

# 1st Summer Shoal on Fish Ethology & Welfare Marina Julia, Monfalcone, Italia – 2 to 5 September 2017

## A) SPEECH ABSTRACTS

In the order of appearance

### **Assessment of fish species' welfare state and welfare potential in farming**

**Billo Heinzpeter Studer**<sup>1</sup>

President fair-fish international, Director FishEthoBase  
Monfalcone, Italia

FishEthoBase (\*2013) establishes **ethological profiles** of farmed fish species in order to provide a scientific basis to improve **fish welfare**.

FishEthoBase **full profiles** represent and interpret all traceable findings from wildlife, lab and farm.

**Short profiles** on the other hand focus on 10 core criteria, scoring the findings in a risk analysis along 3 dimensions: **Likelihood** of fish welfare under minimal farming conditions, **Potential** of improving fish welfare, and **Certainty** of the findings. The sum of high values in the 3 dimensions yields the **FishEthoScore**, a sharp assessment of the welfare state and the potential of a species.

#### **Major results so far:**

- Short profiles ethologically assess the welfare state and the welfare potential of farmed species, demanding 80 working hours per species. To cover the 450 farmed species so far is a matter of time.
- FishEthoScores across the species differ remarkably, with astonishing bad results for some of the most famed species
- The scores provide advice for choice of species, suggest focal points in consultancy, and indicate research gaps.

For data & more: <http://fishethobase.fair-fish.net>

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## **Driving Mr Tinbergen: The four questions of ethology applied to fish welfare.**

**João L. Saraiva<sup>2</sup>**

Researcher, FishEthoBase  
Faro, Portugal

In 1963 Nikolas Tinbergen published a groundbreaking framework for the study of animal behaviour: the Four Questions of Ethology. This pivotal idea establishes the four levels of analysis that offer an integrative approach to any behavioural question. In aquaculture, these questions can be applied in order to seek and provide welfare solutions for humane fish farming, based on solid scientific foundations.

- **Causation** (mechanism): What stimuli elicit the behavioural responses to farming conditions? What are the molecular, neural, endocrine and overall physiological mechanisms behind these behavioural responses?

- **Development** (ontogeny): how does behaviour of farmed fish change with age, and what early experiences are necessary for these behaviours to develop? What are the relative roles of genes vs environment? Do these behaviours occur as in nature?

- **Function** (adaptation): how does the behaviour influence the animal's fitness in the wild? How does it influence the animal's welfare under farming conditions? Is the behaviour performed in the same context as in the wild?

- **Evolution** (phylogeny): how can the behaviour be compared with related species? What are the selection processes leading to this behaviour? How can farming conditions match these processes?

Throughout the talk several examples of species profiled in FishEthoBase will be discussed. The Four Questions of Ethology are therefore proposed as a key framework to develop novel solutions for welfare in fish farming, benefitting the fish, the farmers and the consumers.

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## **Coping styles and welfare in farmed fish: current understanding and future directions**

**Maria Filipa Castanheira<sup>3</sup>**

Researcher, FishEthoBase  
Vienna, Austria

Individual variation in the response to aversive stimuli by different individuals of a same species, even if they are matching in their morphological features and have experienced same environmental condition for equal duration, has always been a puzzle for biologists. Such variation seems to represent adaptive responses that are crucial for survival in a continuously changing environment. Nevertheless, individuals of the same species show consistent responses in stressful situations, i.e. they exhibit coping styles. Over the past years the interest on understanding coping styles in farmed fish has increased because many studies have established links between coping styles and welfare problems. This presentation will review 1) the methodological approaches used to identify coping styles in the most relevant farmed fish, 2) the main behavioural differences between reactive and proactive coping styles and 3) how the knowledge on coping styles may contribute to improve the welfare of farmed fish. This presentation will show that 1) methods are already available for fast screening of coping styles at the farm level, 2) behavioural characteristics of coping styles in fish share many similarities with other vertebrates and 3) coping styles influence a number of welfare relevant issues such as performance traits, disease resistance, aggression, cognitive ability and affective states.

