

Antarctic Killer Whales:

Top of the Food Chain at the Bottom of the World



My lips are sealed: a pack ice killer whale (Antarctic type B, large form) surfaces off the Western Antarctic Peninsula with a live crabeater seal in its mouth. Photo by Ari Friedlaender

by Robert L. Pitman

Although killer whales *Orcinus orca* are found throughout the world's oceans, they are most abundant in the Southern Ocean (i.e., waters south of 60°S). However, until very recently there has been surprisingly little research or even mention of them there.

The Past

Early Antarctic explorers spent most of their time trudging around on the continent but they also reported some remarkable encounters with killer whales. In 1911, Herbert Ponting, photographer for Robert F. Scott's ill-fated second expedition to Antarctica, was accosted by a pack of killer whales at the ice edge. He just barely managed to escape. The whales apparently were breaking up the ice under his feet as he retreated to safety. Perhaps once killer whales were exposed to photographers they developed a taste for them, because in 1915, another photographer, Frank Hurley, who documented Ernest Shackleton's famous *Endurance* expedition to the Weddell Sea, was also chased by killer whales that broke through the thin ice as they pursued him and his dog team to thicker ice.

Most of the early accounts of killer whales in Antarctic waters came from whalers during the early 1900s who regularly described marauding bands scavenging on dead baleen whales being towed by whaling vessels. The killer whales usually ripped out only the tongues and lips, apparently their favorite parts, and whalers hated them for it. Armed with rifles, many whaling captains would shoot to kill at every opportunity, and the net effect of whalers both provisioning and persecuting killer whales during nearly a century of intensive whaling in Antarctic waters will probably never be known.

Twentieth century whaling was also the impetus for the first research efforts on whales in Antarctica, but the focus was almost exclusively on large whales; because killer whales were of little commercial value, relatively few were killed and then only opportunistically. As a result, during the 1900s, when nearly two million large whales were removed from the Southern Ocean, only a couple thousand killer whales were commercially landed. Nearly all of the scientific data collected on Antarctic killer whales came from Soviet vessels, which took approximately 26 killer whales per year between 1935 and 1979. In 1979-80, however, during the final season of Soviet whaling in Antarctica, the

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two Soviet fleets killed a combined total of 916 killer whales. These were the last killer whales ever taken in Antarctica.

In the early 1980s, researchers attached to the two Soviet fleets each, apparently independently, reported a new species of killer whale from Antarctica, based on catches. In 1981, Mikhalev and colleagues described *Orcinus nanus* as a dwarf form – 1-1.5 m shorter than “regular” killer whales – but provided almost no other descriptive details. Furthermore, no voucher specimen (holotype) was collected, which would have allowed other researchers to confirm whether it was a new species. When Berzin and Vladimirov described *O. glacialis* two years later, in 1983, they provided a more detailed description. It was also purported to be a dwarf form: 0.5-1 m shorter than regular killer whales; it ate mainly fish and its skin color had a yellowish cast attributed to a coating of diatoms growing on the body. The authors also included information on bone and body measurements, tooth characteristics, etc., but the holotype that was collected was subsequently lost in a storm that destroyed a laboratory in Vladivostok.

The lack of associated holotype specimens for these descriptions is especially problematic because we now know there are several different types of killer whales in Antarctic waters and trying to match these with either of the Soviet descriptions may not be possible without their original specimens in hand. For example, based on the information they provided, it is not even clear if the descriptions pertain to the same or different “species.” Furthermore, currently there are no killer whale specimens from anywhere in Antarctica – there are almost no beaches on the continent for whales to strand on, and too few people to find them if they did.

At about the same time (1979-81), and apparently unaware that the Soviets were describing new species of killer whales, researchers from Hubbs/Sea



An illustration of Herbert Ponting narrowly escaping attack by killer whales. Taken from Ponting's book "Great White South," an account of experiences with Captain Scott's South Pole Expedition.

