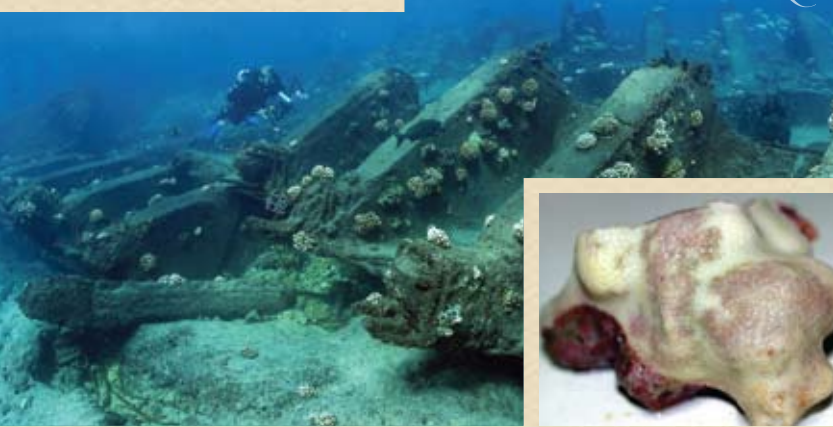


*Malamalama ka lā nui a Kane puka i Hā'ehā'e
Apakau ke kukuua i ka 'ili kai o na kai 'ewalu
He 'ike makawalu ka'u e 'ano'i nei,*

*'O nā au walu o Kanaloa Haunawela noho i ka moana nui
He Hu'akai ka makani o Lehua 'au i ke kai
Kū'ono'ono ka lāa o Kūhaimoana i ke kapa 'chukai o Ka'ula
'O Kū i ka loulou, ulu a'e ke aloha no Nihoa moku manu
Manu o kū i ka 'āhūi, he alaka'i na ka lāhūi
'O Hinapūko'a
'O Hinapūhalako'a
'O Hina kupukupu
'O Hinaikamalama*

*Hua ka 'ōhua, lu'u ke kokolā
Aloha kahi limu kala, kia'i 'ia e ka 'ākala noko i uka
Hānao ka pe'a, puka ka pe'ape'a e ke kai
He 'ina i ka 'āhūi, 'ano i ka hana o ka pa'akai
Manomano ka 'ike li'u o ka houpo o Kanaloa
Koiko'i lāa ho'i no ka leni'eha, 'o kū'u lūhi ia
Hānohāno wale ka 'āhūi kānana, 'o nā moku le'ia
No Pa'āhānānāmokauka lū he inoa*

- Na Kainani Kahauna'ele'a me Halealoha



Monitoring

6. *Monitoring*

6.a Key Indicators for Measuring State of Conservation

As detailed in previous sections, Papahānaumokuākea is unrivaled in its combination of high levels of endemism, overall intact ecosystems, and cultural significance. As a result, the conservation of Papahānaumokuākea’s natural and cultural resources is paramount and a guiding principle of its vision: to forever protect and perpetuate the ecosystem health and diversity and Native Hawaiian cultural significance of Papahānaumokuākea.

Within Papahānaumokuākea’s spacious boundaries, there is phenomenal variation in both landscapes and associated biota. Both the region’s wide latitudinal span and the long geologic succession of islands and atolls create diverse terrestrial habitats and result in a multitude of ecological niches. This geologic succession has also



(Photo: James Watt)

given rise to abundant and diverse marine habitats, from shallow atoll lagoons to submerged seamounts. A central priority of Papahānaumokuākea Marine National Monument is to protect, maintain and preserve this rare ecological integrity as well as ecosystem health and function.

Another management priority of the Monument is to support Native Hawaiian practices and protect cultural resources. The monitoring efforts listed in Table 6.1 strive to deduce key components of the environmental conservation goals while also ensuring the long-term mission of supporting Native Hawaiian cultural practices and resources.