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## **Farming fish: from stress to quality of life**

**Leonor Galhardo<sup>4</sup>**

Instituto Superior de Psicologia Aplicada (ISPA-IU)  
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Behaviour represents a reaction to the environment, as fish perceive it. A negative perception induces a cascade of stress responses; a positive perception induces a range of behaviours that can be used as positive indicators of fish welfare. A lot remains to be understood in terms of fish behavioural and physiological responses but it is already possible to identify a range of animal-based indicators which promote a better understanding of the environmental key elements that can produce better quality of life. The more this knowledge is adapted to aquaculture, the more ethical it becomes in the forthcoming years.

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## **Let the cephalopods talk to you: behavioural indicators of welfare**

**Pablo Arechavala-Lopez<sup>5</sup>**

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And Reviewer FishEthoBase

Mallorca, Spain

There is a recent growing interest in invertebrate welfare and ethics, and in 2013 “any live cephalopods” became regulated for the first time within the European Union (Directive 2010/63/EU), giving them the same EU legal protection as previously afforded only to vertebrates. That means over 700 extant species (cuttlefish, squid, octopus and nautiloids) are now protected from scientific purposes, but does not apply to aquaculture or public aquaria unless research is being carried out in those facilities. The decision to protect cephalopods was based on the “precautionary principle” as it was evidenced the cephalopods’ sentience and capacity to feel pain, including suffering states as hunger, fear, boredom and nausea. Criteria for identification such signs (i.e. PSDLH) vary with the species, but in general these indicators can be summarized as: i) appearance (e.g. abnormal body coloration, morphology, body posture and appearance); ii) behaviour (e.g. feeding, social interactions, responses to stimuli, stereotypic behaviour, abnormal motion, autophagy); and iii) clinical signs (e.g. abnormal ventilation, reduce body weight, etc.). Just watch them and let the cephalopods talk to you! It will improve both the care given and the manner in which experimental procedures are carried out.

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## **Fish Ethology in a Lobbying Strategy**

**Douglas Waley<sup>6</sup>**

Fish Welfare Program leader  
Eurogroup for Animals, Brussels

Eurogroup for Animals is a Brussels based umbrella organisation for 56 member organisations across Europe and the world. We work directly in the Brussels machine to influence policy and its application, we also run campaigns to educate wider populations and demonstrate its support, and we foster cohesion, exchanging best practice and disseminating knowledge. We are one of four animal welfare organisations recently funded to work on fish welfare specifically, and we will be working in all of those areas. Our vision is to have fish respected as sentient individuals, and to see higher welfare fishing and aquaculture go hand in hand with reduced consumption. In the political arena we have legislation which governs fish welfare but in practice is not applied. For us to strengthen fish specific provisions we need to present concrete and practical guidelines to policy makers, and ethological knowledge is key to defining welfare indicators that are practical, non-invasive and can be applied by existing employees. Fish welfare has a low level of recognition in civil society, and even among our membership. We have a big job of awareness raising to do, at the fundamental level of raising empathy towards fish. For communicating the complexity and social nature of fish to people, we are again relying on ethological knowledge to provide authoritative examples of fish behaviours that people can relate to.

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## **Are all farmed fish in aquaculture domesticated?**

