MODIFIED HOOP-NET TECHNIQUES FOR CAPTURING BIRDS AT SEA AND COMPARISON WITH OTHER CAPTURE METHODS

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SUMMARY

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From 2005 to 2008 we developed modified hoop-nets to capture Great and Sooty shearwaters *Puffinus gravis* and *P. griseus*, and Red-necked and Red phalaropes *Phalaropus lobatus* and *P. fulicarius* in the Bay of Fundy, Canada. Hoop-nets allowed daytime captures of more than 200 Great Shearwaters (average 3.4 birds per trip) but only 6 Sooty Shearwaters (0.1 birds per trip) without chumming. Sooty Shearwaters were captured more effectively at night using spotlights and dip-nets (approximately 1.8 birds per trip). Phalaropes (n = 17) were captured at night using spotlights and a lighter hoop-net. We caught 1.5 phalaropes per trip on average (range 0 to 8 individuals). We discuss the limitations of each technique and review reported methods used to capture other species—floating and submerged mist-nets, net-guns, cast-nets, spotlighting, and other hoop-nets. The main advantage of our technique is the ability to catch shearwaters without chumming. It is the only known method for capturing phalaropes at sea. Techniques described here and other at-sea capture methods allow investigators to address new questions about seabird ecology.

Key words: at-sea capture, dip-net, hoop-net, mist-net, spotlighting, phalaropes, shearwaters

INTRODUCTION

Seabirds are often studied at breeding colonies due to the relative ease of observation and capture at those locations, but colony-based studies are limited to the breeding period. Studies in the non-breeding period are also important to our understanding of seabird ecology, but capturing birds at sea is challenging. Historically, lethal methods were used to sample non-breeding seabirds (e.g. Murphy 1936, Brown *et al.* 1981), but nonlethal methods have been developed to capture an increasing variety of species (e.g. Kaiser *et al.* 1991, Whitworth *et al.* 1997, Bugoni *et al.* 2008, Duffy & Jackson 1986). These methods have been used for deployment of electronic tracking devices and in sampling blood and feathers for stable isotopes, fatty acids, and DNA analyses (e.g. Duffy & Jackson 1986, Hull *et al.* 2001, Bradley *et al.* 2004, Perry *et al.* 2006).

Hoop-nets are used to capture various seabirds, especially Procellariiformes (Gibson & Sefton 1959, Gill *et al.* 1970, Suryan *et al.* 2007). A typical hoop-net consists of a lightweight hoop with netting attached to the perimeter, creating a bag in the center of the circular frame. Hoop and mesh size are modified for use with different target species. Chumming (attracting birds by provisioning) can be used with hoop-nets to increase capture success but may be inappropriate if diet is the focus of research.

Here we describe modified hoop-nets used in capturing Great and Sooty shearwaters *Puffinus gravis* and *P. griseus*, and Red-necked and Red phalaropes *Phalaropus lobatus* and *P. fulicarius* in the Bay of Fundy, Canada. Our results demonstrate the feasibility of capturing shearwaters in daylight without chumming, and we find no prior account of live capture for phalaropes at sea. Rates of capture success reported here reflect habitat conditions in the Bay of Fundy and may not apply universally. Nevertheless, the Bay of Fundy typifies many other marine areas with respect to habitat conditions and species assemblages. Having worked successfully with four species, we think the same principles will apply broadly to other species and marine habitats. We review some advantages and disadvantages of our various at-sea capture methods.

METHODS

The work was conducted around Grand Manan Island (44°42'N, 66°49'S) in the Bay of Fundy, New Brunswick, Canada, between 2005 and 2008. Tidal currents created areas of strong upwelling at predictable locations during the flood (Long Eddy rip; 44°49'N, 66°46'S) and ebb tides (Clark's Ground and Bulkhead shoals; 44°33.8'N, 66°39'S). Shearwaters were found predictably at both locations, whereas phalaropes occurred more often south and east of Clark's Ground, beyond the edges of tidal upwellings. Vessels included a 6.1 m boat with a 115 hp engine, inboard steering, and a small cabin (shearwater and phalarope captures) and a 4.9 m open skiff with a 50 hp outboard and tiller steering (shearwaters only). Most shearwaters were captured in daylight, but all phalarope captures occurred at night. We took standard morphological measurements, including mass, and banded the birds before release.

