

KERMADECS ISLANDS EXPEDITION REPORTS

BIO-ACOUSTICS ON THE EXPEDITION

By WILLIAM V. WARD

Because it would afford an opportunity to tape previously-unrecorded birds of a little-explored portion of the South Pacific for Cornell's Laboratory of Ornithology, where I am a member and field collaborator, I applied for membership in the Expedition.

Many people have expressed interest in the sound-recording techniques used by the Laboratory. If I detail these, it will not only describe the bio-acoustics research done by the Expedition, but may also stimulate others to attempt similar work with their own tape recorders, thus encouraging a broader use of this valuable ornithological tool.

EQUIPMENT USED ON EXPEDITION

Tape Recorder

Magnemite 610-E, battery-operated, with spring motor to drive tape transport. Input is handled by two transistors, amplified by three valves. The machine operates at the high speed of 15 inches per second, and has a frequency response of from 50 to 15,000 cycles per second, flutter plus or minus 0.1%. It meets primary National Association of Radio & Television Broadcast Standards in U.S.A.

It has provision for monitoring headphones so that the birds may be heard as they are recorded. Tapes may be played back through headphones to ascertain quality. Tapes were edited in the field, unused portions erased and used over again.

Preamplifier

A *home-made* two-transistor, grounded-emitter, battery-operated preamplifier was used between the microphone and tape recorder. This gave clean amplification of 12 decibels. Frequency response was 45 to 120,000 cycles per second.

Microphones

Altec 688A omnidirectional professional dynamic with frequency range from 35 to 20,000 cycles. Response is flat from 45 to 18,000 cycles. It operates at high or low impedance, but generally was used at low impedance. This was the primary microphone.

Electro-Voice 647A omnidirectional dynamic lavalier-type with frequency range from 70 to 10,000 cycles per second. A small, secondary microphone to use down burrows, and as a standby in event of damage to the Altec.

Hydrophone. U.S. Navy Type Q-41. Frequency response from 500 to 4,500 cycles per second. Does not have flat response; has strong peak at 3,500 cps. This was taken in hopes of recording the voices of whales which frequent these seas. However, the length of time to launch a boat after sighting whales, and the usual unavailability of people to do this, precluded obtaining such tapes.

Parabola

A *parabolic reflector*, of spun aluminium 40" in diameter, with a focal length of 10", was used to focus sound upon the microphones. It provided magnification of 1200 times at the focal centre. Its 40"

diameter enabled it to amplify a sound wave as long as 80" (middle A) without distortion. Smaller parabolas would provide less magnification, and would distort low notes higher up the scale than middle A. Most bird voices are high enough so that a parabola does not distort them.

Miscellaneous

Two-conductor, shielded microphone cables with Amphenol connectors and telephone plugs. A 5-transistor amplifier and speaker to play back songs to birds and to people. A bulk tape eraser for 230-volt mains at the Station. A few tools and a multimeter for fault finding and repairs.

Upon landing on Raoul, we were all immediately impressed with the vociferous Tui and Song Thrushes; and as soon as some of us got ashore on Meyer Island, we realized that the strange and loud calls of seabirds, which most of us had never seen before, would be a valuable addition to the sound recordings we hoped to bring back to New Zealand.

What we did not appreciate at first was that the tremendous seas crashing against Raoul's and Meyer's rocky coasts created a background which our ears overlooked, but which the microphone dutifully recorded. On tape this sounded like strong wind through pine trees. While it did not spoil a tape for scientific use, it lowered the overall quality to a point below what is usually acceptable for gramophone discs. It was avoided only when the microphone was placed extremely close to the bird without using the parabola. This enabled the bird's voice to be recorded so many times louder than the surf that the surf was not heard. We could do this with many of the louder-voiced seabirds; but not on the Tui, Thrush, Blackbird, Yellowhammer and Starling on Raoul which would not permit an approach of much less than 25 feet and where, therefore, the parabola had to be used. Although the sound of the surf was heard from sea level to the peaks of the islands, we found a little rock-enclosed amphitheatre on Meyer, and the upper portion of Nightbell Gully on Raoul where trees and a forested ridge partially screened the surf. These places were used for recording studios whenever possible.

The following descriptions of the recordings list the birds taped, illustrate the mechanics used, and indicate the quality obtained:

Wedge-tailed Shearwater

7.20 p.m., 25/11/66. The lavalier microphone was placed four feet down a nesting burrow on Meyer Island. A loud and clear tape of the bird's moanings and caterwaulings was obtained. Calls of Sooty Terns and Black-winged Petrels flying overhead are heard in the background despite the microphone being underground. A very spectacular tape.

