Fisheries and Seabirds – A Spooky Flight Path

It is to be expected that certain interplays would occur between seabirds, fish species and fishery operations and that seabird conservation issues will inevitably present. In a fisheries context, most attention to date has focused on the potential for commercial overfishing of small pelagic fish species that are the predominant prey of seabirds and the entanglement of birds in recreational and commercial fishing gears. Such a focus is warranted, however there is another vital aspect associated with seabird feeding that has received little attention and which is likely to be causing serious depletions across most seabird populations.

My interest in seabird feeding stems from observations I have made from my home on the Cooloola Coast at the northern extremity of the Sunshine Coast in Queensland. Whilst these observations have primarily been associated with the behavioural dynamics of fish species that are commercially netted in the region and which appear to be severely depleted, it is apparent that seabirds are as directly affected as are the fish by inshore commercial netting.

Many of the commercially targeted predatory fish species such as the mackerels, tunas, trevallies, tailor, australian salmon, bonito and queenfish, to name a few, are vital to the survival of many of our seabirds. This is due to the feeding behaviour of these schooling species which is to herd small baitfishes such as sardine and anchovy to the ocean surface as a ‘bait ball’ where they become easier prey for the predatory fish and accessible to seabirds. Without predatory fish or dolphins to do this herding, the baitfish would stay deeper in the water column so as to avoid predation by seabirds. This is a mutually beneficial arrangement with the seabirds contributing by assisting in keeping the baitfish ‘balled’ for longer which enables feeding by the fish and seabirds to be far more efficient and for longer periods. Tailor are known to regurgitate their stomach contents to enable further feeding in these situations which prolongs and enhances the feeding opportunities for attendant seabirds. This relationship between predatory fish and seabirds occurs in all aquatic habitats and has done for perhaps millions of years.

The predominant herders of baitfish in the Cooloola and South East Queensland inshore region are the mackerels, tunas and tailor with several other species such as dart and trevally occasionally performing this role. While declining steadily in number since the 1970s, schools of these species were being sighted from the shore, or located by fishers not far offshore, up until around 2010 but have been conspicuously absent since then despite conducive rainfall conditions for a pronounced inshore presence.

Tailor populations on the Sunshine Coast have recently been identified by Fisheries Queensland as being low with the collapse of commercial yields in 2011, 2012 and 2013 along with diminishing recreational catches since 2000. Tailor are acknowledged to be migrating further offshore and to be smaller than was the case in the 1970s. Similar concerns for several different mackerel species as well as queenfish exist in central and north Queensland and in the Gulf of Carpentaria where an offshore shift of these species is apparent. Concerns for Queensland's inshore fish populations generally are wide spread with a long list of species appearing to be in decline.

Low inshore numbers of the mackerels, tunas and tailor inevitably has flow on effects to seabirds that are dependent on their herding abilities to feed. The historical and ready availability of feeding schools of predatory fish in the surf zone or near shore region has previously permitted mainland or inshore island based seabirds to easily locate schools within short flight distances from their roosting sites. This has enabled resting periods on nearby beaches between feeding sessions and regular feeding of chicks. Up to now these circumstances have sustained seabird species. But when the schools are further offshore, then the potential for population losses through insufficient, or less nutritious sustenance, along with increased energy consumption and poor delivery of food to chicks are clear and most likely contributing to the global decline in seabird populations.

The observed offshore shift by large and mobile pelagic species that are commercially targeted in Queensland mirrors the documented offshore shift by harvested species globally with climate change identified as being an

exacerbating factor. And although it would seem predictable and logical that heavy harvesting of fish inshore would frighten fish away from the coast, such behaviour by fish isn't accepted by fishery managers in Australia despite the existence of strong evidence in support.

It has indeed been common knowledge in commercial and recreational fishing circles for decades that a haul of netted fish will 'spook' the other fish in the region of the netting and further fishing of that region be unproductive for a period of time. My observations and research point towards this phenomenon being a part of the daily life of fishes, seabirds, dolphins and sharks with conservation concerns presenting for each as a result.

The term 'spooking' in essence is describing a flight reaction by the fish to the net which is perceived by any net harvested species to be a predator. But this predator isn't any normal predator that these fish have evolved with over time and that can take a few individuals at most. This predator is a particularly voracious one that can take thousands of prey in minutes and a predator to which the fish haven't evolved an effective anti-predator response.

Flight reactions, or anti-predator responses by all animals to predators only occurs when the potential prey have acquired the knowledge that a predator is in the vicinity. Extensive energy is dedicated to harnessing any and all predation threat indicators and evolving improved physical attributes that increase the ability to detect such indicators and avoid predators. Whether it be the sight, smell or sound of the predator, or signals emitted by other animals in the vicinity that can be associated with a predator, all animals collect and utilise information in a manner that maximises their chances of avoiding predators whilst maintaining optimal energy intake.

As with terrestrial animals, fish can detect predators and alert each other of the presence of predators by utilising several different finely tuned methods of detection and signalling that have evolved over time. Sound in water travels five times faster than in air and for greater distances which allows fish to listen for predators and communicate audibly when a predator is detected in the region. Similarly, predators can locate prey by listening for their vocalisations

or the sound of other predators feeding on prey. Chemical alarm signals by fish that are startled by, or being preyed upon by a predator are released into the water in two forms which warns other fish for days that danger exists in the region. Similarly, predators can locate prey using their olfactory abilities to detect any chemical cues from their prey.

