



NOAA Fisheries Service

Historical context for interpreting early accounts of Pacific salmon in coastal watersheds of California

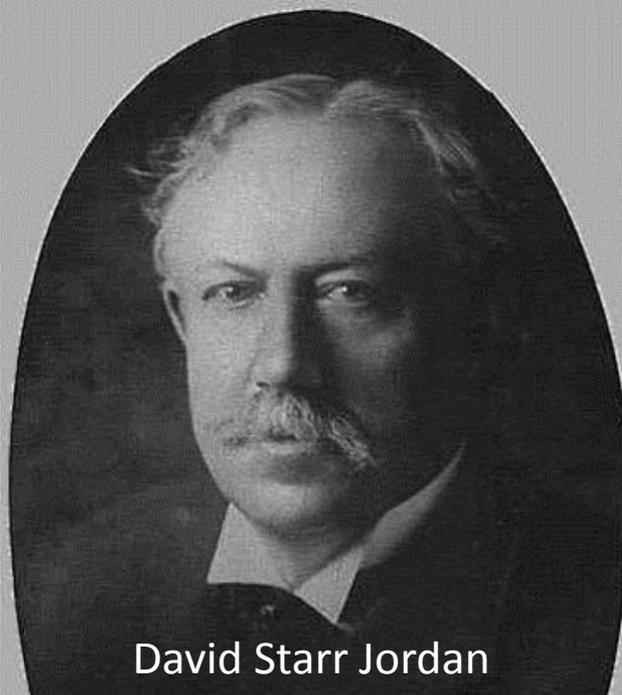
Brian Spence

Southwest Fisheries Science Center

Fisheries Ecology Division – Santa Cruz, California



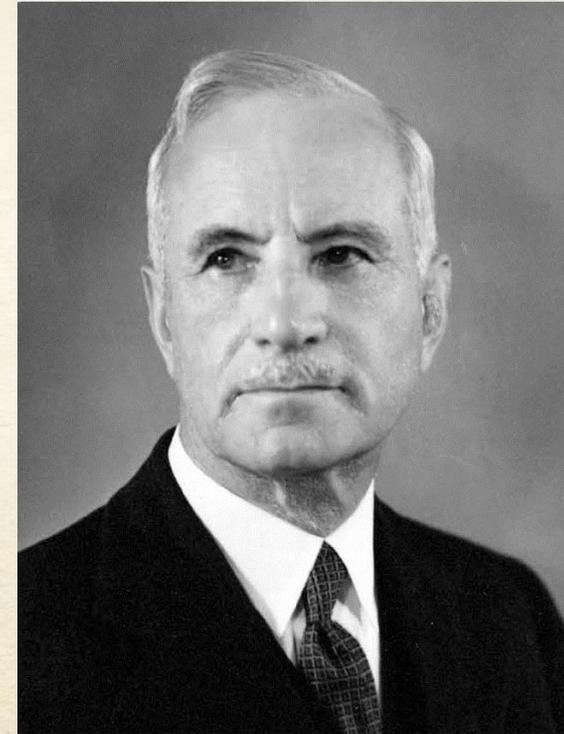
Barton Warren Evermann



David Starr Jordan



Charles Henry Gilbert



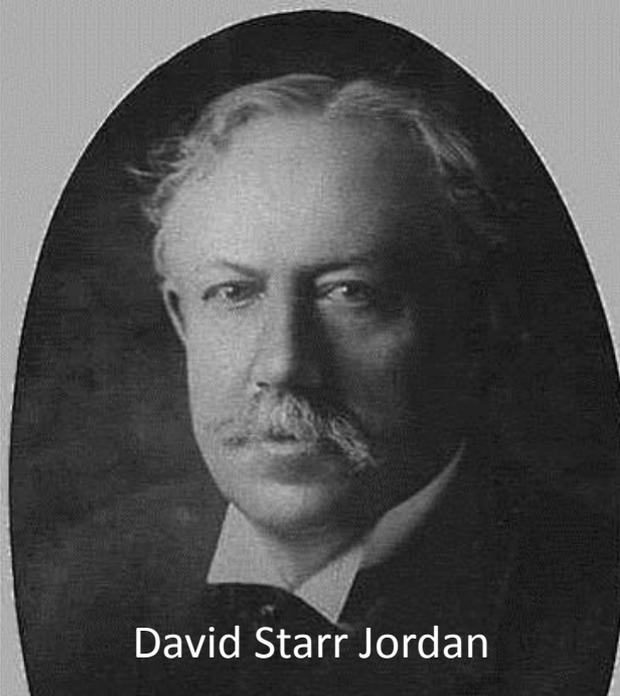
John Otterbein Snyder

Selected writings of Jordan et al. 1878-1908

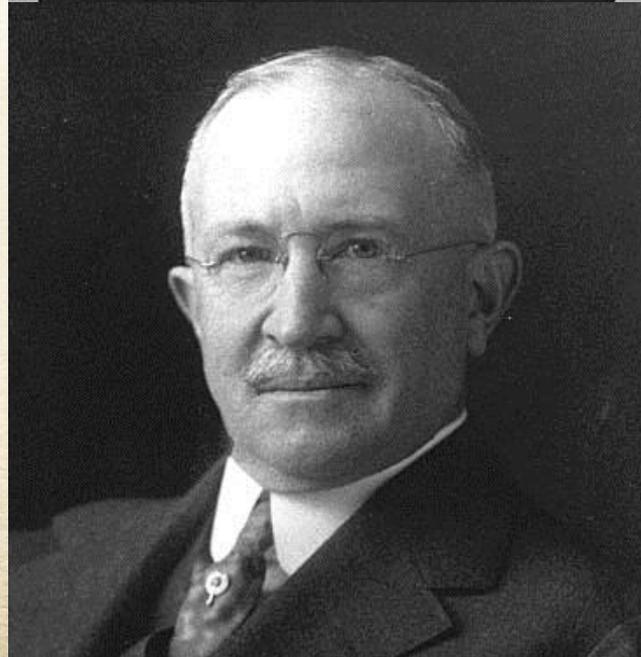
1878. Jordan. *A catalogue of the fishes of the fresh waters of North America*
1881. Jordan & Gilbert. *Notes on the fishes of the Pacific Coast of the United States*
1881. Jordan & Gilbert. *List of the fishes of the Pacific Coast of the United States...*
1881. Jordan & Gilbert. *Observations on the salmon of the Pacific*
1882. Jordan & Gilbert. *Synopsis of the fishes of North America*
1884. Jordan. *The fisheries and fishing industries of the United States*
1884. Jordan. *Manual of the vertebrates of the Northern United States...*
1885. Jordan. *A catalogue of the fishes known to inhabit the waters of North America...*
1887. Jordan. *The fisheries of the Pacific Coast*
1888. Jordan. *Science sketches: the salmon family*
1892. Jordan. *Salmon and trout of the Pacific Coast*
1894. Jordan. *Salmon and trout of the Pacific Coast*
1896. Jordan. *Science sketches: the salmon family*
1896. Jordan & Evermann. *Fishes of North and Middle America: a descriptive catalogue...*
1896. Jordan & Evermann. *A checklist of the fishes...of North and Middle America*
1902. Jordan & Evermann. *American food & game fishes. A popular account...*
1902. Jordan & Snyder. *A review of the salmonoid fishes of Japan.*
1904. Jordan & Evermann. *American food & game fishes. A popular account...*
1904. Jordan. *Pacific species of salmon and trout.*
1906. Jordan. *The trout and salmon of the Pacific Coast*
1908. Jordan & Evermann. *American food & game fishes. A popular account....*



