

DNA-Based Identifications of Tilapia in Hawaii

Jinzeng Yang, Liang Wu, Wayne Okamura, Annette Tanagawa, Cheng-Sheng Lee, Harry Ako, Mike DuPonte

College of Tropical Agriculture and Human Resources,
University of Hawaii, Honolulu, HI, USA 96822

Dept of Land and Natural Resources, State of Hawaii,
Honolulu, HI 96819

The Oceanic Institute, Waimanalo, HI 96795



A local Tilapia



Tilapia Aquaculture

- High-quality food fish;
- Easy to reproduce, breed and farm;
- Farming for freshwater and brackish water;
- Excellent species for aquaponics;
- A potential growth area for Hawaii with groundwork having been laid in the marketing area.

Challenges of Tilapia Farming in Hawaii



Slow growth performance

Impossibility of importing and using known fast growing strains and species.

Questions about the potential of local genetic resources. Are there good genetic resources here?

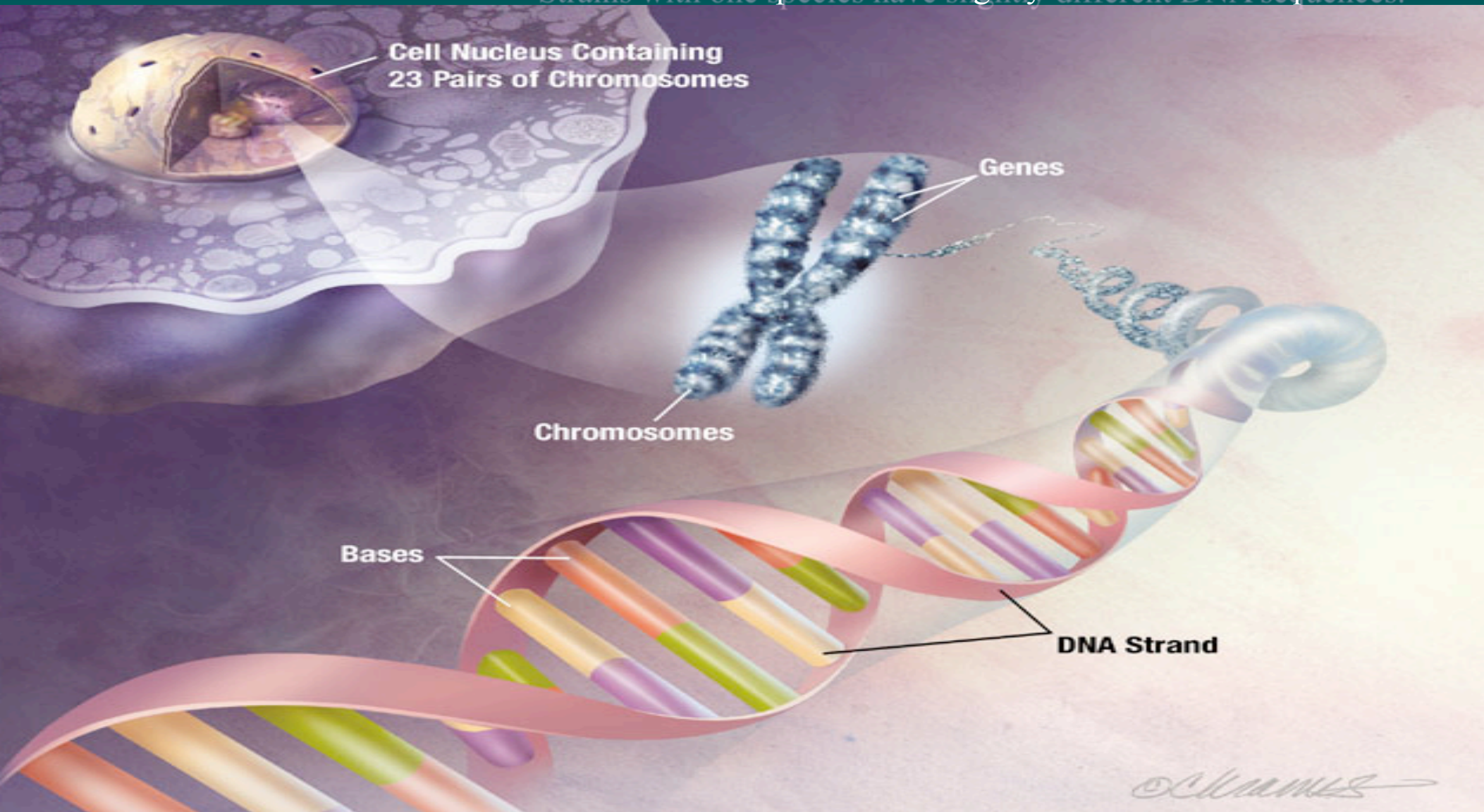
Disease including PRLO.

