What can biostatistics teach us about dolphin culture and communication?

Dolphins are known for their intelligence, but do they also have their own culture? **Dr Ann Weaver**, an ethologist and biostatistician at **Good-Natured Statistics Consulting** and a **National Oceanic and Atmospheric Administration (NOAA)** consultant in the US, has spent over 20 years studying wild bottlenose dolphins. By combining animal behaviour science with statistical tools, Ann has gained cultural insights into dolphin communication and self-expression, along with first-time details of dolphin healing without medical intervention.

Dr Ann Weaver

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Fields of research
Biostatistics, primate behaviour, bottlenose dolphin behaviour

Research project
Using biostatistics to study bottlenose dolphin behaviour, communication and conservation. Ann seeks remote and in-person opportunities to teach animal and dolphin behaviour

Websites
dolphinsdigital.org, goodnaturedstatistics.com

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PROFILE

Talk like a ... biostatistician

Anthropological methods — research techniques used to study human and animal behaviour, involving long-term, immersive observation to understand a culture or social group

Biostatistics — applying mathematical computation in biological research to distinguish reality from chance, helping scientists interpret complex data and draw reliable conclusions

Dorsal fin — the fin located on the back of a dolphin (and many other aquatic animals), often used by researchers to identify individuals based on its unique shape and markings

Ethologist — a scientist who studies animal behaviour, particularly in the species' natural environments

Fieldwork — research conducted in an animal's natural environment, outside of a lab setting or captivity

Grass-wearing — a behaviour observed in dolphins where they place pieces of seagrass on their dorsal fins, possibly as a form of social signalling or communication

Dolphins are among the most intelligent animals on Earth. Known for their playful behaviour and complex communication, they have long fascinated scientists and the public alike. But how much do we really understand about their social lives and emotional worlds? In recent years, researchers have begun to explore the idea that dolphins may possess aspects of culture – behaviours passed between individuals and across generations, much like in human societies.

Dr Ann Weaver, an ethologist and biostatistician at Good-Natured Statistics Consulting and the Maples Center for Forensic Medicine, College of Medicine, University of Florida, is investigating how bottlenose dolphins express themselves, form social bonds and respond to their environment. Through consistent observation and the use of statistical tools, Ann is helping us to understand not just how dolphins behave, but also why.

What does it take to study dolphins in the wild?

Ann has spent over 20 years observing wild bottlenose dolphins along the western coast of Florida in the southeast of the US. Her research involves conducting regular boat surveys, often several times a week, to observe dolphin behaviour in a consistent and non-intrusive way. "My job is to get to know some of the smartest animals on Earth on their own terms, in their own habitat," says Ann. "You could call me a dolphin photojournalist using anthropological and statistical methods to understand a different culture without spoken language."

Studying wild dolphins typically involves long hours on the water, tracking animals by sight and recording their behaviours and interactions. Because bottlenose dolphins live in warm, shallow waters, they are relatively accessible for fieldwork, but this requires a high level of consistency and patience. Over time, researchers can identify subtle patterns that only become visible through observation over many years. "My fieldwork has only changed over time because of my increasing familiarity with the dolphins and their ways," explains Ann. "The more the dolphins trust me, the more they show me, the more I learn and the more I see. Happily, my methods for collecting data have been consistent and stood the test of time."

Can dolphins recognise individual people?

Long-term field studies rely on respectful observation. Ethnologists maintain a strict hands-off approach – no touching, feeding or swimming with dolphins – to avoid influencing their natural behaviour. At the same time, they learn to tell individual animals apart. Dolphin researchers identify individual dolphins by the unique notch patterns on their dorsal fins, a method that allows scientists to recognise hundreds of animals by sight.

Familiarity develops on both sides, and there is evidence that dolphins notice who is watching them. "The dolphins recognise me too," says Ann. "Among countless examples, one summer I started wearing a full-face mask for sun protection. Every time we approached the dolphins while I was wearing it, they refused to let us near and often fled at speed. But after seven weeks, I stopped wearing the mask and the dolphins allowed us to approach as closely as before. The mask scared them."