Table 6.1a: Indicators of Conservation for Natural Resources

Indicator	Parameter Group	Parameters	Periodicity	Location of Records
Marine Ecosystem Monitoring	Algae	Endemism Community composition Abundance and diversity Alien, invasive species	Annual	DLNR, NOAA, FWS
	Corals	Endemism Community composition Abundance and diversity Disease	Annual	DLNR, NOAA, FWS, HIMB
	Deepwater Corals	Abundance and diversity	Annual	NOAA, HURL
	Shallow Water Invertebrates	Endemism Community composition Abundance and diversity Alien, invasive species Lobster monitoring	Annual	NOAA, FWS
	Fish	Endemism Community composition Abundance and diversity Biomass Alien, invasive species Movement patterns	Annual	DLNR, NOAA, FWS, HIMB

Table 6.1a (continued): Indicators of Conservation for Natural Resources

Indicator	Parameter Group	Parameters	Periodicity	Location of Records
Marine Ecosystem Monitoring	Oceanography	Water quality Rainfall Wave height Chlorophyll a, b Dissolved oxygen Sea level change	Annual	NOAA, FWS, UH
		Temperature (water and air) Salinity Wind velocity	Real-time	NOAA
		Ambient sounds	Continuous	NOAA
Threatened, Endangered and Protected Species Monitoring	Reptiles	Turtle nesting	Seasonal (May-October)	FWS, NOAA
	Monk Seals	Population assessments Reproductive success Survivorship	Seasonal (May-October)	FWS, NOAA
	Seabirds	Survivorship Reproductive success Abundance Breeding pairs Movement patterns	Seasonal (May-October)	FWS, NOAA, DLNR
	Cetaceans	Population assessments Acoustic recordings	Seasonal Continuous	FWS, NOAA, DLNR
Terrestrial Ecosystem Monitoring	Terrestrial Birds	Abundance Survivorship	Seasonal (May-October)	FWS
	Terrestrial Plants	Endemism Species composition Abundance and distribution Alien, invasive species	Seasonal (May-October)	FWS
	Terrestrial Invertebrates	Endemism Species composition Distribution and abundance of ants Distribution and abundance of Grey Bird Locust	Annual	FWS
Threat Assessment Monitoring	Marine Debris	Accumulation rates Composition Alien, invasive species	Annual	FWS, DLNR, NOAA, UH, USGS
	Alien Species	Distribution and abundance	Annual	FWS, DLNR, NOAA, UH, USGS
	Disease	Distribution and abundance Prevalence Lethality	Annual	FWS, DLNR, NOAA, UH, USGS
	Human Impacts	Restrict access Review permitted activities Cumulative impacts	Continuous	PMNM Office
	Climate Change	Sea level change Water chemistry Sea surface temperature	Annual	NOAA, FWS, UH

Table 6.1b: Indicators of Conservation for Cultural Resources

Indicator	Parameter Group	Parameters	Periodicity	Location of Records
Public understanding of Native Hawaiian cultural significance to Papahānaumokuākea is increasing	Appreciation and understanding of local values and beliefs about the site	Perceptions of the intrinsic and/or non-market value of Papahānaumokuākea to the continuity of the Native Hawaiian culture	Annual	PMNM Office
		Appreciation of Native Hawaiian cultural, historical and cosmological relationship to Papahānaumokuākea by (1) Native Hawaiian community and (2) broader community	Annual	PMNM Office
	Outreach and education about the importance of natural integrity to cultural protection	Number of permittees educated	Annual	PMNM Office
		Trends in broader community's values about natural and cultural importance of the site	Annual	PMNM Office
	Distribution of formal knowledge about cultural research in PMNM to the community, including (a) the Native Hawaiian community, and (b) where culturally appropriate, the broader community	Measuring the degree of community's awareness about activities of, and information generated by, Native Hawaiian cultural practitioners in PMNM	Annual	PMNM Office
		Facilitating interactions between Native Hawaiian practitioners, Western scientists, resource managers (including Monument staff) and broader community	Annual	PMNM Office
	Outreach & education about Native Hawaiian sea-uses in Papahānaumokuākea	Visitor numbers to Mokupāpapa Interpretive Center; Number of classrooms utilizing Navigating Change curriculum and/or other curricula relating to PMNM's natural and cultural resources	Annual	PMNM Office
Native Hawaiian stakeholder engagement with Papahānaumokuākea	Cultural practitioners' access to the site	Number of berths provided to cultural practitioners by PMNM to access and practice in Papahānaumokuākea; When appropriate, type of cultural access to the PMNM and demographics of individuals participating in cultural access in PMNM (e.g., gender, age, island of origin)	Annual	PMNM Office, OHA Office
		PMNM's commitment to fostering cultural research and practices in Papahānaumokuākea	Annual	PMNM Office, OHA Office
		Native Hawaiian cultural research needs identified and prioritized	Annual	PMNM Office, OHA Office

