ Decreasing ○ Not known	☐ Habitat ☐ Climate ☐ Invasive species ☐ Pollution ☐ Rehabilitation of habitat ☐ Others ☐ Not known	X

Target species, stocks or other management units	Characteristics of species	Capture fisheries	Management measures	Availability of genetic data	Use of genetic data in management	Trends in catches	Future trends in catches	Ecosystem(s) where the fishery is located	Changes in ranges and habitats	Reasons for change in abundance of species	
Panopea generosa	☐ Straddling ☒ Transboundary ☐ Introduced ☒ Native	◉ Yes ○ No ○ Not Known	◉ Yes ○ No ○ Not Known	◉ Yes ○ No ○ Not Known	◉ Yes ○ No ○ Not Known	○ Increasing ◉ Stable ○ Fluctuating ○ Decreasing ○ Depleted ○ Not known	○ Increasing ◉ Stable ○ Fluctuating ○ Decreasing ○ Depleted ○ Not known	☒ Intertital ☐ Coastal in EEZ ☐ High seas ☐ Lake ☐ Reservoir ☐ River ☐ Swamp ☐ Other **(specify)**	○ Increasing ◉ Stable ○ Decreasing ○ Not known	☐ Habitat ☐ Climate ☐ Invasive species ☐ Pollution ☐ Rehabilitation of habitat ☐ Others ☐ Not known	X
Mercenaria mercenaria	☐ Straddling ☒ Transboundary ☐ Introduced ☒ Native	◉ Yes ○ No ○ Not Known	◉ Yes ○ No ○ Not Known	◉ Yes ○ No ○ Not Known	○ Yes ◉ No ○ Not Known	○ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Depleted ○ Not known	○ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Depleted ○ Not known	☒ Intertital ☐ Coastal in EEZ ☐ High seas ☐ Lake ☐ Reservoir ☐ River ☐ Swamp ☐ Other **(specify)**	○ Increasing ○ Stable ○ Decreasing ○ Not known	☐ Habitat ☐ Climate ☐ Invasive species ☐ Pollution ☐ Rehabilitation of habitat ☐ Others ☐ Not known	X

Target species, stocks or other management units	Characteristics of species	Capture fisheries	Management measures	Availability of genetic data	Use of genetic data in management	Trends in catches	Future trends in catches	Ecosystem(s) where the fishery is located	Changes in ranges and habitats	Reasons for change in abundance of species	
Oncorhynchus tshawytscha	☐ Straddling ☒ Transboundary ☐ Introduced ☒ Native	◉ Yes ○ No ○ Not Known	◉ Yes ○ No ○ Not Known	◉ Yes ○ No ○ Not Known	◉ Yes ○ No ○ Not Known	○ Increasing ○ Stable ◉ Fluctuating ○ Decreasing ○ Depleted ○ Not known	○ Increasing ○ Stable ◉ Fluctuating ○ Decreasing ○ Depleted ○ Not known	☒ Intertital ☒ Coastal in EEZ ☐ High seas ☐ Lake ☐ Reservoir ☒ River ☐ Swamp ☐ Other **(specify)**	○ Increasing ○ Stable ◉ Decreasing ○ Not known	☒ Habitat ☐ Climate ☐ Invasive species ☐ Pollution ☐ Rehabilitation of habitat ☒ Others ☐ Not known	X
Salvelinus namaycush	☐ Straddling ☒ Transboundary ☐ Introduced ☐ Native	◉ Yes ○ No ○ Not Known	◉ Yes ○ No ○ Not Known	◉ Yes ○ No ○ Not Known	◉ Yes ○ No ○ Not Known	○ Increasing ○ Stable ◉ Fluctuating ○ Decreasing ○ Depleted ○ Not known	○ Increasing ○ Stable ◉ Fluctuating ○ Decreasing ○ Depleted ○ Not known	☐ Intertital ☐ Coastal in EEZ ☐ High seas ☒ Lake ☒ Reservoir ☐ River ☐ Swamp ☐ Other **(specify)**	○ Increasing ○ Stable ◉ Decreasing ○ Not known	☐ Habitat ☐ Climate ☒ Invasive species ☐ Pollution ☐ Rehabilitation of habitat ☒ Others ☐ Not known	X

Target species, stocks or other management units	Characteristics of species	Capture fisheries	Management measures	Availability of genetic data	Use of genetic data in management	Trends in catches	Future trends in catches	Ecosystem(s) where the fishery is located	Changes in ranges and habitats	Reasons for change in abundance of species	
Mytilus galloprovincialis	☐ Straddling ☐ Transboundary ☒ Introduced ☐ Native	◉ Yes ○ No ○ Not Known	◉ Yes ○ No ○ Not Known	◉ Yes ○ No ○ Not Known	○ Yes ○ No ◉ Not Known	◉ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Depleted ○ Not known	◉ Increasing ○ Stable ○ Fluctuating ○ Decreasing ○ Depleted ○ Not known	☒ Intertital ☐ Coastal in EEZ ☐ High seas ☐ Lake ☐ Reservoir ☐ River ☐ Swamp ☐ Other **(specify)**	○ Increasing ○ Stable ○ Decreasing ◉ Not known	☐ Habitat ☐ Climate ☐ Invasive species ☐ Pollution ☐ Rehabilitation of habitat ☐ Others ☐ Not known	X

Chapter 2: Drivers and Trends in Aquaculture: Consequences for Aquatic Genetic Resources within National Jurisdiction

The main objective of Chapter 2 is to review the main drivers and trends that are shaping aquaculture and their consequences for aquatic genetic resources.

15. Please indicate the ways the aquatic genetic resources (AqGR) of **farmed aquatic species** have been impacted by the following drivers. Please give examples of positive and negative impacts for specific drivers.

This question refers to drivers impacting farmed aquatic genetic resources, not about impacts on the entire aquaculture sector. Drivers should be seen from a national perspective.

Driver impacting aquaculture	Effect on AqGR ***Mark appropriate box***	Comments ***List examples or other relevant information***
Human population increase	○ Strongly positive ◉ Positive ○ Negative ○ Strongly negative ○ No effect ○ Unknown	Per capita seafood consumption in the United States has been relatively flat but the US population continues to grow resulting in increasing demand. The US imports 90% of the seafood consumed at price points at or below farmed fish and shellfish prices. The increasing demand for seafood and stable wild production means that imported wild-caught and aquacultured seafood will continue to grow and US farmers will focus on reducing production costs to better compete against imports or focus on producing live or fresh products that do not compete against imported products. As a result, US farmers are in search of genetic answers to the improvement of the physiological characteristics of farmed aquatic species that concern disease resistance, feed conversion, overall muscle mass, temperature tolerance, nutritional value, increasing plant protein in processed feeds, sterility, stress reduction, and growth rate to reduce costs or to deliver live or fresh products to the market faster and of improved overall quality. Citations Browdy, C.L. and J.A. Hargreaves (eds). 2009. Overcoming Technical Barriers to the Sustainable Development of Competitive Marine Aquaculture in the United States. U.S. Department of Commerce, Silver Spring, MD USA. NOAA Technical Memo NMFS F/SPO-100. Available at: http://www.nmfs.noaa.gov/aquaculture/docs/aquaculture_docs/noaanist_techbarriers_final.pdf Interagency Working Group on Aquaculture. 2014. National Strategic Plan for Federal Aquaculture Research (2014-2019). National Science and Technology Council. Washington DC. Available at: https://www.ars.usda.gov/animal-production-and-protection/aquaculture/docs/national-strategic-plan-federal-aquaculture-research/. National Marine Fisheries Service. 2016. Fisheries of the United States, 2015. U.S. Department of Commerce, NOAA Current Fishery Statistics No. 2015. Available at: https://www.st.nmfs.noaa.gov/commercial-fisheries/fus/fus15/index
Increased wealth and demand for fish	○ Strongly positive ◉ Positive ○ Negative ○ Strongly negative ○ No effect ○ Unknown	See prior explanation regarding seafood (fish and shellfish) demand. Disposable income drives hobbies such as aquarium keeping and water gardening that require hundreds of aquatic animal and plant species and their color or finnage morphs that fuel hobbyist interest. U.S. farmers that produce ornamental species are focused on producing new varieties and are producing genetically modified species that display unusual color. Citations American Pet Products Association. 2014. 2015-2016 APPA National Pet Owners Survey. American Pet Products Association, Greenwich, CT. Available at: http://www.americanpetproducts.org/pubs_survey.asp.

Driver impacting aquaculture	Effect on AqGR ***Mark appropriate box***	Comments ***List examples or other relevant information***
		Livengood, E.J. and F.A. Chapman. 2007. The ornamental fish trade: an introduction and perspectives for responsible aquarium fish ownership. Department of Fisheries and Aquatic Sciences, UF/IFAS Extension. FA-124. Available at: http://edis.ifas.ufl.edu/pdffiles/FA/FA12400.pdf. McCarthy, C. Undated. What are Glofish? PetMed. Available at: http://www.petmd.com/fish/what-are-glofish#.
Governance (ability of government, industry and the public to work together in managing resources)	○ Strongly positive ◉ Positive ○ Negative ○ Strongly negative ○ No effect ○ Unknown	Federal and state governments: 1) fund theoretical and applied research to conserve founder stocks, and develop production animals that pose little to no genetic risk to wild populations if they escape or, in the case of Alaska's salmon hatchery program, co-mingle with wild stocks, and 2) regulate stock enhancement efforts and aquaculture activities to prevent or mitigate genetic risks. Citations Heard, W.R. 2012. Overview of salmon stock enhancement in southeast Alaska and compatibility with maintenance of hatchery and wild stocks. Environmental Biology of Fishes. 94: 273-283. Interagency Working Group on Aquaculture. 2014. National Strategic Plan for Federal Aquaculture Research (2014-2019). National Science and Technology Council. Washington DC. Available at: https://www.ars.usda.gov/animal-production-and-protection/aquaculture/docs/national-strategic-plan-federal-aquaculture-research/. Lorenzen, K., M.C.M Beveridge and M. Mangel. 2012. Cultured fish: integrative biology and management of domestication and interactions with wild fish. Biological Reviews 87, 639-660. Lorenzen, K., A. Agnalt, H. Blankenship, A. Hines, K. Leber, N. Loneragan, and M. Taylor. 2013. Evolving context and maturing science: aquaculture-based enhancement and restoration enter the marine fisheries management toolbox. Reviews in Fisheries Science. 21 (3-4): 215-221. Trushenski, J.T., H.L. Blankenship, J. D. Bowker, T. A. Flagg, J. A. Hesse, K. M. Leber, D. D. MacKinlay, D. J. Maynard, C. M. Moffitt, V. A. Mudrak, K. T. Scribner, S. F. Stuewe, J. A. Sweka, G. E. Whelan and C. Young-Dubovsky. 2015. Introduction to a special section: hatcheries and management of aquatic resources (HaMAR)—Considerations for use of hatcheries and hatchery-0rigin fish. North American Journal of Aquaculture, 77(3):327-342. Waples, R.S., K. Hindar, and J.J. Hard. 2012. Genetic risks associated with marine aquaculture. U.S. Department of Commerce, NOAA Tech. Memo. NMFS-NWFSC-119. Available at: http://www.westcoast.fisheries.noaa.gov/publications/aquaculture/geneticrisksaquaculturetm119.pdf.
Climate change	○ Strongly positive ○ Positive ○ Negative ○ Strongly negative ○ No effect ◉ Unknown	Oceanic carbonate chemistry is changing with increasing atmospheric carbon dioxide concentration. Negative effects have occurred within Pacific Coast shellfish hatcheries but has not impacted genetic resources, but future effects are unpredictable. Current research is turning to finding genetic resources within commercially important shellfish (oysters, clams, mussels and scallops) that probably exist that resist ocean acidification given that that prehistoric oceans exhibited varying chemistries. Citations Ekstrom, J. A., et al. 2015. Vulnerability and adaptation of US