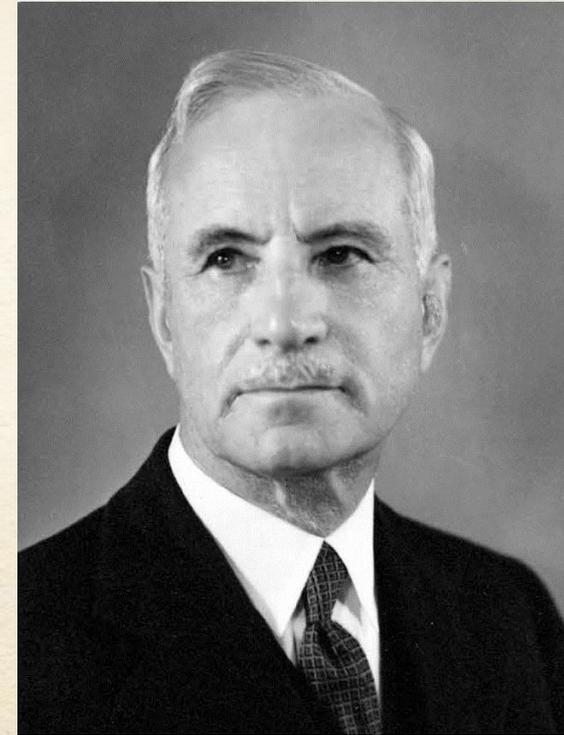
Barton Warren Evermann



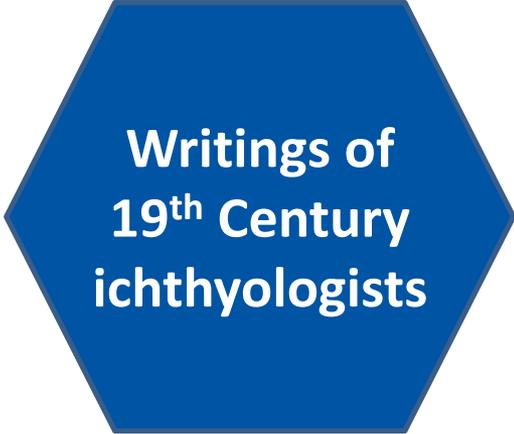
David Starr Jordan



Charles Henry Gilbert



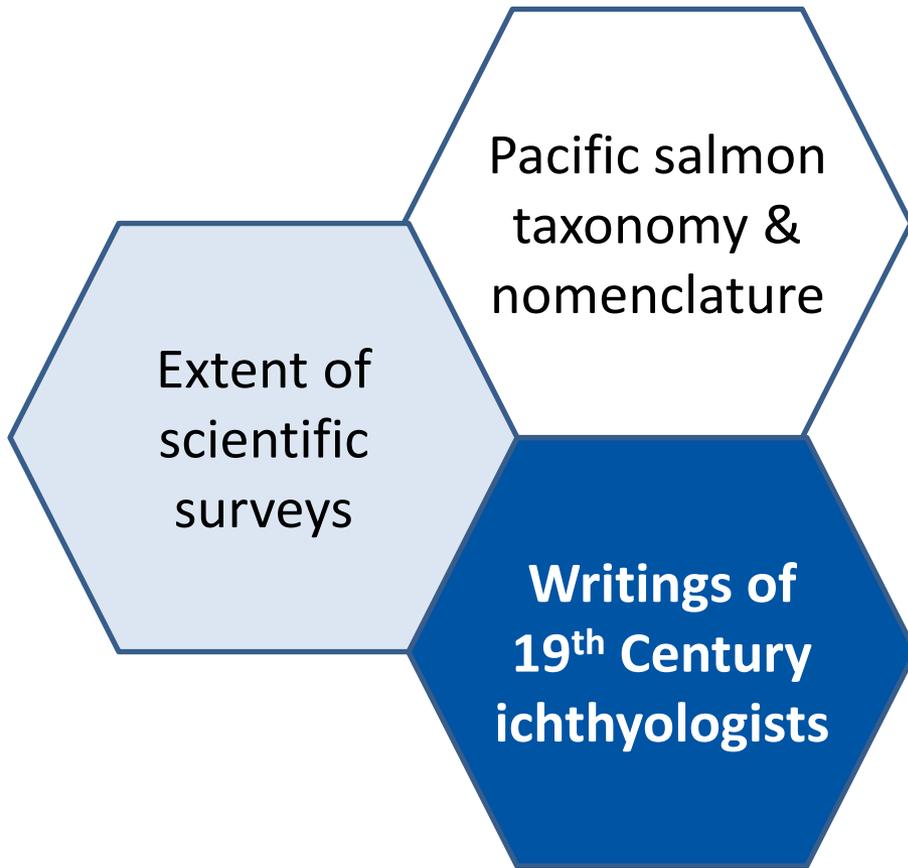
John Otterbein Snyder

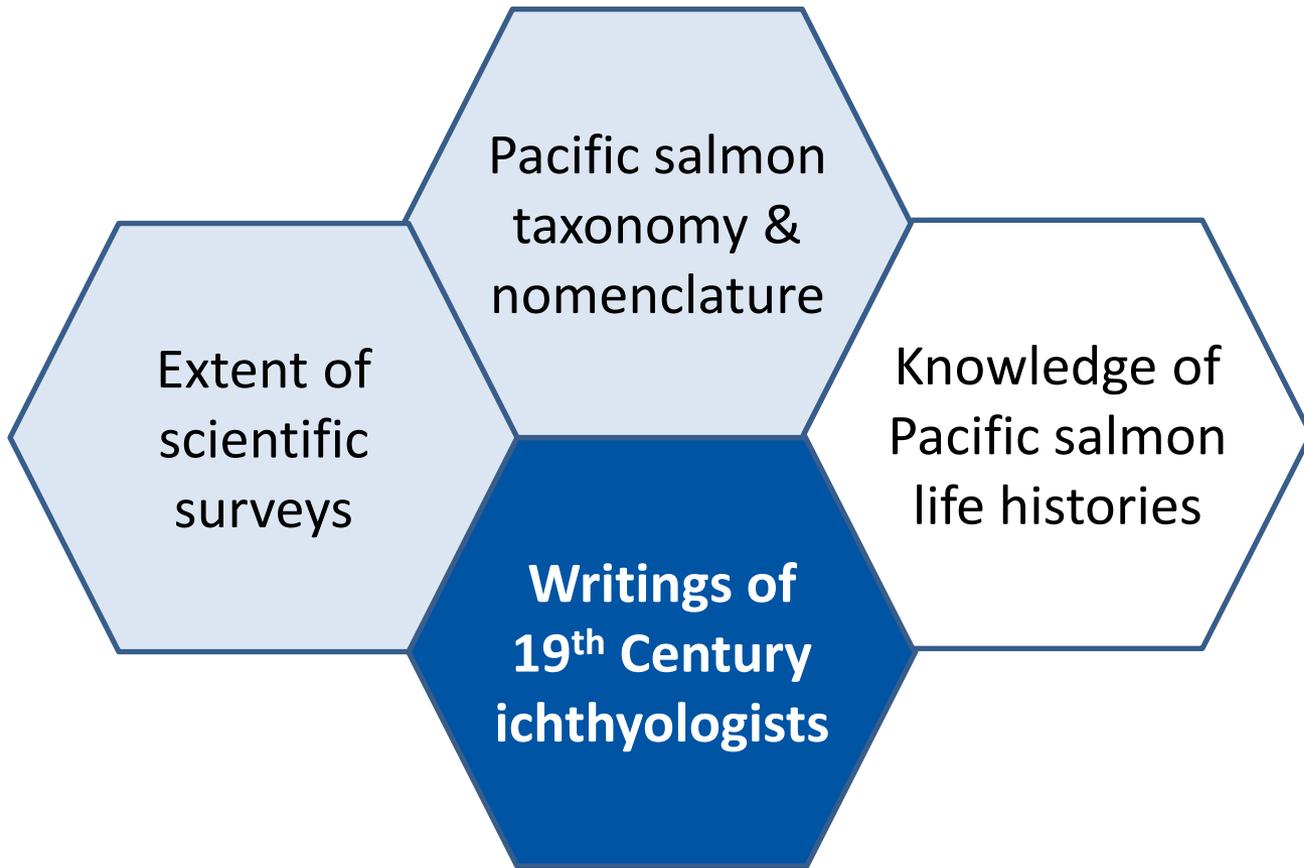


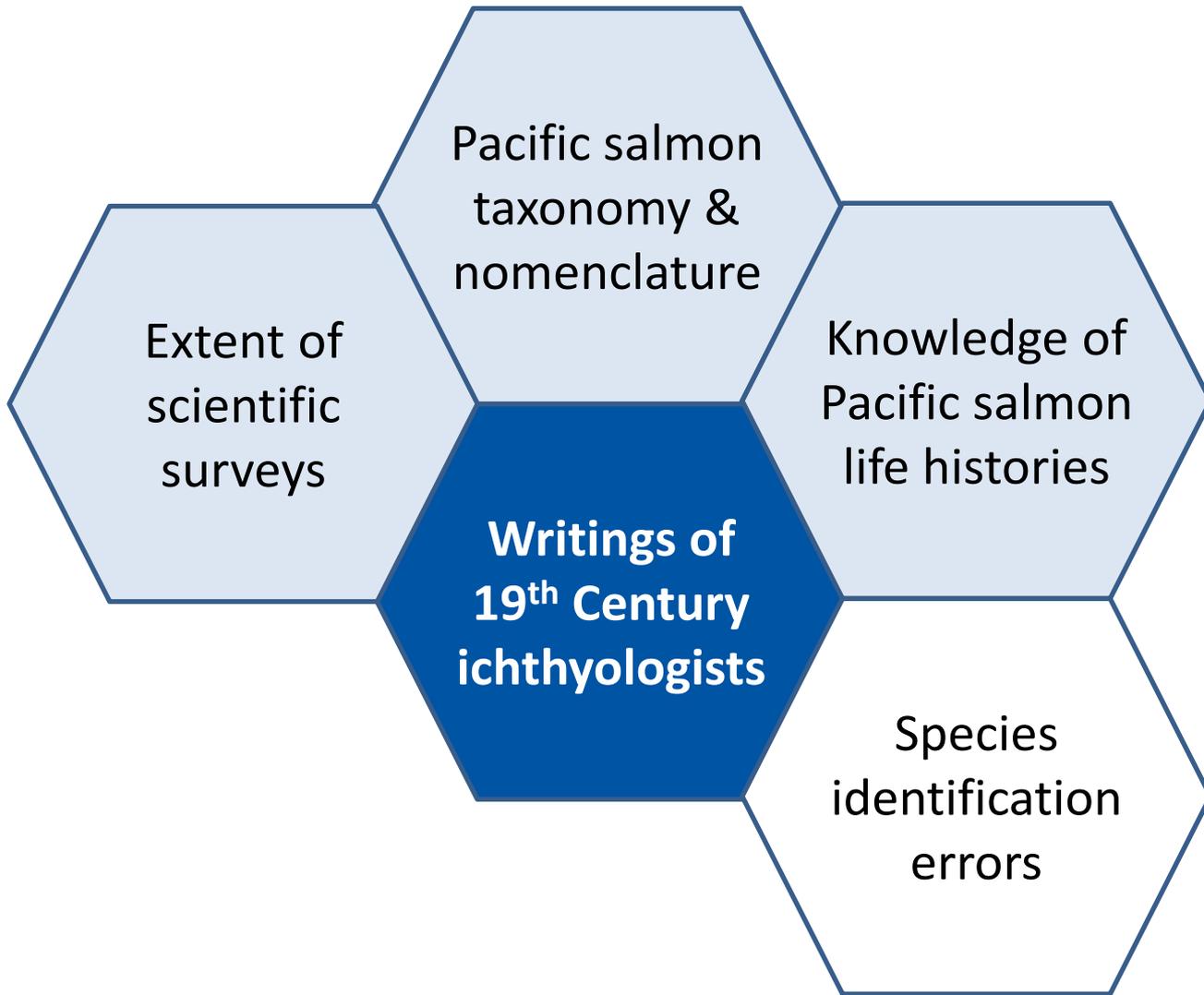
**Writings of
19th Century
ichthyologists**

