UNIVERSITY OF CALIFORNIA, DAVIS, CENTER FOR WATERSHED SCIENCES, 1 SHIELDS AVE, DAVIS, CA 95616
T (cell): +1 (510) 423-2210 • T (lab): +1 (530) 754-9133 • E: asturrock@ucdavis.edu • www.anna-sturrock.com

ANNA STURROCK *(née Lewis)*

EDUCATION

2008-2012 PhD in Ocean and Earth Science. National Oceanography Centre, Southampton (NOCS), University of Southampton, and Centre for the Environment, Fisheries & Aquaculture Science (Cefas). Thesis: *Environmental and physiological influences on otolith chemistry in a marine fish.* Supervisors: Drs Clive Trueman & Ewan Hunter.

2006-2008 MSc in Marine Science (distinction). University of Otago. Thesis: *Connectivity of sea perch (Helicolenus percoides) populations in southern New Zealand*. Supervisor: Prof. Steve Wing.

2001-2004 BSc in Biological Sciences (First Class Honours in Zoology). University of Edinburgh. Thesis: *The current incidence of imposex in grouped populations of dogwhelks (Nucella lapillus) in the Firth of Forth, UK*. Supervisor: Dr Chris Inchley

1996-2000 Dane Court Grammar School**.** 5As at A-level (Biology, Chemistry, Music, English, General Studies).

PRIMARY RESEARCH INTERESTS

- Using an integrative, interdisciplinary approach (primarily natural & applied tags, field and lab studies, modelling) to understand fish migration behaviour, spatial ecology, and physiology.
- Generating empirical data to inform management, focusing on processes driving ecosystem function and sustainable delivery of ecosystem services in a changing climate.

PROFESSIONAL EMPLOYMENT & RELEVANT WORK EXPERIENCE

2017-*present* **Assistant Project Scientist** - University of California (UC) Davis, Centre for Watershed Sciences. Manage multiple projects (grant list below) using isotope and molecular tools, field experiments and modelling to explore salmon migration, survival, mixing rates, food web ecology and growth. Projects range from the upper watershed to the estuary. Currently supervise 8 staff/students and 1 postdoc.

2015-2017 ---------- *Total of one year maternity leave* ----------

2016-2017 **Postdoctoral scholar** - UC Davis with Drs Mike Miller (UC Davis) & Rachel Johnson (NOAA/UC Davis). *Reconstructing juvenile salmon growth, condition and delta habitat use in the 2014-15 drought & beyond.* This project addressed critical data gaps regarding movements, feeding ecology, condition and health of juvenile salmon moving through the San Francisco estuary in drought and flood years.

2016 **Postdoctoral scholar** - UC Berkeley with Dr Stephanie Carlson. *Managing natural resources for adaptive capacity: The Central Valley Chinook salmon portfolio*. Described historical patterns in salmon hatchery releases (1941-2017), modelled the influence of environmental conditions and management practices on straying rates, and reviewed the long-term implications in a changing climate.

2014-2016 **Delta Science Postdoctoral Fellow** - UC Berkeley with Drs Stephanie Carlson and Rachel Johnson. *Scaling of the portfolio effect in California Central Valley Chinook salmon: trends and implications*. Program links young scientists with agency & academic mentors to produce policy-relevant science. Analysed otolith chemistry and juvenile salmon monitoring data across populations and years to explore how environmental conditions influence life history diversity, trait selection and resilience.

2012-2014 **Postdoctoral scholar** - UC Santa Cruz with Dr Rachel Johnson. Explored trends in juvenile salmon life history diversity and selective mortality in the Stanislaus River by combining juvenile salmon trapping data (abundance and phenology) with otolith strontium isotopes from surviving adults.

2007 **Scientific diver** performing underwater surveys to monitor biological and physical habitat changes across a new network of marine reserves and marine protected areas in Fiordland (University of Otago and New Zealand Department of Conservation, PI: Prof Stephen Wing).

2005 **Production assistant** - BBC Natural History Unit working with James Smith (producer/director) on two documentaries: *Battle for the Amazon* and *Tribes of the Amazon.*

2004 **Behavioural ecologist** - Humpback whale Acoustic Research Collaboration [HARC]. Multidisciplinary project analysing how humpback whales use sound (vocalizations and ambient), combining acoustic and visual tracking, behavioural and molecular analyses.

