Genetic variability assessed by microsatellites in wild and cultivated populations of olive flounder (*Paralichthys olivaceus*) in Korea

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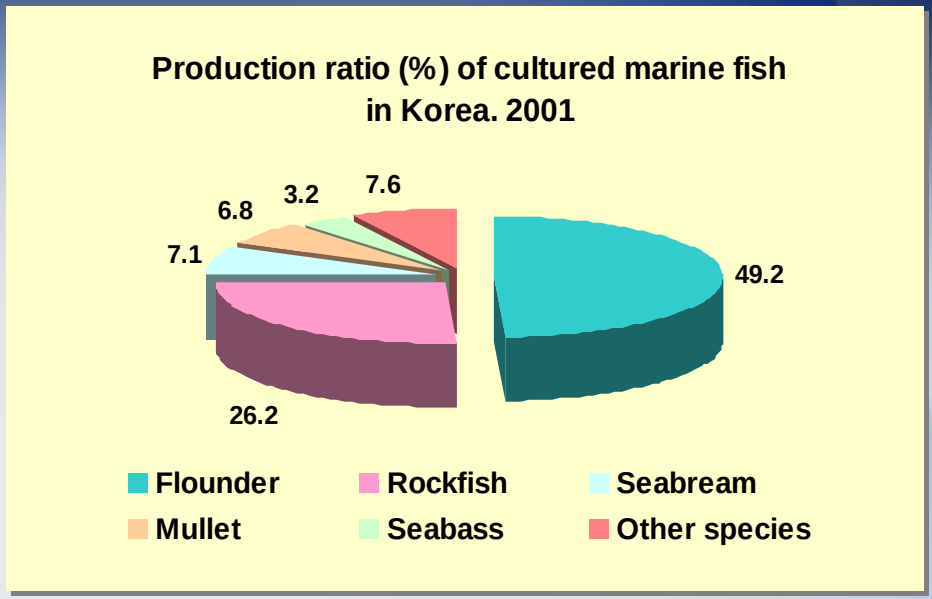
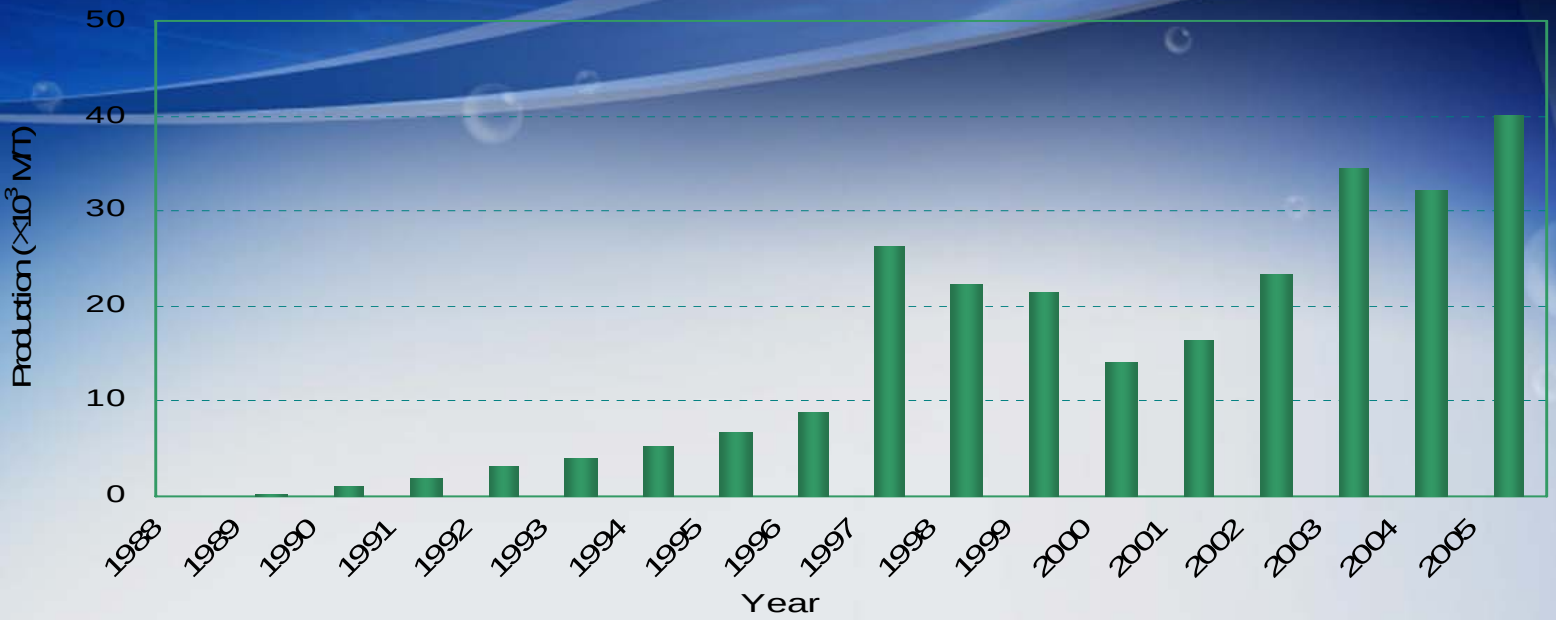


- Olive flounder (*Paralichthys olivaceus*) is distributed along the coast of Korea where it is a commercially important aquacuture fish species that have been cultured for the past 20 years in Korea.