Table 6.1b (continued): Indicators of Conservation for Cultural Resources

Indicator	Parameter Group	Parameters	Periodicity	Location of Records
Native Hawaiian stakeholder engagement with Papahānaumokuākea	Engagement of Native Hawaiian traditional knowledge and practices in the management of Papahānaumokuākea	Degree and type of integration of Native Hawaiian management practices with Western scientific practices in PMNM	Annual	PMNM Office
		Interactions between Monument staff and Native Hawaiian Cultural Working Group	Annual	PMNM Office
		Interactions between Monument staff and broader Native Hawaiian community regarding integrated traditional-Western scientific management of the site	Annual	PMNM Office
		Continued review of all PMNM use permits by Native Hawaiian cultural practitioners	Annual	PMNM Office
		Number of PMNM permits reviewed by Native Hawaiian practitioners	Annual	PMNM Office
		Protections enacted by Native Hawaiian review of permits	Annual	PMNM Office
	Access to site by Hawaiian wayfinders	Number of wayfinding trips allowed in Papahānaumokuākea	Annual	PMNM Office
		If applicable, number and reason for restrictions of wayfinding in Papahānaumokuākea	Annual	PMNM Office
Review of human impacts on the cultural resources.	Integrity of archaeological sites on Nihoa and Mokumanamana	Tracking and evaluating Section 106 consultations (consultation process required under National Historic Preservation act, in the event of use of Nihoa or Mokumanamana)	Annual	PMNM Office, OHA Office

While the natural and cultural resources in Papahānaumokuākea exist in a nearly pristine environment, and are thus removed from major pressures of extensive human population, they are not entirely threat-free. As a result, it is just as important to monitor the threats to Papahānaumokuākea as it is to monitor the state of its natural and cultural resources. Detailed in Section 4.b, the most worrisome threats to resources originate outside the boundaries of Papahānaumokuākea. Marine debris consistently washes up on the reefs and shores of these islands and atolls. On par with these external threats are the imposing effects of climate change, namely sea-level rise, ocean acidification and sea surface temperature increases. It is therefore imperative to monitor both the natural and cultural resources as well as the threats facing these resources on a frequent basis.

6.b Administrative Arrangements for Monitoring Property

Prior to the inception of Papahānaumokuākea, the State of Hawai'i, U.S. Fish and Wildlife and NOAA managed separate jurisdictions in the waters and lands of the NWHI and were responsible for their respective monitoring programs. Since Papahānaumokuākea's designation, the Co-Trustees collectively have administered Papahānaumokuākea Marine National Monument. Each Co-Trustee has maintained their respective monitoring and research regimes but now works in a coordinated fashion to facilitate overall management efforts. The comprehensive Monument Management Plan (MMP), which directs and guides all monitoring efforts in

