Genetic population assignment of humpback whales in the eastern North Pacific

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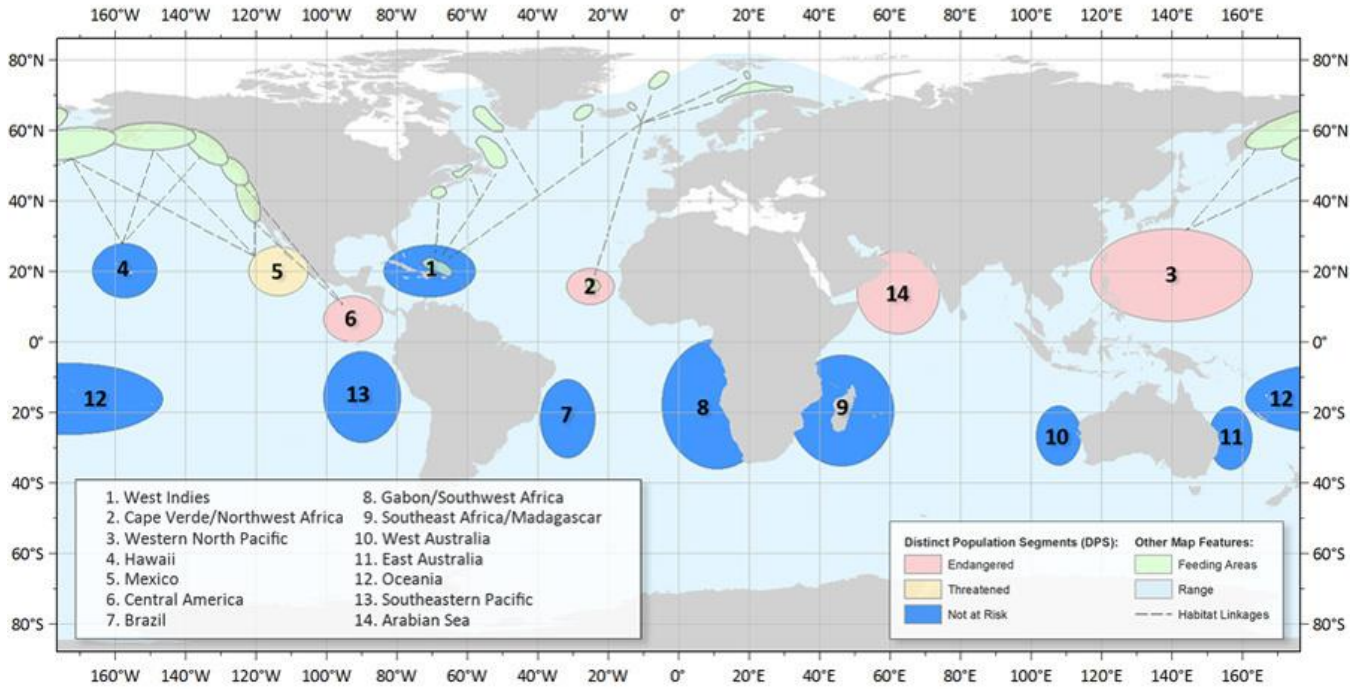
Population based management of humpbacks