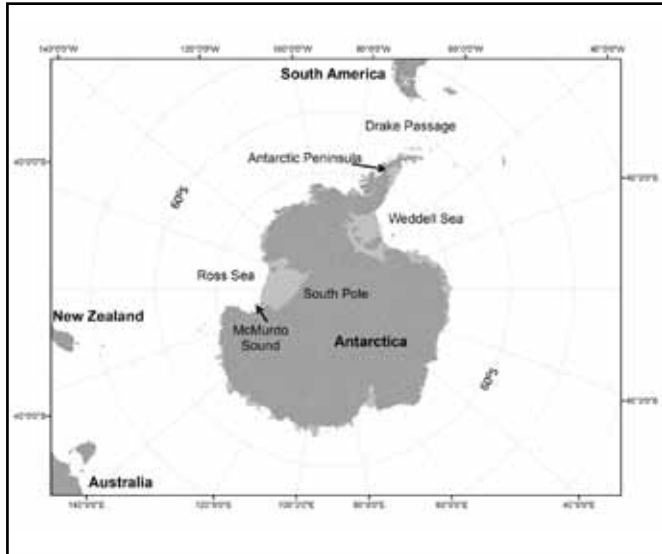
World Research Institute in San Diego, California, were also reporting different-looking killer whales in Antarctica. From field observations in the fast-ice leads near McMurdo Station in the western Ross Sea, they reported killer whales with a distinct “dorsal cape” (a dark overlay on the back), slanted eye patches and a conspicuous yellow tinge that they also attributed to diatom infestation. Underwater recordings indicated that these whales also had distinct vocalizations, and one was photographed with its head out of the water and a large Antarctic toothfish dangling from its mouth.

Another important event in that pivotal 1979-80 season was the start of a series of cetacean survey cruises in Antarctica initiated under the auspices of the International Whaling Commission (IWC). These eventually surveyed around the entire continent almost three times, over 32 consecutive seasons, aboard Japanese research vessels. Although the cruises focused primarily on assessing the status of Antarctic minke whales, they have also provided the most comprehensive information to date on the distribution and abundance of killer whales in Antarctica during the summer (Dec.- Feb.).

Starting in the 1993-94 season, I participated as a marine mammal observer on six of the IWC cruises. Although the descriptions published by the Soviet researchers did not convince scientists that there were new species of killer whale in the Southern Ocean, those observations, along with those of the Hubbs researchers in McMurdo Sound, suggested that there might be different types of killer whales in Antarctica, including, possibly, a smaller form with a markedly different color patterning.

Motivated by this intriguing possibility, a colleague, Paul Ensor, and I submitted a research proposal and, starting with the 1997-98 cruise, we were granted permission to collect biopsy samples

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and photographs of killer whales during those IWC cruises, although always on an opportunistic basis. In addition, we began compiling photographs and sighting records of killer whales from throughout Antarctica. From this, and subsequent field work, we determined that there were in fact *several* types of killer whales in Antarctic waters, forms that were readily distinguishable on the basis of color patterning and with distinct habitat preferences, foraging behaviors, and prey preferences. And although their at-sea ranges often overlapped, they appeared to avoid social interactions and, presumably, interbreeding. This suggested that, at least in some cases, we might be looking at different species of killer whales.

The Present

Currently, we recognize at least five different ecotypes of killer whales in Antarctic and adjacent waters, which we have referred to as types A, B (with a large form and a small form), C and D. Recent genetic evidence published by Phillip Morin and colleagues suggests that at least three of these types (A, large B, and C) could be considered separate species; analyses on the other two types (small B and D) have not yet been completed.

Below I describe the physical characteristics of the five types and discuss what we know about their habits. I also provide some suggestions for common names to replace their former alphameric designations (e.g., “type B”), which have in some cases been in use for almost a decade now – it’s time they had real names.