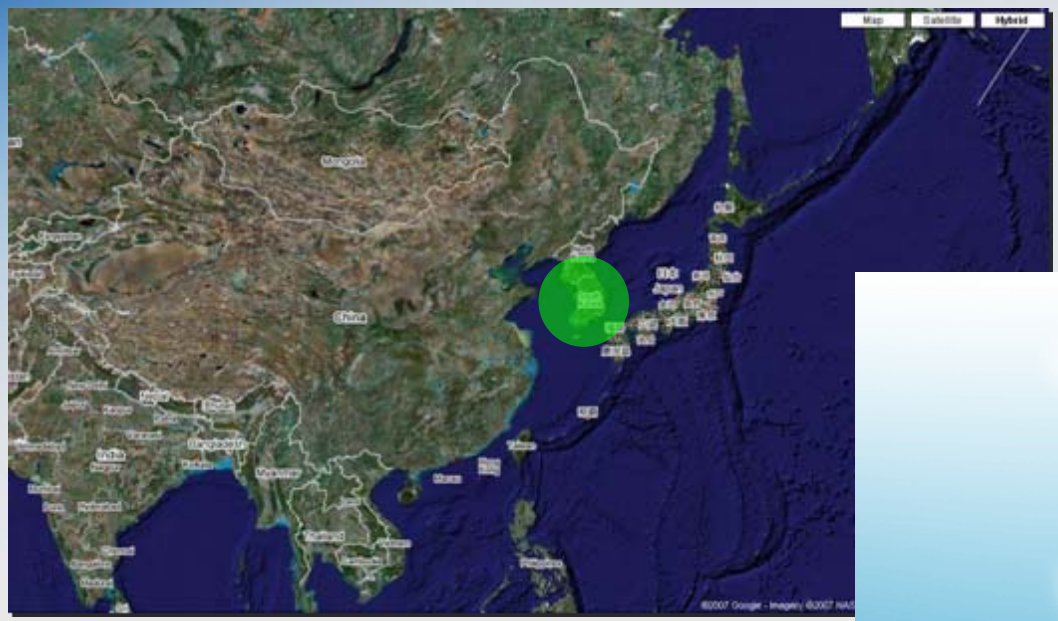
- Production ratio of olive flounder is about half of total cultured marine fish production in Korea.



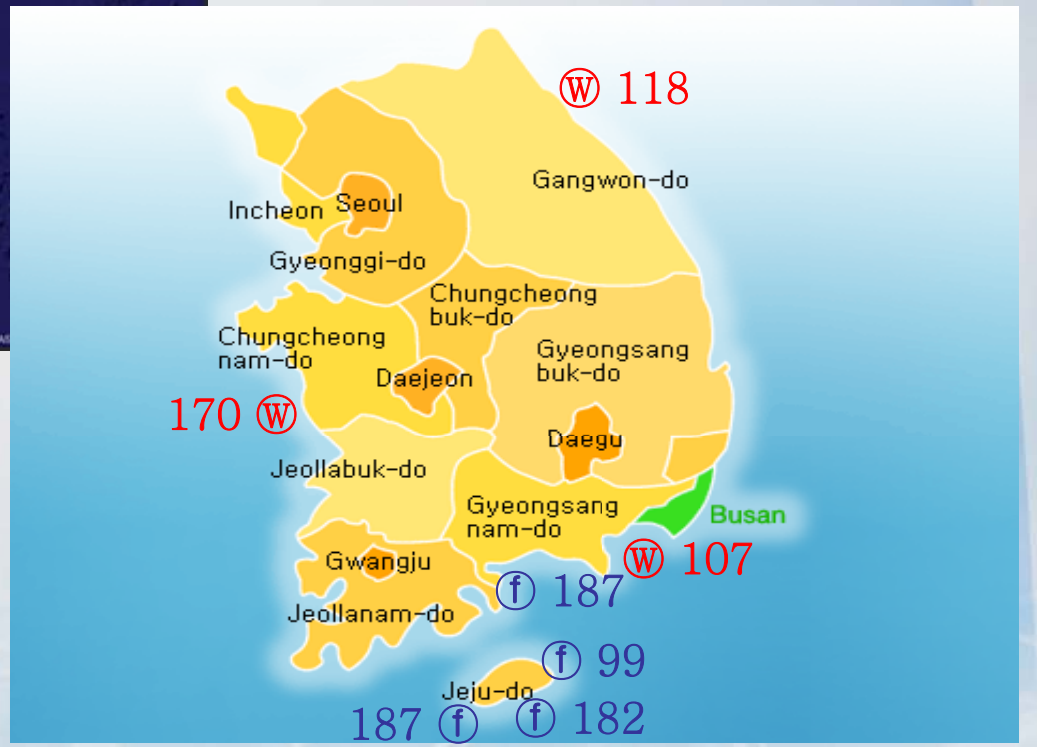
- Recently, the hatchery reared fish showed a loss of disease resistance or a reduction of capacity to adapt to new environments. These may appear to be caused by a reduction of genetic diversity because of the small effective number of parents involving in reproduction. This reduction seems to be due to the growth retardation caused by inbreeding or genetic drift of the limited base population.