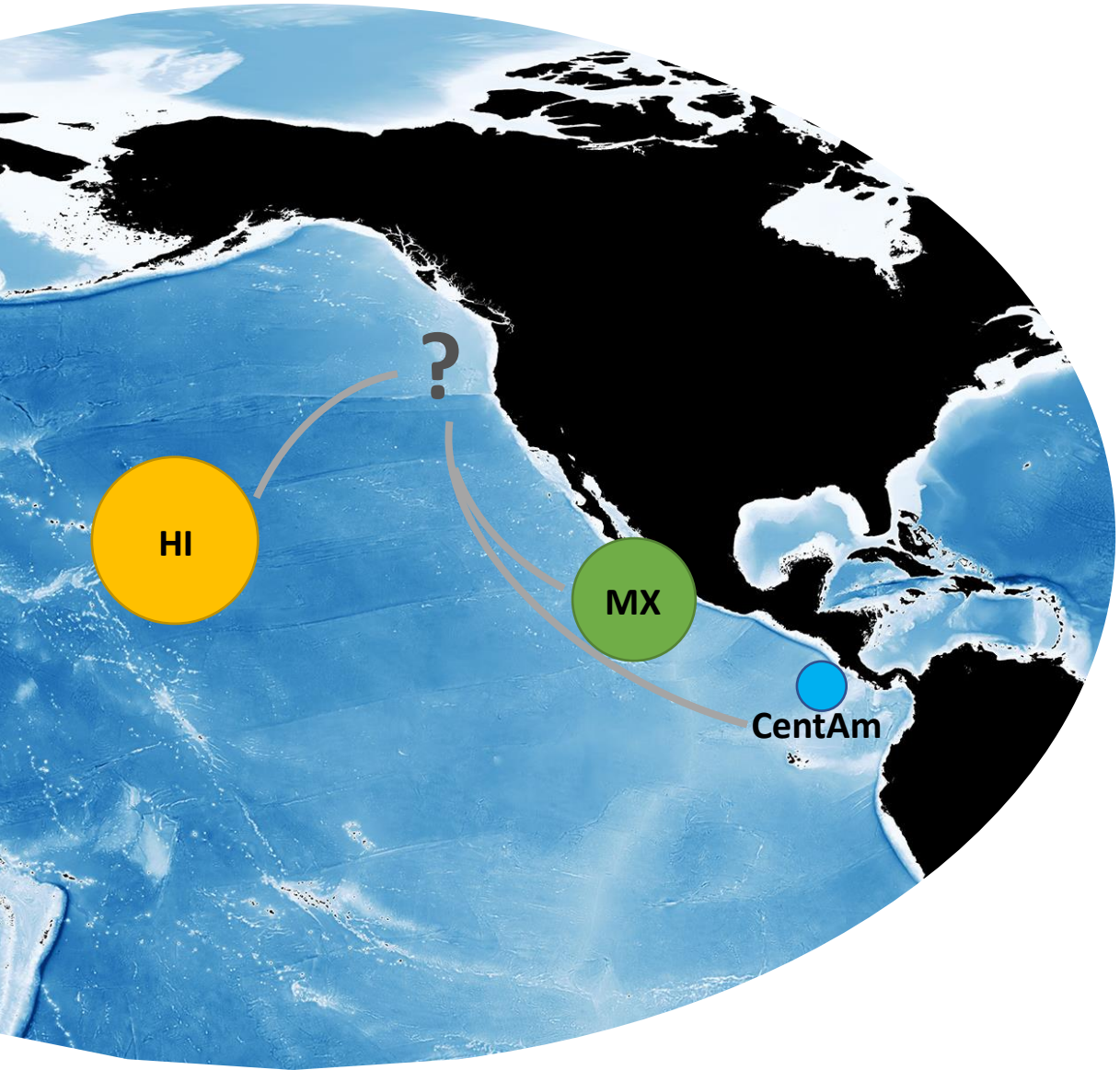
Difficult to manage feeding stock comprised of individuals from multiple Distinct Population Segments (DPS)

- Hawaii: Least concern
- Mexico: Threatened
- Central America: Endangered
- Western NP: Endangered