Why do dolphins wear grass?

In recent years, researchers have begun to understand how dolphins use objects in their environment in more complex ways than previously thought. One such behaviour is 'grass-wearing', where dolphins drape blades of seagrass over their dorsal fins. "I knew that dolphins pay attention to how other dolphins look but initially assumed grass-wearing was accidental," says Ann. "I realised it was intentional the day I witnessed a dramatic sighting: a mother dolphin, frantic over the death of her calf, donning grass to attract other dolphins' attention, possibly to soothe her grief."

To test her hypothesis, Ann examined her long-term dataset closely and applied statistical tools to look for patterns. She asked questions such as: Do all dolphins wear grass? Does it happen more often in certain conditions? Is grass-wearing linked to specific behaviours such as feeding or socialising? "My statistical analysis revealed that dolphins do indeed wear grass intentionally," explains Ann. "This is what statistics do: reveal patterns that help us separate random events from wishful thinking about reality."

What do the data reveal?

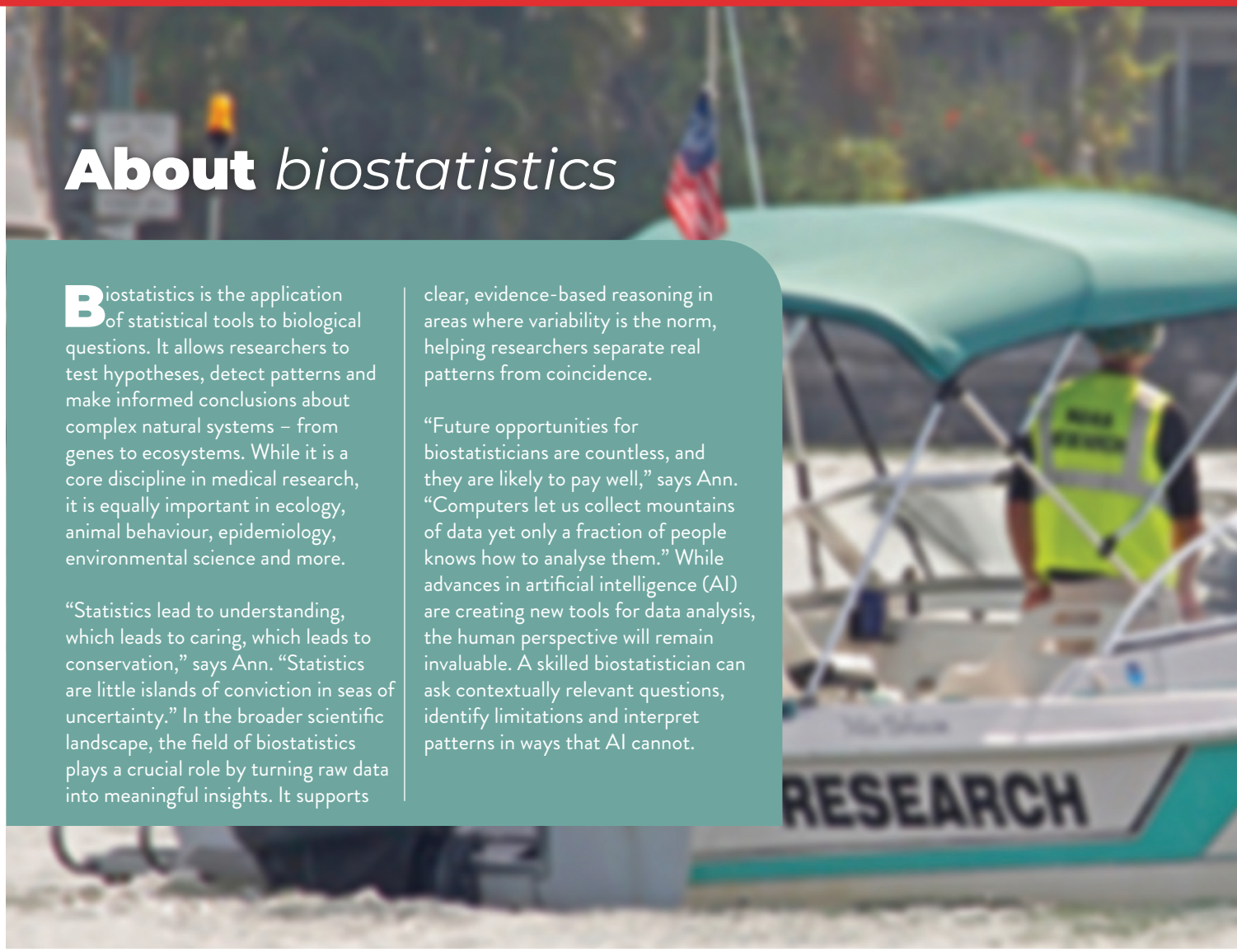
"Every time I saw a dolphin wearing grass, I recorded its identity, the identity of the dolphins it was with, what they were doing at the time, what happened next, how much and what kind of grass they wore, and the date, time and location," explains Ann.

