### Sharks at all-time low

SHARKS and rays are notoriously hard to fish sustainably because their biology predisposes them to over-exploitation. Worldwide demand for shark products, whether shark-liver oil, leather, jewellery, fillets, fishmeal or fertiliser, remains high. So how have shark and ray populations coped with commercial fishing on Australia's South-East Fishery deepwater trawl grounds?

Ken Graham, Neil Andrew and Kate Hodgson, then all with NSW Fisheries, sought to answer this question by comparing survey data for 15 species of sharks and rays collected by trawling off Sydney, Ulladulla and Eden, in 1976–77 and 1996–97. The species are mostly small, bottom-dwelling dogsharks, ghostsharks, school sharks, skates, rays and the like, which live at depths greater than 200 metres.

'We found that overall catch rates of 15 species of sharks and rays were approximately 20% of the 1976–77 levels,' Graham says. 'Put another way, they had suffered an 80% decline.'

The greatest declines occurred in the commercially valuable species, such as dogsharks of the genus *Centrophorus* (99% decline). This mostly devastating impact of trawling on the shark and ray biomass appears to follow the trend shown by most bottomdwelling (demersal) shark stocks worldwide.

Attributes that predispose sharks and rays to overexploitation include slow growth rates, late onset of sexual maturity, low fecundity, and low natural mortality.

Despite their grim history, there are no management measures for any of the rays and sharks caught by trawling in the South-East Fishery. It has been suggested that few managers worldwide are willing to constrain economically or socially important fisheries for the benefit of cartilaginous fish like sharks and rays.

However, Graham and his colleagues say that if these fish are considered an important part



of marine biodiversity on the outer continental shelf and upper slope, conservation measures need to be canvassed.

Graham KJ Andrew NL and Hodgson KE (2001) Changes in relative abundance of sharks and rays on Australian South East Fishery trawl grounds after twenty years of fishing. *Marine and Freshwater Research*, 52: 549–61.

### Steve Davidson

# Weed-beating wheats

IN 1980, the first case of selective herbicide resistance in a weed occurred in Australia when resistant annual ryegrass, a major weed of wheat crops, was detected. Now, some 100 cases of different herbicide-resistant weed species have been reported in 20 wheat-producing countries and it is anticipated that this rapid evolution of troublesome 'super weeds' will continue.

In response to this resistance, and to environmental concerns about herbicide use, researchers are focusing on non-chemical weed control. Deirdre Lemerle, of the CRC for Weed Management Systems, and several colleagues around Australia, have reviewed what we know about weed-wheat competition.

Australian and overseas wheats were found to vary considerably in their ability to compete with annual ryegrass, the main weed of wheat. This offers the potential to improve Australian varieties through such traits as greater early vigour and extensive leaf display: a promising sign for wheat breeders. The scientists also found that farmers can disadvantage particular weeds through manipulating the environment to which a weed is adapted. For example, by changing the cropseeding rate, spatial arrangement or fertiliser strategy.

Lemerle D Gill SB Murphy CE Walker SR Cousens RD Mokhtari S Peltzer SJ Coleman R and Luckett DJ (2001) Genetic improvement and agronomy for enhanced wheat competitiveness with weeds. *Australian Journal of Agricultural Research*, 52:527–548.

#### Steve Davidson

## Bats as aircraft

AERONAUTICAL engineer Robert Bullen, and Norman McKenzie, a biologist with the WA Department of Conservation and Land Management, have applied aerodynamic theory to understanding the form and flight of bats.

They looked at how the airframe designs of small insect-eating bats relate to ecology and flight capability, in particular flight speed, foraging strategy, microhabitat use and mobility.

Bullen and McKenzie tested the airframes of eight microbat species in the Coolgardie Region of WA for flight performance, stability and control, and came up with a novel classification of bat flight manoeuvres.

They measured adult bats, conducted field studies, filmed bats indoors, used radar guns to measure speed, tested the bats' ability to negotiate an obstacle course, and related all this to their ecology. Special attention was paid to airframe characteristics (such as wing loading, aspect ratio, tail volume ratio) that determine a bat's ability to generate lift, to accelerate and maintain airspeed, its stability and its control.

'All species have thin, positively cambered (convex on top) wings and indeed all the dorsal surfaces of a bat – the head, shoulders, ears and tail – are cambered to generate lift, like an aircraft wing,' Bullen says.

'The ears are particularly interesting. Apart from their value in hearing, most of the bats use their ears as additional lifting surfaces (canard wings) and we see four distinct ear designs in the Coolgardie bats. Some species hold their ears nearly horizontal during flight, one species carries them nearly vertically, and so on.'

In terms of agility, three species rated as bat equivalents of the Roulettes. They were able to bank to 80 degrees or more, performed flick rolls (with one wing folded) and experienced maximum loads on the skeleton of at least 4.5 times the force of gravity.

'We identified six airframe ratios that quite accurately predict a bat species' foraging habitat and foraging strategy,' McKenzie says. ' We believe that the flight morphology, the form and shape of a bat, is a useful tool for studying the organisation and ecology of bat communities.'

Bullen R and McKenzie NL (2001) Bat airframe design: flight performance, stability and control in relation to foraging ecology. *Australian Journal of Zoology* 49:235–261.

#### Steve Davidson