Net design

Nets were constructed for less than $100 (US) apiece from materials purchased at local hardware stores, fishing supply stores (shearwater and phalarope nets) and bird banding suppliers (phalarope nets). Important factors in the modification of the nets were: (1) hoop size, shape and material for ease of throwing, (2) mesh size to minimize entanglement, and (3) addition of a weighted skirt to reduce probability of escape by diving (shearwaters).

For shearwaters, the net (Fig. 1) was a circular hoop (80 cm diameter) made of 2-cm polyvinyl chloride plastic pipe (Bow Superpex, Montreal, QC). Fine (2.5 cm) mesh nylon fish netting (a piece 150 cm in diameter) was draped over and attached with zip-ties to the PVC hoop, creating a pocket of net within the hoop and a skirt 45 cm wide that extended beyond the hoop. A lead line (1.2-cm diameter) attached at the perimeter of the skirt caused that portion of the net to sink in water and reduced the potential for underwater escape. The lead line also allowed the net to be thrown a greater distance. A floating nylon line, attached to the PVC frame, allowed quick retrieval after deployment. Total weight of the shearwater net was approximately 1600 g. Rigidity of the hoop proved crucial for successful deployment as the act of throwing caused flimsier hoops to collapse in early trials. Small mesh size (2.5 cm) minimized entanglement of wings or head compared to a larger mesh size (10 cm) used in the trials.

For phalaropes, the capture device was a hand-held floating hoop net 115 cm in diameter (Fig. 2). The hoop was 2 cm diameter polyethylene tubing (aqua-jet pipe, 100 PSI). We used insert connectors and electrical tape to seal tube ends at the desired length. The hoop was fitted with two lightweight struts made from 5 mm x 1.5 m fiberglass rods (Glo Stix, Textron Inc., Rockford, IL). Struts were attached to the perimeter of the hoop at 90° angles and bent to form a rigid dome to support the net material. A custom-fit section of mist-net (36 mm mesh ATX, AFO Mist Nets, Manomet Inc.) overlaid the dome and was sewn tightly to the rim of the hoop with light twine. Total weight of the phalarope net was <1000 g.

Trapping methods

When capturing shearwaters, the boat approached groups of resting or foraging birds in daylight during both flood and ebb tides. We approached at idle speed to minimize rocking, splashing, and boat noise, and refrained from throwing the net until the boat was within 2-3 m of the target bird(s). Once a bird was in range, the net was thrown rapidly in a swirling motion, low and parallel to the water, allowing the skirt of the net to open (Fig. 1a). With the target situated within the perimeter of the hoop, the lead line was able to sink, thus enveloping the bird (Fig. 1b). The birds' buoyancy and lightweight pipe frame kept the net afloat as it was drawn to the boat using the attached nylon line. When within reach (<1 m), birds were gently restrained in the netting as the hoop-net was lifted into the boat. Once in the boat, the captive was removed from the netting and placed in a bird bag.

We attempted to approach flocks of phalaropes by day but were unable to get closer than 7-8 m—too far for accurate throwing. Moreover, the quickness of phalaropes taking flight confirmed the impracticality of daytime captures. We experimented with a net-gun (Coda Enterprises, Inc., Mesa, AZ) but decided the heavy projectiles

Fig. 1. Capture of a Great Shearwater with a modified hoop-net. (a) Net is thrown rapidly, in a swirling motion horizontal to the water. (b) Weighted skirt drapes below the hoop frame to prevent the bird from escaping by diving. Photos by R. Ronconi.