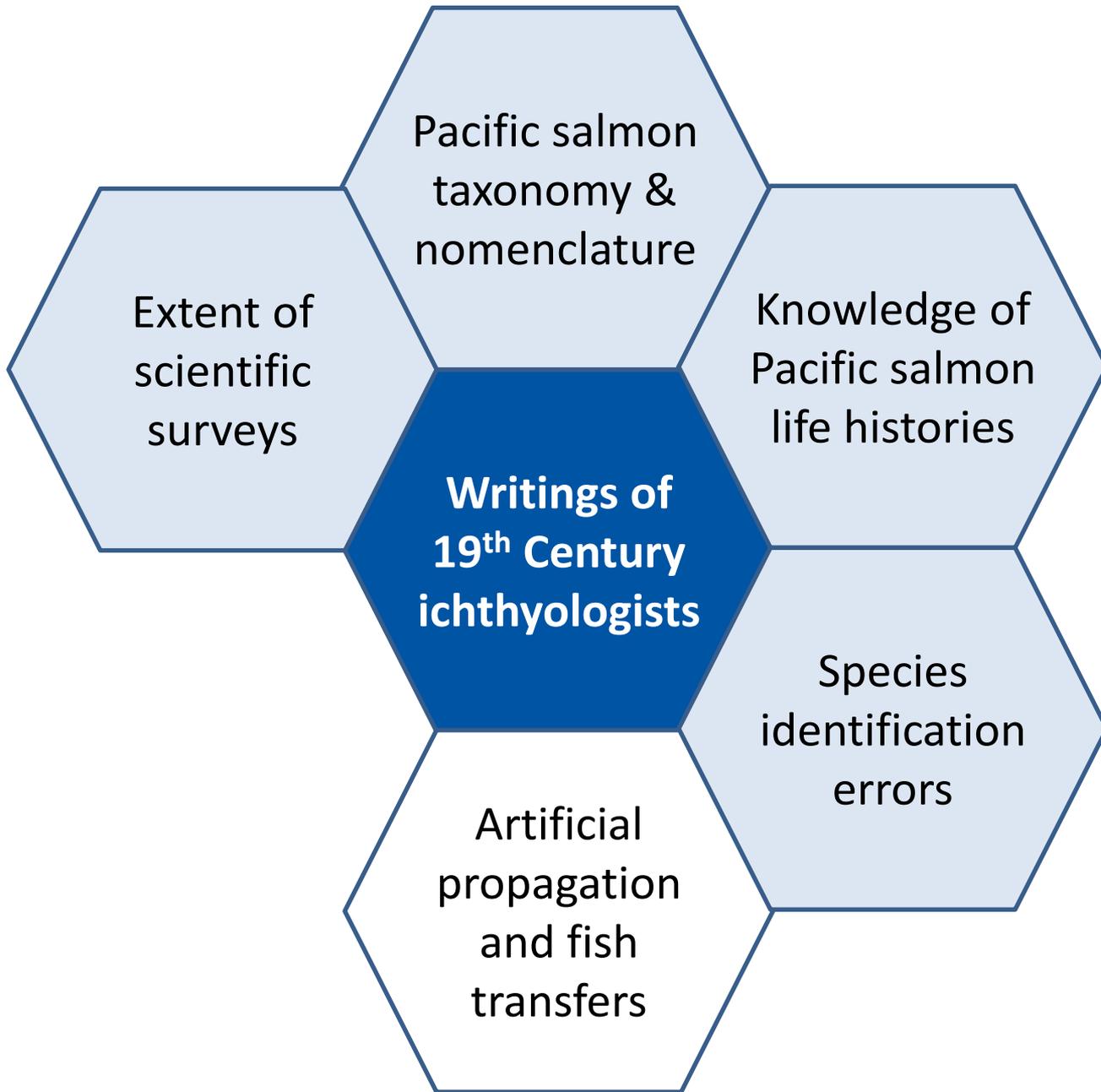
Extent of
scientific
surveys

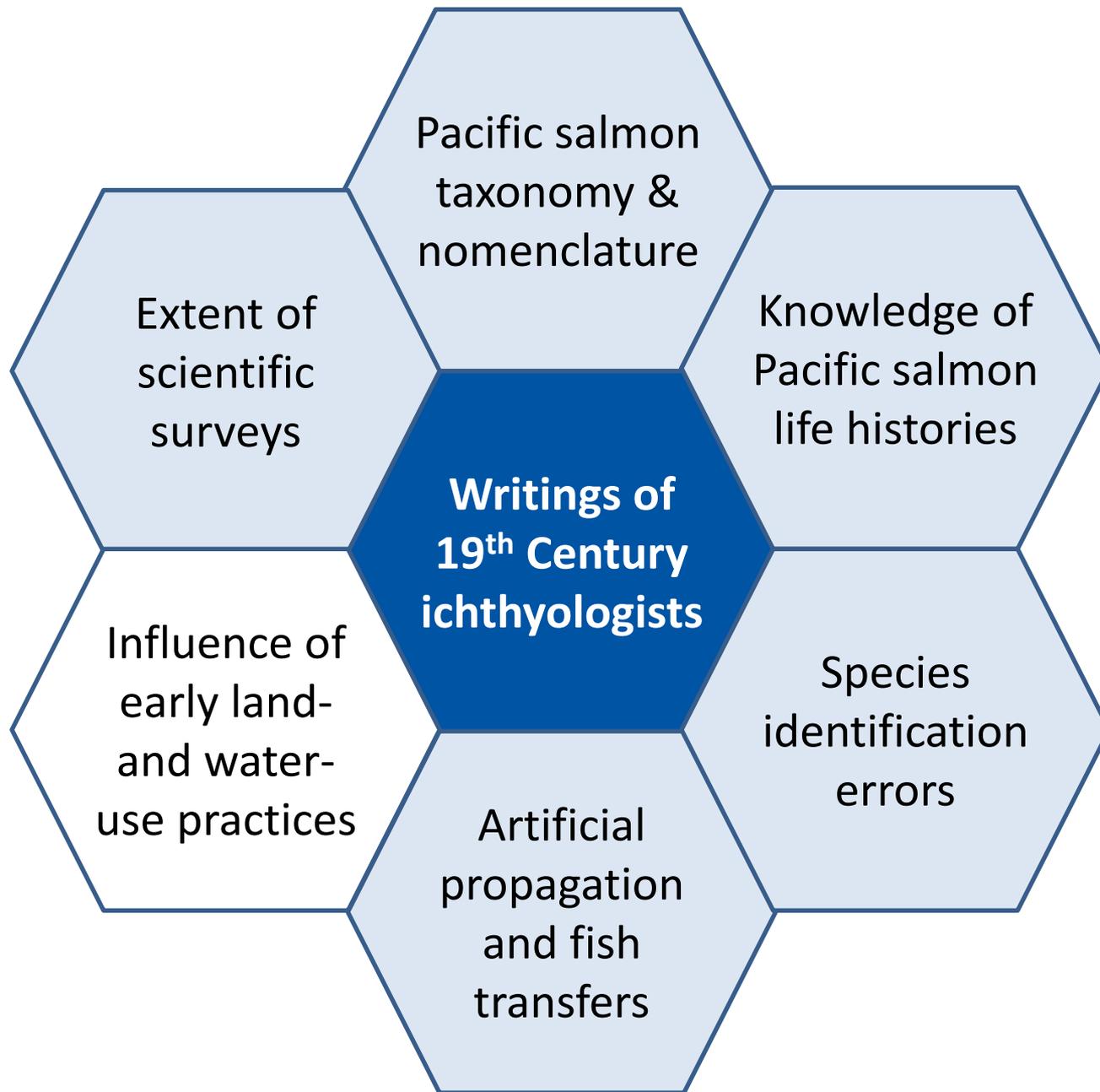
**Writings of
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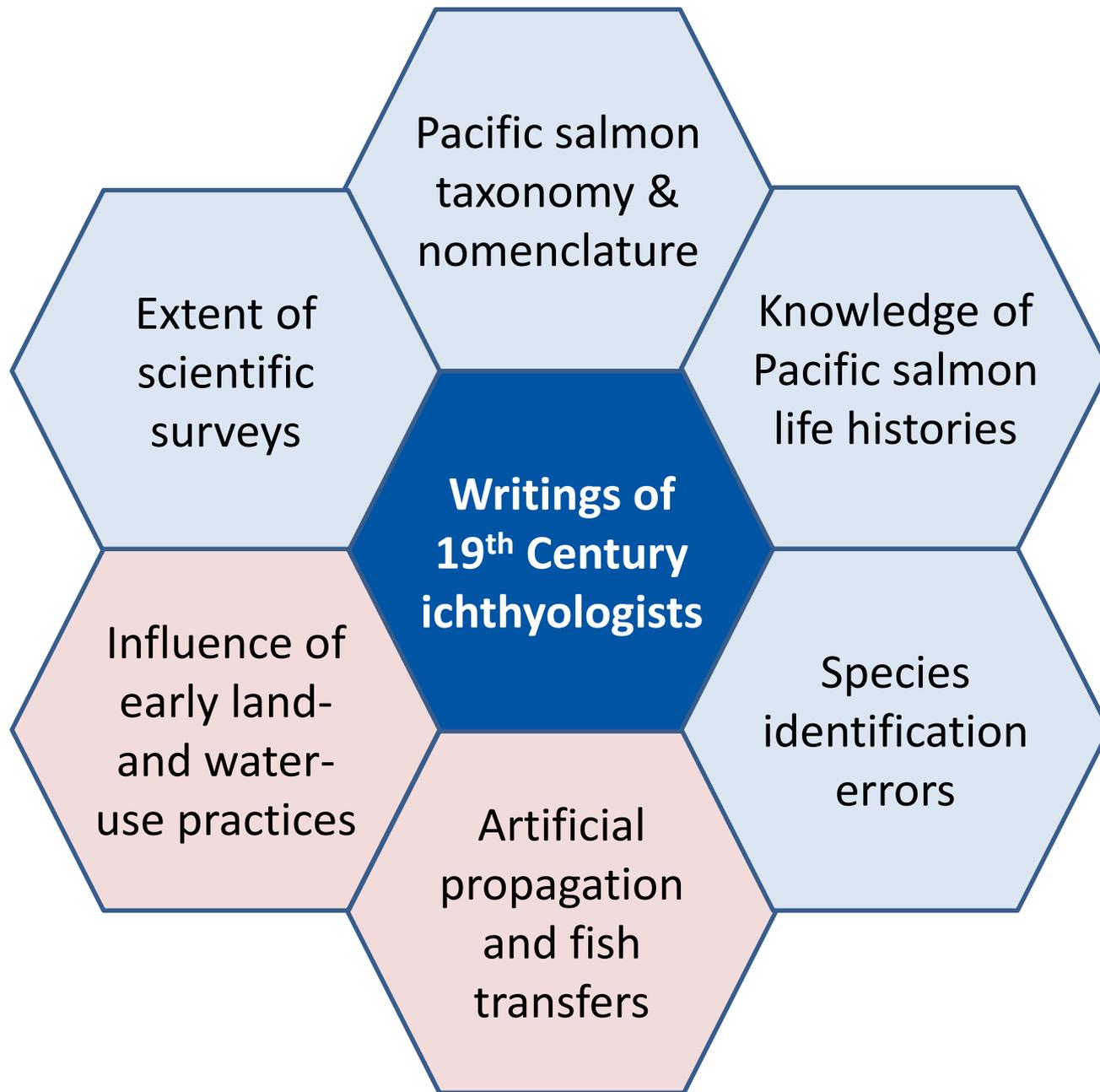