Driver impacting aquaculture	Effect on AqGR ***Mark appropriate box***	Comments ***List examples or other relevant information***
		shellfisheries to ocean acidification. Nature Climate Change, 5(3): 207-214. National Research Council. 2010. Ocean Acidification: A National Strategy to Meet the Challenges of a Changing Ocean. National Academies Press, Washington DC. Available at: https://www.nap.edu/catalog/12904/ocean-acidification-a-national-strategy-to-meet-the-challenges-ofhttps://www.nap.edu/catalog/12904/ocean-acidification-a-national-strategy-to-meet-the-challenges-of
Competition for resources, especially freshwater	○ Strongly positive ◉ Positive ○ Negative ○ Strongly negative ○ No effect ○ Unknown	Resource limitation is evident for fish meal and oil used as processed aquaculture feed ingredients. Genetic research is being conducted to improve feed conversion, assimilation of plant proteins, and growth rate. Citations Interagency Working Group on Aquaculture. 2014. National Strategic Plan for Federal Aquaculture Research (2014-2019). National Science and Technology Council. Washington DC. Available at: https://www.ars.usda.gov/animal-production-and-protection/aquaculture/docs/national-strategic-plan-federal-aquaculture-research/. Rust, M.B. et al. 2011. The Future of Aquafeeds. NOAA/USDA Alternative Feeds Initiative. NOAA Technical Memorandum NMFS F/SPO-124. Available at: http://www.nmfs.noaa.gov/aquaculture/docs/feeds/the_future_of_aquafeeds_final.pdf.
Changes in values and ethics of consumers	○ Strongly positive ◉ Positive ○ Negative ○ Strongly negative ○ No effect ○ Unknown	Public concern that is focused on the escape of farmed animals as potential causes of genetic degradation of wild conspecifics has resulted in regulatory prohibition or severe restrictions on the culture of genetically modified animals. Citations Guidance and Procedures for Genetic Requirements for Gulf Aquaculture Permits available at http://sero.nmfs.noaa.gov/sustainable_fisheries/gulf_fisheries/aquaculture/documents/pdfs/genetic_requirements_guidance.pdf. Gulf of Mexico Fishery Management Council. 2009. Fishery Management Plan for Regulating Offshore Marine Aquaculture in the Gulf of Mexico. Gulf of Mexico Fishery Management Council, Tampa FL. Available at: http://sero.nmfs.noaa.gov/sustainable_fisheries/gulf_fisheries/aquaculture/documents/pdfs/aquaculture_fmp_peis_final_022409.pdf. Waples, R.S., K. Hindar, and J.J. Hard. 2012. Genetic risks associated with marine aquaculture. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-119. Available at: http://www.westcoast.fisheries.noaa.gov/publications/aquaculture/geneticrisksaquaculturetm119.pdf.
Other ***Add other drivers as necessary*** Competition from other protein sources Add Row / Remove Row	○ Strongly positive ○ Positive ○ Negative ○ Strongly negative ○ No effect ◉ Unknown	Americans spend discretionary income to purchase seafood as an alternative to traditional and widely available protein sources including pork, poultry, beef and lamb.

16. Please indicate the ways the aquatic genetic resources of **wild relatives of farmed aquatic species** in nature have been impacted by the following drivers. Please give examples of positive and negative impacts for specific drivers.

This question refers to drivers impacting wild aquatic genetic resources of farmed species, not about impacts on the entire aquaculture sector. Drivers should be seen from a national perspective.

Driver impacting aquaculture	Effect on AqGR ***Mark appropriate box***	Comments ***List examples or other relevant information***
Human population increase	◯ Strongly positive ◯ Positive ◉ Negative ◯ Strongly negative ◯ No effect ◯ Unknown	Human population growth negatively impacts aquatic habitats and water quantity and quality that has resulted in species extinction, extirpation, and endangerment. Citations Jelks, H.L. et al. 2008. Conservation status of imperiled North American freshwater and diadromous fishes. Fisheries 33(8): 372-407. Available at: https://www.srs.fs.usda.gov/pubs/ja/ja_jelks001.pdf. National Water Quality Assessment Program: https://water.usgs.gov/nawqa/ National Wetlands Inventory: https://www.fws.gov/wetlands/index.html.
Increased wealth and demand for fish	◯ Strongly positive ◯ Positive ◉ Negative ◯ Strongly negative ◯ No effect ◯ Unknown	Wild harvest (commercial and recreational practices) may trigger deleterious genetic effects. Citation Allendorf, F.W. et al. 2008. Genetic effects of harvest on wild animal populations. Trends in Ecology and Evolution 23(6): 328-337. Allendorf, F.W., O. Berry and N. Ryman. 2014. So long to genetic diversity, and thanks for all the fish. Molecular Ecology 23:23-25.
Governance (ability of government, industry and the public to work together in managing resources)	◯ Strongly positive ◉ Positive ◯ Negative ◯ Strongly negative ◯ No effect ◯ Unknown	Fishery management plans are beginning to include restrictions to mitigate potential genetic effects triggered by harvesting practices. Citations Berntson, E.A., P.S. Levin, and P.C. Moran (editors). 2007. Conservation of North Pacific rockfishes: Ecological genetics and stock structure. Proceedings of the workshop, March 2-3, 2004, Seattle, Washington. U.S. Department of Commerce, NOAA Tech. Memo. NMFS-NWFSC-80
Climate change	◯ Strongly positive ◯ Positive ◯ Negative ◯ Strongly negative ◯ No effect ◉ Unknown	Carbonate chemistry change driven by atmospheric carbon are projected to negatively impact shellfish larvae and early analysis predicts population distribution shifts. The genetic consequences are uncertain. Citation Hare J.A., et al. 2016. A Vulnerability Assessment of Fish and Invertebrates to Climate Change on the Northeast U.S. Continental Shelf. PLoS ONE 11(2): e0146756. doi:10.1371/journal.pone.0146756

Driver impacting aquaculture	Effect on AqGR ***Mark appropriate box***	Comments ***List examples or other relevant information***
Competition for resources, especially freshwater	◯ Strongly positive ◯ Positive ◉ Negative ◯ Strongly negative ◯ No effect ◯ Unknown	See Human Population Increase remarks.
Changes in values and ethics of consumers	◯ Strongly positive ◉ Positive ◯ Negative ◯ Strongly negative ◯ No effect ◯ Unknown	Nationwide focus on environmental conservation and protection that began in 1970s included primary and secondary school curricula to educate the nation to invest public resources to protect, conserve and restore animals and their habitats or to engage in personal conservation. Personal and societal commitment to environmental protection and conservation is a significant driver of local, state and national investment, regulations and politics. Citations Connolly, J.J., E.S. Svendsen, D.R. Fisher and L.K. Campbell. 2014. Networked governance and the management of ecosystem services: The case of urban environmental stewardship in New York City. Ecosystem Services 10: 187-194. Dalton, W.J. 2015. Waxing or waning? The changing patterns of environmental activism. Environmental Politics 24(4): 530-552. Mihaylov, N.L. and D.D. Perkins. 2015. Local environmental grassroots activism: contributions from environmental psychology, sociology and politics. Behavioral Sciences 5: 121-153
Other ***Add other drivers as necessary*** Add Row / Remove Row	◯ Strongly positive ◯ Positive ◯ Negative ◯ Strongly negative ◯ No effect ◯ Unknown	

17. What countermeasures might be taken to reduce adverse impacts on the aquatic genetic resources that sustain current aquaculture and/or provide for its future development?

Describe countermeasures

Genetic Library - The public archival cryopreservation of genetic material of wild conspecific species.
Species and Habitats Management - Continued and strengthened federal and state partnerships to protect and conserve species and habitat.

Biotechnologies

18. To what extent have the following biotechnologies been used in your country for the genetic improvement of farmed aquatic organisms.

Biotechnology	Extent of use	Comments ***main sources of information, important species for which the biotechnology is applied***
Selective breeding	○ Not at all ○ To a minor extent ○ To some extent ◉ To a great extent	Public and private research institutions or commercial farms selectively breed all vertebrate and many of the invertebrates species cultured in the United States.
Hybridization	○ Not at all ○ To a minor extent ◉ To some extent ○ To a great extent	Public and private research institutions or commercial farms investigate or culture hybrid species of the channel and blue catfish, white and striped bass, tilapia spp., and hard clam (Mercenaria) spp.
Polyploidy (chromosome set manipulation)	○ Not at all ○ To a minor extent ◉ To some extent ○ To a great extent	Public and private research institutions or commercial farms investigate or culture triploid grass carp, Pacific and Eastern oyster, and rainbow trout. Tetraploid and diploid oyster broodstock are used to produce triploid seed.
Monosex production	○ Not at all ○ To a minor extent ◉ To some extent ○ To a great extent	Public and private research institutions or commercial farms investigate or culture monosex tilapia and rainbow trout.
Marker assisted selection	○ Not at all ◉ To a minor extent ○ To some extent ○ To a great extent	MAS and Genome Enabled Selection are the focus of many research programs and used in some public/private partnerships aimed at genetic improvement.
Gynogenesis/androgenesis	○ Not at all ◉ To a minor extent ○ To some extent ○ To a great extent	Used as a research tool to understand the biology of economically important traits and to sequence the genomes of economically important species.
Other **Continue adding row as necessary** Genetic Engineering Add Row | Remove Row	○ Not at all ◉ To a minor extent ○ To some extent ○ To a great extent	Public and/or private research institutions and commercial farms investigate or culture genetically engineered Atlantic salmon, ornamental fish (zebra danios, tetra and tiger barb), tilapia, and channel catfish. Transgenic salmon approved by FDA for human consumption, however they are not yet on the market as product labeling issues are sorted out. There is a great deal of interest in gene editing technologies.

19. Please indicate the ways aquatic genetic resources of the wild relatives of farmed aquatic species have been impacted by drivers that are changing aquatic ecosystems. Please give countermeasures that might be taken to reduce adverse consequences for the aquatic genetic resources that sustain capture fisheries on wild relatives of farmed species.

Drivers that are changing aquatic ecosystems	Effect on AqGR ***mark appropriate box***	Countermeasures and effects
Habitat loss and degradation	○ Strongly positive ○ Positive ◉ Negative ○ Strongly negative ○ No effect ○ Unknown	From Question 16, Human Population Increase. Human population growth negatively impacts aquatic habitats and water quantity and quality that has resulted in species extinction, extirpation, and endangerment. Citations Jelks, H.L. et al. 2008. Conservation status of imperiled North American freshwater and diadromous fishes. Fisheries 33(8): 372-407. Available at: https://www.srs.fs.usda.gov/pubs/ja/ja_jelks001.pdf. National Water Quality Assessment Program: https://water.usgs.gov/nawqa/ National Wetlands Inventory: https://www.fws.gov/wetlands/index.html.
Pollution of waters	○ Strongly positive ○ Positive ◉ Negative ○ Strongly negative ○ No effect ○ Unknown	See above.
Increased frequency of extreme climatic events and long-term climate change	○ Strongly positive ○ Positive ○ Negative ○ Strongly negative ○ No effect ◉ Unknown	Please refer to Question 16, Climate Change. Carbonate chemistry change driven by atmospheric carbon are projected to negatively impact shellfish larvae and early analysis predicts population distribution shifts. The genetic consequences are uncertain. Citation Hare J.A., et al. 2016. A Vulnerability Assessment of Fish and Invertebrates to Climate Change on the Northeast U.S. Continental Shelf. PLoS ONE 11(2): e0146756. doi:10.1371/journal.pone.0146756
Establishment of invasive species	○ Strongly positive ○ Positive ○ Negative ○ Strongly negative ○ No effect ◉ Unknown	In no instances within the United States have a transplanted native species or introduced nonnative species caused the extirpation or extinction of a native species. Extirpation or extinction has been triggered by a variety of stressors, habitat degradation or fragmentation, being the leading cause. In no instance has an analysis been conducted to determine the effects on aquatic genetic resources.

Drivers that are changing aquatic ecosystems	Effect on AqGR ***mark appropriate box***	Countermeasures and effects
Introductions of parasites and pathogens	○ Strongly positive ○ Positive ◉ Negative ○ Strongly negative ○ No effect ○ Unknown	Many pathogens have the capacity for infection in the wild and in culture, selective breeding for disease resistance in populations that are cultured or released has positively impacted population genetics.
Impacts of purposeful stocking and escapes from aquaculture	○ Strongly positive ○ Positive ○ Negative ○ Strongly negative ○ No effect ◉ Unknown	Since the early 1970s intensive stocking of hatchery derived Pacific salmon for the purpose of ocean ranching is conducted by Alaskan public and private entities. Contrasting studies argue that little to no or not clearly understood effects may occur within conspecific wild stocks. Relative to U.S. continental freshwater systems, public and private hatcheries stock approximately 1.7 billion catchable recreational fish per year. Few to no studies have investigated genetic resource effects.
Capture fisheries	○ Strongly positive ○ Positive ◉ Negative ○ Strongly negative ○ No effect ○ Unknown	From Question 16, Increased Wealth and Demand for Fish. Wild harvest (commercial and recreational practices) may trigger deleterious genetic effects. Citation Allendorf, F.W. et al. 2008. Genetic effects of harvest on wild animal populations. Trends in Ecology and Evolution 23(6): 328-337. Allendorf, F.W., O. Berry and N. Ryman. 2014. So long to genetic diversity, and thanks for all the fish. Molecular Ecology 23:23-25.
Other ***Continue listing other driverst*** Add Row / Remove Row	○ Strongly positive ○ Positive ○ Negative ○ Strongly negative ○ No effect ○ Unknown	

Chapter 3: *In Situ* Conservation of Aquatic Genetic Resources of Farmed Aquatic Species and their wild Relatives within National Jurisdiction

The main objective of Chapter 3 is to review the current status and future prospects for the *in situ* conservation of aquatic genetic resources of farmed aquatic species and their wild relatives within national jurisdiction for food and agriculture.