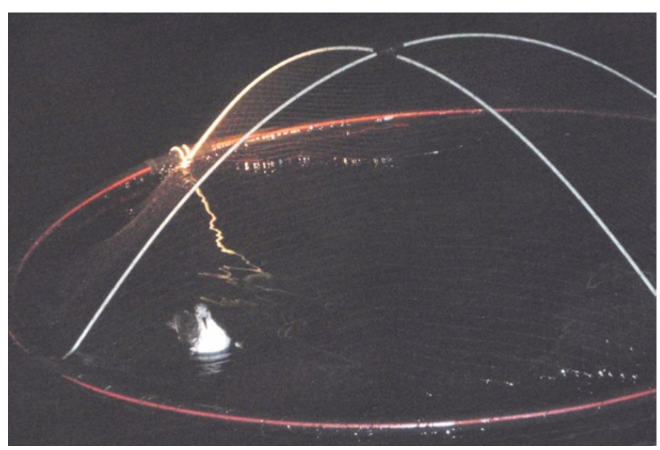

Fig. 2. Red-necked Phalarope floating freely inside the dome-shaped hoop-net. Fine-mesh netting draped over two flexible rods reduced entanglement when the bird was retrieved. Photo by Z. Swaim.

were dangerous for phalaropes. Ultimately, we located phalaropes at night using hand-held spotlights (Whitworth *et al.* 1997). In response to the lights, phalaropes allowed our boat to approach within 2-3 m. Nearing a target, but still underway, the hoop-net was thrown or dropped over a single bird. The hoop floated with the dome upright, forming a surface enclosure. Phalaropes swam freely within the hoop before being retrieved (Fig. 2). Little or no entanglement occurred, thus two handlers were required to lean over the side of the boat and lift the hoop and captured bird from the water together. One handler grasped the phalarope at the rim of the hoop (through the mist netting) while the other grasped the opposite side of hoop. The bird was extracted safely and easily by one handler on deck. Occasionally a phalarope became entangled at the edge of the hoop where netting was sewn to the frame, requiring removal as from a standard mist-net.

Chumming and night-lighting

On days when capture success was low we used chumming to lure shearwaters closer to the boat for capture with the hoop-net or with a dip-net on a 2-m pole. Frozen Pollock *Pollachius virens* livers were effective for generating large feeding aggregations, but individual frozen Herring *Clupea harengus* allowed us to attract individual birds selectively for capture with the hoop-net. Some shearwater captures were done at night using a spotlight to locate and pacify birds for capture with the dip-net (Whitworth *et al.* 1997). Captures utilizing chumming and night-lighting are reported separately for comparison with standard hoop-net techniques.

RESULTS

Shearwaters

On 84 trips between 2005 and 2008, we captured 258 Great Shearwaters and 6 Sooty Shearwaters using the modified hoop-nets (Table 1). Only one shearwater was injured during capture—a broken toenail that caused temporary bleeding. An additional 17 Great Shearwaters and 16 Sooty Shearwaters were captured at night using spotlights and dip-nets (Table 1). All nighttime and most daytime captures (78%) were done without resorting to chum. We used chum more extensively in 2007 and 2008, when shearwaters aggregated less at upwelling areas relative to previous years (R. Ronconi, pers. obs.).

Capture rates per trip (Table 1) and per hour (Table 2) differed greatly among species. Using the hoop-net by day, mean captures per trip were 3.4 and 0.1 for Great and Sooty shearwaters, respectively. On 49 trips for which trip duration was recorded (mean 3.9 h, range 1-10 h, minus approximate travel time to reach capture sites), hourly capture rates averaged 0.97 and 0.01, respectively, for Great and Sooty shearwaters (Table 2). The difference between species was partly due to the lower abundance of Sooty Shearwaters in our study area (approximately 1 for every 100 Great Shearwaters). In addition, Sooty Shearwaters were less inclined to allow close approach by boat in the daytime, they flushed more readily, and when captured in the hoop net they often dove straight down and under the weighted skirt. Chumming did not improve capture success for Sooty Shearwaters because the larger and more aggressive Great Shearwaters typically displaced them. In contrast, we estimate that approximately 1 in 4 approaches resulted in successful capture of Great Shearwaters using the hoop-net. Our capture rate improved when chum was used. At least one shearwater was caught on the majority (>95%) of boat trips.