- Millions of *P. olivaceus* juveniles have been released into Korean coastal waters every year for resource enhancement.

Geographic locations and size of farmed and wild populations



- 3 populations from wild
- 4 populations from hatcheries



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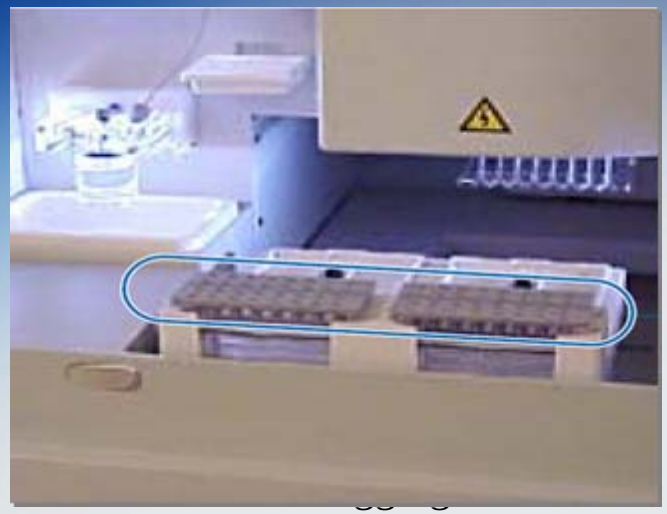
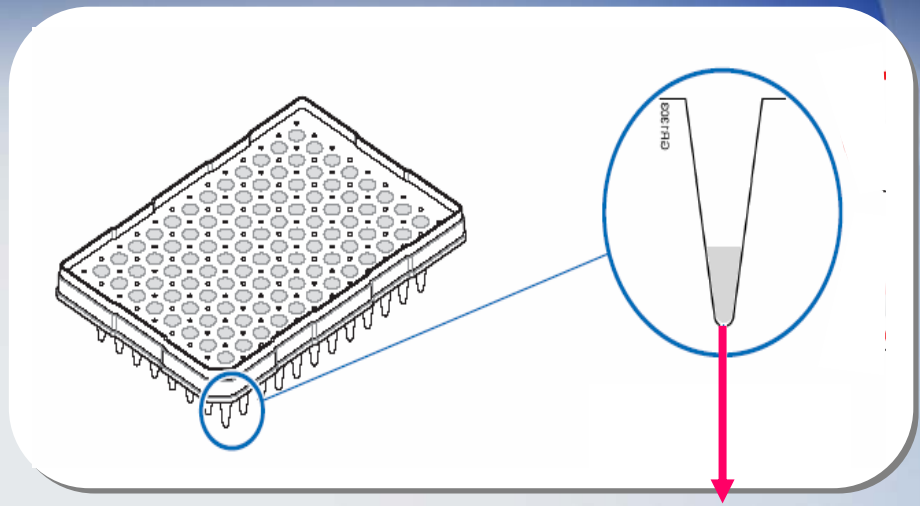
The locations where samples were collected, number of individuals, and phenotypes of *P. olivaceus*