NOAA

Genetic approach to population connectivity



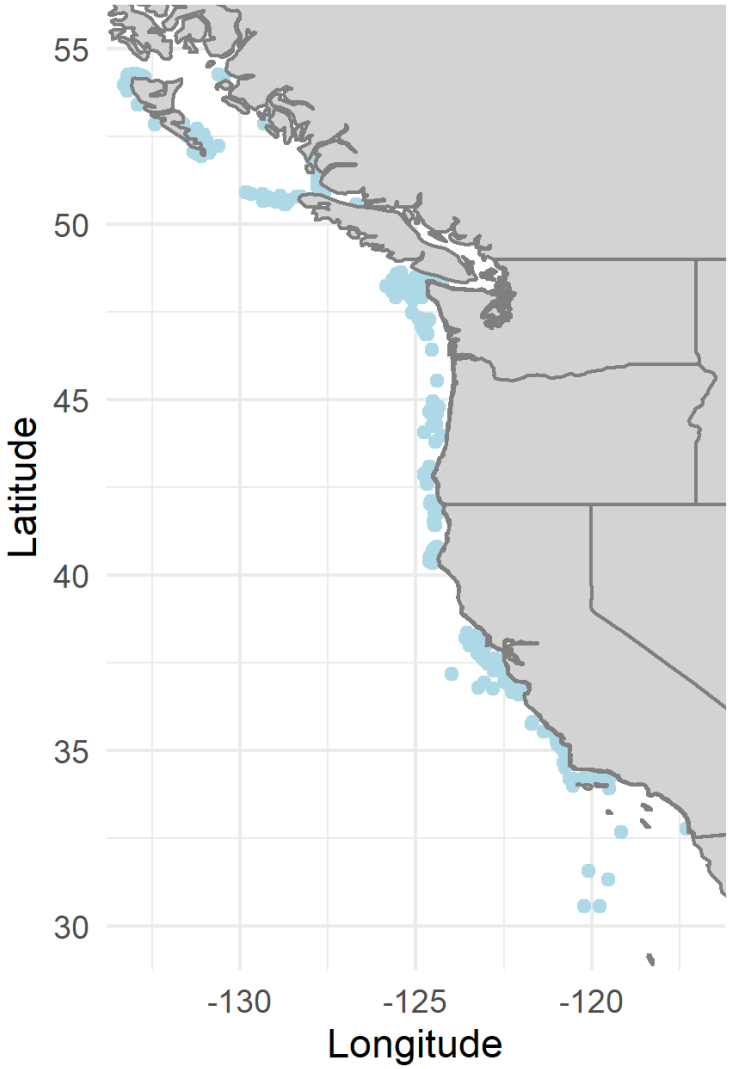
Genetic analysis not limited to re-sights or tagging history of individual humpback whales

SPLASH study (2004-2006) serves as the breeding ground reference allowing us to make inference on breeding ground origins of feeding humpback whales in the eastern NP

Baker et al. 2013 (geneSPLASH)

Genetic samples collected between 2002-19

Region	n
Northern BC	151
Southern BC/WA	133
Oregon	42
California	417
Feeding Ground Total:	**765**
Hawaii	230
Mexico	176
Central America	39
Western NP	248
SPLASH Breeding Ground Total:	**693**