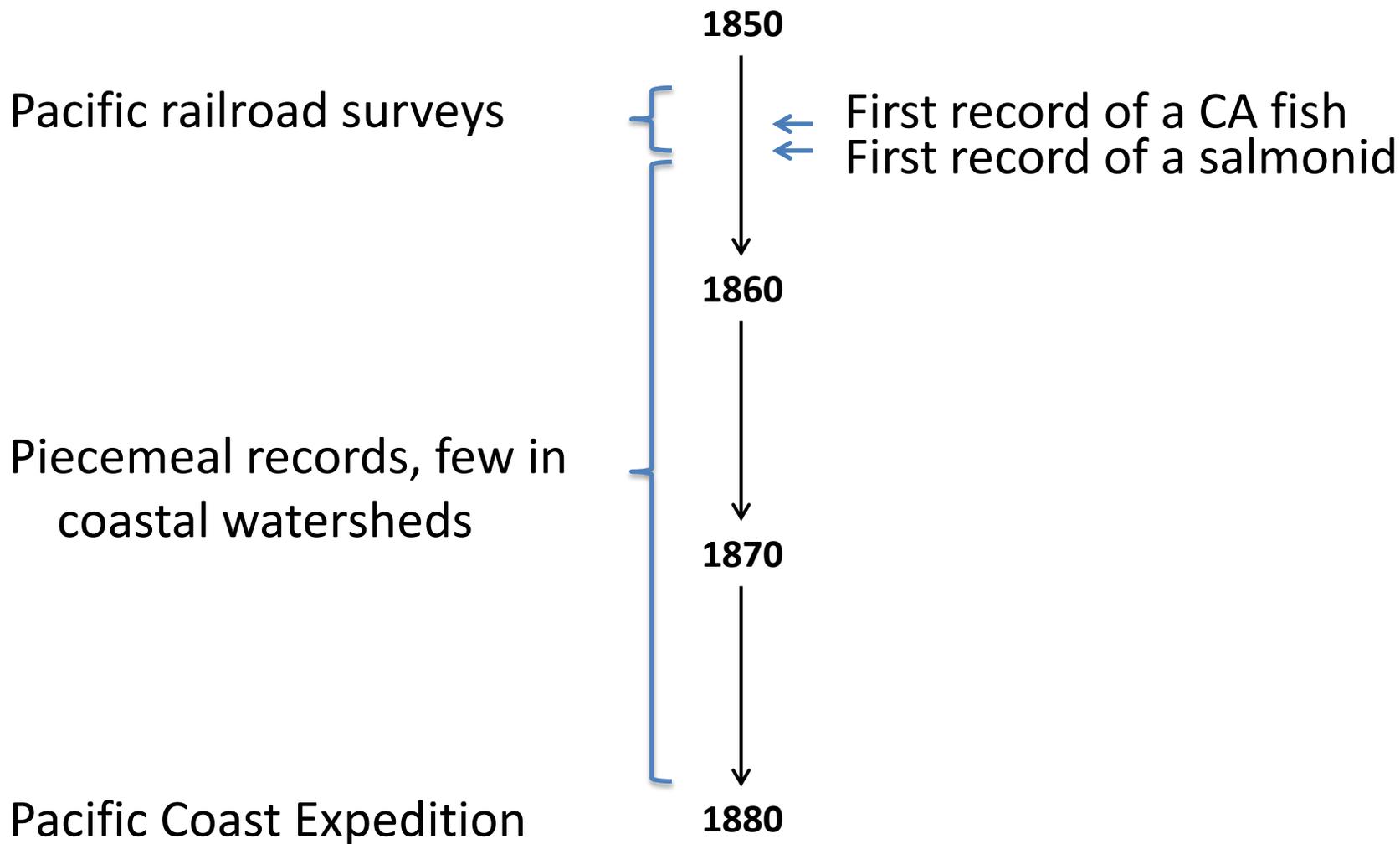




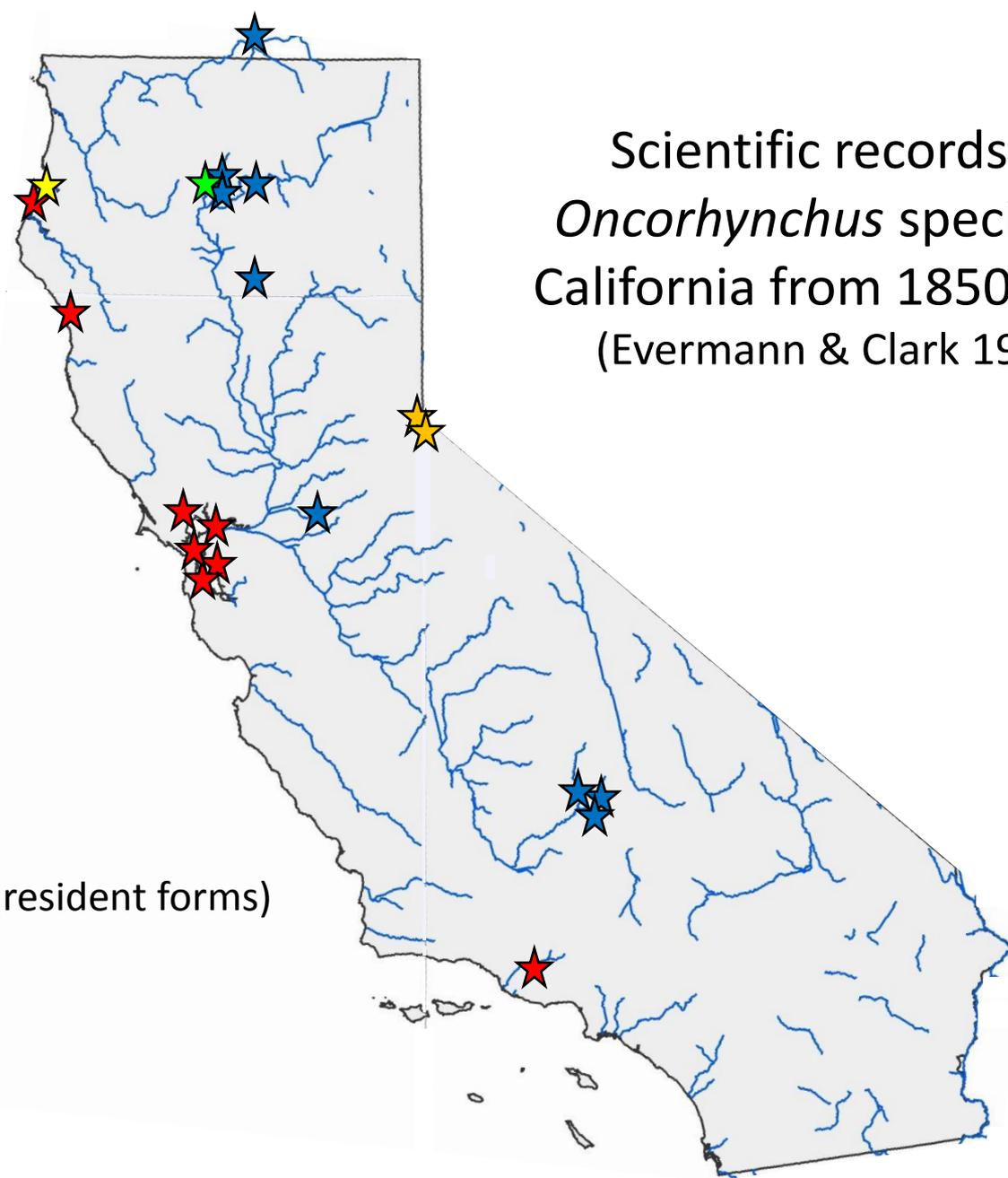




Scientific Exploration in CA: 1850-1879



Scientific records of
Oncorhynchus species in
California from 1850-1880
(Evermann & Clark 1931)



- ★ *O. mykiss irideus*
- ★ *O. mykiss* subsp. (resident forms)
- ★ *O. clarkii clarkii*
- ★ *O. clarkii henshawi*
- ★ *O. tshawytscha*

Taxonomy and Nomenclature



Georg Wilhelm Steller

Steller ~1741, as published by Krasheninnikov 1755

gorbufche

keta

narka

white fish
(milktschutsch)

chavitji

Walbaum 1792

Salmo
Gorbufcha

Salmo
Keta vel Kayko

Salmo
Nerka

Salmo
Hifutch
(Salmo
Milktshitsch)

Salmo
Tjhawytjscha

*Oncorhynchus
gorbuscha*

*Oncorhynchus
keta*

*Oncorhynchus
nerka*

*Oncorhynchus
kisutch*

*Oncorhynchus
tschawytscha*

Salmo proteus

Salmo lagocephalus

Salmo lycaodon

Salmo milktschitch

Salmo argyreus

Salmo goruscha

Salmo scouleri

Salmo japonensis

Salmo kisutch

Salmo warreni

Salmo gibber

Salmo confluentus

Salmo canis

Salmo striatus

Salmo quinnat

Salmo scouleri

Keta vel Kayko

Salmo cooperi

Salmo kysutch

Fario argyreus

Oncorhynchus scouleri

Salmo Keta vel Kayko

Salmo scouleri

Salmo sanguinolentus

Salmo tschawytcscha

Salmo tshawytschifornis

Salmo japonensis

Salmo truncatus

Salmo tsuppitch

Salmo orientalis

Oncorhynchus proteus

Salmo dermatinus

Salmo richardi

Salmo macrostoma

Salmo confluentus

Salmo consuetus

Salmo paucidens

Oncorhynchus lycaodon

Oncorhynchus quinnat

Salmo canis

Salmo dermatinus

Salmo scouleri

Oncorhynchus orientalis

Oncorhynchus lagocephalus

Salmo aurora

Oncorhynchus perryi

Oncorhynchus chouicha

Oncorhynchus haberi

Salmo consuetus

Oncorhynchus tsuppitch

Salmo cooperi

Salmo nerka

Oncorhynchus sanguinolentus

Salmo richardi

Oncorhynchus lycaodon

Salmo kennerlyi

Hypsifario kennerlyi

Salmo tapdisma

Salmo arabatch

Salmo melanopterus

Salmo warreni

Oncorhynchus paucidens

Oncorhynchus nerka kennerlyi

Fario aurora



Spencer Fullerton Baird - 1867