8.30 p.m., 27/11/66. Made with the parabola in the "amphitheatre" on Meyer. An excellent reproduction of the Wedge-tail chorus from birds within and outside their burrows. The rocky cliffs contributed an added dimension. While there is a great deal of individual variation in voice among these birds, no important distinction was noted between the Kermadec birds and those of the lighter-coloured race which I had previously recorded in Hawaii.

Kermadec Petrel

3.05 p.m., 25/11/66. About 2 p.m. these birds started flying up and down the coast of Meyer, yelling their warcry, "Yuk, keroouu, yuk, yuk." We have heard as many as four "yuks" at the end; and these, interestingly, stopped completely about the end of November. Recording was made in the "amphitheatre" using the parabola. It is an excellent reproduction.

6.40 p.m., 1/12/66. The microphone was laid in the grass beside a Kermadec Petrel nest on Meyer. The bird was calling while the other of the pair circled for a landing which was made while the recorded was running. "Conversations" from both were taped. This is an excellent tape, and shows differences from the flight calls.

3.55 p.m., 6/12/66. Made on Meyer with the parabola in the "amphitheatre" while the bird flew overhead. It illustrates the calls made, after the end of November, which have no terminal "yuks." Some ornithologists have written that these petrels omit terminal "yuks" in certain localities; but as these tapes indicate, it may be a matter of timing instead of, or in addition to, location.

Black-winged Petrel

8.00 p.m., 28/11/66. Made on Meyer with the parabola in the "amphitheatre" of birds in flight giving their "Peet, peet" flight calls, and also a puppy-like whine. These sounds are very typical of a Meyer evening, and the tape is a good rendition.

7.30 to 8.15 p.m., 2/12/66. The microphone was laid beside a hillside burrow on Meyer, but the bird was outside. Soft bubbling noises, static buzzes, puppy whines, and bouncing notes on a descending scale were obtained with good quality. These nest calls are much different from the flight calls and would hardly be recognised as coming from the same bird.

Red-tailed Tropic Bird

1.35 to 1.55 p.m., 4/12/66. Soon after noon each day, these birds started circling the chasm between North and South Meyer in whose cliff faces they were preparing to nest. When their paths crossed, a great honking of rasping voices, remindful of Canada Geese, was heard. The parabola was used to record these from birds well over 100 feet overhead. The tape was made in the "amphitheatre," but even so the surf noise could not be kept out.

Spotless Crake

7.20 p.m., 27/11/66. When editing tapes of Shearwaters and Black-wings made with the parabola in the Meyer "amphitheatre," these Crake recordings were noticed, although they were not recognized as such at the time. It is a clucking "Crake, crake," rather faint, with some surf background.

5.30 a.m., 2/12/66. This recording was obtained on Meyer by following a Crake as it picked its way along the edge of the Ngaio and Pohutukawa cover above our camp. It was again making a faint, clucking, "Crake, crake." We did not hear the high-pitched squeak or crooning noise mentioned in the Field Guide. This is a valuable tape because of its rareness; and while there is some surf background in it, it still is of good quality considering the faintness of the bird's call.

Sooty Tern

A series of 12 recordings was made, two of which were taped on Meyer, and the rest at the Denham Bay colony on Raoul. The latter varied from warning calls as people approached the colony, to communicative calls and warnings to each other recorded from a hide when the birds did not know humans were about. Communicative calls between parent and chick were obtained and strong peeps from an unhatched chick which had just chipped a hole in its shell.

Separate communicative calls were recorded as the birds flew overhead: (a) en route to their "nightclub," (b) over their "nightclub" area, and (c) flying overhead before a severe storm. We taped the uproar of a "panic flight" to the sea as the birds took off on the approach of people. The birds did not often use the "wideawake" call, although we made tapes of it; they more frequently used a rolling "Wide-ah, wide-ah, err-wide-ah." It was hoped that this broad coverage of communications, together with behaviour data concurrently recorded, might add a further dimension to John Peart's breeding biology of the colony. No parabola was used in making these tapes. The birds are loud-voiced, and the microphone could usually be placed near them. Tapes are of high quality.

White-capped Noddy

This tape was made up from several recordings made on 30/11/66 and 1/12/66 on Meyer. I carried the sound gear up and down the steep slopes under Pohutukawas where the birds nest and obtained the guttural squeaks and "quorks" they make on being disturbed. The tape also includes some exactly-similar calls made in the "amphitheatre" when the Noddies were unaware of human presence. The parabola was used and the tape includes the surf noise.