Molecular Methods for DNA profiling

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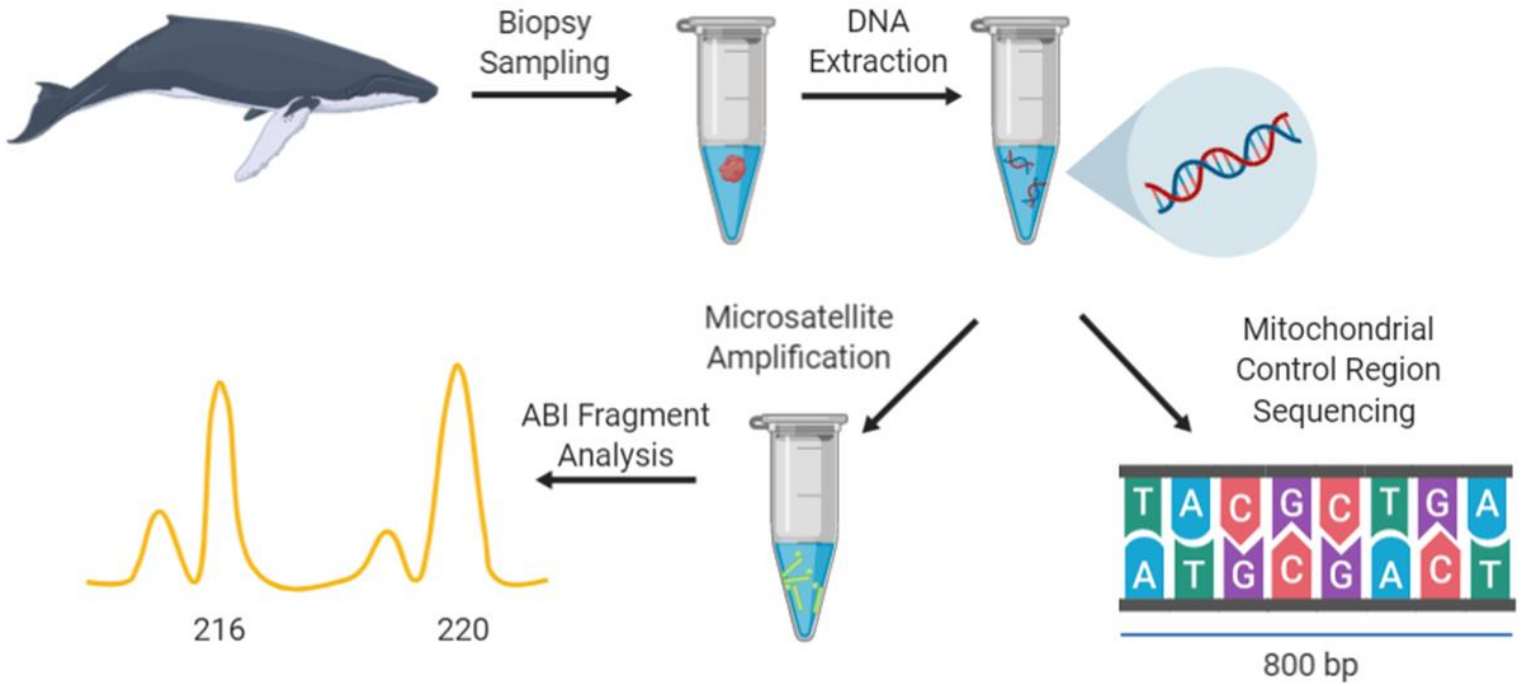
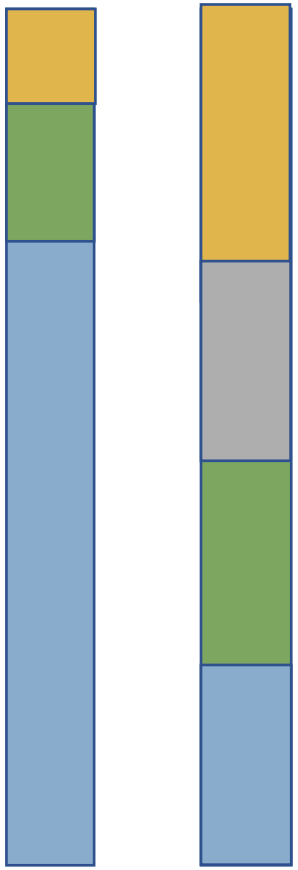


Standard DNA profiling – sufficient for individual identification (feeding ground n = 666) and population genetic analysis

Bayesian population assignment:



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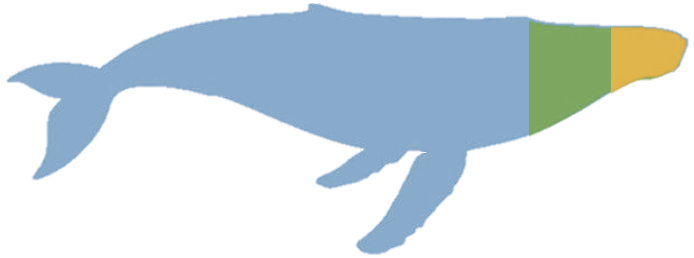


