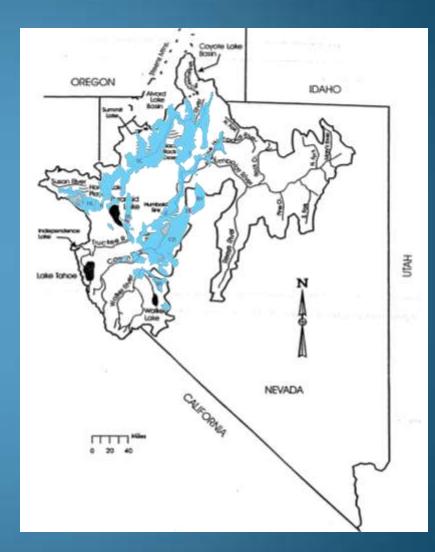
# Applied Conservation Genetics At The Lahontan National Fish Hatchery Complex



Corene Jones Fish Biologist/Broodstock Coordinator, Lahontan National Fish Hatchery Complex

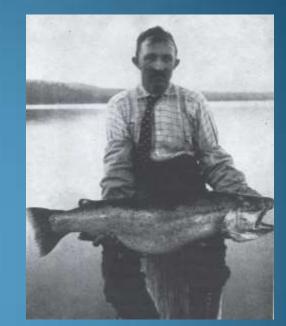
## Lahontan Cutthroat Trout

- Evolved in Pleistocene Lake Lahontan
- Northwest, Humbolt and Western GMUs
- Pilot Peak strain = Lake Tahoe/Truckee River/ Pyramid Lake Basin



# Tahoe/Truckee/Pyramid LCT

- Large, highly piscivorous
- Extirpated from native range by 1940's
- Rediscovered at Pilot Peak, NV in late 1970's
- Confirmed through genetic testing to be direct descendants

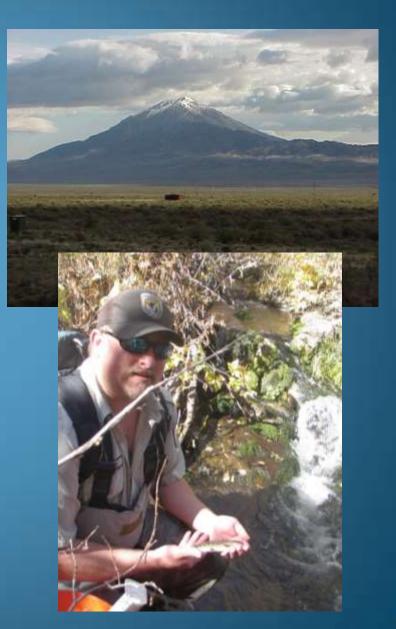




Property of Special Collections Dept., University of Nevada, Reno

#### Pilot Peak Lahontan Cutthroat Trout

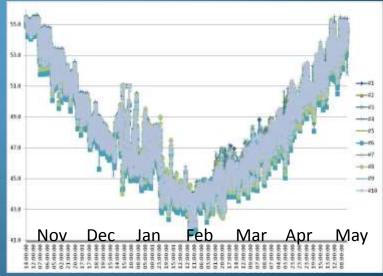
- Complex began propagating Pilot Peak strain in 1996
- Purpose: use native strain for recovery activities in high priority waters
- AND: provide native fish for recreational opportunities



#### **Genetic Management**

- Developed captive broodstock and genetic management techniques over 15 year period
- 2010 restructuring
- In partnership with UNR, developed intensive genetic management protocol





#### **Broodstock Tracking with PIT Tags**

- All broodstock on station at LNFH are PIT tagged
- Individual genetic profiles generated by UNR
- 14 nuclear microsatellite loci, 8-30 alleles





#### **Optimizing Genetics During Spawning**

- Genetic profiles used to pair individuals
- Pairwise mating matrix

Goal: maintain high levels of genetic variation in production fish as well as future broodstock