Type A

This is a “typical” looking killer whale with a familiar black

and white color pattern; the eyepatch is of medium size and oriented parallel with the body axis. The maximum body length of this type is unknown, but in the field, adult males in some groups appear to be fairly small (ca. 7 m), while those in other groups are very large (8-9 m). Researchers on Soviet whaling vessels reported individual killer whales in excess of 9 m, but they did not distinguish differences in color patterning, so it is not possible to know for certain which type(s) are represented in their records. In addition, recent analyses have found that type A killer whales have more genetic variability than do the B and C types, so there may be additional types among what we now call type A.

Type A occurs around the entire Antarctic continent where it occurs mostly in open water, seaward of the pack ice. Presumably most of the Soviet catches were of this form because their catcher boats rarely ventured into the pack ice. To date, type A killer whales in Antarctica have been observed feeding only on Antarctic minke whales and once on an elephant seal, but they may also feed the calves of other large whales. It has been assumed that all killer whales, including type A, migrate away from Antarctica during the southern winter and into lower, warmer latitudes, but there have been too few winter cruises in Antarctica to confirm this.

Type B: Pack Ice Killer Whale; Gerlache Killer Whale

Type B killer whales are two-tone gray and white; they have a dark gray dorsal cape and paler gray sides and flanks. The eyepatch is oriented parallel to the body axis and although variable in size it is always much larger than in all other types of killer whales. Some individuals (and often entire groups) are infested to varying degrees with diatoms that turn their white areas yellow and make the gray areas appear brownish. Based on our satellite tracking data it appears that the gray and white individuals have recently returned from a trip to the tropics where the diatoms are shed – a trip to the carwash.

In Antarctic waters, type B killer whales are found around the entire continent where they forage mainly among the pack ice. Type B was originally identified as a prey specialist that fed mainly on ice seals, but working with my colleague, John Durban, in the Antarctic Peninsula area, we have found that there seems to be at least two forms of type B killer whales – a large form we call “pack ice killer whale” that regularly forages in groups that cooperatively create waves to wash seals off ice floes, and a smaller form that forages in more open water, in larger groups and to date has been observed feeding only on penguins. We refer to the smaller form as “Gerlache killer whale” because for many years now large numbers have been reliably found in the Gerlache Strait off the western Antarctic Peninsula.



A type A killer whale chases an Antarctic minke whale off the western Antarctic Peninsula. Although an adult minke can normally outrun a single killer whale, in this case a tag-team of 30 killer whales successfully brought down this minke after a 2.5 hour chase. Photo by Bob Pitman

Pack ice (PI) killer whales are large, robust animals, and based on observations of animals around our launch we would guess they are at least twice the bulk of the Gerlache killer whales. They have a spectacularly coordinated foraging behavior. In open water, groups travel in fairly tight formations, but when they get into an area of pack ice they fan out. Individuals, or cows with calves, begin spy-hopping - lifting their heads above water to have a look around as they swim by individual ice floes. They are looking for seals that often spend their days resting on the ice. When a whale finds a seal, it spy-hops several times around the floe, apparently to make sure it is the right species. They appear to prefer Weddell seals. If it is the right seal, the whale disappears for 20 to 30 seconds, and then begins spy-hopping around the floe again. During the brief disappearance, the whale apparently goes down to call in the troops, because within a minute or two the rest of the group is there spy-hopping around the floe also.

After a minute or two of collective appraisal, the group decides either to move on or to move in and attack. If they decide to attack, the members begin to swim in formation, side-by-side; then they head away from the floe to a distance of usually 5-50 m (15-150 feet). As if on cue, they turn abruptly toward the floe, swimming rapidly with their tails pumping in unison - synchronized swimming. A deep trough forms above their tail stocks and a wave, approximately 1 m (3 feet) high, forms above the flukes. The whales charge the floe and dive under it at the last second. If the floe is small, the wave will break over it and usually washes the seal into the water. If the floe is large (ca. 10 m [30 feet] or more), the whales carry their wave with them under the floe to the opposite side. This often causes the floe to shatter into smaller pieces, after which one or two whales use their heads to push the floe with the seal on it out into open water where they can wave-wash it again.