Grey Ternlet

2.45 p.m., 27/11/66. This recording was made on Meyer, using the parabola. These are the gentle, "Qu-orr, qu-orr" calls which ternlets give when a person is climbing about the coastline rocks which they frequent. This species is very tame and confiding. When an observer repeats their call, they take notice and come closer, often performing the "footlook" display by pointing the bill to the feet. This tape, made on the shoreline, has considerable surf background.

3.40 p.m., 28/11/66. This was obtained on Meyer in the "amphitheatre" using the parabola. The birds have an interesting display pattern, remindful of that of the Laysan Albatross, and this tape covers the entire sequence. Three birds gathered on a rock. First there was a short, "Qu-orr"; then "Chirr-rrup, chirr-rrup." Next, a bird pointed its bill in the air with a faint whistle; another momentarily put its bill beneath its wing. Then there were some loud "Eee-yah" calls. One bird then flew off, the two remaining sidled together and made quiet noises. We saw this display many times, with little variation. The tape has some surf background, but not as much as the previous, and provides new knowledge of the behaviour of a little-known bird.

Kermadec Parakeet

2.30 p.m., 30/11/66. Made on Meyer Island with the parabola, the tape reveals a rapid chattering and a 3-syllable "pretty dick." An immature bird's calls are also on the tape and can be identified by their higher frequency. There is considerable surf noise on this tape.

Kingfisher

9.35 a.m., 24/12/66. Nightbell Gully, Raoul. The birds would not allow an approach of much less than 50 feet, and the parabola was used. Many birds were taped and the tapes discarded because of surf noise. This tape was of a bird on the other side of a tree and it was unable to see me. Nightbell Gully gave some protection from the surf, but it still can be heard. Nevertheless, this tape gives the, "Kee, kee, kee" identification-of-the-territory call very well. By playing it back other Kingfishers could be brought close in.

Song Thrush

5.45 a.m., 17/11/66. Low Flat, Raoul Island. Six or eight singing birds were stalked before one was found with sufficient courage to continue singing while being taped. It is similar to the New Zealand bird, and is a very good tape but has a surf background.

Blackbird

4.35 a.m., 17/11/66. Low Flat, Raoul Island. This tape illustrates the "chip, chip, chip" warning call and a communicative "zeet" similar to that of the Yellowhammer. Though a few Blackbirds occasionally sang, their songs were not recorded. This tape has surf background.

Yellowhammer

4.20 a.m., 17/11/66. Low Flat, Raoul Island. This species was always difficult to approach, and the surf background remains. The tape illustrates a "Zeet, zeet, zeet" (similar to the Blackbird's) and a buzz.

6.20 a.m., 15/1/67. Bell's Flat, Raoul Island. There were always one or two yellowhammers around Bell's Flat, but they were difficult to approach. Although the singing season was over, this 3-syllable call was heard. The tape has surf background.

Tui

3.45 a.m., 17/11/66. Low Flat, Raoul Island. The morning chorus began at 2.45 a.m. in the Pohutukawas over our tents. I frequently slept away from camp under some trees where there were more birds and had the recording equipment beside my sleeping bag with the parabola lying flat on the ground pointing straight up in the air. The tui started with a few whistles, then some coughs and gurgles and wheezes, next going into some liquid notes. They were quite different from the New Zealand Tui I have recorded at Abel Tasman National Park, and the Bay of Islands, the latter being more like the Kermadec variety. I did not record or hear the deep "bong" bell notes; and the birds did not appear as raucous as the N.Z. Tui, except in their warning or distress calls.

When I returned from Meyer on 21/12/66 the dawn chorus had stopped, although the odd bird might be heard singing here and there. The 1964 Expedition commented on how silent the Tuis were, as had Iredale (Emu 1910, 10: 2-16). Iredale even thought the Kermadec Tui might be a separate race because of its silence. Apparently it has periods of relative silence, and these vary in timing from year to year. This is a good tape, but has surf background.

7.15 a.m., 22/12/66. Low Flat, Raoul Island. R. Veitch picked up a young Tui just able to flutter. I taped its high-pitched distress call. This brought its parents who started their loud, but lower-pitched distress calls, attracting still more Tuis who added their din. All of this was taped. As more Tui were wanted for banding and measurements, this tape was played back through a small loudspeaker near our mist nets. More Tui arrived in quite a frenzy; but they soon sensed something peculiar and quietened down. We did not get many birds in the nets this way. This tape is loud and clear with little surf background.