Table 6.2: Relationship Between Management and Monitoring

Monument Management Goals	Indicators	Criterion
Protect, preserve, maintain, and where appropriate, restore the physical environment and natural biological communities and their associated biodiversity, habitats, populations, native species, and ecological integrity.	Marine Ecosystem Monitoring	ix, x
	Threatened and Endangered Species Monitoring	x
	Terrestrial Ecosystem Monitoring	ix, x
	Threat Assessment Monitoring	viii, ix, x
Support, promote, and coordinate research, ecosystem characterization, and monitoring that increases understanding of the NWHI, improves management decisionmaking, and is consistent with conservation and protection.	Marine Ecosystem Monitoring	ix, x
	Threatened and Endangered Species Monitoring	x
	Terrestrial Ecosystem Monitoring	ix, x
	Threat Assessment Monitoring	viii, ix, x
Manage and only allow human activities consistent with Proclamation 8031 to maintain ecological integrity and prevent or minimize negative impacts for long-term protection.	Threat Assessment Monitoring	viii, ix, x
Provide for cooperative conservation including community involvement that achieves effective Monument operations and ecosystem-based management.	Marine Ecosystem Monitoring	ix, x
	Threatened and Endangered Species Monitoring	x
	Terrestrial Ecosystem Monitoring	ix, x
	Threat Assessment Monitoring	viii, ix, x
Enhance public understanding, appreciation, and support for protection of the natural, cultural and historic resources.	Increased public understanding of Papahānaumokuākea’s cultural significance to Hawaiians	iii, vi
Support Native Hawaiian practices consistent with long-term conservation and protection.	Maintain or increase Native Hawaiian engagement	iii, vi
Identify, interpret, and protect Monument historic and cultural resources.	Review of human impacts on cultural resources	iii, vi

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Papahānaumokuākea, encompasses all of the respective agencies’ goals to manage and conserve Papahānaumokuākea resources. Table 6.2 illustrates how the MMP will facilitate World Heritage monitoring efforts to ensure a responsible and lasting monitoring program.

Examples of enhanced management facilitation include the establishment of a unified permitting process to restrict access and ensure sound research and activities in Papahānaumokuākea. In addition, plans are underway for the creation of a centralized Monument Information Management System which will standardize all monitoring data for managers to evaluate Papahānaumokuākea’s resources in a true ecosystem-based fashion. Proprietary cultural information, however, will be housed in the Office of Hawaiian Affairs’ Wahi Pana Database to offer additional protections that federal and state executive branch agencies are unable to provide.

The overall management and protection of Papahānaumokuākea is under the administrative authority of the following three agencies:

United States Fish and Wildlife Service
 300 Ala Moana Blvd., Room 5-231
 Honolulu, HI 96850
 USA

National Oceanic and Atmospheric Administration
 6600 Kalaniana’ole Hwy, Suite 300
 Honolulu, HI 96825
 USA

State of Hawai’i, Department of Land and Natural Resources
 1151 Punchbowl St, Room 130
 Honolulu, HI 96813
 USA

These three agencies, both independently and on a collaborative basis, have had management responsibility for monitoring resources in Papahānaumokuākea for decades (and in two cases, nearly a century). Much of the monitoring effort has been carried out by these agencies' various subsidiaries and partners, and credit must be given to the following organizations and institutions for their contributions to the enhancement of knowledge of natural and cultural resources found in Papahānaumokuākea:

- Bishop Museum
- Joint Institute for Marine and Atmospheric Research
- Hawai'i Institute of Marine Biology
- Hawai'i Undersea Research Laboratory
- NOAA National Marine Fisheries Service
- NOAA Coral Reef Conservation Program
- NOAA/National Marine Fisheries Science/Pacific Islands Fishery Science Center
- NOAA National Ocean Service/National Center for Coastal Ocean Science
- The Oceanic Institute
- Office of Hawaiian Affairs
- Smithsonian Institution
- State of Hawai'i Division of Aquatic Resources
- United States Geological Survey
- University of Hawai'i

6.c Results of Previous Reporting Exercises

The following list, arranged in reverse chronological order, represents a compilation of status reports for the NWHI derived from monitoring data. In the past century, hundreds of scientific papers have been published incorporating data collected in the NWHI, but this list has been restricted to only those published documents that clearly depict the status and trends of monitoring data in the NWHI.