The Goal and Objectives

- * The long-term goal of the project is to have fast-growing tilapia for farmers in Hawaii.
- * Main Objectives
 1. Identification of the tilapia strains and hybrids existing in the wild and captive populations by DNA barcoding method
 2. Successfully allow importation of fast growing strains or develop DNA-based testing tools for selection of high-growth tilapia by selectively breeding local tilapia resources.

What is DNA and genome?

- Permanent part of the body cells, inheritable;
- Genome: a whole collection of the DNA of a species;
- Different species are made of different genomes;
- Strains within one species have slightly different DNA sequences.



How Can DNA-based Technology be Helpful for Tilapia Farming?

Accurate technologies are available in amplification of DNA and obtaining sequence information.



Variations in DNA sequence are present in individuals, strains, hybrids in all tilapia species.



Quality and inexpensive technology by DNA barcoding and microsatellite DNA markers can be used for tilapia strain/species identifications and growth trait selection.

DNA Barcoding

- It is DNA sequence-based taxonomic method of species identification.
- A 648 base-pair region in the mitochondrial (maternal) cytochrome c oxidase 1 gene (COI) has been extensively studied. FISH-BOL database. Obtain sequences of known species as niloticus, mossambicus, aureus and so on.
- The DNA sequence COI can identify parents (mothers) of existing species in Hawaii, including niloticus.

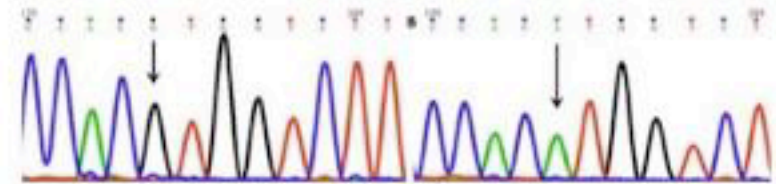
- Amplify and sequence DNA of available tilapia in Hawaii.
- If we have niloticus here already, DOA may let us import.
- If we have niloticus here already, we can reverse breed to get back a fast growing strain.
- (These methods have been used to identify mislabeled fillets.)