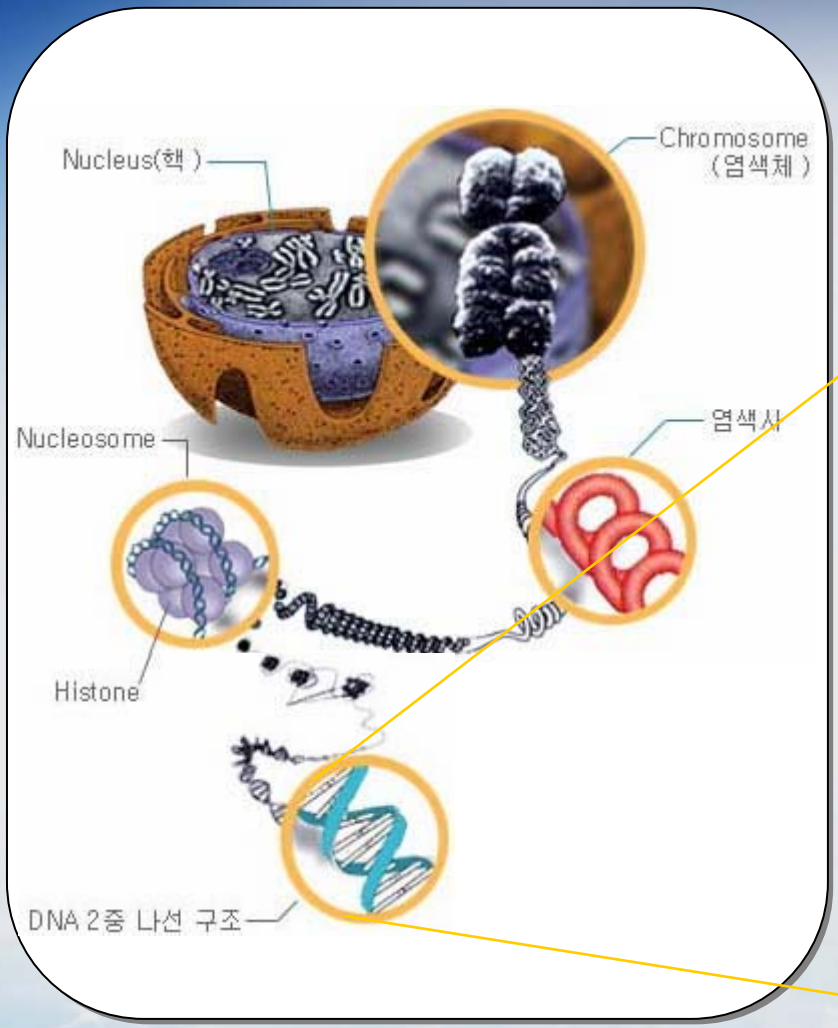
Population	# of individuals	phenotypes (Means±SD)			
		TL(㎝)	BL (㎝)	BD (㎝)	BW (g)
Wild					
WW	170	42.1±4.0	35.8±3.5	13.9±1.5	745±295
WS	107	58.1±7.9	50.3±7.1	20.1±2.9	2,217±920
WD	118	46.3±5.3	39.3±4.7	15.6±1.8	1,019±379
subtotal	(395)	47.9±8.7	41.0±7.9	16.2±3.3	1,249±835
Farmed					
FA Hatchery	188	51.6±5.7	44.2±4.8	19.5±2.6	1,845±770
FB Hatchery	99	52.4±6.2	44.7±5.6	18.8±2.7	1,897±751
FC Hatchery	182	44.1±5.8	37.5±5.0	16.1±2.8	1,121±526
FD Hatchery	187	38.1±1.3	32.8±1.5	13.3±0.6	631± 70
subtotal	(656)	45.9±7.8	39.1±6.6	16.7±3.4	1,306±780
Total	(1,051)	46.7±8.2	39.8±7.1	16.5±3.3	1,284±801

Management of fish and microsatellite analysis

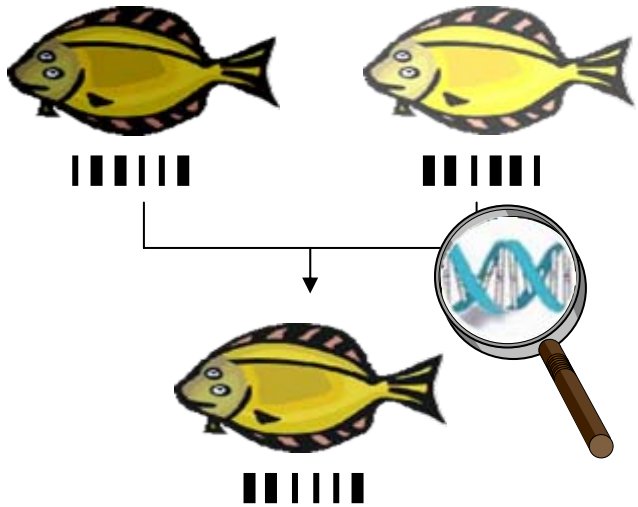




What is DNA marker?