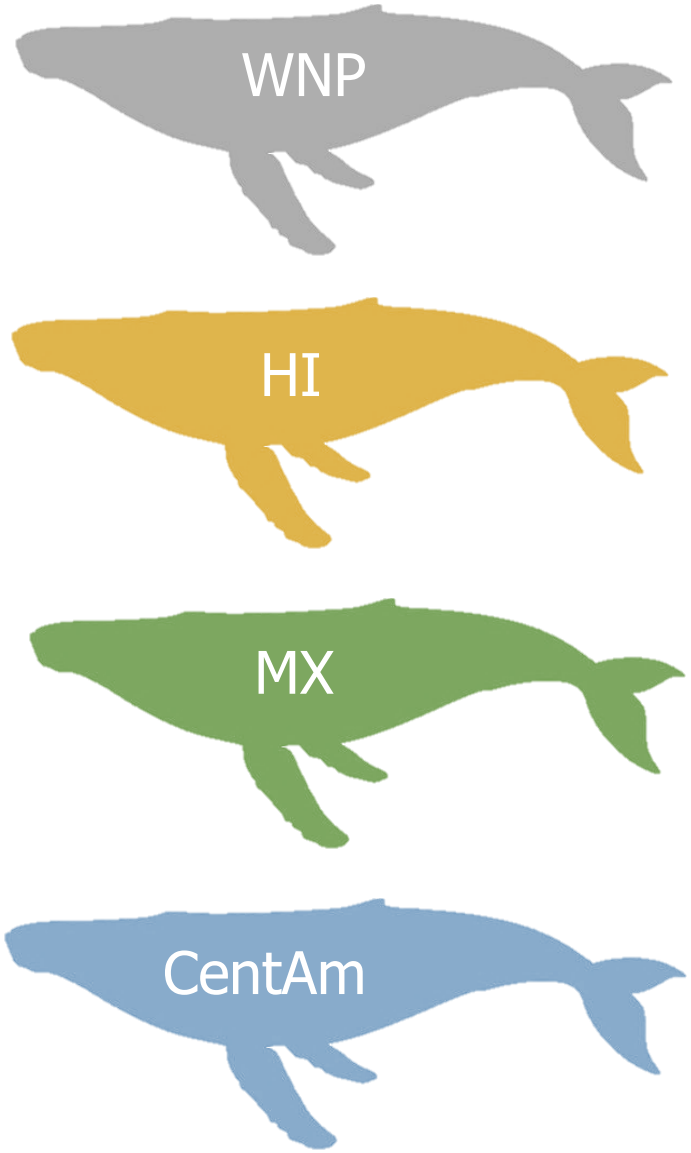
80 % CentAm 10% MX 5% HI

Unknown 2:

20 % CentAm 35% MX 20%WNP 25% HI

?