When the seal goes into the water, the killer whales immediately close in and attempt to take it by its hind flippers to drag it underwater. Although they could at any time easily kill the seal with a single bite or a ramming charge to the mid-section, they



Pack ice killer whales (type B, large form) have located a Weddell seal resting on the ice; on a small floe like this, the seal has little chance of escape. Photo by Bob Pitman



A group of pack ice killer whales (type B, large form) charge an ice floe – the wave being created by their tails will wash the Weddell seal off the ice. Photo by John Durban

choose to wear out the seal and drown it. We think that they want to keep the carcass undamaged so they can take just the preferred bits off of it – much like when they take just the tongues of large whales.

We have seen clear evidence that these killer whales prefer Weddell seals – they sometimes inspect literally dozens of crabeater seals and even leopard seals hauled out on the ice, often within easy reach, but pass them up once they get a good look at them. On the other hand, they attack nearly every Weddell seal that they encounter. It is likely that pack ice killer whales are not always so picky and, like most animals, will pass up less desirable prey only when food is plentiful.

Gerlache killer whales are distinctly different from pack ice killer whales. Overall, they are smaller and slimmer; their eyepatches are large but not quite as big and sometimes they are slightly slanted. They often travel in long, loose groups, as they patrol up and down the straits, preferring more open water – they seem to avoid the pack ice. Also, they regularly feed on penguins – they have seen them take gentoo penguins and chinstraps on numerous occasions. Amazingly, although penguins represent extremely small prey for a killer whale, the whales apparently feed only on the breast muscles and discard the rest of the carcass. This shows once again how selective killer whales can be in their prey choice and how meticulous they can be with their feeding habits. They are so methodical, that we have suggested that at times their prey handling behavior is perhaps best described as “butchering.” We have identified hundreds of individual Gerlache killer whales in and around Gerlache Strait during the southern summer and there can’t possibly be enough penguins there to feed their legions; we suspect that they may actually feed mainly on fish but to date we have no direct observations.

We are only just starting to understand movements of type B killer whales.

We regularly see scars from bites of cookiecutter sharks *Isistius* spp. on the bodies of both pack ice and Gerlache killer whales. The cookiecutter is a small (ca. 0.5 m/1.5 feet) shark that takes only a small bite (the size of an ice-cream scoop) out of much larger “prey,” and when the bite heals it leaves a characteristic scar. These are sharks of tropical and warmer subtropical waters, and their scars on Antarctic killer whales is an indication that the whales move to lower latitudes at times. Our preliminary results from satellite tags on both large and small type B whales confirm that both forms probably make regular trips at least to the edge of tropical waters. But when they make those trips they travel fast, move constantly and spend only a few weeks in the tropics before returning to Antarctic waters. We are a long way from understanding the “where, when and why” of Antarctic killer whale movements, how this might vary among the different types and the impact it has on their prey populations.

Type C: Ross Sea Killer Whale

This type also has a two-tone gray and



Seal tsunami – a wave created by a team of pack ice killer whales is about to crash onto this Weddell seal and wash it into the water where the whales will be waiting. Photo by Bob Pitman

white color pattern with a dark gray dorsal cape visible in good light. Like the type B killer whales, some groups or just individuals are also heavily coated with yellowish diatoms at times. The distinctive eyepatch is narrow and tilted forward at a 45° angle. Using aerial photogrammetry (measuring whales from photographs taken from an aircraft), we determined that adult males of this type reach a total length of only 6 m (20 feet) making it the smallest type of killer whale known. In fact, killer whales with males that grow to 8-9 m (26-29 feet), including type A and pack ice killer whales, probably weigh several times



A Gerlache killer whale (type B, small form) chases a gentoo penguin. Normally just the breast muscles of penguins are eaten and the rest of the carcass is discarded. The dorsal cape and large eye patch that distinguish type B killer whales are clearly visible. Photo by Justin Hofman

as much as Ross Sea killer whales and could conceivably prey upon them. Ross Sea killer whales are known only from east Antarctica where they live deep in the pack ice and patrol leads (cracks) in the fast ice, often miles from open water. They are presumably fish eaters because the only prey identified to date has been large Antarctic toothfish, which can grow to 2 m (6.5 feet) long and weigh over 200 lbs. Not much is known about movements of Ross Sea killer whales, but they have been photographed near New Zealand and Australia, and they also often have scars from cookiecutter shark bites, so they probably are not year-around residents in Antarctic waters.