	* (× *   <del>*</del>				Table	e Tools	2017Ma	trix : Da	tabase (Ac	cess 2	007 - 2010) -	Micros	oft Acc	ess										×
File	Home Create	Extern	nal Data Database	Tools	Fields	Table																	G	0
	🗎 🔏 Cut	2		V Sel	ection *		📄 New	Σ Το	tals 👔	<u>م</u>	ah Cac Replace	C. III.			a laa				z= 1					
	Copy		T Z Descending	Ad	vanced *	R	Bave	Sp Sp	elling		🔿 Go To 🔻	Calibri			* 11			1	100	211				
View P	Paste J Format Painter	Fi	ilter A Remove Sort			Refresh All 🔻	X Delete -	1.20		ind	Select -	B	<u>u</u>	<u>A</u> -	aby - 2	> -	₣₹	=	<b>H</b> *	- 11				
Views	Clipboard		Sort & Filt		2 21 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	All .	Records			1	Find				Text Fo	rmattin	q			15g				
All Tables		TR	tblSimilarity_Matri	~				-																×
		*	fePIT			maPIT	-	• SI	imValue	*		-		-			-		-			_	_	
Party of the local data of the	milarity_Matrix : Table	~	3D6.00156F4CE0		384.1B79				0.4615384	-														4
	AmeetingCriteriaPerFE		3D6.00156F4CE0		384.1B79			_	0.538461															-
gry1FindMatches2016		3D6.00156F4CE0		384.1B79				0.4615384	462															
		3D6.00156F4CE0		384.1879	6C56F0			0.4583333	333														=	
gry4E	DefineGroups2016		3D6.00156F4CE0		384.1B79	6D71E0			0.5769230	077														
gryFi	indSimValue		3D6.00156F4CE0		384.1B79	6D725E			0.5769230	077														
gryNu	umberMAperFE		3D6.00156F4CE0		384.1B79	6D73B5				0.5														
tblHetero	zygosity	*	3D6.00156F4CE0		384.1B79	6D742B			0.4230769	923														
and the second se	eterozygosity : Table		3D6.00156F4CE0		384.1B79	6D74C2			0.5769230	077														
Section 100	FindMatches2016		3D6.00156F4CE0		384.1B79	6D74EC			0.5769230	077														
10.778 - 3299 and	DefineGroups2016		3D6.00156F4CE0		384.1B79	6D75AC			0.3846153	385														
	911		3D6.00156F4CE0		384.1879	6D75C4			0.5769230	077														
Female So		*	3D6.00156F4CE0		384.1B79	6D7640			0.538461	538														
Contraction Contractions	ale Sorting : Table		3D6.00156F4CE0		384.1B79	6D765D			0.5769230	077														
qry1F	FindMatches2016		3D6.00156F4CE0		384.1B79	6D76B8			0.6538463	154														_
qry2M	MatchCount2016		3D6.00156F4CE0		384.1B79	6D76F3			0.3846153	385														
gry4E	DefineGroups2016		3D6.00156F4CE0		384.1B79	6D76F6			0.6153846	515														
Male Sorti	ing	*	3D6.00156F4CE0		384.1879	6D7763			0.6153840	515														
	Sorting : Table		3D6.00156F4CE0		384.1B79				0.4615384															
	FindMatches2016		3D6.00156F4CE0		384.1B79				0.5769230															
			3D6.00156F4CE0		384.1B79				0.6153846															
tbl3match		*	3D6.00156F4CE0		384.1B79				0.6153840															
	natchcount : Table		3D6.00156F4CE0		384.1B79					0.5														-
qry4E	DefineGroups2016		3D6.00156F4CE0		384.1B79				0.5769230															
CrossesTa		*	3D6.00156F4CE0		384.1B79				0.6153840															
Cross	sesTake4and5 : Table		3D6.00156F4CE0		384.1B79				0.4230769															-
gryFin	indSimValue		3D6.00156F4CE0		384.1B79				0.5769230															_
Table1	1	*	3D6.00156F4CE0		384.1B79				0.5384613															
Table	e1 : Table		3D6.00156F4CE0		384.1879					0.5														-
tbl_PIT_ta	g_broodstock_all	*	3D6.00156F4CE0		384.1879					0.5														
-	T_tag_broodstock_all : T.		3D6.00156F4CE0 3D6.00156F4CE0		384.1B79				0.6923070															-
17-00 2017.0					384.1879					0.5														
			3D6.00156F4CE0 3D6.00156F4CE0		384.1B79				0.5769230															=
			CONTRACTOR AND A MARK IN CONTRACTOR IN						0.538461															
			3D6.00156F4CE0 3D6.00156F4CE0		384.1B79				0.538461															=
			3D6.00156F4CE0		384.1B79				0.4615384															
			3D6.00156F4CE0		384.1B79				0.538461															¥
			Record: M 4 1 of 1111	698		K No Fi	lter Search		1000-010										_				_	
Datasheet V	/iew					11.1011	Jocarch															Num Lock	E A	
		1		1	A	General	100	-		6		-							-		-	19251 MI	3:43 PM	
	C mary peacock I		2017		9 Inbox	(1,126) -	🎦	C Jone	es Brood		LNFH Pr	esent B		🍠 C	ulture M	eetin	A	Micr	osoft A	icce	· •	口 🖤	5:43 PN 6/16/201	
			Masses				ale																	