Nighttime use of spotlights and dip-nets was more successful at capturing Sooty Shearwaters (1.8/trip, maximum 6) but less successful at capturing Great Shearwaters (1.9/trip, maximum 4) than daytime work (Table 1). The capture rate for Great Shearwaters at night is likely an underestimate of true potential as we often targeted Sooty Shearwaters at night. We caught nearly every bird we

TABLE 1
Effort and capture rates (birds per trip) of shearwaters and phalaropes captured by hoop- and dip-nets in the Bay of Fundy, Canada. GRSH = Great Shearwater, SOSH = Sooty Shearwater, RNPH = Red-necked phalarope, REPH = Red Phalarope.

Species & capture method	Year	No. trips	No. captures		Mean captures per trip[a]	
Shearwater species			GRSH	SOSH	GRSH	SOSH
Hoop-net (day)	2005	20	42	3	2.1 (5)	0.2 (2)
	2006	19	87	0	4.6 (13)	0
	2007[b]	18	55	2	3.1 (5)	0.1 (2)
	2008[b]	18	74	1	4.1 (12)	0.1 (1)
	All years	75	258	6	3.4 (13)	0.1 (2)
Spotlight & dip-net (night)	All years	9	17	16	1.9 (4)	1.8 (6)
Both methods	All years	84	275	22	3.3	0.3
Phalarope species			RNPH	REPH	RNPH	REPH
Spotlight & hoop-net (night)	2007	2	2	0	1 (2)	0
	2008	4	7	8	1.8 (4)	2 (8)
	All years	6	9	8	1.5	1.3

[a] Maximum number of captures per trip in parentheses.
[b] Chum used in 2007 (32% of captures) and 2008 (55% of captures).

approached at night, thus the main limitation to nighttime captures was finding birds in the dark. Once sighted with a spotlight, most birds stayed motionless as the boat approached. When on occasion a bird took flight, pursuit time was short (on the order of minutes) compared to time spent looking for birds in the dark (on the order of hours). We abandoned the attempt to capture a bird after three unsuccessful approaches.

Phalaropes

During six trips in 2007 and 2008, 9 Red-necked Phalaropes and 8 Red Phalaropes were captured at night using a spotlight and the modified hoop-net. Capture success ranged from 0 to 8 phalaropes per trip, and birds were caught on 66% of the trips made (Table1). The average for all 6 trips (mean duration 5.6 h) was 1.5 birds per trip, and our mean hourly capture of phalaropes (species combined) was 0.52 (Table 2). In general, it was more difficult to locate phalaropes than shearwaters. To facilitate finding birds at night, we located phalarope flocks at dusk and kept them in view as long as possible. Nevertheless, flocks took flight and departed as it grew dark, which necessitated active searching by spotlight. Once phalaropes were located, captures averaged about 1 success in 4 or 5 approaches. If a phalarope took flight on being approached, we tried to keep the flying bird in the spotlight and pursued until it landed. Pursuit times typically lasted 3-4 minutes, whereas time spent actively searching for phalaropes often lasted 2-3 hours.

Other species

In 2008, we attempted to capture gulls in daytime using the modified hoop-net. This proved largely unsuccessful as we captured only two Herring Gulls *Larus argentatus* and two Great Black-backed Gulls *L. marinus*, all of which involved chumming. Gulls responded to failed throwing attempts by staying outside the throwing range of the hoop-net. We devoted few days to gull capture, however, and modifications to the hoop might give better results.