Type D: Subantarctic Killer Whale.

This is a very distinctive type of killer whale with an extremely small eyepatch and more bulbous head than the other types. It has been sighted only a handful of times and almost nothing is known about it. In 1955, a group of 17 stranded in New Zealand but it was almost another 50 years before that unique eyepatch was recognized again – on living whales near Crozet Island in the southwest Indian Ocean. In the last 10 years type D killer whales have been photographed at sea at least six times, around the globe, in largely subantarctic waters at the northern edge of the Southern Ocean. Therefore, we have suggested the name “subantarctic killer whale” for what we think will likely turn out to be yet another species of killer whale. Nothing is known about its feeding habits except that groups have been photographed attending longline vessels fishing for Patagonian toothfish (a.k.a. Chilean seabass), near the Crozet Islands.

The Future

There is still much to learn about Antarctic killer whales. Based on analysis of killer whale sightings data from 19 separate IWC cruises, Branch and Butterworth estimated in 2001 that the total killer whale population in Antarctic waters during summer was 25,000-27,000 individuals, making it the third most



“Stay in your lanes!” An adult male Ross Sea (type C) killer whale travels along a lead in the thick fast ice of McMurdo Sound, while Adélie penguins watch from the sidelines. Photo by Bob Pitman

abundant cetacean species in Antarctica (after Antarctic minke whale and southern bottlenose whale, respectively), and undoubtedly the largest concentration of killer whales to be found anywhere on earth. But this estimate is itself likely a minimum because a substantial number, and possibly a majority, of killer whales summering in Antarctica regularly occur within the pack ice, a place where the survey vessels generally did not go due to hazardous sailing conditions. Furthermore, this estimate includes all of the different ecotypes lumped together.

Regardless of what the actual total number is, it is clear that killer whales are not only the largest apex predators in the Southern Ocean but they occur in large numbers and are therefore expected to play a major, but as yet largely unknown, role in the Antarctic ecosystem. To date, the geographic scope of our research in Antarctica has been constrained by logistics – nearly all of our research has been restricted to two relatively small but accessible areas: McMurdo Sound and the western Antarctic Peninsula. Our dream scenario would be a research cruise around the entire continent, photographing and tissue sampling animals all along the way, and putting out satellite tags everywhere. This would help us answer some of the most important questions: How many species (or ecotypes, or populations) of killer whales are there in Antarctic waters? When, where and why do they migrate? What do the different types of killer whales feed on? More difficult questions will require longer-term studies: How many individual prey items do the different types of killer whales take during the course of, say, a year? How much impact do they have on their prey populations? How will the different types of killer whales respond to the rapidly changing climate in Antarctica, especially in the Peninsula area where conditions are changing the most rapidly? Are they capable of changing their diet as conditions change?

There are pressing conservation questions also. For example, large scale commercial fishing for Antarctic toothfish has only recently been established in the Ross Sea. This fish is currently the only known prey of type C killer whales and David Ainley and colleagues have already reported what they consider to be a decline in the type C population near McMurdo Sound, which they suggest could be linked to prey reduction by the fishery.

For animals that depend on sea ice, climate change means habitat change, and with it, unforeseen consequences, even for top predators like killer whales. How adaptable the different types, or species, of killer whales are will determine how well they survive the coming changes. What we do know is that as humans continue to alter the planet that we all call home, the perch that killer whales occupy on top of the food pyramid will become increasingly precarious.

Whalewatcher

Killer Whale:

The Top, Top Predator



Special Guest Editor
Robert L. Pitman