The specific objectives are as follows:

- To review the current and likely future contributions to *in sit*u conservation of aquatic genetic resources of farmed aquatic species and their wild relatives by those who use them in responsible and well managed capture fisheries, aquaculture, and culture-based fisheries.
- To identify and describe any existing and planned aquatic protected areas that are contributing, or will contribute, to *in situ* conservation of aquatic genetic resources of wild relatives of farmed aquatic species.
- To identify and describe any major existing and planned efforts for the *in situ* conservation of threatened or endangered aquatic genetic resources (farmed and wild).
- To review needs and priorities for the future development of *in situ* conservation of aquatic genetic resources of farmed aquatic species and their wild relatives.

Overview of the current status and future prospects for the *in situ* conservation of aquatic genetic resources of farmed aquatic species and their wild relatives

20. To what extent are responsible and well managed aquaculture and culture-based fisher*ies* contributing to *in situ* conservation of the aquatic genetic resources of farmed aquatic species and their wild relatives.

Please mark appropriate box.

- (•) To a great extent
- ( ) To a limited extent
- ( ) Not at all
- ( ) Not applicable

Please include any additional information

For Rainbow Trout, sea-run Atlantic Salmon, Chinook Salmon, and Lake Trout: The United States Fish and Wildlife Service(USFWS) contributes significant amounts of its rearing resources to the restoration of salmonid species, some of which are also farmed and fished. Rainbow Trout and Chinook Salmon are among the most widely distributed captive fish reared by the USFWS. Maine DPS endangered Atlantic Salmon (while not fished commercially) are reared in USFWS facilities, and USFWS rearing and monitoring efforts have led to population increases of Lake Trout in the US Great Lakes.

Likewise, for NOAA, while commercial aquaculture development and support is a main focus of the NMFS Office of Aquaculture, the use of aquaculture for enhancement, replenishment, and restoration is also of critical importance. Within the regional NOAA NMFS Fisheries Science Centers, conservation of species, populations, and management units/DPSs/ESUs is the primary focus of research-based aquaculture.

21. To what extent are existing facilities contributing to *in situ* conservation of aquatic genetic resources of wild relatives of farmed aquatic species?

Please mark appropriate box.

- (•) To a great extent
- ( ) To a limited extent
- ( ) Not at all
- ( ) Not applicable

Please include any additional information

For the USFWS, many facilities are involved in rearing salmonid species. See question 20. Likewise for NOAA NMFS.

22. Please provide ex*amples* of current or planned activities for the *in situ* conservation of endangered or threatened farmed species and their wild relatives with demonstrated or potential importance for aquaculture, culture-based fisheries, and capture fisheries.

Please describe examples

Endangered Maine DPS Atlantic Salmon: Reared in USFWS facilities and released into the wild. Objectives aim to maximize genetic diversity.

Chinook (King) Salmon: Reared and released by USFWS. Genetic and tags used to monitor and minimize impact of released fish on native stocks. Hatchery Genetic Management Plans required at all rearing facilities.

Abalone:
1) White Abalone (Endangered): Experimental rearing in partner facilities permitted (scientific research or enhancement) by NOAA NMFS toward stock restoration. Genetic management is a concern.
2) Black Abalone (Endangered): Experimental rearing at the NOAA NMFS Southwest Fisheries Science Center toward stock restoration. Genetic management plan will be implemented once culture is successful.
3) Green and Pink Abalones (Species of Concern): Experimental rearing at the OAA NMFS Southwest Fisheries Science Center and permitted partner facilities for stock replenishment; species also commercially reared in at least one southern California facility. Genetic management recommendations are available.

Red drum (depleted): Reared in state and educational facilities throughout the southeastern U.S. (South Carolina, Florida, Texas) for stock enhancement. Genetic management and monitoring is a key aspect of each program.

23. Please rank (from 1 to 10) the importance of the following objectives for *in situ* conservation of aquatic genetic resources of farmed aquatic species and their wild relatives in your country.

Objectives of *in situ* conservation	Rank 1=Very Important 10=No importance
Preservation of aquatic genetic diversity	5
Maintain good strains for aquaculture production	1
Meet consumer and market demands	6
To help adapt to impacts of climate change	5
Future breed improvement in aquaculture	1
Please continue listing any other objectives as needed	
Promote sustainable wild populations of aquatic organisms	1
Add Row / Remove Row	
Please continue listing any other objectives as needed	
Recover species/populations that are listed	2
Add Row / Remove Row	
Please continue listing any other objectives as needed	
Restores species/populations in decline	3
Add Row / Remove Row	

Please continue listing any other objectives as needed	
Mitigate for fishery declines resulting from federal water projects	4
Add Row	Remove Row

Review of the *in situ* conservation of aquatic genetic resources of farmed aquatic species and their wild relatives through their use in responsible and well managed aquaculture and culture-based fisheries

24. Is the *in situ* conservation of aquatic genetic resources included in the policy as an objective in the management of aquaculture and/or culture-based fisheries in your country?

Please mark appropriate box

- (•) Yes
- ( ) Not yet, but planned to be included
- ( ) No
- ( ) Unknown

If yes, please give examples

The USFWS is working hard to develop and implement Genetic Management Plans (GMPs) for all listed species in their propagation facilities. To do so, baseline data on wild genetic variation is critical. In the case of listed species, there are harvest regulations in place which can act to conserve the species/population, including it's genomic resources.

Stated purposes of the National Ocean Policy, the DOC and NOAA Aquaculture Policies, and various federal and state fishery and aquaculture management plans include conservation of wild populations, assurance of sustainable aquaculture, and recommendations for genetic management plans.

25. To what extent are collectors of wild seed and brood stock for aquaculture and culture-based fisheries contributing to the conservation of aquatic genetic resources by maintaining habitats and/or limiting the quantities collected?

Please mark appropriate box

- (•) To a great extent
- ( ) To a limited extent
- ( ) Not at all
- ( ) Not applicable

Please include any additional details

For efforts specific to the USFWS, a great deal of effort is aimed at Habitat and Species Conservation. This works in concert with propagation efforts when they are necessary. One major effort includes increasing fish passage.

Habitat conservation (or assurance of no destruction or alteration) is often integral to the environmental assessment required under the ACOE and NOAA permitting processes.

Review of the *in situ* conservation of aquatic genetic resources of farmed aquatic species and their wild relatives through their use in responsible and well managed capture fisheries

26. Is the conservation of aquatic genetic resources of wild relatives of farmed aquatic species included as an objective in the management of any capture fisheries in your country?

Please mark appropriate box

If yes, please give examples

- (•) Yes
- ( ) Not yet, but under development
- ( ) No
- ( ) Unknown

For USFWS reared species, many examples of GMP's exist to promote wild genetic diversity. In the Pacific Northwest, considerable effort is maintained to monitor the genetic contribution of captive-reared salmonids released in systems where recreational fishing is abundant. Not only are sample collected for analyses, but marking technology is used to prevent harvest of wild fishes, and promote harvest of captive-reared fishes.

Review of the *in situ* conservation of aquatic genetic resources of farmed aquatic species and their wild relatives through the establishment and management of aquatic protected areas

27. Please list any aquatic protected areas in your country that are contributing to the *in situ* conservation of aquatic genetic resources of wild relatives of farmed aquatic species and an assessment of effectiveness

Add Row

Aquatic protected area	Effectiveness of conserving Aquatic Genetic Resources	Comments ***provide any additional information***	
Portions of the Yukon River basin are managed in conjunction with other agencies.	( ) Very effective ( ) Somewhat effective ( ) Not effective ( ) Unknown	In most cases, the USFWS FAC program does not set regulation or harvest limits. Often, state partners do so. In at least one case, the FAC program assists state and federal partners under a federal mandate to maintain certain fish population goals. FAC provides data and monitors populations of Chinook Salmon in portions of Alasksa.	X

Chapter 4: *Ex Situ* Conservation of Aquatic Genetic Resources of Farmed Aquatic Species and their Wild Relatives within National Jurisdiction

The main objective of Chapter 4 is to review the current status and future prospects for the *ex situ* conservation of aquatic genetic resources of farmed aquatic species and their wild relatives.

The specific objectives are:

- To review existing *ex situ* conservation of aquatic genetic resources of farmed aquatic species and their wild relatives in aquaculture facilities, culture collections and gene banks, research facilities, zoos and aquaria;
- To review the contributions that various stakeholders are making to the *ex situ* conservation of aquatic genetic resources of farmed aquatic species and their wild relatives;
- To review needs and priorities for the future development of *ex situ* conservation of aquatic genetic resources of farmed aquatic species and their wild relatives, including any that are threatened or endangered.

Review of existing and planned collections of live breeding individuals of aquatic genetic resources of farmed aquatic species and their wild relatives

28. Please list your country's existing collections of live breeding aquatic organisms that can be considered as contributing to the *ex situ* conservation of aquatic genetic resources. This includes not only collections of species farmed directly for human use, but also collections of live feed organisms (e.g., bacterial flocs, yeasts, microalgae, rotifers and brine shrimp (*Artemia*)).

Add Row

Species (*include information on subspecies or strain in comments if available*)	Type of use ***Please mark all that apply***	Is the species (or subspecies) threatened or endangered for example in the IUCN Red List, CITES Appendices or national lists? ***Please mark appropriate box***	Comments ***Please list any additional information***	
Ictalurus furcatus	☒ Direct human consumption ☐ Live feed organism ☐ Other	○ Yes ◉ No ○ Unknown	Public institutions maintain a wide variety of breeding populations at the species and sub-species level. In addition to serving as research models and resources for public/private genetic improvement programs these populations serve as an ex-situ conservation resources.	X
Ictalurus punctatus	☒ Direct human consumption ☐ Live feed organism ☐ Other	○ Yes ◉ No ○ Unknown	Public institutions maintain a wide variety of breeding populations at the species and sub-species level. In addition to serving as research models and resources for public/private genetic improvement programs these populations serve as an ex-situ conservation resources.	X
Salmo salar	☒ Direct human consumption ☐ Live feed organism ☐ Other	○ Yes ◉ No ○ Unknown	Public institutions maintain a wide variety of breeding populations at the species and sub-species level. In addition to serving as research models and resources for public/private genetic improvement programs these populations serve as an ex-situ conservation resources.	X

Species (*include information on subspecies or strain in comments if available*)	Type of use ***Please mark all that apply***	Is the species (or subspecies) threatened or endangered for example in the IUCN Red List, CITES Appendices or national lists? ***Please mark appropriate box***	Comments ***Please list any additional information***	
Oncorhynchus mykiss	☒ Direct human consumption ☐ Live feed organism ☐ Other	○ Yes ◉ No ○ Unknown	Public institutions maintain a wide variety of breeding populations at the species and sub-species level. In addition to serving as research models and resources for public/private genetic improvement programs these populations serve as an ex-situ conservation resources.	X
Morone saxatilis	☒ Direct human consumption ☐ Live feed organism ☐ Other	○ Yes ◉ No ○ Unknown	Public institutions maintain a wide variety of breeding populations at the species and sub-species level. In addition to serving as research models and resources for public/private genetic improvement programs these populations serve as an ex-situ conservation resources.	X
Morone chrysops	☒ Direct human consumption ☐ Live feed organism ☐ Other	○ Yes ◉ No ○ Unknown	Public institutions maintain a wide variety of breeding populations at the species and sub-species level. In addition to serving as research models and resources for public/private genetic improvement programs these populations serve as an ex-situ conservation resources.	X
Crassostrea gigas	☒ Direct human consumption ☐ Live feed organism ☐ Other	○ Yes ◉ No ○ Unknown	Public institutions maintain a wide variety of breeding populations at the species and sub-species level. In addition to serving as research models and resources for public/private genetic improvement programs these populations serve as an ex-situ conservation resources.	X
Crassostrea virginica	☒ Direct human consumption ☐ Live feed organism ☐ Other	○ Yes ◉ No ○ Unknown	Public institutions maintain a wide variety of breeding populations at the species and sub-species level. In addition to serving as research models and resources for public/private genetic improvement programs these populations serve as an ex-situ conservation resources.	X
Microalga	☐ Direct human consumption ☒ Live feed organism ☐ Other	○ Yes ◉ No ○ Unknown	The USDoC, NMFS Laboratory in Milford, CT perpetuates a collection of ~230 strains of microalgae from ~ 200 species which are used as live feeds in shellfish aquaculture. These strains are distributed to commercial hatcheries throughout the US, and outside the country, and invest considerable resources in maintaining the integrity and purity of these strains.	X

Review of existing *ex situ* conservation activities of aquatic genetic resources of farmed aquatic species and their wild relatives *in vitro*.

29. Please list your country's *in vitro* collections and gene banks of the gametes, embryos, tissues, spores and other quiescent forms of farmed aquatic species and their wild relatives , using cryopreservation or other methods of long-term storage. Describe the major examples, identifying the facilities in which the collections are held. Include examples of any such genetic material from your country that is being kept in *in vitro* collections outside your country on behalf of beneficiaries in your country.