On one occasion, an Atlantic Puffin *Fratercula arctica* caught in our spotlight paddled toward the boat and was scooped out of the water by dip-net. Other birds approachable at night and candidates for dip-netting were Black Guillemot *Cepphus grylle*, Common Murre *Uria aalge*, and Northern Gannet *Morus bassanus*.

TABLE 2
Capture rates (birds per hour) of shearwaters and phalaropes using hoop- and dip-nets in the Bay of Fundy, Canada. Acronyms as for Table 1. Shearwater data was based on 49 trips of known duration (mean duration 3.9 h). Phalarope data was pooled for both species and based on 6 trips (mean duration 5.6 h).

Species	Mean	SD	Minimum	Maximum
Shearwaters				
GRSH	0.97	0.64	0	3.3
SOSH	0.01	0.07	0	0.4
Phalaropes				
RNPH & REPH	0.52	0.6	0	1.33

DISCUSSION

Using the modified hoop-net

Factors influencing capture success included weather, throwing accuracy, bird behaviour, and species targeted. Optimal conditions for capturing birds at night or by day were maximum wind speeds of 5-10 kt and a Beaufort sea-state of 0-1. Some daytime captures of shearwaters occurred in rougher sea conditions, usually with the aid of chumming, but shearwaters more easily took flight with any amount of wind and thus did not tolerate close approach. Calm conditions were essential for nighttime captures of any species and for safe boat operations. Great Shearwaters were easily captured by day, while most Sooty Shearwaters and all Phalaropes were captured at night. Capture success at night was diminished by moonlight, so outings were best made on cloudy nights. Bird behavior also influenced capture success as resting and densely aggregated foraging flocks of shearwaters were easiest to approach. Throwing accuracy was important for daytime capture of shearwaters, but less so for nighttime capture of phalaropes, which could be approached more closely. Considerable practice was required to develop an accurate throwing technique with the hoop-net, which may be a problem for shorter-term (one or two day) projects. Nets described here were designed to capture single birds, which may be impractical for studies requiring large samples.

At night, we were limited mainly by our ability to find birds in the dark. Red-necked Phalaropes were the target species of the phalarope study, but we encountered many more Red Phalaropes in 2008 (approximately 10 for every 1 Red-necked Phalarope). Capture rates might have been higher had we also targeted Red Phalaropes. Success would be higher given prior knowledge of nighttime resting areas of birds at sea, but that is usually unavailable. These challenges notwithstanding, we believe both the observed and potential capture success discussed encourage further development of nighttime capture techniques for seabirds at sea.

The type of boat used had little influence on capture success. We suggest any inflatable or rigid-hulled boat (less than ~10 m) could be used that is sufficiently maneuverable and has a low freeboard to allow recovery of netted birds. In offshore waters, capture boats could be deployed from the deck of a larger support vessel.

Other capture techniques

Both floating and submerged mist-nets have been used to capture a variety of waterfowl (Okill 1982, Breault & Cheng 1990, Snow *et al.* 1990, Schamber 2003, Bowman 2007) (Table 3). Among seabirds, only Marbled Murrelets *Brachyramphus marmoratus* have been captured with floating mist-nets (Kaiser *et al.* 1991, Paton *et al.* 1991, Quinlan & Hughes 1992, Burns *et al.* 1995, Kaiser *et al.* 1995, Vanderkist *et al.* 1999, Hull *et al.* 2001). Vanderkist *et al.* 1999 reported a sex-bias in murrelets captured in mist-nets due to differing flight behaviors of male and females. In recent years, night-lighting murrelets (see below) has proven more effective for catching murrelets than mist-netting. Successful use of floating or submerged mist nets depends on birds being concentrated in narrows or inlets (Okill 1982, Kaiser *et al.* 1995). Birds are sometimes driven into nets by boats (Breault & Cheng 1990, Snow *et al.* 1990) or attracted to nets by decoys (Snow *et al.* 1990, Schamber 2003, Bowman 2007). Using mist-nets at sea entails cumbersome gear, limited deployment locations, a requirement to