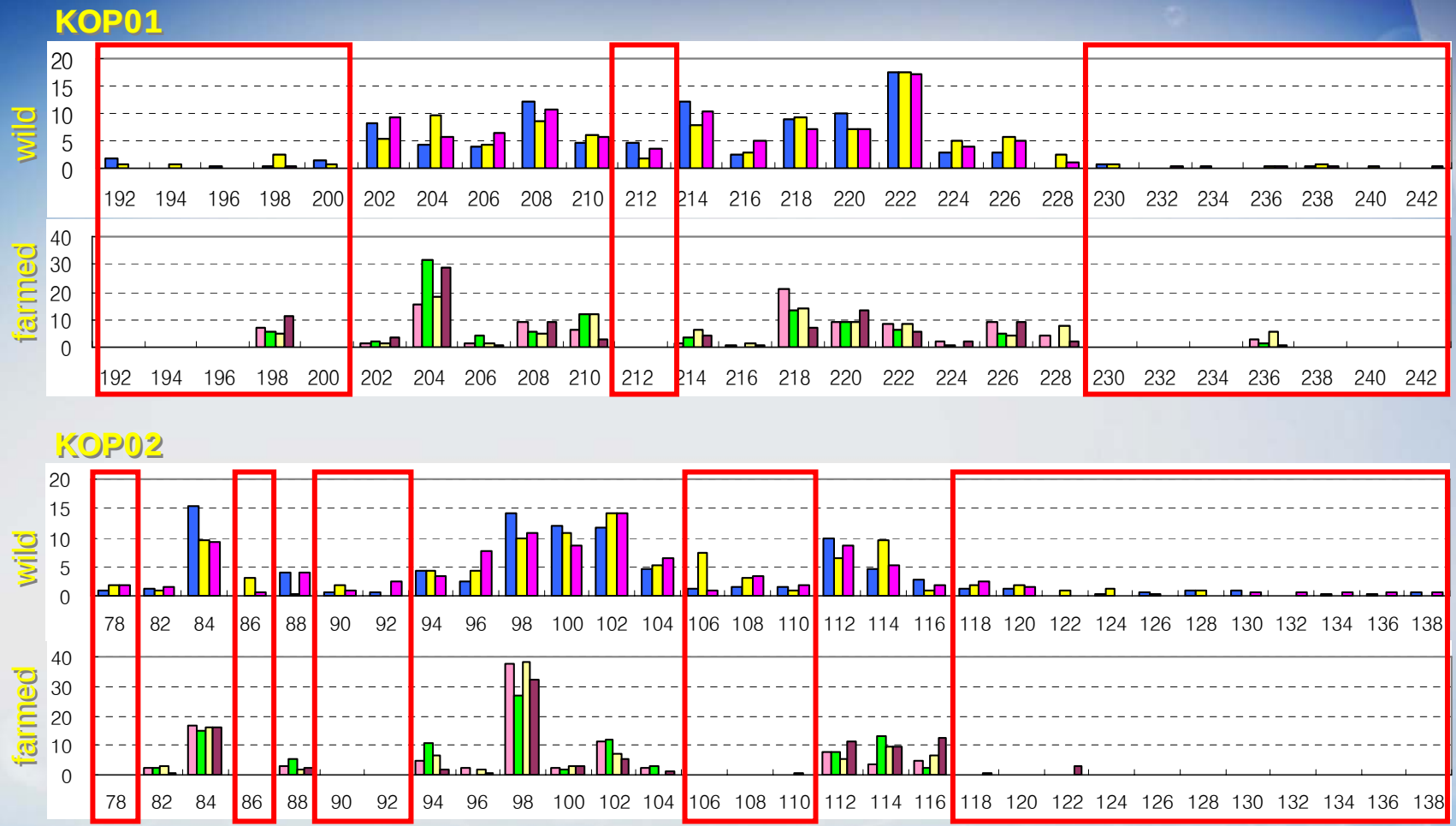
"Nature's own tag"
-> genetic Bar Code



Genetic variability values obtained from microsatellite data from olive flounder

Locus		Group									
		WD	**WW**	**WS**	**FA**	**FB**	**FC**	**FD**	**Wild**	**Farmed**	**Total**
KOP01	*N*	118	170	107	188	99	182	187	395	656	1,051
	A	24	27	26	14	11	12	14	30	16	30
	Ho	0.923	0.893	0.893	0.775	0.848	0.823	0.870	0.902	0.827	0.853
	He	0.926	0.910	0.930	0.804	0.854	0.802	0.829	0.922	0.830	0.876
	PIC	0.917	0.900	0.920	0.783	0.836	0.781	0.808	0.915	0.814	0.865
	Fis	0.0012	0.0165	0.0371	0.0338	0.0050	-0.0284	-0.0513	0.0193	-0.0040	0.0046
KOP02	*N*	118	170	107	188	99	182	187	395	656	1,051
	A	19	19	20	15	16	14	15	21	16	22
	Ho	0.872	0.888	0.806	0.941	0.902	0.895	0.870	0.861	0.905	0.890
	He	0.924	0.919	0.920	0.904	0.883	0.877	0.874	0.923	0.894	0.910
	PIC	0.914	0.911	0.910	0.893	0.871	0.863	0.858	0.917	0.884	0.903
	Fis	0.0542	0.0332	0.1226	-0.0430	-0.0220	-0.0215	0.0032	0.0651	-0.0218	0.0090

Allele distribution of eight microsatellite loci in wild and cultivated populations of olive flounder



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Genetic variability values obtained from microsatellite data from olive flounder

