Since the 90’s, research has focused on the musculoskeletal ontogeny in fishes, studying how larval performance can be linked to particular anatomical and allometric traits observed during ontogeny. Focus is especially to functional performance in feeding and locomotion. Relying on an extensive expertise to study the evolutionary morphology of the musculoskeletal system in vertebrates, we have also been studying normal and abnormal skeletal development in fish, especially focusing on opercular deformities in gilthead seabream. Using methods, such as geometric morphometrics, histology, micro-CT scanning and 3D reconstructions, clearing and staining, biomechanical analysis and modelling, we try to understand the cause, phenotype and implications of skeletal deformities in aquaculture foodfish, such as African catfish, seabream and European eel, but also ornamentals (seahorses and pipefishes).

Relevant publications:

1. **Adriaens, D. & W. Verraes (1996)** - Ontogeny of cranial musculature in *Clarias gariepinus* (Siluroidei: Clariidae): The adductor mandibulae complex. *Journal of Morphology* 229(3): 255-269.
2. **Adriaens, D. & W. Verraes (1997)** - The ontogeny of the chondrocranium in *Clarias gariepinus*: trends in siluroids. *Journal of Fish Biology* 50(6): 1221-1257.
3. **Adriaens, D. & W. Verraes (1997)** - Ontogeny of the hyoid musculature in the African catfish, *Clarias gariepinus* (Burchell, 1822) (Siluroidei: Clariidae). *Zoological Journal of the Linnean Society* 121(1): 105-128.
4. **Adriaens, D. & W. Verraes (1997)** - Ontogeny of the maxillary barbel muscles in *Clarias gariepinus* (Siluroidei: Clariidae), with some notes on the palatine-maxillary mechanism. *Journal of Zoology (London)* 241: 117-133.
5. **Adriaens, D. & W. Verraes (1997)** - Ontogeny of the suspensorial and opercular muscles in *Clarias gariepinus* (Siluroidei: Clariidae), and the consequences for respiratory movements. *Netherlands Journal of Zoology* 47(1): 61-89
6. **Adriaens, D., W. Verraes & L. Taverne (1997)** - The cranial lateral-line system in *Clarias gariepinus* (Burchell, 1822) (Siluroidei: Clariidae): morphology and development of canal related bones. *European Journal of Morphology* 35(3): 181-208.
7. **Lien, N.T.H., D. Adriaens & C.R. Janssen (1997)** - Morphological abnormalities in African catfish (*Clarias gariepinus*) larvae exposed to malathion. *Chemosphere* 35(7): 1475-1486.
8. **Adriaens, D. & W. Verraes (1997)** – Some consequences of modifications in siluroid chondrocrania: a comparison with *Clarias gariepinus* (Burchell, 1822) (Siluroidei: Clariidae). *Netherlands Journal of Zoology* 47(4): 349-363.
9. **Adriaens, D. & W. Verraes** **(1998)** - Ontogeny of the osteocranium in the African catfish, *Clarias gariepinus* (Burchell, 1822) (Siluriformes: Clariidae): ossification sequence as a response to functional demands. *Journal of Morphology* 235(3): 183-237.
10. **De Schepper, N., D. Adriaens, G.G. Teugels, S. Devaere & W. Verraes (2004)** – Intraspecific variation in the postcranial skeleton morphology in African clariids: a case study of extreme phenotypic plasticity. *Zoological Journal of the Linnean Society* 140(3): 437-446.
11. **Huysentruyt, F., D. Adriaens (2005) -** Descriptive osteology of *Corydoras aeneus* (Gill, 1858) (Siluriformes: Callichthyidae). *Cybium*, 29 (3): 261-273.
12. **Geerinckx, T., Brunain, M. & Adriaens, D. (2005) -** Development of the chondrocranium in the suckermouth armored catfish *Ancistrus cf. triradiatus* (Loricariidae, Siluriformes). *Journal of Morphology* 266(3): 331-355.
13. **Ristovska, M., B. Karaman, W. Verraes & D. Adriaens** **(2006)** – Early development of the chondrocranium in *Salmo letnica* (Karaman, 1924) (Teleostei: Salmonidae). *Journal of Fish Biology* 68(2):458-480.