TABLE 3
Summary of techniques used to capture birds at sea (* indicates species captured during the present study)

Technique	Species	Advantages	Limitations	Source
Floating Mist Net	Marbled Murrelet (*Brachyramphus marmoratus*) Red-throated Loon (*Gavia stellata*) Harlequin Duck (*Histrionicus histrionicus*) Black Scoter (*Melanitta nigra*) Eiders (*Somateria spp.*)	day or night use; good for species with predictable movements	constant monitoring necessary; cumbersome gear	b, c, e, k, l n, o, q, r, u
Submerged Mist Net	Red-throated Loon (*G. stellata*) Eared Grebe (*Podiceps nigricollis*)	day or night use; good for species with predictable movements	constant monitoring necessary; cumbersome gear; mortality risk	c, n
Spotlighting	Waterfowl Marsh birds Marbled Murrelet (*B. marmoratus*) Xantus' Murrelet (*Synthliboramphus hypoleucus*) Great Shearwater (*Puffinus gravis*)* Sooty Shearwater (*Puffinus griseus*)* Red-necked Phalarope (*Phalaropus lobatus*)* Red Phalarope (*Phalaropus fulicarius*)* Northern Fulmar (*Fulmarus glacialis*) Glaucous-winged Gull (*Larus glaucescens*) Herring Gull (*L. argentatus*) Atlantic Puffin (*Fratercula arctica*)*	approach skittish birds; relatively inexpensive; low impact; target individual birds	increased search time at night; more danger associated with limited nighttime visibility	a, f, i, s, w, x
Cast net	Albatrosses (*Diomedea spp.* & *Thalassarche spp.*) Petrels (*Procellaria spp.* & *Daption capense*) Giant Petrels (*Macronectes spp.*) Wilson's Storm-petrel (*Oceanites oceanicus*) Southern Fulmar (*Fulmarus glacialoides*) Great Shearwater (*P. gravis*) Sooty Shearwater (*P. griseus*)	efficient; capture many species; inexpensive	requires chumming;	d
Barbless hooks	Black-footed Albatross (*Phoebastria nigripes*) Black-browed Albatross (*Thalassarche melanophris*) White-capped Albatross (*Thalassarche steadi*)			j, p
Net Gun	Marbled Murrelet (*B. marmoratus*) Petrel spp. Shearwater spp. Albatross (*Phoebastria spp.*) Common Eider (*Somateria mollissima*)	fast-acting; target skittish species	high risk of injury and mortality; expensive; time for practice to obtain accurate firing skills	m, v
Hoop Net	Black-footed Albatross (*P. nigripes*) Laysan Albatross (*Phoebastria immutabilis*) Short-tailed Albatross (*Phoebastria albatrus*) Fulmar (*Fulmarus spp.*) Great Shearwater (*P. gravis*)* Sooty Shearwater (*P. griseus*)* Herring Gull (*L. argentatus*)* Great Black-backed Gull (*L. marinus*)* Wilson's Storm-petrel (*Oceanites oceanicus*) Leach's Storm-petrel (*Oceanodroma leucorhoa*)	inexpensive; target individual birds; versatile application with other techniques i.e. chumming or spotlighting; efficient with chumming;	use on approachable species only; biases when used with chumming, e.g. compromise diet study, individual health bias	g, h, t, x

[a] Bishop & Barratt (1969), [b] Bowman (2007), [c] Breault & Cheng (1990), [d] Bugoni *et al.* (2008), [e] Burns *et al.* (1995), [f] Cummings & Hewitt (1964), [g] Gibson & Sefton (1959), [h] Gill *et al.* (1970), [i] Hull *et al.* (2001), [j] D. Hyrenbach pers. comm., [k] Kaiser *et al.* (1991), [l] Kaiser *et al.* (1995), [m] Milton *et al.* 2004, [n] Okill (1982), [o] Paton *et al.* (1991), [p] Petersen *et al.* (2008), [q] Quinlan & Hughes (1992), [r] Schamber (2003), [s] Snow *et al.* (1990), [t] Suryan *et al.* (2007), [u] Vanderkist *et al.* (1999), [v] D. Varoujean II pers. comm., [w] Whitworth *et al.* (1997), [x] present study.

monitor nets continuously, and the risk of injury or mortality of birds, particularly with submerged nets. Mist-nets are not practical for most seabird species in open waters.