Collaborators: University of Queensland (UQ), Scripps and Woods Hole Oceanographic Institutions. PI: Dr Mike Noad (UQ).

2004 **Science officer** - independent expedition to study geographic dialect in the Great Call of agile gibbons (*Hylobates agilis*), Borneo.

2002-2003 **Survey coordinator/project leader** - independent diving expeditions to assess coral reef health in Zanzibar (2002) and Madagascar (2003). As expedition leader in 2003, I supervised eight Edinburgh University students and three local scientists from the Université de Toliara.

TEACHING & MENTORSHIP

2019 **Lecturer**. UC Davis Environmental Policy and Management (EPM200A, MSc program). *Water and fish management in California: Balancing competing needs in a changing climate.*

2019 **Lecturer**. UC Davis Wildlife, Fish, and Conservation Biology (WFC10, Wildlife Ecology and Conservation, BSc program >100 students). *Marine systems and climate change in the oceans.*

2019 **Lecturer**. UC Davis Wildlife Conservation & Fisheries Biology (WCB120, Biology and Conservation of Fishes, BSc program >100 students). *Fish movement: Monitoring & managing moving targets.*

2019 **PhD external examiner** (Jasmin Martinho, University of Adelaide, Australia).

2019 **Lecturer**. UC Berkeley - Environmental Science, Policy & Management (Wildlife, Fisheries, and Conservation Biology Seminar / ESPM C115C Fish Ecology undergrad program). *Weakened salmon portfolios in regulated riverscapes: What have we done & can we be smarter?*

2017-*present* **Supervisor/mentor.** UC Davis. Currently supervise/co-supervise four lab technicians, three undergraduate students, one MSc student, and one postdoctoral scholar. Previously mentored two lab technicians & four undergraduates who recently moved into industry or onto graduate school.

2016 **Lecturer**. University of Alaska Fairbanks (FISH 493 Salmon & Society, MSc class). *A perspective on California Central Valley Salmon.*

2015 **Lecturer**. UC Berkeley - Environmental Science, Policy & Management (Wildlife, Fisheries, and Conservation Biology Seminar). *Listening into the past: Using fish earbones to reconstruct life history patterns & migration pathways across species, systems and hydroclimatic regimes.*

2013 **MSc external examiner** (Genevieve D'Avignon, Memorial University of Newfoundland).

2013 **Public lecture.** "14 Black Poppies Science Bytes seminar series" at Progressive Grounds Café, San Francisco, USA. *Finding Nemo: Where were your fish last night?*

2009 **Public Lecture**. Marine Life Talk series at the National Oceanography Centre, Southampton, UK. *Validation and development of otolith microchemistry in free-ranging marine fish.*

2008-2012 **Teaching assistant** for *SOES2006 Phytoplankton & Primary Production* undergraduate classes at the National Oceanography Centre, University of Southampton. Demonstrated in lab and field classes.

2006-2008 **Public educator** at the New Zealand Marine Studies Centre, Otago, New Zealand.

2006-2008 **Educator** for the *Gifted & Talented Education Program* at the New Zealand Marine Studies Centre in Otago, New Zealand – supervising and helping secondary school children plan and implement marine biology projects in the field and laboratory (program director: Steve Cutler).

2005-06, 2008 **Private tutor**. GCSE (all sciences), A-level biology & chemistry. Osborne Cawkwell Tuition, London.

PUBLICATIONS & REPORTS *(Citations = 381, h-index = 7 https://scholar.google.com/citations?User=z33oxkyaaaaj&hl=en)*

Sturrock, A.M., Carlson, S.M., Wikert, J.D., Heyne, T., Nusslé, S., Merz, J, Sturrock, H., Johnson. R.C. (in press) Unnatural selection of salmon life histories in a modified riverscape. *Global Change Biology.*

Sturrock, A.M., Satterthwaite, W., Yoshida, K.M., Huber, E.R., Sturrock, H.J.W., Nusslé, S., Carlson, S.M. (2019) Eight decades of hatchery salmon releases in the California Central Valley: Factors influencing straying and resilience *Fisheries* 44(9), 433-444. doi: 10.1002/fsh.10267 [online web application: baydeltalive.com/fish/hatchery-releases]

Morais, P., Dias, E., Cerveira, I., Carlson, S.M., Johnson, R.C., Sturrock, A.M. (2018) How scientists reveal the secret migrations of fish. *Frontiers for Young Minds* 6:67. doi: 10.3389/frym.2018.00067.