14. **Geerinckx, T., M. Brunain & D. Adriaens** **(2007)** - Development of the osteocranium in the suckermouth armored catfish *Ancistrus* cf. *triradiatus* (Loricariidae, Siluriformes). *Journal of Morphology* 268(3): 254-274.
15. **Geerinckx, T., Brunain, M., A. Herrel, P. Aerts & Adriaens, D. (2007) -** A head with a suckermouth: a functional-morphological study of the head of the suckermouth armoured catfish *Ancistrus* cf. *triradiatus* (Loricariidae, Siluriformes). *Belgian Journal of Zoology*  137(1): 47-66.
16. **Verhaegen Y., D. Adriaens, T. De Wolf, P. Dhert & P. Sorgeloos (2007)** **-** Deformities in larval gilthead seabream (*Sparus aurata*): a qualitative and quantitative analysis using geometric morphometrics. *Aquaculture* 28: 156-168.
17. **Geerinckx, T. & D. Adriaens** **(2007)** - Ontogeny of the intermandibular and hyoid musculature in the suckermouth armoured catfish *Ancistrus* cf. *triradiatus* (Loricariidae, Siluriformes). *Animal Biology* 57(3): 339-357.
18. **Geerinckx, T., De Poorter, J. & Adriaens, D.** **(2007)** – Morphology and development of teeth and epidermal brushes in loricariid catfishes. *Journal of Morphology* 268: 805-814.
19. **Huysentruyt, F., T. Geerinckx & D. Adriaens** **(2007)** - A descriptive myology of *Corydoras aeneus* (Gill, 1858) (Siluriformes: Callichthyidae), with a brief discussion on adductor mandibulae homologies. *Animal Biology* 57(4): 433-452.
20. **Geerinckx, T., Y. Verhaegen & D. Adriaens (2008)** - Ontogenetic allometries and shape changes in the suckermouth armoured catfish *Ancistrus* cf. *triradiatus* (Loricariidae, Siluriformes), related to suckermouth attachment and yolk sac size. *Journal of Fish Biology* 72:803-814.
21. **Geerinckx, T. & D. Adriaens (2008)** - Ontogeny of the suspensorial and opercular musculature in the suckermouth armoured catfish *Ancistrus* cf. *triradiatus* (Loricariidae, Siluriformes). *Zoomorphology* 127: 83-95.
22. **Huysentruyt, F., M. Brunain & D. Adriaens** **(2008)** - Ontogeny of the chondrocranium in *Corydoras aeneus* (Gill, 1858) (Callichthyidae, Siluriformes). *Journal of Morphology* 269: 522-532.
23. **Frédérich, B., D. Adriaens and P. Vandewalle** **(2008)** - Ontogenetic shape changes in Pomacentridae (Teleostei: Perciformes) and their relationships with feeding strategies: a geometric morphometric approach. *Biological Journal of the Linnean Society* **95(1):** 92-105.
24. **Geerinckx, T., F. Huysentruyt & D. Adriaens (2009)** - Ontogeny of the jaw and maxillary barbel musculature in the armoured catfish families Loricariidae and Callichthyidae (Loricarioidea, Siluriformes), with a discussion on muscle homologies. *Zoological Journal of the Linnean Society* **155:** 76-96.
25. **Van Wassenbergh, S., G. Roos, A. Genbrugge, H. Leysen, P. Aerts, D. Adriaens & A. Herrel (2009) -** Suction is kids play: extremely fast suction in newborn seahorses. *Biology Letters* **5:** 200-203.
26. **Huysentruyt F., Moerkerke, B., Devaere, S. and D. Adriaens (2009).** Early development and allometric growth in the armoured catfish *Corydoras aeneus*. *Hydrobiologia* 627: 45-54.
27. **Huysentruyt F., M. Brunain & Adriaens D. (2009) -** Ontogeny of the cranial musculature in *Corydoras aeneus* (Gill, 1858) (Callichthyidae, Siluriformes). *Journal of Fish Biology* 75(7): 1601-1614.