Add Row

Species (include information on subspecies or strain if available in comments)	Users and managers ***List all that apply***	Type of *ex-situ* conservation collection *in vitro* ***mark all that apply***	Facilities where collection is located ***mark all that apply***	Comments ***list all breeds, subspecies of the species and any additional information***	
Acipenser fulvescens	USDA ARS National Animal Germplasm Program Fort Collins, CO	☒ In vitro collection of gametes ☐ In vitro collextion of embryos ☐ In vitro collection of tissues ☐ Spores ☐ Other	☐ Aquaculture facilities ☒ Research facilities ☐ Universities ☐ Zoos and aquaria ☐ Other	0 subpopulations 55 animals 944 units	X
Ictalurus furcatus	USDA ARS National Animal Germplasm Program Fort Collins, CO	☒ In vitro collection of gametes ☐ In vitro collextion of embryos ☐ In vitro collection of tissues ☐ Spores ☐ Other	☐ Aquaculture facilities ☒ Research facilities ☐ Universities ☐ Zoos and aquaria ☐ Other	6 subpopulations 117 animals 3,405 units	X
Ictalurus punctatus	USDA ARS National Animal Germplasm Program Fort Collins, CO	☒ In vitro collection of gametes ☐ In vitro collextion of embryos ☐ In vitro collection of tissues ☐ Spores ☐ Other	☐ Aquaculture facilities ☒ Research facilities ☐ Universities ☐ Zoos and aquaria ☐ Other	1 subpopulation 52 animals 3,026 units	X
Morone chrysops	USDA ARS National Animal Germplasm Program Fort Collins, CO	☒ In vitro collection of gametes ☐ In vitro collextion of embryos ☐ In vitro collection of tissues ☐ Spores ☐ Other	☐ Aquaculture facilities ☒ Research facilities ☐ Universities ☐ Zoos and aquaria ☐ Other	1 subpopulation 21 animals 280 units	X

Species (include information on subspecies or strain if available in comments)	Users and managers ***List all that apply***	Type of *ex-situ* conservation collection *in vitro* ***mark all that apply***	Facilities where collection is located ***mark all that apply***	Comments ***list all breeds, subspecies of the species and any additional information***	
Morone saxatilis	USDA ARS National Animal Germplasm Program Fort Collins, CO	☒ In vitro collection of gametes ☐ In vitro collextion of embryos ☐ In vitro collection of tissues ☐ Spores ☐ Other	☐ Aquaculture facilities ☒ Research facilities ☐ Universities ☐ Zoos and aquaria ☐ Other	1 subpopulation 52 animals 1,536 units	X
Perca flavescens	USDA ARS National Animal Germplasm Program Fort Collins, CO	☒ In vitro collection of gametes ☐ In vitro collextion of embryos ☐ In vitro collection of tissues ☐ Spores ☐ Other	☐ Aquaculture facilities ☒ Research facilities ☐ Universities ☐ Zoos and aquaria ☐ Other	2 sub populations 49 animals 506 units	X
Oncorhynchus mykiss	USDA ARS National Animal Germplasm Program Fort Collins, CO	☒ In vitro collection of gametes ☐ In vitro collextion of embryos ☐ In vitro collection of tissues ☐ Spores ☐ Other	☐ Aquaculture facilities ☒ Research facilities ☐ Universities ☐ Zoos and aquaria ☐ Other	12 subpopulations 964 animals 18,254 units	X
Oncorhynchus tshawytscha	USDA ARS National Animal Germplasm Program Fort Collins, CO Nez Peirce Tribe, ID	☒ In vitro collection of gametes ☐ In vitro collextion of embryos ☐ In vitro collection of tissues ☐ Spores ☐ Other	☐ Aquaculture facilities ☒ Research facilities ☐ Universities ☐ Zoos and aquaria ☐ Other	0 subpopulations 1,594 animals 29,599 units	X
Salmo salar	USDA ARS National Animal Germplasm Program Fort Collins, CO	☒ In vitro collection of gametes ☐ In vitro collextion of embryos ☐ In vitro collection of tissues ☐ Spores ☐ Other	☐ Aquaculture facilities ☒ Research facilities ☐ Universities ☐ Zoos and aquaria ☐ Other	0 subpopulations 20 animals 586 units	X

Species (include information on subspecies or strain if available in comments)	Users and managers ***List all that apply***	Type of *ex-situ* conservation collection *in vitro* ***mark all that apply***	Facilities where collection is located ***mark all that apply***	Comments ***list all breeds, subspecies of the species and any additional information***	
Crassostrea gigas	USDA ARS National Animal Germplasm Program Fort Collins, CO	☒ In vitro collection of gametes ☐ In vitro collextion of embryos ☐ In vitro collection of tissues ☐ Spores ☐ Other	☐ Aquaculture facilities ☒ Research facilities ☐ Universities ☐ Zoos and aquaria ☐ Other	3 subpopulations 193 animals 6,134 units	X
Crassostrea virginica	USDA ARS National Animal Germplasm Program Fort Collins, CO	☒ In vitro collection of gametes ☐ In vitro collextion of embryos ☐ In vitro collection of tissues ☐ Spores ☐ Other	☐ Aquaculture facilities ☒ Research facilities ☐ Universities ☐ Zoos and aquaria ☐ Other	0 subpopulations 16 animals 1036 units	X
Rachycentron canadum	USDA ARS National Animal Germplasm Program Fort Collins, CO	☒ In vitro collection of gametes ☐ In vitro collextion of embryos ☐ In vitro collection of tissues ☐ Spores ☐ Other	☐ Aquaculture facilities ☒ Research facilities ☐ Universities ☐ Zoos and aquaria ☐ Other	0 subpopulations 1 animal 179 units	X
Sciaenops ocellatus	USDA ARS National Animal Germplasm Program Fort Collins, CO	☒ In vitro collection of gametes ☐ In vitro collextion of embryos ☐ In vitro collection of tissues ☐ Spores ☐ Other	☐ Aquaculture facilities ☐ Research facilities ☐ Universities ☐ Zoos and aquaria ☐ Other	0 subpopulations 5 animals 289	X

30. Please rank (from 1 – 10) the importance of the following objectives for ex situ conservation of aquatic genetic resources of farmed aquatic species and their wild relatives in your country

Objectives of *ex situ* conservation	Rank 1=Very Important 10=No importance
Preservation of aquatic genetic diversity	1
Maintain good strains for aquaculture production	1
Meet consumer and market demands	4
To help adapt to impacts of climate change	3
Future breed improvement in aquaculture	1
Other ***Continue adding row as necessary***	
Add Row / Remove Row	

Chapter 5: Stakeholders with Interests in Aquatic Genetic Resources of Farmed Aquatic Species and their Wild Relatives within National Jurisdiction

The main objective of Chapter 5 is to provide an overview of the perspectives and needs of the principal stakeholders who have interests in aquatic genetic resources of farmed aquatic species and their wild relatives for food and agriculture. Stakeholder groups can be identified from existing institutional knowledge, from sectoral and sub-sectoral consultations conducted during the country reporting process and where necessary from expert opinions. Gender issues pertaining to the conservation, sustainable use and development of aquatic genetic resources of farmed aquatic species and their wild relatives should be considered, as well as the perspectives and needs of indigenous peoples and local communities.

The specific objectives are:

- To describe the different principal stakeholder groups with interests in aquatic genetic resources of farmed aquatic species and their wild relatives To identify the type(s) of aquatic genetic resources of farmed aquatic species and their wild relatives in which each stakeholder group has interests and why.

- To describe the roles of stakeholder groups and the actions they are taking for the conservation, sustainable use and development of the aquatic genetic resources in which they have interests.

- To describe the further actions that stakeholder groups would like to see taken for the conservation, sustainable use and development of aquatic genetic resources in which they have interests, and the constraints that are hindering those actions, including lack of capacity and perceived threats.

Overview of the principal stakeholder groups who have interests in aquatic genetic resources of farmed aquatic species and their wild relatives

31. Please indicate the principal stakeholder groups who have interests in aquatic genetic resources of farmed aquatic species and their wild relatives including, *inter alia*: fish farmers; fishers in capture fisheries; persons involved in stocking and harvesting in culture-based fisheries; persons employed in postharvest chains; government officials; staff and members of aquaculture associations; managers of aquatic protected areas and others working for the conservation of aquatic ecosystems; researchers; and civil society.

Stakeholders	Role of stakeholder in regards og AqGR ***mark all that apply***	Genetic resource of main interest ***mark all that apply***	Comments ***Please provide any information or explanation of stakeholders' role***
Fish Farmers	☐ Conservation ☒ Production ☒ Feed manufactoring ☒ Breeding ☒ Research ☒ Marketing ☒ Processing ☒ Advocacy ☒ Outreach/Extension ☐ Other (**specify**)	☐ DNA ☒ Stock, breed or variety ☒ Species ☐ Other	US Fish farmers include large and small companies, some larger companies are vertically integrated and have capacities for research, marketing, and processing. Farmers from small and large companies participate in advocacy and outreach by representing themselves and through membership in associations. Research emphasizes include breeding, nutrition and management practices that improve production efficiency, product quality and animal health
Fishers	☒ Conservation ☒ Production ☐ Feed manufactoring ☐ Breeding ☒ Research ☒ Marketing ☒ Processing ☐ Advocacy ☐ Outreach/Extension ☐ Other (**specify**)	☐ DNA ☒ Stock, breed or variety ☒ Species ☐ Other	US Fishers defined as those interested in commercial and recreation fisheries. US Fishers currently provide the majority of domestic seafood production, they work within State and Federal guidelines towards sustainable fisheries. Research emphasizes include aspects of conservation of native populations and product quality.

Stakeholders	Role of stakeholder in regards og AqGR ***mark all that apply***	Genetic resource of main interest ***mark all that apply***	Comments ***Please provide any information or explanation of stakeholders' role***
Fish hatchery people	☒ Conservation ☐ Production ☐ Feed manufactoring ☒ Breeding ☒ Research ☐ Marketing ☐ Processing ☐ Advocacy ☒ Outreach/Extension ☐ Other (**specify**)	☒ DNA ☒ Stock, breed or variety ☒ Species ☐ Other	Fish hatcheries in the US include State and Federal hatcheries in the public sector that support conservation and recreation activities, releases to the wild support the fisheries industries. Research emphases include conservation genetics that maintain diversity of native populations and aquatic animal health.
People involved in marketing	☒ Conservation ☒ Production ☒ Feed manufactoring ☒ Breeding ☐ Research ☒ Marketing ☒ Processing ☒ Advocacy ☒ Outreach/Extension ☐ Other (**specify**)	☐ DNA ☒ Stock, breed or variety ☒ Species ☐ Other	Marketing often includes narratives about the way food is produced, impacts of production on the environment, product quality and healthfulness, and other aspects of food production that distinguish a product from competition, including local production.
Government resource managers	☒ Conservation ☒ Production ☒ Feed manufactoring ☒ Breeding ☒ Research ☒ Marketing ☒ Processing ☒ Advocacy ☒ Outreach/Extension ☐ Other (**specify**)	☒ DNA ☒ Stock, breed or variety ☒ Species ☐ Other	State and Federal Agencies have many roles concerning aquatic genetic resources including protecting native populations, funding intramural and extramural research programs, product labeling, and many regulatory functions of fisheries and aquaculture industries.

Stakeholders	Role of stakeholder in regards og AqGR ***mark all that apply***	Genetic resource of main interest ***mark all that apply***	Comments ***Please provide any information or explanation of stakeholders' role***
Fishing or aquaculture associations	☒ Conservation ☐ Production ☐ Feed manufactoring ☐ Breeding ☒ Research ☒ Marketing ☐ Processing ☒ Advocacy ☒ Outreach/Extension ☐ Other (**specify**)	☐ DNA ☒ Stock, breed or variety ☒ Species ☐ Other	In the US there are many associations that advocate for state, region, or national interests or for companies having interest in one or more closely related species.
Aquatic protected area managers	☒ Conservation ☐ Production ☐ Feed manufactoring ☐ Breeding ☒ Research ☐ Marketing ☐ Processing ☒ Advocacy ☒ Outreach/Extension ☐ Other (**specify**)	☒ DNA ☒ Stock, breed or variety ☒ Species ☐ Other	Emphasis on conserving genetic diversity and aquatic habitats, while overseeing restoration efforts.
Policy Makers	☒ Conservation ☒ Production ☒ Feed manufactoring ☒ Breeding ☒ Research ☒ Marketing ☒ Processing ☒ Advocacy ☒ Outreach/Extension ☐ Other (**specify**)	☐ DNA ☒ Stock, breed or variety ☒ Species ☐ Other	Policy makers at the State and Federal levels engage every aspect of fisheries and aquaculture production and protection of natural resources, including genetic diversity.