*“The western salmon (*Salmo quinnat?*)—...The waters of California, Oregon, and British Columbia boast of the possession of several kinds [of salmon], how **many of which has not been ascertained**, as the different ages and sexes of one have in many instances been described as two or more totally distinct species. One of the **objects of the Fish Commission is to solve the problem in question**, by securing specimens of all ages and both sexes from all North American localities, and, by critical investigation and comparison, to determine precisely the limitations and relationships of each kind.”*

Baird 1874

Oncorhynchus gorbuscha

Oncorhynchus keta

Oncorhynchus nerka

Oncorhynchus kisutch

Oncorhynchus tschawytscha

Salmo proteus

Salmo gorbuscha

Salmo gibber

Salmo scouleri

Oncorhynchus scouleri

Salmo tshawytschiformis

Oncorhynchus proteus

Salmo lagocephalus

Salmo scouleri

Salmo confluentus

Keta vel Kayko

Salmo Keta vel Kayko

Salmo japonensis

Salmo dermatinus

Salmo consuetus

Salmo canis

Oncorhynchus lagocephalus

Oncorhynchus haberi

Salmo lycaodon

Salmo japonensis

Salmo canis

Salmo cooperi

Salmo scouleri

Salmo truncatus

Salmo richardi

Salmo paucidens

Salmo dermatinus

Salmo aurora

Salmo consuetus

Salmo nerka

Oncorhynchus lycaodon

Salmo kennerlyi

Hypsifario kennerlyi

Salmo tapdisma

Salmo arabatch

Salmo melanopterus

Salmo warreni

Oncorhynchus paucidens

Oncorhynchus nerka kennerlyi

Fario aurora

Salmo milktschitch

Salmo kisutch

Salmo striatus

Salmo kysutch

Salmo sanguinolentus

Salmo tsuppitch

Salmo macrostoma

Oncorhynchus lycaodon

Salmo scouleri

Oncorhynchus perryi

Oncorhynchus tsuppitch

Oncorhynchus sanguinolentus

Salmo argyreus

Salmo warreni

Salmo quinnat

Fario argyreus

Salmo tschawytcsha

Salmo orientalis

Salmo confluentus

Oncorhynchus quinnat

Oncorhynchus orientalis

Oncorhynchus chouicha

Salmo cooperi

Salmo richardi



Major George Suckley

*“Since Steller’s time, writers of **all degrees of incompetence**, and writers with **scanty materials** or with **no material** at all, have done their worst to confuse our knowledge of these salmon, until it became evident that no exact knowledge of any of the species remains...”*