**Fabrice Teletchea<sup>7</sup>**

UR AFPA, Université de Lorraine - INRA,  
Vandœuvre-lès-Nancy, France

Historically the bulk of aquatic products destined to human consumption came from the capture of wild fish in nature. Yet, partly due to the stagnation or even decline of global capture fisheries since the late 1980s, aquaculture has tremendously increased in the past decades. The exponential growth of aquaculture has chiefly relied on the domestication (which is by definition a long and endless process during which animals become adapted to both humans and captive conditions) of an increasing number of both freshwater and marine fish species, particularly since the 1980s for the latter. The first goal of the present study is to describe how fish domestication has evolved throughout the world in the past decades by using a new classification published in 2014, which contains five levels of domestication: from 1 (first trials of domestication) up to 5 (the entire life cycle is closed in captivity and selective breeding programs are used to increase specific traits, such as growth rate, resistance to disease). Then, based on this new classification, the second goal is to discuss three main emerging questions: (i) Is there a link between domestication level and the volume of production? (ii) Is domestication of fish species going too fast in particular in regards to resiliency of production modes and welfare of farmed fish?, and (iii) Following what has occurred on land in the past millennia, should we now focused on a small number of species that will be strongly selected and introduced globally or promote the diversification of the production, based chiefly on native species? For the latter question, a brief overview of the STOREFISH project developed since 2005 will be presented.

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## **Fish Welfare and Seafood Ethics**

**Mimi E Lam<sup>8</sup>**

Centre for the Study of the Sciences and the Humanities (SVT),  
University of Bergen, Norway

Public concern over fish welfare is increasing, particularly in relation to seafood ethics. Fish have neuro-architecture analogous to mammals that can process and integrate complex information and organize behaviour in response to environmental stimulation. Cognitive and emotional capacities and behavioural patterns vary between and within fish species. Individual fish can exhibit distinct 'personalities' and stress coping styles. Fish are likely sentient beings capable of pain, fear, stress, and suffering. Expanding the "moral circle" to include fish would give them moral consideration to ensure their basic welfare, such as the five freedoms: freedom from hunger and thirst; freedom from discomfort; freedom from pain, injury or disease; freedom from fear and distress; and freedom to express normal behaviour. Within this context, I have developed an ethical matrix to evaluate seafood production systems along the ethical principles of wellbeing, freedom and justice for individual fish, fish populations, and the ecosystem, as well as for human consumers, producers, government agents, other stakeholders, and society. Proposed indicators of fish welfare include: the maintenance of health and minimal induced pain, fear, stress, and suffering. Similarly, freedom includes the flexibility to develop through various life history stages and engage in naturally evolved behaviours, such as feeding, antipredator, mating, and schooling. Justice includes ethically acceptable or humane treatment of exploited fish in sustainable fish production systems, such as selective catch and limited discards, bycatch and waste in capture fisheries, and access to food, care, and protection from predators in aquaculture systems; killing without suffering (painlessly and unknowingly); and intrinsic value. Fish welfare and ethics should be considered in both aquaculture and capture fisheries, but presently, ethical regulations exist for farmed, but not wild fish. From this science and ethics of fish is emerging seafood ethics, the empirical study and normative reflection upon pro-social attitudes, values-based trade-offs, and ethical dilemmas related to aquatic food, by various stakeholders and publics, across the seafood product life cycle.

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## **Fish welfare through the eyes of a commercial RAS farmer**

**Andreas Graber<sup>9</sup>**

Chairman of the company Basis57 <sup>10</sup>  
Erstfeld, Switzerland

We humans have a problem to „talk“ to fish and read their body language, as we are „animals of the air“ and miss the sensors for water quality. So how else can we communicate with fish then? How can the farmer observe and „read“ the behaviour of his fish to learn about the impact of his farming conditions, and what he can do to improve them? What does a dead fish tell him? What are the stress factors for a fish living in a RAS? And: a farm with a high mortality is a badly constructed farm or a badly managed farm. Any fish welfare index is obsolete if it does not include mortality as the main parameter first. Should aquaculture open this Pandora’s box and make farming mortality transparent in consumer marketing?

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<sup>10</sup> Comment: I am not representing the opinion of Basis57 or any other company here, but only my own personal view.