Stakeholders	Role of stakeholder in regards og AqGR ***mark all that apply***	Genetic resource of main interest ***mark all that apply***	Comments ***Please provide any information or explanation of stakeholders' role***
Non-Governmental Organizations	☒ Conservation ☐ Production ☐ Feed manufactoring ☐ Breeding ☐ Research ☐ Marketing ☐ Processing ☒ Advocacy ☒ Outreach/Extension ☐ Other (**specify**)	☐ DNA ☒ Stock, breed or variety ☒ Species ☐ Other	Primary role is advocacy and outreach.
Intergovernmental Organizations	☒ Conservation ☐ Production ☐ Feed manufactoring ☐ Breeding ☒ Research ☐ Marketing ☐ Processing ☒ Advocacy ☐ Outreach/Extension ☐ Other (**specify**)	☐ DNA ☒ Stock, breed or variety ☒ Species ☐ Other	Intergovernmental efforts seek to collaborate on protecting natural resources and conduct per-competative research in areas of mutual interest.
Donors	☒ Conservation ☐ Production ☐ Feed manufactoring ☐ Breeding ☒ Research ☐ Marketing ☐ Processing ☒ Advocacy ☐ Outreach/Extension ☐ Other (**specify**)	☐ DNA ☒ Stock, breed or variety ☒ Species ☐ Other	

Stakeholders	Role of stakeholder in regards og AqGR ***mark all that apply***	Genetic resource of main interest ***mark all that apply***	Comments ***Please provide any information or explanation of stakeholders' role***
Consumers	☐ Conservation ☐ Production ☐ Feed manufactoring ☐ Breeding ☐ Research ☐ Marketing ☐ Processing ☐ Advocacy ☐ Outreach/Extension ☐ Other (**specify**)	☐ DNA ☐ Stock, breed or variety ☒ Species ☐ Other	Consumers seek reasonably priced, healthy, and high quality safe seafood products, often with a preference for local and environmentally sustainable production.

a) Please indicate the most important role of women in regards to AqGR

In the US many of our researchers and aquaculture professionals are women and have the same roles as men.

b) Please indicate the most important role of indigenous and local communities in regards to AqGR

The US Fish and Wildlife Service's Fish and Aquatic Conservation (FAC) program works to fulfill Tribal trust and subsistence responsibilities. The involves three specific goals.
1. Promote a full understanding of the scope and importance of the FAC program's roles in meeting Tribal trust fish and wildlife conservation obligations.
2. Develop and maintain effective relationships between the Service and Federally recognized Tribes.
3. Deliver Tribal trust fish and wildlife conservation and manage subsistence uses of fishery resources.

Chapter 6: National Policies and Legislation for Aquatic Genetic Resources of Farmed Aquatic Species and their Wild Relatives within National Jurisdiction

The main objective of Chapter 6 is to review the status and adequacy of national policies and legislation concerning aquatic genetic resources of farmed aquatic species and their wild relatives including access and benefit sharing.

The specific objectives are as follows:

- To describe the existing national policy and legal framework for the conservation, sustainable use and development of aquatic genetic resources of farmed aquatic species and their wild relatives.
- To review current national policies and instruments for access to aquatic genetic resources of farmed aquatic species and their wild relatives and the fair and equitable sharing of benefits arising from their utilization.
- To identify any significant gaps in policies and legislation concerning aquatic genetic resources of farmed aquatic species and their wild relatives..

Review of national policies and legislation for Aquatic Genetic Resources of farmed aquatic species and their wild relatives within national jurisdiction

32. Please list national legislation, policies and/or mechanisms that address aquatic genetic resources of farmed species and their wild relatives (see question 47 regarding international agreements).

Add Row

National legislation, policy and/or mechanism	Date established	Scope ***Select all that apply***	Comments ***Please provide any additional information for example whether it has been effective or not; and main sources of information***	
Clean Water Act (CWA)	10/18/1972	☐ Genes or molecules only ☐ Aquaculture ☐ Capture fisheries ☒ Conservation ☐ Intellectual property protection ☐ Importation ☐ Trade and commerce ☐ Access and benefit sharing ☒ Other	Section 404 of this law regulates discharges of dredged and/or fill material into waters of the U.S. As it relates to aquaculture operations, the Army Core of Engineers (ACOE) permit authorizes activities such as seeding, rearing, cultivating, transplanting, and harvesting. The primary focus is on the potential effects of these activities on the chemical, physical, and biological integrity of waters of the U.S. Section 401 of this law requires state or tribal certification that the activities authorized by the ACOE permit comply with water quality standards.	X

National legislation, policy and/or mechanism	Date established	Scope ***Select all that apply***	Comments ***Please provide any additional information for example whether it has been effective or not; and main sources of information***	
National Environmental Policy Act (NEPA)	1/1/70	☐ Genes or molecules only ☐ Aquaculture ☐ Capture fisheries ☒ Conservation ☐ Intellectual property protection ☐ Importation ☐ Trade and commerce ☐ Access and benefit sharing ☒ Other	This law may require the ACOE to prepare an environmental assessment or an environmental impact statement on the effects of aquaculture activities.	X
Rivers and Harbors Act	3/3/1899	☐ Genes or molecules only ☐ Aquaculture ☐ Capture fisheries ☐ Conservation ☐ Intellectual property protection ☐ Importation ☐ Trade and commerce ☐ Access and benefit sharing ☒ Other	Section 10 of this law regulates activities and/or structures in, on, over, or under navigable waters of the U.S. The ACOE permit authorizes activities, such as the installation of buoys, floats, racks, trays, nets, lines, tubes, containers, and other structures, in navigable waters of the U.S. The primary focus is on the potential for these activities to interfere with other activities in navigable waters.	X
Endangered Species Act (ESA)	12/28/1973	☐ Genes or molecules only ☐ Aquaculture ☐ Capture fisheries ☒ Conservation ☐ Intellectual property protection ☐ Importation ☐ Trade and commerce ☐ Access and benefit sharing ☒ Other	Section 7 of this law requires the ACOE to consult with NMFS and/or the USFWS, if a proposed federal action has the potential to adversely affect an ESA-listed species and/or the designated critical habitat for an ESA-listed species. The focus of these consultations is on the likelihood that the aquaculture activities authorized under the ACOE permit would jeopardize ESA-listed species or result in the destruction or adverse modification of their critical habitat.	X
Magnuson-Stevens Fishery Conservation and Management Act	4/13/1976	☐ Genes or molecules only ☐ Aquaculture ☐ Capture fisheries ☒ Conservation ☐ Intellectual property protection ☐ Importation ☐ Trade and commerce ☐ Access and benefit sharing ☒ Other	The Essential Fish Habitat (EFH) provisions of this law require the ACOE to consult with NMFS, if a proposed federal action has the potential to adversely affect the habitat of wild fish stocks managed by NMFS. The focus of these consultations is on the potential for activities authorized under the ACOE permit to adversely affect EFH. One example of EFH is submerged aquatic vegetation in nearshore areas where most U.S. shellfish aquaculture production currently takes place.	X

National legislation, policy and/or mechanism	Date established	Scope ***Select all that apply***	Comments ***Please provide any additional information for example whether it has been effective or not; and main sources of information***	
Coastal Zone Management Act	10/27/1972	☐ Genes or molecules only ☐ Aquaculture ☐ Capture fisheries ☐ Conservation ☐ Intellectual property protection ☐ Importation ☐ Trade and commerce ☐ Access and benefit sharing ☒ Other	The federal consistency provisions of this law require state certification that the activities authorized by the ACOE permit comply with the enforceable policies of approved state coastal zone management programs and that these activities will be conducted in a manner consistent with the program.	X
National Historic Preservation Act	10/15/1966	☐ Genes or molecules only ☐ Aquaculture ☐ Capture fisheries ☐ Conservation ☐ Intellectual property protection ☐ Importation ☐ Trade and commerce ☐ Access and benefit sharing ☒ Other	Section 106 of this law requires the ACOE to consult with the State Historic Preservation Officer or Tribal Historic Preservation Officer, if the aquaculture activities authorized by the permit may affect historic properties or areas of historic or cultural significance.	X
Fish and Wildlife Coordination Act	3/10/1934	☐ Genes or molecules only ☐ Aquaculture ☐ Capture fisheries ☒ Conservation ☐ Intellectual property protection ☐ Importation ☐ Trade and commerce ☐ Access and benefit sharing ☒ Other	This law requires the ACOE to consult with USFWS, NMFS, and appropriate state agencies, if the aquaculture activities authorized by the permit would modify a body of water in ways that could potentially harm fish and wildlife resources.	X
National Marine Sanctuaries Act	10/23/1972	☐ Genes or molecules only ☐ Aquaculture ☐ Capture fisheries ☒ Conservation ☐ Intellectual property protection ☐ Importation ☐ Trade and commerce ☐ Access and benefit sharing ☒ Other	Section 304(d) of this law requires the ACOE to consult with the National Marine Sanctuary Program, if the aquaculture activities authorized by the permit are likely to destroy or injure any sanctuary resource (for Stellwagen Bank National Marine Sanctuary, such consultations are required for action that "may affect" that sanctuary, which is a lower threshold).	X

National legislation, policy and/or mechanism	Date established	Scope ***Select all that apply***	Comments ***Please provide any additional information for example whether it has been effective or not; and main sources of information***	
National Aquaculture Act of 1980	9/26/1980	☐ Genes or molecules only ☒ Aquaculture ☐ Capture fisheries ☐ Conservation ☐ Intellectual property protection ☐ Importation ☐ Trade and commerce ☐ Access and benefit sharing ☐ Other	promote and support the development of private aquaculture and to ensure coordination among the various federal agencies that have aquaculture programs and policies. It provided for a national aquaculture policy, including a formal National Aquaculture Development Plan; established a Joint Subcommittee on Aquaculture on which officials of USDA, Commerce, the Interior, and nine other federal agencies sit; designated USDA as the lead agency for coordination; and authorized the National Aquaculture Information Center within the National Agricultural Library.[1][2]	X
Fishery Management Plan for Regulating Offshore Marine Aquaculture in the Gulf of Mexico	January 2009	☐ Genes or molecules only ☒ Aquaculture ☐ Capture fisheries ☒ Conservation ☐ Intellectual property protection ☐ Importation ☐ Trade and commerce ☐ Access and benefit sharing ☒ Other	In January 2016, NOAA Fisheries issued a final rule to implement a regional permitting program to manage the development of aquaculture in federal waters of the Gulf. The program was proposed by the Gulf of Mexico Fishery Management Council through a regional FMP developed in 2009 under the Magnuson-Stevens Fishery Conservation and Management Act. The FMP is the first comprehensive regional approach to authorizing aquaculture in federal waters. Prior to implementation of this FMP, the U.S. did not have a framework to permit long-term aquaculture projects in the Exclusive Economic Zone (EEZ), federal waters that are three to 200 miles (five to 322 kilometers) offshore.	X

National legislation, policy and/or mechanism	Date established	Scope ***Select all that apply***	Comments ***Please provide any additional information for example whether it has been effective or not; and main sources of information***	
Department of Commerce Aquaculture Policy	June 9, 2011	☐ Genes or molecules only ☒ Aquaculture ☒ Capture fisheries ☒ Conservation ☐ Intellectual property protection ☐ Importation ☒ Trade and commerce ☒ Access and benefit sharing ☒ Other	The purpose of the DOC Aquaculture Policy is "to support the development of sustainable aquaculture within the context of the DOC goals of encouraging economic growth and employment opportunities in the United States and of enhancing United States competitiveness in, and exports to, global markets. This policy applies to a broad range of responsibilities at the DOC relating to trade, technology, innovation and entrepreneurship, economic development, and environmental stewardship. For purposes of this policy, aquaculture is defined as the propagation and rearing of aquatic organisms for commercial, recreational, or public purposes. This definition covers all authorized production of finfish, shellfish, plants, algae, and other aquatic organisms for 1) food and other commercial products; 2) wild stock replenishment for commercial and recreational fisheries; 3) rebuilding populations of threatened or endangered species under species recovery and conservation plans; and 4) restoration and conservation of aquatic habitat."	X