David Starr Jordan 1887

*“...The descriptive literature of the Pacific salmon is among the very worst extant in science. This is not, however, altogether the fault of the authors, but it is in great part due to the **extraordinary variability in appearance of the different species of salmon**. These variations are, as will be seen, due to several different causes, notably to differences in **surroundings**, in **sex**, and in **age**, and in conditions connected with the process of **reproduction**.”*

David Starr Jordan 1887

Jordan. 1878. A catalogue of the fishes of
the fresh waters of North America

Oncorhynchus gorbuscha. North Pacific coasts of Asia and America

Oncorhynchus keta. North Pacific coasts of Asia and America

Oncorhynchus nerka. North Pacific coasts of Asia and America

Oncorhynchus quinnat. Coasts of California to British Columbia

Oncorhynchus kennerlyi. Sacramento River to British Columbia

Jordan. 1878. A catalogue of the fishes of the fresh waters of North America

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Oncorhynchus quinnat. Coasts of California to British Columbia

Oncorhynchus kennerlyi. Sacramento River to British Columbia

Salar tsuppitch. California to Washington

Jordan & Henshaw. 1878. Report of the Chief of Engineers to the Secretary of War

Salmo tsuppitch:

“This trout appears to be quite widely distributed, and specimens were obtained at several localities far distant from each other.”

Localities:

N. Fk. Kern River

Lake Tahoe, Pyramid Lake

tributary of Pitt River (Modoc Co.)

Clackamas River, OR

Adding to the confusion

Quinnat salmon = Chinook salmon?

Silver salmon = coho salmon?

Dog salmon = chum salmon?

The 1880 Pacific Coast expedition



Jordan 1880 (age 29)



Gilbert 1880 (age 21)

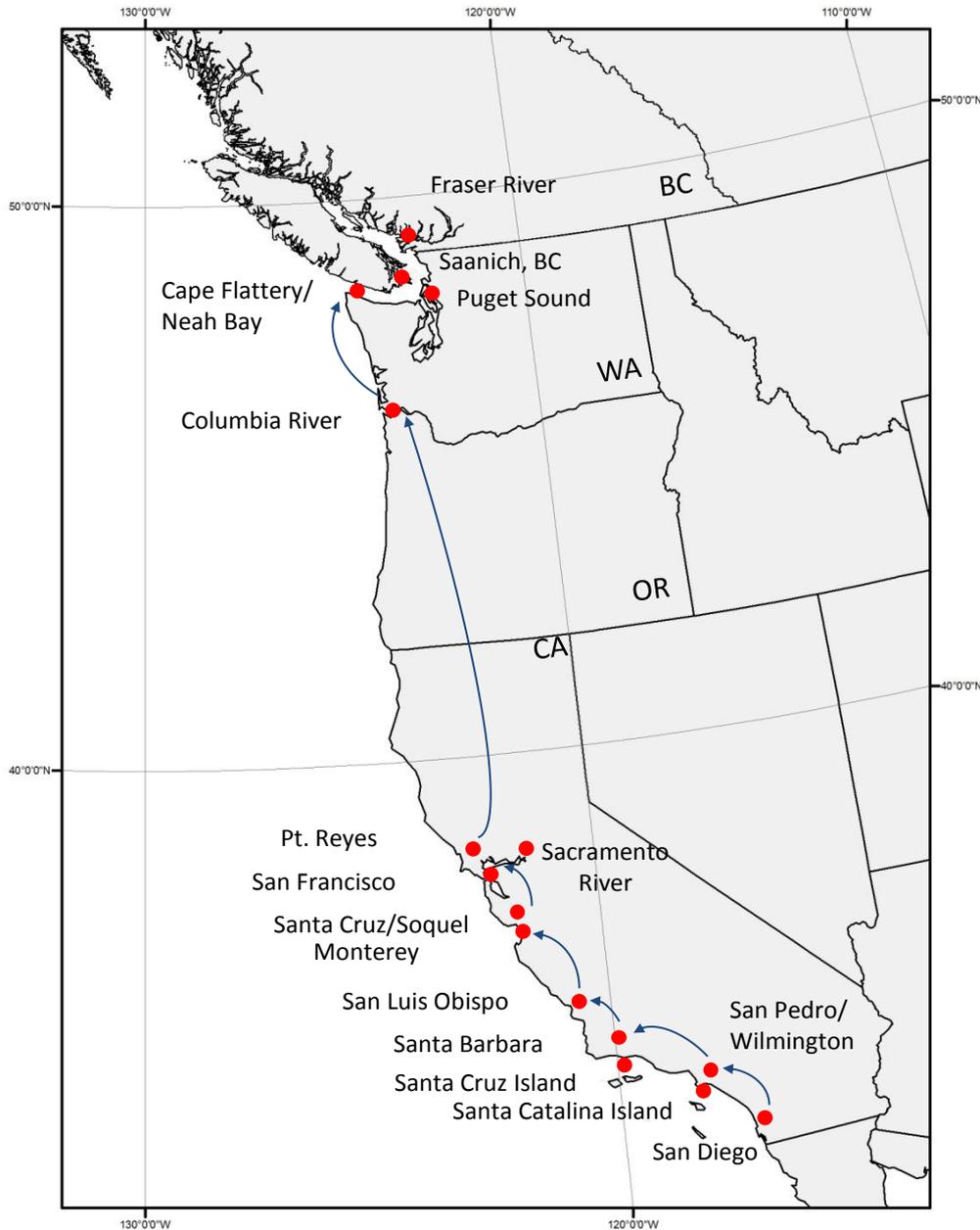


Route of 1880 Pacific Coast Expedition led by Jordan & Gilbert



Route of 1880 Pacific Coast Expedition led by Jordan & Gilbert

- Focus on marine fishes



Route of 1880 Pacific Coast Expedition led by Jordan & Gilbert

- Focus on marine fishes
- Timing not optimal for fall-spawning salmon



Route of 1880 Pacific Coast Expedition led by Jordan & Gilbert

- Focus on marine fishes
- Timing not optimal for fall-spawning salmon
- Bypassed all of northern California and Oregon

Name.	Number of gill-rakers.	Number of anal rays (developed).	Number of pyloric cæca.	Number of scales in a longitudinal series.	Number of branchioste- gals.	Average weight (pounds).	Markings.
Kisutch	$\frac{10}{13}$	13	70	128	13-14	6	Back spotted; tail unspotted, except upper ray.
Chouicha	$\frac{10}{14}$	16	160	142	15-19	20	Back and tail spotted.
Keta	$\frac{9}{14}$	15	160	145	13-14	12	Dorsal region with fine spots, which are often obsolete.
Nerka	$\frac{16}{23}$	14	80	132	13-15	6	No spots anywhere in spring; young with vague spots on back; tail speckled in fall.
Gorbuscha.....	$\frac{11}{17}$	14	225	180	12	4	Back and tail spotted.

Oncorhynchus gorbuscha

*“**Sacramento River northward** to the Arctic Sea; abundant in Puget Sound on alternate years, 1880 being a year of scarcity. Occasionally seen in the Columbia and Sacramento, but not sufficiently abundant to constitute a distinct run.”*

Oncorhynchus keta

*“**San Francisco to Behring’s Straits**; very abundant in the fall when it runs in all streams, but not to a great distance.”*

Oncorhynchus nerka

*“**From Columbia River to the Aleutian Islands**: the principal salmon of Frazer’s River; unknown in Eel River, Rogue River, and in the Sacramento.”*

Oncorhynchus kisutch

*“**Sacramento River to Puget Sound and northward**; very abundant in summer and fall.”*

Oncorhynchus chouicha

*“**From Ventura River northward** to Behring's Straits, ascending Sacramento, Rogue's, Klamath, Columbia, and Frazer's Rivers in spring, as well as the streams of Alaska, Kamtschatka, Japan, and Northern China; in fall ascending these and probably all other rivers in greater or less abundance; the young taken in Monterey Bay, Puget Sound, etc., in summer in considerable numbers.”*

Jordan and Gilbert 1881

Name.	Puget Sound.	Columbia River.	San Francisco.	Monterey Bay.	San Luis Obispo.	Santa Barbara.	San Pedro.	San Diego.	Greatest abundance.
210. <i>Salvelinus malma</i> * (Walb.) J. & G.	+	+	N
211. <i>Salmo purpuratus</i> Pallas	+	+	+	+	N
212. <i>Salmo irideus</i> Gibbons	.	.	.	+	N
213. <i>Salmo gairdneri</i> Rich	+	+	+	+	N
214. <i>Oncorhynchus kennerlyi</i> (Suckl.) Jor	+	+	N
215. <i>Oncorhynchus gorbuscha</i> (Walb.) Gill & Jor	+	+	+	N
216. <i>Oncorhynchus keta</i> † (Walb.) Gill & Jor	+	+	+	N
217. <i>Oncorhynchus kisutch</i> ‡ (Walb.) J. & G.	+	+	+	N
218. <i>Oncorhynchus tshawytscha</i> (Walb.) J. & G.	+	+	+	+	N
219. <i>Oncorhynchus nerka</i> (Walb.) Gill & Jor	+	+	N

*“It is the prevailing impression that the salmon have some special instinct which leads them to return to spawn in the same spawning grounds where they were originally hatched. **We fail to find any evidence of this** in the case of the Pacific Coast salmon, and we do not believe it to be true.”*

Jordan & Gilbert. 1881. Observations on the salmon of the Pacific.