Night-lighting from boats using spotlights and nets is a useful technique for capturing waterfowl (Cummings & Hewitt 1964, Bishop & Barratt 1969, Snow *et al.* 1990), alcids (Whitworth *et al.* 1997, Hull *et al.* 2001), shearwaters (J. Adams, pers. comm., present study), and phalaropes (present study). Capture rates vary from one or no captures per night (present study) to >800 birds in 72 h (Cummings & Hewitt 1964). Cummings & Hewitt (1964) captured 14 species of waterfowl and 13 species of marsh and shorebirds using gasoline-powered generators and large flood lights mounted on a small vessel. While night-lighting can be an effective technique (Table 3), it is limited by the difficulty of finding birds over water at night, as discussed earlier. Boat operations at night pose added risks to personnel relative to daytime work, but night-lighting is relatively inexpensive, requires minimal gear, and few personnel. Other advantages are the ability to target individual birds, rather than disturbing large groups, and to avoid potential biases associated with chumming.

Net guns have been used to capture petrels, shearwaters, and albatrosses (D. Varoujean II, pers. comm.), Marbled Murrelets (P. Jodice, pers. comm.), and Common Eiders (Milton *et al.* 2004). Net guns have been fired from boats with an effective range of 5-10 m and also from helicopters (Milton *et al.* 2004). They are useful for catching fast, skittish birds otherwise difficult to trap (D. Varoujean II, pers. comm.). Limitations include cost and the time required to master firing skills. Because nets come with heavy metal projectiles, there is a risk of injury or mortality to birds. They appear to be relatively safe for some species, however—Milton *et al.* (2004) netted >1400 Common Eiders over 5 years, with 1.4% mortality.

Bugoni *et al.* (2008) used cast nets to catch about 500 birds of 13 species attracted to fishing vessels discarding offal in the South Atlantic. Baited, barbless hooks have been used to capture Black-footed Albatross *Phoebastria nigripes* off California, and Black-browed *Thalassarche melanophris* and White-capped *Thalassarche steadi* albatrosses off South Africa (D. Hyrenbach, pers. comm., Petersen *et al.* 2008). In Alaska, dip nets were used to catch Northern Fulmars *Fulmarus glacialis* and gulls *Larus argentatus* and *L. glaucescens* attracted to boats (D. Forsell, pers. comm.). In Newfoundland, dip nets were used to capture newly fledged Northern Gannets near colonies (W. Montevecchi, pers. comm.).

Chumming is a useful strategy with many of the above methods. Seabirds attracted to fish discards are more approachable and easily captured with hoop-nets, dip-nets, and cast-nets. Using hoop-nets, with cod liver as an attractant, Gill *et al.* (1970) caught 72 Great Shearwaters in 3 h and 117 Wilson's Storm-petrels *Oceanites oceanicus* over two summers. Similarly, Bugoni *et al.* (2008) captured 23 birds in a single throw of a cast-net. We found chumming was effective in 2007 and 2008, when shearwaters were less abundant in the Bay of Fundy. But despite its efficiency, chum has some drawbacks. Notably, feeding flocks that result from chumming may exclude timid species. We frequently observed Great Shearwaters displacing Sooty Shearwaters, making it difficult to catch the latter when using chum.

Capturing seabirds over water requires ingenuity, flexibility, and patience. We encourage further trials and modifications to the techniques discussed in this paper, as the successful capture of birds at sea opens important aspects of their biology to research.

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