Using biostatistics, Ann analysed these records to find meaningful patterns. The results showed that grass-wearing is not accidental or limited to a few individuals – males, females, young and old all wear grass. The main context for grass-wearing is social. Dolphins seem to use it when new individuals arrive, as part of a friendly competition for attention. Interestingly, adult females wear grass regardless of whether they are fertile, pregnant or nursing, which suggests that grass-wearing is more than just 'flirting' or attracting a mate.

What does the future hold?

"Dolphin behaviour is a never-ending story," says Ann. "I look forward to completing several future studies." Ann has recently described how dolphins heal from injuries and is currently focusing on shark-dolphin interactions, two topics that are closely connected. Dolphins surface regularly, making them easier to observe, while sharks rarely come to the water's surface, so direct observation of shark-dolphin interactions is difficult. Instead, researchers like Ann can study the evidence left behind, such as shark bite wounds and scars on dolphins.

Using patterns in dolphin behaviour to infer how dolphins and sharks interact, Ann aims to better understand how sharks and dolphins share their coastal environment. By identifying dolphin behaviours that would not occur if sharks were mindless predators, Ann hopes to challenge the negative stereotype of sharks.



About *biostatistics*

Biostatistics is the application of statistical tools to biological questions. It allows researchers to test hypotheses, detect patterns and make informed conclusions about complex natural systems – from genes to ecosystems. While it is a core discipline in medical research, it is equally important in ecology, animal behaviour, epidemiology, environmental science and more.

"Statistics lead to understanding, which leads to caring, which leads to conservation," says Ann. "Statistics are little islands of conviction in seas of uncertainty." In the broader scientific landscape, the field of biostatistics plays a crucial role by turning raw data into meaningful insights. It supports clear, evidence-based reasoning in areas where variability is the norm, helping researchers separate real patterns from coincidence.

"Future opportunities for biostatisticians are countless, and they are likely to pay well," says Ann. "Computers let us collect mountains of data yet only a fraction of people knows how to analyse them." While advances in artificial intelligence (AI) are creating new tools for data analysis, the human perspective will remain invaluable. A skilled biostatistician can ask contextually relevant questions, identify limitations and interpret patterns in ways that AI cannot.

A guide to *dolphin fieldwork*

"Dolphin fieldwork requires a manageable study area, a reliable boat and captain, a dolphin dictionary, a camera and commitment," says Ann. "Establish a study area, survey it regularly, ask questions that interest you, and collect dolphin data to answer them." This might include: Where are dolphins most often found? Do they follow daily routines? How do they resolve conflict? Why do they babysit? Why do males form long-term bonds? Do males and females form long-term bonds too?

A reliable, small and sturdy boat is essential. Smaller vessels offer better visibility and access to shallow waters (e.g., 60 cm deep) – places where dolphins often show their most interesting social behaviours. Equally important is a skilled captain who handles the boat predictably and can read dolphin body language. Smooth, respectful manoeuvring helps build trust, which is crucial for close-range observation.