## **Developing welfare standards for farmed fish in the UK**

**Eoina Rodgers<sup>11</sup>**

Royal Society for the Prevention of Cruelty to Animals (RSPCA)  
United Kingdom

At any given time, between 70 and 90% of the Scottish Salmon aquaculture industry adheres to the welfare standards for Farmed Atlantic Salmon which are developed and implemented by the Royal Society for the Prevention of Cruelty to Animals (RSPCA). Through the drafting and implementation of welfare standards for farmed Atlantic Salmon and Rainbow Trout, the RSPCA is positively influencing the welfare of millions of farmed fish in the United Kingdom. One of the most pressing biological challenges facing the Scottish aquaculture industry is sea lice. This issue has prompted the increasing use of Cleaner fish such as Wrasse and Lumpfish within farmed salmon pens, and questions regarding the welfare of these fish have been raised. In response to this, The RSPCA is currently developing welfare standards to cover both wrasse and lumpfish. The rearing of Cleaner fish within a farming system designed for another species has often proven to be problematic. Ethological studies have contributed to our knowledge of salmon, trout, wrasse and lumpfish and have permitted the RSPCA to make recommendations which endeavour to replicate the natural environment of the fish, such as the requirement to include environmental enrichment within wrasse tanks. This has ultimately led to a reduction in stress and an improvement in their health and welfare. The RSPCA work to continually develop and improve the welfare standards for farmed fish using a range of information, including the latest scientific research and practical farming experience. Additionally, the RSPCA regularly consult with other animal welfare and aquaculture scientists, veterinary surgeons, and fish farming industry representatives.

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## **Fish welfare as an added value to a certification scheme**

**Dr. Paolo Bray<sup>12</sup>**

Founder and Director of Friend of the Sea  
Milano, Italia

Organic, sustainability and responsible certifications of seafood approach the issue of animal welfare differently and some of them do not take it into account. A report of the current situation is provided, as well as an analysis of consumers interest and willingness to pay. In conclusion a prospect of potential future developments is built for the certification arena as a whole and for the most likely market trends.

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## **Priorities and opportunities for improving fish welfare**

**(N. N.)<sup>13</sup>**

Compassion in World Farming (CIWF)  
Godalming, UK

Fish are farmed or caught from the wild each year in very large numbers and many suffer very poor welfare.

Farmed fish suffer from a range of welfare problems. They are commonly kept very intensively leading to problems of aggression and associated injury, water quality and disease build-up. They need to be handled for such reasons as grading, treatment or preparation for transport or slaughter which involve pre-handling starvation, stress of crowding and a risk of physical injury and mortality.

The ethological needs of fish are often poorly understood and their environments are not adapted to meet many of them. For example, solitary species need space, benthic species need access to bottom substrate, deep-swimming fish may need low lighting conditions, migratory species may need to roam; but these are commonly not provided for in standard farming systems.

Wild fish suffer during capture, landing, slaughter and processing. A high proportion of those caught are not for direct human consumption but to provide feed for factory farmed animals, especially farmed fish.

A range of opportunities for improving welfare will be discussed. For farmed fish, key priorities include the adoption of humane slaughter methods and improvements to transport. Rearing conditions can be improved by adjusting stocking densities, avoiding the need for stressful treatments through better systems and husbandry, improving water quality and, ideally, by developing extensive environment-based systems.

Wild fish welfare could be improved through the adoption of humane slaughter, reducing capture duration and through the development of gentler handling systems. Most important of all, the numbers caught should be reduced by reducing overfishing, developing marine nature reserves and through the development of alternatives to fishmeal and fishoil as feeds for fish, crustaceans and other farmed animals.

These improvements can be facilitated through the policies of food businesses, the development of legislation, through informing consumers and educating the public on the sentience and welfare needs of fish.

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## **Finfish welfare in the dialogue with the industry**

**Phil Brooke<sup>14</sup>**

Compassion in World Farming (CIWF),  
Vice-chair of the finfish working group of the  
European Aquaculture Advisory Council (AAC)  
Godalming, UK

The Aquaculture Advisory Council (AAC) has been set up to advise the EU on the sustainable development of aquaculture. It is made up of a 60:40% ratio of industry and NGO members respectively. Where possible, advice will be based on consensus.

The NGO contingent is based on a range of organisations concerned about sustainability, the marine environment, consumer concerns and one angling organisation. We are one of four animal welfare organisations which have joined the body to ensure that sustainable goals include safeguarding the welfare of fish.