Locus		Group									
		WD	**WW**	**WS**	**FA**	**FB**	**FC**	**FD**	**Wild**	**Farmed**	**Total**
KOP03	*N*	118	170	107	188	99	182	187	395	656	1,051
	A	20	22	19	16	14	15	15	26	16	26
	Ho	0.923	0.888	0.893	0.893	0.844	0.901	0.846	0.900	0.871	0.881
	He	0.909	0.919	0.916	0.889	0.846	0.899	0.863	0.915	0.883	0.907
	PIC	0.898	0.910	0.905	0.877	0.831	0.888	0.847	0.908	0.873	0.900
	Fis	-0.0172	0.0325	0.0229	-0.0058	0.0016	-0.0030	0.0185	0.0171	0.0027	0.0078
KOP04	*N*	118	170	107	188	99	182	187	395	656	1,051
	A	6	7	10	5	6	5	5	10	6	10
	Ho	0.701	0.669	0.667	0.656	0.713	0.635	0.699	0.678	0.677	0.677
	He	0.701	0.692	0.711	0.682	0.695	0.599	0.749	0.711	0.698	0.710
	PIC	0.645	0.629	0.656	0.621	0.639	0.546	0.701	0.654	0.645	0.656
	Fis	-0.0020	0.0330	0.0599	0.0364	-0.0273	-0.0615	0.0643	0.0315	-0.0002	0.0110

Allele distribution of eight microsatellite loci in wild and cultivated populations of olive flounder

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Genetic variability values obtained from microsatellite data from olive flounder

Locus		Group									
		WD	**WW**	**WS**	**FA**	**FB**	**FC**	**FD**	**Wild**	**Farmed**	**Total**
KOP05	*N*	118	170	107	188	99	182	187	395	656	1,051
	A	19	20	22	16	15	13	14	23	16	23
	Ho	0.880	0.909	0.922	0.795	0.872	0.762	0.796	0.901	0.813	0.844
	He	0.930	0.910	0.926	0.773	0.840	0.769	0.765	0.925	0.809	0.872
	PIC	0.921	0.910	0.916	0.756	0.820	0.744	0.743	0.919	0.790	0.861
	Fis	0.0513	-0.0001	0.0024	-0.0293	-0.0392	0.0077	-0.0440	0.0184	-0.0245	-0.0081
KOP06	*N*	118	170	107	188	99	182	187	395	656	1,051
	A	16	17	16	14	12	10	15	18	16	18
	Ho	0.798	0.767	0.828	0.884	0.708	0.782	0.798	0.793	0.785	0.788
	He	0.897	0.867	0.892	0.828	0.748	0.840	0.889	0.883	0.827	0.850
	PIC	0.883	0.867	0.877	0.804	0.723	0.819	0.874	0.872	0.808	0.835
	Fis	0.1080	0.1146	0.0687	-0.0692	0.0531	0.0673	0.1005	0.1017	0.0344	0.0582

Allele distribution of eight microsatellite loci in wild and cultivated populations of olive flounder

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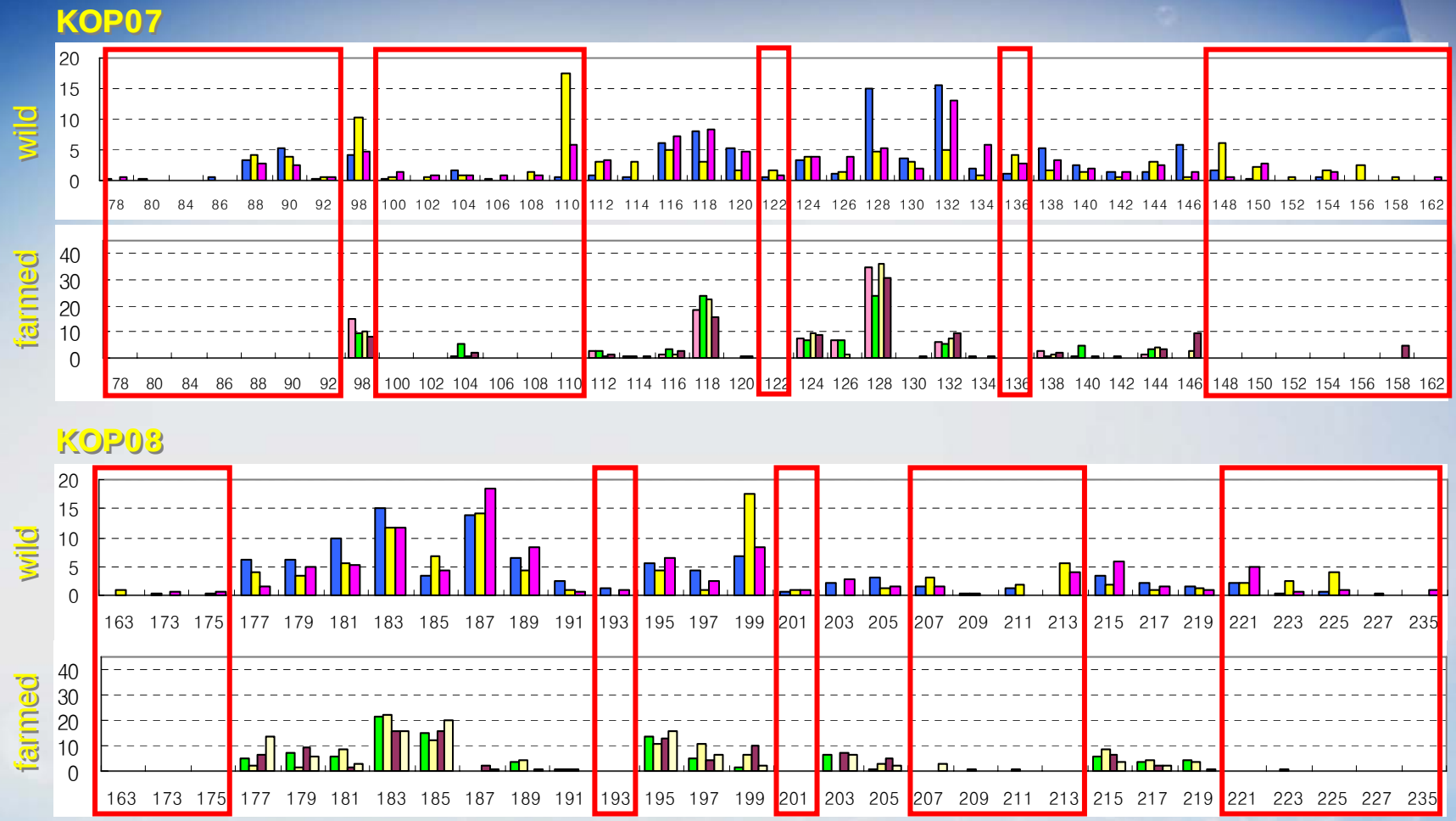
Genetic variability values obtained from microsatellite data from olive flounder