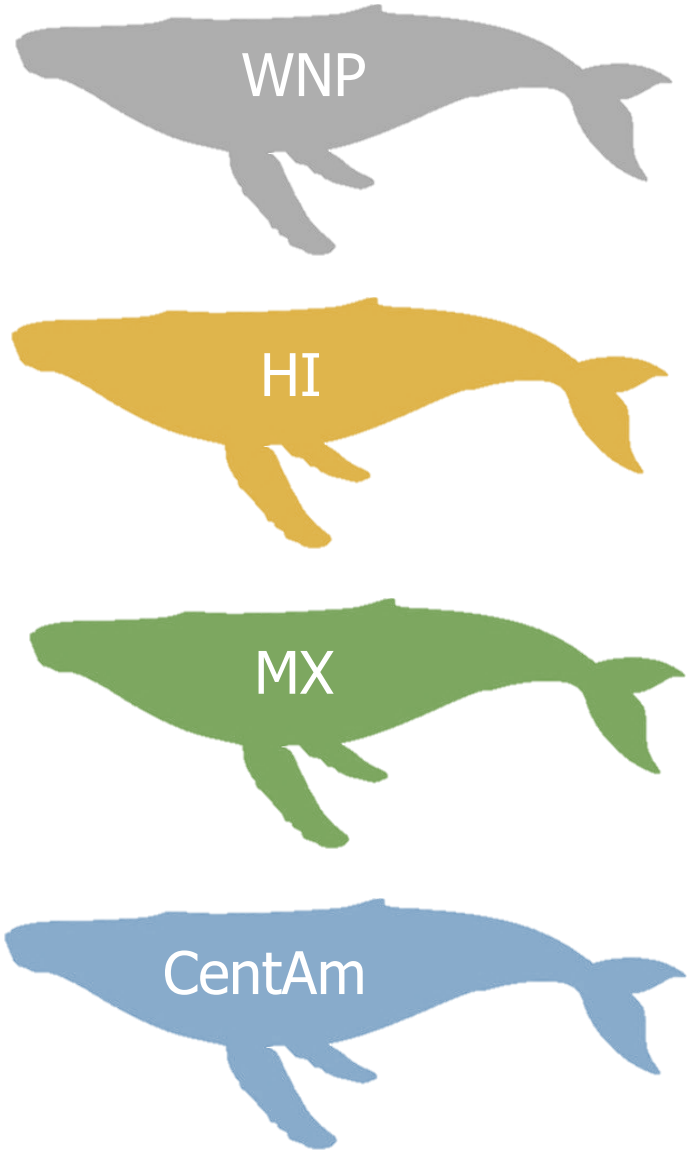
Reference Genotypes



Piry et al. 2004, Rannala & Mountain 1997

Bayesian population assignment:

Reference Genotypes



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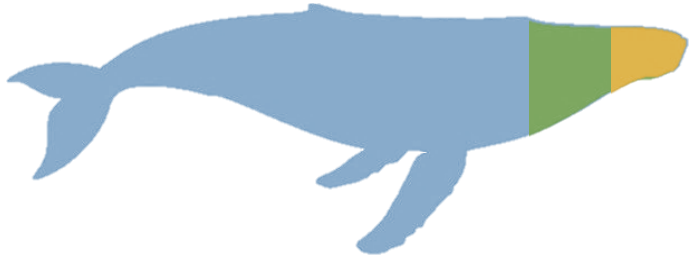

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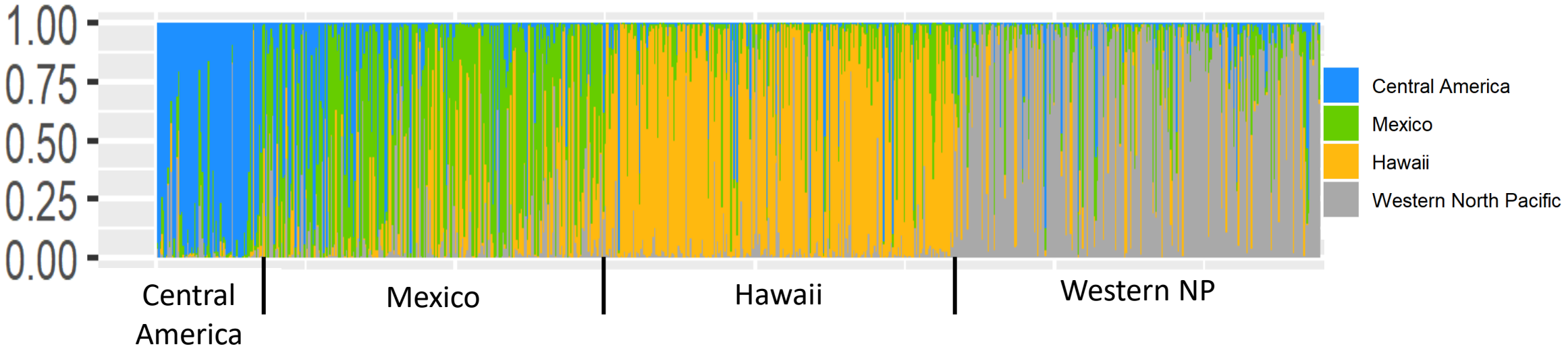
?