U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Sanctuary Program. 2008.

Papahānaumokuākea Marine National Monument condition report 2008. Silver Spring, MD. 41 pp.

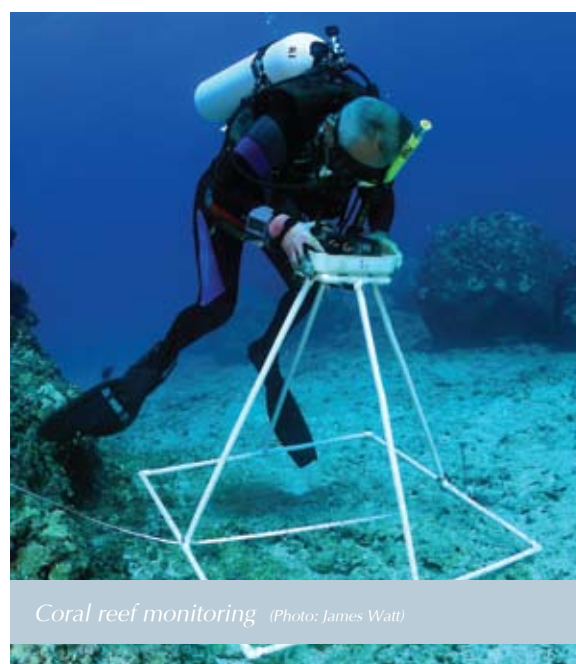
Waddell, J.E. and A.M. Clarke, eds. 2008. (NOAA/NCCOS Center for Coastal Monitoring and Assessment's Biogeography Team) The state of coral reef ecosystems of the United States and Pacific Freely Associated States: 2008. NOAA Technical Memorandum NOS NCCOS 73. Silver Spring, MD. 569 pp.

Athens, J.S., J.V. Ward, and D.W. Blinn. 2007. Vegetation history of Laysan Island, Northwestern Hawaiian Islands. *Pacific Science* 61: 17–37.

Dameron, O.J., M. Parke, M.A. Albins, and R. Brainard. 2007. Marine debris accumulation in the Northwestern Hawaiian Islands. *Marine Pollution Bulletin* 54: 423–433.

Morishige, C., M.J. Donohue, E. Flint, C. Swenson, and C. Woolaway. 2007. Factors affecting marine debris deposition at French Frigate Shoals, Northwestern Hawaiian Islands Marine National Monument, 1990–2006. *Marine Pollution Bulletin* 54: 1162–1169.

NOAA Fisheries. 1999–2007 Stock assessment reports: Hawaiian Monk Seal (*Monachus schauinslandi*). Available: www.nmfs.noaa.gov/pr/sars/species.htm#phocids



Coral reef monitoring (Photo: James Watt)



Maritime archaeology monitoring (Photo: James Watt)

Waddell, J.E. ed. 2005. (NOAA/ NCCOS Center for Coastal Monitoring and Assessment's Biogeography Team) The State of coral reef ecosystems of the United States and Pacific Freely Associated States: 2005. NOAA Technical Memorandum NOS NCCOS 11. Silver Spring, MD. 522 pp.

Balazs, G.H. and M. Chaloupka. 2004a. Thirty-year recovery trend in the once depleted Hawaiian Green Sea Turtle stock. *Biological Conservation* 117: 491–498.

Antonelis, G.A., J.D. Baker, T.C. Johanos, R.C. Braun, A.L. Harting. 2006. Hawaiian Monk Seals (*Monachus schauinslandi*): Status and conservation issues. In: Macintyre, I.G., ed., Northwestern Hawaiian Islands third scientific symposium. *Atoll Research Bulletin* 543: 75–101.