Starling

4.30 a.m., 17/11/66. Low Flat, Raoul. Some harsh squawk warnings were taped with the parabola while the bird was perched in a tree. The tape has a surf background.

Kermadec Cicada

8.55 a.m., 17/1/67. Low Flat, Raoul Island. After a heavy storm, this insect landed on a sunny spot on one of the tents to sing. The microphone was held 6 to 8 inches away. The cicada gave forth low-frequency buzzes heard only when the ear is close to it; otherwise only the high frequencies were heard. The microphone emphasized the low frequencies. In order to hear the high ones properly, the tape must be played through a high-fidelity playback, with bass control set at a minimum and the treble increased.

Dr. Charles Fleming reviewed this tape, and commented that this Cicada, *Melampsalta exulis*, has the same type of song as its mainland relative, *M. cutora* (which he recorded), except that *cutora* has long "snoring" notes alternating with more rapid passages. But what intrigued Dr. Fleming was the occurrence of faint clicks fairly regularly spaced in *exulis*' song. He asked if the insect flapped its wings while singing. It did not. A loud, clear tape; no surf.

Black Australian Cricket

6.30 p.m., 25/1/67. Bell's Flat, Raoul. This cricket is common, and sings the same song as in New Zealand. The tape has surf background, and was made with a parabola.

The above tapes are the ones which were kept; many others of course were made in order to be able to obtain this edited selection. Copies made at 15 inches per second were given to Cornell's Laboratory of Ornithology, and copies made at 7½ inches per second to the Dominion Museum and the Society. Some quality is lost in tapes copied at the slower speed, but in New Zealand the New Zealand Broadcasting Corporation is about the only place where 15-inch playback is available. Tapes I make in New Zealand as Cornell's Field

Collaborator theoretically belong to Cornell; however, Cornell granted permission to the Society to use the tapes commercially or in any way it might so desire.

Some of the tapes, especially the land songbirds, were copied through a 1.5 kilocycle high-pass filter. This reduced some of the background noise by cutting out all sounds below 1,500 cycles per second. This filter cannot be used on low-voiced birds like Shearwaters as it cuts out part of their sound, making their voices sound thin and reedy.

Interested persons wishing to try similar work with their own tape recorders might start by hanging a microphone out of a window to tape such loud-voiced songbirds as the Song Thrush, Tui and Blackbird. Playing the tapes back to the birds often will make them think there is a rival about, and they will come closer to the microphone. The closer the bird is, the louder its song will be in proportion to generally-always-present background noise. A mirror placed beside the playback loudspeaker sometimes causes the bird to fight his image with the possibility of aggression calls being obtained.

A longer cable on the microphone helps in getting closer to the bird. However, this causes electronic complications, as high impedance microphones, which come with most tape recorders, will not work properly with more than 12 or 15 feet of cable. A more expensive, low-impedance, dynamic microphone then will have to be obtained, plus a line transformer to step up the microphone's low impedance to the high impedance input of the recorder. These longer microphone cables must be two-wire, shielded cables or else hum and other noises will be picked up. Instead of a line transformer, I now use a home-made 2-transistor preamplifier which not only steps up the low-impedance microphone to high but also adds 12 decibels of clean amplification.

A parabolic reflector is the next piece of equipment an amateur recordist should acquire. As these are expensive and hard to find, perhaps the easiest way to get one is to make a fibre-glass copy of a parabola belonging to someone else. I understand that New Zealand Broadcasting Corporation makes parabolas at their Dunedin works. A 40-inch parabola gives very little distortion to bird songs, but smaller sizes do distort and do not have as much amplification. The trouble with a parabola is that it picks up all sounds behind the bird, such as wind in the trees and sounds like the surf in the Kermadecs. It is almost impossible to use one in town because it picks up traffic hum; but in the country on a windless day it works wonderfully well.

People making such tapes should not overlook the communicative calls of birds as well as their songs. Playing these back to the birds often causes reactions which enable us to learn more about their behaviour. Many birds vocalize differently in different parts of New Zealand. Playing one dialect back to another and noting

the reaction can sometimes be an important clue in helping to determine different races. The same applies to insects. Practically no underwater recording of cetaceans or fishes has yet been done in New Zealand.