23andMe

*For humpback whales

Piry et al. 2004, Rannala & Mountain 1997

Power of population assignment



Population Assignment Accuracy	
DPS	%
Central America	88.24
Mexico	53.02
Hawaii	82.17
WNP	73.79
Total	71.68

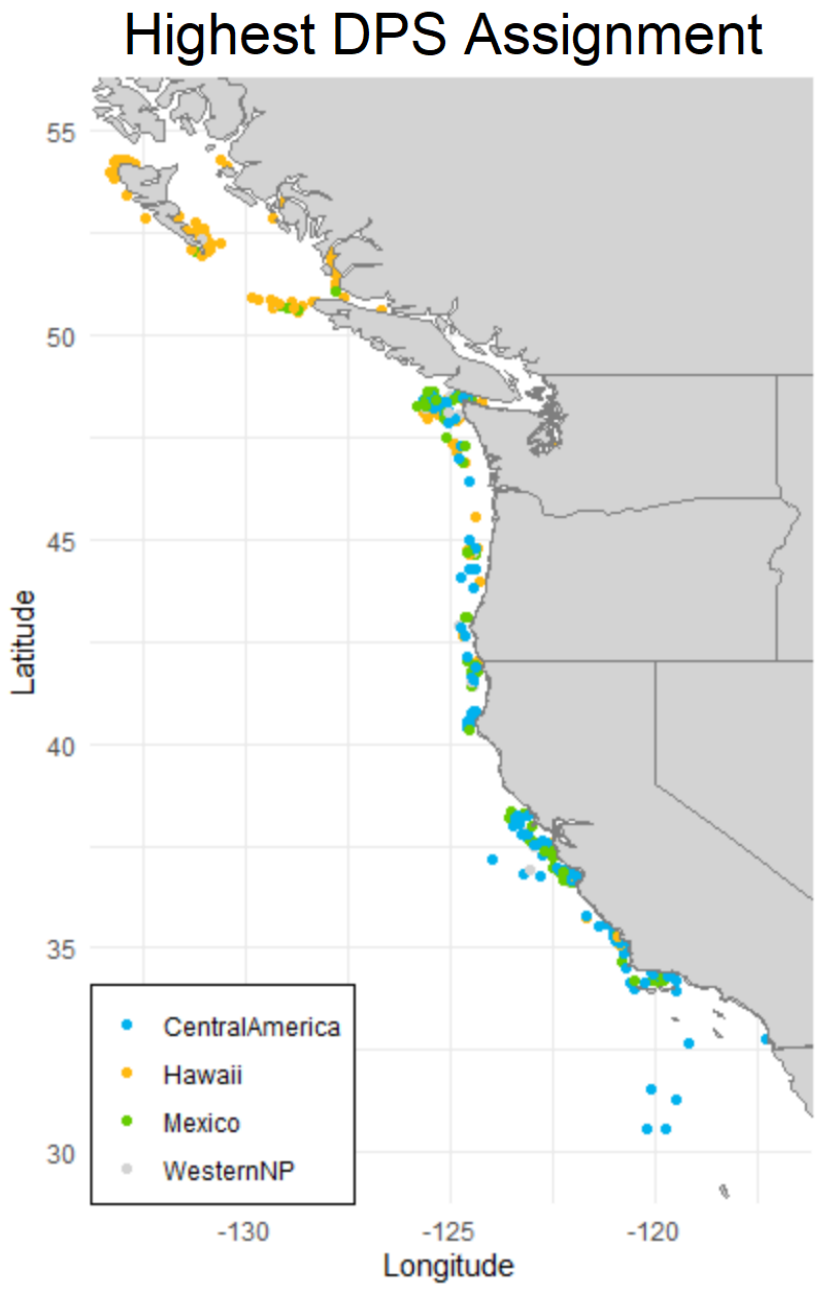
Forensic application for assignment of injury or mortality

Assignment to DPS of feeding ground samples

Distribution of inferred DPS assignments shows pattern of mixing consistent with other lines of evidence

Potential application for the spatial risk assessment of each DPS along the US West Coast