Netted fish release alarm vocalisations and chemical alarm signals with an intensity and in quantities unequalled in any natural context. A chorus of vocalisations emitted by fish when trapped in a net travel for many kilometres through the water. On hearing these audible alarm signals, fish that perceive a net to be a predator flee away from the netted region. Flight reactions by all affected species are instantaneous and have been repeatedly witnessed occurring at distances greater than 10 kilometres from the netted site. Avoidance of areas thought to be as great as 20 – 30kms in all directions from the netted site are observed to last for up to a week due to the ongoing presence of the chemical alarm signals which remain active for days. Over time a general avoidance of dangerous locations where netting is regularly conducted begins to occur as species' populations decline through overfishing and an offshore shift to avoid inshore fishing pressure occurs.

Our fisheries are largely based upon the evolved aggregation tendencies of species for spawning or feeding purposes. Such evolved tendencies coincide with environmental factors such as water temperature and flood or with prey species' spawning migrations and dynamics. Fisher knowledge of time of year and locations for such aggregations has provided efficient and consistent harvests, but with obviously high costs in terms of species' recruitment. Long term targeting of aggregations and especially those of inshore species is causing these species to alter their evolved spatial dynamics in order to avoid heavily netted spawning regions or individual nets. Displacement from evolved spawning and feeding grounds and the environmental characteristics and prey availability that has afforded survival of affected species in the past has repercussions to spawning and feeding success. Egg fertilisation and larval survival are compromised, growth rates and fecundity reduced and vulnerability to disease increased. Mortality rates associated with the

displacement of fish species due to net avoidance are believed to potentially be as high as the harvest itself.

Of key importance in understanding the behavioural dynamics of commercially targeted fish species and the dependent seabirds, is the use of alarm signals by fishes. Recognition that all species that have a history of being netted will respond to the alarm signals of any species in a net because the net is a common predator to them all, is vital. This means, for instance, that tailor recognise the alarm signals of mullet and will always flee a net that contains only mullet because both species are taken by nets and are of the same 'prey guild'. The mackerels and tunas and all other netted species likewise, even if some of these species are only taken infrequently as bycatch in nets intended for other species. Netting of mullet during their spawning migration which occurs all along the Queensland and New South Wales coastline during autumn and winter, leaves little option for these species other than to move offshore to find safer habitats. The implication of heterospecific anti-predator responses such as that of tailor to mullet alarm signals, is that there is little value in fishery managers banning just the netting of tailor, for instance, should the protection of tailor be desired.

The science is clear and indisputable regarding conspecific and heterospecific anti-predatory responses to alarm signals in fishes. My observations of flight reactions by tailor, mackerel and tuna to mullet nets confirms that the science is applicable to these species in South East Queensland's inshore waters at least. The reality is however that the science is applicable to every net deployed irrespective of locality and inshore species are most affected.

The past 3 years in Cooloola has seen changes in the feeding behaviour of each of the tern species that inhabit this region at various times of the year. Whereas before the terns would leave their roosts early in the morning and search for schools of feeding predatory fish, they are now rarely even looking at the water for prey. Terns are now predominantly searching for insects along the beaches and above the dunes as well as scavenging for scraps left by tourists and fishers on the beach. This naturally exposes the terns to potential entanglement in fishing line and the swallowing of fish hooks, but such a

dietary change has further implications to energy levels, growth rates and fecundity as well as egg strength and will clearly result in increased mortality rates.

The causes for populations of migratory and sedentary seabirds to reduce in number are likely to be numerous. Survival of seabirds into the future in a changing climate will require all of these potential causes to be addressed in one manner or another. It is quite apparent however that our seabird populations are inextricably linked to that of predatory fish populations and that by maintaining healthy predatory fish and baitfish populations, seabirds are afforded greater opportunities for survival.

Healthy inshore fisheries, or the recovery of overfished species and regions, have been demonstrated to be attained by closing regions to commercial netting and particularly those of significant spawning or feeding importance. We now know why this is the case as the fish are seeking safe refuges from nets. But even without this awareness of why, net free regions must now be a major ambition of marine and seabird conservationists alike because we know they work. Although this may be perceived as being at the expense of the commercial fishery and the supply of fish to the general public, this hasn't proven to be the case as commercial yields outside of net free regions are documented to increase. Viability for individual fishers improves rather than decreases.

The obstacle remains that to create net free regions is a costly exercise for Governments to buy out commercial licence holders that harvest regions of high ecological value. These costs have in many states of Australia and various locations around the world been met by the revenue attained through the sale of recreational fishing permits. However, in Queensland where no such permit is required for recreational fishing, funds for the buy out of commercial licence holders for the creation of net free regions are not being made available despite increasing demands by the concerned recreational fishing public. It is imperative that this situation be rectified.

There is a willingness on the part of the majority of recreational fishers in Queensland to purchase a fishing permit due to their recognition that they would be contributing to the establishment of net free regions. A common understanding amongst anglers that net free regions will have substantial benefits to fish stocks and subsequently to the quality of their fishing, is of course the motivating factor. The Queensland Government however are unwilling to implement a permit system due to a fear that to do so would be electorally unpopular. But when greater than half of all recreational fishers in Queensland want a permit system and every other Queenslander should also, then it would seem obvious that such a move would in fact be electorally popular.

We certainly can't allow our affected species' populations to continue to deplete and the situation has now become urgent. Now is the time for implementation of a recreational fishing permit system and for strategic net free regions to be created. Our fisheries, seabirds, dolphins and sharks are absolutely dependent on it.

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