Locus		Group									
		WD	**WW**	**WS**	**FA**	**FB**	**FC**	**FD**	**Wild**	**Farmed**	**Total**
KOP07	*N*	118	170	107	188	99	182	187	395	656	1,051
	A	33	32	32	15	23	16	17	38	27	39
	Ho	0.949	0.893	0.951	0.882	0.844	0.851	0.846	0.925	0.856	0.880
	He	0.938	0.925	0.950	0.806	0.858	0.790	0.850	0.947	0.833	0.893
	PIC	0.930	0.925	0.943	0.782	0.842	0.763	0.832	0.944	0.816	0.884
	Fis	-0.0141	0.0331	-0.0042	-0.0963	0.0148	-0.0789	0.0030	0.0108	-0.0355	-0.0182
KOP08	*N*	118	170	107	188	99	182	187	395	656	1,051
	A	26	25	26	19	20	17	16	30	23	30
	Ho	0.897	0.964	0.913	0.882	0.889	0.895	0.878	0.931	0.887	0.902
	He	0.918	0.924	0.922	0.890	0.892	0.899	0.882	0.925	0.898	0.920
	PIC	0.908	0.924	0.912	0.877	0.881	0.887	0.866	0.919	0.889	0.914
	Fis	0.0204	-0.0458	0.0078	0.0068	0.0027	0.0029	0.0019	-0.0098	0.0050	-0.0002

Allele distribution of eight microsatellite loci in wild and cultivated populations of olive flounder



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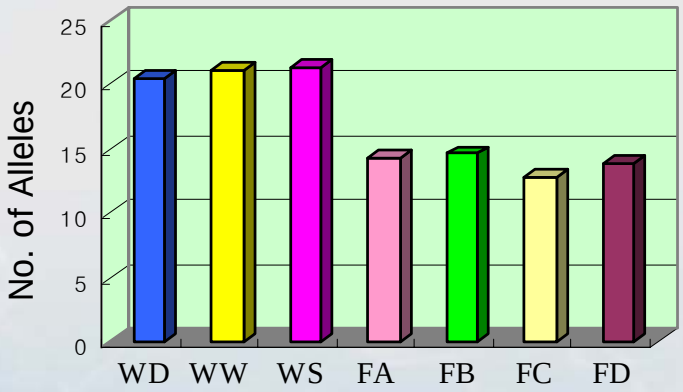
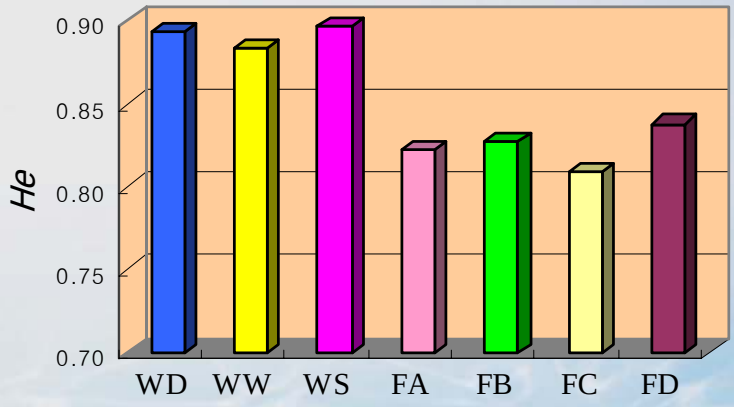
Average number of alleles and expected heterozygosity compared with wild and farmed flounder groups