Many New Zealand tape recorders run at $1\frac{1}{2}$ inches per second. People with these machines should not be discouraged about using them. Interesting tapes have been made with such instruments. They do have more hum and background noise in the machine itself than higher-speed models. After a person has worked with a slow-speed machine for a while, and has learned to like the study of animal sounds, he usually will want to acquire a more suitable recorder. The reason Cornell and the British Broadcasting Corporation prefer 15-inch tapes is because birds have such great volume at high frequencies that high speed is necessary to prevent distortion. One should remember that the presently-popular 4-track machines are bound to be noisier than dual track or full track ones.

Even an excellent tape, made at full track at 15 inches per second, is of little value to the scientist unless it is properly documented with date, time, weather, temperature, and a description of the behaviour of the animal while vocalizing. The scientist is also interested in a description of all the electronic equipment used in making the recording: parabola, microphone, preamplifier, line transformer, tape recorder, and type of tape used. This is so that he can ascertain the weakest link in the chain insofar as frequency response is concerned. For instance, if the sound fades out above 8,000 cycles per second, is it because of the bird or the microphone, or some part of the equipment? Figure 1 illustrates the type of documentation used by Cornell; this can be used by New Zealand recordists, or they can make adaptations from it.

Summarising, we brought back the major sounds of Kermadec wildlife, with high quality for the louder-voiced seabirds; but surf interfered with obtaining first-class tapes of land songbirds. Tapes proved that the Kermadec Tui sings differently from the New Zealand Tui. When we compared our notations with those of earlier observers we found that like Tui elsewhere in New Zealand it has periods of relative silence which may vary somewhat from year to year. In 1966 we found that the terminal "yuk" on the Kermadec Petrel's flight call ceased on Meyer Island about the end of November. This may be a seasonal variation instead of (or in addition to) a geographical variation.

We hope that the Expedition's bio-acoustical efforts may encourage other New Zealand ornithologists to contribute toward further development of this useful ornithological tool, especially in advancing our knowledge of bird behaviour and racial distinction, as well as increasing the library of songs and calls.

FIELD AND EDITING NOTES

Ward

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No. and Family PROCELLARIIDAE		Name Sci. <u>Puffinus pacificus</u> Com. Wedge-tailed shearwater		Ref. Falla Sibson Turbott	Cut No. 3	Date and Time November 25, 1966 7:20 p m	Recorded By: Expedition and Personnel Ornithological Society of N.Z. 1966-67 Kermadecs Expedition Ward, Crockett, Soper		
Locality North Meyer Islet Kermadec Islands		Lat. 29° 15' S Long 177° 52' W Alt. 20'	Habitat Widely distributed tropical Pacific & Indian Oceans. In NZ region, breeds only in Kermadecs.		Level of Recording +4db	Length of Cut 3 minutes 3 seconds	Quality A	Weather Clear, light breeze. Temp.: Air 77°F Water 68°F	
Recorder Original Magnemite 610-E 7050 1/2 track	Tape Speed MMM 200 15"/Sec.	Microphone Electro- Voice 647-A	Parabola? Dia./f. No	Dist. from Animal 10 inches	Identification By: Ward How? visual and aural		If Rerecording, Type of Original Catalog No. of Orig.		Specimen Collected Yes By D. V. Merton Dominion Where Located Museum
Number of Animals Male or Female Immature Indeterminate			Physical Description of Sound; How Distinguished A moaning sound with rising inflection, often followed by a low growl. Could distinguish no important differences between this cut and cuts 1 & 2 made in Hawaii.						
1			What Behavior Accompanied Vocalization Sat in burrow.			What Did Animal Do When Not Vocalizing? Same.			
Apparent Biological Purpose of Sound Not known.									
Response to Imitation, Playback, Decoy etc.; Equipment Used No playback. 2-transistor, grounded-emitter, battery-operated pre-amplifier.							Edited By: Ward		
Description of Exact Place From Which Sound Was Made; Special Set-up etc. A small, lavalier-type microphone was placed down the bird's burrow which was located on the western side of Meyer Islet. The cable was led about 30 feet to the main tent at the Meyer Islet camp on Boat Harbour. The bird was vocalizing loudly, and there was no problem in recording. At one point the bird fluttered its wings; at another, the voices of sooty terns and black-winged petrels could be heard as they flew overhead, despite the microphone being 2 or 3 feet underground. Meyer Islet is about 40 acres in size compared to neighboring (1 mile) Raoul's 7,200 acres. Raoul now has only a few remnant breeding populations of Procellariidae because of rats and feral cats, which do not exist on Meyer.							On Species Reel		
							Cataloged		
							Region KERMADEC ISLANDS		
Background Sounds (Underline Species To Be Cross-Indexed) How Are Other Species Distinguished?			Sooty terns and black-winged petrels.						