National legislation, policy and/or mechanism	Date established	Scope ***Select all that apply***	Comments ***Please provide any additional information for example whether it has been effective or not; and main sources of information***	
National Oceanic and Atmospheric Administration Marine Aquaculture Policy	June 9, 2011	☐ Genes or molecules only ☒ Aquaculture ☒ Capture fisheries ☒ Conservation ☐ Intellectual property protection ☐ Importation ☒ Trade and commerce ☒ Access and benefit sharing ☒ Other	The purpose of the NOAA Marine Aquaculture Policy is "to enable the development of sustainable marine aquaculture within the context of the [NOAA] multiple stewardship missions and broader social and economic goals. Meeting this objective will require NOAA to integrate environmental, social, and economic considerations in management decisions concerning aquaculture. This policy reaffirms that aquaculture is an important component of NOAA's efforts to maintain healthy and productive marine and coastal ecosystems, protect special marine areas, rebuild overfished wild stocks, restore populations of endangered species, restore and conserve marine and coastal habitat, balance competing uses of the marine environment, create employment and business opportunities in coastal communities, and enable the production of safe and sustainable seafood."	X
National Program 106 – Aquaculture Action Plan (2015-2019)		☐ Genes or molecules only ☒ Aquaculture ☐ Capture fisheries ☐ Conservation ☐ Intellectual property protection ☐ Importation ☐ Trade and commerce ☐ Access and benefit sharing ☐ Other	The strategic vision of the USDA ARS National Program 106 - Aquaculture Action Plan (2015-2019) is to conduct high quality, relevant, fundamental, and applied aquaculture research to improve the systems for raising domesticated aquaculture species, and to transfer technologies that enhance the productivity and efficiency of U.S. producers and the quality of seafood and other aquatic animal products. "Research outcomes to support a thriving domestic industry based on improved genetic stocks and scientific information on biotechnologies and management practices to ensure a high quality, safe supply of healthful seafood and aquatic products."	X

National legislation, policy and/or mechanism	Date established	Scope ***Select all that apply***	Comments ***Please provide any additional information for example whether it has been effective or not; and main sources of information***	
National Ocean Policy Implementation Plan and Appendix	April 16, 2013	☐ Genes or molecules only ☒ Aquaculture ☐ Capture fisheries ☒ Conservation ☐ Intellectual property protection ☐ Importation ☒ Trade and commerce ☐ Access and benefit sharing ☒ Other	The National Ocean Policy Implementation Plan and Appendix translate President Obama's Executive Order 13547 -- National Policy for the Stewardship of the Ocean, Our Coasts, and the Great Lakes into on-the-ground actions. These documents describe specific actions Federal agencies will take to address key ocean challenges, give states and communities greater input in Federal decisions, streamline Federal operations, save taxpayer dollars, and promote economic growth. In particular, the Plan and Appendix recognize the utility of streamlining permitting process and coordinated research to support sustainable aquaculture; promoting job growth through support of the National Shellfish Initiative and existing efforts, such as the Gulf of Mexico FMP; and maximizing the commercial value and environmental benefits of, specifically, shellfish aquaculture by coordinating efforts with the commercial and restoration aquaculture communities.	X
National Strategic Plan for Federal Aquaculture Research (2014-2019)	June 16, 2014	☐ Genes or molecules only ☒ Aquaculture ☐ Capture fisheries ☒ Conservation ☐ Intellectual property protection ☐ Importation ☒ Trade and commerce ☒ Access and benefit sharing ☒ Other	The vision of the Strategic Plan is to develop a "globally competitive, technologically appropriate, and diverse aquaculture sector in the United States that meets increasing demand for seafood and products that are affordable and meet high standards for safety, quality, and environmental stewardship, with maximum opportunity for profitability and economic growth." An important component of this viable domestic aquaculture industry, however, is to develop it in accordance with the natural ecosystems that already support valuable recreational, fishery, and environmental services.	X

National legislation, policy and/or mechanism	Date established	Scope ***Select all that apply***	Comments ***Please provide any additional information for example whether it has been effective or not; and main sources of information***	
National Shellfish Initiative	June 9, 2011	☐ Genes or molecules only ☒ Aquaculture ☐ Capture fisheries ☒ Conservation ☐ Intellectual property protection ☐ Importation ☒ Trade and commerce ☒ Access and benefit sharing ☒ Other	The goal of the National Shellfish Initiative is to increase populations of bivalve shellfish (oysters, clams, and mussels) in our nation's coastal waters through commercial production and conservation activities. Efforts focus on encouraging shellfish aquaculture, advancing science and research, and streamlining permitting at federal, state, and local levels.	X
Aquaculture Technology Transfer Initiative	June 9, 2011	☐ Genes or molecules only ☒ Aquaculture ☐ Capture fisheries ☒ Conservation ☐ Intellectual property protection ☐ Importation ☐ Trade and commerce ☒ Access and benefit sharing ☒ Other	The Aquaculture Technology Transfer Initiative was announced in concert with the 2011 aquaculture policies. The purpose is to foster the development of innovative technology for commercial aquaculture in the United States.	X
Public Law 101-624 - National Genetic Resources Program	12/28/1990	☐ Genes or molecules only ☒ Aquaculture ☐ Capture fisheries ☒ Conservation ☐ Intellectual property protection ☐ Importation ☐ Trade and commerce ☐ Access and benefit sharing ☐ Other	Directs USDA to establish the National Genetic Resources Program which includes: plants, animals, aquatic, insect and microbial genetic resources important for food and agriculture.	X
Federal Food, Drug, and Cosmetic Act (FD&C Act)	6/30/1906 with many later amendments	☐ Genes or molecules only ☐ Aquaculture ☐ Capture fisheries ☐ Conservation ☐ Intellectual property protection ☐ Importation ☐ Trade and commerce ☐ Access and benefit sharing ☒ Other	Directs regulation of food, drugs and other regulated articles by the Food and Drug Administration (FDA). Includes definitions that allows regulation of animals, including fish, with intentionally altered genomic DNA under the new animal drug provisions of the Act.	X

National legislation, policy and/or mechanism	Date established	Scope ***Select all that apply***	Comments ***Please provide any additional information for example whether it has been effective or not; and main sources of information***	
CVM Guidance for Industry 187: Regulation of Genetically Engineered Animals Containing Heritable Recombinant DNA Constructs	1/15/2009; Revised draft issued in Janaury 2017	☐ Genes or molecules only ☐ Aquaculture ☐ Capture fisheries ☐ Conservation ☐ Intellectual property protection ☐ Importation ☐ Trade and commerce ☐ Access and benefit sharing ☒ Other	Guidance issued by FDA's Center for Veterinary Medicine (CVM) that addresses regulation of genetically engineered animals under the FD&C Act and provides non-binding recommendations for developers. This guidance document has recently been revised to address regulation of intentionally altered genomic DNA in animals, e.g., gene editing; however, the revised document is still a draft as of April 2017 and subject to public comments before it is finalized.	X
Coordinated Framework for the Regulation Biotechnology	1986, updated January 2017	☐ Genes or molecules only ☐ Aquaculture ☐ Capture fisheries ☐ Conservation ☐ Intellectual property protection ☐ Importation ☐ Trade and commerce ☐ Access and benefit sharing ☒ Other	Clarifies the roles and responsibilities for the three US Federal agencies (EPA, FDA, USDA) that regulate products of biotechnology; Clarifies which biotechnology product areas are within the authority and responsibility of each agency. Products of biotechnology include genetically engineered animals and those with intentionally altered genomic DNA.	X

Review of the current status and gaps in national policies and legislation for the conservation, sustainable use and development of aquatic genetic resources of farmed aquatic species and their wild relatives

33. Please list any gaps in the coverage or constraints in implementing national legislation, policies and/or mechanisms in regard to aquatic genetic resources.

Although this is an important topic, from a Federal perspective we do not have data and analyses to bring to bear on this question.

34. Please indicate any national aquatic genetic resources of farmed aquatic species and their wild relatives for which your country restricts access.

Type of genetic resource (can be species name, DNA, gametes or other descriptor)	Comments ***Please, provide verifiable main sources of information, effectiveness of the restriction, description of type of restriction and for whom does the restriction apply***
DNA	The US has no overarching national access and benefit-sharing regulations. Access to genetic resources on private lands/waters are determined by the owners; access to governmental lands/waters are determined by the relevant government agencies
Stock, breed or variety	In an effort to protect wild populations of Atlantic salmon , producers in the Northeast must culture stocks of North American Origin as defined by genetic assays.
Species	State and Federal jurisdictions offer varying levels of protection of wild relatives of farmed species that are in decline. For example: five species of west coast abalone are endangered, species of concern, or depleted. While three of these species are cultured commercially, access to wild animals (fishery or broodstock) of all species is restricted under the California Abalone Recovery and Management Plan (2005) and the federal Endangered Species Act and White Abalone Recovery Plan (2008); the federal Black Abalone Recovery Plan is in preparation. Similarly, possession of Atlantic cod from Georges Bank is prohibited due to significant depletion from overfishing and cod fishery in the Gulf of Maine is heavily regulated by the New England Fishery Management Council (under Title 50 CFR Part 648 Subpart F: Management Measures for the Northeast Multispecies and Monkfish Fisheries, current as of 25 Apr 2017), despite limited commercial culture of the species in Maine using wild broodstock.
Other **Continue adding row as necessary** Add Row Remove Row	

35. Over the past 10 years, indicate the actions your country has taken to maintain or enhance access to aquatic genetic resources of farmed aquatic species and their wild relatives located outside your country; for example, by establishing germplasm acquisition agreements or material transfer agreements.

Add Row

Action taken to enhance access to aquatic genetic resources outside your country	Type of genetic resource ***Mark all that apply***	Comment ***for example other types of genetic resources***	
	☐ DNA ☐ Genes ☐ Gametes ☐ Tissues ☐ Embryos ☐ Living specimens		X

36. Please indicate any obstacles your country has encountered when trying to access aquatic genetic resources of farmed aquatic species and their wild relatives outside of your country (including access for research purposes).

Obstacles to accessing aquatic genetic resources	Please describe type of genetic resource ***mark all that apply***	Comments ***please include additional information as needed***
Intellectual property protection	☐ DNA ☐ Stock, breed or variety ☐ Species ☐ Other	
National laws of your country	☐ DNA ☐ Stock, breed or variety ☐ Species ☐ Other	
National laws of donor country	☐ DNA ☐ Stock, breed or variety ☐ Species ☐ Other	
Internationl laws or protocols	☐ DNA ☐ Stock, breed or variety ☐ Species ☐ Other	
Too expensive	☐ DNA ☐ Stock, breed or variety ☐ Species ☐ Other	
Material transfer agreements required	☐ DNA ☐ Stock, breed or variety ☐ Species ☐ Other	
Knowledge gaps	☐ DNA ☐ Stock, breed or variety ☐ Species ☐ Other	
Public perception	☐ DNA ☐ Stock, breed or variety ☐ Species ☐ Other	

Obstacles to accessing aquatic genetic resources	Please describe type of genetic resource ***mark all that apply***	Comments ***please include additional information as needed***
Other **Continue adding row as necessary** Add Row | Remove Row	☐ DNA ☐ Stock, breed or variety ☐ Species ☐ Other	

Chapter 7: Research, Education, Training and Extension on Aquatic Genetic Resources within National Jurisdiction: Coordination, Networking and Information

The main objective of Chapter 7 is to review the status and adequacy of national research, education, training and extension, coordination and networking arrangements and information systems that support the conservation, sustainable use and development of aquatic genetic resources of farmed aquatic species and their wild relatives for food and agriculture.

The specific objectives are:

- To describe the current status, future plans, gaps, needs and priorities for research, training, extension and education on the conservation, sustainable use and development of aquatic genetic resources of farmed aquatic species and their wild relatives
- To describe existing or planned national networks for the conservation, sustainable use and development of aquatic genetic resources of farmed aquatic species and their wild relatives.
- To describe existing or planned information systems for the conservation, sustainable use and development of aquatic genetic resources of farmed aquatic species and their wild relatives.

Research

37. Does your national research programme support the conservation, sustainable use and development of aquatic genetic resources of farmed aquatic species and their wild relatives? If yes, give details of current and/or planned research; if no, explain the main reasons why not in box below.

Please mark appropriate box

- (•) Yes
- ( ) No
- ( ) Unknown

Please provide details

The National Strategic Plan for Federal Aquaculture Research (Interagency Working Group on Aquaculture 20141) lists among nine strategic goals, the goal to "Employ Genetics to Increase Productivity and Protect Natural Populations Federal interagency aquaculture". This was developed by the Interagency Working Group on Aquaculture. One of the primary functions of this group (and document) is to increase the overall effectiveness of Federal aquaculture research, technology transfer, and assistance programs.

The following outcomes and milestones are listed in that document:

"Outcomes
• The establishment of breeding programs and other genetic tools that can rapidly improve the agronomic, product quality and production traits of aquaculture species
• Conservation of genetic variation and diversity in wild populations
• Measure, monitor, model, and control the risks of the genetic impacts of cultured populations on wild stocks
Milestones
• Development and implementation of genetic improvement programs with multi-trait selective breeding for growth efficiency, disease resistance, and product quality that maximize production efficiency and environmental compatibility of aquaculture
• Defined distribution of genetic variation within and between populations of interest for commercialization, augmentation, restoration, or recreation. This will inform decision making on which populations have the most potential for economic development or which natural populations are most sensitive to environmental perturbation and responsive to habitat restoration
• Development and refinement of genetic risk models to aid in science-based regulation and management of commercial and public aquaculture activities
• Development of techniques to reduce the risks of undesired genetic impacts on natural populations that can adversely impact sensitive native or endangered species or biodiversity in natural systems"

1 2014. Interagency Working Group on Aquaculture. National Science and Technology Council, Committee on Science. National Strategic Plan for Federal Aquaculture Research (2014-2019). 21 pages.