Locus		Group									
		WD	**WW**	**WS**	**FA**	**FB**	**FC**	**FD**	**Wild**	**Farmed**	**Total**
Mean	*A*	20.38	21.13	21.38	14.25	14.63	12.75	13.88	24.50	17.00	24.75
	He	0.893	0.883	0.896	0.822	0.827	0.809	0.838	0.894	0.834	0.867
	PIC	0.877	0.867	0.88	0.799	0.805	0.786	0.816	0.881	0.815	0.852





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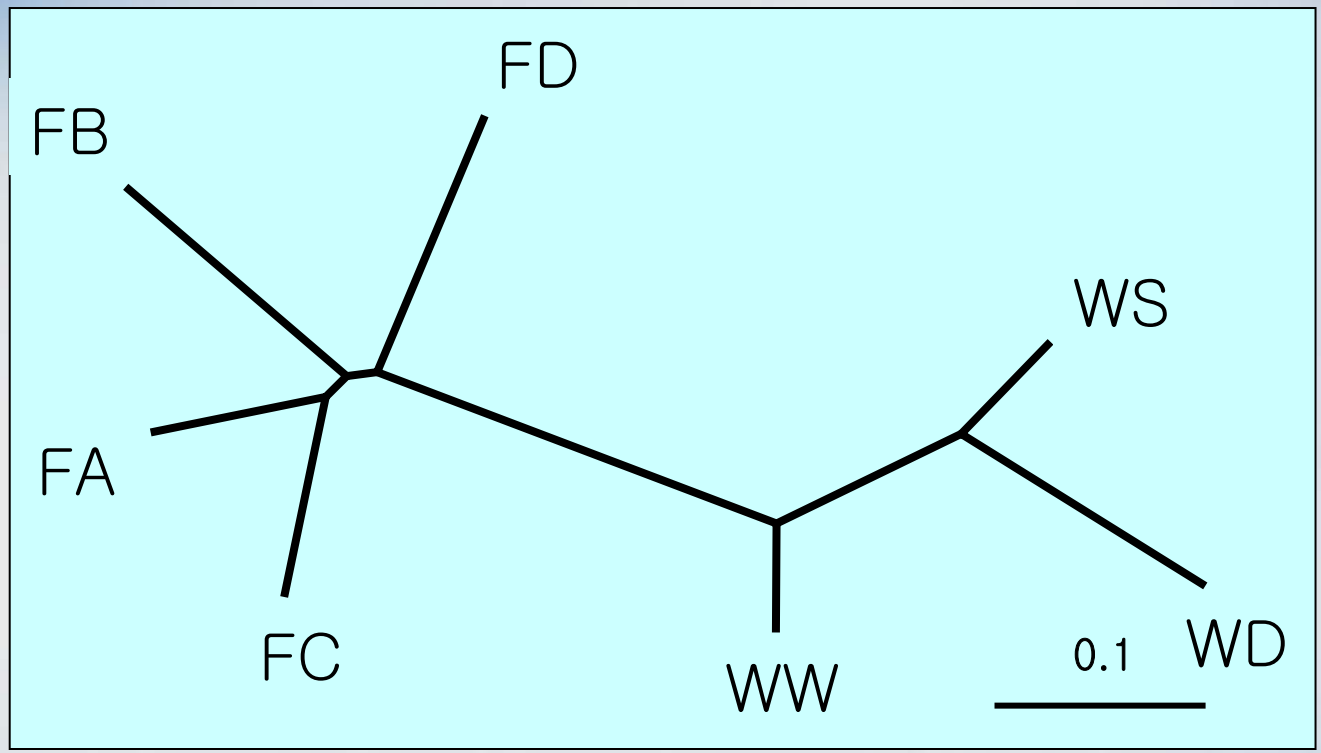
Neighbor-joining tree showing the genetic distance among seven populations of olive flounder



CONCLUSION

- **The number of alleles**
  per locus in the wild flounder groups (ranged from 10 to 33) had 1.5 fold more then farmed flounder groups (ranged from 6 to 23).

- **Expected heterozygosity (*He*)**
  of wild and farmed flounder groups were between 0.654~0.947 and 0.645~0.898 respectively.

- **The allele frequency**
  in farmed flounder groups showed high only in a few certain alleles.

- **Unrooted NJ tree**
  generated from the genetic distances. Tree shows two clustered as wild and farmed flounder groups.

- **Farmed flounder has less alleles and genetic diversity than wild one**
  While 20 year for 7-8 generations elapse, probably be caused by reduction of genetic variability because of the unscientific management of broodstock and the small effective number of parents involving in reproduction.

- **For the aquaculture with bright future,**
  development of the breeding program which considers the introduce and maintenance of genetic diversity is demanded.