# **Spawning Protocol**

- P4 tag entry/tracking software
- Sort, scan and record spawning condition
- Pair ripe individuals according to genetic criteria



A				2017Matrix : Database (Acc	ess 2007 - 2010) - Mi	crosoft Access				×
File Home Create	Externa	al Data Database	e Tools							۵ (?)
Cut	7	Z↓ Ascending	Selection *	₩ New Σ Totals	ab Replace	Calibri	<ul> <li>▼ 11</li> <li>▼ 1Ξ 1Ξ 1Ξ 1Ξ 1Ξ</li> </ul>	E M -		
View Paste Format Painter	Fil	ter	t 🍸 Toggle Filter	Refresh X Delete - More -	Find Select		• 🤍 - 💁 - 📄 🚍 🔠	• 🖽 •		
Views Clipboard		Sort & Fi		Records	Find		Text Formatting	15		
	14	gry4DefineGroup	And and a second se							×
	NO.M.		NAME OF COMPANY OF COMPANY	thill the second state of		maPIT +	and the details a 2010 1	d Timelt And	aten Value	
7-	*	1		<ul> <li>tblHeterozygosity.Hete -</li> </ul>			qry1FindMatches2016.F + qr	yirindivia +		<b>^</b>
tblSimilarity_Matrix : Table			3D6.00156F6935 3D9.239F892609	0.923076923076923		384.1B796D8496 3D6.000B96F5EE	0.384615384615385		0.384615385	=
NoMAmeetingCriteriaPerFE	_			0.615384615384615			0.615384615384615			
gry1FindMatches2016			3D9.239F88A986	0.666666666666666		3D9.239F888D02 3D9.239F8924C8	0.769230769230769 0.923076923076923		0.375	
qry4DefineGroups2016			3D9.1C2DB94FCB 3D6.000B96F500	0.538461538461538 0.538461538461538	<b>V</b>	3D9.239F8924C8	0.846153846153846		0.384615385	
gryFindSimValue			3D6.000B96F0AC	0.769230769230769		3D6.000B96F41B	0.538461538461538		0.384615385	
						3D6.000B96F3DE	0.769230769230769	V		
gryNumberMAperFE		-	3D6.000B96F0AC 3D9.239F88AE59	0.769230769230769 0.846153846153846		3D9.239F88A6C7	0.461538461538462		0.384615385	
Contraction of the second s	*  -		3D9.239F88AE59	0.846153846153846		384.1B796D7B76	0.615384615384615		0.384615385	
tblHeterozygosity : Table		-	3D6.000B969B04	0.769230769230769		384.18796D7876	0.615384615384615		0.346153846	
qry1FindMatches2016			3D6.000B969B04	0.769230769230769		3D9.239F88A6C7	0.461538461538462		0.384615385	
gry4DefineGroups2016			3D6.000B969CFC	0.769230769230769		3D9.239F8919C4	0.5833333333333333333	E	0.375	
Female Sorting 3	*		3D6.000B969CFC	0.769230769230769		3D9.239F88A6C7	0.461538461538462		0.384615385	
Female Sorting : Table			3D6.000B96F11B	0.846153846153846	7	384.1B796D8496	0.384615384615385	<b>E</b>	0.346153846	
gry1FindMatches2016			3D6.000B96F11B	0.846153846153846	V	3D9.1C2DB8D9C7	0.692307692307692		0.384615385	
gry2MatchCount2016			3D6.000B96F11B	0.846153846153846	2	3D6.000B96F5EE	0.615384615384615		0.384615385	