Citta, J., M.H. Reynolds, and N.E. Seavy (USGS Pacific Island Ecosystems Research Center). 2006. Seabird monitoring assessment for Hawaii and the Pacific Islands. Rept. to U.S. Fish and Wildlife Service, Migratory Birds and Habitat Programs, Portland, Oregon.

Keenan, E.E., R.E. Brainard, and L.V. Basch. 2006. Historical and present status of the pearl oyster, *Pinctada margaritifera*, at Pearl and Hermes Atoll, Northwestern Hawaiian Islands. *Atoll Research Bulletin* 543: 333–344.

Firing, J. and R.E. Brainard. 2006. Ten years of shipboard ADCP measurements along the Northwestern Hawaiian Islands. *Atoll Research Bulletin* 543: 347–364.

National Oceanic and Atmospheric Administration. 2006. State of the Reserve: Northwestern Hawaiian Islands coral reef ecosystem reserve 2000–2005. Silver Spring, MD. 41pp.

Vroom, P.S. and K.N. Page. 2006. Relative abundance of macroalgae (RAM) on Northwestern Hawaiian Island reefs. *Atoll Research Bulletin* 543: 533–548.

Maragos, J., D. Potts, G. Aeby, D. Gulko, J. Kenyon, D. Siciliano, and D. VanRavenswaay. 2004. 2000–2002 rapid ecological assessment of corals on the shallow reefs of the Northwestern Hawaiian Islands. Part 1: Species and distribution. *Pacific Science* 58(2): 211–230.

Wilkinson, C. ed. 2004. Status of coral reefs of the world: 2004. Volume 2. Australian Institute of Marine Science, Townsville, Queensland AUS. 301pp.

Boland, R.C., and M. Donohue. 2003. Marine debris accumulation in the nearshore marine habitat of the endangered Hawaiian monk seal, *Monachus schauinslandi* 1999–2001. *Marine Pollution Bulletin* 46(11): 1385–1394.

Bishop Museum. 2002. Hawaiian terrestrial arthropod checklist, 4th Edition. Bishop Museum Technical Report 22., Bishop Museum Press, Honolulu. pp i–iv, 1–313.

DeFelice, R.C. D. Minton, and L.S. Godwin. 2002. U.S. Fish and Wildlife Service. Records of shallow-water marine invertebrates from French Frigate Shoals, Northwestern Hawaiian Islands, with a note on non-indigenous species. Technical Report No. 23. Contribution No. 2002–01 to the Hawai'i Biological Survey Bishop Museum, Honolulu.

Eldredge, L.G. 2002. Literature review and cultural, geological, and biological history for the Northwestern Hawaiian Islands coral reef ecosystem reserve. Contribution to the Hawaii Biological Survey No. 2002–026. Bishop Museum, Honolulu, HI.

Maragos J. and D. Gulko eds. 2002. U.S. Fish and Wildlife Service and the Hawai'i Department of Land and Natural Resources. Coral reef ecosystems of the Northwestern Hawaiian Islands: Interim results emphasizing the 2000 surveys.

Wilkinson, C. ed. 2002. Status of coral reefs of the world: 2002. Australian Institute of Marine Science, Townsville, Queensland AUS. 388 pp.

Starr, F. K. Martz, and L. Loope. 2001. Department of Land and Natural Resources, Division of Forestry and Wildlife. Botanical inventory of Kure Atoll.

United States Fish and Wildlife Service (USFWS). 2001. NOWRAMP 2000 Terrestrial arthropod report. Honolulu, HI.