38. Please list main institutions, organizations, corporations and other entities in your country that are engaged in field and/or laboratory research related to the conservation, sustainable use and development of aquatic genetic resources of farmed aquatic species and their wild relatives.

Add Row

Main institutions, organizations, corporations and other entities	Area of research ***Mark all that apply***	Comments ***Please provide any additional information***	
The Agricultural Research Service (ARS) is the U.S. Department of Agriculture's chief scientific in-house research agency. ARS conducts research to develop and transfer solutions to aquaculture problems of high national priority and provide information access and dissemination of research findings to sustain a competitive aquaculture industry.	☒ Genetic resource management ☒ Basic knowledge on aquatic genetic resources ☒ Characterization and monitoring of aquatic genetic resources ☒ Genetic improvement ☐ Economic valuation of aquatic genetic resources ☐ Conservation of aquatic genetic resources ☒ Communication on aquatic genetic resources ☒ Access and distribution of aquatic genetic resources ☐ Other		X
Within the US Department of Agriculture, the National Institute of Food and Agriculture (NIFA) provides leadership and extramural funding for integrated programs that advance aquaculture-related sciences. Through partnerships with the Land-Grant University System, Cooperative Extension, and government, private, and non-profit organizations, NIFAs research, education, and extension programs provide support for U.S. aquaculture.	☒ Genetic resource management ☒ Basic knowledge on aquatic genetic resources ☒ Characterization and monitoring of aquatic genetic resources ☒ Genetic improvement ☒ Economic valuation of aquatic genetic resources ☒ Conservation of aquatic genetic resources ☒ Communication on aquatic genetic resources ☐ Access and distribution of aquatic genetic resources ☐ Other		X

Main institutions, organizations, corporations and other entities	Area of research ***Mark all that apply***	Comments ***Please provide any additional information***	
The USDA National Institute of Food and Agriculture (NIFA) administers the Regional Aquaculture Center program (RAC), which address challenges and opportunities in each geographic region of the U.S. The role of the RACs is to solve problems identified by the aquaculture industry and sharing knowledge to support the aquaculture industry. The Centers tackle high priority projects that would be too costly for one organization to handle by sponsoring regional research and education activities.	☐ Genetic resource management ☒ Basic knowledge on aquatic genetic resources ☒ Characterization and monitoring of aquatic genetic resources ☐ Genetic improvement ☒ Economic valuation of aquatic genetic resources ☐ Conservation of aquatic genetic resources ☒ Communication on aquatic genetic resources ☐ Access and distribution of aquatic genetic resources ☒ Other		X
Within the Department of Commerce, the National Oceanic and Atmospheric Administration (NOAA) has marine aquaculture research capabilities at in-house laboratories within the Fisheries Service and the Ocean Service, and extramural research through the National Sea Grant Office. NOAA engages in aquaculture research at many of its labs and science centers to examine scientific issues that will lead to greater efficiency, cost-effectiveness, and environmental compatibility in marine aquaculture.	☒ Genetic resource management ☒ Basic knowledge on aquatic genetic resources ☒ Characterization and monitoring of aquatic genetic resources ☒ Genetic improvement ☐ Economic valuation of aquatic genetic resources ☒ Conservation of aquatic genetic resources ☒ Communication on aquatic genetic resources ☒ Access and distribution of aquatic genetic resources ☐ Other		X

Main institutions, organizations, corporations and other entities	Area of research ***Mark all that apply***	Comments ***Please provide any additional information***	
Within NOAA, the Sea Grant Program provides funds to support aquaculture research and development though the National Sea Grant Aquaculture Competition, which typically is a biennial competition to fund aquaculture research and technology transfer. At the state level, individual state Sea Grant Programs hold their own competitions and may include aquaculture in their priorities. In addition, the Sea Grant network of 33 state programs include extension educations who transfer research and technology to marine aquaculture stakeholders	☐ Genetic resource management ☒ Basic knowledge on aquatic genetic resources ☒ Characterization and monitoring of aquatic genetic resources ☐ Genetic improvement ☒ Economic valuation of aquatic genetic resources ☐ Conservation of aquatic genetic resources ☒ Communication on aquatic genetic resources ☒ Access and distribution of aquatic genetic resources ☐ Other		X
In the Department of the interior, the Fish and Wildlife Service's National Fish Hatchery System (NFHS) is comprised of a network of field stations located throughout the nation that work with tribal, local, and state governments, other federal agencies, and foreign nations to conserve fisheries. Scientists with diverse specialties in ecology, statistics, botany, physiology, fish culture, microbiology, and veterinary medicine conserve America's fisheries, including conserving rare imperiled species and common game fishes.	☒ Genetic resource management ☒ Basic knowledge on aquatic genetic resources ☒ Characterization and monitoring of aquatic genetic resources ☐ Genetic improvement ☐ Economic valuation of aquatic genetic resources ☒ Conservation of aquatic genetic resources ☒ Communication on aquatic genetic resources ☒ Access and distribution of aquatic genetic resources ☐ Other		X

Main institutions, organizations, corporations and other entities	Area of research ***Mark all that apply***	Comments ***Please provide any additional information***	
Private aquaculture companies that maintain aquatic genetic resources as part of their breeding programs and active in field and laboratory research related to the conservation, sustainable use and development of AGR. These include finfish and shellfish species for commercial use, as well as for recreational fish stocking.	☒ Genetic resource management ☒ Basic knowledge on aquatic genetic resources ☐ Characterization and monitoring of aquatic genetic resources ☒ Genetic improvement ☒ Economic valuation of aquatic genetic resources ☐ Conservation of aquatic genetic resources ☐ Communication on aquatic genetic resources ☒ Access and distribution of aquatic genetic resources ☐ Other		X
There are non-governmental, research institutes (including zoo and aquarium efforts) that are active in field and laboratory research related to the conservation, sustainable use and development of AGR. These include finfish and shellfish species for both commercial food production and species for stocking.	☒ Genetic resource management ☒ Basic knowledge on aquatic genetic resources ☒ Characterization and monitoring of aquatic genetic resources ☒ Genetic improvement ☐ Economic valuation of aquatic genetic resources ☒ Conservation of aquatic genetic resources ☒ Communication on aquatic genetic resources ☐ Access and distribution of aquatic genetic resources ☐ Other		X

Main institutions, organizations, corporations and other entities	Area of research ***Mark all that apply***	Comments ***Please provide any additional information***	
Within states, fisheries management agencies often include recreational fish stocking programs for state waters. State hatcheries manage aquatic genetic resources from captive broodstock and the wild. This primarily is finfish aquaculture for both freshwater and marine recreational fishing.	☒ Genetic resource management ☒ Basic knowledge on aquatic genetic resources ☒ Characterization and monitoring of aquatic genetic resources ☐ Genetic improvement ☐ Economic valuation of aquatic genetic resources ☒ Conservation of aquatic genetic resources ☒ Communication on aquatic genetic resources ☐ Access and distribution of aquatic genetic resources ☐ Other		X

39. What capacity strengthening is needed to improve national research in support of the conservation, sustainable use and development of aquatic genetic resources of farmed aquatic species and their wild relatives?

Please rank the following in regard to capacity strengthening.

Capacities	Rank 1=Very Important 10=No importance
Improve basic knowledge on aquatic genetic resources	3
Improve capacities for characterization and monitoring of aquatic genetic resources	1
Improve capacities for genetic improvement	1
Improve capacities for genetic resource management	1
Improve capacities for economic valuation of aquatic genetic resources	5
Improve capacities for conservation of aquatic genetic resources	2
Improve communication on aquatic genetic resources	5
Improve access to and distribution of aquatic genetic resources	5
Add other rows as appropriate and rank Add Row Remove Row	

Please describe any other capacity building needs in regards to aquatic genetic resources

Education, training and extension

40. Please indicate the extent that education, training and extension in your country covers the conservation, sustainable use and development of aquatic genetic resources of farmed aquatic species and their wild relatives? List the main institutions involved and the types of courses offered.

Add Row

Institution	Thematic Area	Type of courses **mark all that apply**	Comments	
Land-Grant University System, including Cooperative Extension	Genetic resource management	☒ Undergraduate ☒ Post-graduate ☒ Training ☒ Extension		
	Characterization and monitoring of aquatic genetic resources	☒ Undergraduate ☒ Post-graduate ☒ Training ☒ Extension		
	Genetic improvement	☒ Undergraduate ☒ Post-graduate ☒ Training ☒ Extension		X
	Economic valuation of aquatic genetic resources	☐ Undergraduate ☒ Post-graduate ☐ Training ☒ Extension		
	Conservation of aquatic genetic resources	☒ Undergraduate ☒ Post-graduate ☒ Training ☒ Extension		

The state Sea Grant network of 33 state programs include extension educations who transfer research and technology to marine aquaculture stakeholder	Genetic resource management	☒ Undergraduate ☒ Post-graduate ☒ Training ☒ Extension		
	Characterization and monitoring of aquatic genetic resources	☒ Undergraduate ☒ Post-graduate ☒ Training ☒ Extension		
	Genetic improvement	☐ Undergraduate ☒ Post-graduate ☐ Training ☐ Extension		X
	Economic valuation of aquatic genetic resources	☐ Undergraduate ☒ Post-graduate ☐ Training ☐ Extension		
	Conservation of aquatic genetic resources	☐ Undergraduate ☒ Post-graduate ☒ Training ☒ Extension		
The Cooperative Research Unit program conducts research on renewable natural resource questions, participates in the education of graduate students and continuing education of natural resource professionals, and provides technical assistance and consultation on natural resource issues. Each unit is a partnership among the U.S. Geological Survey, a state natural resource agency, a host university, and the Wildlife Management Institute.	Genetic resource management	☐ Undergraduate ☒ Post-graduate ☒ Training ☐ Extension		
	Characterization and monitoring of aquatic genetic resources	☐ Undergraduate ☒ Post-graduate ☒ Training ☐ Extension		
	Genetic improvement	☐ Undergraduate ☐ Post-graduate ☐ Training ☐ Extension		X
	Economic valuation of aquatic genetic resources	☐ Undergraduate ☐ Post-graduate ☐ Training ☐ Extension		
	Conservation of aquatic genetic resources	☐ Undergraduate ☒ Post-graduate ☒ Training ☐ Extension		

Coordination and networking

41. Please list any mechanisms within your country responsible for coordinating the aquaculture, culture-based fisheries and capture fisheries subsectors with the other sectors that use watersheds and coastal ecosystems and have impacts on aquatic genetic resources of wild relatives of farmed aquatic species (e.g., agriculture, forestry, mining, tourism, waste management and water resources).

If no mechanism exists check here: ☐

Add Row

Name of mechanism	Description of how mechanism operates	
The Interagency Working Group on Aquaculture (IWG-A) operates under the Life Sciences Subcommittee of the Committee on Science of the National Science and Technology Council. Pursuant to Sec. 6(b) of the National Aquaculture Act of 1980, the IWG-A (formerly known as the Joint Subcommittee on Aquaculture) was created to increase the overall effectiveness and productivity of Federal aquaculture research, technology transfer, and technology assistance programs.	Coordination of Federal aquaculture research, technology transfer, and technology assistance programs.	X
Professional Societies.	The US has many professional societies that facilitate coordination and networking among professionals working with aquatic species including representatives of industry, science, and government.	X

42. Please indicate how capacity strengthening can be improved in intersectoral coordination in support of the conservation, sustainable use and development of aquatic genetic resources.

Please rank the following in regards to capacity strengthening.

Capacities	Rank 1=Very Important 10=No importance
Increase awareness in institutions	2
Increase technical capacities of institutions	3
Increase information sharing between institutions	1
Add other rows as appropriate and rank Add Row Remove Row	

Please specify in box below

43. Please list any national networks in your country or any international networks your country belongs to that support the conservation, sustainable use and development of aquatic genetic resources.

Add Row

Network	Objectives of the network ***Please mark all that apply*** to your country	Comments	
National Animal Germplasm Program's Aquatic Species Committee	☐ Improve basic knowledge on aquatic genetic resources ☒ Improve capacities for characterization and monitoring of aquatic genetic resources ☐ Improve capacities for genetic improvement ☐ Improve capacities for economic valuation of aquatic genetic resources ☒ Improve capacities for conservation of aquatic genetic resources ☒ Improve communication on aquatic genetic resources ☒ Improve access to and distribution of aquatic genetic resources	The committee is comprised of Federal, university and industry members and addresses aquaculture conservation activities.	X

Information systems

44. Please list any information systems existing in your country for receiving, managing and communicating information about the conservation, sustainable use and development of aquatic genetic resources of farmed aquatic species and their wild relatives.