Willmes, M., Hobbs, J.A., Sturrock, A.M., Bess, Z., Lewis, L.S., Glessner, J., Johnson, R.C., Kurth, R., Kindopp, J. (2018). Fishery collapse, recovery, and the cryptic decline of wild salmon on a major California river. *Canadian Journal of Fisheries & Aquatic Sciences* 75, 1836-1848.

Phillis, C.C., Sturrock, A.M., Johnson, R.C., Weber, P.K. (2018) Endangered winter-run Chinook salmon rely on diverse rearing habitats in a highly altered landscape. *Biological Conservation* 217, 358-362.

Nusslé, S., Hendry, A.P., Knapp, R, Bogan, M., Sturrock, A. M., Carlson, S.M. (2017) Thirty-five experimental fisheries reveal the mechanisms of selection." *bioRxiv* doi: https://doi.org/10.1101/141259

Sturrock, A.M., Heyne, T., Wikert, J.D., Mesick, C., Hinkelman, T., Hubbard, A., Weber, P.K., Whitman, G., Glessner, J.J., Johnson, R. (2015). Reconstructing the migratory behavior and long-term survivorship of juvenile Chinook salmon under contrasting hydrologic regimes *PLoS ONE* 10(5): e0122380;
Sturrock, A.M., Johnson R.C. et al (2015) Juvenile chinook salmon life history variation and phenotype success contributing to the 2014 American River escapement. Report prepared for the Sacramento Water Forum.
Sturrock, A.M., Hunter, E., Milton J.A., EIMF, Johnson, R.C., Waring, C.P., Trueman, C.T. (2015). Quantifying physiological influences on otolith microchemistry. *Methods in Ecology and Evolution* 6(7): 806-816.
Darnaude, A.M., Sturrock, A.M., Trueman, C.T., EIMF, Mouillot, D, Campana, S.E., Hunter, E. (2014). Listening in on the past: what can otolith $\delta^{18}O$ really tell us about the environmental history of fishes? *PLoS ONE* 9(10): e108539
Sturrock, A.M., Trueman, C.T., Milton J.A., Waring, C.P., Cooper, M., Hunter, E. (2014). Physiological influences can outweigh environmental signals in otolith microchemistry research. *Marine Ecology Progress Series* 500, 245-64
Sturrock, A. M., Johnson, R.C. (2013). Contribution of hatchery and natural origin Chinook salmon to the Lower Yuba River. Report for the Bay-Delta Sport Fishing Enhancement Stamp Program & CDFW. Award # P0981101.
Sturrock, A.M., Trueman, C.T., Hunter, E. (2013). Analysis methods and reference concentrations of 12 minor and trace elements in fish blood plasma. *Journal of Trace Elements in Medicine and Biology* 27, 273-285.
Sturrock, A.M., Whitman, G., Johnson, R. (2012) Otolith microchemistry to determine size at outmigration of adult Chinook salmon in the Tuolumne and Merced rivers. Report for AD Consulting and CDFW (30 pp, Dec. 2012).
Sturrock, A.M., Trueman, C.T., Darnaude, A.M., Hunter, E. (2012). Can otolith microchemistry track individual movements of fully marine fish? *Journal of Fish Biology* 81, 766-795.
Lawton, R., Wing, S. & Lewis, A.M. (2010). Evidence for discrete subpopulations of sea perch (*Helicolenus percoides*) across four fjords in Fiordland, New Zealand. *New Zealand Journal of Marine & Freshwater Research* 44, 309-22

RECENT GRANTS (2014-PRESENT)

In review **UNIfying Concepts and Approaches to marine COnnectivity for improved Ecosystem and Resource maNagement for the SEAs (SEA-UNICORN) e-COST proposal.** Large, multi-disciplinary effort (67 scientists/stakeholders from 26 countries) to improve our understanding of marine connectivity and how to incorporate it into management. Wrote the proposal with PI Dr Audrey Darnaude (CNRS, Montpellier).