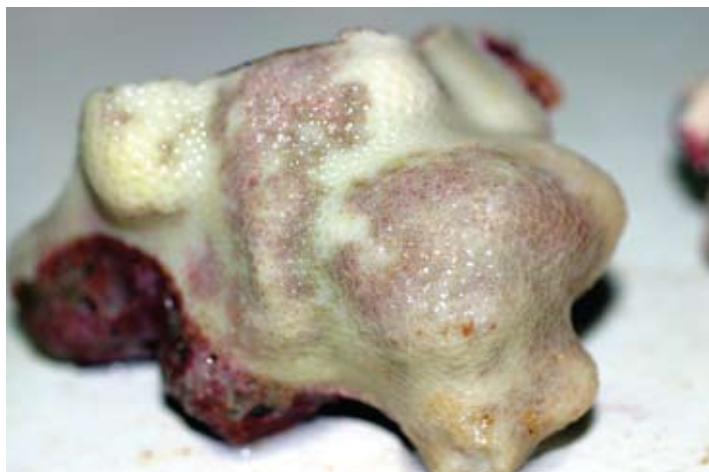
Wilkinson, C. ed. 2000. Status of coral reefs of the world: 2000. Australian Institute of Marine Science, Cape Ferguson, Queensland, AUS. 363 pp.

Starr, F. and K. Martz. 1999. Midway Atoll National Wildlife Refuge. Botanical survey of Midway Atoll. 1999 Update. Prepared for USFWS.

DeFelice, R.C. S.L. Coles, D. Muir, and L.G. Eldredge, 1998. Investigation of the marine communities of Midway Harbor and adjacent lagoon, Midway Atoll, Northwestern Hawaiian Islands. Hawai'i Biological Survey Contribution No. 1998-014. Bishop Museum, Honolulu.

Nishida, G. 1998. Hawaii Biological Survey, Bishop Museum. Midway terrestrial arthropod survey, Final Report prepared for USFWS.

Hope, B., S. Scantolini, E. Titus, and J. Cotter. 1997. Distribution patterns of polychlorinated biphenyl congeners in water, sediment and biota from Midway Atoll (North Pacific Ocean). Marine Pollution Bulletin 34(7): 548–563.



Diseased coral (Photo: PMNM)

Cleghorn, P. 1988. The settlement and abandonment of two Hawaiian outposts: Nihoa and Necker. In: *Bishop Museum Occasional Papers 28*: 35–49. Bishop Museum Press, Honolulu.

Newman, A.L. 1988. Mapping and monitoring vegetation change on Laysan Island (dissertation). University of Hawai'i. Available from: University of Hawai'i Geography Department.

Riley, T.J. 1982. U.S. Fish and Wildlife Service, Honolulu, Hawai'i. Report of a reconnaissance of archaeological sites on Nihoa Island, Hawai'i, June 1980. Department of Anthropology, University of Hawai'i Manuscript #031882 (Project 286). Honolulu, HI.

Clapp, R. B., and E. Kridler. 1977. The natural history of Necker Island, Northwestern Hawaiian Islands. *Atoll Research Bulletin* 207: 1–147.



Photographic quadrat sampling (Photo: James Watt)



Monitoring such an expansive archipelago requires all eyes on the resource - including those of our underwater cousins (Photos: James Watt, lower left: FWS)



Amerson, A.B. Jr., R.C. Clapp, and W.O. Wirtz, II. 1974. The natural history of Pearl and Hermes Reef, Northwestern Hawaiian Islands. *Atoll Research Bulletin* 174: 1–306.

Ely, C.A. and R.B. Clapp. 1973. The natural history of Laysan Island, Northwestern Hawaiian Islands. *Atoll Research Bulletin* 171: 1–361.

Clapp, R.B. 1972. The natural history of Gardner Pinnacles, Northwestern Hawaiian Islands. *Atoll Research Bulletin* 163: 1–25.

Woodward, P.W. 1972. The natural history of Kure Atoll, Northwestern Hawaiian Islands. *Atoll Research Bulletin* 164: 1–318.

Amerson, A.B. 1971. The natural history of French Frigate Shoals, Northwestern Hawaiian Islands. *Atoll Research Bulletin* 150: 1–383.

Emory, K. 1928. The archaeology of Nihoa and Necker Islands. *Bishop Museum Bulletin* 53. Bishop Museum Press, Honolulu.