and the second se			3D6.000B96F11B	0.846153846153846	V	384.1B796D7EF9	0.384615384615385		0.384615385	
gry4DefineGroups2016			3D9.1C2DB8CA61			3D6.00156F4C93	0.923076923076923	V	0.384615385	
No service second state of the second state of	*		3D9.1C2DB8CA61			3D6.000B96F5EE	0.615384615384615		0.384615385	
Male Sorting : Table			3D9.1C2DB8CA61			3D9.239F88A6C7	0.461538461538462		0.384615385	
qry1FindMatches2016			3D9.1C2DB8CA61			3D9.239F88ACAC	0.8		0.4	
tbl3matchcount #	*		3D9.239F88ABCF	0.692307692307692	7	3D9.1C2DB8C572	0.769230769230769	1	0.384615385	
tbl3matchcount : Table		1.000	3D9.239F88ABCF	0.692307692307692	V	3D6.000B969C4B	0.615384615384615	V	0.384615385	
gry4DefineGroups2016			3D9.239F88ABCF	0.692307692307692	7	3D9.239F8920DA	0.846153846153846		0.384615385	
	*	71	3D9.239F88ABCF	0.692307692307692	V	3D9.239F892744	0.615384615384615		0.384615385	
CrossesTake4and5 : Table	~	72	3D6.000B96F6A1	0.615384615384615		384.1B796D7EF9	0.384615384615385		0.384615385	
		72	3D6.000B96F6A1	0.615384615384615	(1771)	384.1B796D742B	0.615384615384615	(m)	0.384615385	
qryFindSimValue	_		3D6.000B96F6A1	0.615384615384615		384.1B796D8496	0.384615384615385	Ē	0.384615385	
	*	72	3D6.000B96F6A1	0.615384615384615		3D9.239F892418	0.769230769230769		0.384615385	
Table1 : Table	_	72	3D6.000B96F6A1	0.615384615384615		3D9.239F88ACAC	0.8		0.4	
	*	73	3D6.000B96F68A	0.615384615384615		384.1B796D8496	0.384615384615385		0.346153846	
tbl_PIT_tag_broodstock_all : T		73	3D6.000B96F68A	0.615384615384615		3D6.000B96F3DE	0.769230769230769		0.384615385	
		73	3D6.000B96F68A	0.615384615384615		3D9.239F891566	0.538461538461538		0.384615385	
		73	3D6.000B96F68A	0.615384615384615		3D9.239F88A6C7	0.461538461538462		0.384615385	
		73	3D6.000B96F68A	0.615384615384615		3D6.000B969C0C	0.615384615384615	V	0.384615385	
		74	384.1B796D82AF	0.692307692307692		3D6.000B969948	0.615384615384615		0.346153846	
		74	384.1B796D82AF	0.692307692307692		3D9.239F88ACC3	0.538461538461538		0.384615385	
		74	384.1B796D82AF	0.692307692307692		3D9.239F88A6C7	0.461538461538462		0.384615385	-
	R	ecord: 14 4 1 of 533	3 🕨 M 🚈 🕵 M	lo Filter Search						
first clear contents then copy and pa	aste the	e results of qry2Matc	h count into this tat	ble					Num Lock 🔲 🏙 🕮	SQL 🖌
mary peacock I		2017	o Inbox	(1,126) 🏾 🍢 C Jones Broc	od 💽 LNFH	Present B	Culture Meetin Koros	oft Acce	▲ 📭 🛱 🌒 3:47 PI 6/16/20	367.
									0/10/20	