2019-2021 **A Genetic and Isotopic Analysis of Yuba River Chinook Salmon in Relation to Flow Conditions.** Combining otolith and genetic tools to tease apart mixing at ecological and evolutionary time-scales and to ascertain how flow management influences juvenile emigration timing and adult homing rates. PI with Dr Mariah Meek (University of Michigan). Trout Unlimited ($50,000)

2019-2022 **Juvenile salmon distribution, abundance, and growth in restored & relict Delta marsh habitats.** Using otolith isotopes and microstructure, isotopic clocks, diet analyses, eDNA, caging studies, and trawling to determine the distributions, sources, feeding ecology, residence times, growth rates, and habitat associations of salmon in the San Francisco estuary, and to improve parameterization of multiple life cycle models. PI with Drs Brett Harvey (DWR); Lenny Grimaldo, Jason Hassrick (ICF); Rachel Johnson, Steve Lindley, Correigh Greene (NOAA); Carson Jeffres (UC Davis). California Department of Water Resources ($2,082,808).

2019-2021 **Eyes and Ears: Using Lens & Otolith Isotopes to Quantify Critical Rearing Habitats for Salmon Viability.** Using isotopic markers recorded in the eye lenses and otoliths of endangered and harvestable salmon to reveal the importance of floodplain habitats for growth and survival. PI with Drs Carson Jeffres and Rachel Johnson. California Department of Fish and Wildlife (CDFW) ($838,279)

2017-2019 **Sacramento River winter-run Chinook salmon life history diversity, growth, and habitat use among varying hydroclimatic regimes.** Characterizing the emigration strategies that enabled endangered winter run salmon survive the drought years of 2013-15. Mentor to Dr Pedro Morais (UC Berkeley) with Drs Rachel Johnson and Stephanie Carlson. Delta Science Fellowship Program & California Sea Grant ($219,288)

2016-2019 **Reconstructing juvenile salmon growth, condition and delta habitat use in the 2014-15 drought & beyond.** Using otolith microstructure and strontium isotopes, and gut contents analyses to fill critical data gaps regarding the use of the San Francisco estuary by juvenile Chinook salmon by determining source populations, rearing behaviours, residence times, trophic subsidies, and growth of juveniles as they move through the estuary under extreme hydrologic conditions. PI with Drs Rachel Johnson & Michael Miller. CDFW ($800,484).

2014-2016 **Scaling of the portfolio effect in California Central Valley Chinook salmon: trends & implications.** Combining otolith strontium isotopes and juvenile salmon monitoring data to explore patterns in rearing behaviour and survival across populations, runs, and hydrologic conditions. PI with Drs Rachel Johnson and Stephanie Carlson. Delta Science Fellowship Program & California Sea Grant ($144,904).

INVITED PRESENTATIONS

2019 Invited speaker at the Collaborative Adaptive Management Team Delta Salmonid Research Workshop, Sacramento, USA. *Salmon rearing in the Delta: Insights from the fish.*

2019 Invited speaker in two sessions in the 2019 joint American Fisheries Society/Wildlife Society meeting in Reno, USA. *Evaluating the role of environmental flows on juvenile salmon life history diversity, growth, and survival; Recent progress in salmon science in the San Francisco Estuary.*

2019 Invited speaker at the Interagency Ecological Program Conference, Folsom, USA. *Weakened salmon portfolio: Does the Delta play a role?*

2017 Invited speaker at the Central Valley Science Integration Team meeting, Sacramento, USA. *Seventy-seven years of Chinook salmon hatchery releases in the California Central Valley.*

2016 Plenary speaker at the Association of California Water Agencies Region 4 Annual Meeting, Woodland, USA. *Juvenile salmon life history diversity & survival in the American River: Developing science that will inform future salmon recovery efforts.*

2016 Plenary speaker at the Sacramento Water Forum annual meeting, Sacramento, USA. *Natal contributions and juvenile salmon life history diversity in the American River.*

2016 Expert speaker at the State Water Resources Control Board public hearing *"Amendment to the Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary: San Joaquin River Flows & Southern Delta Water Quality",* Sacramento. *Salmon life history portfolios in a regulated river (www.waterboards.ca.gov/board_info/media/nov2016/baydelta_phase1_hearing_112916.shtml at 04:59).*

2016- Inviter speaker for various agency partners: US Fish & Wildlife Service Delta Juvenile Fish Monitoring Program (2016, 2017, 2018), Central Valley Project Salvage Facility (2018), various IEP Project Work Team meetings (Tidal Wetlands – 2016; Biotelemetry – 2017), National Marine Fisheries Service (2016), Yuba River Management Team (2016), USA.