“It seems more probable that the young salmon, hatched in any river, mostly remain in the ocean within a radius twenty, thirty, or forty miles of its mouth.”

Jordan & Gilbert. 1881. Observations on the salmon of the Pacific.

1895-1900

Systematic sampling of coastal watersheds
begins

Stanford Zoology Club - 1898



Stanford Zoology Club - 1898



Chas.
Gilbert

Stanford Zoology Club - 1898



Mrs. Chas.
Gilbert

Chas.
Gilbert

Stanford Zoology Club - 1898



Lou
Henry

Stanford Zoology Club - 1898



Norman
Scofield

Alvin
Seale

Chas.
Pierson

Stanford Zoology Club - 1898



Cloudsley Rutter

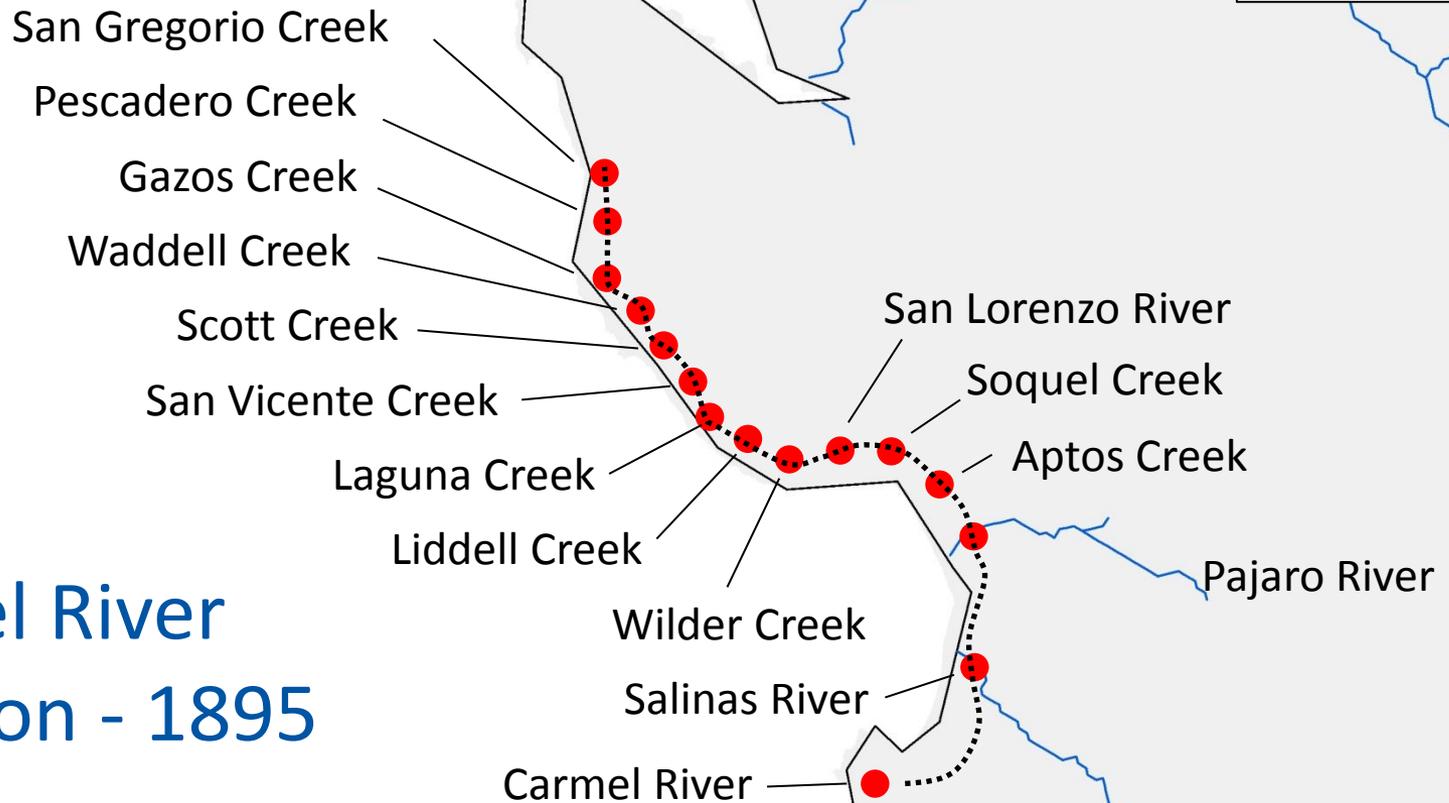
Norman Scofield

Alvin Seale

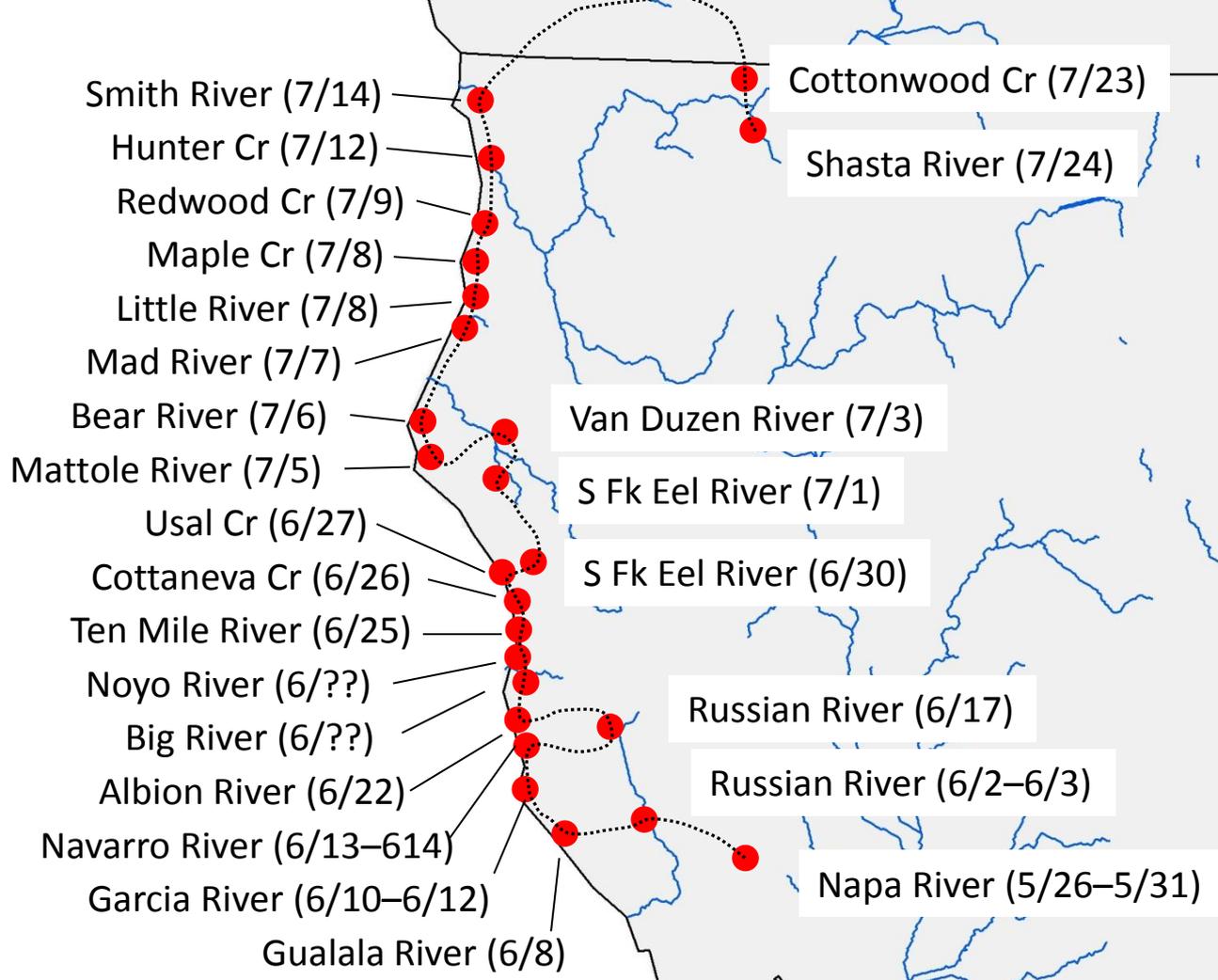
Chas. Pierson

Carmel River Expedition - 1895

Rutter, Scofield, Seale, Pierson



Stream	1895 Identification	Modern identification
Carmel River	<i>S. irideus</i>	<i>O. mykiss</i>
Salinas River	<i>S. irideus</i>	<i>O. mykiss</i>
Soquel Creek	<i>S. irideus</i>	<i>O. mykiss</i>
San Lorenzo R.	<i>S. irideus</i>	<i>O. mykiss</i>
Wilder Creek	<i>S. irideus</i>	<i>O. mykiss</i>
Liddell Creek	<i>S. irideus</i>	<i>O. mykiss</i>
Laguna Creek	<i>S. irideus</i>	<i>O. mykiss</i>
San Vicente Cr.	<i>S. irideus, O. keta</i>	<i>O. mykiss, O. kisutch, O. tshawytscha?</i>
Scott Creek	<i>S. irideus, O. tshawytscha</i>	<i>O. mykiss, O. kisutch</i>
Waddell Creek	<i>S. irideus, O. keta</i>	<i>O. mykiss, O. kisutch</i>
Gazos Creek	<i>S. irideus, O. keta</i>	<i>O. mykiss, O. kisutch</i>
Pescadero Cr.	<i>S. irideus</i>	<i>O. mykiss</i>
San Gregorio Cr.	<i>S. irideus</i>	<i>O. mykiss</i>



Northern California Expedition – 1897

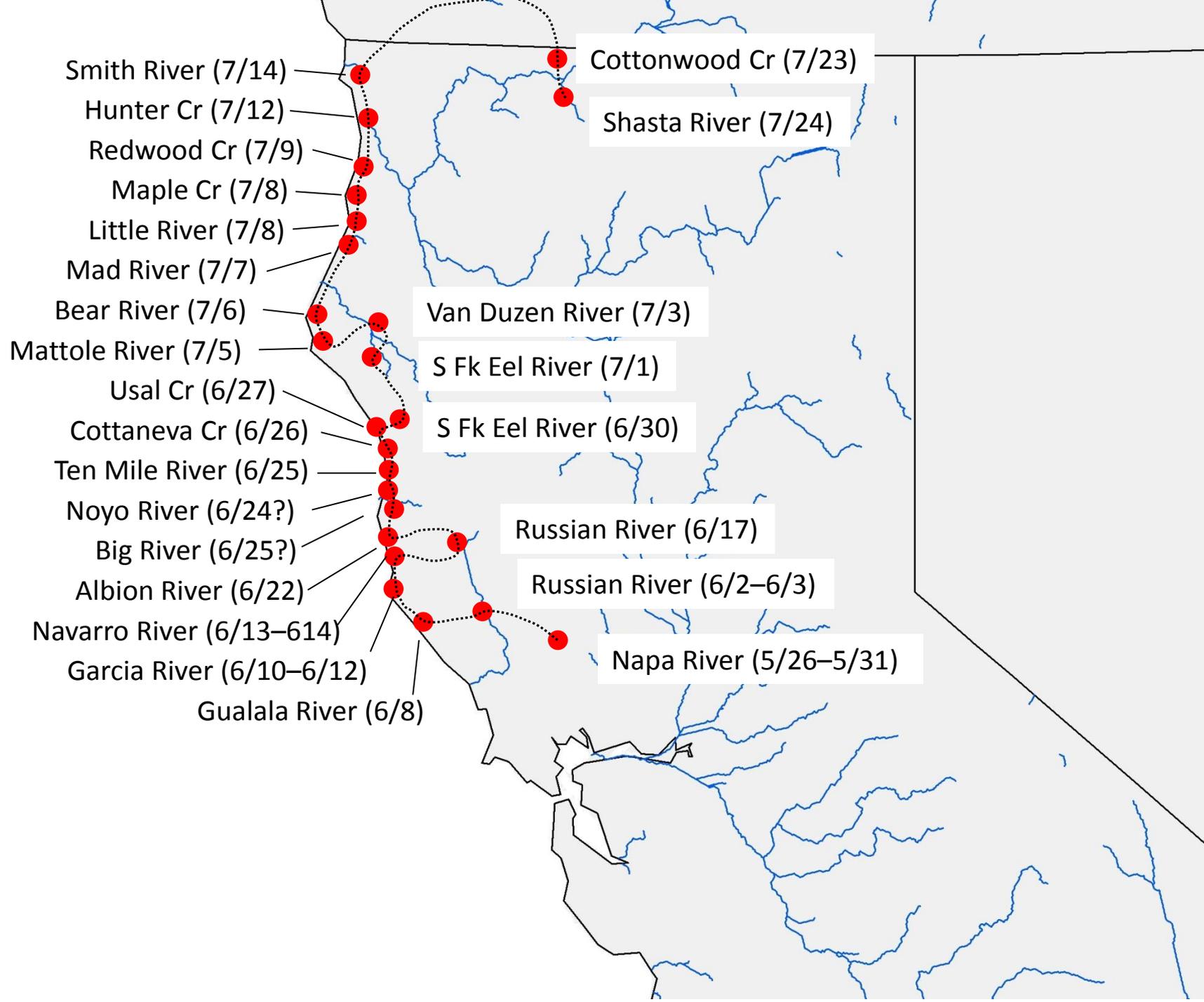
Gilbert & Snyder

27. *Oncorhynchus keta* (Walbaum)

*“Occurs in all except the smallest streams between the Sacramento and Columbia rivers. **The young of this salmon were apparently more abundant than those of any other**”*

29. *Oncorhynchus kisutch* (Walbaum)

*“Said to be commonly found in the larger streams. Specimens were taken in Takenitch Creek, Butte Creek at Eagle Point, Oregon, and in **Redwood Creek**, near Orick, Cal.”*



Gilbert 1912 on *O. keta*

*“Our knowledge of the young is entirely due to Chamberlain [1907], who secured them on their seaward migration as fry....Records of yearling dog salmon have been made by the writer [Gilbert] and by others in the streams of Washington, Oregon, and California, but **all such have been founded on incorrect identification of coho yearlings.**”*