Identifying individual dolphins is done through photo-identification, using a high-speed digital camera to capture images of dorsal fins. Each fin has a unique pattern of notches and scars, like a fingerprint. Current smartphone cameras are not fast or sharp enough for the required level of detail.

Researchers also rely on a behavioural reference guide called an ethogram or dolphin dictionary. "It is the 'codebook' that breaks the endless stream of behaviour into quantifiable data points for statistical analysis," explains Ann. "Just as games are bound by rules, each statistical test is bound by rules called 'assumptions'. These assumptions dictate the type of question you investigate and the data you need to answer it."

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Explore careers in *biostatistics*

To learn more about careers in biostatistics, useful websites to explore include The Analysis Factor (**theanalysisfactor.com**), which offers practical advice and training resources for biostatisticians; Dolphins Digital (**dolphinsdigital.org**), Ann's website where you can learn more about dolphin behaviour research and statistical applications in marine science; and The Society for Marine Mammalogy (**marinemammalscience.org/professional-development/how-to-become-a-marine-mammal-scientist**), which offers guidance on becoming a marine mammal scientist — someone who studies cetaceans (whales, dolphins and porpoises), pinnideds (sea lions, seals and walruses), manatees, polar bears and sea otters.

Pathway from school to *biostatistics*

Ann advises you build a broad knowledge base by studying botany, biology, animal sciences such as ornithology (birds) and ichthyology (fish), along with chemistry, argumentation, mathematics, logic, writing and illustration.

"Take many different classes to find out what you love, like, tolerate, don't like, etc., then head in the indicated direction," says Ann. "Career planning can be as much about elimination ("No way does that interest me!") as finding your bliss."

"Develop the skills you love – they will come in handy at some point," says Ann. "For example, after college, I started drawing silhouettes from photos of animals with a black magic marker but did not understand what drew me to do so. Later, I got good enough to illustrate my statistics books with pen-and-ink illustrations."

Q&A

Meet *Ann*

You earnt bachelor's degrees in biology and English literature. How do these subjects complement each other?

I pursued both for balance. Biology is comforting as the *real* world, an indescribably complex mesh of interlocking parts of which each of us is a part. Literature, poetry and writing are the world of human creativity, soothing because we communicate with words. The combination lets me do dolphin science and write both technical and popular science articles (460 articles to date).

What inspired you to become an animal behaviourist and biostatistician?

What attracted me is that animals treat each other far better than people treat each other. I love the natural world. To me, other animals are role models on how to live honestly and gracefully. But you need statistics and constant observation to convince other people of this!

What experiences have shaped your career?

My passion was shaped by a major 'Eureka!' moment when I was 18 years old and clueless about my future. I found a book by Nobel Prize winner Konrad Lorenz, *On Aggression*, in a humble bookstore. I opened it idly. The phrase, "ethology, the science of animal behaviour," leapt off the page. I was struck as if by lightning. Instantaneously and irreversibly, it set my life's course in search of this mysterious, glowing possibility that I too might someday be an animal behaviorist, whatever that was. This was before animal behavior was a popular career choice or easy to see online. Lacking other guideposts, my search was simple: I took every job with animals that came my way, kept records, and periodically went back to university until I had a post-doc level education.

Unlike many dolphin biologists, I did not pursue dolphins as a career goal. Dolphins came to me in various invitations to study them in different seas. My fifth invitation was to study the dolphins in west central Florida. I ran with it.

What are your proudest career achievements so far?

I'm proud of everything I've been able to do so far. Each is a privilege beyond description. In particular, I wrote and illustrated a 1000-page Natural History Guide of the animals at the San Diego Zoo. I interconnected three major theoretical frameworks for my PhD on the development of peacemaking (attachment, reconciliation and psychobiological attunement theories). I am very proud of earning enough trust from wild dolphins at sea to write and illustrate the 2500-page Faithful Canvas collection.

Ann's *top tip*

You were put on this Earth to follow your bliss. It is up to you to find your passion and a way to live it. Find what you love and hold it close despite the sacrifices and costs. If you do, you will leap out of bed every morning, ready for the day's new adventures!