2014 Invited speaker at the Interagency Ecological Program Conference, Folsom, USA. *When to bolt, fry or smolt? Using otolith strontium isotopes to determine juvenile salmon migration pathways and survival across phenotypes and hydrologic regimes.*

OTHER CONFERENCE PRESENTATIONS

2019 Salmon Restoration Federation, Santa Rosa, USA. *Co-author on two posters presented by my students.*

2018 Bay Delta Science Conference, Sacramento, USA. *Oral presentation & co-authored 2 presentations.*

2018 International Otolith Symposium, Keelung, Taiwan. *Oral presentation & co-authored 2 presentations.*

2018 American Fisheries Society (AFS), Cal-Neva Chapter. San Luis Obispo, USA. *Oral presentation*

2017 Interagency Ecological Program Conference, Folsom, USA. *Poster presentation*

2016 AFS meeting, Cal-Neva Chapter. Santa Cruz, USA – *Oral presentation.*

2016 Interagency Ecological Program Conference, Folsom, USA. *Poster presentation*

2016 Bay Delta Science Conference, Sacramento USA. *Oral & poster presentation; co-author on 3 presentations.*

2015 12th Biennial State of the San Francisco Estuary Conference, Oakland, USA. *Poster presentation*

2015 AFS National Meeting, Portland, USA. *Oral presentation*

2014 Interagency Ecological Program Conference, Folsom, USA. *Poster & oral presentations*

2014 International Otolith Symposium, Majorca, Spain. *Oral presentations.*

2014 AFS meeting, Cal-Neva Chapter. Sacramento, USA. *Oral presentation.*

2014 Bay Delta Science Conference, Sacramento USA. *Oral & poster presentation; co-author on 2 presentations.*

2013 Coastal & Estuarine Research Federation meeting, San Diego, USA. *Oral presentation.*

2013 Interagency Ecological Program Conference, Folsom, USA. *Poster presentation*

2012 Bay Delta Science Conference, Sacramento, USA. *Poster presentation.*

2012 ICES Annual Science Conference, Bergen, Norway. *Oral presentation.*

2012 6th World Fisheries Congress Meeting, Edinburgh, UK. *Oral presentation.*

2011 8th International Flatfish Symposium, Ijmuiden, The Netherlands. *Oral and poster presentation.*

2011 FSBI Conference, Bournemouth, UK. *Poster presentation.*

2010 AFS National meeting, Pittsburgh, USA. *Poster presentation.*

2010 Marine Biological Association student conference, Southampton, UK. *Oral presentation.*

2010 Institute of Fisheries Management conference, Portsmouth, UK. *Poster presentation.*

2009 International Otolith Symposium, Monterey, USA. *Oral and poster presentations.*

2009 Marine Biological Association student conference. Glasgow, UK. *Oral presentation.*

SERVICE & OUTREACH

2019 Wrote science blog and developed a database and web app in R (Shiny) to accompany manuscript (app includes links to the code and database) *https://californiawaterblog.com/2019/09/22/the-long-and-winding-road-of-salmon-trucking-in-california/* and *https://baydeltalive.com/fish/hatchery-releases*

2019 Creating a strontium isotope database/web app (early version here: *annasturrock.shinyapps.io/ca_sr_isoscape*)

2019 Symposium session organizer for the 2019 joint American Fisheries Society/Wildlife Society meeting: *Novel Tools and Approaches to Measuring Restoration Benefits for Native Fishes*

2018 Wrote a blog about our article showing frequent use of unprotected habitats by an endangered fish: *www.californiawaterblog.com/2018/01/07/new-paths-to-survival-for-endangered-winter-run-chinook-salmon*

2018 Bay Delta Art-Science collaboration with Tamar Assaf. Our short film '*Hanging by a Thread*' was shown at the Bay-Delta Conference, Sacramento (available at: *www.tamarassaf.com/salmon*).

2017-18 Ran public education exhibit at the 2017 & 2018 Stanislaus River Salmon Festivals, CA (~4000 attendees).

2018 Organized a SPEAK (Scientists for Public Engagement and Knowledge) lecture at UC Davis with visiting scientist Zoe Doubleday (University of Adelaide): *The other side of scientific writing - Increasing the readability and readership of what we write*.