A				2017Matrix : [	)atabase (Acco	ess 2007 - 2010) -	Microsoft Access				X
File Home Create Ext	ternal Data	Database To	ols								چ ۵
K Cut	Z AL	Ascending 🏹	Selection *	New Server	Σ Totals	an en Rep	Calibri	* 11 * E E E	E CELLAR -		
Сору	I Z↓	Descending	Advanced *	Save	Spelling	Go 🖨 🖉	To *				
View Paste	Filter	Remove Sort 🚿		All - X Delete	More *	Find 🔓 Sel	t BIU	<u>A</u> • ♥ • <u>A</u> •   ≣ ≡ ≡	<b>Ⅲ</b> • <b>Ⅲ</b> •		
Views Clipboard		Sort & Filter		Records		Find		Text Formatting	15		
All Tables 🛞 «	arv4	DefineGroups20	116								×
tblSimilarity_Matrix	CONTRACTOR CONTRACTOR	D +		<ul> <li>tblHeterozygos</li> </ul>	ity Hoto - t	hlHeterozygos	- maPIT	• gry1FindMatches2016.F •	and FindMat	simValue -	
tblSimilarity_Matrix : Table		100	6.00156F6935	1.	923076923	EDITIELEI OZYGOS	384.1B796D8496	1.1.2.2		0.384615385	1
	18	and the second second	9.239F892609		615384615		3D6.000B96F5EE			0.384615385	=
NoMAmeetingCriteriaPerFE			9.239F88A986		6666666667		3D9.239F888D02			0.375	
gry1FindMatches2016			9.1C2DB94FCB		538461538		3D9.239F8924C8		1	0.384615385	
gry4DefineGroups2016			6.000B96F500		538461538		3D9.239F8920D/			0.384615385	
gryFindSimValue			6.000B96F0AC		769230769		3D6.000B96F41E			0.384615385	
gryNumberMAperFE			6.000B96F0AC		769230769		3D6.000B96F3D			0.384615385	
	-		9.239F88AE59		846153846		3D9.239F88A6C		and the second se	0.384615385	
tblHeterozygosity			9.239F88AE59		846153846		384.1B796D7B70			0.384615385	
tblHeterozygosity : Table			6.000B969B04		769230769		384.1B796D7B76			0.346153846	
qry1FindMatches2016			6.000B969B04		769230769		3D9.239F88A6C			0.384615385	
gry4DefineGroups2016			6.000B969CFC		769230769		3D9.239F8919C4			0.375	
Female Sorting			6.000B969CFC		769230769		3D9.239F88A6C			0.384615385	
Female Sorting : Table			6.000B96F11B		846153846	7	384.1B796D8496			0.346153846	
gry1FindMatches2016			6.000B96F11B		846153846	V	3D9.1C2DB8D90			0.384615385	
gry2MatchCount2016			6.000B96F11B		846153846	7	3D6.000B96F5EE			0.384615385	
The second se			6.000B96F11B		846153846		384.1B796D7EF9			0.384615385	
gry4DefineGroups2016		5.420 Mat 1973	9.1C2DB8CA61		461538462	1	3D6.00156F4C93			0.384615385	
Male Sorting			9.1C2DB8CA61		461538462		3D6.000B96F5EE			0.384615385	
Male Sorting : Table			9.1C2DB8CA61		461538462		3D9.239F88A6C			0.384615385	
gry1FindMatches2016			9.1C2DB8CA61		461538462	[E]	3D9.239F88ACA			0.4	
tbl3matchcount		161210340200000	9.239F88ABCF		692307692	7	3D9.1C2DB8C57	261 U		0.384615385	_
tbl3matchcount : Table			9.239F88ABCF		692307692		3D6.000B969C4		-	0.384615385	
gry4DefineGroups2016			9.239F88ABCF		692307692		3D9.239F8920D/		and the second se	0.384615385	
CrossesTake4and5			9.239F88ABCF		692307692	<b>V</b>	3D9.239F892744			0.384615385	
CrossesTake4and5 : Table			6.000B96F6A1		615384615		384.1B796D7EF9			0.384615385	
			6.000B96F6A1		615384615	[7]	384.1B796D742E			0.384615385	
gryFindSimValue			6.000B96F6A1		615384615		384.1B796D8496		and the second se	0.384615385	
Table1	-		6.000B96F6A1		615384615	(E)	3D9.239F892418			0.384615385	
Table1 : Table			6.000B96F6A1		615384615	<b></b>	3D9.239F88ACA			0.4	
tbl_PIT_tag_broodstock_all			6.000B96F68A		615384615	[7]	384.1B796D8496			0.346153846	
tbl_PIT_tag_broodstock_all : T			6.000B96F68A		615384615		3D6.000B96F3D			0.384615385	
			6.000B96F68A		615384615	(E)	3D9.239F891566			0.384615385	
			6.000B96F68A		615384615	<b></b>	3D9.239F88A6C			0.384615385	
			6.000B96F68A		615384615	[17]	3D6.000B969C00			0.384615385	
			4.1B796D82AF		692307692		3D6.000B969948			0.346153846	
			4.1B796D82AF		692307692	(FT)	3D9.239F88ACC			0.384615385	
			4.1B796D82AF		692307692		3D9.239F88A6C		10	0.384615385	
	Record: 14			lo Filter Search							
first clear contents then copy and past										Num Lock 📗 🖽	🕮 sol 🖌
mary peacock I		,	6	(1,126)	C1	D.	IFH Present B	Culture Meetin	icrosoft Acce	3:	47 PM
The mary peacock I	201	1	9 Inbox	(1,126)	C Jones Broo		rn Present B		croson Acce	▲ 🕨 🛱 🌒 5/1	6/2017