This talk will discuss the opportunities that will arise to improve fish welfare. Early opportunities include fish transport and slaughter and the use of more sustainable (hopefully including more humane) feeds.

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## Shellfish welfare in the dialogue with the industry

**Paul Denenkamp<sup>15</sup>**

Board member of Vissenbescherming  
Vice-chair of the finfish working group of the  
European Aquaculture Advisory Council (AAC)  
Amsterdam, Netherlands

As representative of the Vissenbescherming I'm within European Aquaculture Advisory Council a member and vice chair of the Shellfish Working Group. The European shellfish farmers are mainly keeping mussels and oysters. Within this working group I see it as my task to promote the welfare of these animals. But how to do that? In science very little is known about these animals and their natural behaviour. Often is suggesteld that they don't feel much and because of that it's not a problem to keep them alive as long as possible and also to consume oysters alive. But can we be sure about that? I don't think so and I want to develop together with the farmers a research programma on shellfish welfare.

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## B) POSTER ABSTRACTS

### **A novel emotional and cognitive approach for welfare phenotyping in rainbow trout exposed to hypoxia**

**Violaine Colson<sup>16 17</sup>, A Mure<sup>17</sup>, C Valotaire<sup>17</sup>, JM Le Calvez<sup>18</sup>, L Goardon<sup>18</sup>, L Labbé<sup>18</sup>, I Leguen<sup>17</sup>, P Prunet<sup>17</sup>**

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Recent scientific evidence for fish sentience has stressed the need for novel sentience-based detection tools of fish welfare impairment in commercial farms. In order to mimic a well-characterized stress situation, rainbow trout (*Oncorhynchus mykiss*) were exposed to hypoxia for three weeks (Stressed group, S) and compared to a Non-Stressed control group (NS). After a normoxia return, emotional responses were assessed in fish subjected to two potentially threatening situations: (i) social isolation in a novel environment and (ii) human presence. In addition, we used a food-anticipatory paradigm to determine whether a previous chronic hypoxia disturbs fish cognitive abilities. Spontaneous behavior was also recorded in the tanks during the hypoxia challenge as a reference for fish activity. We observed that in S fish, plasma cortisol levels are increased before and after a social isolation in a novel environment despite the absence of behavioral difference between the two groups. Under hypoxia, fish locomotor activity was globally reduced and this reduction was correlated to increased shoaling behavior. Farmers can use these first behavioral modifications as a sentinel detector for fish welfare impairment. More importantly, we showed that reactivity to a human in home-environment and food-anticipatory behavior are both inhibited in S group. We consider that these two sentience-based tests are highly relevant for fish welfare assessment at the group level and easy to use under aquaculture conditions.

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# **Effect of plant abundance in coupled aquaponic systems on the welfare status of African catfish (*Clarias gariepinus*)**

**Björn Baßmann<sup>19 20</sup>, Harvey Harbach<sup>19</sup>, Stephan Weißbach<sup>19</sup>,**

**Harry W. Palm<sup>19</sup>**

Department of Aquaculture and Sea-Ranching  
University of Rostock, Germany

Since animal welfare is a matter of increasing interest and the effects of aquaponic cultivation on fish welfare have not yet been deeply studied, we investigated the effects of the plant abundance on African catfish (*Clarias gariepinus*) in three coupled aquaponic raft-systems over 85 days. These recirculating aquaculture systems (RAS) included fish tanks and hydroponic units, each in triplicates. In the hydroponic units Basil (*Ocimum basilicum*) was absent in the control group (n=0) and used in the aquaponics in different abundances (n=48, n=144). The plant growth was documented in detail and relevant water quality parameters were surveyed in regular intervals. For fish welfare evaluation the behaviour, and after the application of an induced stressor, the external injuries as well as different physiological responses, such as blood glucose, lactate and plasma cortisol, were considered. Additionally the fish growth performance was analysed. The results demonstrate a visible influence of the aquaponic cultivation on fish welfare. In the control group fish welfare was impaired. Although the cortisol response was increased in the system with the highest plant abundance, both aquaponic systems promoted fish welfare.

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