2017- Share ideas, articles, code, job postings via Twitter *(@otolithgirl*, 442 followers), personal website (*www.anna-sturrock.com*), and Github (*https://github.com/annasturrock*)

2017- *Ad-hoc* University service – peer group service, biweekly lab meetings, monthly PI meetings, voting on promotions, organizing new hires –job postings, selection committees, leading interviews.

2017- Collaborator and member of the Sutter Bypass Working Group.

2015- Media coverage and comments: *www.methodsblog.com/2015/06/15/otoliths*
www.newscientist.com/article/dn27541-exact-map-of-salmon-journeys-drawn-from-strontium-in-their-ears
www.sacbee.com/news/state/california/water-and-drought/article187861334.html
https://twitter.com/otolithgirl/status/1176211930114998273

2010 Organized the 2010 Marine Biological Association (MBA) Student Conference, Southampton.

2008-11 Ran the "Rhubarb" postgraduate talk series at National Oceanography Centre, Southampton.

Ad-hoc reviewer for Sea Grant College Program, Comparative Biochemistry and Physiology, Ecology of Freshwater Fish, Estuarine Coastal & Shelf Science, Fish & Fisheries, Fisheries Research, Geochimica et Cosmochimica Acta, ICES Journal of Marine Science, Journal of Experimental Marine Biology, Journal of Fish Biology, Journal of Marine Systems, Marine Biology, Marine Ecology Progress Series, Marine & Freshwater Research, Methods in Ecology & Evolution, NZ Journal of Marine & Freshwater Research, PLoS ONE, Transactions of the American Fisheries Society.

AWARDS AND PREVIOUS GRANTS (2003-2013)

2016 Interagency Ecological Program Conference, Folsom CA - best poster award.

2014 Interagency Ecological Program Conference, Folsom CA - best oral presentation award.

2012 Fisheries Society of the British Isles (FSBI) Representative- ICES Annual Conference, Norway (£1000).

2011 National Environmental Research Council Grant to use the Edinburgh Ion Microprobe Facility (>£20,000).

2011 8th International Flatfish Symposium, Ijmuiden, The Netherlands - best poster award.

2010 Institute of Fisheries Management conference, Portsmouth, UK – best poster award.

2010 FSBI/IFS Student travel award to attend the American Fisheries Society conference in Pittsburgh then visit and present at Simon Thorrold's lab at Woods Hole Oceanographic Institute (c. £1,500).

2010 Challenger Society travel award to attend the MBA Conference, Glasgow (£250)

2009 FSBI travel award to attend the International Otolith Symposium, Monterey, USA (£1,000).

2008-12 FSBI PhD Studentship to study at the University of Southampton & Cefas (£53,530).

2007 Royal Forest and Bird NZ small project grant towards MSc research (NZ$2,000).

2006-08 Leverhulme Trust Study Abroad Studentship for MSc at the University of Otago (£50,000).

2003-04 Edinburgh University - multiple grants for self-led expeditions (c. £25,000 total).

2006 Winner of the University of Otago 'Best Student Presentation' & John Jillet Prize.

OTHER SKILLS

- **LAB SKILLS.** Inductively Coupled Plasma Mass Spectrometry (single/multi-collector, solution/solid), Secondary Ion Mass Spectrometry. Water/tissue CNS isotope analysis. Otolith prepping/ageing. Clean room protocols. Blood assays.
- **FIELD SKILLS.** Beam trawl, beach seine, line fishing, push netting, grabs; water sampling; CTD casts; plankton tows; theodolite use. Clean UK & CA driving licences; Powerboat-handling level 2; PADI Divemaster.
- **ANIMAL HANDLING.** UC Santa Cruz CITI Animal Care and Use Stage 1 course (completed Sept 2017). UK Home Office Personal License [expired 2016]. Fish blood sampling, tagging, transport, and husbandry.
- **DATA AND SPATIAL ANALYSES.** Proficient in R, JMP, SPSS, MYSTAT, ArcGIS, QGIS. Completed courses in Spatio-temporal Isotope Analytics using R and ArcGIS (5 days in 2014. University of Utah), mixed effects models in R (2 days in 2011. Exeter University), SPSS multivariate statistics (2 days in 2007. Otago University) and SQL (1 day in 2017. National Marine Fisheries Service/UC Santa Cruz).