#### **Spawning Protocol**

- Upload tag lists
- Re-sort males, collect milt into vials
- Spawn females, add milt from matching male
- 700-1000 crosses per year





### **Tracking Crosses**

Data on individual crosses:

- egg and milt condition
- # of eggs
- percent eye-up
- survival to swim-up
- parentage



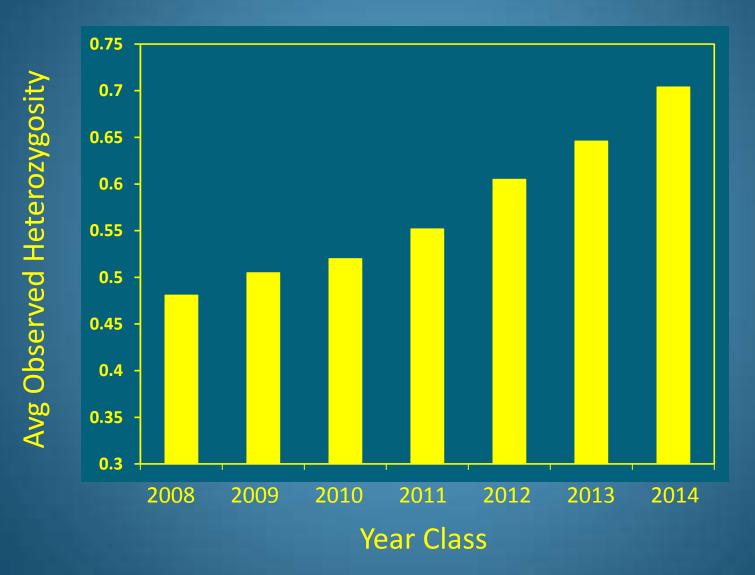


## **Future Broodstock**

- all crosses genetically analyzed
- rare alleles, high heterozygosity
- individuals from 150 crosses
- housed separately until taggable size (60-100mm)



#### Average heterozygosity of Broodstock



### Marlette Lake Offsite Broodstock

- offsite replicate broodstock
- In partnership with NDOW
- Returning fish PIT tagged and genetic clipped





## **Pyramid Lake Potential Broodstock**

- Possible egg/milt source
- 6,000+ eggs per female





















# **Questions?**