28. **Morel, C., D.  Adriaens, M. Boone, T. De Wolf, L. Van Hoorebeke & P. Sorgeloos (*2010*)** – Visualizing mineralisation in deformed opercular bones of larval gilthead sea bream (*Sparus aurata*). *Journal of Applied Ichthyology* **26:** 278-279 (short communication).
29. **Roos, G., S. Van Wassenbergh, A. Herrel, D. Adriaens & P. Aerts (2010)** – Snout allometry in seahorses: insights on optimisation of pivot feeding performance during ontogeny. *Journal of Experimental Biology* **213:** 2184-2193.
30. **Geerinckx, T., A. Herrel & D. Adriaens (2011)** - Suckermouth armoured catfishes resolve the paradox of simultaneous respiration and suction attachment: a kinematic study of *Pterygoplichthys disjunctivus*. *Journal of Experimental Zoology A* 315: 121-131.
31. **Roos, G., S. Van Wassenbergh, A. Herrel, D. Adriaens & P. Aerts (2011)** – Effects of snout dimensions on the hydrodynamics of suction feeding in juvenile and adult seahorses. *Journal of Theoretical Biology* **269(1):** 307-317.
32. **Huysentruyt F., Geerinckx T., Brunain M. & Adriaens D. (2011) -** Ontogeny of the osteocranium in *Corydoras aeneus* (Gill, 1858) (Callichthyidae, Siluriformes). *Journal of Morphology* **272:** 573-582.
33. **Leysen, H**.**, J. Christiaens, B. De Kegel, M.N. Boone, L. Van Hoorebeke & D. Adriaens (2011)** – Musculoskeletal structure of the feeding system in *Hippocampus reidi* and *Doryrhamphus dactyliophorus*: Implications of snout elongation in Syngnathidae. *J. Fish Biol.* **78(5):** 1799-1823.
34. **Van Wassenbergh, S., G. Roos, P. Aerts, A. Herrel & D. Adriaens (2011)** – Why the long face? A comparative study of feeding kinematics of two pipefish with different snout lengths. *J. Fish Biol.* **78(5):** 1786-1798.
35. **Leysen, H., G. Roos & D. Adriaens (2011) -** Morphological Variation in Pipefish and Seahorse Head Shape in Relation To Snout Length and Developmental Growth. *Journal of Morphology* **272(10):** 1259-1270.
36. **Leysen, H., E.R. Dumont, L. Brabant, L. Van Hoorebeke & D. Adriaens (2011)** – Modelling stress in the feeding apparatus of seahorses and pipefishes (Teleostei: Syngnathidae). *Biological Journal of the Linnean Society* **104(3):** 680-691.
37. **Wyckmans, M., A. Herrel & D. Adriaens (2011)** – Analysis of ontogenetic changes in head shape and diet in a catfish with moderately enlarged jaw adductors (*Clariallabes melas*). *Belgian Journal of Zoology* **141(2):** 11-20.
38. **Declercq, A.M., K. Chiers, W. Van den Broeck, A. Rekecki, S. Teerlinck, D. Adriaens, F. Haesebrouck & A. Decostere (2013)** - White necrotic tail tips in estuary seahorses (*Hippocampus kuda*, Bleeker 1852). *Journal of Fish Diseases. (published on-line - DOI: 10.1111/jfd.12138).*
39. **Nikolakakis, S., P. Bossier, G. Kanlis, K. Dierkens & D. Adriaens (2014) -** Protocol for quantitative shape analysis of deformations in early larval seabass (*Dicentrarchus labrax* L.). *Journal of Fish Biology* **84:** 206-224. (*DOI: 10.1111/jfb.12284*)
40. **Franz-Odendaal, T.A. & D. Adriaens (2014)** – Comparative developmental osteology of the seahorse skeleton reveals heterochrony amongst *Hippocampus* sp. and progressive caudal fin loss. *BMC EvoDevo* **5(45)**: 1-11 (DOI: 10.1186/2041-9139-5-45).