Assigned DPS	n
Central America	258
Mexico	243
Hawaii	184
WNP	47
Total	765



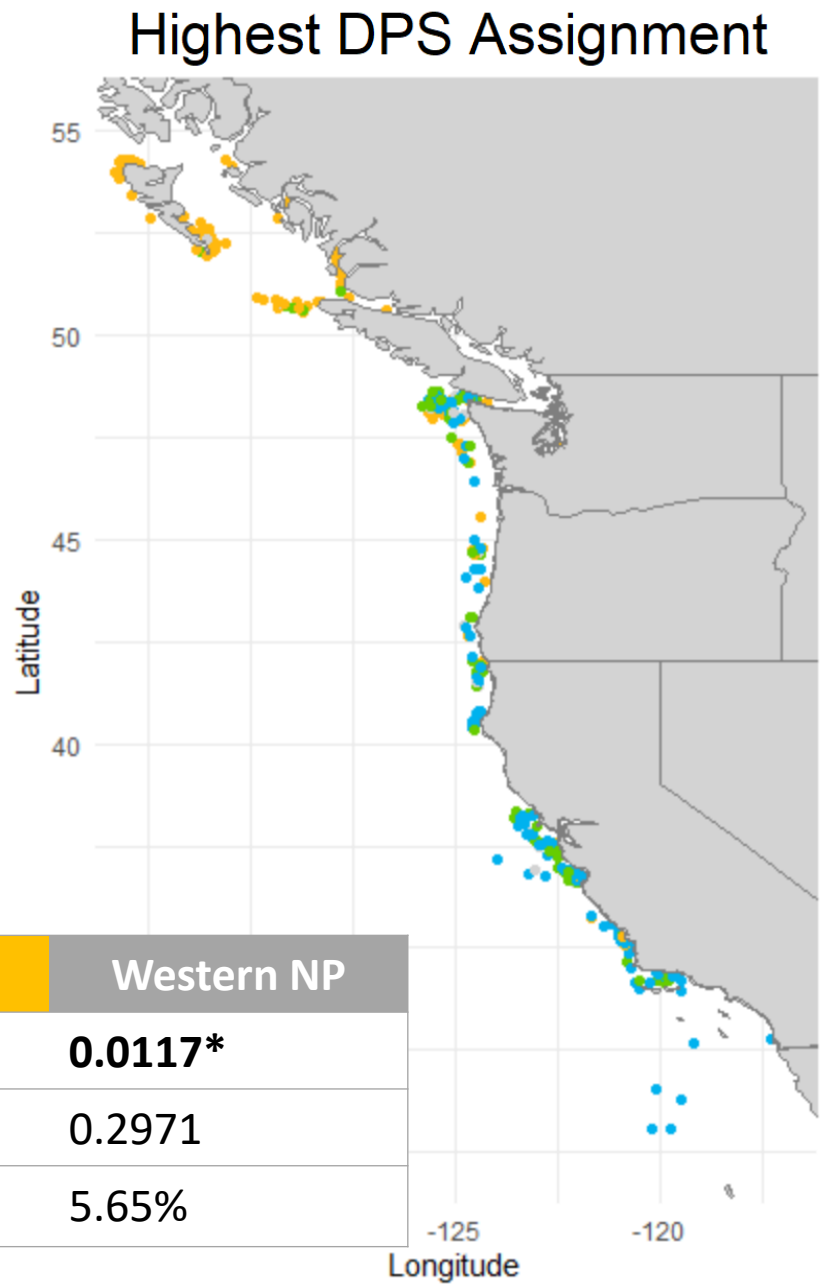
Modeling DPS assignment

Estimate the spatial and temporal probability of DPS assignment of humpback whales feeding in the eastern NP using Generalized Additive Models

DPS Assignment Probability ~

s(Location), + s(SST), + Year + Month

	Central America	Mexico	Hawaii	Western NP
Location p-value	**<2e-16*** **	**0.0115***	**<2e-16*** **	**0.0117***
SST p-value	0.082	0.2744	**0.00222****	0.2971
Deviance Explained	**43.6%**	16.1%	**57.1%**	5.65%



Many thanks!

Samples Collected by:
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Daniel Palacios & Bruce Mate, Whale Habitat, Ecology Telemetry Lab/OSU MMI

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Cetacean Conservation and Genomics Laboratory

GRFP
NSF GRADUATE RESEARCH FELLOWSHIP PROGRAM

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Geospatial Ecology of Marine Megafauna Lab

Oregon State University Marine Mammal Institute

Oregon State University

Whale Habitat, Ecology, and Telemetry Lab

Image: Dr. Leigh Torres/GEMM Lab