Snyder 1931 on *O. keta* and *O. gorbuscha*

*“Humpback and dog salmon are not common enough anywhere in the state [California] to be of commercial importance; in fact, **they are so rarely seen as to be unknown to any but the most observant fisherman.**”*

*“Of these species, the blue-back predominates in Frazer's River, the silver salmon in Puget Sound, the quinnat in the Columbia and the Sacramento, and the **silver salmon** in most of the small streams along the coast...”*

Jordan & Gilbert 1881, Jordan 1892, Jordan and Evermann 1896

*“Of these species, the blue-back predominates in Frazer River and in the Yukon River, the silver salmon in Puget Sound, the quinnat in the Columbia and the Sacramento, and the **dog salmon** in most of the small streams along the coast...”*

Jordan & Evermann 1902, 1904, 1908

“Only the quinnat salmon has been observed south of San Francisco, and its range has been traced as far as Ventura River...”

Jordan & Gilbert 1881, Jordan 1892, Jordan and Evermann 1896,
Jordan & Evermann 1902, 1904, 1908.

*“Only the quinnat and **dog salmon** have been observed south of San Francisco....*

Jordan 1904b, 1907

*“Only the quinnat salmon or king salmon has been observed south of San Francisco. Its range has been traced as far as **Ventura River**.*

Jordan and Evermann 1896 Jordan & Evermann 1902, 1904, 1908

*“It is found on both coasts of the Pacific, **from Monterey Bay, California**, and China, north to Bering Straits...*

Jordan & Evermann 1902, 1904, 1908

Conclusions

- Salmon science was in its infancy in 1800s
 - *limited exploration of coastal watersheds*
 - *taxonomy not resolved until 1880*
 - *life history understanding poor*
- Legacy of these early writings remains with us today

Conclusions

- Intensive study of many types of information needed to draw conclusions about spp. ranges
 - *early explorers*
 - *newspaper accounts (timing/size)*
 - *museum records (with caution)*
 - *ethnographic/archaeological information*
- Some questions unanswerable

Acknowledgments

Kit Johnston (NOAA SWFSC librarian/magician)

Stanford University Library

Dave Catania (California Academy of Sciences)

*“Sometimes you gotta go back, to
actually move forward”*

Matthew McConaughey 2014