PCR



DNA Extraction



DNA Sequencing



Fish Samples



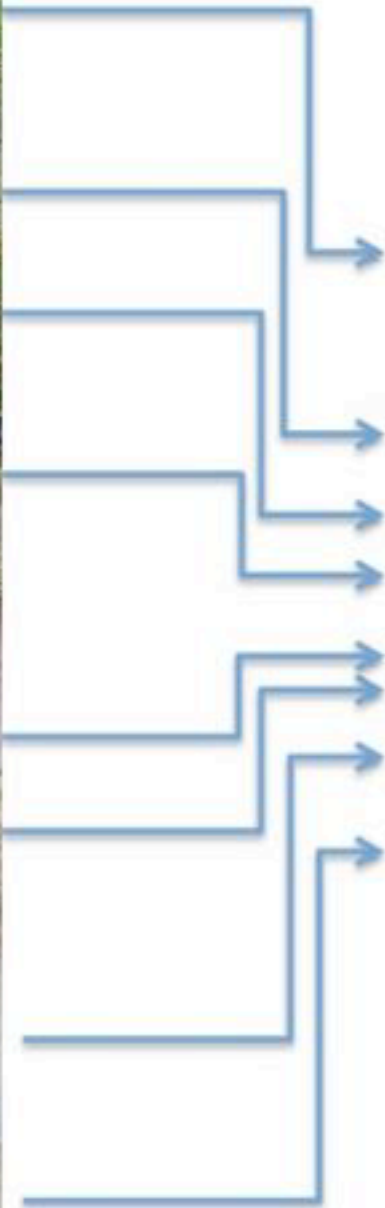
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C2
O. niloticus AF233481
S
O. niloticus AF233489
G
O
F
O. niloticus AF236467
A
O. niloticus AF236467
E
M
O. niloticus AF236467
I
S. niloticus AF236467
T. niloticus AF236467
S
A-TAACGATTAAATACCACTGAAAGATAGTTTAAACCGAAACACAACT-C 194
A-TAACGATTAAATACCACTGAAAGATAGTTTAAACCGAAACACAACT-C 194
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G-AAACATTTGAAAAACCACTGAAAGATAGTTTAAACCGAAACACAACT-C 195
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A-CATAATTTGAAAAACCACTGAAAGATAGTTTAAACCGAAACACAACT-C 195

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DNA Sequence Alignment and Recognize





C2
*O. niloX0.mossa*AY833481
 D
*O. mossambic*AY833459
 G
 F
*O. urolepis*AF296467
 A
*O. aureus*AF328851
 B
 C1
 E
 H
*O. niloticus*AF485083
 I
*S. melanotheron*AF484717
*T. rendalli*AF328854
 J

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A-TAACGATTAAATACCACTGAAAGATAGTTTAAGACCGAACACAACCT-C 196
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A-CATATTTTATAAAGTACTAAAAGATAGTTTAAGACCGAGCACAGATAAC 195
A-CATACCTTATAAAGTACTAAAAGATAGTTTAAGACCGAGCACAGATAAC 195
  
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Table 1. Identifications of the tilapia samples by DNA sequence.

Population (Site)	Number of fish	Claimed species	Genetic composition
Aquaculture Sites			
A	51	Unknown	<i>O. aureus</i>
B	34	<i>O. Aureus</i>	<i>O. aureus</i>
C	30	Unknown	<i>O. niloticus</i> × <i>O. mossambicus</i> and <i>O.aureus</i>
D	102	Unknown	<i>O. mossambicus</i>
E	50	Unknown	<i>O. aureus</i>
F	50	Unknown	<i>O.urolepis</i>
G	50	Unknown	<i>O.mossambicus</i>
H	29	Unknown	<i>O. niloticus</i>
Wild/Feral Sites			
	44	Unknown	<i>S. melanotheron</i>
J	44	Unknown	<i>T.rendali</i>
K	22	unknown	<i>O. niloticus</i> x <i>O. mossambicus</i>

Summary

- Based on 382 samples collected from 14 farm (captive) and wild tilapia populations in Oahu and the Hawaii Islands, mtDNA CR had higher nucleotide diversity than COI.
- The neighbor-joining tree analysis identified seven distinctive tilapia species: *O. aureus*, *O. mossambicus*, *O. niloticus*, *S. melanotheron*, *O. urolepies*, *T. redalli*, and a hybrid of *O. massambicus* and *O. niloticus*.

Significances

- Determination of genetic resources in Hawaii
 - To allow importation of fast growing species since they may already be here or
 - To develop genetic selection programs to fast growing strains that originally got in
- To use microsatellite markers if there is a selected breeding program.
- Sponsored by CTSA.