41. **Bouilliart, M**.**, J. Tomkiewicz, P. Lauesen & D. Adriaens (2015)** - Musculoskeletal anatomy and feeding performance of pre-feeding engyodontic larvae of the European eel (*Anguilla anguilla*). *Journal of Anatomy* **227:** 325-340.
42. **De Meyer, J., J. Christiaens & D. Adriaens (2016)** - Diet-induced phenotypic plasticity in European eel (*Anguilla anguilla*). *Journal of Experimental Biology* **219:** 354-363. (DOI 10.1242/jeb.131714).
43. **Fragkoulis S., Paliogiannis H., Kokkinias P., Chiers K., Adriaens D. & Koumoundouros G. (2017)** - Saddleback syndrome in European sea bass *Dicentrarchus labrax* (Linnaeus, 1758). Anatomy, ontogeny and correlation with lateral-line, anal and pelvic fin abnormalities. *J. Fish Disease*, **40(1):** 83-95. *(DOI 10.1111/jfd.12494)*
44. **Nguyen Phuc, T., B. Verstraeten, B. De Kegel, J. Christiaens, T. De Wolf,  P. Sorgeloos, D. Bonte & D. Adriaens (2017*)*** *-* Ontogenesis of opercular deformities in gilthead sea bream (*Sparus aurata*): A histological description. *J. Fish Biol.* **91(5):** 1419-1434. *(doi:**10.1111/jfb.13460).*
45. **De Meyer, J., A. Herrel, C. Ide, B. De Kegel, J. Christiaens & D. Adriaens (2017)** – Broader head, stronger bite: *in vivo* bite forces in European eel (*Anguilla Anguilla*). *J. Fish Biol. (published on-line) (doi:10.1111/jfb.13511)*
46. **De Meyer, J., G. Maes, R. Dirks, & D. Adriaens (*2017*)** - Differential gene expression in narrow- and broad-headed glass eels (*Anguilla anguilla*) point to a transcriptomic basis for head shape dimorphism, growth rate and chemotaxis in European eel. *Molecular Ecology* **26:** 3943-3953*. (DOI: 10.1111/mec.14155)*
47. **Nikolakakis, S., K. Dierckens, P. Bossier & D. Adriaens (2018)** - Effects of antibiotic-induced differences in bacterial load on growth and shape of early larval European seabass (*Dicentrarchus labrax* L.). *Aquaculture Research* **49(2):** 988-1000*. (DOI:* *10.1111/are.13546).*
48. **De Meyer, J., Bouilliart, M., Dhaene, J. & Adriaens, D. (2018)** - Built to bite? Differences in cranial morphology and bite performance between narrow- and broad-headed European glass eels. *J. Morph.* **279(3):** 349-360. *(DOI: 10.1002/jmor.20776).*
49. **Nikolakakis, S., K. Dierckens, P. Bossier and D. Adriaens (2018)** - Phenotypic effects of antibiotic-induced axenity and disinfection in early larval European seabass (*Dicentrarchus labrax* L.). *Aquaculture Research* **49(7):** 2536-2552 *(DOI* *10.1111/are.13716)*.
50. **Dimitriadi, A., D. Beis, C. Arvanitidis, D. Adriaens, G. Koumoundouros (2018) -** Developmental temperature has persistent, sexually dimorphic effects on zebrafish cardiac anatomy. *Scientific Reports* **8(8125):** 1-10 (*DOI: 10.1038/s41598-018-25991-8)*
51. **De Meyer, J., T. Goethals, T. Augustijns, J. Habraken, J. Hellemans, V. Vandewiele, J. Dhaene, M. Bouilliart & D. Adriaens (2018)** – Dimorphism throughout the European eels’ life cycle: ontogenetic changes in head shape related to dietary differences. *J. Anat.* ***233(3):*** *289-301. (DOI: 10.1111/joa.12836)* .
52. **De Meyer, J., Belpaire, C., Boeckx, P., Bervoets, L., Covaci, A., Malarvannan, G., B. De Kegel & Adriaens, D. (2018)** - Head shape disparity impacts pollutant accumulation in European eel. *Environmental Pollution* **240:** 378-386.