Add Row

Name of information system	Type of information stored ***mark all that apply***	Main stakeholders ***mark all that apply***	
National Animal Germplasm Program's Animal - GRIN database	☐ DNA sequence ☒ Genes and genotype ☒ Breeds, strains or stocks ☒ Species names ☒ Production figures ☐ Distribution ☐ Level of endangerment ☐ Other	☒ Fish farmers ☐ Fishers in capture fisheries ☒ Fish hatchery people ☐ People involved in marketing ☒ Government resource managers ☒ Fishing or aquaculture associations ☐ Aquatic protected area managers ☒ University and academic people ☒ Non-Governmental Organizations ☒ Intergovernmental Organizations ☒ Policy makers ☐ Donors ☐ Consumers ☐ Politicians **Please list other stakeholders as necessary**	X

45. What capacity strengthening is needed to improve national information systems to support the conservation, sustainable use and development of aquatic genetic resources?

Please describe what capacities need to be strengthened

Continued software development and data accumulation to characterize the uniqueness of aquatic genetic resources.

Please describe any other capacity building needs in regards to information systems for aquatic genetic resources

Greater agreement about phenotypic parameters for measurement.

Chapter 8: International Collaboration on Aquatic Genetic Resources of Farmed Aquatic Species and Their Wild Relatives

The main objective of Chapter 8 is to review the mechanisms and instruments through which your country participates in international collaborations on aquatic genetic resources of farmed aquatic species and their wild relatives.

The specific objectives are:

- To identify your country's current participation in bilateral, sub-regional, regional, other international and global forms of collaboration on aquatic genetic resources. List national memberships, status as a Party and other forms of affiliation in agreements, conventions, treaties, international organizations, international networks and international programmes.
- To identify any other forms of international collaboration on aquatic genetic resources.
- To review the benefits from existing forms of international collaboration on aquatic genetic resources.
- To identify needs and priorities for future international collaboration on aquatic genetic resources

International collaboration includes bilateral arrangements and the sharing of particular waters and stocks of wild relatives of farmed aquatic species.

International, regional or sub-regional agreements, conventions and treaties concerning aquatic genetic resources of farmed aquatic species and their wild relatives

46. Please list the international, regional or sub-regional agreements your country subscribes to that cover aquatic genetic resources of farmed species and their wild relatives, such as the Nagoya Protocol[2] the Convention on Biological Diversity and the Cartagena Protocol and how they have impacted aquatic genetic resources and stakeholders in your country. Examples could include:

[2] http://www.cbd.int/abs/nagoya-protocol/signatories/

- Establishment and management of shared or networked aquatic protected areas as far as wild relatives of farmed aquatic species are concerned
- Aquaculture and culture-based fisheries in transboundary or shared water bodies
- Sharing aquatic genetic material and related information
- Fishing rights, seasons and quotas as far as wild relatives of farmed aquatic species are concerned
- Conservation and sustainable use of shared water bodies and watercourses as far as wild relatives of farmed aquatic species are concerned
- Quarantine procedures for aquatic organisms and for control and notification of aquatic diseases

Add Row

International, Regional, bilateral or Sub-Regional agreement	Year your country ratified or subscribed to the agreement	Impact on aquatic genetic resources	Impact on stakeholders	Comments	

International, Regional, bilateral or Sub-Regional agreement	Year your country ratified or subscribed to the agreement	Impact on aquatic genetic resources	Impact on stakeholders	Comments	
Regulatory Cooperation Council	2011	○ Strongly positive ○ Positive ○ Negative ○ Strongly negative ◉ No effect	○ Strongly positive ○ Positive ○ Negative ○ Strongly negative ◉ No effect	Canada-US regulatory cooperation bilateral. Status: active but too early to evaluate. Cooperation on marine aquaculture led by DFO Canada and NOAA. Focused on environmental management of the marine net pen aquaculture sector, including comparison of regulatory environmental management objectives and outcomes for net-pen aquaculture; cooperation on farmed and wild fish interactions (incl. genetic impacts); cooperation on regulatory development initiatives for offshore aquaculture; and, evaluation of the feasibility, as well as costs and benefits, of a joint-statement on the equivalence of Canada and US regulatory programs.	X
Galway Statement on Atlantic Ocean Cooperation	2013	○ Strongly positive ○ Positive ○ Negative ○ Strongly negative ◉ No effect	○ Strongly positive ○ Positive ○ Negative ○ Strongly negative ◉ No effect	European Union-Canada-US trilateral research alliance. Status: active but too early to evaluate. Cooperation on the aquaculture research priority (incl. genetic impact modeling theme) led by DFO Canada, NOAA, and the European Commission.	X
United States/ Japan Cooperative Program in Natural Resources	1964	○ Strongly positive ◉ Positive ○ Negative ○ Strongly negative ○ No effect	○ Strongly positive ◉ Positive ○ Negative ○ Strongly negative ○ No effect	Japan-US research bilateral. Status: active and well-established. Panel on Aquaculture was formed in 1969, with annual meetings and symposia alternating between the two countries since 1971, during which scientists identify topics of mutual interest and joint	X

International, Regional, bilateral or Sub-Regional agreement	Year your country ratified or subscribed to the agreement	Impact on aquatic genetic resources	Impact on stakeholders	Comments	
				research projects. The theme for the 42nd-44th UJNR Aquaculture Symposia was "Genetics and breeding studies in the aquaculture industry."	
United States-Chile Fisheries Cooperation Program	1995	◯ Strongly positive ◉ Positive ◯ Negative ◯ Strongly negative ◯ No effect	◯ Strongly positive ◉ Positive ◯ Negative ◯ Strongly negative ◯ No effect	Chile-US fisheries bilateral. The basic instrument establishing the program is a memorandum of understanding (MOU) between NOAA Fisheries and the Chilean Servicio Nacional de Pesca (SERNAPESCA) signed in 1995 and extended in 2004. Meetings have included discussions on management, enforcement, recreational fisheries, marine mammals and endangered species, research, environment, aquaculture, and information exchange.	X
United States-China Science and Technology Agreement and Protocol	1979 (resurrected 2011)	◯ Strongly positive ◯ Positive ◯ Negative ◯ Strongly negative ◉ No effect	◯ Strongly positive ◯ Positive ◯ Negative ◯ Strongly negative ◉ No effect	China-US research bilateral. Status: active but too early to evaluate. NOAA is the lead US agency and the State Oceanic Administration is lead for China. The Protocol contains five major areas of cooperation where bilateral panels have been set up to meet periodically, where the Living Marine Resources Panel is the formal body that implements collaborative science activities on fisheries and related issues. In 2011, the two countries committed to reinvigorate the LMR Panel in order to advance science collaboration in the area of fisheries. Meetings are generally held biennially.	X

International, Regional, bilateral or Sub-Regional agreement	Year your country ratified or subscribed to the agreement	Impact on aquatic genetic resources	Impact on stakeholders	Comments	
United States-France Cooperative Program	2008	○ Strongly positive ○ Positive ○ Negative ○ Strongly negative ◉ No effect	○ Strongly positive ○ Positive ○ Negative ○ Strongly negative ◉ No effect	France-US fishery science bilateral. Modest marine fisheries research involvement under the umbrella of the US-France Science and Technology Agreement for general S&T cooperation.	X
Arrangement for Scientific and Technical Cooperation in Integrated Coastal and Ocean Resources Management	2000	○ Strongly positive ◉ Positive ○ Negative ○ Strongly negative ○ No effect	○ Strongly positive ◉ Positive ○ Negative ○ Strongly negative ○ No effect	Korea-US research bilateral. Status: active and well-established. Agreement signed by NOAA and the Korean Ministry of Maritime Affairs and Fisheries. Joint Coordination Meetings for Aquaculture Cooperation are similar to the UJNR bilateral. Topics under genetics include species identification, population genetics, and genetic improvement.	X
United States-Mexico Fisheries Cooperation Program	1983	○ Strongly positive ◉ Positive ○ Negative ○ Strongly negative ○ No effect	○ Strongly positive ◉ Positive ○ Negative ○ Strongly negative ○ No effect	Mexico-US fisheries bilateral. There is no formal instrument establishing the program. NOAA Fisheries and the predecessor agency to the Mexican Secretaría de Mexico Ambiente, Recursos Naturales, y Pesca (SEMARNAP) informally agreed to meet annually to review the broad range of fisheries issues. There are three MOU that formalize different aspects of the fisheries relationship: MEXUS-Gulf research program, MEXUS-Pacífico research program, and information exchange.	X

International, Regional, bilateral or Sub-Regional agreement	Year your country ratified or subscribed to the agreement	Impact on aquatic genetic resources	Impact on stakeholders	Comments	
US-Morocco Joint Statement on Environmental Cooperation	2004 (MOU in 2012)	◯ Strongly positive ◉ Positive ◯ Negative ◯ Strongly negative ◯ No effect	◯ Strongly positive ◉ Positive ◯ Negative ◯ Strongly negative ◯ No effect	Morocco-US bilateral. Status: active but finishing in 2017. Involves an Inter-Agency Agreement between the US Dept of State and NOAA that is supported by State Dept funds. Related to the Joint Statement, an MOU was signed in 2012 to support modern principles of sustainable fisheries management, including exchange of best management practices in marine aquaculture.	X
United States-Chile Environmental Cooperation Agreement	2003	◯ Strongly positive ◉ Positive ◯ Negative ◯ Strongly negative ◯ No effect	◯ Strongly positive ◉ Positive ◯ Negative ◯ Strongly negative ◯ No effect	Chile-US environmental bilateral. Under the Agreement, the US and Chile are working to improve long-term health of aquatic animal populations. The USDA APHIS is cooperating with SERNAPESCA on salmon aquaculture to strengthen disease detection and response in farmed salmon populations	X
Miscellaneous organizational collaborations	Various	◯ Strongly positive ◉ Positive ◯ Negative ◯ Strongly negative ◯ No effect	◯ Strongly positive ◉ Positive ◯ Negative ◯ Strongly negative ◯ No effect	Organizations that have aquaculture programs with whom NOAA Fisheries has collaborated: · The United Nations Food and Agriculture Organization · Asia Pacific Economic Cooperation Forum · International Council for Exploration of the Seas · North Atlantic Salmon Conservation Organization · World Organization for Animal Health · North Pacific Marine Science Organization · World Bank	X

47. Please list the priority needs regarding collaboration on conservation and sustainable use of aquatic genetic resources of farmed aquatic species and their wild relatives. Are they being addressed, i.e. are there any critical gaps?

Collaboration is needed in order to ...	Rank 1=Very Important 10=No importance	To what extent are the needs being met	Comments ***For example any critical gaps***
Improve information technology and database management	1	(•) To a great extent ( ) To some extent ( ) None ( ) Unknown	
Improve basic knowledge on aquatic genetic resources	3	( ) To a great extent (•) To some extent ( ) None ( ) Unknown	
Improve capacities for characterization and monitoring of aquatic genetic resources	1	( ) To a great extent (•) To some extent ( ) None ( ) Unknown	
Improve capacities for genetic improvement	1	( ) To a great extent (•) To some extent ( ) None ( ) Unknown	
Improve capacities for economic valuation of aquatic genetic resources	5	( ) To a great extent (•) To some extent ( ) None ( ) Unknown	
Improve capacities for conservation of aquatic genetic resources	2	( ) To a great extent (•) To some extent ( ) None ( ) Unknown	
Improve communication on aquatic genetic resources	5	( ) To a great extent (•) To some extent ( ) None ( ) Unknown	

Collaboration is needed in order to ...	Rank 1=Very Important 10=No importance	To what extent are the needs being met	Comments ***For example any critical gaps***
To improve access to and distribution of aquatic genetic resources	5	◯ To a great extent ◯ To some extent ◯ None ◉ Unknown	
Other **Continue adding row as necessary** Add Row Remove Row		◯ To a great extent ◯ To some extent ◯ None ◯ Unknown	

48. Please describe the types of collaboration that have been most beneficial for your country, and why?

The most beneficial collaboratives are research-based with countries having the same or congeneric species of interest, with which a common problem is addressed (e.g. genome sequencing and assembly) or a researcher/student exchange takes place.

49. Is there a need for your country to expand its collaboration concerning the conservation, sustainable use and development of aquatic genetic resources? If yes, give details, including any requirements for capacity strengthening in box below

(•) Yes

( ) No

If yes, please give details

Needs for capacity strengthening include developing genotype-to-phenotype solutions for aquaculture, creating shared knowledge bases (data repositories), developing big data mining tools.

50. Describe important roles that your country performs within its region (and/or sub-region) and globally in terms of being a keeper, user and sharer of aquatic genetic resources.

The United States is a leader in genetic and genomic data generation and manipulation, development of next-generation DNA sequencing technologies, and publication of peer reviewed scientific research.

The US Educational system provides opportunities for visiting students and scientists.

The US is a world leader in responsible science based fisheries management, conservation and aquaculture production.

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